

**GENERAL TECHNICAL
SPECIFICATIONS FOR ELECTRIC
WORKS**



DESIGN CONDITIONS & SCOPE OF WORK:

All equipment and materials will be selected and rated for use at the following site conditions.

Ambient air temperature.	50° C.
Ground temperature.	30° C.
Solar gain	1100 w / m ²
Earth resistivity	200 deg. C. cm / w
Relative Humidity.	95% Max.
Atmospheric condition	Non corrosive, Humid and Dusty

GENERAL REQUIREMENTS

- The scope generally describes to design, manufacture, assemble, connect, wire, supply, test and commission 11 kv vacuum circuit breaker panel.
- The unit shall consist off tee off spring assisted three position , three pole vacuum circuit breaker.
- All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.
- The equipment shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

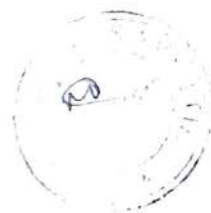
COMPLETENESS OF SUPPLY

- It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship.
- Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge.

DESIGN CRITERIA

The Switchgear shall be capable of continuous operation at specified rating under the following condition:

- Voltage variation : + / - 10 %
- Frequency variation : + 3%, -6%
- Combined voltage & frequency variation : 10 %



- The de rating of the equipments shall be done taking 50 deg C as an ambient temperature if it is designed at lower temperature. The maximum temp. in any part of the equipment at specified rating shall not exceed 85 deg C considering reference ambient temperature as 50 deg C.
- The system fault level for 11KV system is 350MVA. The breakers of the respective system shall have the breaking capacity corresponding to above fault levels specified.
- The breaker shall be Vacuum type. The circuit breaker shall be fitted with micro processor based self powered relay inside the front cover.
- The breaker ratings shall be as per drawing and bill of quantity.
- The cable termination shall be done by heat shrinkable termination method. The compartment should have sufficient height space for proper Termination / Bonding of cable leads.

SPECIFIC REQUIREMENTS

- The switchgear enclosure shall conform to the degree of protection IP-4X. The minimum thickness of sheet steel used shall be 2mm CRCA steel.
- The switch gear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with recessed neoprene gaskets. All doors shall have pad locking arrangement. Switchgear shall be fire retardant type.
- Circuit breakers, instrument transformers, bus-bars, cable compartment etc., shall be housed in totally isolated air tight separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units. Suitable venting arrangement shall be provided to release the gas pressure developed due to the operation of the breaker or due to live arc of fault.
- Each cubicle shall be separated from adjacent one by grounded sheet steel barrier and bus sealing arrangement.
- The switchgear panel shall be of arc proof version. Test report as per DIN VDE 0670 part 601, IEC-694/IEC-298 shall be furnished.
- All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle.
- Each switchgear cubicle shall be provided with a thermostat controlled space heater and single phase plug point operated at 230 V AC. 50 Hz.
- Bus connection from bus compartment to breaker compartment & breaker compartment to cable compartment and bus compartment to adjacent panels shall be through sealed resin cast bushing assembly.
- Each breaker cubicle shall be provided with 'service' and 'test' position limit switches, each having at least 4 NO & 4 NC contacts. All fixing bolts, screws, etc. appearing on the panel

shall be so arranged as to present a neat appearance. The swing of the door shall be more than 90 deg C.

BUS AND BUS TAPS

- The main buses and connections shall be of high conductivity copper, sized for specified continuous and fault current ratings with maximum temperature limited to 85 deg C (i.e. 35 deg C rise over 50 deg C ambient).
- Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and locknuts.
- Bimetallic connectors shall be furnished for connections between dissimilar metals.
- All Busbars, Jumpers and connection shall be fully insulated for working voltage with adequate phase/ground clearances. Epoxy cast-resin shrouds for joints shall be provided. All jointing hardware shall have nylon caps. All busbars, links, jumpers etc. shall be sleeved with sleeves of Raychem/DSG make and non-in flame able heat shrinkable type. Busbars, links, live parts etc. shall have nonflammable shrouds.
- No paper/cotton based insulation shall be used anywhere in the switch gear. Minimum amount of combustible and low smoke generation type insulating material shall be used.
- Safety shutter, phase barrier, busbar seal-off bushing plate, support insulators etc. shall be non-inflammable high tracking fiber glass/epoxy insulation system of grade 94V-O as per UL.
- All buses and connections shall be supported and braced to withstand dynamic electromagnetic stresses due to maximum short circuit current and also to take care of any thermal expansion.
- Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switchgear assembly.
- The successful tenderer shall submit the calculation in support of selection of busbar conductor size, spacing and short time withstand capability.

CIRCUIT BREAKER

- Circuit breaker shall be triple pole, single throw, Vacuum type.
- Circuit breaker shall be drawout type, having SERVICE, TEST and DISCONNECTED positions with positive indication for each position.
- Circuit breakers of identical rating shall be physically and electrically interchangeable.
- Circuit breaker shall have motor wound spring charging facility with Mechanical & Electrical anti-pumping features and shunt trip. In addition facility for manual charging of spring shall be provided. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage. Spring charging motor shall be in a standard enclosure.



- For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.
- Mechanical safety interlock shall be provided to prevent:
 - The circuit breaker from being racked in or out of the service position when the breaker is closed.
 - Racking in the circuit breaker unless the control plug is fully engaged.
 - Closing & opening of the breaker in an intermediate position between 'service' & 'test' and between 'Test' and 'Disconnected' position.
- Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position.
- Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator. The manual trip device shall be located on the front door. Indicators with shrouds will be visible from front door even when breaker is closed.
- Suitable padlocking arrangement shall be provided as stated below:
 - Circuit Breaker operating handle in the OFF position.
 - Each feeder panel operating handle in CLOSED , OPEN , EARTH position.
 - Each breaker shall be provided with following :
 - Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the drawout portion of the switchgear.
 - Position/cell switch with minimum 3 NO + 1 NC contacts, one each for TEST and SERVICE position.
 - Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position.
 - Limit/auxiliary switches shall be convertible type that is facility for changing N.O. contact ton N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage.
 - Circuit breaker shall be draw out type, complete with transfer trucks, self-aligning primary and secondary disconnects, positive guides to ensure proper alignment.
 - Each breaker shall be provided with suitable encased rollers.
 - The trip coils shall be operated satisfactorily at voltage between 70 % and 110 % of rated control supply voltage.

- Each circuit breaker cubicle shall be provided with an earthing facility to earth the incoming or outgoing feeders by the arrangement specified below. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts.
- Separate earthing truck, which can be inserted in place of circuit breakers, one truck suitable for incoming and the other for outgoing circuits shall be provided.
- Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions in which the safety shutters are in open position.
- Insulation used for auxiliary switches shall be anti tracking type.

INDICATION & MONITORING

- Each breaker cubicle shall be equipped with following:
 - One (1) number heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip handle.
 - Three (3) indicating lights front of compartments:
 - GREEN : Breaker Open
 - RED : Breaker Closed
 - Amber : Trip
 - Blue : Spring charged/Low vacuum
- Lamp shall be LED type with series resistor, Lamp and lens shall be replaceable from the front.

CURRENT TRANSFORMER

- Current transformers shall be bar primary, cast resin type. All secondary connections shall be brought out to terminal blocks where Y or D connection will be made.
 - a. Class PS for differential & restricted earth fault relaying.
 - b. Class 5P20 for other relaying.
 - c. Class 1.0 and ISF < 5 for metering.
- The current transformer shall be capable of safely withstanding the short circuit, stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified.
- All CT secondary shall be earthed through separate switch link on terminal block. The secondary terminals of the CTS shall have the provision of shorting and disconnecting facilities by links.
- CT terminals & their polarities shall be clearly marked.



VOLTAGE TRANSFORMER

- Voltage Transformer shall be cast-resin, draw out type and shall have an accuracy class of 1.0, 3P. Voltage Transformer mounted on breaker carriage is not acceptable.
- High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.
- Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.
- The connections from main circuit to PT shall be capable of withstanding short circuit stresses.

