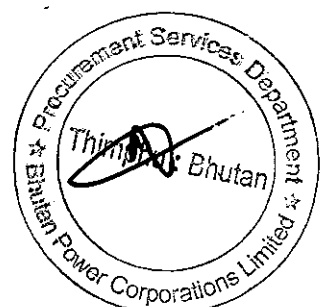


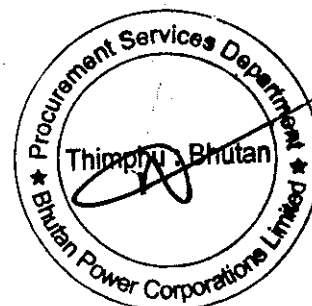
PART 2- Supply Requirement



Section V. Schedule of Supply

Table of Contents

1. Delivery and Completion Schedule.....	3
2. Technical Specifications and Drawings.....	4

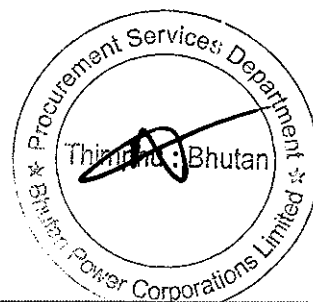


1. Delivery and Completion Schedule

- a. The delivery period shall commence from the date of signing contract.

Lot No.	Lot Description	Required Arrival Date of Goods or Completion Date for Related Services
Lot 1	<i>Lubricants</i>	120 days from the signing of contract
Lot 2	<i>Distribution Boards</i>	150 days from the signing of contract
Lot 3	<i>Paints</i>	120 days from the signing of contract
Lot 4	<i>Insulators</i>	150 days from the signing of contract
Lot 5	<i>Lightning Arrestors</i>	150 days from the signing of contract
Lot 6	<i>Line Materials & Transformer Spare Parts</i>	120 days from the signing of contract
Lot 7	<i>Earthing Equipment</i>	120 days from the signing of contract
Lot 8	<i>CT Rings</i>	150 days from the signing of contract
Lot 9	<i>CT,PT & CTPT Combined Unit</i>	120 days from the signing of contract
Lot 10	<i>Battery and Battery Chargers</i>	120 days from the signing of contract
Lot 11	<i>VCB & LBS</i>	150 days from the signing of contract

Location / Destination as specified in BDS -Shall be RSD, Stores at Pasakha, Phuentsholing

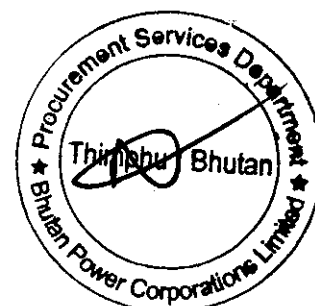


2. Technical Specifications and Drawings

Table of Content

Sl #	Technical Specification	Page No.
1	Section I- Common Technical Requirements	5-26
2	Test Standards	1-7
3	Technical Specification for Lot 1(Lubricants)	1-3
4	Technical Specification for Lot 2 (Distribution boards)	1-4
5	Technical Specification for Lot 3 (Paints)	1-2
6	Technical Specification for Lot 4 (Insulators)	1-5
7	Technical Specification for Lot 5 (Lightning Arrestors)	1-3
8	Technical Specification for Lot 7 (Earthing Equipment)	1-2
9	Technical Specification for Lot 8 (CT Rings)	1-2
10	Technical Specification for Lot 9 (CT, PT and CTPT Combined Unit)	1-8
11	Technical Specification for Lot 10 (Battery and Battery Charger)	1
12	Technical Specification for Lot 11 (VCB & LBS)	1-25
13	Table of guaranteed technical particulars (GTP Forms)- bidders to fill up	
14	Price schedule	

Note: Serial no. 14 (Table of guaranteed technical particulars -Bidders to fill up), and serial no 15 (Price Schedule) are enclosed at the end of the bidding document for convenience.



Section I - Common Technical Requirements

1.1 General

In the following sections, this document describes equipment required for the tender. The common technical specifications are to mainly state the general requirements commonly applied for all the Packages. If there is any discrepancy in the requirements between the General Specifications and the Technical Specifications in this Section, the requirements mentioned in Technical Specifications shall prevail.

1.2 Scope of Work

The supply contract includes the design, manufacture, testing, insurance, delivery in complete form (assembly at warehouse if required) unloading and proper handing over the supplies to the Purchaser's Warehouse at Phuentsholing/Pasakha, Bhutan, of the Equipment as specified in the Price Schedule.

All necessary foundation bolts, rag bolts, nuts and washers, grouting packing and the like required for mounting and securing the equipment/assemblies should be included in the supply.

Bidders shall furnish guaranteed particulars in the Schedules enclosed. Drawings of all components shall be provided together with the equipment type and reference number to ensure their identification.

The unloading of the goods (items) in the purchaser's warehouse shall be in the scope of the suppliers.

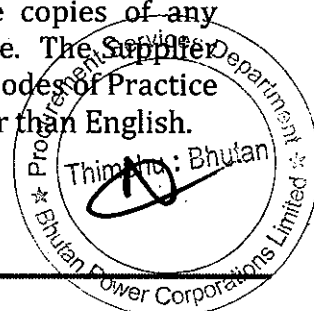
1.3 Units of Measurement

Metric units of measurement (System International) shall be used on all Contract documentation. Angular measurement shall be in degrees with 90 degrees comprising one right angle.

1.4 Standards

The design material, construction, manufacture, inspection and testing of all equipment supplied under this Specification shall conform to the latest editions of the International Electro-technical Commission (IEC) Specifications and other international standards where the material is not covered by IEC. Other national or international standards are accepted if they promise to confer equal or superior quality and performance than IEC or the specified standards.

The Supplier shall provide to the Purchaser, English language copies of any Standards and Codes of Practice, which the Supplier wishes to use. The Supplier shall provide English language translations of any Standards and Codes of Practice which the Supplier wishes to use and which are in a language other than English.



1.5 Language

The English language shall be used on all Contract documents, drawings and calculations and in all correspondence between the Supplier and the Purchaser. Any documents and drawings submitted by the Supplier in the language other than English to the Purchaser will be returned to the Supplier without review by the Purchaser.

1.6 Site Conditions

1.6.1 The conditions for the design of the equipment are as follow:

Basic Design Parameters	Basic Design Value
Altitude	2400 metres
Ambient Air Temperature : minimum Maximum	-10°C +40°C
Average Annual Isokeraunic Level	75 thunderstorm days
Average Annual Rainfall & Period	1400 mm (May to September)
Climate	Varied (From tropical to severe winters)
Relative Humidity	20 – 100%
Seismic Acceleration : Horizontal Vertical	0.1 g 0.05 g
Snow Incidence and period	150 –300 mm (December to March)
Wind Pressure : Conductors Towers, Supports	45 kg/m ² 195 kg/m ²

1.6.2 Special Conditions

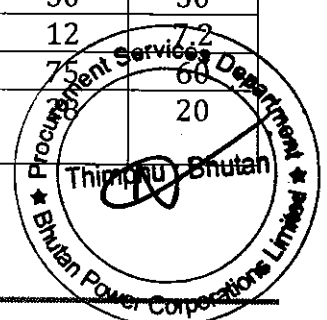
The equipment under this tender shall be designed for 2400m and accordingly shall the equipment/components shall be altitude corrected to 2400m.

1.7 Electrical Design Parameters

The electrical parameters of the equipment in accordance with relevant IEC and IS standards for 33kV and below are shown in following tables.

Medium Voltage

Nominal System Voltage	kV	33	11	6.6
Nominal System Frequency	Hz	50	50	50
Maximum System Voltage	kV	36	12	7.2
Rated Impulse withstand voltage (Peak)	kV	170	75	60
Rated one minute power frequency withstand voltage (rms)	kV	70		20



Rated one second short time current (rms)	kA	16	20	20
Rated short circuit withstand current (peak)	kA	40	50	50
Creepage Distance	(mm/kV)	25	25	25

Low Voltage

Insulation parameters- Low Voltage

Nominal System Voltage	V	400/230
Nominal System Frequency	Hz	50
Maximum System Voltage	V	424/244 ¹
Rated one minute power frequency withstand voltage (rms)	V	3000
Rated impulse withstand voltage (peak)	kA	7500

Note 1: Phase to Phase / Phase to Neutral

System Variation

Parameters permissible at 75 °C		Variation
Voltage Regulation of MV System	33,11,6.6 kV	±10%
Voltage Regulation of LV System	400/230 V	±6%
System Frequency	50 Hz	-2%, +1% ¹
Parameters permissible at 75 °C		Variation

Note 1: Maintain the System frequency between 49.0-50.5Hz.

