TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS
1.0 STANDARD SPECIFICATIONS ISSUED BY CPWD

1.1 Civil Engineering Works

CPWD Specification 2009 Vol. I & II. These Specifications have replaced CPWD Specifications 1996 along with Correction Slips issued on them. These Specifications cover all types of Building Works. The specifications are available as a printed document issued by CPWD and also in soft copy PDF Format in CPWD website.

1.2 Electrical Engineering Works

Part No.	Description	Year of issue
I	General Specification of Electrical Work Part-1 (Internal)	2013
IV	General Specification of Electrical Work Part-IV (Substation)	2013
VII	General Specification of Electrical Work Part-VII (DG SET)	2013

The above documents are available as Priced Document issued by CPWD and in soft copy PDF Format in CPWD website.

SPECIAL CONDITIONS & GENERAL TECHNICAL SPECIFICATIONS FOR EXTERNAL AND INTERNAL ELECTRICAL WORKS

1. General:

The following Special Conditions shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Special Conditions, which are at Variance with the provisions in the above-mentioned documents, the Provisions in this Special Conditions shall take precedence.

2. Working Agency:

a) The electrical work shall be done by "A" Class Electrical Contractor approved by Govt. having similar nature and value of work executed.

3. Inspection & approval of the work by local authority:

The contractor has to obtain all clearances & approvals from any statuary authority/local bodies pertaining to electrical installations. The contractor shall obtain all information relating to local regulations, Bye- laws, applicable if any and all laws relate to his work or profession and his having to execute work as required. Contractor shall obtain approval of the installation from the relevant inspection authorities at all stages and on completion of the installation work. Any fee payable to the statutory authority for obtaining approvals is required to be paid by the contractor. However the necessary reimbursement of the fee deposited by the contractor to any statutory authority (as mentioned above) will be made on production/submission of the valid documentary proof/evidence.

4. Training:

The contractor has to provide training to the client staff and also operate the system (if required) for a period of one month from the date of handing over free of cost.

5. Pre-delivery Inspection & approval:

The contractor shall offer the pre-delivery inspection of all the materials at manufacturers work to the Engineer-in-charge. The intimation for such inspections shall be given at least 15 days in advance from the date of proposed inspection. CLIENT/RITES representative may inspect any/all the materials required in this project.

The contractor shall make all facilities and expenditure for two persons of tours & travels by air and local journey by taxi, stay and local journey for inspection of material at manufacturer/site premises as per their entilement of RITES/Client representative. The contractor shall include all expenditure towards inspection for two persons in their rates. All the testing facilities, Tools and Tackels and all the consumables including the fuel etc. shall be provided by the contractor and nothing extra shall be paid on this account.

6. Tender drawings and Shop Drawings:

The work shall be executed as per latest working drawings to be prepared by the contractor after award of work and submitted to the Engineer-in-charge for approval.

The Drawings & data provided are for guidance to the contractor. The exact dimensions, location, distance & levels etc shall be governed by the space conditions. The tender drawings are indicative and are for the guidance of the contractor. The drawings appended with the tender documents are intended to show the space allotted for various equipment, bus duct, cable and pipe routes etc. besides general electrical layout. The equipment offered shall be suitable for installation in the spaces shown in these drawings / available at site. The contractor shall prepare and submit for approval detailed shop/working drawings of all works on award of the work. Two set of all such working drawings shall be submitted for approval, including such changes as may have been suggested by the Engineer-in-charge as required at the earliest - within 15 days of awarding of the work.

The contractor shall also take parallel action (after award of work) for submission of applications along with the drawings, documents & details etc. to various Statutory Bodies/Authorities for obtaining their approval/clearances.

The contractor shall re- submit 4 sets of all the drawings within 7 days from date of receiving comments if any from the client after incorporating the comments.

7. Completion Drawings:

After completion of work, the contractor shall have to submit the following set of drawing.

4 set of hard copies + 3 soft copies (in ‘Auto CAD’ applicable version) in CD of the following layout drawings. (Indicating complete Equipment like switch boards, panels, cabinets, Bus-trunking, Ducting, cable laying, piping, other works installed & single line diagrams of electrification of installations etc. For final record & maintenance.

8. Documents to be furnished on completion of installation

a) Completion Drawings as per contract.

b) Manufacturer's catalogues of all equipment and accessories, operation and maintenance manuals of all major equipment, detailing all adjustments, operation and maintenance procedure.
c) Manufacturer's Guarantee /Warrantee certificates of all the equipments & materials etc.
d) Clearances/approval of various Statutory Bodies/Authorities for this system.
e) Any other information the Engineer-in-charge may deem fit.

No completion certificate will be issued until the above drawings and documents are submitted to the Engineer-in-charge.

9. Performance Testing at Site:

After completion of erection at site & a preliminary warm up period, acceptance trial run of a minimum period of 7 days duration shall be conducted at site. The trial shall be conducted in the presence of the Engineer-in-charge and the test results shall be recorded in an approved format. The contractor at his cost shall provide all Testing facilities like testing Engineers, assistants, instruments, materials and consumables etc. as required for the test. Tests proving the satisfactory performance of all operating switch gears, transformers and safety functions and controls shall be carried out. All calibrated instruments, materials, load configuration, fuel, lubricating oil and labour required for carrying out of the test shall be provided by the contractor free of cost. The contractor shall give ample notice of the test to the Engineer-in-charge.

10. The contractor shall be fully responsible for the maintenance including watch and ward of all the Electrical installations provided by him until the works are handed over to client. Thereafter, the work can be handed over to the Client along with all inventories, completion plans etc. as required.

11. CO-ORDINATION:

The Contractor shall co-operate with any other agency working in the same project, compare plans, specifications and the time schedules and so arrange his work that there will be no interference. The Contractor shall forward to the Engineer-in-charge all correspondence and drawings so exchanged. Failure to check plans for conditions will render the contractor responsible for bearing the cost of any subsequent change found necessary or damages done. However, contractor shall afford necessary facilities to execute the work simultaneously with other agencies executing the works like Civil, architect, horticulture, external services and other building works for the same project shall entertain no claim on this account.

The electrical work shall be executed in close Coordination with the progress of building work. This being the essence of the contract, an activity chart clearly showing critical areas should be furnished before commencing the work for proper monitoring and coordination.

12. HANDING OVER THE WORKS ON COMPLETION:

On satisfactory completion of all the works as per the provision of the Contract, the Contractor shall hand over the works to the client. The Contractor shall ensure that all the testing commissioning & trial run operation of all the system are simultaneously carried out so as to make the same functional immediately on completion.

It shall be the responsibility of the contractor to obtain clearances from all the Statutory Bodies like Electrical Inspector & Fire Officer etc. as required for the installations prior to commissioning & handing over the same after completion of work.

13. All material to be used on works shall bear I.S. Certification work unless otherwise the make specified in the item or special conditions appended with the tender document. In case I.S. marked materials or the materials mentioned in the tender document are not used due to non-availability, the materials used

shall conform to I.S. code or CPWD Specifications applicable for this contract. In such cases the Engineer-in-charge shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified as "First Quality" by the manufacturers shall be used unless otherwise specified. All materials not having I.S. marking shall be tested as per provision of the Mandatory Tests in CPWD Specifications and the relevant IS specifications. The Engineer-in-charge may relax the condition regarding testing if the quantity of materials required for the work is small. For the products bearing ISI certification work, no further testing is required at site. In all such cases of use of IS certified materials, proper proof of procurement of materials from authentic manufactures shall be provided by the contractor to the satisfaction of Engineer-in-charge.

14. Other agencies doing work of Civil, Plumbing, Air conditioning or other building work, horticulture work etc. for this project will also simultaneously execute the works and the contractor shall afford necessary facilities for the same. The contractor shall leave such necessary holes, openings, etc. as may be required for the electric, sanitary, air-conditioning, fire-fighting, PA system, telephone system, C.C.T.V. system etc. and nothing extra over the agreement rates shall be paid for the same.

15. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of local body under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-charge and nothing extra shall be paid on this account.

16. For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the engineer-in-charge and nothing extra shall be payable on this account.

17. CLARIFICATIONS OF DISCREPANCIES:

In case of any discrepancy between technical specifications, approved drawings and BOQ, or disputes in respect thereof, the interpretation of the Engineer-in-Charge shall be final and binding on the contractor.

ELECTRICAL TECHNICAL SPECIFICATIONS

1. 11kV VCB Panel Board

SCOPE

Design, Manufacturing, supply, installation, testing & commissioning of integrated cubicle type metal clad, floor mounted and draw out type free standing, front operated Indoor type 11 KV switchgear including foundations and all other Civil Works required to complete the job.

System

The switchgear enclosure shall conform to degree of protection IP 4 X.

The switchgear panel shall be of sheet steel construction with aluzinc not less than 2 mm thickness for load bearing section and not less than 1.6 mm tihckness for non load bearing and shall totally dust and vermin proof.

The switchgear assembly shall form a continuous dead front line up of free standing vertical cubicles. Each cubicle shall have a lockable front hinged door and a removable bolted back cover. All covers and doors shall be provided with neoprene gaskets. Suitable arrangement for lifting of each cubicle shall be provided. Design and construction of the switchgear shall be such as to permit extension at either end.

Vacuum Circuit breaker shall be provided with surge arresting device for protection against lightning and switching over voltage. Two separate and distinct connections to earth shall be provided for each surge arrestor.

BREAKER COMPARTMENT

Vacuum Circuit Breaker shall be mounted in draw out truck with front plate which covers the cubicle when the breaker is in service position. This front plate shall be provided with view glass to facilitate observation of mechanical ON/OFF indication of Circuit breaker, spring charged / discharged indication and operation counter. Necessary orifice shall be provided for manual charging of the springs. ON/OFF push button for opening and closing of the circuit breaker shall also be provided. The draw out truck shall have two positions for the circuit breaker VIZ isolated / Test & Service.