RELAYS

- Protective relay shall be micro processor based.
- Relays shall be of drawout design with built-in site testing facilities. Small auxiliary relays may be in non-drawout execution and mounted within the cubicle.
- Relays shall be rated for operation on 110 V secondary voltage and 5 A secondary current as shown on drawings. Number and rating of relay contacts shall suit the job requirements.

METERS

- All meters are digital type of 96 x 96 mm accuracy class of $\pm 2\%$.

SECONDARY WIRING

- The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.
- Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired upto terminal blocks.
- Wiring shall be done with flexible, 650V grade, FRLS PVC insulated switchboard wires with stranded copper conductors of 1.5 mm^2 for control and current circuits and 1.5 mm^2 for voltage circuits. All power wiring like space heater supply etc. shall be carried out with min. 4 mm^2 Cu, conductor, Wiring of trip circuit shall be with fluoro-plastic wires.
- Each wire shall be identified, at both ends, with dependent & cross addressing permanent markers bearing wire numbers as per Contractor's Wiring Diagrams. Trip circuit shall have red colour ferrule.
- Wire termination shall be made with crimping type ring connectors with insulating sleeves. Wires shall not be spliced between terminals.

- The wires shall run preferably through metallic trough adequately supported along its run to prevent sagging due to flexibility or vibration. The control & power wires shall be routed through separate troughs.
- Inter-panel wiring trough shall be furnished for wiring between switchgear cubicles. All wiring required for interlocking between the cubicles of any switchgear shall be furnished and installed. Wherever wires are passing through cutouts or openings they shall be protected by providing suitable grommet or gasket around the openings. Inter panel wiring at shipping sections shall be through terminal blocks placed suitably at intersection points.
- The colour of wire shall be taken as follows :
 - AC System Black
 - DC System Grey
 - Earthing System
 - CT & PT Wiring System Red, Yellow, Blue colour code.

TERMINAL BLOCKS

- Terminal blocks shall be 660 V grade box-clamp type with marking strips ELMEX 10 mm² or equal. Terminal for C.T. Secondary leads shall be disconnecting link type and shall have provision for shorting. Terminal for P.T. Secondary lead shall also be disconnecting link type.
- Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Multi connection terminal strip to be used if required.
- Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.
- Terminal blocks for inter panel / external / Space Heater wiring shall be separate from inter panel wiring.
- All control wire shall be terminated with ring type insulated lug only.
- The terminal block shall be grouped according to circuit functions and individual terminals in each block shall be serially numbered in accordance with the drawings. Such numbering shall be legible, permanent and indelible.
- The terminal blocks of different voltage classes shall be segregated.
- Similar type of terminal block shall be used for inter panel wiring at shipping sections.

CABLE TERMINATION

- Switchgear shall be designed for cable entry from the top. Sufficient space shall be provided for ease of termination and connection.
- Power cables shall be XLPE insulated, armored, overall PVC sheathed with stranded Aluminum/copper conductor

- Control cables shall be PVC/XLPE insulated, armored, overall PVC sheathed with 1.5mm² stranded copper conductor.
- All provisions and accessories shall be furnished for termination and connection of cables, including removable aluminium gland plates, cables supports etc.
- The gland plates shall be minimum 4mm thick aluminium sheet. The gland plate and supporting arrangement for 1/C power cables shall be such as to minimise flow of eddy current.
- Sufficient space shall be provided between the power cable termination (end-boxes) and gland plate. Core balance C.T.s, wherever specified, shall be accommodated within this space.

GROUND BUS

- A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear.
- The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 50 x 6 mm G.I. flat.
- Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and drawout P.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.
- Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.
- C.T. and P.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.
- Suitable ground terminal, directly connected with the ground bus shall be provided in the cable chamber for grounding connection of cable screen / armour.
- All hinged doors shall be grounded using silver plated and braided copper flexible of adequate size.

NAMEPLATES

- Nameplates of approved design shall be furnished at front & back side of each cubicle and at each instruments & device mounted on or inside the cubicle.
- The material shall be 3ply lamcold or approved equal, 3 mm thick with white letter on black background. The letters of the nameplates shall be engraved.
- The nameplate shall be held by self-tapping screws. Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm for panels.
- Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

Following plate size & letter size shall be considered for nameplate.

SR.	NAMEPLATE NO.	PLATE SIZE (mm × mm)	LETTER SIZE (mm × mm)
1.0	Main nameplate	40 × 150	25 × 25
1.0	Equipment & device (Front)	20 × 75	5 × 5
1.0	Equipment & device (Internal)	6 × 20	3 × 3

SPACE HEATERS AND PLUG SOCKETS

- Each cubicle shall be provided with thermostat controlled space heaters and 10A, 3 pin plug socket.
- Cubicle heater, Plug/socket circuits shall have Individual MCBs.

A.C. POWER SUPPLY

- The following power supplies will be made available to the switchgear: A. C. supply : Double Feeder with manual change over switch.
- Isolating MCB will be provided at the switchgear for the incoming supplies.
- Bus-wires of adequate (minimum 4 sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating MCB shall be provided at each cubicle for A.C. supplies.
- A.C. load shall be so distributed as to present a balance loading on three-phase supply system.

TROPICAL PROTECTION

- All equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects & corrosion.
- Screens of stainless steel shall be furnished on all ventilating louvers to prevent the entrance of insects.

PAINTING

- All surfaces shall be sanding blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease rust and foreign adhering matter.
- After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and staved after each coat.
- The switchgear shall be finished in powder coat, shade RAL-7032 MATT finish.



- Sufficient quantity of touch-up paint (approx. 5 ltrs.) shall be furnished for application at site.

ACCESSORIES

- The following accessories shall be furnished along with the Switchgear:
- Earthing equipment suitable for earthing the bus or outgoing cable.
- Breaker carrier trolley if C.B. is of that design.
- Cubicle door opening key (1 for each panel).
- Withdrawal handles for breaker.
- Commissioning spares (Provide list of spares along with offer)

TESTS

- The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

ROUTINE TEST

- The tests shall include but not necessarily limited to the following for switchgear :
- Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- All wiring and current carrying part shall be given appropriate High Voltage test.
- Test for meter/ relays for the respective function.
- Primary current and voltage shall be applied to all instrument transformers.
- Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, meters etc.
- One minute power frequency withstands insulation test as per relevant-IS.

TEST CERTIFICATE

- Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.
- The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.
- The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

SPARES

- The Bidder shall submit a list of recommended spare parts for two (2) years satisfactory and trouble free operation, indicating the itemized price of each item of the spares in the appropriate annexure. Self life of consumable spares would be indicated specifically.

DRAWINGS, DATA & MANUALS

- Drawings, Data & Manuals shall submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of contract and/or elsewhere in the specification for approval & subsequent distribution after the issue of Letter of intent.

Drawing / Document to be submitted:

- Outline dimensional drawing of the switchgear showing general arrangement, space requirements and cable entry points, location of breaker, CT, Pt busbar chamber, grounding arrangement etc.
 - Bill of Materials.
 - Typical foundation plan.
 - Typical breaker control schematic.
 - Test reports on circuit breaker/CT/PT.
 - Technical leaflets on & complete specifications & OEM address for bought out items.
 - Bus bar & circuit breaker sizing calculation along with relevant Test Reports.
- Instruction manuals of switchgear & individual equipment. The manual shall clearly indicate that the installation method, check-up and tests to be carried out before commissioning of the equipment as well as monitoring tests, their interval & maintenance / overhauling procedure & schedule.