1.7.1 De-rating

Since various standards or recommendations enforce validity limits on device characteristics, therefore the values mentioned in this specification are for the normal condition of use i.e. below 1000 m. Beyond these limits, it is necessary to deduce certain values, in other words to de-rate the device. De-rating must be considered;

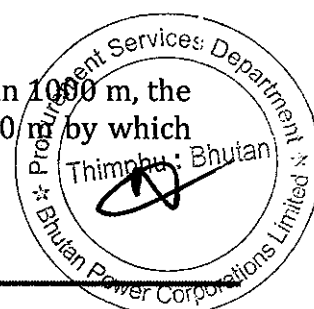
- For insulation level of external insulation.
- For electrical clearances of two conductive parts measured through air.

1.7.2 Basic Insulation Level (BIL) De-rating According to Altitude

For installation at an altitude higher than 1000 m, the correction method recommended in IEC 60694 is convenient to use for purpose of the determination of withstand test voltages.

1.7.3 Electrical Clearance De-rating According to Altitude

If the equipment is specified for operation at an altitude higher than 1000 m, the clearance requirements shall be increased by 1.25% for every 100 m by which



the altitude exceeds 1000 m. Requirements are given for phase-to-earth; phase-to-neutral and phase-to-phase clearance.

1.8 Spare Parts, Tools and Appliances

The bidder shall attach the spares, special tools and/ or appliances which are recommended.

The Purchaser may order all, none or any of the recommended items. Those ordered shall be delivered not later than the date of receipt of the last shipment of the associated item of plant. The price of the items shall be subject to the same price conditions as the associated item of plant.

All spares shall be interchangeable with the original parts. They shall be treated and packed for long term storage under the climatic conditions of site.

Each item shall be clearly and permanently labelled on the outside of its container with its description and purpose. When several items are packed in one case, a general description of the contents shall be given on the outside of the case. Spare parts shall not be shipped in the same cases as components, which are used for erection. The cases shall be clearly labelled to indicate that they contain spare parts or tools and each tool or appliance shall be clearly marked with its size and purpose.

All case containers or other packages are liable to be opened for inspection and checking on site.

The cost of recommended spares, special tools (other than those specified in the BOQ) will not be taken into consideration when comparing bids.

1.9 Electrical Power Supplies

a) Power Supplies

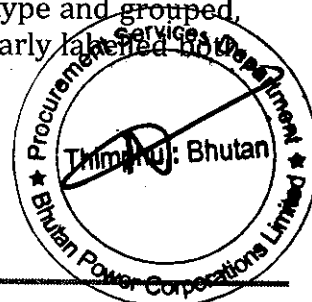
Power supplies for plant and equipment shall be:

- i. 400 V, 3 phase, 4-wire, 50 Hz for power.
- ii. 230 V, 1 phase, 50 Hz for lighting, indication, and anti-condensation heaters.

48/110 V DC for relays, essential indication, CB spring charging, controls/ protection, alarms, CB tripping and closing.

b) Miniature Circuit Breakers

Means shall be provided for protection and isolation of circuits associated with protection, control and instruments. They shall be of approved type and grouped, as far as possible, according to their functions. They shall be clearly labelled on the panels and the associated wiring diagrams.



Miniature circuit breakers shall be of the thermal and magnetic tripping type, and comply with IEC 60898 and IEC 60947-2.

c) Instruments

All electrical instruments and meters shall comply with IEC 60051 and IEC 61010 and, unless otherwise specified, shall be of industrial grade accuracy. Three-phase power measuring instruments shall be of the three-phase unbalanced load pattern wherever the current and Voltage references permit. Energy meters shall be three phase four wire having maximum demand indicator, RS485 port and optical port.

All indicating and recording instruments shall be flush mounted in dust proof cases complying with IEC 60068 and dimensions to IEC 61554.

The size of all indicating instruments shall be 96 mm square with long scale and instruments supplied from transducers shall have 4-20 mA movements. Running hour meters shall have 6 digit cyclo-meter type indicators.

Instrument dials shall be white with black markings. A red line shall be drawn on each scale to represent rated conditions. Bezels shall have uniform semi-gloss black high-grade finish.

The movements of all electrically actuated instruments shall be of the deadbeat type. Instruments shall be provided with a readily accessible zero adjustment wherever possible.

d) Terminals

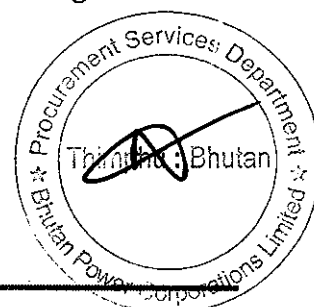
Moulding materials shall be self-extinguishing or resistant to flame propagation, substantially non-hygroscopic and shall not carbonise when tested for tracking. The insulation between any terminal & framework or between adjacent terminals shall withstand a test of 2 kV rms. for one minute. The mouldings shall be mechanically robust to withstand handling while making terminations.

All terminals shall be mounted in accessible positions. Adjacent terminals shall be adequately spaced with respect to each other and to the incoming cable gland plate. Separate terminations shall be provided on each terminal strip for the cores of incoming and outgoing cables including all spare cores.

Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. Terminals provided for current transformers shall incorporate facilities to enable secondary windings to be short-circuited without disturbing fixed wiring and earthing facilities.

Terminations for circuits operating at Voltages greater than 60 V shall be protected by transparent insulating covers marked with the working Voltages.

DC circuit terminals shall be segregated from AC terminals.



Unless otherwise specified, all the terminal blocks except the terminal blocks for CTs shall be suitable for connecting minimum two 2.5 sq.mm copper conductors of the external cables at each connecting point. The terminal blocks for CTs and PTs shall be suitable for connecting minimum of 4.0 sq. mm and 2.5 sq. mm copper conductors respectively.

All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.

The terminal assemblies shall give the required number of ways plus 20% spare with a minimum of 5 terminals. These shall be uniformly distributed on all rows of terminal blocks.

e) Panel Wiring

All wiring shall be carried out with 1100 V grade, single core, stranded copper conductor wires with FRLS PVC insulation and shall be Vermin, rodent proof. The minimum size of the stranded copper conductor used for panel wiring shall be as follows:

- a) All circuits except CT circuits : 1.5 mm² per lead.
- b) CT Circuit : 2.5 mm² per lead.

The minimum number of strands per conductor shall be seven. Extra flexible wires shall be used for wiring of devices mounted on moving parts such as swinging panels and doors.

The wiring shall be bound and supported by clamping, roughing or lacing. Spiral wrapping will not be accepted. Wire ways shall not be more than 50% full. Adequate slack wire shall be provided to allow for one re-stripping and reconnection at the end of each wire. When screened cables or wires are necessary, an insulating sheath shall be included.

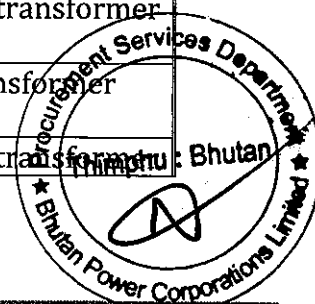
Wiring and supports shall be of fire resistant material.

Wiring shall only be jointed or teed at terminals. Terminals of the clamp type shall not have more than two wires connected.

f) Wire Colour Code

Wire colours shall be as follows:

Colour	Purpose
Red	R-phase connections in current and Voltage transformer circuit only
Yellow	Y-phase connections in current and Voltage transformer circuits only
Blue	B-phase connections in current and Voltage transformer circuits only



	circuits only.
Green with Yellow Stripes	Connections to earth
Black	AC neutral connections, earthed or unearthed, connected to the secondary circuits of current and Voltage transformers.
Any other Colours	AC connections other than those above.