BUS BAR COMPARTMENT

Bus bars of rectangular cross section of copper conductor supported by cast epoxy insulator to withstand full short circuit currents upto 18.4 KA or as per detailed design,BOQ for one second for 11 KV system shall be provided at the rear. Bus bar chamber shall be provided with inter panel barriers with epoxy cast seal off bushings.

CT AND CABLE COMPARTMENTS

At the rear of the panel sufficient space shall be available to accommodate three numbers epoxy CT's of double core and two numbers three core cable termination. The cable entry shall be from the top / bottom.

SEPARATE COMPARTMENTS

Circuit breakers, instrument transformer, bus bars, cable etc shall be housed in a district different compartment as required, compartmentalization. All relays, switches, lamps, etc. comprising the control, indication and protective devices shall be housed in a separate compartment on the front of the cubicle.

TECHNICAL PARTICULARS OF VCB CIRCUIT BREAKER

S.NO.	DESCRIPTION	11 KV
a	Rated Current	630 A
b	Rated Voltage	12KV
c	Rated Frequency	50 Hz
d	Rated Short Circuit breaking Current	18.4 KA for 1 sec.
e	Rated short circuit making current (KAP)	50 KA
f	Insulation level (KV rms/KVP)	28KV / 75 KV
g	IEC Standard:	IEC: 62271-100/200

EARTHING SWITCH/EARTHING TRUCK:

Cable earthing switch shall be provided in the cable chamber and shall be operated from the front of the panel. The ON/OFF position of switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

Earthing switch shall also be provided on bus bar side. The ON/OFF Switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

Alternatively, 1 No. Earthing trunk to be provided for each set of panel if earthing switch is not built-in their design.

ISOLATING CONTACTS

The breaker isolating contacts shall consist of two parallel flat silver plated copper bars with ball point contacts to give a vertical tolerance of ±10 mm.

LOW VOLTAGE PLUG AND SOCKET CONNECTOR

A twenty pin plug and socket connection along with flexible leads shall be provided to connect control instrumentation and interlock circuits on the breaker truck and in the panel. The plug and socket assembly shall be suitably interlocked with the truck positions like service and test/isolated position

INTERLOCKS AND SAFETY DEVICES

The following interlocks shall be provided:

a. The truck cannot be moved from either test to service position or vice versa, when the circuit breaker is 'ON'.

b. The circuit breaker can not be switched 'ON' when the truck is in any position between test and service position.

c. Front part of the truck can not be removed when the breaker is in 'ON' position.

d. The low voltage plug and socket can not be disconnected in any position except test/isolated position.

e. The truck can not be moved inside the panel, when the LT plug and socket is disconnected.

f. Earthing switch can not be switched 'ON' when the truck is inside the panel.

g. The truck can not be inserted when the earthing switch is 'ON'.

SAFETY DEVICES

The following Safety devices shall be provided for the safety of the operating personnel :

a. Individual explosion vents shall be provided for breaker/bus bar/cable chambers on the top of the panel to let out the gases under pressure generated in case of fault inside the panel.

b. Cubicle with front plate to withstand the pressure for internal arc fault as per PEHLA recommendation.

c. Circuit breaker and sheet metal enclosure shall be fully earthed.

d. Self locking shutters shall be provided which shall close automatically when the truck is withdrawn to 'Test position' and no separate padlocking of the shutter shall be required.

PROTECTIVE EARTHING

The earthing connection between the truck and the cubicle shall be by means of sliding contacts so that the truck is earthed in the isolated position when inserted and remains earthed when the truck is pushed further into the connected position or when the truck is being withdrawn until the truck has moved apart to isolated position.

CURRENT TRANSFORMER

I. GENERAL REQUIREMENTS

Accommodation shall be provided in the circuit breaker panel, to mount one set of duel ratio CT. Access to the CTS for cleaning, testing or changing shall be from the front, back or top of the panel.

II. RATING

Duel ratio CTS of suitable burden (but each not less than 15 VA) shall be preferred with 5 amps secondaries.

Instrument Security Factor (ISF) of each CT shall not be more than 5.

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. CT terminals shall be shorting type. Current & voltage circuits shall be laid in separate wire ways. Secondary terminals of CTS shall be brought out to a suitable terminal block which will be easily accessible for terminal connections. Test terminal block shall be provided in the front side of the panel for testing purpose.

CT'S shall have 2 Nos. of cores for following application:

Core -1	for metering
Core -2	for over current & earth fault protection.

Class of accuracy of each winding

Metering class	1
Protection class	5P10

POTENTIAL TRANSFORMERS

The potential transformers shall be confirming to IS 3156/ IEC 60185.The primary windings of the potential transformers shall be insulated and shall be of the cast epoxy resin type.

Potential transformer (PT'S) shall be mounted on a draw out trolley and housed in separate metal compartment and shall have control fuses on the H.V. side and a miniature circuit breaker on the L.V. side of the windings. HT HRC Control fuses shall be confirming to IS – 9385/ IEC –60282. Miniature Circuit breaker shall comply with IS – 8828/ IEC – 60898.

Padlocking facilities shall be provided for both service and isolated position.

The potential transformer shall be as specified below:

Ratio	:	11kV/ sqrt (3)/ 110 V/ sqrt(3)/ 110 V
V A Burdan	:	50 V A for 100/V3 and 110 V winding

Class	:	CL –1 for both the windings.
Basic Insulation level	:	Same as mentioned for VCB in clause -6.
Over voltage factor	:	1.2 Continuous

Single phase PT'S shall be used and shall be connected in Star/ Star.

PROTECTION AND TRIPPING ARRANGEMENT

PROTECTION

All protection relay shall be numeric type of approved make.

The protection and tripping arrangement of circuit breaker shall be:

a. Numeric type instantaneous short circuit protection Device No.50 Range 500 – 2000% shall be provided on all phases.
b. Numeric type back up over current protection for Phase faults Device No.51 Range 50 – 200% shall be provided on all phases.
c. Numeric type ground fault protection Device No.50G. CT's. Range 20 – 80% shall be provided.
d. Lockout and trip supervisory relays etc shall be provided with manual reset facility.
e. Auxiliary relay for transformer fault.
f. Surge Arrestor

CONTROL WIRING

The control wiring shall be carried out with minimum 2.5 sq. mm. PVC insulated copper conductor cables. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification PVC ferrules shall be fitted to all wire terminals to render easy identification and facilitate checking in accordance with IS 5578 and 11353.

METERING INSTRUMENT PANEL ACCESSORIES

I. METERING

Digital Square/Trivector type meter of approved make (Smart demand controller) shall be provided on the incomer feeder. Specification of the meter shall be as follows:

Accuracy	:	Class 0.5, compliant to revenue class certification.
	:	Real time measurement per phase & average V, I, PF, KW, KVAR, KVA
	:	Peak demand
Communication	:	One each of RS 485

II. INSTRUMENT PANELS

The instrument panel shall be part of the housing. Relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the

Contractor for approval before starting the work. They shall be of flush mounting type.

III. INSTRUMENTATIONS

a) Digital type Voltmeter of class 1.0 accuracy and 96 x 96 mm square in size as per IS-1248 shall be provided at incomer panel, with selector switch. The instrument shall be calibrated for the ranges specified.

b) Digital type Power factor meter of class of 1.0 accuracy conforming to IS: 1248 shall be provided at incomer panel.

c) Digital type Ammeter of specified range to class 1.0 accuracy and 96 x 96 sq mm in size as per IS - 1248 shall be provided at both incomer and outgoing panels along with necessary selector switches.

d) Digital type frequency meter class of 1.0 accuracy conforming to IS: 1248 shall be provided at incomer panel.

IV. The following minimum indication lamps shall be provided in the front of cubicle.

Breaker open / closed / tripped, spring charged trip circuit healthy and control supply healthy. Lamps shall be clustered LED type and trip circuit supervision scheme shall be of continuous supervision type.

V. After meeting all necessary control and indication requirements 2 nos. NO and 2 nos. NC auxiliary of the breaker shall be made available for the owner, wired up to terminal block.

VI. Separate MCB's shall be provided for lamps, heaters and other instrumentation etc. on each panel.

VII. Anti-condensation space heaters suitable for operation on 240 V single phases, 50 Hz A.C. for each cubicle and with thermostat control one incandescent lamp with switch and 3 pin 5 amps plug socket.

DRAWINGS/DOCUMENTS REQUIRED FOR REVIEW/APPROVAL

Following drawings/documents shall be submitted by the Contractor to the Project Incharge for approval before start of work.

a. General arrangement (GA) of equipment layout and SLD.

b. Equipment list with complete specifications.

c. Relay and metering system schematics.

d. Supply and erection schedule.

e. Catalogue and specification sheets of manufacturers.

INSPECTION AND TESTING

After manufacturing of switchgear panels, tests shall be carried out on the equipment as per relevant IS and Electricity Regulations. **The inspection and testing will be carried out as per the instructions of the Engineer-in-charge of the work in the manufacturer factory outlet before brought at site of work.**

QUALITY ASSURANCE

Contractor shall submit in substantial detail a quality assurance plan indicating all activities step by step at various manufacturing/fabrication stages to meet the requirement of this specification and various standards/regulations/practices to enable comprehensive assessment of its merits and reliability.

1.2 POWER PACK (BATTERY CHARGER UNIT):

i General

The battery charger shall be Float cum Boost type Thyristor controlled. The charger shall have selector switch for Auto Float – Boost / Manual Float / Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost mode and Vice-Versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to trickle charge.

ii. Construction Feature

Float cum Boost charger and DC Distribution Board shall be housed in sheet steel cubicle with panels of 1.6 mm thickness, louvers for ventilation glands plate will be provided for cable entry from bottom. The cubicle shall be paintedas per standard. The battery charger is divided into two compartments. The upper compartment houses the battery charger with all the necessary controls. The lower compartment is suitable for housing the batteries.

iii. Performance

The D.C output voltage of Float / Boost charger shall be stabilized within ± 2% for AC input variation of 230 V ± 10%, frequency variation of 50 Hz ± 5% and DC load variation of 0-100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response SCR control. The ripple content will be within 3% of DC output nominal voltage.

