No.	Name of S/S	Year	Contents		Remark
			Equipment	Qty.	
9	Gomberi	2007	33/11kV 5MVA TR	1	Construction Start in 2006
			33kV CB with CT	1	Construction Span 18 months
			33kV DS	1	
			33kV CVT	1	
			Station Service TR	1	
			Lightning Arrester	1	
			Structure	1	
			Bus Material	1	
			Protection Panel for TR	1	
			Protection Panel for 33kV Line	1	
			11kV Cubicle	3	
			Monitor Panel	1	
			Auxiliary Panel	1	
			DC Supply Equipment	1	
			Control House	1	
			Construction Material	1	
			Installation	1	
10	KCMC	2007	33kV CB with CT for Line	1	Coordination work
			33kV DS for Line	2	with Gomberi S/S construction
			33kV CVT	2	
			Protection Panel for 33kV Line	2	Construction Start in 2006
			Construction Material	1	Construction Span 18 months
			Installation	1	
11	Boma Ngombe	2005	33/11kV 5MVA TR	1	Construction Start in 2006
			33kV CB with CT	1	Construction Span 18 months
			33kV DS	1	
			Station Service TR	1	
			Lightning Arrester	1	
			Structure	1	
			Bus Material	1	
			Protection Panel for TR	1	
			Protection Panel for 33kV Line	1	
			11kV Cubicle	3	
			Monitor Panel	1	
			Auxiliary Panel	1	
			DC Supply Equipment	1	
			Control House	1	
			Construction Material	1	
			Installation	1	

7.3 Distribution Facilities Conceptual Design

(1) System Configuration

(a) 33kV distribution line

Recently, 33kV distribution lines are increasing though TANESCO has determined 11kV as the standard high-voltage distribution voltage. Because power demanding points in suburbs or remote places are far away from the power supply and small-scale towns and villages are scattered in a wide area, long distribution lines are required, causing a problem of voltage drops. To solve such problem, 33kV distribution is adopted.

Because the 33kV distribution line consists of only overhead lines, areas demanding power are in the same direction, and the load density is low, single circuit branch-type distribution system is used as standard.

(b) 11kV distribution line

Generally, the line is in a branch-type. In cities such as Dar es Salaam, lines are connected to neighboring lines via section switches and form loop circuits connected via manual switches that are normally open. The section switches installed on lines in cities are used not only for opening or closing the load. Their main purpose is to raise the supply reliability by interchanging the load between distribution lines.

On the other hand, it is a rare case to form loop circuits by section switches on the lines in Arusha and Moshi. As one of the characteristics of distribution lines in the country, the line branched from the trunk line is relatively long and it requires a long time to recover from any faults or problem. By installing a switch at a branch point of the long lines, a faulty line can be easily isolated, allowing continuous supply on the main line in good condition.

(c) Low-voltage distribution line

Low-voltage distribution facilities consist of pole transformers, low-voltage distribution line, and lead-in wires. The line should be in an independent branch type with the size varying depending on the transformer capacity.

(2) Basic concept of facilities maintenance/expansion plan

For the distribution facilities, when the relationships between the demand and facilities or between the area demand characteristics and service conditions are not well balanced, counteractions should be studied. Normally, when the distribution facilities are in the following conditions, quantitative and qualitative reinforcing actions should be studied:

- The maximum allowable current is usually exceeded.
- Voltage is dropped above the allowable range.
- The transformer load capacity is exceeded.

Generally, when planning expansion of the distribution facilities, the optimum plan is adopted by studying the gains and losses of the actions given below. Before starting the study, the distribution lines, load density, and load increase in the neighborhood should be thoroughly surveyed.

- Adding new feeders
- Upgrading high-voltage line conductors
- Installing voltage regulator
- Adding transformers (dividing low-voltage line)
- Increasing line capacity
- Relocating transformers to load center

Actual actions for reinforcing the facilities and system are given below.

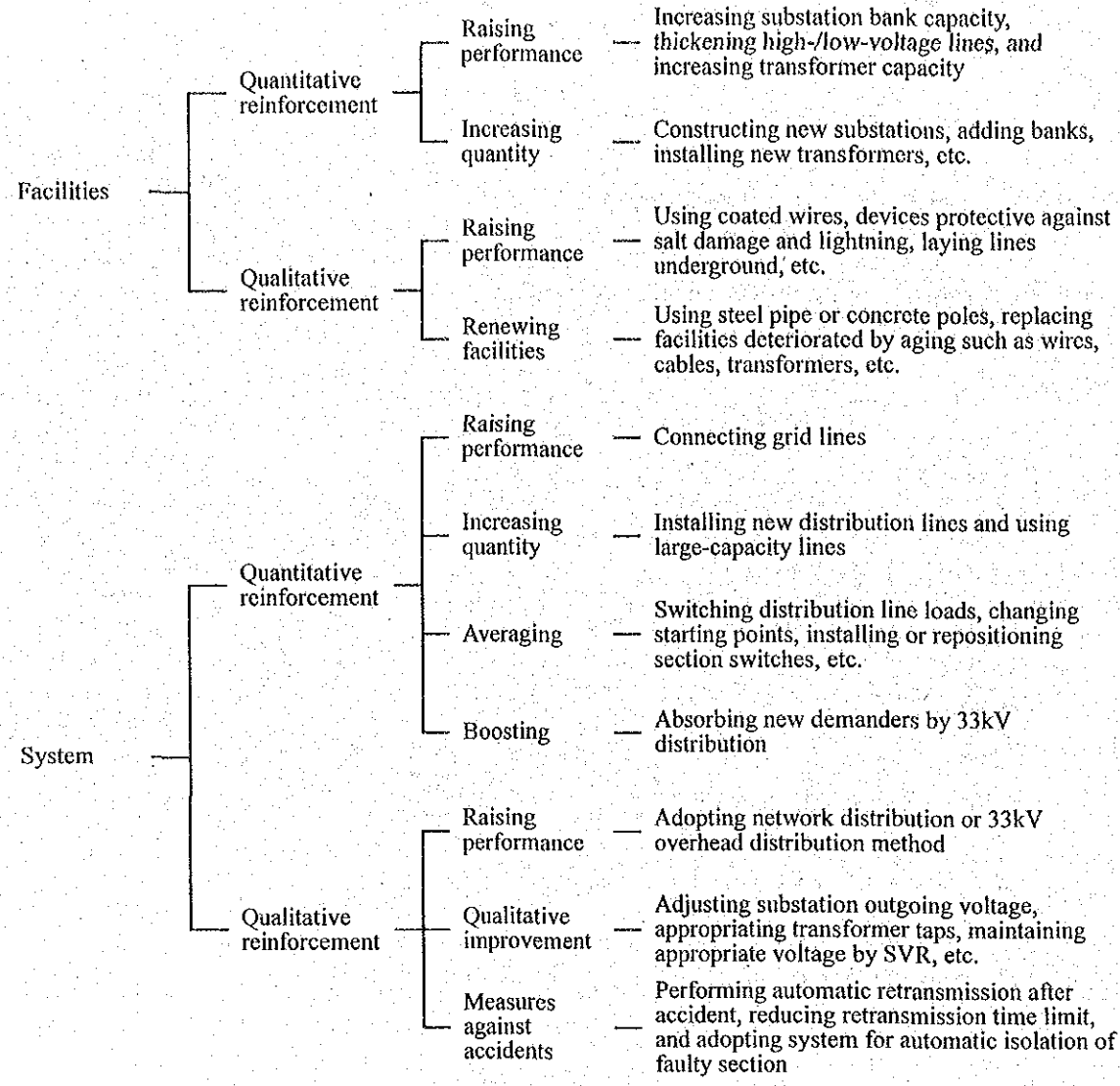


Fig. 7.3.1 Reinforcing actions for distribution facilities and system

(3) Reserving public safety

Because the distribution facilities are installed in a wide area close to local communities, they have close relationships with general users and society. The facilities should provide high quality power while they are in a place accessible from public; that is, they should cope with both reserving public safety and supplying.

Especially, the distribution facilities in a town or underground distribution facilities are placed closer to the public compared to ordinary overhead distribution facilities, requiring design of reliable devices and configuration to prevent public disasters from occurring. Actually, the live parts are to be concealed and fuses or relays are to be used for protection.

7.3.1 Setting Target Values for Expansion Plan

(1) Supply Reliability

The distribution facilities for Dar es Salaam have been much improved through Japanese aid and European financial cooperation. But, still now, deteriorated facilities, or facilities with insufficient capacity or functions are used for distribution in many areas.

Considering the revitalization of the economy and the progress of open economy in recent years, the demand for electric power is estimated to increase in the future. Moreover, because of improvement of the domestic and overseas investment environments accompanied by economical activities, reserving sufficient supply capacity for increased demand, improving the reliability, and promoting safety measures are urgently required.

TANESCO is very busy expanding and repairing facilities, taking measures for accidents that occur frequently, treating many complaints given from consumers, and so forth, and has not yet set definite targets for the service levels and supply reliability.

In order to expand and improve the facilities, aiming to stabilize the power supply in the future, it is indispensable to set targets such as service levels and reliability as prerequisites for setting the system expansion plan.

For supply reliability, the target value is set integrally considering service interruption time, its frequency, time for recovery from failures, influence on the users, etc. In this plan, no target values are to be set for service interruption time and frequency considering the current conditions of the distribution facilities maintenance and management. As for the system configuration and recovery time from failures for reserving the reliability, target levels should be set as described below.