TECHNICAL DATA SHEET FOR H. V. INDOOR SWITCHGEAR:

Sr. No.	DESCRIPTION	
1.0	GENERAL :	
1.1	Ambient temperature	50° c.
1.2	Atmosphere	Non corrosive, Humid and Dusty
1.3	Location	Indoor
1.0	ELECTRICAL DATA :	
1.1	Type of breaker	Vacuum Circuit Breaker
1.2	Service	Continuous
1.3	Voltage	A SPER TENDER
1.4	System earthing	Solidly earthed
1.5	Frequency	50 Hz. +/- 3%
1.6	No. of phase	3
1.7	System fault level	AS PER TENDER
1.8	Fault current	AS PER TENDER
1.9	Max. system voltage	AS PER TENDER
1.10	Auxiliary supply :	24V D.C derived from batteries
1.11	Rated short time current	AS PER TENDER
1.12	Making capacity	AS PER TENDER
1.13	Busbar current rating and Material	AS PER TENDER
1.14	Cable entry	AS PER TENDER
1.15	Cable size	AS PER TENDER
1.16	Breaker particulars :	
(a)	Operating duty	0 - 3 M CO – 3M – CO
(b)	Operating mechanism	Motor charged spring / manual trip & close
(c)	Spring charging motor	230 V AC, 200 W
(d)	Trip / Closing coil	24 V DC, 180 W
(e)	Anti pumping feature	To be provided
(f)	Latching requirement	Trip free
(g)	Emergency trip push button	Required
(h)	Space heater and cubicle lamp	Required
1.17	Constructional requirements	Simplex Type

Sr. No.	DESCRIPTION	
(a)	Thickness of sheet steel for frame, enclosure, doors, covers & partitions	CRCA sheet - 2 mm, hinge type door with neoprene rubber gasket
(b)	Degree of protection	IP 44X
(c)	Colour	Powder coating – RAL-7032 MATT
(d)	Earth bus size	50 × 6 mm GI
(e)	Foundation frame	ISM-75, Suitable for five breakers with necessary bed plate and foundations bolt.
1.18	Annunciation : (1) Main incoming – Trip	To be Provided
1.19	PANEL ACCESSORIES	
(a)	Toggle switch for space heater and socket	230 V A.C, 10 A
(b)	Socket	3 pin 10 A
(c)	MCB for spring charging motor circuit	6 A, DP MCB
(d)	MCB for ON / OFF	Double pole, 16 A, 110 V D.C for D.C ckt. Double pole, 16 A, 230 V A.C for A.C ckt.
(e)	Local / Remote selector switch	4 ways, 2 positions, lockable in any position, angular movement, stay put, lever type handle.
(f)	Auto- Off – Manual switch	18 ways, 3 positions, lockable in all position, stay put, wing type handle.
(g)	Breaker control switch (Trip – Neutral – Trip)	6 ways, 3 position, spring return to neutral, angular movement, pistol grip type handle.
(h)	LED indicating lamp (230V A.C)	Breaker RYB On - Red colour Breaker RYB Off - Green colour Auto trip - Amber colour Trip ckt healthy - Amber colour Spring charged - Blue colour Low vacuum - Blue colour 100 ohm, 3 / 4 W resistor
(i)	Filament Bulb	2 / 3 W bulb for R, Y, B, Healthy indication
(j)	Space Heater	230 V A.C, 100 W
(k)	Limit switch for test and service position	Not applicable

Sr. No.	DESCRIPTION	
1.0	RELAY	
1.1	Instantaneous Phase Over Current Relay : 50/50n	To be Provided
1.2	AC Inverse Definite Minimum Phase Over Current Relay : 51/51n	To be Provided
1.3	Lock out relay : 86	To be Provided
1.4	Under Voltage Relay : 27C	To be Provided
1.5	Buchholz relay : 63 GP & Aux. Relay for alarm & trip – 63 GP X1 & X2	To be Provided
1.6	Oil Temperature Indicator : 49-2 & Aux. Relay for alarm & trip 49-2 X1 & X2	To be Provided
4.0	METERING	
4.1	Digital Multi Function Meter including parameters Amp., Voltage, KW, KWH, KVAR, KVARH, PF, Frequency etc.	To be Provided
5.0	CURRENT TRANSFORMER / POTENTIAL TRANSFORMER	
5.1	CT For Metering. Accuracy Class VA burdon	Cast Resin type 1.0 15 VA
5.2	CT For Protection. Accuracy Class VA burdon	Cast Resin type 5P15 / PS 15 VA
5.3	PT For Metering. Accuracy Class VA burdon	Cast Resin type 1.0 100 VA
5.4	PT For Protection. Accuracy Class VA burdon	Cast Resin type 5P15 100VA

METHOD OF MEASUREMENT

- All the items will be measured as mentioned in Bill of quantity.

H.V. / H.T. XLPE CABLES



SCOPE

- The scope shall cover supplying, laying, testing and commissioning of 3 core H.T cables which shall be capable of operating at a sustained conductor temperature of 90°C and suitable for a maximum conductor short-circuit temperature of 250°C.
- This specification gives the general requirement of cables. However, it is the responsibility of the vendor to take the joint measurement and obtain client's approval before the placement of orders to the main supplier / manufacturer. Cut lengths will not be accepted.

REFERENCE CODES & STANDARDS:

- IS : 8130 – 1984 Conductors of Insulated Cables.
- IEC : 228 - Conductors of Insulated Cables.
- IS : 10810 - Methods of various tests on cables and their accessories
- IEC : 502 - Extruded solid dielectric-insulated power cables for rated voltage from 1 KV up to 30 KV.
- IEC : 287 - Calculations of continuous current rating of cables (100% load factor).
- IS : 7098 (Part II) - Cross-linked polyethylene insulated PVC sheathed cable for Voltage from 1.3 KV up to 33 KV.
- IS : 5831 - 1984 PVC insulation & sheath of electrical cables.

OPERATING CONDITIONS

Electric system

- System Voltage : 11 KV/1.6 KV
- Frequency : 50 Hz.

Environment

- Ground temperature : 40°C.
- Ambient air temperature : 50°C.
- Solar gain : 1100 w/m²
- Earth resistivity : [The bidder shall confirm the Earth Resistivity Test]
- Atmospheric conditions : Humid, salty and dusty

MEASUREMENTS

- The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable. Total quantity in meters shall be measured lug to lug basis.

CONSTRUCTION

CONDUCTORS

- The conductor shall be of circular stranded Aluminium to IS : 8130 & IEC : 228. It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends.

CONDUCTOR SCREEN

- The conductor screen shall consist of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.

INSULATION

- The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogenous body.

INSULATION SCREEN

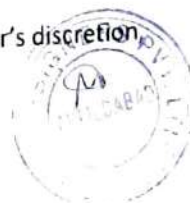
- Each insulation have an insulation screen in two parts consisting of :
 - Non-metallic semi-conducting compound tape part and a metallic screen part.
- The non-metallic part shall be directly applied upon the insulation of each core and may consist of an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).
- The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.
- The metallic part shall consist of a copper tape helical applied with a 10% overlap. A binder tape of copper shall be applied over the copper wire metallic screen.

LAYING UP

- The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.
- The cores shall be laid up with a right hand direction of lay.
- No cables shall be directly buried in the ground. They shall be laid in trenches, trays, racks or in conduits or pipes. The cables of different voltage grade shall be laid in different trays. 2 mtr loop to be provided on both the sides.

Binder tape / Moisture barrier:

- During lay up, a suitable open spiral binder may be applied, at the manufacturer's discretion before the application of an extruded inner covering.



FILLERS

- Fillers shall be PVC.

INNER COVERING / SHEATH

- The inner covering shall be extruded over the laid up cores to form compact and circular bedding for the metallic layer.

METALLIC LAYER

- The metallic layer shall be galvanized steel wire.

OUTER SHEATH

- The tough outer sheath, black coloured best resisting PVC polyethylene compound type ST-2 as per IS : 5831 for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.

CABLE MARKING

Embossing on outer sheath:

- The PVC outer sheath shall be legibly embossed with the legend: "ELECTRIC CABLE 11000 VOLT "etc.
- The letter and figures shall be raised and shall consist of upright block characters. The maximum size of the characters shall be 13 mm. And the minimum size 15% of the cable circumference or 3 mm, whichever be the greater. The gap between the end of one set of embossed characters as above and the beginning of the next shall not exceed 150 mm.

Identification of Manufacturer and year of manufacture:

- An identification of the manufacturer, the year of manufacturing, cable size shall be embossed at regular intervals on the PVC outer sheath. This shall not affect the spacing between repetitions of the legend as given above.

