NLC TAMIL NADU POWER LIMITED (NTPL)

FGD FOR NTPL TUTICORIN THERMAL POWER PROJECT(2X500MW)

TECHNICAL SPECIFICATION FOR

LOW VOLTAGE SWITCHGEAR

BHEL DOCUMENT NO. : SBD-TS-CPBG-FGD-TUT, REV-00

BHARAT HEAVY ELECTRICALS LIMITED
SOLAR BUSINESS DIVISION
BANGALORE – 560012

CONTENTS:

1. INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

1) Signed and stamped copies of the following shall be furnished by all the bidders as technical offer:

   a) Signed copy of "Contents"

   b) Signed copy of "Instruction to Bidders"

   c) Signed copy of unpriced "PRICE FORMAT"

   d) Signed copy of Annexure-B1 to B11, C , D , E , F , G , H , I

   e) No. of Verticals considered for each switchboard considering the no. of feeders mentioned in the load data and break-up of no. of verticals considered shall be provided i.e no. of breaker verticals and no. of MCC verticals. Bidder shall also furnish dimensions & weight of each switchboard.

   f) Technical deviations, if any, mentioning the clause and page no. of specification.

2) Two (2) copies of credentials required as per "PQR" shall be filed properly. One copy shall be submitted along with bid and second copy shall be submitted to CPBG during technical scrutiny.

3) Any confirmations/ comments with reference to technical specification shall be mentioned in mentioned in Deviation sheet and reply shall be sought in writing from BHEL. Any references mentioned elsewhere/ covering letter shall not be considered by BHEL.

4) Any confirmations/ comments regarding delivery schedules shall be furnished as part of commercial offer. Any references mentioned elsewhere/ covering letter shall not be considered by BHEL.

   Any changes made by the bidder in the module wise bill of material/ board wise load data/ any other document of technical specification will not be considered by BHEL until and unless it is mentioned in deviation sheet.

5) Bidders to quote for all line items of price format.

6) Bidder shall be responsible for obtaining any clarification with respect to NIT before quoting, in case, if any technical deviations are observed during technical scrutiny w.r.t NIT, bidder shall meet the technical requirements of NIT without any price implication to BHEL.

7) In case of any ambiguity in specification between various clauses, vendor should clearly mention the same in technical deviations, failing which decision of BHEL would be final during execution of the order and this shall not have any price impact to BHEL.

8) In case of non-submission of technical deviation sheet, it is understood that the bidder does not have any technical deviations and BHEL will proceed further with technical scrutiny, without any further query.

9) Vendor to complete the switchboard/ line item in all respects and offer same to BHEL for inspection, prior to offering the same to customer for inspection.

10) All the bidders meeting "PQR" criteria will be forwarded to customer for approval. Offers of only approved bidders will be technically evaluated. Customer reserves the right to approve/ reject any bidder, without citing any reason.

BIDDER'S STAMP & SIGNATURE

2. SCOPE OF ENQUIRY

1. This specification covers the design, manufacture, relay parameterization and site support, supply of networking hardware, site modification(if any), inspection and testing at manufacturer's works, proper packing and delivery to site of LV switchgear as mentioned in different sections of this specification for FGD FOR NTPL TUTICORIN THERMAL POWER PROJECT(2X500MW) .

2. It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to vendor's guarantee.

3. The general terms and conditions, instruction to tenderer and other attachment referred to elsewhere are hereby made part of the tender specification.

4. The tendered shall be responsible for and governed by all requirements stipulated hereinafter.

5. Deviations, if any should be brought out very clearly on deviation sheet enclosed with specification only. Otherwise it will be presumed that the tenderer's offer is in line with what has been stated/ asked for in this specification.

6. The offer should be complete with technical data, catalogues, brochures and drawings as applicable.

7. Qualification data: In order to be able to propose to the client the proven-ness of the equipments/ item offered, the bidder is required to elaborate details of experience, capabilities, reference list etc. in the offer.

8. The documents shall be in English language and MKS system of units.

3. PROJECT INFORMATION

VOLUME : II-A

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

NLC Tamil Nadu Power Limited (NTPL) is presently operating a thermal power plant having two units of 500 MW capacity each, in Tuticorin, Tamil Nadu.