There shall be provision to select Auto Float / Manual Float / Manual Boost modes. During Auto Float Mode the battery charging shall automatically changeover from Boost Mode to Float Mode and Vice Versa. During Manual Float / Boost modes it shall be possible to set the output volts by separate potentiometers.
The battery charger shall have automatic output current limiting feature.

iv. Components

The battery charger shall essentially comprise of the following

1 No. double pole ON/OFF MCB at AC input.

1 No. pilot lamp to indicate charger ON.

1 No. Main Transformer: Double wound, naturally air cooled, having copper winding.

1 set single phase full wave bridge rectifier consisting of 2 Nos. diodes and 2 Nos. SCRs, liberally rated, mounted on heat sinks and complete with resistor / condensor network for surge suppression.

1 No. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.

1 set solid state constant potential controller to stabilize the DC output voltage of the float cum boost charger at ± 2% of time set value for AC input voltage variation of 230 V ± 10%, frequency variation of ± 5% from 50 Hz and simultaneous load variation of 0-100% and also complete with Current Limiting Circuit to drop the Float Charger output voltage upon overloads to enable the battery to take over.

1 No. electronic controller to automatically changeover battery charging from boost to float and vice versa.

1 No. DC ammeter and toggle switch to read charger output current and battery charge / discharge current.

1 No. moving coil DC voltmeter to read the DC output voltage.

2 set potentiometer to adjust the output voltage during manual /auto float and boost modes.

1 No. double pole ON/OFF MCB for Charger Output (24 V DC Rating).

2 set DC output terminals. 1 set for the load and the other set for the battery.

Alarm Annunciation : Visual and audible alarm with manual accept reset facility shall be provided for the following :

a. AC mains fail
b. Charger Fail
c. Load / Output overvolt.

Rating

AC Input	:	230 V ± 10% AC 50 Hz single phase.
DC Output	:	**To float / boost charge 24 V / 200 AH batteries and also supply a continuous load.**

Current Rating	:	**30.0 Amps**
Float Mode	:	**27.0 V nominal (Adjustable) between 24-28.0 V.**
Boost Mode	:	**28.2 V nominal (Adjustable) between 24-29.0 V.**
Voltage Regulation	:	**± 2% for AC input variation of 230 V ± 10%. Frequency Variation of 50 Hz ± 5% and DC load variation 0-100%**
Ripple	:	**Less than 5%**

v. DC Distribution Board

It shall be provided in the charging cubicle, it will comprise of the following:

Incoming : 1 No. 63 A DP MCB

Outgoing : 10 Nos. 16 A DP MCB

2 500 KVA, 11/0.415KV Oil Filled, Copper wound, Level -II Transformers with ON Load Tap Changing Links on HV Side.

SCOPE

Design, manufacture, testing, supplying and commissioning of 1000 KVA, 11/0.415 KV step down transformer complete with all the accessories and fittings for efficient and trouble free operation.

CODES and STANDARD

Transformer shall conform to Indian Standard IS: 2026-Part I to Part IV, ECBC-2007 (Revised in May 2008).

RATING

Selected transformer shall be of specified rating suitable for continuous operation.

CONNECTIONS AND VECTOR GROUP

Delta on High Voltage side and star on low voltage side with neutral terminal brought out for solid earthing corresponding to the Vector Symbol Dyn - 11.

SYSTEM OF SUPPLY

3 phase, 50 Hz, 11 KV earthed system.

TAPPINGS

'ON' load tap changing links on HV side. The tapings to be provided for variation on HV side from +/- 2.5% to +/- 5% & -7.5% in steps of 2.5% each or as per latest IS:

TEMPERATURE RISE

Continuously rated for full load, temperature rise not exceeding 45° C by thermometer in oil or 55 Deg C by resistance.

TYPE

Indoor type.

TERMINALS

The cable box with glands on H T side shall be suitable for 3 core 240 Sq.mm. XLPE 11KVcable. Cable box on LT side shall be suitable for bus duct 50 KA Bus-duct. All cable glands shall be earthed.

COOLING

Natural Air cooling by means of pressed/round tubes around transformer tank.

INSULATION

The transformer shall be oil insulated type.

EARTHING

Two separate earthing terminals to be provided at the bottom on both sides.

FITTINGS AND ACCESSORIES

The following accessories and fittings shall be provided.

a) Lifting Lugs: The arrangement for lifting the active part out of the transformer tank alongwith the cover by means of lifting lugs without disturbing the connections.

b) Swivel Type Rollers: the transformer to be provided with 4 Nos. Bi-Directional rollers fitted on cross channels to facilitate the movement of the transformer in both directions.

c) Oil Conservator: The Transformer to be provided with an oil conservator with welded end plates. It is to be bolted to the cover and can be dismounted for purpose of transport. It has to be provided with magnetic oil level gauge and an oil filling hole 1 1/4" BSF size with a cap, which can be used for filtering oil. For draining purpose a plug shall be provided. A connection pipe between the conservator and the main tank is to be provided which projects inside the conservator and the main tank

d) Air release Valve: An air release valve is to be provided on the top of the tank cover facilitate the release of the entrapped air and filling of oil.

e) Breather : The transformer to be provided with an indicating dehydrating silicagel breather of sufficient capacity.

f) Drain-cum-oil Filter Valves: The transformer to be provided with a drain-cum-oil filter valve of 1 1/4" BSF size at the bottom of the tank.

g) Diagram and rating plate: Diagram and rating plate shall be provided indicating the details of transformer, connection diagram, vector group, tap changing diagram etc.

h) Dial type thermometer for Oil (150 mm dia) with maximum set pointer at 75 deg C and electrical contacts for electrical alarm at high temperature.

i) Winding temperature indication and electrical contacts for trip / alrm.

k) Filter valve of 1 1/4" BSF at top.

l) Explosion vent.

m) Disconnecting chamber shall be provided for cable termination.

n) Outdoor type Marshalling box with interconnecting cables

o) HT Cable box suitable for 3 C x 240 sq.mm HT XLPE (E) cable

p) LV Cable box suitable for bus-duct 800 Amp

WINDING

The transformer shall be copper conductor wound.

CORE

The magnetic core shall be made up of prime grade cold rolled grain oriented of M4 or betterwith low loss steel stampings. The core design to be boltless design.

DRAWINGS AND LEAFLETS

Three copies of operation and maintenance manual with complete instructions for the installation, operations, maintenance and repairs, circuit diagram, foundation and trenching details shall be provided with the transformer. The transformer manufacturer shall have type tested.

Maximum Allowable Power Transformer Losses

Maximum allowable losses for oil filled distribution transformers with highest voltage for equipment 11 KV, at 50% and 100% of the load.

TRANSFORMER CAPACITY KVA	MAXIMUM ALLOWABLE LOSSES AT 50% KVA or Load	MAXIMUM ALLOWABLE LOSSES AT 100% KVA or Load
1000	AS per level II Transformer	AS per level II Transformer

Measurement and Reporting of Transformer Losses

TESTING

The transformer shall be subject to the following tests at the factory before dispatching the same and test certificates shall be furnished. The OEM should conduct the testing at NABL accrediated lab.

a. Measurement of winding resistance.

b. Ratio polarity and phase relationship.

c. Impedance voltage.

d. Load losses.

e. No-load losses and no-load current.

f. Insulation resistance.

g. Induced over voltage withstand.

h. Separate - source voltage withstand.

j. Temperature rise.

k. Di-electric strength of oil.

1. Remote Tap Changer Control Panel (RTCC) for 11/0.433kV, 1000 kVA transformer

RTCC panel shall be of sheet steel cabinet for indoor installation, floor mounting type. The RTCC panel shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors, Neoprene gasket and padlocking arrangement. RTCC panel with AVR having provision of master slave shall be suitable for the climatic conditions as specified in Special Conditions. Steel sheets used in the construction of RTCC panel shall be 14 SWG CRCA sheet steel 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-I) for factory built assembled switchgear & control gear for voltage upto 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 RTCC panel. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panel.

The following components shall be provided in the RTCC panel:

a) Digital Tap Position Indicating Meter
b) Raise/Lower Push Buttons for Remote Control of OLTC
c) Tap Change in Progress Signal Lamp.
d) Supply on Signal Lamp
e) Local / Remote Control Indicating Lamps
f) Panel illuminating lamp with door switch.
g) Space Heater with Switch and Thermostat.
h) Automatic Voltage Relay with Time Delay Element.
i) Selectors switch for Auto/Manual Operation.
j) Undrilled Gland Plate for Cable entry.
k) Earthing Terminal
l) Lifting Eyes Bolts.

Add the following data sheet

Vender has to furnish the technical data sheet and get it approved before procurement.

