

Scope of Supply of Plant and Installation Services by the Contractor**Contents**

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ABBREVIATIONS

ABBREVIATION	DEFINITION
A	Amperes
AABC	Associated Air Balance Council.
AASHTO	American Association of State Highway and Transportation Officials
AC	Alternating Current
ACB	Air Circuit Breaker
ACI	American Concrete Institute
ACLD	Long Duration AC
ACS	Overhead Grounding Wire
ACSD	Short Duration AC
ACSR	Aluminum Conductor Steel Reinforced
ADC	Analog to Digital Converter
AES	Automatic Electronic Shutter
AGC	Automatic Gain Control
AIS	Air Insulated Switchgear
AISC	American Institute of Steel Construction
ALF	Accuracy Limiting Factor
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATCC	Automatic Tap Change Control
ATOL	Air Traffic Obstruction Lights
AVR	Automatic Voltage Regulation
AWM	Aircraft Warning Markers
BB	Busbar
BCPU	Bay Control & Protection Unit
BCR	Bay Control Room
BCU	Bay Control Unit
BDS	Bid Data Sheet
BDV	Break Down Voltage
BEMS	Building and Energy Management System
BER	Bit Error Rate
BIL	Basic Lightning Impulse Level
BMS	Building Management System
BNC	Bayonet Neill Concelman Connector
BOD	Basis of Design
BRE	Building Research Establishment
BS	British Standards
BSL	Basic Switching Impulse Level
CADD	Computer-aided Drafting and Design

ABBREVIATION	DEFINITION
CCD	Charge Coupled Device
CCTV	Closed-circuit Television
CD	Compact Disk
CDEGS	Current Distribution Electromagnetic Field Grounding and Soil Analysis
CENELEC	European Committee for Electrotechnical Standardization
CIGRE	International Council on Large Electric Systems
CIP	Carriage and Insurance Paid
CNF	Control Notification Form
COW	Commencement of Work
CP	Clock Pulse
CPU	Central processing unit
DAU	Data Acquisition Unit
DC	Direct Current
DG	Diesel Generator
DNP	Distributed Network Protocol
DNS	Domain Name System
DO	Digital Output
DP	Double Point
DS	Disconnect Switch
DSES	Disconnect Switch with Earthing Switch
DTMF	Dial Tone Multi Frequency
DTT	Direct Transfer Trip
DVD	Data Versatile Disc
DWDM	Dense Wavelength Division Multiplexing
ECC	Error Correction Code
EEC	Error Correction Code
EHV	Extra High Voltage
EMC	Electronic Magnetic Compendium
EMI	Electro Magnetic Interface
EN	European Standards (Norm)
EOW	Engineering Order Wire
EPABX	Electronic Private Automatic Branch Exchange
EPC	Engineering, procurement, and construction
ES	Earthing Switch
FAT	Factory Acceptance Test
FCC	Federal Communication Commission
FEC	Forward Error Correction
FHD	Full High Definition
FM	Frequency Modulation
FO	Fiber Optic
FRP	Fiber Reinforced Plastic
FSK	Frequency Shift Keying
FTIR	Fiber To The Room

ABBREVIATION	DEFINITION
FTP	File Transfer Protocol
FX	Frequency Exchange service
GB	Gigabytes
GGBS	Ground Granulated Blast-furnace Slag
GIS	Gas Insulated Switchgear
GPR	Ground Potential Rise
GPS	Global Positioning System
HD	high definition
HDD	Hard Disk Drive
HDMI	High-Definition Multimedia Interface
HF	High Frequency
HMI	Human Interface Machine
HRC	High Rupturing Capacity
HSE	Health, Safety & Environment
HTTP	Hypertext Transfer Protocol
HV	High Voltage
HVAC	Heating, Ventilation, and Air Conditioning
HZ	Hertz
IBC	International Building Code
IBD	Inverted Block Drains
ICAO	International Civil Aviation Organization
ICB	International Competitive Bidding
IEC	International Electrotechnical Commission
IED	Intelligent Electronic Device
IEEE	Institute of Electrical and Electronics Engineers
IFB	Independent Financial Brokers
ILAC	International Laboratory Accreditation Cooperation
IP	Internet Protocol address
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITP	Inspection Test Procedure
ITU	International Telecommunication Union
K	Kelvin
KEBS	Kenya Bureau of Standards
KETRACO	Kenya Electricity Transmission Company
KHZ	Kilo Hertz
KM	Kilo Metter
KN	kilo Newton
KV	Kilovolt
KVA	Kilo-volt-amperes
KVAC	Kilo-volt-amperes-alternative current
LA	Lightning Arrester
LAN	Local Area Network
LCC	Local Control Panel

ABBREVIATION	DEFINITION
LCD	liquid crystal display
LDPE	Low Density Polyethylene
LF	Low Frequency
LI	Line input
LILO	Loop in Loop Out (Line In Line Out)
LP	Liquefied petroleum
LSI	Long time, Short time, Instantaneous
LSOH	Low Smoke Zero halogen
LTE	Long Term Evolution
LV	Low Voltage
LVAC	Low-voltage Alternating Current
LVD	Low Voltage Directive
LVDC	Low-voltage Direct Current
MAC	Media access control address
MB	Mega byte
MBB	Make before break
MCB	Miniature Circuit Breaker
MCCB	Molded Case Circuit Breaker
MHZ	Mega Hertz
MM	mile meter
MODBUS	Modicon Communication Bus
MPA	Mega Pascals
MPLS	Multi-Protocol Label Switching
MTBF	Mean Time Between Failures
MV	Megavolt
MVA	Mega Volts Amperes
MVAR	Mega Volts Amperes Reactive
MW	Megawatt
N	Newton
NCA	National Construction Authority (Kenya)
NCC	National Control Center (Kenya)
NDT	Non-Destructive Test
NEMA	National Environment Management Authority (Kenya)
NFPA	National Fire Protection Association (USA)
NIST	National Institute of Standards and Technology (USA)
NO	Normally open
NTP	Network Time Protocol
ODF	Optical Distribution Frame
OFAF	Oil Forced Air Forced
OHTL	Overhead Transmission Line
OLCM	Online Condition Monitoring
OLTC	On-Load Tap-Changer
ONAF	Oil Natural Air Forced
ONAN	Oil Natural Air Natural

ABBREVIATION	DEFINITION
OPC	Ordinary Portland Cement
OPGW	Optical Ground Wire
OS	Operating System
OTB	Optical Termination Block
OTDR	Optical Time Domain Reflectometer
PA	Pascal
PABX	Private Automatic Branch Exchange
PAT	Performance Acceptance Test
PC	Personal Computer
PCB	Polychlorinated biphenyls-Printed Circuit Board
PCI	Peripheral Component Interconnect
PCM	Pulse code modulation
PD	Partial Discharge
PDC	Phasor Data Concentrator
PDF	Portable Document Format
PDH	Plesiochronous Digital Hierarchy
PDMS	Plant Design Management System
PE	Protective earthing
PFC	Power Factor Correction
PI	Post Insulator
PLC	Power Line Carrier
PMD	Polarization mode dispersion
PMU	Phasor Measurement Unit
POTT	Permissive Over-Reaching Transfer Trip
POW	Point on Wave
PPS	Pulse Per Second
PRP	Parallel Redundancy Protocol
ABBREVIATION	DEFINITION
PRV	Peak Residual Voltage
PSLD	Protection Single Line Diagram
PSS	Power System Simulator
ABBREVIATION	DEFINITION
PSTN	Public Switched Telephone Network
PT	Potential Transformer
PTT	Push to talk
PTZ	Pan, Tilt, and Zoom
PVC	Polyvinyl chloride
RCCB	Residual Current Circuit Breaker
RCD	residual current device
RF	Radio Frequency
RIV	Radio Interference Voltage
RMS	Root Mean Square
ROCOF	Rate of change of frequency
ROM	read-only memory

ABBREVIATION	DEFINITION
RPM	Revolutions per Minute
RTU	Remote Terminal Unit
RTV	Room-Temperature-Vulcanizing
RX	Receive Signal
SACS	Substation Automation Control System
SAP	Mechanical Software
SAS	Substation Automation System
SAT	Site Acceptance Test
SATA	Serial Advanced Technology Attachment
SCMS	Substation Control and Monitoring Systems
SCP	substation control point
SCS	Substation Control System
SD	Secure Digital
SDH	Synchronous Digital Hierarchy
SDHC	Secure Digital High Capacity
SDXC	Secure Digital Extended Capacity
SEF	Sensitive Earth Fault
SF6	Sulfur hexafluoride
SFRA	Sweep Frequency Response Analysis
SI	String Insulator
SIM	Subscriber Identity Module
SIP	Session Initiation Protocol
SLD	Single Line Diagram
SMB	Microsoft Server Message Block
SMTP	Simple Mail Transfer Protocol
SNMP	simple network management protocol
SNR	Signal to noise
Sntp	Simple Network Time Protocol
SODIMM	Small Outline Dual In-line Memory Module
SOTF	Switch-onto-fault
SPT	Standard Penetration Testing
SRCC	Solar Rating and Certification Cooperation
SS	Substation
SSD	Solid-state Drive
SSH	Secure Shell Protocol
SSVT	Station Service Voltage Transformer
STM	Synchronous Transfer Mode
SUV	Sports Utility Vehicle
SVL	Sheath Voltage Limiters
TB	Terabyte
TCP	Transmission Control Protocol
TRV	Temporary Residual Voltage
TX	Transmit Signal
UHF	Ultra-high frequency

ABBREVIATION	DEFINITION
UK	United Kingdom
UPS	Uninterruptable Power Supply
USB	Universal Serial Bus
UTM	Universal Transverse Mercator
UV	Ultraviolet
V	Voltage
VA	Volts Amperes
VAC	Volts Amperes-AC
VAR	Volt-Amps Reactive
VGA	Video graphics Array
VHF	Very high frequency
VSWR	Voltage Standing Wave Ratio
W	Watts
WLAN	Wireless Local-area Network
WWAN	Wireless Wide Area Network
XLPE	Cross-linked polyethylene
YN system	Star connection with neutral point connected to Earthing

Employer Representative shall also mean Engineer which shall refer to the consultant

1. Scope of Work

The works related to the project will be executed on a turnkey basis , design, supply, installation and commissioning of::

- New substation (400/220 kV Kimuka) including two 200 MVA 400/220/11 kV transformers and related equipment
- LILO works of the double circuit 400 kV Suswa-Isinya line into the 400/220 kV Kimuka substation and construction and all associated works to implement a double circuit 220 kV line from 400/220 kV Kimuka substation to the existing 220/66 kV Kimuka substation.
-

The scope also includes civil works, all structural and architectural works, construction of buildings, boundary wall, fences, internal access roads, access road to substation, construction of cable duct and cable trenches, transformer foundations with fire protection / blast walls and oil collection pits, outdoor equipment foundations, calculations, design, manufacture, assembly and acceptance testing in the Contractor's workshop as well as the supply, customs clearance, delivery, unloading, installation, adjusting, painting, identification, commissioning, acceptance and testing of new equipment to be installed, complete in every respect and suitable for satisfactory operation. etc with all the necessary facilities provided for a fully functional substation.

The Contractor shall be fully responsible to study this document and existing practice of KETRACO and assess the works by visiting the site and collect the necessary data required to establish the satisfactory implementation and operation of the systems. The Cost required for any such study is construed to be included in the Contract price. Notwithstanding that any details, works, equipment, accessories, etc. required for the complete installation and satisfactory operation are not specifically mentioned in the principal drawings, outline specifications, or price schedules, the cost required to collect such details is considered to be included in the Contract price. The substation shall fully meet the requirements of KETRACO & relevant applicable standards.

All the bid drawings are only principal and indicative. The bidder shall visit the Substations' sites before preparing his drawings and documents, foresee all eventualities that may arise during execution and taking into account of availability of labor, machineries, equipment and materials required and should make sure that the project works can be fulfilled and equipment, panels and etc. can be installed and commissioned for satisfactory operation of the Substations. The design documents shall be supported with comprehensive calculations and the drawings prepared by the Contractor shall contain all dimensions in detail ensuring that there are adequate clearances as per KETRACO practice and international standards.

Note: The Bidder/Contractor must provide a comprehensive outage plan (according to KETRACO General Guidelines for Outages during construction) before commencement of executive works in site to minimize the shut down time for implementation of the required activities for each substation extension or OHL connection

(including destructions, displacements and new erections/installations), for the Employer/Employer's Representative review and approval.

The Contractor shall be responsible for implementing all temporary and permanent works that are required for successful completion of this contract.: In this regard, the following items are included in the contractor's scope of work:

- Substation land visit and providing a site visit report, including all coordination, levels, discrepancies, required modifications (if any), etc.;
- Site survey (substation topography as well as LILO's route survey), check with the design documents and present the discrepancies;
- Detailed Soil investigation studies (Geotechnical and geo-electrical)
- The work includes site clearance, site surfacing, excavation, backfilling, leveling and all concrete works.
- All buildings to be constructed and equipped, with reinforced concrete frames, masonry walling, bolted connections preferably (welding may be adopted for steel roof trusses).
- Concrete cable trenches/ducts
- Supply, installation, test and commissioning of switchyards' equipment
- Outdoor galvanized steel apparatus support structures and foundations, grading and leveling of the site and spreading of crushed aggregates over all unpaved areas.
- Supply, installation, test and commissioning of main and auxiliary transformers.
- Foundations, concrete firewalls and oil pits for main transformers, auxiliary transformers. Grading, Fencing, Oil pit sizing shall be based on approved calculations. In addition, burnt oil pit common for both transformers shall be provided and its sizing shall be subject to approved calculations.
- Interconnection between the OPGW and fiber optic cable and final ODF-ODF testing
- Substation Control Building Civil works (including Excavation, concrete works, backfilling, and etc.) together with building services such as Lighting, Small Power System, Water Supply and Sewage System, HVAC, Water Solar Heating, Fire Detection and hand-held capsule fire extinguishers, Eyewash facility and access control
- Substation Guard House and Telecom Collocation Room Civil works (including Excavation, concrete works, backfilling, and etc.) together with building services such as Lighting, Small Power System, Water Supply and Sewage System, HVAC, Water Solar Heating, Fire Detection and hand-held capsule fire extinguishers, Eyewash facility and access control
- Substation Diesel generator house Civil works (including Excavation, concrete works, backfilling, and etc.) together with building services (e.g. Lighting, Small Power System, Fire Detection and hand-held fire extinguishers)

- Firefighting Pump House Civil works (including Excavation, concrete works, backfilling, and etc.) together with building services e.g. Lighting, Small Power System, Fire Detection and hand held capsule fire extinguishers and access control, etc.
- Substation Storage Warehouse Civil works (including Excavation, concrete works, backfilling, and etc.) together with building services e.g., Lighting, Small Power System, HVAC, Fire Detection and hand-held capsule fire extinguishers, Eyewash facility and access control, etc.
- Integrated Closed Circuit Television (CCTV) System for the substation buildings and outdoor area
- Technical staff Housing Civil works (including Excavation, concrete works, backfilling, and etc.) together with building services e.g., Lighting, Small Power System, Water Supply and Sewage System, HVAC, Water Solar Heating, Fire Detection, access control and hand-held capsule fire extinguishers, furniture and furnishing
- Security staff Housing Civil works (including Excavation, concrete works, backfilling, and etc.) together with building services e.g., Lighting, Small Power System, Water Supply and Sewage System, HVAC, Water Solar Heating, Fire Detection and hand-held capsule fire extinguishers, furniture and furnishing
- A Complete water supply system shall be provided. A borehole will be provided. The water supply for the control building, guard house and staff housings will be via an overhead tank. Main water reservoir of prestressed steel water tank with a minimum capacity of 30,000 liters, with automatic level controls shall be provided. Also 5000 liters x 5 elevated prestressed water tanks of 6m height with automatic level controls shall be provided near the control building, guard house, warehouse, staff housings and security housing. All the necessary piping systems and pumps shall be provided and installed.
- Standard drainage system including flood protection and storm water canals shall be implemented around the whole substation perimeter for complete dewatering of the compound and external storm water. Canals shall be surfaced by stone pitching. All waste drainage shall be taken to septic tank and soak away pit. The design for the plumbing and drainage system should ensure smooth operations in the substation.
- Complete sewage system (including pipes, Vent Pipes, Floor Drain, Toilet, Septic Tank with sufficient size) and other Mechanical Installations (including Shower with Faucet, Basin Faucet, Basin, Kitchen Sink, Pedestal Eye Wash), etc.
- For water heating, solar heaters and backup electric heating element shall be considered, which its design shall be subjected to approval of Employer/Employer's Representative.
- HVAC system shall include DX Split Units and shall be considered in the control building, guard house and telecom collocation room, staff housings, BCRs and etc. according to KETRACO requirements. These should be adequately sized to ensure the room temperature is ideal for the optimal performance of equipment. The refrigerant should comply to KEBS standards. The individual HVAC units will be sized according to the dimensions of the particular room for approval by the Employer/Employer's Representative. In addition, the HVAC system is to be designed to fit the particular local conditions of the substation.
- Fire Detection and Alarm System for Transformers and Buildings

- Fire protection system for transformers, reactors and buildings
- Compound boundary wall/chain-link fence with barbed wire equipped with electric shock facilities for the substation plot, fencing, gates, concrete trenches/ tunnels/ duct banks, and etc. shall be constructed, which their design shall be subjected to approval of Employer/Employer's Representative.
- Internal access roads to switchyard and to buildings shall be implemented to bituminous standard. Necessary warnings / signage shall also be fixed. Suitable slopes / drains / manholes shall be provided for water to flow to the substation drainage system. The road shall have adequate lighting which is automatically controlled based on the ambient light intensity.
- External access road from main road to substation by a standard junction shall be implemented according to bituminous standard (as per substation) and according to Kenya roads regulations. Necessary warnings / signage shall also be fixed. Suitable slopes / drains / manholes shall be provided for water to flow to the drainage system.
- Required vehicles and covered car parking
- Machineries, tools, appliances, instruments and test equipment
- Temporary works, mobilization and de-mobilization

1.1 Site Location

New Kimuka 400/220kV substation located about 30km away from Nairobi toward west and about 8km away from Ngong railway station. The location of Kimuka substation is in the power grid map shown in the figure below. The length of the transmission line to Suswa and Isinya substations is about 44km and 60km, respectively

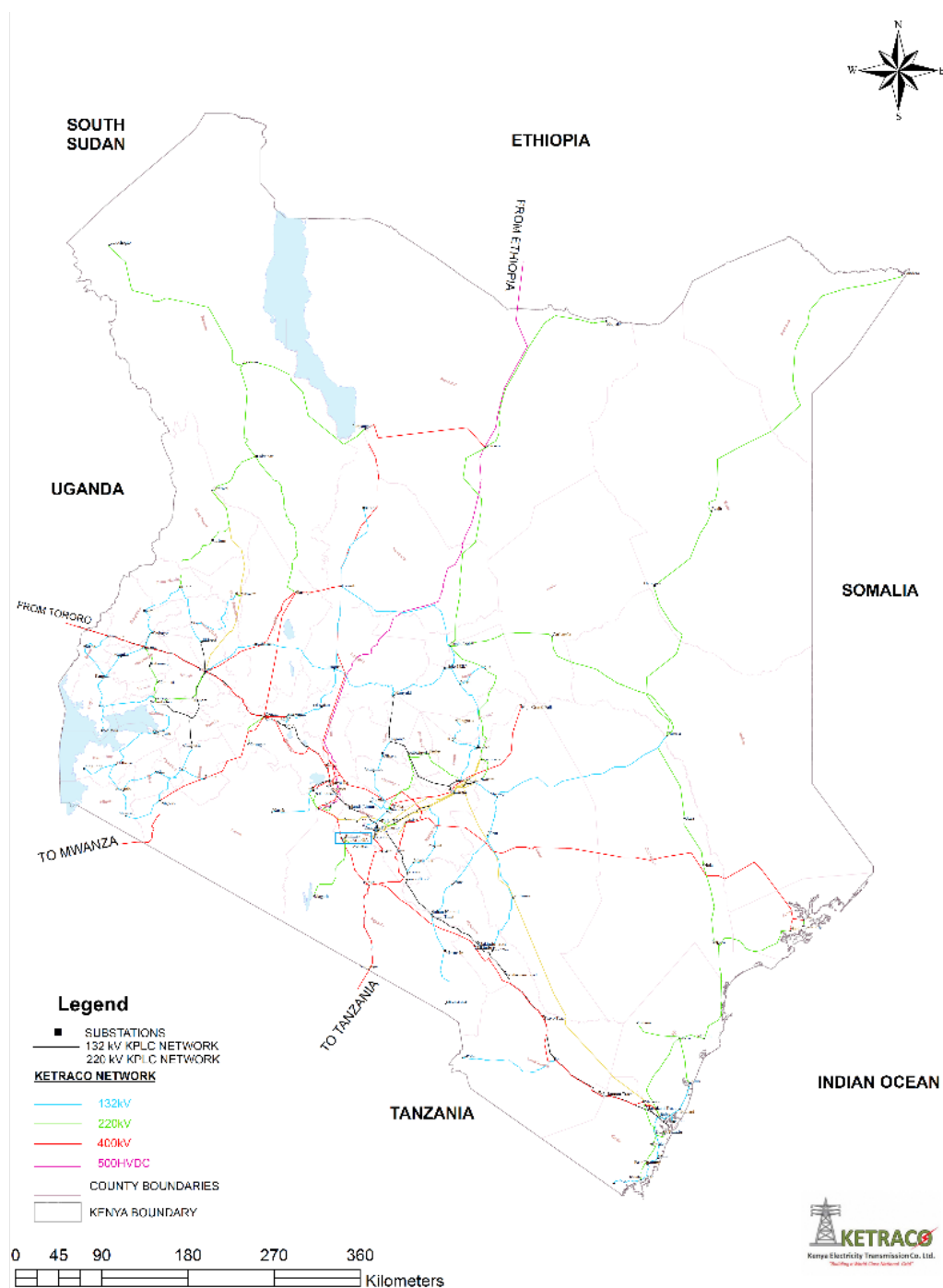


Figure 1: Approximate location of New Kimuka Substation in the Kenya Transmission Grid Map.