Alternatively, where equipment is wired in accordance with a manufacturer's standard diagram, wiring may be carried out in a single colour except that all connections to earth shall be green with yellow stripes.

g) Terminations and Ferrules

The ends of every wire and every cable tail shall be fitted with numbered ferrules of white with alpha numbers clearly engraved in black.

Moisture and oil resisting insulating material shall be used. The ferrules shall be of the interlocking type and shall grip the insulation firmly.

Wires and terminals associated with tripping circuits shall be distinctively marked.

h) Electrical Insulation

Insulating materials shall be finished to prevent deterioration of their qualities under the specified working conditions.

Plastics, elastomers, resin-bonded laminates and inorganic materials shall be of suitable quality selected from the grades or types in the appropriate IEC Standard.

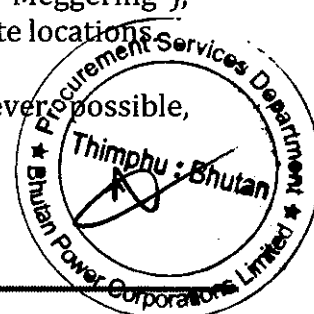
All cut or machined surfaces and edges of resin-bonded laminates shall be cleaned and then sealed with an approved Varnish as soon as possible after cutting.

i) Electronic and Control Equipment

Equipment shall be capable of withstanding randomly phased transient over-voltages of either polarity on the power supply or interruptions of the power supply without damage or impairment to the equipment's subsequent performance. In the case of controls, no mal-operation shall occur.

Where manufacturers require that electronic equipment supplied under this Contract should not be subjected to insulation resistance tests ("Meggering"), suitable warning notices shall be provided and installed in appropriate locations.

No thermionic valves shall be used in the equipment. Wherever possible, integrated circuits shall be used.



It shall be possible to remove/replace card from/to electronic equipment without damage and without interfering with the operation of the rest of the equipment or system. If necessary, consideration should be given to switching off the supplies locally to a card to prevent inadvertent interference to the equipment or system during removing/replacing a card.

j) Alternating Current Supply Practice

Double-pole switches shall be used to break single-phase ac mains supplies. For multi-phase supplies, each phase shall be switched simultaneously and the neutral should preferably not be switched. If it is switched, it shall be opened after and closed before the phase-lines.

All mains circuits shall be protected only in the phase-lines by MCBs of suitable rating or by other suitably approved protective devices. The neutral shall be connected by a removable link located near the protective devices.

All main transformers shall have an electrostatic screen, which shall be earthed.

k) Direct Current Supply Practice

Double pole switches shall be used to break dc supplies, one pole for the positive line and one pole for the negative.

DC circuits shall be protected by MCBs of suitable rating installed in both positive and negative lines.

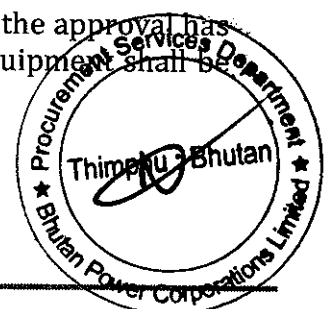
Measures shall be taken to prevent arcing across switches or relay contacts which are required to break inductive circuits (e.g. bypass diodes or capacitors connected across coils).

Power supply bus bars in cubicles shall be shrouded.

The duplicate auxiliary power supply feeders shall be provided in Control panels. Auto-changeover facility in DC DB shall be provided so that in case of failure of one power source, other shall cut in automatically. The protective relays shall not give a trip signal for momentary loss of control Voltage or during changeover of control Voltage.

l) Batteries

Electronic equipment shall not use local internal batteries unless the approval has been obtained. Where approval is given, batteries used inside equipment shall be of the totally sealed, leak-proof type.



m) Earthing

Provision shall be made for earthing all equipment intended for connection in an ac mains supply.

All structural metal work and metal chassis shall be connected to earth. Earthing conductors shall be at least equal in cross-sectional area to the supply conductors and shall be capable of carrying the fault current for 1 second.

n) Anti-Condensation Heaters

Any items of electrical equipment which are liable to suffer from internal condensation (due to atmospheric or load variations) shall be fitted with heating devices suitable for electrical operation at 230 Volts ac, 1 phase, 50 Hz of sufficient capacity to raise the internal ambient temperature by 5°C. The electrical apparatus so protected shall be designed so that the maximum permitted rise in temperature is not exceeded if the heaters are energised while the apparatus is in operation. Where fitted, a suitable terminal box and control switch shall be provided and mounted in an accessible position. A thermostat shall be provided in the heater control circuit to cut-off the heater at 45° C.

o) Interior lighting and Receptacles

The panels shall be provided with a compact fluorescent lamp (CFL) lighting fixture (11 W) rated for 240 V, 1 phase, 50 Hz supply for the interior illumination of the panel during maintenance. Switching of the fitting shall be controlled by the respective panel door switch. All CFL lamps shall be with pin type holder.

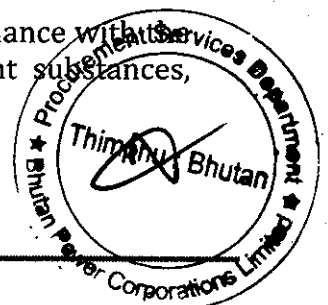
The panels shall be provided with a 230 V, 1 phase, 50 Hz, 6 Amps, 3 Pin receptacle with switch. The receptacle with switch shall be mounted inside the panel at a convenient location.

1.10 Materials and Finishes

1.10.1 General

Unless otherwise provided for in the Contract, all materials, fixtures, fittings, and supplies furnished (hereafter called "materials") shall be new and of standard first grade quality. All assembly and construction work shall be done in a neat and professional manner. Materials shall be free of defects. Materials shall be brought to site only after inspection and issuance of proper dispatch clearance. The dispatch clearance shall be issued within three working days after the inspection from the BPC head office. The local materials like bricks, sand aggregates shall be tested in the local laboratories before bulk supply.

All of the plant, whether temporary or permanent, shall be in accordance with the Contract with respect to character, type, construction, constituent substances, weight, strength, shape, dimensions, etc.



In choosing materials and their finishes, due regard shall be given to the harsh climatic conditions which can occur in the area. Some relaxation of the following provisions may be permitted where equipment is hermetically sealed, but weatherproof materials should be used wherever possible.

All structural members, nuts and bolts shall be galvanised and shall conform to the requirements.

1.10.2 Surface Coating and Galvanising

All ferrous metalwork shall be provided with an effective galvanised or corrosion resistant paint treatment applied in accordance with the best trade practice. The paint treatment for each application shall be selected from the 'Paint Procedure' described in subsequent paragraphs.

The formulation and application procedure for the paint shall be as recommended by the manufacturer for the appropriate exposure conditions.

Coatings shall not be applied before vessels and chambers have passed any required pressure or vacuum tests. Precautions shall be taken to prevent corrosion occurring in the period of time between cleaning of the steel and commencing the painting.

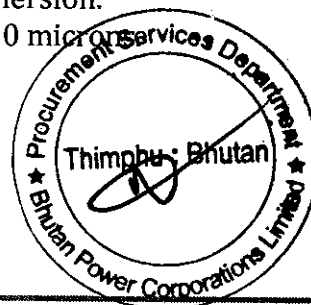
Adequate amounts of each type and colour of finish coat as applied to the major equipment items shall be provided for "touch-up" purposes.

The colour of equipment shall be painted with RAL 7032 (exterior) and glossy white (interior).

1.10.3 Paint Procedure

- (a) For Mild Steel Items Exposed to Weather:
 - (i) Blast clean.
 - (ii) 1st coat - Inorganic zinc primer to give a dry film build of not less than 75 microns.
 - (iii) 2nd coat - Chlorinated Rubber to give a dry film build of not less than 100 microns.
 - (iv) 3rd coat - Chlorinated Rubber to give a dry film build of not less than 75 microns.
- (b) Mild Steel Items Immersed in Oil :
 - (i) Blast clean.
 - (ii) 1st and 2nd coats - Epoxy paint treatment system in accordance with coating manufacturer's recommendation for oil immersion.
 - (iii) Total dry film build thickness shall not be less than 350 microns.