Particulars	**1000 kVA, 11/0.433 kV**
Specification	IS 2026 IS 1180 Part I - 1977 Part II - 1977 Part III – 1981 Part IV - 1977 IEC -60076 – 2000/2002
Type	Three phase, core type, oil filled
Duty	Outdoor, installed in open yard / trafo pen.
Voltage HV/LV kV	11/0.433
Frequency	50 Hz
No. of phase	3
Continuous rating	1000 kVA
Insulation class	Class A
Cooling	ONAN
Winding connection	Star/ Delta
Vector group	Dyn11
System earthing	11kV- Effectively earthed 0.433kV
Percentage impedance	6.25 % @ 1000 kVA or as per latest IS code.
Impedance tolerance	
Termination	11kV – AL. cable

Particulars	1000 kVA, 11/0.433 kV
	0.433kV – Bus Duct/ AL. cable
Temperature rise over 50°C ambient temp	
a) In oil (measured by Thermometer)	50 deg. C
b) In winding (measured by Resistance method)	55 deg. C
Bushing mounted CT's	
a) HV bushing mounted PS class CT for differential protection	
b) HV Neutral bushing PS Class CT for REF protection.	-
c) HV Neutral bushing CT for standby E/F protection class 5P20	-
d) LV bushing mounted PS class CT for differential protection	
e) LV Neutral bushing PS class CT for REF protection.	AS PER REQUIREMENT
f) LV Neutral bushing CT for strand by E/F protection 5P20	AS PER REQUIREMENT
Tap changer on primary side	On load
a) Range	+5%, to -15%
b) Total tap positions	17
c) Taps above nominal voltage	4
d) Taps below nominal voltage	12
e) Voltage per step variation	+/-1.25%
f) Tap change controls	Local Manual, local electrical, remote electrical, fully automatic
Impulse test withstand voltage kVp	75/-
One minute dry and wet power frequency withstand voltage kV rms	28/3
Induced over voltage withstand voltage	As per IS 2026, Part III – 1981
Short circuit level on HV (11kV) side	500 MVA
Short circuit level on LV (0.433kV) side	50 kA
Withstand time without injury for 3 phase short circuit at secondary terminals	3 Seconds.
Auxiliary supply voltage	220 V DC/ 415 V AC
Parallel operation	Suitable for parallel operation with transformers of similar ratings
Overload capacity	As per IS 6600 –1972
Radiators	Detachable type
Flux density (at rated voltage)	1.6 Tesla Max
Magnatizing current	1.0% of rated current
Current density	2.5A / sq.mm
Maximum Losses (As per latest IEC and	No Load Loss :

Particulars	1000 kVA, 11/0.433 kV
IS standard)	Load Loss :

3 M.V. PANEL DISTRIBUTION BOARD

i GENERAL

Medium voltage power control centres (generally termed as switchboard panels) shall be in sheet steel clad cubicle pattern, free floor standing / wall mounting type, totally enclosed, compartmentalized design having multitier arrangement of the incomers and feeders as per details given in the schedule of quantities. The panels shall be of extensible type with provision of bus bar extensions. All panels shall conform to the requirements of the latest addition of IS and shall be suitable for 415 V, 3 phase AC supply or 230 V single phase AC supply as required.

ii CONSTRUCTION

All switch board panels or power control centres of free standing 4b type shall have a bus bar chamber at the top and the cable compartment at the bottom or as approved by the Architects/Consultants depending upon the specific requirements of the job. The space between the bus chamber and cable compartment shall be suitably compartmentalized to accommodate either air circuit breakers or moulded case circuit breaker of various ratings. The cable terminations shall be carried out on the rear side of the panels for which adequate space and clamping arrangements shall be provided. Where panels have to be installed with very little access space at the rear, the cable terminations shall be carried out in suitable cable alleys provided on the front of the panel. All the live parts shall be properly shrouded with Bakelite barriers. All the equipment shall be accessible from the front. However, protection relays, KWH meters, etc. may be mounted on the rear side/front side if required. Arrangements and marking of bus bars, main connections and wiring shall be in accordance with IS: 5578 -1985 and 11353-1985.

The structure of the panel shall be robust and provided with adequate bracing's to withstand the operation of the equipment and stresses due to system short circuit. The panels shall be fabricated out of best quality heavy gauge sheet steel. The panel shall be machine pressed with punched openings for meters, indicating lamps etc.

iii DIMENSIONS

All power control centres shall have dimensions of not more than that given on the layout drawings. Panels arranged side by side shall have the same height and depth. The height of the panel should be limited to 2400 mm. All the operating levers, handles etc. of the highest unit shall not be at a height more than 1700 mm from F.F.L. For all incoming cables a removable gland plate will be provided in the panel and a minimum distance of 300 mm will be provided between the gland plate and the nearest terminal for proper dressing and termination of the cable. All the components of a module will be mounted on a component plate using the machine screws and taped holes (excepting the components mounted on the door). These component plates should be fixed with bolts for easy replacement.

Standardization will be adopted while making these plates so that the component plates of the same size modules can be changed from one module to another. In case of panel of lengths more than 4 meters the fabrication of any single section will be limited to a maximum length of 4 mtr. for the purpose of shipping and shifting at the site. These sections will be assembled at the location of installation with the help of nuts and bolts. While making these sections consideration will be given to the place of sectionalization and select the location where the minimum electrical connections are transferred from one section to another. All the hardwares used in the assembly will be electroplated for protection and neat appearance.

iv BUS BARS

The bus bars shall be suitable for 4 wire, 415 volts, 50 Hz, system. The main bus bar shall be made of high conductivity electricity conductor grade electrolytic AL 91E Aluminium and shall be liberally sized. In case of copper bus bar it shall be electrically conductor grade electrolytic copper and at the time of joining of two copper buses tinning will be done on the copper strips ends to a length equal to the lap length of the joint plus one each. The bus bars shall have uniform cross section throughout. The bus bars shall be capable of carrying the rated current at 415 volts continuously. The bus bar will run in a separate bus bar chamber using bus insulators made of nondeteriorating, vermin proof, non hygroscopic materials such as epoxy fiber, reinforced polyester or moulding compound. The interval between the two insulators will be designed after considering:

a) Strength and safe load rating of the insulator,

b) The vibrating force generated during a fault,

c) A Factor of safety of 1.8

d) A set of insulators at both ends of the bus.

The size of the bus bar calculations must be approved by the consultants. The bus bars shall be designed to withstand a temperature rise of 50° C above the ambient. To limit the temperature rise in the bus bar chamber a set of louvers can be provided at strategically places considering the air circulation. The louvers provided will have a brass wire mesh covering from inside with more than 100 openings per sq. inch. The overall temperature of bus bar shall not exceed 85°C in any case. A current density of 1.0 Amps/Sq.mm shall not be exceeded for aluminium bus bars.

All the bus bars shall be insulated with PVC heat shrinking sleeves suitably throughout (except at joints) the length. The electro galvanized high tensile steel nuts, bolts, plain or spring washers of suitable size will be used in connecting the various section of the bus bar. A minimum of 1.6 times the width of bus bar will be the lapping length of each joint.

v EARTHING

The panels shall be provided with an aluminium or copper earth bus of suitable size running through out the length of the switchboard. Suitable earthling eyes/bolts shall be provided on the main earthing bus to connect the same to the earth grid at the site. Sufficient number of star washers shall be provided at the joints to achieve earth continuity between the panels and the sheet metal parts.

vi INTERLOCKING

The panels shall be provided with the following interlocking arrangement.

a) The door of the switch-fuse compartments is so interlocked with the switch drive or handle that the door can be opened only if the switch is in `OFF' position. De-interlocking arrangement shall also be provided for occasional inspection.

b) It shall not be possible for the breaker to be withdrawn when in `ON' position.

c) It shall not be possible for the breakers to be switched on unless it is either in fully inserted positions or for testing purposes in fully isolated position.

d) The breaker shall be capable of being raked in to `testing' `isolated' and `maintenance' positions and kept locked in any of these position.

e) A safety latch to ensure that the movement of the breaker as it is withdrawn, is checked before it is completely out of the cubicle shall be provided.

f) The main LT panel shall have suitable interlocking of two nos. of transformer and two nos. of DG sets on auto/manual mode complete as required.

vii PROTECTION & INSTRUMENTATION

Protection and instrumentation shall be as per standard specifications.

viii CONTROL WIRING

The control wiring of all the panels will be done with PVC single core flexible copper wires of cross section 1.5 sq.mm and 2.5 sq.mm. All the wiring involving current transformers or circuits with currents of more than 5 Amps will be wired with 2.5 sq.mm cross section wire and the others with 1.5 sq.mm. Similarly all the interconnecting between the incoming bus and the outgoing of 100 Amps and above rating shall be done by insulated copper strips of suitable sizes and equipment below 100 Amps rating shall be wired with insulated copper conductors. All of the control wiring will be done by properly dressing all the wires in a laminar manner either in a PVC duct of liberal size or bunched together by PVC strapping tapes at a distance not exceeding 150 mm. Each wire will terminate with a copper ferule crimped to the wire. The PVC ferules will be used to identify each wire of the circuit and the same number will be marked on the drawing for the corresponding wire. Only one outgoing wire will be connected to one connector. When the control wiring is crossing from fixed parts to moving parts such as door etc. the wire will be run in PVC sleeve of suitable size and the same will be mechanically clamped at both the ends i.e. one end of the fixed part and the other on the moving part. Under no circumstances the wiring should be under any kind of stress for which sufficient length of control wiring in the PVC sleeve should be provided. All the potential circuits shall be protected by fuses mounted near the tap off point from the main connections.

ix SURFACE TREATMENT

The each part of the fabricated panel will be subjected to minimum seven tank treatment and all sheet metal accessories and components of power control centres and switchboard panels shall be thoroughly cleaned, degreased, de-rusted and hot dip phosphatised before red oxide primer is applied. The panel shall be stove enameled gray shade finish and the Interior surfaces of the panel shall be painted to an off-white shade.

x ENCLOSURE

The panel enclosure shall be totally dust and vermin proof and shall be suitable for indoor installation. All the cubical will be adopted with front located, outward openings, lockable doors having hidden hinges and a bolted back cover both using no deteriorating neoprene rubber gasket. Enclosure design shall be in accordance with degree of protection IP 54 as per IS : 13947. All the nut bolts handles, meters, knobs etc. appearing from out side of the panel should be located in symmetry so as to give a neat appearance.

xi NAME PLATE

The panel as well as the feeder compartment doors shall be provided with name plate giving the switchboard/feeder descriptions as indicated on the drawings. The above shall be mounted in metal holder with a clear plastic sheet on inside surface of the front door.

xii TESTING

The power control centres shall be tested at factory after assembling of all components and completion of all interconnections and wiring. Tests shall be conducted in accordance with the requirements of BS:3659.

