

**SCOPE OF WORK – WATAMU 33/11KV  
SUBSTATION**

## 4.2 SCOPE OF WORK - WATAMU SUBSTATION

### 4.2.1 General

The Bidder shall examine the scope of works in this section in close connection with the other documents and particulars forming these Bidding Documents.

Special attention shall be paid to General Specifications and Particular Technical Specifications, in which the general technical requirements are specified. The drawings enclosed in are for bidding purposes only.

If the Specifications and/or Drawings do not contain particulars of materials or goods, which are necessary for the proper and safe completion, operation, and maintenance of the equipment in question, all such materials shall be deemed to be included in the supply.

In the event of any conflict between the Drawings and the Specifications, the latter shall prevail.

In the event of any conflict between scaled dimensions and figures on the Drawings, the figures shall prevail.

Should the Bidder find discrepancies in or omissions from these Specifications or from the other Documents, or should he be in doubt as to their meaning, he should immediately contact the Project Manager for interpretation, clarification or correction thereof before submitting his Bid. Such action shall, however, in no case be considered as a cause for altering the closing date of the Bid.

The scope of work for equipment shall cover engineering design, manufacture, testing before shipment and packing sea worthy or otherwise as required, delivery CIP site, of all equipment as specified in the preceding chapters.

For substations contracted on turnkey basis the substation contractor shall be responsible for design, material supply, transport, erection, and installation and commissioning as well as having the full responsibility for civil works including design and construction of transformer foundations and control building.

The Contractor shall design and construct the transformer foundations with oil collection pit, oil trap and fire damper consisting of crushed stones laying on a galvanised steel grating.

Loose equipment for the Employer's rehabilitation shall be complete with documentation and ancillaries like programs, licences and programming tools.

Equipment that is to be dismantled and removed from existing substations is to be recovered by the Contractor and deposited to sites within or in the immediate vicinity of each substation. Such sites are to be designated by the Employer. The recovered equipment is to be taken over by the Employer at these sites.

KPLC has a SCADA (Supervisory, Control & Data Acquisition) system that is controlled from the Regional Control Centres & the National Control Centre. The National Control Centre (NCC) is at Juja Rd and controls the entire transmission network & substations (ie some 66kV, all 132kV, all 220kV & soon to be introduced 400kV stations.)

There are 4 regional control centres in total. These are located in the following locations; Juja Rd (Nairobi region), Rabai (Coast region), Lessos (West Kenya region) & Kiganjo (Mt Kenya region). These Regional Control Centres monitor & control the 11KV, 33kV & 66kV Distribution networks & substations in their specific regions.

The Control Centres all run ABB's Network Manager WS500 which is the software used for monitoring & Control of all the incorporated substations. The Communication protocol currently supported by KPLCs front end servers is ABBs PCU 400, for data telegram exchange with Remote Terminal Units (RTUs). Whereas, the Station Control Management Systems (SCMS) in the substations in its SCADA system are IEC 60870-5-101&IEC 60870-5-104.

The interconnected KPLC's telecommunications system is based on a backbone of SDH STM1/4 terminal equipment, FOX 515 from ABB. A network management system (NMS) for the telecommunication system has been installed at NCC.

#### 4.2.2 Standard Substation

This section defines the standard substation components. The actual quantities to be included in the price schedules are found for each substation in the subsequent sections.

#### 4.2.3 33 kV Switchgear Outdoor Type

##### 4.2.3.1 Transformer Bay

1 (one) complete bay shall be equipped with:

1 (one) circuit breaker

2 (two) isolator with motor operation

1 (one) earthing switch

1 (one) set of busbars

1 (one) complete set of three-phase line including clamps for the flying busbars and for connection between the gantries, to the transformer bushings, to the busbars and to and between the apparatus.

1 (one) set of current transformers

1 (one) set of surge diverters

1 (one) set of steel structures for support

1 (one) bay control unit with proper display, for measurements (V,I,MVAR,MW)

Tapchanger voltage regulating relay (AVR)

1 (one) multifunctional protection unit as per 4.1.2.4.2.2 Section VI Particular Technical specifications substations control, and Protection

HV overcurrent protection relay.