1.10.4 Galvanising



Galvanising shall be applied by the hot dipped process generally in accordance with ASTM A 123-78 for structural steel and ASTM A 153-73 for iron and steel hardware.

For structural steel, galvanising shall average not less than 0.61 kg/m² (no individual specimen shall show less than 0.55 kg/m²) except for 6.35 mm and heavier materials in which case galvanising shall average not less than 0.702 kg/m² (no individual specimen shall show less than 0.61 kg/m²).

For iron and steel hardware, galvanising shall be in accordance with Table 1 of ASTM A 153-73.

The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising and the galvanising itself shall not adversely affect the mechanical properties of the coated material.

1.10.5 Castings

All castings shall be free from blowholes, flaws and cracks as far as is practicable. No welding, filling or plugging of defective parts shall be done under any circumstances. All cast-iron shall be of close-grained quality approved by the Engineer.

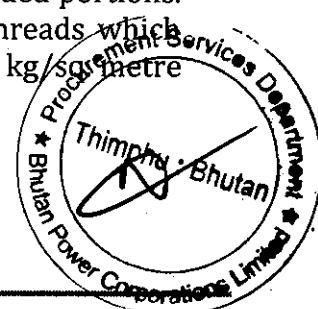
1.10.6 Welding

All joints shall be bolted joints and welded joints shall not be permitted either during the design stage or the construction stage. However, during erection in case of additional unforeseen requirements by the Employer, if welding needs to be resorted to, the same shall be done with prior approval of the Engineer, and shall conform to BIS specifications. In such a case, the Contractor shall specifically indicate the location and purpose along with the proposed methodology for welding for the Engineers' approval. The welding shall be carried out by a certified welder who have undergone minimum of certificate level training in this trade.

1.10.7 Nuts and Bolts

Nuts and bolts for incorporation in the plant shall conform to ISO Metric. Other sizes or threads may be permitted only for threaded parts not to be disturbed once manufacturing is complete. Each bolt shall have rolled threads, one hexagonal nut and two washers. Thread length shall be 50 percent of bolt length or maximum 150 mm.

All steel bolts and screwed rods shall be galvanised including the threaded portions. All associated nuts shall be galvanised with the exception of the threads which shall be oiled. The thickness of zinc coating shall be not less than 0.45 kg/square metre of surface area.

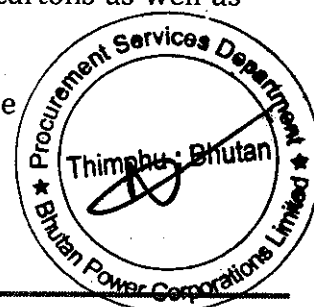


All bolts, nuts and washers shall be of non-corroding material where they are in contact with non-ferrous parts in conductor clamps and fittings and elsewhere where specifically required by the Purchaser.

1.11 Packing and Shipping

- 1.11.1 The goods/materials shall not be shipped/ dispatched unless dispatch clearance from Purchaser/Engineer is issued. The dispatch clearance will be issued from the BPCs office after the inspectors submits its inspection report to BPC, within 4 working days after the submission of the report.
- 1.11.2 Any items liable to be damaged in transit shall be effectively protected and securely fixed in their cases. All cases of over 2 tonnes shall be marked to show where slings should be placed.
- 1.11.3 All cases shall be clearly identified giving particulars of manufacturer's name and type of equipment. All identification marks on the outside of cases shall be waterproof and permanent. All electrical equipment shall be adequately sealed and desiccating agents used where necessary to prevent damage from condensation. All equipment shall be packed and protected, bearing in mind that it will be shipped to a harsh environment, that a considerable period may elapse between its arrival on site and it's unpacking and that covered storage may not always be possible.
- 1.11.4 All wood and other materials used in packing cases shall be insect free. Adequate protection and precautions are to be taken to exclude termites and other vermin, noxious insects, larvae or fungus from the packing materials or plant. All contents are to be clearly marked for easy identification against the packing list.
- 1.11.5 The Supplier shall protect all steelwork before shipment, to prevent corrosion and/or damage. Bundles of steel sections shall be properly tied together by an approved method and care shall be taken to ensure that they are robust and that they can be handled easily during shipment.
- 1.11.6 Bolts and nuts shall be double bagged and crated for shipment. Crating of dissimilar metals is not acceptable.
- 1.11.7 Packing cases where used, shall be strongly constructed and in no case shall timber less than 25 mm in thickness be used. The contents of packing cases shall be securely bolted or fastened in position with struts or cross battens. Cross battens supporting weight in any direction shall not rely for their support on nails or screws driven lengthwise into the grain of the wood, but shall be supported by cleats secured from inside.
- 1.11.8 The following information shall be marked on the containers/cartons as well as boxes:

- a) Supplier's name, Project title and Contract reference
- b) Identification number



- c) Net/Gross weight
 d) Purchaser's name with other despatch particulars such as destination.

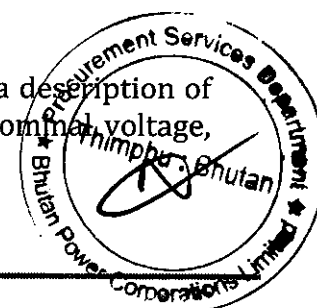
Sl. No.	Description	Marking
1	Cables	Every 1 meter Consecutively

1.12 Cable / Conductor Drums

- 1.12.1 HV Cables shall be supplied in a steel drum. The covers with wood is acceptable. LV Cables and bare conductors shall be wound on non-returnable seasoned wooden drums provided with lagging of adequate thickness and treated to an approved international standard by vacuum impregnation with copper-chrome-arsenate (CCA) preservative to resist rotting and termite and fungus attacks. Drums with an outside diameter exceeding 2.0 metres and an outside width exceeding 1.4 metres shall not be used. The central hole of the drums shall be reinforced with a steel plate of thickness not less than 10 mm, or be fitted with suitable steel hub bushing to suit an axle diameter of 95 mm.
- 1.12.2 The drums shall be new and sturdy in construction so as to withstand several times loading and unloading, transport on rough roads, storage for five (5) years in tropical areas and hauling and handling during field erection etc. In the event that the drums are received at the destination in damaged condition thereby, preventing rolling out of cable, the Supplier shall supply extra drums at his own cost. Also, the cost incurred by the Purchaser in rewinding the cable from the damaged drums onto the new drums will be deducted from the amount due to the Supplier.
- 1.12.3 Internal and external surfaces of the drum shall be painted with bitumen based paint. A layer of waterproof material shall be provided on the barrel under the cable and on the inner surfaces of the flanges. Another layer of waterproof material shall be provided over the outer layer of cable under lagging.
- 1.12.4 Drums shall be adequately protected by securely fastening substantial wooden battens around the periphery. These battens shall be secured by means of steel tap bindings.
- 1.12.5 Cables shall be securely fastened around the periphery of the drum. Cables shall be supplied with both ends properly capped, and protected against damage. Each drum and one of each cable length shall bear a metal label detailing manufacturer's name, specified voltage and type and length of conductor. The leading end of cable on cable drums shall be the 'A' end as defined in BS 6480.
- 1.12.6 The inner cable end attached to the drum shall be capped and sealed in such a manner that the core screening and sheath can be meggered from the outer cable end without removing the inner end cap.

1.13 Labels

- 1.13.1 All equipment shall be provided with labels or name plates, giving a description of the equipment, together with information regarding the rating, nominal voltage,



nominal current and the like under which the item of plant in question has been designed to operate. The labels shall be provided on packaging to the Purchaser's approval.

1.13.2 Such nameplates or labels are to be of non-corrodible, non-hygroscopic material with lettering of a contrasting colour.

1.13.3 Labels on cable drums shall state the cable details, including the length in metres.

1.14 Locks

Provision shall be made for padlocking of mechanism boxes, isolators and outdoor switchgear as required by the Specification or as necessary to limit access or the safety of personnel. All padlocks will be provided by the Purchaser.

1.15 Supplier Documents and Drawings

1.15.1 General

The Supplier shall be responsible for submission, re-submission and obtaining approval as required of all the documents and drawings listed below (but not limited to), so that there shall be no delay to the work due to the absence of such documents and drawings. Any approval by the Purchaser will not relieve the Supplier of any obligations under the Contract.

