



Gaza Electricity Distribution Corporation Ltd.

Technical Specifications

ELECTRICAL WORKS

1 GENERAL SPECIFICATIONS

1.1 Completeness of Contract

- 1.1.1 All apparatus, accessories or fittings which may not have been specifically mentioned, but which are usual or necessary in the respective equipment for the completeness of the finished work in an operable status, shall be deemed to be included in the Contract and shall be provided by the Contractor without any extra charge. All equipment shall be complete in all details, whether or not such details are mentioned in the Specifications. This includes fixation details and connection clamps and/or terminals.
- 1.1.3 Any reference in the quantity and price schedules, the delivery period schedule or in the various clauses and schedules of the text of either the Specification or the Bid, to any equipment shall imply that the equipment is complete with all accessories, apparatus and fittings as outlined in sub-clause 1.1.1 above.
- 1.1.4 The Bidder shall be responsible for ensuring that the equipment supplied is fit for the purpose intended. Available information on the characteristics of the system to which the works will be connected and associated will be supplied on request to the Bidder who shall be responsible for obtaining and determining all applicable knowledge relevant to the works.

1.2 Drawings and Documentation

The Contractor shall prepare and submit to the Engineer/GEDCo/UNDP for approval dimensioned general and detailed design drawings and other pertinent information of all the Equipment specified in the Specifications.

The Contractor shall supply detailed instructions for erection, operation and maintenance of all equipment and components in English and preferably Arabic language.

In the event of any difference between the drawings and the Specifications, the latter shall prevail.

Approval of drawings shall not relieve the Contractor of his obligations to supply the Plant in accordance with the Specifications. In the event of any difference between scaled dimensions and figures on the drawings, the figures shall prevail

All text on drawings provided by the Contractor shall be in the English language in addition, if necessary, to that of the country of origin. All drawings shall be dimensioned in millimeters.

1.3 Time of Delivery and Completion

The guaranteed delivery times shall be stated in the appropriate schedule in this document.

1.4 Quality of Materials

All materials supplied 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 in the setting up of undue stresses in any parts and also without affecting the suitability of the various parts of the Works for which they were designed. No toxic material (such as Halon, PCB, and Asbestos) shall be utilised.

1.5 Contractor's Quality Assurance Procedures

The Bidder shall have established a quality assurance system based on ISO 9001 or 9002. The Contractor shall include a documentation of the system with a list of current procedures, an organigram of the quality organisation and the name of the quality manager. He shall also submit a list of quality revisions performed the last twelve months with a list of closed and unclosed findings as well planned revisions the coming twelve months.

The Contractor shall submit for approval a program of quality control and inspection procedures to assure that the product during manufacture and on completion complies with the specified requirements. The program shall relate the quality control and inspection activities to the production cycle. In support of the quality control and inspection program the Contractor shall provide details of quality control and inspection procedures available for use in the execution of the Contract. The Contractor shall retain responsibility for quality control and inspection activities made by his sub-contractors and shall indicate on the program, which items are to be sub-contracted.

1.6 Guarantees and Particulars

The Works shall comply with the technical guarantee data stated in the Bid. The Contractor shall be responsible for any discrepancies, errors and omissions in the particulars and guarantees, whether the Engineer/GEDCo/UNDP has approved such particulars and guarantees or

not.

1.7 Places of Manufacture and Sub-Contractors

The manufacturer's identity and places of manufacture, testing and inspection before shipment for the various portions of the Contract Works shall be specified in the Technical Schedules and shall not be departed from without the agreement of the Engineer/GEDCo/UNDP.

All Sub-contractors and Sub-suppliers of components and materials shall be subject to the approval of the Engineer/GEDCo/UNDP. Information shall be given on each Sub-order sufficient to identify the material or equipment, to which the sub-order relates, stating that the material is subject to inspection by the Engineer/GEDCo/UNDP before dispatch.

All equipment offered shall be the product of recognized and experienced manufacturers and shall be proven equipment of the same basic design and size similar to that which has been in successful continuous operation for at least three years preferably under similar climatic conditions. Proven plant reliability and high availability are of prime importance and the attention of the Bidder is drawn to these particular requirements.

1.8 Inspection and Testing

All materials used in the Contract Works may be to inspection by the Engineer/GEDCo/UNDP and it is the Contractor's responsibility to advise the Engineer/GEDCo/UNDP when equipment and materials are available for inspection, at least 1 month in advance.

Factory tests on equipment shall be made according to the applicable IEC Standards, or as specifically specified or according to standards approved by the Engineer/GEDCo/UNDP.

Routine tests shall be made on each unit of all equipment.

Type tests shall be made on one unit of each type of different equipment. Instead of carrying out the type tests the Contractor may submit suitable certificates of tests made on equipment of the same type; however, the Employer reserves the right of accepting these certificates or to reject them partially or totally.

The Engineer/GEDCo/UNDP shall be at liberty to demand any additional testing at the manufacturer's works, at site or elsewhere in order to verify that the equipment complies with the conditions of the Specifications.

A test program shall be submitted to the Engineer/GEDCo/UNDP for approval at least 1 month ahead of the commencement of testing.

Measuring apparatus shall be approved by the Engineer/GEDCo/UNDP and if required shall be calibrated at the expense of the Contractor at an approved laboratory.

1.9 Packing, Transportation and Storage

Packing shall give adequate protection to the enclosed materials against mechanical damage during transport to its final destination, including rough handling during sea, rail and road transport and transition from one mode of transport to another.

Packing should be stout close-boarded wooden cases of adequate thickness, suitably braced and banded and lined internally with water-resistant material or equally solid enclosures.

Steelworks sections and similar items may be bundled provided that the ends are adequately protected and the enclosing bands or wires are robust.

Indoor electrical equipment must be enclosed in welded polythene envelopes inside packing cases and the envelopes shall be evacuated or have a desiccant inside.

All items in cases or crates shall be secured so that they are not free to move and cannot work loose in transport. If rotating parts are shipped within their bearings or mountings, they must be adequately braced and restrained to prevent relative movement. Loose items shall be placed in bags in a case, each bag having stitched onto it a label indicating the number and nature of its contents. Where a filler material is used in a case to restrict movement or provide additional protection, it must be inorganic and non-hygroscopic.

All surfaces liable to corrosion shall be thoroughly cleaned and special steps adapted to the nature of the materials and the time interval between packing and unpacking shall be taken to prevent corrosion. These steps may constitute the greasing on surfaces, the application of a protective coat, enclosure of the items in a hermetically sealed container, the addition of vapour phase inhibitor paper to the package or other approved means.

Steps shall be taken to ensure that moisture, moulds, insects or rodents cannot damage insulated materials. Items that include materials liable to be damaged by moisture shall be packed in hermetically sealed containers in which silica gel, or some other approved desiccant has been inserted.

Cases shall be marked with large lettering to show which side of the case is to be up, and if the contents are fragile, marked "FRAGILE" in large letters with the international wineglass symbol. Packages shall be marked with their place of destination in such a way that rough handling or the effect of weather cannot remove or obliterate the marking. Each item shall be marked with its gross weight and, for all lifts over two tonnes, marks on the cases shall show the correct positions for the slings.

Special steps shall be taken to guard against theft during transport. No small items such as padlocks nameplates and so forth that could be torn off or unscrewed shall be accessible.

Cases, crates, barrels and drums shall be banded in such a manner as to obstruct the theft of any of the timber used for packaging and the bands shall be so secured that they are not rendered ineffective by shrinkage of the wood.

A descriptive and fully itemized list shall be prepared of the contents of each packing case. A copy of this list shall be placed in a waterproof envelope under a metal or other suitable plate securely fastened to the outside of one end of the case, and its position indicated by stenciling on the case. Where appropriate, drawings showing the erection markings of the items concerned shall be placed inside the case.

All stenciled markings on cases and crates, or other markings on descriptive metal tabs fixed to cable drums, bundles of structural steelworks and so forth, shall be applied in two places with a material which cannot wash off and shall be additional to any erection or other marks or impressions which may be specified elsewhere.

Shipping marks are to be stenciled in oil based paint in block letters and symbols. When unobstructed flat smooth surfaces of sufficient size are not available on the case for the shipping marks they are to be stencilled on marine-ply notice boards of adequate size and of at least 6 mm thickness securely fastened to the packing case.

All packing cases, though not steel containers, shall remain the property of the Employer.

1.10 Tools

The Supplier shall supply in lockable boxes, for the Employer's use, any special tools that may be required for assembly, dismantling and adjustments to the equipment. The tools shall be unused and in new condition at the time of hand over. Suitable special spanners shall be provided for bolts and nuts which are not properly accessible by means of an ordinary spanner.

2 GENERAL TECHNICAL SPECIFICATION

2.1 General

This Chapter contains a general technical specification of electrical distribution equipment and may cover equipment not to be procured under this contract. For details about each type of equipment to be procured reference is made to **Section 3-Particular Technical Specifications**.

The design shall incorporate every reasonable precaution and provision for the safety of the general public as well as for all those engaged in the operation and maintenance of the Contract Equipment and of associated works supplied under other Contracts.

2.2 Drawings

The Bidder shall in his Bid enclose overall drawings showing dimensions, main working principles, internal components and fixing methods to a detail level allowing the Employer to evaluate the functionality and completeness of the equipment.

2.3 Standards

Ratings, characteristics, tests and test procedures, etc. for the electrical equipment encompassed by this specification shall comply with the relevant provisions and requirements of the Recommendations of the International Electro technical Commission (IEC), unless otherwise expressly stated in Particular Technical Specifications. This applies even where the specific standards are not referred to in the Particular Specifications. Where the IEC Recommendations do not fully cover all provisions and requirements for the design, construction, testing, etc. and for equipment and components that are not covered by IEC Recommendations, recognised national standards shall be applied. The rules of CEE (International Commission for the approval of electrical equipment) and the standards of CENELEC (Comite Europeen de Normalisation Electrotechnique) may also be applied.

The latest revision or edition in effect at the time of Bid Invitation shall apply. Where references are given to numbers in the old numbering system from IEC it shall be taken as to be the equivalent number in the new five digit number series.

The Precise Standard, complete with identification number, to which the

various equipment and materials are manufactured shall be specifically stated by the Bidder.

In case of conflict or disagreement between the particulars of the Standard adopted by the Bidder and the particulars of this Specification, this Specification shall prevail over the Standard. All conflicts or disagreements, mentioned above, must be clearly stated, failing which the materials and equipment offered shall be deemed to comply in every respect with this Specification both in manufacture and in performance, and compliance thereof be insisted upon without additional cost to the Employer.

2.4 Units

The SI-system (meter, Newton, second) shall be used throughout the works covered by this Specification.

2.5 Definitions

Whenever the following terms or words are found in the specifications and/or other documents, they shall have the following meaning:

"High Voltage Equipment" (HV):

Mostly used for equipment provided for a maximum operating voltage higher than 36 kV (generically also used for voltages down to 1000 V).

"Medium Voltage Equipment" (MV):

Equipment provided for a maximum operating voltage higher than 1000 V and up to 36 kV.

"Low Voltage Equipment" (LV):

Equipment provided for operation at 1000 V or below. (For transformers the term Low Voltage Winding is used for the side with lowest rated voltage regardless of value, . IEC 60076)

Reference to degree of protection (IP) is according to the classification in IEC 60529

2.6 System Characteristics

The basic characteristics of the electrical systems and equipment shall be as follows (not all voltages are applicable to this contract):

MV Equipment 33 kV

Maximum operating voltage 36 kV, 3-phase, 50 Hz, delta connected system with neutral solidly earthed via zigzag-star connected earthing transformer.

MV Equipment 22 kV

Maximum operating voltage 24 kV, 3-phase, 50 Hz, delta connected system with neutral solidly earthed via zigzag-star connected earthing transformer.

MV Equipment 11 kV (also to be used for 6.6 kV net)

Maximum operating voltage 12 kV, 3-phase, 50 Hz, neutral solidly earthed.

MV Equipment 6.6 kV

Maximum operating voltage 7.2 kV, 3 phase 50 Hz, neutral solidly earthed.

LV Equipment, 0.4 kV

Maximum operating voltage 420 V, 3-phase, 50 Hz, loaded and effectively earthed neutral TN-S system.

2.7 Phase Relationship

The standard phase colors are Red (L1), Yellow (L2), Blue (L3) (RYB).

2.8 Design Criteria

The equipment shall be designed to withstand the design stresses given below without damage and disruption of service. All tests shall as a minimum is based on these design parameters.

Item	Description	Unit	Nominal voltage level				
			33	22	11	6.6	0.4
1	Nominal system voltage phase to phase	kV	33	22	11	6.6	0.4
2	Highest system voltage phase - phase ¹⁾	kV	36	24	12	7.2	0.42
3	System Frequency	Hz	50	50	50	50	50
4	System earth(see above)	----	Solid	solid	Solid	Solid	Solid
	Minimum Design Short circuit Current (1 sec. arch test) ²⁾	kA	25	25	25	25	25

5	Impulse withstand voltage (1.2/50 μ sec wave) ³⁾	kV peak	170	125	75	75	-
6	Power frequency withstand voltage (1 min.) ³⁾	kV	70	50	28	28	2.5
	Min creepage distance over outdoor insulators (Pollution class 3- severe, IEC 60815/85 - 2.5cm/kV)	cm	90	60	31	31	-

Note 1)

Ref. IEC 60038

Note 2)

For all current carrying parts the permissible short circuit duration shall be at least 1 second. Indoor equipment shall be arc tested in accordance with IEC 60298 amendment 2. The dynamic or momentary short circuit current on which the equipment design shall be based shall be computed by multiplying the r.m.s. value of the symmetrical short circuit current by the factor $1.8 \times \sqrt{2}$.