SEALING AND DRUMMING

- After tests at the manufacturers works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.
- Cable shall be supplied in lengths of 500 mtrs. or as required in non-returnable drums of sufficiently sturdy construction.
- The spindle hole shall be 110 mm. minimum diameter.
- Each drum shall bear on the outside flange, legibly and indelibly in the English language, a distinguishing number, the manufacturer's name and particulars of the cable viz. voltage, length, conductor size, cable type, insulation type and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow.

TESTING

- Type tests and Routine tests shall be carried out in accordance with the relevant IEC standards / IS. The copies of routine test results shall be submitted along with each drum length or part thereof.

TRANSPORTATION & DELIVERY

- The cable shall be supplied in the actual length as per joint measurement at site.
- The cable shall be dispatched at client's store or at site as per detailed instructions given by Client at later stage.
- The cables shall be loaded from the main vendor's store, transported, unloaded at Client's stores and properly stocked as per instruction of client's local representative.

1.6 TECHNICAL DATA SHEET FOR H. T. XLPE CABLE :

Sr. No.	Particulars	Description
1.0	ENVIRONMENT DETAILS	
1.1	Ambient Temp In Degree Celsius	50 Degree Celsius
1.2	Ground Temp In Degree Celsius	35 Degree Celsius
1.3	Relative Humidity	90 % At 35 Degree Celsius
1.4	Altitude	< 1000 Meter Above MSL
1.5	Atmosphere	Non Corrosive, Humid and Dusty
1.0	SYSTEM DETAILS	
1.1	System Voltage	AS PER TENDER
1.2	System Frequency	AS PER TENDER
1.3	Grounding	AS PER TENDER
1.4	Fault Level	AS PER TENDER AS PER TENDER
1.0	CABLE	
1.1	No. of Cores	3 (Three)
1.2	CABLE CONDUCTOR	
1.1.1	Size Of Conductor	As per BOM
1.1.2	Material	High Purity Aluminium
1.1.3	Construction	Stranded
1.1.4	Shape	Compacted Circular
1.1.5	Confirming To	Is-8130
1.3	Conductor Screen	Extruded Semi-conducting Material
1.4	CONDUCTOR INSULATION	
1.4.1	Material	High Purity Void And Moisture Free Cross-Linked Polyethylene (XLPE) Using Gas Curing Process

Sr. No.	Particulars	Description
1.4.2	Thickness	$\geq 5.5\text{mm}$
1.5	INSULATION SCREEN	EXTRUDED SEMI-CONDUCTING MATERIAL HAVING COPPER TAPE OVER IT
1.6	CORE IDENTIFICATION TAPE	Yes Required
1.7	CORE LAYING	Right Hand Direction
1.8	INNER SHEATH / COVER	Extruded
1.9	ARMOURING	
1.9.1	Material	Flat Steel GI Strip
1.9.2	No Of Strip	4
1.9.3	Size Of Strip	0.8 mm
1.10	OUTER SHEATH	
1.10.1	Material	PVC
1.10.2	Type	St-2 As Per Is-5831-1984
1.10.3	Thickness	$\geq 1.4\text{ Mm}$
1.10.4	Colour	Black
1.11	MARKING ON OUTER SHEATH	YES
1.11.1	Voltage Grade	Yes
1.11.2	No. of Cores/Size of Conductor / Material of Conductor	Yes
1.11.3	Type Of Insulation	Yes
1.11.4	Details About Armour	Yes
1.11.5	Details Of Standards	Yes
1.11.6	Year Of Manufacturer	Yes
1.11.7	Any Other Details	Yes
4.0	TESTING	
4.1	Type Test As Per Is	Certificate To Be Provided for each drum
4.2	Routine Test As Per Is	Yes To Be Witnessed By Client
4.3	Acceptance Test	Yes To Be Witnessed By Client
5.0	CABLE DRUM	Non Returnable
5.1	Material	Wooden / Steel
5.2	Marking On Cable Drum	As Per Manufacturer's Standard

METHOD OF MEASUREMENT

- All the items will be measured in running metre and termination in unit nos as in Bill of quantity.

DISTRIBUTION TRANSFORMER



SCOPE OF WORK

Design, manufacture, testing and inspection at places of manufacturer, painting, supply, delivery to site, the transformers with all related accessories and specifications as specified below with technical data sheet and bill of quantity.

CODES & STANDARDS

- The design, material, construction, manufacture, inspection, testing and performance of power transformers shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice.
- Transformers shall conform to the current applicable standards and codes of practice as specified as under. In case of conflict between the applicable reference standards and this specification, this specification shall govern.

SR.	ITEM	RELEVANT IS	RELEVANT IEC
1	Power transformer	IS 2026	IEC 76
2	Fittings & Accessories	IS 3639	
3	Climate Proofing	IS 3202	IEC 354
4	Loading of Transformer	IS 6600	IEC 296
5	Oil	IS 335	IEC 137
6	Bushings	IS 20650	IEC 144
7	Degree of Protection	IS 2147	IEC 76
8	Testing, Tolerances on guaranteed Particulars	IS 2026	IEC 76
9	Buchholz Relay	IS 3637	
10	Electrical Insulation	IS 1271	IEC 85

CONSTRUCTION

GENERAL CONSTRUCTIONAL FEATURES

- All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.

- Similar parts, particularly removable ones, shall be interchangeable. Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per the relevant standards. Bolts and nuts exposed to atmosphere shall be galvanized.
- Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washers or locknuts.
- Exposed parts shall not leave pockets where water can collect.
- Internal design of transformer shall ensure that air is not trapped in any location.
- Facility shall be provided for lubrication of bearings and mechanisms.
- Materials in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated.
- Labels shall be provided for all identifiable accessories like relays, switches, fans, current transformers etc. All label plates shall be of non-corrosive material.
- All internal connections and fastenings shall be capable of operating under overloads and over-excitation allowed as per specified standards without injury.

PAINTING

- The interior of all transformer tanks and other oil filled chambers and internal structural steel work shall be cleaned of all scale and dust by shot blasting unless otherwise approved. These surfaces shall be painted with not less than two coats of heat resistant, oil insoluble and insulating varnish. Steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy oil and weather resisting non fading paint of specified shade.
- Metal parts not accessible for painting shall be made of corrosion-resistant material.
- Interior surfaces of mechanism chambers and marshalling kiosks shall receive three coats of paint after proper cleaning. The final coat shall be of a light colour anti-condensation paint.

ELECTRICAL AND PERFORMANCE REQUIREMENTS

- Transformers shall operate without injurious heating at the rated kV at any voltage within +10 % to -15 % of the rated voltage of that particular tap.
- Transformers shall be capable of delivering the rated current at a voltage equal to 105 percent of the rated voltage without exceeding the limiting temperature rise.
- Unless otherwise specified, transformers shall be designed for operation at a frequency of 50 Hz.
- The maximum flux density in any part of the core and yokes, at normal voltage and frequency shall be such that the flux density under over voltage conditions shall not exceed the maximum permissible values for the type of core and yoke material used. The type of material and values of flux density in the core/ yoke for the 100%, 125% and 140% and the hysteric characteristic curves shall be included in the Bid, and shall be subject to approval. In

case of transformers with variable flux density the voltage variation which affects the flux density at every tap shall be kept in view while designing transformers.