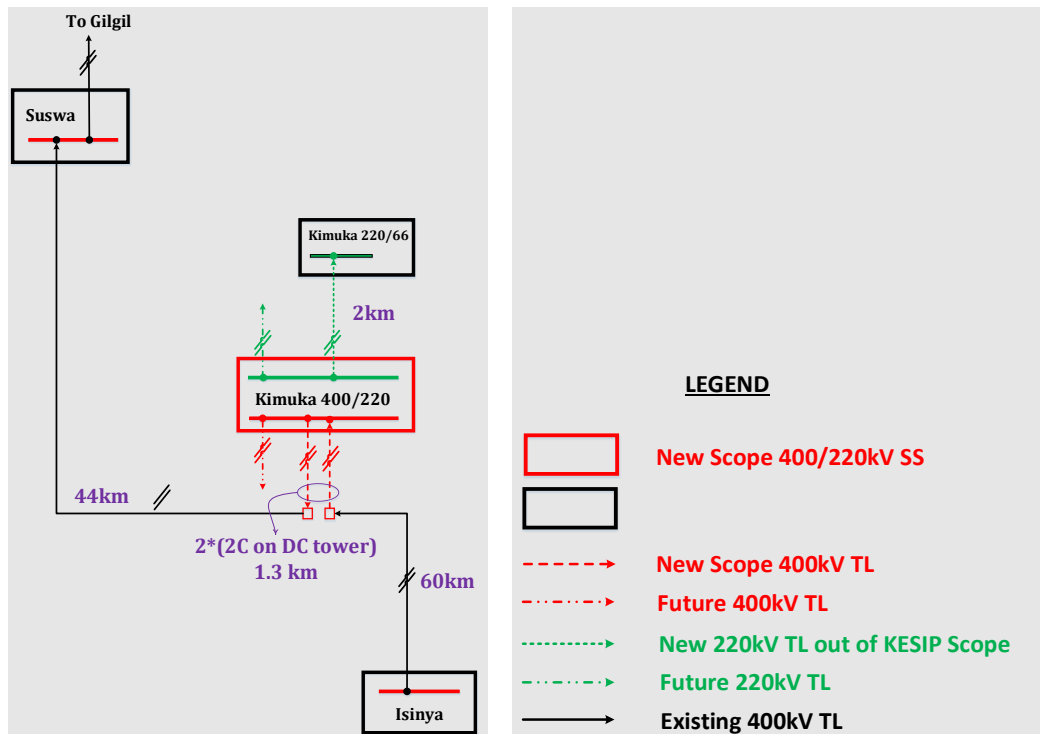


Figure 2: New Kimuka 400/220kV and Existing Kimuka 220/66kV substation sketch indicating scope of works.

The distance from New Kimuka substation to existing Kimuka (Ngong) 220/66kV substation is about 2km:

- The New Kimuka 400/220kV SS will be connected to existing Kimuka 220/66kV SS by a double circuit 220kV overhead line.
- In addition, a LILO (Loop In and Loop Out) will be established from the double circuit Suswa-Isinya to New Kimuka SS.

The location of New Kimuka SS has been illustrated in the below figure.

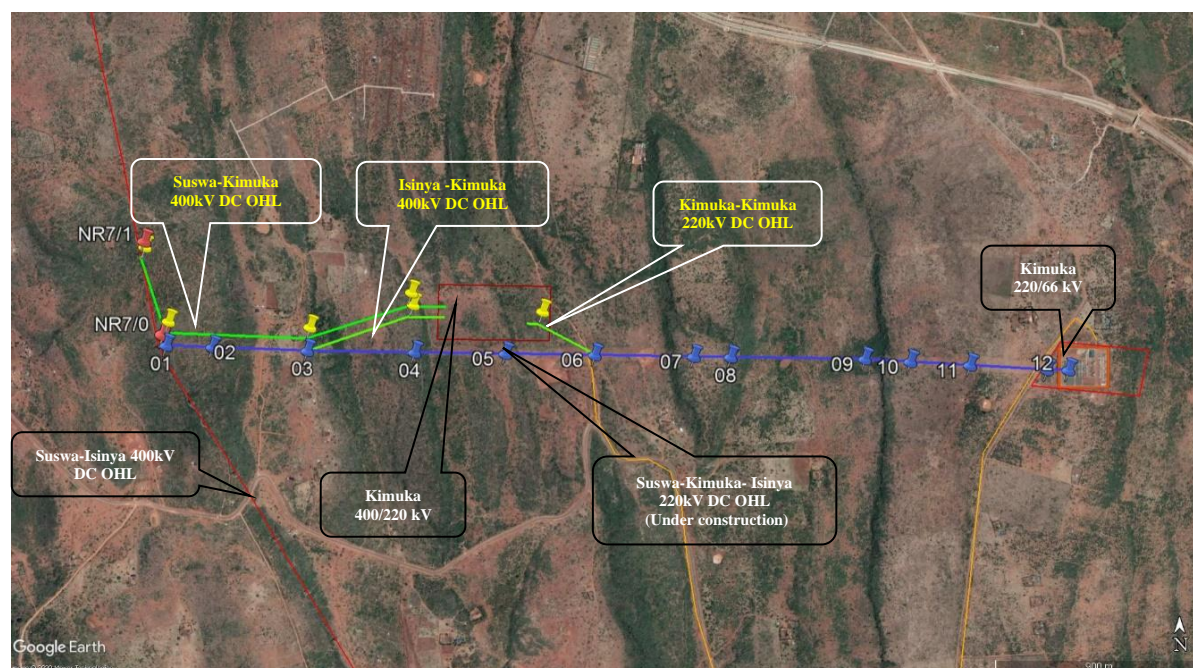


Figure 3: Location of New Kimuka 400/220kV and Existing Kimuka 220/66kV substations, LILO from Suswa-Isinya Transmission Line and Connection between Substations.

The coordinates of New Kimuka substation are shown in the table below.

Name of Substation	Substation Coordinates (ARC 1960 UTM ZONE 37 M)		
	Name	Easting (m)	Northing (m)
New Kimuka 400/220kV Substation	KSS1	230470.907	9853075.756
	KSS2	230945.951	9853069.254
	KSS3	230938.270	9852836.617
	KSS4	230463.226	9852843.120

The scope of works under this bid / project includes the substations' works and transmission works which includes loop in loop out (LILO) works for new New Kimuka 400/220kV and intertie transmission line works with the existing Kimuka 220/66kV substation.

1.2 Substation Works

The bidder/contractor is responsible for design, supply, transportation, test, installation, commissioning and successful energization of substations, subject to Employer/Employer's Representative's approval.

All of the bid drawings included in the tender documents are only conceptual drawings and intended for the guidance of the Bidder. The bidder is responsible to provide the detailed design drawings to finally obtain the Employer/Employer's Representative's approval on "For Construction/ As-Built" documents (the As-Built documents shall be resubmitted once again after final takeover for Employer/Employer's Representative's approval including all equipment, material, design drawings, modification and calculations). All submissions shall be provided in both un-editable and editable versions (e.g. pdf and Word, Autocad, Excel, etc.). Drawings

provided for brownfield sites must also show the existing/old infrastructure in addition to the new. The substation layout and all other designs shall satisfy the following requirements:

- a) The layout and all other designs shall comply with latest KETRACO Standards and regulations of other concerned Authorities, Organizations and so on.
- b) The Bidder shall ensure that satisfactory and safe access for maintenance, inspection, and operation is provided to all equipment and measurement points. Further, considerations for future expansion of the substation shall be taken into account and foreseen. Road access for unloading, loading and transportation of equipment shall be considered especially for heavy equipment such as transformer.
- c) Equipment Vendor's recommendation for minimum all-around clearances, arrangements, etc. shall be also considered. Minimum clearances shall comply with all local regulations, KETRACO standards, international standards, and maintenance access requirements as applicable.
- d) The Bidder shall include provisions in his tender proposal for any works necessary to relocate buried services, pipes and associated equipment to avoid unidentified hazards in advance.
- e) The bidder shall maintain not only the civil requirements given in this tender but also any local requirements/present practices during the civil design/construction works subject to Employer /Employer's Representative's approval.

Note: The Contractor shall provide a comprehensive outage plan for each substation (according to KETRACO General Guidelines for Outages during construction), before commencement of executive works on site to minimize the shut down time for implementation of the required activities for each substation extension or OHL connection (including destructions, displacements and new erections/installations), which shall be approved by the Employer/ Employer's Representative. No outage should last longer than 8 hours.

1.2.1. Works at New Kimuka 400/220 kV Substation

Refer to bid drawings for proposed SLDs, Equipment layout and other basic drawings for scope of works of Construction of New 400/220kV substation (including supply, installation and commissioning of 2 x 200MVA 400/220/11kV Auto-Transformers) along with associated LILO works.

The new Kimuka 400/220 kV substation will be connected to the existing Kimuka 220/66kV substation by a double circuit overhead line. The complete 400kV and 220kV switchyards shall be constructed as a new air insulated switchgear (AIS) substation and configured in "one and half circuit breaker arrangement including:

- a) The new 400kV switchyard shall comprise of the following:
 - Two (2) fully populated diameters. Diameter 1 connecting Suswa 1 and A-Tr. 1 and diameter 2 connecting Suswa 2 and A-Tr. 2.
 - Two (2) partially populated diameters. Diameter 3 connecting Isinya 1 and future A-Tr. 3 and diameter 4 connecting Isinya 2 and A-Tr. 4
 - Space for a full diameter shall be considered for future extension.

- Required works for termination of LILO from 400kV double circuit Suswa-Isinya OHL.
- b) Supply, installation, test and commissioning of Two (2) numbers, 400/220/11kV, 200MVA YNa0d11, ONAN/ONAF1/ONAF2 auto transformers (A-TR.) with OLTC in step of 1.25%, 17 Steps, percentage impedance of 14% are required and shall feed into a new 220kV switchyard. Depending on the location of the earthing & auxiliary transformer (EAT), 11kV power cable shall be installed between the auto transformer and the earthing & auxiliary transformers.
- c) Two (2) number, 11/0.415kV, 500kVA, ZNyn11 Earthing & Auxiliary transformers (EAT).
Note: The proposed capacity for EATs is based on preliminary evaluation for tendering purpose. It shall be finalized during detail design stage but there shall be no price adjustment.
- d) Supply, installation, test and commissioning of One (1) 0.415kV, 500kVA Diesel Generator.
Note: The proposed capacity for Diesel Generator is based on preliminary evaluation for tendering purpose. It shall be finalized during detail design stage.
- e) The new 220kV switchyard shall be comprised of the following:
 - Two (2) fully populated diameters. Diameter 1 connecting A-Tr. 1 and existing Kimuka OHL and diameter 2 connecting A-Tr. 2 and Existing Kimuka OHL 2.
 - Space for three (3) full diameters shall be considered for future extension.
 - Required works for termination of Kimuka 220kV double circuit line connection.
- f) Substation control building complete with substation control, protection and communication system
- g) Bay Control Rooms as per technical requirements and tender drawings
- h) The HVAC system including the DX Split units and the fans for Control Building, BCR, Storage warehouse, Guard House and Telecom Collocation Room, Technical Staff Housings and Security Staff Housings.
- i) Substation firefighting systems include portable fire extinguishers for buildings, fire hydrant for yard and Trolley mounted fire Extinguisher firewall and Nitrogen injection fire protection system for Transformers.
- j) Complete water and sewage system plumbing for Control Building, Guard House and Telecom Collocation Room, Technical Staff Housing and Security Staff Housing
- k) Water supply for substation buildings and yard fire hydrant
- l) Elevated water supply reservoir for control building, Guard house, Security staff Housing, warehouse and Technical Staff Houses
- m) Septic tanks shall be considered for waste drainage
- n) Other electrical, mechanical and civil works as per technical requirements and tender drawings:
 - Guard House and Telecommunication Collocation Room
 - Diesel Generator House
 - Fire Water Pump Houses and Equipment and Machineries
 - Nitrogen injection fire protection system for auto-transformers
 - HVAC Systems

- Solar Water Heating Systems (and Backup Electric Elements)
 - Storage Warehouse
 - Internal Access Roads
 - External Access Road
 - Technical Staff Housings (4 units, equipped and furnished)
 - Security Staff Housings (4 units, equipped and furnished)
 - Boundary Chain-Link Fence and Entrance Gate
 - Covered Car parking (suitable for 10 cars)
- o) Tests, end to end testing, commissioning and training.
- p) Complete and functional system integration to existing power grid.
- q) Phasor measurement unit (PMU) and fault monitoring system (FMS) together with required facilities and accessories (as per technical specifications) shall be supplied and commissioned
- r) All data engineering at the gateways and NCC (National Control Center) and point to point testing of the signals from process to gateway and to the NCC.
- s) Required facility for interconnection between the OPGW and fiber optic cable (including joint box, splicing, termination at the gantry, etc.) and final end to end (ODF-ODF) OTDR and core-matching testing and preparing as-built documents.
- t) Test, commissioning and training
- u) End to end tests (with Dispatching Centers)
- v) Other requirements as per Technical requirements and Tender drawings.
- w) Complete and functional system integration to existing power grid.
- x) Required modifications in remote substations and dispatching centers.
- y) Protection settings study report design including remote end stations settings revision to incorporate the new station scope of works
- z) Remote end stations modification including but not limited to protection settings, changes of panel labels, relay feeder names, SCADA etc
- aa) Remote end stations testing after settings revision
- bb) Submission of Complete Final As-built documents for whole of Substation approved by the Employer/ Employer's Representative

1.2.2. Works at Existing Kimuka 220/66 kV Substation

Secondary modification works and remote end works (including protection, SAS and Telecommunication) required to execute the connection between the existing 220/66 kV Kimuka substation with the new 400/220 kV Kimuka substation. The distance protection relays for Suswa and Isinya lines shall be removed and delivered to the Employer. Then New Differential protection relays (as Main II protection) shall be supplied and installed for both circuits. All required modifications such as relay settings, tags, SCADA, telecommunication system, alarms and signals shall also be carried out in the remote substations and dispatching centers.

1.2.3. Works at Existing Suswa 400/220 kV Substation

Relocation of the one circuit currently operated at 220 kV, connected to the 220 kV yard of Suswa to the 400 kV yard of Suswa, and associated required secondary modifications and remote end works (including related Protection, SAS and Telecommunication systems re-setting, re-testing and re-commissioning). This circuit will need to be connected to an existing under bus arrangement system in order to access the 400 kV switchyard.

1.2.4. Works at Existing Isinya 400/220 kV Substation

Connecting the existing 400kV SUSWA-1 OHL to 400kV switchyard, which includes completion of the connection between feeder's equipment (LA-CVT-CVT-CT) and connection of the LA to the 400kV SUSWA-1 OHL (note that the existing Suswa-1 line is used as 220kV line but designed for 400kV) and associated required secondary modifications and remote end works (including related Protection, SAS and Telecommunication systems re-setting, re-testing and re-commissioning).

In addition, removal of the connection of the existing 220kV OHL from the 220kV switchyard which is connected to diameter no.2 in place of IBT-1 and then completion of the connections of the IBT-1 LV(220 kV side) to 220kV Switchyard which includes the removal of the existing LAs from 220 kV bay side and installation of new LAs on the transformer 220 kV side and installation of PI where the LA originally were installed, and completing the connection of feeder's equipment such as CSE to PI and LA to 220kV bushings. The existing LA's that will be recovered will be handed over to KETRACO as spares.

In Isinya 220 kV, diameter 2, one feeder bay is currently being used to connect the Suswa- Isinya line on 220 kV. Once Kimuka 400 kV is constructed, this circuit of Suswa- Isinya line will be transferred to the 400 kV side of Isinya and hence that feeder bay on 220 kV will be freed up. This freed up bay will be used to connect IBT-1. which is already connected on Isinya 400 kV side but did not have a bay to be connected to the 220 kV Isinya side.

IBT-1 is fully installed, tested and commissioned on the 400 kV side. All the panels on the 400 kV are in service. On the 220 kV side, this panel are not installed. The panel is available and is with KETRACO. The panel will be handed over to the contractor for installation, testing and commissioning. The scope of work will include but will not be limited to:

- a) Dismantling the 3 existing surge arrestors on the Suswa line bay
- b) Installation of 3 new surge arrestors on the 220 kV side of IBT-1
- c) Mantling and connecting all the connection works on the 220 kV side of the IBT-1 to ensure the connection of the transformer is complete up to the feeder bay equipment. There is a cable in between but the cable connection is completed between the 2 cable sealing ends.
- d) Dismantling connection of all the cables from the existing RP 14 (Suswa line protection Panel)
- e) Dismantle and recover the existing Suswa line protection panel and handover to KETRACO.

- f) Install the new RP 14 (IBT-1 protection panel) in the same location where the Suswa line protection panel was installed
- g) Perform all wiring works required from this panel to the existing equipment in the 220 and 400 kV yards and also to 400 kV IBT1 panels.
- h) Fully test this panel including all modifications works required in the existing system to match existing philosophy.
- i) Fully integrate this panel to the existing systems including SCADA, RCC/NCC, busbar protection etc.
- j) Fully test the IBT-1 protection system which includes both 400 and 220 kV system, inter-tripping schemes and interlocks.

1.3. Transmission line Works

Apart from the substation works detailed, the scope of works includes the provision of the associated overhead line entries at the substations.

The Scope of Works consists of the design, manufacture, testing, supply, delivery, storage at the site, installation, start-up field tests and work related commissioning for the transmission lines, including all works. Supplementary requirements for the various line components are contained in the appurtenant sections of the specifications.

The transmission line configuration which defines this project scope is as described below:

- Currently, the Suswa-Isinya 400kV double circuit transmission line is constructed at 400kV but one circuit is operating at 400 kV while the second circuit is operating at 220kV voltage level.
- The Suswa 220 kV to Isinya 220 kV circuit has a LILO into Kimuka 220/66kV substation.
- After construction of Kimuka 400/220 kV SS, the 220kV yard of Kimuka 400/220 kV SS will be connected to 220kV yard of existing Kimuka 220/66 kV SS. In addition, the circuit operating at 220 kV will be upgraded to operate at 400 kV and the double circuit 400 kV Suswa-Isinya will have a LILO at Kimuka 400/220 kV SS.

Therefore, the final configuration, which shall be carried out under this project, is as follows:

1.3.1. 400kV Loop in (to Kimuka 400/220kV substation)

The loop into the Kimuka 400/220kV substation will be about 1.5 km long starting by constructing a new double circuit (D/C) tension tower near existing tower No.NR7/1 of the Suswa – Isinya 400kV line (in order to connect both lines from Suswa to Kimuka 400 kV SS) and end at Kimuka 400 kV Substation.

The final line will be double circuit 400kV Suswa-Kimuka OHL.

Scope of works includes supply and installation of all towers required including fittings, hardware, conductors, OPGW, earth wire and all associated works to implement the required works.

1.3.2. 400kV Loop out (of Kimuka 400/220kV substation)

The loop out of the Kimuka 400/220kV substation will be about 0.6 km long starting from Kimuka 400 kV Substation and end at tower No.3 of the loop into the existing Kimuka 220/66kV substation. This existing LILO into Kimuka 220/66kV substation is on double circuit towers.

In addition, a tower (special tower if necessary) will be designed and constructed on Isinya – Kimuka corridor near Tower No.1 of the 220 kV line and connect to the existing 220 kV line (which has been designed and constructed at 400 kV) to Kimuka 220/66kV substation. The corridor for 220 kV line will be maintained until Tower No. 3 where the connection to Kimuka 400 kV substation will be established. This will ensure that both circuits from Isinya connect to Kimuka 400kV substation.

The final line will be double circuit 400kV Isinya -Kimuka OHL.

Scope of works includes supply and installation of all towers required including fittings, hardware, conductors, OPGW, earth wire and all associated works to implement the required works.

1.3.3. 220kV Connection (Kimuka 400kV to 220kV substation connection)

The proposed line from the Kimuka 400/220kV substation to the existing Kimuka 220/66kV substation will be about 0.4 km long by terminating the existing 220kV line (Suswa-Kimuka-Isinya) near tower No.6 and connecting it to the new 400/220 kV substation (at 220 kV bus bar).

In addition, the scope of work of this part includes recovering the towers no 4 and 5 of the existing 220kV line (Suswa-Kimuka-Isinya), which will be unused and delivery to location as specified by KETRACO,

The final line will be 220kV Kimuka (400/220kV) - Kimuka (220/66kV) D/C OHL.

It should be noted that this line will be constructed as 400 kV, but will operate at 220 kV.

Scope of works includes supply and installation of all towers required including fittings, hardware, conductors, OPGW, earth wire and all associated works to implement the required works.