(a) System configuration

The 33kV distribution line should be a single circuit overhead line of a tree form, which is the simplest type. Load break switches should be installed at major branch points to facilitate system operation.

The overhead 11kV distribution line in city area should be sectioned by section switches, each section linked to another distribution line. Thus, the service interruption range is limited to the section where a failure occurs. In the standard configuration, three sections and three links are to be used considering reliability, economics, system management, and serviceability. The distribution line in the suburbs should be a single circuit overhead line in tree form, like the 33kV distribution line mentioned above. In this plan, no underground system for trunk or interconnecting lines would be used.

(b) Setting and studying standards for supply reliability

The target times for recovery from failures are given below.

Table 7.3.1 Target times for recovery from failures

Reliability rank	Longest service interruption time
Service rank A	60 minutes
Service rank B	90 minutes
Service rank C	150 minutes
Service rank D	180 minutes

Note Service rank A: Major government and municipal offices, important facilities
Service rank B: Other government and municipal offices, industrial zone
Service rank C: Busy and shopping streets
Service rank D: Residential zone and others

(2) High-voltage distribution line plan

The 11kV distribution line is planned as described below. For distribution lines with heavy load and those with voltage drops exceeding the allowable limit, the load should be shared with the feeder from the expanded, upgraded or new substations, and the system is to be switched.

For deteriorated and small-sized wires in the trunk lines, reinforcing should be done by replacement or use of larger sized wires. The basic configuration for the distribution line in the city area should be 3 sections and 3 links and section switches should be installed. Thus reliability will be improved by interchanging the load efficiently and limiting the service interrupted area for accidents. For the distribution line in the suburbs, installing load break switches at major T-off points of a long branch line should reduce the service interruption time. The standards for distribution line capacity and maintaining of voltage are given below.

(a) Distribution line capacity

The standard capacities of the 11kV distribution line trunk section are given below (assuming that normal value is 3,000kVA/cct and maximum value is 5,000kVA/cct).

Normal capacity: 200A
Short-time capacity: 300A

(b) Maintained voltage

The voltage drop of the distribution line should be limited to 10%.

(3) Low-voltage Distribution Line

Voltage drops and fluctuation for consumers are caused by too long low-voltage distribution line, insufficient wire size, deteriorated or improperly jointed wire, bad contacts, etc. Since the distribution transformer has a large capacity, supply area under a transformer is to be inevitably wide in many cases, causing long low-voltage line to be used.

To solve the problem above, small-capacity transformers should be used, sharing the load and reducing the supply area. When necessary, wires should be replaced with larger sized ones.

From the standpoint of facilities and public safety, insulated wires should desirably be used for all wires including lead-inr. The target voltage for the low-voltage distribution line is 231V±15V for single-phase, and 402±40V for three-phase.

(4) Maintenance and operation system

Currently, the distribution facilities are deteriorated and maintenance operations are not well organized. Therefore, it is necessary to establish the system covering the entire maintenance and operations.

(a) Establishing management organization

Management and personnel organizations should be established to perform appropriate maintenance operations. In addition, reserving materials and budgetary support are necessary to implement permanent measures that come after emergency actions.

(b) Periodical check and inspection

To prevent human and facilities accidents from occurring, periodic checks and inspections should be organized under certain standards.

Inspection means visually surveying facilities to maintain safety, grasp deterioration, and prevent accidents of the distribution line. Inspection should be carried out based on certain standards. Sample standards for inspection are given below.

Table 7.3.2 Sample standards for inspection

Objects		Frequency
Overhead lines	- Poles, cross-arms, stays, pole cross-arm braces, conductors, and insulators - Other nearby objects, trees, or obstacles	Once a year
	Transformers, load break switches, disconnecting switches, lightning arresters	Once a year
	Lead-in wires	Once a year
Underground lines	Underground lines (including indoor metering device)	Once a year

Check means searching facilities for any troubles using tools and/or measuring instruments if necessary. A periodic check is done in a certain period of time and an unscheduled check is done to prevent troubles as required. See Table 7.4.1 for sample standards for a periodic check.

An unscheduled check should be done in the following cases:

- After natural disasters have occurred
- When troubles occur frequently on a line
- When accidents occur frequently or reclosing occurs frequently on a line
- When accidents or reclosing occur continuously
- When necessary

(c) Carrying out periodic measurement

For precise voltage management and grasping distribution line operating states, it is necessary to periodically measure the voltage and current and maintain the

measurement data. In addition, unscheduled measurement should be done in the following cases:

(i) Measuring transformer load current
- When transformer replacement is necessary accompanied by facilities addition or installation and forecasting of the current load is difficult
- When the transformer primary fuse has blown due to overload

(ii) Measuring high-voltage distribution line current and voltage

When major changes have occurred in the load and high-voltage distribution facilities and forecasting of the voltage and current is difficult

(iii) Measuring low-voltage distribution line current and voltage

When complaints are given from consumers or major changes have occurred in the load and low-voltage distribution facilities and forecasting of the voltage and current is difficult

(iv) Measuring grounding resistance

When it is necessary to know the grounding resistances of the outer box. of the high-voltage devices except the transformer tank, guard net, protective barrier, etc

(v) Measuring other values

When it is necessary to know the leakage current of the low-voltage facilities for leakage current research, etc.

7.3.2 Facilities Expansion Plan

Along with addition or construction of substations, reinforcement should be done by constructing overhead lines and replacing wires in the related areas as given in the table below.

Table 7.3.3 Distribution facilities expansion plan (Dar es Salaam)

Year	Name of Feeder	New (km)	Replacement (km)	U/G line (m)	Switch (Qty.)	Remarks
2002	Mbezi - MB5	8.0		50	3	
	Bahari Beach - BB04	6.0		50	3	
	Bagamoyo	6.0		50	3	
	Sokoine - SK5	1.0		50	3	
	City Center - C9	2.0		50	3	
	Kurasini - KR5	8.0		50	3	
	Mbagala -MB5	15.0		50	3	
	Mbagala -MB6	15.0		50	3	
	Ubungo - U9	6.0		50	3	
	Mikocheni - MK5	13.0		50	3	
	Tandale - MG6	8.0		50	3	
	Factory Zone III - F36	9.0		50	3	
	Factory Zone III - F37	9.0		50	3	
2003	Ilala - D14	4.0		50	3	
	Ilala - D15	4.0		50	3	
	Muhimbili - MH1	3.0		50	3	
	Muhimbili - MH2	3.0		50	3	
	Muhimbili - MH3	3.0		50	3	
	TOL - T01	17.0		50	3	
	TOL - T02	17.0		50	3	
	TOL - T03	17.0		50	3	
	University - UN1	6.0		50	3	
	University - UN2	6.0		50	3	
	University - UN3	6.0		50	3	
	New Oysterbay - KN1	10.0		50	3	
	New Oysterbay - KN2	10.0		50	3	
	New Oysterbay - KN3	10.0		50	3	
	Oysterbay - O7	6.0		50	3	
	Msasani - MS4	10.0		50	3	
	Msasani - MS5	10.0		50	3	
2004	Bahari Beach - BB05	12.0		50	3	
	Bahari Beach - BB06	12.0		50	3	
	Mburahati - BH1	7.0		50	3	
	Mburahati - BH2	7.0		50	3	
	Mburahati - BH3	7.0		50	3	
	Yombo - YB1	10.0		50	3	
	Yombo - YB2	10.0		50	3	
	Yombo - YB3	10.0		50	3	
	Kitunda - KT1	10.0		50	3	

Year	Name of Feeder	New (km)	Replacement (km)	U/G line (m)	Switch (Qty.)	Remarks
	Kitunda - KT2	10.0		50	3	
	Kitunda - KT3	10.0		50	3	
2005	Kawe - KW1	8.0		50	3	
	Kawe - KW2	8.0		50	3	
	Kawe - KW3	8.0		50	3	
	Ilala - D16	4.0		50	3	
	Kinondoni - KD1	6.0		50	3	
	Kinondoni - KD2	6.0		50	3	
	Kinondoni - KD3	6.0		50	3	
	Chang'ombe - CG6	7.0		50	3	
2006	Kunduchi - KD1	10.0		50	3	
	Kunduchi - KD2	10.0		50	3	
	Kunduchi - KD3	10.0		50	3	
	Kigogo - KG1	10.0		50	3	
	Kigogo - KG2	10.0		50	3	
	Kigogo - KG3	10.0		50	3	
	Kurasini - KR6	10.0		50	3	
2007	Mbezi - MB6	6.0		50	3	
	Kariakoo - KA5	4.0		50	3	
	Kariakoo - KA6	4.0		50	3	
2008	Msasani - MS6	10.0		50	3	
	Msasani - MS7	10.0		50	3	
2009	TOL - T04	10.0		50	3	
	Factory Zone III - F37	9.0		50	3	
	11kV Line Total	529.0		3,150	189	
2004	33kV Tabata Line	14.0				33kV D/L
	33kV Kigamboni Line	25.0				33kV D/L
	33kV Line Total	39.0				

Table 7.3.4 Distribution facilities expansion plan (Arusha)