1 (one) lock-out trip relay with electrical/hand reset facilities

1 (one) lot of necessary interposing relays, MCB's, terminal blocks and wiring to form a complete operative bay control. The control scheme shall be prepared for SCADA operation

##### 4.2.3.2 INCOMING Feeder Bay

1 (one) complete bay shall be equipped with:

1 (one) circuit breaker

2 (two) isolator with motor operation

1 (one) earthing switch

1 (one) complete set of three-phase line including clamps for the flying busbars and for connection between the gantries, to the busbars and to and between the apparatus.

1 (one) set of current transformers

1 (one) set of voltage transformers

1 (one) set of steel structures for support

1 (one) set of control/protection panel

**4.2.3.3 Bus Bar Protection**

1 (one) bus bar protection unit included in the control panel for all 33KV bus bars.

**4.2.4 11 kV Switchgear Outdoor Type****4.2.4.1 11KV FEEDER**

1 (one) complete bay shall be equipped with:

- 1 (one) Autorecloser/circuit breaker
- 1 (one) earthing switch
- 1 (one) set of current transformers
- 1 (one) set of surge diverters
- 2 (TWO) sets of air break switches
- 1 (one) neutral current transformer
- 1 (one) bay control unit with display and measuring functions
- 1 (one) restricted fault relay function
- 1 (one) neutral point earth fault relay function
- 1 (one) lock-out trip relay with electrical/hand reset facilities
- 1 (one) lot of necessary interposing relays, MCB's, terminal blocks and wiring to form a complete operative bay control. The control scheme shall be prepared for SCADA operation.
- 1 (one) set of voltage transformers (with a facility for primary isolation)

Note: 11KV Capacitor bank switchgear shall be equipped with the necessary protection and control relays for Capacitor banks. .

**4.2.4.2 Current Transformers for Neutral current measurements**

- (a) 2 (two) current transformers for neutral current measurements one on each winding

**4.2.4.3 Lightning Arresters**

- (a) 33kV lightning arrestors erected close to HV side of power Transformer

**4.2.5 MV Power Cables from Transformer to Indoor Switchgear**

- 1 (one) lot of 11 kV cable from main transformers to 11 kV switchgear, rated for 120 % of nominal transformer rating
- 1 (one) lot of 11 kV cable terminations for transformer and switchgear connection
- 1 (one) lot of support structures for lightning arresters and transformer connection
- 1 (one) lot of 11 kV cable from switchgear to auxiliary transformer
- 1 (one) lot of 11 kV cable terminations for auxiliary transformer and switchgear connection
- 1 (one) lot of support structures for auxiliary transformer.

**4.2.6 Control, Protection, Metering and Signalling****4.2.6.1 Substation Automation System****General**

1 (one) lot complete system (equipment and software) for substation control.

To the extent the internal control and interlocking system for the equipment supplied is not

included for that particular equipment, it shall be included herein. All interconnections needed to form a complete installation shall also be included herein.

The control system specified hereunder shall include all necessary equipment for control, protection, metering and signalling. The system shall include all instruments, meters, switches, position indicators, inscriptions and mimic diagrams, protective and auxiliary relays, terminal blocks, internal wiring and any other equipment required to form a complete installation.

Drawings showing the control system, protection units and the boards as they are proposed shall be supplied with the Bid.

The space needed for the boards should not exceed the available space.

Information defining the internal local control communication protocol shall be submitted with the Bid.

Complete sets of schematic diagrams for control, protection, indication, metering, signalling, alarms, etc. shall be supplied as part of the project and shall be subject to the Project Manager's approval.

The requirements as to submission of diagrams, drawings and other documents with the Bid and after award of Contract are stated in the standard form of contract.

#### **4.2.6.1.1 Scope SCADA/SAS.**

For existing Substations with SAS/RTU in operation. One complete (lot) extension of the SAS/RTU to accommodate the additional switchgear. This shall include Hardware and software and necessary Engineering.

For a point-to-point communication link the IEC 60870-5-101 protocol shall be implemented.

As part of the supply necessary engineering of the substation signal list (I/O list) shall be included. The engineering shall be carried out on the format prescribed to KPLC by the SCADA contractor.

#### **4.2.6.2 Control and Measuring Cables**

All external cables, conventional or fibre optical, for control, protection, measuring, indication, etc., for the complete plant. Wiring between the switchyard apparatus, transformers, the board(s) and the control system in the control building and the interconnections between the various apparatus in the switchyard shall be included.