1.3.4. 400 kV Suswa Line works

Includes the primary scope of works on the transmission line in Suswa 400 kV to facilitate termination of the one circuit from 220 kV to 400 kV Suswa. Include also primary works of disconnecting the line from 220 kV Suswa gantries. Include also the scope of recovering and handover to the Employer any towers, conductors and accessories that will be unused after the OHL is terminated into 400 kV yard. This circuit will need to be connected to an existing under bus arrangement system in order to access the 400 kV switchyard.

All required material and implementation works in order to connect both circuits to the 400 kV bus bar, is included in the contractor scope and shall be deemed considered in the Contractor's price.

1.3.5. 400 kV Isinya Line works

Includes the primary scope of works on the transmission line in Isinya 400 kV to facilitate termination of the one circuit from 220 kV to 400 kV Isinya as well as termination works of IBT-1 into the freed up bay. Includes also the scope of recovering and handover to the Employer any towers, conductors and accessories that will be unused after the OHL is terminated into 400 kV yard. All required material and implementation works, in order to connect both circuits to the 400 kV bus bar, is included in the contractor scope and shall be deemed considered in the Contractor's price.

1.4. Temporary Bypass works

There shall be established temporary bypass works on Emergency Restoration System Towers (ERS) that shall be procured, supplied, and installed to ensure continuity of power supply between Suswa, Isinya substations as well as Kimuka 220/66 kV substation during the construction of the LILOs. The ERS towers will be recovered and handed over to KETRACO after successful completion of LILO works.

1.5. Recovery of Redundant Sections of Transmission Lines

For the section between Tower No. 3 and Tower No.6 on the LILO to Kimuka 220/66kV substation, the section on Suswa – Isinya line between Tower NR7/1 and the Tower NR7 and the transmission line section between 400 kV Isinya and 220 kV Isinya, the Contractor shall recover all transmission line materials including towers, conductors, OPGW, earthwire, insulators and deliver them to KETRACO's appointed storage area. The RC concrete foundation chimneys for the tower foundations will be destroyed until 1m below the ground and the RC concrete waste disposed according to Environment and Social Management Plan. The stub will be recovered until this same depth and handed over to KETRACO.

1.5.1. Scope of Work for OHL

The design, manufacture, supply, delivery to and off-loading at Site, erection, testing, installation, completion, testing and handover the following and other works incidental thereto included in the Specification and Conditions of Contract and shall comprise, but not limited to the following.

- Detailed line survey
- Preparation of plan and profile
- Tower plotting (in PLS-CADD) and line calculations, including sagging tables

- Tower site pegging and checking of PLS-CADD profiles produced
- Bush clearing.
- Soil investigation
- Right-of-way clearance and access roads
- Tower design and testing
- Supply of foundation materials.
- Tower manufacture, supply, and delivery to site.
- All supply, transport, storage at site, and installation of conductors, earth wires (conventional and optical fibre ground wire), insulators and fittings, hardware and fittings, and tower earthing materials.
- All line construction works.
- Foundation works
- Erection of towers
- Stringing works
- Dismantling surplus part of existing lines (and packing and transferring to the Employer's store/specified location as per Employer requirements)
- Re-tensioning part of existing lines in order to connect the new lines to the existing ones.
- Re-location of existing lines in Suswa and Isinya substation so that both circuits are connected to the 400kV bus bar.
- Testing, final inspection and commissioning.
- All other supplies or works as set out in the Tender Documents.
- Compliance with all applicable Health, Safety, and Environmental Protection Requirements.
- Provision of complete as-built documentation and maintenance manuals
- Any other works deemed necessary to ensure the HVAC transmission lines can be operated and maintained in a safe and environmentally friendly manner.
- All required work and materials for achieving the final transmission line configuration and proper operation and functionality of all the subjected lines shall be deemed considered in the Contractor's price and must be supplied and installed by the Contractor at no additional cost to the Employer, even if not explicitly called for herein.

2. Extent of Work

The Contract Works to be supplied shall include all works at New Kimuka 400/220 kV substation (as well as relating works in the existing Kimuka 220/66 kV substation, Suswa and Isinya substations) and relevant LILOs incidental thereto whether specified in detail or not and shall be carried out by the Contractor in accordance with the Specification and Conditions of Contract.

The extent of work is described below in subsequent sections of this document. The Contract is of the 'Turnkey' type for the Substation and associated works in which the Contractor is responsible for ensuring that all items of work required for the safe, efficient and satisfactory completion and functioning of the works over expected plant life, are included in the tender's price whether or not they have been specifically described in the related section or specification.

Details of the requirements and the technical specifications have been referred in the relevant Bid drawings and documents.

Bidder to note the following:

- a) Project scope of work (Part 2-A, current section), technical specifications (Part 2-B), drawings (Part 2-D), technical data sheets (Part 2-E) and KETRACO Standard Operating Procedures are applicable for the project (also KEBS standards, Kenya building code and applicable Kenya regulations).
- b) Any shutdown requirements for modification/ Installation work(s) to be carried out under this project shall be submitted to Employer/ Employer's Representative for approval before starting the work clearly indicating the activities to be carried out and duration required for completion of each activity. Bidders are required to develop detailed method statement to minimize the shutdown.
- c) Shutdown will be given only one circuit at one time and continuous shutdown period will not be possible. Hence the contractor should factor this in his construction and commissioning. All temporary works required for arranging the shutdown with Employer and National Control Center are included in Contractor's scope of work. Shutdown that results in total station outages for more than one day will not be possible.
- d) All the major equipment shall be installed and tested under the direct supervision of vendor's supervisor(s) at each stage of installation and testing which then would be verified/approved by Employer/ Employer's Representative.
- e) All the Substation equipment and systems shall include necessary contacts/signals and other facilitation required for future extensions. Spare margins in capacities, feeders, contacts, etc. shall be over and above future provisions. LVAC, DC System, Inverter, Fire Water System, building's openings, etc. shall have provisions for future expansion.

3. Service Conditions

- (a) **Rainfall**
The annual rainfall is approximately 1000 mm for the area, with the highest daily rainfall being 150 mm.
- (b) **Temperatures**

Minimum temperature	1°C
Maximum temperature	40°C
Max. Conductor temperature	80°C
Annual average temperature	25°C
- (c) **Humidity**

Mean relative humidity (max/average)	95% / 50%
Relative humidity	60%
- (d) **Isokeraunic Level**

An isokeraunic level (TD/Y) of 80 thunderstorm days/year shall be considered for substation design purposes.

(e) Maximum Solar Radiation

For design purposes, average annual solar radiation value of 1200 kWh/m² shall be considered.

(f) Earthquake loading

For design purposes, an earthquake loading of > 0.25g shall be assumed.

(g) Wind load

For design purposes, a maximum wind velocity of 40m/s (gust wind) shall be assumed.

(h) Altitude

The height above sea level shall be considered as 1850m.

The insulation levels of external insulation shall be determined in accordance with IEC 62271-1, Clause 2.2.1.

Important Note: All main and spare equipment shall be provided for proper operation in four altitude categories (to optimize main equipment/ spare parts and achieve interchangeability at country level), including 1000, 1500, 2000 and 2500 meter above sea level. In case of other range may has been mentioned in the schedules of technical information (Part 2-E), the higher altitude category shall be considered.

(i) Pollution

External insulation shall be designed to Pollution Level IV (Very Heavy) in accordance with IEC60071-2, Table 1.

4. Transport

The Contractor shall provide a site-specific transportation plan to ensure equipment is delivered to the relevant substation site safely and on time. This should include as a minimum: -

- Freight instructions/specifications
- Pro-forma packing lists
- Nominated freighting and forwarding companies
- Procedures for shipping release
- Route of land transportation / transport survey
- Unloading procedures
- Heavy lifting plan for bulky consignments / cargo
- Timing of freight and delivery

As part of the transportation plan the Contractor shall conduct a pre-road survey for the delivery of the respective power transformers from the dock to site. This survey should identify the entire route of transportation, any traffic restrictions for movement of large trailers, obstacles such as gantries, overhead lines and bridges, limitation of road and bridge widths, limitation of allowable axle load on bridges and the requirement of temporary road constructions at site. The survey shall be issued to KETRACO for approval prior to the completion of the transformer design.

All transport costs including road widening or bridge strengthening are deemed to be included in the contract price.

The Contractor shall inform himself fully as to all available transport facilities, road width, and axle load limitations, loading gauges and any other requirements and shall ensure that equipment as packed for transport shall conform to the relevant limitations. Any cost arising from the use of roads or tracks, including tolls, shall be borne by the Contractor.

The Contractor shall ensure by his own enquiries that the facilities available for unloading and bearing capacity of wharfs at ports are adequate for his proposed plant and equipment.

The Contractor shall take reasonable steps to prevent any highways or bridges from being damaged by his traffic and shall select routes, choose and use vehicles and restrict and distribute load so that the risk of damage shall be limited as far as is reasonably possible. The Contractor shall immediately report to the Employer/ Employer's Representative any claims made against him arising out of alleged damage to a highway or bridge.

The Contractor shall be responsible for all costs including those incurred by KETRACO or the Employer/ Employer's Representative, arising from repair or replacement due to damage to equipment or materials during transport, off-loading or erection on site, until take-over by KETRACO.

The Contractor shall be responsible for obtaining from the relevant authorities all permissions necessary to use docking, off-loading, highway, and bridge facilities required for the transportation of contract materials and plant.

5. Health and Safety

1.1. Safety of Personnel

The maximum safety, consistent with good erection practice, must be afforded to personnel directly engaged on this Contract, or who in the normal course of their occupation find it necessary to utilize temporary works erected by the Contractor or frequent the working area. Reasonable measures shall be taken to afford adequate protection against material falling from a higher level onto personnel below.

The works shall be conformed to the requirements of ISO 45001 standard (valid certificate to be submitted).

The Contractor and his representatives shall always comply with the Employer Safety Rules regarding electrical apparatus and the safety of men working thereon.

Particular care shall be taken during work at places where the line runs parallel to other lines that may be energized.

No testing or other work on apparatus which has been delivered to Site and which is liable to be electrically charged from any source shall be permitted except under a "Permit to Work" which will be issued for the purpose by the Employer.

At the completion of the Contract Works the Employer/ Employer's Representative shall undertake an inspection to ensure the operational safety of the overhead electricity transmission lines. For this purpose, the Contractor shall jointly undertake with the Employer/ Employer's Representative an inspection of the Contract Works. The cost of any re-inspection occasioned by non-compliance with the Specification by the Contractor shall be borne by the Contractor.

Prior to construction work commencing, the Contractor shall provide a H&S Plan, incorporating the Environmental, Health and Safety Management plan, for review by the Employer/ Employer's Representative. This Plan shall cover all activities related to the execution of the Project.

6. Compliance with Regulations

All apparatus and materials supplied and all work carried out shall comply in all respects with such of the requirements of the Regulations and Acts in force in Kenya as are applicable to the Contract Works and with other applicable Regulations to which the Employer is subject.

7. General Particulars and Guarantees

The Works shall comply with the general particulars and guarantees stated in the Schedules of Technical Information.

All working methods employed and all plant and apparatus supplied under this Contract shall be to approval.

The Contractor shall be responsible for any discrepancies, errors or omissions in the particulars and guarantees, whether the Employer/ Employer's Representative has approved such particulars and guarantees or not.

8. Compliance with Standard Specifications

Except where otherwise specified or implied, the works shall comply with the latest applicable Standards or Recommendations of the International Electrotechnical Commission (IEC), Institute of Electrical and Electronics Engineers (IEEE) or to the standards of the British Standards Institution (the said Specifications being hereinafter referred to as BS).

Where the use of a standard other than IEC or BS is agreed then this standard shall be used, where applicable, throughout the work. Where other standards are proposed in place of IEC, IEEE or BS standards confirmation shall be provided that the provisions of the standards are equivalent to or exceed those of equivalent IEC, IEEE or BS standards.

Copies of any standards proposed in substitution for IEC, IEEE Standards or Recommendations or British Standards must be submitted with the Bid accompanied where necessary by English translations of the appropriate sections.

No departures from the Specification are to be made without the written approval of the Employer/ Employer's Representative.

Standards and Codes

The work is to be performed according to the most recent relevant codes, standards, accident prevention regulations and legal regulations. All materials and equipment supplied and all work carried out as well as calculation sheets, drawings, quality and class of goods, methods of inspection, constructional peculiarities of equipment and parts and acceptance of partial plants, as far as these are beyond the special requirements of partial plants and as far as they are beyond the particular requirements of the technical requirements shall comply in every respect with the technical codes of the International Organization for Standardization (ISO). IEC recommendations apply to the electrical equipment.

Goods and special guarantees beyond the scope of ISO and IEC shall conform at least to the following standards and codes in the following priority:

- EN
- DIN
- BS
- ASTM
- Other internationally accepted standards which ensure a quality equal to or higher than the standards mentioned above, but only if these are submitted in the English language edition and accepted by the Employer.

The Contractor must submit a list of standards to be applied for the equipment manufacturing testing installation and commissioning, for approval.

During the design stage the Contractor shall supply indexed lists (in English), of all standards, codes and their referred associated standards, to which the Plant and Works are to be performed.

Contractor, sub-Contractors, sub-suppliers and shops are to be certified according to ISO 9000.

It is the Contractor's responsibility to provide sufficient evidence that any national or other standard the Contractor proposes (other than those mentioned above) will ensure an equivalent or higher standard.

9. Variations from Conditions of Contract

In the event of there being any inconsistency between the provisions of this Technical Specification and the Conditions of Contract, the provisions of the Conditions of Contract shall prevail and shall be considered as incorporated in the Contract.

10. Subcontracted Plant, Materials and Labour

The Contractor shall also provide the Employer/ Employer's Representative with names and details of local subcontractors before such subcontracts are placed. The Employer reserves the right to withdraw its consent to local subcontract arrangements if such are considered unsuitable, but consent will not be unreasonably withheld. In addition, contractor should get an approval for the subcontractors in advance and before starting the work.

Subcontractors/manufacturers for major items of supply or services identified in the bidding document must meet or continue to meet the minimum criteria specified therein for each item.

Sub-contracting is not permitted to exceed 30% of contract price. Bidder shall include with the bid a list of subcontractors (if any) for major items of services, with elements of work/items and the proposed subcontractor(s) clearly identified including their past experience/capacity.

In the case of a Bidder who offers to supply and install major items of supply under the contract that the Bidder did not manufacture or otherwise produce, the Bidder shall provide the manufacturer's authorization, using the form provided in Section IV, showing that the Bidder has been duly authorized by the manufacturer or producer of the related plant and equipment or component to supply and/or install that item in the Employer's country. The Bidder is responsible for ensuring that the manufacturer or producer complies with the requirements of ITB 4 and 5 and meets the minimum criteria listed above for that item.

11. Access to Manufacturers' Works

Access to the Contractor's and Subcontractors' works shall be granted to the Employer/ Employer's Representative for the purpose of inspection, testing and ascertaining progress.

12. Planning and Progress Reports

The Contractor shall submit for review, within 4 weeks of the Effective Date of the Contract, an outline design, manufacture, delivery and construction and erection chart. Within a further period of 4 weeks the Contractor shall provide a detailed programme in a format to be agreed by the Employer/ Employer's Representative; this programme shall also include details of drawing submissions. The detailed programme shall cover all aspects of

the Contract: design, procurement, manufacture, testing, shipment and transport, delivery to site, all site operations related to construction, erection and installation, testing at site, commissioning and completion of the works.

The Contractor shall submit to the Employer/Employer's Representative's at monthly intervals, not later than the fifth day of the following month, and in such formats as may be required by the Employer/Employer's Representative's, detailed progress reports of the status of design, material procurement, manufacture, works tests, site transportation plan, delivery to Site, erection of all plant and materials included in the Contract, testing and commissioning with regard to the agreed contract programme. The Monthly and Quarterly progress reports shall be prepared by the contractor and submitted to the Employer/Employer's Representative's before the end of each month/quarter. It includes (but not limited to) all engineering/procurement/construction progresses as well as financial reporting.

Reports shall include a chart detailing plant manufacture, delivery and erection. The chart shall indicate all phases of the work with provision for modification if found necessary during execution of the Works.

The design aspect of the progress report shall include a comprehensive statement on drawings and calculations submitted for review.

The details on material procurement shall give the dates and details of orders placed, indicating delivery dates and expected inspection dates quoted by the manufacturer. If any delivery date has an adverse effect on the contract programme the Contractor shall state, the remedial action taken to ensure that delays do not occur.

The section on manufacture shall indicate dates of arrival of material, the progress of manufacture and testing and shall state the date on which the material will be ready for transport. Any events which may adversely affect completion in the manufacturer's works shall also be reported.

All works tests and the test results shall be listed and a commentary provided. Any test failures shall be explained and the Contractor shall state his proposed actions to prevent delay to the project completion. The shipping or transport of each order shall be monitored in the progress report and shall give the date when equipment is available for transport, the expected time of delivery to site and the dates actually achieved.

The report on the site works shall be subdivided into each of the activities included in the detailed construction programme and each activity shall be monitored giving work achieved, the percentage completion and estimated completion dates for each activity, in accordance with the contract programme. The number of men working on site, both labour and supervisory staff, shall be reported together with any incidents or events that may affect the progress of site works. The progress reports shall include photographs of work items of interest and any unusual form of construction or foundation work.

A site weekly programme of work shall be provided each week during the previous week.

Any delays which may affect any milestone or completion date shall be detailed by the Contractor who shall state the action taken to effect contract completion in accordance with the contract programme.

The Contractor shall forward two copies of each progress report to the Employer/ Employer's Representative. If during the execution of the Contract the Employer/ Employer's Representative considers the progress position of any section of the work to be unsatisfactory the Employer/ Employer's Representative shall be at liberty to call progress meetings at site or in his office with a responsible representative of the Contractor.

Project progress meetings shall be held at monthly intervals or as mutually agreed between the Contractor, KETRACO and the Employer/ Employer's Representative. The venue for each project progress meeting (including necessary refreshments etc.) is to be provided by the Contractor throughout the duration of the contract.

13. Quality Assurance

To ensure that the supply and services under the Scope of this Contract, whether manufactured or performed within the Contractor's works or at his subcontractors' premises or at Site or at any other place of work are in accordance with the Specification, with the Regulations and with relevant authorized standards, the Contractor shall adopt suitable quality assurance programmes and procedures to ensure that all activities are being controlled as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001:2008.

The systems and procedures which the Contractor will use to ensure that the Works comply with the Contract requirements shall be defined in the Contractor's Quality Plan for the Works.

The Contractor shall operate systems that implement the following:

Hold point - "A stage in material procurement or workmanship process beyond which work shall not proceed without the documented agreement of designated individuals or organisations."

The Employer/ Employer's Representative written agreement is required to authorise work to progress beyond the hold points indicated in reviewed quality plans.

Notification point – "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness."

If the Employer/ Employer's Representative does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice, then work may proceed.

13.1. Quality Assurance Requirements

The Contractor and subcontractors, shall, for all phases of work to be performed under the Contract, establish and implement quality assurance arrangements which, as a minimum, meet the requirements of ISO 9001:2000, "Quality management systems: Requirements".

The Contractor shall ensure that all work carried out under the Contract is performed by suitably qualified and skilled personnel and that good quality materials, which meet relevant international standard specifications, where such exist, are used.

13.2. Quality Assurance Arrangements – Quality Plan

The Contractor shall submit a comprehensive contract specific Quality Plan for review and comment, within two weeks of award of Contract.

The Quality Plan shall identify as a minimum:

- a. the Contractor's organisation and responsibilities of key management including quality assurance personnel;
- b. the duties and responsibilities assigned to staff ensuring quality of work for the Contract;
- c. the prime project documents, specifications, codes of practice, standards;
- d. the correspondence and reporting interfaces, and liaison between the Employer/ Employer's Representative and the Contractor;
- e. the procedures the Contractor intends to use to manage and control the Contract, including:
 - i. the duties and responsibilities assigned to staff ensuring quality of work for the Contract;
 - ii. hold and notification points;
 - iii. submission of engineering documents required by the Specification;
 - iv. the inspection of materials and components on receipt;
 - v. reference to the Contractor's work procedures appropriate to each activity;
 - vi. inspection during fabrication/construction;
 - vii. final inspection and test.

It is recommended that separate Quality Plans be submitted for the design/manufacture and construction/installation phases.

The Contractor shall review, amend and re-submit quality plans as necessary during the Contract.

13.3. Monitoring by the Employer/ Employer's Representative

During the course of the Contract the Employer/ Employer's Representative reserves the right to monitor the implementation of the Contractor's quality assurance arrangements.

The Contractor's compliance with equipment, documentation, drawing, delivery, construction, installation and commissioning schedules shall be monitored by the Employer/ Employer's Representative.

Monitoring may be by means of a programme of formal audits and/or surveillance of activities at the work locations. Where deficiencies requiring corrective actions are identified, the Contractor shall implement an agreed corrective action programme. The Employer/ Employer's Representative shall be afforded unrestricted access at all reasonable times to review the implementation of such corrective actions.

For site work the Employer's Representative may monitor all aspects of the Contractor's daily work including that of subcontractors and assess the achievement of milestones as detailed by schedule deliverables.

The Employer/ Employer's Representative reserves the right to monitor the subcontractors and the Contractor shall ensure that all subcontracts include, and subcontractors are aware of, this requirement.

13.4. Contractor Quality Audits

The Contractor shall carry out a formal programme of project quality audits. These shall include audits of the design, manufacture, assembly, erection, installation, test and commissioning functions of the Contractor's organisation and those of its subcontractors and suppliers. The Employer/ Employer's Representative reserves the right to accompany the Contractor on such audits.

