

2. Technical Specification

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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:

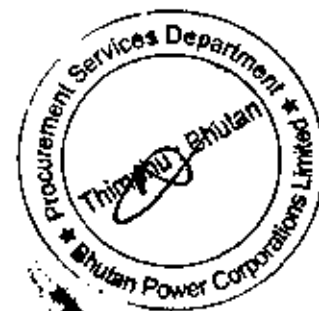
Basic Design Parameters	Basic Design Value
Altitude	2400 metres
Ambient Air Temperature : minimum Maximum	-10°C +40°C
Average Annual Isokeraunic Level	75 thunderstorm days
Average Annual Rainfall & Period	1400 mm (May to September)
Climate	Varied (From tropical to severe winters)
Relative Humidity	20 - 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 equipments 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 equipments 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	28	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

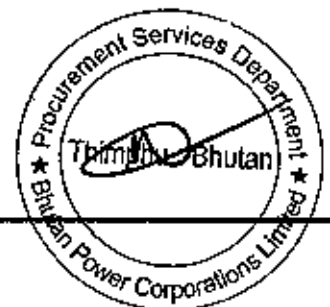
Nominal System Voltage	V	400/230
Nominal System Frequency	Hz	50
Maximum System Voltage	V	424/244 ¹
Rated one minute power frequency withstand voltage (rms)	V	3000
Rated impulse withstand voltage (peak)	kA	7500

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.

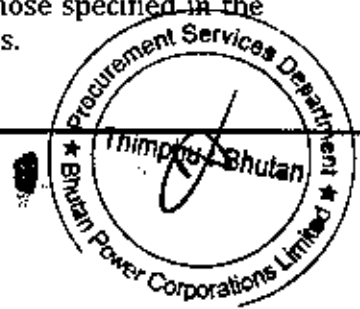
The Purchaser may order all, none or any of the recommended items. Those ordered shall be delivered not later than the date of receipt of the last shipment of the associated item of plant. The price of the items shall be subject to the same price conditions as the associated item of plant.

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 labeled 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 labeled 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 labeled both 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

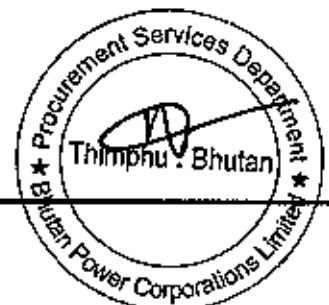
All electrical instruments and meters shall comply with IEC 60051 and IEC 61010 and, unless otherwise specified, shall be of industrial grade accuracy. Three-phase power measuring instruments shall be of the three-phase unbalanced load pattern wherever the current and Voltage references permit. Energy 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. Wireways 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.
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.

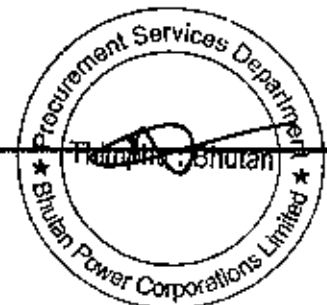
m) Earthing

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.

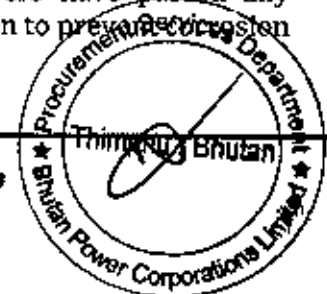
All structural members, nuts and bolts shall be galvanised and shall conform to the requirements.

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.

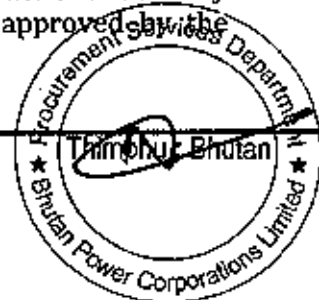
For structural steel, galvanising shall average not less than 0.61 kg/m² (no individual specimen shall show less than 0.55 kg/m²) except for 6.35 mm and heavier materials in which case galvanising shall average not less than 0.702 kg/m² (no individual specimen shall show less than 0.61 kg/m²).

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/sq. metre of surface area.

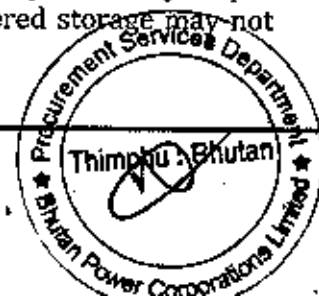
All bolts, nuts and washers shall be of non-corroding material where they are in contact with non-ferrous parts in conductor clamps and fittings and elsewhere where specifically required by the Purchaser.

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.

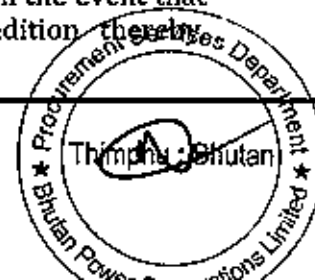


- 1.11.4 All wood and other materials used in packing cases shall be insect free. Adequate protection and precautions are to be taken to exclude termites and other vermin, noxious insects, larvae or fungus from the packing materials or plant. All contents are to be clearly marked for easy identification 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 they shall be replaced.



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.

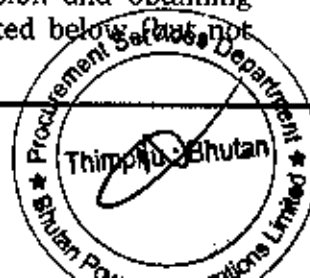
1.14 Locks

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.



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 manufacturer's



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.

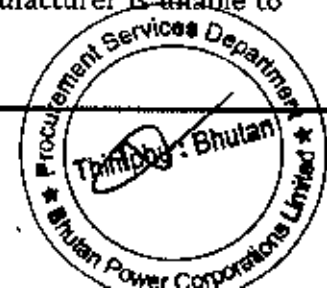
1.18.1 Routine Tests

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 for the

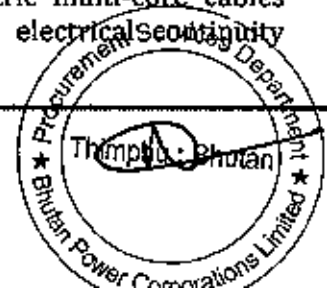


otherwise specified, for direct starting by the switching of full line voltage on to a standing motor. All starters should preferably be supplied by one manufacturer.

- 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 unscaling 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.

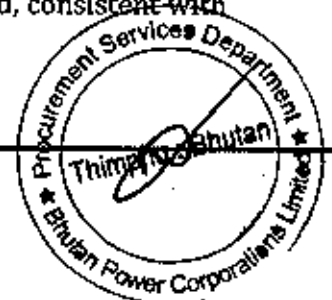
Standard components only shall be used and any individual selection necessary to obtain particular parameters shall be subject to the approval of the purchaser.

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.

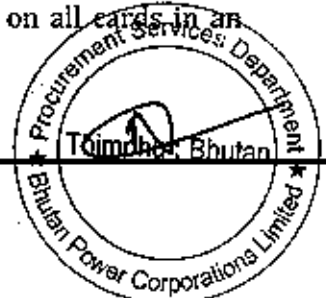
d) Noise and Vibration

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.

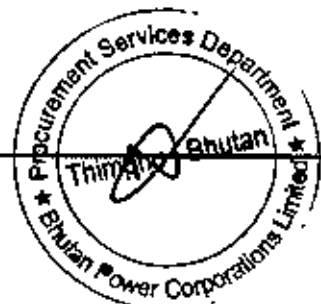
Control, Protection and Indication Devices

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.

Preset Controls

The circuit reference and if possible, the function shall be marked adjacent to each preset 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 pipework 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 preferably 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 experienced 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 rustless 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 Electrotechnical 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

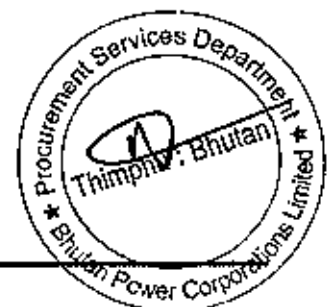
All the routine tests specified by the standards shall be carried out. If the tests are not witnessed by the Purchaser's representatives, test certificates shall be submitted to the Purchaser for approval. The test certificates must show the actual values obtained from the tests, in the units used in 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:

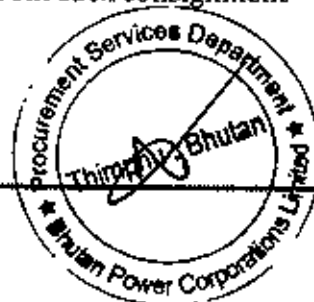
- length;
- cross section of cross arm
- dimensions of clamp;
- position and size of holes;
- vertical alignment of all through holes.

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.

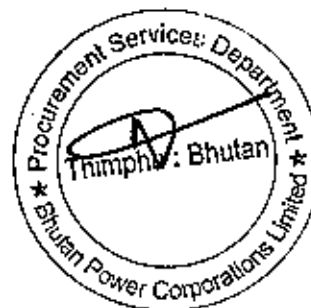
Tests

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.



TECHNICAL SPECIFICATION OF THE LOTS



LOT-1: GALVANISED STEEL POLES

1. Scope

This specification covers the design, manufacture, testing, supply, delivery and performance requirements of following Galvanised steel poles.

- a) Steel swaged poles
- b) Telescopic poles

2. Standards

The equipment shall comply with the latest editions of and amendments to Indian standards listed below. Where any provision of this specification differs from those of the standards listed hereafter, the provision of this specification shall govern.

IS - Indian Standards

- IS 2713: Specification for tubular steel poles for overhead power lines
- IS 2062: Steel for general structural purposes

Note:

In case of conflict, the order of precedence shall be:

- This Specification
- IS Standards
- Other Standards

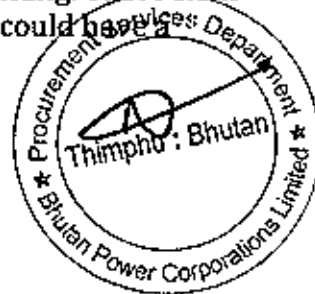
Alternative Standards may be approved, provided the Supplier demonstrates that they give a degree of quality and performance equivalent to that of the referenced Standards. Acceptability of any alternative Standard is at the discretion of the Purchaser.

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.

3. Galvanising

Galvanizing of the steel poles shall be in accordance with ISO 1459 and ISO 1461. The zinc coating shall not be less than 600 g/m² of steel surface area.

The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath, which could have a deleterious effect on the durability of the zinc coating.



Before pickling, all welding, drilling, cutting, grinding must be completed and all grease, paint, varnish, oil and welding slag completely removed. All protuberances, which would affect the life of galvanising should be removed.

To avoid the danger of white rust, galvanised material shall be stacked during transport and stored in such a manner as to permit adequate ventilation.

Galvanized steel items shall be thoroughly checked for damage before transport to the work site.

Any material found to be damaged shall be returned to its source. Cracked, flaked or scratched surfaces shall not be acceptable.

Galvanized steel shall be handled carefully during loading, transporting and unloading, and shall not be dropped on the ground, or dragged or scraped along the ground or any surface.

4. Steel Swaged Poles

Steel poles shall be swaged, mild steel poles manufactured in accordance with the requirements of IS 2713 and fabricated in three parts for assembly at site. The poles shall be hot dip galvanized internally and externally up to the level, which goes inside the earth. Data on standard poles used by BPC is mentioned in table below and drawing no. BPC-DDCS-2020-15.

Height	Strength	Size as per (2713)	Normal Service
7.5 m	1.81 kN	410-SP-9	LV ABC
10 m	2.02 kN	410-SP-45	11 kV & 33 kV

The poles shall be supplied complete with taper plug and base plate.

The 7.5m poles shall be provided with 18 mm dia. through holes at 150mm, 350 mm, 550 mm and 750mm from the pole top at 90° cross angles for fixing the LV cable. Earthing of LV pole is not required as the overhead conductor is insulated.

4.1 Shape, Assembly of Poles

Poles are to be manufactured in swaged form.

Swaged poles shall be manufactured from tubes worked while hot. Swaged poles shall consist of two tube sections with tapering diameters, the bottom section having the largest diameter. The length of the overlap shall be at least three times the diameter of the smaller tube, in each case. The Supplier shall state the length of overlap. The upper edge of the tube at each joint shall be chamfered at an angle of 45°.

The poles shall be supplied in two sections for assembly at site by bolting. Galvanized bolts of adequate strength, required for joining the poles at site, shall also be supplied, with manufacturer's instructions for the pole assembly.



Transportation of full-length poles is avoided in Bhutan, due to hand cartage in the mountainous terrain.

Cost of bolts, nuts and washers for joining pole sections shall be deemed included in the schedule rates for pole supply.

4.2 Bolts, Nuts and Washers

All bolts, nuts and washers, supplied under this Specification shall comply with the following:

The bolts and nuts shall comply with ISO 4016. Mechanical properties shall be in accordance with ISO 898.

The dimensions and characteristics in this Specification are intended to describe typical ISO metric bolts, nuts, and washers, such as are commonly used in the construction of electrical distribution lines, plant and equipment.

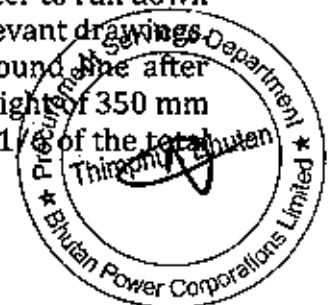
The safe working shear stress of bolts is taken as 120 MPa, with the area of the bolt measured at the root of the thread. The table below shows the ultimate tensile strength, the tensile stress areas, the safe working tensile loads and the safe working shear loads for the bolts covered by this Specification. The ultimate shear strength has been assumed to be 75% of the ultimate tensile load and a factor of safety of 2.5 has been applied:

Bolt Size	Ultimate Tensile Stress (N/mm ²)	Tensile Stress Area (mm ²)	Ultimate Tensile Strength (kN)	Working Tensile Load (kN)	Safe Working Shear Load (kN)
M16	400	157.0	62	25	18
M18	400	204.0	81	32	24
M20	400	245.0	98	39	29

Screw threads shall be parallel throughout their length. They shall be so formed that, after galvanising, the nut can be easily screwed by hand over the whole length of thread, without excessive play. Before despatch from the works, one washer shall be fitted to each bolt and a nut shall be screwed on the whole threaded length and left in that position. Washers shall be round, flat, of mild steel, unless where otherwise specified.

4.3 Base Plate, Pole cap and pole Earthing

Steel swaged poles shall be supplied complete with pole cap and base plate. The pole cap shall be welded to the pole top and shall be curved at the top to allow water to run down whereas the base plate shall be as per the dimensions indicated in the relevant drawings. All HT steel poles shall have provision for earth points above the ground line after installation. This shall be through bolt of 12 mm diameter located at a height of 350 mm above the ground line. The ground line position shall be approximately 1/6 of the total pole length.



5. GALVANIZED TELESCOPIC POLE

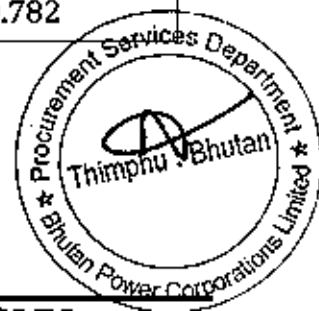
The standard overall length of telescopic poles used in BPC shall be of 11.2 m and 12 m which comes in 5 and 6 sections respectively. All 5 sections of 11.2 m and 12 m pole shall be same in design from the bottom, except the top section of the 12 m pole. This has been designed to offer inter-changeability during construction phase as the top section of 12 m pole can be easily capped on 11.2 m pole. The side taper for the pole is recommended between 10-25 mm per meter length which shall be uniform for all the sections. Length of pole sections shall be at a minimum lap of 1.5 times with the largest inside diameter of the female section with allowances for fabrication tolerance. The 12 m poles shall be equipped with 18 mm diameter through holes (for through bolt size M16) at 100 mm from pole top for fixing suspension clamp for shielding wire. The holes shall be at right angles to the run of the direction of the conductors. The distance of footing bar shall be 300 mm.

Total Length	Design Working Load	No. of Sections	Remarks
12.0 m	2.8 kN	6	33 & 11 kV with shield wire
11.2 m	2.8 kN	5	33 & 11 kV without shield wire

Details of the telescopic pole are given in the table below and drawing no. BPC-DDCS-2020-19



SL#	Description of Parameters	UoM	Telescopic Pole	
1	Overall length of poles	m	12	11.2
2	Embedded Length	m	2.0	1.87
3	Number of Sections	nos	6	5
4	Length of Sections (of whole section)			
	Section-I	m	1.08	2.65
	Section-II	m	2.65	2.65
	Section-III	m	2.65	2.65
	Section-IV	m	2.65	2.65
	Section-V	m	2.65	2.65
	Section-VI	m	2.65	-
5	Outside Diameter (Top & Bottom)			
	Section-I (Top)/(Bottom)	mm	100/132	119/197
	Section-II (Top)/(Bottom)	mm	119/197	180/258
	Section-III (Top)/(Bottom)	mm	180/258	240/318
	Section-IV (Top)/(Bottom)	mm	240/318	298/375
	Section-V (Top)/(Bottom)	mm	298/375	352/430
	Section-VI (Top)/(Bottom)	mm	352/430	-
6	Thickness of Steel			
	Section-I	mm	2.1	2.1
	Section-II	mm	2.1	2.1
	Section-III	mm	2.1	2.1
	Section-IV	mm	2.1	2.1
	Section-V	mm	2.1	2.1
	Section-VI	mm	2.1	-
7	Design Working Load (Horizontal)	kgf	286	286
8	Design Working Load (Vertical)	kgf	500	435
9	Weight of Pole (of all sections including wt. of zinc coating)	kg	207.333	200.495
	Section-I	kg	6.477	21.678
	Section-II	kg	21.678	30.054
	Section-III	kg	30.054	38.309
	Section-IV	kg	38.309	46.162
	Section-V	kg	46.162	53.695
	Section-VI	kg	53.695	-
10	Size of base plate (L x B x Thickness)	mm	500x500x3	500x500x3
11	Weight of Baseplate	kg	9.782	9.782



5.1 Base Plate, Pole cap and Pole Earthing

Telescopic pole shall be provided with galvanized pole cap and base plate. The pole cap for 11.2 m pole or 12 m pole shall not be welded on poles. The pole caps shall be designed and manufactured to fit on the pole top respectively. Base plates shall be galvanized steel with minimum thickness of 3 mm. The base plate shall be made circular and provided with proper fixing arrangements for easy installation at site.

Each telescopic pole shall be provided with an earthing lug welded on the pole earthing. This shall be with 14 mm dia hole with bolt and nut arrangement at 350 mm above ground level to connect to spike earthing.

5.2 Foot Bars and Installation lugs

Telescopic poles shall be designed to enable installing removable foot-bars. Installation lugs for mounting the foot-bars shall be welded on the pole surface. Four (4) galvanized removable foot-bars shall be supplied for each pole which shall kept permanently on the pole above the anti-climbing device. Details are given on drawing no. BPC-DDCS-2020-16/3-5

6. Identification Marks

The following identification marks shall be legibly engraved/ punched/ embossed on each pole at a height of 3m from bottom end of the pole, before painting:

- (a) Manufacturer's name/Trade mark
- (b) Year of manufacture
- (c) Batch Number

The size of the letters shall be at least 5mm and the depth of engraving/height of embossing shall be such that the text remains legible after painting.

7. Quality Control

All poles shall be inspected by an inspector appointed by the Purchaser. The Supplier shall assist the work of the Purchaser's inspector by providing copies of all relevant Standards, and allowing the inspector full use of the necessary tapes, measures and laboratory equipment, together with ample space and assistance in the handling of poles for inspection. Any costs incurred by the Supplier in aiding the inspector shall be deemed to be included in the contract.

Poles as delivered to the designated stores shall be free of all damage to protective paint coating, and shall not be out of straight by more than one thousandth of the length of the pole.

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.

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.

8. List of 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.

9. Number of Samples to be Tested

The number of samples to be drawn from each consignment for testing shall be determined using the following formula:

$$S = 4 + \frac{1.5 N}{1000} \quad \text{where: } S = \text{Number of samples}$$

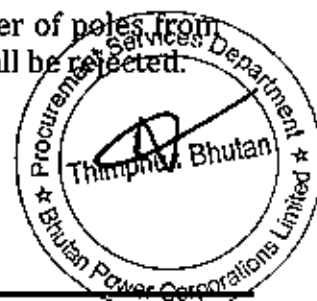
$$N = \text{Quantity in consignment}$$

The value of S obtained is subject to an absolute minimum of 4.

The test procedure for the above tests shall be mutually discussed and agreed between the Purchaser and the Supplier.

10. Rejection

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.



11. Tolerances

The poles shall meet the requirements of relevant standards IS 2713 in all respects. In case of weight of the pole, though the standard allows negative tolerance on the weight of the pole (for individual pole as well as for the LOT), while the acceptance of the poles will be based on their conformity to the standards (in case of weight within the specified tolerance limits), the payment will, however, be prorated for any reduction in weight from the standard weight based on to the actual weight of the LOT (within the specified limits) compared to the calculated weight for the LOT based on standard weight indicated in the standard.

For example,

IS 2713 allows 10% below the standard weight for individual poles, subject to 7.5% below the calculated standard weight for the LOT. If the pole and LOT weights are within the specified limits, the LOT will be considered as having met the requirement for acceptance, as far as weight is concerned, and will be accepted subject to its having met all other tests / requirements. However, the actual payment will be based on the following.

Payment as per contract rates = $R \times N$

Less reduction for lower weight = $R \times N \times \left\{ \frac{W_s - W_a}{W_s} \right\}$

I.e Actual Eligible Payment = $R \times N \times \left(\frac{W_a}{W_s} \right)$

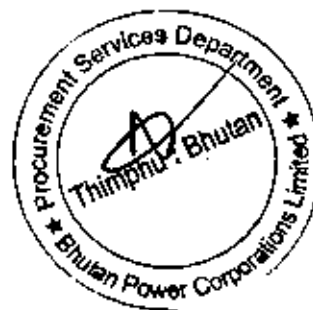
where,

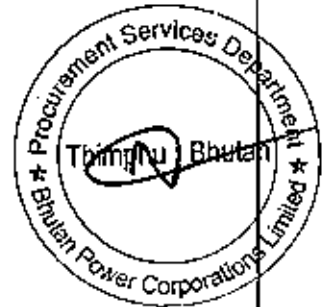
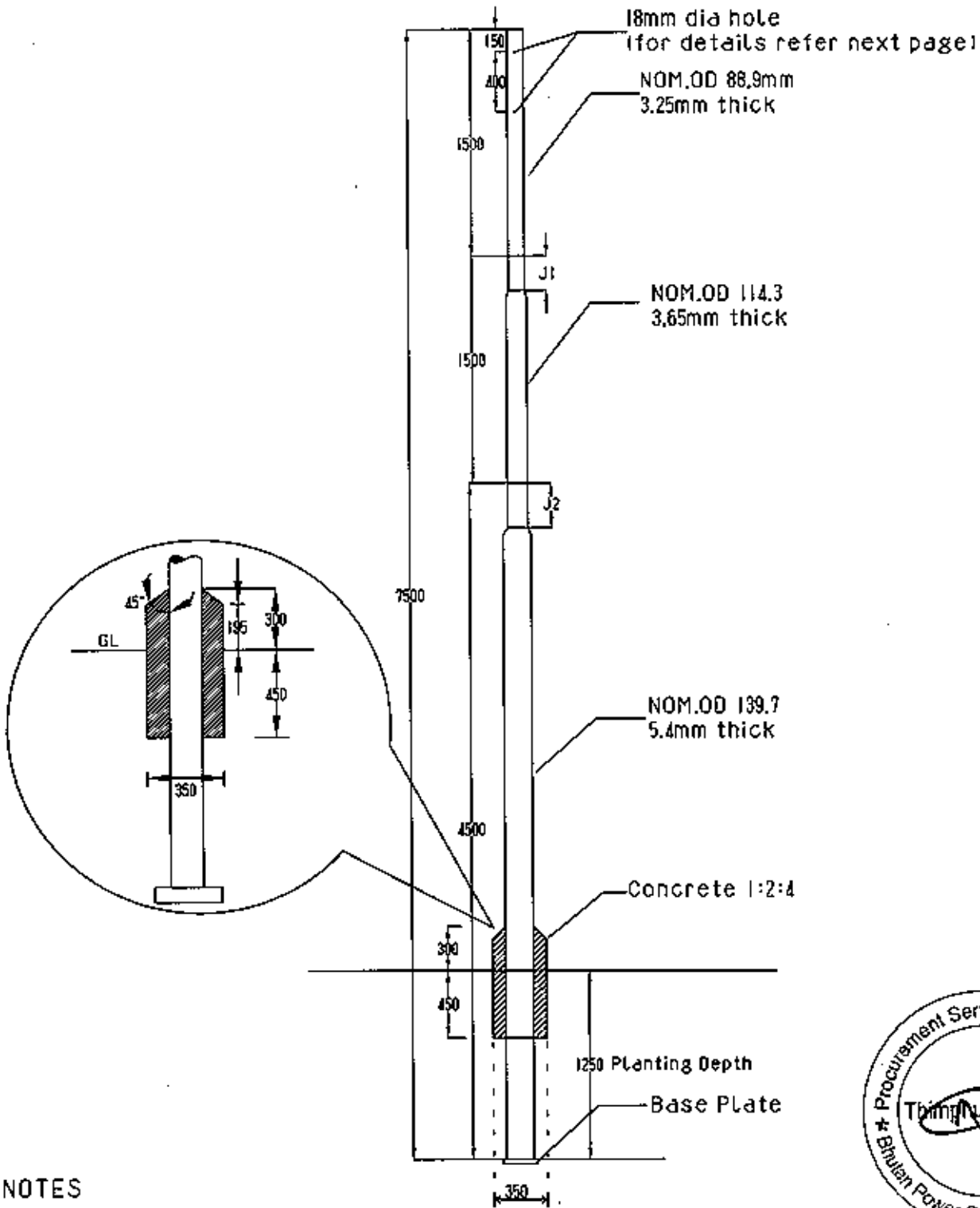
R is the rate per pole in the contract

N is the no. of poles in the LOT


$W_s = N \times W$, where W is the standard weight per pole

W_a = Actual weight of the LOT





- NOTES**
1. DIMENSIONS AS SHOWN ARE IN MM.
 2. SPECIFICATIONS AS PER IS:2713 (PART I TO III : 1980)
 3. POLE TOP CAP -M.S. PLATE WOULD BE TAG WELDED TO THE POLE

	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
1.5 METERS SWAGED POLE ASSEMBLY			DRAWING NO. BPC-DDCS-2020-15/1-7	REVISION 2020
TITLE	NAME	DATE		
DESIGNED BY				
CHECKED BY				
APPROVED BY				

NOM. OD 88.9mm



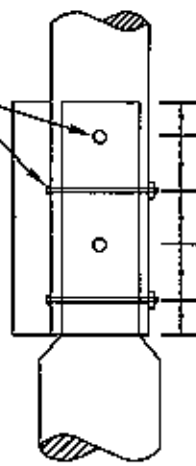
POLE TOP DETAILS

Circumferential weld

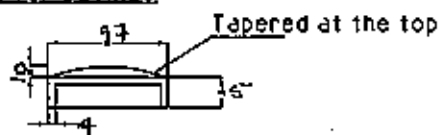


WELDED JOINT J1 DETAILS

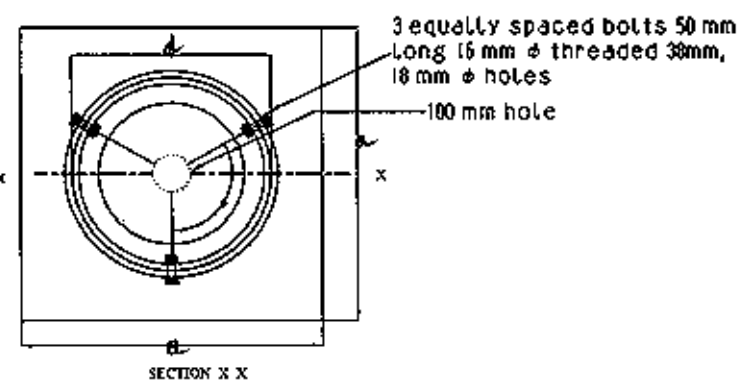
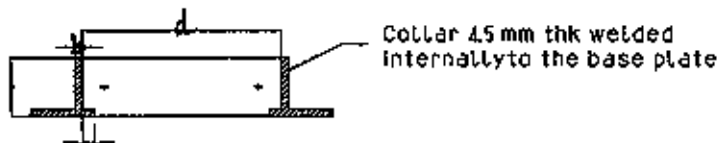
Through bolt M16 x Bolt Length



BOLTED JOINT J2 DETAILS



POLE CAP DETAILS (WELDED TO THE POLE)



DETAILS OF MS BASE PLATE (Separately packed)

Pole Type		7.6 M (410-SP-8)	
Length		mm	7500
Top Segment	OD	mm	88.9
	Thickness	mm	3.25
	Length	mm	1500
Middle Segment	OD	mm	114.3
	Thickness	mm	3.65
	Length	mm	1500
Bottom Segment	OD	mm	139.7
	Thickness	mm	5.4
	Length	mm	4500
Joint J1	Welded Joint		
	d	mm	230
Joint J2	a	mm	45
	b	mm	70
	c	mm	300
	BL	mm	150
Planting Depth		mm	1250
Base plate details	a	mm	220
	b	mm	4.5
	c	mm	70
	d	mm	139.7
	e	mm	10

NOTES

1. DIMENSIONS AS SHOWN ARE IN MM.
2. DRAWING NOT TO SCALE.
3. SPECIFICATIONS AS PER IS:2113 (PART I TO III : 1980)
4. POLE TOP CAP - M.S. PLATE WOULD BE TAG WELDED TO THE POLE

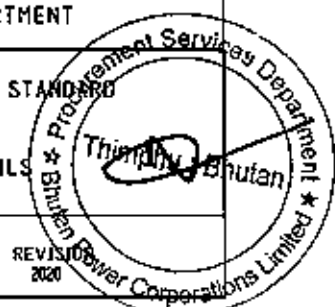


BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

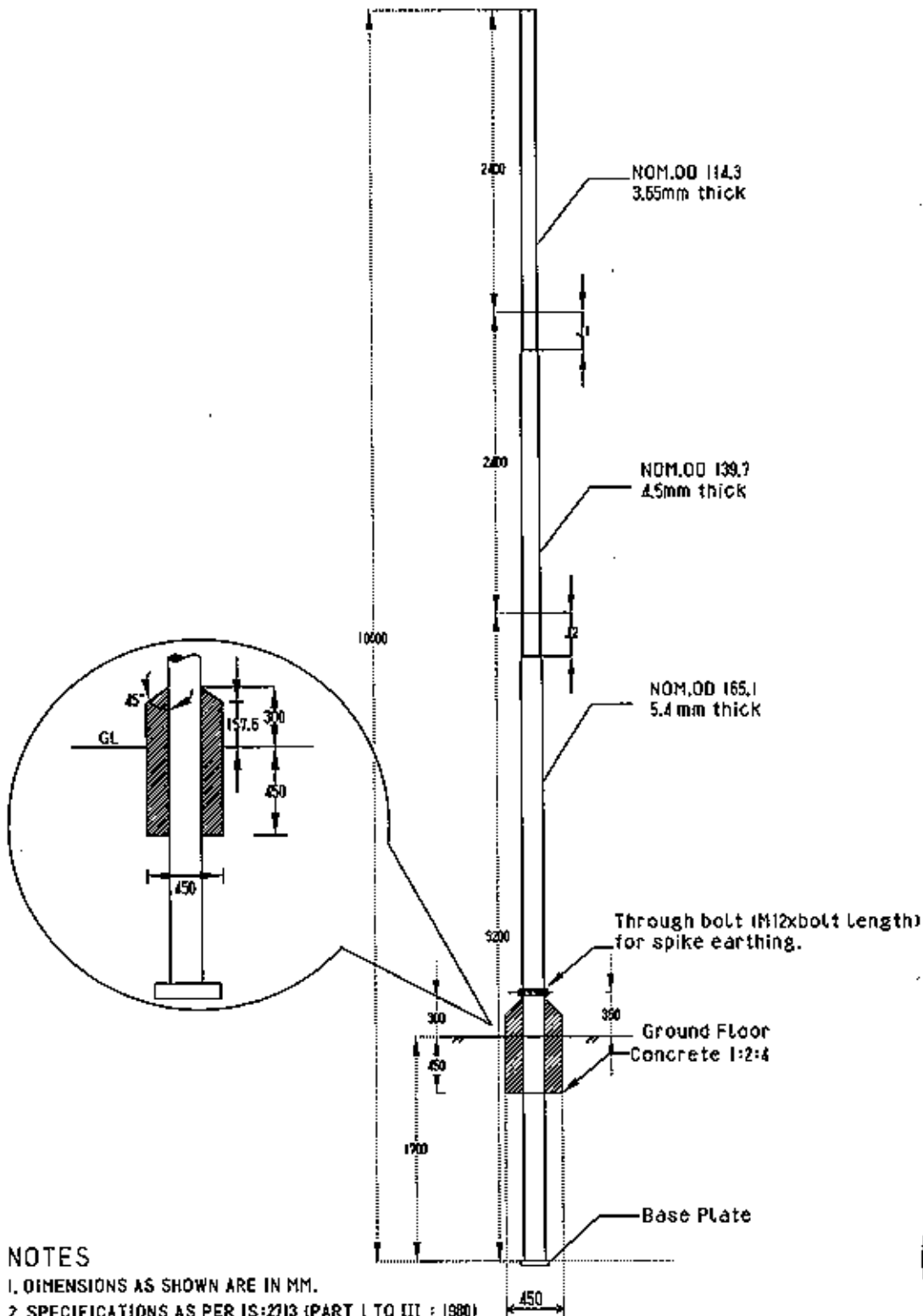
7.5 METERS SWAGED POLE DETAILS



TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

DRAWING NO. BPC-ODCS-2020-15/2-7


REVISION 2020

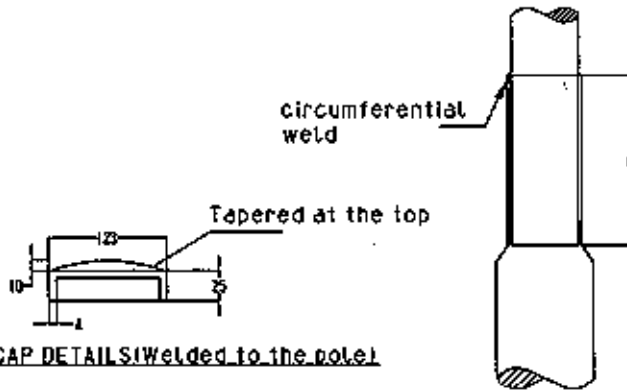


NOTES

1. DIMENSIONS AS SHOWN ARE IN MM.
2. SPECIFICATIONS AS PER IS:2713 (PART I TO III : 1980)
3. POLE TOP CAP -M.S. PLATE WOULD BE TAG WELDED TO THE POLE

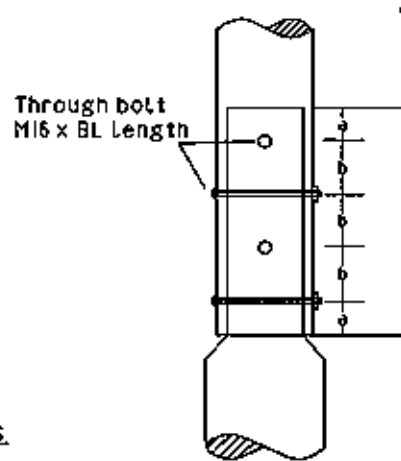


	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE			10 METER SWAGED POLE ASSEMBLY	
DESIGNED BY	NAME	DATE	DRAWING NO. BPC-ODCS-2020-15/3-1	
CHECKED BY				
APPROVED BY				
			REVISION 2020	

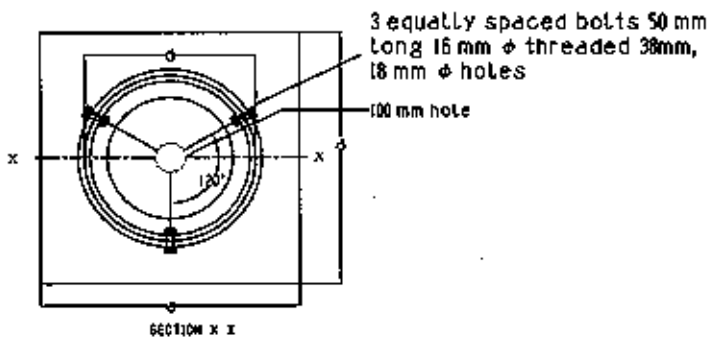
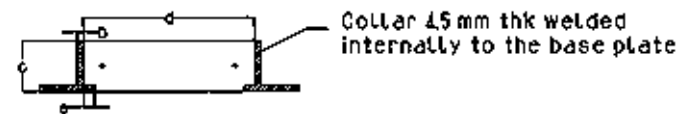


POLE CAP DETAILS (welded to the pole)

WELDED JOINT J1 DETAILS



BOLTED JOINT J2 DETAILS



DETAILS OF MS BASE PLATE (separately backed)

Pole Type		10 M (410-SP-25)	
Length		mm	1000
Top Segment	OD	mm	114.3
	Thickness	mm	3.65
	Length	mm	2400
Middle Segment	OD	mm	139.7
	Thickness	mm	4.5
	Length	mm	2400
Bottom Segment	OD	mm	165.1
	Thickness	mm	5.4
	Length	mm	5200
Joint J1	Welded Joint		
	d	mm	300
Joint J2	a	mm	55
	b	mm	80
	c	mm	350
	BL	mm	180
	Planting Depth	mm	1700
Base Plate details	a	mm	250
	b	mm	5
	c	mm	70
	d	mm	165.1
	e	mm	10

NOTES

1. DIMENSIONS AS SHOWN ARE IN MM.
2. DRAWING NOT TO SCALE.
3. SPECIFICATIONS AS PER IS:2713 (PART I TO III : 1980)
4. POLE TOP CAP -M.S. PLATE WOULD BE TAG WELDED TO THE POLE



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

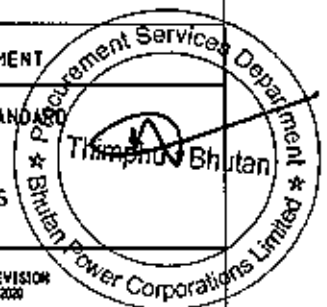
DISTRIBUTION DESIGN & CONSTRUCTION STANDARDS