- Unless otherwise specified, transformers shall be designed for the following over fluxing withstand capability:
 - 110% - Continuous for all transformers.
 - Transformers shall operate below the knee of the saturation curve at 110 percent voltage to reduce ferro resonance and non-linear oscillations.
- Unless otherwise stated, transformers shall be capable of operation continuously, in accordance with the applicable standard loading guide at their rated kVA and at any of the specified voltage ratios.
- Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, on-load tap changers or other auxiliary equipment shall apply.
 - Transformer core shall be built up of low loss non-ageing grain oriented silicon steel insulated laminations. Adequate cooling ducts shall be provided. Transformer tanks shall be of robust construction fabricated out of M.S. plate. All welded joints and valves shall be tested after fabrication of the tank to withstand up pressure of 1.0 kg/sq.cm. in excess of the static head of oil. Bolted joints shall carry non-deteriorating gaskets.
 - Transformer cooling shall be as specified under equipment schedule with fixed or removable radiator tubes of seamless construction and adequately braced to the tank.
 - All normal fittings required under section 14 of IS: 2026 - Part I shall be provided. Additional fittings shall also be provided as stipulated in the Datasheet.
 - The transformer shall be supplied with oil conforming to IS: 335. The transformer shall be delivered after drying out and ready to put into commissioning without further drying out at site.
 - The thermal ability to withstand short circuit shall be demonstrated by the calculations.
 - The dynamic ability to withstand short circuit shall be demonstrated by reference to tests on similar transformers.
 - Every care shall be taken to ensure that the design and manufacture of all transformers shall be such as to reduce noise and vibration to the level obtained in good modern practice.
 - The transformers shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth, so as to eliminate wave form distortion and from any possibility of high frequency disturbances reaching such a magnitude as to cause interference with communication circuits.

- All rated quantities subject to the guarantees shall be within the tolerances given in applicable standards.
- The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.
- All internal metal parts of the transformer, with the exception of individual laminations, core bolts and their individual laminations, core bolts and their individual clamping plates shall be earthen.
- Windings shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.
- Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil, and shall not soften or be otherwise affected under the operating conditions.
- The completed core and coil assembly shall be dried in vacuum at not more than 0.5 mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum oven tank or in the transformer tank.

VALVES

- Valves shall be of forged carbon steel upto 50 mm size and of gun-metal or of cast iron bodies with gun-metal fittings for sizes above 50 mm. They shall be of full-way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.
- Every valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection.
- All valves shall be provided with flanges having machined faces drilled to suit the applicable requirements. Oil-tight blank flanges shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required, the same shall be provided.

TRANSFORMER COOLING EQUIPMENT

- Radiators and coolers shall be designed to withstand the vacuum and pressure conditions specified for the tank. They shall be so designed as to avoid pockets in which moisture may collect, to completely drain oil into the tank and to prevent formation of gas pockets when the tank is being filled.
- The clearance between all pipe work and live parts shall be more than the clearance for live parts to earth.



BUILT-ON RADIATORS

- Unless otherwise approved, for transformers rated 500 kVA and above, tank mounted radiators / coolers shall be of the detachable type with bolted and gasketed flanged connections.

TAPS AND TAP CHANGE GEAR

- Tapings shall be On Load / Off Load (where ever applicable as mention in data sheets) and brought out from HV winding and terminated in an external motor operated tap switch with position indicator. Transformer output shall remain unaffected for any tap position.

ON-LOAD TAP CHANGE GEAR

- The tap changers shall be of ON circuit type mechanically rugged and arranged to provide for convenient inspection and maintenance without necessity for un-tanking. The position indicators shall be positive and there shall not be any ambiguity resulting into incomplete tap change with respect to the mechanical tap position indication. The operating handle of tap exchanger shall be brought out of the tank at the side at an accessible height from ground level. Tap changer operating switch mounted on the top of the transformer tanks will not be acceptable. Provision of padlocking the tap changers without interfering with visual tap position indicator shall be provided.

LOSSES

- Bids will be evaluated based on the formula furnished.
- For the purpose of evaluation of Bids, the quoted load losses and iron losses shall be increased to take into consideration tolerance as permitted by applicable standards.

REJECTION

- The client may reject any transformer if during tests or service any of the following conditions arise:
 - No load loss exceeds the guaranteed value by 20% or more.
 - Load loss exceeds the guaranteed value by 20% or more.
 - Impedance value exceeds the guaranteed value by + or - 10% or more.
 - The difference in impedance values of any two phases during single phase short circuit impedance test exceeds 2 percent of the average value guaranteed by the BIDDER.
 - Oil or winding temperature rise exceeds the specified value by 5 Deg.Cent.
 - Transformer fails on impulse test.
 - Transformer fails on power frequency voltage withstand test.
 - Transformer is proved to have been manufactured not in accordance with agreed specification.

- The client reserves the right to retain the rejected transformer and take it into service until the BIDDER replace, at no extra cost, the defective transformer by a new transformer. Alternatively, the BIDDER shall repair or replace the transformer within a reasonable period to the client satisfaction at no extra cost.

DRAWINGS & INFORMATION

ALONGWITH OFFER

- The bidder shall submit completely filled data sheet as per the given format along with GA drawing indicating list of accessories.

HANDING OVER DOCUMENTS

The supplier shall submit following:

- GA drawing
- HV / LV Cable Box
- Foundation layout
- Rating and Diagram Plate
- Data sheet indicating results of tests
- Test reports

INSPECTION AND TESTING

Following tests should be performed as acceptance test at manufacturing place,

- Measurement of winding resistance
- Measurement of voltage ratio and check of voltage vector relationship
- Measurement of impedance voltage/short-circuit impedance (principal tapping) and load loss
- Measurement of no-load loss and current
- Measurement of insulation resistance
- Tests on on-load tap-changers, where appropriate
- Any other special test, if asked for in data sheet

MODE OF MEASUREMENT

- Supply of the transformer including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

TRANSPORT, DELIVERY AND STORAGE

- The quoted price must include all the costs for necessary mode of transportation upto the final location of transformer or site store. The transformer should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including insurance.
- The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.
- The extra transformer oil, if asked for, shall be supplied in sealed non returnable drums.



GUARANTEE OF PERFORMANCE

- The quotes values of parameters shall be within given tolerance for given period of service life.

SPARES

- The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.

MAKE OF COMPONENTS

- The bidder should indicate the list of manufactures for bought out items. The client / Consultant reserve the right to select or change the make of material from the submitted list.

1.0 ATTACHMENTS

DATASHEET

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.0	GENERAL FEATURES		
1.1	Make		
1.2	Installation	AS PER TENDER	
1.3	Service	Continuous	
1.4	Climate	Non Corrosive	
1.5	Type of cooling	ONAN	
1.7	Allowable temperature rise	Oil - 50 deg.c. Winding - 55 deg.c.	
1.8	Painting	Epoxy, shade no. 631 as per IS : 5	
1.9	Oil type	Mineral oil	
1.10	Position	Plinth mounted	
1.0	ELECTRICAL DATA :		
1.1	Earthing : L.V. side	Solid	

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.2	No. of windings	Two	
1.3	Phase	3	
1.4	Frequency	50 Hz.	
1.5	Voltage ratio	AS PER TENDER	
1.6	Phase connection	AS PER TENDER	
1.7	Vector group	AS PER TENDER	
1.8	% impedance	Max. 5% without IS tolerance	
1.9	Rating in KVA	AS PER TENDER	
1.10	Winding insulation class	"A"	
1.11	Terminations :		
a)	H.V. side	Cable box	
b)	L.V. side	Disconnecting Type cable box with rain coated protected system at Horizontal / Vertical joints.	
		AS PER TENDER	
1.0	TAP CHANGER :		
1.1	Tapings	H.V.	
1.2	Tap changer	ON load	
1.3	Tapping range	-10 % to +15%	
1.4	No. of steps	in steps of 1.5%	
4.0	Limit for transformer operation under over load condition as per IS	Required	
5.0	ACCESSORIES :		



SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
	Double float Buchholz relay with alarm & trip contacts Marshalling box Sampling valve Plain oil level gauge Conservator & conservator drain valve Bidirectional rollers Oil temp. indicator with alarm & trip contacts Bottom drain / Filter valve Double diaphragm Explosion vent Silica-gel breather Air release plug	Required	
	Separate neutral bushing Top oil filter valve Jacking pads Lifting lug Earthing terminal 1 set of detachable radiator with shutoff valve Winding temp. indicator with alarm & trip contacts Rating and diagram plate HV & LV gland plate	Required	
6.0	PERFORMANCE DATA :		
6.1	Rated guaranteed losses without tolerance		
a)	No load at 100% voltage	Required	

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
b)	No load at 110% voltage	Required	
c)	Full load Cu. Loss	Required	
6.2	Rated No load current	Required	
a)	No load at 100% voltage		
6.3	Rated efficiency at 0.8 P.F.	Required	
a)	At full load		
b)	At 75% load		
c)	At 50% load		
6.4	Rated regulation	Required	
a)	At 0.9 P.F. lag		
b)	At 0.8 P.F. lag		
c)	At unity P.F.		
6.5	Impedance voltage	Required	
a)	Primary – Secondary		
6.6	Load at which max. efficiency occurs	Required	
6.7	Maximum efficiency	Required	
6.8	Maximum flux density	Required	
6.9	Current density	Required	
7.0	MECHANICAL DATA :	Required	
7.1	Weight :	Required	
a)	Core & windings		
7.2	Dimensions (mm.) : (Dimensions should be considered including all accessories)	Required	

Note : All routine tests as per 'IS' shall be carried out in presence of purchaser / consultant's representative



DIESEL GENERATOR SET

SCOPE:

- This specification covers the design, construction features, manufacture and performance of emergency diesel generator. The scope includes supply, installation, testing and commissioning of D.G. set along with fuel pipeline, residence type exhaust pipe insulation and all the accessories required for trouble free operation.