Note 3)

Ref. IEC 60071

2.9 Ambient Temperatures, Relative Humidity, Wind Pressure

Unless otherwise specifically stated in Particular Technical Specification, any equipment, component and assembly shall be designed for the following service conditions:

Description	Unit	Value
1 Altitude of site above sea level	m	- 400 to + 900
2 Ambient Temps:- Maximum Minimum	°C °C	45 - 5
3 Wind Speed	m/s	15
4 Isokeraunic Level		15
5 Pollution Type		Dust
6 Relative Humidity Maximum Minimum	% %	100 <10

7	Rainfall Average annual	mm	600
8	Hail		Yes
9	Fog		Yes
10	Sand Storms		Occasional

Wherever any of these maximum or 24 hour average temperatures exceed the normal service condition temperatures of the IEC Recommendations for the relevant equipment, or of such other standard which is approved to be applied, the permissible temperature rises of the recommendations or the standard shall be reduced by the same amount as the difference between the above figures and the normal service condition temperatures.

The Contractor shall guarantee these reduced temperature rises.

2.10 Power Cables

The following assumed values of soil thermal resistivity, soil and air temperatures are for Tender evaluation purposes only.

Maximum ground temperature	°C	30
Soil thermal resistivity	°C m/W	1.8
Max. ambient shade temperature	°C	30-40

The underground cables shall be designed to withstand a short circuit current of 30 kA for 1 sec.

2.11 TECHNICAL DATA SCHEDULES

2.11.1 PREAMBLE

- 1.1 All the Technical Schedules shall be filled in and completed by the Tenderer, and submitted with the Tender.**
- 1.2 All documentation necessary to evaluate whether the equipment offered is in accordance with this Specification shall be submitted with the Tender.**
- 1.3 All data entered in the Schedules of Technical Data are to be regarded as values guaranteed by the Tenderer and shall not be deviated from unless approval to do so is obtained from the Engineer.**
- 1.4 All data entered in the Schedules of Informative Data are also to be regarded as values guaranteed by the Tenderer. These data may only be deviated from if approval to do so is obtained from the Engineer.**
- 1.5 Necessary copies of the schedules format shall be used if necessary to provide space to submit data on all the equipment offered.**
- 1.6 Equipment or Systems offered which are not in accordance with the Specification shall be listed and described in Schedule 'F' - Deviations from Specifications. If there are no deviations, this shall also be stated in Schedule 'F'.**

2.11.2 DEFINITIONS AND ABBREVIATIONS

The following terms may be met in these Technical Schedules and shall be interpreted as follows:

Hz	shall mean hertz
kW	shall mean kilowatt
MW	shall mean megawatt
VA (kVA, MVA)	shall mean volt-ampere (kilo-, mega-)
A (kA)	shall mean ampere (kilo-)
V (kV)	shall mean volt (kilo-)
W/m	shall mean watt per metre
AC	shall mean alternating current
DC	shall mean direct current
I_N	shall mean rated (nominal) current
U_N	shall mean rated (nominal) voltage
Ah	shall mean ampere-hours
lm	shall mean lumen
lm/w	shall mean lumen per watt
min	shall mean minute
min.	shall mean minimum
(prefix)	shall mean micro
rms	shall mean root mean square
p.u.	shall mean per unit
p/p	shall mean peak to peak
T	shall mean Tesla
kg	shall mean kilogram
N	shall mean Newton
s or sec.	shall mean second
No.	shall mean number
dB	shall mean decibel
Amp	shall mean amperes
F	shall mean Farad
°C	shall mean centigrade
K	shall mean degree Kelvin
m²	shall mean square metre (mm ² for millimetre,
etc)	
m³	shall mean cubic metre (mm ³ for millimetre, etc)
m³/s	shall mean cubic metres per second
m	shall mean metre
cm	shall mean centimetre
mm	shall mean millimetre
joules	shall mean joules per hour
tonne	shall mean metric tonne
%	shall mean percentage
Pascal	1 N/m ²
cst	shall mean centistoke

2.11.3 SCHEDULE 'A' - National Standards for Equipment not Complying with IEC Standard Recommendations

<u>Equipment</u>	<u>National Standard</u>	<u>English Title</u>
.....
.....
.....
.....
.....

Tenderer's Signature: _____ **Date:** _____

2.11.4 SCHEDULE “B” - DEVIATIONS FROM THE REQUIREMENTS OF THE SPECIFICATION

It will be assumed that the equipment offered will conform to the Specification in all respects, unless departures are mentioned in this Schedule.

Tenderer's Signature: _____ Date: _____

2.11.5 SCHEDULE 'C' - PRICE SCHEDULES

Preamble

The Price Schedules shall be read in conjunction with the Instructions to Tenderers, General and Special Conditions of Contract and the Technical Specifications.

The rates and prices tendered in the Price Schedules shall, except insofar as it is otherwise provided under the Contract, include all materials, insurance, profit, together with all general risks, liabilities and obligations set out or implied in the contract.

A price shall be entered against each item in the Price Schedules, whether quantities are stated or not. The cost of Items against which the Supplier has failed to enter a rate or price shall be deemed to be covered by the Contract Price.

The whole cost of complying with the provisions of the Contract shall be included in the Items provided, the Price Schedules, and where no Items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items.

In the Price Summary, Total Amount of Tender, the provisional sums of 5% shall be added to cater for any additional equipment that may be required.

Tenderer's Signature: _____ Date: _____

3 PARTICULAR TECHNICAL SPECIFICATIONS FOR CABLES

Low voltage material

Low voltage cables and conductors

Underground cables

General

All low voltage cables shall be in compliance with relevant IEC-Standards. The low voltage cables for the 400/230 V voltage level are to consist, according to requirements, of single, two, three and four-core low voltage power cables.

The standard phase colors shall be Red (L1), Yellow (L2), Blue (L3) (RYB), unless otherwise specified by IEC 60173. The IEC Standard will be mandatory with regards to cable colors.

The neutral of the 400/230 V system is solidly earthed (TT-S system).

All cables accessories and materials shall be in accordance with the latest editions (including all amendments) of CENELEC HD 620 IEC and ISO recommendations.

The manufacturer shall have established a quality control system based on regularly accelerated test of production samples according to CENELEC HD620. This system shall be described in the Bid.

Conductors

All conductors shall be stranded copper or aluminium as specified in the schedules. The conductor shall be clean, uniform in size, shape and quality, smooth and free from scale, spills, splits, sharp edges and other harmful defects.

They shall be circular, shaped, stranded, as required, to suit the cable specification and shall comply with the requirements of IEC 60228 where applicable.

Where joints are permitted in individual wires, formed into a conductor, they shall be made in the manner prescribed in the appropriate standard and the frequency shall conform to the limiting dimensions stated therein. No joints shall be made in the conductor after it has been formed.

Insulation

Power cables shall be XLPE insulated except if specified otherwise.

Only dry processes shall be used in vulcanizing and cross linking of the XLPE-insulation, special precautions shall be taken to avoid ingress and spreading of moisture and development of water- treeing. The Bidder shall document the construction measures used to achieve these requirements. The Supplier can propose an alternative treatment to prevent the possibility for treeing.

Laying up and fillers

The cores of all twin and multicore cables shall be laid-up together with suitable fillers, wormed circular and binding tapes applied overall.

The fillers for XLPE cables shall be non-hygroscopic. The direction of lay of the cores shall be right- hand for all twin and multicore power cables. The term "right-hand" has the same meaning as for screw threads. All cables shall be circular.

Identification

The manufacturer's identification shall be provided on outer sheath throughout the length of the cables by means of a tape under the sheath printed with the manufacturer's name. Alternatively the manufacturer's identification may be embossed on the outer PVC sheath together with the identification and voltage markings. The cables shall be marked for each meter.

Testing

Notwithstanding that cables are manufactured to an approved National Standard, all cables accessories and materials shall be subjected to and withstand satisfactorily the test requirements detailed in this specification subject to any exceptions stated therein. All materials shall withstand such routine tests as are customary in the manufacture of the cables and accessories included in the Contract.

Sealing and drumming

The cable shall be wound on strong non-returnable drums arranged to take a round spindle of a section adequate to support the loaded cable drum installation and handling. The drum shall be lagged with strong closely fitting battens that shall be securely fixed to prevent any damage to the cable. Wooden drums shall be constructed of seasoned timber to prevent shrinkage of drums during shipment and subsequent storage on site. Each drum shall be clearly marked in a manner that cannot be obliterated with the particulars of the cable including voltage, length, conductor size, number of cores, type of protective covering, section number, gross and net weight, together with the direction of rolling.

The ends of cables shall be suitably sealed to prevent the ingress of moisture. The end of the cable left projecting from the drum shall at all times be securely protected against damage by mishandling during transport or storage.

Drum lengths of cables shall not exceed the following:

Voltage	Cable Type	Maximum Length (m)
600/1000V	4-core cables	500
600/1000V	2-core cables	500
600/1000V	1-core cables	500

600/1000V	ABC Cables	1000
600/1000V	concentric cables	1000

Current Carrying Capacity and Design Parameters

The maximum continuous current carrying capacity and maximum permissible continuous conductor temperature, and the factors for determining such rating and temperature shall be based on IEC Recommendation and all conditions prevailing on Site.

Low voltage aerial cables

General

The Aerial bunch cable shall be 600/1000V grade cross-link polyethylene and shall be of the types and construction stated in the schedules. All cables shall be manufactured and tested to the CENELEC HD 626. Cables shall be designed for a maximum continuous conductor temperature of 90°C and for operation on a system with the neutral solidly earthed.

The cable shall be of self supporting type where all conductors share the load; i.e. no messenger wire or reinforced neutral conductor shall be used alone for suspension of the cable.

Conductors

The conductors shall be hard drawn stranded aluminium and shall comply with all the requirements of IEC 60228.

Insulation

The materials used in the manufacture shall be black weather-resistant cross-linked polyethylene with a high resistance to ultra violet radiation. The insulation shall fit closely on but shall not adhere to the conductors.

Cable identification

Identification of individual cores of the cable shall be by longitudinal ridges on the insulation and shall be provided throughout the length of all cables.

Testing

All cables, accessories and materials shall be subjected to and satisfactorily withstand the test requirements specified herein. All materials shall withstand such routine tests as are customary in the manufacture of the cables and accessories included in the contract.

Sealing and drumming

The cable shall be wound onto a strong non-returnable drum with enclosed flanges and barrel arranged to take a round spindle of a section adequate to support the loaded cable drum during installation and handling. The drum shall be lagged with strong closely

fitting battens which shall be securely fixed to prevent damage to the cable. Wooden drums shall be constructed of seasoned timber to prevent shrinkage of drums during shipment and subsequent storage on site. Each drum shall be clearly marked in a manner that cannot be obliterated with the particulars of cable, including voltage, length, conductor size, number of cores gross and net weights, together with direction for rolling.

The ends of the cables shall be sealed by enclosing them in approved caps, tight fitting and adequately secured to prevent the ingress of moisture
The ends of the cable left projecting from the drum shall at all times be securely protected against damage.

Single-phase split concentric cable

Single phase, split concentric, Cu conductor, for households and street lighting services, incorporates separate neutral wire, suitable for overhead installation.

Medium Voltage Cable

The conductor shall be covered with:

- Conductors to be with swelling powder to prevent axial ingress of water along the conductor
- An extruded semi-conducting layer
- A layer of dry vulcanised cross-linked polyethylene (XLPE) insulation
- An extruded vulcanised semi-conducting layer
- A layer of swelling tape to prevent axial ingress of water along the screen
- A layer of earthing screen of stranded copper with copper tape.
- Water blocking tape.
- A black outer LDPE (Low Density polyethylene) sheath .

Conductors

All conductors shall be stranded copper or aluminium as specified in the Schedules. The conductor shall be clean, uniform in size, shape and quality, smooth and free from scale, spills, splits, sharp edges and other harmful defects.

They shall be circular, shaped, stranded, bunched and multiple stranded, as required, to suit the cable specification and shall comply with the requirements of IEC 60228 where applicable.

Where joints are permitted in individual wires, formed into a conductor, they shall be made in the manner prescribed in the appropriate standard and the frequency shall conform to the limiting dimensions stated therein. No joints shall be made in the conductor after it has been formed.

Conductor Screening

Conductor screening shall be employed at rated voltages above 1.8/3.0 kV for cables insulated with XLPE, and shall consist of a layer of extruded semi-conducting material having a smooth even surface in intimate contact with the cable insulation and the conductor, but easily strippable from the conductor surface.

Insulation

Power cables shall be insulated with one of the following materials EXCEPT where the type of cable is definitely specified in detail in the Schedules:-

- Cross-linked polyethylene (XLPE) for 22kV cables.

Only dry processes shall be used in vulcanising and cross linking of the XLPE-insulation. Special precautions shall be taken to avoid ingress and spreading of moisture and development of water-treeing. The Bidder shall document the construction measures used to achieve these requirements. The Supplier can propose an alternative treatment to prevent the possibility for treeing.

