

Hindustan Prefab Limited
(A Govt. of India Enterprise)
Jangpura, New Delhi – 110014



Substation and External Electrification works (Phase –I) at IIIT Guwahati permanent campus near Mirza, under Kamrup (R) District, Guwahati.

LIST OF SPECIFICATIONS & PREFERRED MAKES

NIT NO: HPL/DGM(C)/TC/IIITG/2017-18/74 Dated: 31.10.2017

Last date for issue of Tender Form : 08.11.2017 upto 15:00 Hrs.

Last date for submission of Tender : 08.11.2017 upto 15:00 Hrs.

COST OF TENDER: Rs. 1500/-

EMD: Rs. 6.00 Lakhs.

ISSUED TO M/s:

Ph- (011) 43149800-899, Fax: (011) 26340365
E-mail:- hindprefab@gmail.com
Website: www.hindprefab.in, www.iiitg.ac.in

LIST OF PREFERRED MAKES FOR ELECTRICAL WORKS

S.No.	Description	Manufacturer's Name
1.	MCB / RCCB / ACB/RCBO / DB	ABB/Legrand (Lexic)/ Schneider/ L&T/C&S
2.	Industrial Outlet	L&T (Hager)/ABB/Legrand (Lexic)/ Schneider
3.	MCCB (Thermo Magnetic/Static)	ABB/L&T/Schneider/ Legrand/C&S
4.	Switch Fuse Unit With HRC Fuses	L & T / ABB/Schneider/Siemens
5.	Contractors/ Relays	L&T /Siemens/ABB/ Schneider
6.	Instrument Transformer	Kappa/ AE / G&M
7.	Capacitors/APFCR	ABB/L&T/Schneider/ Legrand
8.	Ammeters/ Voltmeters And Metering Equipments	L&T/Siemens/AE/Neptune/HPL
9.	Selector Switches	Kaycee/Salzar/L&T
10.	LED Lights	Philips /Bajaj/Syska/HPL/Panasonic
11.	Change Over Switches	GE/L&T /ABB/HPL
12.	PVC Insulated Copper Conductor Wires	Finolex/Polycab/ Skytone/ Havells
13.	Protection relays	ABB/L&T/Schneider/ Legrand
14.	PLC	ABB/L&T/Schneider/ Legrand
15.	Cables (LT & HT)	Finolex/ Polycab/Skytone/Havells/KEI
16.	Cables Lugs & Joints	Dowell/ 3M/C.C.I.
17.	Cable Glands	Siemens/Comet/Gripwell
18.	Street Light Poles & Fixture	Havells /Philips/Bajaj/Nezone
19.	LT Panel Builders (CPRI Approved)	Neptune/Advance/Adelec/SPC Electro Tech / Shriram Power Control
20.	Transformer	Kirlosker/ Crompton Greaves/ ABB/Electro Therm
21.	HT Panel	ABB/Siemens/Crompton Greaves/ Schneider/ SPC Electro Tech
22.	D.G. Set	Cummins Jakson/Kirloskar Green
23.	Bus Bar	Hinalco/Jindal
24.	Energy Meter	L&T/C&S/Trinity/Neptune/HPL
25.	Any Other Items	On Approval Of Engineer-In- Charge
Note:-	In Case, Any Other Item/ Material Required To Complete The Work For Which Makes Are Not Specified Above, The Contractor Shall Take Prior Approval Of The Engineer-In- Charge	

Assam

Note: - Make list placed at page no. 3 to 7 will supersede the make list given on page no. 2 wherever applicable against each item.

ASSAM POWER DISTRIBUTION CO. LTD

Project, Planning & Design
6th floor, Bijulee Bhawan, Paltanbazar
Email Id. Cgmppd_aseb@hotmail.com

No CGM (PP&D)/APDCL/Tech Scrutiny/2014/ 14/

Dated 19.11.2014

To

The Chief General Manager
LAR / CAR / UAR / APDCL,
Bijulee Bhawan, Paltanbazar, Guw-1

Sub : List of Preferred Vendors of APDCL

Sir

This is to inform you that we are considering standardisation of the technical specifications of substation and sub transmission line equipments that are to be procured by all offices under APDCL in order to expedite the work of checking and approval of GTP and drawings.

As a first step towards implementation of the above, a List of Preferred Vendors of APDCL supplying different equipments is enclosed for your necessary action. Purchases may be made preferably from the list of preferred vendors.

In case of deposit work at field level where GTP approval etc is accorded by GM/DGM /AGMs, they are to allow equipments from the VENDOR LIST only. Moreover, for all steel items like channels, angles, cross arms, nuts & bolts etc only GI material should be approved.

A technical specification for substation and line equipments together with civil works of substation erection and control room building governed by standard norms is being prepared and will be circulated shortly.

In this regard your suggestion and advice if any will be extremely helpful.

Encls: As above

Yours faithfully

Chief General Manager (PP&D),
APDCL, 6th floor, Bijulee Bhawan,
Paltanbazar, Guwahati-1

Memo No: CGM (PP&D/ APDCL) /Tech Scrutiny/ 2014/ 14(a)

Date: 19.11.2014

Copy to

1. The MD, APDCL, Bijulee Bhawan, Guw-1 for favour of his kind information.
2. The CGM, HQ, APDCL
3. The CGM, RE, APDCL
4. The CPM (PIU), PP&D, APDCL
5. The GM(R APDRP), PP&D, APDCL
6. All GM /CEO /DGM /AGM (field officers) APDCL

DGM, GEC-II *[Signature]*
Jalukbari Bye Pass

SAC DGM / GEC-II / APDCL / DPT / 19/11/2014 / 1656

according to all SDE's, AGMs over email

DTE 24-11-14

Chief Executive *[Signature]*

For information and
necessary action

Chief General Manager (PP&D),
APDCL, 6th floor, Bijulee Bhawan,
Paltanbazar, Guwahati-1

ASSAM POWER DISTRIBUTION CO. LTD

Project, Planning & Design
6th floor, Bijulee Bhawan, Paltanbazar Guw-1

List of Utility's preferred vendors

Sl. No.	Equipments	Vendors List (Name mentioned or equivalent)
✓1	33/11KV POWER TRANSFORMER	M/s Power Maker, M/s Vijoy Electric, M/s Marsons(kolkata), Marson's (Agra), M/s CGL, M/s Schneide Electric, M/s EAST INDIA, M/s PROLEC GE, M/s TESLA Transformers
2	36 KV VACUUM CIRCUIT BREAKER	M/s Crompton Greaves Ltd., M/s ABB Ltd., M/s Schneider Electric, M/s Siemens, M/S Stelmec
3	33 KV and 11 KV AUTO RECLOSER WITH COMMUNICATION MODEM	M/s Schneider Electric, M/s ABB, M/S PNC Technologists M/s Jinkwang E&C Corp
4	33 KV & 11 KV SELF POWERED AUTO RECLOSER	M/s Schneider Electric, M/S PNC Technologists M/s Jinkwang E&C Corp
5	33 KV OUTDOOR SF6 CIRCUIT BREAKERS (AIS TYPE)	M/s Crompton Greaves Ltd., M/s ABB Ltd., M/s Siemens
6	33 KV & 11 KV CONTROL AND RELAY PANELS FOR TRANSFORMERS & FEEDERS	M/s ABB Ltd., M/s Crompton Greaves Ltd M/s System Control & Automation, M/s Siemens, M/s Venson, M/s C & S Electric, M/s Ape Power Pvt. Ltd, M/s Schneider Electric M/s Pascal
7	11KV OUTDOOR VCB	M/s Crompton Greaves Ltd., M/s Siemens, M/s Schneider Electric, M/s ABB, M/S Stelmec
8	33kv & 11kv INDOOR VACUUM SWITCHGEAR	M/s Crompton Greaves Ltd., M/s Siemens, M/s Schneider Electric, M/s ABB, M/s Pascal, M/S Stelmec M/s Pascal

P. H. Hussain
5/11/14
P. H. Hussain
M (PP&D), APDCL

M. M. Hussain
5.11.14
M. M. HUSSAIN
DGM-II (PP&D)

General Manager
5/11/14
O/o the CGM (PP&D) APDCL
Bijulee Bhawan, Paltanbazar
Guwahati-781 001

Chief General Manager (PP & D)
APDCL, Bijulee Bhawan
Guwahati-781001

9	33KV & 11 KV ISOLATORS	M/s Crompton Greaves Ltd., M/s Siemens, M/s Project Electricals, M/s S & S, M/s G R Power, M/s ADCO, M/s Ape Power Pvt. Ltd., M/S RM Electric M/S Hightension Electrical Equipments
10	OUTDOOR CURRENT AND POTENTIAL Transformer	M/s Crompton Greaves Ltd. M/s Siemens, M/s Mehru, M/s Kapco, M/s Laxmi, M/s Sandas & Co., M/s Ape Power Pvt. Ltd.
11	33kv & 11KV LIGHTNING ARRESTORS	M/s Oblum, M/s Lamco, M/s Crompton Greaves Ltd., M/s Areva, M/s Raychem RPG, M/s Naresh Potteries, M/s Compaq International
12	33 KV AND 11 KV GANG OPERATED SWITCH	M/s S & S, M/s G R Power, M/s ADCO, M/s G. K. Electric, M/s Raychem RPG, M/s Ape Power Pvt Ltd. M/S Hightension Electrical Equipments
13	BATTERY BANK	M/s Amra Raja, M/s HBL, M/s Exide
14	BATTERY CHARGING EQUIPMENTS	M/s Amra Raja, M/s HBL, M/s Exide (Caldyne), M/s ESI M/s Instant Solutions
15	DG DISTRIBUTION BOARD	M/s Amra Raja, M/s HBL, M/s Ape Power Pvt. Ltd. M/S Chloride Power System M/s Instant Solutions
16	A.C. DISTRIBUTION BOARD	M/s Amra Raja, M/s HBL, M/s Ape Power Pvt. Ltd.
✓ 17	DISTRIBUTION TRANSFORMERS OF CAPACITY 63 KVA, 100 KVA, 250 KVA	M/S TESLA M/s Vijoy Electrical, M/s PowerMaker M/s Technoval, M/s Kamakhya, M/S NK POWER .
18	MCCB (Thermal Magnetic Adjustable)	M/s Legrand (DPX & DPX ²), M/s Schneider (NSX), M/s Siemens (3VL), M/s L & T (D-Sine), M/s ABB (T max), M/s Havells (Loadline MCCB), M/s HPL India Ltd
19	STEEL STRUCTURES RS JOIST	M/s Jyoti Structure, M/s Utkal, M/s Nezone, M/s Baba Strips & Tubes Ltd., M/s Shiv Steel



Signature
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Signature
21/11/14