Insulation Test

a) Insulation of the main circuit, i.e. the insulation resistance of each pole to the earth and that between the poles shall be measured.

b) Insulation resistance to earth of all secondary wiring should be tested with 1000 volt meggar.

Insulation test shall be carried out both before and after high voltage test.

High Voltage Test

A high voltage test with 2.5 KV for one minute shall be applied between the poles and earth. Test shall be carried out on each pole in turn with the remaining poles earthed, all units raked in position and the breakers closed. Original test certificate shall be submitted along with panel.

xiii STORING, ERECTION AND COMMISSIONING

a) The panels shall be stored in a well ventilated, dry place, with suitable polythene covers shall be provided for necessary protection against moisture.

b) Erection

Switch boards shall be installed on suitable foundation. Foundation shall be as per the dimensions supplied by the panel manufacturer. The foundation shall be flat and leveled. Suitable grouting holes shall be provided in the foundation. Suitable MS base channel shall be embedded in foundation on which the panel can be directly installed. The switch boards shall be properly aligned and bolted to the foundation by at least four bolts. Cables shall be terminated on the bottom plate or top plate as the case may be, by using high quality brass compression glands. The individual cables shall then be led through the panel to the required feeder compartments for necessary terminations. The cables shall be clamped to the supporting arrangement. The switchboard earth bus shall be connected to the local earth grid.

c) Pre-commission Tests

Panels shall be commissioned only after the successful completion of the following tests. The tests shall be carried in the presence of Architect's/Consultant's or their representatives.

i) All main and auxiliary bus bar connections shall be checked and tightened.

ii) All wiring termination and bus bar joints shall be checked and tightened.

iii) Wiring shall be checked to ensure that it is according to the drawing.

iv) All wiring shall be tested for insulation resistance by a 1000 volts meggar.

v) Phase rotation tests shall be conducted

vi) Suitable injection tests shall be applied to all the measuring instruments to establish the correctness and accuracy of calibration and working order.

vii) All relays and protective devices shall be tested for correctness of settings and operation by introducing a current generator and an ammeter in the circuit.

xiv STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.

Low Voltage switchgear & control gearIS 60947 : 1993
Part I : General rules
Part II : Circuit Breakers
Part III : Switches, disconnectors, switch disconnectors and fuse combination units
Part IV: Contactors and Motor starters
Part V : Control circuit devices and switching elements

Marking of Switchgear busbarsIS 11353 : 1985
Degree of Protection of Enclosures for low voltage switchgear. IS 2147 : 196 Electrical relays for power system protectionIS 3231 : 1986 Code of Practice for selection, installation and Maintenance of switchgear & control gearIS 10118 : 1982 Low voltage switchgear & control gear assembliesIS 8623 : 1993

xv SWITCHGEARS

a Medium Voltage Air Circuit Breakers

Technical Parameters

- The circuit breaker shall be of the air break type, robust and compact design suitable for indoor mounting and shall comply with the requirement of IS/IEC:60947 part II & IEC 60947-2&3 Rupturing capacity shall be 35 MVA or 50KA RMS at 415 Volts AC as per schedule of quantities. The ACB should have Ics=Icu=Icw =50KA for 1sec. Manufacturer should submit test certificates for Combined sequence as per IS/IEC standards.
- All 4 Pole ACBs should have 100% Neutral rating (fully rated neutral pole)

Constructional Features

The Circuit Breaker shall be of modular construction having double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety, flush front, metal clad, horizontal draw-out pattern, three/four pole as required and fully interlocked. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.

- The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal and insertion. The movement shall be free of jerks, easy to operate and positive.

- All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts. In addition, Arc chutes shall be provided for each pole, and these shall be suitable for being lifted out for the inspection of the main and the arcing contacts without using any tools

- Self aligning cluster type isolating contacts shall be provided for the Circuit Breaker, with automatically operated shutters to screen live cluster contacts when the Breaker

is withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.

- The cubicle for housing the Breaker shall be free standing dead front pattern, fabricated from the best quality sheet steel.

- It should be possible to know the control voltage ratings for all electrical accessories from ACB front facia.

Operating Mechanism

- The Circuit Breaker shall be trip free with independent manual spring operated or motor wound spring operated mechanism as specified and with mechanical ON/OFF indication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energised.

- The operating handle and mechanical trip push button shall be at the front of and integral with the Circuit Breaker.

- The Circuit Breaker shall have the following four distinct and separate positions which shall be indicated on the face of the panel.

  "Service" -- Both main and secondary isolating contacts closed
  "Test" -- Main isolating contacts open and secondary isolating contacts closed
  "Isolated" -- Both main and secondary isolating contacts open

Circuit Breaker Inter locking

- Sequence type strain free interlocks shall be provided to ensure the following:

- It shall not be possible for the Breaker to be withdrawn from the cubicle when in the "ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated. The racking shutter should open only when ACB is OFF and Door interlock is defeated.

- It shall not be possible for the Breaker to be switched "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position.

- It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFF position.

- Mechanical and electrical anti pumping devices shall be incorporated in the ACB's as required.

Circuit Breaker Auxiliary Contacts

The Circuit Breaker shall have minimum 4 NO/NC auxiliary contacts rated at 16 amps 415 volts 50 Hz. These contacts shall be approachable from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn Out of the cubicle.

Protective Devices

All ACBs shall be provided with CT operated microprocessor based release having following inbuilt protections & features:

i) Adjustable Over Load 40% to 100% (Phase & Neutral) with adjustable time delay
ii) Adjustable Short Circuit with adjustable time delay
iii) Adjustable Instantaneous S/C without intentional time delay
iv) Adjustable Earth Fault protections with selectable time delay.
v) The Release should have LCD display for current & voltage metering & 10 trip fault History with time and date on real time basis along with Zone Selective interlocking feature.
vi) The release should separate fault indication by LEDs for identification of type of fault on ACB release with % load bar graph of each phase also on ACB release.
vii) The release shall sense true RMS value of current to avoid nuisance tripping during starting.
viii) The release shall meet the EMI / EMC requirements.

All **Incomer ACBs (except bus couplers & APFC panels)** shall have following additional protections & features other than mentioned above to be achieved thru Relays / releases:

- Under & Over Voltage
- Under & Over Frequency
- Under Current & Current unbalance (for DG set only)
- Reverse Power (for DG set only)
- Maximum Demand
- Restricted Earth Fault protection
- Trip Circuit supervision

Safety Features:

- Draw out ACBs shall be provided with automatically operated safety shutters to prevent accidental contact with live contacts when breaker is withdrawn from the Cradle.

- For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle. It shall not be possible to interchange two circuit breakers of different thermal ratings.

- For safety of users, interlock should be provided between breaker operating mechanism & the arc chutes to prevent closing in case the arc chutes are not properly secured.

- The insulation material used shall conform to Glow wire test as per IEC60695.

Accessories:

- Under/no voltage trip coil as required.
- Shunt trip coil for remote operation as required.
- Door Interlock
- Neutral CT should be provided for 3Pole ACBs for Earth Fault sensing
- Common Fault Indication (O/L & S/C) Micro switch should be provided for all ACBs except bus couplers

Instrument Transformers

The Circuit Breaker shall have the required Current Transformers as specified for metering and protection mounted outside the Circuit Breaker compartment but within the free standing cubicle. The transformers shall comply to the relevant Indian Standards and the Class of Accuracy required for metering and protection. Separate sets of Current transformers shall be provided.

Metering

The metering required to be provided for each Circuit Breaker shall be as per the Schedule of Quantities. Such metering shall not be provided on the front panel of the Circuit Breaker compartment. A separate compartment shall be provided for the metering and Protective relays as required.

Square pattern flush mounting meters complying with the requirements of the relevant Indian Standards shall only be used.

Selector switches of the three way and OFF pattern complying to the relevant Indian Standards shall be used.

Indicating Lamps

Neon type indicating lamps shall be provided for indication of phases and Breaker position as required in the Drawings/Schedule of Quantities.

Control Wiring

All wiring for relays and meters shall be of copper conductor PVC insulated and shall be colour coded and labelled with appropriate plastic ferrules for identification. The minimum size of control wires to be used shall be 1.5 sq mm.

All control circuits shall be provided with protective MCB. Instrument testing plugs shall be provided for testing the meters.

Earthing

The frame of the Circuit Breaker shall be positively earthed when the Circuit Breaker is racked into the cubicle.

Type Test Certificates

The Contractor shall submit type test certificates from CPRI/ERDA or any International recognized test house for the Circuit Breakers offered.

b Moulded Case Circuit Breakers

MCCBs 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 IS/ IEC60947 – Part 2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA/ any NABL accredited lab.

MCCB shall comprise of double break contact Structure with 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 minimum 35 KA or as specified in drawings/schedule of quantities. The rated service breaking capacity should be equal to rated ultimate breaking capacities (Ics=Icu) at 415V AC. The rated operational voltage shall be minimum 415V AC. Rated insulation voltage (Ui): 690V AC and rated Impulse voltage 8 KV.

MCCBs shall be provided with Thermal Magnetic type release with adjustable settings for both Overload and Short circuit protections with Frame size 32Amp to 250Amp of one frame & 400/630Amp of one frame.

The electrical Life of MCCB should be minimum 10000 no. Electrical on load operations for Ratings upto 250Amp & 6000 no. Electrical life for 400Amp & 4000 no. Electrical life for 630Amp rating.

All MCCBs should be provided with the Rotary Operating Mechanism. All rotary mechanism should be with door interlock (with defeat feature) & padlock facility.

MCCB above 63A rating should be provided with Copper spreader links and phase barriers as standard feature

MCCB should have superior quality of engineering grade plastics used for insulation purpose and conform to glow wire test (Ref: IEC60695-2-1)

MCCBs shall be provided with following accessories, if specified in drawings/schedule of quantities

- Under voltage trip
- Shunt trip
- Auxiliary and trip alarm contact

For Motor application, motor duty MCCBs (as SCPD) to be selected with reference to Type 2 coordination chart of manufacturer.