CODES AND STANDARDS:

The DG set shall meet the requirements of the following standards and rules:

IS : 2253	Designation for type of construction and mounting arrangement of rotating electrical machines.
IS : 4691	Degree of protection providing by enclosures of rotating electrical machinery.
IS : 4728	Terminal marking of rotating electrical machines.
IS : 7132	Guide for testing 3 Phase Synchronous Machines.
IS : 5422	Turbine type generators.
IS : 4889	Methods of determination of efficiency of rotating electrical machines.
IS : 1271	Insulating materials for Electric machinery and apparatus in relation to their thermal stability service, classification.
IS : 4722	Specification for rotating electrical machines.
IS : 13947	AC circuit breakers.

DESIGN CONDITIONS:

All equipment and materials will be selected and rated for use at the following site conditions.

Summer outdoor design temperature	50° C.
Surface temperature	80° C.
Relative Humidity	95% Max.

DESIGN & CONSTRUCTION :

GENERAL :

- The diesel engine offered shall be of the regular production models of the manufacturer for industrial applications and already type tested either at the manufacturer's works or outside. The type test report shall be furnished to the purchaser for his review if so desired.

In case the proposed engine model has not been type tested, vendor shall furnish with the offer, a reference list of its existing industrial installation and at least three of these engines should have completed, 5000 hours of running at site.

- Unless otherwise specified in the equipment data sheets, the diesel engine shall be provided with class A1 governing as per the latest edition of B.S. 5514.
- The "Cyclic irregularity" of the diesel engine for direct coupling to an electric generator, "angular deviation of A.C. generators" given by diesel engine for parallel operation, and the "engine governor speed droop characteristics", shall be restricted to the values specified under the latest edition of B.S. 5514.



- The vendor shall be responsible for carrying out torsional analysis of the dynamic system as specified in the latest edition of British Standard-5514. The results in the form of a report shall be submitted to the purchaser for scrutiny and reference, if desired.
- Vendor shall provide the flexible exhaust connections to connect the engine exhaust to the exhaust piping. The required size of the exhaust piping should be clearly specified by the vendor.
- The common base plate for mounting the diesel engine and the driven equipment as well as the flexible coupling, shall be supplied by the vendor.
- Vendor shall indicate in the bid, the IS Noise Level rating of the diesel engine with the offered exhaust silencer, which should not exceed more than 75 db at 1 Mtr. distance.

ENGINE STARTING:

- Diesel engines shall be capable of starting without the use of cold starting aids so long the ambient temperature at the site is not below 4° c.
- Where the diesel engine is specified / offered with battery starting arrangement, the starter motor shall be capable of starting the engine without having to disengage the driven machine with the help of a clutch. Where the diesel engine is equipped with a dual starter the synchronizing switch and the corresponding wiring / connection with the starter motor shall be provided by the vendor.
- In case of diesel engines driving the engine mounted battery charging alternator, the Vendor shall also provide Battery, automatic Electronics float & boost type battery charger suitable for taking power from supply authority's power source and mounted on a free standing type of a panel.
- The battery charger as specified in the equipment data sheet, shall be capable of delivering a current equal to 100% of the 20 hour discharge rate of the battery and also equipped with charging rate selector device.
- As specified in the data sheets, the diesel engine is required to start / stop automatically, the vendor shall provide the necessary controls (automatic - cum -manual) in the engine panel and the interconnecting wiring and piping from the panel to the engine and starting equipment. A pilot lamp shall be provided in the line side of the starting equipment circuit to indicate that the controller is in the automatic position. In the event the engine does not start after three attempts have been made, the controller shall stop all further cranking and operate the audio-visual alarm. Shaft driven lubrication system is acceptable, alternatively D.C. motor driven lubrication pump with timer suitably interlocked with the starting system is acceptable.

ENGINE COOLING:

- Vendor shall supply radiator based cooling system.

ENGINE FUEL SYSTEM:

- Engine fuel system shall be complete in all respects but not limited to following :
- The daily service fuel tank capacity 990 liters shall be equipped with shielded level gauge, strainer and a hand hole of not less than 150mm diameter, besides the required fuel connections and a drain plug. One tanks of suitable capacity to be provided.
- The inside surfaces of the fuel tank and the float tank shall be coated with Enamel Red or Black of I.C.I. or its equivalent and the outside surface to be given two coats of the oil resistant primer paint. The fuel tank shall be hydrostatically tested at a pressure not less than 0.35 Kg./Cm.²
- Fuel oil transfer pump to transfer oil from barrels to day tank shall also be provided.
- All piping, valves, fittings and supports inside D.G. house shall be part of supply.

INSPECTION & TESTING:

- The vendor shall have the responsibility of providing purchaser's representative with all requisite facilities / equipment for carrying out satisfactory testing.
- The diesel engines shall be tested in the presence of purchaser's representative accordance with latest edition of B.S. 5514 or any other equipment standard as agreed to with the purchaser before the finalization of order.
- The routine load and fuel consumption test shall be of the 4 hours.
- Unless otherwise specified, 10% overload provision shall be kept while setting the fuel limit for the site running.
- The engine control panel/s after assembly and wiring, shall be functionally tested in the presence of the client's / consultant's representative.

ALTERNATOR:

- This specification define the requirements of design, manufacture, testing and supply of self excited emergency generator complete with automatic voltage regulator, control panel, isolator and other accessories as specified in the material requisition.
- Unless otherwise specified the emergency generator shall be supplied complete with :
 - Brush less excitation system complete with AVR.
 - Electric panel including control cubicle and associated auxiliary devices, relay panel and generator breaker / isolator, battery and battery charger.
 - Air inlet and outlet for generator cooling (inlet shall be oriented to suit total plant layout).
 - Lifting arrangement for the machine.
 - Foundation frame complete with foundation bolts to install alongwith engine on common base frame.
 - Lub. oil system integral with the prime mover lub. oil system.
 - Spares for commissioning.
 - Spares for two years of operation and maintenance.



- Any other part / accessories not specifically mentioned above but considered necessary for safe and reliable operation.