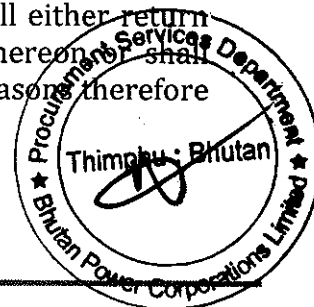
Any alterations to the documents and drawings which may be required by the Purchaser for approval shall be made by the Supplier at his own expense. All materials and work involved in their manufacture shall be as indicated in such drawings.

No work shall be done on any part of the Goods, the design or construction of which is dependent on the approval of such drawings or data, until such approval has been given.

1.15.2 Manner of Submission and Approval of Drawings

The Supplier shall submit three prints of each drawing or document (including all the drawings, documents, calculations, manuals required under the Contract) for approval marked 'For Approval'. One copy will be returned to the Supplier marked up with approval or any proposed alterations or conditions. The Supplier shall provide the same number of further prints for any drawings that are altered. The submission of drawings for approval shall be repeated until 'Approved' or 'Approved with conditions' is given by the Purchaser.

Within fifteen working days after receipt by the Purchaser of any drawing or document requiring the Purchaser's approval, the Purchaser shall either return one copy thereof to the Supplier with its approval endorsed thereon or shall notify the Supplier in writing of its disapproval thereof and the reasons therefore and the modifications that the Purchaser proposes.



All drawings, information, design reports, etc shall be neatly type written and be presented as bound documents. The documents presented shall have neatly drawn title pages that clearly show the name of the Purchaser, identify the project name, the contract number, the date, the revision number, etc, and shall be provided with a table of contents.

Bidder need to submit 3 (three) hard copies of GTP's and drawing for approval after the award of contract.

1.15.3 Manuals

The Supplier shall submit the instruction manual for all the goods supplied under the contract. The Supplier shall follow the requirements as mentioned in the relevant clauses in the Technical Specifications.

1.16 Quality Assurance

1.16.1 The manufacturer must operate a quality assurance system that complies with ISO 9000. The Supplier shall provide current certification showing the manufacturers' compliance with ISO 9000 or equivalent national standard. The certificate must be issued by an independent, accredited issuing authority.

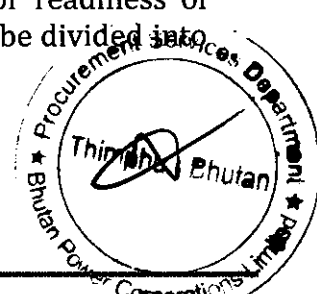
1.16.2 In compliance with the proposed quality assurance system of ISO 9000 or equivalent, Bidder shall submit with Bid the quality assurance plan for manufacturing the Goods. Especially, if the Bidder proposes to form a joint-venture or consortium, such a Bidder shall submit with Bid a quality assurance plan, including explanation how to manage the same quality of Goods by the joint-venture partners.

1.17 Tolerance

The variation in quantity to be supplied against confirmed order shall be permissible up to One (1) percent per item per consignee for delivery. However, for the short supply the payment shall be made as per the actual supply and for over supply the payment shall be limited to the ordered quantity.

1.18 Inspection and Testing

The materials will be inspected at the Manufacturer's works by the Purchaser's representative. Tests shall be performed in accordance with the relevant IEC standards. In the absence of IEC recommendations the tests must be equivalent at least to the conditions, provisions and definitions of the above-mentioned standards. The supplier shall give at least one month's notice for readiness of equipment for testing at the manufacturer's works. The tests shall be divided into the categories described below.



1.18.1 Routine Tests

All the routine tests specified by the standards shall be carried out. If the tests are not witnessed by the Purchaser's representative, test certificates shall be submitted to the Purchaser for approval. Despatch clearance will be given only if the test results are approved.

1.18.2 Type Tests

Bidder shall include with his bid type test certificates, issued by an approved, reputed, independent testing laboratory. The type tests should have been carried out in the last five years.

In addition, the Purchaser may call for type tests to be carried out at the Manufacturer's Works and to be witnessed by the Purchaser or his representative. Such tests will be on random samples at the discretion of the Purchaser and failure to meet the conditions of test could result in the rejection of a complete batch of equipment. Type testing shall only be performed if the manufacturer is unable to provide type test certificates issued by an independent test laboratory of international repute.

Inspection

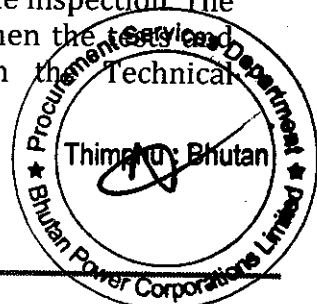
The Supplier shall intimate the Purchaser about the detailed program about the tests and inspection at least one month in advance.

Inspection and tests on all the Goods offered shall be carried out in the presence of Purchaser's representative unless inspection waiver has been given to the Supplier. The inspection shall be carried out as per the test procedure that has been approved by the Purchaser. The Supplier shall assist the work of the Purchaser's inspector by providing copies of all relevant Standards and test procedures, and allowing the inspector full use of the necessary tapes, measures and laboratory equipment, together with ample space and assistance in the handling of Goods for inspection.

The Supplier shall submit all final test and inspection reports to Purchaser's representative (inspector) during his stay at the workshop for the inspection. The inspector shall issue a "Dispatch Clearance" to the Supplier when the tests and inspection has successfully completed in compliance with the Technical Specifications.

1.19 Dispatch Clearance

1.19.1 The Supplier shall submit all final test and inspection reports to Purchaser's representative (inspector) during his stay at the workshop for the inspection. The inspector shall issue a "Dispatch Clearance" to the Supplier when the tests and inspection has successfully completed in compliance with the Technical Specifications.



- 1.19.2 The goods have to reach to the delivery warehouse within Twenty (20) days from the date of issuance of dispatch clearance (if the goods are supplied/manufactured from India & Nepal).
- 1.19.3 The goods have to reach to the delivery warehouse within Forty Five (45) days from the date of issuance of dispatch clearance (if the goods are supplied/manufactured from Third Countries).

Section - 2 Technical Requirements -Electrical

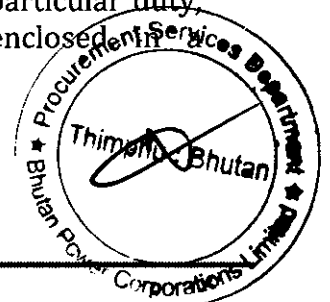
The following electrical technical requirements shall also apply to the equipment supplied under this Contract.

2.1 Electrical Supplies for Auxiliary Plant

The equipment provided under this Contract shall be capable of operating reliably at voltages down to 80% of the nominal voltage except where otherwise specified.

2.2 Electric Motors

- 2.2.1 All motors shall be in accordance with IEC 60034 and 60072 unless otherwise specified, shall be of the totally enclosed fan cooled type, suitable for continuous operation and direct on-line starting.
- 2.2.2 They shall be suitable in all respects for service in a damp tropical climate. Main conductor and slot insulation shall be non-hygroscopic and in accordance with Class F as per IEC 60085.
- 2.2.3 Motors to be located outdoor shall be entirely suitable for operation under the climatic conditions at site.
- 2.2.4 Motors shall be capable of operating continuously at rated output at any frequency between 48 and 51 Hz and at any voltage within ten percent of the nominal value. Motors shall be designed to be operated for a period of not less than five minutes at a voltage of 25% below the nominal value and at normal frequency without injurious overheating. If required by the purchaser, the supplier shall demonstrate that the motors comply with this requirement.
- 2.2.5 The starting current at full voltage shall not exceed six times the rated full load current.
- 2.2.6 All bearings shall be fitted with oil or grease lubricators. Vertical shaft motors shall have approved thrust bearings.
- 2.2.7 All terminals shall be of the stud type of adequate size for the particular duty, marked in accordance with an approved standard and enclosed in a weatherproof box.