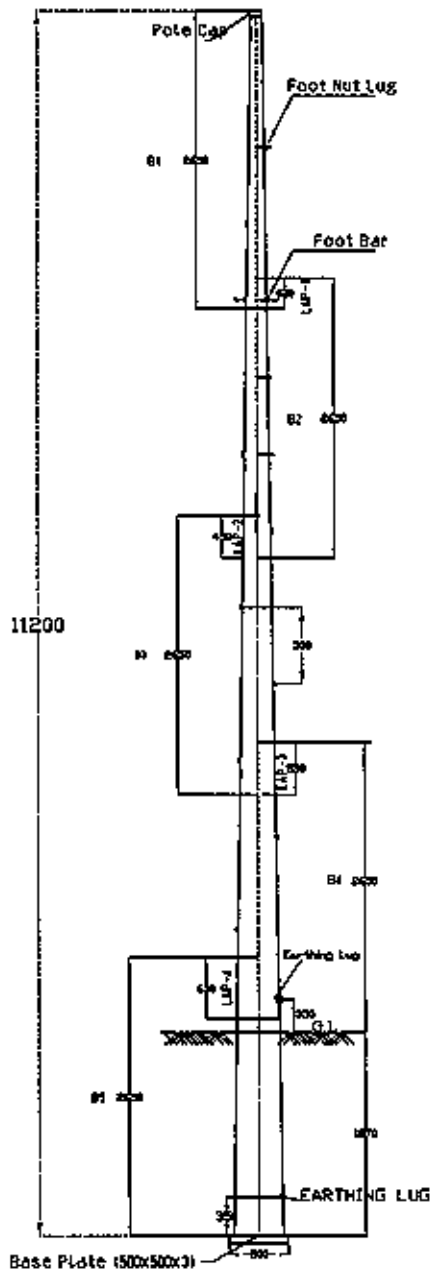
10 METER SWAGED POLE DETAILS

	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

DRAWING NO. BPC-DBCS-2020-15/4-7

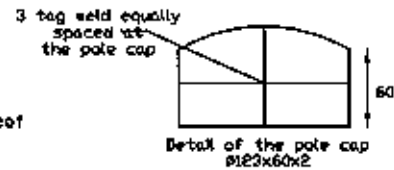
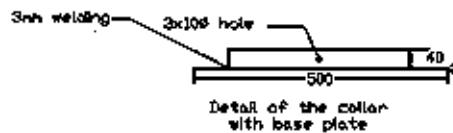
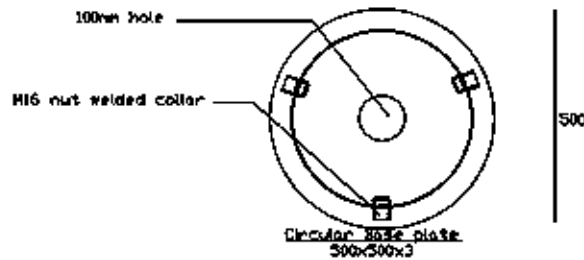
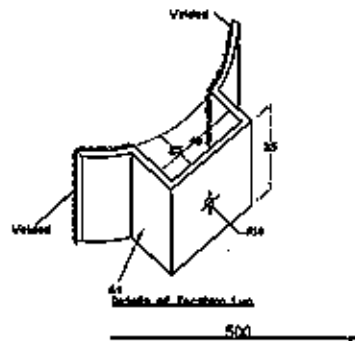
REVISION 2020





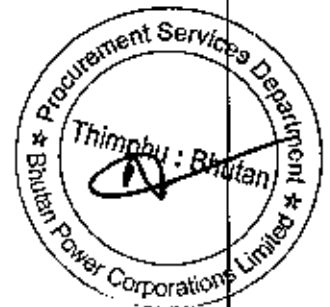
PARAMETERS					
SECTION	B1	B2	B3	B4	B5
LENGTH(mm)	2650	2650	2650	2650	2650
THICKNESS(mm)	2.1	2.1	2.1	2.1	2.1
TOP DIAMETER(mm)	119	180	240	298	352
BOTTOM DIAMETER(mm)	197	258	318	375	430

OVERLAPS				
OVERLAPS	LAP-1 B1/B2	LAP-2 B2/B3	LAP-3 B3/B4	LAP-4 B4/B5
OVERLAPS	420	450	550	630

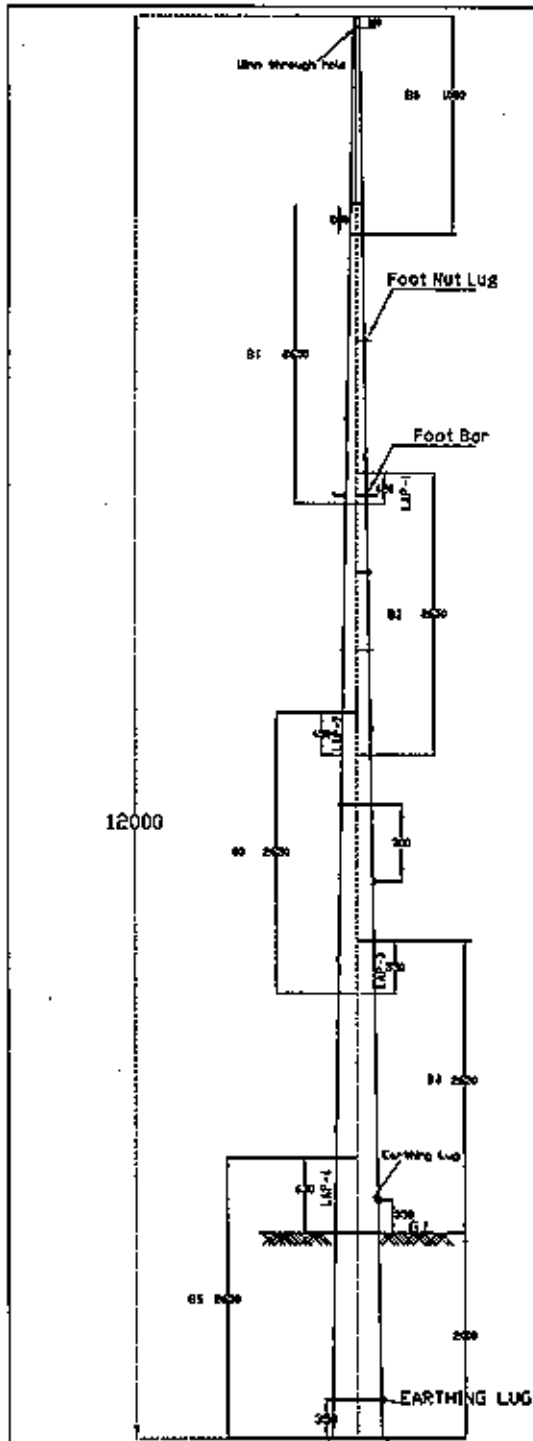


Note:

- All Parts shall be BS 4360: 1986 Grade 50C and Galvanization as per IS 2629-1985 or BS 128-1871 or Equivalent National or International Standards and any revision thereof
- All Dimensions in mm
- Footing bar distance to be maintained at 300mm

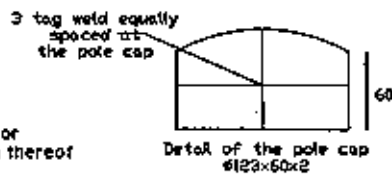
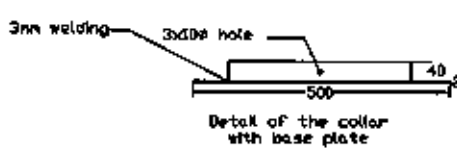
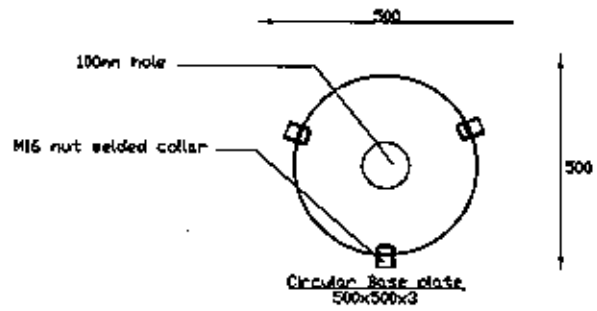
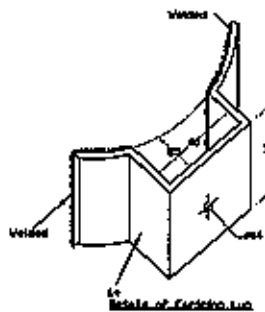


BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
		TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TELESCOPIC POLE DETAILS FOR 11.2M			
TITLE	NAME	DATE	
DESIGNED BY			
CHECKED BY			
APPROVED BY			
DRAWING NO. BPC-DOCS-2020-16/1-5			REVISION 2020



PARAMETERS						
SECTION	B1	B2	B3	B4	B5	B6
LENGTH(mm)	2650	2650	2650	2650	2650	1000
THICKNESS(mm)	2.1	2.1	2.1	2.1	2.1	2.1
TOP DIAMETER(mm)	119	160	240	298	352	100
BOTTOM DIAMETER(mm)	197	258	318	375	430	192

OVERLAPS					
OVERLAPS	LAP-1 B1/B2	LAP-2 B2/B3	LAP-3 B3/B4	LAP-4 B4/B5	LAP-5 B5/B6
OVERLAPS	420	450	550	630	280



Note:
 *All Parts shall be BS 4360: 1986 Grade 50 C and Galvanization as per IS 2623-1985 or BS 729-1974 or Equivalent National or International Standards and any revision thereof
 *All Dimensions in mm
 *Through hole dia 18mm at 100mm from the pole top for shielding wire
 *Footing bar distance to be maintained at 300mm

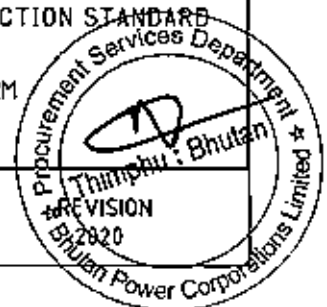
BHUTAN POWER CORPORATION LIMITED		
TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

ENGINEERING AND RESEARCH DEPARTMENT

TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

TELESCOPIC POLE DETAILS FOR 12M

DRAWING NO, BPC-DDCS-2020-16/2-5



LOT 2 &3 #: GALVANIZED POLE FITTINGS

General

This specification represents the minimum requirements for the works. The Supplier shall provide equipment, which meets or exceeds these minimum requirements. These items are being sought as additions to existing networks; it is essential to maintain compatibility with existing hardware and line design, as well as with established local work practices and methods.

Anti-climbing devices

In order to prevent unauthorized person from climbing any of the supports of HT lines and substations, anti-climbing devices are provided to each pole. Anti-climbing device shall be a clamp with protruding spikes installed at the height of 3.5 m-4 m above the ground level for lines and below 3 m for substations. Details are shown in drawing no. BPC-DDCS-2020-16/4-5

Clamps

The clamps shall be designed and manufactured to properly fit the channels on the poles at the expected height. The internal diameter of semi-circle ring part in clamp shall be designed to suit the outer diameter of poles at the expected height. The clamps shall be adjustable to be used for some range of poles diameters so that such universal design will reduce the number of clamp sizes. The size of bolt and nut for pole clamps shall be equal or more than M16.

Clamps for Galvanized Telescopic Pole

The recommended clamp for telescopic pole is categorized into three types as stipulated below: All materials shall be galvanized. Details are given in drawing no. BPC-DDCS-2020-16/5-5.

Full Clamp

This clamp shall be designed to suit for mounting two steel channels on the double pole structures such as cross arm assemblies for lines and substations. This clamp consists of two sets of bolt and nut (comprised of a full threaded bolt, a flat washer, a spring washer and a nut) provided to support the cross-arms. Welding of bolts on the clamps shall not be allowed. These bolts-heads shall not bulge on the internal surface of the ring after assembly. Another two sets of bolt and nut (comprised of a full thread bolt, a nut, a spring washer and a two flat washers) shall be provided for coupling the half-round rings.

Half-Clamp

A semicircle clamps shall be designed for mounting one steel channel/ angle on the single or double pole structures. This clamp will consist of two sets of bolt and nut (comprised of a full



thread bolt, a nut, a spring washers and two flat washers). The clamp shall be designed to fit the single channel on poles and the space of bolting part between clamp and channel may be designed at approximately ¼ of the outer diameter of pole.

Stay Clamp Assembly

Stay clamp assembly for telescopic pole consist of stay clamp and the V-hanger.

Clamps for Steel swaged Pole

- "M" clamp is used for supporting two channels on the double pole structures such as cross arms and transformer platform.
- "U+M" clamp is used for supporting single cross arm channel on single pole structure. It is a combination of "U" clamp and "M" clamp.
- "Full clamp" is used for supporting intermediate supports for cross bracing, ABS handle support and equipment supports.
- Stay clamp consist of two "U" clamps.

The detail of clamps used for steel swaged pole is given in the drawing no. BPC-DDCS-2020-15/7-7

Line Cross-arm Assemblies for Steel Swaged Pole.

Single Pole Assemblies

Single pole structure is used for small angle or tangent lines. Single pole assembly shall consist of following items:

Pole fittings for Single pole assemblies		
	Items	Quantity
A	SP Top Hamper Assembly	
i	ISMC 100 x 50, welded in L-shape	1 No.
ii	"U+M" clamp with GI nuts and bolts, 16 mm dia, 125 mm long, complete with one flat washer and one spring washer	1 Set
B	SP Cross Arm Assembly	
i	ISMC 100x50, 1620 mm length complete with necessary hole	1 No.
ii	U+M" clamp with GI nuts and bolts, 16 mm dia, 125 mm long, complete with one flat washer and one spring washer	1 Set

Details are given in drawing no. BPC-DDCS-2020-18/1-11

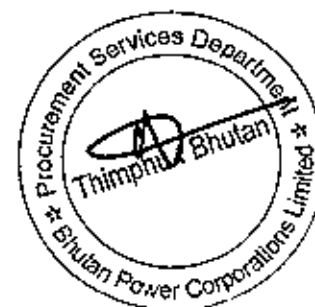


Double Pole Assemblies

Double pole will be used for large angle lines or at the dead end point on MV distribution lines.

Pole Fittings for Double Pole Assemblies		
	Items	Quantity
1	DP Top Cross arm Assembly (10 m)	
i	ISMC 100x50, 3150 mm length complete with necessary holes	2 Nos
ii	"M" Clamp	4 Nos
iii	Sets of GI Nuts and bolts, 16 mm dia, 175 mm long, complete with one flat washer and one spring washer along with 20 mm dia GI pipe for clamps	4 sets
iv	MS flat string bracing, 50 x 6 mm, 227 mm length complete with necessary holes for fixing insulator	6 Nos
v	Sets of GI nuts and bolts, 16 mm dia, 150 mm long, complete with one flat washer and one spring washer along with 20mm dia pipe for bolting MS flat and disc insulator	6 Sets
2	DP cross Bracing Assembly (10 m)	
i	MS angle 50x50x6 mm, 2030 mm length complete with necessary holes	1 No.
ii	MS angle 50x50x6 mm, 2000 mm length complete with necessary holes	1 No.
iii	MS angle 50x50x6 mm, 2919 mm length complete with necessary holes	2 Nos.
iv	Full clamp (pole dia 114.3 mm outer dia)	2 Nos.
v	Full clamp (pole dia 165.1 mm outer dia)	2 Nos.
vi	Sets of GI nuts and bolts, 16 mm dia, 100 mm long, completed with one flat washer and one spring washer	8 sets
vii	Sets of GI nuts and bolts, 16 mm dia, 35 mm long, complete with one flat washer and one spring washer	5 Sets

Details are given in drawing no. BPC-DDCS-2020-18/2-11



Line Cross-arm Assemblies for Telescopic Pole (11.2 m)

Pole fittings for telescopic pole shall be galvanized and there is no need of painting and concreting at site.

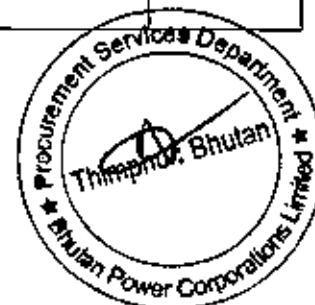
Single Pole Assemblies

Pole fittings for Single-Pole Assemblies		
	Items	Quantity
A	SP Top cross arm Assembly (11.2 m)	
i	ISMC 100 x 50, 300 mm length complete with necessary holes	1 No.
ii	Set of half clamp with GI nuts and bolts, 16 mm dia, 105 mm long, complete with one flat washer and one spring washer	1 Set
B	SP Lower Cross Arm Assembly (11.2)	
i	ISMC 100x50, 1620 mm length complete with necessary holes	1 No.
ii	A set of half clamp with GI nuts and bolts, 16 mm dia, and 127 mm long, complete with one flat washer and one spring washer	1 Set

Details are given in drawing no. BPC-DDCS-2020-19/1-21

Double Pole Assemblies

Pole fittings for Double pole Assemblies		
	Items	Quantity
1	DP Top Cross Arm Assembly (11.2 m)	
i	ISMC 100x50, 3650 mm length complete with necessary holes	2 Nos.
ii	Sets of full clamp	2 sets
iii	Sets of GI nuts and bolts, 16 mm dia, 175 mm long, complete with one flat washer and one spring washer along with 20 mm dia GI pipe for the clamps	4 Sets
iv	MS flat string bracing, 50x6 mm, 268 mm length complete with necessary holes for fixing insulator	6 Nos.
v	Sets of GI nuts and bolts, 16 mm dia, 150 mm long, complete with one flat washer and one spring washer along with 20 mm dia GI pipe for bolting MS flat and disc insulator	6 Sets
2	DP cross Bracing Assembly (11.2)	
i	MS angle 65x65x6 mm, 2346 mm length complete with necessary holes	1 No.
ii	MS angle 65x65x6 mm, 2400 mm length complete with necessary holes	1 No.
iii	MS angle 65x65x6 mm, 2746 mm length complete with necessary holes	2 Nos.
iv	Half Clamp to suit different section of the pole with 8 sets of GI nuts and bolts, 16mm dia, complete with one flat washer and one spring washer.	4 Nos.
v	Sets of GI nuts and bolts, 16 mm dia, 35 mm long, complete with one flat washer and one spring washer	5 Sets



Details are given in drawing BPC-DDCS-2021-19/3-21

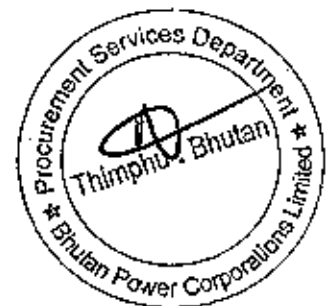
Line Cross-Arm Assemblies for Telescopic Pole (12 meter)

12 meter telescopic poles is used with shielding wire and the arrangement of the shielding wire for the single pole assembly will be hanged by U-Bolt on the top side of pole. A "U" bracket with M16 hook bolt and nut shall be provided under hardware fittings. The top segment of 12m pole shall have holes for a through bolt (M16) for the suspension clamp. For double pole structure, the shield wire will be stringed on the top cross-arm by a preformed assembly comprising of a preformed dead-end termination, an eye-thimble and a cross arm strip.

Single Pole Assemblies

Pole fittings for Single pole Assemblies		
	Items	Quantity
A	SP Shielding Arrangement	
i	200 mm long, 16 mm dia bolts threaded at both ends	1 No.
ii	U-type connector of 75x50x6 mm with 12 mm dia and 17.5 mm dia holes	1 Set
iii	L-Bolt of 10 mm dia, 35 mm long threaded	1 Set
B	SP Top Cross arm Assembly (12 m)	
i	ISMC 100x50, 1000 m long	1 No.
ii	Set of half clamp with GI nuts and bolts, 16 mm dia, complete with one flat washer and one spring washer.	1 Set
iii	Bracing angle ISA 40x40x5, 892 mm long with full clamping arrangement with necessary nuts and bolts	1 No.
C	SP Lower Cross Arm Assembly (12 m)	
i	ISMC 100x50, 1650 mm length complete with necessary holes	1 No.
ii	Set of half Clamp with GI nuts and bolts, 16 mm dia, complete with one flat washer and one spring washer.	1 Set

Details are given in drawing no. BPC-DDCS-2020-19/5-12



Double Pole Assemblies

Pole fittings for Double pole Assemblies		
	Items	Quantity
A	DP Shielding Arrangement	
i	ISMC 75x40x2283 mm long	1 No.
ii	Sets of half clamp with GI nuts and bolts, 16 mm dia, complete with one flat washer and one spring washer	2 sets
iii	Sets of cross arm strap with thimble socket	2 Sets
iv	Shielding wire preform	2 Nos.
B	DP Top Cross Arm Assembly (11.2 m)	
i	ISMC 100x50, 3650 mm length complete with necessary holes	2 Nos.
ii	Sets of full clamp	2 sets
iii	Sets of GI nuts and bolts, 16 mm dia, 175 mm long, complete with one flat washer and one spring washer along with 20 mm dia GI pipe for the clamps	4 Sets
iv	MS flat string bracing, 50x6 mm, 268 mm length complete with necessary holes for fixing insulator	6 Nos.
v	Sets of GI nuts and bolts, 16 mm dia, 150 mm long, complete with one flat washer and one spring washer along with 20 mm dia GI pipe for bolting MS flat and disc insulator	6 Sets
C	DP cross Bracing Assembly (11.2)	
i	MS angle 65x65x6 mm, 2346 mm length complete with necessary holes	1 No.
ii	MS angle 65x65x6 mm, 2400 mm length complete with necessary holes	1 No.
iii	MS angle 65x65x6 mm, 2746 mm length complete with necessary holes	2 Nos.
iv	Half Clamp to suit different section of the pole with 8 sets of GI nuts and bolts, 16mm dia, complete with one flat washer and one spring washer.	4 Nos.
v	Sets of GI nuts and bolts, 16 mm dia, 35 mm long, complete with one flat washer and one spring washer	5 Sets

Details are given in drawing no. BPC-DDCS-2020-19/8-21



Substation structure Assemblies

Substation structure will be used for mounting the transformer, lightning arrestors, drop out fuse and transformer distribution board. There shall be proper interface between transformer base channel and mounting platform on the pole.

All the complete set of assembly, including cross-arm, transformer platforms, clamps for cross-arms, tension straps, Stay clamps, bolts, nuts and washers, etc. shall be designed as shown on relevant drawings. Following are the details of fittings for IS poles and similar fittings are also used for telescopic poles as shown in the drawings.

Pole fittings for Substation structure Assemblies		
	Items	Quantity
A	Substation Pole Top Cross Arm Assembly	
i	ISMC 100x50, 3110 mm length complete with necessary holes	2 Nos.
ii	"M" clamp	4 Nos.
iii	Sets of GI nuts and bolts, 16 mm dia, 175 mm long, complete with one flat washer and one spring washer along with 20 mm dia GI pipe for clamp	4 Sets
iv	Sets of MS flat string bracing, 50x6mm, 227 mm length complete with necessary holes	6 Sets
v	Sets of GI nuts and bolts, 16 mm dia, 150 mm long, complete with one flat washer and one spring washer along with 20 mm dia GI pipe for bolting MS flat and disc insulator	6 sets
B	Substation equipment Mounting assembly	
i	ISMC 75x40, 3110 mm length complete with necessary holes	3 Nos.
ii	"U+M" Clamp	6 Nos.
iii	Sets of GI nuts and bolts, 16 mm dia, 125 mm long, complete with one flat washer and one spring washer.	12 sets
C	Transformer platform Assembly	
i	ISMC 125x65, 3110 mm length complete with necessary holes	2 Nos.
ii	"M" Clamp	4 Nos.
iii	Sets of GI nuts and bolts, 16 mm dia, 240 mm long, complete with one flat washer and one spring washer	4 Sets

Details are given on drawing no. BPC-DDCS-2020-18 & BPC-DDCS-2020/19



Load Break Switch/Air Break Switch Assemblies

LBS/ABS/is mounted on double pole structure in vertical configuration. Assembly includes items shown in drawing no. BPC-DDCS-2020-18/8-11 & BPC-DDCS-2020-19/18-21, 19/19-21, 19/20-1, 19/21-21

Auto Re-closer Assemblies

The auto recloser (AR) is either mounted on double or single pole structures. For double pole mounting, the mounting platform will be similar to that of transformers. Auto recloser tank and the PT tank shall be provided with base channels similar to transformers with anchor bolts and nuts to fit on the mounting platform. Typical ARCB installation is shown in drawing no. BPC-DDCS-2020-18/10-11 & 2011-11

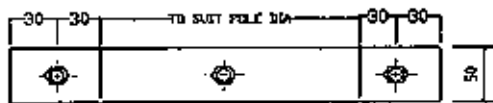
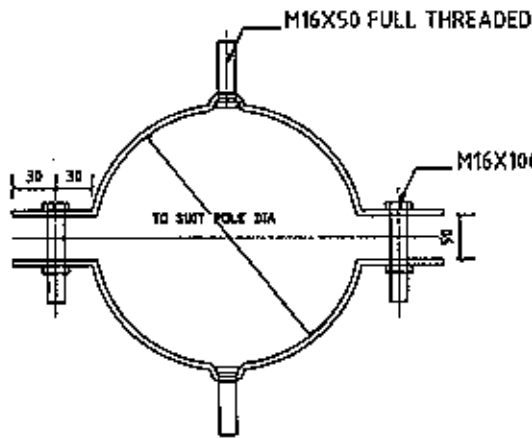
Stay Assembly

Stay assembly is installed at dead-end and angular locations to counter balance the load on the supports due to pulling of the conductors so that supports remain straight in vertical position without bending in any direction. They are also provided at mid span support as a protection against the wind load. The stay set (Line Guy set) will consist of the following components:

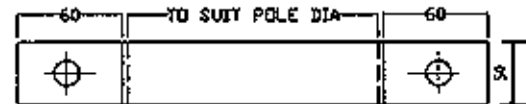
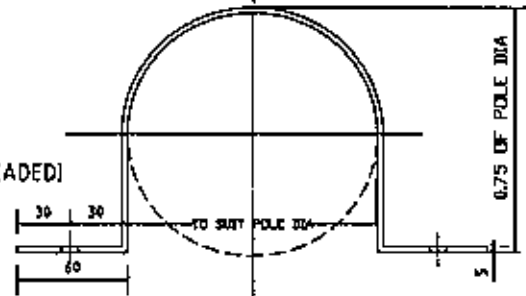
Description	33 kV & 11 kV
Anchor rod	2.5 m long with 20 mm dia. GI rod
Stay Plate	300 x 300 x 6 mm with 22 mm hole at its centre
Turn buckle, eye bolt with nuts	20 mm dia. G.I rod, 460 mm long
Bow with welded channel (V-hanger) only for telescopic structure	16 mm dia. GI rod. The apex or top of the bow shall be bent at an angle of 10R. The other end shall be welded with proper and good quality welding to a G.S. Channel 200 mm long having dimension of 100 x 50 x 6 mm. the Channel shall have 2 holes of 18 mm dia. at its centre.
Thimble 2 Nos.	1.5 mm thick GI sheet into a size of 75 x 22 x 40 mm and shaped as per standard
Preform 4 Nos.	Preform suitable for stay wire

Details are given on drawing no. BPC-DDCS-2020-22

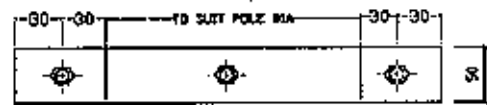
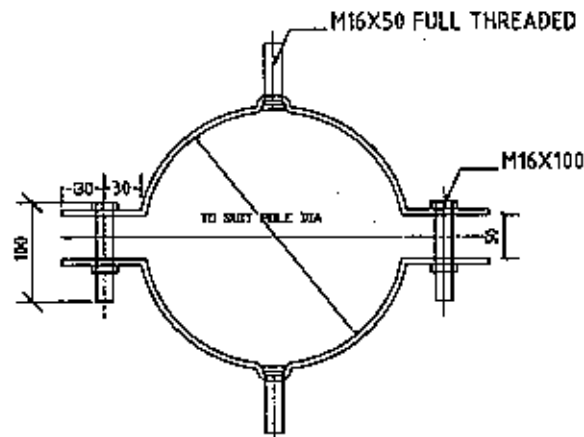




Y TYPE - CLAMP (FULL CLAMP)



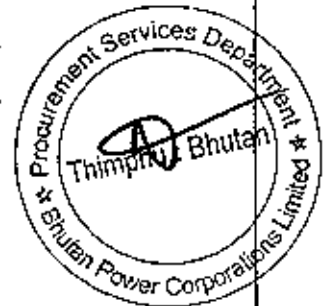
X TYPE - CLAMP (HALF CLAMP)





STAY CLAMP

NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. ALL MATERIALS SHALL BE GALVANIZED
4. ALL THE BOLTS SHALL BE FULL THREADED TYPE

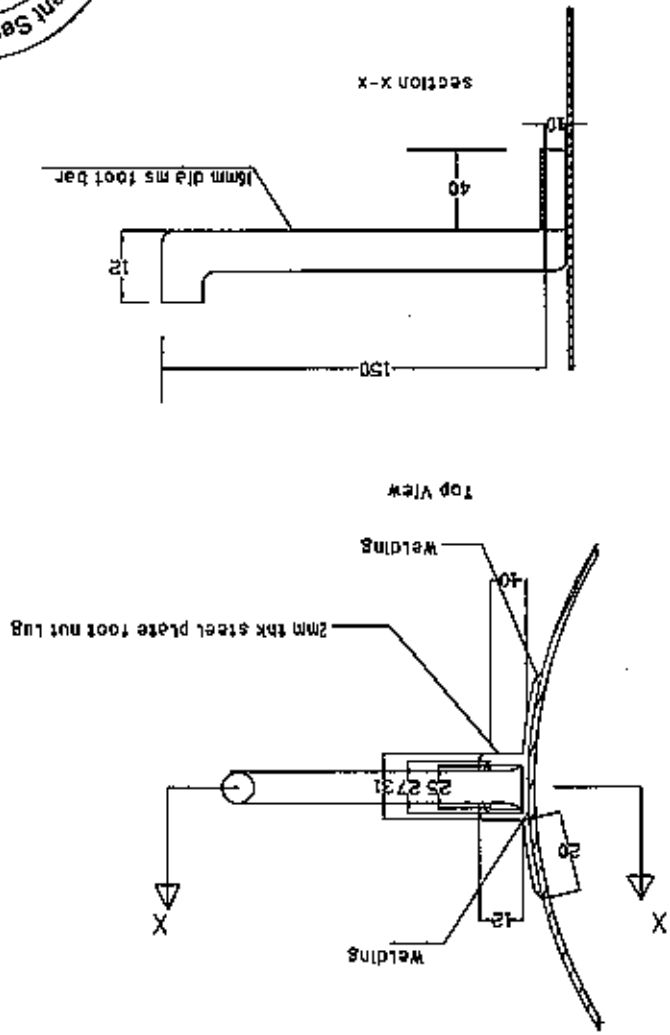


	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE DESIGNED BY	NAME	DATE	CLAMPS FOR TELESCOPIC POLE	
CHECKED BY APPROVED BY			DRAWING NO. BPC-DDCS-2020-16/5-5	REVISION 2020

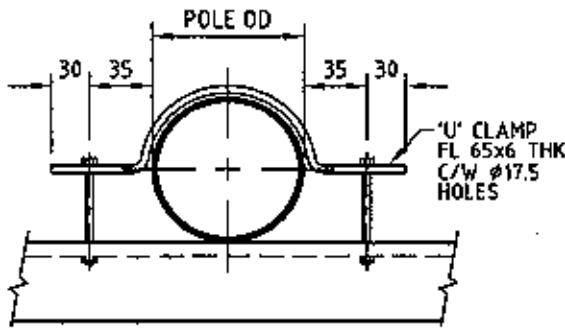
APPROVED BY		DRAWING NO. BPC-DACS-2020-16/3-5	REVISION	2020
CHECKED BY				
DESIGNED BY				
TITLE	NAME	DATE	Foot Bar for Telescopic Pole	
	BHUTAN POWER CORPORATION LIMITED		DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
	ENGINEERING AND RESEARCH DEPARTMENT			

NOTES

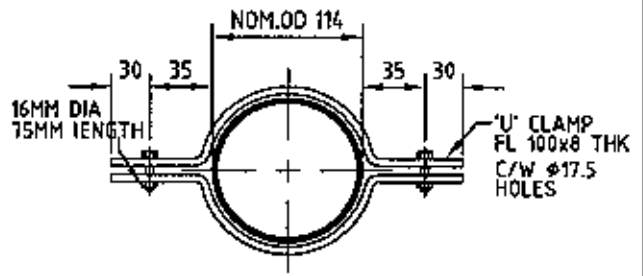
1. FERROUS PARTS HOT DIP GALVANIZED AS PER BS-729
2. DIMENSIONS AS SHOWN ARE IN mm.
3. TOLERANCE $\pm 5\%$
4. DRAWING IS NOT TO SCALE.
5. FOUR NUMBERS PER POLE



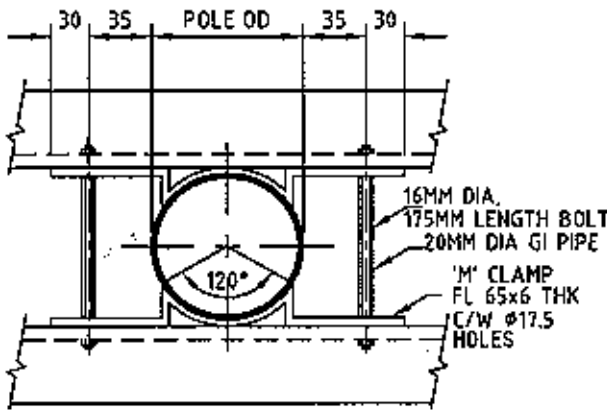
Details of Footbar



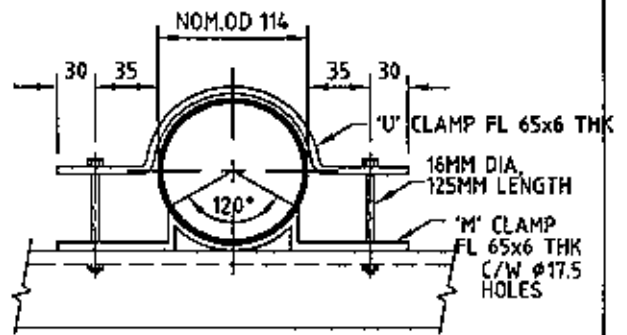
1 'U' CLAMP



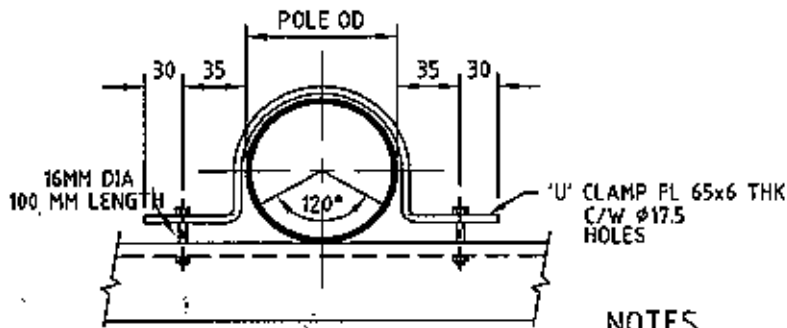
4 STAY CLAMP



2 'M' CLAMP



5 CROSS ARM CLAMP (U+M)



3 FULL CLAMP



- NOTES**
1. DIMENSIONS AS SHOWN ARE IN mm.
 2. DRAWING IS NOT TO SCALE.
 3. ALL BOLTS TO BE Ø16 C/W NUTS & SPRING WASHERS.