Core Screening

Core screening shall be employed at rated voltages above 1.8/3.0 kV for cable insulated with XLPE, and shall consist of a layer of semi-conducting material having a smooth even surface in intimate contact with the cable insulation and a concentric screen of copper wires and tape applied overall. Full details of the method used for stripping the screen shall be provided with the Tender.

Identification of Cores

The cores of all twin, three and four core power cables shall be identified by numbers or colours in accordance with IEC standard or approved National Standard.

Laying-up and Fillers

The cores of all twin and multicore cables shall be laid-up together with suitable fillers, wormed circular and binding tapes applied overall.

The fillers for XLPE cables shall be non-hygroscopic. The direction of lay of the cores shall be right-hand for all twin and multicore power cables. The term "right-hand" has the same meaning as for screw threads. All cables shall be circular.

Manufacturer's Identification

The manufacturer's identification shall be provided on outer sheath throughout the length

of the cables and the name of GEDCo/UNDP by means of a tape under the sheath printed with the manufacturer's name. Alternatively the manufacturer's identification may be embossed on the outer PVC sheath together with identification and voltage markings. The cables shall be marked for each meter.

Testing

Notwithstanding that cables are manufactured to an approved National Standard all cables, accessories and materials shall be subjected to and withstand satisfactorily the test requirements detailed in this specification subject to any exceptions stated therein. All materials shall withstand such routine tests as are customary in the manufacture of the cables and accessories included in the Contract.

Sealing and Drumming

The cable shall be wound on strong non-returnable drums arranged to take a round spindle of a section adequate to support the loaded cable drum during installation and handling. The drum shall be lagged with strong closely fitting battens that shall be securely fixed to prevent damage to the cable. Wooden drums shall be constructed of seasoned timber to prevent shrinkage of drums during shipment and subsequent storage on site. Each drum shall be clearly marked in a manner which cannot be obliterated with the particulars of the cable including voltage, length, conductor size, number of cores, type of protective covering, section number, gross and net weight, together with the direction for rolling.

The ends of cables shall be suitably sealed to prevent the ingress of moisture. The end of the cable left projecting from the drum shall at all times be securely protected against damage by mishandling during transport or storage.

Drum lengths of cables shall not exceed the following:

22 kV, 1-core cables, maximum length	1000m
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Current Carrying Capacity and Design Parameters

The maximum continuous current carrying capacity and maximum permissible continuous conductor temperature, and the factors for determining such rating and temperature shall be based on IEC Recommendation No. 287 and subsequent amendments and all conditions prevailing on the Site.

CABLES AND ACCESSORIES

Cable Joints and Terminations

The Tenderer shall submit with his Tender drawings showing the types of joints proposed for each of the cables included in the Contract.

The joints shall be of a watertight, pull-over heat shrink type (Raychem or similar) without moulding, free from sharp points or ridges, thoroughly clean internally and externally. The sleeves shall be of sufficient diameter and length to permit colour-to-colour jointing without undue bending, handling or deformation of the cores.

Terminations

Detailed drawings showing the types of cable sealing ends, terminal boxes and glands and overhead line terminations shall be submitted to the Engineer/GEDCo/UNDP for approval.

Stress cones or other approved means shall be provided for grading the voltage stress on the core insulation of screened cables.

Terminations for all HV cables shall be of an appropriate heat shrink design incorporating a suitable arrangement of stress control, and rain-sheds for outdoor use

Termination kits shall include suitable heat shrink tubing to effectively shroud, seal and insulate the exposed cable conductor and connector, and shall include a heat shrink glove to effectively seal the crutch of the cable to prevent ingress of moisture into the interstices of the cable. Suitable arrangements shall be provided to earth the cable screen and armour (if specified).

Terminations into cable boxes shall include brass compression glands and back nuts of the correct size, which shall secure the cable outer sheath and ensure effective electrical continuity between the cable armouring wires and the metal enclosures on which the cable is terminated. At all rising terminations the cable inner sheath shall pass through the gland to terminate not less than 6 mm above the gland.

Provision shall be made for earthing all sealing end baseplates, cable boxes, glands and armour clamps.

Instructions

As soon as possible after the commencement of a contract and before materials are despatched, copies of the jointing and termination instructions applicable to the joints, sealing ends and terminations to be supplied shall be submitted in English to the Engineer/GEDCo/UNDP for approval, together with details of the physical and electrical characteristics of the filling medium proposed.

Materials

Sets of jointing materials for terminating cables shall be complete with all miscellaneous jointing materials to complete the termination. One set of materials shall be sufficient for terminating one end of the cable or cables specified into one joint box. Each set of jointing materials shall be packed as one complete self-contained unit package for direct issue to a joiner at a work site.

Heat Shrink Materials

Heat shrink tubing and moulded parts shall be flexible, flame retardant, polyolefin-based material of electrical insulating quality, and shall be obtained from an approved manufacturer. They shall be suitable for use indoors or outdoors in the conditions prevailing on site.

Each part shall bear the manufacturer's mark, part number and any other necessary markings to ensure correct identification for use on the correct size and type of cable. Each set of parts shall be packed as one unit with full and complete installation instructions and clearly marked to show the application.

The material shall reduce to the predetermined size and shape when heated above 120°C. The components shall also be provided with an internal coating of hot melt adhesive compound that shall not flow or exude at temperature below 85°C. All parts and materials shall be tested to a programme of tests to be agreed with the manufacturer.

3.1.2 WORKS TESTS

General Requirement

As provided in the Conditions of Contract, the whole of the materials used in the Works shall be subject to such inspection and test at the manufacturer's works as the Engineer/GEDCo/UNDP may direct from time to time as the work proceeds. The cost of such inspection and tests, including the provision and use of test equipment, shall be included in the Contract.

Not less than three weeks notice of all tests shall be given to the Engineer/GEDCo/UNDP in order that he may be present if he so desires. As many tests as in the opinion of the Engineer/GEDCo/UNDP are possible shall be arranged together. Three copies of the Contractor's records of all tests shall be furnished to the Engineer/GEDCo/UNDP.

The approval by the Engineer/GEDCo/UNDP of the results of such inspection and tests shall not relieve the Contractor of his obligations under the Contract for the satisfactory performance of the plant and materials.

If, due to the Contract Works and/or component materials not complying with this specification, further tests are necessary, the Contractor shall pay all additional costs which may be incurred in re-testing.

During the execution of the Contract, test specimens, if required by the Engineer/GEDCo/UNDP shall be taken from the materials for the purpose of check tests or analyses by Independent Authorities. Such specimens shall be prepared for testing and forwarded at the expense of the Contractor to the Testing Authorities selected by the Engineer/GEDCo/UNDP.

The Engineer/GEDCo/UNDP reserves the rights to call for further tests which are in his opinion necessary to confirm satisfactory performance. Tests shall as far as possible simulate site conditions.

The Contractor shall submit certified type test certificates for all equipment covering the type tests detailed in this section. Evidence to this effect shall be submitted at the time of bidding.

Type tests will normally only be required when certified test certificates are not available for identical equipment.

Routine tests will be required on all equipment as described in this Section. High voltage tests shall be to IEC 60060 unless otherwise indicated.

Except where otherwise indicated all electrical tests shall be carried out at rated frequency with an approximately sinusoidal waveform.

All instruments shall be approved by the Engineer/GEDCo/UNDP and if required shall be calibrated at the Contractor's expense.

PVC or XLPE Insulated Power Cables

Routine Tests

Routine tests shall be carried out on completed cable lengths of PVC or XLPE insulated power cables in accordance with IEC 60502 and supplements, and shall include the following:

- (a) Measurement of electrical resistance of conductors
- (b) High voltage test
- (c) Partial discharge test (XLPE insulated cables only)

Special Tests

The Contractor shall carry out the special tests detailed in IEC Recommendation No. 60502 and supplements as appropriate to the type of cable under test, and shall include the following :-

- (a) Conductor examination
- (b) Check of dimensions
- (c) Electrical test for cables of rated voltage above 3.6/6 kV
- (d) Hot set test for XLPE insulation
- (e) Tests at low temperature for PVC

Type Tests

The Contractor shall carry out the type tests detailed in IEC Recommendation No. 502 (1978) and supplements as appropriate to the type of cable under test. These type test requirements may be waived on production of documentary proof that samples of similar cable manufactured in the same works with the equivalent or larger conductor section have passed identical or more onerous tests which have been witnessed by an approved electricity authority or their duly appointed representatives. Failure by the Contractor to provide such documentary proof in advance of cable manufacture commencing will render the Contractor liable to carry out the full type test programme in entirety.

3.3 SCHEDULES

All schedules shall be filled in and submitted with the Tender. The Tenderer may copy or modify the schedules, if necessary, in order to provide sufficient space for all the equipment and relevant data.

3.3.1 SCHEDULE 'A' - TIME PERIODS TO COMPLETE DELIVERY

Time Periods shall be stated in weeks from the date of Contract Commencement Date (which is the date of Contractor's receipt of advance down payment against bank guarantee) to the complete delivery.

Section of the works	Time Period (Weeks)
Cables and Accessories:	

Date: _____ Signature of Tenderer: _____

3.3.2 SCHEDULE 'B' - MANUFACTURERS, PLACES OF MANUFACTURE AND INSPECTION

Item	Manu facturer	Place of Manufacture	Place of Inspection
Cables and Accessories 24 kV XLPE single core cables			
LV Cables			
ABC cables			
Joints			
Terminations			
Other:			

Date: _____ Signature of Tenderer: _____

3.3.3 SCHEDULE 'C' - TECHNICAL GUARANTEES, POWER CABLES

Sheet 1 of 2

POWER CABLES		Guaranteed Data			
Item	Particulars	Unit	MV Cables	0.6/1 kV	
			24 kV	UGC	ABC
a.1	Manufacturer Type designation Insulation Material Design Voltage Cross section Conductor Material Number of Cores Continuous current carrying capacity in three foil formation in ground at 30 °C Maximum temperature rise of conductor Short-circuit capacity, 1 sec Test voltage	kV mm ² A °C kA kV			
b.1	Cable designation - Screen material - Insulation screen bonding - Material of outer protection - Overall diameter of cable - Weight of heaviest reel, including cable - Size of biggest reel, diameter/width	 mm kg mm/mm			

Tenderer's Signature: _____ **Date:** _____

3.3.4 SCHEDULE 'D' - DRAWINGS

3.3.4.1 Drawings to be Submitted with the Tender

24 kV, XLPE insulated cable cross-sections

LT Cables (UG-ABC Cables)

Drawings of joints and terminations

All conductors and wire cross-sections

Type test reports are to be submitted for all equipment.

3.3.4.2 Drawings to be Submitted for Approval after Award of Contract

24 kV, XLPE insulated cable cross-sections

LT Cables (UG-ABC Cables)

Drawings of joints and terminations

Type test reports are to be submitted for all equipment.

4 PARTICULAR TECHNICAL SPECIFICATIONS FOR TRANSFORMERS

This chapter covers the particular technical requirements of the medium (33 and 22 kV) voltage equipment to be procured under this contract. By conflict between the general specification and the particular specifications below the particular specifications shall prevail.

4.1 TRANSFORMERS

Sealed Liquid Immersed Power Transformer

1. **Type:** 3-phase, two winding, liquid immersed, sealed type rated for continuous operation under site ambient conditions at full rated power, naturally cooled (ONAN), with off load, manual, operated tap-changer, lockable in all positions on primary side.
2. **Transformer shall comply with:** IEC 76, 354 and 404-2.
3. **Construction:** Variable volume steel tank, with corrugated wall design forming integral cooling pockets, heavy rolled and welded steel bottom and base frame and hermetically sealed bolted-on cover. Tank is to be completely filled with insulating liquid drawn in under vacuum. Tank cover is to have provision for two thermometers or temperature sensors, lugs for lifting, four lashing lugs and filler-pipe with valve. Tank is to have drain plug at bottom, earthing bolt on cover and earthing pad on base-frame, and a rating plate.
4. **Noise Level:** In general is to be less than 76 dB at 0.3m for ratings up to 1600 kVA and in accordance with IEC 551.
5. **Windings:** Copper.
6. **Bushings:** Plug-in, tank-cover mounted, or tank-side mounted to manufacturer's standard, and as approved.
7. **Finish:** Surfaces are to be steel grit blasted, caustic washed and phosphatized, primed with waterproof primer and finished with weather-resistant enamel and final coat of air-drying enamel. Alternative finish may be used subject to approval.

8. Characteristics:

- a. rated power: 1600 kVA /1250 kVA /630kVA /400kVA
- b. winding connection: Dyn 11, neutral insulated and brought out
- c. frequency: 50 Hz
- d. rated voltage primary: 22 kV
- e. rated voltage secondary 0.400kV
- f. impedance
6% For 1600KVA ,
5% For 1250KVA
4.5% For 630 KVA
4.4% For 400 KVA
- g. tap-changer positions: at $\pm 2.5\%$ / $\pm 5\%$ and -7.5%
- h. Insulation level:
1.2/50 Us (kV) 125
50 Hz, 1 minute(kV) 50
- i. available fault current of system at location: 20kA
- j. duration of short-circuit: 3 sec.
- k. terminal connections:
HV side: fully insulated with epoxy sealed end, bolted
LV side: LV busbars or cables to LV compartment

9. Accessories are to include the following:

- a. magnetic liquid gauge with N.O. low level alarm contact
- b. dial type thermometer with N.O. contact and maximum pointer
- c. pressure relief device with N.O. contact
- d. Oil conservator with synchronous oil level indicator of magnetic type.
- e. Filling and drain valves for conservator.
- f. Oil sampling valves for testing purposes.
- g. Silicagel breather.
- h. Air breather.