The Contractor shall formulate a 6-month project specific audit programme, covering 6-month periods, which shall be submitted to the Employer/ Employer's Representative for review within 4 weeks of the Effective Date of the Contract and thereafter every 6 months. Any revision to the audit programme shall be forwarded to the Employer/ Employer's Representative.

13.5. Control of Subcontractors

The Contractor shall be responsible for specifying the quality assurance requirements applicable to subcontractors and suppliers, for reviewing the implementation of subcontractors' quality assurance arrangements and for ensuring compliance with the requirements.

The Contractor shall ensure that all appropriate technical information is provided to subcontractors and suppliers. The Contractor shall, for the supply of items, plant or equipment (including those subcontracted), arrange for suitable protection for the product at all stages including delivery and installation at the site.

The Contractor shall submit, for information, a detailed programme defining the basis of control to be applied to each subcontract or supply order.

13.6. Inspection and Tests

Inspection and test plans shall be prepared for all major items of equipment/plant, defining the quality control and inspection activities to be performed to ensure that the manufacture and completion of the plant complies with the specified requirements.

Inspection and test plans shall be submitted for review.

The Contractor shall submit for review, within 30 days of the Contract Award, a schedule defining the plant/equipment/systems/services that are to be subcontracted, identifying all items for which inspection and test plans will be submitted.

The Contractor shall review all inspection and test plans and associated control documents, of any subcontractors and suppliers, to ensure their adequacy prior to submission.

The Contractor shall be responsible for identifying and arranging any statutory verification activities in the country of manufacture.

Inspection and test plans may be of any form to suit the Contractor's system, but shall as a minimum:

- a. Indicate each inspection and test point and its relative location in the production cycle including incoming goods, packing and site inspections.
- b. Indicate where subcontract services will be employed (e.g. subcontractor NDT or heat treatment).
- c. Identify the characteristics to be inspected, examined, and tested at each point and specify procedures, acceptance criteria to be used and the applicable verifying document.
- d. Indicate mandatory hold points established by the Employer/Employer's Representative's that require verification of selected characteristics of an item of process before this work can proceed.
- e. Define or refer to sampling plans if proposed and where they will be used.
- f. Where applicable, specify where lots or batches will be used.

The Contractor shall include in all orders to subcontractors, a note advising that all materials and equipment may be subject to inspection by the Employer/ Employer's Representative as determined by the inspection and test plan. The Contractor shall include in all orders to subcontractors, a note advising that all materials and equipment may be subject to inspection by the Employer/Employer's Representative's as determined by the inspection and test plan. Copies of such purchase orders shall be forwarded to the Employer/Employer's Representative's.

In order to verify compliance with engineering, procurement, manufacturing requirements and programmes, the Employer's Representative shall have access, at all times, to all places where materials or equipment are being prepared or manufactured, including the works of the Contractor's subcontractors or supplies of raw materials.

The Contractor shall advise the Employer/Employer's Representative's of the readiness of inspection at least 4 weeks prior to a nominated inspection/surveillance witness or hold point. Work shall not proceed beyond a hold point without the written agreement of the Employer/Employer's Representative's.

Inspection of the plant/equipment may be made by the Employer/Employer's Representative's and could include the following activities:

- i. Periodic monitoring to confirm the effectiveness of, and the Contractor's compliance with, the established quality plan, system procedures and inspection and test plan.
- ii. Witnessing of inspections and tests and/or verification of inspection records to be carried out at the Employer/Employer's Representative's discretion covering:
 - compliance of raw material with specified requirements
 - compliance of manufactured parts, assemblies and final items with specifications, drawings, standards and good engineering practice
 - witnessing of inspection and tests

- packing for shipment including check for completeness, handling requirements, and case markings and identification.

Raw materials, components, shop assemblies, and the installation thereof, shall be subject to inspection and test by the Employer's Representative as required by the Specification and to the extent practicable at all times and places, during the period of manufacture.

The Contractor shall keep the Employer's Representative informed in advance of the time of starting and of the progress of the work in its various stages so that arrangements can be made for inspection and for test. The Contractor shall also provide, without additional charge, all reasonable facilities and assistance for the safety and convenience of the Employer's Representative in the performance of his duties. All of the required tests shall be made at the Contractor's expense, including the cost of all samples used.

The Contractor shall not offer, unless otherwise agreed, any item of equipment or system for inspection to the Employer's Representative until all planned inspections and tests to date have been completed to the satisfaction of the Contractor.

The Employer's Representative shall endeavour to schedule the performance of inspection and tests so as to avoid undue risk of delaying the work. In the event of postponement, by the Contractor, of tests previously scheduled, or the necessity to make additional test due to unsatisfactory results of the original tests, or other reasons attributable to the Contractor, the Contractor shall bear all costs for new tests and the costs incurred by the Employer's Representative or his nominated representative in re-inspecting the non-conforming item or its replacement.

The inspection and tests by the Employer's Representative of any equipment/component or lots thereof does not relieve the Contractor of any responsibility whatever regarding defects or other failures which may be found before the end of the defect liability period.

The Contractor shall provide a quality release certificate confirming compliance with the Contract requirements and a data book, comprising the inspection, test, qualification and material records required by the pertaining specifications.

No material shall be shipped to the Site or put to work until all tests, analysis and inspections have been made and certified copies of reports of test and analysis or Contractor's certificates have been accepted and released by the Employer's Representative or by a waiver in writing.

13.7. Construction/Installation Phase

Within 30 days of mobilisation of works, inspection and test plan(s), similar in form and content to that described in the 'Inspection and Tests' part of this specification above, shall be submitted defining relevant inspection and test points for all stages of construction/erection, installation and commissioning. The inspection and test plans shall identify activities for which method statements shall be prepared.

Method statements shall be submitted to the Employer's Representative for review.

Programmes of site construction works shall be submitted to the Employer's Representative, giving notification of forthcoming test/inspections on a weekly basis.

13.8. Non-Conformances

All items or services not in accordance with the Contract technical specification, or deviating from a previously reviewed document, shall be considered non-conforming.

All such items shall be clearly identified and isolated where practical, and reported to the Employer's Representative via a non-conformance report. Information to be provided with non-conformance notifications shall include:

- a. identification of the item(s);
- b. reference to relevant specification/drawings, including applicable revisions;
- c. reference to the application inspection and test plan stage;
- d. description of the non-conformance, with sketch where appropriate;
- e. method by which the non-conformance was detected;
- f. cause;
- g. proposed corrective action, with technical justification, where necessary;
- h. for significant non-conformances, proposed action to prevent recurrence;
- i. applicable procedures.

The Employer's Representative shall have complete authority to accept or reject any equipment or part thereof considered not to be in accordance with the specified requirements.

Approval of any concession applications is the prerogative of the Employer's Representative, and approval of a particular case shall not set a precedent.

Any non-conformances identified by the Employer's Representative shall be notified by issue of the Employer's Representative's non-conformance report to the Contractor. Notification of re-inspection shall not be made until the completed non-conformance report, together with any applicable concession applications have been accepted by the Employer's Representative.

Acceptance or rejection of the equipment and/or components will be made as promptly as practicable following any inspection or test involvement by the Employer's Representative. However, failure to inspect and accept or reject equipment and/or components shall neither relieve the Contractor from responsibility for such items, which may not be in accordance with the specified requirements, nor impose liability for them on the Employer's Representative.

13.9. Records

Records packages to be delivered shall be agreed with the Employer's Representative prior to setting-to-work of each phase, i.e. design, manufacture, construction, installation and commissioning.

13.10. Method Statements

Prior to commencing work, the Contractor shall submit method statements setting out full details of his methods of working. This is a hold point.

14.Design and Standardization

The design shall comply with KEBS¹ standards. Corresponding parts of all material shall be made to gauge and shall be interchangeable. When required by the Employer's Representative the Contractor shall demonstrate this quality by actually interchanging parts. As far as possible all insulators, fittings and conductor joints and clamps should be interchangeable with the equivalent items of the existing transmission system, details of which are obtainable from the Employer's Representative.

The Works shall be designed to facilitate maintenance and simplicity of operation, inspection, cleaning and repairs, and for operation where continuity of supply is the first consideration. All apparatus shall also be designed to ensure satisfactory operation under the atmospheric conditions prevailing at the Site, and under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to faulty synchronising and short circuit.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the Works and of associated works supplied under other contracts.

15.Quality of Material

All material used under this Contract shall be new and of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform. No repair of defective parts including welding, filling and plugging will be permitted without the sanction in writing of the Employer or Employer's Representative.

¹ Kenya Bureau of Standards

16. Language, Weights and Measures

The English language shall be used in all written communications between KETRACO, the Employer's Representative and the Contractor with respect to the services to be rendered and with respect to all documents and drawings procured or prepared by the Contractor pertaining to the work.

Whenever anything is required under the terms of the Contract to be marked, printed or engraved, the English language shall be used except where otherwise provided in the Specification.

The design features of all equipment, all quantities and values which are required to be stated in the Schedules of Technical Information and all dimensions on drawings whether prepared by the Contractor or not shall be stated in the International System of Units (SI).

17. Testing and Inspection

Introduction

This section contains general requirements for inspections and tests of material, parts, equipment and workmanship of the plant during manufacture, assembling and erection and upon completion to demonstrate compliance with General Technical Requirements/Particular Technical Requirements, codes and standards to ensure overall reliability of plant operation and performance.

All materials used in the Contract Works shall be made available for inspection and test by the Employer and the Employer's Representative during manufacture and it is the Contractor's responsibility to advise KETRACO when equipment and materials are available for inspection.

The Contractor shall carry out the tests stated in the Technical Specifications in accordance with the conditions thereof and the latest applicable Standards or Recommendations and such additional tests as in the opinion of the Employer's Representative are necessary to determine that the Works comply with the conditions of this Specification either under test conditions (in the Manufacturer's Works, on the Site, or elsewhere), or in ordinary working. Type tests may be omitted at the discretion of the Employer's Representative if satisfactory evidence is given of such tests already made on identical equipment.

All tests, inspections and examinations, as well as the results and finding established thereby shall be recorded and duly signed by the parties involved. The Contractor shall prepare complete test reports on all tests carried out in the factory or by the subcontractors. The reports shall include all measured and calculated data presented in tables and graphs. The reports shall demonstrate compliance of the Works with the requirements of the Contract. Six copies of all reports shall be furnished to the Employer.

The Employer / Employer's Representative shall, at all reasonable times, be allowed free and ready access to the Contractor's premises and those of his suppliers for the purpose of inspecting the specified equipment components, and obtaining information as to the progress of the work. Failure on the part of the Employer / Employer's Representative, at this or any other time, to discover or reject materials or work which do not meet specified requirements shall not be deemed an acceptance thereof nor a waiver of defects therein.

The approval of the Employer / Employer's Representative will not prejudice the right of the Employer to reject the Plant if it does not give complete satisfaction in service.

The Contractor shall submit an Inspection & Test Plan (ITP) to the Employer for approval. The ITP shall cover all items of equipment to be provided under this project through the manufacturing and erection stages of the project, and shall indicate the salient points of manufacture and/or erection at which the Employer/Employer's representative is required to attend. Stages of manufacture or erection where attendance is required by the Employer/Employer's representative is required, shall be Witness/Hold points in the process. Adequate advance notice shall be provided to the Employer by the Contractor of any forthcoming Witness/Hold points in the reports to be submitted by the Contractor as required. Formal written notification shall be given 28 days prior to any Witness/Hold point inspection to be performed.

Inspection and testing shall consist of:

- inspection and tests on raw materials
- factory tests and inspections:
- routine tests
- type and special tests
- factory acceptance tests
- inspections and tests during construction
- inspections at the end of construction works (final construction checks)
- tests on completion
- performance verifications.

All costs related to the inspection and testing are deemed to be included in the contract price.

Scope, Program, Documentation

All main components and equipment offered for and supplied under this Contract shall be type tested. Bidders shall enclose in his Bid Type Test Certificates separately for each such main component and equipment offered.

Such Type Test Certificates shall be issued by internationally recognized testing organizations for type tests carried out on components and equipment which are, in the opinion of the Employer / Employer's Representative, of identical type or identical in all essential respects to the equipment offered. If any of the Type Tests Certificates submitted is not applicable to the component or equipment offered, the Employer / Employer's Representative reserves the right to require re-testing or the inclusion of additional tests in the routine test program.

The Bidder shall enclose in his Bid the reports for all type tests and additional type tests certificates as per technical specification along with equipment / material drawings separately for each such main component and equipment offered. The type tests conducted earlier should have been conducted in accredited laboratory based on ISO / IEC Guide 25 / 17025 and the test reports submitted shall be of the tests conducted within last 10 ten) years prior to the date of bid opening (unless specially agreed with the purchaser). In case the test reports are of the test conducted earlier than 10(ten) years prior to the date of bid opening, the Bidder shall repeat these test(s) at no extra cost to the Employer. In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

In case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected.

During manufacture, erection and after completion all materials, components and equipment supplied as well as works performed under this Contract may be subjected to inspection by the Employer / Employer's Representative, should they so require. The works may also be subjected to inspection and tests by any approved agencies of insurance or inspection companies, approved by the Employer / Employer's Representative, in accordance with the provisions of these technical requirements.

Quality assurance

The Contractor shall provide and operate a quality assurance system both in his facilities and the facilities of his sub-Contractors and at site capable of producing objective evidence that the material and equipment meet the quality requirements of the technical requirements. The system shall be in accordance with ISO 9001.

With the installation of electrical systems and in the examinations for initial commissioning of the electrical facilities the rules and standards of the European Union to work safety and protection of persons against accidents are strictly to observe for tools and electrical equipment and for their exams to be repeated regularly.

The Contractor shall include an outline inspection plan in his Bid. Before delivery to site a detailed inspection plan shall be submitted to the Employer/Employer's Representative for approval. It shall describe the facilities and site inspection for each major component and for the finally assembled equipment and shall include the following:

- a schedule or flow chart indicating each inspection and the stages in the manufacturing and erection process where the Contractor proposes inspection shall be carried out.

- a short-written description of the method for each inspection

- standards of acceptance, with references to International Standards or Codes where applicable. Where the Contractor's acceptance standards are proposed, copies of such standards shall be provided.

The Contractor has primary responsibility for ensuring the quality of items of equipment supplied under the Contract and remains accountable when manufacture or erection is subcontracted. It is therefore a requirement of the technical requirements that works are only subcontracted to companies with effective Quality Assurance (QA) organization and that the Contractor monitors the quality control by the attendance at tests of experienced inspectors employed by the Contractor.

Adequate notice shall be given when the equipment is ready for inspection or test and every facility shall be provided by the Contractor and his sub-Contractors to enable the Employer / Employer's Representative to carry out the necessary inspection of the plant.

A detailed record of the results of all tests and inspection shall be maintained by the Contractor and copies provided to the Employer / Employer's Representative within a reasonable time after the tests.

Facilities for inspections and tests

The Contractor shall propose detailed programs and procedures for the inspections and tests for individual components as well as for the entire system.

The programs and procedures shall be prepared based on the "Quality Assurance System".

The detailed and final inspection and testing programs shall be submitted for the approval of the Employer/Employer's Representative according to the schedule of documents submittals.

Final notification or confirmation of the inspection or test dates shall be not later than twenty-eight (28) days in advance.

The tests shall be performed to the agreed inspection and test plan using acceptance criteria approved by the Employer/Employer's Representative.

The Contractor shall provide all the test equipment and test sets required for carrying out the inspection and tests.

All equipment shall have current calibration certification.

The Contractor shall submit test programs for factory and site testing that is subject to approval by the Employer / Employer's Representative. Test methods shall be based on IEC recommendations and standards. Bidders shall state the applied standards and test methods. A tentative test program and a test procedure shall be supplied before each individual test.

The test procedure shall specify in detail the tests to be performed, based on the specified requirements. Detailed documentation (e.g. circuit diagrams, flow charts) of the tested system/equipment shall also be available to the Employer/Employer's Representative at the same time. Formats of the test report which are intended to be used shall be submitted for approval together with test program.

The Contractor shall duly consider provisions specified in the Bidding Document Documents as minimum requirements when preparing the inspection and test plan with respect to type and extent of inspection and tests, to location, orientation and number of test samples, to frequency and amount of taking samples for statistical quality control and with respect to acceptance criteria for all QA measures.

The Employer/Employer's Representative will return a copy of the Contractor's proposed inspection program indicating those inspection stages for which notification is required. Notification shall be by letter and shall be sent at least 20 days prior to the intended test. If the Employer and/or the Employer's Representative intends to be present at the test he will provide at least 24 hours notice and if his representative does not attend on the notified date the test may proceed unless an alternative date has been requested by the Employer / Employer's Representative.

After completion of each and every test, copies of all test records, test certificates and performance curves shall be supplied for all tests carried out in accordance with the provision of the contract, whether or not the Employer/Employer's Representative has witnessed them. Information given on such test certificates and curves shall be sufficient to identify the equipment and software to which the certificates refer and shall also bear the Contractors' reference and heading.

The test reports shall indicate the tests performed, contract references, the results obtained, instruments used, names of test personnel, and provide for witnesses' signatures. They shall also be numbered and dated.

Rejection of Elements

Any item of plant or component which fails to comply with the requirements of these technical requirements in any respect at whatever stage of manufacture, test and erection or on completion at site may be rejected by the Employer / Employer's Representative either in whole or part as he considers necessary and well-founded.

After adjustment or modification if so directed by the Employer / Employer's Representative, the Contractor shall submit the item for further inspection and/or tests. Plant or components with defects of such a nature, that the Technical Requirements cannot be met by adjustment or modification, shall be replaced by the Contractor at his own expense and to the satisfaction of the Employer / Employer's Representative.

Rules and Standards

All equipment shall be inspected and tested in accordance with the requirements of the relevant standards and rules and the present technical requirements and data sheets.

The inspections and tests shall be in accordance with the standards used for design, manufacture and erection/construction of the respective Works or parts thereof.

Test procedures and test conditions shall be sent to the Employer/Employer's Representative for approval prior to commencement of design of such equipment.

Failure to do so can result in rejection of the tests or even of the equipment or material so tested.

The type and extent of inspection shall generally be in accordance with that specified in the standard used for design and construction of the item of equipment supplemented or amended by the provisions of the technical requirements.

Additional design tests are also to be carried out as described in the other parts of this technical requirements.

Reference to special rules and standards, where designated either directly or as "relevant", is intended to provide a measure of performance, safety, in-shop and on-site testing, and methods of construction and/or installation that should be considered acceptable for use under these technical requirements. If more than a single degree of quality or accuracy is permitted within the scope of particular code or standard, the highest quality shall be applicable and the degree of accuracy commensurate with the intended function shall be selected but with the understanding in either case that the decision as to degree will be made finally along with procedures by the Employer / Employer's Representative.

Works or parts thereof supplemented or amended by the provisions of the technical requirements.

In all instances, the finally accepted applicable code or standard shall be the version last published prior to the date of submission of the Bid selected as the basis for this Contract.

If no appropriate standards are available, inspection and testing shall be made in accordance with the Manufacturer's/Contractor's standard practice, subject to the approval of the Employer / Employer's Representative.

In such cases the Contractor shall submit to the Employer Employer's Representative complete data and a suggested procedure for the testing to be performed before manufacture commences.

If the proposed procedure is accepted, the Contractor shall provide the Employer / Employer's Representative with at least four additional copies in English before any test is performed.

The Contractor's attention is drawn to the climatic conditions in the site area. De-rating factors are to be in accordance with the relevant IEC codes and standards or an approved equivalent.

Services Prior to and During Inspections and Tests

In accordance with and in addition to agreed standards, the Contractor shall submit procedures for material testing, manufacture, quality control and performance testing as they apply from the procurement phase of raw materials to the finished product.

No inspection will be made or deemed valid unless the Employer / Employer's Representative, the Contractor and Sub-supplier are in possession of all relevant approved drawings and procedures for the item to be tested.

The Contractor on request shall supply the Employer / Employer's Representative with a copy of drawings and procedures at least one week prior to testing.

All instruments and apparatus required for the inspection or used for the performance of tests shall be calibrated to an agreed standard at a laboratory of national standing. The cost of making such calibrations shall be borne by the Contractor in all cases.

Test Equipment and Instruments

Test equipment, apparatus and instruments required for measurement or recording the test results shall be to an appropriate accuracy and shall be calibrated. The related costs shall be borne by the Contractor.

In the case of Performance Tests, the Instruments shall have been calibrated by an independent calibration authority or institute, the costs of which shall be borne by the Contractor.

Independent Agency

Inspection and testing may be performed by an independent testing agency on behalf of the Contractor. Such an agency requires approval by the Employer / Employer's Representative.

The Employer / Employer's Representative may delegate inspections and witnessing of tests to a consultant or to any independent testing agency.

Type Tests

All equipment being supplied shall be fully type tested in accordance with the technical specifications and relevant standards and shall be subject to routine tests in accordance with the requirements stipulated under the respective sections. KETRACO reserves the right to witness any and all the type tests required. Type Test Reports shall be furnished by the Bidder along with other documents as stipulated in Section 2. Type tests should be conducted in a reputable international third party (and/or witnessed

by third party) laboratory certified in line with ISO / IEC Guide 25 / 17025 and the test reports submitted shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening (unless specially agreed with the purchaser). In case the test reports are of the test conducted earlier than 10(ten) years prior to the date of bid opening, Bidders shall repeat these test(s) at no extra cost to the Employer Accreditation certificate should be included in the Bid. Type tests should be conducted on the same type and make of the equipment, proving ratings and parameters, as required by this Contract and/or other data and information furnished by the Contractor.