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

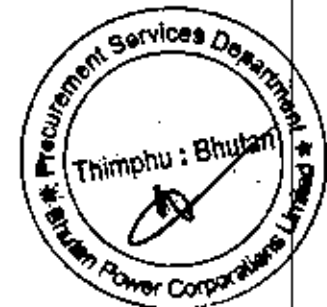
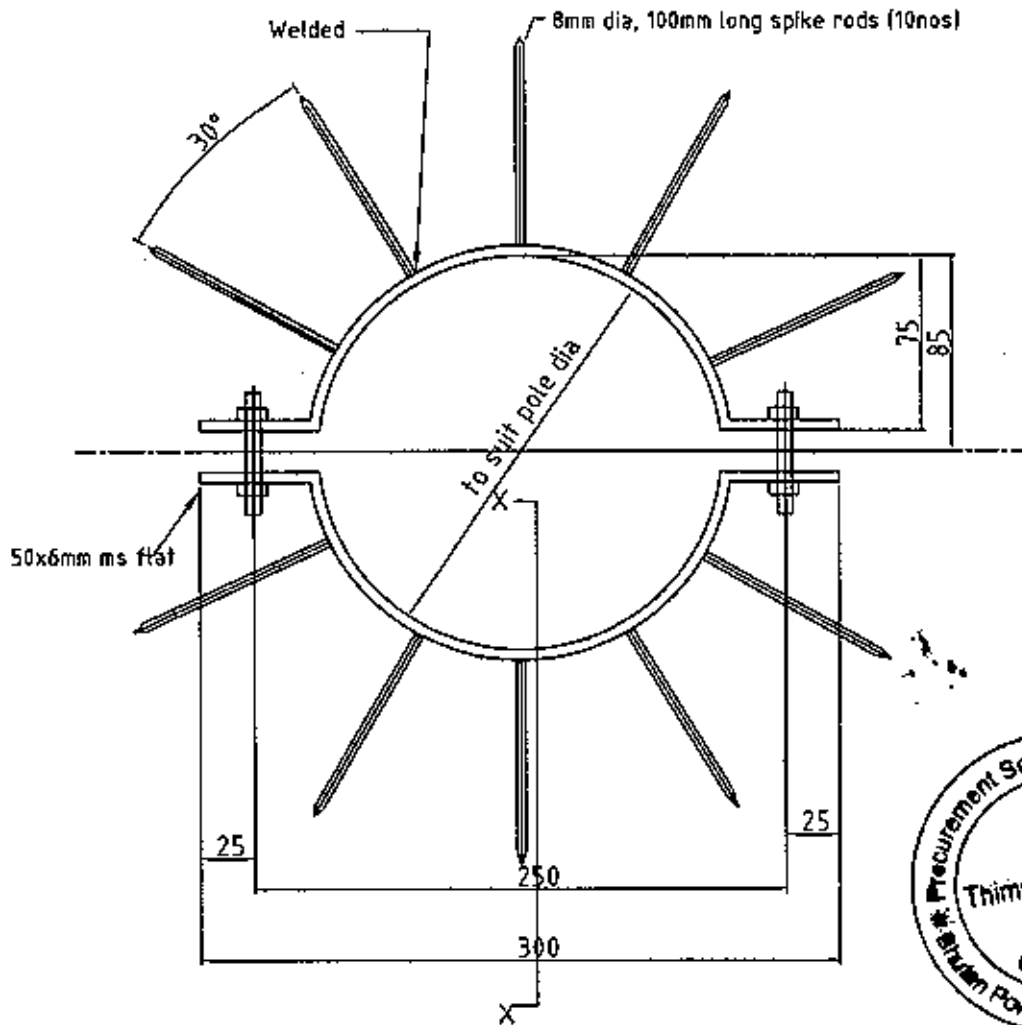
TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

**33 & 11 kV
CLAMP DETAILS FOR STEEL TUBULAR POLE**

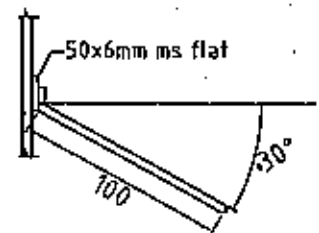
TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

DRAWING NO. BPC-DDCS-2020-15/7-7

**REVISION
2020**




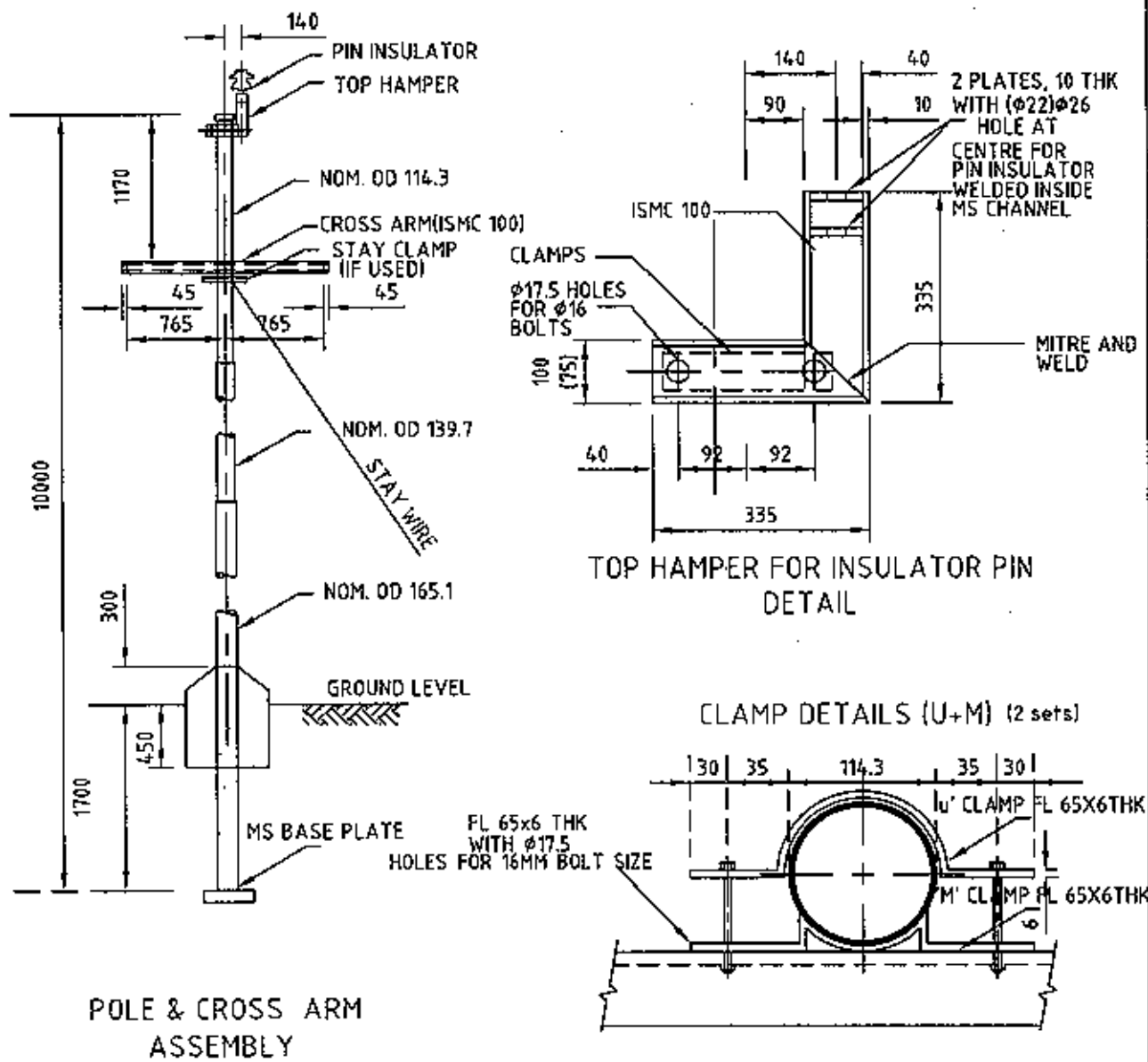
section X-X



NOTES

1. FERROUS PARTS HOT DIP GALVANIZED AS PER BS-729
2. DIMENSIONS AS SHOWN ARE IN mm.
3. TOLERANCE $\pm 5\%$
4. DRAWING IS NOT TO SCALE.
5. ONE NUMBER PER POLE


	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
			ANTI-CLIMBING DEVICE	
TITLE	NAME	DATE		
DESIGNED BY				
CHECKED BY				
APPROVED BY			DRAWING NO. BPC-DDCS-2020-16/4-5	REVISION 2020



NOTES

1. DIMENSIONS AS SHOWN ARE IN mm
2. DRAWING IS NOT TO SCALE.
3. ALL NUTS AND BOLTS TO BE HOT DIPPED GALVANISED

DESCRIPTION	QTY	MATERIAL
10M STEEL TUBULAR POLE	1	STEEL
CROSSARM CHANNEL	1	MS
TOP HAMPER WELDED IN "L" SHAPE	1	MS
PIN INSULATOR	3	PORCELAIN
CLAMP WITH NUTS & BOLTS (U+M)	2	MS
STAY SET ASSEMBLY	1	MS
BASE PLATE	1	MS

 <p>BHUTAN POWER CORPORATION LIMITED</p>		
	TITLE	DATE
	DESIGNED BY	
	CHECKED BY	
	APPROVED BY	

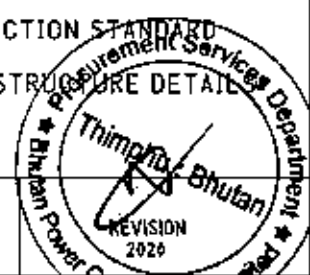
ENGINEERING AND RESEARCH DEPARTMENT

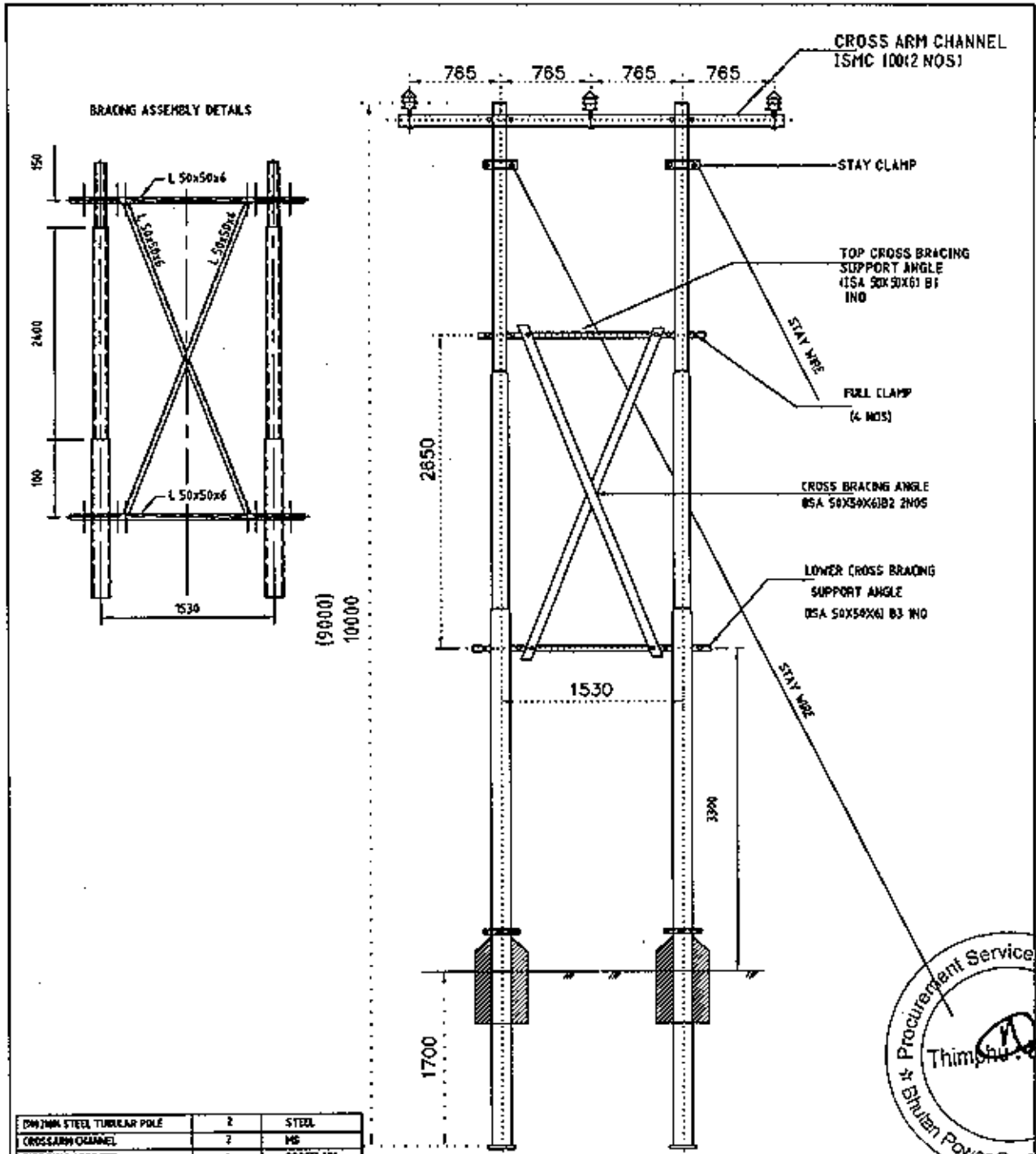
DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

STEEL TUBULAR-SINGLE POLE STRUCTURE DETAIL

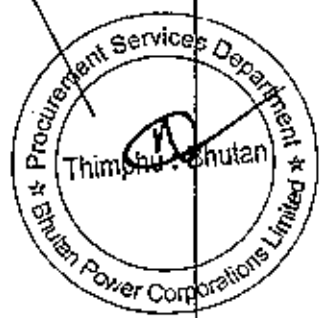
11 & 33 KV

DRAWING NO. BPC-DBCS-2020-18/1-11





(9000)
10000



Ø90X3MM STEEL TUBULAR POLE	2	STEEL
CROSS ARM CHANNEL	2	MS
EMC INSULATOR SET	6	PORCELAIN
PM INSULATOR SET	3	PORCELAIN
CLAMP WITH NUTS & BOLTS M-H	2	MS
STAY SET ASSEMBLY	2	MS
BASE PLATE	2	MS
DESCRIPTION	QTY	MATERIAL

- NOTES
1. DIMENSIONS AS SHOWN ARE IN mm
 2. DRAWING IS NOT TO SCALE.



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

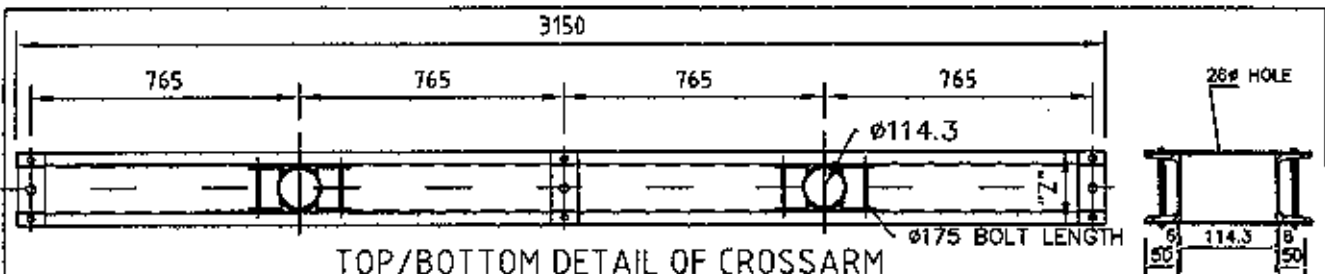
11kV/33 KV H-FRAME

DOUBLE POLE ARRANGEMENT (STEEL TUBULAR POLES)

TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

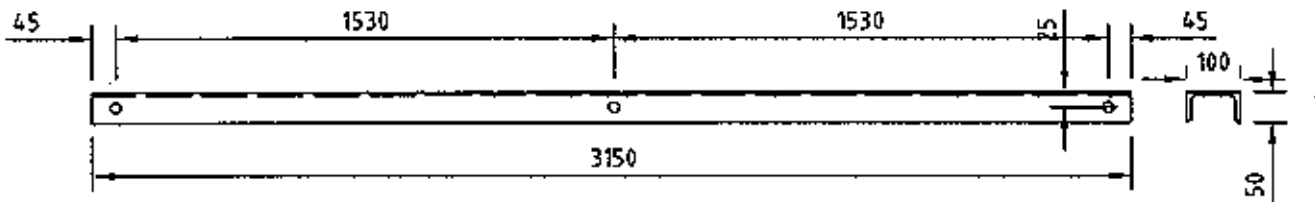
DRAWING NO.
BPC-DDCS-2020-18/2-11

REVISION
2020



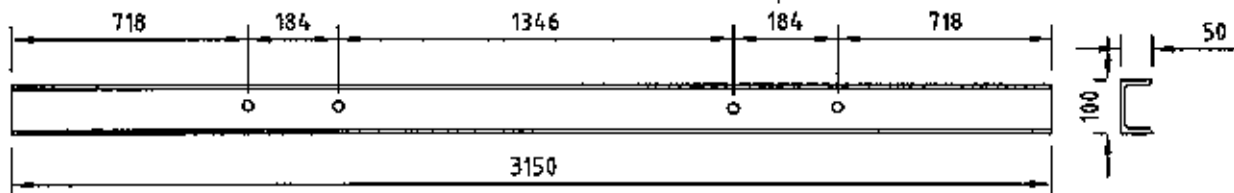
TOP/BOTTOM DETAIL OF CROSSARM

ISMC 100x50 (2 NOS)



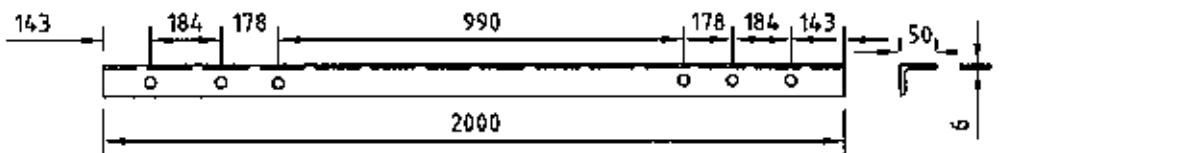
TOP VIEW OF CROSSARM - CHL

ISMC 100x50 (2 NOS)



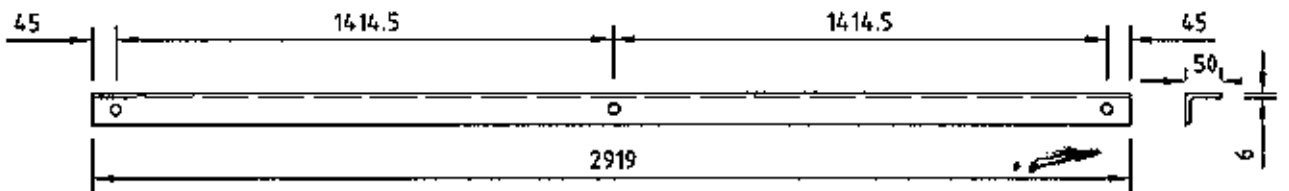
FRONT VIEW OF CROSSARM - CHL

ISMC 100x50 (2 NOS)



DETAIL OF BRACING - B1

ISA 50x50x6 (1 NO)



DETAIL OF BRACING - B2

ISA 50x50x6 (2 NOS)

NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. ALL BOLT HOLES TO BE 18MM EXCEPT FOR THE ONE INDICATED.



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

11 & 33 KV H-FRAME

CHANNEL & BRACING DETAIL (STEEL TUBULAR POLES)

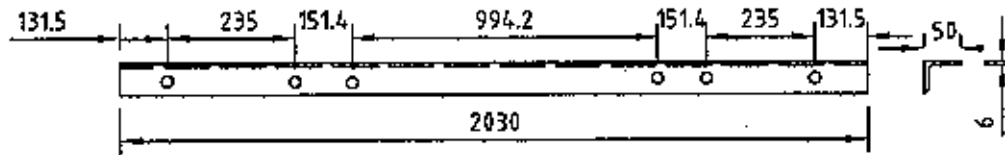
TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

DRAWING NO.
BPC-DCS-2020-18/3-II

REVISION
2020

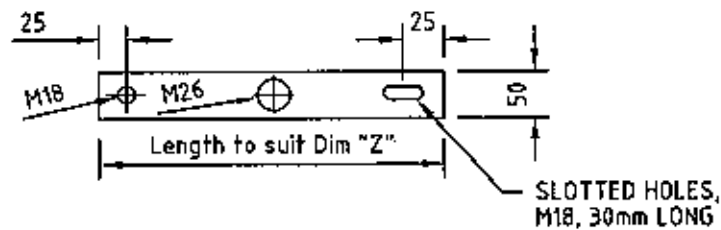


DETAIL OF BRACING - B3



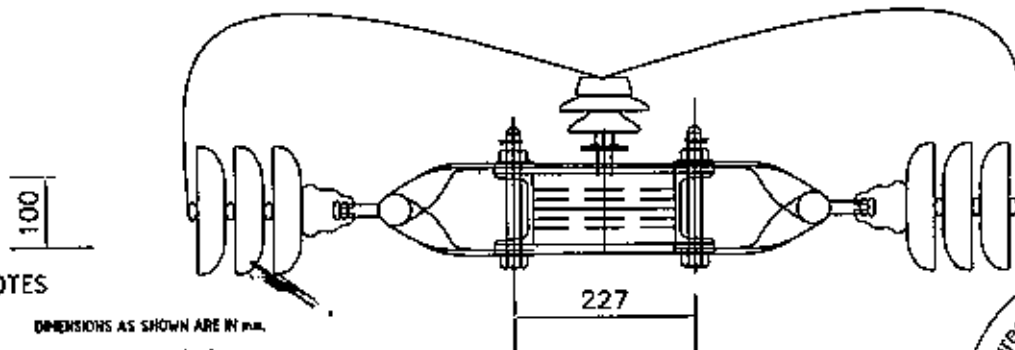
ISA 50x50x6 (1 NO)

DETAIL OF MS STRING LACING FLAT



FL 50x6 (6 NOS)
M16X185 MM BOLT LENGTH (6NOS)


FIXING OF PIN AND DISC INSULATOR ON CROSSARM

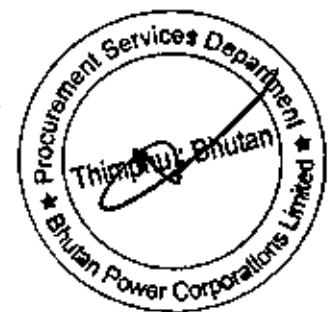
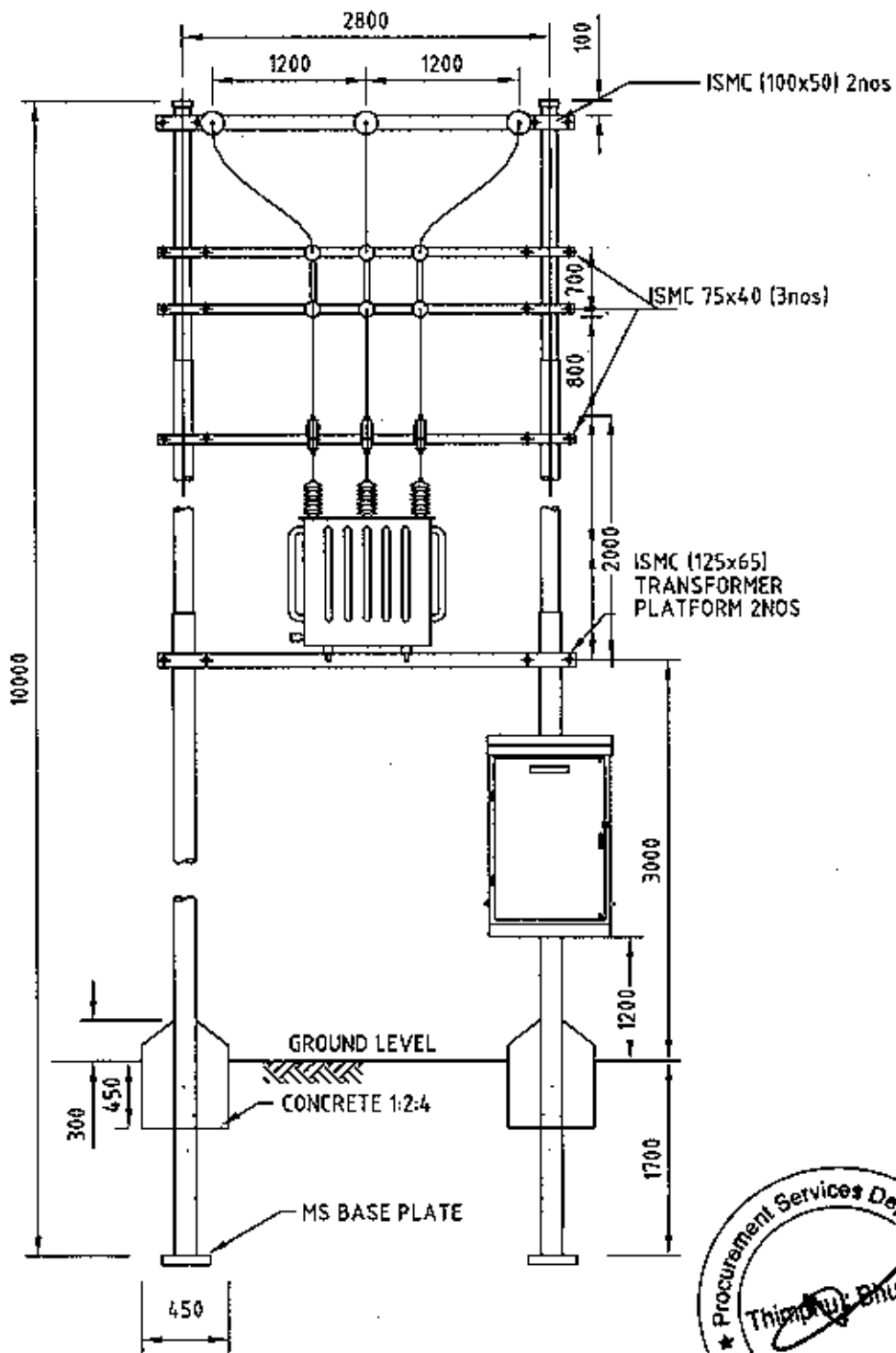


NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. STANDARDS
IS 2062-1992/IS 1961 OR EQUIVALENT STEEL FOR GENERAL STRUCTURAL PURPOSES
IS 808-1964 OR EQUIVALENT DIMENSIONS FOR HOT ROLLED STEEL BEAM COLUMN CHANNEL AND ANGLE SECTION
4. MINIMUM TENSILE STRENGTH - 420 MPA
5. ALL ITEMS SHALL BE MILD STEEL (MS) PAINTED WITH ONE COAT OF RED OXIDE PRIMER IN ACCORDANCE WITH ISO 12954-7 OR ANY OTHER EQUIVALENT INTERNATIONAL STANDARD, HOWEVER, NUTS AND BOLTS SHALL BE HOT DIPPED GALVANISED WITH ZINC COATING 600 GRAM PER SQUARE METER.
6. DISC ARRANGEMENT IS SHOWN FOR 33KV SYSTEM, TAKE ONE DISC INSULATOR FOR 11KV SYSTEM



	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD 11 & 33 KV H-FRAME CHANNEL & BRACING DETAIL (STEEL TUBULAR POLES)	
TITLE	NAME	DATE	DRAWING NO. BPC-DCCS-2020-18/4-11	
DESIGNED BY				
CHECKED BY				
APPROVED BY				
			REVISION 2020	



NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

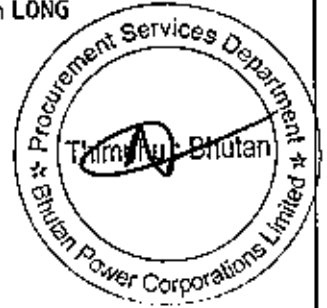
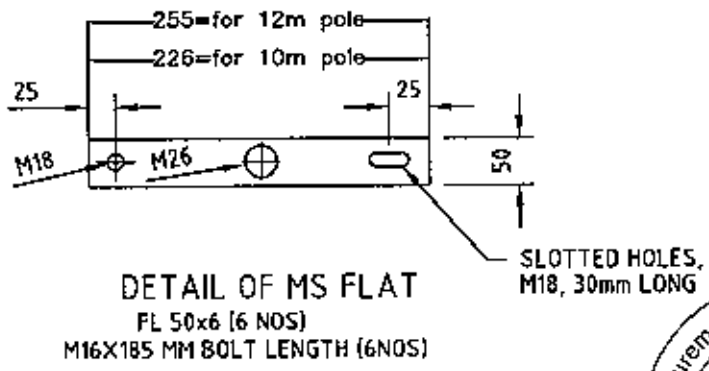
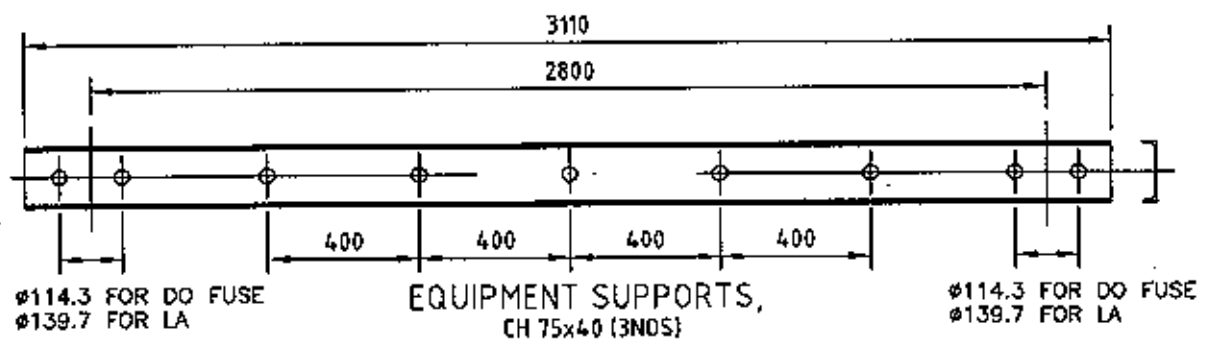
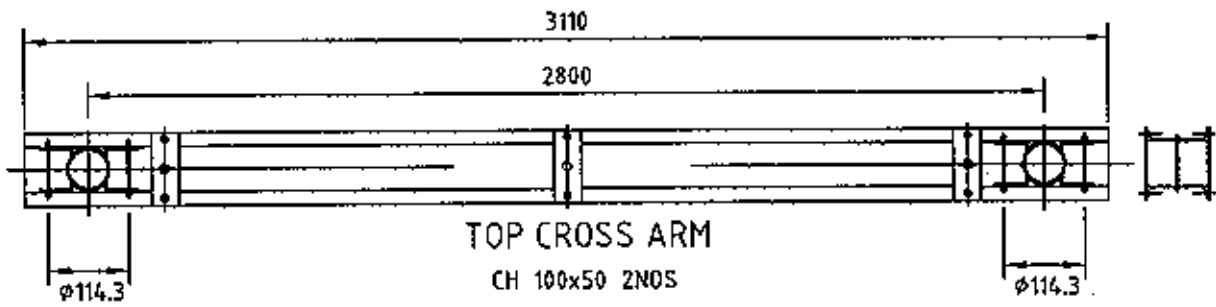
DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

POLE MOUNTED SUBSTATION STRUCTURE DETAILS

TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		


DRAWING NO. BPC-DDCS-2020-18/5-11

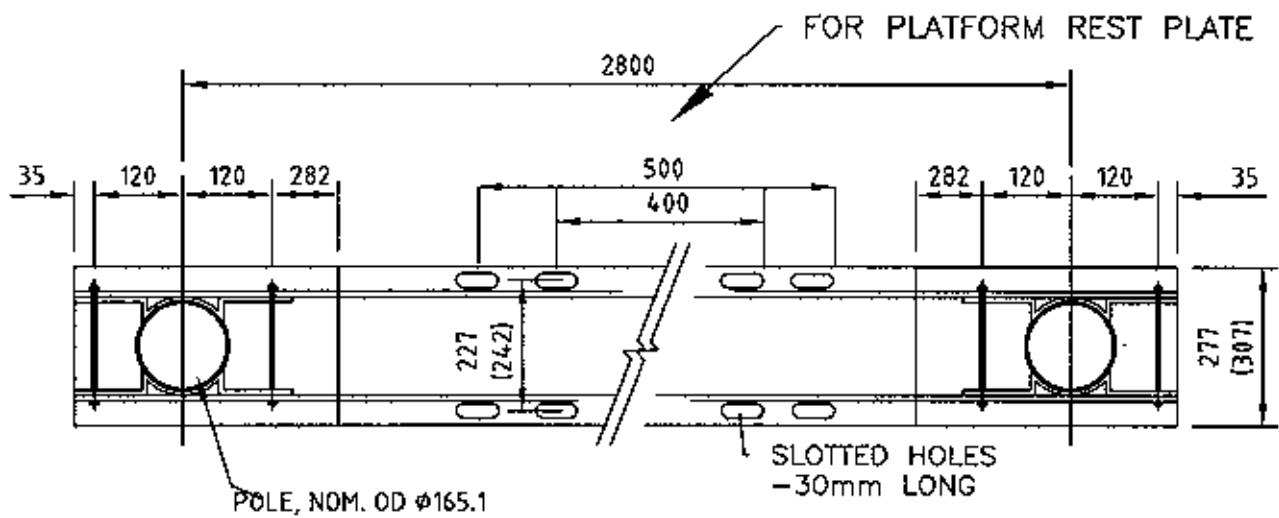
REVISION 2020



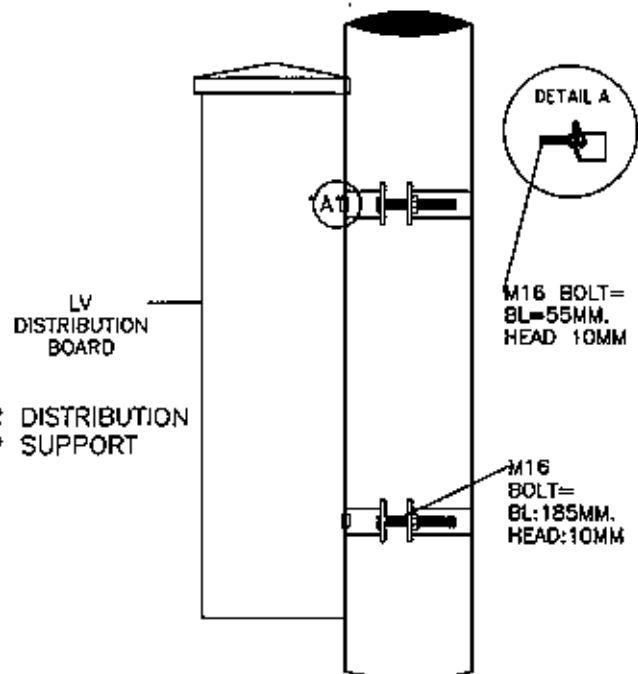
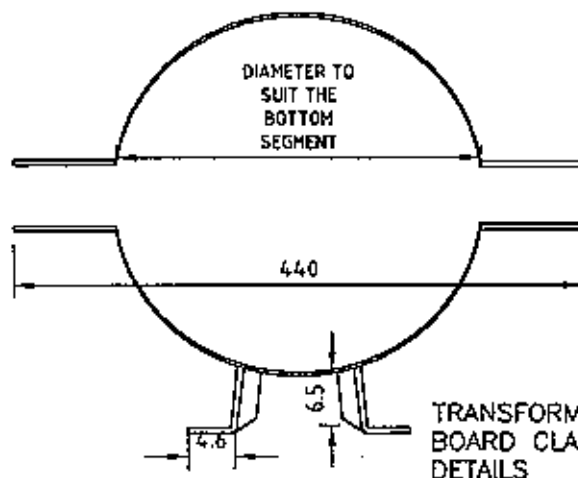
NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. TRANSFORMER LT PANEL SUPPORT REQUIRE ONLY FOR 125kVA TRANSFORMERS
4. GENERAL ARRANGEMENT OF SUBSTATION BE REFERRED FROM DRAWING NO. BPC-DDCS-(9 TO 11)

 BPC	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
		POLE MOUNTED SUBSTATION STRUCTURE DETAILS FOR STEEL TUBULAR POLE		
TITLE	NAME	DATE		
DESIGNED BY				
CHECKED BY				
APPROVED BY			DRAWING NO. BPC-DDCS-2020-18/6-11	REVISION 2020




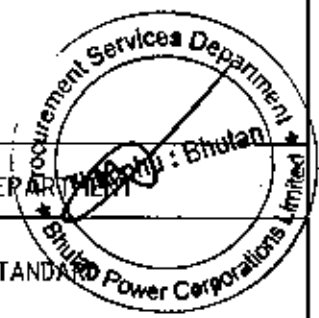
TRANSFORMER PLATFORM (2Nos.)
ISMC 125x65

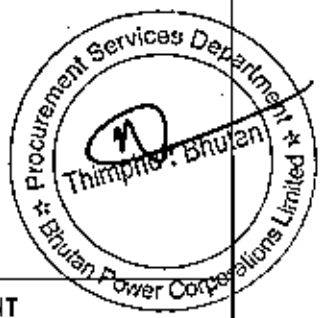
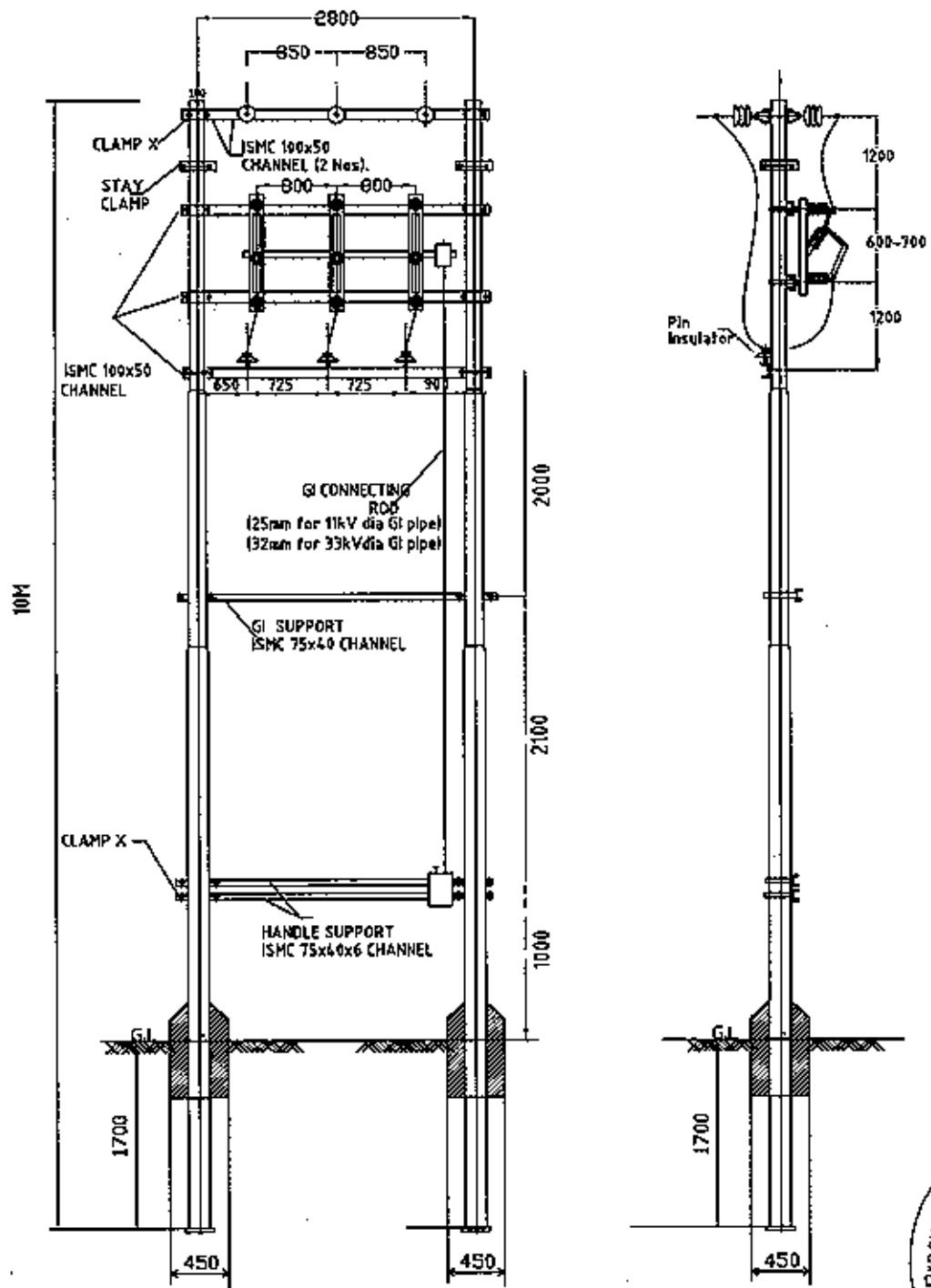



NOTES

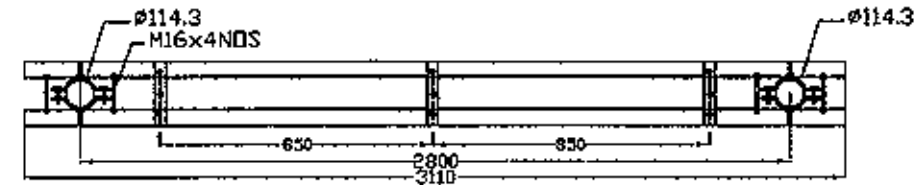
1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. 400 mm hole centre to centre length for 25 kVA and below
500 mm hole centre to centre length for 63 kVA and above

	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE			33 & 11 kV TRANSFORMER PLATFORM FOR STEEL TUBULAR POLE	
DESIGNED BY	NAME	DATE	DRAWING NO. BPC-DDCS-2020-18/7-11	
CHECKED BY			REVISION 2020	
APPROVED BY				

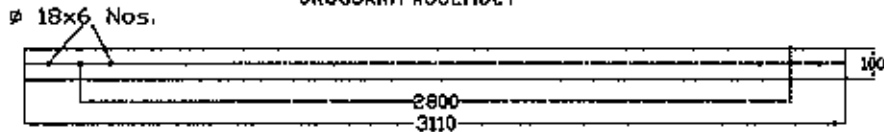




	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
11 & 33kV AIRBREAK SWITCH ARRANGEMENT			STEEL TUBULAR POLE	
TITLE	NAME	DATE	DRAWING NO. BPC-DDCS-2020-18/8-11	
DESIGNED BY				
CHECKED BY				
APPROVED BY				
			REVISION 2020	



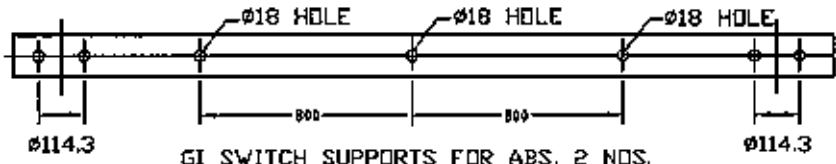
CROSSARM ASSEMBLY



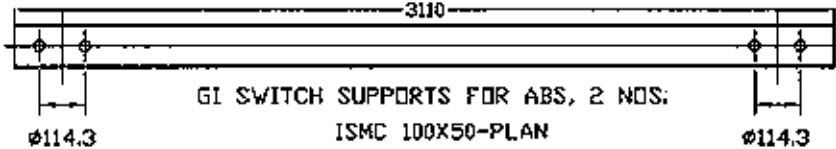
CROSSARM CHANNEL (ISMC 100x50) - ELEVATION



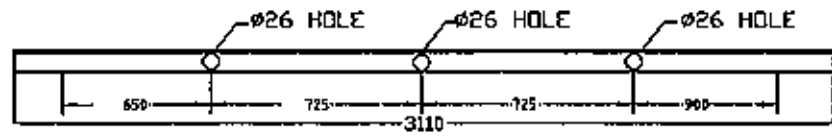
CROSSARM CHANNEL (ISMC 100x50) - PLAN



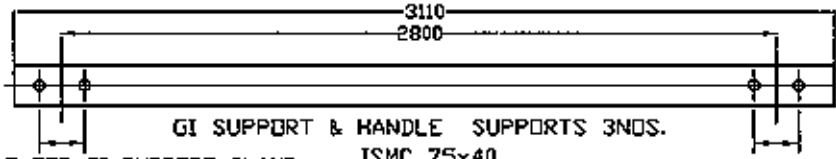
GI SWITCH SUPPORTS FOR ABS, 2 NOS.
ISMC 100x50



GI SWITCH SUPPORTS FOR ABS, 2 NOS.
ISMC 100x50-PLAN



PIN INSULATOR SUPPORTS, 1 NO.
ISMC 100x50



GI SUPPORT & HANDLE SUPPORTS 3NOS.
ISMC 75x40

CLAMP X-0139.7 FOR GI SUPPORT CLAMP
X-0165.1 FOR HANDLE SUPPORT

NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. ALL HOLES ARE 18mm AND ALL BOLTS TO BE 16mm.