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21/11/14

Signature
Chief Engineer, Manager TPP & L

20	GALVANIZED CHANNEL CROSS ARMS	M/s Jyoti Structure, M/s Utkal, M/s Nezone M/s Baba Stripes & Tubes Ltd.
21	33 KV & 11 KV DISC INSULATOR (B&S) 70 KN	M/s Joyshree, M/s Aditya Birla, M/s Naresh Potteries, M/s Raychem
22	33 KV COMPOSITE POLYMERIC DISC INSULATORS 70 KN	M/s Compaq International, M/s Gold Stone Infratech, M/s Relco Industries, M/s Naresh Potteries, M/s Raychem RPG, M/s PRITHVI, M/s DECCAN
23	11 KV COMPOSITE POLYMERIC PIN INSULATORS	M/s Compaq International, M/s Gold Stone Infratech, M/s Relco Industries, M/s Naresh Potteries, M/s Raychem RPG, M/s PRITHVI, M/s DECCAN
24	HARDWARE FITTING FOR DISC INSULATOR, 70 KN(B & S)	M/s Raychem RPG, M/s Naresh Potteries
25	POLYMERIC 33 KV AND 11 KV PIN INSULATOR	M/s Compaq International, M/s Gold Stone Infratech, M/s Relco Industries, M/s Raychem RPG, M/s Naresh Potteries
26	33 KV AND 11KV PIN INSULATOR	M/s Jayashree, M/s Raychem RPG
27	G.I. PIN OF 33KV and 11KV PIN INSULATOR	M/s Raychem RPG
28	AAA "WOLF" & "RACCOON" CONDUCTOR	M/s Neccon, M/s Singhi, M/s Cabcon India, M/s Lumino, M/s SAI Conductors
29	Hardware Fittings including Tension Clamp Assembly (Aluminium Alloy) FOR "RACCOON" AND "WOLF" CONDUCTOR	M/s Raychem RPG
30	P.G CLAMP FOR AAA RACCOON WOLF CONDUCTOR	M/s Raychem RPG, Ms HOWRAH ELECTRICAL
31	XPLE CABLE FOR 11 KV SYSTEM (Power Cable)	M/s Universal, M/s KEI, M/s NECCON, M/s DimondPower, M/s Crystal, M/s Dynamic Cables, M/s RM Electric, M/s Sing hi Cables & Conductors Pvt. Ltd. M/s Havells India Ltd.
32	HEAT SHRINK CABLE END TERMINATION KIT (OUTDOOR AND INDOOR)	M/s Raychem, M/s Universal, M/s Compaq International, M/s 3M
33	COLD SHRINK CABLE END TERMINATION KIT (OUTDOOR, INDOOR & STRAIGHT THROUGH JOINTING)	M/s Raychem, M/s Compaq International, M/s 3M

11/14
T. BARUAH
PPAD), APDCL

Md. M. HUSSAIN
DDM-II (P.P. D.)

into the CCM it is

Chief General Manager (PP & L)
APDCL, Bhubaneswar

34	CONTROL CABLES	M/s Universal, M/s KEI, M/s Polycab, M/s Dimond Power, M/s Crystal, M/s Dynamic Cables, M/s RM Electric, M/s Singhi Cables & Conductors Pvt. Ltd., M/s NECCON, M/s Havells India Ltd.
35	Unarmoured LT XLPE cable	M/s Universal, M/s KEI, M/s Polycab, M/s Singhi Cables & Conductors Pvt. Ltd., M/s NECCON, M/s Havells India Ltd.
36	G.I STAY WIRE	
37	HT GUY INSULATOR	
38	GI WIRE	
39	Gas filled LT capacitor unit	M/s TDK-EPC (EPCOS), M/s ABB
40	11 KV AUTOMATICALLY SWITCHED CAPACITOR BANKS (APFC) AT 33/11 KV SUB- STATIONS	M/s TDK-EPC (EPCOS), M/s ABB
41	LT APFC PANELS FOR DTR	M/s TDK-EPC (EPCOS), M/s ABB
42	LT ABC CONDUCTORS	M/s Orion Cables, M/s Capital Cables, M/s Seshwat Cables, M/s Sing hi Cables & Conductors Pvt. Ltd., M/s Havells India Ltd, M/S RAJASTAN CABLE, M/s KEI
43	ACCESSORIES AND HARDWARE FITTINGS FOR LT - ABC	M/s Secame, M/s 3M, M/s Raychem RPG, M/s ENSTRO
44	RMU	M/s Crompton Greaves Ltd., M/s ABB Ltd., M/s Schneider, M/s Siemens.
45	Single Phase Digital meters	M/s Secure Meters M/s Genus Power Infrastructure Ltd M/s Larsen & Toubro Ltd M/s Indotech Ltd
46	Three Phase Digital meters	M/s Secure Meters M/s Genus Power Infrastructure Ltd M/s Larsen & Toubro Ltd M/s Indotech Ltd
47	DTR Main Switch TPN (Re- wireable) 63A, 100A,200A	M/s GECO Electrical Corporation M/s Havells Ltd
The equipments and materials should be of make mentioned against each item. Make of equipments other than the above or equivalent make must be supported with Performance Certificate of three years satisfactory service issued by GM / DGM of any two utilities in their office stationery.		

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TECHNICAL SPECIFICATION

H.T VACCUUM CIRCUIT BREAKERS SWITCHBOARD:-

This specification covers the technical requirements of three phase, 33 kV, panel, front operative switch boards. The panel board shall be integrated indoor metal clad floor mounted, dead front free standing extensible sheet enclosed as per specifications.

CODES AND STANDARDS:

The design, manufacture and performance of equipment shall be as per all current statutory regulations and safety codes in the locality where the equipment will be installed. Nothing in these specifications shall be construed to relieve the vendor of this responsibility.

CONSTRUCTION:

The panel board shall be made from Powder coated, M.S sheet steel 2 mm thick and shall be folded and braced as necessary to provide a rigid supports for all components. All panels and covers shall be properly fitted and square with frames, and holds in the panels correctly positioned. Self threading screws shall not be used in the construction of switchboard. The panel board shall be of totally enclosed design, dust tight and vermin proof and extensible type the circuit breaker shall be mounted on a separate carriage arranged for horizontal isolation and horizontal withdrawal. It should be possible to put the Vacuum Circuit Breakers in the “plug – in” condition and withdrawal to the ‘test’ position. The bus bar shall be made of Aluminium flats and supported on rigid epoxy support and insulators and insulated. Two independent earth connections shall be provided. The circuit breakers shall be provided with the necessary auxiliary contacts for indication, control, interlocking or other purposes. Excluding the contacts already used for the circuit, six spare seats of contact with three “NO” and three “NC” shall be left free in each unit. The equipment when assembled shall form a neat and compact unit and shall be completed with all supporting frame work, mounting channels: foundation bolts etc and shall be designed so as insure complete inter- changeability of components from one panel to another.

The H.T Vacuum Circuit Breaker panel shall comprise of one 4 panel indoor type 33 kv metal clad switch board to the following specification:

- | | | |
|---|--------------------|--|
| 1 | System | : 33,000 Volts, 3 phase, 3 wires, 50 Hz neutral earthed |
| 2 | Breaking Capacity | : 25.0 k A at 33 KV |
| 3 | Situation | : Indoor |
| 4 | Control | : Spring Operated |
| 5 | Sequence of panels | : Left to right looking at the front of the |
| | Panel No 1 | : Control of incoming supply |
| | Panel No 2, 3 & 4 | : Control of outgoing feeders |
| 6 | General Finish | : Tropical |
| 7 | Paint | : Powder coated – approved shade. Instruments & Relay-Matt. Black. |

- 8 Indicating Lamps : 1- Circuit Breakers 'ON'-RED
: 1- Circuit Breakers 'OFF'-GREEN
: 1- Breaker tripped due to abnormal condition, to be provided on each panel- AMBER.
: 1- Trip Circuit Healthy Lamp
: 1- Eight (8) Window Annunciator Panel with required wiring & protective devices for incomer
: 1- Four (4) Window Annunciator Panel for each of the Outgoing breakers.
- 9 Bus Bar Rating : 1250 Amp
- 10 Label reading : Incomer/ Outgoing Panel
- 11 Circuit Breaker : 1250 A rated Vacuum Circuit Breaker
- 12 Trip Coils : 24 Volts D.C.
- 13 Current Transformers : Silica filled epoxy resin insulated, in air insulated Chambers
: 3- CTs, 15 VA, Class 1.0 and 5 P 10 accuracy for protection and meter operation
- 14 Voltage Transformer : 1- Three phase, ratio 33 kV /3/110V/3 cast resin insulated 100 VA per phase, class 1.0 accuracy, withdraw able, complete with H.T AND L.T fuse, and circuit wiring.
- 15 Relays : 1- Triple pole Numeric IDMT Type Relay similar to SPAJ-14OC of Alstom/ Schneider/ L&T make with the 2 outer elements connected for non- directional over current and the inner element connected for non- directional earth fault protection with setting for:
Over Current: 50 – 200 %
Earth fault : 20 – 80 %
1- Numeric Relay for under voltage Protection
2- Numbers triple pole hand reset auxiliary check alarm numeric relay.
(One for annunciation and other for tripping) of Alstom / Schneider / L& T make type 'VAA - 33' with associated lamp.
- 16 Instruments : 1- 2 pole, 3 ways and off Voltmeter selector switch
1- 96 mm x 96 mm digital Voltmeter scaled 0 – 37 kV
1- Electronic Load Manager Instrument without communication port.

- 17 Cable Particulars : The incomer cable is 33 kV, Aluminium XPLE – 3 core x 185 sq mm /120 sq mm. Provision should be available for epoxy end sealing kit for end termination inside the cubical itself. Suitable double compression brass gland shall be provided. The cable entry will be from bottom to suit site conditions.
- 18 Control wiring : The control wiring using multi strand conductor super Flexible flame proof wires for AC Power, D C control & CT circuit control terminal shall be screw type for auxiliary, wiring and short up / Disconnecting for CT wiring minimum 10 % spare terminal shall be provide for control circuit.

Additional Equipment for the switch Board

- 19 Alarm Bell : One alarm bell each to be mounted for audible alarm Purpose for AC & DC failure indication.
- 20 Switch : One push button switch for the cancellation of audible Alarm.
- 21 Padlock and keys : Provision for padlock shall be made for each panel.
- 22 Drawings : Drawings giving full and complete physical and electrical details shall be submitted for approval in 5 sets prior to take – up of production. The owner will return two sets of Approved drawings to the contractor and send one set to the Consultant. Full set of test results shall be provided to the Owner in 5 sets prior to dispatch. The owner, after studying the furnished data, shall decide whether inspection visit to the manufacture's factory is necessary or not. Only after receiving written permission from the owner shall the switch board be dispatched to the project site.
- 23 Commissioning : The commissioning of the H.T switch boards will be done. after all the site test are carried out .The contractor , if necessary , will have to arrange for visit (s) by the manufactures , representative at the time of commissioning at no extra cost to the owner.
- 24 Tests : Routine test shall be carried out as per relevant standards at manufactures works. Type test report may be submitted for verification

BUS BARS AND INSULATION

All bus bars and jumper connections shall be of high conductivity aluminium. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Bus bar cross section shall be uniform throughout the length to switch gear with current density 1.0/sq.mm. Colour coding of bus bar shall be achieved through heat shrinkable sleeves.

Contact surface at all joints shall be properly cleaned to ensure an efficient and trouble free connections. All bolted joints shall have necessary plain and spring washers. All connection Hardware shall have high corrosion resistance.

Bus bar insulators shall be of track – resistance high strength non hygroscopes non combustible type shall be suitable to withstand stresses due to over voltages and short circuit current. Bus bar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulator. The temperatures of the bus bars and all others equipment's when carrying the rated current continuously shall be limited as per the stipulations of relevant Indian standards, duly considering the specified ambient temperature.

EARTHING AND PROTECTIVE EARTHING

Tin plated copper earth bus shall be provided throughout the length of switch board size. It shall be bolted /welded to the frame work of such panel. The earth bus shall have sufficient cross-section to carry the momentary short circuit and short time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting earthing conductors and the earth bus.

The truck and the breaker frame shall get earthen while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all the positions service and test as well as throughout the intermediate travel.

METERING AND PROTECTION

The breaker shall be provided with epoxy resin current transformer for metering and protection. The CT's shall conform in all respects to IS 2705 –1964 part I, II 7 III and potential transformers shall conform specifications of IS 3156-1965. Ammeter and voltmeter to be installed on panel as per item of work shall be of moving iron type with industrial grade accuracy class 1.0 for metering 10 p 10 for protection and shall conform to IS 1248-1968. All meters shall be tested for 2000 V for 1 minute and shall be 144sq pattern flush mounting type with necessary selector switches. Necessary indicating lamps as per item work shall be provided on panels which shall be of low wattage filament type with series resistors. Phase indications lamps shall be provided on incoming relay panel.

Relays shall be provided for over current & earth fault protection and shall be provided as required. Also alarm strip shall be required for Oil type transformer. Setting range for over current relay shall have to be 50 to 200 per cent in steps of 25% earth fault relays shall have a setting range of 20% to 80 % in steps of 10%. The relay shall be flush mounted.