Year	Name of Feeder	New (km)	Replacement (km)	U/G line (m)	Switch (Qty.)	Remarks
2002	Mt. Meru - M01		8.0	50	1	S/S TR Expansion
	Mt. Meru - M02		10.0	50	1	
	Mt. Meru - M03		13.0	50	1	
	Mt. Meru - M04		5.0	50	1	
2003	Unga Ltd. - F2		70.0	50	1	S/S TR Expansion
	Unga Ltd. - F3		6.0	50	1	
	Unga Ltd. - F4	3.0		50	3	

Year	Name of Feeder	New (km)	Replacement (km)	U/G line (m)	Switch (Qty.)	Remarks
	Monduli - M01	1.0		50	3	New S/S Construction
	Monduli - M02	1.0		50	3	
	Monduli - M03	1.0		50	3	
	Kiltex -Kiltex		5.0	50	1	
	Kiltex -Breweries		5.0	50	1	
	Sakina - S01	3.0		50	3	New S/S Construction
	Sakina - S02	3.0		50	3	
	Sakina - S03	3.0		50	3	
2005	Njiro B - NB1	3.0		50	3	New S/S Construction
	Njiro B - NB2	3.0		50	3	
	Njiro B - NB3	3.0		50	3	
2007	Themi - T01		25.0	50	1	S/S TR Expansion
	Themi - T02	3.0		50	3	
	11kV Line Total	27.0	147.0	1,000	42	

Table 7.3.5 Distribution facilities expansion plan (Moshi)

Year	Name of Feeder	New (km)	Replacement (km)	U/G line (m)	Switch (Qty.)	Remarks
2002	Boma Mbuzi - Kibo		10.0	50	1	
	Boma Mbuzi - Town		10.0	50	1	
	Boma Mbuzi - Boma		10.0	50	1	
	Boma Mbuzi - B04	5.0		50	3	
	Boma Mbuzi - B05	5.0		50	3	
	Trade School - M1		10.0	50	3	
	Trade School - M2		10.0	50	3	
	Trade School - M3		10.0	50	3	
	Machame - Spare		15.0	50	1	
	YMCA	5.0			3	
	11kV Line Total	15.0	75.0	450	22	
2003	33kV Kifaru-Himo Line	18				33kV D/L

7.3.3 Basic Design

(1) 33kV Distribution Line

(a) Conductor

The conductor used in this project should have sufficient capacity for supplying demanded power for the related grid section, provide satisfactory mechanical strength and anti-corrosiveness, and be of advantageous price. The conductors to be studied are hard-drawn copper stranded conductor (HDCC), aluminum alloy stranded conductor

(AAC), and aluminum cable steel reinforced (ACSR). Of these, ACSR is assumed to be totally advantageous and satisfies the TANESCO standards. Thus, ACSR is adopted.

From the standpoint of construction and maintenance, it is advantageous to select only a few conductor sizes and make them standards. In consideration of sharing with the 11kV distribution line and interchanging of materials, ACSR 100mm^2 and 150mm^2 are adopted.

(b) Anti-corrosive design

Though Dar es Salaam is a coastal city facing the Indian Ocean, strong wind seldom blows and salty spray is rarely carried to the land. In addition, there is appropriate rainfall. Thus, the possibility of salty dirt stuck to the insulators is assumed to be low. However, the conditions may be severer than in inland areas, and influence by salty dirt should be considered especially when selecting pin insulators. Salt contamination is not be considered for Moshi and Arusha.

(c) Conductor arrangement and assembling

There are various conductor arrangements such as horizontal, vertical, and triangular. Considering cooperation with the existing facilities, triangular arrangement is adopted for cities, and horizontal arrangement for the suburbs. See Fig.s 7.4.1 to 7.4.3 for standard assembling.

(d) Supports

There are various supports for the 33kV transmission line such as concrete, steel pipe, and wooden poles. A concrete pole has a high mechanical strength, long life, and a high reliability, but is heavy, and requires a special trailer and machines for construction. A steel pipe pole has a high mechanical strength, can be assembled separately, and has a superior sight, but the price is the highest among the three. A wooden pole has inferior strength and life than the others, but the price is the lowest. Because TANESCO uses wooden poles in most facilities and has experience on using many wooden poles, wooden poles are to be used basically.

(e) Major device specifications

The general specifications of the major devices and materials used for the 33kV distribution lines of this project are given below.

(i) Wires

Applied standards	BS 125, Part 2	
Type	ACSR 150	ACSR 100
Stranding	Al 30/2.65, St 7/2.59	Al 6/4.72, St 7/1.57
Calculated section area	194.9 mm^2	118.5 mm^2
Outer diameter	18.13 mm	14.15 mm
Weight per unit length	725.6 kg/km	394.3 kg/km
Tensile strength	7,060 kg	3,330 kg
Electric resistance	0.1828 Ω/km	0.2733 Ω/km

(ii) Pin type insulators

Applied standards	BS 137, Part 1
Rated voltage	33kV

Wet flashover voltage at commercial frequency	95kV
50% impulse flashover voltage (positive)	215kV

(iii) Suspension insulators

Applied standards	IEC 383
Outside dimensions	254mm x 146mm
Wet flashover voltage at commercial frequency	45kV
50% impulse flashover voltage (positive)	125kV
Maximum tension load	4,000 kg

(iv) Lightning arrester

Applied standards	IEC 99, IEC 37
Rated voltage	42kV
Nominal discharge current	10 kA
Maximum residual voltage	140 kV

(v) 33kV power cable

Applied standards	IEC 502
Type	XLPE insulated
Nominal section area	185 mm^2
Electric resistance	0.0601 Ω/km at 20℃
Insulation resistance	2,000MΩ-km at 20℃

(2) 11kV Distribution Line

(a) Wire

ACSR 100 mm^2 is adopted as the standard wire used by TANESCO for the 11kV distribution line.

(b) Wire arrangement and assembling

The current assembling for the overhead distribution line is of the wishbone type or horizontal arrangement. Recently, facilities are made of the horizontal arrangement, which is easy for construction and has a simple cross-arm form. The horizontal arrangement allows easy wiring of the lead or jumper wires to the pole mounted equipment when adding transformers or section switches and is more economical than other assembling method because it requires shorter poles. Thus, the horizontal arrangement is the optimum assembling method in an area where occupied space can be easily reserved and therefore is mostly used in distribution lines. In this project, the horizontal arrangement method is adopted considering the factors above and cooperation with the existing facilities. Fig.s 7.4.3 and 7.4.4 show the standard assembling.

(c) Supports

Similarly to the 33kV transmission line, wooden poles are basically used in consideration of economics and cooperation with the existing facilities. However, steel pipe poles are to be used for the overhead trunk section of the feeder led out from a new substation in the urban area.

(d) Underground cable

The feeder led out from a new substation is connected through an underground cable to the structures or poles outside the substation. This cable should also match the standards of TANESCO, that is, 11kV steel armored CV cable 185mm^2 (11kV CVMAZV 185mm^2).

(e) Major devices and materials

The general specifications of the major devices and materials used for the 11kV distribution lines of this project are given below.

(i) Conductors

Applied standards	BS 125, Part 2
Type	ACSR 100
Stranding	Al 6/4.72, St 7/1.57
Calculated section area	118.5 mm^2
Outer diameter	14.15 mm
Weight per unit length	394.3 kg/km
Tensile strength	3,330 kg
Electric resistance	0.2733 Ω/km

(ii) Pin type insulators

Applied standards	BS 137, Part 1
Rated voltage	33kV
Wet flashover voltage at commercial frequency	95kV
50% impulse flashover voltage (positive)	215kV

(iii) Suspension insulators

Applied standards	IEC 383
Outside dimensions	254mm x 146mm
Wet flashover voltage at commercial frequency	45kV
50% impulse flashover voltage (positive)	125kV
Maximum tension load	4,000 kg

(iv) Lightning arrester

Applied standards	IEC 99, IEC 37
Rated voltage	42kV
Discharge start voltage at commercial frequency	21kV
Lightning impulse discharge start voltage	50kV
Nominal discharge current	5 kA
Maximum residual voltage	50 kV

(v) 11kV power cable

Applied standards	IEC 502
Type	XLPE insulated
Nominal section area	185 mm^2
Electric resistance	0.0991 Ω/km at 20℃
Insulation resistance	1,500MΩ-km at 20℃

(3) Low-voltage Distribution Line

(i) Conductors

Applied standards	BS 125, Part 1
Type	AAC 50mm^2
Stranding	7/3.10
Calculated section area	52.83 mm^2
Outer diameter	9.30 mm
Weight per unit length	145 kg/km
Tensile strength	8.28 kN
Electric resistance	0.5419 Ω/km

(ii) Low-voltage fuse cut-out

Rated voltage	415V
Rated current	400A
Rated frequency	50 Hz

(iii) Insulator and fittings

Insulator	Low-voltage shackle insulator
Metal fittings	Low-voltage rack
Stay	Galvanized steel stranded wire