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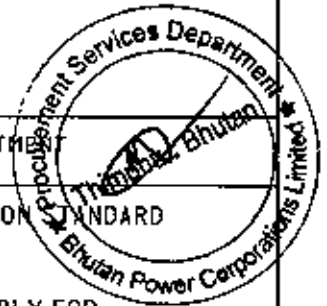
ENGINEERING AND RESEARCH DEPARTMENT

DISTRIBUTION DESIGN & CONSTRUCTION

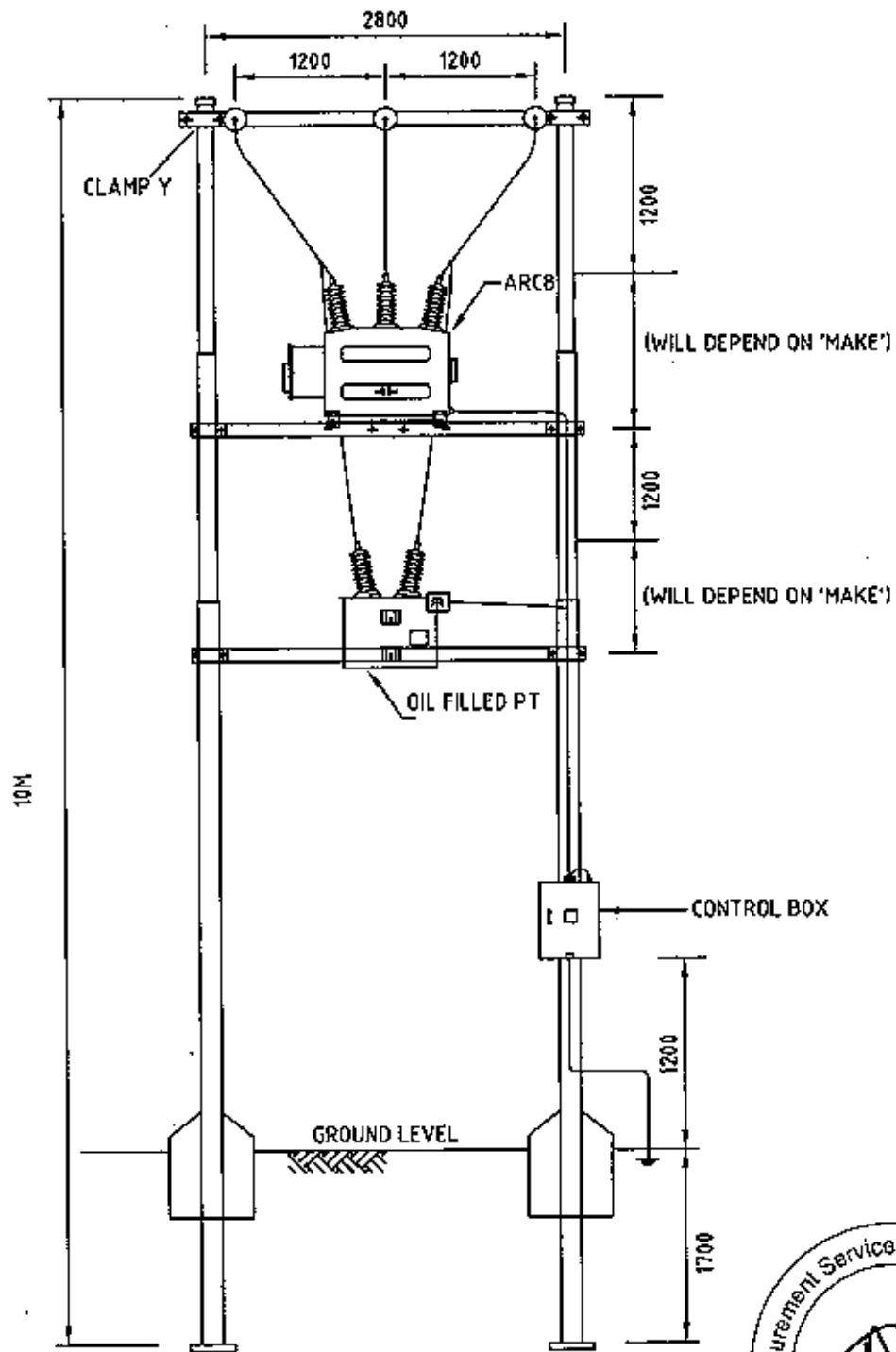
AIRBREAK SWITCH CROSS-ARM ASSEMBLY FOR STEEL TUBULAR POLE

DRAWING NO. BPC-DDCS-2020-18/9-11

REVISION 2020




TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

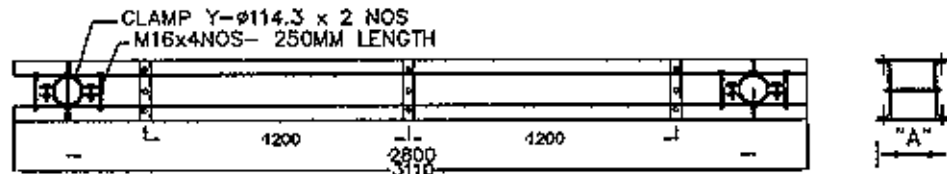


NOTES

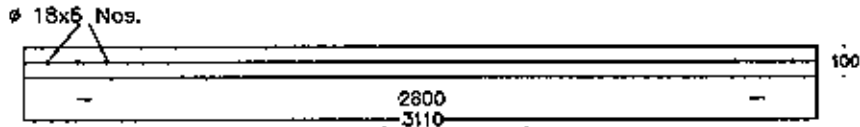
1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.



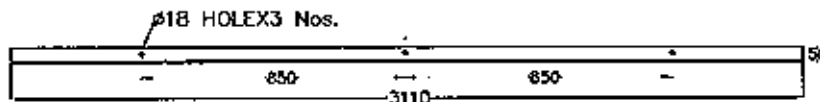
	SHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TYPICAL ARCB ARRANGEMENT ON STEEL TUBULAR POLE				
TITLE	NAME	DATE		
DESIGNED BY				
CHECKED BY				
APPROVED BY				
			DRAWING NO. BPC-DDCS-2020-18/10-11	REVISION 2020



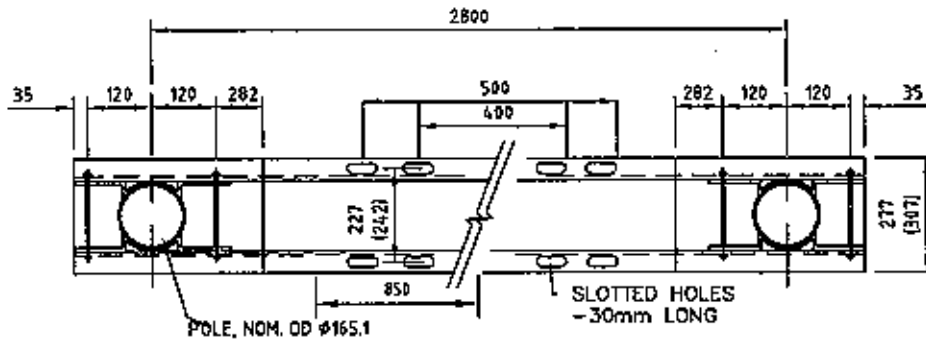
CROSSARM ASSEMBLY



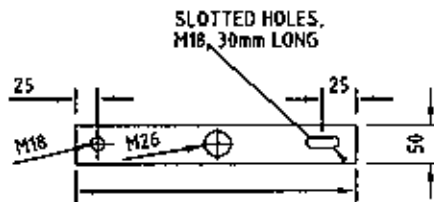
CROSSARM CHANNEL (ISMC 100x50) -- ELEVATION



CROSSARM CHANNEL (ISMC 100x50) - PLAN



ARCB & PT PLATFORM (2Nos.)
ISMC 125x65




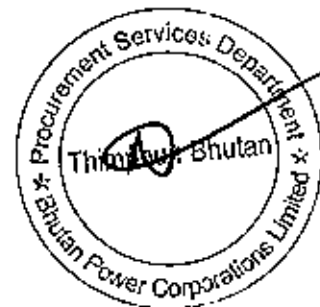
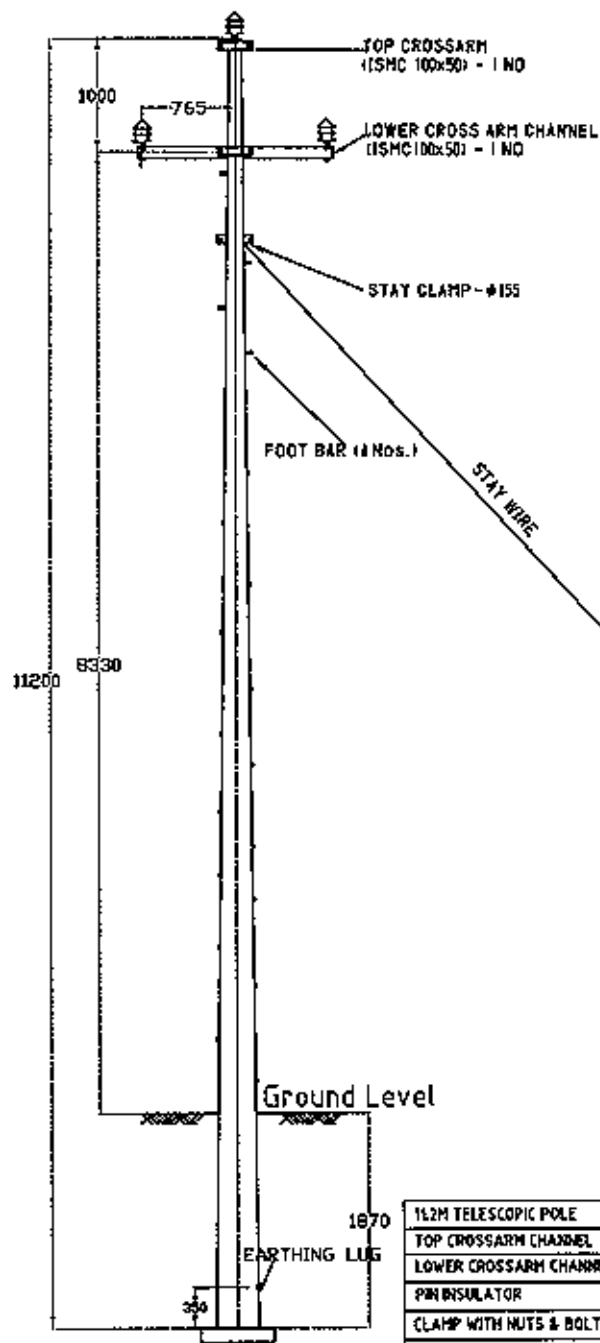
LENGTH TO SUIT "A" IN TOP CROSS ARM
DETAIL OF MS FLAT
FL 50x6 (6 NOS)
M16 x185 MM BOLT LENGTH (6NOS)



NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
ALL HOLES ARE 18mm AND ALL BOLTS TO BE 16mm.
DRAWING IS NOT TO SCALE.


	BHUTAN POWER CORPORATION LIMITED	ENGINEERING AND RESEARCH DEPARTMENT	
		DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE		CROSS-ARM ASSEMBLY FOR MOUNTING ARCB ON STEEL TUBULAR POLE	
DESIGNED BY	NAME	DATE	DRAWING NO. BPC-DDCS-2020-18/11-11
CHECKED BY			
APPROVED BY			
			REVISION 2020

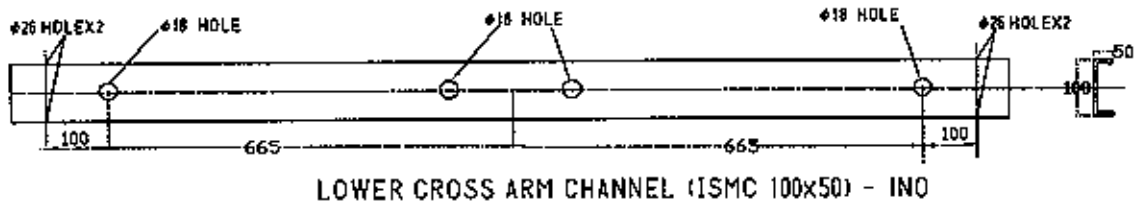
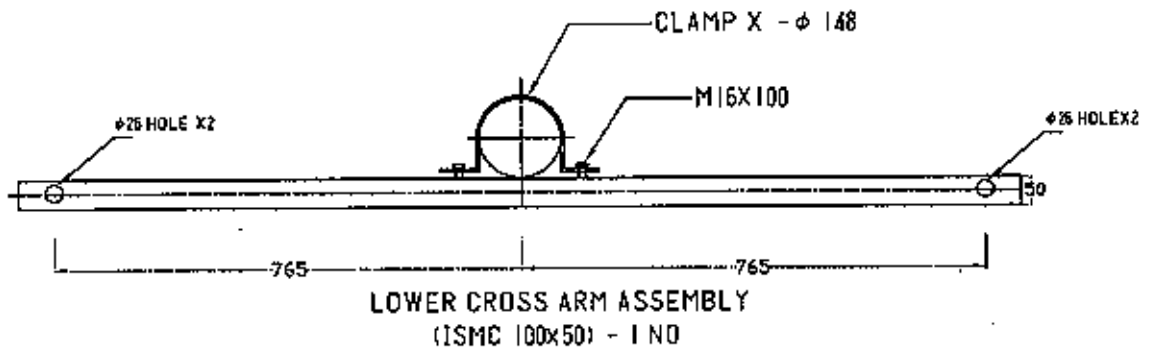
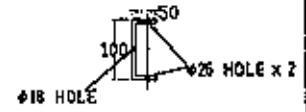
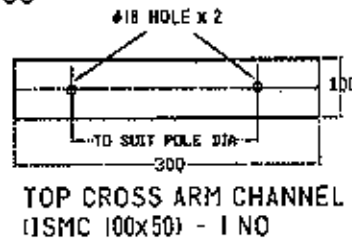
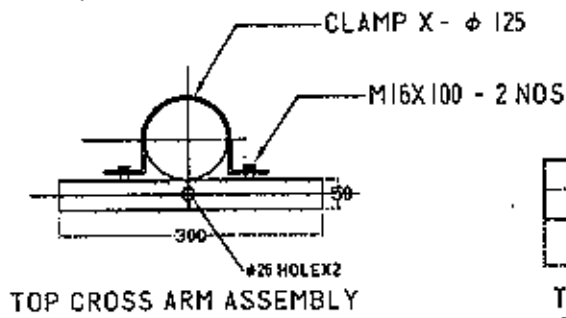


NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.


DESCRIPTION	QTY	MATERIAL
11.2M TELESCOPIC POLE	1	GS
TOP CROSSARM CHANNEL	1	GS
LOWER CROSSARM CHANNEL	1	GS
PORCELAIN INSULATOR	3	PORCELAIN
CLAMP WITH NUTS & BOLTS	2	GS
STAY SET ASSEMBLY	1	GS
BASE PLATE	1	GS

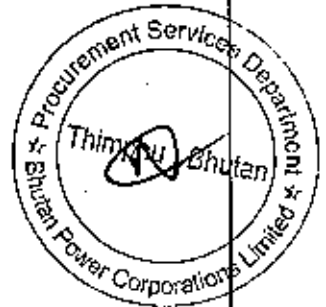
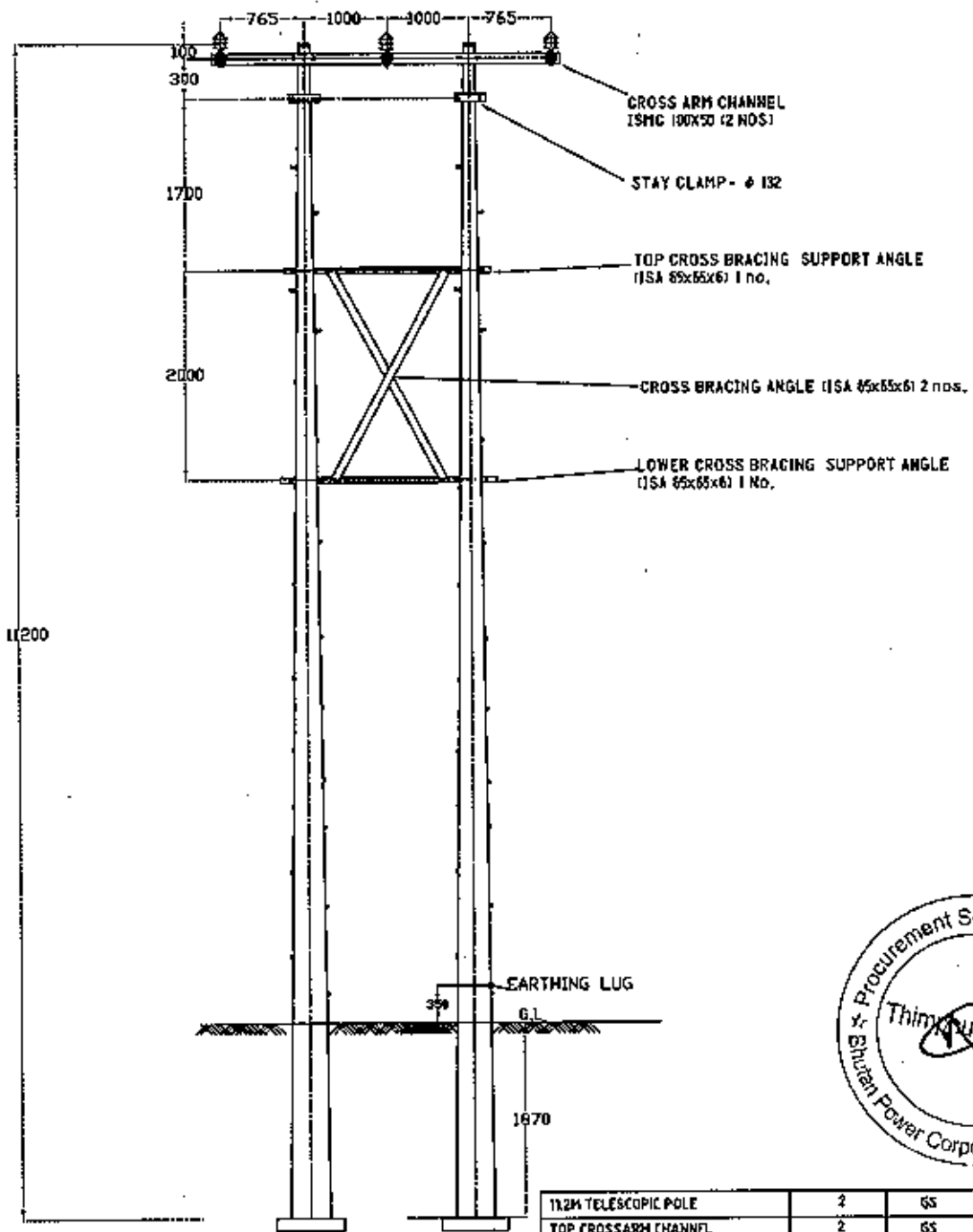
	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
		SINGLE POLE ASSEMBLY - 11.2 M TELESCOPIC POLE (11 kV & 33kV)		
TITLE	NAME	DATE	DRAWING NO. BPC-DDCS-2020-19/1-21	REVISION 2020
DESIGNED BY				
CHECKED BY				
APPROVED BY				



NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. LENGTH OF THE BRACING ANGLE SHALL BE DESIGNED BY THE SUPPLIER

	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT		
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD		
SINGLE POLE CROSS ARM ASSEMBLY - 11.2M TELESCOPIC POLE (11 kV & 33kV)			REVISION 2020		
TITLE	NAME	DATE			DRAWING NO. BPC-DDCS-2020-19/2-21
DESIGNED BY					
CHECKED BY					
APPROVED BY					



NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.

DESCRIPTION	QTY	MATERIAL
11.2M TELESCOPIC POLE	2	GS
TOP CROSS ARM CHANNEL	2	GS
DISC INSULATOR SET	6	PORCELAIN
PIN INSULATOR	3	PORCELAIN
CLAMP WITH NUTS & BOLTS	2	GS
STAY SET ASSEMBLY	1	GS
BASE PLATE	1	GS
	QTY	MATERIAL

BHUTAN POWER CORPORATION LIMITED

TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

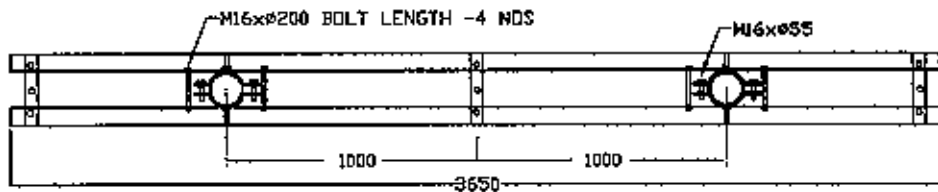
ENGINEERING AND RESEARCH DEPARTMENT

DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

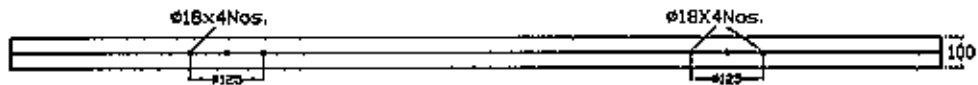
DOUBLE POLE ASSEMBLY - 11.2 M TELESCOPIC POLE
(11 kV & 33kV)

DRAWING NO. BPC-DDCS-2020-19/3-21

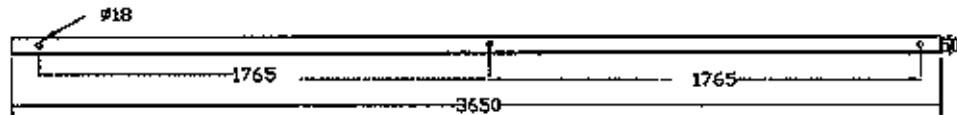
REVISION
2020



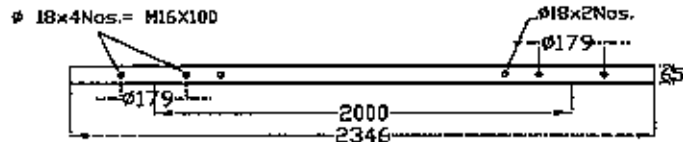
CROSS ARM ASSEMBLY PLAN



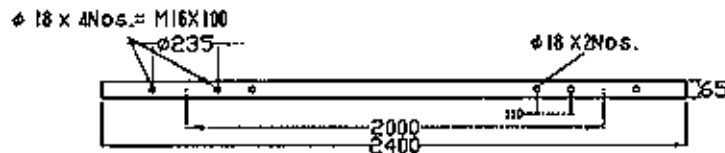
CROSS ARM CHANNEL (ISM 100x50) - ELEVATION



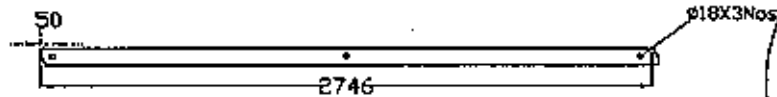
CROSS ARM CHANNEL (ISM 100x50) - PLAN



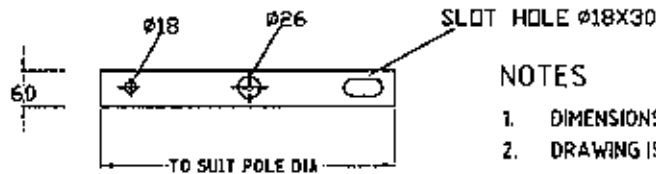
ANGLE FOR TOP CROSS BRACING SUPPORT (ISA 65x40x6) - 1 NO



ANGLE FOR LOWER CROSS BRACING SUPPORT (ISA 65x65x6) - 1 NO



ANGLE FOR CROSS BRACING (ISA 65 x 65 x 6) - 2 NOS



MS TENSION STRAP (60x6) - 6 NOS.
M16 x 105 MM BOLT LENGTH - 6 NOS.

NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. LENGTH OF THE CROSS BRACING ANGLE SHALL BE DESIGNED BY THE SUPPLIER



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

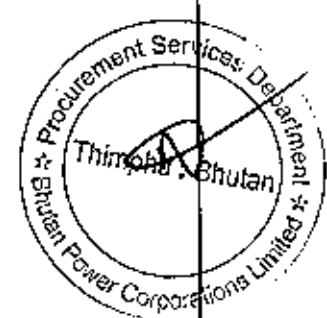
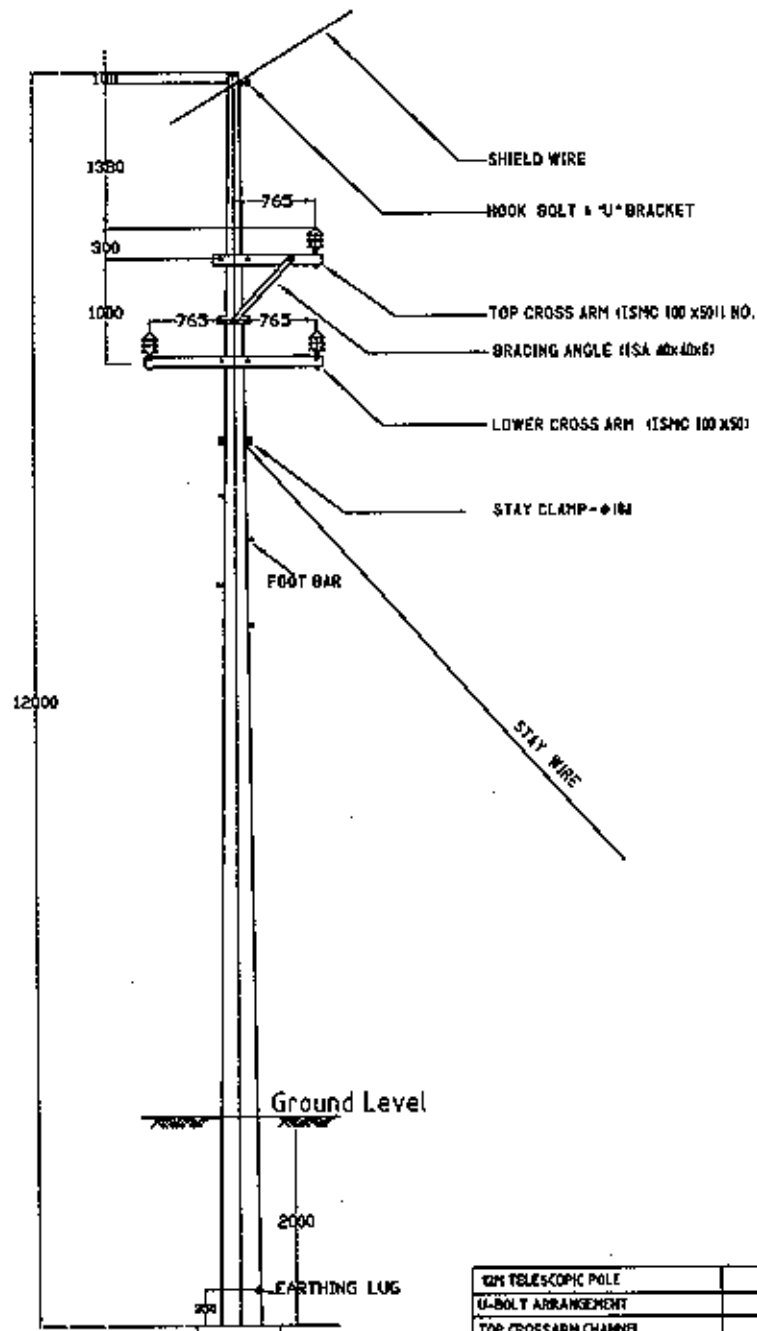
DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

DOUBLE POLE CROSS ARM ASSEMBLY - 11.2M TELESCOPIC POLE (11 KV & 33KV)

TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

DRAWING NO. BPC-DDCS-2020-19/4-21


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2020

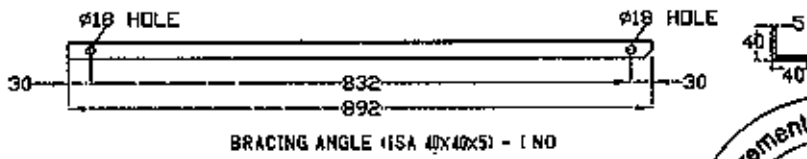
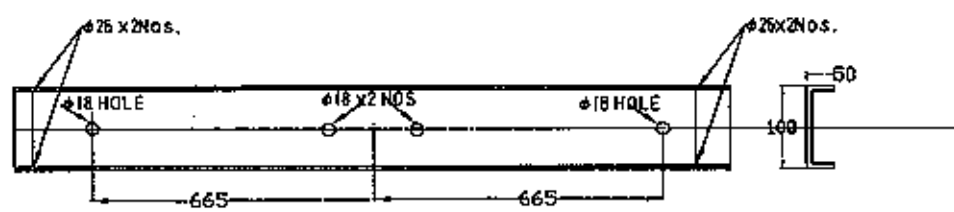
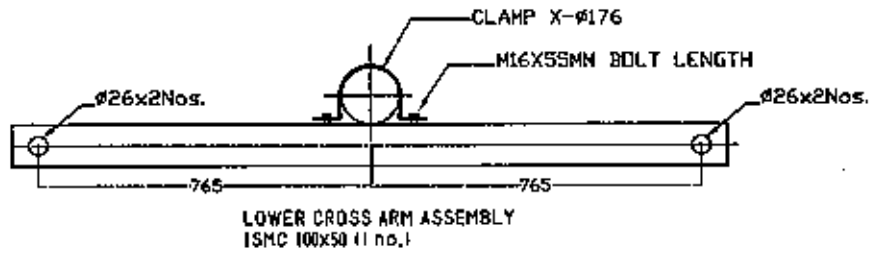
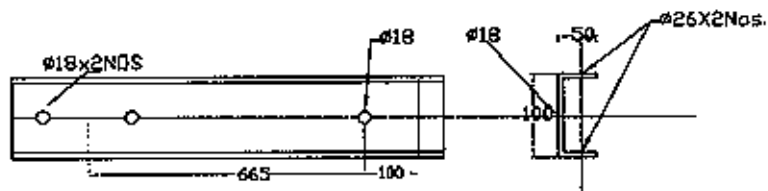
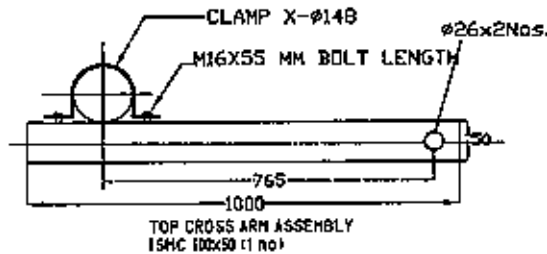


NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. PROVIDE 18MM DIA THROUGH HOLE AT 100MM BELOW THE POLE TOP FOR FIXING THE HOOK BOLT & U-BRACKET

DESCRIPTION	QTY	MATERIAL
12M TELESCOPIC POLE	2	GS
U-BOLT ARRANGEMENT	1	GS
TOP CROSSARM CHANNEL	1	GS
LOWER CROSSARM CHANNEL	1	GS
PI INSULATOR	3	PORCELAM
CLAMP WITH NUTS & BOLTS	1	GS
STAY CLAMP	1	GS
	QTY	MATERIAL


 <p>BHUTAN POWER CORPORATION LIMITED</p>	ENGINEERING AND RESEARCH DEPARTMENT	
	DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
SINGLE POLE ASSEMBLY FOR 12 M TELESCOPIC POLE WITH GROUNDWIRE (11 KV & 33KV)		
DESIGNED BY	NAME	DATE
CHECKED BY		
APPROVED BY		
DRAWING NO. BPC-DDCS-2020-19/5-20		REVISION 2020

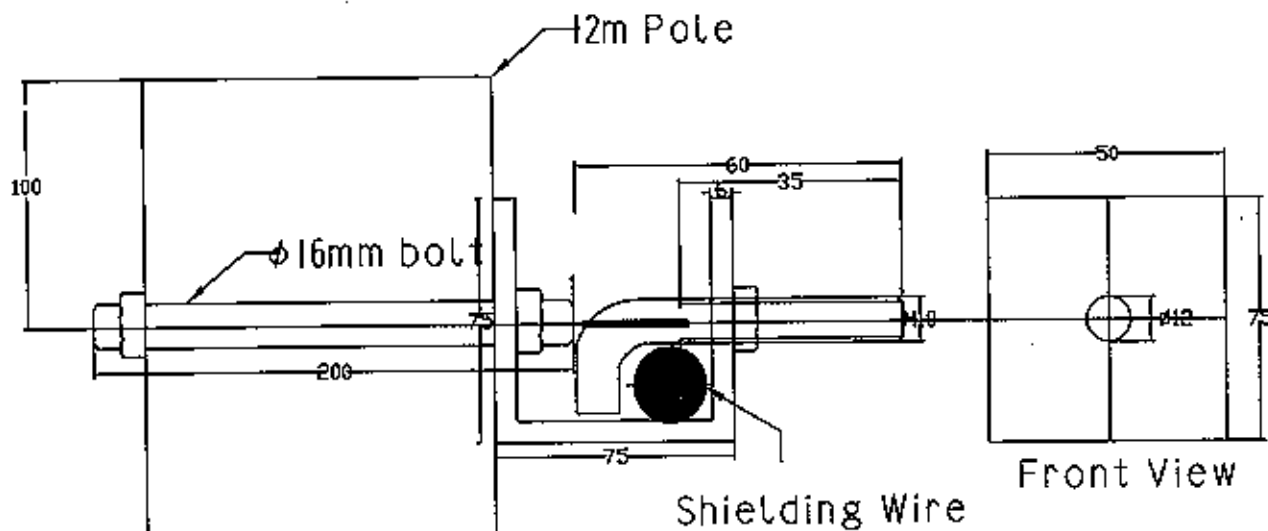


NOTES

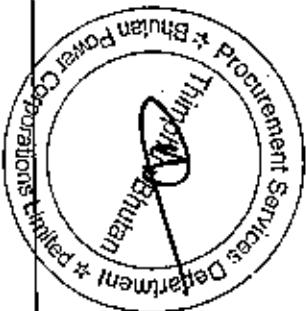
1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. LENGTH OF THE BRACING ANGLE SHALL BE DESIGNED BY THE SUPPLIER



	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
		SINGLE POLE ASSEMBLY FOR 12 M TELESCOPIC POLE WITH GROUNDWIRE (11 KV & 33KV)		
DESIGNED BY	NAME	DATE	DRAWING NO. BPC-DDCS-2020-19/6-20	
CHECKED BY				
APPROVED BY				
			REVISION 2020	



SL#	DESCRIPTION	QUANTITY	MATERIAL
1	200mm long bolt with nut and washer, threaded at both ends	1	HDG Steel
2	U-Type Connector of 75x50x6 with $\phi 12$ mm hole and $\phi 17.5$ mm hole	1	HDG Steel
3	L-Bolt of $\phi 10$ 35mm long threaded	1	HDG Steel



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

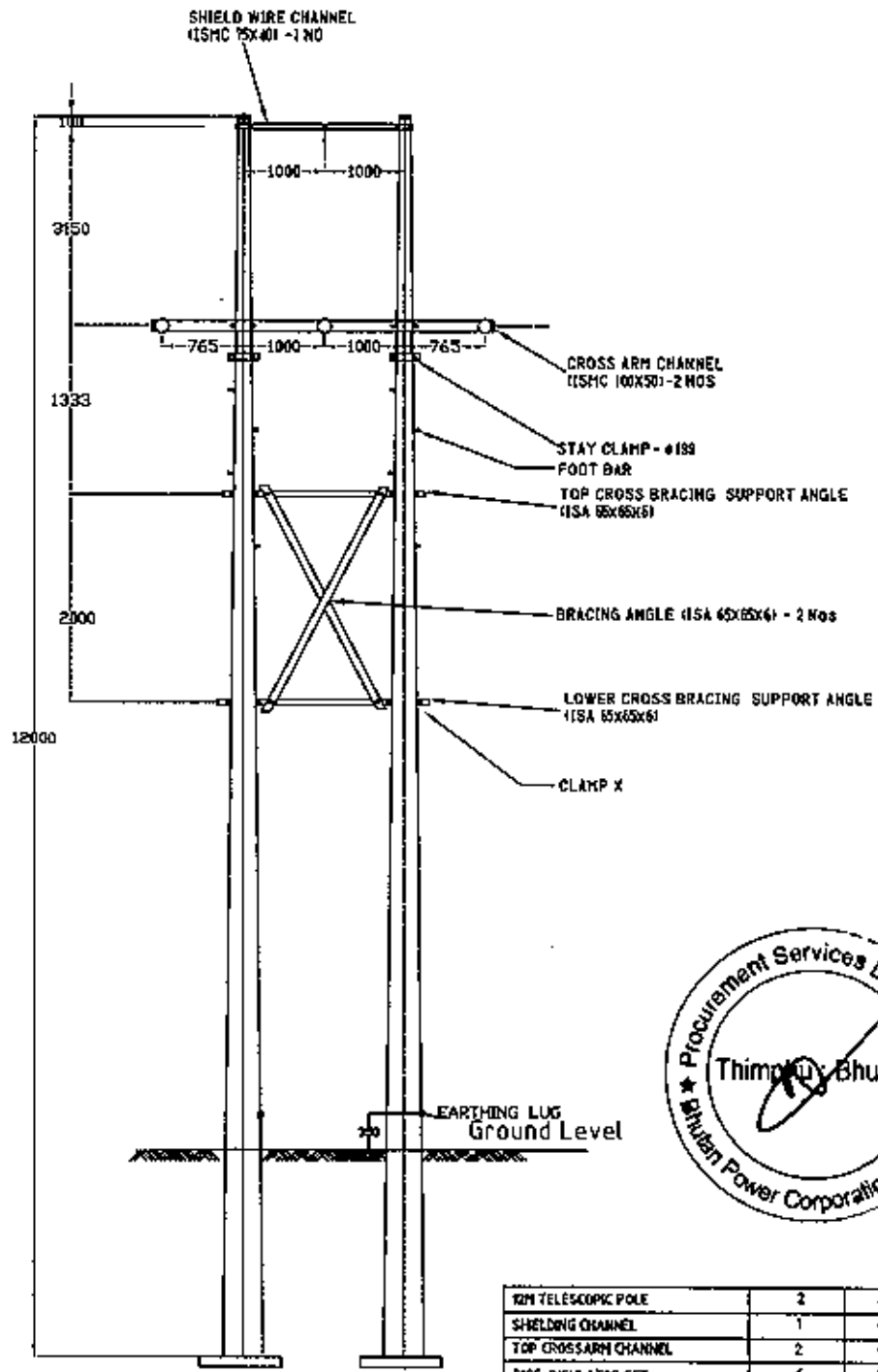
DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

U-BOLT FOR SHIELD WIRE FOR SINGLE POLE STRUCTURE

DRAWING NO. BPC-DCS-2020-19/7-20

REVISION
2020

TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		



DESCRIPTION	QTY	MATERIAL
12M TELESCOPIC POLE	2	GS
SHIELDING CHANNEL	1	GS
TOP CROSS ARM CHANNEL	2	GS
DISC INSULATOR SET	6	PORCELAIN
PIN INSULATOR SET	3	PORCELAIN
CLAMP WITH NUTS & BOLTS	1	GS
BRACING ANGLE SET	1	GS
STAY CLAMP SET	2	GS

NOTES

DIMENSIONS AS SHOWN ARE IN mm.
DRAWING IS NOT TO SCALE.