In the case that type tests reports furnished with the Bid are incomplete and / or not meeting specified requirement, in the case of the Contract award, the Contractor shall arrange necessary type testing at its own cost. The Employer has the right to witness any or all of those type tests. All costs related to the witnessing of type tests shall be born by the Contractor. Test program shall be developed by the Contractor and approved by the Employer only after all certificates (documents) on tests are submitted to the Employer.

Type tests reports shall be provided as complete set, including clearly readable copies of all documents describing tested object (data, drawings, photos) and test results (including graphs, measurement readings, calculations, conclusions, remarks if any, etc). In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design / manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

Bidders shall intimate the Employer the detailed program about the tests at least 8 (eight) weeks in advance.

Type tests shall be made on one unit of each type supplied. The Contractor shall submit valid certificates of tests made on equipment of the same type. Upon receipt of complete type tests reports, covering all type tests applicable as per specified standards and conducted by an independent, internationally recognized testing agency, and proof that the equipment and material to be tested are identical to that covered by the test certificates, the Employer will waive the requirements for corresponding type tests called for in this Specification and/or specified in the Standards.

Quality Control of Materials**General**

Materials shall be tested in accordance with the specified standards approved by the Employer / Employer's Representative.

Unless otherwise specified, the quality of materials shall be verified generally by:

- chemical analysis (composition, stability by aggressive agents, etc.)
- mechanical tests (yield point, tensile strength, elongation, etc.)
- electrical tests (insulation properties, conductivity, resistivity, etc.)
- thermal tests (thermal constants, thermal stability, etc.).

Non destructive tests like X-rays, ultrasonic examination, magnetic particle testing shall be applied as much as possible.

Test specimens and samples for analysis shall be plainly marked to indicate the materials they represent.

Workshop assembly

In addition to the quality and production control tests, the following shop assembly work and tests shall be made to check measurements, fitting and functioning.

Equipment to be furnished shall be shop assembled to a status sufficient to prove that the design and workmanship have been executed in accordance with the specifications, that the delivery is complete, and that no work remains to be done at site, which reasonably may or should be done in the workshop.

Where applicable, each item of the equipment shall be assembled completely prior to delivery.
Field joints shall be temporarily connected.

All parts shall be properly match marked, identified and doweled to ensure and, where practicable, to facilitate correct and quick field assembly.

If the assembly shows defects in the design or manufacture or unforeseen difficulties in assembling and dismantling, these must be eliminated. If required, design alterations or corrective machining may be executed provided that no sacrifice with respect to reliability of operation or interchangeability is made and provided that the agreement of the Employer / Employer's Representative has been obtained.

If the corrections cannot be carried out in accordance with the terms mentioned above, the components concerned will be rejected. The decision on possible subsequent corrections is reserved exclusively to the Employer / Employer's Representative. Faulted equipment parts shall not be delivered.

Thermal insulating materials

All insulation materials shall be asbestos free vermin proof, non-hygroscopic, chemically inert both wet and dry, and fire resistant.

Materials shall be tested for bulk density, specific heat, compressive strength, fire resistance under pressure, service temperature limit.

Insulated cables and conductors

- IEC 60227-3
Power cables insulated and non-sheathed with thermoplastic material based on polyvinyl chloride
- IEC 60227-4
Power cables insulated and sheathed with thermoplastic material based on polyvinyl chloride
- IEC 60227-5
Cables and flexible cords for electric power and lighting

- IEC 60794
Optical fiber cables for telecommunication and data processing systems
- IEC 60502-1, -2
Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m=1.2$ kV) up to 30 kV ($U_m=36$ kV). Characteristic impedance and dimensions of radio-frequency coaxial cables.

Installation material

- IEC 60335-1
Safety of household and similar electrical appliances - Part 1: General requirements
- IEC 60364-1
Electrical installations of buildings - Part 1: Scope, object and fundamental principles

Materials for earthing and lightning protection

The materials for the installation of earthing equipment and lightning protection shall be tested in accordance with the relevant IEC regulations.

Welding tests

For all major structural welded items, the Contractor shall submit the following documented proposals prior to commencement of welding:

- welding procedure specifications with qualification records
- post weld heat treatment procedures where applicable.
- inspection schedule including quality requirements.
- non-destructive testing procedures
- standard weld repair procedures.

All welders employed on items of plant for this Contract shall be qualified.

All welds shall be visually examined and shall be of smooth contour, free from cracks, undercuts and other significant defects. Welds shall be non-destructively tested in accordance with the construction standard applicable to the item of plant. Where appropriate, the magnetic particle testing, or the ultrasonic examination is to be applied.

Galvanized zinc coatings

Surfaces shall be visually inspected. Bare patches, lumps blisters or inclusions of foreign matter shall be cause for rejection.

Inspections and Tests During Manufacture

General

As far as practicable, quality of materials, workmanship and performance of all items of the equipment furnished under the present contract shall be inspected at the places of manufacture by the Contractor's QA inspectors.

Equipment shall wherever practical be subject to tests on completion in the Manufacturer's work to prove that the reliability, operation and performance conform to the requirements of these technical requirements and the provisions of the appropriate standards.

All facilities shall be provided by the Contractor to enable the Employer / Employer's Representative to carry out the necessary inspection of the equipment components and the costs of all tests during manufacture and preparation of test records are to be borne by the Contractor.

The Contractor shall submit for approval procedures describing the proposed test methods to be used. Type and layout of test facility, location of instrumentation, formula for calculation of results and correction to site conditions, etc. shall be included where appropriate.

All measuring instruments used in tests shall be regularly calibrated at the expense of the Contractor and records shall be available for examinations by the Employer / Employer's Representative.

The passing of the inspection or test will not, however, prejudice the right of the Employer / Employer's Representative to reject the equipment components if they do not comply with the technical requirements when erected, or give complete satisfaction in service. Where the Contractor desires to use stock material, not manufactured specially for the work, satisfactory evidence that such material conforms to the requirements of the Contract shall be submitted. In this case tests on these materials may be waived, but certificates are to be submitted.

Arrangements shall be made for expediting the shop inspection by having all shop assemblies or pieces covering a single shipment ready at one time. Any packing work as well as transport to the site of the equipment concerned shall not be started before the approval of the Employer / Employer's Representative has been obtained and all QA certificates due at this time for the equipment concerned have been received and reviewed by the Employer / Employer's Representative.

Testing of control and monitoring equipment shall comply with all local laws, rules and regulations applicable and be governed by internationally recognized codes and standards.

Substation Material

High voltage switchgear

Type test certificates issued by an independent test authority shall be submitted.

Testing of electrical equipment shall comply with all local laws, rules and regulations applicable and be governed by internationally recognized codes and standards.

The test requirements for primary equipment shall be observed as specified in the Particular Technical Requirements.

Tests for other equipment shall be tested according to the requirements specified below.

Lamps and accessories

- IEC 60081 Double-capped fluorescent lamps - Performance specifications
- IEC 61347-2-8 / Ballasts for tubular fluorescent lamps - General and safety requirements
- IEC 61347-2-11
- IEC 60921 Ballasts for tubular fluorescent lamps - Performance requirements
- IEC 60155 Glow-starters for fluorescent lamps
- IEC 60598-2-3 Luminaries - Part 1: General requirements and tests
- IEC 60188 High-pressure mercury vapor lamps
- IEC 61347-2-9 Auxiliaries for lamps - Ballasts for discharge lamps (excluding tubular fluorescent lamps) - General and safety requirements
- IEC 60923 Auxiliaries for lamps - Ballasts for discharge lamps (excluding tubular fluorescent lamps) - Performance requirements
- IEC 60400 Lampholders for tubular fluorescent lamps and starterholders

Electrically operated tools

The following individual tests are to be carried out on electrically operated tools:

Each tool must run on no-load at rated voltage and frequency for at least 30 minutes the following tests:

- voltage withstand test at 3000 V during a period of 1 minute: for all insulated tools provided with protective conductor connection.

- voltage withstand test at 4000 V during a period of 1 minute: for double insulated tools not provided with an earthing conductor.
- voltage withstand test at 500 V during a period of 1 minute: for tools rated at 24 V, 50 Hz (low-voltage protection).

Power installations up to 1000 V

- IEC 60364-1 Electrical installations of buildings
- IEC 61439-4 Low voltage switchgear and control gear assemblies - particular requirements for assemblies for construction sites.

Protection equipment

Equipment for modular static protection systems (e.g. generator, distance, busbar protection etc.) pre-assemblies in the relevant boards/cubicles etc. shall be tested in the Contractor's workshops as far as wiring and proper function is concerned. Simulated inputs (binary signals, current and voltage inputs from test power supplies) shall be used for the tests.

High and low voltage cables

Routine Tests, Special Tests and Type Test shall be performed according to IEC 60060-1 & IEC 60060-2, IEC 60071-1 & IEC 60071-2, IEC 60230, IEC 60811 and IEC 60840.

Optical fiber cables

Test shall be performed in accordance with IEC 60793 and IEC 60794.

Control and monitoring equipment.

Testing of control and monitoring equipment shall comply with all local laws, rules and regulations applicable and be governed by internationally recognized codes and standards.

All control and monitoring equipment shall be tested at the Manufacturer's workshops before dispatch to site.

The Contractor shall submit a comprehensive description of each test for Employer's / Employer's Representative's approval. This shall include the type and classification of all test equipment and shall be submitted at least two months before the proposed date on which each test is to be carried out unless otherwise specified.

On request the correct operation of equipment with specified temperature of humidity limits shall be demonstrated by tests conducted within the limits.

Electrical measuring instruments

- IEC 60258 (1968-01) Direct-recording electrical measuring instruments and their accessories
- IEC 61010-1 Safety requirements for electrical equipment for measuring, control and laboratory use - Part 1: General requirements
- IEC 61010-3 Safety requirements for electrical equipment for measuring, control and laboratory use - Part 3: Protocol for the preparation of conformity verification reports for the IEC 61010 series

Electrical remote indication

- IEC 60338 Telemetry for consumption and demand

Calibration tests

The Contractor shall conduct calibration tests of the following instruments and equipment:

- all local indicators over the full range of the indicator
- all transmitters over the full range of the transmitter
- all binary transmitters over the full range including initial setting
- all analogue limit modules, function generators, flow evaluators
- all remote indicators over the full range of the indicator
- all recorders over the full range of the recorder

- one of each type of indication loop with circuit resistance of the loop increased to a value which is equal to the highest value expected, and under worst case operating conditions
- one of each type of thermocouple or resistance element
- all modules and subassemblies for measuring and control e.g. analogue limit monitors, flow evaluators, function generators
- all quantity meters
- all synchronizing units according to IEC standards.

Telecommunication Equipment

General

The communication system shall be tested according to all relevant parts of IEC 60870.

Special care shall be taken for the interfaces with the SCS equipment as well as the telephone and radio system.

Teleprotection equipment

Equipment and system performance testing according to IEC 60834-1 and IEC 60834-2 shall be performed. In addition to IEC 60834-1, Clause 20, a measurement of transmission time shall be performed.

Transmission Line Equipment

Type test certificates issued by an independent test authority shall be submitted.

Testing of electrical equipment shall comply with all local laws, rules and regulations applicable and be governed by internationally recognized codes and standards.

The test requirements for primary equipment shall be observed as specified in the Particular Technical Requirements.

ROUTINE TESTS

The Contractor shall perform routine tests in accordance with requirements of the Specification and the Contractor's test specification approved by the Employer. The Contractor shall give the Employer access to Works to determine or assess compliance with the provisions of this Specification or to witness the Contractor's routine shop tests. The Contractor shall submit results of routine tests within fifteen (15) days after performance of the tests.

All materials used shall also be subjected to and shall withstand satisfactorily such routine tests as are customary in the manufacture of the types of plant or material included in the Works.

All tests shall be carried out to the satisfaction of the Employer and Employer's Representative and in his presence, at such reasonable times as he may require, unless agreed otherwise.

Not less than 4 weeks' notice of all tests shall be given to the Employer's Representative in order that he may be represented if he so desires. As many tests as in the opinion of the Employer's Representative are possible shall be arranged together.

The original and copies of test records whether or not they have been witnessed by the Employer and Employer's Representative shall be supplied to the Employer's Representative.

Measuring apparatus shall be approved by the Employer's Representative and if required shall be calibrated at the expense of the Contractor at an approved laboratory.

The Contractor shall be responsible for the proper testing of work completed or plant or materials supplied by a sub-Contractor to the same extent as if the work, plant or materials were completed or supplied by the Contractor himself.

The Contractor shall supply suitable test pieces of all materials as required by the Employer's Representative. If required by the Employer's Representative test specimens shall be prepared for check testing and forwarded at the expense of the Contractor to an independent testing authority selected by the Employer's Representative.

No inspection or passing by the Employer and Employer's Representative of work, plant or materials whether carried out by the Contractor or sub-Contractor, shall relieve the Contractor from his liability to complete the Contract works in accordance with the Contract or exonerate him from any of his guarantees.

Factory Acceptance Tests

All FATs shall be carried out in accordance with the Employers Requirements and applicable standards as defined above.

During manufacturing process, but not later than 45 days prior the planned FAT date, the Contractor shall submit program for testing and procedures for review and approval. Test procedures shall specify in detail the tests to be performed, relevant standard reference, testing sequence, arrangements and conditions, as well as acceptance criteria. Formats of the test report, which are intended to be used, shall be submitted for approval together with test program. Detailed documentation (e.g. circuit diagrams, flow charts) of the tested system/equipment shall also be available to the Employer/Employer's Representative at the same time.

After completion of each test, copies of all test records, test certificates, oscilographs, photos and other documents necessary to represent test objects, test values and results obtained, shall be supplied for all tests carried out in accordance with the provision of the Contract, whether or not the Employer/Employer's Representative has witnessed them.

The test reports shall indicate the tests performed, contract references, the results obtained, instruments used, names of test personnel, and provide for witnesses' signatures. They shall also be numbered and dated.

Any approval of or waiving of FAT shall not relieve the Contractor of its obligations under the Contract.

Prior to shipping and final inspection, tests hereinafter referred to as Factory Acceptance Tests (FAT) shall be conducted by the Contractor at his plant and will be witnessed by the Employer.

If a certain test is required for which a standard is not specified in this Contract, but is required as per internationally recognized standard and practice then the relevant International standard will be accepted.

The Contractor shall immediately advise the Employer should any failures occur during the FAT and shall take remedial action subject to the Employer's approval and shall repeat the FAT as and when directed by the Employer. It shall be the Employer's prerogative to order a repeat of all such tests that he deems may have been affected by the failure and the Contractor shall be liable for all costs including the Employers costs arising therefrom.

The Contractor shall ensure that during the test, all hard copies from output devices are retained, that an accurate record of tests is kept and each individual test is duly initialled and marked either passed or failed. The reason for any test failure shall be established and corrective actions agreed prior proceeding with remaining tests. Tests witnessed by the Employer will be initialled accordingly on the test record. The test record, and any other pertinent supporting data and documents shall form part of a test report to be submitted to the Employer in accordance with these Employers Requirements

The equipment listed below, shall require factory acceptance tests according to Employers Requirements and applicable standards to be witnessed by two representatives from the Employer and one representative from the Consultant as a minimum:

- Main (Auto-)Transformers
- (Earthing and) Auxiliary Transformers
- Neutral Earthing Resistor
- Instrument Transformers
- Circuit Breakers
- Disconnectors & Earth Switches
- Surge Arrestors
- Power Cables
- Protection, Control & Metering Panels
- Substation Automation and Control System
- Telecommunication Equipment
- Fault Monitoring System
- Phasor Measurement Units
- 110Vdc, 48Vdc Batteries, Battery Chargers and UPS
- AC and DC Distribution Panels
- Solar PV Modules, Charge Controllers, Hybrid Inverters and Batteries for Outdoor and Indoor lighting
- Gtries, Steel Structures and Accessories
- Towers and Accessories
- ERS towers and Accessories
- Conductors, Shield Wires and OPGW
- Post and String Insulators
- Fittings and Accessories

The costs associated to carrying out the above FATs shall be borne by the Contractor and the Contractor should consider this cost in Section IV- Price Schedule. This shall include but not limited to

- I. Return flight ticket on economy class for employer and consultant.
- II. Visa application and processing fee and Local transport expense at the manufacture's country.

- III. Full board accommodation in a minimum 4-star hotel including laundry services, local and domestic transportation, per diem allowances, all internet and international calls expenses, FAT documentation and daily allowance of USD 200 to cater for incidental expenses per KETRACO Engineer per day.

The contractor shall issue a 45day notification prior to commencement of the FAT. All FAT related documentation including Quality control documents, design documents, test record sheets, test procedures shall be approved before offering equipment for FAT. The duration of each FAT shall be discussed and agreed by KETRACO and the Employer's Representative. This shall be reasonable enough to allow for conclusive testing of the equipment.

Inspections and Tests during Erection

General

The Contractor's scope of delivery includes all site test and inspection expenses, e.g. all labour, materials, water, electricity, consumables, chemicals and stores. The Contractor is responsible for and shall include in his delivery all safety measures such as barriers, warning signs etc. required for inspection and testing while erection is in progress and all interruption of work in this connection will be at his expense.

The Contractor is responsible for ensuring that safe procedures are adopted for the use, handling and storage of radioactive sources and an inventory of all sources supplied to the site shall be maintained.

All instruments and apparatus used for site inspection and testing shall be calibrated to an agreed standard at a laboratory of an international standing to be nominated by the Contractor. The cost of making such calibrations shall be borne by the Contractor in all cases.

During the erection of all mechanical, electrical, control, monitoring and telecommunication equipment the Contractor shall make the plant item available at any reasonable time for inspection by the Employer / Employer's Representative, should either so require.

To assist the Employer / Employer's Representative in their review of the quality of the work being performed, the Contractor shall provide them with a schedule of the specific areas and items of work that will be performed during each work day on a weekly basis.

All work that is executed prior to such notification shall be done at the Contractor's own risk and may, at the Employer's / Employer's Representative's request, be subject to removal and replacement by the Contractor at his expense.

In particular the Contractor has to mark on his implementation schedule all stages of erection or commissioning which are subject to the Employer's / Employer's Representative's acceptance and has to notify one week in advance when such acceptance becomes due. The stages subject to acceptance shall include but not be limited to the items indicated in the technical requirements.

The Employer's / Employer's Representative's written approval of completed work stages shall be obtained before continuing with erection and should it be necessary to dismantle subsequently erected parts in order to gain access for inspection on rectification this shall be at the Contractor's expense and no claim by the Contractor for delay shall be considered.

The following checks and tests measurements for the substation and transmission line components shall be made during erection unless otherwise specified in this specification (as appropriate) in accordance with agreed standards:

- checking for complete delivery

- cable route and laying depth inspection
- special filling resistance tests
- torque testing of all screwed and bolted electrical connections
- verification of terminals and terminal connections for correct assembly and compliance with approved for construction drawings and hook-up drawings/lists
- checking of earthing connections and testing of earthing resistance between the equipment and the ground grid, and overall ground grid resistance
- measurement of insulation resistance values on all cables, and continuity and polarity tests on all cables
- fire-proof partitioning
- marking, inscription, and provision of all designation plates
- safety signs and warning signs
- settings on indicators
- checks on wiring and cabling for compliance with the approved for construction circuit-drawings and plans
- primary and secondary injection of all current and voltage transformers to verify polarity and compliance with design performance requirements
- digital low reading ohmmeter tests across all HV conductor joints, HV equipment connections, and MV busbar joints.

Earthing System Resistance Measurement

The earthing system resistance shall be measured during initial installation and immediately before commissioning, but at least once during the dry season under reasonably dry soil conditions.

The measurements are to be carried out by means of a high frequency earth resistance measuring instrument, in order to allow readings of the impulse resistance value of the earthing system.

The stand-alone grid measurement shall be performed with the earth wires from OHLs disconnected.

The measurements shall be recorded. The schedules used for the recordings shall contain in addition to the measured ohmic values, details of the surface soil and underground data at the time of tests, the soil resistivity values, and the climatic conditions at the time of the test. Tests shall not be undertaken within 24hrs of any rainfall.

Galvanizing Thickness

The galvanizing thickness shall be tested on site after receiving the galvanized components as well as during erection. The zinc coatings shall comply with the thickness requirements defined in the specifications.

The Contractor shall have available on site for the Employer's / Employer's Representative's use an instrument suitable for the accurate checking of galvanizing thickness. The measuring instrument shall be available from the time of arrival of the first consignment of steelworks until the issue of the taking over certificate. The cost of the gauge and other operating expenses are deemed to be included in the Contract Price.

If evidence of white rust is apparent upon receipt at site of bundled steel section, the Employer's Representative /Employer shall order the Contractor to make such tests as he deems necessary to determine the extent of damage, if any, and the remedial measures necessary.

Tests on Completion

General

After final erection checks, the tests on completion shall be performed . They comprise:

- pre-commissioning tests
- cold commissioning tests
- hot commissioning tests which are the tests to be performed with all the control and LV voltage sources in operation from the permanent source, and shall repeat all tests undertaken in cold commissioning. When the repeat of the cold commissioning tests is successfully completed, a performance test shall be undertaken to confirm the capability of the substation to operate at the rated output.

Pre-Commissioning Tests

The pre-commissioning tests comprise the tests to be performed as site tests for the individual primary equipment items. They include:

- the loop checks to be performed on all circuits for the control and monitoring equipment
- injection tests to verify correct performance of protective devices and metering on each individual item of Plant; transformer winding tests
- AC & DC voltage withstand tests
- ground grid resistance tests.