#### **4.2.6.3 Telecommunications**

In order for the SCADA data to be transferred to the Regional control centres, the bidder shall design and commission an appropriate communication system based on Fibre, PLC, Radio or other approved communication media for data and speech requirement.

Equipment supplied shall be digital and latest technology and shall comply to the latest ITU-T, IEC, ITU-R, IEEE and ETSI standards.

It is required that one remote subscriber be implemented in each substation.

Interface for data transmission shall be according to ITU-T recommendation V.24 or V.35

Bit error rates of  $1 \times 10^{-6}$  shall not be exceeded.

It is the responsibility of the contractor to interconnect with existing SCADA and

Telecommunications system. However use and extension of existing infrastructure where possible shall be encouraged.

The Tenderer shall acquaint himself with all the sites and determine the requirements for towers or masts to suit his design. When a new tower or mast is necessary is necessary, the Tenderer shall supply drawings for the proposed installation. All towers shall be 36 m and self supporting. The tenderer shall provide details of loading and guy stresses for masts or towers to be erected on buildings. All antennae mounting components including wave-guides, cables, cable clamps and external cable connectors shall be specified.

Where PLCs are to be used or where the T-offs affect existing PLC communication links, blocking line-traps including support structures shall be in scope of supply.

All communications equipment installed in the country must be type approved by the Communications Commission of Kenya (CCK). The Contractor will obtain the type approval.

The CCK has to be consulted and give approval for each new project and an application has to be submitted stating the location of the sites and request for the frequencies to be used. Unless otherwise stated this application for frequencies is normally done by KPLC.

The radio frequency plan shall be prepared by the Contractor and closely coordinated with KPLC during the project design stage. All path surveys shall be carried out by contractor.

The Contractor shall provide a list of recommended spares, the quantities and prices to last for a period of five (5) years after expiry of guarantee period.

The contractor shall offer training for four (4) technical appointees of the employer for 2 weeks at manufacturer's premises. Terms and conditions similar to 4.2.15

The contractor shall provide necessary configuration software pre-installed on a maintenance laptop with a one time software license.

#### **4.2.6.3.1 Scope of works - Telecommunication**

The scope as described shall include detailed system design, manufacture, supply, installation, testing, commissioning, remedying of defects, maintaining the works during the defects liability period and any incidental work necessary for the proper completion of the work in accordance with this contract. Scope shall include integration of STM-4, to the existing KPLC Network Management System. In some cases there shall be need to upgrade existing Telecommunication equipment in order to achieve data and speech routing to Regional and National control centres. Survey and necessary preparation works on existing systems, Equipment and substations to achieve specified functionality shall be in the scope of supply. Contractors shall be required to submit for approval detailed design of system before manufacture.

The STM 4 equipment shall include Tele-protection modules (4 Command), High Speed Ethernet modules and 1+1 protection.

Necessary upgrade of communication and SCADA Front Ends (PCUs) equipment at terminal stations and at Control centres shall achieve complete Data and Speech to RCC/NCC shall be included in scope.

In addition all substations (irrespective of whether SCADA functionality to control centre is established) shall be equipped with a Base Radio capable of communicating with the ASTRO trunking radio system for use during switching operations. Where OLTEs are the terminal equipment, additional Ethernet capability shall be established to cater for other corporate data. All stations shall be equipped with two (2N0.) telephone extensions originating from existing PAXes in Regional control centres.

All communication equipment supplied under this project shall be type approved by the regulator, Communication Commission of Kenya (CCK) and the Kenya Bureau of Standards (KBS) where applicable. It is the responsibility of the contractor to obtain these necessary

approvals.

The type of required communication link shall be detailed in scope of supply for individual stations.

#### **4.2.1 Auxiliary AC Supply Equipment**

##### **4.2.1.1 Main AC Distribution Board**

1 (one) main distribution board designed for minimum 200 A with the necessary number of panels for:

- (a) 1 (one) circuit breaker, manual operated, minimum 200 A, for the feeder from the station supply transformer.
- (b) 2 (two) current transformers 200/1/1 A with two cores, one core for measuring and one for protection.
- (c) 1 (one) constant time over current relay.
- (d) 1 (one) earth fault relay.
- (e) 1 (one) A-meter function with selector switch.
- (f) 1 (one) V-meter function with selector switch.
- (g) 1 (one) lot of feeder circuit breakers with electro-BAHnetic and thermal releases. The breaker ratings shall be chosen to suit the different consumers to be connected. 20% of the breakers of each size shall be spare and readily mounted.