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

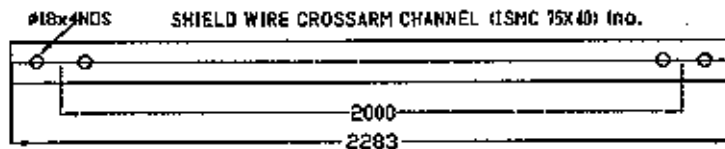
DOUBLE POLE ASSEMBLY FOR 12 M TELESCOPIC POLE WITH GROUNDWIRE (11 KV & 33KV)

	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

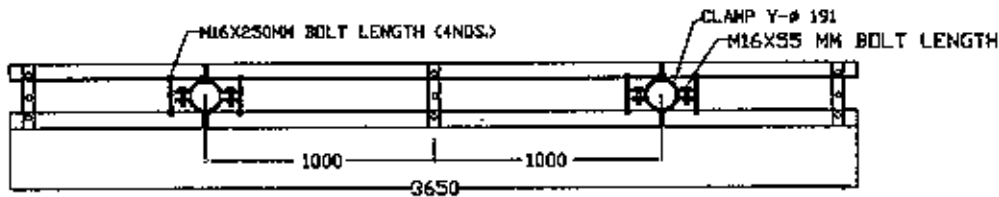
DRAWING NO. BPC-DDCS-2020-19/8-20

REVISION
2020

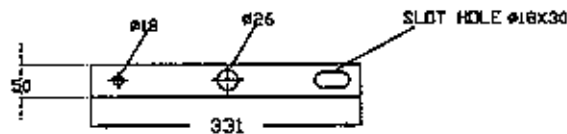
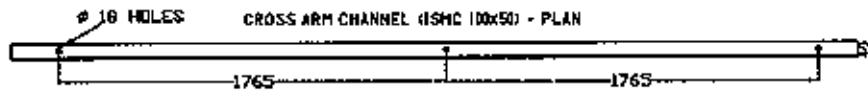
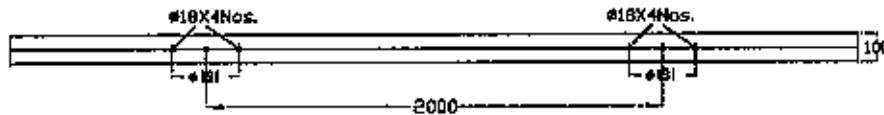
SHIELD WIRE CROSSARM ASSEMBLY
ISMC 75X40, 1 NO.



CROSS ARM CHANNEL (ISMC 100x50) 2 NOS



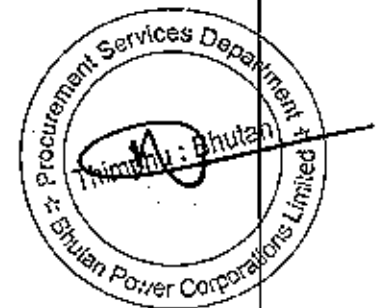
CROSS ARM CHANNEL (ISMC 100x50) - ELEVATION




MS TENSION STRAP (50x6) - 6 NOS
M16X 185 MM BOLT LENGTH - 6 NOS

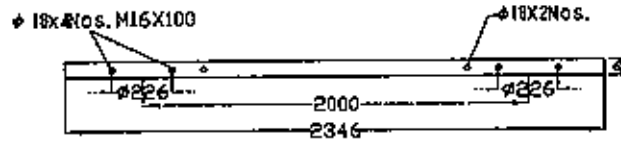
NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.

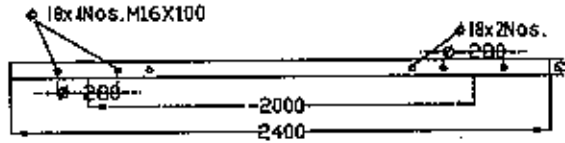


	SHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
		DOUBLE POLE ASSEMBLY FOR 12 M TELESCOPIC POLE WITH GROUNDWIRE (11 kV & 33kV)		
	NAME	DATE		
DESIGNED BY				
CHECKED BY				
APPROVED BY			DRAWING NO, BPC-DOCS-2020-19/9-20	REVISION 2020

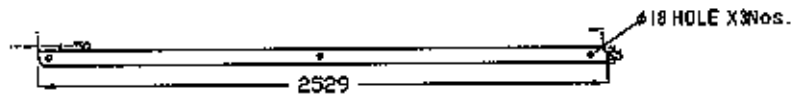
ANGLE FOR TOP CROSS BRACING SUPPORT (ISA 65x65x6) - 1 NO



ANGLE FOR LOWER CROSS BRACING SUPPORT (ISA 65x65x6) - 1 NO

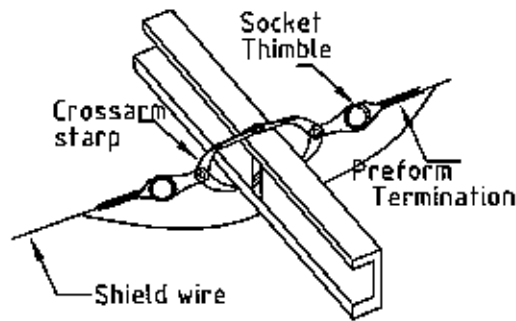


ANGLE FOR CROSS BRACING (ISA 65 x 65 x 6) - 2 NOS




SHIELDING ARRANGEMENT ON DOUBLE POLE STRUCTURES

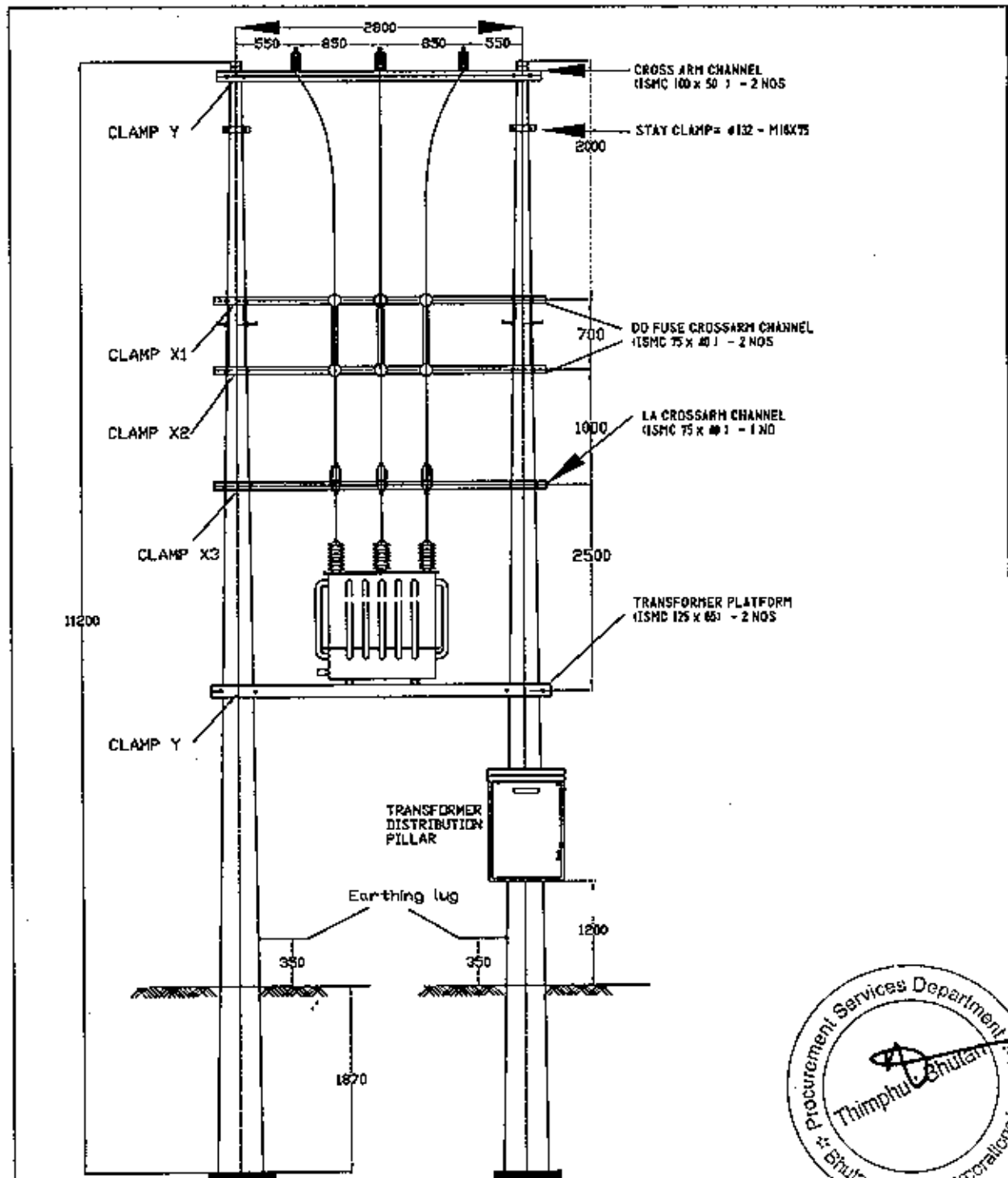
SHIELD WIRE CHANNEL



NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. LENGTH OF THE CROSS BRACING ANGLE SHALL BE DESIGNED BY THE SUPPLIER

	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
	TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD DOUBLE POLE ASSEMBLY FOR 12 M TELESCOPIC POLE WITH GROUNDWIRE (11 KV & 33KV)			
DESIGNED BY	NAME	DATE		
CHECKED BY				
APPROVED BY			DRAWING NO. BPC-DDCS-2020-19/10-20	
			REVISION 2020	

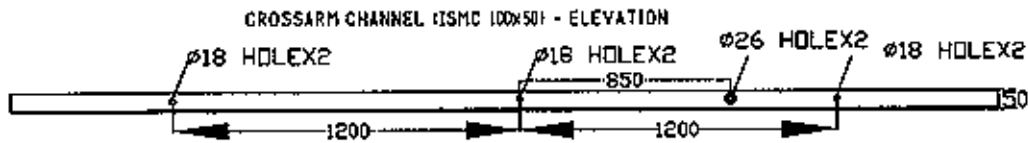
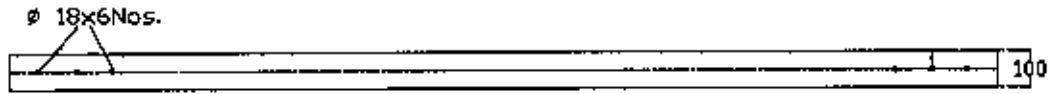


- NOTES
1. DISTRIBUTION PILLAR MOUNTING CHANNEL ONLY REQUIRE FOR 125 KVA TRANSFORMERS
 2. MOUNTING HEIGHT OF THE TOP DO FUSE TO BE ADJUSTED WITHIN 6M FOR USE OF HOY STICK
 3. CLAMP X AND Y DETAILS AS PER DRAWING NO. BPC-DDCS-2020-29

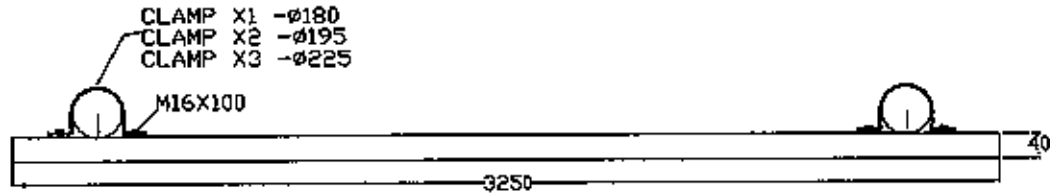
BHUTAN POWER CORPORATION LIMITED <small>Subsidiary of BPC Ltd. #124</small>		ENGINEERING AND RESEARCH DEPARTMENT	
		DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
		SUBSTATION STRUCTURE ASSEMBLY FOR 11.2 M TELESCOPIC POLE	
TITLE	NAME	DATE	DRAWING NO. BPC-DDCS-2020-19/11-21 REVISION 2020
DESIGNED BY			
CHECKED BY			
APPROVED BY			



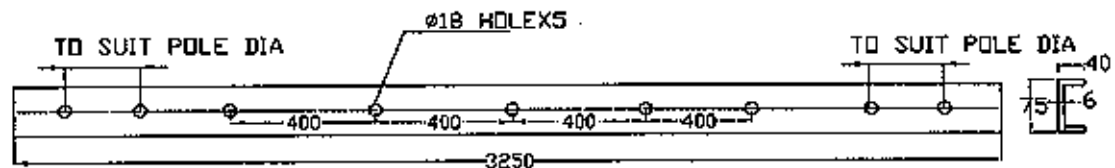
TOP CROSSARM ASSEMBLY



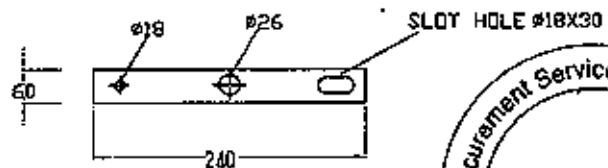
CROSSARM CHANNEL (ISMC 100x50) - PLAN



EQUIPMENT CROSSARM CHANNEL ASSEMBLY



EQUIPMENT CROSSARM CHANNEL (ISMC 75x40) - 3 NOS



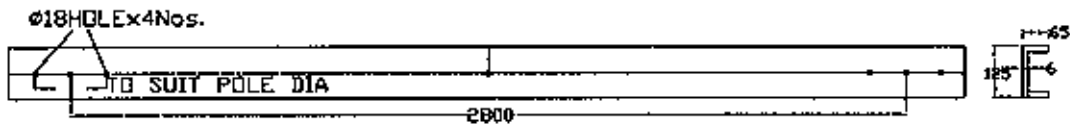
MS TENSION STRAP (60x6) - 6 NOS.
M16 x 185 MM BOLT LENGTH - 6 NOS.



NOTES

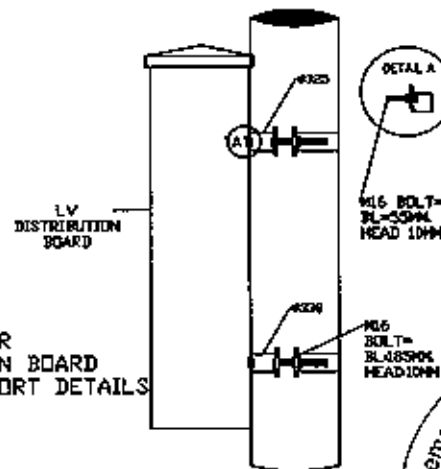
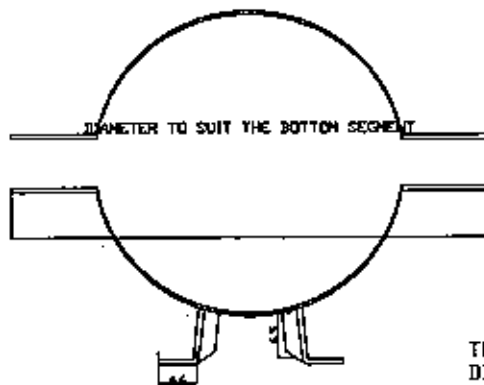
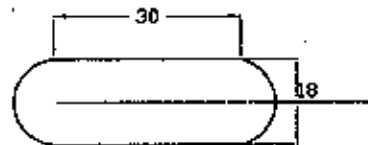
1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. CLAMP X AND Y DETAILS AS PER DRAWING NO. BPC-DDCS-2020-29

BHUTAN POWER CORPORATION LIMITED <small>Engineering Dept. Reg. No. 2020</small>		ENGINEERING AND RESEARCH DEPARTMENT	
		TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
		SUBSTATION (1 or 3 PHASE) STRUCTURE CROSS-ARM ASSEMBLY FOR 11.2 M TELESCOPIC POLE	
TITLE	NAME	DATE	DRAWING NO. BPC-DDCS-2020-19/12-21
DESIGNED BY			
CHECKED BY			
APPROVED BY			
			REVISION 2020



TRANSFORMER SUPPORT CROSSARM CHANNEL (ISMIC 125X65) - 2 NOS - ELEVATION

SLOT DETAILS FOR TRANSFORMER SUPPORT

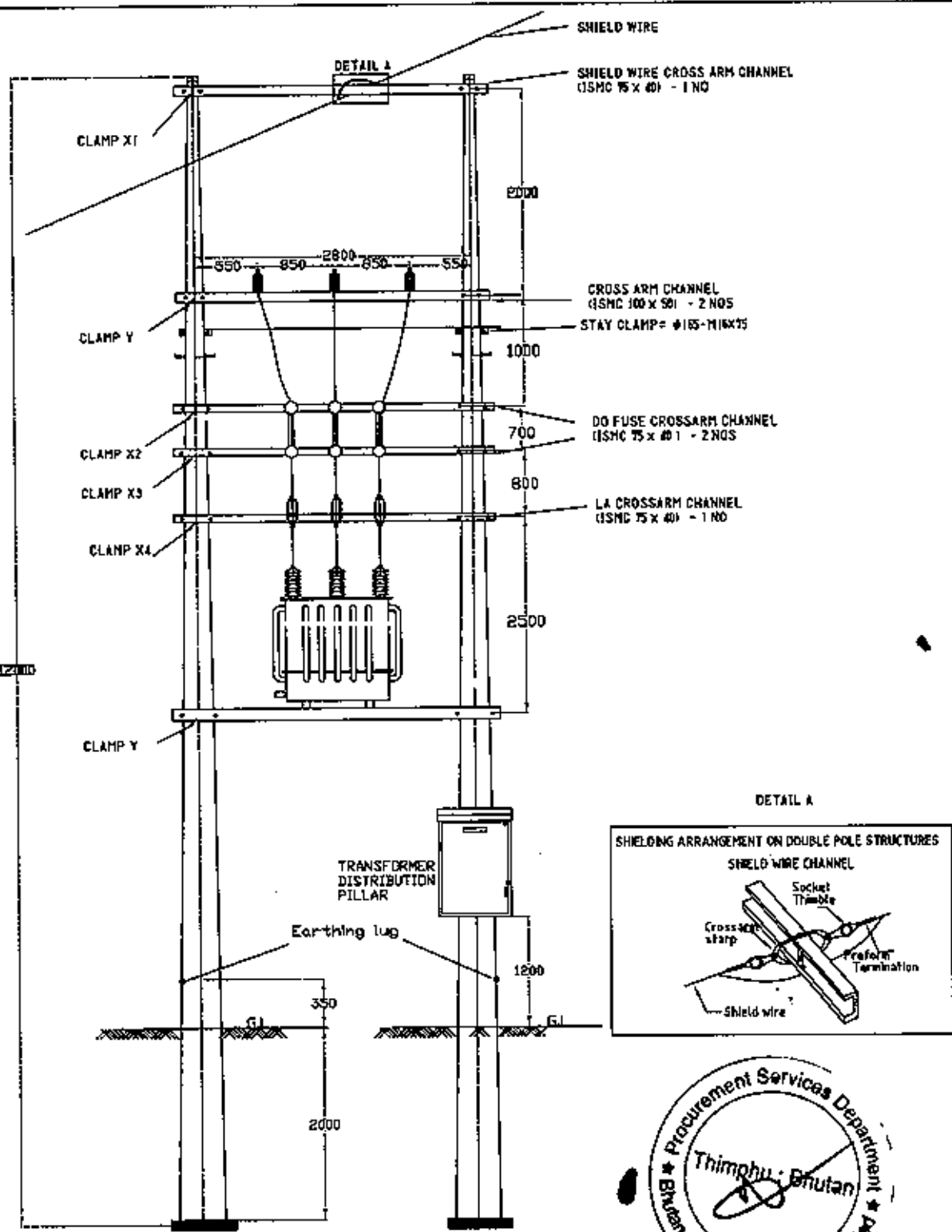


TRANSFORMER DISTRIBUTION BOARD CLAMP SUPPORT DETAILS

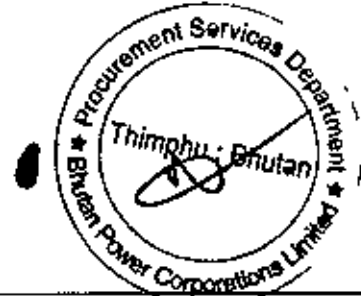
NOTES


1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. The hole centre to hole centre 400mm for trfs upto 25 kVA, 500mm for trfs above 25kVA

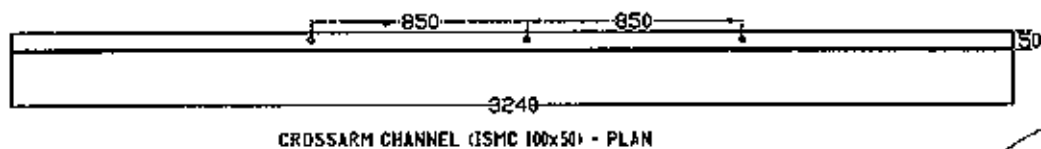
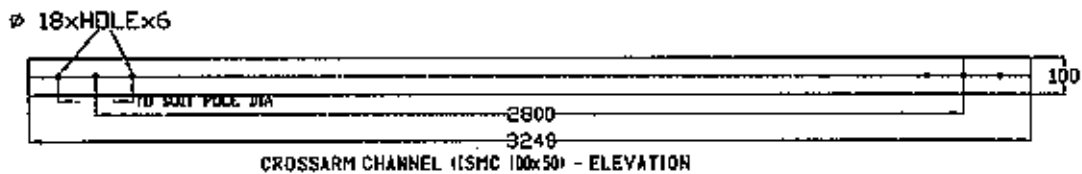
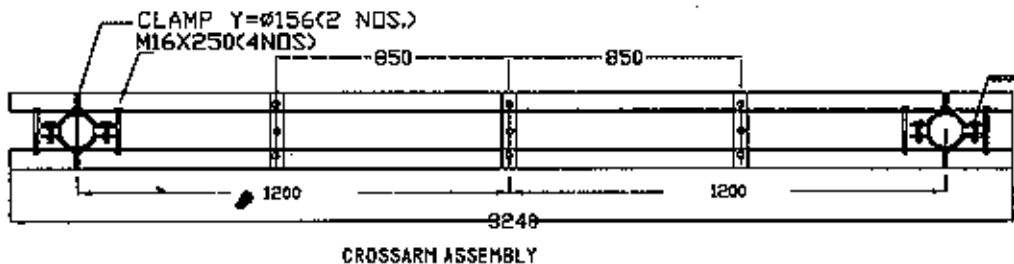
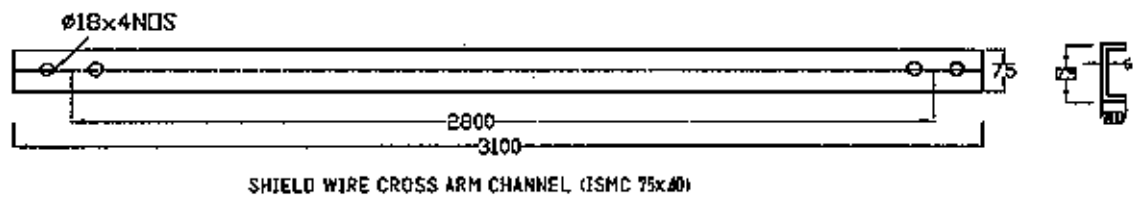
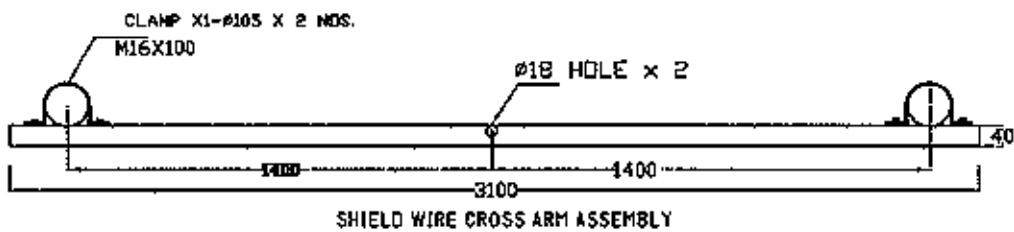
BHUTAN POWER CORPORATION LIMITED <small>འབྲུག་རྒྱལ་ཁོག་གི་འགན་ཁུར་ལས་ཁུངས་</small>			ENGINEERING AND RESEARCH DEPARTMENT	
			TITLE : DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
SUBSTATION (1 or 3 PHASE) STRUCTURE CROSS-ARM ASSEMBLY FOR 11.2 M TELESCOPIC POLE				
TITLE	NAME	DATE		
DESIGNED BY				
CHECKED BY				
APPROVED BY			DRAWING NO. BPC-ODCS-2020-19/13-21	
			REVISION 2020	



DISTRIBUTION PILLAR MOUNTING CHANNEL ONLY REQUIRE FOR 125 KVA TRANSFORMERS
 MOUNTING HEIGHT OF THE TOP DO FUSE TO BE ADJUSTED WITHIN 6M FOR USE OF HOT STICK

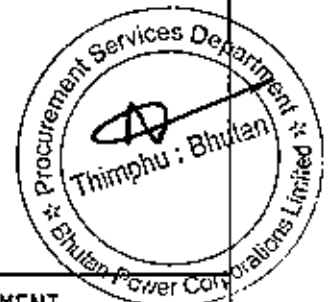



	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE			SUBSTATION (3 PHASE) STRUCTURE ASSEMBLY - 12 M TELESCOPIC POLE WITH SHIELDWIRE	
DESIGNED BY	NAME	DATE	DRAWING NO. BPC-DDCS-2020-19/14-21	
CHECKED BY				
APPROVED BY				
			REVISION	2020

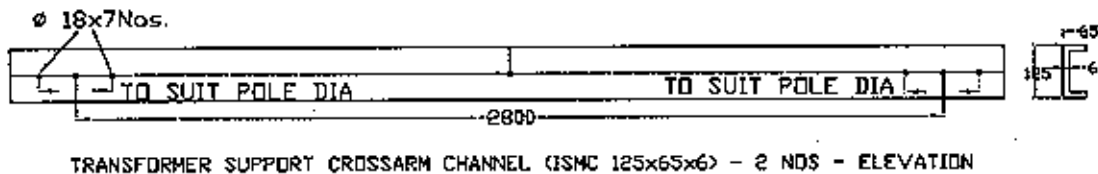
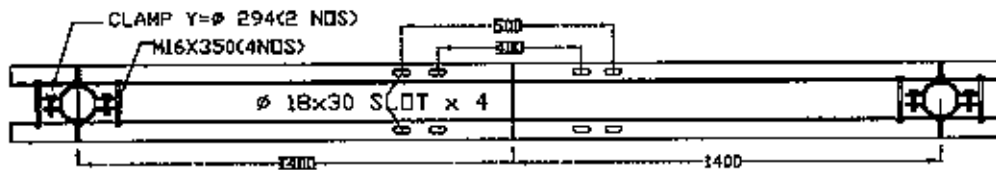
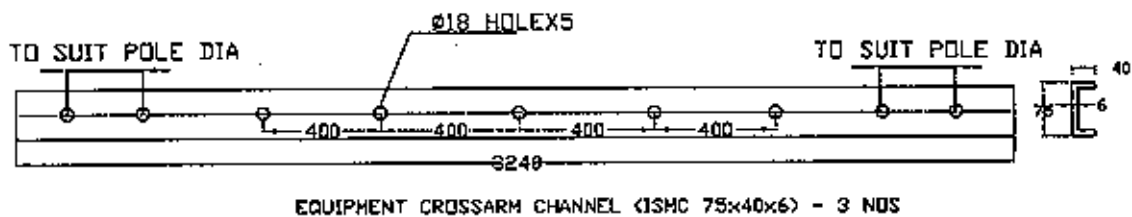


NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. CLAMP X AND Y DETAILS AS PER DRAWING NO. BPC-DDCS-2020-29

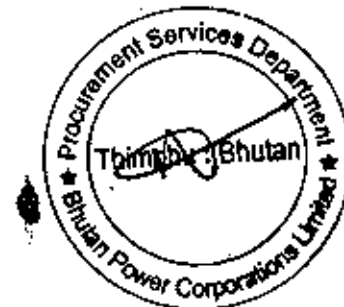



 BHUTAN POWER CORPORATION LIMITED			ENGINEERING AND RESEARCH DEPARTMENT													
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD													
<table border="1"> <thead> <tr> <th>TITLE</th> <th>NAME</th> <th>DATE</th> </tr> </thead> <tbody> <tr> <td>DESIGNED BY</td> <td></td> <td></td> </tr> <tr> <td>CHECKED BY</td> <td></td> <td></td> </tr> <tr> <td>APPROVED BY</td> <td></td> <td></td> </tr> </tbody> </table>			TITLE	NAME	DATE	DESIGNED BY			CHECKED BY			APPROVED BY			SUBSTATION (1 or 3 PHASE) STRUCTURE CROSS-ARM ASSEMBLY FOR 12 M TELESCOPIC POLE WITH SHIELD WIRE	
			TITLE	NAME	DATE											
			DESIGNED BY													
CHECKED BY																
APPROVED BY																
DRAWING NO. BPC-DDCS-2020-19/15-21		REVISION 2020														

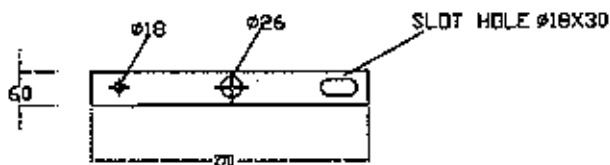


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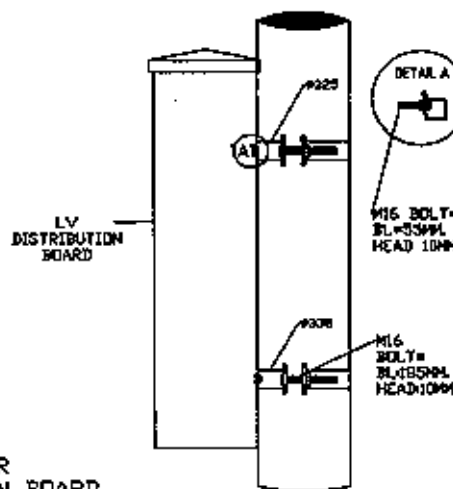
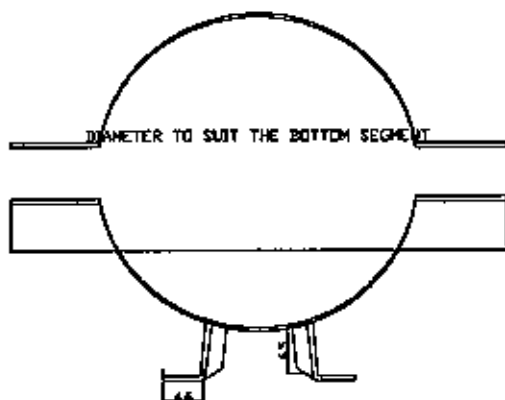
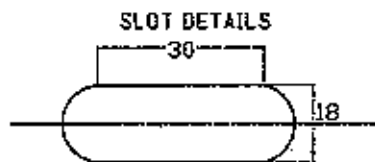
1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. The hole centre to hole centre 400mm for trfs upto 25 kVA, 500mm for trfs above 63 kVA



	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
	DISTRIBUTION DESIGN & CONSTRUCTION STANDARD		SUBSTATION (1 or 3 PHASE) STRUCTURE CROSS-ARM ASSEMBLY FOR 12M TELESCOPIC POLE WITH SHIELD WIRE	
TITLE DESIGNED BY CHECKED BY APPROVED BY	NAME	DATE	DRAWING NO. BPC-DDCS-2020-19/15-21	REVISION 2020



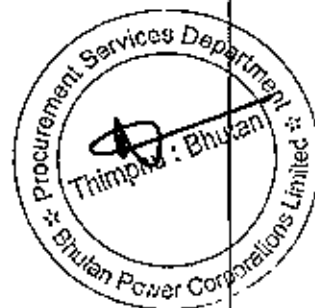
MS TENSION STRAP (160x6) - 6 NOS
M16X185




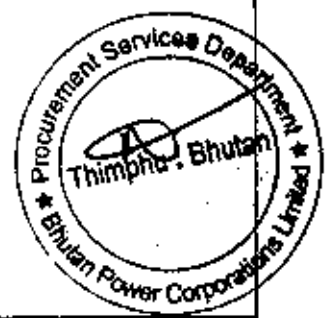
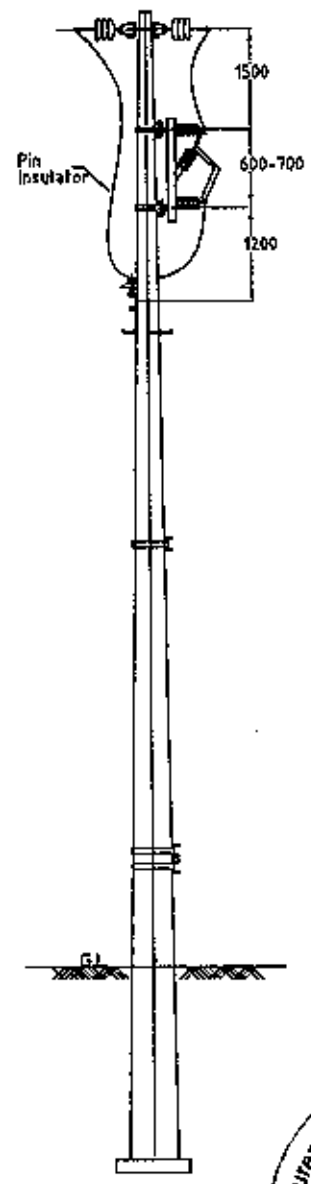
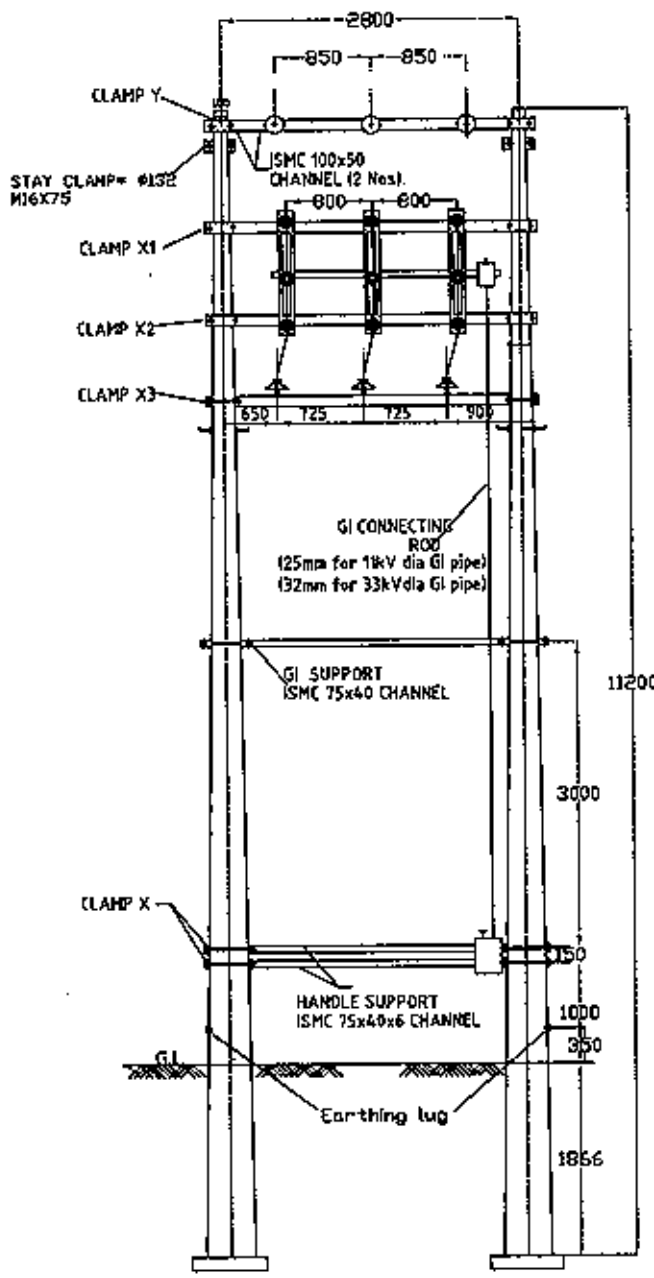
TRANSFORMER
DISTRIBUTION BOARD
CLAMP SUPPORT DETAILS

NOTES

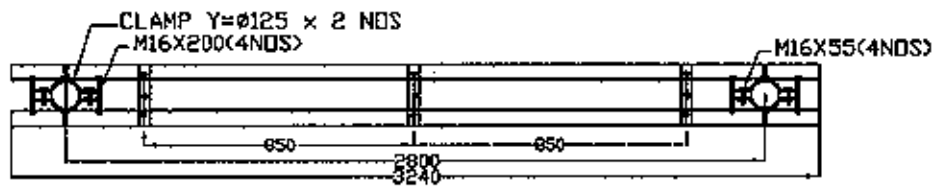
1. DIMENSIONS AS SHOWN ARE IN mm.
2. DRAWING IS NOT TO SCALE.
3. The hole centre to hole centre 400mm for trfs upto 25 kVA, 500mm for trfs above 63 kVA



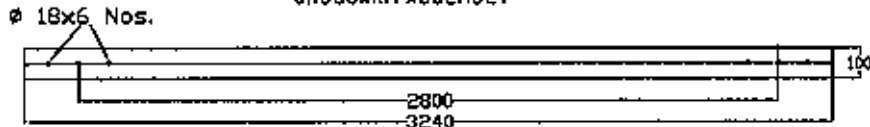
	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
	DISTRIBUTION DESIGN & CONSTRUCTION STANDARD		SUBSTATION (1 or 3 PHASE) STRUCTURE CROSS-ARM ASSEMBLY FOR 12 M TELESCOPIC POLE WITH SHIELD WIRE	
TITLE	NAME	DATE	DRAWING NO. BPC-DDCS-2020-19/17-21	
DESIGNED BY			REVISION 2020	
CHECKED BY				
APPROVED BY				



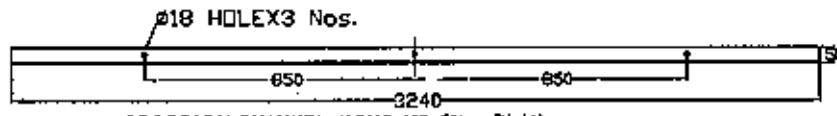
BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
		DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE NAME DATE		11 & 33kV AIRBREAK SWITCH ARRANGEMENT-11.2M	
		TELESCOPIC POLES	
		DRAWING NO. BPC-DOCS-2020-19/18-21	
DESIGNED BY			REVISION 2020
CHECKED BY			
APPROVED BY			



CROSSARM ASSEMBLY



CROSSARM CHANNEL (ISMC 100x50) - ELEVATION



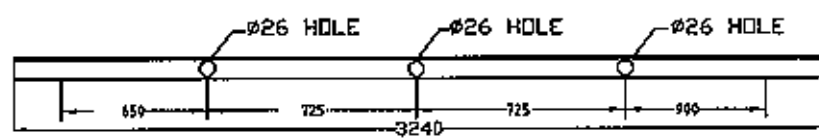
CROSSARM CHANNEL (ISMC 100x50) - PLAN



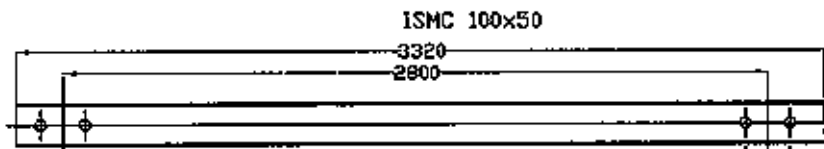
GI SWITCH SUPPORTS FOR ABS, 2 NOS.