C MOTOR PROTECTION CIRCUIT BREAKER (MPCB)

Motor circuit breakers shall conform to the general recommendations of standard IEC 947 - 1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752) and to standards UL 508 and CSA C22-2 N°14.
The devices shall be in utilization category A, conforming to IEC 60947-2 with CE marked & breaking Capacity of 100KA for rating upto 10Amp & 10KA breaking capacity for rating from 9Amp to 32Amp AC3 conforming to IEC 947-4.MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without de-rating. Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the "isolated" position.
The motor circuit breakers shall be equipped with a "PUSH TO TRIP" device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream contactor enabling the provision of a perfectly coordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1.Type 2 co-ordination shall be guaranteed by tables tested and certified by an official laboratory: LOVAG (or other official laboratory). The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of 12 Ir.
All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 60°C without de-rating. The thermal trips shall be adjustable on the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available. Temperature compensation (-20°C to +60°C)

d **Power Contactors:**

The contactors shall comply with the requirements of IEC 60947-4-1/ with CE marking. Ambient Temperature 60DegC. Contactors for motor application should be of 3 Pole AC3 duty as specified in standards.

Main contacts of contactors shall be silver plated copper. Coil insulation should be of class H to withstand the higher temperature rise. Spare contact kits & spare coils replacement should

be possible for the entire range for maintenance. The maintenance of contactors and replacement of spare kits should be possible with disturbing busbar / cable termination.

The contactor should be having front and rear parts are in thermoplastics for rugged construction. The contactor should confirm to glow wire tests as per IEC 60695-2-1 with superior quality of engineering grade plastic used for insulation purpose. Complete range should be suitable for AL termination.

Contactors should have the possibility of having finger proof structure safety feature.

e Thermal Overload Relay:

Thermal Overload Relay used in the circuit with contactor shall be in conformity with IS: 842 part 2-1966 and it shall withstand insulation test to IS:12083 part 2. The relay shall be provided with adjustable current settings and with a provision of sealing the same to make it tamper proof.

The relay shall have built in single phasing protection and over load protection as per IEC60947- part 4. The relay shall have in built NO & NC contact. The thermal over load relay shall be suitable for Copper / Aluminum termination, with a maximum permissible temperature rise of 65°C, at the terminals, with maximum ambient temperature of 45°C.

For MCC Panels / motor feeders published Type II coordination chart of reputed manufacturers should be followed.

f Miniature Circuit Breaker:

The miniature circuit breakers shall be SP / DP / TP or FP as specified in BOQ. The tripping characteristics shall conform to classification C. MCB's should be minimum of 10KA breaking Capacity and should confirm to international and national standards IEC 898 – 1995 / IEC 947 – 2 / IS 8828 – 1996.

MCB's should have low let thro energy (Energy limitation class 3) with line load reversibility. MCB should be suitable for Isolation and have trip free mechanism.

MCB's should have provision for Bi-connect facility i.e. Cable and bus bar can be terminated separately allowing fast & safe connection. Two position din rails should be available. MCB's should have provisions to fix auxiliaries and earth leakage add – on at site in future. MCB's should have touch proof terminals.

MCB's should minimum have an electrical endurance of 20000 operations for 0.5A to 32A and 10000 operations for 40A to 63A.

The MCB shall be of plug in type with individual locking off facility; automatic trip reset facility and a common trip bar on TP MCBs.

MCB should have positive isolation feature for safety purpose and should have On OFF.

The MCB shall have self-wiring contacts with full size silver tungsten alloy contacts. Indications ON/OFF shall be moulded into MCB.

MCB used for controlling power circuits shall be with tripping characteristics of ‘C’ curve where as MCBs used to protect control transformer circuits & APFC Panels shall be with tripping characteristic of ‘D’ curve.

g Metering, Instrumentation and Protection.

Ratings, type and quantity of meters, instruments and protective devices shall be as per drawings and schedule of quantities.

Current Transformers

CTs shall confirm to IS 2705 (part -I, II and III) in all respects. All CTs used for medium voltage application shall be rated for 1 kV. CTs shall have rated primary current, rated burden and class of accuracy as specified in schedule of quantities/drawings. Rated secondary current shall be 5A unless otherwise stated. Minimum acceptable class for measurement shall be class 0.5 to 1 and for protection class 10. CTs shall be capable of withstanding magnetic and thermal stresses due to short circuit faults of 31 MVA on medium voltage. Terminals of CTs shall be paired permanently for easy identification of poles. CTs shall be provided with earthing terminals for earthing chassis, frame work and fixed part of metal casing (if any). Each CT shall be provided with rating plate indicating:

- Name and make
- Serial number
- Transformation ratio
- Rated burden
- Rated voltage
- Accuracy class

CTs shall be mounded such that they are easily accessible for inspection, maintenance and replacement. Wiring for CT shall be with copper conductor PVC insulated wires with proper termination works and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Potential Transformer

PTs shall confirm to IS 3156 (Part-I, II and III) in all respects.

Measuring Instruments

Direct reading electrical instruments shall conform to IS 1248 or in all respects. Accuracy of direct reading shall be 1.0 of voltmeter and 1.5 for ammeters. Other instruments shall have accuracy of 1.5. Meters shall be suitable for continuous operation between -10o C and +500C. Meters shall be flush mounting and shall be enclosed in dust tight housing. The housing shall be of steel or phenolic mould. Design and manufacture of meters shall ensure prevention of fogging of instrument glass. Pointer shall be black in colour and shall have Zero position adjustment device operable from out side. Direction of deflection shall be from

left to right. Selector switches shall be provided for ammeters and volt meters used in three phase system.

Ammeters

Ammeters shall be of moving iron type. Moving part assembly shall be with jewel bearings. Jewel bearings shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks. Ammeters shall be manufacture and calibrated as per IS 1248

Ammeters shall normally be suitable for 5 A secondary of current transformers.

Ammeters shall be capable of carrying substantial over loads during fault conditions.

Voltmeters

Voltmeters shall be moving iron type range of 3 phase 415 volt voltmeters shall be 0-500. Volt meters shall be provided with protection MCB.

Watt meter

Wattmeter shall be of 3 phase electro dynamic type and shall be provided with a maximum demand indicator if required.

Power factor meters

3 phase power factor meters shall be of electro dynamic type with current and potential coils suitable for operation with current and potential transformers provided in the panel. Scale shall be calibrated for 50% lag - 100% - 50% lead readings. Phase angle accuracy shall be +40.

Load Manager / Mutifunction Meter

1. The load manager shall be of 3 phase, 4 wire type and shall provide true RMS measurements of following parameters :

- Voltage – Line to Line & Average, Line to Neutral & Average, Neutral to Earth
- Current – Phase currents & Average, Neutral current
- Phase angles of Vr, Vy, Vb, Ir, Iy, Ib
- All parameters of Power for each Phase and Total
- All parameters of Energy – kVAh, kWh, kVARh
- Frequency of Supply

2 They shall be complete with the following functions :

- History log of Hi-lo profile with minimum 4 peaks and minimum 4 lows for Voltage, Current, Frequency, Power factor and all other parameters of power with Day, Date and Time of Occurrence.
- Shall have RS-485 Communication port.
- Meter should have LCD Display with IEC 62053-21/22 compliance with 64 sampling rate, percentage THD and individual Harmonics of upto 31st level.

Protection Relays

Protection relays shall be provided with flag type indicators to indicate cause of tripping. Flag indicators shall remain in position till they are reset by hand reset. Relays shall be designed to make or break the normal circuit current with which they are associated. Relay contacts shall be of silver or platinum alloy and shall be designed to withstand repeated operation without damage. Relays shall be of draw out type to facilitate testing and maintenance. Draw out case shall be dust tight. Relays shall be capable of disconnecting faulty section of network without causing interruption to remaining sections. Analysis of setting shall be made considering relay errors, pickup and overshoot errors and shall be submitted to Project Manager for approval.

Over current & Earth Fault relays

Three Phase Numerical 3 Over Current + 1 Earth Fault relay with highest protection for both Over current and Earth Fault, Draw out type relay with internal CT shorting links and following features:

.

1. Digit seven segment LED display
2. Selectable Trip time characteristics like Normal Inverse (NI), Very Inverse Extremely Inverse (EI), Definite Time (DT) etc
3. CT secondary 1/ 5 A site selectable through menu operations.
4. Relay Settings:
   Over Current - 0.2 to 2.0 times In, in steps of 0.05In
   High set Over Current [Ihs]- 0.2 to 40 times In, in steps of 0.2 In or Disable
   Earth Fault - 0.05 to 0.8 times On in steps of 0.05 On
   High set Earth fault - 0.1 to 20 times On in steps of 0.1 On or Disable
   Time Multiplier 0.1 to 1.6 in steps of 0.05 (independent settings for O/C & E/F modes)
5. Separate LED indications for Power ON, Trip status for R, Y, B & E (These LEDs blink when input crosses set point and become steady on when relay has tripped. LEDs have to be manually reset)
6. Output contacts: 4 NO contacts for trip signal on feeder fault.
7. Actual Measurement and display - RYB current and zero sequence current

Over / Under voltage relay

Over Voltage/Under Voltage Relay should be microcontroller based single-phase voltage relay suitable for Over voltage/Under voltage protection schemes in LV, MV and HV Power distribution systems, generators, Synchronous motor, Induction motors, automatic change over schemes etc.