##### **4.2.1.2 Sub-distribution Boards and Panels**

- (a) 1 (one) lot of all necessary sub-distribution boards and panels (including the distribution panel for lighting and small power of the control building).

The boards shall be completely equipped with bus bars, circuit breakers, miniature circuit breakers etc. Contactors, motor starters, instruments, operating switches, push buttons, indicating lamps, etc., shall be included whenever required. 20% of the breakers of each size shall be spare and readily mounted.

##### **4.2.1.3 Cables**

- (a) 1 (one) lot of all necessary armoured power and control cables for supply to the main distribution board and to the sub-distribution boards, panels and equipment except for the cables for lighting and small power which are included in the civil Goods under separate contract.

#### **4.2.2 Earthing System**

An earthing network shall be installed comprising the following:

- (a) 1 (one) lot of underground earthing system covering the platform and control building with risers
- (b) 1 (one) complete set of "above-floor" earthing system for the control building, as applicable, with connections to the risers from the under-ground system.

#### **4.2.3 Ancillary Equipment**

##### **4.2.3.1 Station Equipment**

- (a) 2 (two) self-contained, rechargeable, portable hand-held lights.
- (b) 1 (one) audible alarm system with the necessary wiring.

##### **4.2.3.2 Earthing Devices**

- (a) 1 (one) set of three phase portable earthing devices for outdoor 33kV with operating

rods suitable for earthing of the bay conductors and bus bars.

- (b) 1 (one) set of voltage indicator for 33 kV and 11KV with audible and visual indication for voltage

#### 4.2.3.3 Cable Accessories

- (a) 1 (one) lot of all connecting material, cable boxes and material for fixing the cables. Terminals and terminal labels to the extent that this is not included in other sections.

#### 4.2.3.4 Racks, Conduits, Ducts, etc

- (a) 1 (one) lot of all cables, racks and trays to the extent necessary for the proper distribution of cables. Note all cable trays to be perforated aluminium type  
All the conduits and protection tubes, wherever cables may deteriorate or where cable laying may otherwise present difficulties.

#### 4.2.4 Power transformers

To be supplied by client as specified in accordance with below data.

#### 4.2.6.4 Type of transformers-KPLC shall supply-Vector group DYNy0

Main data for the transformers that shall be supplied:

Pos.	Rating MVA (ONAN/ONAF)	Voltage	Tapping range	OLTC
1	7.5/Mva	33/11	□ 8 x 1.67%	yes

**Transformers in Coastal region- shall** are of vector group: Ynynd1 (with stabilizing winding).

#### 4.2.7 Civil Works

##### 4.2.7.1 Platform works

Platform with fence roads and ditches shall be constructed as specified in particular specifications and in scope of work.

##### 4.2.7.2 Switchgear buildings

The existing building shall be extended to accommodate the new equipment with necessary relocation of septic and soak pit and refurbishment of existing room and make goods all disturbed areas, bidder to give the extension proposal for approval. Extensions not exceeding 40sm

##### 4.2.7.3 Transformer foundations

Transformer foundations shall be constructed as specified particular specifications and in scope of work. Plinth size will be limited to 2.7x4.5m (contact area) of base and to include oil sump, grating and oil separator.



#### 4.2.7.4 Cable Trenches

Cable trenches shall be constructed as specified in particular specifications and in scope of work. This will be limited to 600mm width and depth including covers and refurbishment of existing and replacement of damaged covers. NOTE covers to be 75mm precast reinforced concrete

#### 4.2.8 Training in control (SAS), Telecommunication and protection system (LS-008a, 008b)

The training includes travel for the 3 (Three) KPLC engineers as well as all course material and other expenses shall be catered by the Contractor in full including the per diems. The training shall be held at the manufacturer's place. The training shall cover design, application, testing, commissioning and maintenance of the relevant digital control and protection systems. The training course shall have a minimum of 2 (two) weeks duration for SAS and Protection and one week for communication.