CLAMP X1-Ø165
CLAMP X2-Ø218
CLAMP X3-Ø254
M16X100

ISMC 100x50



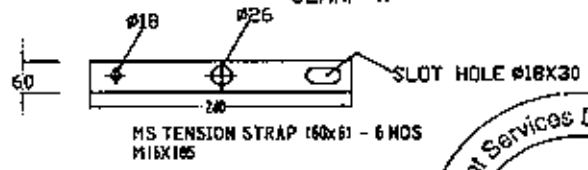
PIN INSULATOR SUPPORTS, 1 NO.



GI SUPPORT & HANDLE SUPPORTS 3 NOS.

ISMC 75x40

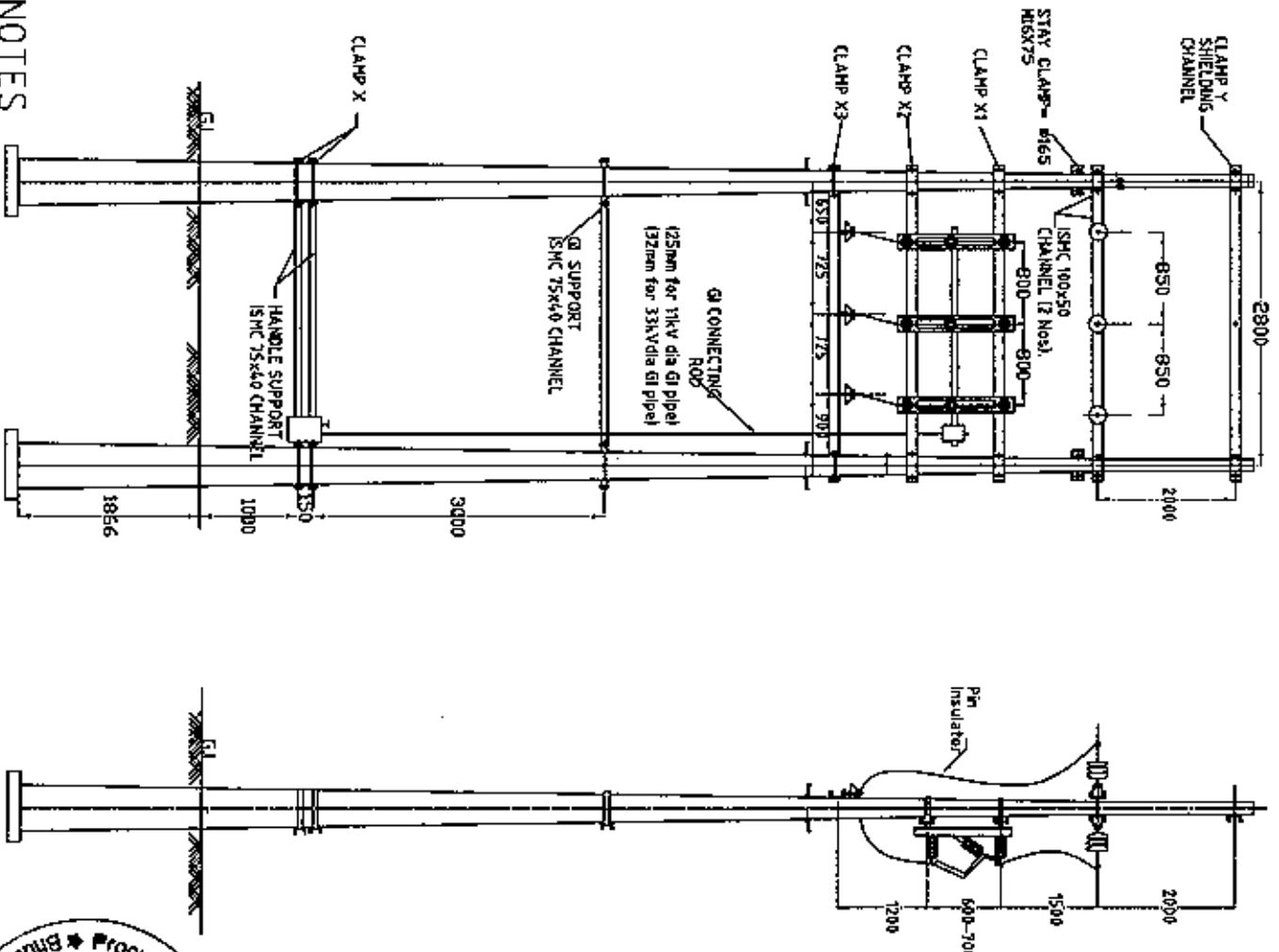
CLAMP X-Ø264 - GI SUPPORT
CLAMP X TOP-Ø345-HANDLE SUPPORT
CLAMP X BOTTOM-Ø351-HANDLE SUPPORT
M16X100



NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. ALL HOLES ARE 18mm AND ALL BOLTS TO BE 16mm.
3. SHIELDING ASSEMBLY FOR 12M POLE TO BE SAME FOR ALL

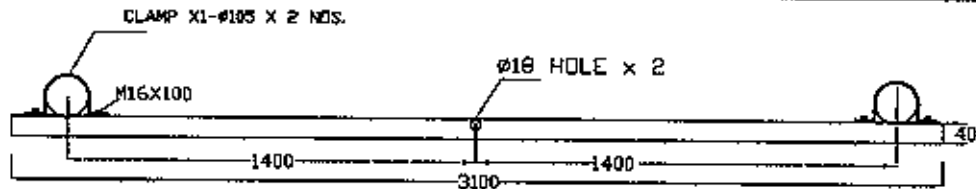
BHUTAN POWER CORPORATION LIMITED ENGINEERING AND RESEARCH DEPARTMENT			DISTRIBUTION DESIGN & CONSTRUCTION STANDARDS AIRBREAK SWITCH CROSS-ARM ASSEMBLY FOR 11.2M & 12M TELESCOPIC POLE		
					DRAWING NO. BPC-DDCS-2020-19/19-21
TITLE	NAME	DATE			
DESIGNED BY					
CHECKED BY					
APPROVED BY					



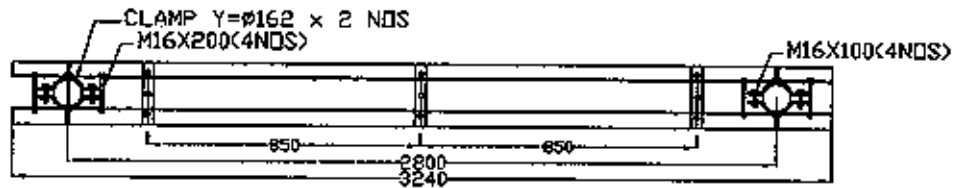
- NOTES**
1. DIMENSIONS AS SHOWN ARE IN MM.
 2. ALL HOLES ARE 18MM AND ALL BOLTS TO BE 16MM.



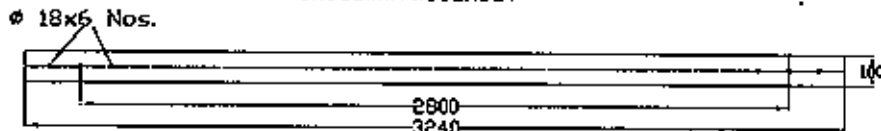
BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
CORPORATION LIMITED		DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE	NAME	DATE	33 kV AIRBREAK SWITCH ARRANGEMENT - 12M TELESCOPIC POLES
DESIGNED BY			
CHECKED BY			
APPROVED BY			DRAWING NO. BPC-DDCS-2020-19/20-21
			REVISION 2020



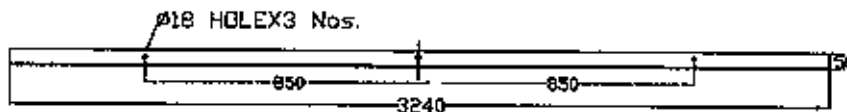
SHIELD WIRE CROSS ARM ASSEMBLY



CROSSARM ASSEMBLY



CROSSARM CHANNEL (ISMC 100x50) - ELEVATION



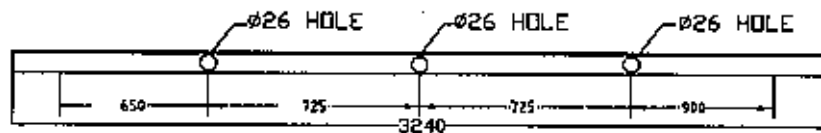
CROSSARM CHANNEL (ISMC 100x50) - PLAN



GI SWITCH SUPPORTS FOR ABS, 2 NOS.

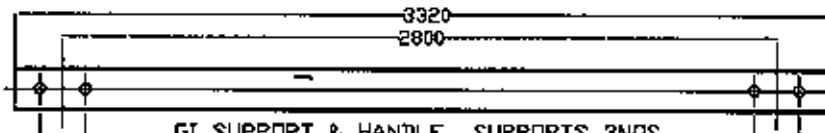
ISMC 100x50

CLAMP X1-φ200
CLAMP X2-φ220
CLAMP X3-φ256
M16X100



PIN INSULATOR SUPPORTS, 1 NO.

ISMC 100x50



GI SUPPORT & HANDLE SUPPORTS 3NOS.

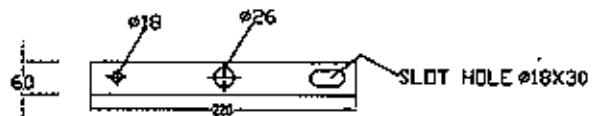
ISMC 75x40

M16X100
CLAMP X-φ264 - GI SUPPORT
CLAMP X TOP-φ345-HANDLE SUPPORT
CLAMP X BOTTOM-φ351-HANDLE SUPPORT

CLAMP X

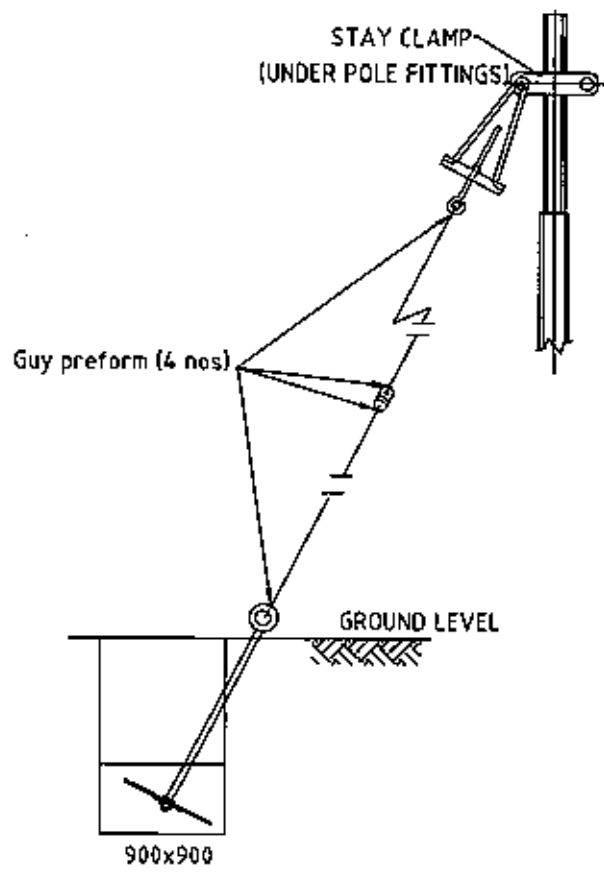
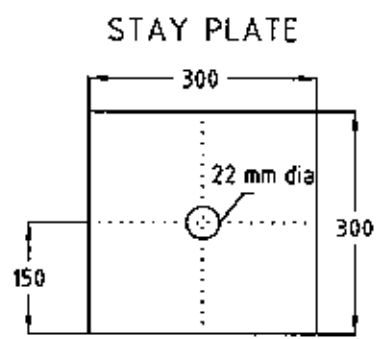
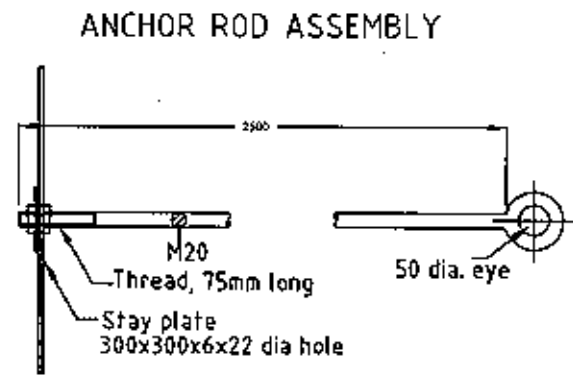
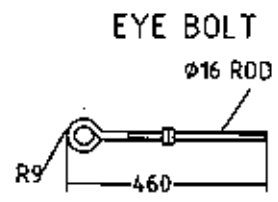
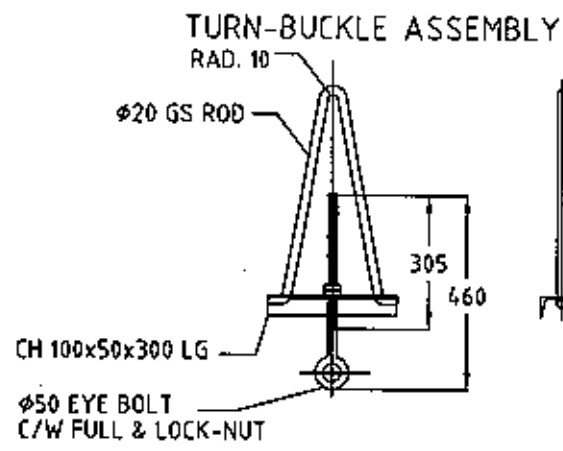
NOTES

1. DIMENSIONS AS SHOWN ARE IN mm.
2. ALL HOLES ARE 18mm AND ALL BOLTS TO BE 16mm.
3. SHIELDING ASSEMBLY FOR 12M POLE TO BE SAME FOR ALL



MS TENSION STRAP (60x6) - 5 NOS.
M16X185


BHUTAN POWER CORPORATION LIMITED			ENGINEERING AND RESEARCH DEPARTMENT		
			DISTRIBUTION DESIGN & CONSTRUCTION STANDARD		
TITLE			AIRBREAK SWITCH CROSS-ARM ASSEMBLY		
NAME			FOR 11.2M & 12M TELESCOPIC POLE		
DATE			DRAWING NO. BPC-DDCS-2020-19/21-21		
DESIGNED BY					
CHECKED BY					
APPROVED BY					



NOTES

Stay rod and nuts assembled and packed together
 Anchor plates packed separately
 Material :- BS 4360 Grade 43A
 Galvanizing :- BS 729
 Threads :- ISO Metric
 Nut :- BS 4190 Grade 4.0

STAY WIRE (7/8 SWG) (IN METERS)	IN-POLE HEIGHT	H.D.G STEEL
STAY ROD (2.5 M) WITH THIMBLE	1	H.D.G STEEL
ANCHOR PLATE (300 X 300 X 6MM)	1	H.D.G STEEL
TURNBUCKLE ASSEMBLY WITH THIMBLE	1	H.D.G STEEL
GUY PREFORMED SUITABLE FOR 7/8 SWG	4	GALVANISED STEEL WIRE
STAY INSULATOR	1	PORCELAIN
NAME OF THE ITEM	QTY	MATERIAL



BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT

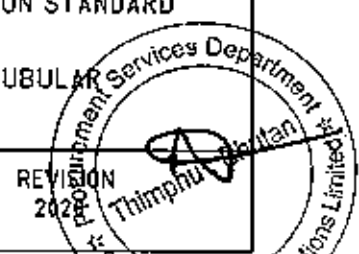
DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

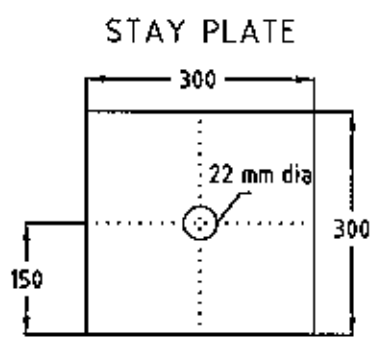
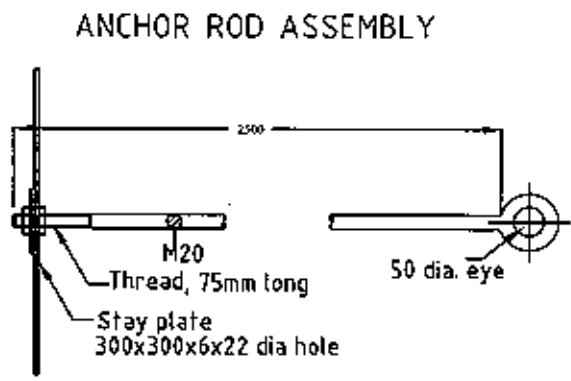
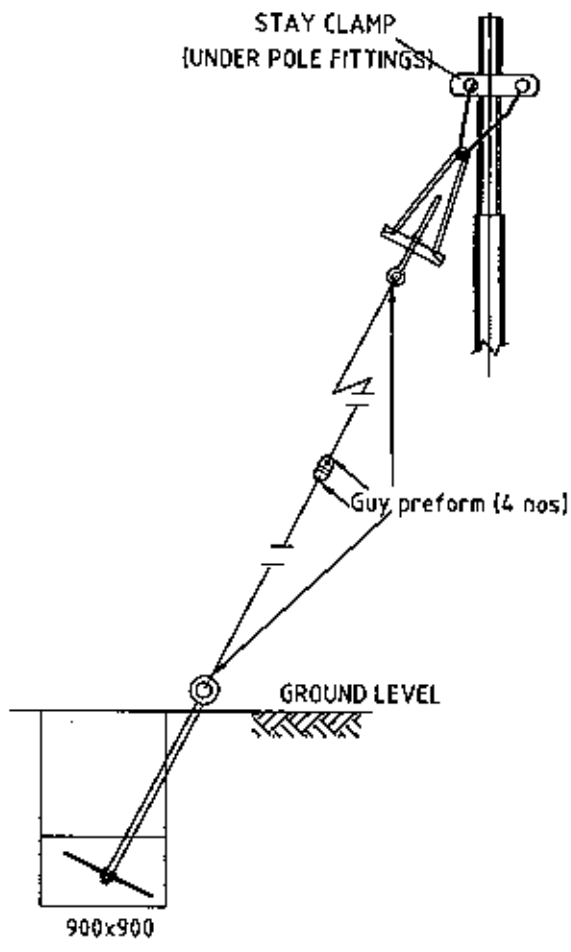
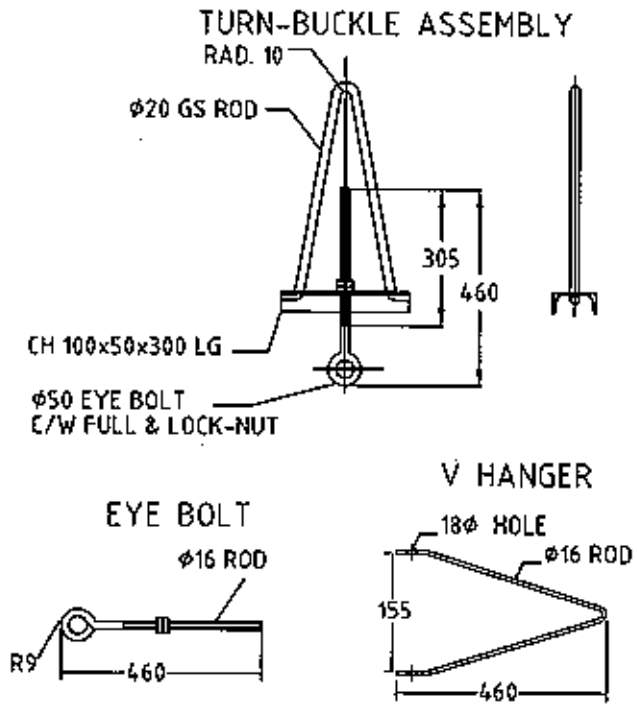
STAY SET ASSEMBLY FOR STEEL TUBULAR

TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

DRAWING NO. BPC-DCCS-2020-22/1-2

REVISION 2020





NOTES
 Stay rod and nuts assembled and packed together
 Anchor plates packed separately
 Material :- BS 4360 Grade 43A
 Galvanizing :- BS 729
 Threads :- ISO Metric
 Nut :- BS 4190 Grade 4.0

NAME OF THE ITEM	QTY	MATERIAL
V-HANGER	1	H.D.G STEEL
STAY WIRE (7/8 SWG) IN METERS	4x-POLE HEIGHT	H.D.G STEEL
STAY ROD (2.5 M) WITH THIMBLE	1	H.D.G STEEL
ANCHOR PLATE (300 X 300 X 6MM)	1	H.D.G STEEL
TURNBUCKLE ASSEMBLY WITH THIMBLE	1	H.D.G STEEL
GUY PREFORMED SUITABLE FOR 7/8 SWG	4	GALVANISED STEEL WIRE
STAY INSULATOR	1	PORCELAIN

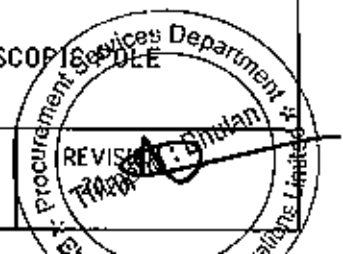


BHUTAN POWER CORPORATION LIMITED

ENGINEERING AND RESEARCH DEPARTMENT
DISTRIBUTION DESIGN & CONSTRUCTION STANDARD

TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		

STAY SET ASSEMBLY FOR TELESCOPIC POLE
 DRAWING NO. BPC-DDCS-2020-22/2-2



LOT 4: CONDUCTOR FITTINGS AND ACCESSORIES

MV Overhead Conductor Fittings and Accessories
HV Overhead Conductor Fittings and Accessories



LOT-4: MV OVERHEAD CONDUCTOR FITTINGS & ACCESSORIES

General

This specification covers the design, manufacture, testing, supply, delivery and performance requirements of MV overhead conductor fittings and accessories.

MV overhead conductors' fittings:

- (a) P.G. Connectors
- (b) Preformed Dead End Terminations
- (c) Compression Joints

Applicable Standards

IEC 61238-1 for compressions and connectors
IS 2121-2 & 4 for conductors and earth wire accessories for overhead power line
IEC 60502-2&4 for constructions, dimensions and test requirements

TECHNICAL SPECIFICATIONS

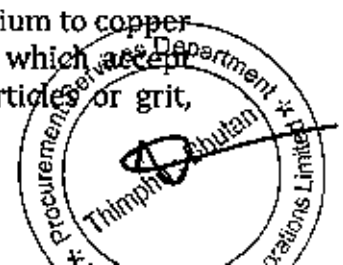
General

Connectors are required for aluminium to aluminium, aluminium to copper and steel to steel non-tension and tension joints, and for connecting copper and aluminium conductor to terminals of electrical equipment. The connectors shall be complete with any special tools, protective grease, tapes, bolts and washers appropriate for their application. In addition all connectors shall comply with the following:

- 1) the contact shall be firm so that the current distribution among the strands of the conductors is uniform;
- 2) the conductivity of the connector shall be at least 95% of that of the conductor and it shall be designed to carry continuously the full rated current of the conductor for which it is used;
- 3) the contact pressure shall be maintained throughout its service life; and
- 4) corona discharge shall be kept to a minimum.

All compression connectors shall be suitable for installation using either manual or hydraulic compression tools. Details of dies and tools required for the compression connectors offered shall be submitted with the bid. Complete instructions for the installation of each type of connector shall be provided by the Supplier.

Oxide inhibiting grease shall be suitable for aluminium to aluminium to copper bolted joints and as a filling compound for aluminium fittings which are used on copper conductors. The compound shall be free from zinc particles or grit,



shall be high 'drop point' grease based and shall remain stable at high temperatures.

Parallel Groove (PG) Connector

General

Non-tension type bolted parallel groove connectors (P.G. connector) are required for jumpers, spur take-offs, and drop connections to dropout fuses. The P.G. connector shall be of one or two bolt type (one bolt type shall be used for connection of shield wire SWG 7/2mm only). IEC61238 or other national or international Standards which ensure equal or higher quality shall be applicable.

The edges of the connector barrels shall be rounded to assist stress relief when the connectors are used with covered conductors.

All connectors shall be supplied pre-filled with high quality oxide inhibiting compound and shall be protectively capped to prevent spillage or spoilage of this compound. All connectors shall be clearly and permanently marked with the correct conductor size range and category.

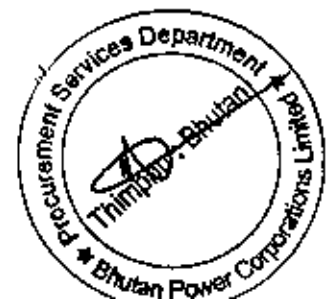
In addition all connectors shall comply with the following:

- The current must be uniformly distributed among the strands of the conductors.
- The connector must have at least the same conductance as the conductor and carry the full continuous current rating of the conductor size they are designed for.
- The original quality of contacts shall be maintained throughout the connectors service life.

The connectors shall be made of corrosion-resistant alloy with a minimum tensile strength 400 MPa. The resistance of all clamps shall not be more than 50% of the resistance of the conductor itself over the same length as the clamp.

The connectors shall:

- Have serrated conductor grooves,
- Interlocking fingers,
- Be recessed to prevent bolt head turning during tightening,
- Have a one, two, or three bolt pattern to suit conductor size and current rating,
- Have bolts of sufficient length to allow installation without disassembling the connector,
- Have conductor entries of a generous radius to prevent damage to strands, and
- Be pre-filled with joint compound.



Packaging

Each connector shall be supplied in an individual sealed clear plastic bag or pocket. The bag shall be adequately durable to ensure no grease or oxide inhibiting compound is lost or spoiled prior to the time of installation. The bag shall be labelled with the makers name or trade mark, and the size range of the fitting. Bags shall be further packaged in cardboard or similar containers in quantities of approximately 100 fittings of the identical description.

Preformed dead end terminations

Preformed dead end terminations for AAAC covered conductor shall be manufactured from aluminium alloy. Dead end terminations for galvanised steel conductor shall be manufactured from galvanized steel. A UV-radiation and weather resistant end (terminations) cap shall be provided one for each preform termination. The end caps shall be suitable size for fitting with the outer of covered conductors.

The minimum failing load of the dead end fittings shall be not less than 100% of the breaking load of the matching conductor, as mentioned in the relevant clauses in this Technical Specification. The loop dimensions shall be suitable for the matching thimble fittings. The fittings shall have marks to show the crossover points for correct installation.

The preformed terminations shall be supplied for termination of the following shield wire and guy wire

- 7/8 SWG G.I. stay wire; and
- 7/2.0 mm G.I. shield wire with accessories

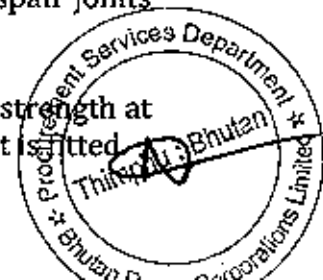
The 7/2.0 mm G.I. shield wire will be terminated by a preformed dead end termination at top cross arm (G.I. Channel 75mm x 50mm x 6mm). *The necessary strain clamp sets for connecting the preformed dead end termination to the top cross arms shall be provided along with the preformed terminations for shield wire (refer to drawing).* The cost for provision of these clamp sets shall be included in the itemized prices for preformed dead end terminations for shield wire.

Tension Joints

Full Tension Mid-Span Joints (Tension Joints) shall be of the compression in-line sleeve type suitable for connection of AAAC Covered Conductor;

The Supplier shall provide appropriate type of full tension mid-span joints conforming to the conductors' strands.

The compression type jointing sleeve shall be designed to have the strength at least 95% of the rated breaking strength of the conductor to which it is fitted



The outer insulation cover shall be provided along with mid-span joints for covered conductors with UV-radiation and weather resistant thermoplastic.

G.I. Suspension Clamp for Shield wire

The galvanized steel suspension clamp for shield wire will be used for installation of shield wire on the top of single telescopic pole. The materials other than galvanized steel shall not be used for the suspension clamp because of shield wire's connectivity to the earthing. The gripping part shall suit for the size of shield wire. The Supplier shall refer to the installation method of shield wire mentioned in relevant Technical Specifications in relation to shield wire, and properly design a type of suspension clamp for shield wire.

The suspension clamps shall be supplied along with necessary hock bolt (M16), nut and washers by individual packing.

Strain Fittings for Shield Wire with Preformed Dead End Termination

All the necessary fittings for straining the shield wire at the cross-arm (G.I. Channel 75 x 5 x 6 mm) on the top of double pole structure shall be supplied by the Supplier for this Package along with the preformed dead end termination. The fittings shall be properly designed/selected by the Supplier. The Purchaser recommends that the fitting may include a crossarm strap, an eye-thimble, bolts, washers and nuts.

INSPECTIONS AND TESTS

General

All tests shall be carried out in accordance with the relevant IEC Standards and other applicable Standards.

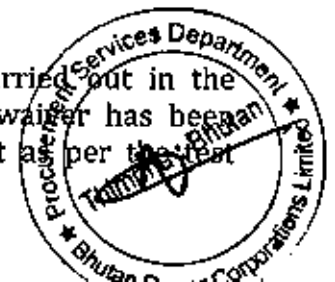
The cost for the tests shall be included in the prices estimated in the Price Schedules of Goods.

The Bidder shall submit type test reports with the bid. In case the type test reports submitted with Bid are of the tests conducted earlier than five years as on the date of bid opening, the Supplier shall repeat these type tests at no extra costs to the Purchaser.

Inspection

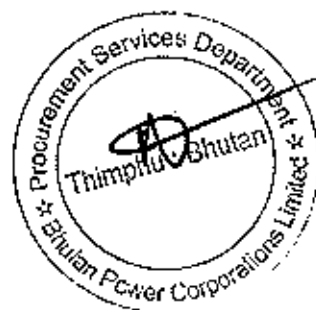
The Supplier shall intimate the Purchaser about the detailed program about the tests and inspection at least one month in advance.

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



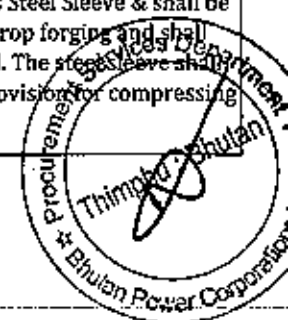
procedure that has been approved by the Purchaser. The Supplier shall assist the work of the Purchaser's inspector by providing copies of all relevant Standards and test procedures, and allowing the inspector full use of the necessary tapes, measures and laboratory equipment, together with ample space 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.

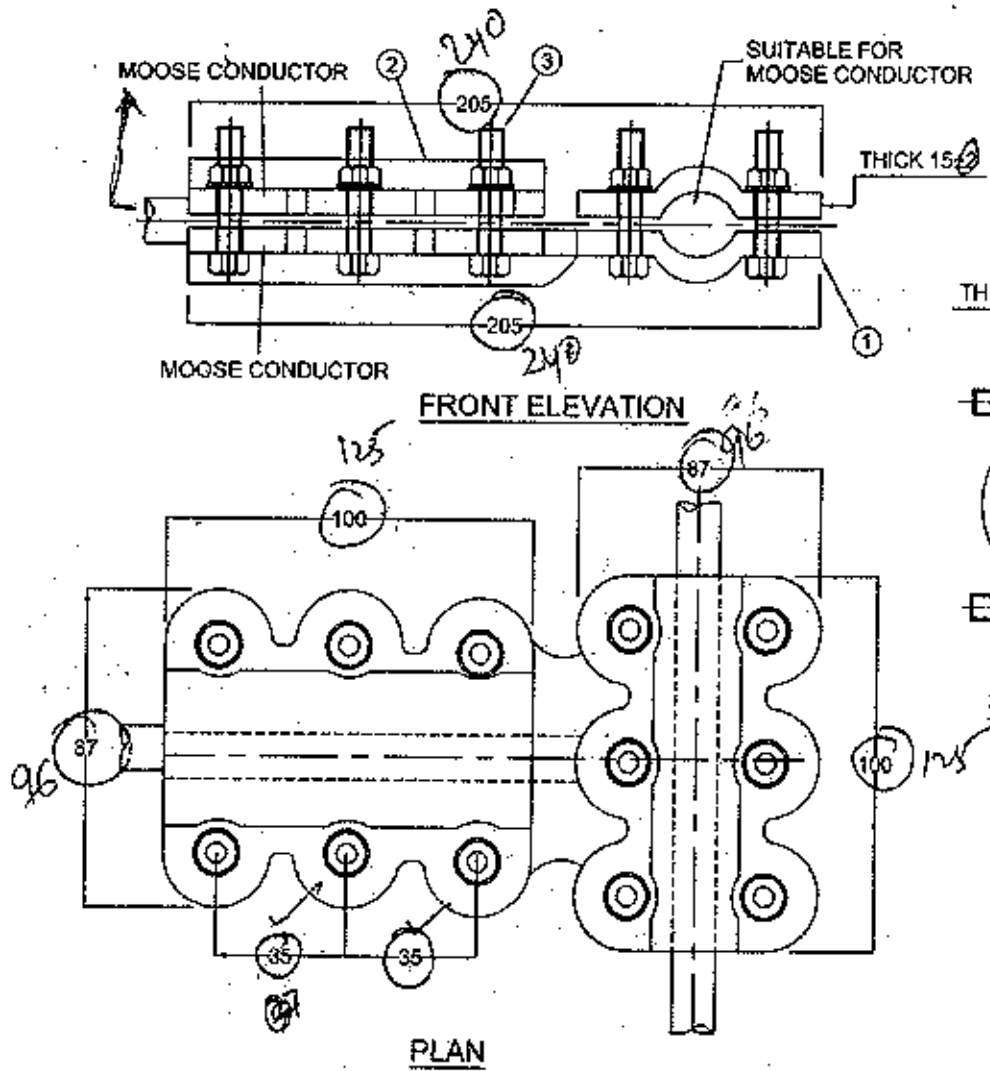


Technical Specification for HV Conductor Fittings and Accessories

SL#	Material Description	Technical Specification
3	T Clamp for MOOSE Conductor	T-clamp suitable for ACSR Moose conductors conforming to IS 5561 with connector body made up of aluminum alloy, nuts & bolts of mild steel and dimensions as per attached drawing Annexure-1.
4	T - Clamp for Zebra Conductor	T-clamp suitable for ACSR zebra conductor conforming to IS 5561 with connector body made up of aluminum alloy, nuts & bolts of mild steel and dimensions as per attached drawing Annexure-2.
5	T - Clamp for Panther Conductor	T-clamp suitable for ACSR Panther conductor conforming to IS 5561 with connector body made up of aluminum alloy, nuts & bolts of mild steel and dimensions as per attached drawing Annexure-2.
6	T - Clamp for Dog Conductor	T-clamp suitable for ACSR Dog conductors conforming to IS 5561 with connector body made up of aluminum alloy, nuts & bolts of mild steel.
7	T Clamp for Wolf Conductor	T-clamp suitable for ACSR Wolf conductors conforming to IS 5561, connector body made up of aluminum alloy, nuts & bolts of mild steel, dimension as per attached drawing.
8	T Clamp for Panther-Dog conductor	T clamps for two conductors suitable to connect both Panther and dog conductor together, conforming to IS-5561, body made up of aluminum alloy, nuts & bolts of mild steel.
9	Jumper Terminal for Wolf Conductor	Jumper cone/jumper terminal suitable for ACSR Wolf conductors, made up of EC grade aluminium and jumper must be non-tension joint with conductor as per attached drawing Annexure-3.
10	Jumper Cone with Nuts & Bolts for Wolf Conductor	Jumper cone/jumper terminal suitable for ACSR Wolf conductors, made up of EC grade aluminium and jumper must be non-tension joint with conductor as per attached drawing Annexure-3.
11	Repair Sleeve for Wolf Conductor	Repair sleeve suitable for ACSR Wolf conductors conforming to IS 2121, slip strength 85.5kN. The diameter of inner surface of sleeve should be 20.6 mm and approximate sleeve weight of 0.3kg.
12	Repair Sleeve for Panther Conductor	Repair sleeve suitable for ACSR Panther conductors & conforming to IS 2121 with slip strength of 85.5kN. The compression pressure 100T and approximate weight of sleeve weight of 0.43kg as per attached drawing as Annexure-4
13	Mid span joint (Al & Steel): Panther	Mid span joint suitable for joining of ACSR Panther conductors and conforming to IS 2121, ferrous part hot dip galvanized as per IS 2633, strength: 85.5kN and Brinell hardness of steel joint between 100 to 200 max. The compression pressure 100T for both aluminum and steel and approximate jointing sleeve of 1.46kg, as per attached drawing Annexure-5.
14	Mid span joint (Al & Steel): Wolf	Mid span joint suitable for joining ACSR Wolf conductors conforming to IS 2121, outer sleeve of Aluminium (IS-733), inner sleeve of steel (2629) and total weight of approx. 0.9kg as per attached drawing Annexure-6.
15	Parallel Groove Clamp (Zebra)	Parallel Groove (PG) Clamp suitable for ACSR Zebra conductors conforming to IS 5561, ferrous parts hot dip as per IS-2633 and current rating equal to conductor, dimensions as per attached drawing Annexure-7.
16	Parallel Groove Clamp (Panther)	Parallel Groove (PG) Clamp suitable for ACSR Panther conductors conforming to IS 5561, ferrous parts hot dip as per IS-2633 and current rating equal to conductor, dimensions as per attached drawing Annexure-7
17	Dead End Joint (both Al & Steel): Wolf	The dead end joints/clamps shall be suitable for supporting of ACSR Wolf conductors. The clamp comprises of outer sleeve and inner sleeve. Outer sleeve & jumper cone shall be made of EC grade Aluminium. The inner Sleeve is Steel Sleeve & shall be made by Forged Steel. The steel sleeve of dead end clamp shall be single piece obtained by process of drop forging and shall not be made by joining, welding, shrink fitting or any other process for more than one piece of material. The steel sleeve shall be hot dip galvanized. The dead end clamp for ACSR Wolf conductor shall be compression type with provision for compressing jumper terminal at one end as per attached drawing Annexure-8