Some of the above mentioned tests may require sections of the control and/or LV system voltages to be available and in operation.

Cold Commissioning Tests

The cold commissioning tests comprise mainly the tests of subsystems and systems, which are the tests to be performed on each individual item of Plant with the control voltages in operation and may require a temporary LV voltage source to be available for the section of equipment under test. Such tests consist of automatic changeover testing, generator load testing, OLTC operation testing, transformer cooling fan sequencing and operation, all interlocking, battery charger performance testing, function and trip testing of all circuit breakers. Examples of typical requirements are:

- establishing the AC and DC control voltages and the relevant tests
- local control of the HV and MV equipment, interlocking, sequencing
- start up of the substation control system, remote control of all equipment, intertrip send and receive testing to connected substations
- tests of the protection relays
- tests of the communication equipment
- checking correctness of measurements
- measurement of insulation resistance, contact resistance, continuity tests, phase sequence tests, polarity tests
- measurement of dew points, gas leakage tests, oil tests for power transformers
- testing the air conditioning system.

Hot Commissioning

The hot commissioning tests during occur during and after energization from the permanent source and typically comprise of:

Tests during energization

- energization of all HV, MV, LV equipment
- check correct voltage levels and current measurements

- synchronization tests of CBs
- checking and verification of correct phase rotation
- checking the operation of the voltage regulators of the power transformer and cooling fan sequencing
- testing the functionality of the protection relays.
- The Contractor is duty to coordinate the commissioning works regarding protection, telecommunication etc. of the 400kV OHL and Substation

Tests after energization

The tests after energization comprise of:

- performance and load testing
- stability tests of the protection system
- thermographic imaging of the joints.

18.Erection, Supervision and Checking of Work on Site

The carrying out of all work on the Site included in this Contract shall be supervised throughout by a sufficient number of qualified representatives of the Contractor who have had thorough experience of the erection and commissioning of similar Works.

The Contractor shall ascertain from time-to-time what portions of the work on the Site the Employer's Representative desires to check, but such checking shall not relieve the Contractor from the liability to complete the Works in accordance with the Contract or exonerate him from any of his guarantees.

If at any time it appears to the Employer's Representative that the Contractor will be unable to complete any Section of the Works in the time stipulated, then the Contractor shall, if required by the Employer's Representative, carry on such work outside normal working hours and shall not make any claims for any extra expense thereby incurred unless, in the opinion of the Employer's Representative, the delay is due to causes for which the Contractor would be entitled to an extension of time under the Conditions of Contract.

The Contractor shall satisfy himself as to the correctness of all connections made between the apparatus supplied under the Works and apparatus supplied under any other contract before any of the former is put into operation.

If the Employer's Representative shall certify that defects have shown themselves in the Works, the Contractor shall, for the purpose of the maintenance after the completion of the Works provided for by the Conditions of Contract, keep on Site supervisory staff of such numbers and for such periods as the Employer's Representative may require.

The Contractor is to keep the site, on which he erects or stores plant, reasonably clean removing all waste material resulting from the Works as it accumulates and as reasonably directed. On completion of the Works the Site is to be left clean and tidy to the satisfaction of the Employer's Representative. Any damage done to buildings, structures and plant or property belonging to KETRACO is to be made good at the Contractor's expense.

19.Tools and Appliances for Maintenance

The following tools and appliances shall be supplied under this Contract.

- (A) One set of standard tools, spanners, etc., at each Site of appropriate size and type to fit each nut and bolt on the whole of the plant and equipment covered by the Contract at that Site.
- (B) One set of any special tools or gauges, at each Site, required for the normal maintenance of the plant and equipment covered by the Contract at that Site.
- (C) One set of any special lifting and handling appliances, at each Site required for the normal maintenance of the plant and equipment covered by the Contract at that Site.
- (D) One set of any special tools, gauges or other test equipment required for the dismantling, re-assembly, checking or adjustment (but not normal maintenance) of the whole of the plant and equipment covered by the Contract.
- (E) One tool box to include electrical appliances for example multi-meter, electrically insulated star and flat screwdrivers, set of spanners, testing leads, different sizes and types of lugs, crimping tools, wire strippers, pliers, insulating tape.

Each tool or appliance is to be clearly marked with its size and/or purpose and is not to be used for erection purposes.

Each set of tools and appliances under categories (A) and (B) above together with the smaller items under (C) and (D) above are to be suitably arranged in fitted boxes of mild steel construction, the number of boxes being determined in relation to the layout of the plant and equipment in question. If the weight of any box and its contents is such that it cannot conveniently be carried it is to be supported on steerable rubber wheels.

Each box is to be fitted with a lock and is to be painted black and clearly marked in white letters with the name of the plant or equipment for which the tools and appliances therein are intended.

The tools and appliances with the appropriate boxes are to be handed over to the Employer at Completion of the Facilities.

20.Tools and Equipment for Erection, Installation, Commissioning and Operation

Functional tests on partial assemblies and/or complete assemblies shall be carried out as far as possible in the Contractor's workshops (or in any workshop of his subcontractors', as the case may be). Such tests shall be performed as far as possible under simulated operational conditions.

When requested, by the Employer, the functional and operational tests shall be repeated until full proof has been obtained that the functioning of the assemblies will comply with the requirements of the Contract Documents.

The Contractor shall perform field tests, pre-commissioning tests and commissioning / guarantee tests on each substation in order to determine whether the requirements of the specifications have been fulfilled. The Contractor shall submit test criteria to be performed to the Employer for review and approval. The Contractor shall perform no tests unless witnessed by the Employer and/or the Employer's Representative.

The Contractor shall supply special tools and equipment as recommended by the manufacturer for erection, installation and commissioning purposes as mentioned in the general technical specification (including the following items, but not limited to). Acceptance of any tool/equipment will not take place before the Contractor submit the complete final detailed list of all special tools and equipment.

The finalized special tools and appliances shall be supplied under this Contract for each substation of appropriate size and type. Each tool or appliance is to be clearly marked with its size and/or purpose.

Following special tools and equipment shall be supplied, but not limited to:

- A. Multi-ammeter (clamp type) for each substation
- B. Megger with 1/2/5/10 kV for each substation
- C. Digital ground resistance measuring test 1 set
- D. Test set specially designed for timing of C.B. 's (operating sequence, duty cycle) operating, making, dead time (auto reclosing), reclosing and closing
- E. Test set specially designed for measuring of low resistance path portable type (specially for measuring of resistance between CB's and DS's contacts)
- F. Test plugs of protection system
- G. Thermometer, density meter, tools for battery filling and fuse puller
- H. Thermo-vision camera 1 set
- I. Digital camera (1 for each substation)
- J. Walkie-talkie (2 pairs for each substation)
- K. Gas handling trolley (complete set), 1 set
- L. Portable Earth Leads for each voltage level
- M. Forklift, 1 set for storage warehouse

- N. Flood lighting and wall packs and portable alarm lighting, 2 sets
- O. Aluminium ladder, 1 set
- P. Signs requirements

Warning signs and boards:

- **General**

Safety colors, safety symbols and safety signs must comply in construction, geometrical form, color and meaning with ISO 3864-1 and ISO 7010.

Signs for plant identification during the erection period shall be to Employer's approval.

The signs should be of an approved material which is weather-resistant and of sufficient durability for the conditions prevailing on site.

Mounting and installation

The positions for the signs shall be chosen so that they are within the field of vision of the persons to whom they apply. The signs should be permanently attached. Temporarily dangerous areas (e.g. construction sites, assembly areas) may also be marked by movable signs. The safety signs must be mounted or installed in such a manner that there is no possibility of misunderstanding.

Information signs

Information signs should supply the necessary information to acquaint personnel with the physical arrangement and structure of site, buildings and equipment, e.g. floor numbers, load-carrying capacities including marking of floor areas, working loads of cranes, lifting gear and lifts, room identification, etc. The routing of underground pipes and cables is to be indicated by substantial marker blocks showing the relevant identification numbers.

In the choice of information signs in situations not covered by ISO (7010 and 3864) the possibility of using pictograms should be considered. Pictograms are particularly suitable for the identification of rooms, areas and buildings in the non-technical parts of the plant, sanitary etc.

Emergency signs

In the event of accidents, all necessary information should be available immediately to those affected. Thus, a sufficient number of signs of appropriate size should be installed, e.g. escape routes (including marking of floor areas), emergency exits, fire alarms, fire extinguishers, first aid equipment, first aid points, telephones, etc.

Mandatory signs

Signs indicating obligatory actions must be provided and installed wherever certain action is necessary e.g. do not obstruct the entrance; keep right, etc.

Signs should also indicate when the wearing of protective clothing and equipment is necessary and obligatory.

Warning signs

Warning signs should refer to the existence or possible existence of danger, e.g., general danger, width / height restriction, steps, risk of trapping, slipping, falling, etc.

In addition to warning signs, appropriate black-yellow strip markings should also be used where necessary.

- Q. Working clothes, safety shoes and safety helmet, safety harness, safety glasses, safety gloves, insulating gloves, safety rope, welding mask, 1 lot for each substation (for 8 representatives of the Engineer and KETRACO, besides the required facilities for the contractor's staff)

R. First aid kit, 1 set for each substation

S. Mobile phones:

The Contractor shall provide mobile phones, in the quantities given in the respective schedule of rates and prices, for use by the Employer's Project Implementation Team (PIT) in the manner indicated below. The mobile phones shall remain property of the Employer. The mobile phones shall be of the latest flagship models of Samsung or equivalent. The Contractor shall also provide airtime allowance of KES 10,000/- per month per phone for the duration of the contract. The cost of providing monthly airtime allowance is deemed incorporated into the appropriate item of the Schedule of Prices. The mobile phones shall meet the following minimum specifications:

Type 1 (10 number)

Chipset:	Qualcomm SM8550-AC Snapdragon 8 Gen 2 (4 nm)
CPU:	4nm 64-bit Octa-Core Processor * 3.36GHz (Maximum Clock Speed) + 2.8GHz + 2.0GHz
GPU:	Adreno 740
Dimensions:	Folded 154.9 x 67.1 x 13.4 mm, Unfolded: 154.9 x 129.9 x 6.1 mm
Weight:	253g
Display:	Main display: 7.6", foldable Dynamic AMOLED 2X, 120Hz refresh rate, 2176 x 1812 pixels (QXGA) Sub display: 6.2", Dynamic AMOLED 2X, 2316 x 904 pixels (HD+)
Front camera:	10MP
Rear camera:	50.0 MP (Wide) + 12.0 MP (AF Ultra-Wide) + 10.0 MP (Telephoto), 10 MP (Cover camera)
Battery capacity:	Minimum 4,400mAh
Charging:	Fast Wireless Charging 2.0
Network & Connectivity:	5G, LTE, Wi-Fi, Bluetooth, Ultra-Wide Band
Memory & Storage:	Minimum 12GB Memory with 512GB internal storage
SIM Card:	Nano SIM and eSIM
OS:	Android 13 or latest

Type 2 (10 numbers)

Chipset:	Qualcomm SM8550-AC Snapdragon 8 Gen 2 (4 nm)
CPU:	4nm 64-bit Octa-Core Processor * 3.36GHz (Maximum Clock Speed) + 2.8GHz + 2.0GHz
GPU:	Adreno 740

Dimensions:	78.1 x 163.4 x 8.9mm
Weight:	233g
Display:	6.8", Dynamic AMOLED 2X, 3088 x 1440 (Quad HD+), 120Hz refresh rate
Front camera:	12MP
Rear camera:	200.0 MP (Wide) + 12.0 MP (AF Ultra-Wide) + 10.0 MP (Telephoto), 10 MP (Front camera)
Battery capacity:	Minimum 5,000mAh
Charging:	Fast Wireless Charging 2.0
Network & Connectivity:	5G, LTE, Wi-Fi, Bluetooth, Ultra-Wide Band
Memory & Storage:	Minimum 12GB Memory with 512GB internal storage
SIM Card:	Nano SIM and eSIM
OS:	Android 13 or latest

T. Laptops

Eight (8) Project Laptops for each of new substations shall be provided by the Contractor for use by the Employer. The laptops shall remain property of the employer upon completion of the project. The laptops shall meet the following minimum specifications:

- Windows 11 Pro for Workstations
- Intel Core i7-620 @ 2.67GHz, 1066MHz FSB; 3MB L3 Cache
- 16 GB (2x8 GB) DDR4 3200 SODIMM ECC
- 1 TB PCIe-3x4 2280 NVME Self Encrypted (SED) OPAL2 TLC SSD
- 15.6" diagonal, FHD (1920 x 1080), UWVA IPS, anti-glare, 250 nits, 45% NTSC, for HD Webcam
- NVIDIA® T1200 Graphics (4 GB GDDR6)
- 1TB (7200RPM) Seagate Momentus 7200.4 ST9320423AS
- Intel® AX201 Wi-Fi 6 (2x2) and Bluetooth® 5 Combo, vPro
- DVD R/W dual-layer LightScribe Optical Drive
- 2.0-megapixel webcam
- VGA and Display Port outputs
- USB 3.0 x 4; eSATA x 1
- RJ-45 (Ethernet 10/100/1000)
- SD / MMC / SDHC Multimedia Card Reader
- Removable 55WHr 6-Cell or 9-cell 100WHr Li-ion Battery
- 13.21" x 9.30" x 1.23" (Dimensions)
- Windows 7 Professional (64-bit)
- Genuine leather Laptop carry bag.
- Key Board-Full size, Dual Point Backlit spill-resistant keyboard with drains
- Audio by Bang & Olufsen, dual stereo speakers, dual array digital microphones, functions keys for volume up and down, combo microphone/headphone jack, HD audio
- 150 Watt Smart PFC Slim AC Adapter
- C13 1.0m Premium Power Cord
- 8 Cell 94 WHr Long Life Battery
- Three-year warranty
- External I/O Ports:
Left side: 1 RJ-45; 1 headphone/microphone combo; 1 SuperSpeed USB Type-A 5Gbps signaling rate (charging); 1 SuperSpeed USB Type-A 5Gbps signaling rate; 1 nano security lock slot
Right side: 1 power connector; 1 Mini DisplayPort™ 1.4; 1 HDMI 2.0b; 2 Thunderbolt™ 4 with USB4™ Type-C® 40Gbps signaling rate (USB Power Delivery, DisplayPort™ 1.4, Sleep and Charge)
- Expansion slots 1 smart card reader; 1 SD 7.0 media card reader
- Security management

Absolute persistence module; Device Access Manager; Power On Authentication; Integrated smart card reader; Master Boot Record security; Pre-boot authentication; Windows Defender; Secure Erase; Manageability Integration Kit; Sure Sense & Click; Secure Platform; Sure Recover; BIOSphere; Sure Start; Sure Run; Tamper Lock; Nano Security Lock Slot; Client Security Suite; Trusted Platform Module TPM 2.0; Windows Secured Core

- Integrated Security- Security Lock Slot plus steel cable (5.5mm thick) with a combination lock
- Applicable software (MS Office, PDF, AutoCAD, Relays software)

Two (2) Rugged Laptop to be provided by the Contractor used for the substation control and protection systems (CRP/SAS) configuration and setting which shall have the appropriate software and licenses installed to facilitate the communication and interfacing with the IEDs, Ethernet switches as well as relevant substation automation systems equipment. The Contractor shall provide communication/interface cable for all types of relays/IEDs installed in the substation.

The Rugged Laptop specifications:

- Display 14.0" FHD (1920 x 1080), 1000 nits DynaVue® sunlight readable display with capacitive multi-touch screen, User selectable touch mode for Finger/Water, Glove, or Stylus programmable function
- Operating System Windows® 10 Pro 64-bit
- Processors Intel® Core™ i7-1185G7 vPro™ (11th Gen) 3.0GHz processor with Turbo Boost Technology up to 4.8GHz, 12MB cache
- Memory 2 slots 8GB up to 64GB (3200MHz DDR4)
- Storage Main: 256GB/512GB/1TB NVME PCIE SSD, Optional 256GB/512GB/1TB SATA SSD
- Graphics Intel® Iris® Xe Graphics, Optional NVIDIA® GEFORCE GTX 10501
- Camera Integrated 2.0 MP web-cam with shutter design, Optional IR camera for Windows Hello1
- Audio Integrated microphone, Intel® High Definition Audio Compliant, Integrated speaker x 2, Keyboard volume and mute controls
- Media Bay (One Option Only) Optional DVD super Multi, Optional 2nd battery, Optional SATA SSD
- Expansion Box Optional PCI-Express 3.0 (2 slots)1,6, Optional discrete VGA1,6, Optional storage extension with RAID 0/1/5/101,6, Optional military-grade connectors1
- I/O Ports:
 - Thunderbolt 4 (type C) x 1
 - USB 3.2 Gen2 (type C) x 1 (support DP)
 - USB 3.2 Gen2 (type A) x 1
 - USB 3.2 Gen1 (type A) x 1
 - USB 2.0 (type A) x 1
 - Audio in/out (combo jack) x 1
 - microSD card (microSDXC) x 1
 - 10/100/1000 Ethernet (RJ45) x 2
 - VGA port (D-sub,15-pin) x 1
 - HDMI port (type A) x 1
 - Serial port (RS232 : D-sub,9-pin) x 25
 - Docking connector (41-pin Pogo) x 1
 - SIM card x 1
 - Smart card reader x 1
 - DC-In jack x 1
 - ExpressCard 54 x 1 (default) or PCMCIA Type II x 1
 - Optional RF antenna pass-through for GPS, WWAN, and WLAN
- Keyboard & Pointing Device, 2 user-definable keys (P1/P2), RF signal slide-switch, Standard membrane keyboard with LED backlight
- Communications Integrated 10/100/1000 Ethernet, Intel® Wi-Fi 6 AX201 (802.11 ax), Bluetooth® V5.2 ,Optional dedicated GPS module (UBLOX-NEO-M8N), Optional 4G LTE multi-carrier mobile broadband, Optional RF antenna pass-through for GPS, WWAN, and WLAN
- Security
 - Intel® vPro™ Technology (per CPU options)
 - TPM 2.0

- NIST BIOS compliant
- Easy removable SSD
- Smart card reader
- Stealth mode
- Night vision mode
- Kensington lock
- Optional Windows Hello1
- Optional fingerprint scanner
- Optional HF/LF RFID reader1
- Power
 - AC adapter : 100-240V, 50Hz-60Hz, 90W
 - Optional AC adapter (100-240V, 50Hz-60Hz, 120W), with NVIDIA® VGA
 - Main battery Li-Ion, 10.8V, 7800mAh, 16 hours2
 - Optional 2nd battery Li-Ion 10.8V, 4700mAh, 9 hours2
 - Optional bridge battery : 5 minutes swap time3
- Warranty
 - 3-year warranty standard

U. Control System Printers

One (1) SOE Printer, One (1) Station Log Printer and One (1) General Purpose Printer for each new substation shall be provided by the Contractor for use by the Employer.

V. Software

The contractor shall provide software, server based licenses (where available) and subscriptions for the Employer. The contractor shall provide six user licenses for a period of six years. This software shall be as indicated in the Scope of supply document. The following, in addition to other software used by the contractor in the project design, shall be provided in the latest version:

- AutoCAD for windows
- STAAD Pro
- DIgSILENT
- DIALux
- BIM software

21. Drawings, Models and Samples

A list of the drawings attached to bid documents is given in the Part 2-D.

A list of the drawings that are to be submitted by the contractor with his Bid and a list of drawings to be submitted after the Effective Date are given in the relevant Technical Specification. The Contractor shall provide free of

charge any additional drawings and/or copies of any reviewed drawings required by the Employer's Representative.

The Contractor shall submit samples of materials as required from time to time by the Employer or Employer's Representative.

The Contractor shall submit all drawings or samples of materials for review in sufficient time to permit modifications to be made and the drawings or samples resubmitted without delaying the initial deliveries or the completion of the Contract Works.

If the Contractor shall require review of any drawing within 4 weeks of its submission in order to avoid delay in the completion of the Contract Works, he shall advise the Employer's Representative to such effect when submitting the drawing.

The number of copies of each drawing or of any subsequent revision to be submitted to the Employer's Representative is given elsewhere in the Tender Documents. Following review, further copies of the reviewed drawing shall be supplied to the Employer's Representative for distribution to KETRACO and to Site.

Drawings for review shall be submitted electronically in a commonly used format and as paper prints and shall bear the authorised Contract reference.

All drawings shall be drawn to one of the preferred scales quoted in Section 7 of BS Publication PD6031 or available on a standard ruler and on paper of the appropriate size from the International Series of A sizes.

All detail drawings submitted for review shall be to scale and of a size not less than 1/25 full size. All-important dimensions shall be given and the material of which each part is to be constructed shall be indicated.

Except as otherwise specifically approved, all drawings shall be of size not be greater than A0 (normally 841 mm x 1189 mm) or smaller than A4 (normally 210 mm x 297 mm).

All dimensions marked on the drawings shall be considered correct although measurement by scale may differ there from. Detailed drawings shall be acted on where they differ from general arrangement drawings.

The Employer's Representative reserves the right to request any further additional information that may be considered necessary in order fully to review the Contractor's drawings.

Any drawing modified from a previously submitted drawing shall bear a new version number. Revised drawings reissued for review shall have at least one copy clearly marked indicating the amendments to the drawing. Revision boxes must be provided giving the date, revision letter and brief description of each drawing.