(iv) Watt-hour meter

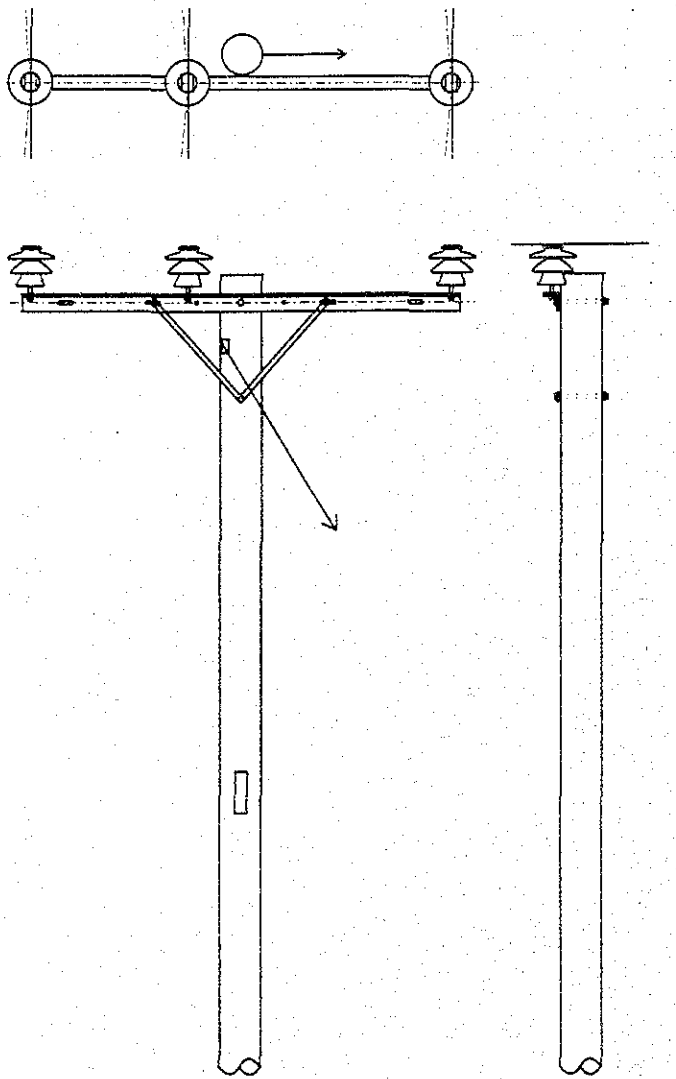
Type	Single-phase two-wire	Three-phase four-wire
Rated voltage	240 V	415/240 V
Rated current	15 (60) A	20 (80) A
Rated frequency	50 Hz	50 Hz
Accuracy	Class 2	Class 2

Table 7.3.6 Inspection and check items for distribution line

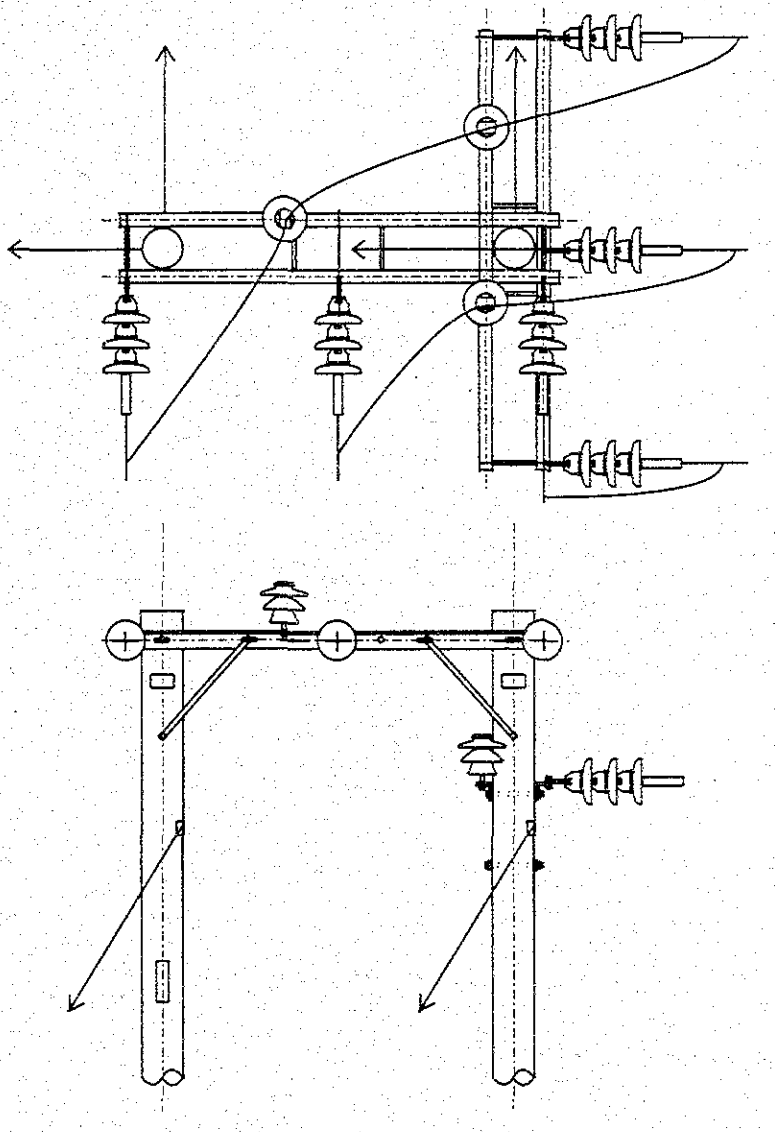
Type	Check item		Attention
Wooden pole	Deterioration	Deteriorated, burnt	
		Damage by birds, bird nest	
Steel pipe pole		Rusted, deformed	Especially, rusty near ground
Steel tower		Metal part rusted, deformed	
		Bolt/nut loosened, dropped	
		Base split, cracked, peeled off	
Concrete pole		Split, cracked, peeled off	
		Red rust spread	
Pole	Grounding	Ground wire cut	
		Insulation coating deteriorated	
	Others	Inclined, floated, sunk	
		Insufficient length	Insufficient separation from others
		State of soil near pole	Loosened, broken, insufficient setting
		Vehicle accident	Damaged by accident
		Trouble in lifting	
		Number plate	Attachment fault, unclear characters

Type	Check item		Attention
Stay	Separation	Separation from high-/low-voltage line	
		Separation from road	
	Others	Wire cut, corroded, loosened	
		Block/anchor lifted	
		State of soil near stay	
		Stay insulator damaged	
		Pole brace corrosion	
		Metal piece deformed, loosened	
Assembling metal	Deterioration	Assembling metal piece corroded, rusted, cracked	
		Inclined, bent, dropped	
		Bolt/nut loosened, dropped	
	Others	Angle inappropriate	
		Obstacle	
		Indicator error	
		Attachment error	
Insulators		Damaged, cracked, spotted, bad	
		Binding wire dropped, loosened	
		Nut loosened, dropped, corroded	
Wire	Separation	Separation from buildings	
		Separation from overhead low-current line	
		Separation from antennas, trees	
	Height above ground	Height above road	
		Height above railway	
		Others	
	Defect	One stripe or span connected at three or less points	Connection point discolored, deformed
		Conductor cut, damaged	Carefully check neutral conductor.
		Arc traces, tracking traces	
		Coating damaged	
	Sag	Sag inappropriate, uneven	
		Interval between lines	
	Others	Kite, obstacles hung	
		Stolen	
		Separation from lead-down or jumper wire	
		Bolt connector loosened	
		Insulation treatment point error	
Transformer	Appearance	Case rusted, corroded, cracked	
		Bushing damaged, cracked, spotted	
		Oil leakage	
	Others	Silica gel error	
		Separation from lead-down and lead-in wires	
		Abnormal heating or noise	
		Lead wire support/connection error	
		Mount position error	

Type	Check item		Attention
Switch		Operation cord or rod error	
		Operation handle or open/close indicator error	
		Contactor or operating mechanism error	
		Lead wire support or connection error	
		Heating trace	
Fuse switch		Damaged, cracked, spotted	
		Connecting screw loosened	
		Holder or cover damaged	
		Lead wire error	
		Lead wire support or connection error	
		Fuse unmatched	
Lightning arrester		Porcelain damaged or spotted	
		Connection line type unmatched	
		Connection line cut	
		Connection terminal error	
Lead-in wire	Separation	Separation from buildings	
		Separation from overhead low-current line	
		Separation from antennas, trees	
	Height above ground	Insufficient height above ground	
		Insufficient height of attaching point	
		Height above ground of high-voltage lead-in wire	
	Line	Insulation coating damaged	
		Size of 2.6 mm or more used	
	Others	Metal piece or insulator damaged	
		Sag, binding wire state	
		Contact with building or antenna stay	
		Bolt or nut dropped	
		Lead-in box terminal discolored, loosened	
Watt-hour meter	Appearance	Instrument box damaged	
		Attaching state abnormal	Inclined 3 degrees or less
		Attaching position inappropriate	Check for vibration or dust.
	Others	Sealing error	Lack of seal
		Wiring error	
		Instrument box damaged or spotted	
		Cable deteriorated	