The loose items to be supplied with HT panel shall comprise of the following:

- a) Instruction book
- b) Maintenance manual

- c) Withdrawal handle
- d) Handle for spring charging mechanism
- e) Foundation bolts

OIL TYPE TRANSFORMER (AS PER IS:1180)

Scope

The specification covers the design, manufacture testing and inspection before dispatch and delivery at site.

The specification covers oil immersed, naturally air cooled (type ON), outdoor type, three phase, 50 Hz, 33/0.433 step down Power transformers .

Applicable Standards

(A) Unless otherwise modified in the specification, the transformers shall comply with the requirement of IS:1180 (latest issue) and REC specification 2/1973 and ISS:2099 (latest issue). The bushings used shall conform to ISS: 2099 (latest issue) except as modified herein.

(B) Type: The transformers shall be double wound, three phase oil immersed, oil natural cooled (type 'ON', core type suitable for outdoor installation in tropical climate and shall be insulated with DPC insulation on HV and LV windings.

(C) Design and Standardization

The transformers and accessories shall be designed to facilitate operation, inspection, maintenance and repairs. All apparatus shall also be designed to ensure satisfactory operation under such sudden variations of load and voltage as may be met with under working conditions on the system, including those due to short circuits.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment keeping in view the requirement of Indian Electricity Rules.

All material including brought out items like bushings, oil radiator, conductor and insulating materials used shall be of the best quality and of the class most suitable for working under the conditions specified and shall withstand the variation of temperature and atmospheric conditions arising under working conditions without undue distortion or deterioration or setting up of undue stresses in any part and also without affecting the strength and suitability of the various parts for the work which they have to perform

Corresponding parts liable to replacement shall be interchangeable.

Cast iron shall not be used for chambers of oil filled apparatus or for any part of the equipment which is in tension or subject to impact, stresses or where corrosion due to acidity or sludging is likely to

occur. This clause is not intended to prohibit the use of suitable grades of cast iron for parts where service experience has shown it to be satisfactory e.g. large valve bodies.

All outdoor apparatus, including bushing insulators with their mounting shall be designed so as to avoid external pocket in which water can collect and internally air could trap.

All taper pins used in any mechanism shall be of the split type complying with IS: 2593 for these items.

All connections and contacts shall be of ample section and surface for carrying continuously the specified currents without heating and fixed connection shall be secured by bolts or set screw of common size adequately locked against vibration. Lock nuts shall be used on stud connections carrying current.

All apparatus shall be designed to minimize the risk of accidental short circuit caused by animals, birds or vermin.

Continuous Maximum rating and temperature rise

The transformers shall have a continuous maximum rating at the specified normal ratio, frequency and temperature rise.

(A) All transformers shall be capable of operation continuously in accordance with IS loading guide at their continuous maximum rating and at any ratio without exceeding, temperature rise.

(B) Transformers with tapping ranges (+) 5% to (-) 15% in step of 2.5% for HV variation below normal voltage shall meet the temperature rise limits specified in IS: 1180 on all tapings on which the rated current is not more than 95% of the maximum rated current in lowest voltage tapping. On other tapplings they shall operate continuously without injurious heating. The loading of the transformers is to be in accordance with IS: 6600 guide for loading of oil immersed transformers natural cooled units.

(C) The transformers shall be capable of operation without danger on any particular tapping at the rated voltage in KV provided that the voltage does not vary by more than + 10% of the voltage corresponding to the tapping.

The maximum temperature rise in each transformer when tested at its continuous maximum rating shall not exceed the following limit at the reference ambient air temperature of 50 degree C:-

i) Temp. of oil by thermometer	50 Deg.C 50 Deg.C
(ii) Temp. of winding by test resistance	50 Deg.C

No Load Voltage Ratio

The no load voltage ratio corresponding to the principal tapping shall be 33,000/433 Volts.

Oil

Transformer oil to be used for first filling shall comply with the specification indicated hereunder, generally as per IS: 335 of 1983 (Third revision) and REC specification No.39/1985 except in so far as values indicated separately as per Board's specification for EHV Grade Oil.

Taps

Off load Tap changer shall have taps ranging from +5% to -15% in steps of 2.5% each on HV winding for HV variation, to give normal 433V on LV side.

Winding connections & Vectors

The primary winding shall be connected delta and secondary winding star as per vector symbol Dy.11 (IS: 2026) so as to produce positive displacement of 30 Deg.C from the primary to the secondary vector of the same phase (vector rotation assumed counter clockwise).

The neutral point of the secondary (LV winding) is intended for solidly earthed system and should be brought out to a separate insulated terminal, enabling external insertion of a current transformer in the earth lead to be connected wherever required.

All winding of transformers shall have uniform insulation when tested in accordance with ISS: 2026/1977. The minimum basic impulse withstands level of windings for 1.2/50 micro sec. full wave shall be as given below:-

33 KV	170 KV peak
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Guarantee and penalty for losses of power transformers - Capitalization of transformer losses:

(A) The no load losses in Kilo watts at rated voltage and rated frequency and the total losses in Kilo watts at rated full load current and rated frequency at 75 Deg. C shall be guaranteed under penalty for each transformer. For the purpose of penalty computations, the test figures of the no load and the load losses will be compared with the corresponding guaranteed figures.

(B) The penalties shall be separately evaluated from:

- (i) The excess of the test figures of the no load loss in KW over the corresponding guaranteed value and,
- (ii) The excess of the test figures of the load losses in KW over the corresponding guaranteed value.

No tolerance shall be permitted over the guaranteed figures for computation of penalty.

(C) The penalties shall be calculated at the rate of Rs.102000/- per KW for the excess of no load loss and at the rate of Rs.44, 000/- per KW for the excess of load losses. For fraction of a KW, the penalties shall be applied on prorata basis. If the test figures of the losses are less than the guaranteed values, no bonus will be allowed.

(D) The tenders must clearly specify whether the losses quoted are FIRM or subject to IS tolerance. In case of any ambiguity, loading as per IS tolerance shall be considered for price comparison purpose.

(E)The purchaser reserves the right to reject any transformer, if during tests at supplier's works, the tested no load losses and total losses, exceed the corresponding maximum guaranteed losses by more than the following values:

Total losses	10% of the total guaranteed losses
Component losses	15% of each component losses provided that the tolerance for total losses of 10% is not exceeded.

(F)Owner reserves the right to test any one transformer, selected at random out of the transformers offered for inspection/supplied, in any independent laboratory of national repute, preferably CPRI, for the purpose of routine tests as per IS 2026. The entire expenses for the same shall be borne by the contractor.

Terminal Arrangement

The transformers shall be fitted with HT cable connectors on HV side and bus-bar connections on LV side.

The bushings shall be filled with transformer oil, EHV grade, which shall be of non oil communicating type with small aperture of 2mm diameter.

The HV/LV bushings shall have the characteristics as per IS: 2099 (latest issue).

The electrical characteristics of bushing insulators shall be in accordance with IS: 2099 as amended from time to time. All type and routing tests shall be carried out in accordance with IS: 2099-1973. The test voltages for various tests as stipulated in IS: 2099-1973 are below:

Normal system voltage	Rated voltage Of the	Visible discharge test	One minute wet and dry withstand	Lighting Withstand test (impulse voltage)	Impulse
KV	KV	KV	KV	KV	
11	12	9	35	75	
33	36	27	75	170	

Dimensions of the LV 12 bushings including neutral (LV side) shall conform to IS:3347 (Part-III) and those of the 36 KV bushing (33 KV side) shall conform to IS:3347 (Part-V).

Vibration and noise

(A) Every care shall be taken to ensure that the design and manufacture all transformers and accessories shall be such as to reduce noise and vibration to the level obtained in good modern practice.

(B) The manufacturers will ensure that the noise level shall not be more than 5 Db above the NEMA standard publication TR-1.

Flux density: Over fluxing

(A) Over fluxing of the core shall be limited to 12.5%.

(B) However, in case of transformers with variable flux, the voltage variation which would affect flux density at every tap shall be kept in view while designing the transformers.

Internal earthing arrangement

(I) General:

All metal parts of the transformer with the exception of the individual clamping plates shall be maintained at some fixed potential.

(II) The top main core clamping structure shall be connected to the tank body by a copper strip. The bottom clamping structure shall be earthed by one or more of the following methods.

(A) By connection through vertical tie rods to the top structures.

(B) By direct metal to metal contact with the tank base maintained by the weight of the core and the windings.

(C) By a connection to the top structures on the same side of the core as the main earth connection to the tank.

(III) Size of Earthing Connections

All earthing connections with the exception of these from the individual cell clamping rings shall have a cross sectional area of not less than 0.8 sq mm. Connections inserted between laminations of different section of core as per clause-17 III (B) shall have a cross sectional area of not less than 0.2 sq mm.

(IV) Leads from winding to bushing and intercake connection

The leads from winding to bushing and intercake connection should be rigid enough to winding normal vibration and transportation shocks and short circuit stresses. They should be spaced in such a way that necessary clearances are maintained not only in air but with oil medium at the lowest electrical strength as per relevant ISS over the period of normal service.

Guarantee:

The manufacturer shall among other things guarantee the following:

(I) Quality and strength of material used, both electrical and mechanical.

(II) Satisfactory operation during the guarantee period of 24 months from the date of receipt of Stores. This period will be reckoned from the day all accessories are received enabling assembly testing, commissioning and commercial operation of transformers.

(III) Performance figures are to be supplied by tender in the schedule of guaranteed particulars. In schedule of 'GUARANTEED TECHNICAL PARTICULARS', all details as required in IS: 2026 shall be given.

Wheels and Axles

The transformers shall be provided with bi-directional flat roller.

Fittings & Accessories:

The following standard fittings as given below. The fittings shall be in accordance with the details to the extent these area specified in IS:2026.

- i) Inspection cove
- ii) Rating plate
- iii) Diagram plate with tap position and relative HV/LV voltage.
- iv) Two earthing terminals.
- v) Lifting lugs.
- vi) 4 jacking pads.
- vii) Conservator with top fill up cap and bottom drain valve.
- viii) Dehydrating breather of required sizes.
- ix) Connecting pipe with valve and Buchholz relay.
- x) Radiator with top air release plugs and connected valves top and bottom for connection to main tank.

- xi) HV - 3 bushings
- xii) LV - 4 bushings
- xiii) On load circuit tap switch with lock and 2 keys
- xiv) Mercury Thermometer
- xv) Thermometer (dial type) with one contact for alarm
- xvi) Thermometer pocket
- xvii) Magnetic oil level gauge indicating three position of oil marked as follows:

Minimum - (-5 Deg.C) :	(30 Deg.C)
Maximum	- (98 Deg.C)

- xviii) Oil filling hole and cap
- xix) Air release device on tank top
- xx) Pressure relief device through explosion vent diaphragm with fresh equalizer pipe air release plug.
- xxi) Gas and oil actuated relay.
- xxii) 2 filter valves (top valve, lower valve to be used also as drain valve).
- xxiii) First filling of oil.