#### 4.2.9 Factory Acceptance Test

The Contractor shall arrange for 2 participants from KPLC and the Project Manager to witness tests of major equipment listed below in the manufacturer's plant. All routine tests shall be carried out in the presence of the Employer's representatives. The representatives shall approve shipment of the equipment if they are satisfied that the requirements of the specification are fully met

The Contractor shall arrange and meet the full cost of the air tickets and local transportation

- **Circuit breakers**
- **Instrument transformers**
- **Disconnectors/ Isolators**
- **SAS**
- **Telecommunications Equipment**
- **Steel structures**

FAT shall be carried out as prescribed in the particular technical specifications of the equipment. The cost of per diem and accommodation shall be met by contractor

#### 4.2.10 Test Equipment (TS –001)

- Lap top computers: Two units per Lot, set up with comprehensive software. The pc shall be supplied with all the necessary accessories and ports and loaded with latest operating system. The Lap top must be able to run all the relay and equipment software's supplied under the contract. The lap top specifications shall be approved by the project manager.

#### 4.2.11 Final documentation

As built drawings:                   5 paper copies delivered in binders  
   3 CD-ROM copy (all drawings in auto card )  
   1 set of transparencies

Operation and maintenance manuals: 2 copies per equipment

#### 4.2.12 Site Offices and site facilities

At the location where the Contractor will establish his main site administration:

- At the location where the Contractor will establish his main site administration, an office for site supervisors from the Project Manager with basic office furniture, internet, telephone and access/use of fax and copier shall be provided by the contractor for the implementation period
- The contractor shall provide mobile phone for coordination of activities with project team of a maximum of 4 including project manager, engineer ,supervisor and regional representative

## 4.2.13 Scope of Works

### 4.2.13.1 WATAMU 33/11KV SUBSTATION

The scope of works include

- Extension of bus bar to accommodate new bay
- Establishment of 1No transformer bays complete with protection and control equipment.
- Establishment of proposed 33kv incoming line complete with protection and control equipment.
- Transportation, positioning testing and commissioning of new transformer.
- Extension of the switchgear room and rearrangement of the equipment to accommodate additional feeder panels.
- Reconstruction of the access road up to paved standards to the new transformer bays.
- Recovery of disused structures
- Refurbishment and /or relocation of guard room and toilet and connection to septic tank
- Extension of the 11kv bus bar and installation of 2 no 11kv future bays.(bidder to re configure the existing 11kv bus bar)

<b>Watamu 33/11kV Substation works</b>			
<b>Item no.</b>	<b>Item</b>	<b>Unit</b>	<b>Quantity</b>
	<i>Equipment/materials:</i>		
	33 kV Circuit Breaker	Pc	2
	33 kV motorized Isolator without earth switch	Pc	1
	33 kV motorized Isolator with Earth Switch	Pc	2
	33 kV Current Transformer	Pc	6
	33Kv Voltage Transformer	Pc	3
	33 kV Bay/Bus bar Material	Lot	1
	Steel Structures for support for all equipment(to match existing)	Lot	1
	33 kV Surge Arresters	Pc	3
	33 kV Transformer Protection and control Panel	Pc	1
	33 kV Line protection and Control Panel	Pc	4
	33 kV Bus Section protection SWITCH	Pc	1
	33 kV Bus Section protection and Control Panel	Pc	1
	11 kV Bus Section protection SWITCH	pc	1
	11 kV Current Transformer	pc	4
	11kv Post insulator	pc	1
	11 kV Neutral Current Transformer	Pc	1
	11 kV Neutral Link	Pc	1
	11 kV Surge Arresters	Pc	3

Auxiliary transformer 100 kv, 33/0.415 kV, with HV fuse protection	Pc	1
Control and measuring cables	Lot	1
Auxiliary AC supply panel	Lot	1
Earthing system	Lot	1
Ancillary Equipment	Lot	1
Switchyard Lighting system	Lot	1
Lightning protection system	Lot	1
<b><u>Works</u></b>		
Transformer Foundations	Lot	1
Switchgear Building extension	Lot	1
Platform works (earth work, foundations, trenches, fence rehabilitation ,plaster and installation of chain link and electric fence etc)	Lot	1
Cable trenches (excavating, protection, backfill, etc) and refurbishment of existing	Lot	1
Erection and commissioning	Lot	1
Reconstruction and realignment of 33& 11kv bus bar	Lot	1
Telecoms / SCADA Installation and commissioning	Lot	1
Access road works	Lot	1
Automation Engineer for substation automation integration	Lot	1
Site adaptation works including reballasting,clearing of bushes on lower substation plot and full treatment to ballasting	Lot	1
External works on drainage ,water supply, and utilities refurbishment/relocation	lot	1