10. Transformer Losses: (Low Loss Type)

**** 1600 kVA**

- a. Iron Losses : Less than 1800 Watts
- b. Copper Losses at 75 °C : Less than 15000 Watts

**** 1250 kVA**

- a. Iron Losses : Less than 1500 Watts
- b. Copper Losses at 75 oC : Less than 11300 Watts

**** 630 kVA**

- a. Iron Losses : Less than 900 Watts
- b. Copper Losses at 75 oC : Less than 5600 Watts

**** 400 kVA**

- a. Iron Losses : Less than 650 Watts
- b. Copper Losses at 75 oC : Less than 4600 Watts

11. Limits of temperature rise:

The temperature rise shall be limited and guaranteed to the following values:

- Oil temperature measured by thermometer at top level 50 °C.
- Winding temperature measured by resistance 60 °C.

The above temperature rises shall be based on a peak value of the ambient temperature of 45 °C.

12. Over load capacity:

Transformers are to be capable of working at 110% of their continuous rated output at least one hour after being running continuously at 90% of rated output without causing danger or other bad effects to the windings and core, and without exceeding the permissible limit of temperature rise.

4.2 SCHEDULES

4.2.1 SCHEDULE 'A' - TIME PERIODS TO COMPLETE DELIVERY

Time Periods shall be stated in weeks from the date of Contract Commencement Date (which is the date of Contractor's receipt of advance down payment against bank guarantee) to the complete delivery.

Section of the works	Time Period (Weeks)
Section – Transformers:	
Item: 1600kVA Transformers	
Item: 1250kVA Transformers	
Item: 630kVA Transformers	
Item: 400kVA Transformers	

Date: _____

Signature of Tenderer: _____

4.2.2 SCHEDULE 'B' - MANUFACTURERS, PLACES OF MANUFACTURE AND INSPECTION

Item	Manufacturer	Place of Manufacture	Place of Inspection
Transformers:			
Item: 1600kVA Transformers			
Item: 1250kVA Transformers			
Item: 630kVA Transformers			
Item: 400kVA Transformers			

Date: _____ Signature of Tenderer: _____

4.2.3 SCHEDULE 'C' TECHNICAL GUARANTEES, POWER DISTRIBUTION TRANSFORMERS

Distribution Transformers

Sheet 1 of 2
Guaranteed Data

Item	Particulars	Unit	22/0.4			
			1600 kVA	1250 kVA	630 kVA	400 kVA
1	Continuous Maximum Rating C.M.R	kVA				
2	Nominal Voltage between phases at no load					
	a) H.V.	Volts				
	a) L.V.	Volts				
3	Tapping					
	a) Plus	%				
	b) Minus	%				
4	Performance Data at sea level, corrected at 75%					
a)	No Load Loss at Normal Primary Voltage	Watts				
b)	No load Loss at Normal 10% primary over voltage	Watts				
c)	Load Losses at C.M.R	Watts				
d)	Impedance volt at C.M.R and normal ratio	%				
e)	Regulation at C.M.R and unity Power Factor	%				
f)	Regulation at C.M.R and 0.8 Power Factor	%				
g)	Max. Temp. Raise at C.M.R					
	i) Top Oil by Thermometer	°C				
	ii) Average Winding by resistance	°C				
	iii) Hot spot corresponding to (ii)	°C				
5	Type of insulation used in windings					
	a) HV					
	b) LV					

Tenderer's Signature: _____ **Date:** _____

Distribution Transformers

Guaranteed Data

Item	Particulars	Unit	22/0.4			
			1600 kVA	1250 kVA	630 kVA	400 kVA
6	Lightening Impulse Insulation Level of :					
	a) H.V Winding	kVpk				
	b) L.V Winding	kVpk				
	c) Tap change equipment and connections:	kVpk				
	i) To earth	kVpk				
	ii) Between contacts	kVpk				
7	Are test certificates supplied supporting the level stated in clause 6.					
8	Silica gel Breather					
	a) Make of unit fitted					
	b) Size of unit					

Tenderer's Signature: _____ **Date:** _____

4.2.4 SCHEDULE 'D' INFORMATIVE DATA, POWER DISTRIBUTION TRANSFORMERS

Sheet 1 of 2

Distribution Transformers

Guaranteed Data

Item	Particulars	Unit	22/0.4			
			1600 kVA	1250 kVA	630 kVA	400 kVA
1	Transformer Type					
2	Type of winding a) H.V. b) L.V.					
3	Type of insulation a) H.V. winding b) L.V. winding					
4	Type of tap changer					
5	Tap changer designation					
6	Type of axial coil support a) H.V. winding b) L.V. winding					
7	Winding conductor material a) H.V. winding b) L.V. winding					
8	Core lamination designation loss					
9	Specific core loss	W/m ³				
10	Type of bushing: a) H.V. b) L.V.					

Tenderer's Signature: _____ **Date:** _____

Distribution Transformers

Guaranteed Data

Item	Particulars	Unit	22/0.4			
			1600 kVA	1250 kVA	630 kVA	400 kVA
11	Bushing insulator a) H.V. b) L.V.					
12	Creepage distance across bushing a) H.V. b) L.V.	Mm mm				
13	Type of cooling system					
14	Total Oil Quantity					
15	Total weight					
16	Volume of conservator tank	L				
17	Overall dimensions Length Width Height	 mm mm mm				
18	State all standards applied underneath					

Tenderer's Signature: _____ **Date:** _____

4.2.5 SCHEDULE 'E' - DRAWINGS

Drawings to be Submitted with the Tender

General Dimension - Layout

Name plate

Protection devices

Type test reports are to be submitted for all equipment.

Drawings to be Submitted for Approval after Award of Contract

General Dimension - Layout

Name plate

Protection devices

5 PARTICULAR TECHNICAL SPECIFICATIONS FOR 24 kV RING MAIN UNIT

This chapter covers the particular technical requirements of the medium (33 and 22 kV) voltage equipment to be procured under this contract. In the event of conflict between the general specification and the particular specifications below the particular specifications shall prevail.

General

This Section covers the manufacture and supply of indoor Ring Main Units, associated equipment and spares.

Delivery on Supply Basis

The Supply shall cover Engineering, design, manufacture, testing before shipment and packing sea worthy or otherwise as required, delivery DDU

Design

This specification applies to SF₆ insulated switchgear for maximum system voltage 24 kV.

The switchgear shall be suitable for indoor mounting conditions with natural ventilation.

The switchgear shall be maintenance-free and all the electrical parts including the arcing chamber and the main contacts of the switchgear, as well as the connection busbars, are to be mounted in a metal enclosure, hermetically sealed.

All the external parts of the switchgear shall be protected against corrosion. The switchgear shall be of a self-supporting construction type.

The cubicles shall be short circuit type tested by an internationally recognised test institution. The switchgear shall consist of cubicles of tropical design. The cubicles shall be metal-enclosed.

Each cubicle shall be provided with test points for capacitive voltage tester.

Internal H. V connection shall be made of copper or aluminium alloy.

Products

1. Components: Components are to include metal enclosed ring main SF6 switch gear unit, comprising two incoming switch-disconnectors for ring main network feeders, one transformer protection fuse-switch combination, cable terminal fittings behind dead front panels and front mounted switch gear operating handles, control, indication

2. Characteristics:

Rated Voltage	24 kV
Normal system voltage	22 kV
BIL Rated	125 kV
Continuous Current	630 Amp
Short-Circuit Current	20 kA
At Rated Maximum kV	
Close and Latch Capability	68 kA (Momentary)
One Second Rating	20 kA
Rated Interrupting Time	Five cycles
Rated frequency	50 Hz
Rated power frequency withstand voltage (rms)	50kV for I min
Busbar current rating	630 A (minimum).
Rated peak withstand current	63 kA

3. Switch-Disconnecter: General purpose, 3-pole, load-break, Short-circuit make, category B to IEC 265

4. Switch-Disconnecter Ratings:

Rated nominal current	630 A
Rated short-circuit making	equal rated peak
Capacity (peak)	withstand current

5. Switch-Disconnecter Operation: By removable handles at front of unit Switching mechanism is to be manual, spring charge, quick-make, quick-break, with speed of switching independent of operator: Main switch and earth switch operations are to be separated and safety interlocked with the manual handle Inserted in separate access holes for on/off operation of main switch and earth on/earth off operation of earth switch Handle design IS to ensure delay between closing and re-opening of main Switch or earthing switch, to provide an anti-reflex operation. It is to be Impossible to move earth switch inadvertently into or from earth position except when main switch is in the open position .Indication of switch position is to be mechanical, directly connected to moving contacts Each switch IS to have padlocking device in the open, closed and earth positions.

6. Fuse-Switch Combination: To consist trip-free, load-break, short-circuit make fuse-switch combination, with operational requirements as for switch-disconnector. Fuse is to be separately located in fuse chamber with interlocked earthing switches providing upstream and downstream earthing of the fuse

assembly, Automatic trip switching is to be actuated by fuse striker pins which actuate common trip bar in switch mechanism. Once operated, striker pins remain in ejected position, preventing closure of switch until fuses have been replaced. Single phasing is not to be possible. Fuses are to be totally enclosed, current limiting, cartridge type, high-breaking capacity, with striker pins, and withdrawable from front of unit

7. Fuse-Switch Combination Ratings:

rated normal current	200 A
rated prospective short circuit breaking current	25 kA to IEC 420 A
rated prospective short circuit making current	420 kA
rated current of fuse link (to suit)	63 kA
	100 A, 80A, 63A

8. Incoming/Outgoing Cables: AL or Cu 3* 1 *400mm² XLPE

9. Cable Terminal Connectors: Stress-relieving, epoxy sealed end, bolted type, complete with all accessories. Alternative arrangement may be proposed by manufacturer.

10. Accessories: Include the following:

- a. Two N. C and two N. O. auxiliary contact on each switch:
- b. Shunt trip release on fuse-switch combination;
- c. Earth fault indicator, operated by core-balance type current transformer, located near and outside cable box/termination's with indicator visible from front and with automatic reset.

5.1 SCHEDULE 'A' - TIME PERIODS TO COMPLETE DELIVERY (RMU)

Time Periods shall be stated in weeks from the date of Contract Commencement Date (which is the date of Contractor's receipt of advance down payment against bank guarantee) to the complete delivery.

Section of the works	Time Period (Weeks)
Section – Ring Main Unit	
Items: 24 kV Switchgear CTCC	
Items: 24 kV Switchgear CTC	

Date: _____

Signature of Tenderer: _____

5.2 SCHEDULE 'B' - MANUFACTURERS, PLACES OF MANUFACTURE AND INSPECTION (RMU)

Item	Manufacturer	Place of Manufacture	Place of Inspection
Section – Ring Main Unit :			
Items: 24 kV Switchgear CTCC			
Items: 24 kV Switchgear CTC			

Date: _____ Signature of Tenderer: _____

5.3 SCHEDULE 'C' -TECHNICAL GUARANTEES, Ring Main Units

Sheet 1 of 1

24 kV Ring Main Units

Guaranteed Data

Item	Particulars	Unit	Guar. Fig	Tolerance
a1	SF6 Insulated Switchgear Rating - Rated voltage - Impulse withstand voltage - to earth and between phases - across the terminals of open switch disconnectors - One minute power frequency withstand voltage: - to earth and between phases - across the terminals of open switch disconnectors - Rated frequency - Rated current of the cable unit - Rated current of the transformer unit - Rated short time current 1 sec - Rated peak withstand current - Rated short-circuit making capacity - Rated breaking capacities of - M a III active current 11 - Closed loop current 12 - Transformer off-load current 13 - Single capacitor bank 14 - Line charging current 15 - Cable charging current I6 - Normal gas density (represented by gas pressure) - at 20 °C - at 45 °C - Minimum gas density for safe operation: - at 20 °C - at 45 °C - Volume of gas used In the SF6 switchgear - Internal fault withstand for 1 sec - Manufacturer's Name - Country of Manufacturer	kV kV peak kV peak k V rms kV rms HZ A A kA kA kA A A A A A A Bar Bar Bar Bar dm3		

Tenderer's Signature: _____ **Date:** _____

5.4 SCHEDULE 'D' -INFORMATIVE DATA, Ring Main Units

Sheet 1 of 2

24 kV Ring Main Units

Guaranteed Data

Item	Particulars	Unit	Guar. Fig	Tolerance
a1	<p>Test data</p> <ul style="list-style-type: none"> - State of type test -Certificate -Report of performance -Sate with what standard the SF6 insulated Switch gear Complies - Does the Switchgear comply to all test duties as required in this specification -Is routine test program attached -Additional test -Test for arcing due to internal fault of 20 kA/sec -Partial discharge test 	<p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p>		
a2	<p>Design data</p> <ul style="list-style-type: none"> -Is the enclosure made of stainless steal? -Thickness of steal plats -Sate the treating and painting cycle of the metal elements -Cable connectors which may be installed -For cable units -For transformer units -Is the operating mechanism of the spring load type -Is it possible to provide the cable unit with quick making and breaking mechanism? -Is the transformer unit provided with a fuse-tripping device via the striker pin? -Is it possible to provide the transformer with a tripping device via fuse striker pin and trip coil at the same time ? - Is it possible to provide all cable units with breaking mechanism via the trip coil? - Interlock between switch and earthing switch? - Interlock between earthing switch and cable connection cover? Is the isolator provided with gas inspection device? - Are each or the main contacts of the switches enclosed separately in hermetically scaled SSSSF6 gas filled chambers? 	<p>Yes/no</p> <p>Mm</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p> <p>Yes/no</p>		

Tenderer'sSignature: _____ Date: _____

5.5 SCHEDULE 'E' - DRAWINGS

Drawings to be Submitted with the Tender

Details and dimensions of Ring Main Units

Type test reports are to be submitted for all equipment.