SCHEDULE - I

1.	Rating and terminal marking plate: Following details are to be given on the name plate:	
	i) Name of the manufacturer	
	ii) Order No. and date	
	iii) Rating of transformer and voltage ratio	

	iv) Year of manufacturer	
	v) S.No.of transformer	
	vi) Max.guaranteed losses (a) No load losses (b) Load Losses	
	viii) Type of coating	
	ix) HV/LV Amps	
	x) Percentage impedance	
	xi) Maximum temperature rise Maximumwindingtemperature	50 Deg.C.
	xii) Weight of transformer (a) Core and winding - Kg. (b) Weight of oil - Kg. (c) Total weight - Kg. (d) Oil (Total) - Liter	
	xiii) Tap positions and corresponding voltage on HV and LV side	
2	HV bushings oil filled bushings	Non oil communicating type with aperture in the base diaphragm and to air release device where applicable.
3.	LV bushings, stud in porcelain bushing 11 KV bushings shall be provided with arcing horns	
4	Earthing terminals - 2 Nos.	
5	Tank lifting lugs - 2 Nos.	
6	Packing pads - 4 Nos.	
7.	Silicagel Dehydrating Breather (with one kg. minimum gel content)	
8.	Conservator with oil filling cap, drain valve with plug and magnetic oil level gauge with alarm contacts. The oil level gauge shall have three positions of oil marked as follows: a) Minimum (-5Deg.C) b) (30 Deg.C)	

	c) Maximum (98 Deg C)	
9	Pressure relief device through explosion vent diaphragm.	
10	Gas and oil actuated relay with 2 contacts.	
11	Thermometer (dial type) with one contact for Alarm.	
12	Filter valves top and bottom (lower valve to be used as drain valve which should be able to drain oil completely).	
13	Air release device	
14	Axles and wheels : The transformers of 2000 KVA rating shall be provided with flanged wheels. These wheels shall be suitable for being turned through an angle of 90 Degree C. and locked in that position when the tank is jacked up,	
15	Thermometer pocket.	
16	Detachable radiators with top and bottom shut off valves and air release plug on each radiator top.	
17	a) Winding temperature indicator with one set of contacts for 2000 KVA transformers for alarm and trip. b) Oil temperature, indicator with alarm	These shall be housed in WP box with flexible leads and required electrical connectors
18	Inspection cover	
19	WP Terminal box alarm and trip contacts with requisite connector.	
20	OLTC with taps ranging from (+) 5% to (-) 15% in steps of 2.5% on HV side for HV variation.	

Before installing, the accuracy of the temperature indicators shall be checked by hot oil or water bath. The switches shall be adjusted to make contacts at the desired temperatures depending upon the site conditions i.e. ambient temperature loading conditions etc. The capillary tube shall be protected adequately to withstand all normal handling. It should not however be bent sharply or repeatedly and should be supported by clips to prevent sagging. On no account it shall be cut. The thermometer pocket shall be filled with sufficient transformer oil to ensure good thermal contact between the pocket walls and the thermometer bulb.

Bare conductors of copper or aluminium as directed by Engineer-in-Charge shall be used for connections to the transformer terminals. These may be of flexible type or the rigid type having rectangular or hollow circular cross-section. Where connections are rigid and more than 3 to 4.5 meters long special expansion type of connectors are recommended to prevent the terminal bushings being unduly stressed due to thermal expansion. For aluminium or ACSR conductors used for connections to the transformer terminals made of copper, suitable bimetallic type of connectors should be used to prevent electrolytic corrosion at the contact surfaces of dissimilar metals and necessary precautions taken in making these joints.

The transformer should be so installed that there is no risk of anyone receiving an electric shock. Although, with all metal parts of the metal tank bonded together and properly earthed the tank may be considered quite safe, yet consideration should be given to the arrangements of the connections.

MEDIUM VOLTAGE SWITCHGEAR:-

GENERAL

This section covers specification of Medium Voltage Switchboards incorporating items of switchgear like Air Circuit Breakers, MCCB, MCB, metering and protection

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 gear IS 60947: 1993

Part I : General rules

Part II : Circuit Breakers

Assam

Part II I	:	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 bus bar	IS 11353: 1985
Degree of Protection of Enclosures for low voltage switchgear.	IS 2147: 1962
Electrical relays for power system protection	IS 3231: 1986
Code of Practice for selection, installation and Maintenance of switchgear & control gear	IS 10118: 1982
Low voltage switchgear & control gear assemblies	IS 8623: 1993

SWITCHGEAR

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. Rupturing capacity shall be 35 MVA or 50KA RMS at 415 Volts AC as per schedule of quantities. The ACB should have $I_{cs}=I_{cu}=I_{cw}$ 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 fascia.

OPERATING MECHANISUM

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 energized.

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 INTERLOCKING

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

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 protections & features:

Adjustable over Load (Phase & Neutral) with adjustable time delay
Adjustable Short Circuit with adjustable time delay
Adjustable Instantaneous S/C without intentional time delay
Adjustable Earth Fault protections with selectable time delay.
The Release should have LED/LCD display for current metering & fault History with time and date on real time basis.
The release should separate fault indication by LEDs for identification of type of fault
The release shall sense true RMS value of current to avoid nuisance tripping during starting.
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 TRANSFORMER

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 ways 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 CERTIFICATE

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

MOULDED CASE CIRCUIT BREAKERS

MCCBs should be current limiting type with trip time of less than 10 m sec 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 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 16 KA or as specified in drawings/schedule of quantities. The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=I_{cu}$) at 415V AC. The rated operational voltage shall be minimum 415V AC. Rated insulation voltage (U_i): 690V AC and rated Impulse voltage 8 KV.

All MCCBs in Main LT/DG panels at incomer levels only shall be provided with Microprocessor based release having inbuilt adjustable protections Over Load (L), Short Circuit (S) and Ground Faults (G). MCCBs at outgoing level should be provided with Thermal Magnetic type release with adjustable settings for Overload and fixed short circuit protections.

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.

POWER CONTRACTOR

The contactors shall comply with the requirements of IEC 60947-4-1/ IS13947 – Part 4-1. 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 bus bar / 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.

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 / Aluminium 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.

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 touched 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.

METERING, INSTRUMENTATION & PROTECTION

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

CURRENT TRANSFORMER

CTs shall conform 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 mounted 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 conform to IS 3156 (Part-I, II and III) in all respects.

MEASURING TRANSFORMER

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 -10°C and +50°C. 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 outside. 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 METERS

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.

ENERGY & REACTIVE POWER METER

Trivector meters shall be two element, integrating type, KWH, KVA, KVA hour reactive meters. Meters shall conform to IEC 170 in all respects. Energy meters, KVA, and KVARH meters shall be provided with integrating registers. The registers shall be able to record energy conception of 500 hours corresponding to maximum current at rated voltage and unity power factor. Meters shall be suitable for operation with current and potential transformers available in the panel.

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:

Digit seven segment LED display

Selectable Trip time characteristics like Normal Inverse (NI), Very Inverse Extremely Inverse (EI), and Definite Time (DT) etc

CT secondary 1/ 5 A site selectable through menu operations.

4. Relay Settings:

Over Current - 0.2 to 2.0 times I_n , in steps of $0.05 I_n$

High set Over Current [I_{hs}] - 0.2 to 40 times I_n , in steps of $0.2 I_n$ 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)

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)

Output contacts: 4 NO contacts for trip signal on feeder fault.

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

POWER FACTOR CORRECTION CAPACITORS

Scope:

This specification covers design, manufacture, supply, installation, testing, commissioning of Power Factor Correction (PFC) system with capacitor banks and harmonic filters suitable for continuous duty. The capacities given in SLD are for reference only and are to be verified by contractor after doing

complete reactive load analysis and also necessary changes if required in the rating of capacitors and harmonic filters is within scope of contractor. All necessary hardware / supports required for installation of the panel is scope of the works.

Standards:

The design, manufacture and performances of the power factor correction panel with capacitor banks shall comply with all currently applicable statutes, regulations and safety codes in the locations of installations. The capacitors used will also conform to the latest applicable Indian / British / IEC standards. In particular, the equipment shall conform to the latest revisions of the following.

IS : 13340 , 13341 & 12672	Capacitors for power system.
IS : 2208 , 13703	HRC cartridge fuse and links upto 600V
IS : 8828	MCB
IS : 13947	MCCBs

When the above standards are in conflict with these specifications, this specification shall prevail.

Capacitor Bank

Capacitor bank shall comprise of identical three phase capacitors in case of PFC. The capacitor element used in unit shall have multilayer metalized polypropylene film (MPP) having low loss dielectric and impregnated with such impregnate, which shall have high dielectric constant, low viscosity and high chemical stability. The impregnate should be inert gas to avoid risk of fire in case of failure of capacitor. Stacked winding shall be adopted to form three phases in order to facilitate the better heat dissipation, same proper contact area for each winding and no heat concentration in the winding cores.

Capacitor shall be tubular (Cylindrical) MPP self-filling type. The PP film should be in wave cut design, so that higher current carrying capabilities can be achieved. Active binding element shall be properly heated and then vacuum dried prior to encapsulation in gas impregnation. The contact area must be carefully prepared so as to achieve high in rush current and long life. The capacitor shall consist of many such elements in series / parallel combinations for getting desired kVAr output. The dielectric losses of capacitor shall be restricted to 0.5 watts per kVAr.

The phase terminal connections of the capacitor unit shall be brought out at the top, for suitable connections. The capacitor shall be provided with suitably rated discharge resistor. Discharge resistance shall reduce the residual voltages to less than 50 volts within one minute as required by IS: 13340. The capacitor shall be provided with over pressure interrupter mechanism, which will automatically disconnect faulty capacitor unit from the network without bursting, bulging or exploding the capacitor.

The rating of the step should be decided by due consideration of de-rating due to harmonic reactors, so as to ensure that each capacitor feeder delivers net output equivalent to the step rating. PF capacitors should be rated for minimum 480/525 VAC, 3-ph, 50 Hz.

Capacitor Panel

The capacitor control panel shall operate in Automatic mode as specified in the data sheet. The panel for capacitor shall be fabricated from 2 mm thick sheet steel and shall be finished with 7tank process followed by powder coating. Earthling terminal shall be provided. The panel shall be provided with suitably rated T.P. copper bus bar supported on epoxy insulator. Each capacitor unit shall be connected to main bus bar through capacitor duty contactor of suitable rating with safety margin. Protective HRC/MCBs /MCCBs fuses of suitable rating shall be provided with base / holder as mentioned in the drawing. Connection shall be made with PVC insulated flexible copper cables having crimped copper lugs.

All capacitor units shall be earthed; sufficient ventilation shall be provided to limit the temperature rise to maximum 85° C. Cooling fans shall be provided to each heat sink as per requirement. Suitable exhaust fans shall be provided in order to dissipate the internal heat of the panel and maintain the internal temperature rise of the panel within safe limits. The operation of fans shall be automatic with temperature sensor. Drawing pocket shall be provided at the door of each panel. A 15-amp switch & socket and the lamp holder shall also be provided for panel illumination at the suitable location.

The main Bus bar shall be terminated on suitably rated SFU /MCCB /SDU / ACB. Detachable gland plates shall be provided with suitable knockout for incoming cable connection from bottom/top as specified. Capacitor unit shall be mounted a frame of adequate strength construction.

The panel shall be mounted on MS channel section at the bottom for easy installation. The panel shall be provided with lifting hooks /eye bolts for handling. Automatic Power Factor Correction Relay shall be provided with all related circuits and three load CT's for each phase in order to control/ achieve target Power Factor OR unity as per setting.

The controller shall be capable of correcting Power Factor within seconds in case of PFC. The capacitor shall be switched ON and OFF using capacitor duty contactor from APFC controller.

Average compensation required and compensation supplied shall be continuously monitored for all the three phase simultaneously and total low kVAr requirement shall be calculated accordingly. It would automatically switch ON and OFF the capacitor bank so as to attain the set target power factor. The panel shall be provided as per respective drawing.

Power factor controlling shall be on cycle-to-cycle basis. Proportionate correction or cutting A.C. waveform will not be allowed. The controller shall be capable to work at voltage between 200 to 440 volts. Digital controller shall be provided which minimum indication of line voltage and current, capacitor current, Power factor, active power /reactive power/ apparent power, injected capacitive kVAr, uncompensated capacitive kVAr, CT ratio selected, switching time, LED indication for capacitor bank step switch ON, power factor lag/lead shall be provided.

The enclosure of capacitor unit shall be provided with 2 nos. 10 mm earth terminals or strip, each complete with two plain and one spring washer, nuts etc. These terminals shall be effectively bonded to the common sheet steel framework. Each bank in case of APFC will have two external terminals in the bus bar chambers complete with hardware.