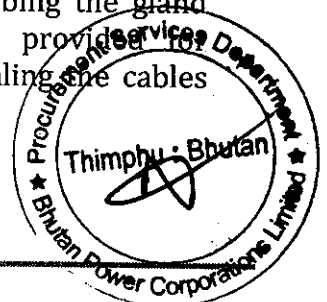
- 2.2.8 All terminal boxes shall be fitted with an approved sealing chamber, conduit entry or adapter plate, as required, together with the necessary fittings to suit the type of cable specified.

2.3 Starters and Contactors

- 2.3.1 Where starters are to be provided under this Contract, each motor shall be equipped with two or three pole control gear as appropriate and suitable, unless otherwise specified, for direct starting by the switching of full line voltage on to a standing motor. All starters should preferably be supplied by one manufacturer.
- 2.3.2 Contactors are to be of robust design and are to comply with IEC 60947-4. They shall operate without undue noise or vibration.
- 2.3.3 Contactors shall be mounted in ventilated metal cubicles. Unless otherwise approved, the metal surface of the cubicle walls adjacent to the contactors shall be protected by fireproof insulating material. Where two or more contactors are contained in the same cubicle, they shall be separated by barriers of fireproof insulating material. The cubicles shall be complete with all locks, cable sealing boxes, busbars, internal wiring, terminal boards and accessories. All bare copper connections shall be taped and all secondary wiring is to be so arranged and protected as to prevent it being damaged due to arcing.
- 2.3.4 Starters shall be of the electrically held-in type with integral "start" and "stop" push buttons mounted externally on the door, with integral interlocked isolators. Where required, auxiliary switches shall be included for the operation of "red" and "green" indicating lights in remote instrument panels.
- 2.3.5 All motor contactors and their associated apparatus must be designed to operate for a period of not less than 5 minutes at a voltage of 25% below the nominal value and at normal frequency without injurious overheating.
- 2.3.6 For circuits controlling motors of 15 kW and above, transformer operated overload and phase failure relays shall be provided. For controlling motors of less than 15 kW, thermal overload trips shall be acceptable.

2.4 Cables, Cable Boxes, Sealing End Chambers and Glands

- 2.4.1 This Contract includes power, auxiliary power and multi-core control cabling as specified in the appropriate sections of the Specification. All cables where required shall be fitted with approved cable end boxes or glands, complete with all necessary fittings.
- 2.4.2 Air filled cable boxes shall be of adequate dimensions and designed in such a manner that they can be opened for inspection without disturbing the gland plate or incoming cable. Disconnecting chamber shall be provided for disconnecting and moving away the transformer without unsealing the cables leaving the cable box or chamber.



2.4.3 Phase to phase and phase to ground clearances shall be subject to purchaser's approval.

2.4.4 Provision shall be made for earthing the body of each cable box.

2.4.5 Corrosion protected brass material, compression type glands with armour and bonding clamps for the termination of all solid dielectric multi-core cables designed to secure the armour wires and to provide electrical continuity between the armour and the threaded fixing component of the gland and to provide watertight seals between the cable outer sheath and gland and between the inner sheath and threaded fixing component. The gland shall project above the gland plate to avoid ingress of condensed moisture.

2.4.6 All cable boxes shall have at least IP 54 degree of protection.

2.5 Electronic and Control Equipment

2.5.1 Component Ratings

Components and materials shall not be subjected to voltages; currents, temperature stresses, or any other condition outside the operational values given in the manufacturer's published data, over the range of temperature variations and climatic conditions indicated elsewhere.

Where circuits use components, which operate under unusual conditions, the Bidder shall produce documentary evidence that the life, stability and characteristics of the components used will be satisfactory.

Components which in their normal function may have full supply voltage applied shall be capable of withstanding continuous energisation.

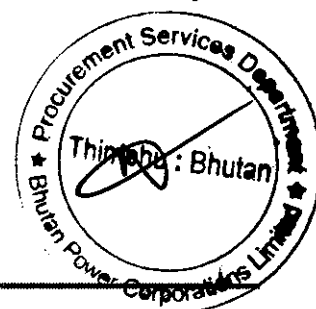
2.5.2 Component Tolerances and Aging

The design of the circuits used shall be such that initial tolerances and also cyclic and non-cyclic changes in component values and parameters which may occur during the operational life of the equipment are either inconsequential or are compensated for. Such compensation shall not necessitate the use of adjustable controls without the prior approval of the purchaser.

Standard components only shall be used and any individual selection necessary to obtain particular parameters shall be subject to the approval of the purchaser.

The combined effects of all tolerances, within a single component and between components, shall be allowed for by taking all tolerances in all worst case combinations produced by environmental and operating conditions. Other statistical assumptions that only certain combinations of tolerances will occur shall not be made, unless the relevant parameters involved are invariably interdependent.

2.5.3 Protection



All circuits shall be protected so that in the event of a component fault, no damage occurs to any interconnecting wiring and any other damage that does occur is confined as closely as possible to the fault.

Protective devices shall be so arranged that the risk of fire within the equipment be minimised. The greatest possible protection shall be provided, consistent with reliability and the ability to withstand operational conditions.

Power supply units' with/without stabilisers shall be protected with voltage trip and overload current circuits with an auto recovery feature.

If any protective device, such as MCB, is incorporated in the output circuits of a current-limited power supply unit, the available current under short circuit conditions shall be sufficient to operate them. MCBs shall be in the 'non-common side of the circuit.

Indication of trip of MCBs shall be clearly displaced by monitoring of trip. Circuits shall be grouped so that, following the operation of a protective device, no false operation shall occur as a result of an MCB trips.

The design, location and connections of MCB shall be such that they do not present a danger to the operator when it is in service.

2.5.4 Interference

a) Self-generated Interference

Equipment shall not generate any type of interference at a level which could be detrimental to the performance of any other equipment or which could cause annoyance or discomfort to personnel.

The earthing and cabling arrangements shall be such that detrimental interference is not generated.

b) External Interference

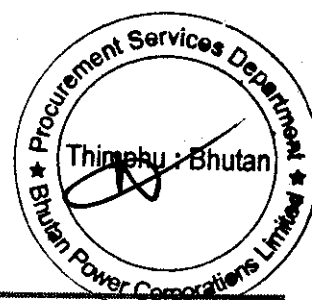
In the presence of interference expected in power station and substation environments, the design of the equipment shall be such that no damage occurs and performance is maintained to the requirements of the individual specifications.

c) Spark Quenching

Spark quenching devices shall be fitted wherever necessary to ensure continued satisfactory operation of contacts and prevent mal-operation of electronic devices.

d) Noise and Vibration

The acoustical noise levels and/or vibration produced by the equipment in operation shall be as low as is reasonably practicable for the type of equipment concerned and shall be agreed with the purchaser.



2.5.5 Setting-Up and Maintenance Facilities

All equipment shall be provided with sufficient easily accessible test points to facilitate setting-up and fault location together with maintenance aids such as extension boards, jumper leads and special maintenance tools.

Pin or terminal numbering of all cards in all crates shall be consistently uniform throughout. Power supplies shall use the same pin positions on all cards in an equipment or system.

2.5.6 Loose Equipment

Special connecting leads extension boards and any special item required for calibration or maintenance purposes, together with the mating half of all necessary connectors shall be supplied.

2.5.7 Printed Circuit Boards

Printed circuit boards shall be epoxy glass fabric boards to comply with IEC - 60321 suitable for use in hot humid climates. Printed circuit boards may be single-sided, double-sided or multi-layer.

Printed boards shall, in general, comply with IEC 60326. They shall not bow perceptibly when they are mounted in their shelves or racks. Means shall be provided to prevent boards being plugged into the wrong sockets and the plugging in/out action shall be arranged in a positive manner.

An approved protective coat shall be applied to the printed circuit side of the board to protect against tracking, tarnishing and general deterioration due to moisture and deposition of dust. The coating shall not have any adverse reaction with any other material or components used and shall be suitable for use under tropical conditions. When boards are repaired in the field it shall be possible to apply (or 'touch up') such a finish by simple convenient means.

2.5.8 Component Identification

a. A component reference number shall be marked adjacent to each component. Where this is impossible, components shall be identifiable from the layout drawings provided.

b. The following shall be marked in all instances:

MCBs

The rating and the circuit identification of each MCB shall be marked adjacent to the MCB base.

Control, Protection and Indication Devices

The function of each control, protection and indication device shall be marked. The caption and its arrangement shall be subject to the approval of the purchaser.