The Contractor shall acquaint himself with the conditions prevailing at site by a visit to the site, before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained/ collected by the Contractor.

2.00.00 APPROACH TO SITE

The site is accessed by National Highway No. 7A adjacent to plant. Due South connecting Madurai. The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km. Tuticorin sea port is located adjacent to the plant. Nearest airstrip is located at Pudukottai at a distance of 16.5 km. Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallayamkottai, away from 60 km from the plant.

3.00.00 LAND

The site encompasses about 108 Ha, which is located at Tuticorin Taluk in Tuticorin district in the Southern Part of Tamil Nadu along the Bay of Munnar.
Latitude : $8^0$45'38.09"N
Longitude : $78^0$10'15.85"E

The natural land profile of the site 1.46 m above mean sea level.

4.00.0 SOURCE OF FUEL

The primary fuel for this plant is Coal. The Power plant will use coal from Talabira Mines and imported coal.

The daily coal requirement for 2x500 MW units is about 15360 tonnes (at TMCR). Annual coal requirement for the plant is around 4.48 MTPA.

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5.00.00 **SOURCE OF WATER**

Main source of water of the plant is sea water, which shall be taken from the Bay of Munnar. The existing 2x 500 MW NTPL Tuticorin plant uses sea water based closed cooling system with Natural Draft Cooling Towers (NDCT). The sea water intake system comprises of gravity intake channels of a capacity 15000 m^3/hr. Out of this, around 9000 m^3/hr is fed as cooling tower makeup water through CT makeup pumps (2W+1S). Around 3000 m^3/hr sea water is utilized in the RO plant for utilization as service water, potable water, power cycle makeup and miscellaneous uses. The blow down from the Cooling tower back to sea is around 7000 m3/hr.

6.00.00 **DELETED**

7.00.00 **METEOROLOGICAL DATA**

7.01.00 For the purpose of equipment design, the following Meteorological data of site (as per IMD Tuticorin) shall be taken into consideration

a)	Ambient temperature	:	36.5 °C maximum 20.8 °C minimum
b)	Extreme Ambient temperature	:	36.4 °C maximum (Annual) 24.1 °C minimum (Annual)
d)	Relative humidity (i) Maximum (ii) Minimum (iii) Average	:	 82% 35% 57 to 68%
e)	Annual Rainfall	:	437 mm
f)	Wind load	:	In accordance with IS-875, Part-3
g)	Seismic Zone	:	Zone II as per IS: 1893 latest edition.
h)	Altitude	:	1.46 M above MSL

Note: For design of HVAC system bidder shall consider data from tender specification Vol-IIA, Sec-II, Cl 7.01.00

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GENERAL PROJECT INFORMATION

1	Owner / Purchaser	NLC Tamil Nadu Power Limited (NTPL) (A Joint Venture Between NLC INDIA LIMITED and Tamil Nadu Electricity Board)
2	Project Name	NTPL Tuticorin Thermal Power Project
3	Capacity and Configuration	1000 MW [2 x 500 MW]
4	Owner's Consultant	Development Consultants Private Limited
5	Geographical Location	Latitude 8^{0}45'38.09"North Longitude 78^{0}10'15.85"East At Tuticorin Taluk in Tuticorin district in the Southern Part of Tamil Nadu along the Bay of Munnar, India
6	Access to site	
6.1	Nearest Airport	Nearest airstrip is located at Pudukottai at a distance of 16.5 km
6.2	Nearest port	Tuticorin sea port is located adjacent to the plant.
6.3	Nearest Railway Station	The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km
6.4	Nearest Town	Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallayamkottai, away from 60 km from the plant.
6.5	Nearest Highway	National Highway No. 7A adjacent to plant
7	Meteorological data	
7.1	Site Elevation	The natural land profile of the site 1.46 m above mean sea level
7.2	Ambient Temperature DBT	
i.	Maximum DBT	36.5 ^{0}C
ii.	Minimum DBT	20.8 ^{0}C
iii.	Performance DBT	27 ^{0}C
7.3	RELATIVE HUMIDITY	
i.	Maximum	82 %
ii.	Minimum	35 %

iii.	Performance	50%
7.4	Earthquake Zone	Zone II
7.5	Predominant Wind direction	East to West
7.6	Wind velocity	Civil/structural design will be done considering IS 875 part 3
7.7	Rainfall	
i.	Annual	437 mm
7.8	Availability of Raw Water	Main source of water of the plant is sea water, which shall be taken from the Bay of Mannar.