DRAWING

The following drawings will be submitted along with the bid.

General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.

Power wiring diagram of capacitor panel.

Control wiring diagram of capacitor panel.

C.T. Connection.

Manual for Automatic Power Factor Correction Relay and entire panel. Installation diagram.

APFC RELAY

Microprocessor based APFC relay (Intelligent controller) 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.

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 within 5 years of the date of bid opening. 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.

MEDIUM VOLTAGE SWITCH BOARDS:-

GENERAL

All medium voltage switchboards shall be suitable for operation at three phase/three phase 4 wires, 415 volt, 50 Hz, neutral grounded at transformer system with a short circuit level withstand of 35 MVA at 415 volts or as per schedule of quantities.

The Switch Boards shall comply with the latest edition with up to date amendments of relevant Indian Standards and Indian Electricity Rules and Regulations.

SWITCH BOARD CONFIGURATIONS

The Switch Board shall be configured with Air Circuit Breakers, MCCB's, and other equipment as called for in the Schedule of Quantities.

The MCCB's shall be arranged in multi-tier formation whereas the Air Circuit Breakers shall be arranged in Single or Double tier formation only to facilitate operation and maintenance.

The Switch Boards shall be of adequate size with a provision of 25% spare space to accommodate possible future additional switch gear.

EQUIPMENT SPECIFICATIONS

All equipment used to configure the Switch Board shall comply with the relevant Standards and Codes of the Bureau of Indian Standards and to the detailed technical Specifications as included in this tender document

CONSTRUCTIONAL FEATURES

The Switch Boards shall be metal enclosed, sheet steel cubicle pattern, extensible, dead front, floor mounting type and suitable for indoor mounting.

The Switch Boards shall be totally enclosed, completely dust and vermin proof. Synthetic rubber gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust and vermin proof to provide a degree of protection of IP 42/IP 54 as specified. All doors and covers shall also be fully gasket with synthetic rubber and shall be lockable.

The Switch Board shall be fabricated with CRCA Sheet Steel of thickness not less than 2.0 mm and shall be folded and braced as necessary to provide a rigid support for all components. The doors and covers shall be constructed from CRCA sheet steel of thickness not less than 1.6 mm. Joints of any kind in sheet metal shall be seam welded and all welding slag ground off and welding pits wiped smooth with plumber metal.

All panels and covers shall be properly fitted and square with the frame. The holes in the panel shall be correctly positioned.

Fixing screws shall enter holes tapped into an adequate thickness of metal or provided with hank nuts. Self threading screws shall not be used in the construction of the Switch Boards.

SWITCH BOARD DIMENSIONAL LIMITATIONS

A base channel 75 mm x 5 mm thick shall be provided at the bottom.

A minimum of 200 mm blank space between the floor of switch board and bottom must be provided.

The overall height of the Switch Board shall be limited to 2300 mm

The height of the operating handle, push buttons etc shall be restricted between 300 mm and 2000 mm from finished floor level.

SWITCH BOARD COMPARTMENTLIZATION

The Switch Board shall be divided into distinct separate compartments comprising

A completely enclosed ventilated dust and vermin proof bus bar compartment for the horizontal and vertical bus bars.

Each circuit breaker and MCCB shall be housed in separate compartments enclosed on all sides.

Sheet steel hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "on" and "off" position.

For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, busbars and connection.

A horizontal wire way with screwed cover shall be provided at the top to take interconnecting control wiring between vertical sections.

Separate cable compartments running the height of the Switch Board in the case of front access Boards shall be provided for incoming and outgoing cables.

Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top.

Adequate and proper support shall be provided in cable compartments to support cables.

SWITCH BOARD BUS BARS

The Bus Bar and interconnections shall be of electrolytic Copper /Aluminum and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bar. The maximum current density for copper shall be 1.6 amps per sq. mm. and for Aluminum shall be 1 amp per Sq. mm. and suitable to withstand the stresses of a 35 MVA fault level or at 415 volts for 1 second or as per schedule of quantities. .

The bus bars and interconnections shall be insulated with insulation tape/ fibre glass.

The bus bars shall be extensible on either side of the Switch Board.

The bus bars shall be supported on non-breakable, non-hygroscopic insulated supports at regular intervals, to withstand the forces arising from a fault level of 31 MVA at 415 volts for 1 second.

All bus bars shall be colour coded.

All bus bar connections in Switch Boards shall be bolted with brass bolts and nuts. Additional cross section of bus bars shall be provided wherever holes are drilled in the bus bars.

SWITCH BOARD INTERCONNECTIONS

All connections between the bus bars/Breakers/cable terminations shall be through solid tinned copper strips of adequate size to carry full rated current and PVC/fibre glass insulated.

For unit ratings up to 100 amps PVC insulated copper conductor wires of adequate size to carry full load current shall be used. The terminations of all such interconnections shall be crimped and aluminium lugs shall be used.

DRAW OUT FEATURES

Air Circuit Breakers shall be provided in fully draw out cubicles. These cubicles shall be such that draw out is possible without disconnection of the wires and cables. The power and control circuits shall have self aligning and self isolating contacts. The fixed and moving contacts shall be easily accessible for operation and maintenance. Mechanical interlocks shall be provided on the draw out cubicles to ensure safety and compliance to relevant Standards. The MCCB's shall be provided in fixed type cubicles.

INSTRUMENT ACCOMMODATION

Instruments and indicating lamps shall not be mounted on the Circuit Breaker Compartment door for which a separate and adequate compartment shall be provided and the instrumentation shall be accessible for testing and maintenance without danger of accidental contact with live parts of the Switch Board.

For MCCB's instruments and indicating lamps can be provided on the compartment doors.

The current transformers for metering and for protection shall be mounted on the solid copper/aluminium bus bars with proper supports.

WIRING

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

CABLE TERNMINATIONS

Knockout holes of appropriate size and number shall be provided in the Switch Board in conformity with the location of incoming and outgoing conduits/cables.

The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located at the rear of the panel.

The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards or in the cable compartment in the case of front access Switch Boards.

The Switch Boards shall be complete with tinned brass cable sockets, tinned brass compression glands, gland plates, supporting clamps and brackets etc for termination of 1100 volt grade aluminium conductor PVC/PVCA cables.

SPACE HEATERS

The Switch Board shall have in each panel thermostatically controlled space heaters with a controlling 15 amp 230 volt switch socket outlet to eliminate condensation.

VENTILATION FANS

The Switch Board shall be provided with panel mounting type ventilation fans in each panel with switchgear rated for 2000 amp and above. The fan shall be interlocked with switchgear operation.

EARTHING

A main earth bar of G.I./copper as required shall be provided throughout the full length of the Switch Board with a provision to make connections to the sub-station earths on both sides.

SHEET STEEL TREATMENT AND PAINTING

Sheet Steel materials used in the construction of these units should have undergone a rigorous rust proofing process comprising of alkaline degreasing, decaling in dilute sulphuric acid and a recognised phosphate process. The steel work shall then receive two coats of oxide filler primer before final painting. Castings shall be scrupulously cleaned and fettled before receiving a similar oxide primer coat.

All sheet steel shall after metal treatment is spray or powder coated paint of approved shade on the outside and inside.

NAME PLATES AND LABELS

Suitable engraved white on black name plates and identification labels of metal for all Switch Boards and Circuits shall be provided. These shall indicate the feeder number and feeder designation.

OUTDOOR TYPE 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, decaling in dilute sulphuric acid solution and recognised phosphate 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 Hylum, 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 there from 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 outgoing cables.

CONTROL DEVICES

- a) 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

b) **Indicating Lights**

The indicating lights used in the panel will be LED type pleasant looking and;

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.

TESTING AT WORKS

Copies of type test carried out at ACB/MCCB manufacturers works and routine tests carried out at the switchboard fabricators shop shall be furnished along with the delivery of the switchboards. Project Manager reserves the right to get the switchboard inspected by their representative at fabricators works prior to dispatch to site to witness the routine tests as per I.S.

INSTALLATION

The foundations prepared as per the manufacturers drawings shall be leveled, checked for accuracy and the Switch Board installed. All bus bar connections shall be checked with a feeler gauge after installation. The cable end boxes shall be sealed to prevent entry of moisture. The main earth bar shall be connected to the sub-station earths.

A 15 mm thick rubber matting of approved make on a 100 mm high timber platform shall be provided in front of and along the full length of the Switch Board. The width of the matting shall be 1000 mm.

The rubber mat shall withstand 15 KV for 1 minute and leakage current shall not exceed 160 MA/sq. metre.

After installation the Switch Board shall be tested as required prior to commissioning.

TESTING AT SITE

Pre-commissioning tests as required and as per manufacturers recommendations shall be carried out on each switchboard at site before energizing the switchboards including but not restricted to the following. Physical checking of the switchboards including checking alignment of panels, interconnection of Bus bars, tightness of bolts/connections and evidence of damage/cracks in any components.

Physical checking and inspections of Inter panel wiring

Checking free movement of ACBs/MCCBs/SFUs

Checking of operation of breakers

Insulation tests of bus bar supports and control wiring etc. with 1.1 kV megger.

Primary & secondary injection tests of relays and CTs.

Checking of Interlocking function.

CABLES AND EARTHING:-

H. T. CABLE (XLPE)

The cross linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (part-I) and (part- II) 1973.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as Water pipes, sewerage, lines etc may not be damaged any telephone or other cable coming in the way shall be Properly protected as per instructions of the engineer – in – charge. The H .T. cable shall be laid at least 1200 mm for cable up to 33 K V (E) below the ground level.

After laying and jointing work is completed a high voltage test shall be performed and test results submitted for approval in order to insure that they have not been damaged during or after the laying operation .In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost.

L. T. CABLE (XLPE)

All Medium voltage or low voltage supply cables shall be PVC sheathed and steel wire armoured or steel tape armoured construction. The conductors of cable from 16 mm sq. to 35 mm sq size shall be stranded. Sector shaped stranded conductor shall be used for cables of 50 mm sq size and above. The cables shall conform to IS: 1554 part – I (1988) in all respect

Rating

The cable shall be rated for a voltage of 1100 volts.

Construction

The conductors shall be made of solid stranded electrical parity Aluminium in case of aluminium conductor and high conductivity copper conductor for the copper conductor cables. The conductor shall be insulated with high quality PVC base compound comparing to IS: 5831- 1970. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of un vulcanised compound. Armouring shall be applied over the inner sheath of bedding. Over the amounting a tough outer sheath shall be extruded. The outer sheath shall bear the manufactures name and trade mark at every meter length.

Core identification

Core shall be provided with the following colour scheme of PVC insulation.

1.0 Core	:	Red / Black / Yellow / Blue
2.0 Core	:	Red & Black
3.0 Core	:	Red / Yellow / Blue
3.5 Core	:	Red / Black Neutral / Yellow / Blue
4.0 Core	:	Red / Black Neutral / Yellow / Blue

Current Rating

The current ratings shall be based on the following condition:

- | | | | |
|----|-------------------------------|---|---------------------|
| a) | Maximum conductor temperature | : | 75 deg. C |
| b) | Ambient Air Temperature | : | 40deg. C/ 45 deg. C |

- c) Ground temperature : 30 deg. C
- d) Depth of laying : 75 cm.

Short circuit rating

Short circuit ratings for the cables shall be as specified in IS: 1554 part- I.

Selection of cables

Cables have been selected considering the condition of the maximum connected load, ambient temperature, grouping of cables and the allowable voltage drop. However, the contractors shall re check the size before the cables are fixed and connected to the service.

CABLE WORK IN UNDER GROUND

While laying underground cables care should be taken so that any underground structure such as water pipes, sewerage lines, etc may not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of Architect/. All cable routes shall be carefully measured and cable cut to the required lengths leaving sufficient length for the final connection of the cable. All cable trenches entering sub- stations plants etc. Shall be effectively sealed after installation of cables to avoid entry of water.