Drawings to be Submitted for Approval after Award of Contract

Details and dimensions of Ring Main Units

6 PARTICULAR TECHNICAL SPECIFICATIONS FOR L.V DISTRUBUTION PANNELS

A: Indoor Panels

1. Construction: dead front type, consisting of main circuit breaker, busbars, outgoing circuit breakers or fuses, where shown on the drawings, instrumentation and accessories.
2. Main circuit breakers shall have solid state unit with long-time short-time and ground-fault pick up and time-delay adjustments and with high instantaneous over-current trip, to correspond with transformer rating and LV interrupting capacity at location, time and current coordinated with MV protection on primary side and circuit breakers or protective devices downstream.
3. Main circuit breaker shunt trip device shall be provided, operated by pressure relief device and thermometer.
4. Busbar assembly shall comprise fully insulated set of 3-phase and neutral copper busbars. Neutral is to be fully rated. Earth bar is to be provided at lower end of compartment.
5. Outgoing circuit breakers shall be moulded case type and must be rated for three phases, 380V A.C, 50 Hz to IEC 157-1 and BS EN60947-2:1992 specifications.
6. Moulded case circuit breakers shall be suitable to accommodate auxiliaries and under-voltage release. They shall be of the thermal magnetic or solid state type with a short circuit capacity withstand of not less than 50 KA at 380V and shall be suitable for the ambient temperature operation within the prevailing enclosure condition. Pad locking facility for the MCCB shall be provided. The exposed incoming terminals shall be provided with a suitable insulated cover up to the equipment mounting plate in order to allow no access to the live incoming terminals. There shall be minimum clearance of 300mm between the incoming glanded cable and input terminals of the MCCB.
7. Bus bars shall be provided throughout the main power circuit. All bus bars are to be silver plated copper and colour sleeved according to phase.
8. The capacity of the Terminal sockets for MCCB shall be 300 sq.mm stranded Cu/Al cables through suitable terminal silver plated copper bars.

B: LOW VOLTAGE DISTRIBUTION PILLARS (FEEDER PILLARS)

400 Volt 3 phase Distribution Pillar (Feeder Pillar) Weatherproof Housing

The weatherproof housing (IP 54) shall be manufactured from sheet steel or other approved material. The pillar shall be rigid and self-supporting, designed for ground mounting on a flat base or pier or for fixing to standard lattice steel towers at accessible height. Fixing holes in the bottom and on the back shall be provided complete with M16 foundation or fixing bolts. The pillar shall consist of at least two compartments. The bottom cable entrance compartment to be with removable shield plates in bottom and back (depending of direction of cable entrance).

Cable glands or cable muffs shall be used where cables enter/exit the waterproof housing. The bottom cable entrance compartment must be prepared for such arrangement. It shall be possible to maintain sufficient dust proofing (IP54) as specified, without all glands or muffs being installed. Necessary glands or muffs shall be delivered in accordance with the table below and be designed so they, after installation satisfy the requirements (IP54). It shall be possible and simple to install glands or muffs independent of each other. The placing of glands/muffs must be logical in relation to attachment/contact clamps, so that crossing of cables and unnecessary bending of cables is avoided.

The table shows number and sizes of cable glands, for which the housing bottom shall be prepared:

Feeder Pillar	Glands for cable diameter 20-65mm	Glands for cable diameter 15-45mm	Glands for cable diameter 8-12mm
2 way	2	4	1
4 way	4	4	1
6 way	6	8	1

There shall be an arrangement that allows for temporary attachment of cables between housing entrance and electrical connections, in order to avoid mechanical stress directly on the electrical connections during cable laying. Relevant attachments shall be delivered in accordance with the above table.

The upper, equipment compartment shall be arranged for front access only by means of side hinged doors that shall be fitted with an internal document holder and a locking bar to secure them top and bottom. The locking bar shall be operated by a central handle that shall be lockable by means of a padlock having a 10 mm or larger diameter hasp.

The equipment compartment shall be dust and vermin proof, but adequate ventilation shall be maintained to permit circulation of filtered air. The compartment shall be at least IP 2X with doors open. Provision shall be made for the installation of an electrical heating device to prevent condensation within the housing. Such heaters shall be of the

metal clad convection type, and shall be continuously rated complete with fuses and control switch. It shall be possible to switch on/off. When the heating device is on, it shall be controlled by a thermostat with minimum regulating range 0-30 degrees Celcius.

Incoming Cables, Links, Busbars and Conductors

Links, busbars and conductors shall be manufactured from hard drawn copper and arranged for access from the front only. The busbars must be fully shrouded.

Busbar support insulators shall be capable of withstanding rated short circuit conditions without undue stress and be resistant to mechanical shock and vibration however caused.

The pillar shall be equipped with internal ammeter and voltmeter allowing measurements in all phases on the incomer.

The pillar shall be equipped with ample dimensioned earth and neutral bars interconnected by a removable link.

Busbars shall be dimensioned for not less than 1200 Amps. The busbars shall have identification codes as per Clause 2.7. The standard phase colours are Red (L1), Yellow (L2) and Blue (L3) (RYB).

Distribution Circuits

Each feeder pillar shall be equipped for the number of 3 phase, 4 wire distributor circuits as specified in the Schedules. Each switch-circuit shall have a circuit breaker (C.B.) for disconnecting all 3 phases simultaneously. The circuit breaker shall be designed to disconnect at highest load. Each phase circuit shall be controlled by a moulded case circuit breaker (MCCB). The nominal rating of the C.B. shall be one of the standard values within the range 160 A to 630 A with min. I.C. 35KA for 160 A M.C.C.B. and increases according to M.C.C.B. current rating .

The installation shall fulfil the requirements for c.b. replacement stated in the general technical specifications.

Auxiliary circuits 63 A and below shall be protected by miniature circuit breakers.

And each pillar should have two spare spaces for extra feeders with all needed internal connections.

6.1 SCHEDULE 'A' - TIME PERIODS TO COMPLETE DELIVERY

Time Periods shall be stated in weeks from the date of Contract Commencement Date (which is the date of Contractor's receipt of advance down payment against bank guarantee) to the complete delivery.

Section of the works	Time Period (Weeks)
Section – Low Tension Distribution Panel:	
Items: LTDB with MBC 2500 A	
Items: LTDB with MBC 2000 A	
Items: LTD pillars	

Date: _____

Signature of Tenderer: _____

6.2 SCHEDULE 'B' - MANUFACTURERS, PLACES OF MANUFACTURE AND INSPECTION (Low Tension Distribution Panel)

Item	Manufacturer	Place of Manufacture	Place of Inspection
Section – Low Tension Distribution Panel:			
Items: LTDP with MBC 2500 A			
Items: LTDP with MBC 2500 A			
Items: LTD pillars			

Date: _____ Signature of Tenderer: _____

6.3 SCHEDULE 'C'-TECHNICAL GUARANTEES, Low Voltage Distribution pannels

Sheet 1 of 2

Guaranteed Data

Item	Particulars	Unit	Guar. Fig	Tolerance
a.1	For all Equipment -Rated voltage -Service voltage -Rated frequency -Power frequency test voltage, 1 min.	V V Hz kV		
a.2	Main Switchboard's Busbars -Rated current -Thermal overload capacity, 1sec. -Dynamic capacity -Temperature rise of busbars at rated current	A kA rms kA peak °C		
a.3	Circuit Breakers (to be filled in for each type and size) -Rated current -Power frequency test voltage, 1 min. -Permissible short-time current, 1 sec -Dynamic short time current -Breaking capacity at service voltage -Making capacity -Temperature rise of the contacts at rated current	A kV kA rms kA peak kA rms kA peak °C		
a.4	Current Transformers -Rated primary current -Rated secondary current -Power frequency test voltage, 1 min -primary -secondary Thermal overload capacity, 1 sec. Dynamic capacity Cores for measuring instruments -burden -class -instrument security factor Cores for protection relays -burden -class -accuracy limit factor	A A kV kV kA rms kA peak VA VA		

Tenderer's Signature: _____ Date: _____

Sheet 2 of 2
Guaranteed Data

Item	Particulars	Unit	Guar. Fig	Tolera nce
a.5	Manufacturer's Name -Main switchboards -Circuit breakers -Sub-distribution limit factor			
a.6	Country of Manufacture Main switchboards Circuit breakers Sub-distribution limit factor			

Tenderer's Signature: _____ **Date:** _____

6.4 SCHEDULE 'D' -INFORMATIVE DATA, Low Voltage Distribution pannels

Sheet 1 of 1

Guaranteed Data

Item	Particulars	Unit	Guar. Fig	Tolerance
b.1	Main switchboards -Reference standards - Type designation -overall dimensions -Length -width -height - weight and complete board	mm mm mm		
b.2	Circuit Breakers and Contactors (to be filled in for each type and size) - Reference standards - Type designation - Type of main contacts - Type of arc control device - weight - Power consumption - closing coil -tripping coil -motor, when starting -motor, when running -Running time for motor for loading the spring.	kg W W W W sec		
b.3	Current Transformer -Type -weight -Type of insulation	kg		
b.4	LTD Pillars (to be filled in for each type) - Type -Dimensions -Length -width -height			

Tenderer's Signature: _____ **Date:** _____

6.5 SCHEDULE 'E' - DRAWINGS

Drawings to be submitted with the Tender

Details and dimensions of Low tension distribution Panel / Pillar

Type test reports are to be submitted for all equipment.

Drawings to be submitted for Approval after Award of Contract

Details and dimensions of Low tension distribution Panel / Pillar

7 PARTICULAR TECHNICAL SPECIFICATIONS FOR OVERHEAD LINE MATERIALS

7.1 Conductors and Accessories

Standards

Aluminium clad steel reinforced aluminium conductor (ACSR/AW) aluminium alloy conductor (AA) and copper conductors shall comply with IEC standards or such other equivalent recognised national standard which the Bidder shall define.

Manufacture of ACSR and Aluminium Conductor

The manufacture of the ACSR/AW and AA conductor shall be carried out in a portion of the works specially set aside for such purposes. Precautions shall be taken during the manufacture and storage of ACSR conductor to prevent the possibility of contamination by copper or other materials that may adversely affect the aluminium. In the event of any machinery used for conductor manufacture being used for materials other than aluminium or steel strand the Supplier shall furnish the Engineer with a certificate that the machinery has been thoroughly cleaned before use on aluminium or steel wire and the conductor supplied under this Contract is free from contamination.

The aluminium shall be of the highest purity commercially obtainable and the Supplier shall submit certificates of analyses giving the percentage and nature of any impurities in the metal of which the aluminium wires are made.

There shall be no joints in steel wires forming the core of composite conductors, excepting those made in the base rod or wire before drawing, unless the core consists of seven or more wires. In the latter case joints in individual wires are permitted, additionally to those made in the base rod or wire before drawing, but no two joints shall be less than 15 m apart in the complete steel core.

The steel strands shall be performed so that they remain inert and do not move relative to each other when the conductor is cut.

The steel core wires shall be uniformly covered with approved grease. In addition the inner aluminium wires shall be similarly treated. The grease shall fill all internal spaces except that excess grease shall be removed from the conductor before the application of the final layer of wires.

The outermost layer of all conductors shall be stranded with the right-hand lay.

Mechanical Properties

Steel Core

The steel core shall be comprised of stranded aluminium covered steel wire in accordance with ASTM B-416, "Concentric-Lay-Stranded Aluminium-Clad Steel Conductors". The covering on each individual wire shall achieve a continuous dependable weld with the steel core and shall provide a uniform guaranteed minimum thickness of aluminium of 10 percent of the wire radius. The zone of diffusion shall be clearly defined.

Grease

The grease to be used in the conductor shall be chemically inert, shall not flow within nor exude from the conductor when at a temperature of 90oC nor shall its characteristics be impaired after heating to 20oC above its drop point for 150 hours. The grease shall be suitable for service temperatures in the range -10°C to +75°C. The suitability of the grease shall have been proven by tests acceptable to the Engineer.

Conductor Characteristics

The conductors shall have the following mechanical and physical properties.

ACSR /AW Conductor

Code Name	Unit	Dingo	Dog	Rabbit
Nominal Cross-sectional area	mm ²	150	100	50
Overall diameter	mm	16.75	14.15	10.05
Stranding Aluminium	No/mm	18/3.35	6/4.75	6/3.35
Steel Wire	No/mm	1/3.35	7/1.57	1/3.35
Maximum d.c. resistance at 20°C	ohms/km	0.182	0.273	0.5426
Nominal breaking load	Kgf	3640	3335	1870
Weight	kg/km	505.7	394	213.9

Stranded Copper Conductors

Conductor Type		Copper
Nominal Cross-sectional area	mm ²	120
Nominal Cross-sectional area	mm ²	95
Nominal Cross-sectional area	mm ²	70
Nominal Cross-sectional area	mm ²	50
Nominal Cross-sectional area	mm ²	35

Conductor Drums

General

Conductor shall be supplied on drums of sufficient sturdiness to withstand shipment and transportation, and the drums shall be securely battened to prevent damage to the conductor. Each drum shall be marked with the type, size and length of conductor on the drum, and with the direction of rolling. Conductors shall be supplied in lengths as long as can be conveniently handled, and placed only on drums appropriate to its particular size.