Pre-set Controls

The circuit reference and if possible, the function shall be marked adjacent to each pre-set control in a position where it will be clearly visible while the adjustment is being made.

Connectors

The diagram reference number shall be marked on or adjacent to each connector.

Test points shall be individually marked with the diagram reference number.

The polarity of any polarised devices (e.g. diodes) shall be marked.

Section - 3 Technical Requirements - Mechanical

The following mechanical general technical requirements shall apply to equipment supplied under this Contract.

3.1 Pipe Supports

3.1.1 The whole of the pipe work and accessories included in this Contract shall be supported and mounted in an approved manner. All necessary saddles, structural steelwork, foundation bolts, fixing bolts and all other attachments shall be supplied.

3.1.2 The number and positions of all intermediate flexible supports between anchor points shall be determined by the weights to be carried and by the steelwork available for the purpose and will be subject to the approval of the purchaser.

3.2 Valves

3.2.1 Valves shall be arranged so that the hand wheel moves in a clockwise direction to close the valve. The face of each hand wheel shall be clearly marked with the words "open" and "shut" and be provided with an arrow to indicate direction for opening and shutting. As far as possible valves shall not be fitted in an inverted position.

3.2.2 It shall be possible to remove and replace, or recondition in situ, the seats and to remove the gates. Valves of 50-mm nominal bore and above shall be provided with valve position indicators showing the amount by which the valve is open or closed in relation to its full travel.

3.2.3 All valve hand wheels shall be fitted with nameplates.

3.2.4 Suitable means shall be provided to protect the operating mechanisms of all valves against mechanical damage and dust or dirt. Adequate provision shall be made for the lubrication of the mechanism and guides and this shall be of the pressure type.



- 3.2.5** Where it will be necessary to lock valves in the open or closed position, they shall be provided with a non-detachable locking arrangement.

3.3 Oil Level Indicators

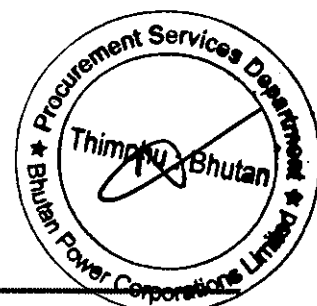
- 3.3.1** Unless otherwise approved, oil level indicators of approved design shall be fitted to all oil containers other than hermetically sealed items.
- 3.3.2** The indicators shall show the level at all temperatures 'likely to be experience in service, be marked with the normal level at 20°C clearly visible from normal access levels and be easily dismantled for cleaning.

3.4 Pressure Gauges

- 3.4.1** All pressure gauges shall be fitted with stopcocks immediately adjacent to each gauge and all pressure gauge piping shall be fitted with an isolating valve at each point of connection to the main system. Where pressure gauges are mounted on panels, the stopcocks shall be suitable for the connection of a test gauge.
- 3.4.2** Where a difference in level exists between the situation of the gauge and the point at which pressure is to be measured, appropriate compensation shall be made in the dial reading and the dial must be marked with the amount of compensation applied. Where the compensation would amount to two percent or less of the total movement indicated under normal conditions, it may be ignored.
- 3.4.3** All pressure gauges where practicable shall be mounted on panels in locations approved by the Purchaser. Stopcocks of gauges must be readily accessible. All pressure gauges shall be clearly identified by means of separate labels of approved type and lettering.
- 3.4.4** All high pressure gauge piping shall be of rust less steel but other pressure gauge piping may be of copper tube or other material approved by the purchaser.

3.5 Thermometer Pockets

- 3.5.1** Thermometer pockets and instruments connections of an approved pattern are to be fitted in such a position as may be determined to suit the operation and testing of the plant to the approval of the purchaser. Where necessary, the pocket shall be of approved material suitable for the required service.
- 3.5.2** All thermometer pockets shall comply with the requirements of BS 2765 or equivalent Indian standard.



2. Test Standards

1. Standards

The design material, construction, manufacture, inspection and testing of all equipment supplied under this Specification shall conform to the latest editions of the International Electro technical Commission (IEC) Specifications and other international standards where the material is not covered by IEC. Other national or international standards are accepted if they promise to confer equal or superior quality and performance than IEC or the specified standards.

2. Testing

The tests shall be divided into the categories described below.

2.1 Routine Tests

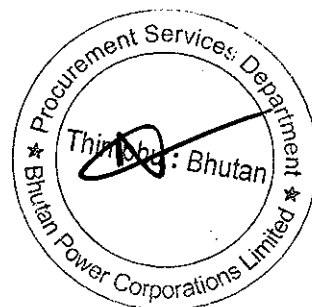
All the routine tests specified by the standards shall be carried out. If the tests are not witnessed by the Purchaser's representatives, test certificates shall be submitted to the Purchaser for approval. The test certificates must show the actual values obtained from the tests, in the units used in this Specification, and not merely confirm that the requirements have been met. No materials shall be dispatched until the test certificates have been received by the Purchaser and the Supplier has been informed that they are acceptable.

Despatch clearance will be given only if the test results are approved.

2.2 Type Tests

Bidder shall include with his bid type test certificates, issued by an approved, reputed, independent testing laboratory. The type tests should have been carried out in the last five years. Type tests shall be carried out at an independent testing laboratory or be witnessed by a representative of such laboratory or some other representative acceptable to the Purchaser. Type tests may be dispensed with at the Purchaser's discretion, if the Supplier furnishes evidence to the Purchaser's satisfaction, that the relevant tests have already been performed on identical materials and equipment.

In addition, the Purchaser may call for type tests to be carried out at the Manufacturer's Works and to be witnessed by the Purchaser or his representatives. Type testing shall only be performed if the manufacturer is unable to provide type test certificates issued by an independent test laboratory of international repute. Such tests will be on random samples at the discretion of the Purchaser and failure to meet the conditions of test could result in the rejection of a complete batch of equipment.



3. Inspection and Testing of Pole Fittings

The inspector shall examine the poles for, among other things, the following characteristics:

- general appearance;
- finish;
- dimensions; and
- straightness.

At least the following dimensional checks shall be made by the inspector:

- length;
- butt diameter and circumference;
- top diameter and circumference;
- non-circularity;
- accuracy of drillings;
- suitability of pole sections to overlap and bolt together;
- straightness, where appropriate;
- internal dimensions.

All cross-arms, clamps and fittings shall be examined by the inspector for, among other things, the following characteristics:

- general appearance;
- finish;
- dimensions;
- straightness;
- appropriate markings; and
- accuracy of drillings.

At least the following dimensional checks shall be made by the inspector:

- length;
- cross section of cross arm
- dimensions of clamp;
- position and size of holes;
- vertical alignment of all through holes.

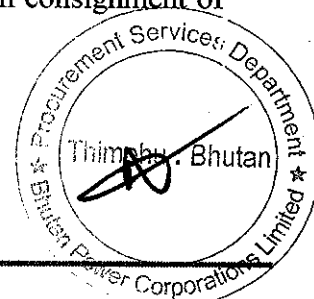
The group of poles or fittings offered at any one time shall constitute a batch. Within a batch, poles and fittings presented for inspection shall be segregated on a size basis. If 5% of the inspected items show damage or serious deviations from the design criteria, the entire batch shall be unconditionally rejected without further sorting.

Dimensions, such as length and top diameter, shall be measured with a standard steel tape.

Tests

The following tests shall be carried out on samples drawn from each consignment of the poles:

- i) Deflection Test/Permanent Set Test
- ii) Drop Test.



All the samples subjected to above tests shall pass the tests. Should one or more number of poles fail in any of the test, a second set of samples, double in number shall be drawn and subjected to above tests. Should one or more number of poles from second set of poles fail in any of the tests, the entire consignment shall be rejected.

4. Inspection and Testing for Overhead Line, Switching Equipment, Surge Arresters, HV & LV Circuit Breakers

Tests to establish whether the performance guarantees in the Schedules have been met shall be carried out by the Contractor, to the satisfaction of the Purchaser.

Type and routine factory tests shall comprise the following:

- Insulation level tests, including withstand tests at power frequency voltages on auxiliary equipment.
- Temperature rise test.
- Rated peak withstand current and rated short-time withstand current tests.
- Tests to prove satisfactory operation and mechanical endurance.