The L.T. cables shall be laid not less than 75 cm below ground level in a trench 35cm wide minimum .The depth of the trenches shall be uniform throughout. A bed of 17 cm dry sand shall be laid before cable is laid.

When the cable is properly straightened and laid in the trench, it should be covered all around 8mm thick layer of sand. Approved cable indicators shall be fixed at suitable distances along the route of the cable.

Unless otherwise specified the cables shall be protected by second class bricks of not less than 22.5x 10.0x7 cm or stone tiles or any other approved material placed on sides and top of the cable to form a channel throughout the length.

Spun reinforced concrete pipes shall be provided for all road crossings. The size and nature of the pipe shall be decided by Architect and shall not be less than 10cm in diameter for a single cable and not less than 20cm for more than one cable. These pipes shall be laid in the ground with 10cm thick bed of cement concrete 1:5:10 and may be loose jointed. The top surface of pipe shall be at minimum depth of 90cm from the ground level when laid under the roads/ pavements.

Filling of trenches shall be done after the sand cushioning and laying of tiles are carried out to the satisfaction of a architect, where road berms or lawns have been cut of Keri stones displaced the same shall be repaired to the satisfaction without any extra cost.

CABLE WORK;-**LAYING OF CABLES OVER DUCTS / WALL/ TRAYS;-****A) DUCT SYSTEM**

Wherever specified such as road crossing, entry to building or in paved area etc. cables shall be laid in underground ducts. The duct system shall consist of a required number of stone Ware pipes, GI, CI or spun reinforced concrete pipe with simplex joints and all the jointing work shall be done according to the CPWD building specifications or as per the instruction Of the Engineer – in – charge as the many case may be. The size of the pipe shall not be less than 100 mm in diameter for a single cable and shall not be less than 150 mm for more than one cable and so on. The pipe shall be laid directly in ground without making any special bed but wherever asbestos cement pipes are used, the pipes shall be encased in concrete of 75 mm thick. The top surface of the cable ducts shall not be less than 60 cm below the ground level. The duct shall be laid a gradient of at least 1:300. The duct shall be provided manholes of adequate size at regular intervals for drawing the cables. The manholes and cover frames shall be cast iron and machine finished to ensure a perfect joint. The manholes covers shall be installed flush with the ground or paved surfaces. The duct entry to the manholes shall be made leak proof with lead proof joints. The duct shall be properly plugged at the ends to prevent entry of water, rodents, etc. The duct marker shall at least be 15 cm. Square embedded in concrete, indicating duct. Suitable cables supports made of angle iron shall be provided in the manholes for supporting the cables. Proper identification tags shall be provided for each cable in the manholes.

B) CABLES IN OUT DOOR TRENCHES

Cable shall be laid in outdoor trenches wherever called for. The depth of the trenches shall not be less than 75 cm from the final ground level. The width of the trenches shall not be less than 45cm. However, where more than one cable is laid, an axial distance of not less than 15 cm. shall be allowed between the cables. The trenches shall be excavated in reasonably straight line with vertical side walls and with uniform depth. Wherever there is a change in direction suitable curvature shall be provided complying with the requirements.

Suitable shoring and propping may be done to avoid caving in of trench walls. The bottom of the trench shall be level and free from stone brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushions of not less than 8 cm in depth.

The cable shall be pulled over rollers in the trenches steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be paved off in one stretch. However where this is not possible the remainder of the cable may be removed by “faking” i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 mtrs apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable then laid in reasonably straight line.

For short cut runs and sizes up to 50 sq.mm of cables up to 1.1 KV grade any other suitable method of direct handling and laying can be adopted with the prior approval of the Engineer – in – charge.

When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and the cable length then measured. The ends of all cables shall be sealed immediately. In case of PVC cables suitable moisture seal tape shall be used for this purpose.

Cables laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less 17 cms above the base cushion of sand before the protective cover is laid. In the case of vertical multi tier formation after the first cable has been laid a sand cushion of 30 cms shall be provided over the initial bed before the second tier is laid. If additional tiers are former each of the subsequent tiers also shall have a sand cushion of 30 cms as stated above .The top most cable shall have a final sand covering not less than 17 cms before the protective cover is laid.

Unless otherwise specified, the cables shall be protected by the second class bricks of not less than 20 cms x 10 cms x 10 cms.(normal size) protection covers placed on top of the sand (bricks to be laid breadth wise) for the full length of the cable. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at 5 cm. over the sides of the end cables. The trenches shall be taken back filled with excavate earth free from stones or other sharp edge debris and shall be rammed and watered , if necessary , in successive layers not exceeding 30 cm, unless otherwise specified.

ROUTE MARKER

Cable route marker marked “cable” shall be provided along with the route of the cable and location of loops. The route markers shall be tapered concrete slab of 60 x 60 cm at bottom and 50 x 50 cm. at top having a thickness of 10 cm .Cable marker shall be mounted parallel to and 50 cm away from the edge of the trench.

C) CABLES IN INDOOR TRENCHES

Cables shall be laid in indoor trenches wherever specified .The trench shall be made of brick masonry with smooth cement mortar finish with suitable removable covers (i.e. precasted slabs or checkered plates). The dimensions of the trench shall be determined depending upon the maximum number of cables that is expected to be accommodated and can be conveniently laid. Cables that is arranged in tier formation in trenches and if , necessary cables may be fixed with clamps, hook and saddles shall be used for securing the cable in position .Spacing between the cables shall not be less than 15 cm centre to centre .Wherever specified , trenches shall be filled with fine sand and covered with RCC or steel checkered trench covers.

D) CABLE ON TRAYS/ RACKS

I) Cable shall be laid on cable trays/ racks wherever specified. Cable racks/ trays shall be of ladder, through on channel design suitable for the purposes .The nominal width of the trays / racks shall be 150 mm. The width of the trays shall be made of steel or aluminium. The trays / racks shall be hot dip galvanized .Cable tray s shall be erected properly to present a neat and clean appearance .Suitable cleats or saddles made of aluminium strips with PVC covering shall be used for securing the cables to the cable trays. The cable trays shall comply with the following requirements.

- ii) The tray shall have suitable strength and rigidity to provide adequate support for all contained cables.
- iii) It shall not present sharp edges burrs, or projection injurious to the insulation of wiring / cables.
- iv) If made of metal, it shall be adequately protected against corrosion or shall be made of corrosion resistant material.
- v) It shall have side rails or equivalent structural members.
- vi) It shall include fittings or other suitable means for changes in direction and elevation of runs.

INSTALLATION

- A) Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cables tray system shall be rigid.
- B) Each run of the cable tray shall be completed before the installation of cables.
- C) In portions where additional protection is required, non combustible covers/ enclosure shall be used.
- D) Cable trays shall be exposed and accessible.
- E) Where cables of different system are installed on the same cable tray, non combustible, solid barriers shall be used for segregating the cables.
- F) Cables trays shall be grounded by two nos., earth continuity wires. Cable trays shall not be used as equipment grounding conductors.

JOINTING AND TERMINATION'S

Cable jointing shall be done as per the recommendations of the cable manufacturer. All jointing work shall be done only by qualified/ licensed cable jointer.

All jointing pits shall be of sufficient dimension as to allow easy and comfortable working.

Jointing materials and accessories like conductor , ferrules , solder, flex, insulating and protective tapes , filling compound , jointing box etc. of right quality and correct sizes, confirming to relevant Indian Standards.

Each termination's shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool shall be used for making the end termination's .Cable gland shall be bonded to the earth by using suitable size copper wire/ tape.

Cable jointing shall be tested at factory as per the requirements of IS : 1554. Part -1 . Test shall incorporate routine tests, type tests and acceptance tests.

Cable shall be tested at site after installation and the results shall be submitted to the Architects/ Engineer.

Insulation resistance between conductors and neutral and conductors and earth.

Pressure test for 15 minutes.

TESTING OF CABLES:-

After laying and jointing work is completed, a high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is no fault in the jointing. For 33KV/11KV XLPE cable high pot test shall be done at site by 50KV system and nothing extra shall be payable. Cable for use on low and medium voltage system (1.1 K V grade cables) should stand for 15 minutes a pressure of 3000 volts DC applied between conductors and also between each conductor and sheaths .In the absence of "Pressure testing facility" it is sufficient to test for one minute with a 1000 volts insulation tester. In case, the test results are unsatisfactory the cost of all repairs and replacement and relaying will be made good by the contractor. Nothing shall be payable for conducting high pot test.

EARTHING:-

All electrical equipments to be earthen should be connected by two earth tapes from the frame of the equipment ring will be connected via several earth electrodes. The cable arm our will be earthen through the cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62,, 67,& 68 of Indian Electricity rules 1956 and as per IS- 3843-1986.

The following shall be earthen:-

1. Transformer & D.G. set neutrals. (Only one DG neutral shall be earthed and balance two DG's will have a floating earth.)
2. Transformer housing.
3. H .T. Panel.
4. Non –current carrying metallic parts of electrical equipment such as switch gear, bus ducts, panel boards, motor control centers, O. H. Bus bars, distribution boards, cable trays.
5. Generator & motor frames.

The earth connections shall be properly made .A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

The shop drawings for earthing system shall be prepared by the contractor and be got approved by Architect. The work shall be done in accordance with approved drawings.

All earth electrodes shall be given to a depth sufficient to reach permanently / moist soil. Their location shall be marked and approval taken from engineer – in charge before excavation for the same.

The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 1.0 ohms.

The earth loop resistance to any point in the electrical system shall not be in excess of 1.0 ohms in order to ensure satisfactory operation of protective devices.

The resistance to earth shall be measured at the following: -

- a) At each electrical system ground or system neutral ground.
- b) At one point on each grounding system used to ground electrical equipment enclosures.
- c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable sheaths or armour.

All earthing conductors shall be of high conductivity, copper. GI and shall be protected against mechanical damage. The cross-sectional area of earth conductors shall but be smaller than half that of the largest current carrying conductor. However the contractor shall use the sizes specified in the bill of quantities of the tender.

For earthing of “neutral” of transformers the earthing electrode shall consist of tinned copper plate (60cm x 60 cm x 3 mm) G. I. Plate (60 cm x 60 cm x 6 mm) shall be used for body earthing. The plate electrode shall be buried in ground with its face vertical and top not less than 4.5 m below G. L. The earth plate shall be buried in the ground below the permanent moisture level. The plate shall be filled with charcoal dust and common salt filling extending 15 cm around it on all sides. There shall be a 20mm dia medium class G. L. pipes running from top of the plate up to the ground level for watering pipe. The top of the pipe shall be provided with a funnel and a GL mesh screen of watering the earthing. This will be used in a masonry sump with cement plastering not less than 30-cm square and 30 cm deep. A.M.S. frame heavy duty with hinged cover and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by GL pipe. The portion of this protection pipe within ground shall be buried at least 30 cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode the earthing lead shall be securely noted to the plate with two bolts, nuts, check nuts and washers. All materials used for connection the earth lead with electrode shall be GI in case of GI plate earth electrodes and of tinned brass in case of tinned copper plate electrode.

All non-current carrying metal parts of electrical installation shall be earthing as per IS: 3043-1986 with latest amendments. All metal conduits, cable sheathes, switch gear, D B's light fixture equipment and all other parts made of metal shall be bonded together and connected to earth electrodes. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian electricity rules (1956).

All earthing conductors shall be of high conductivity copper, GI and shall be protected against mechanical damage. The cross sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor. However the contractor shall use the sizes specified in the bill of quantities.

All fixtures and socket outlets, fans, switch boxes and junction boxes, etc. shall be earthen with bare copper wire as specified in the item of work. The earth wire ends shall be connected with solder-less bottle type copper lugs.

All single phase D B's up to 60Amps shall be earthen with 8 SWG GI wire as per item of work.

All 3 phase switch boards up to 100Amps rating shall be earthen with 2Nos. Separate and 25 x 3mm GI strip as per item of work.

All switch boards of ratings more than 100Amps and above shall be earthen with 2Nos. Distinctive separate 25 x 6mm GI strips as per item of work.