The Bidder shall submit with his Bid, drawings showing the general details and dimensions of the drums to be offered for approval.

Materials

All wooden components shall be manufactured from sound defect-free seasoned softwoods and suitable for prolonged storage without deterioration. The wood shall be planed or finely sawn to facilitate accuracy in assembly and clear stencilling. The thickness of the boards of each ply or component part shall be of reasonable uniformity.

Design

The flanges of drums shall be constructed from two plies of wood, laminated in such a manner as to give cross grain to each other. The boards shall be close butted to provide maximum support. Fastening of the flanges shall be with suitable bright nails with the heads countersunk on the inside of the flange.

A flange conductor hole of sufficient diameter for the free passage of the conductor shall be cut in one flange. A suitable sheet metal plate shall protect the exposed end of the conductor.

The spindle hole shall be round and cut through the centre of the board of each flange ply. The spindle holes, of not less than 80 mm diameter, shall be reinforced by a 6 mm mild steel plate bolted to each flange.

The drum barrel shall be of the segmental type, with supports and cross struts. The barrel lagging shall be closely butted and shall provide a smooth external surface to the conductor. The barrel and flanges shall be securely clamped together.

Drainage holes shall be provided through each flange as close as possible to the underside of the barrel lagging.

Circumference battens shall enclose the conductor space completely. They shall fit flush with the outer flanges. Battens shall be securely fixed in an approved manner.

End Fixing of Conductors

The inner end of the conductor shall be brought through the drum flange and secured by staples. The outer end shall also be secured to the inner face of the flange in a similar manner.

Protection of Conductors

The drum barrel shall be covered with a layer of waterproof sheet plastic or wax paper or in the case of aluminium conductors shall be painted with aluminium flake paint. The inner cheeks of the drum shall be painted with a bitumen-based paint or in the case of aluminium conductors with aluminium flake paint. The outer layer of conductor on the drum shall be covered by a layer of sheet plastic or waxed paper secured immediately under the circumference battens so that it is not in contact with the conductor.

All bolts and nuts on insulator string fittings shall be galvanised as specified and shall be locked in an approved manner.

7.2 Medium Voltage Line Isolators and Switch Isolators

Isolators

All isolators shall be of the triple pole, gang operated open type, suitable for outdoor installation designed in accordance with IEC 60129. The isolators shall be for horizontal or vertical mounting in standard lattice towers and shall be supplied complete with base plates, pole coupling rods, operating rods, angels and triangular plates for operating rods, operating handles and all accessories, including items such as guide plates or mounting brackets. Facilities shall be incorporated in the design for aligning the main contacts and adjusting the linkages during erection and maintenance, and all the conductor straps, nuts, bolts, and washers necessary to mount and electrical connect the isolators, together with all auxiliary equipment, on their supports shall be provided.

Provision shall be made for adjusting the insulator posts in the vertical axis.

Contacts shall be of the high pressure; self-aligning type made of metal not subject to corrosion, for example hard drawn copper or phosphor bronze. If silver plating is applied the plating shall be in accordance with BS 2816 applying a coating that has a specified silver content of at least 95.0 % by mass, and a thickness of at least 25 μm .

The design of the contacts shall be such that periodic lubrication of their surfaces is unnecessary for efficient operation of the switch. Service conditions require that isolating switches shall remain live, and in service without being operated for periods of up to two years. The contacts will therefore be expected to remain capable of carrying their rated load, and short circuit currents without overheating or welding for this period under the atmospheric and climatic conditions existing at site. The advantage of the electromechanical forces created by a fault current to increase the contact pressure where most needed at the contact shall be incorporated in the design.

Isolators shall be designed and tested such that the isolator cannot be opened by forces due to short circuit currents passing through it, and shall be self locking in both the "open" and "closed" positions.

The stationary contacts shall be backed by stainless steel pre-stressed compression springs with multi finger contacts to provide the required contact pressure, resulting in minimum electrical clearance.

Provision shall be included for locking the switches in either the open or closed positions by means of padlocks that will be provided by the Employer.

Where "outboard" bearings are required they shall be suitable for mounting at either end of the isolator.

All roller or ball type bearings shall be grease packed and efficiently sealed to prevent the ingress of dust and moisture. Completely enclosed, weatherproof type

bearings that require no maintenance is preferred.

When made of steel or malleable iron, operating boxes, handles, rods, tubes and other fittings for outdoor equipment shall be hot dip galvanised.

Bidders shall state in the Technical Schedules the load current, line charging current and transformer magnetising current which they guarantee that all isolators offered will break without damage to the contacts. Bidders shall declare in their Bid whether special contacts are required to achieve any of the current breaking conditions; details of any such contacts shall be given.

Full details of all heavy current carrying contacts which incorporate moving parts shall be submitted with the tender together with associated electrical and mechanical type test reports.

On Load Switch Isolators

All isolators shall be prepared for extension with load breaking heads allowing breaking of minimum 630 A when operating the isolator. The isolator functions shall be retained when the load break head is mounted.

Load Interruption

The load interruption shall take place within the interrupter head without an external arc or flame conforming to IEC 265, Category A. Electronic controlled arc interrupters are not acceptable.

The load interruption shall be achieved by providing a parallel circuit for re-directing the load current path from the main isolator contacts at the instant of their separation. The design of the equipment shall allow the replacement of load interrupter head after a specified number of operations. The manufacturer shall indicate the number of load break operation possible without changing the interrupter head.

The inner layer of the arcing chamber shall be suitable for generating arc-quenching-gas. The generated deionized gas shall extinguish the arc and be dissipated through a rear exhaust chamber, well clear of the switch.

The internal contacts shall be spring loaded and be of such design as to provide a positive and independent tripping action.

The interrupter contacts shall not be in the main current path when the main contacts are in a fully closed position.

The load interrupter head shall be designed to prevent leakage of water to the arcing chamber (where the control mechanism including the spring for opening and closing is housed) and be made of non corrosive materials.

Operating Handle

Operating mechanisms shall be designed so that all three poles close simultaneously and be arranged so that any mechanism may be mounted at either end of the supporting structure. All operating handles shall be securely earthed.

Remote Control

It shall be possible to equip the isolators and switch isolators with a motor driven mechanism connecting to the normal operation rod. The switches must be so designed that such installation also can be done at a later stage. Where the motor operated mechanism is specified it shall be designed to provide electrically initiated opening and closing of the isolator from local or remote switches or relays. Local manual tripping shall also be provided together with manual closing of the isolator; the manual closing operation shall reset a spring or weight operated mechanism.

Provision shall be made for locking the local tripping device with a padlock to be supplied by the Employer. The mechanisms shall be totally enclosed in weatherproof and vermin proof metal panel with padlock hasp.

Automatic operating mechanisms shall be provided with an auxiliary switch to isolate the trip or operating coil when the switch is opened.

Auxiliary contacts should clearly indicate the position of the switch.

Rating Plate

The rating and data of the load break switch shall be engraved or embossed on a weather and corrosion proof metal plate. The rating plate containing the following information shall be positioned at the base supporting frame of the post insulator and shall be prominently visible.

- a) Manufacturer's Identification (Trade Mark)
- b) Country and Year of Manufacture.
- c) Number and the Year of the standard adopted.
- d) Designation of Type, Class etc.
- e) Rated voltage and frequency (kV & Hz)
- f) Rated 1 minute power frequency withstand voltage (kV) wet.
- g) Rated lightning impulse withstand voltage (kV) dry.
- h) Rated continuous current (A)
- i) Rated short circuit making current (kA)
- j) Rated short time (1 sec.) current (kA)
- k) Total net weight (kg.)
- l) Serial No. **CEB / LB /**

Tests

Equipment shall be routine and type tested in accordance with IEC 60129

7.3 Lightning Arresters

Design

This section covers the design, manufacture and testing of lightning arresters for outdoor service.

The arresters shall be capable of protecting the following equipment:

- Transformers which are directly connected to a line
- Transformers which are connected to a line via cables
- Capacitors
- Cables
- Autoreclosers and sectionalisers
- Circuit breakers and isolators
- Instrument transformers

The outdoor lightning arresters shall be of the metal oxide gap-less type, complying with IEC 60099-4.

The lightning arresters shall have the following characteristics:

Description	Unit	Nominal voltage level		
		22		
Rated voltage of arrester	kV	27		
Nominal discharge current (8.20 μ s)	kA	10		
Class Distribution Min. protective ratio		1.2		

The arresters shall be designed horizontally or vertically (standing or hanging) in standard lattice towers. The arresters shall be supplied complete with fixing materials and connection clamps.

The lightning arresters shall be fitted with a pressure relief device.

All arresters shall be fitted with incorrodible metal nameplates which are visible when the arrester is completely mounted and which clearly indicate the data specified in IEC in engraved or embossed characters.

All external ferrous parts shall be hot-dip galvanised.

Protection Characteristics

This is a combination of the following:

- Maximum residual voltage for steep current impulse (1/20 μ s)
- Maximum residual voltage for current impulses with waveform (8/20 μ s) and 0.5, 1.0 and 2.0 times nominal current
- Maximum residual voltage for switching impulse (30-100/60-200 μ s)

The protection level for lightning impulse is the highest of

- maximum residual voltage for steep current impulse divided by 1.15
- and
- maximum residual voltage at nominal current and 8/20 μ s

The protection level for switching impulse is the maximum residual voltage at the specified switching impulse current.

The protection level shall have at least a margin of safety of 30 % compared to the BIL of the arrester housing.

Energy Requirements

The lightning arresters shall be designed to minimum line discharge class 2 according to IEC 99-4 for heavy duty arresters.

Housing

The outer housing shall be of a silicone rubber material offering high resistance to pollution. The specific creepage distance for any arrester shall be greater than 31mm/kV system voltage, corresponding to heavy pollution according to IEC. Established practice in Gaza is 800 - 1050mm for 24kV, which shall be complied with.

Tests

Lightning arresters offered or supplied to this specification shall comply with the tests detailed in IEC 99-4 including wet tests and any additional tests specified. Tests shall include requirements set out in the following:

Certified copies of type test reports shall be submitted with the bid and shall include calibrated oscillogram demonstrating that each type of arrester offered complies with the minimum specified requirements. The catalogue numbers applicable to each arrester shall appear on the oscillogram. The time to spark-over applicable to each test involving spark-over of the series gap shall be clearly shown.

Bidder should state what routine tests are carried out to prove the effectiveness of the seals of the arresters.

7.4 OVERHEAD LINE INSULATORS

General

Pin, post and reel type insulators shall be brown glazed porcelain or epoxy resin and shall comply with the requirements of adequate IEC publications.

Tension insulators shall be either of strings of toughened glass disc insulators or comprise epoxy resin long rod type units. The design of insulators and fittings shall be such as to avoid local corona formation and no significant radio interference shall be exhibited. The insulator units and the complete insulator sets shall conform to the electrical and mechanical design criteria given in General Technical Specification of this Specification.

Pin Insulators for Over Head Lines

Pin type insulators for use on 33, 22 and 11 kV lines shall have as a minimum the electrical characteristics required in Section 2 of this Specification and they shall be fitted with galvanised mild steel spindles having a minimum failing load of 10kN.

Spindles for pilot insulators must have a minimum failing load of 700N. Conductor sizes to be accommodated shall vary from 6.0mm to 19.0mm diameters with Preformed Distribution Ties.

Tension Insulators

Tension insulator sets shall be either made up of strings of toughened glass disc insulators of 254mm diameter and fixing centres at 140mm of 16mm ball and socket couplings, or of epoxy resin long rod type insulators of equivalent electrical and mechanical performance.

Complete tension insulator sets, including fittings, shall have a minimum withstand factor of 2.5 based upon the ultimate mechanical strength.

The ultimate mechanical strength of an insulator set shall be the load at which any part of the insulator string fails to perform its function of providing a mechanical support without regard to electrical failure.

Individual insulator units shall have a minimum withstand factor of 2.5 based upon the combined electro-mechanical strength of the insulator unit. This is defined as that load at which any part of the insulator fails to perform its function either electrically or mechanically when voltage and mechanical stresses are applied simultaneously.

Marking of Insulators

Each insulator shall have marked upon it the manufacturers name or trade mark, the date of manufacture or firing, and indication of the guaranteed electro-mechanical strength and other such marks as may be required to denote each batch for the purpose of sample tests.

Unless otherwise approved the insulators submitted, as a batch for a test shall bear the same marks.

These marks shall be imprinted and not impressed. For porcelain, the marks shall be imprinted before glazing. When a batch of insulators bearing a certain identification mark has been rejected no further insulators bearing this mark shall be submitted and the Supplier shall satisfy the Engineer that adequate steps will be taken to mark or segregate the insulators constituting the rejected batch in such a way that there shall be no possibility of the insulators being re-submitted for test or supplied for the use of the Employer.