4. GTP OF LV SWITCHGEAR

SCHEDULE-IIIF/6

PCC/PMCC/MCC, ACDB & DCDB, DC STARTER

1.0 ASSEMBLY

1.1 Make :

1.2 Type :

1.3 Reference Standard :

1.4 Voltage (Nom./Max.) Volt :

1.5 Phase, Frequency No., Hz :

1.6 Short Circuit Rating

a) Interrupting Symmetrical KA :

b) Short time for 1 sec. KA $_{rms}$:

1.7 Insulation Level
1-min. 50 Hz Voltage withstand KV $_{rms}$:

1.8 Construction

a) Metal clad, air insulated,
Floor mounting Yes/No :

b) Suitable for mounting against
building wall Yes/No :

1.9 Enclosure

a) Degree of Protection :

b) Minimum thickness of
sheet metal mm :

1.10 PCC/PMCC/MCC fully assembled,
wired and tested at factory Yes/No :

2.0 CONSTRUCTION

2.1 Design

a) Completely compartmentalized :

b) Working height limits from floor
level mm :

2.2 Drawout features provided for

a) Circuit breaker with SERVICE, TEST and ISOLATED position Yes/No :

b) Voltage Transformers Yes/No :

c) Protective Relays Yes/No :

d) MCC module provided with service test & isolated position Yes/No :

2.3 Breaker Cubicle

a) Breaker cubicles restricted to bottom 2-tiers only Yes/No :

b) Working height limits from floor level mm :

c) Cubicle door can be closed with Breaker in isolated position Yes/No :

2.4 Control Compartment provided with individual front access door? :

2.5 PCC/PMCC/MCC section provided with

a) Removable back cover :

b) Full height cable chamber :

2.6 Horizontal wire way for inter panel wiring :

2.7 All meter, switch and relays flush mounted type Yes/No :

2.8 Minimum clear space required at

a) Front for breaker withdrawal mm :

b) Rear mm :

2.9 Vertical Section for

a) Overall Dimension (L x B x H) mm :

i. Incomer/Tie :

ii. Feeder/Motor :

b) Approximate Weight Kg :

3.0	BUSBAR		
3.1	Make		:
3.2	Material & Grade		:
3.3	Reference, Standard		:
3.4	Cross Sectional area sq.mm		
	a) Main Busbar	Ph/N	:
	b) Vertical Busbar	Ph/N	:
3.5	Continuous current (at site condition, 50 ^{0}C ambient & within cubicle)		
	a) Main bus bar	Amp	:
	b) Vertical bus bar	Amp	:
3.6	Maximum temperature rise over 50 ^{0}C		:
3.7	Short-time current for 1 sec.	KA $_{rms}$	:
3.8	Separate enclosure/phase barriers Sleeving/shrouding provided for		
	a) Main busbar		:
	b) Vertical droppers		:
	c) Circuit Breaker connections		:
3.9	Bus Connections		
	a) Silver plated		:
	b) Provided with anti- oxide grease		:
	c) Bimetallic connectors between dissimilar metals		:
3.10	Minimum clearance of bare busbar and connection		
	a) Phase to phase	mm	:
	b) Phase to ground	mm	:
3.11	Busbar support spacing	mm	:
3.12	Busbars colour coded	Yes/No	:

3.13 Bus Support Insulator

a) Make :

b) Type :

c) Reference Standard :

d) Voltage class KV :

e) Minimum Creepage Distance mm :

f) Cantilever Strength Kg/sq.cm :

g) Net Weight Kg :

4.0 CIRCUIT BREAKER

4.1 Make :

4.2 Type :

4.3 Reference Standard :

4.4 Rated Voltage KV :

4.5 Rated Frequency Hz :

4.6 No. of Poles No. :

4.7 Rated Currents :

a) Continuous (at site condition, 50 ^{0}C ambient & within cubicle) Amp. :

b) Short-time Current for 1 sec. KA $_{rms}$:

4.8 Maximum temperature rise over 50 ^{0}C ambient ^{0}C :

4.9 Rated Operating Duty :

4.10 Interrupting Capacity at rated Voltage and Operating duty

a) Symmetrical KA $_{rms}$:

b) Asymmetrical KA $_{rms}$:

4.11 Rated Making Current KA $_{peak}$:

4.12 Transient Recovery Voltage

a) Rate of Rise KV/ms :

b) Peak Voltage KV :

4.13 Insulation Level

1-minute 50 Hz voltage withstands KV rms. :

4.14 At 100% interrupting capacity

a) Opening time ms. :

b) Arcing time ms. :

c) Total tripping time ms. :

4.15 Total closing time ms. :

4.16 Number of breaks per pole :

4.17 Total length of breaks per pole mm :

4.18 Total length of contact travel mm :

4.19 Rate of Contact Travel

a) At tripping m/s :

b) At closing m/s :

4.20 No. of breaker operations permissible, without requiring inspection, replacement of contacts and other main parts :

a) At 100% rated current :

b) At 100% rated interrupting current :

4.21 Type of Contacts

a) Main :

b) Arcing :

4.22 Material of Contacts

a) Main :

b) Arcing :

	c)	Whether contacts are silver plated		:
	d)	Thickness of silver plating		:
4.23	Contact Pressure at no load		Kg	:
4.24	Minimum clearance in air -			
	a)	Between poles	mm	:
	b)	Between live parts & ground	mm	:
4.25	Type of arc control device?			:
4.26	Operating Mechanism			
	a)	Type		:
	b)	No. of breaker operations stored		:
	c)	Trip free or fixed trip?		:
	d)	Anti-pumping features provided?		:
4.27	Spring Charging Motor			
	a)	Rating	KW	:
	b)	Voltage	V	:
	c)	Permissible Voltage variation	%	:
4.28	Closing Coil			
	a)	Voltage	V	:
	b)	Permissible Voltage variation	%	:
	c)	Closing current at rated voltage	A	:
4.29	Tripping Coil			
	a)	Voltage	V	:
	b)	Permissible Voltage variation	%	:
	c)	Trip current at rated voltage	A	:
4.30	For trip circuit supervision can the tripping coil be connected in series with			:
	a)	Green lamps when breaker is open		:

b) Red lamps when breaker is closed :

4.31 Breaker/Cubicle Accessories

Accessories such as control switch, indication lamps, relays furnished as specified: Breaker/Breaker Cubicle provided with following :

a) Mechanical safety interlock :

b) Automatic safety shutter :

c) Emergency manual trip :

d) Mechanical ON-OFF indicator :

e) Manual spring charging device :

f) Manual operating handle :

g) Operation counter :

h) Charge/Discharge indication :

I) Cell switch with 4 NO+4 NC contacts:

j) Spare auxiliary switch with 6 NO+6 NC Contacts for interlock mounted on Stationary parts as specified :

4.32 Cell/Auxiliary Switch

a) Are switch contacts convertible type? :

b) Contact rating 220V DC

i) Make & Continuous Amp :

ii) Break (Inductive) Amp :

4.33 Net weight of the breaker Kg :

4.34 Impact load for foundation design (to include dead load plus impact values on opening at maximum interrupting rating) Kg :

4.35 Overall Dimension (LxBxH) mm :

4.36 Type test report on identical breaker Furnished :

5.0 CONTROL MODULE

5.1 Control Modules :

a) Fully drawout for PCC/PMCCs/ MCCs/SVB Yes/No :

b) Fixed type for DBs :

5.2 Power/Control disconnects silver plated for good contacts :

5.3 Drawout Modules of same type & rating are physically & electrically interchangeable :

5.4 Module sizes (L x D x H)

a) Incomer/Bus coupler/ Tie

3200 A Circuit Breaker	mm	:
2500 A Circuit Breaker	mm	:
2000 A Circuit Breaker	mm	:
1600 A Circuit Breaker	mm	:
1250 A Circuit Breaker	mm	:
800 A Circuit Breaker	mm	:
630 A Circuit Breaker	mm	:
400 A MCCB	mm	:
200 A MCCB	mm	:

b) Outgoing feeder with

2500 A Circuit Breaker	mm	:
1600 A Circuit Breaker	mm	:
1250 A Circuit Breaker	mm	:
800 A Circuit Breaker	mm	:
630 A Circuit Breaker	mm	:
400 A MCCB	mm	:

	200 A MCCB	mm	:
	100 A MCCB	mm	:
	63 A MCCB	mm	:
	32 A MCCB	mm	:

c) Motor feeder with ACB & starter units

800 A ACB	mm	:
400 A Starter	mm	:
300 A Starter	mm	:
160 A Starter	mm	:
100 A Starter	mm	:
63 A Starter	mm	:
63 A Starter reversing	mm	:
32 A Starter	mm	:
32 A Starter reversing	mm	:
16 A Starter	mm	:
16 A Starter reversing	mm	:

6.0 SWITCHES

6.1 Make :

6.2 Type :

6.3 Reference Standard :

6.4 Switch furnished with :

a) Operating handle :

b) Door interlock :

c) Provision for padlocking in ON & OFF Positions. :

6.5 Current Ratings at 50 ^{0}C ambient & within cubicle

a) :

b) :

c) :

d) :

e) :

f) :

6.6 Breaking current @ 415 V A.C. or 220 V D.C.

a) :
b) :
c) :
d) :
e) :
f) :

7.0 FUSE

7.1 Make :

7.2 Type :

7.3 Reference standard :

7.4 Rupturing capacity KA $_{rms}$ (sym) :

7.5 Continuous current at 50 ^{0}C ambient & within cubicle Amps :

7.6 Cut off currents KA peak :

7.7 Fuse characteristics furnished for various fuse ratings :

8.0 CONTACTORS

8.1 Make :

8.2 Type :

8.3 Reference standard :

8.4 Duty class :

8.5 Utilization category :

8.6 Operating Coil Voltage

a) Rated :

b) Pick-up :

c) Drop-out :

8.7 Continuous Current rating at 50ºC & within cubicle A :

8.8 Power Consumption

a) During closing VA :

b) After closing VA :

8.9 Auxiliary Contacts furnished per Contactor

a) Normally open (NO) :

b) Normally closed (NC) :

8.10 Aux. Contact rating

a) Make & Continuous Amp :

b) Break (Inductive) at -

i. 240 V A.C. Amp :

ii. 220 V D.C. Amp :

8.11 Time range of delayed dropout Contactors furnished Sec. :

8.12 Thermal Overload Relay & Single Phase Preventer

a) Temperature compensated? :

b) Hand Reset? :

c) No. & type of contacts :

d) Thermal overloads characteristics Furnished? :

e) Tolerance on current injection

1 - pole :

2 - pole :

3 - pole :

9.0 CONTROL & INDICATIONS

9.1 Push Buttons

a) Make :

b) Type & Cat. No. :

c) Contact rating

i) Make & Continuous Amp :
a) 240 V AC Amp :
b) 220 V DC Amp :

ii) Break (Inductive) Amp :
a) 240 V AC Amp :
b) 220 V DC Amp :

9.2 Lamps

a) Make :

b) Type & Cat. No. :

c) Watts/Voltage :

d) Series resistance in Ohm :

e) Lamp & Lens replace from front :

9.3 Selector Switch

a) Make :

b) Type & Cat. No. :

c) 3-position stayput type :

d) Contact rating at
i) Make & Continuous Amp :
a) 240 V AC Amp :
b) 220 V DC Amp :

ii) Break (indicative) Amp :
a) 240 V AC Amp :
b) 220 V DC Amp :

e) Key interlock furnished ? :

10.0 CURRENT TRANSFORMER

10.1 Make :

10.2 Type :

10.3 Reference Standard :

10.4 C.T. Ratios as per drawings? :

10.5 Rated frequency :

10.6 Class/ALF or ISF/VA burden furnished for :

a) Differential C.T. :

b) Relaying C.T. :

c) Metering C.T. :

10.7 Short-Circuit Withstand

a) Short-time current for 1 sec. KA rms.:

b) Dynamic current KA_{peak} :