All the earth wires in switch boxes, D B's and light fixtures/fans shall be provided with green colour sleeving.

Main earth bus shall be taken from the LT. Switch board to earth electrodes. The electrical resistance of earthing conductors shall be low enough to permit passage of fault current necessary to operate fuse or circuit breaker and shall not exceed 2 ohms.

A-PLATE EARTHING

The earthing electrode shall consist of GI plate (60cm x 60cm x 6mm/tinned copper plate 60cm x 60cm x 3mm) as specified in item of work. Galvanizing of the plate shall conform to relevant Indian Standard. The plate electrode shall be buried in the ground with its faces vertical and top not less than 4.5m below GL. The earth plate pipe shall be buried in the ground below the permanent moisture level but not less than 4.5m below ground level. The plate shall be filled with charcoal dust and common salt filling extending up to 15cm around it on all sides. There shall be a 20mm dia, medium class GI pipe running from top plinth plate up to the ground level for watering pipe. The top of the pipe shall be provided with a funnel and a GI mesh screen for washing the earth. This will be housed in a masonry sump with cement plastering not less than 30cm deep. M. S. Frame heavy duty with hinged cover and locking arrangement shall be suitably provided over the sump. The earthing leak from electrode onwards shall be suitably protected from mechanical injury by GI pipe. The portion of this protection pipe within the ground shall be buried at the least 30cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In

Assam

the case of plate earth electrode, the earthing load shall be securely bolted to the plate with two bolts, nuts check nuts and washers. In case of pipe earth electrode, it should be counted by means of a 'through' connection with the earth lead with electrode shall be GI brass in case of copper plate electrode.

The electrical resistance of earthing conductors shall be low enough to permit passage of fault current necessary to operate the fuse or circuit breaker and shall not exceed 2 ohms.

DIESEL GENERATOR SETS:-

SCOPE OF CONTRACT

SCOPE OF WORK

Work covered by this contract shall include design, manufacture, supply¹ transportation, delivery, installation, testing and commissioning of automatic start direct coupled Diesel Generator Sets and shall include but not limited to the following.

Radiator cooled engine with alternator mounted on a rigid fabricated steel base frame with resilient anti-vibration mountings.

Daily fuel oil service tank with oil piping and filters.

Air intake filter

Exhaust piping with residential type silencers.

Obtaining necessary permission from State Electricity Board for installation and operation of DG Sets.

Obtaining statutory approvals from Chief Electrical Inspector, to the State Government.

Obtaining approvals from State and Central Pollution Authorities as required before commencement of work as also after completion of work as required.

Obtaining approvals Central Electrical Authority for noise level and other norms as per Gazette – July, 1999.

Scope of work shall also include all civil works associated with electrical system works and making good and painting the civil works as required.

Scope of work shall also include the following:

Operation maintenance of equipment for 12 months from the date of commissioning.

Housekeeping and maintenance of work area during the tenure of contract.

Demobilisation and clearing of all temporary works/ facilities after completion of work at site.

The Contractor's scope of work shall include supplying and fixing of complete work as set down in these tender documents, materials and components not specifically stated in the tender documents but which are necessary for satisfactory installation and operation of the system shall be deemed to have been included in the Contractor's the scope of work.

AMBIENT CONDITIONS

DG sets and auxiliaries shall be capable of operating continuously and delivering the rated output at ambient conditions prevailing at site. The anticipated maximum and minimum extremes at site, which is at an elevation of 300 mts above sea level, are as below.

Maximum - Ambient temperature 50 deg C RH 90 %

Minimum - Ambient temperature 0 deg C RH 90 %

The Conditions of Site shall be applicable.

SUPPLY SYSTEM

The equipment supplied shall be suitable for operation on a 433 volt, 3 phase, 4 wire, 50 cycles per second system.

STANDARDS

The equipment offered shall conform to the latest revision of relevant Indian or British standard (BSS.) and Codes together with the requirements of the Local Supply Authority.

Tenderers shall clearly state the standards to which the equipment conforms.

ENGINE AND ACCESSORIES**ENGINE**

The engine shall have the following characteristics:

Type - Suitable for generating set application, multi-cylinder, solid injection, cold starting.

Cycle - Four strokes.

Speed - 1,500 r.p.m.

Speed Variation – Within 2% for operation between 1% and 10%

Method of Starting – Battery

Net site output - As per Schedule of quantities. This shall be the continuous rating under the ambient conditions given in Clause 1.3 above.

The output shall be based on base duty application i.e. continuous operation around the clock with varying loads.

The engine rating shall be stated in the tender in accordance with the latest revision of relevant I.S. or B.S. The DG Sets shall be equipped for automatic starting and stopping with logic panel as specified.

ACCESSORIES FOR ENGINE

The accessories to be provided with the engine shall be included (but not limited) to the following:

On the Engine:

Flywheel to suit flexible coupling.

Flexible coupling with guard.

Air cleaner dry type.

Corrosion resistor.

Fuel pump.

NIT-IIIT-G
Assam
Governor – electronic.
Fuel filter
Lub. Oil filter.

Specification

- a) Heavy duty batteries with leads and battery charger.
- b) Exhaust silencer residential type
- c) Interconnection wiring, cabling and piping as required
- d) Cooling system.

FUEL CONSUMPTION

The engine shall be suitable for satisfactory operation on H.S.D. as per Indian Standards as locally available. The tenderer shall declare the guaranteed fuel consumption in liters per BHP/hr; in accordance with relevant I.S. or B.S. at 60%, 80%, 110%, load under the maximum output after de-rating to ambient conditions.

Such guaranteed fuel consumption is also to be expressed for convenience in subsequent checking of performance in liters per net kWh output from the alternator (after supplying the requirements of auxiliaries) at full load and at 0.8 and unity power factor.

If guaranteed fuel consumption is exceeded, the Contractor shall make such amendments or alterations as are necessary to bring the consumption within the guaranteed figures.

Minimum guaranteed fuel consumption on 100% load should be specified

Tolerance of + 5% as defined in BSS-649-1958 shall be allowed.

LUBRICATING OIL CONSUMPTION

The tenderer shall state the guaranteed lubricating oil consumption in liters per hour.

GOVERNING

The governor shall be of electronic type with governing class A direct.

MOUNTING

The engine and direct-coupled alternator shall be rigidly secured to a common truly rigid fabricated steel base frame of substantial and proven design. The DG sets shall be installed on isolated inertia foundation to be provided. Ant vibration mountings shall be provided between the base frame and the foundation (to completely isolate residual vibrations from AVMs to the structure). The tenderer shall confirm the type of mountings and mounting arrangements provided and state the guaranteed vibration isolation efficiency in the tender.

Approved vibration isolation shall also be provided between DG sets and all rigid piping connected to the DG set such that transmission of vibration to the piping system is less than 1%.

AIR FILTERS

The engine air intake shall be fitted with a substantial clearable air cleaner of the dry type. The filter shall be suitable for operation under dusty conditions for periods of not less than 200 hours between cleaning operations.

CRANK CASE BREATHER

The crankcase breather outlet of the engine shall be fitted with a filter cap capable of preventing entry of dust.

FUEL AND LUBRICATING OIL FILTERS

Filter for fuel and lubricating oil systems shall be of dual type to permit removal of one strainer if necessary whilst the engine is running. Lubricating oil filters shall be of an efficient full flow type of ample capacity and suitable for use with detergent oils. They shall be capable of removing all foreign matter above a particle size of 5 microns and shall also operate for at least 200 hours between cleaning operations.

LUBRICATING OIL SYSTEM

The engine shall be of the totally enclosed type and fitted with a positive pressure system of lubrication to all working parts. There shall be no moving parts which require lubrication by hand prior to the starting of the engine or whilst it is in operation.

The lubricating oil shall be circulated in the engine by an engine driven fuel pump.

ENGINE CONTROLS**SPEED CONTROL**

Speed control shall be so arranged that a 12-1/2% increase over normal rated speed shall cut off fuel supply, thus stopping the engine.

OVERLOAD PROTECTION

The engine shall be adequately protected against operating under overload conditions. The requirements shall be met by the provision of a fixed overload limit stop on the fuel pump rack control rod to prevent the set being subjected to a load exceeding the site rating plus 1%.

EXCESS STARTING TIME

Circuit for the automatic mains failure diesel generator sets shall be arranged to attempt up to three starting cycles, each not exceeding 1 second's duration with a similar OFF period between each cycle. If the set fails to start upon completion of the third attempt the starting circuit shall be locked out until it is restored manually. An alarm shall be given and "Set failed to start" indication given on the panel.

Provision shall also be made to avoid re-engagement of the starter pinion until after the engine has come to rest. Failure of the starter motor to disengage shall close down or lock out the engine.

LOW LUBRICATING OIL PRESSURE

Pressure switches shall be fitted such that in the event of a fall in the lub oil pressure, an alarm and indication shall be actuated. In addition, the engine shall be automatically shut down in the event of lub oil pressure dropping to a predetermined low value.

HIGH WATER TEMPERATURE

An alarm shall be given if the water temperature exceeds the safe limits and the engine shall be shut down when a pre-determined set water temperature is reached.

FUEL LEVEL OPERATION

In the daily service fuel tank, a float operated switch control shall be of the fuel transfer pump shall be provided to start and stop the pump when the tank contents are respectively at one third and full levels. A low level control shall be provided to give visual and audible alarms if the level in the tank falls to ¼ full.

EXHAUST SYSTEM

EXHAUST PIPING

The engine shall be provided with an exhaust pipe carried to the shaft of the building and fitted with a residential type silencer to reduce the noise level to the minimum. Height at which exhaust shall be let out shall be as per the requirements of Pollution Control Authorities.

Exhaust piping shall be fabricated from class 'A' MS pipes of size suitable to limit back pressure to within permissible limit. All exhaust piping inside the DG room shall be insulated with 50 mm mineral of density 32 kg. Per Cum TF quality wool lagging covered with 24 SWG aluminium sheet cladding. Flanged joints in the exhaust piping shall be covered with removable moulded asbestos sectional mufflers or similar composition.

Exhaust piping shall be fitted with a flexible section or an expansion joint and shall also be graded to a drain pocket inside the building. The pocket shall be fitted with a drain cock.

Inspection chambers at the bend shall be provided for removal of soot.

ALTERNATOR

RATING

The Alternators shall have the following rating and characteristics

Type	Drip Proof Screen protected for power generation
Speed	1500 R.P.M.
Net Site Output	As per Schedule of Quantities
Voltage Regulation -	Within + 1.0% of the rated voltage from no load to full load

Overload		More than 10% of the nominal for 1 hour every 12 hours without excessive heating
Harmonics	-	Maximum 1% between phase and neutral and total maximum 3%
Voltage	-	433 V + 1.0% 3- phase at 50 H Z

CONSTRUCTION

A direct coupled, screen protected drip proof type and self excited and self regulated alternator shall be provided with the diesel engine. The combined engine alternator unit shall be mounted on a common rigid fabricated base frame, and the alternator shall be continuously rated. The alternator shall have its windings star connected with the neutral connection brought out to a separate terminal. The alternator shall fully comply with the latest Standard BS 2613 and BS 269 in respect of winding insulation and fast response to maintain steady voltage.

TEMPERATURE RISE

The maximum temperature rises of the various components of the alternator shall not exceed those permitted under I.S. with full output and under the ambient temperature conditions specified in Clause 1.3 above.

RATING AND REGULATION

The alternator shall be directly coupled to the diesel engine through a flexible coupling and shall be suitable to deliver the rated output at 0.8 P.F. lagging, on a 3 phase 4 wire 433 volts 50 cycle system. The alternator shall be of the self-regulated and self excited type in a screen protected, drip proof enclosure. The alternator shall be with static excitation system and the voltage regulation from no load to rated load shall be within 1% of rated voltage.

ALTERNATOR INSULATION

The alternator should have class H insulation to withstand tropical conditions.