5. Inspection and Testing for Distribution Pillar

The Distribution Pillar shall be subject to following tests:

- High voltage test (2000V for 1 minute)
- Megger test
- Electrical control, interlocking and sequential operation test.

6. Inspection and Testing for ACSR Conductor

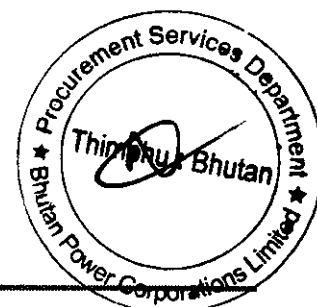
Testing to be conducted in accordance with IS-398:

- Measurement of length, weight, diameter, lay ratio;
- Testing for breaking load, uniformity of zinc coating and resistance in Ω/km at 20°C .
- Ductility test and Wrapping test
- Dip Test – samples subjected to 40 nos. one minute dip in copper sulphate solution as per IS 2633 (no copper deposit should be found)

7. Inspection and Testing for PVC Cables

Following **acceptance test** in accordance with IS: 1554 (Part-1) 1988 should be conducted:

- Annealing test (for copper)
- Tensile test and Wrapping test (for Aluminium)
- High Voltage test



- Conductor resistance test and Insulation resistance test
- Insulation and sheath thickness
- Tensile strength and elongation test at insulation and sheath breakdown

8. Inspection and Testing for XLPE Cables

Following **acceptance test** in accordance with IS: 7098 (Part-1) 1988 should be conducted:

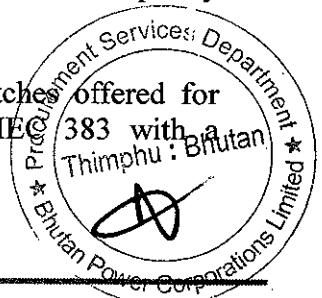
- High Voltage test – using HT voltage test equipment
- Conductor resistance test – using Kelvin bridge meter
- Insulation resistance test – using Mega ohm meter
- Insulation and sheath thickness – using dial vernier calliper
- Tensile strength and elongation test at insulation and sheath breakdown – using tensile testing machine.

9. Inspection and Testing for Insulators

Insulators shall be tested in accordance to the requirements of the following standards in respect to type tests, unless certification is already available for the exact type being supplied, routine tests and sample tests.

- IEC Radio Interference characteristics of overhead
- IEC 60 High Voltage Test Techniques
- IEC 120 Dimensions of ball and socket coupling string insulators units
- IEC 305 Characteristics of string insulators of the cap and pin type
- IEC 372 Locking devices for ball and socket couplings of string insulator units: dimensions and tests
- IEC 383 Tests on insulators of ceramic materials and glass
- IEC 437 Radio interference test on high voltage insulators
- IEC 506 Switching impulse tests on high voltage insulators
- IEC 507 Artificial pollution tests on high voltage insulators to be used on A.C. systems
- IEC 575 Thermal - mechanical performance tests and mechanical performance test on string insulator units
- IEC 591 Sampling rules and acceptance criteria when applying statistical control methods for mechanical and electromechanical tests on insulators
- CISPR 18-2 Power lines and high voltage equipment
- IEC 797 Residual strength test
- ANSI C29.2 Impact strength test
- ASTM C151 Autoclave expansion of Portland Cement test
- BS 729 Hot dip galvanized coating on iron and steel articles
- BS 443 Specification for testing zinc coatings on steel wire for quality requirement.

Tests shall be carried out on random insulators taken from batches offered for inspection. The number of samples shall be selected as per IEC 383 with a Thimphu : Bhutan



minimum of five units. The samples shall be subjected to the following tests after having been subjected to routine tests in the same order:

- (a) Verification of dimensions
- (b) Temperature cycle test
- (c) Electro-mechanical or mechanical failing load test in accordance with the type of insulator, including thermal-mechanical performance test to IEC 575.
- (d) Puncture test
- (e) Porosity test
- (f) Galvanising test

In the event of one unit failing to pass any of the sample tests, a further quantity, double that of the first quantity shall be subject to retesting. In the event of two or more insulators or metal parts failing to pass any of the sample tests, or if any failure occurs on insulators or metal part subject to retesting, the complete batch will be rejected.

12.1 Type Tests

Bidders shall include with their offers type test certificates, including thermal, mechanical performance carried out in accordance with IEC575, which are issued by an approved, internationally acknowledged, reputed, independent testing laboratory. When type tests are called for by the Purchaser, they will comprise the following:

- 1.1 Dry lightning impulse withstand voltage test
- 1.2 Wet power frequency withstand voltage test

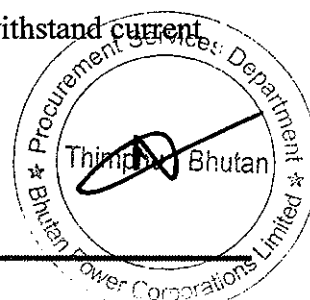
10. Inspection and Testing for RMUs

Type test and Routine tests shall be carried out as per relevant standards.

a) Type and routine tests

Type test certificates should be supplied for the following :

- Impulse withstand test;
 - Temperature-rise test;
 - Short-time withstand current test;
 - Switch, circuit breaker breaking capacity;
 - Internal arc withstand;
 - Checking of partial discharge on complete unit;
- b) In addition, for switches, test reports on rated breaking and making capacities shall be provided.
 - c) For earthing switches, test reports on making capacity, short-time withstand current and peak short-circuit current shall be provided.



- d) The routine tests carried out by the manufacturer shall be backed by test reports signed by the factory's quality control department. They shall include the following:

- Conformity with drawings and diagrams;
- Measurement of closing and opening speeds;
- Measurement of operating torque;
- Checking of filling pressure;
- Checking of gas-tightness;
- Checking of partial discharges on individual components;
- Dielectric testing and main circuit resistance measurement;

13.1 Type test

The Bidder shall provide the above type test certificates in the bid that are done within last five (5) years. In case, if the valid type tests certificates are not available, then the bidder shall carryout the type test without any cost implication to the purchaser. Type Tests shall be as per standards.

11. Inspection and Testing for LV Switchboards

Tests and test reports

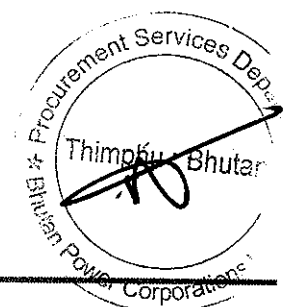
The meter shall pass the manufacturer's standard routine tests. The following type tests shall be in accordance with the latest relevant IEC or ANSI:

- Test of insulation properties:
 - impulse voltage test
 - A.C. voltage test
- Influence of short-time over currents
- Influence of heating:
 - windings, if any
 - external surface
- Electromagnetic compatibility (E.M.C.):
 - radio interference measurement
 - fast transient/burst test
 - immunity to electromagnetic HF field test
 - immunity to electrostatic discharge test
- Others according to manufacturer's standard
- Heating (permissible temperature rise) of:
 - windings, if any, in K
 - external surface in K

The acceptance inspection shall be according to the latest relevant IEC or ANSI

Routine factory testing, in accordance with IEC standards, shall be carried out and shall include the following:

- Check of conformity with wiring diagrams and plans.
- Mechanical operation tests and checking of interlocks.



- Low voltage dielectric tests.
- Low voltage functional checking.

12. Inspection and Testing for Energy Meters

Tests and test reports

The meter shall pass the manufacturer's standard routine tests. The following type tests shall be in accordance with the latest relevant IEC or ANSI:

- Test of insulation properties:
 - impulse voltage test
 - A.C. voltage test
- Influence of short-time over currents
- Influence of heating:
 - windings, if any
 - external surface
- Electromagnetic compatibility (E.M.C.):
 - radio interference measurement
 - fast transient/burst test
 - immunity to electromagnetic HF field test
 - immunity to electrostatic discharge test
- Others according to manufacturer's standard
- Heating (permissible temperature rise) of:
 - windings, if any, in K
 - external surface in K

The acceptance inspection shall be according to the latest relevant IEC or ANSI