Any drawing or document submitted for information only shall be indicated as such by the Contractor. Drawings submitted for information only will not be returned to the Contractor unless the Employer's Representative considers that such drawings do need to be reviewed, in which case they will be returned suitably stamped with comments.

All drawings submitted by the Contractor shall include the following particulars in the lower right hand corner: Contractor's name, date, scale, number and title of the drawing, contract number, substation title and equipment description.

The Contractor when submitting drawings, shall provide an indexing system for all the drawings categorized for each type of equipment.

The drawing format and the indexing system will be agreed at the first Contract meeting between the Contractor and the Employer's Representative.

All prints shall be folded to A4 size and the title, drawing number and revision suffix shall remain visible.

Drawings, samples and models already submitted by the Contractor and reviewed by the Employer's Representative (and such drawings, samples and models as shall be thereafter submitted by the Contractor and reviewed by the Employer's Representative) shall not be departed from without the instruction in writing of the Employer's Representative.

All drawings, samples and models shall be submitted in accordance with the provisions in the Schedules and shall become the property of KETRACO.

22. Submittals during contract period

22.1. Program of submittals

The contractor will be required to submit and use the document management system that will provided to them in order to manage all submissions for the project.

All submissions shall be provided in both un-editable and editable versions (e.g. pdf and Word, Autocad, Excel, etc.). Drawings provided for brownfield sites must also show the existing/old infrastructure in addition to the new.

The Contractor shall arrange his design and drawing programme so that the works can be properly co-ordinated by the Employer's Representative. He shall provide the documentation as specified below within 4 weeks of the award of Contract, together with any drawings and information considered necessary by the Contractor or Employer's Representative.

A detailed schedule of all plant to be supplied under the Contract. This schedule shall have space for the following information as a minimum requirement in respect of each item:

- a. Manufacturer
- b. Country of origin
- c. Planned CIP delivery date
- d. Planned date of arrival on site

- e. Sub-order number (as applicable)
- f. Allocated drawing numbers

A preliminary schedule of drawings to be submitted to the Employer's Representative for approval in respect of all items of equipment to be supplied under the Contract. The schedule shall include a programme for submittal of all drawings required by the Specification. The schedule shall have space for at least the following information to be added at a later date:

- a. Drawing number
- b. Drawing title
- c. Proposed date of submission
- d. Actual date of submission
- e. Resubmissions
- f. Revision numbers
- g. Date of approval
- h. Release as a working drawing
- i. Date to site
- j. Date to Engineer
- k. Date of as-built drawing

22.2. Drawing numbers

The Contractor will apply drawing numbers to all drawings, including those from sub-contractors and those issued for information before they are submitted to the Employer's Representative. The Contractor's drawing office will be expected to issue the numbers in batches that will cover broad subject areas. The Contractor shall submit to the Employer's Representative for approval the subject areas he proposes to use prior to the issue of any drawing. The Contractor shall each month issue an up-to-date drawing list to the Employer's Representative.

23.Final Records

After completion of work on Site all Contract drawings shall be revised where necessary to show the equipment as installed and the number of copies of revised drawings as specified in Volume 2 shall be submitted for review. A complete set of reviewed records shall be provided comprising, one full size reproducible copy and one full size print. Record drawings shall be endorsed "As-Built" and shall be correctly titled and carry the Engineer's review number, Contractor's drawing number and where appropriate KETRACO's number allocated to the item. As-Built documents include approved documents of all equipment, material, design drawings, modification and calculations.

After final review of the "As-Built" record drawings the Contractor shall submit complete sets of records on 3 hard copies, 3 soft copies on 3 discs and 3 flash drives, one of which is for KETRACO as detailed in Volume 2. Electronic copies of the drawings shall be in electronic format suitable for reproduction on paper using KETRACO's preferred software packages. Each disc shall provide a comprehensive drawing list containing the drawing number, sheet, revision and title of every drawing. The raw files/editable files for all drawings shall be provided. Each single file drawing record shall be self-supporting without referencing other files. Non-standard items such as fonts, line types, etc. should not be used. If compression techniques are applied to files then any software necessary to decompress the files shall be included on the discs. The Contractor shall ensure that all information contained on the discs has been checked for virus contamination. Each compact disc shall be supplied suitably encased and accompanied with printed documentation describing the contents of the compact discs, the formats and software used to compile the discs and the print hardware required to reproduce the record drawings.

Final record copies shall be handed over before the issue of the Operational Acceptance Certificate.

24. Installation and Maintenance Instructions

The Contract Price shall be deemed to include illustrated installation and maintenance instructions written in English. The Installation and Maintenance Instructions shall be sufficiently detailed to enable a skilled maintenance person to undertake the maintenance, fault finding, repair or replacement activities that may become necessary during the life of the equipment.

The instructions are to be as simple and clear as possible, fully illustrated with drawings and diagrams as necessary and detailed with part numbers for ordering of replacements.

As stated in Volume 2 further copies are to be reproduced as a book or books of approximately A4 size and bound into strong black durable imitation leather covers inscribed upon the front generally in the form of the title page to this document except that the references to Specification, Conditions of Contract, drawings, etc., will be replaced by "Installation and Maintenance Instructions".

The name of the main Contractor, but not that of any subcontractor, may also be inscribed upon the cover after the description of the plant. The name of KETRACO shall be inscribed upon the spine.

The finished books are to be handed to the KETRACO not later than 1 month before the Taking-Over Certificate is issued.

25. Responsibility of Contractor

Until each Section of the Works has been taken over or deemed to have been taken over under the Conditions of Contract, the Contractor shall be entirely responsible (save as is provided in the Conditions of Contract) for such section of the Works, whether under construction, during tests or in use for KETRACO's service.

During the period of maintenance, the Contractor shall make such arrangements as to ensure the attendance on the Site, within a reasonable time of his being called upon to do so, of a competent representative for the purpose of carrying out any work of maintenance for which the Contractor shall be liable and during such part or parts of the said period as the Employer's Representative shall deem it necessary, the said representative shall be continuously available on the Site.

Any work that may be necessary for the Contractor to carry out in pursuance of his obligations under the Conditions of Contract shall be carried out so as to interfere as little as practicable with the normal operation of the substations. Work on the Site shall be carried out at such time and during such hours as the Employer's Representative may require.

The Contract is to include the whole of the Works that are described in or implied in the Contract Document. All matters omitted from the Specification which may be inferred to be obviously necessary for the efficiency, stability and completion of the Works, shall be deemed to be included in the Contract Price.

Works shown upon the drawings, and not mentioned or described in the Technical Specification and Works described in the Technical Specification and not shown on the drawings will nevertheless be held to be included in the Contract and their execution is to be covered by Contract Price in the same manner as if they had been expressly shown upon the drawings or described in the Technical Specification.

26. Additional Services of Contractor's Staff

If the Employer's Representative shall so require, the Contractor shall provide the services of skilled workmen for the repair of any defect with the Works or for any adjustments necessary which may occur in the period between KETRACO commencing to use any Section of the Works (whether taken over or not) and the expiry of the period of maintenance.

27. Contractor's Employees

The Contractor shall fulfil all his obligations in respect of accommodation, feeding and medical facilities for all personnel in his employment, in accordance with the responsibilities imposed on him by the Specification or as necessary to ensure satisfactory execution of the Contract. He is also to comply with the requirements of all local Statutory Employment Regulations.

The Contractor shall be responsible for the behaviour on site of all personnel employed by him.

28. Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give, barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift, barter or disposal by the Contractor's Personnel.

29. Packing and Shipment

All materials shall be carefully packed for transport by sea (with seaworthy packing), rail and road and in such a manner that the packing provides adequate protection against all climatic conditions experienced in transit and storage on site during the construction period.

The whole of the materials shall be packed where necessary in non-returnable cases or on non-returnable drums or otherwise prepared for overseas shipment in a manner suitable to withstand rough handling without sustaining damage.

Bundles of steel angle sections shall be properly tied together by an approved method and care taken to ensure that they are robust and not of excessive length for handling during shipment.

The Contractor's attention is drawn to the provision of the Specification wherein the Contractor is required to suitably protect all steelwork before shipment to prevent damage to galvanized surfaces by white rust.

Packing cases where used shall be strongly constructed and the contents shall be securely bolted or fastened in position with struts or cross battens. Cross battens supporting weight in any direction are not to rely for their support on nails or screws driven length wise into the grain of the wood, but are to be supported by cleats secured from the inside.

Bolts and nuts shall be crated for shipment.

Crating together of components of dissimilar metals is not acceptable.

Particular attention shall be given to strutting before packing cases are fastened down. Cases shall be upended after packing to prove that there is no movement of the contents.

Timber wedges or chocks shall be firmly fastened in place to prevent their displacement when the timber shrinks.

Where bolts are used, large washers shall be fitted under the head and nut to distribute the pressure and the timber shall be strengthened by means of a pad.

All stencil marks on the outside of the casings shall be either of a waterproof material or protected by shellac or varnish to prevent obliteration in transit.

Wood wool shall be avoided as far as possible.

Waterproof paper and felt linings are to overlap at seams by at least 12 mm and seams shall be secured together in an approved manner but the enclosure is to be provided with screened openings to provide ventilation.

Each crate or package shall contain a packing list in a waterproof envelope. All cases, packages, etc should be clearly marked on the outside to indicate the total weight, show where the weight is bearing, the correct position of the slings and to bear an identification mark relating to the appropriate shipping documents.

The Employer's Representative may require to inspect and review the packing before items are despatched but the Contractor is to be entirely responsible for ensuring that the packing is suitable for transit and such inspection will not exonerate the Contractor from any loss or damage due to faulty packing.

Equipment shall be moved or handled in its crating or protective covering until it is ready for mounting in its permanent location. During unpacking and installation, unnecessary impact to the equipment shall be avoided.

30.Accommodation and Site Storage, Design Meeting, Students'

Internship and Graduates' Employment (at each substation)

30.1. Site Office and Living Accommodation

Living accommodation: The Contractor shall make his own arrangements with regard to accommodation for his expatriate and locally recruited staff during the construction period. Living or dwelling camps within the substation land is not accepted. All dwellings and buildings existing or erected for the purpose by the Contractors shall comply with local regulations with regard to construction, water supply, sanitation and other requirements. Temporary construction camps shall be provided with proper sanitation and other necessary facilities. All accommodation shall serve as permanent residences and form future communities, if such use can be foreseen or be removed by the Contractor when no longer required and before the granting of the final certificate. After the removal of accommodation, the ground shall be left in a clean and tidy condition.

Medical facilities: These will not be provided by KETRACO and the Contractor shall be required to make his own arrangements where these services may be required for his expatriate or locally engaged staff.

Staff transport: The Contractor shall provide, at his own expense all necessary transport for his own men and materials.

General: Without prejudice to the generality of the several clauses of the Contract and except for the facilities referred to in this Clause, particular attention is drawn to the obligation of the Contractor to make his own arrangements at his own expense for supply and furnishing of offices, workshops, stores and store compounds and the watching and guarding of such.

Office accommodation: The Contractor shall provide office accommodation of permanent construction which can be used by KETRACO after project commissioning.

The Contractor shall also provide at his own cost, two furnished rooms in his site office to accommodate 8 representatives of the Engineer and KETRACO. The site office shall be kept clean and habitable at all times. The Contractor shall be responsible for timely payment of any monthly utility bills and expenditure for the site office that may occur for the entire project duration.

Each site office provided by the Contractor shall be fully furnished using a good standard of office furniture to be approved by the Employer/ Employer's Representative and fully equipped with:

- Eight desks and chairs
- Eight filing cabinets
- Eight desktop computers (equipped with the same software mentioned in clause No. 21)
- Two common photocopiers (A3 and A4, specifications as below table)
- Two common printer, scanner and fax machines (A3 and A4, specifications as below table)

The desktop computers shall meet the following minimum specifications:

- Intel Core i7-620 @ 2.67GHz, 1066MHz FSB; 3MB L3 Cache
- 8GB of DDR3 RAM (1333MHz; 2x4GB)
- 23" LED Monitor
- NVIDIA Quadro FX 380M (512MB) graphics
- 1TB (7200RPM) HDD
- 802.11a/b/g/n Wi-Fi
- DVD R/W dual-layer LightScribe Optical Drive
- VGA and Display Port outputs
- USB 3.0 x 4; eSATA x 1
- RJ-45 (Ethernet 10/100/1000)
- Windows 10 Professional (64-bit)
- Key Board-Full size
- Mouse
- Speaker
- Warranty-1year
- Applicable software (MS Office, PDF, AutoCAD, SCADA/DCS software)

Table: Printer, Scanner and Copier Minimum Specifications:

S no.	Parameter	Specifications
1.	General Type	Colour multifunctional for A3 format
2.	Technology	Laser Colour, HyPAS Solutions platform
3	Engine speed	Up to 30/15 pages A4/A3 in colour and black/white.
4.	Resolution	600×600 dpi; Multi-bit technology for print quality of 9,600 dpi equivalent ×600dpi.
5.	Warm up time	Approximately 25sec or less.
6.	Time to first copy	Approx. 5.5 sec or less in black/white, approx. 7.3 sec or less in colour
7.	Power Supply	AC 220-240vac, 50Hz
8.	General Memory	3.5GB RAM +160GB HDD

9.	Duplex unit	Yes.
10.	Max output capacity	250 sheet face down, max output capacity 4.300 sheets.
11.	Processor	Dual core 800MHz
12.	Applicable OS	All current windows operating systems, Mac OS X version 10.4 or higher, UNIX, LINUS etc.
13.	Max original size for copy	A3
14.	Continuous copy	1-999
15.	Digital copy feature	Scan once copy many, electronic sort, 2in 1 and 4in 1 function, Image repeat copy, page numbering, cover mode, booklet copy, interrupt copy, form overlay, stamp function etc.
16.	SCAN file type	PDF (High Compressive, encrypted, PDF/A), JPEF, TIFF, XPS
17.	Max scan size	A3
18.	Scan functionalities	Scan to email, scan to FTP, Network-TWAIN, Scan to SMB, scan to Box, scan to USB host, WSD scan.
19.	Scan resolution,	600dpi, 400dpi, 300dpi, 200×100dpi, 200×400dpi (256 greyscales)
20.	Scan Speed	Colour:100 images/minute, black/white:100 images/minute (A4, 300dpi with DP772)
21.	Scanner Type	Flatbed/Sheetfed
22.	Zoom Range	25-400 %

- The printer, photocopier and scanner shall remain the property of KETRACO upon completion of the project.
- Two telephones with international dialling capability
- Shelving units
- Toilet and sanitary facilities
- Air conditioning
- Lighting
- Sufficient number of fire extinguishers of suitable size and type
- Clean and safe drinking water.
- High Speed Wi-Fi (Minimum 15mbps) for internet access.
- Tea/coffee/beverages and refreshments

The contractor shall maintain the printers/scanner/photocopier in good working condition including the supply of printer tonners, Cartridges and 10 cartons of A4 size printing papers as well as five (5) rims of A3 papers per month for entire project duration. The printing/photocopying papers shall be handed over to KETRACO project team on a monthly basis.

The desktop computers are to be provided with internet connection with service provided throughout the duration of the contract by a secure broadband internet service provider, for which the Contractor shall be responsible for all associated charges and costs. An UPS system shall be provided to support the computer system for a minimum of 30 minutes in the event of a power failure. The computers and printer shall be networked on a LAN with facilities to access the Internet (broadband) on a continuous basis. The Contractor shall be responsible for all associated charges and costs.

The Desktop computer / Work station operating system shall be latest version of MS Windows. It should be suitable for continuous process application and should have been tested for the same. The hardware configuration should be of the latest available in the market, industrial type, and subject to approval of KETRACO. Monitoring and control system shall have an option for printing all trend plots, reports, displays etc. A color printer shall be provided in the substation. For storing historical database, sufficient storage facility shall be provided. The complete software package on CDs / DVDs shall be supplied as a backup. Windows operating system with licenses, Monitoring software, drivers for modems and printers and software for remote access shall be included. It should be possible to upgrade / update the system software throughout the lifetime of the system with ongoing development in the technology.

The Contractor shall provide safe bottled drinking water, Tea/coffee/beverages and refreshments for the duration of the Contract.

Adjacent to the Employer's Representative's offices, the Contractor shall supply graded parking areas including open sided sun shaded parking places adequate for ten (10) vehicles. Each parking bay shall be 3m x 6m and surfaced either by concrete or asphalt. Adequate lighting must also be provided in the parking bays.

The office accommodation is to be provided with an electricity supply, water supply and phone line. All phone rental and usage charges relevant to the transmission project shall be paid for by the Contractor.

Fully Furnished Kitchenettes: The Contractor shall provide a fully furnished Kitchenette with Electric cooker with three rings and oven, one two-burner LP gas cooker with cylinder and valves, deep freeze and refrigerator of minimum size 200 litres and 350 litres respectively, kitchen sink unit with storage work top units and water filter and an adequate number of kitchen utensils.

Storage facilities: The Contractor shall make his own arrangements for storage areas and campsites. The Contractor shall in all cases obtain the approval of the Employer's Representative for the places along the route of the lines where he intends to store materials. In no case will this be outside the authorised area unless special arrangements are made with the Employers of adjacent property, at the Contractor's own expense. The Contractor is to provide any necessary protection and watchmen to safeguard materials in the areas allocated to him. The handling and storage of any equipment at the site is to be at the risk of the Contractor and without responsibility to KETRACO. The Contractor is to arrange for the protection to the satisfaction of the Employer's Representative, of these materials against vermin attack, corrosion and mechanical damage during storage and erection at site.

The site storage areas shall be prepared with adequate hard-standing for the orderly storage of equipment, conductor/cable drums, steel, aluminium conductor, insulators, earthing and fittings so that the material will not be damaged by the effects of adverse weather during storage, appropriate housing to be foreseen. Items packed in flammable crates or drums shall be stored in such a manner as to limit the extent of any damage arising from fire.

Compressed air: The Contractor is to make his own arrangements for a supply of compressed air if required for the execution of the contract work.

Lifting facilities: The Contractor is to make his own arrangements with regard to lifting facilities required for transport or on site.

The land on which accommodation and office facilities are to be located shall be supplied/leased by the Contractor as part of the facilities.

Supply of Foodstuffs: The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the KETRACO's Personnel for the purposes of or in connection with the Contract.

30.2. Living Accommodation for use by KETRACO During Operation

The Contractor shall provide and erect for KETRACO staff, permanent housings (required units mentioned in clause 1 of this document and as per bid drawings in Part 2-D) at Kimuka Substation, inside the Substations' land, including roads, fencing, water supply system and sewage system, electrical services, lighting, HVAC, etc. The accommodation shall be available before putting the Substation into service.

The types of accommodation shall be as follows, and subject to compliance with Kenya buildings Code and KEBS regulations and Employer/Consultant's approval.

a) Technical Staff Housing

A detached housing containing living room with a dining area, bedrooms, bathroom with shower and bath, toilet, kitchen, storage accommodation, veranda and car port as per bid drawing.

b) Security Staff Housing

A detached housing containing living room with a dining area, bedrooms, bathroom(s) with shower and bath, toilet, kitchen, storage accommodation, veranda and car port as per bid drawing.

The roof shall be designed to limit the effects of the sun including provision of generous eaves. All materials shall be of a good durable standard, and all wood shall be preserved by an approved method against fungal and termite attack. The accommodation shall be provided with all necessary plumbing and sewage disposal to approved standards. Provision shall be made for freshwater storage of 5,000 litres. The Staff Housing shall be provided with complete electrical services connected to the mains supply with each unit having its own independent meter as well as another separate meter for the common areas. There shall also be a back up generator suitable for the maximum installed electrical load of the premises but not less than 200 kVA rated. The generator is required to supply all the loads for a full day without refuelling. The required auto changeover facilities between main supply and the back up generator shall be implemented as well. Air conditioners shall be provided for each bedroom, living room and dining room. Ceiling fans or table fans shall be provided for the living rooms and kitchen. Security lights shall be provided on each outer wall of the Staff Housing. All windows and outside doors shall be provided with mosquito screens and burglar bars shall be fitted to all windows. A suitable perimeter fence shall be provided.

The housing area shall be surrounded by a suitable fencing/boundary wall.

The following are the specifications for interiors of the Technical Staff Housing:

All rooms shall be decorated and equipped with hard and soft furnishings including the following minimum provisions.

- **Living/dining room**

Dining room with complete split unit, table and six chairs, sideboard with storage facilities, cutlery, china, book-case,

Living room with complete split unit , 7 seater seats, 1 coffee table, two side tables, desk and general floor covering.

- **Bedrooms**

Two full size double beds with complete split unit, mattresses, pillows, dressing table, wardrobe, chest of drawers, bedside table, easy chair and stool.

- **Kitchen**

Electric cooker with three rings and oven, one two-burner LP gas cooker with cylinder and valves, deep freeze and refrigerator of minimum size 200 litres and 350 litres respectively, kitchen sink unit with storage work top units and water filter and an adequate number of kitchen utensils.

- **Bathroom**

Shower including hot and cold mixer unit, bath, toilet, hand basin and solar water heater with backup electric heating element (which could also supply the kitchen).

- **TV and Cable TV network**

Provision for supply and installation of a 42 inch full HD TV and Dish Antenna for TV shall be provided for each Technical Staff Housing. Necessary cabling inside the Staff Housing from the proposed location of Dish Antenna shall be done. The cable shall be suitable for TV signals and Data Network as well. Junction Boxes, Pull Boxes, Splitter Boxes for TV and Data, TV Adopter, etc. shall be installed to make the network suitable for TV and Data connection. The network shall be available in living room, study room and bedrooms.