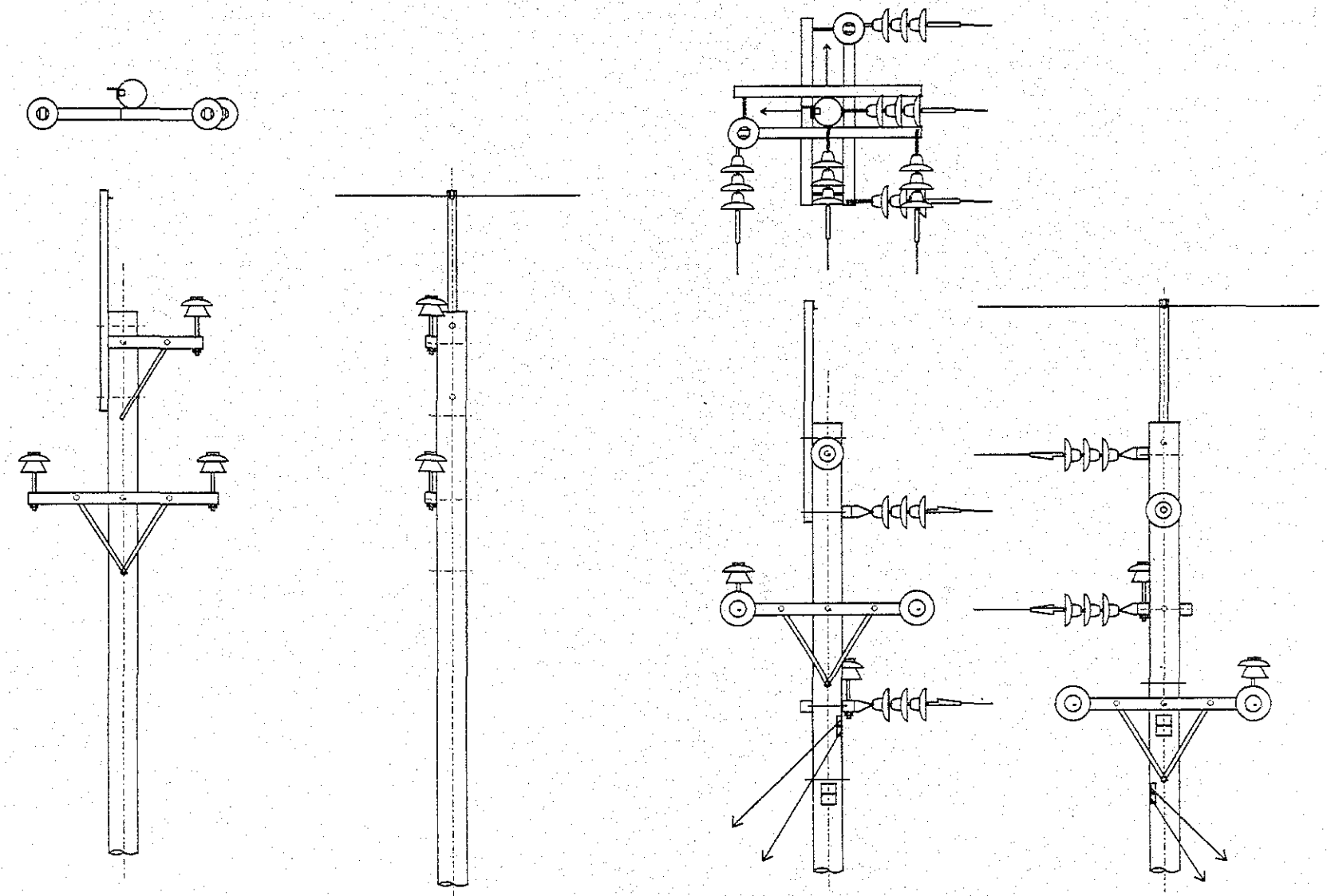


STRAIGHT LINE POLE



SHARP ANGLE POLE

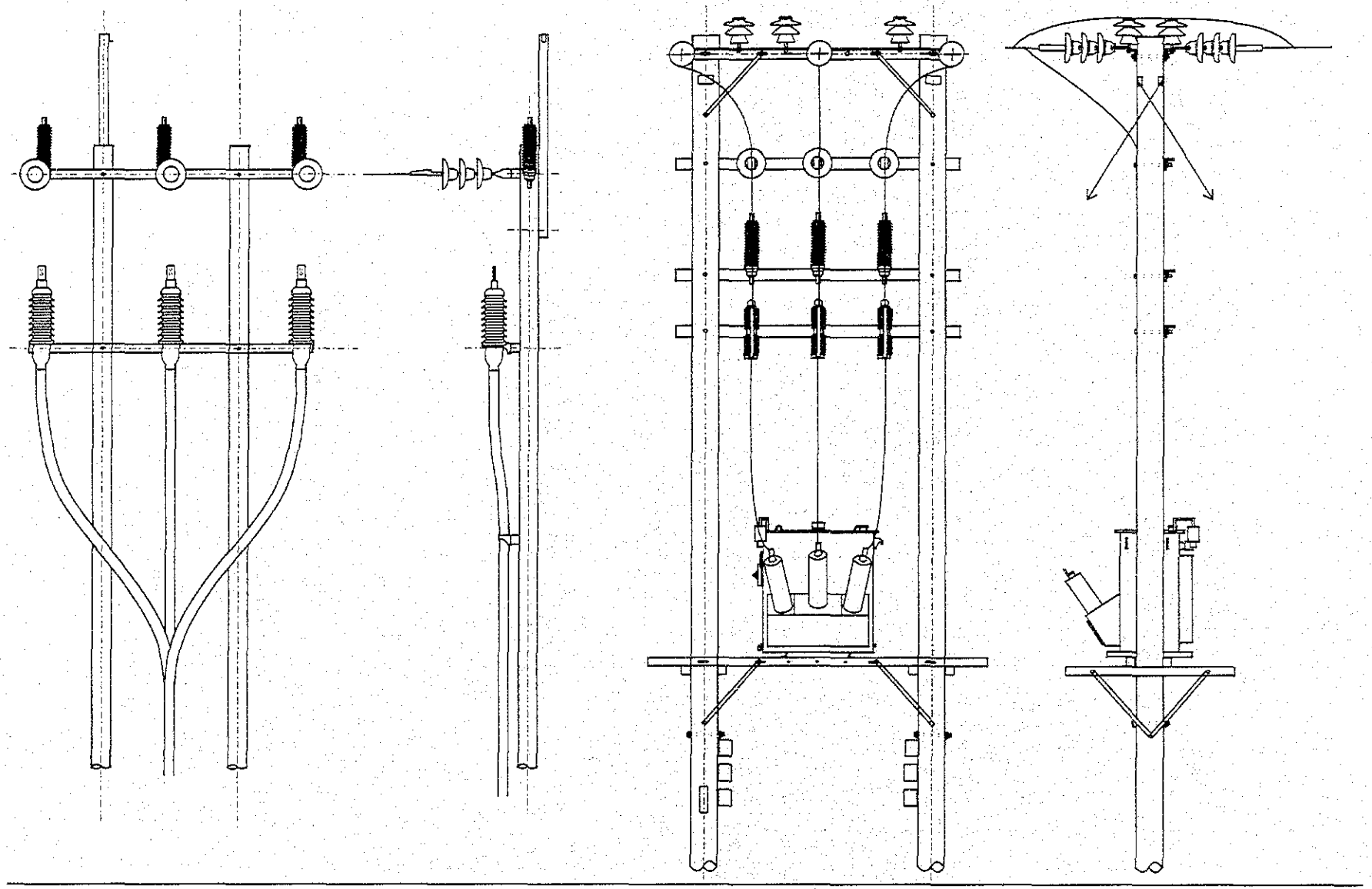
Fig. 7.3.1 33kV distribution line assembling drawing -1



STRAIGHT LINE POLE

SHARP ANGLE POLE

Fig. 7.3.2 33kV distribution line assembling drawing -2



CABLE HEAD

TRANSFORMER PLATFORM

Fig. 7.3.3 33kV distribution line assembling drawing -3

7.4 Approximate Construction Cost

On the basis of conceptual design mentioned above, the Team estimated the approximate construction cost of each project. The calculated costs are shown in from Tables 7.4.1 to 7.4.4.

Basically, the estimation method is based on the cost of similar projects carried out in Tanzania in the past. The Team executed further study such as economic analysis, determination of priority of the projects, modification of master plan and so on with the result of estimation.