MANUAL MODE

Under manual mode it shall be possible for the operator to start up the generator set by pressing the (START) push button.

Three attempt starting facility shall also be operative for the start up function.

Alternator, Bus-coupler and mains circuit breakers 'CLOSE' and 'TRIP' operations as required shall be manual by pressing the appropriate push button on the panel. Closure shall be feasible only after alternator has built up full voltage. If the load is already on 'MAINS' pressure on 'CLOSE' button shall be ineffective.

When running under manual mode, if the mains supply has failed, the load shall automatically get transferred to the alternator immediately overriding the stipulation of pressure on 'CLOSE' button.

Engine shut down, other than due to faults shall be manual by pressing a 'STOP' button

TEST MODE

When under 'TEST' mode pressure of 'TEST' button shall complete the start up sequence simulation and start the engine. The simulation will be that of mains failure. Sequence 1.8.1.1 and 1.8.1.2 shall be completed.

Engine shall build up voltage but the set shall not close alternator circuit breaker when the load is on the mains. Monitoring performance for voltage/frequency etc. should be feasible without supply to load.

If during TEST run the power supply has failed, the load shall automatically get transferred to alternator.

Bringing the mode selector to auto position shall shut down the sets.

FUEL OIL SYSTEM

DAILY SERVICE FUEL TANK

Daily service fuel tank shall be provided by the Contractor of rated capacity.

The tank shall be waterproof and dust proof and shall be fabricated from not less than 14 SWG M.S. Sheet.

A float operated fuel level indicator, fuel draw off connection, drain cock and overflow connection shall be provided on the tank. A removable cover of ample size with lock shall allow free access to the interior. The tank shall be mounted on steel supports.

FUEL TRANSFER HAND PUMP

A semi-rotary hand transfer pump shall be provided and installed by the Contractor along with necessary piping as required for filling the daily service fuel tank.

ENGINE AUXILIARY MOTORS AND WIRING

The Contractor shall supply, install and test all engine auxiliaries. This shall include the supply and installation of all electrical and control wiring between the Main L.V. Switchboard and the individual auxiliaries. Wiring shall be with copper conductor P.V.C. insulated wires in flexible/rigid conduits including loop earthing or armoured cables.

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The Contractor shall supply, install and test all engine auxiliaries. This shall include the supply and installation of all electrical and control wiring between the Main L.V. Switchboard and the individual

auxiliaries. Wiring shall be with copper conductor P.V.C. insulated wires in flexible/rigid conduits including loop earthing or armoured cables.

STARTING BATTERY AND PROTECTION

A 24 volt heavy duty battery of adequate capacity, 180 AH. Complete with battery charging equipment shall be supplied and installed by the supplier to energise electric starting equipment. The battery shall be contained in an approved steel frame. The charging unit shall be contained in the control cubicle and be, complete with ammeter and voltmeter, fuses, charging rate adjustment and interconnection

RADIO INTERFERENCE

All equipment provided under this specification shall be so designed that it will not cause interference with radio equipment. In the event of the inherent characteristics of the equipment being such that radio interference is possible, efficient devices to nullify the same shall be provided. Suppressers shall be as per the relevant I.S./B.S. Standards.

PIPING

PIPING MATERIALS

Unless otherwise specified, pipes shall be medium class MS (black steel) as per IS 1239 (Class B) suitable for welded joints. Wherever so specified, class B GI pipes with screwed joints could be used for pipes upto 50 mm dia. MS/GI pipes shall be of makes as per approved list. Pipes shall be given one primary coat of rust inhibiting paint before being installed.

Fittings shall be new and from approved manufacturers, Fittings shall be of pressure ratings suitable for the piping system. Flanges shall conform to ISS. Supply of flanges shall include bolts, nuts, washers, gaskets etc., as required. All equipment and valve connections shall be through flanges (welded for MS pipes and screwed for GI pipes).

Gate valves and check valves shall conform to IS: 780/1969. Gate valves shall have non-rising spindles unless otherwise specified. Valves up to 40 mm dia. shall have gun metal body and valves of more than 40 mm dia. Cast iron body unless otherwise specified. Valves shall be suitable for test pressures as per piping system requirements and as per ISS.

Butterfly valves shall conform to BS: 5155, MSS SP 67 & API 609. The valves shall be suitable for flow in either direction and seal in both directions. The valve shall be of integral moulded design.

Strainers shall be Y type or Pot type as per schedule of quantities and /or as required with CI or fabricated steel bodies. Strainers shall have removable bronze screen with 3mm perforations. All strainers shall be provided with equal size isolating valves so that the strainer may be cleaned without draining the system.

Pressure gauge shall be not less than 10 mm dia and of appropriate range and be complete with shut off gauge cocks etc. and shall be duly calibrated before installation.

Gauges shall be provided at the following locations:

- a) Suction and discharge of pumps.
- b) Inlet and outlet of heat exchangers.

Care shall be taken to protect pressure gauges during pressure testing.

Thermometers shall be either 10 mm dia dial or direct reading industrial type of appropriate range duly calibrated before installation.

Thermometers shall be installed in separable wells.

Thermometers shall be provided on supply and return of heat exchangers.

PIPING INSTALLATION

The Contractor, on award of work, shall prepare detailed working drawings showing the piping route, typical sections, location and detail of fittings, valves, strainers and instruments. The reform of piping system shall take existing wall and ceiling openings, if any, into consideration. Piping layout shall take due care for expansion and contraction in pipes.

Piping shall be installed only after thorough cleaning. Pipes shall be cut square. Proper edge preparation with 'V' grooves shall be done and edges grinded before welding. Sufficient gap shall be maintained. Electrodes of approved makes only shall be used for welding and tacking.

Pipes shall be supported from wall mounted or ceiling suspended supports at an interval of maximum 2 meters unless otherwise states/approved. Supports shall be designed to withstand the weight of pipes, fittings and fluid in motion. Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated with 2coats of enamel paint of approved colour. Where pipes and clamps are of dissimilar material, a gasket shall be provided in between. Pipe hangers shall be fixed on walls and ceilings by means of dash fasteners. Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 12mm thick ribbed rubber pad or any other approved resilient material. Where pipes pass through the terrace floor, suitable curbing shall be provided to prevent water leakage. Risers shall also have a suitable concrete pipe support at the lowest point.

Pipe sleeves of 50mm or larger diameter shall be provided wherever pipes pass through wall and the annular space filled with felt and finished with retaining rings.

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation.

Ping shall be pitched towards drain points. Drain outlets shall be provided at all low points in the piping system with 25 mm dia pipe (for up to 300 mm dia water pipes) with gate valves of equal size with rising spindles. Drain outlets shall be connected through equal size GI pipe to the nearest drain or floor waste.

All buried pipes shall be cleaned and coated with zinc chromate primer and bituminous paint, than wrapped with two layers of bituminized RP tissue cloth.

TESTING

All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 7 Kg/sq cm for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer in Charge.

Piping required subsequent to the above pressure test shall be retested in the same manner.

Systems may be tested in sections and such sections shall be securely capped.

The Engineer in charge shall be notified well in advance by the contractor of his intention to test a section of piping and all testing shall be witnessed by the Engineer in charge or his authorized representative.

The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. If proper circulation is not achieved due to air bound connections, the Contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification including the tarring-up and re-finishing of floors, walls etc. as required.

No insulation shall be applied to piping until the completion of the pressure testing to the satisfaction of the Engineer in charge.

The Contractor shall provide all materials, tools, equipment, instruments, services and labor required to perform the test, and shall ensure that the plant room and other areas are cleaned up and spill over water is removed.

After the piping has been installed, tested and run for at least ten days of eight hours each, the piping shall be given two finish coats, 3 mils each of approved colour and shade.

GENERAL

The DG sets with support systems shall be complete with all equipment, visual and audible alarms, indications and controls required for fully reliable and safe operation of the DG sets whether specifically stated in these specifications or not. It is essential that the operation of all protection equipment be completely reliable in all respects.

Whenever the engine is shut down due to over speed, low lubricating oil pressure, high water temperature or excess starting time, the circuit breaker shall also be tripped and the starting systems of the engine shall be locked out until the respective protective relay is reset.

PERFORMANCE TESTING AT SITE

after completion of erection at site and a preliminary warm up period and acceptance trial run of minimum 10 hours duration, 2 hour at 60%, 3 hour at 80% and 4 hours at 100%, followed by 1 hour at 110% shall be conducted at site for each D.G set for proving performance to the stipulated site ratings. The trial shall be conducted in the presence of the Engineer In Charge and the test results shall be recorded in an approved format. Test results shall be recorded at 30 minute intervals. All facilities, Labour instruments, materials and consumables including fuel and lubricating oil required for the test shall be provided by contractor at his cost. Load as required shall be arranged by the Contractor for Performance Testing of the D.G sets

Tests proving the satisfactory performance of all operating gear and safety functions and controls shall be carried out.

Performance tests at site shall include (but not limited to) the following

Test	Acceptance criteria
1. Fuel consumption at 60%, 80%	+ 5% of performance Determined in the manufactures Consumption ratio.
2. Luboil consumption at 60% 100% 110% and 11% load	+ 5% of guaranteed performance
3. Voltage variation	433 V + 1%
4. Voltage regulation	+ 1%
5. Frequency regulation	+ 0.5%
6. Maximum water temperature	+ 5% of guaranteed performance
7. Maximum luboil temperature	+ 5% of guaranteed performance
8. Maximum luboil pressure	+ 5% of guaranteed performance

The Contractor shall be required to carry out any further tests/trials that the Engineer In Charge may desire to satisfy themselves that the Generator Sets and associated equipment fully comply with the conditions as set out in these Specifications.

All calibrated instruments, materials, load configurations, 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.

SPECIAL CONDITIONS:-

- 1.1 All electrical work shall be carried out in compliance with specifications given hereunder in this section and in compliance with Indian Standard specifications and Indian Electricity Act and Rules in force. The works shall also conform to any special requirement of Local State Electricity Board. If any case, the above-mentioned rules, regulations etc. are not in accord, the division of the consultant /Engineer-in-charge regarding rules to be followed or manner of execution of work shall be final and binding. The work shall be executed under the direct supervision of person holding a certificate of competency issued by the State Government (Chief Electrical Inspector, Assam) for the type of works involved in conformity with the best methods of modern engineering practice and to the entire satisfaction of the Consultant/Engineer-in-Charge. The contractor has to submit the test report at various stages of completion as per requirement of the client.

MATERIALS

All materials, equipment's, fittings and fixtures used in electrical work shall conform to the attached Appendix A. All material shall be new, soundly and robust in construction and well finished surplus material after completion of work shall be taken back by the contractor and the cost shall be recovered if the advance payment has been made earlier by the client.

Unless otherwise stated in the conditions of contract, samples of all materials, fitting and fixtures to be supplies by the contractor shall be submitted to the consultant for his approval. The contractor shall not commence the work until the samples are approved, in writing from the consultant. The contractor shall ensure that all the materials incorporated in the work are identical in all respects with the approved sample. All samples not destroyed in testing shall be returned to the contractor after completion of contract. No payment shall be made for samples destroyed in testing.

DRAWINGS

The drawings, specification and bill of quantities shall be considered as a part of this contract. Any work or material shown on the drawings but not included in the schedule of quantities or vice versa shall be executed as if specifically called drawings indicate the extent and general arrangement of various equipment's and their wiring etc and are essential diagrammatic. The work shall be installed change if found essential to coordinate the installation of this work with other trades shall be made without any additional cost to the owner. The data given herein and on the drawings is as could be secured, but its complete accuracy is not for the assistance and guidance of the contractor, the exact locations, distances and levels will be governed by the space conditions. The contractor shall be responsible to check exact location of all electrical outlets, the routes and length of cable etc.

Shop drawing for all system shall be prepared by the contractor & got approved before starting of the work. (H.T. Panel / transformer /LT Panel & Sub Panel / Bus duct and Rising main).