The relay shall have the following features

- Two change over contact for tripping
- Less Burden at PT & Auxiliary supply
- Selectable Trip time characteristics
- Selectable Voltage level on site
- Separate LED indications for Power On, Over Voltage , Under Voltage Trip status, Trip time current Characteristics

h CONTROL DEVICES

Push Buttons

The push buttons used in the panels will be rated for more than 415 volts and 2 amps. All the push buttons will be mounted on the front door and the assembly will be in two parts. All the push buttons will be mounted on the front door of the cubicle in regular symmetrical fashion as per the general norms being practiced. Only one make of push buttons will be used in the assembly of all the panels. The selection of the colour of the push buttons will be as follows

Function	Colour
Starting/Switching ON	Green
Stopping/Switching OFF	Red
Resetting	Black
Forward ON	Yellow
Reverse ON	Blue
Emergency OFF	Red/Mushroom

Indicating Lights

The indicating lights used in the panel will be LED type pleasant looking and round shape having the following features;

1. A separate front lens for its easy replacement.
2. Facility to replace the bulb from the front.
3. Baynet pin cap bulbs of standard size to be used.
4. The shape of the lens to allow viewing from sides.
5. Series resistance with use of low voltage bulb for longer life.
6. Clear and distinct indication for light ON and OFF with differences of brightness of the lens.

The selection of the colours of the indicating lamps will be as follows:

- Red for system in operation
- Amber for system ready for operation.
- Green for system being put off.
- Red, yellow and blue for incoming supply.

4. APFC Panel (Automatic Power Factor Correction Panel)

SCOPE

This specification covers the requirements of design, manufacture, supply installation, testing and commissioning of APFC Panel with Detuned Filters (Switchable in Steps) complete with all accessories for efficient and trouble-free operation.All the capacitors shall be heavy duty type.

CODES AND STANDARDS

All Panels covered under this specification shall be designed, manufactured and tested in accordance with relevant standards and their latest amendments: IS 13340-1993, IS 13341-1992, IEC 60831-1+2.

GENERAL

440V capacitor banks are intended for supplying compensating leading VARs, thereby improving the overall power factor. Capacitor units shall be mounted inside the APFC panel, in separate cubicles. APFC panels with necessary controls, protections and accessories as per the specific requirements listed in this specification shall be supplied.

RATING

Capacitor units as specified in the BOQ shall be used to form a bank of capacitors.

ENCLOSURE

The panel shall be indoor type, free standing, and floor mounting with IP42 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure with angle supports as necessary and shall be finished with powder coating in the approved colour shade/s. The thickness of powder coating should be minimum 60-80 microns. Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided as a necessary. The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors. The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

APFC RELAY

Microprocessor based APFC relay (Intelligent VAr controller with BMS compatable port) shall sense the PF in the system and automatically switch ON / OFF the capacitor unit or stage to achieve the preset target PF. The controller shall have digital settings of parameters like PF, Switching time delay, Step limit etc, indication of PF, preset parameters, Minimum threshold setting of 1% of CT current.

CAPACITORS

The Capacitor should comply with the following standards and their latest amendments: IS 13340-1993, IS 13341-1992, IEC 60831-1+2

General Specifications: 3 phase, Delta connected MDXL type Super Heavy Duty designed to withstand system over voltage, increased voltage due to series reactor and harmonics. The combined kvar output for reactor and capacitor combination shall be designed at 440V AC. Capacitor should be 3 Phase Delta connected for suitable voltage & KVAR 50 HZ

Capacitor type : Ultra Heavy Duty mixed dielectric MDXL type with low loss with double side metalized tissue paper oil impregnated and self healing type with bi-axially oriented polypropylene film. The dielectric shall be combination of capacitor tissue paper and biaxially oriented polypropylene film impregnated with non PCB bio-degradable impregnant. Capacitor should be fitted with safety device like Pressure sensitive Disconnector. The Capacitor should be low loss type (Total losses should not exceed 0.5 W/ kVAR).

Capacitors shall be provided with permanently connected discharge resistors so that residual voltage of capacitors is reduced to 50 volts or less within one minute after the capacitors are disconnected from the source of supply.

SWITCHGEAR & PROTECTION

Incomer switchgear shall be TP&N breaker appropriate rating. Suitable capacitor duty

contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection. Busbars shall be suitably colour coded and must be mounted on appropriate insulator supports.

All capacitors shall be suitably protected against over current and short circuit by suitably rated HRC Fuses/ MCCB as mentioned in BOQ.

Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures upto 125 deg.C.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc. Suitable bus links for input supply cable termination shall be provided.

CONTROL CIRCUIT & GENERAL PROTECTION

The control circuit shall be duly protected by using suitable rating MCB. An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset). Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire. 440 V caution board on the panel shall be provided.

INSTALLATION

Capacitors banks shall be installed as per installation manual of supplier and shall conform to relevant Indian Standards. All interconnections in the control panel shall be checked before commissioning. Cable end boxes shall be sealed after cable connections to prevent absorption of moisture.

TESTING AND COMMISSIONING

The Manufacturer shall furnish the reports of type tests carried out on capacitors. Tests shall be as per specification and relevant standards conducted on identical components/ systems to those offered / proposed to be supplied under this contract Type test report from external agency such as CPRI/ERDA to be submitted for Capacitor & Reactor.

All routine tests shall be carried out as per applicable standards.

Components to be mounted and wired: Relays, contactors, Auto/ Manual selector switches, indicating instruments, timers, status indicating lamps, push button, fuses etc. required for satisfactory operation.

j **OUTDOOR TYPE DOUBLE DOOR DISTRIBUTION FEEDER PILLARS**

The feeder pillar shall be of the floor mounting type, totally enclosed, and weather proof, conforming to ISI IP 54. The feeder pillar shall be suitable for 440 volts 3 phase 4 wires, 50 cycles AC supply.

The cubicle should be fabricated out of heavy gauge sheet steel of thickness not less than 2 mm thick with suitable side frame and stiffeners. Hinged doors of not less than 1.6 mm thick

should be provided at the front and rear of the cubicle to provide access for installation, operation, tests and inspection. The rear door is provided to facilitate cable termination and the front door for inspection of breaker, to switch 'ON' and 'OFF' the switch as and when required. All doors should be fitted with dust excluding neoprene gaskets. The doors should also be fitted with suitable locking arrangement with lock to prevent unauthorized opening. The cubicle should be designed for mounting over cement concrete plinths by the roadside, and should be of substantial construction capable of withstanding the vibrations normally experienced due to vehicular traffic. The top of the feeder pillar is of slanting construction in all directions to prevent any collection of water due to rain. A gland plate is provided at the bottom of the feeder pillar (removable) for mounting the cable glands. The feeder pillar shall be fitted on an angle iron pedestal at the bottom covered with sheet metal from all the four sides which facilitates cable bending etc specially with aluminium cables. Two lifting hooks shall be provided at the top. A door switch shall be provided in the feeder pillar so as to switch 'ON' and 'OFF' the lamp fixed in the brass batten holder below the top sheet of the pillar.

The sheet steel materials used in the construction of the cubicle should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulfuric acid solution and recognised phosphating process. After metal treatment, the interior of the cubicle should be painted with two coats of air-drying red lead primer followed by two coats of air drying anti-condensation paint. The exterior of the cubicle should be painted with two coats of staving red oxide primer followed by one coats of epoxy finishing paint. One final spray of epoxy paint shall be applied at the time of handing over the installation.

All the nuts, bolts shall be cadmium plated with spring washers. A minimum spacing from cable connection to the bottom of gland plate shall be 300mm.

The bus bars should be of electrical grade copper. They should be air insulated with adequate clearances between conductors and between conductors and earth. These should be colour coded to enable immediate identification of the phases and neutral. The current density for bus bars shall not be more than 1.2 amps per square mm. All bus bar joints and tapings should be of the clamped type as far as possible thereby avoiding drilling of holes on bus bars. The bus bars should be carried on supports made out of a suitable non-inflammable and non-hygroscopic material such as Hylam, Permali or Formics. Suitable insulating phase barriers should be provided to prevent accidental short-circuits during operation.

The neutral bus bar shall be rated at 100 % of the phase bus bars. The design should allow for neutral cable sockets to be fitted directly to the bus bars. A GI earth bar of size 40x5mm together with two cable eyes shall be provided for connections to earth pits. All the cables shall be terminated at ELEMEX terminal block and therefrom wiring shall be done with PVC insulated aluminium conductor cable to breaker units. The wiring shall be neatly bunched and shall be secured to wiring cradles.

A circuit cardholder to be made inside the front door and the card duly engraved / painted on Aluminium / Hylam sheet, Identification ferrules shall be used for incoming and out going cables.

4. SILENT TYPE WITH CANOPY D.G. Set

This specification covers the design, manufacture, supply, installation, testing and commissioning. Auto start Diesel Generating Sets of capacity as per BOQ each alongwith accessories & allied equipment as per Schedule of Requirement to meet the requirement of the load.

The D.G. Sets covered in this Specification shall fully comply with the requirements/stipulations contained in Ministry of Environment & Forests (MOEF) Notification dated 17.05.2002 & subsequent amendments (dated 01.07.2003 & 12.07.2004) & any other notification and amendment, currently in force, and shall include integrated accoustic enclosures (canopy) approved by Central/State Pollution Control Board/ local authorities. The outlets of exhaust pipes shall be located at a height so as to meet the requirements of Pollution Control Board (s). The Bidder shall specifically confirm in his bid that the D.G. Sets offered by him meet with these requirements and shall furnish copies of the relevant documents in support thereof. D.G. Sets not complying with these requirements shall not be acceptable.

The Diesel Generating sets shall be suitable for operation to deliver rated output at 415 Volts, 3 phase, 50 HZ and 1500 rpm. Further, the sets shall be capable to give continuous output with minimum 10% overload capacity for one hour in every 12 hours and short time overload capacity of 50% for 15 seconds. The detailed output requirement shall further be in accordance with the stipulations laid in BS – 5514/ ISS as amended upto date.

STANDARDS

All material and equipment shall comply, in every respect, with the requirements of latest editions of relevant ISS or any other equivalent recognized International Standard as amended upto date. In case, standards other than ISS have been adopted, copies of such standards in English language shall be furnished alongwith the offer.