T Clamps for ACSR MOOSE Conductors



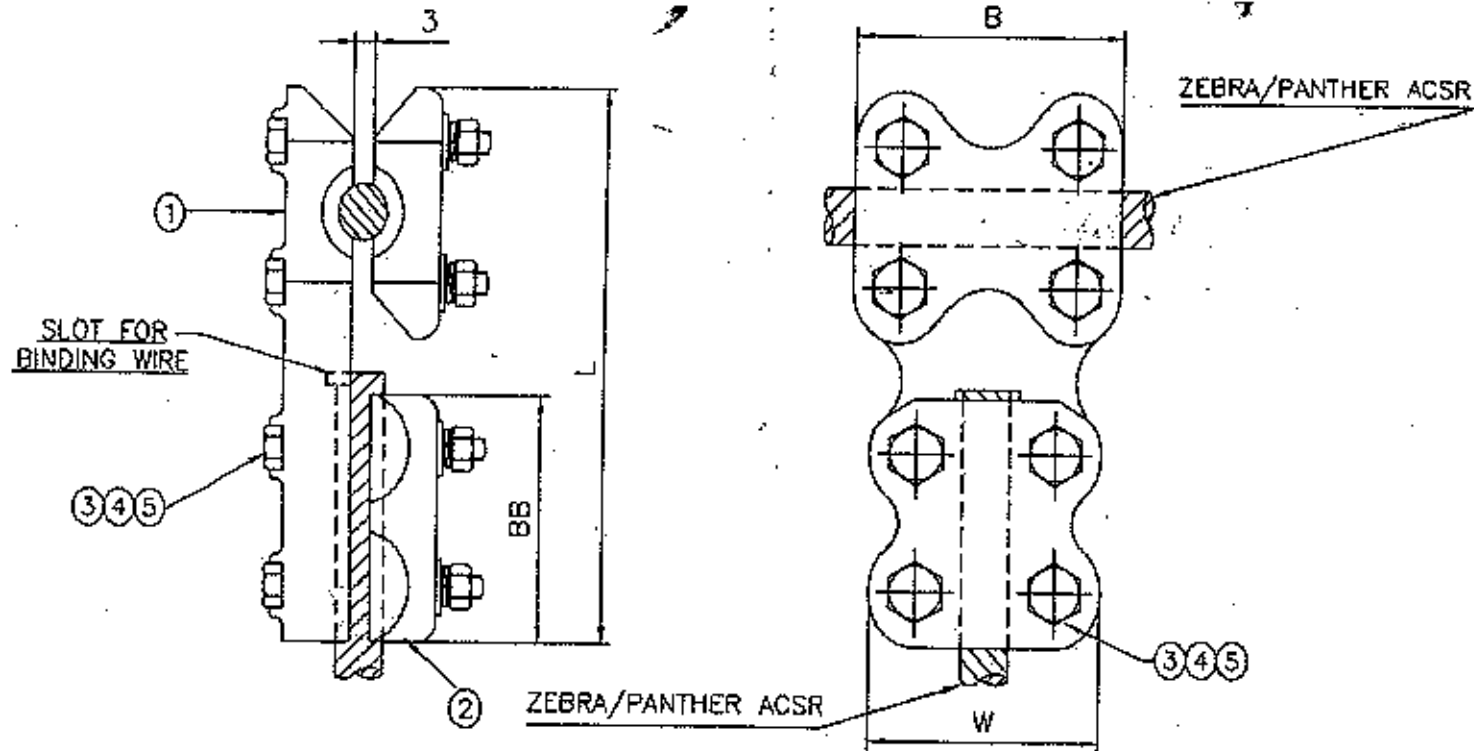
SL. NO	DESCRIPTION	QTY. PER STRING	MATERIAL
1.	CONNECTOR BODY	1	ALUMINIUM ALLOY
2.	CLAMPING PIECE	2	ALUMINIUM ALLOY
3.	M12 HEX. BOLT WITH NUT, PLAIN WASHER & SPRING WASHER	12	MILD STEEL HDG

TECHNICAL DATA -

- 1) GALVANISING CONFORMS TO IS:2633/EQUIVALENT
- 2) SPECIFICATION:- AS PER IS:5561
- 3) ALL DIMENSIONS ARE IN MM



**TEE CONNECTOR TO SUIT
PANTHER/ZEBRA ACSR CONDUCTOR**

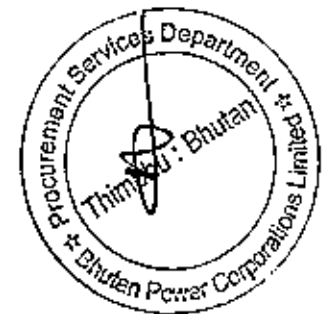


NOTE:-

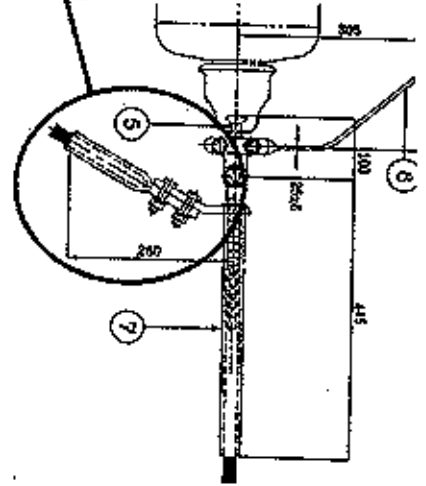
1. Clamp as per IS-556.
2. Ferrous parts will be hot dip galvd as per IS-2633
3. Current carrying capacity - Equal to Conductor.
4. Dimensions in mm. Tolerance $\pm 5\%$ (Min $\pm 1\text{mm}$).
5. Thickness not less than 10mm of current carrying part.

ITEM No	DRG No	ACSR CONDUCTOR		L	B	BB	W
		RUN 'A'	TAP 'AA'				
18	TC - 2	PANTHER	PANTHER	151	79	79	74
17	TC - 1	ZEBRA	ZEBRA	171	89	89	80

SL	DESCRIPTION	MATERIAL	QTY
1	CLAMP	ALUM ALLOY	1
2	KEEPER	ALUM ALLOY	2
3	BOLT & NUT 12 ϕ	GALV STEEL	8
4	FLAT WASHER	GALV STEEL	8
5	SPRING WASHER	SPRING STEEL	8



Jumper cone/jumper terminal
for ACSR Wolf conductor

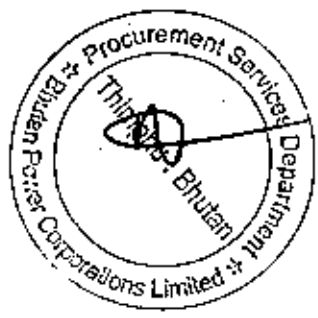
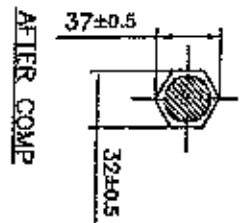
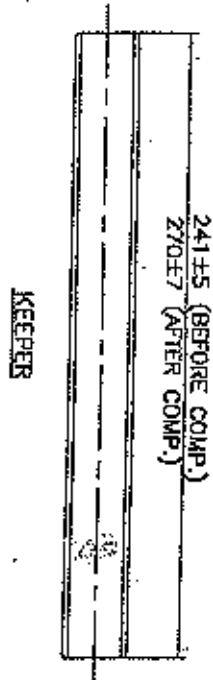
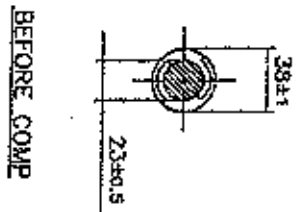


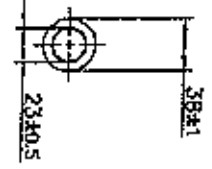
Annexure - 3

REPAIR SLEEVE FOR PANTHER ACSR CONDUCTOR

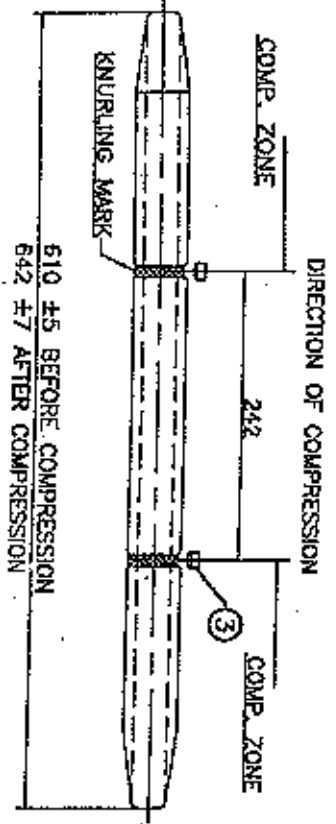
NOTES:-

1. Fittings as per IS-2121 (Pt. II)
2. Dimensions in mm
General tolerance $\pm 3\%$
Unless otherwise specified.
3. Slip strength 85.5 KN
4. Compression Pressure 100 Tons
5. Weight is indicative only
and not mandatory.
6. Approx. Weight : 0.43 Kg

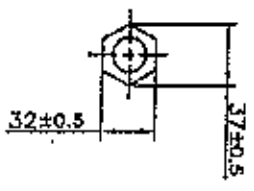




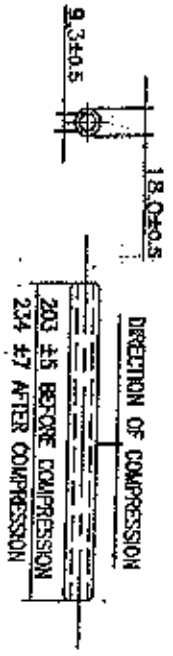
BEFORE COMP



① ALUMINIUM JOINT

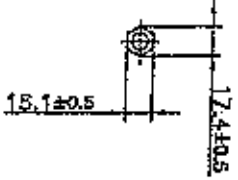


AFTER COMP



BEFORE COMP

② STEEL JOINT

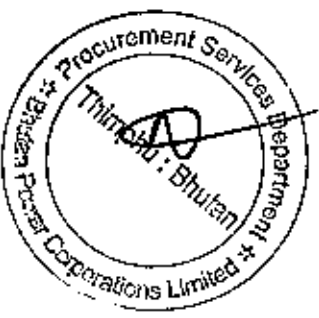


AFTER COMP

MIDSPAN COMPRESSION JOINTS FOR PANTHER ACSR CONDUCTOR

NOTES :-

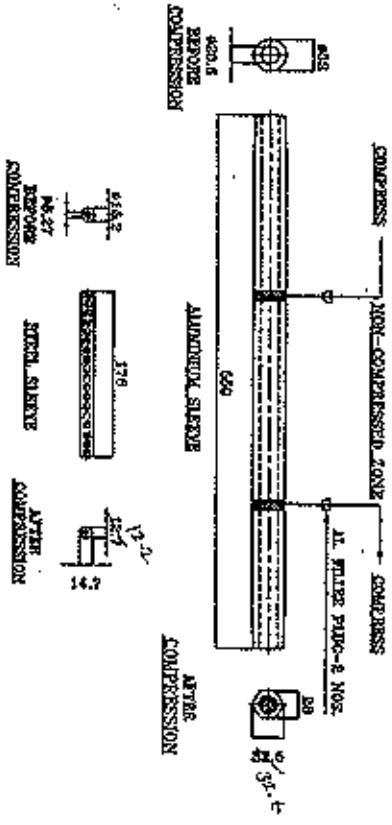
1. Fittings as per IS-2121 (Pt. II)
2. Ferrous parts not dip galvd as per IS-2633
3. Dimensions in mm
General tolerance ±3%
Unless otherwise specified.
4. Slip strength 85.5 KN
5. Brinell Hardness of steel joint ~ 100-200 max.
6. Compression Pressure 100 Tons for both Alum & steel
7. Weight is indicative only and not mandatory.
8. Approx weight : 1.45 KG.



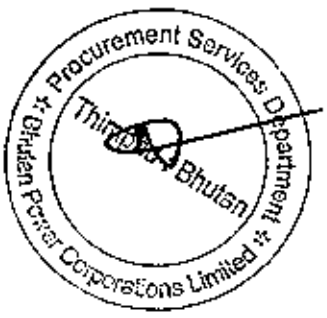
MINSPAN COMPRESSION JOINT FOR ACSR NON COMPRESSION

TECHNICAL DATA :-

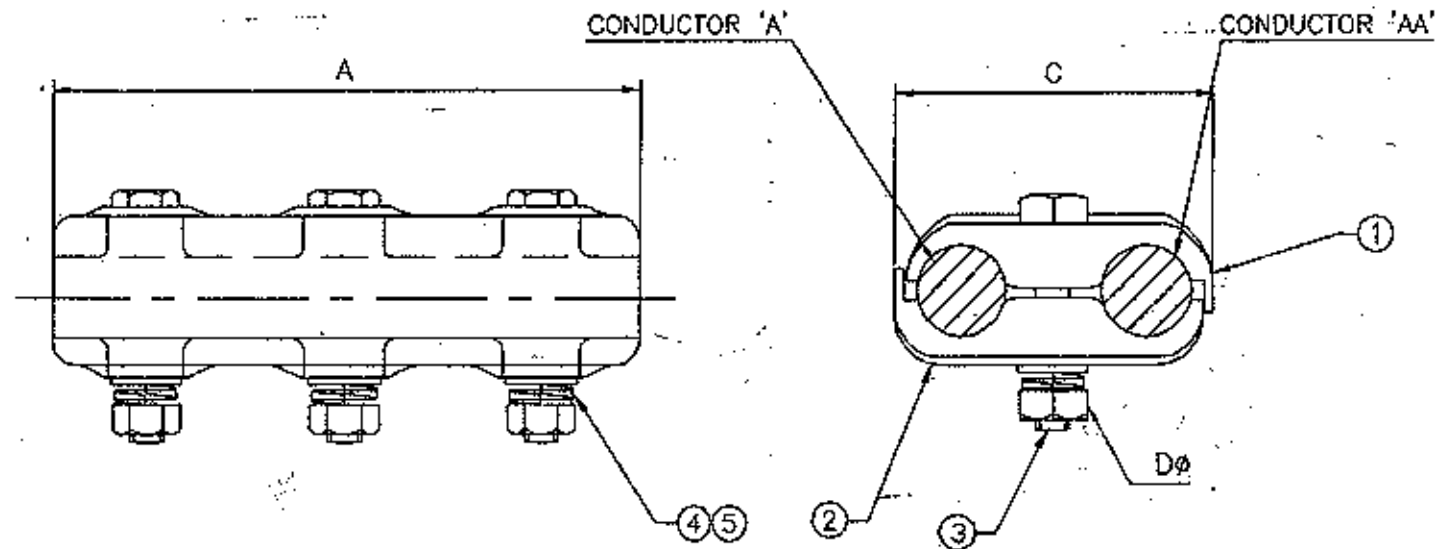
- 1. MATERIALS:**
- a) ALUMINIUM SLEEVE - EXTRUDED ALUMINIUM.
 - b) STEEL SLEEVE - MILD STEEL HOT DIP GALVANIZED.
1. MIN. TENSILE LOAD/SUP. STRENGTH AFTER COMPRESSION - 95% OF CONDUCTOR RTS.
 2. MIN. TENSILE LOAD/SUP. STRENGTH AFTER COMPRESSION - 95% OF CONDUCTOR RTS.
 3. AFTER COMPRESSION DIMENSIONS SHOULD BE AS PER FIELD USE ONLY.



Annexure - 6



P G CLAMP FOR ZEBRA /PANTHER ACSR

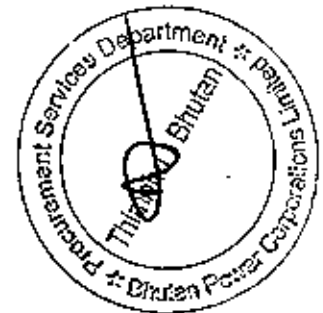


NOTE:-

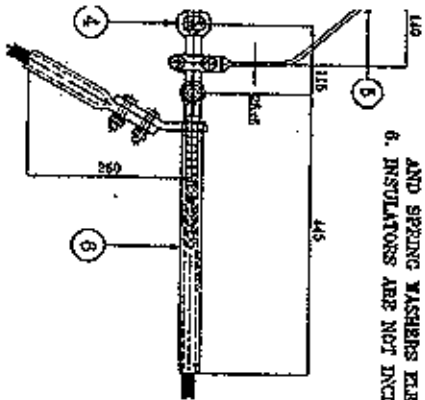
1. Clamp as per IS-556.
2. Ferrous parts hot dip galvd as per IS-2633
3. Current rating equal to conductor
4. Minimum Thickness - 10mm
5. Dimension in mm
Tolerance $\pm 5\%$
(Min $\pm 1\text{mm}$)

ITEM NUMBER	DRAWING NUMBER	CONDUCTOR		DIMENSIONS IN mm			NO.OF BOLTS
		A	AA	A	C	D	
13	RPG-86	ZEBRA ACSR	ZEBRA ACSR	170	100	16	3
14	RPG-84	PANTHER ACSR	PANTHER ACSR	134	74	12	3

SL	DESCRIPTION	MATERIAL	QTY
1	CLAMP	ALUM ALLOY	1
2	KEEPER	ALUM ALLOY	1
3	BOLT & NUT	GALV STEEL	3
4	FLAT WASHER	GALV STEEL	3
5	SPRING WASHER	SPRING STEEL	3

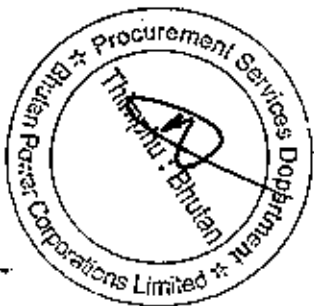
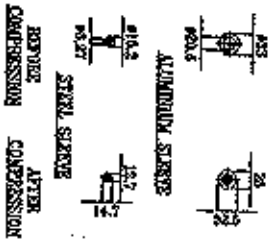


BILL OF MATERIALS			
SL.NO	DESCRIPTION	MATERIAL	NO. OF
6.	DEAD END CLAMP (COMPRESSION TYPE)	ALUMINIUM AND STEEL	1 SET,
6.	ARCING HORN (LINE SIDE)	M.S. PLAT	1 NO.
4.	SOCKET EYE (H.H.)	FORGED STEEL	1 NO.
3.	ARCING HORN (TOWER SIDE)	M.S. PLAT	1 NO.
2.	BALL LINK (H.H.)	FORGED STEEL	1 NO.
1.	ANCHOR SHACKLE	FORGED STEEL	1 NO.



TECHNICAL DATA:

1. BALL AND SOCKET SIZE - 16mm. "B".
2. SOCKET EYE FITTED WITH SECURITY CLIP MADE OF STAINLESS STEEL.
3. DEAD END CLAMP SUITABLE FOR ACSE ROLF CONDUCTOR.
4. MIN SLIP STRENGTH / VRS OF TENSION CLAMP - 85% OF CONDUCTOR VRS.
5. ALL STEEL COMPONENTS EXCEPT SPRING WASHERS NOT DIP GALVANISED AND SPRING WASHERS ELECTRO GALVANISED.
6. INSULATORS ARE NOT DECIDED IN OUR SUPPLIES.



Amorwe - 8

LOT-5: ABC FITTINGS AND ACCESSORIES

1.0 HV ABC Accessories

1.1 Pole Accessories

The following accessories are required for the installation of the HV aerial bundled cables.

- a) Suspension assembly
- b) Strain Clamp/Dead end assembly
- c) GI Support Hook
- d) Bundled Restraint assembly
- e) Jointing Sleeves

Each assembly shall be delivered complete with all necessary devices suitable for attachment to round steel poles by stainless steel strap. All metal fitting shall be of good quality galvanized mild steel or cast aluminium alloy. Each of the suspension/angle/dead end assemblies shall be supplied with a 1.75 m of stainless steel trap with two buckles.

Bundled end protection shall be provided for protecting cable dead ends and shall comprise a set of heat shrinkable polymeric terminal caps for fitting on each conductor, together with protective black PVC sleeve of 500 mm length.

1.2 HV ABC Connectors

The following connectors are required for the connection of HV aerial bundled conductors.

- a) Insulated tension jointing sleeve
- b) XLPE Cable Termination Push On Type

The connections shall be insulated and suitable for use on live lines. The teeth of the contact plates shall penetrate the bundled conductor insulation to establish contact with ABC cable without the need to strip the bundled conductor insulation. The connector shall be suitable for copper or aluminium tee-off conductor. The Tee-off shall be capable of removal and subsequent re-installation.

Insulated tension jointing sleeves shall be provided for the bundled conductors. These shall be of the compression type, but compression shall not damage or displace the sleeve insulation. The sleeve connectors shall be designed to have the full rate breaking strength of the Aluminium or Aluminium alloy cable on which they are fitted.



2.0 LV ABC Accessories

2.1 Pole Accessories

The following accessories are required for the installation of the LV aerial bundled cables.

- a) Suspension assembly (including angles up to 30 deg)
- b) Large angle assembly (angles over 30deg.)
- c) Dead end assembly
- d) End caps

Each assembly shall be delivered complete with all necessary devices suitable for attachment to round steel poles by stainless steel strap. All metal fitting shall be of good quality galvanized mild steel or cast aluminium alloy. Each of the suspension/angle/dead end assemblies shall be supplied with a 1.75 m of stainless steel trap with two buckles.

Bundled end protection shall be provided for protecting cable dead ends and shall comprise a set of heat shrinkable polymeric terminal caps for fitting on each conductor, together with protective black PVC sleeve of 500mm length.

2.2 LV ABC Connectors

The following connectors are required for the connection of LV aerial bundled conductors.

- (a) Insulated service/tee-off connection (IPC Connector)
- (b) Insulated tension jointing sleeve
- (c) Insulated connectors between ABC and PVC cables

Bundled conductor connectors are required for connection of service cables to bundled conductors, for tee-offs of bundled conductors and for connection to PVC cables. The connections shall be insulated and suitable for use on live lines. The teeth of the contact plates shall penetrate the bundled conductor insulation to establish contact with ABC cable without the need to strip the bundled conductor insulation. The connector shall be suitable for copper or aluminium tee-off conductor. Bidder shall describe the method used to ensure that the contact plates make adequate contact with the main conductor. The Tee-off shall be capable of removal and subsequent re-installation.

The range of connector for ABC to ABC and for ABC to service cable shall be as follows:

Main conductor size(mm ²)	Tee-off Conductor Size (mm ²)
120	95, 50
95	95
95	50, 16, 10, 6, 4
50	50
50	10, 6 & 4



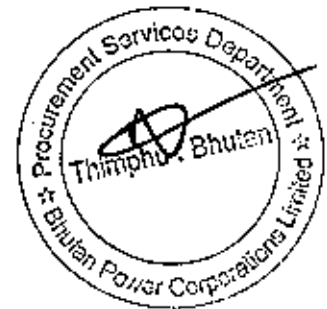
The range of connector for ABC to PVC cable shall be as follows;

LV ABC Cable	LV PVC Cable
50mm ² XLPE	4C x 16mm ²
	4Cx 50mm ²

Insulated tension jointing sleeves shall be provided for the bundled conductors and service cables. These shall be of the compression type, but compression shall not damage or displace the sleeve insulation. The sleeve connectors shall design to have the full rate breaking strength of the aluminium or aluminium alloy cable on which they are fitted.

2.3 LV service dead-end Clamps

An open sided stainless steel wedge clamp or similar dead-end be supplied for dead ending two core service conductor cables at the pole and the consumer premises. The clamp shall be suitable for the LV service cables. Above and shall have a pull out tension of not less than 16 kN.



LOT-6: EARTHING EQUIPMENT

1. Spike Earthing

Spike earthing is used for 11 kV & 33 kV pole earthing. Spike Earthing consist of 25 x 6 mm, 1.5 meter GI Flat, 2.5 meter long spike earthing electrode with necessary holes as indicated on the drawing no. BPC-DDCS-2020-21/1-2

2. Pipe Earthing

2.1 Pipe Earthing for Distribution Substations

Pipe earthing is used for the earthing of distribution substations. Pipe earthing consists of heavy gauge GI pipe of 40 mm diameter, 4 mm thick, 2500 mm long with perforated and 25x 6 mm , 6.5 meter GI Flat. One end of the GI pipe shall be threaded with 50 mm length to fix the plate (250 x 250 mm) and other end to be pointed to drive into the ground. Details are given in drawing no. BPC-DDCS-2020-21/2-2

2.2 Pipe Earthing for Transmission Line Towers

GI pipe earthing along with earthing pipe to tower connecting GI flats, nuts & bolts as required. Pipe earthing size shall be 25 mm diameter, 3050 mm long, class-B, 6mm holes apart at 150 mm. GI flat shall be 50 x 6 mm thick and 4050 mm long. GI nuts and bolts size shall be 16 mm.

3. Stay wire

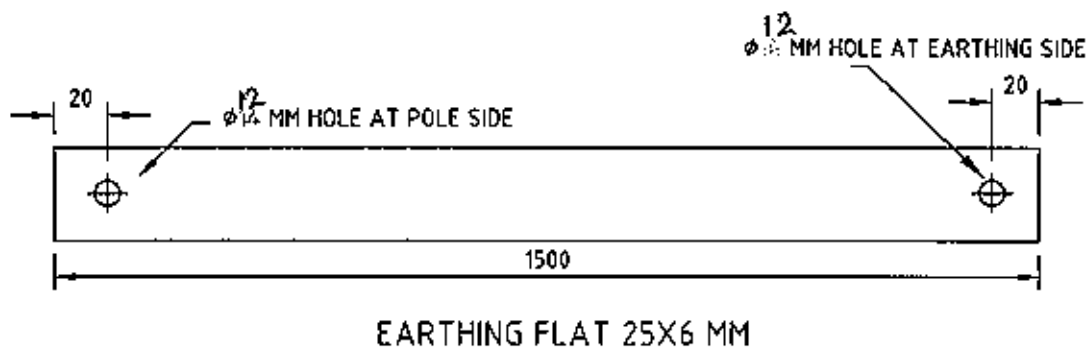
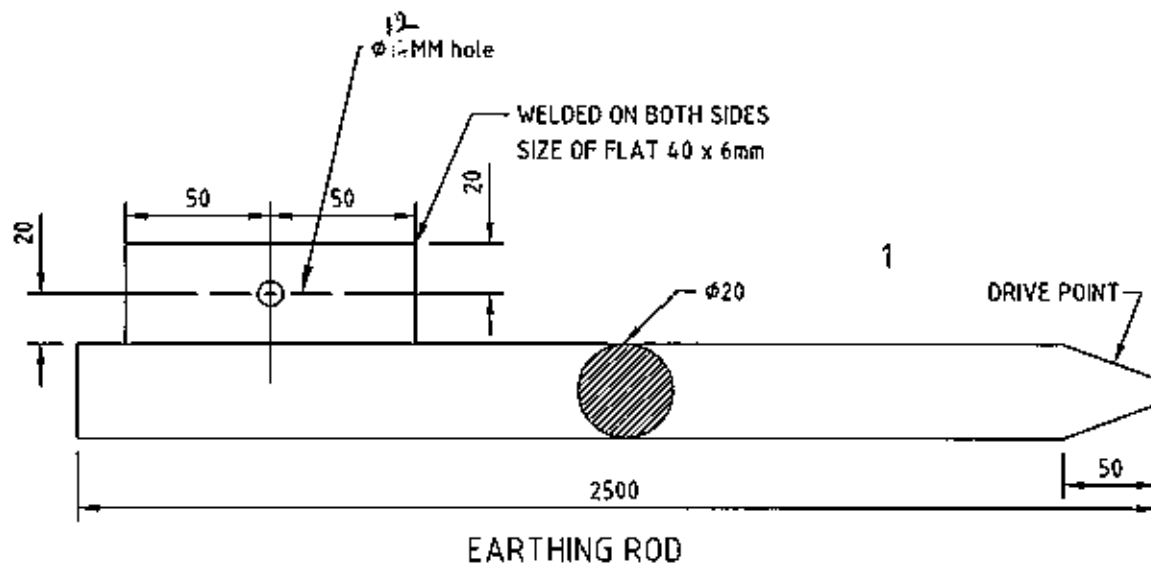
Utilities grade galvanized steel stranded shall be used for guy wire as shown in below table.

Designation	No. of strands	Strand SWG	Stranded Diameter (mm)	Overall diameter (mm)	Approx. Weight per meter (kg)	Min. Breaking load (kN)
7/8	7	8	4.04	12	0.72	90

4. Counterpoise Earth Wire

Galvanized stranded steel wire of 7/3.15 mm for counterpoise earthing at transmission line towers




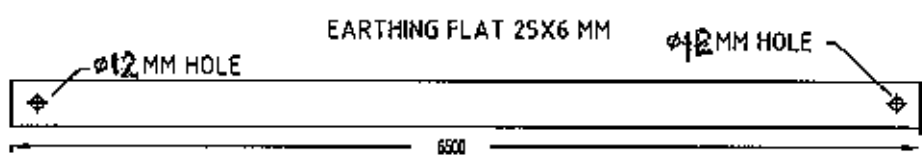
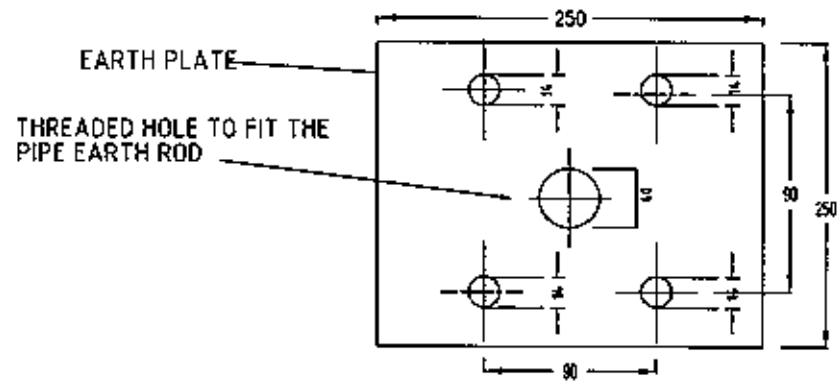
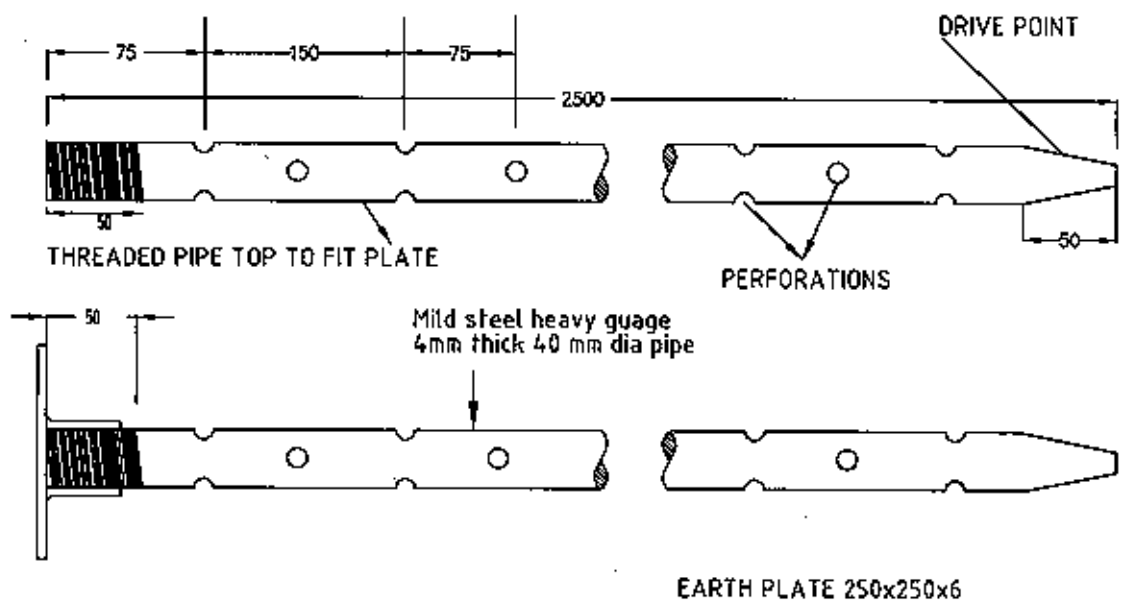


GRADE OF STEEL: BS 4360 GRADE 43A OR EQUIVALENT
 GALVANISED TO: BS 729 OR EQUIVALENT
 PACKING: EARTING RODS, NUTS & BOLTS, FLATS
 TO BE PACKED SEPARATELY



5	WASHER SPRING	4	HDG STEEL	M12
4	NUT HEX	4	HDG STEEL	M12
3	EARTHING FLAT 25X6MM	1	HDG STEEL	1.5Meter
2	BOLT HEX	4	HDG STEEL	M12 x 25 x FT
1	EARTHING ROD	1	HDG STEEL	M20 x 2500
ITEM	NAME OF ITEM	QTY	MATERIAL	SIZE

	BHUTAN POWER CORPORATION LIMITED		ENGINEERING AND RESEARCH DEPARTMENT	
			DISTRUBUTION DESIGN & CONSTRUCTION STANDARD	
TITLE	NAME	DATE	SPIKE EARTHING SET	
DESIGNED BY				
CHECKED BY				
APPROVED BY			DRAWING NO. BPC-DDCS-2020-21/1-2	REVISION 2020



GRADE OF STEEL: BS 1387 OR EQUIVALENT
 GALVANISED TO: BS 729 OR EQUIVALENT
 PACKING: EARTING ROD,LUGS, BOLTS & NUTS
 & GI FLAT , PLATE PACKED SEPARATELY

EARTHING FLAT (4.5 METER)	11	H.D.G STEEL
FLANGED PLATE	1	H.D.G STEEL
SPRING WASHER	4	H.D.G STEEL
HEX NUT M16	4	H.D.G STEEL
HEX BOLT M16X25	4	H.D.G STEEL
EARTHING ROD	1	H.D.G STEEL
NAME OF THE ITEM	QTY	MATERIAL



BHUTAN POWER CORPORATION LIMITED	ENGINEERING AND RESEARCH DEPARTMENT	
	DISTRIBUTION DESIGN & CONSTRUCTION STANDARD	
PIPE EARTHING		
TITLE	NAME	DATE
DESIGNED BY		
CHECKED BY		
APPROVED BY		
DRAWING NO, BPC-DDCS-2020-21/2-2		REVISION 2020

LOT-8: CTPT COMBINED UNIT

1. GENERAL:

This specification covers the design, engineering, manufacture, assembly, stage testing, inspection, supply and delivery of following equipment:

- a) 33kV outdoor type combined CT PT Unit

APPLICABLE STANDARDS:

Unless otherwise modified/specified in this specification, the CT/PT Unit shall comply with the latest version of the following standards:-

- 1) Current Transformers - IS:2705
- 2) Potential Transformers - IS:3156
- 3) HV Porcelain Bushing - IS:2099
- 4) Oil - IS:335
- 5) Terminal Connector - IS:5561
- 6) Application guide for CT - IS:4201

2. TYPE RATING AND PERFORMANCE REQUIREMENTS:

3.1. The 3 Phase 4 Wire, CT/PT unit should be of pole mounting type for outdoor use. They are to be used in 33kV Three Phase with solidly earthed neutral and suitable for 50Hz network. The equipment is required for operation of HT meters installed inside the substation building of 33/11kV Sub Stations and should be oil cooled.

3.2. 33kV CT/PT Metering Equipment unit shall comprise of 3 nos CTs conforming to IS: 2705 and 1 No Three phase PTs conforming to IS-3156, with latest amendments.

3.3. The rating and other Electrical Characteristics shall be as follows:-

2.3.1. 33kV Metering CT

Sl. No.	Technical Description	Requirement
1	Purpose	Metering
2	Primary Current Rating	100-50 A and 200-100A
3	Secondary Current Rating	1A
4	Rated Burder	10 VA
5	Accuracy Class	0.5s
6	Short time current rating	16kA for 1 sec
7	Dynamic peak current	40kA



3.3.2. 33kV Metering PT

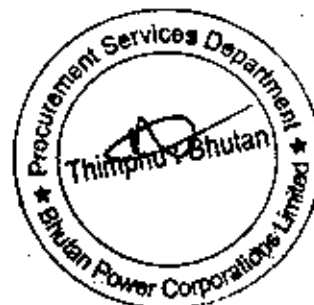
Sl. No.	Technical Description	Requirement
1	Purpose	Metering
2	Primary Voltage	33/√3 kV
3	Secondary Voltage	110/√3 V
4	Rated Burder	15 VA
5	Accuracy Class	0.5
6	Winding connector	Star-Star

- Highest System Voltage : 36kV
- Normal System Voltage : 33kV
- Frequency : 50Hz -2%, +1%
- 1.2/50µs impulse withstand voltage : 170kV (peak)
- One minute power frequency withstand Voltage (Dry & wet) : 70kV (rms)
- Creepage Distance : 900mm
- One minute power frequency withstand voltage on secondary winding : 3kV (rms)
- Max temperature rise above ambient temp as relevant IS : 55°C
- Minimum Clearances
- Phase to Phase : 320 mm
- Phase to earth : 350 mm

4. CLIMATIC CONDITIONS

4.1. The CT PT unit shall be suitable to work satisfactorily under the following climatic conditions:

i	Maximum ambient temperature (°C)	40
ii	Minimum ambient temperature (°C)	-20
iii	Maximum altitude above mean sea level (m)	2400
iv	Relative humidity (%)	20% to 100%
v	Average Annual rainfall	1400 mm
vi	Maximum Wind pressure	195 kg/m sq.



5. DESIGN AND CONSTRUCTION

The equipment shall be designed to ensure satisfactory operation under all conditions of service as per Cl 4.1 to facilitate easy inspection, cleaning and repairs.

The metering equipment (CT and PT) shall be contained in a weather proof outdoor structure/RCC mounting type M.S. tank with 6 nos. of 33 KV weather proof bushings with Brass stud as per rating of combined CT: PT (metering equipment) units. These bushings shall conform to IS-2099. The dimension and electrical characteristics of the bushing shall be in accordance to IS.