Porcelain Insulators

All porcelain shall be sound, free from defects and thoroughly vitrified. The glaze shall not be depended upon for insulation. The glaze shall be smooth, hard, of a uniform shade and shall cover completely all exposed parts of the insulator. Insulators and fittings shall be unaffected by atmospheric conditions due to weather, proximity to the coast, fumes, ozone, acids alkalis, dust or rapid changes of air temperature between minus 40°C and plus 75 °C under working conditions.

Insulator Caps and Pins

The caps of insulator units shall be of malleable cast iron or other suitable material having the necessary strength to enable the complete unit to comply with this Specification. The pins shall be made of steel or other suitable material of such quality that the finished unit shall comply with this Specification.

The design of the unit shall be such that stresses due to expansion and contraction of any part of the insulator shall not lead to deterioration.

The porcelain shall not engage directly with hard metal. Cement used in the construction of an insulator shall not fracture by virtue of expansion, or loosen by contraction and proper care shall be taken to locate the individual parts correctly during cementing. The cement shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

Fittings

Ball and socket connections shall be provided with specially designed □W□ clips, which effectively locks the connection against accidental uncoupling without detracting from its flexibility. The □W□ clip shall be of stainless steel.

The design shall be such as to permit easy removal for replacement of insulator units under live line conditions without the necessity of removing the entire string from the cross-arm. All split pins for securing the attachment of fittings of insulator sets shall be of stainless steel and shall be backed by washers. Plated split pins shall not be used.

All clamps, ties, joints, lugs and all other fittings to be supplied under this contract shall be of proven standardised design in compliance with internationally recognised Technical Standards and practices and shall be suitable for the specified equipment to be supplied. The electrical and mechanical properties shall match the equipment to which the fittings shall be connected. The Supplier (Contractor) shall be responsible for proving to the satisfaction of the Engineer, the adequacy of the fittings to be supplied.

Ferrous Metal Parts

All ferrous metal parts except those of stainless steel shall be hot dipped galvanised to give an average coating of zinc equivalent to 610 grams per square metre.

7.5 WOOD POLES AND ACCESSORIES

Wood Poles

The poles shall be salt or creosote impregnated wooden poles. Other impregnation may be considered if it is sufficiently documented that the quality and pole life span can match that of creosote impregnated poles.

The wooden poles shall fulfil the requirement in BS 1990 or other equivalent internationally recognised Standard. Relevant documentation shall be submitted with the Bid.

The poles shall be manufactured in a factory practicing continuous quality control.

The poles shall be marked with length, diameter and year of manufacture. The marking shall be placed 4 m from the pole base.

Test certificates from full-scale tests of the strength of different type of poles shall be submitted upon request.

Any deviation from the specifications and Standards, which have any effect with regard to function, strength, interchangeability and life span shall be reported to the Employer or the Engineer for consideration and decision.

A deviation may be accepted, subject to rectification, or rejected by the Employer or the Engineer, and his decision will be recorded and returned to the Supplier. When delivering the item concerned, the Supplier shall ensure that the decision is included in the documentation package. He shall also certify that any conditions applicable to the acceptance of the deviation have been fulfilled.

Routine tests shall be performed in accordance with the relevant standards and according to instructions from the Employer or the Engineer.

If so required by the Employer or the Engineer, representative samples of poles selected at random among lots ready for dispatch, shall be subject to tests in order to verify their conformity with the specification.

Any tests required shall be performed by the Supplier and the costs are deemed to be included in the quoted prices.

The insulating part shall be clearly and permanently marked with the name of the manufacturer or his trademark, the year of manufacture and type of insulator.

The Supplier shall carry out the type, sample and routine tests as prescribed in IEC 60383.

Test certificate issued by the testing laboratory shall be submitted together with the tender.

Stay Wire

The stay wires shall be hot dip zinc-coated and manufactured from steel. They shall be in accordance with internationally recognised Standard. Such information shall be submitted with the Bid.

The wire shall have the following dimensions and strength:

Nominal area	52 mm ²
Calculated approximate diameter	9.2 mm
Rated breaking strength	70 kN
Number of strands	19

Stay Wire Accessories

The following accessories shall be delivered, as specified in the price schedules.

Stay wire tension adjusting device, of the U-bolt type, complete sets with necessary nuts and fittings.

Stay wire attachment devices for attachment to wood or steel pole. The attachment may be preformed grip or clamp type. The device shall be as complete sets suitable for the specified stay wire and its rated strength.

Suitable and matching stay wire anchors for soil and rock shall be supplied as per price schedules.

7.6 WORKS TESTS

Conductors

Conductors shall be tested in accordance with the following requirements:

(a) Samples

Samples of individual wires shall be taken from each length of conductor before stranding and a sample from each length of finished conductor shall be taken at the option of the Engineer.

(b) Failure

If a sample should fail, a second and third sample shall be taken from the same length and if one or other of these additional samples fails under tests, the entire length of conductor from which the sample wires are taken shall be rejected.

(c) Tensile Tests

Tensile tests shall be carried out as detailed in the relevant Standard.

(d) Wrapping Tests

Wrapping tests shall be carried out as detailed in the appropriate Standard.

(e) Resistance Tests

Electrical resistance tests shall be carried out in accordance with the details in the appropriate Standard.

Overhead Line Insulators

General

Type, routine and sample tests shall be carried out in accordance with IEC 383 on all insulators and insulator string fittings.

Type Tests

The tests shall prove the required parameters laid down in the Specification. In addition type tests shall be carried out in accordance with IEC 383 and the following minimum test values shall be obtained for 33 kV:-

	Post	Tension
Transverse (pin only) Min Failing Load	10kN	-----
(Tension)	-----	70kN
Impulse Withstand Voltage	200kV	300kV
Wet 1 minute power frequency withstand Voltage	90 kV	135 kV

Sample and Routine Tests

Insulators shall pass the sample and routine tests set out in IEC 383. In the event of failure under the retest procedure the whole of the batch or batches from which the selection was made will, except at the discretion of the Engineer, be rejected.

STEEL WORKS

1. GENERAL SPECIFICATIONS

1.1 Scope of Work

The Scope of Work covered by this Contract comprises the manufacture, testing, delivery at Employer's store in Gaza, off-loading and insurance to the Employer's stores of steel poles/structures for MV and LV distribution lines.

Quantities and types of steel poles/structures and accessories are specified in the Schedule of Quantities and Prices in Section forming part of these Bidding Documents.

1.2 Site Conditions

The site conditions shall be assumed to be as follows:

Description	Unit	Value
1 Altitude of site above sea level	m	0-1000
2 Ambient Temps:- Maximum	°C	+45
Minimum	°C	+ 5
3 Wind Speed Maximum	m/s	38.8
4 Isokeraunic Level		15
5 Pollution Type		Dust
6 Relative Humidity Maximum	%	100
Minimum	%	<10
7 Rainfall Average annual	mm	600
8 Hail		Yes
9 Fog		Yes
10 Sand Storms		Occasional

1.3 Electrical Design Data

Item	Description	Unit	Nominal voltage level	
			kV	
			33	0.4
1	Nominal system voltage phase to phase (delta connected)	kV	33	0.4
2	Highest system voltage phase – phase	kV	36	0.42
3	System Frequency	Hz	50	50
4	System earth		Solid	Solid
5	Impulse withstand voltage (1.2/50 µsec wave)	kV peak	170	
6	Power frequency withstand voltage 1 min.	kV	70	
7	Assumed highest switching surge		3.5	2.5

Other electrical design criteria and parameters, such as electrical clearances in the pole/structure top, mechanical loading, load cases and phase spacing shall comply with the standard practice of Gaza Electricity Distribution Corporation (GEDCo/UNDP) and the neighbouring IEC.

2 GENERAL TECHNICAL SPECIFICATIONS

2.1 Standards

Basically, the established standard practice of GEDCo/UNDP and IEC (Israel) shall be applied. Additionally, well reputed and internationally widely used standards will apply as outlined below.

Unless otherwise specified herein, all material used and equipment supplied and all workmanship and tests shall be in accordance with the latest editions of IEC (International Electro-technical Commission) and ISO standards, or other relevant standards e.g. ANSI, ASTM, BS. In all cases, the Contractor must inform the Employer or the Engineer well in advance precisely to which standards the materials, workmanship or tests will conform. For any such standards that are not written in the English language, the Contractor shall make available copies of an English translation thereof.

The Contractor will be required to hand over to the Employer or the Engineer two copies of all approved Standards or an English translation thereof.

Where no standards exist, as in the case of patented or special materials, all such

materials and workmanship shall be of the best quality, and full details of the material and any quality control tests to which they may be subjected shall be submitted to the Employer or the Engineer for approval.

The Contractor shall at all times keep copies of the specified standards and codes and all amendments thereto available for reference and inspection at the places of manufacture.

2.2 Type of Works

The Works covered by this part of the Specifications include the following:

- Standard design of all steel poles/structures and accessories;
- manufacture of steel poles/structures according to standard design;
- galvanising of steel poles/structures;
- timely delivery of steel poles/structures to sites including transport, handling and on/off loading; and
- any other works necessary for full compliance to the Employer's standard

2.3 Completeness of Contract

All components and materials which may not have been specifically mentioned, but which are usual or necessary in the respective equipment for the completeness of finished work in an operable status, shall be deemed to be included in the Contract and shall be provided by the Contractor without any extra charge. All equipment shall be complete in all details, whether or not such details are mentioned in the Specification.

All materials and skilled labour, whether of temporary or permanent nature, required by the Contractor for the design, manufacture, erection and testing at site of equipment shall be supplied and paid for by the Contractor.

Any reference in the quantity and price schedules, the delivery times or in various clauses and schedules of the text of either the Specification or the Tender Documents, to any equipment shall imply that the equipment is complete with all accessories, apparatus and fittings as outlined above.

2.4 Materials and Equipment

All materials, whether fully specified herein or not, shall be of first class quality particularly with regard to manufacture, strength, ductility, durability and ability to function and shall conform with the best modern practice and comply in all respects with these specifications. Where applicable, all equipment shall be of tropical design.

All material shall be inspected and tested in full to prove compliance with the requirements of the specifications to the satisfaction of the Employer or the Engineer, if so required. The testing shall be carried out according to the relevant standards approved by the Employer or the Engineer.

2.5 Standardization of Equipment

All small mechanical and electrical equipment, material and devices for the works shall as far as possible be of the same make and type.

The Contractor shall be responsible for the standardisation of all small mechanical and electrical equipment, materials and devices for the Works. He shall arrange and perform the necessary co-ordination work with his subcontractors for the purpose of such standardisation.

2.6 Workmanship

All work, methods of work and workmanship, whether fully specified herein or not, shall be of the highest order. In all respects, the generally accepted requirements and commonly recognised good practice for first class work of this nature are to be adhered to. All work shall be to the satisfaction and approval of the Employer or the Engineer.

2.7 Drawings and Calculations

The GEDCo/UNDP standard drawings for poles/structures and accessories shall be used.

To the extent that new drawings have to be made, such drawings shall comply with the following:

The Contractor shall prepare all drawings necessary for the works, which shall comply with the specifications included in the contract documents. The Contractor shall prepare his drawings to show the most suitable arrangement of all details and accessories having regard to the conditions applicable. The Contractor shall be entirely responsible for all design and drawings applied.

The Contractor shall inform himself fully of the actual dimensions, levels, etc., of any other existing or proposed structure before commencing the manufacture of parts dependent on such data.

The design calculations for each member forming part of the works shall be based on the most unfavourable combination of all the loads which the said member or part is intended to support or assist in supporting either permanently or temporarily.

The Contractor shall submit to the Employer or the Engineer for review and approval, within the times named in the specifications or agreed in accordance with these conditions, such general, workshop and erection drawings, structure lists and calculations, as are called for in the specifications or required by these conditions, or as the Employer or the Engineer may reasonably require.

Copies of all drawings to be reviewed by the Employer or the Engineer shall be provided to him in triplicate by the Contractor or more copies if requested by the Employer, and the Contractor shall ensure that such drawings are submitted in sufficient time to permit checking and correcting thereof before they are required to be used. Dispatching of drawings to and from the Employer or the Engineer shall be effected by the most expeditious way of transport.

Within a reasonable period not exceeding one month after receiving such drawings and calculation one copy of each document will be returned to the Contractor, dated, signed and marked by the Employer or the Engineer and, where necessary with proposed corrections indicated.

Drawings marked "Not Approved" shall be corrected by the Contractor and sent to the Employer or the Engineer for his further review.

No drawings prepared by the Contractor which require to be reviewed by the Employer or the Engineer, shall be used for manufacturing purposes until they have been marked "Approved" and signed by the Employer or the Engineer. Manufacturing starting prior to receipt of "Approved" drawing is done at the Contractor's own responsibility.

Approval of the Contractor's drawings shall not relieve the Contractor of any of his obligations under this contract or of his responsibility for the correctness of the design and drawings.

As soon as the Contractor's transparent copies have been approved, the Contractor shall, in addition to the copies for his own use, distribute copies of the approved drawings and such other particulars as directed by the Employer or the Engineer, to the Employer (3 paper copies) and to any other parties who may, in the opinion of the Employer or the Engineer, require them. One copy of the drawings shall be kept by the Contractor, and shall at all reasonable times be available for inspection and use by the Employer or the Engineer and by any other person authorised in writing by the employer. The latest updated version of drawings shall be used during the manufacturing and erection period.