DESIGN AND CONSTRUCTION:

- The alternator design shall meet the requirement specified in data sheet and shall be suitable for the site conditions specified therein.
 - The alternator shall be mounted on a common base frame together with the prime mover unless otherwise agreed. The generator shall be provided with necessary lifting hooks and two earth terminals for connection to main earth grid.
 - The alternator winding shall be class "F" insulation with temperature limitation to Class "B".
 - The stator windings shall be brought out to six insulated terminals in two separate terminal boxes. The alternator shall, therefore, be provided with three separate terminal boxes i.e. for the line and neutral stator connection and for control connection. The terminal box for the line terminal shall have 40 % free space and each segregated for easy cable end connection of cable size specified in data sheet. The neutral box shall in addition to the space for neutral earthing cable shall have sufficient room for the current transformers used for the protection of the generator. Star connection shall be formed in the neutral side of terminal box. The terminal box for control cable shall contain properly marked terminals for all internal equipments e.g. embedded temp. detectors etc. All terminals shall be stud type. The terminal boxes shall be complete with lugs and double compression type cable glands. Current transformers shall be as specified in data sheet.
 - All parts and accessories shall be suitable to withstand stresses due to over speed / overload / short circuit conditions specified.
 - Bearings shall be double shielded and prelubricated. Grease in the bearing enclosure shall provide additional lubrication to bearings as well as provide sealing against dust and moisture. On line greasing facility with excess grease expulsion system shall also be provided.
 - The alternator shall be air cooled unless otherwise agreed, alternator enclosure shall be as specified in data sheet.
 - The direction of rotation of the rotor of the machine shall be compatible with that of the prime mover. A clear indication of the direction of rotation shall be given on either end of the machine.
 - Field winding shall have class "H" insulation with excellent electrical and mechanical properties. The field winding shall be capable of operating at a field voltage with Excitation capacity $E_{max} / E_n = 1.6$ for at least two minute to meet improved stability requirements.
 - A rating plate of S.S material shall be fixed on the generator frame and shall give the following information :
 - a) Manufacturer's name.
 - b) Serial Number, Type and frame reference

- c) Rated output in KVA & KW
- d) Rated power factor, frequency and voltage
- e) Rated stator current and speed in Rev. / Min.
- f) Class of insulation
- g) Phase rotation (CW or CCW)
- h) Customer's Indent no.
- i) Year of manufacture
- j) Weight of rotor and stator in Kg.

EXCITATION SYSTEM:

- The generator shall be provided with brush less type solid state excitation system. The field of the exciter shall be either permanent magnet type or externally excited through external power, transformer and AVR. AC voltage generated in the exciter shall be rectified by the rotary rectifier assembly and feed power to the main field circuits of the generator. The exciter capacity shall be at least 20% more than the maximum requirement at any time. The exciter winding shall be insulated with class "F" insulation. Automatic solid state voltage shall be provided with the following features as a minimum.
 - Short circuit protection.
 - Manual voltage control switch with adjuster.
 - Cross current compensation for parallel operation.
 - Voltage build up circuitry.
 - Stator current limiter.
 - Field current limiter.

The current and potential transformers required to feed the AVR from the generator terminal shall be adequately rated.

SYSTEM OPERATION:

- The emergency generator set shall normally be in an unattended area. The control system shall operate in fail safe mode and shall include all controls and protection necessary for the safe operation of the package. The generator set shall function as per one of the following schemes :
 - Manual start in service mode.
 - Manual test mode.

PAINTING, PACKING AND TRANSPORT:

- All metal surfaces shall be thoroughly cleaned of scale, rust and grease etc. Prior to painting. Cleaned surfaces shall be given two coats of primer and prepared for final painting. Final finish shall be free from all sorts of blemishes.
- The equipment shall be shipped to site suitably packed to prevent any damage. Each package shall have labels to show purchaser's name, purchase order and equipment no. suitable lifting lugs etc. shall be provided and lifting points shall be clearly marked on the package. Packing shall be suitable for storage at site for a minimum period of 6 months.

TESTS AND INSPECTION:

- The owner or his authorised representative may visit the works during manufacture of equipment to assess the progress of work as well as to ascertain that only quality raw materials are used for the same. He shall be given all assistance to carry out the inspection.



- Detailed test procedure alongwith the facilities available at vendors works shall be furnished along with the bid Owner's representative shall be given minimum four weeks advance notice for witnessing the final testing. Test certificates including test records and performance curves etc. shall be furnished for the complete D.G., individual test certificates of engine / alternator / common panel should be submitted, only thereafter complete D.G. would be tested.

TESTS:

- Equipment shall be tested to conform to the appropriate standards and the following tests shall be conducted in the presence of purchaser's :
- Functional tests, continuity tests and high voltage test on control panel to establish the performance called for in the specification.
- Power frequency voltage test on switch gear and mechanical / electrical operational check.
- Routine tests for alternator as per IS : 4721.
- Over speed test (1.2 times the rated speed for 2 minutes.)
- Transient response tests for sudden application and rejection of loads of 25% , 50%, 75% and 100% of rated capacity.
- Phase sequence test.
- Vibration test.
- Noise level test.
- Dimensional and alignment test.
- Wave from test.

DATA SHEET FOR DIESEL GENERATOR SET

SR. NO.	PARTICULARS	REQUIRED DATA
1.0	Prime mover	Diesel Engine
1.0	Quantity required	AS PER TENDER
1.0	Service	Prime mover for generating set
4.0	Rating	AS PER TENDER
5.0	RPM	AS PER TENDER
6.0	Voltage	1% or less
7.0	Voltage variation / regulation Steady state - slow variation In load (0.0% to 100% at P.F. 0.8)	-5%, recovery time - 0.25 sec.
8.0	Voltage drop (sudden load application 0.0% to 100% at P.F. 0.8)	50 Hz.
9.0	Frequency	0.5 Hz.
10.0	Frequency variation / regulation	Class 'F' used as Class 'B'
11.0	Temperature rise	VPI Insulation preferred
11.0	Alternator Insulation Material	Required
11.0	Flywheel	Required (fluid type only)
14.0	Vibration damper	Required
15.0	Fuel pump air cleaner	Required
16.0	Fuel pump	Required
17.0	Oil filter, fuel filter etc.	Required
18.0	Lub oil pump	Required
19.0	24 V DC electrical system consisting of SMF lead acid battery set and suitable charger	Required
20.0	Safety controls	Required
21.0	Residential type Silencer	Required
21.0	Acoustic Hood	Required
21.0	AMF panel with MCCB	Required
24.0	Coupling	Required
25.0	Instrument panel consist of a) Starter switch with key b) Lub oil temp. gauge c) Water temp. gauge d) Lub oil pressure gauge e) Tacho cum Hour meter	Required Required Required Required Required Required
26.0	Fuel tank	Required (Capacity -990 Litres Max.)
27.0	Battery charger	Required (Electronics float & boost type)
28.0	Engine testing a) At shop b) At site	Required
28.0	Tool kits	Required
29.0	Literature (Two sets each) a) Operation & maintenance manual b) Parts catalogue / list	Required Required



Note:

- The engine H.P. should be selected so as to achieve required KW rating to be generated at site condition and derated considering temperature inside acoustic enclosure..
- D.G. set should be able to start by push button AMF relay, or remote command.
- The engine test shall be witnessed by the OWNER's representative.
- The engine should have automatic belt tensioning arrangement for battery charging alternator system.
- The engine should have facility for the indication of oil level in oil sump during running of the engine.
- The noise level should not be more than 75 db at 1 Mtr. distance and engine exhaust smoke emission level should be less than 1 bosch.
- Engine should be preferably from the engine manufacturers who maintain quality - assurance to international standard of ISO 9001.
- Engine should be fitted with electronic governor only.
- The engine water circular pump should be directly driven by engine gear system. V-belt driven system should not be adopted / accepted.

MODE OF MEASUREMENT

- Supply of the DG SET including transport to site, loading and unloading , exhaust etc. as specified will be treated as one unit for measurement and payment.

LT DISTRIBUTION PANEL



GENERAL DESCRIPTION

- Main Distribution Panels, Sub-Distribution Panels and Final Distribution shall be covered under this section. Panels/Boards shall be suitable for operation on 3 Phase/single phase, 415/240 volts, 50 cycles, 4 wire system with neutral grounded at transformer. All Distribution panels shall be CPRI tested design and manufactured by an approved manufacturer. CPRI certificate shall be made available.
- Distribution panels shall comply with the latest Relevant Indian Standards and Electricity Rules and Regulations and shall be as per IS-13947-1991.