Table 7.4.1 Approximate Construction Cost(Dar es Salaam) (Case-A)Unit: US$1,000

Year	Name of S/S	Specification	Type	foreign	local	Remark	Name of Transmission Line	Specification	Type	foreign	local	Remark	Specification	foreign	local	Remark	foreign(total)	local(total)	Total
2002	Mbezi S/S	33kV 15MVAx1	R/E	1236	185	2x15-->1x15							Distribution	3883	17	33kV and 11kV			
	Bahari Beach S/S	33kV 15MVAx1	New	923	138	On Going	Tegeta-Bahari Beach	33kV 100mm2 2cct 13km	New	869	113	On Going 1cct							
	Bagamoyo S/S	33kV 5MVAx1	New	1062	154		Tegeta-Bagamoyo	33kV 100mm2 2cct 60km	New	9136	977	On Going 2cct							
	Sokoine S/S	33kV 15MVAx1	Expansion	892	131		City Center-Sokoine	33kV 100mm2 1cct 3km	Reinforce	183	19								
	City Center S/S	33kV Leadout	Expansion	192	31	Sokoine Line													
	City Center S/S	33kV 30MVAx1	R/E	1415	215	1x15-->1x30													
	Kurasini S/S	33kV 15MVAx1	Expansion	708	108		Ilala-Kurasini	33kV 150mm2 1cct 7.1km	Reconductor	395	47								
	Kurasini S/S	Switchgear	Replace	262	38														
	Mbagala S/S	33kV 15MVAx1	Expansion	831	123														
	Ubungo S/S	33kV 15MVAx1	Expansion	7908	1185	On Going													
	Mikocheni S/S	33kV 15MVAx1	Expansion	808	123														
	Tandale S/S	33kV 15MVAx1	Expansion	854	131		Ubungo-Tandale Tap	33kV 100mm2 2cct 1km	New	152	19	2cct							
	Magomeni S/S	33kV 15MVAx1	New	877	134	On Going	Magomeni-Magomeni Tap	33kV 100mm2 1cct 1km	New	54	6								
	FZ III S/S	33kV 15MVAx1	Expansion	731	108														
	Tandika S/S	33kV 15MVAx1	New	923	138		FZ III-Tandika	33kV 100mm2 2cct 5km	New	373	44	1cct							
	FZ III S/S	33kV Leadout	Expansion	192	31	Tandika Line													
	FZ I S/S	Panel, others	Replace	223	31														
	FZ II S/S	Switchgear etc	Replace	231	31														
			Subtotal	20270	3032				Subtotal	11242	1222		Subtotal	3883	17		35195	4271	39466
2003	Ilala S/S	33kV 15MVAx1	Expansion	1192	177								Distribution	4999	23	33kV and 11kV			
	Muhimbili S/S	33kV 15MVAx1	New	854	131		Ilala-Muhimbili	33kV 100mm2 1cct 6km	New	326	38								
	Ilala S/S	33kV Leadout	Expansion	192	31	Muhimbili Line													
	TOL S/S	33kV 15MVAx1	New	885	131		Ilala-TOL	33kV 100mm2 2cct 5km	New	373	44	1cct							
	Ilala S/S	33kV Leadout	Expansion	192	31	TOL Line													
	University S/S	33kV 15MVAx1	New	854	131		Ubungo-University	33kV 100mm2 1cct 7km	New	380	44								
	Ubungo S/S	33kV Leadout	Expansion	192	31	University Line													
	New Oysterbay S/S	132kV 45MVAx2 33kV 15MVAx2	New	5200	777		Ubungo-New Oysterbay	132kV 240mm2 1cct 6.5km	New	1893	587								
	Ubungo S/S	132kV Leadout	Expansion	392	62	NOB Line													
	Oysterbay S/S	33kV 15MVAx1	R/E	1385	208	2x5-->1x15	New Oysterbay-Oysterbay	33kV 150mm2 2cct 1.8km	New	126	15	1cct							
	Msasani S/S	33kV 15MVAx1	Expansion	1192	177		New Oysterbay-Msasani	33kV 150mm2 2cct 5km	New	394	46	1cct							
			Subtotal	12530	1887				Subtotal	3482	754		Subtotal	4999	23		21011	2664	23675
2004	Bahari Beach S/S	33kV 15MVAx1	Expansion	1115	169								Distribution	5181	24	33kV and 11kV			
	Tegeta S/S	33kV Leadout	Expansion	200	31	Bahari Beach Line													
	Mbrahati S/S	33kV 15MVAx1	New	854	131		Ubungo-Mbrahati	33kV 100mm2 1cct 4km	New	217	25								
	Ubungo S/S	33kV Leadout	Expansion	192	31	Mbrahati Line													
	Yombo S/S	132kV 45MVAx1 33kV 15MVAx1	New New	3385	508		FZ III-Yombo	132kV 240mm2 1cct 6.5km	New	1893	567								
	FZ III S/S	132kV Leadout	Expansion	492	77	Yombo Line													
							Yombo-Mbagala	132kV 240mm2 1cct 10km	New	2216	667								
	Kitunda S/S	33kV 15MVAx1	New	854	131		Yombo-Kitunda	33kV 100mm2 1cct 3.9km	New	212	25								
	Mbagala S/S	132kV 45MVAx1	Expansion	2523	377		Kurasini-Mbagala	132kV 240mm2 1cct 15km	New	3545	1067								
	Kurasini S/S	132kV 45MVAx2	Expansion	3736	562		Ilala-Kurasini	132kV 240mm2 1cct 10km	New	2216	667								
	Ilala S/S	132kV Leadout	Expansion	492	77	Kurasini Line													
			Subtotal	13845	2094				Subtotal	10289	3018		Subtotal	5181	24		29315	5136	34451
2005	Kawe S/S	33kV 15MVAx1	New	854	131		Mbezi-Kawe	33kV 100mm2 1cct 9km	New	499	57		Distribution	1920	9	33kV and 11kV			
	Mbezi S/S	33kV Leadout	Expansion	185	31	Kawe Line													
	Kinondoni S/S	33kV 15MVAx1	New	854	131		Mikocheni-Kinondoni	33kV 100mm2 1cct 6km	New	435	50								
	Mikocheni S/S	33kV Leadout	Expansion	269	38	Kinondoni Line													
	Chang'ombe S/S	33kV 15MVAx1	Expansion	800	123		Kurasini-Chang'ombe	33kV 120mm2 1cct 3km	Reinforce	166	19								
			Subtotal	2962	454				Subtotal	1090	126		Subtotal	1920	9		5972	589	6561

Year	Name of S/S	Specification	Type	foreign	local	Remark	Name of Transmission Line	Specification	Type	foreign	local	Remark	Specification	foreign	local	Remark	foreign(total)	local(total)	Total
2006	Kunduchi S/S	33kV 15MVAx1	New	854	131		Tegeta-Kunduchi	33kV 100mm2 1cct 3.2km	New	174	20		Distribution	2360	11	33kV and 11kV			
	Tegeta S/S	33kV Leadout	Expansion	282	38	Kunduchi Line													
	City Center S/S	33kV 30MVAx1	R/E	1038	154	1x15-->1x30													
	Kigogo S/S	33kV 15MVAx1	New	854	131		Ilala-Kigogo	33kV 100mm2 1cct 12km	New	852	76								
	Ilala S/S	33kV Leadout	Expansion	185	31	Kigogo Line													
	Kurasini S/S	33kV 15MVAx1	Replace	777	115														
	Ilala S/S	132kV 45MVAx1	Expansion	2077	315		Ubungo-Ilala	132kV 240mm2 1cct 7.5km	Reinforce	403	85								
		33kV 15MVAx1	Expansion				Ilala-City Center #2	33kV 100mm2 1cct 2.8km	Reconductor	152	18	1cct							
			Subtotal	**6047**	**915**				**Subtotal**	**1381**	**199**		**Subtotal**	**2360**	**11**		**9786**	**1125**	**10913**
2007	Mbezi S/S	33kV 15MVAx1	Expansion	777	115		Tegeta-Mbezi	33kV 100mm2 1cct 8.4km	Reinforce	456	53		Distribution	508	2	33kV and 11kV			
	Tegeta S/S	33kV Leadout	Expansion	262	38	Mbezi Line													
	Kariakoo S/S	33kV 15MVAx1	Expansion	1215	185		Ilala-Kariakoo	33kV 100mm2 1cct 1.3km	Reinforce	71	9								
	Ilala S/S	33kV Leadout	Expansion	185	31	Kariakoo Line													
			Subtotal	**2439**	**369**		**Subtotal**		**Subtotal**	**527**	**61**		**Subtotal**	**508**	**2**		**3474**	**432**	**3906**
2008	Msasani S/S	33kV 15MVAx1	Expansion	877	131								Distribution	674	3	33kV and 11kV			
			Subtotal	**877**	**131**								**Subtotal**	**674**	**3**		**1551**	**134**	**1685**
2009	TOL S/S	33kV 15MVAx1	Expansion	1185	177								Distribution	843	3	33kV and 11kV			
	Ilala S/S	33kV Leadout	Expansion	185	31	TOL Line													
	FZ III S/S	33kV 15MVAx1	Expansion	785	115														
	Tandika S/S	33kV 15MVAx1	Expansion	1023	154														
	FZ III S/S	33kV Leadout	Expansion	195	31	Tandika Line													
	Ubungo S/S	132kV 60MVAx1	Expansion	1631	245														
			Subtotal	**4994**	**754**								**Subtotal**	**843**	**3**		**5837**	**757**	**6594**
2010																			
																	0	**0**	**0**
			Total	63964	9636				Total	28011	5380		Total	19998	92		111943	15108	
			Substation			73600			Transmission			33391	Distribution			20060	Grand Total		127051