The design shall incorporate every reasonable precaution and provisions for safety of all those concerned in the operation and maintenance of the equipment. A pressure relief valve/Explosion vent shall be invariably provided at the top cover of the tank of the ME.

All outdoor apparatus shall be so designed that water cannot collect at any point and enter the ME. The top cover of the tank, secondary terminal cover, inspection chamber cover plate may be designed accordingly to prevent the accumulation/stagnation of water on the ME surface.

All connections and terminals shall be of sufficient size for carrying the specified currents continuously without undue heating.

All bolts, nuts, washers in contact with non-ferrous parts shall be of brass.

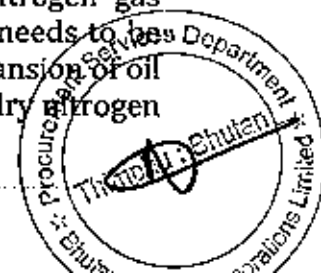
Top cover flange of metering unit should be provided with 4 nos. bolt with sealing holes for proper sealing arrangement at all four corners of the tank and cover. Secondary terminal box cover should have 8 nos. nuts & bolts with 4 bolt duty hole for sealing arrangement. For this, 8 nos. holes should be provided on the cover & flange of secondary terminal box at the corners & middle of each face for fixing nut bolts.

All ferrous parts including bolts & nuts liable to corrosion, forming integral part of the equipment shall be hot dip galvanized.

The core shall be high grade non-ageing electrical silicon laminated steel of low hysteresis loss and high permeability to ensure high accuracy, at both normal and over current/ voltage.

All winding shall be of insulated high grade Electrolytic copper wire and the manufacturing of the units shall be done in completely closed and air-conditioned room otherwise Fibre glass insulation sleeves are to be provided for primary winding. Details of winding and core shall be furnished.

The volume above the oil level in the tank shall be filled with Nitrogen gas conforming to commercial grade as per IS: 1747:72. A suitable space needs to be provided for dry nitrogen in order to accommodate the volumetric expansion of oil due to change in temperature. The volume of space to be provided for dry nitrogen shall be atleast 10% in volume that of total quantity of oil in ME.



The procedure for filling of dry nitrogen and making the unit hermetically sealed shall be as per manufacturer's standard practice but subject to approval by the purchaser.

Sealing bolts for sealing at 4 points on the secondary terminal box (both inner & outer door), inspection cover, the top cover of the tank shall be provided. This may be made by providing a hole on tail of corner bolts of adequate size to pass the sealing wire of above 13 SWG.

The voltage transformer shall be so designed that the increased magnetizing currents due to any persisting over voltage, does not produce injurious overheating. Phase barriers shall be provided.

The winding shall be neatly laid and anchored. The CT & PT winding within the tank shall have proper mounting arrangement. Floating windings with paper insulation are not acceptable. The windings must be secured & fixed to guard against physical movements during transit and/or during system short circuits. This shall be got verified during final inspection of the lot, on opening of one CT:PT Unit at firms work.

The metering set tank and other metal parts shall be galvanized both inside & outside as per latest IS applicable.

Primary terminals: - Primary Terminals shall be adequately sized as per current rating of the CT/PT Unit. No undue overheating shall occur even for 150% overloading of the CT/PT unit. The primary winding shall be of adequate cross section to carry continuously the rated current plus 50% over load continuously.

The oil filled container incorporating the CT and VT should be fitted with incoming and outgoing primary terminals and secondary terminal box. Adequate level of oil shall be maintained in the tank for proper cooling & curb flashover. M and L (Main side and Load side) shall be indelibly marked/embossed on the top cover of MS tank to identify the incoming and outgoing terminals of CT/PT unit.

During lowest temperature condition when oil level is lowest, atleast 40mm of bushing bottom shall remain dipped in the oil. Bidder shall submit clear dimensional drawing indicating the lowest oil level and physical location of bottom of bushing proposed to be used. This drawing shall also indicate the space/volume available above the oil level for dry nitrogen to accommodate expansion of oil without generation of under pressure.

The mounting of the bushing on the metering equipment should be in oblique plane. CT primary and secondary terminals shall be marked clearly as indicated in Annexure-C of IS: 2705, the terminal marked P1 of primary and S1 of secondary in case of current Transformer and corresponding in case of PT shall have the same polarity at any instant.



The tank shall be built with a plate of 5 mm thick top and 3 mm sides and bottom and with all fittings shall be capable of withstanding without leakage or distortion at the standard test pressure. All joints of the tank and fittings shall be hot oil tight and no leakage should occur during service. Both side of the joint should have continuous welding.

The welded joints of the metering unit shall be strengthened by providing 25 x 25 x 3mm angle all along the welded length and welded properly inside the tank. All joints of the tank and fitting shall be oil tight.

ME shall be provided with an oil gauge. The oil gauge glass shall be fixed to the side of the raised wall of the inspection box for monitoring the oil level of the ME.

The tank shall be provided with necessary lifting lugs.

The secondary terminal box cover, tank cover and inspection cover and other vertical joints where gaskets are used may be suitably bent with necessary sealing arrangement with sealing bolts at all corners. Bolts should be at least 10 mm diameter GI bolts spaced maximum 70 mm apart. This is to safeguard against seepage of water into tank in case of damaged gasket.

The 6 mm gaskets shall be dovetailed without joints to prevent moisture entry. In case of dovetailed joint, they shall not be more than two. The gaskets shall be of good quality Neoprene or superior quality rubberized gasket. The quality of gasket should be selected keeping in mind the ambient temperature of 75°C.

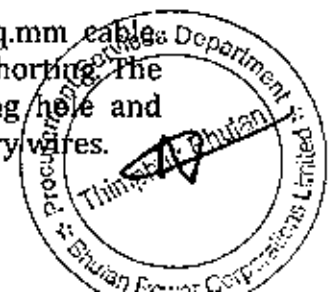
EARTHING: Two earthing terminals of adequate size protected against corrosion, metallicly clean and identified by means of the sign marked in a legible and indelible manner adjacent to the terminals shall be provided.

Size of the primary conductor or CT circuit shall be worked out on the basis of nominal current density and also to meet out requirements stipulated in clause 9.6 of IS 5705 (Part-I) 1992 relating to short time thermal current test. The requirements of size of conductor shall be worked out for both criteria and higher of the two cross section area will have to be adopted.

PT winding should have uniform insulation throughout from live terminal to neutral end, and not the graded insulation. Secondary winding of PT should be three phase star connected with neutral brought out. On secondary side of PT four terminals shall be marked as r, y, b and n.

The Secondary terminal box incoming hole should be suitable for 40 mm dia GI pipe and at a suitable height from bottom to avoid replacement/ modification of secondary wires pipe when ME is replaced.

The secondary terminals should be suitable for termination of 4 Sq.mm cable. Disconnecting type TBs shall be provided for CT with provision for CT shorting. The terminals should be provided at least 70 mm height from incoming hole and clearances shall be as per IS to avoid shorting terminals due to secondary wires.



The CT/PT unit shall be supplied with first filling of high grade oil. The insulation oil used in the tank shall comply with the requirements specified in latest relevant IS: 335/93. The test certificate of oil being used shall be provided at the time of inspection. The oil in the CT/PT shall be filled under vacuum. Oil drain valve or sampling cock or non-return type oil filling valve provided to facilitate factory processing shall be sealed before dispatch of CT/PT unit.

The tank should be given three coats of rust preventing paint and finished with light grey no. 631- IS-5 on all external surfaces. The internal surface of the tank shall be painted with two coats of suitable oil -insoluble paint.

All the fuses and the links for VT shall be provided at the Terminal Boxes.

The insulating materials for winding between HV & LV between interlayer of the winding and for end turn shall be as per relevant ISS. However, end turns have to be provided with reinforced insulation and end connecting the bushing shall be provided extra insulation of fiber glass sleeve.

6. NAME PLATE AND MARKING:

The CT/PT Unit shall be provided with non-corrosive, legible name plate with the information specified in relevant standards, duly engraved/punched on it. The following details shall be provided on the Name Plate:

- a) Property of "Bhutan Power Corporation Limited"
- b) Manufacturer's Name :
- c) P.O.No & date :
- d) Sr No :
- e) Year and Month of Manufacture :
- f) CT ratio/Accuracy Class/Burden :
- g) PT ratio/Accuracy Class/Burden :
- h) CT Sr No :
- i) PT Sr No :
- j) Overall CT PT multiplying factor :
- k) Rated frequency :
- l) Highest System Voltage :
- m) Rated Insulation Level :
- n) Standard (CT/PT) :
- o) Connection Diagram



The Primary and Secondary terminals of the CT/PT unit shall be clearly marked. The polarity and the other details shall be permanently etched on the body of the CT/PT unit.

The terminals of the instrument transformer shall be clearly marked by distinctive letters as stated in Annex "C" of ISS: 3156/Part. I/1992 (latest version) for voltage

transformer and Annex "C" of IS-2705/Part. I/1992 (latest version) for current transformers.

The above name plate shall be metallic and shall be affixed on a MS Plate which shall be welded to the body of CT PT chamber so that there is no passage hole when the name plate is removed.

7. MOUNTING ARRANGEMENT:

The CT/PT unit shall be suitable for mounting on RCC or steel structures. The necessary flanges bolts etc for the base of CT shall be supplied and these shall be galvanized.

8. TERMINAL CONNECTORS:

The Terminal connector (bimetallic for Cu terminal) shall be provided with the CT/PT unit. The Terminal connector shall be so designed to work effectively without any overheating of the CT/PT unit's Primary terminal in case of over loading. The detail of the conductor used in the Switchyard is ACSR Panther conductor having cross-sectional area of 200 Sqmm.

The Terminal Connector shall be manufactured and tested as per IS:556 or equivalent IEC

All castings shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

All current carrying parts shall be designed and manufactured to have minimum contact resistance.

Suitable terminal earth connectors for earthing connections shall also be provided.

9. TESTS:-

9.1. TYPE TESTS:-

The equipment offered should be fully type tested as per the latest edition of Indian Standards from CPRI/NABL accredited lab. In case, the equipment of the type and design offered has already been type tested, the supplier shall furnish 2 sets of type test reports along with the offer. The type test report should not be more than 5 years old, reckoned from the date of Bid opening. The tenderer shall also submit along with type test certificate, copies of drawings of the equipment actually tested (duly authenticated by testing agency) indicating the complete bill of material and material of various parts. Following type test reports shall be submitted by the tenderer:-

Type test for CTs



- i. Verification of terminal marking and polarity
- ii. Short time current test
- iii. Temperature rise test
- iv. Lightning Impulse test
- v. High Voltage Power Frequency wet withstand voltage test
- vi. Determination of errors or other characteristics according to the requirements of the appropriate designation of accuracy class.

Type test for PTs

- i. Verification of terminal marking and polarity
- ii. Temperature rise test
- iii. Power frequency dry withstand test on primary and secondary windings
- iv. Lightning Impulse test
- v. High Voltage Power Frequency wet withstand voltage test
- vi. Determination of errors or other characteristics according to the requirements of the appropriate designation of accuracy class.

However temperature rise test is covered under type tests, it shall be conducted by the supplier on one piece of total ordered quantity at his premises in the presence of the Inspecting Officer, without any extra charges.

9.2. ACCEPTANCE AND ROUTINE TESTS

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in the presence of Inspecting officer unless dispensed with in writing by the purchaser.

Sampling for carrying out the routine tests shall be carried out as per the relevant Indian Standards. However, the tests for the sampled quantity will be witnessed by BPC's officer, routine test certificate for the lot inspected shall be furnished for verification/checking.

BPC reserves the right to get the tests carried out at the cost of the supplier, by an independent agency whenever there is a dispute regarding the quality of material being supplied.

Immediately after finalization of the programme of routine / acceptance testing, the supplier shall give sufficient advance intimation to the BPC to enable him to depute his representative for witnessing the tests.

Routine Tests for CTs

- i. Verification of terminal marking and polarity
- ii. Power frequency dry withstand test on primary and secondary windings
- iii. Over-Voltage Inter turn tests
- iv. Determination of errors or other characteristics according to the requirements of the appropriate designation of accuracy class.



Routine Tests for PTs

- i. Verification of terminal marking and polarity
- ii. Power frequency dry withstand test on primary and secondary windings
- iii. Determination of errors or other characteristics according to the requirements of the appropriate designation of accuracy class.
- iv. Induced voltage test on PT of metering unit

Breakdown voltage test of transformer oil.

Pressure test on tank of metering unit.

Insulation resistance test with 1kV megger.

10. DRAWINGS AND DOCUMENTS

Technical Guaranteed particulars as per the format attached shall be duly filled and submitted by the vendor along with the bid.

Deviations: The deviations between the tendered CTPT set specification and the CTPT set supplied shall be submitted along with the tender.

Two sets of following drawings shall be submitted along with the bid.

- i. Outline and assembly drawing
- ii. Dimensional Drawing
- iii. Sectional view of CT/PT unit
- iv. Fitting details and Electrical Connection
- v. Foundation details
- vi. Drawing of Secondary terminal block showing the arrangement of secondary terminals of the CT/PT unit.
- vii. Name Plate drawing
- viii. Graphs showing the magnetization characteristics of core used in CT/PT unit.
- ix. Quality Assurance Plan for the raw materials being used in manufacturing process.

The Successful supplier shall submit four sets of final versions of all the drawings mentioned in Cl 10.2 within 15 days of date of receipt of acceptance of offer from the purchaser. BPC shall study the drawings submitted and give his comments/approval on the drawings for further clarification. The Supplier shall furnish the modified drawings and get the approval from BPC.

The manufacture of the CT/PT unit shall be started only after getting the drawing approval from BPC. The manufacturing shall be strictly in accordance with the



approved drawings and no deviation shall be permitted without written consent of the BPC.

Supplier shall submit the final "AS BUILT" drawings along with each set of CT/PT unit at the time of dispatch. The final "AS BUILT" drawings shall be submitted in hard as well as soft copy to the head office BPC.

11. INSPECTION

All tests and inspection shall be made at the place of the manufacturer unless otherwise especially agreed upon by the manufacturer and the purchaser at the time of purchase. The manufacturer shall afford the inspector representing the purchaser, all reasonable facilities, without charge to satisfy him that the material being supplied is in accordance with the specification.

The purchaser has the right to get the tests carried out at his own cost by an independent agency, whenever there is a dispute regarding the quality of the supply.

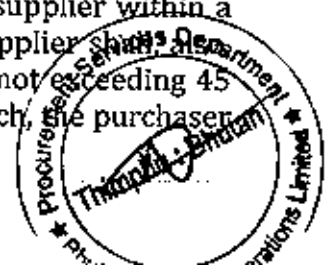
The manufacturer shall be responsible to pay the penalty of Rs 20,000/- for each occasion at which the fake inspection call has been made or the material is rejected during testing/inspection by the authorized agency/representative of the BPC. This penalty would be in addition to the expenses incurred by the BPC in deputing the Inspecting Officer, carrying out such inspection.

12. CHALLENGE CLAUSE

The material offered/received after the inspection by the authorized inspecting officer may again be subjected to test for or any parameter from any testing house/i-house technique of the BPC & the results if found deviating un-acceptable or not complying to approved GTPs, the bidder shall arrange to supply the replacement within 30 days of such detection at his cost including to & fro transportation. In addition, penalty @10% of cost of the inspected lot of material be imposed on the supplier.

13. WARRANTY PERIOD

The supplier shall be responsible to replace, free of cost, with no transportation or insurance cost to the purchaser, up to destination, the whole or any part to the material which in normal and proper use proves the defective in quality or workmanship, subject to the condition that the defect is noticed within 18 months from the date of receipt of material in stores or 12 months from the date of commissioning whichever period may expire earlier. The consignee or nay other officer of BPC actually using the material will give prompt notice of each such defect to the supplier. The replacement shall be effected by the supplier within a reasonable time, but not, in any case, exceeding 45 days/ The supplier shall arrange to remove the defective within a reasonable period, but not exceeding 45 days from the date of issue of notice in respect thereof, failing which, the purchaser



reserve the right to dispose of defective material in any manner considered fit by him (purchaser), at the sole risk and cost of the supplier. Any sale proceeds of the defective material after meeting the expenses incurred on its custody, disposal handling etc., shall however be credited to the supplier's account and set off against any outstanding dues of the purchaser against the supplier. The warranty for 12/18 months shall be one time.



TECHNICAL SPECIFICATION
FOR
LOT -10: BATTERY BANK AND ACCESSORIES



Item #	Material Description	Technical Specification	Preferred Make
1	220V Battery Bank with Charger, 200 AH	220VDC, 200AH capacity battery bank with float cum boost battery charger suitable use in substations, 2V per cell (110 Nos. Cells), VRLA type batteries (maintenance free batteries), charger type: FCB (Float cum Boost charger), AC input: three phase, 4 wire, 415VAC, 50Hz. DC output (Float mode: 245.3VDC, Boost mode: 253VDC), maximum charging current: 40A, max. Allowable ripple: 20% rms.	AMARA RAJA, India
2	Battery Bank 110 V, 400 AH	110V, 400AH capacity battery bank without charger suitable to use in substations, VRLA type batteries (maintenance free batteries), 2V per cell, one set of 110V battery bank shall consist of 55 Nos. of 2V battery cells.	HBL/AMARA RAJA, India.
3	Battery Charger, 110 V Charger	Battery charger for 110VDC, 200AH capacity battery bank with complete accessories suitable to use in substations, charger type: F and FCB (Float and Float cum Boost charger) with two independent rectifier circuits in one battery charger system, float charger to feed loads and float cum boost charger to charge battery bank; AC input- three phase, 4 wire, 415VAC, 50Hz., DC output- for Float charger: 118-124VDC/30A, and for Float cum Boost charger (Float mode: 118-124VDC, Boost mode: 99-151VDC), current: (Float: 30A, Boost: 20A)	Universal Instruments MFG Co. Pvt. Ltd, India.
4	Battery Cell, 110 V, 200 AH	Lead acid battery cell, 2Volt per cell electrolyte battery, Cell model No. YKP17, 200Ah,	Exide Industries Ltd., India.
6	Sulphuric acid for batteries	Sulphuric acid to be used for above battery cells YK17, 200AH.	Exide Industries Ltd.



LOT-10: BATTERY BANK AND ACCESSORIES

Technical Specification for Item# 5: 220V Indoor DCDB with two incomers

1.1 CONSTRUCTIONAL DETAILS OF DCDB BOARD

The scope shall be for the design, engineering, manufacture, assembly, testing at manufacturer's works before dispatch and services for supply, insurance, transportation, delivery at Regional Store.

Equipment shall be delivered at Regional Store Division, PSD, BPC, Phuentsholing, Bhutan.

The goods shall have a warranty against any type of defective materials or faulty workmanship for a period of twelve (12) months from the date of satisfactory commissioning or eighteen (18) months from the date of despatch of material, whichever is earlier. The defective/damage materials should be replaced/replenished by supplier at their own cost.

- 1.1.1 All boards shall be of metal enclosed, indoor floor mounted, compartmentalized construction and freestanding type.
- 1.1.2 All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Frames shall be enclosed in cold-rolled sheet steel of thickness not less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Stiffeners shall be provided wherever necessary.
- 1.1.3 All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members.
- 1.1.4 The complete structures shall be rigid, self-supporting, free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.
- 1.1.5 All boards shall be of dust and vermin proof construction and shall be provided with a degree of protection of IP: 52 as per IS 2147. However, the busbar chambers having a degree of protection of IP: 42, in accordance with IS 2147, are also acceptable where continuous busbar rating exceeds 1000 Amp. Provision shall be made in all compartments for providing IP: 52 degree of protection, when Circuit breaker or module trolley, has been removed. All cut-outs shall be provided with neoprene/Synthetic rubber gaskets.
- 1.1.6 Provision of louvers on boards would not be preferred. However, louvers backed with metal screen are acceptable on the busbar chambers where continuous busbar rating exceeds 1000 Amps.

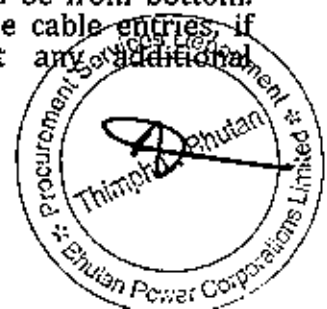


- 1.1.7 All boards shall be of uniform height not exceeding 2450 mm.
- 1.1.8 Boards shall be easily extendible on both sides, by the addition of the vertical sections after removing the end covers.
- 1.1.9 Boards shall be supplied with base frames made of structural steel sections, along with all necessary mounting hardware required for welding the base frames to the insert plates.
- 1.1.10 All boards shall be divided into distinct vertical sections, each comprising of:
- (i) A completely enclosed busbar compartment for running horizontal and vertical busbars. Busbar chamber shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical busbars and all joints for repair and maintenance, which shall be feasible without disturbing feeder compartment.
 - (ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.
 - (iii) A compartment or alley for power and control cables. Cable alley door shall preferably be hinged. Cable alley shall have no exposed live parts, and shall have no communication with busbar chamber. It shall be of at least 350mm width.
 - (iv) A compartment for relays and other control devices associated with a circuit breaker.
- 1.1.11 Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.
- 1.1.12 All equipment associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheet steel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities.
- 1.1.13 Group of MCB feeders can be offered in common compartment with necessary connection up to TB. The number of MCB provided in the bill of material shall be equally divided between the bus The compartment shall have a viewing port of toughen glass sheet for viewing and sheet steel door shall be lockable with star knob/panel key.
- 1.1.14 After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.
- 1.1.15 The minimum clearance in air between phases and between phase and earth for the entire run of horizontal and vertical busbars shall be 250mm.



mm. For all other components, the clearance between "two live parts", "A live part and an earthed part" and isolating distance shall be at least ten (10) mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25mm should be maintained even if they are sleeved.

- 1.1.16 The temperature rise of horizontal & vertical busbars when carrying rated current along its full run shall in no case exceed 55°C, with silver plated joints and 40°C with all other type of joints over an outside ambient temperature of 40°C.
- 1.1.17 All single front boards shall be provided with removable bolted covers at the rear. The covers shall be provided with danger labels.
- 1.1.18 All identical circuit breakers of same test size shall be fully interchangeable without having to carryout modifications.
- 1.1.19 All Circuit breaker boards shall be of Single Front type, with fully draw out circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.
- 1.1.20 Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit when working on the other circuit.
- 1.1.21 All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power draw out contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.
- 1.1.22 All DC boards shall be of single Front type.
- 1.1.23 All installation shall be fixed type except air circuit breaker, which shall be draw out type.
- 1.1.24 The connections from busbars to the main switch shall be fully insulated/shrouded, and securely bolted. The partition between the feeder compartment and cable alley may be non-metallic and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.
- 1.1.25 All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all component shall be subject to PURCHASER approval during engineering.
- 1.1.26 The tentative power and control cable entries shall be from bottom. However, Purchaser reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implication.



1.1.27 All sheet work shall be pre-treated, in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall 'Class-C' as specified in IS: 6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating after primer application, two coats of finishing synthetic enamel paint on panels shall be applied, Electrostatic painting shall also be acceptable.

Finishing paint on panels shall be shade 692 (Smoke grey) of IS:5 unless required otherwise by the PURCHASER. The inside shall be properly stoved. The paint thickness shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches grease dirt and oily spots during testing, transportation, handling and erection.

1.2 RATING OF EQUIPMENTS

The current ratings of all equipment as specified in the 'Bill of Materials are the minimum standards current ratings at a reference ambient temperature of 40°C as per relevant Indian Standards.

1.3 POWER BUS BARS AND INSULATORS

1.3.1 All DC Distribution Boards shall be provided with two busbars.

1.3.2 All busbars and jumper connections shall be of high conductivity copper of adequate size with insulation and the bus bar size calculation shall be submitted for approval during engineering.

1.3.3 The Cross-Section of the busbars shall be uniform through out the length of Switchgear and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.

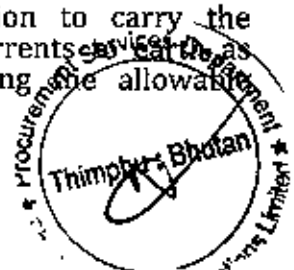
1.3.4 All busbars shall be adequately supported by Non-hygroscopic, non-combustible, track-resistant & high strength type Insulators. Separate supports shall be provided for each phase and neutral busbar. If a common support is provided anti-tracking barriers shall be provided between the supports.

1.3.5 All busbars joints shall be provided with high tensile steel bolts, Belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars joints shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.

1.3.6 All busbars shall be colour coded as per IS: 11353.

1.4 EARTH BUS

1.4.1 The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents as indicated in 'Bill of Materials' without exceeding the allowable temperature rise.



- 1.4.2 Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to Purchaser's earthing conductors. The horizontal earth bus shall project out the switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.
- 1.4.3 All non-current metal work of the Switchboard shall be effectively bonded to the earth bus. Electrical conductivity of the whole switchgear enclosures frame work and the truck shall be maintained even after painting.
- 1.4.4 The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions, SERVICES & ISOLATED, as well as through out the intermediate travel.
- 1.4.5 Each module frame, if used shall get engaged to the vertical earth bus. Before the disconnecting contacts on these module are engaged to the vertical busbar.
- 1.4.6 All metallic cases of relays, instruments and other panel mounted equipment shall be connected to earth by independent stranded copper wires of size not less than 2.5 mm². Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors.
- 1.4.7 VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.
- 1.4.8 All hinged doors shall be earthed through flexible earthing braid.
- 1.4.9 Caution nameplate 'Caution-Live Terminals' shall be provided at all points where the terminals are like to remain live and isolation is possible only at remote end.
- 1.5 **AIR CIRCUIT BREAKERS**
- 1.5.1 Circuit breakers shall be three-pole air break horizontal draw out type and shall have inherent fault making and breaking capacities as specified in "Technical Parameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable.
- 1.5.2 Circuit breakers shall be mounted along with its operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimise misalignment of the breaker.
- 1.5.3 There shall be 'Service', 'Test' and 'Fully Withdrawn' positions for the breakers. In 'Test' position the circuit breaker shall be capable of being tested for operation without energising the power circuits i.e. the power Contacts shall be disconnected while the Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the 'SERVICE TEST OR FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.



- 1.5.4 All circuit breakers shall be provided with 4 NO and 4 NC potentially free auxiliary contacts. These contacts shall be in addition to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE' & 'TEST' position of the breaker. All contacts shall be rated for making continuously carrying and breaking 1 Amp (Inductive) at 220V DC.
- 1.5.5 Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN', 'CLOSE', 'SERVICE', 'TEST' and 'SPRING CHARGED' positions.
- 1.5.6 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.
- 1.5.7 All circuit breakers shall be provided with the interlocks as explained in further clauses.
- 1.5.8 Movement of a circuit breaker between SERVICE and TEST positions shall not be possible unless it is in OPEN position. Attempted withdrawal of a closed circuit breaker shall trip the circuit breaker.
- 1.5.9 Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.
- 1.5.10 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, be possible to open the shutters intentionally, against spring pressure for testing purpose.
- 1.5.11 A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.
- 1.5.12 Circuit breakers shall be provided with electrical anti-pumping and trip free feature, even if mechanical anti pumping feature is provided.
- 1.5.13 Mechanical tripping shall be possible by means of front mounted RED 'Trip' push-button. In case of electrically operated breakers these push buttons shall be shrouded to prevent accidental operation.
- 1.5.14 Breaker controlled motors shall operate satisfactorily under the following conditions:
- (i) Direct on-line starting of Induction Motors rated 50 kW to 110 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.
 - (ii) Breaking on-load, full load and locked rotor currents of Induction Motors for rated 50 kW to 100 kW.
- 1.5.15 Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of contacts, in service position slow closing shall not be possible.
- 1.5.16 Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variator.



from 90% to 110% rated voltage. Motor insulation shall be class 'E' or better.

- 1.5.17 The motor shall be such that it requires not more than 30 seconds for fully charging the closing spring.
- 1.5.18 Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.
- 1.5.19 The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.
- 1.5.20 Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.
- 1.5.21 All circuit breakers shall be provided with closing and trip coils. The closing coils shall operate correctly at all values of Voltage between 85% to 110% at rated control voltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.
- 1.5.22 Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be made.

1.5.23 **PROTECTION CO-ORDINATION**

- 1.5.23.1 Protection co-ordination shall be finalised during detail engineering.

1.6 **MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB**

- 1.6.1 MCCB shall in general conform to IS: 13947 Part-2. All MCCB shall be of P2 duty.
- 1.6.2 MCCB shall be flush mounted on the DC distribution boards.

MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between 75% to 100% of the rated current. The MCCB shall have breaking capacity not less than 20kA.

- 1.6.3 MCCBs used for DCDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.
- 1.6.4 Miniature circuit breaker (MCB) shall conform to IEC: 898-1987 and IS: 8828.

1.7 **RELAYS**

All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective

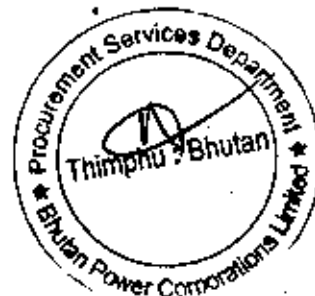


relays shall have a draw out construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-draw out cases.

- 1.7.1 All AC relays shall be suitable for operation, at 50 Hz with 110 Volts VT secondary and 1 Amp or 5 Amps CT secondary.
- 1.7.2 All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.
- 1.7.3 All protective relays auxiliary relays and timers shall be provided with hand reset operation indicators (Flags) for analysing the cause of operation.
- 1.7.4 All relays shall withstand a test voltage of 2 kV (rms) for one minute.
- 1.7.5 Motor starters shall be provided with three elements, ambient temperature compensated, time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relays shall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.
- 1.7.6 All fuse-protected contactor-controlled motors shall have single phasing protection, either as a distinct feature in the overload relays (by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

1.8 CONTACTORS

- 1.8.1 Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS:13947 (Part 4).
- 1.8.2 Contactors shall be double break; non-gravity type and their main contacts shall be silver faced.
- 1.8.3 Direct on-line starter contactors shall be of utilisation category AC2. These contactors shall be as per IS:13947 (Part 4).
- 1.8.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.
- 1.8.5 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of the rated voltage. The Contactor shall drop out at 70% of the rated voltage.



1.9 **INSTRUMENT TRANSFORMERS**

- 1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 40°C.
- 1.9.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.
- 1.9.3 All instrument transformers shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.
- 1.9.4 Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The Bus VTs shall be housed in a separate compartment.
- 1.9.5 All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

1.10 **INDICATING INSTRUMENTS**

- 1.10.1 All meters shall be digital, flush mounted on panel front.

1.11 **CONTROL & SELECTOR SWITCHES**

- 1.11.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.
- 1.11.2 Circuit breaker selector switches for breaker Controlled motor shall have three stay put positions marked 'Switchgear', 'Normal' and 'Trial' respectively. They shall have two contacts of each of the three positions and shall have black shade handles.
- 1.11.3 Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble-free service.
- 1.11.4 The contact ratings shall be at least the following :
- | | | |
|------|-----------------------------|-------------------|
| (i) | Make and carry continuously | 10 Amp. |
| (ii) | Breaking current at 220V DC | 1 Amp (Inductive) |

1.12 **AIR BREAK SWITCHES**

- 1.12.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS:4064.
- 1.12.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such as overload, locked motor, short circuit etc.



- 1.12.3 Switch operating handles shall be provided with padlocking facilities to lock them in 'OFF' position.
- 1.12.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in 'OFF' position and to close the switch only when the door is closed. However suitable means shall be provided to intentionally defeat the interlocks explained above.
- 1.12.5 Switches and fuses for DC control supply and heater supply wherever required shall be mounted inside the cubicles.

1.13 PUSH BUTTONS

- 1.13.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.
- 1.13.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.
- 1.13.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.
- 1.13.4 The colour of the button shall be as follows:
- | | | | |
|-------|--------|---|--------------------------------|
| (i) | GREEN | : | For motor START, Breaker CLOSE |
| (ii) | RED | : | For motor TRIP, Breaker OPEN |
| (iii) | BLACK: | | For overload reset. |
- 1.13.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left of green push-buttons.

1.14 INDICATING LAMPS

- 1.14.1 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary.
- 1.14.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application:
- | | | | |
|-------|-------|---|---|
| (i) | RED | : | For motor ON, Breaker CLOSED |
| (ii) | GREEN | : | For motor OFF, Breaker OPEN |
| (iii) | WHITE | : | For motor Auto-Trip |
| (iv) | BLUE | : | For all healthy conditions (e.g. control supply, and also for 'SPRING CHARGED') |
| (v) | AMBER | : | For all alarm conditions (e.g. overload) |
- Also
For 'SERVICE' and 'TEST' positions indicators.

- 1.14.3 Lamps shall be easily replaceable from the front of the cubicles.



1.14.4 Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In case a white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lamps should normally be located above the Red and Green lamps.

1.14.5 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

1.15 **FUSES**

1.15.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for AC Circuits shall be of class 2 type, 20 kA (RMS) breaking current at 415V AC, and for DC circuits Class 1 type 4 kA breaking current.

1.15.2 Fuses shall have visible operation indicators.

1.15.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mounted on plug in type of bases. In such cases one set of insulated fuses pulling handles shall be supplied with each switchgear.

1.15.4 Fuse rating shall be finalized during detail engineering.

1.16 **TERMINAL BLOCKS**

1.16.1 Terminal blocks shall be of 750 Volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, clip-on-type/stud type terminals for Control Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to 'ELEMEX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent

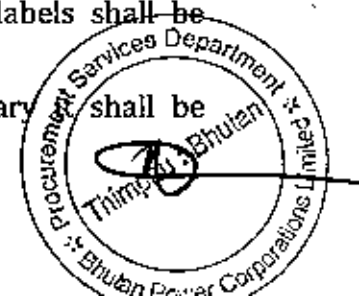
1.16.2 Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. It shall be similar to 'Elem.' 'CATD' - Type.

1.16.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also be available.

1.16.4 All terminal blocks shall be suitable for terminating on each side.

1.16.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

1.16.6 Wherever duplication of a terminal block is necessary achieved by solid bonding links.



1.16.7 Terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

1.17 NAME PLATES AND LABELS

1.17.1 DC distribution boards shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder designation.

1.17.2 All name plates shall be of non-rusting metal or 3-ply lamincoid with white engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to PURCHASER approval.

1.17.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number as mentioned in the module wiring drawings.

1.18 SPACE HEATER

1.18.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.

1.18.2 The space heaters shall be suitable for continuous operation on 240V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided.

1.19 CONTROL AND SECONDARY WIRING

1.19.1 All switchboards shall be supplied completely wired internally upto the terminal blocks ready to receive Purchaser's control cables.

1.19.2 All inter cubicle and inter panel wiring and connections between panels of same switchboard including all bus wiring for AC and DC supplies shall be provided by the supplier.

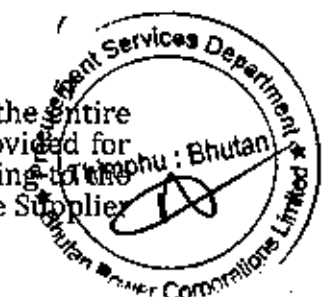
1.19.3 All internal wiring shall be carried out with 1100 V grade, single core, 1.5 square mm or larger stranded copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 square mm copper wires. Voltage grade and insulation shall be same as above.

1.19.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.

1.19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

1.20 POWER CABLES TERMINATION

1.20.1 The gland plate shall be of removable type and shall cover the entire cable alley. Supplier shall ensure that sufficient space is provided for all cable glands. Gland plates shall be factory-drilled according to the cable gland sizes and number which shall be informed to the Supplier.



during detail engineering. For all single core cables, gland plates shall be of non-magnetic Material.

1.21 TYPE TESTS

1.21.1 Type tests reports on Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall be submitted during engineering. :

- i) Verification of temperature rise limits.
- ii) Verification of the dielectric properties.
- iii) Verification of short circuit strength.
- iv) Verification of the continuity of the protective circuit.
- v) Verification of clearances and creepage distances.
- vi) Verification of mechanical operation.
- vii) Verification of degree of protection.

1.22 ERECTION, TESTING AND COMMISSIONING

1.22.1 Not applicable.

1.23 SPECIAL TOOLS AND TACKLES

1.23.1 Not applicable.

1.24 EQUIPMENT TO BE FURNISHED

1.24.1 The Bill of Materials shall be as under. These are minimum indicative requirement of the system. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item/component required for efficient and reliable operation shall be deemed to be included in supplier's scope. The scheme shall have provision for remote annunciation for the followings:

- (a) Station LT (415V) AC incomer supply unhealthy.
- (b) 220V DCDB U/V, O/V & Earth leakage relay operated.
- (c) DG set start.
- (d) DG set protection operated.

1.24.2 Circuit Breaker for Motor control Feeder

1.24.3 One (1) Triple pole Circuit Breaker complete with accessories, and power operated mechanism.

1.24.4 DC Metering and Protection

- (i) One (1) Voltmeter 0-220 V for 220V DC DB/Voltmeter 0-75V DC for 50V DCDB
- (ii) One (1) Three (3) position voltmeter selector switch.
- (iii) One (1) Instantaneous under voltage relay.



- (iv) One (1) Instantaneous over voltage relay.
- (v) One (1) Earth leakage relay.

1.24.5 DC Incomer I & II and Bus Coupler from Battery & Chargers

- (i) One (1) Double pole 220V DC MCCB for each incomer from Battery.
- (ii) One (1) Digital ammeter from each incomer
- (iii) One (1) Digital Voltmeter from each incomer

1.24.6 Out going Feeder MCB

Forty (40) 16 A, Double pole MCB (Equally distributed between the buses)

1.25 PARAMETERS

1.25.1.1 DC System 2 Wire, unearthed.

- (a) System voltage 220V ± 10%.
- (b) Fault Level 4 kA.
- (c) System Voltage 50V ± 10%.
- (d) Fault Level --

1.25.2 Control Supply Voltage

- (a) Trip and closing coils 220V DC Unearthed.
- (b) Spring charging 220V DC Unearthed.

1.25.3 Cubicle Data

1.25.3.1 Busbar Rating

- (a) Continuous 600A.
- (b) Short time (1 sec. kA (rms) 20 kA.
- (c) Ambient Temperature 40°C.
- (d) **One Minute Power Frequency Withstand**
 - (i) Power Circuit 2500 Volts (rms).



(ii) Control Circuit 2500 Volts (rms).

1.25.3.2 **Cubicle Colour Finish**

- (a) Interior Glossy white.
(b) Exterior Light Grey shade No.631 of IS:5.

1.25.4 **MOULDED CASE CIRCUIT BREAKER**

	AC System	DC System.
(a) No. of poles	4	2.
(b) Voltage & Frequency	415V \pm 10%, 50 Hz \pm 5%	220 V.
(c) Rated Operating Duty	P2	P2.
(d) Symmetrical interrupting rating	20 kA (RMS)	4 kA.
(e) No. of auxiliary contacts	2 NO & 2 NC	2 NO & 2 NC.
(f) Short Circuit breaking current		
(I) AC Component	20 kA (RMS)	As per IS.
(II) DC Component	As per IS 13947	As per IS

1.25.5 **Meters**

- (a) Accuracy class 2.5.
(b) One minute power frequency withstand test voltage in kV 2.0.