For all documents, written or drawn, the SI system of units shall be used.

Drawing sizes shall conform to the ISO standards, i.e.

	A1 (594 x 841 mm)
A2	(420 x 594 mm)
A3	(297 x 420 mm)
A4	(210 x 297 mm)

Sizes larger than A1 shall be avoided.

All measurements on the drawings shall be given in mm. All text in the documentation shall be in the English language. Each calculation and main drawing shall have a blank space in the lower right hand corner for the client's title block and identification numbers. A revision block shall be located adjacent to the title block.

Calculations shall be in size A4.

The Contractor shall during the total project time maintain a List of Documentation to be updated by him whenever needed. The list of Documentation shall include the date of original issue of each document submitted as well as the dates of every revision. The List of Documentation shall also include a time schedule for submittal of the documentation.

2.8 Samples

The Contractor shall without extra payment submit to the Employer or the Engineer for testing and review, samples, patterns and models as are called for in the specifications or required in these conditions or as the Employer or the Engineer may reasonably require for proving compliance with the contract.

The sample is to be truly representative of the bulk manufacture and is to be manufactured with the same method and with the same equipment used for the bulk manufacture.

Measurements, design and material shall be in accordance with the drawing, valid standards and technical requirements.

The supplier shall provide samples clearly marked: "sample", manufacturer, contract number, detail designation and drawing number.

Within a reasonable period not exceeding one month after receiving such samples, patterns and models a written document will be returned to the Contractor, dated, signed and marked by the Employer or the Engineer, approved or where necessary with proposed corrections indicated.

Manufacturing starting prior to such approval is done at the Contractor's own responsibility.

2.9 Progress Reports

Progress Reports V-1.10 **Progress Reports**V-1.10 **Progress Reports**V-1.10
1.10 **Progress Reports**Work plans, programmes and reports shall be provided by the Contractor.

At the end of each month the Contractor shall submit suitable written progress reports to the Employer or the Engineer. The progress of design, manufacture, transport and delivery during the period, and the total completed to date shall be shown in the reports.

2.10 Manufacture

The Contractor is responsible for the quality of the final product conforming to the requirements laid down in the appropriate specifications and drawings.

Before commencing any manufacture of the works the Contractor shall submit for the approval of the Employer or the Engineer, the names of the manufacturers and subcontractors from whom he proposes to order any parts of the work. After such approval has been given, the manufacture shall be planned and performed according to the

specifications and to the satisfaction of the Employer or the Engineer.

The Employer or the Engineer shall be afforded every opportunity to control and inspect the manufacture and testing of materials and their assembly in the workshops of the Contractor and his subcontractors.

2.11 Inspection and testing

A programme of the tests in factory written by the Contractor showing the different inspection procedures shall be mutually agreed between the Contractor and the Employer or the Engineer.

The Contractor shall keep the Employer or the Engineer informed about the course of manufacture of materials and works, so that the inspection and testing can be performed in the presence of the Employer or the Engineer.

Before every inspection and test witnessed by the Employer or the Engineer the Contractor shall satisfy himself that the work is in all respects in accordance with the specification ready for inspection and testing.

All parts shown to be defective during testing or inspection shall be rejected if so directed by the Employer or the Engineer or shall be made good or repaired to the satisfaction of the Employer or the Engineer at the Contractor's cost. Such parts as are made good or repaired shall be re-tested and re-inspected.

Full and complete testing of components shall be carried out to the satisfaction of the Employer or the Engineer.

The Contractor shall give a complete description of proposed test methods. All instruments and equipment necessary for testing shall be provided by the Contractor. The test reports shall be submitted to the Employer or the Engineer for review in three copies.

The Contractor shall, at his own cost, carry out all non-destructive tests necessary to prove compliance with the specifications.

Such tests as radiographic examination, ultrasonic control, magnetic-particle testing, etc., shall be carried out either in the workshops or at the site, and the results shall be to the satisfaction of the Employer or the Engineer.

Full scale tests of steel poles/structures, if applicable, shall be performed at test loads to be agreed and under all other specified conditions to the satisfaction of the Employer or the Engineer.

3 PARTICULAR TECHNICAL SPECIFICATIONS

3.1 Steel Poles/Structures

3.1.1 General

Steel poles/structures shall be of lattice steel self-supporting, bolted construction.

The poles/structures shall be designed with main dimensions and electrical clearances according to the Employer's standard design.

The poles/structures shall be designed in accordance with BS, ASCE or other recognised standard to the approval of the Engineer.

3.1.2 Pole/Structure types

The types and sizes of poles/structures shall be as described in the Schedule of Quantities and Prices. The types and design shall comply with GEDCo/UNDP and Israeli standard practice.

3.1.3 Accessories to Poles/Structures

All accessories, such as cross-arms, transformer arms, brackets, bases, bolts nuts, washers and all other parts necessary for completeness of supply, shall be included in the supply and be suitable to the poles/structures as described in the Schedule of Quantities and Prices. All accessories shall be in compliance with GEDCo/UNDP and Israeli standard practice.

3.2 Corrosion Protection

3.2.1 General

All parts of the work shall be protected against corrosion under service conditions. The protection shall also prevent corrosion during transport and handling.

Damage to the protection during transport and handling shall be repaired to the same quality as specified for the object.

3.2.2 Galvanising

Except where otherwise specified all ferrous parts shall be galvanised.

Galvanising shall be applied by the hot-dip process and shall consist of a continuous coating to minimum thickness as follows:

Average of Specimens tested $\mu\text{m (g/m}^2\text{)}$	Any Individual Specimen tested $\mu\text{m (g/m}^2\text{)}$
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Rolled steel exposed to the atmosphere only	t<5 mm	87 (610)	79 (550)
	t≥5 mm	95 (685)	87 (610)
Rolled steel under ground			
Surface and in contact with ground	215	(1550)	190 (1370)
Cast iron and malleable iron	87	(610)	70 (500)
Bolts, nuts and washers	45	(305)	45 (305)

The zinc coating shall meet the requirements according to ASTM A123, A153, A239 and A385, or relevant BS.

All steel shall be fully fabricated before galvanising, no machine or shop work, boring, punching etc. will be allowed after galvanising. Minor damage to the galvanising resulting from transportation and handling shall be repaired in an approved manner, e.g. by painting with an approved zinc-rich paint, containing at least 92 weight per cent zinc powder.

After galvanising all members shall be dipped in a dichromat solution bath to avoid formation of white rust during storage and transportation.

Prior to bundling of steel members, after galvanising, all members shall be completely dry.

3.3 Structural Steel

Structural steel shall be made by the open hearth basic oxygen or electrical furnace process, and shall comply in quality with the requirements for ST37-2 in DIN17100 or Grade 43 A in BS 4360. Steel of higher tensile grade if offered, shall comply with relevant DIN or BS Standards.

Only two strength classes may be used, low tensile steel (yield point 220-250 N/mm²) and high tensile steel (yield point 300-350 N/mm²). For tubular poles the thickness shall be >2.2mm < 5.0mm, and the factor of safety shall be the ratio ultimate stress/yield point = 1.5 minimum.

Steel shall comply with the requirements of ASTM A143 and embitterment tests shall be made in accordance with that specification.

If the Contractor intends to use more than one quality of steel, he will be required to take every precaution to the satisfaction of the Employer or the Engineer against any possible intermixing of different qualities during transport, storage, handling, manufacture and installation.

Cast iron shall have a tensile strength of at least 140 N/mm². It shall be made from the best grey pig and scrap iron and shall be close-grained, tough and uniform in character.

Malleable iron shall be of the black hearth type with a tensile strength of not less than 330

N/mm².

3.4 Bolted Connections

Bolts shall conform to the requirements of Clause 3.5 below.

Bolted connections may have one bolt only.

Minimum bolt spacing is equal to two point five (2.5) times the bolt diameter.

The distance from the centre of a fastener hole to the end of any connected part shall not be less than two (2.0) times the bolt diameter minus five (5.0) mm, and the distance to the adjacent edge shall not be less than one point five (1.5) times the bolt diameter.

The distance from the centre of a bolt to the face of the out standing flange of an angle or other members shall be such as to permit the use of a socket wrench, in tightening the nut.

The bolt hole diameter shall be equal to the bolt diameter plus one point five (1.5) mm.

Allowable ultimate bearing stress for bolts as well as members are equal to one point zero (1.0) times the ultimate stress F_u of the steel.

Allowable ultimate shearing stress for bolts and members is equal to zero point six (0.6) times the ultimate stress F_u of the steel.

3.5 Bolts, Nuts and Washers

Bolts in poles/structures shall be high strength with M-threads. Connection bolts, step bolts and nuts shall be high strength bolts conforming to ASTM - A325 or equivalent, except as specified herein.

Bolts and nuts shall be of standard design. Nuts shall be tapped after galvanising and the threads of the nuts left bare and greased. Washers shall be used under the nuts. Bolt lengths shall be such as to ensure that bearing is upon the shank and not upon the thread of the bolt. The threaded part shall end within the washer. When installed, the bolt shall project through the nut not less than three (3) mm and not more than ten (10) mm. Taper washers shall be used where required.

An extra 5% bolts, nuts and washers shall be delivered to compensate for loss during construction. The costs of the extras shall be included in the appropriate unit prices in the Price Schedules.

3.6 Splices

Splices in all members of lattice steel structures shall be of the butt-splice or lap-splice type.

Splices of the main members shall be located immediately above horizontal members or diagonal brace connection.

Welding will be permitted in splices for tubular steel poles.

3.7 Cutting

Members shall be cut, drilled or punched and shaped to jig or by other means ensuring a proper fit. Arris formed by sawing or shearing shall be removed. Cracks and unevenness or sheared surface shall be removed by suitable means. Burrs shall be removed.

3.8 Holes

Final hole diameter may not exceed the corresponding bolt diameter by more than 1.5 mm. Holes may be punched to full size in steel not exceeding 13 mm in thickness provided that the diameter of the hole exceeds the thickness of the material. Holes in steel thicker than 13 mm may be punched to a diameter 3 mm less than final and centre drilled to full size. Steel thicker than 16 mm must not be punched.

Incorrectly drilled or punched holes shall not be refilled by welding.

Cutting and punching may not be carried out at lower steel temperature than 0°C.

Detail design shall be such as to avoid as far as possible eccentricities of joints. Pockets or depressions which would hold water shall be avoided. Tubes and similar profiles shall be properly drained.

3.9 Welding

3.9.1 Qualifications for Executing the Welding Work

The welding work on the structures, if employed, shall be performed with a labour management experienced in welding and with skilled welders. The qualifications shall be testified by a certificate.

3.9.2 Execution of the Welding Work

The sequence of welding shall be such as to cause as small deformations and welding stresses as possible.

The welding shall be performed with equipment and in premises suitable for the purpose.

Equipment shall be well suited to the type of weld to be performed so that the right quality shall be attained.

No gaps or hollows may appear in the welding into which acid may penetrate during the pickling procedure preceding galvanising.

The weld shall be ground flush to the surface in such places where the welding bulge prevents a perfect fitting of components together.

A high bulge or uneven weld surface may be levelled out by chiselling or grinding.

3.9.3 Filler Metals for Welding

Standard filler metals shall be used and the strength class and quality shall be chosen to correspond to the base material.

4 SCHEDULES

4.1 Schedule 'A' - Time Periods to Complete Delivery

See Section VII – Schedule of Requirements.

4.2 Schedule 'B' - Manufacturers, Places of Manufacture and Inspection

See Section VII – Schedule of Requirements.

4.3 Schedule 'C' - Technical Data

The Bidder shall complete in full all of the information required in these Schedules. Partially completed Schedules will not be accepted.

4.3.1 Schedule 'C1' for Lattice Steel Poles

	Description		
1.	Thickness of zinc coating, steel members	µm	
2.	Thickness of zinc coating, nuts and bolts	µm	
3.	Type of steel for members, lattice structures		
4.	Strength class of steel		
5.	Yield point	N/mm ²	
6.	Type/class of bolts and nuts		

4.3.2 Schedule 'C2' for Tubular Steel Poles (The Tenderer shall submit one completed schedule for each type of pole to be supplied)

No	Description	Unit	Guarantee Data	Bottom diameter (mm)	Top Diameter (mm)	Thickness (mm)	Length (m)
1	Pole strength	DaN					
2	Pole material (steel type)	Type					
3	Conical shaped poles						
4	Sectionalised poles						
4.1	Section No. 1						
4.2	Section No. 2						
4.3	Section No. 3 (if any)						
5	Slip joints overlap	mm					
6	Pole total length	m					
7	Pole weight	kg					
8	Thickness of galvanising	µ					

4.4 Schedule 'D' – Drawings

The following drawings shall be submitted with the Tender:

- Lattice steel poles – standard design 70/80, 80/90, 90/110
- Channel steel pole U14 for MV, 12 m
- Cross-arms with accessories
- Anti-climbing devices
- Channel steel pole U14 for LV, 9m
- Tubular steel poles, strength classes:
 - 80 daN
 - 80 to 120 daN
 - 120 to 250 daN
 - 250 to 400 daN

4.5 Schedule 'E' - Deviations from the Requirements of the Specifications

It will be assumed that the equipment offered will conform to the Specification in all respects, unless departures are mentioned in this Schedule.

No	Description of deviation	Advantage or result of deviation