Table 7.4.2 Approximate Construction Cost(Dar es Salaam) (Case-B)Unit: US$1,000

Year	Name of S/S	Specification	Type	foreign	local	Remark	Name of Transmission Line	Specification	Type	foreign	local	Remark	Specification	foreign	local	Remark	foreign(total)	local(total)	Total
2002	Mbezi S/S	33kV 15MVAx1	R/E	1238	185	2x15-->1x15							Distribution	2725	13	33KV and 11kV			
	Bahari Beach S/S	33kV 15MVAx1	New	923	138	On Going	Tegeta-Bahari Beach	33kV 100mm2 2cct 13km	New	869	113	On Going 1cct							
	Bagamoyo S/S	33kV 5MVAx1	New	1062	154		Tegeta-Bagamoyo	33kV 100mm2 2cct 60km	New	9136	977	On Going 2cct							
	City Center S/S	33kV 30MVAx1	R/E	1415	215	1x15-->1x30													
	Kurasini S/S	Switchgear	Replace	262	38														
	Ubungo S/S	33kV 15MVAx1	Expansion	7908	1185	On Going													
	Mikocheni S/S	33kV 15MVAx1	Expansion	908	123														
	Magomeni S/S	33kV 15MVAx1	New	877	131	On Going	Magomeni-Magomeni Tap	33kV 100mm2 1cct 1km	New	54	6								
	Tandika S/S	33kV 15MVAx1	New	923	138		FZ III-Tandika	33kV 100mm2 2cct 5km	New	373	44	1cct							
	FZ III S/S	33kV Leadout	Expansion	192	31	Tandika Line													
	FZ I S/S	Panel, others	Replace	223	31														
	FZ II S/S	Switchgear etc	Replace	231	31														
			Subtotal	16062	2400				Subtotal	10532	1140		Subtotal	2725	13		29319	3553	32872
2003	Sokoine S/S	33kV 15MVAx1	Expansion	892	131		City Center-Sokoine	33kV 100mm2 1cct 3km	Reinforce	163	19		Distribution	4192	19	33KV and 11kV			
	City Center S/S	33kV Leadout	Expansion	192	31	Sokoine Line													
	Tandale S/S	33kV 15MVAx1	Expansion	854	131		Ubungo-Tandale Tap	33kV 100mm2 2cct 1km	New	152	16	2cct							
	Ubungo S/S	33kV Leadout	Expansion			Tandale Line													
	FZ III S/S	33kV 15MVAx1	Expansion	731	108														
	New Oysterbay S/S	132kV 45MVAx2 33kV 15MVAx2	New	5200	777		Ubungo-New Oysterbay	132kV 240mm2 1cct 8.5km	New	1883	567								
	Ubungo S/S	132kV Leadout	Expansion	392	62	NOB Line													
	Oysterbay S/S	33kV 15MVAx1	R/E	1385	208	2x5-->1x15	New Oysterbay-Oysterbay	33kV 150mm2 2cct 1.5km	New	126	15	1cct							
			Subtotal	9646	1448				Subtotal	2324	617		Subtotal	4192	19		16162	2084	18246
2004	Mbagala S/S	33kV 15MVAx1	Expansion	931	123								Distribution	4635	22	33KV and 11kV			
	Muhimbili S/S	33kV 15MVAx1	New	854	131		Ilala-Muhimbili	33kV 100mm2 1cct 6km	New	326	38								
	Ilala S/S	33kV Leadout	Expansion	192	31	Muhimbili Line													
	TOL S/S	33kV 15MVAx1	New	985	131		Ilala-TOL	33kV 100mm2 2cct 5km	New	373	44	1cct							
	Ilala S/S	33kV Leadout	Expansion	192	31	TOL Line													
	University S/S	33kV 15MVAx1	New	854	131		Ubungo-University	33kV 100mm2 1cct 7km	New	380	44								
	Ubungo S/S	33kV Leadout	Expansion	192	31	University Line													
	Yombo S/S	132kV 45MVAx1	New	3365	508		FZ III-Yombo	132kV 240mm2 1cct 8.5km	New	1883	567								
		33kV 15MVAx1	New																
	FZ III S/S	132kV Leadout	Expansion	492	77	Yombo Line													
							Yombo-Mbagala	132kV 240mm2 1cct 10km	New	2216	667								
	Kitunda S/S	33kV 15MVAx1	New	854	131		Yombo-Kitunda	33kV 100mm2 1cct 3.9km	New	212	25								
	Mbagala S/S	132kV 45MVAx1	Expansion	2523	377		Kurasini-Mbagala	132kV 240mm2 1cct 16km	New	3545	1067								
	Kurasini S/S	132kV 45MVAx2	Expansion	3738	562		Ilala-Kurasini	132kV 240mm2 1cct 10km	New	2216	667								
	Ilala S/S	132kV Leadout	Expansion	492	77	Kurasini Line													
	Kurasini S/S	33kV 15MVAx1	Expansion	708	108		Ilala-Kurasini	33kV 150mm2 1cct 7.1km	Reconductor	365	47								
			Subtotal	16192	2449				Subtotal	11546	3166		Subtotal	4635	22		32373	5637	38010
2005	Mbrahati S/S	33kV 15MVAx1	New	854	131		Ubungo-Mbrahati	33kV 100mm2 1cct 4km	New	217	25		Distribution	1401	7	33KV and 11kV			
	Ubungo S/S	33kV Leadout	Expansion	192	31	Mbrahati Line													
	Msasani S/S	33kV 15MVAx1	Expansion	1192	177		New Oysterbay-Msasani	33kV 150mm2 2cct 5km	New	394	46	1cct							
			Subtotal	2238	339				Subtotal	611	71		Subtotal	1401	7		4250	417	4667
2006	Kinondoni S/S	33kV 15MVAx1	New	854	131		Mikocheni-Kinondoni	33kV 100mm2 1cct 8km	New	435	50		Distribution	2462	11	33KV and 11kV			
	Mikocheni S/S	33kV Leadout	Expansion	269	38	Kinondoni Line													
	Kawe S/S	33kV 15MVAx1	New	854	131		Mbezi-Kawe	33kV 100mm2 1cct 9km	New	489	57								
	Mbezi S/S	33kV Leadout	Expansion	185	31	Kawe Line													
	City Center S/S	33kV 30MVAx1	R/E	1038	154	1x15-->1x30													
	Kurasini S/S	33kV 15MVAx1	Replace	777	115														
	Ilala S/S	132kV 45MVAx1	Expansion	2077	315		Ubungo-Ilala	132kV 240mm2 1cct 7.5km	Reinforce	403	65								
		33kV 15MVAx1	Expansion				Ilala-City Center #2	33kV 100mm2 1cct 2.8km	Reconductor	152	18	1cct							
			Subtotal	6054	915				Subtotal	1479	210		Subtotal	2462	11		9995	1136	11131

Year	Name of S/S	Specification	Type	foreign	local	Remark	Name of Transmission Line	Specification	Type	foreign	local	Remark	Specification	foreign	local	Remark	foreign(total)	local(total)	Total
2007	Behari Beach S/S	33kV 15MVAx1	Expansion	1115	169								Distribution	2824	13	33kV and 11kV			
	Tegeta S/S	33kV Leadout	Expansion	200	31	*Behari Beach Line*													
	Kunduchi S/S	33kV 15MVAx1	New	854	131		Tegeta-Kunduchi	33kV 100mm2 1cct 3.2km	New	174	20								
	Tegeta S/S	33kV Leadout	Expansion	262	38	Kunduchi Line													
	Kigogo S/S	33kV 15MVAx1	New	854	131		Ilala-Kigogo	33kV 100mm2 1cct 12km	New	852	76								
	Ilala S/S	33kV Leadout	Expansion	185	31	Kigogo Line													
							Tegeta-Mbezi	33kV 100mm2 1cct 8.4km	Reinforce	456	53								
			Subtotal	3470	531				Subtotal	1282	149		Subtotal	2824	13		7576	693	8269
2008	Chang'ombe S/S	33kV 15MVAx1	Expansion	800	123		Kurasini-Chang'ombe	33kV 120mm2 1cct 3km	Reinforce	166	19		Distribution	242	1	33kV and 11kV			
			Subtotal	800	123				Subtotal	166	19		Subtotal	242	1		1208	143	1351
2009	Mbezi S/S	33kV 15MVAx1	Expansion	777	115								Distribution	1190	6	33kV and 11kV			
	Tegeta S/S	33kV Leadout	Expansion	262	38	Mbezi Line													
	Msasani S/S	33kV 15MVAx1	Expansion	877	131														
			Subtotal	1916	284								Subtotal	1190	6		3106	290	3396
2010	Kariakoo S/S	33kV 15MVAx1	Expansion	1215	185		Ilala-Kariakoo	33kV 100mm2 1cct 1.3km	Reinforce	71	8								
	Ilala S/S	33kV Leadout	Expansion	185	31	Kariakoo Line													
	Ilala S/S	33kV 15MVAx1	Expansion	1192	177														
			Subtotal	2562	393				Subtotal	71	8						0	0	0
			Total	58970	8882				Total	28011	5360		Total	19671	92		106652	14354	
			Substation			67852			Transmission			33361	Distribution			19763	Grand Total		121006