CONSTRUCTIONAL DETAILS

Engine

The diesel engine, conforming to IS 10000/BS-5514, suitable for generating set application. It shall be multi cylinder, cold starting, and compression ignition, equipped with water cooled type radiator and should develop rated capacity at normal temperature and pressure conditions. The mechanical power developed by the engine shall be such that the electrical power output from the alternator shall not be less than its rated capacity at 1500 rpm and 0.8 power factor.

It shall be equipped with safety devices against high cylinder head temperature, low lube oil pressure and overspeed. It shall be equipped with fuel tank of capacity suitable for minimum eight hour continuous running of D.G. Sets on full load. Suitable temperature & pressure gauges shall also be provided.

The diesel engine shall be fitted with all standard accessories/fittings and complete in all respects with regard to the following:-

i) Oil type air cleaner
ii) Exhaust silencer (industrial type) having outlet outside the building.
iii) Expansion bellow

iv) Lube oil cooler
v) Lube oil filter
vi) Mono block fuel injection pump (with governor) and fuel feed pump
vii) Flywheel
viii) Exhaust gas turbocharger (if applicable)
ix) Electric starter motor
x) Battery charging alternator
xi) V- belt driven axial flow blower.
xii) Engine control panel consisting of ON/OFF/Start Key, lube oil pressure gauge, ammeter indicating batteries charging current, electronic hours meter & tachometer.
xiii) Front and rear engine mounting support
xiv) Mechanical shutdown arrangement in case of V-belt failure
xv) Any other required accessories

Alternator

The alternator conforming to IS 4722 Each alternator shall be self excited and self regulated type having rated capacity as per BOQ at 3-phase, 4-wire, 415 volts, 50 HZ, 1500 rpm and shall have static excitation unit. Under normal operating conditions, the voltage regulation shall be ± 5% of rated voltage. The alternator shall be brushless type & guaranteed to deliver rated output at the specified ambient conditions.
The alternator shall be suitable for direct coupling with engine and mounted on a sturdy, extremely rigid channel section steel base/rail. The alternator shall be screen protected by drip proof enclosure with IP-21 degree of protection. The alternator shall be air cooled type with fan mounted unit. The insulation of the windings shall be of class-F and temperature rise shall be limited as applicable for class F insulation, mentioned in IS-4722.

Automatic Mains Failure Panel (AMF Panel)

The control panel shall be completely enclosed type, dust & vermin proof, mounted on base plate frame and shall be fabricated from 2mm thick CRCA M.S. Sheet. Suitable gaskets for tropical conditions shall be provided to hinge door. Necessary electrical clearances shall be ensured. The control panel shall be provided with bus bars of adequate rating, internal wiring, instruments, fuses, relays etc. with suitable provision for connection to incomers installed at A.C. Distribution Board.

All control fuses shall be so located as to be easily accessible for replacement.
Following accessories shall be included in the panel:-
i) Contactor for alternator supply.
ii) Flush mounted voltmeter with selector switch and fuses.
iii) Flush mounted ammeter, with selector switch, for measurement of load.
iv) Flush mounted frequency meter
v) Digital flush mounted electronic KW & KWH meter.
vi) One set of mains supply voltage monitor to identify low voltage/ complete failure and initiate necessary signal for operation of automatic control gear.
vii) Push Buttons for START/STOP.
viii) Master switch for AUTO/MANUAL/TEST/OFF.
ix) One no. solid state annunciator, with inputs, shall be provided to annunciate the following fault conditions:-
    a) Set fail to start
    b) Lub oil pressure low
    c) Lub oil temperature high

d) D.C. Battery voltage low
e) D.G. set incoming ACB trip
f) A.C incoming Aux. supply trip
g) 3 nos. spare windows
h) Push buttons for ACCEPT/REST/TEST.

x) Indication Lamps
a) For indicating D.G. Set `On Load'
b) For indicating `mains supply ON'
c) For battery charging indication

xi) One audio alarm (electronic type)

xii) Battery charger consisting of following:-

a) Transformer of adequate rating
b) Rectifier of adequate rating
c) D.C. ammeter
d) D.C. voltmeter
e) Charge rate selector switch for trickle or boost

The panel finish & paint shall be light grey colour powder coated as per shade 631 of IS-5.

Battery & Battery Charger

Maintenance free D.C. Battery of suitable capacity alongwith compatible battery charger would be provided alongwith each D.G. Set.

FUNCTIONAL REQUIREMENTS

i) On the failure/ under voltage of mains supply, on a particular section of L.T. Bus, Corresponding D.G. sets shall start automatically.

ii) When the mains supply is restored, D.G. sets shall get switched off on `auto' and the load shall transfer to mains supply.

iii) In the event of failure of D.G. sets to start on failure of mains supply on one attempt, two more starting impulses shall be automatically given and if still the engine does not start due to some defect within 30 seconds of first starting impulse, it shall get disconnected and locked out automatically and audio & visual signal shall appear.

iv) The circuit shall consist of required number of relays/ contactors and control wiring. In the manual or test operation, the D.G. sets shall be able to be started by pulling master control switch in manual/test position and by pressing push button, irrespective of the condition of the mains-supply.

ADDITIONAL ACCESSORIES

Following material/ accessories shall be supplied, erected and installed alongwith each D.G. set and are included in the scope of work without any extra cost to the purchaser.

i) Anti vibration mounting pads.
ii) First filling of lubrication oil.
iii) First filling of diesel oil for eight hour working of D.G. set at full load - in fuel tank of suitable capacity
iv) Asbestos roping to section of exhaust pipe inside the control room, to avoid heat dissipation.
v) High temperature bearing gaskets for the silencers.
vi) Double earthing arrangement with G.I. strip of suitable size.
vii)

MATERIAL AND WORKMANSHIP

All the material used/workmanship adopted in the manufacture and assembly of Diesel Generating Sets shall be of the best quality.

All the name plates, warning signs and markings on the equipment and its parts & accessories shall be in English/ Hindi language. The contents of the packages shall have placement marks for easy identification during reassembling and erection.

All the connections/cables shall be arranged in such a manner so as to minimize the risk of fire.

The manufacturer/ contractor shall assume full responsibility for co-ordinated and adequate design and shall adopt best engineering practices for the operating conditions specified. The conservative factors of safety shall be adopted for the design of complete equipment including such parts which are subject to alternating stresses.

DRAWIGNS & LITERATURE

The Bidder should submit, with his Bid, the dimensional drawing of the D.G. sets offered alongwith the illustrated and descriptive literature so as to clearly bring out the features of the offered design & establish their conformity with this specification.

The Contractor shall submit four copies each of the following drawings/ data, within 30 days of placement of order, for approval of the purchaser:-

i) General arrangement drawings with all the dimensions
ii) Complete bill of material
iii) Technical details of Engine, Alternator, AMF panel, Battery, Battery Charger etc.
iv) Schematic drawings of AMF panel

Also Catalogues, Instruction Books and other drawings as supplied by the manufacturers of Diesel Engine, Alternator and other components shall be furnished by the contractor.

TESTING AT MANUFACTURER WORKS:

During factory inspection DG set shall be tested for 12hrs. on full load and 1hr at 110% load after 12hrs.All the fuel consumption will be borne by the contractor.The necessary statutory testing has to be carried at manufacturers premises before dispatch.

COMMISSIONING TESTS

The contractor shall carryout following commissioning tests:-

Load Test

The engine shall be given test run for a period of atleast six hours. The D.G. set shall be then run on full rated load.

During the load test, following parameters shall be recorded/observed on half hourly basis:-

a) Ambient temperature
b) Exhaust temperature if exhaust thermometer is fitted.
c) Lubricating oil temperature where oil cooler fitted
d) Lubricating oil pressure
e) Colour of exhaust gas
f) Speed
g) Voltage, wattage and current ouput
h) Oil tank level

Insulation Resistance Test for Alternator

Insulation resistance test with a 500V megger shall be carried out for measuring insulation resistance between the coils and the frame of the alternator.

Check of Fuel Consumption

A check of the fuel consumption shall be made during the load test run. This test may also be utilized for the purpose of proper tuning of the engine.

Functional Tests

The following Functional Tests on the following shall also be carried out:-

a) AMF Control Panel
b) Starting scheme of the engine
c) All Field devices
d) AVR and speed governor.

Measurement of Vibrations

The vibrations shall be measured at load as close to maximum load. The measured values shall not exceed 250 microns.

Noise Level check

Noise level measurement shall be carried out as per IS 12065. The measurement shall be carried out with a calibrated interacting sound level meter as per IS 9779.

COMPLETENESS OF EQUIPMENT

All accessories & apparatus whether specially mentioned in this specification or not, but which are actually necessary for the completeness of the set, shall be deemed to have been included in the offer. All equipment shall, therefore, be complete in all respect/ details whether such details are specified or not. All power & control cables/ wires etc. required for connection of D.G. Sets, battery, battery charger, AMF Panel etc. shall be in the scope of contractor.

Statutory Approval

The bidder shall be wholly responsible for obtaining all the statutory/administrative approvals for installation/operation of DG Sets, including, but not limited to the approval for to & operate the DG set from Pollution Control Board/MC/Electricity Board.

5 EXHAUST SYSTEM OF DG SET.

The exhaust gas piping should of suitable dia. Welded black MS, B Class pipe confirming to IS : 3589 cut to required lengths and installed with necessary bends, supports and clamps, anti-vibration mountings, insulation of exhaust system with mineral wool/Rockwool, 50 mm thick wiremesh & aluminium clading etc.

Stack Height for Generator Sets:

Capacity	Stack height
0-50 KVA	Height of building in m + 1.5 m
50-100 KVA	Height of building + 2.0 m
100-150 KVA	Height of building + 2.5 m
150-200 KVA	Height of building + 3.0 m

For Generators of higher KVA: Stack height= Height of building in m + 0.2 Meter / KVA