- **High Speed Wi-Fi (Minimum 15mbps) for internet access in the Technical Staff housings.**

- **Fire Protection Provisions for Materials and for Building Elements**

Sufficient number of fire extinguishers of suitable size and type.

All equipment, connections and cabling shall be designed and arranged to minimize the risk of fire and any damage, which might be caused in the event of fire. Where equipment is normally energized, corresponding precautions, such as fusing, overvoltage or overcurrent protection, shall be provided to avoid risk of fire in the event of excessive current due to a fault on one of the components in the circuit. This is particularly important where voltages are derived from voltage dropping circuits in which failure of a component could lead to the full supply voltage being applied across other components.

Unless otherwise specified or agreed with the Employer / Employer's Representative, the following design principles shall be observed as minimum fire prevention requirements:

The stuffing of cable and wall penetrations shall be of incombustible material. Cable and pipeline ducts shall be arranged so as to avoid the risk that they will be flooded with flammable liquid.

Covered floor ducts shall be easily accessible for inspection and cleaning. All parts of plant and equipment shall be arranged so that no corners or pits difficult to inspect and clean are formed, where flammable matter could collect. For the paneling of walls and ceilings, for floor covering as well as for cubicles and cabinets, incombustible materials are to be used. Fire escape paths shall not be longer than 30 m and not less than 1.0 m wide.

The following are the specifications for the interiors of the Security Staff Housing:

The bedsitter shall be decorated and equipped with hard and soft furnishings including the following minimum provisions.

- **Living area**

Living space complete with a table and a split 3-seater sofa sideboard with a coffee table and general floor covering.

- **Sleeping area**

A full-size single bed with a mattress, pillow, wardrobe, bedside table and easy chair.

- **Kitchen area**

Electric cooker with three rings and oven, one two-burner LP gas cooker with cylinder and valves, deep freeze and refrigerator of minimum size 200 litres and 350 litres respectively, kitchen sink unit with storage work top units and water filter and an adequate number of kitchen utensils.

- **Bathroom**

Shower including hot and cold mixer unit, bath, toilet, hand basin and solar water heater with backup electric heating element (which could also supply the kitchen).

- **Armoury**

Each unit of security staff housing shall have a permanently fixed and lockable armoury as per the requirements of the Critical Infrastructure Protection Unit.

- **TV and Cable TV network**

Provision for supply and installation of a 42 inch full HD TV and Dish Antenna for TV shall be provided for each Security Staff Housing. Necessary cabling inside the Staff Housing from the proposed location of Dish Antenna shall be done. The cable shall be suitable for TV signals and Data Network as well. Junction Boxes, Pull Boxes, Splitter Boxes for TV and Data, TV Adopter, etc. shall be installed to make the network suitable for TV and Data connection. The network shall be available in living room, study room and bedrooms.

- **High Speed Wi-Fi (Minimum 15mbps) for internet access in the Security Staff housings.**
- **Sufficient number of fire extinguishers of suitable size and type**
- **Intercom between Guard House and Individual Technical and Security Staff Housings**

A private EPABX system for communication between guard house to individual Staff Housings and amongst all Staff Housings shall be provided. The system shall be complete with necessary exchange, telephone equipment, junction boxes, cabling, power supply with battery back-up, etc. and its installation and commissioning. The exchange with power supply shall be installed in a safe and secure place and necessary cabling up to the individual consumer shall be done in a manner subject to approval of the Employer. The type of cables used shall be such that any faults/damages due to movement of vehicles, landscaping and its upkeep, etc. are avoided. Cable route markers to be installed. Manholes shall be provided at suitable locations in case cables are laid in conduits to facilitate cable pulling and maintenance. The make of the EPABX system shall be a reputed one with adequate installed base and is subject to approval by the Employer. In addition, an established aftersales service network is another main requirement. Any statutory approvals necessary for installation and operation of such a system shall be obtained by the contractor.

30.3. Design Review Meeting

The contractor shall arrange for a design review meeting at the contractor's home country's design office to be attended by a minimum of 4 KETRACO Engineers and two Employer's representatives (at least 10 days).

The substation design review shall be done at an early stage of the project to facilitate the understanding and Employer's requirements of the substation designs before any designs are submitted by the contractor for approval.

The detailed agenda items for the design review meeting shall be discussed and finalized at Contract negotiation and kick off meeting.

The Contractor shall provide for each KETRACO staff the following:

- One economy class return air ticket
- Visa expenses, airport taxes and other incidental travel expenses as required.
- Full board 4-star hotel accommodation including laundry services and with international phone dial capability.
- Local transportation to the contractor's home office.
- Daily stipend allowance of US\$ 200 per day to cater for incidental expenses for the entire duration of the design review period.

The Contractor shall provide for each Employers representative staff the following:

- One economy class return air ticket
- Visa expenses, airport taxes and other incidental travel expenses as required.

- Full board 4-star hotel accommodation including laundry services and with international phone dial capability.
- Local transportation to the contractor's home office.

30.4. Students' Internship and Graduates' Employment

The Contractor shall accommodate a batch of ten (10) students on internship/apprenticeship for the entire duration of the Contract. The internship shall be for diploma and degree level of education and shall cover students in the following disciplines.

- Electrical engineering
- Civil and Structural engineering
- Telecommunication engineering

A monthly stipend allowance of Ksh 25,000 shall be provided to each intern. While undergoing internship, the contractor should ensure the interns obtain maximum practical training on the various fields within the scope of works.

The contractor shall employ graduate engineers (1 civil and 1 electrical) for the duration of the contract. The graduate shall have had not more than 2 years' experience. The minimum monthly remuneration shall be Kshs 100,000 after all deductions. The graduate shall be supervised by a registered engineer. A training and experience report must be provided signed by the supervising engineer at the end of the project.

The details of the interns/graduates will be provided by KETRACO.

30.5. Transport for Employer & Employer's Representative

The Contractor shall provide, for the use of the Employer/Employer's Representative, on a 24-hour basis, the vehicles specified later on. The Contractor shall provide the services of one driver mechanic per vehicle whose remuneration shall be not less than net Ksh 60,000 after all deductions. Drivers allowances shall be paid by Contractor when are out of office at not less Ksh 6,300 per night. The Contractor shall maintain each vehicle in efficient working condition, repair, replace defective parts and tyres and provide fuel and oil and other consumables. The Contractor shall provide all documentation in accordance with Kenya Law, including full comprehensive insurance cover at all times for all vehicles and all drivers for unlimited Third-Party claims, at the rates stated in contract forms.

A fuel card from a reputable oil company shall be provided for each vehicle loaded with a minimum of Ksh 100,000 per month.

The vehicles provided under the contract are to be available for use by the Employer/Engineer's site supervisors (including reasonable personal use) within the general area of the entire project and be available for their use 24 hours per day, seven days per week and shall be provided within two months of Contract Effectiveness. Although the maintenance, condition and roadworthiness of the vehicles are the responsibility of the Contractor, the movements of the vehicles will be entirely under the control of the Employer/Engineer's site supervisors.

The vehicles shall be new as below table, purchased locally and shall be approved by the Employer before purchase. Each vehicle shall comply with all relevant road traffic laws and be right hand drive. The Contractor will be required to make the vehicles available at all times during the Contract Period and until completion of the specified maintenance period and to provide replacement vehicles when the servicing or repair time (including accidents) exceeds a period of 24 hours. The provision of such replacement vehicles will not be subject to additional payment. When a vehicle is out of action for any cause, the Contractor shall make a similar vehicle available for the Engineer's use at the Contractor's expense.

Item	Description	Quantity
1	Type 2: Toyota Double Cabin pick –up, with at least 2.5 liter diesel engine, with air conditioning, full service and maintenance The pickups must have lockable rear bucket roller covers	6
2	Toyota land cruiser 76, or equivalent, 4 Litre Engine MTD-1011-045-18 Heavy Duty Cabin Pick Up, 4000-4200cc Diesel with Super Structure; Toyota Land cruiser HZJ79R-TJMRS 1HZ (Converted to 9-Seater S/W (Japan) Branding of the unit to Ketraco corporate colours.	3

The vehicles, shall be 4-wheel drive with additional low ratio gears for cross-country work and each vehicle shall be fitted with the following standard equipment: alternator, ammeter, oil pressure gauge, water temperature gauge, speedometer (km/h) with trip, ash tray, fire extinguisher (including fixing bracket and screws), exterior sun visors, external wing-mirrors, windscreen wiper unit (passenger side), front and side airbags (for driver and front and rear passengers), rubber pads for clutch and brake pedals, spare wheel carrier on dished deluxe bonnet with provision for lock, bonnet lock, lock for spare wheel on bonnet, lock for fuel filler, locking doors and windows, radio interference suppressors, towing pintle, steering damper, front axle with reinforced casing, radiator chaff guard and cross-country tyres.

Each vehicle shall be supplied with the basic maintenance tools together with spare belts (fan, cam serpentine and power steering), top and bottom radiator hoses, 6 fuses, a high lift jack, felling axe, cutlass, trenching tool, 15 m of 0.75 tonne fibre rope, inspection lamp and 5 m of 2 core cable.

The Contractor will ensure that one spare tyre is available for each vehicle throughout the duration of the contract. All tyres will be of a roadworthy condition and comply fully with Kenyan Law. Each vehicle shall be fitted with driver and passenger air bags.

Vehicles Type 2 and type 3 shall be equipped with a hydraulic winch.

Type 2 shall be provided within two months of Contract Effectiveness.

On completion of the Contract, the vehicles and all equipment shall remain the property of the Employer and the Contractor shall transfer the ownership to the Employer.

Brand new Type 3 vehicles shall be delivered to the Employer after completion but before commissioning of the project.

31. Training

The Contractor shall provide on-site practical training to KETRACO staff during all stages of the installation works and testing and commissioning stages.

There shall be no limitation on the number of KETRACO staff to be trained at site during the entire project duration and shall be covering theoretical and practical aspects of systems and equipment. training manuals, in hard and electronic copy, shall be provided for all participants. these manuals and provided training in practice shall include equipment installation, testing, commissioning, calibration, routine operation and maintenance requirements and also spare parts replacement procedure, principle and philosophy of systems and equipment, the method of detection, troubleshooting and analysis of defects. the training program and schedule at three stages of installation, testing and commissioning and operation & maintenance for equipment and systems shall be subject to approval of KETRACO/Employer's Representative. The language of the training shall be as specified in the 'Special conditions of the Contract'.

The employer's personnel will be present during the installation and testing and commissioning stages of the project and will be fully involved in the activities.

The Contractor shall also provide specific training for KETRACO's personnel. The following trainings shall take place during the design stage at the contractor's home country or a reputable training centre preferably run by manufacturer or power transmission electricity utility.

The specific training for the project shall include but not limited to the following:

1. Equipment Sizing, Design and Calculations (4 Engineers for 3 weeks):

- Earthing System Design and Calculations by CYMGrd/CDEGS Software
- Procedure and main criteria for designing of layout drawings in HV substations
- Minimizing the dimension of high voltage AIS substations by hybrid/compact equipment
- 3D Modelling in high voltage substations by AutoCAD, 3D-Max and PDMS software
- Electrical/mechanical buswork calculation of Stranded and Rigid conductors
- CT and CVT sizing calculations
- Cable sizing by ETAP software
- Surge arrester and lightning protection system calculations
- AC/DC load evaluation, battery and battery charger calculation and design of AC/DC systems
- Indoor/outdoor Lighting calculation by DIALux and related requirements
- Online monitoring of transformer and its bushings
- Power transformer technical specifications and
- Auxiliary and earthing transformers technical specification
- Heat, ventilation and Air-Conditioning system calculations (HVAC)
- Equipment lifetime analysis
- Risk assessment /management in substations
- Preventive maintenance of high voltage equipment

2. Protection and Control for Electrical Power Systems (4 Engineers for 3 weeks)

- Introduction to a large electrical power system and overview on the general requirements and objectives of transmission line protection
- Overview of the power system structure and behaviour
- Different configurations of substations and their components and typical substation automation system structures
- Interfacing the primary system (switchgear) with the substation automation system
- Understanding the most common protection schemes and basic requirements for protection systems and the role of protection and station automation in power systems
- Protection philosophies, principles, typical application arrangements and tripping methodologies for different power devices. Study protection principles and evaluate the appropriate protection concepts
- Principles and calculation rules for instrument transformers and describe the influence of CT saturation.
- Design protection schemes for transmission lines and select important protection functions
- Coordinate different protection and establish selective and graded schemes
- Calculate the settings of several protection functions
- Specify and verify instrument transformers for use with line protection
- Design protection schemes for busbars, circuit breakers and transformers and select important protection functions
- Prepare a protection coordination study Work intensively with advanced protective relay applications. The goal is to familiarize technical personnel with the area of numerical protection devices.
- Role of substation automation in the power system management
- Finalise with the Design of the protection system for the substation under Construction by the Contractor.

3. Power System Analysis (4 Engineers for 2 weeks)

- Overview of the properties of transmission, distribution and industrial power systems
- Explain the power system dynamic and stable behaviour including the transitions between the different power system states
- Components and general behaviour of the power system from generation over transmission and distribution to consumption
- Basic power flow concepts and system analysis based on some system examples
- Power system modelling and analysis the
- Learn computation techniques for fault calculations
- Power system modelling simulation and analysis (load flow, contingency, switching, shortcircuit, protection, etc as necessary for power line planning, design and operation) using DlgSILENT software
- Power system planning and studies (load flow, contingency, switching, shortcircuit, protection, etc as necessary for power line planning, design and operation) by PSS/E software

4. Communication & Substation Control System– Application & Design (4 Engineers for 2 weeks)

- Introduction in IEC61850 standard structure - used protocol elements.
- Need for a communication standard for substation automation and an overview of the communication in power systems and basics of communication and of functions in substation automation systems including protection and the approach of IEC 61850

- Summarize the concepts of data communication, protocols and standards
- Requirements of the signal data flow for utilities and the properties of the signal data flow in a substation from the power process level (switchyard) through the bay and station level up to the network level
- Features of the most common standardized protocol used in communication systems of power utilities and especially in substations
- List and compare the essential features of all these protocols and explain the use of all these protocols
- System Architecture Design for Substation Automation with IEC61850 – Application & System Design
- Principles for SCS and changing parameters such as database objects, signal texts, measurement scaling and others
- Create graphic displays in SCS e.g. single line diagrams, overview pictures, system overview picture
- Configure NCC communication protocols IEC 60870-5-101,104 and configuration of device hardware CPU and interfaces (Ethernet, GPS ...).
- Configuration and interrogation of the energy meters, energy meter software interaction.

5. Civil Engineering (4 Engineers for 3 weeks)

- Substation foundation design,
- Steel structure design and detailing
- Use of relevant software in design
- Using Civil and mechanical software including: ETABS, SAFE, SAP, REVIT MEP, HAP
- Transmission line tower design and detailing for lattice and monopoles inclusive of development of fabrication drawings.
- Transmission line foundation design and detailing,
- Plan and Profile Designs and detailing using PLS CADD
- Use of relevant software in design and detailing (PLS-Tower, PLS-CADD, PLS-Pole). Cost of providing the software during training shall be borne by the Contractor and shall be part of quoted price.

6. PMU, PDC, Wide Area Monitoring System and requirements of IEEE C37.118 and IEC 61850-90-5 (5 Engineers for 3 weeks)

- Relevant standards: IEEE C37.118.1&2, IEEE C37.242&244, IEC 61850-90-5, IEC 60255
- Wide Area Monitoring, Protection and Control system
- PMU device Requirements, Synchrophasor technology and application
- Phasor Data Concentrator (PDC)
- GPS features and time synchronization
- Router features
- Configuration feature
- Ethernet switches
- Data measurement/calculation such as V,I,F, ROCOF, P ,Q , Wh , Varh, power factor, THD ,harmonics up to 11th , ...
- Communication protocol
- Calibration and testing
- Dynamic analyzer software

The following trainings shall take place in the Employer's home country and will be conducted on site.

1. Operations & Maintenance (4 Technicians for 2 weeks)

- a. Safety procedures and safety gear
- b. Switching operation procedures in high voltage systems
- c. Operation and maintenance in transmission substations

The technicians training shall be more of practical involving the trainees.

2. Site Operation and Maintenance Training

The training will be tailored for substation operators and maintenance engineers (at least twenty person) with a task of equipping the staff with operation principles as well as capacity for trouble shooting and repairs of key substation equipment.

This shall be well structured to last for four (4 weeks at site.

The substation operators and maintenance engineers will be trained on the hands on operation of the Substation Control systems as well as operation of all key substation equipment including but not limited to battery chargers, UPS systems, battery banks, AC DC panel (auxiliary services panels) operations, Diesel generator operations.

The Contractor shall submit a detailed site training proposal for review/approval by Employer/ Employer's Representative.

For each of the training above that is not held within the Client's country, the Contractor shall provide for each KETRACO staff the following:

- One economy class return air ticket
- Visa expenses, airport taxes and other incidental travel expenses as required.
- Full board accommodation in a minimum 4-star hotel including laundry services and with international phone dialling capability for the entire training duration Local transportation.
- Daily allowance of US\$ 200/day for incidental expenses for the duration of the training

For each of the training above that is held within the Client's country, the Contractor shall cater for the cost of transport to site, meals and refreshments for the site training (during the class time) for all participants.

32. Temporary Works

Temporary works (including provision of safety facilities for the Contractor's and the Employer's staff/ representatives) are identified as follows but not necessarily limited to:

- Establishing site office
- Required machineries, tools and instruments
- Site power and water supply
- Site temporary fencing
- Project sign boards
- Site internet connection
- First aid facilities
- Working clothes, safety shoes and safety helmet, safety harness, safety glasses, safety gloves, insulating gloves, safety rope, welding mask
- Firefighting extinguishers (CO2, Dry powder, foam)
- Ambulance facilities
- Site Toilets
- Drinking water for workers
- Watch and ward and access control to site during construction
- Storage facilities

The Contractor shall be responsible for proper storage for equipment under his responsibility. Equipment will be stored in secured, fenced area.

Care shall be taken to ensure adequate storage to avoid damage to equipment due to rain, dust or strong sunshine.

The storage shall be in an environment similar to the installed location, i.e., indoor equipment shall be stored indoors (without heating and ventilation), and outdoor equipment shall be stored outdoors. Where required to protect against condensation and humidity, a desiccant shall be provided and its presence, with the need of periodic removal and dry-out, shall be so marked. When electric space heaters are provided for that purpose, these should be wired to the outside of the equipment so that energising immediately upon receipt is possible without disassembly of crates, etc. This also requires that no combustible materials be left in the inside of the equipment.

Items, which may be subjected to open storage for several months on site shall be suitably packed and protected from the weather.

The Contractor shall provide storage and handling instructions including descriptions for periodic inspection and/or storage maintenance to ascertain that no deterioration will occur during storage. One set of these instructions shall be fastened securely to the outside of the shipping unit.

The Contractor shall provide at the Employer's request, the Contractor recommended instructions for long-term storage.

When equipment is specified for export shipment, the Contractor shall include packaging adequate for export shipment, and this packaging shall be such as to obtain approval and acceptance by transportation companies.

All equipment shall be shipped from the factory completely assembled as far as practicable, subject to the limitations of length, height, depth, and weight, etc. described in the Technical Data Sheets for each of the equipment under this specification.

33.Spare Parts

All Recommended spare parts for the equipment shall be listed in the appropriate Recommended Spare Parts Schedules.

The Employer shall have the option of ordering or omitting any of the recommended spares listed in the schedules.

The requirements regarding testing, surface treatment and painting, delivery point, terms of payment, guarantees, etc., in accordance with the Contract and applicable to the supplies shall also apply to the spares.

All spares furnished shall be interchangeable with the corresponding original parts. They shall also be new, of the same material and workmanship, and shall have all the features and provisions of the corresponding original parts.

All spares are to be suitably treated and packed for long term storage under conditions prevailing at the site. Each spare shall be clearly marked or labelled on the outside of its packing with description and purpose, and, when more than one spare is packed in a single case, box or container, an inventory list is to be shown on the outside of same, and a detailed list enclosed inside. All cases, containers, boxes and other packages shall be suitably marked and numbered for the purpose of identification.

The Contractor shall manufacture the mandatory and recommended spare parts and deliver them to site prior to the Time for Completion. Spares shall be handed over to the Employer not later than 28 days prior to the start of the pre-commissioning tests, they shall not be packed in the same packages as equipment to be built into the Plant by the Contractor.

34.Consumable Goods

All consumable goods needed for completing the installation as well as for maintaining and operating the Work for at least five (5) years after Taking Over shall be furnished and shall be included in the Contract Price and shall be handed over to the Employer not later than at the date 28 days prior to the start of the Tests on Completion. Such consumables shall be separately packed and shall include oil, SF6 gas, grease, paint, electrodes (if required), solvents, filters, bulbs, tubes, fuses and any other goods as required for normal maintenance and operation.

A specified list of consumables shall be submitted to the Employer for approval.

35.Tree Growing Initiative

The contractor shall undertake a tree growing exercise at location(s) to be identified in consultation with KETRACO and relevant authorities. The contractor shall plant 50,000 trees. The cost shall be deemed to cover the entire exercise which shall involve the following:

1. Selection of trees species with highest survival rate and can grow with baseline environmental conditions at the selected planting locations.

2. Transportation of the seedlings to the selected planting locations.
3. Preparation of the land including but not limited to clearing the site of invasive species and preparing the hole.
4. Planting the seedlings at the onset of long rains.
5. Protection and care of the planted tree for a period of 12 months.