Table 7.4.3 Approximate Construction Cost(Arusha, Moshi) (Case-A) Unit: US$1,000

Year	Name of S/S	Specification	Type	foreign	local	Remark	Name of Transmission Line	Specification	Type	foreign	local	Remark	Specification	foreign	local	Remark	foreign(total)	local(total)	Total
2002	Njiro S/S	Switchgear	Replace	908	92								Distribution	752	3	Arusha			
		132kV 45MVAx1	Expansion	2531	262								Distribution	1826	9	Kilimanjaro			
	Mt. Meru S/S	33kV 10MVAx3	Expansion	1646	246		Njiro-MtMeru	33kV 100mm2 7.3km	Reinforce	397	46								
	Kyungi S/S	Switchgear etc	Replace	1086	162														
		132/33kV 45MVAx1	Expansion	1762	262														
	Boma Mbuzi	Switchgear etc	Replace	915	92		Kyungi-Boma Mbuzi	33kV 100mm2 7km	Reinforce	380	44								
		33kV 10MVAx1	Expansion	592	85														
	Trade School S/S	33kV 10MVAx1	R/E	1208	185		Kyungi-Trade School	33kV 100mm2 10km	Reinforce	543	83								
	Macharne S/S	33kV 5MVAx1	R/E	138	23	1x2.5-->1x5													
	YMCA S/S	33kV 10MVAx1	New	531	77	On going													
	Marangu S/S	33kV	New	731	108		Kyungi-Marangu	33kV 100mm2 43km	New	2336	271								
			Subtotal	12047	1594				Subtotal	3656	424		Subtotal	2578	11		18281	2029	20310
2003	Unga LTD S/S	33kV 10MVAx3	R/E	2131	323	2x5-->3x10	Njiro-Unga LTD	33kV 100mm2 5.8km	Reinforce	315	37		Distribution	2376	11	Arusha			
	Kitex S/S	33kV 10MVAx1	R/E	723	108	1x5-->1x10							Distribution	306	1	Kilimanjaro			
	Usa River S/S	33kV 10MVAx1	New	662	100		Njiro-Usa River	33kV 100mm2 21.3km	New	1157	134								
							Tengeru-Usa River	33kV 100mm2 12.5km	New	679	79								
	Monduli S/S	33kV 10MVAx1	New	662	100		Njiro-Monduli	33kV 100mm2 38.6km	New	2097	243								
	Same	Switchgear etc	Replace	339	54														
			Subtotal	4516	685				Subtotal	4248	493		Subtotal	2682	12		11446	1190	12636
2004	Sakina S/S	33kV 10MVAx1	New	662	100		Njiro-Sakina	33kV 100mm2 13.2km	New	717	83		Distribution	0	0	Arusha			
							MtMeru-Sakina	33kV 100mm2 6.1km	New	440	51		Distribution	742	3	Kilimanjaro			
	KCMC S/S	33kV 10MVAx1	New	662	100		Trade School-KCMC	33kV 100mm2 3.7km	New	201	23								
	Trade School	33kV Leadout	Expansion	185	31	KCMC Line													
			Subtotal	1509	231				Subtotal	1358	157		Subtotal	742	3		3609	391	4000
2005	Njiro B S/S	33kV 10MVAx1	New	662	100		Njiro-Njiro B	33kV 100mm2 3km	New	163	19		Distribution	361	2	Arusha			
							Njiro-Kyungi	132kV 240mm2 7.0km	Reinforce	7755	2334	(1/2)	Distribution	1045	5	Kilimanjaro			
			Subtotal	662	100				Subtotal	7918	2353		Subtotal	1406	7		9986	2460	12446
2006	Njiro S/S	220kV 60MVAx1	Expansion	4508	677														
		132kV 45MVAx1	Expansion				Njiro-Kyungi	132kV 240mm2 7.0km	Reinforce	7755	2334	(2/2)							
	Gomben S/S	33kV 5MVAx1	New	569	85		KCMC-Gomben	33kV 100mm2 4.9km	New	266	31								
	KCMC	33kV Leadout	Expansion	185	31	Gomben Line													
	Kyungi S/S	132kV Leadout	Expansion	439	62	Njiro Line													
			Subtotal	5700	855				Subtotal	8021	2365						13721	3220	16941
2007	Themi S/S	33kV 10MVAx1	Expansion	1115	169								Distribution	621	3	Arusha			
	Boma Ngombe S/S	33kV 5MVAx1	New	569	85								Distribution	1045	5	Kilimanjaro			
			Subtotal	1684	254				Subtotal	0	0		Subtotal	1666	8		3350	262	3612
2008													Distribution	0	0	Arusha			
													Distribution	1045	5	Kilimanjaro			
													Subtotal	1045	5		1045	5	1050
2009	Usa River S/S	33kV 10MVAx1	Expansion	738	109														
	Sakina S/S	33kV 10MVAx1	Expansion	738	109														
	Kyungi S/S	132/33kV 45MVAx1	Expansion	1231	185														
			Subtotal	2707	401				Subtotal	0	0		Subtotal	0	0		2707	401	3108
2010																			
																	0	0	0
			Total	28825	4120				Total	25201	5792		Total	10119	46		64145	9958	
			Substation			32945			Transmission			30983	Distribution			10165	Grand Total		74103

Table 7.4.4 Approximate Construction Cost(Arusha, Moshi) (Case-B) Unit: US$1,000

Year	Name of S/S	Specification	Type	foreign	local	Remark	Name of Transmission Line	Specification	Type	foreign	local	Remark	Specification	foreign	local	Remark	foreign(total)	local(total)	Total
2002	Njiro S/S	Switchgear	Replace	908	92								Distribution	752	9	Arusha			
		132kV 45MVAx1	Expansion	2531	262								Distribution	2131	10	Kilimanjaro			
	Mt. Meru S/S	33kV 10MVAx3	Expansion	1646	248		Njiro-MtMeru	33kV 100mm2 7.3km	Reinforce	397	46								
	Kiyungi S/S	Switchgear etc	Replace	1085	162														
		132/33kV 45MVAx1	Expansion	1762	262														
	Boma Mbuzi	Switchgear etc	Replace	915	92		Kiyungi-Boma Mbuzi	33kV 100mm2 7km	Reinforce	380	44								
		33kV 10MVAx1	Expansion	592	85														
	Trade School S/S	33kV 10MVAx1	R/E	1208	185		Kiyungi-Trade School	33kV 100mm2 10km	Reinforce	543	63								
	YMCA S/S	33kV 10MVAx1	New	531	77	On going													
	Marangu S/S	33kV	New	731	108		Kiyungi-Marangu	33kV 100mm2 43km	New	2336	271								
			Subtotal	11909	1571				Subtotal	3656	424		Subtotal	2883	13		18448	2008	20456
2003	Unga LTD S/S	33kV 10MVAx3	R/E	2131	323	2x5-->3x10	Njiro-Unga LTD	33kV 100mm2 5.8km	Reinforce	315	37		Distribution	1850	9	Arusha			
	Kiltex S/S	33kV 10MVAx1	R/E	723	108	1x5-->1x10							Distribution	0	0	Kilimanjaro			
	Machame S/S	33kV 5MVAx1	R/E	138	23	1x2.5-->1x5													
	Same	Switchgear etc	Replace	338	54														
			Subtotal	3330	508				Subtotal	315	37		Subtotal	1850	9		5495	554	6049
2004	Usa River S/S	33kV 10MVAx1	New	662	100		Njiro-Usa River	33kV 100mm2 21.3km	New	1157	134		Distribution	526	2	Arusha			
							Tengeru-Usa River	33kV 100mm2 12.5km	New	679	79		Distribution	742	3	Kilimanjaro			
	Monduli S/S	33kV 10MVAx1	New	662	100		Njiro-Monduli	33kV 100mm2 36.6km	New	2097	243								
			Subtotal	1324	200				Subtotal	3933	456		Subtotal	1268	5		6525	661	7186
2005	Sakina S/S	33kV 10MVAx1	New	662	100		Njiro-Sakina	33kV 100mm2 13.2km	New	717	83		Distribution	361	2	Arusha			
							MtMeru-Sakina	33kV 100mm2 8.1km	New	440	51		Distribution	1045	5	Kilimanjaro			
							Njiro-Kiyungi	132kV 240mm2 70km	Reinforce	7755	2334	(1/2)							
	KCMC S/S	33kV 10MVAx1	New	662	100		Trade School-KCMC	33kV 100mm2 3.7km	New	201	23								
	Trade School	33kV Leadout	Expansion	185	31	KCMC Line													
			Subtotal	1509	231				Subtotal	9113	2491		Subtotal	1406	7		12028	2729	14757
2006	Njiro B S/S	33kV 10MVAx1	New	662	100		Njiro-Njiro B	33kV 100mm2 3km	New	163	19		Distribution	361	2	Arusha			
	Njiro S/S	220kV 60MVAx1	Expansion	4508	677								Distribution	0	0	Kilimanjaro			
		132kV 45MVAx1	Expansion				Njiro-Kiyungi	132kV 240mm2 70km	Reinforce	7755	2334	(2/2)							
	KCMC	33kV Leadout	Expansion	185	31	Gomberi Line													
	Kiyungi S/S	132kV Leadout	Expansion	438	62	Njiro Line													
			Subtotal	5793	870				Subtotal	7918	2353		Subtotal	361	2		14072	3225	17297
2007	Gomberi S/S	33kV 5MVAx1	New	569	85		KCMC-Gomberi	33kV 100mm2 4.9km	New	266	31		Distribution	0	0	Arusha			
													Distribution	1045	5	Kilimanjaro			
			Subtotal	569	85				Subtotal	266	31		Subtotal	1045	5		1880	121	2001
2008	Thami S/S	33kV 10MVAx1	Expansion	1115	169								Distribution	0	0	Arusha			
	Boma Ngombe S/S	33kV 5MVAx1	New	569	85								Distribution	1045	5	Kilimanjaro			
			Subtotal	1684	254				Subtotal	0	0		Subtotal	1045	5		2729	259	2988
2009													Distribution	621	3	Arusha			
													Distribution	0	0	Kilimanjaro			
													Subtotal	621	3		621	3	624
2010																			
																	0	0	0
			Total	26118	3719				Total	25201	5782		Total	10479	49		61798	9560	
			Substation			29837			Transmission			30983	Distribution			10528	Grand Total		71358