CONSTRUCTION FEATURES:

- Distribution panels shall be 2 mm thick sheet steel cabinet for indoor installation, dead front, floor mounting/wall mounting type and shall be form as per site construction requirements. The Distribution panels shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors and folded covers, Neoprene gasket, padlocking arrangement and bolted back. All removable/ hinged doors and covers shall be grounded by flexible standard connectors. Distribution panel shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of Distribution panels shall be 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to IS-8623-1977 (Part-1) for factory built assembled switchgear & control gear for voltage up to and including 1100 V AC.
- All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Distribution panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum operating clearance of 275 mm shall be provided between the floor of Distribution panels and the lowest feeder compartment.
- Distribution panels shall be of adequate size with a provision of spare switchgear as indicated on the Single Line Diagram. Feeders shall be arranged in multi-tier. Knockout holes of appropriate size and number shall be provided in the Distribution panels in conformity with the location of cable/conduit connections. Removable sheet steel plates shall be provided at the top to make holes for additional cable entry at site if required.
- Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram engraved on PVC sheet. All live accessible connections shall be shrouded and shall be finger touch proof and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

BUSBAR CONNECTIONS:

- Bus bar and interconnections shall be of high conductivity electrolytic grade aluminium / copper as indicated in the bill of quantities complying with requirement of IS : 5082 – 1981 and of rectangular cross section suitable for carrying the rated full load current and short circuit current and shall be extendable on either side. Bus bars and interconnections shall be insulated with heat shrinkable sleeve of 1.1 KV grade and shall be colour coded. Bus bars shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bars shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area to be added to the bus bar to compensate for the holes. All

connections between bus bars and breakers shall be through solid copper / aluminium strips of proper size to carry full rated current and insulated with insulating sleeves. Maximum current density for the bus bars shall be 1A/sq.mm for aluminium and 1.4 A/sq.mm for copper bus bars. **Maximum allowable temperature for the Bus bar to be restricted to 85 deg C**

TEMPERATURE – RISE LIMIT

- Unless otherwise specified, in the case of external surface of enclosures of bus bar compartment which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per IS 8623(Part-2) 1991.
- All main distribution panels and sub distribution panels shall be provided with MCCB of appropriate capacity as per Single Line Diagram. All final Distribution boards shall be provided with Miniature Circuit Breakers. Final Single Phase Distribution boards shall be connected to the incoming supply through double pole MCB units & earth leakage circuit breakers. All wiring for final distribution boards shall be concealed behind 5 mm thick bakelite sheet or M S sheet cover. All Distribution boards shall be completely factory wired, ready for connection. All the terminals shall be of proper current rating and sized to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.
- Continuous earth bus sized for prospective fault current shall be provided with arrangement for connecting to station earth at two points. Hinged doors/ frames shall be connected to earth through adequately sized flexible braids.

CABLE COMPARTMENTS

- Cable compartment of adequate size shall be provided in the Distribution panels for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables.

Moulded Case Circuit Breaker (MCCB)

- The MCCB should be current limiting type with trip time of less than 10 msec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ. MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2/IEC 60947-2 and should have test certificates for Breaking capacities from independent test authorities CPRI / ERDA or any accredited international lab.
- MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses
- The breaking capacity of MCCB shall be as specified in the schedule of quantities. The rated service breaking capacity (Ics) should be equal to rated ultimate breaking capacities (Icu). MCCBs for motor application should be selected in line with Type-2 Co-ordination as per IEC-60947-2, 1989/IS 13947-1. The breaker as supplied with ROM should meet IP54 degree of protection.



Current Limiting & Coordination

- The MCCB shall employ maintenance free minimum let-through energies and capable of achieving discrimination up to the full short circuit capacity of the downstream MCCB. The manufacturer shall provide both the discrimination tables and let-through energy curves for all.

Protection Functions

- MCCBs with ratings up to 200 A shall be equipped with Thermal-magnetic (thermal for overload and magnetic for short-circuit protection) trip units
- Microprocessor MCCBs with ratings 250A and above shall be equipped with microprocessor based trip units.
- Microprocessor and thermal-magnetic trip units shall be adjustable and it shall be possible to fit lead seals to prevent unauthorised access to the settings
- Microprocessor trip units shall comply with appendix F of IEC 60947-2 standard (measurement of rms current values, electromagnetic compatibility, etc.)
- Protection settings shall apply to all poles of circuit breaker.
- All Microprocessor components shall withstand temperatures up to 125 °C

TESTING

- a) Original test certificate of the MCCB as per IEC 60947-1 & 2 or IS13947 shall be furnished.
- b) Pre-commissioning tests on the switch board panel incorporating the MCCB shall be done as per standard specifications.

Interlocking

- Moulded, case circuit breakers shall be provided with the following interlocking devices for interlocking the door of a switch board.
 - Handle interlock to prevent unnecessary manipulations of the breaker.
 - Door interlock to prevent the door being opened when the breaker is in ON position.
 - Defeat-interlocking device to open the door even if the breaker is in ON position.
- The MCCB shall be current limiting type and comprise of quick make – Break switching mechanism. MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable over load & short circuit pick-up both in Thermal magnetic and Microprocessor Trip Units.
- All MCCB with microprocessor based release unit, the protection shall be adjustable Overload, Short circuit and earth fault protection with time delay.
- The trip command shall override all other commands.

Miniature Circuit Breaker (MCB)

- Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 240/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B, C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. MCB shall ensure complete electrical isolation & downstream circuit or equipment when the MCB is switched OFF.
- The housing shall be heat resistant and having high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP, TPN and 4 Pole miniature circuit breakers shall have a common trip bar independent to the external operating handle.

Residual Current Circuit Breaker Current Operated Type (RCCB)

System of Operation

- Residual Current Circuit Breaker shall conform to IEC 61008. RCCB shall work on the principle of core balance transformer. The incoming shall pass through the torroidal core transformer. As long as the currents in the phase and neutral shall be the same, no electro motive force shall be generated in the secondary winding of the transformer. In the event of a leakage to earth, an unbalance shall be created which shall cause a current to be generated in the secondary winding, this current shall be fed to a highly sensitive miniature relay, which shall trip the circuit if the earth leakage current exceeds a predetermined critical value. RCCB shall be current operated independent of the line voltage, current sensitivity shall be of 30 mA at 240/415 volts AC and shall have a minimum of 20,000 electrical operations.

Mechanical Operation

- The moving contacts of the phases shall be mounted on a common bridge, actuated by a rugged toggle mechanism. Hence, the closing /opening of all the three phases shall occur simultaneously. This also shall ensure simultaneous opening of all the contacts under tripping conditions.

Neutral Advance Feature

- The neutral moving contact shall be so mounted on the common bridge that, at the time of closing, the neutral shall make contact First before the phases; and at the time of opening, the neutral shall breaks last after allowing the phases to open first. This is an important safety feature which is also required by regulations.

Testing Provision

- A test device shall be incorporated to check the integrity of the earth leakage detection system and the tripping mechanism. When the unit is connected to service, pressing the test knob shall trip the ELCB / RCCB and the operating handle shall move to the "OFF" position.

EARTHING

- Earthing shall be provided as per IS: 3043-1987.

PAINTING

- All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivating (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per BOQ confirming to IS Code No.5.

LABELS

- Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the distribution panels shall be pasted on inside of the panel door and covered with transparent plastic sheet.

METERS

- All voltmeters and indicating lamps shall be through MCB's.
- Meters and indicating instruments shall be flush type.
- All CT's connection for meters shall be through Test Terminal Block (TTB).
- CT ratio and burdens shall be as specified on the Single line diagram/BOQ.

CURRENT TRANSFORMERS

- Current transformers shall be provided for Distribution panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondaries for operation of associated metering.
- The CTs shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

POTENTIAL FREE CONTACTS

- Potential free contacts shall be provided for connection to Building Automation System in panels indicated in Schedule of Quantities.

INDICATING PANEL

- All meters and indicating instruments shall be in accordance with relevant Indian Standards. Meters shall be flush mounted type. Indicating lamps shall be of low burden, and shall be backed up with 2 amps MCB/MPCB as per relevant fault level and toggle switch.

TESTING

Testing of panels shall be as per following codes:

- I. IS: 8623 (Part -I) 1977 for factory built assemblies of switch gear for voltages upto and including 1000 VAC.
- II. IS: 13947 : 1993 Degree of protection
- III. IS: 5578 & 11353:1985 Arrangement of bus bars.