10.8 Class of Insulation :

10.9 Temperature rise over 50 ^{0}C ambient :

10.10 Basic Insulation level KV_{rms} :

11.0 CONTROL TRANSFORMER

a) Make :

b) Ratio :

c) VA rating :

d) Taps available :

12.0 VOLTAGE TRANSFORMER

12.1 Make :

12.2 Type :

12.3 Reference Standard :

12.4 Voltage ratio :

12.5 Rated frequency :

12.6 Accuracy class :

12.7 VA burden :

12.8 Over Voltage factor

a) Continuous :

b) 30 seconds :

12.9 Class of Insulation :

12.10 Temperature rise over 50 ^{0}C ambient :

12.11 Basic Impulse Level Kv $_{peak}$:

12.12 Winding Connection

a) Primary :

b) Secondary :

12.13 Fuses

a) Continuous rating Amp. :

b) Symmetrical fault rating KA rms.:

13.0 RELAYS

13.1 Drawout type with built in test facilities :

13.2 Type of mounting? :

13.3 Reference Standard :

13.4 All relays furnished as per the drawings & Annexure :

13.5 All relevant relay leaflets and catalogue furnished? :

13.6 Relay Details Make Type Range

13.6.1 Incoming PCC/PMCC/MCC feeder

a) 3-Inverse time O/C relay for phase fault 51 :

b) 1-Inverse time O/C relay for earth fault 51N :

13.6.2 Motor feeder

a) 1-Motor protection relay 99 :

13.6.3 Lighting transformer feeder

a) 3-Inverse time O/C relays with high set Instantaneous unit for phase faults (50/51) :

b) 1-Instantaneous O/C relay for Earth fault 51N :

13.6.4 Outgoing feeder

a) 2-Inverse time O/C relay for phase fault 51 :

b) 1-Inverse time O/C relay for earth fault 51N :

13.6.5 Bus Transfer Scheme
device used for Bus Transfer scheme :

a) :

b) :

c) :

d) :

e) :

f) :

13.6.6 Miscellaneous relay

a) Antipumping relay 94 :

b) Trip supervision relay 74 :

c) Time delay relay 2 :

d) Under Voltage relay frequency compensate 27

i. 3-pole :

ii. 1-pole :

e) Auxiliary relay with 4 pairs of contacts

220 V DC Hand reset 86 :

220 V DC Self reset ..X :

24 V DC Self reset ..Y :

f) Auxiliary relay for alarm 30 :

g) Inverse time voltage neutral Displacement relay (1-pole) 64 :

14.0 METERS

14.1 Make :

14.2 Type :

14.3 Reference Standard :

14.4 Size :

14.5 Scale :

14.6 Accuracy class :

14.7 Meter Switch

a) Make :

b) Type :

c) Cat. No. :

15.0 SECONDARY WIRING

15.1 Type of Insulation :

15.2 Voltage grade :

15.3 Conductor material :

15.4 Conductor Size (Minimum)

a) Potential & Control Circuit :

b) Current Circuit :

15.5 Wires identified at both ends with markers? :

16.0 TERMINAL BLOCK

16.1 Make :

16.2 Type :

16.3 Cat. No. :

16.4 Voltage grade :

16.5 20% spare terminals furnished :

17.0 CABLE TERMINATION

17.1 Cable termination/connection furnished as specified :

17.2 Cable termination kit furnished

a) Make :

b) Type :

c) Complete with all accessories :

17.3 Cable entry provision from top and bottom Yes/No :

17.4 Cable Lugs

a) Type :

b) Material :

17.5 Cable Gland

a) Type :

b) Material :

c) With tapered washer :

d) With armour clamp :

17.6 Removable Gland Plate

a) Material for multicore cable :

b) Material for I/C cable :

c) Thickness of the plate :

18.0 BUSDUCT CONNECTION

18.1 Busduct connection suitable for -

a) Top entry Yes/No :

b) Side entry Yes/No :

18.2 Busduct connection as per drawing furnished Yes/No :

18.3 Average length assumed for bus duct :

19.0 GROUND BUS

19.1 Ground bus furnished :

19.2 Material :

19.3 Size :

20.0 NAME PLATE

20.1 Material :

20.2 Thickness :

20.3 Size for :

a) Panel :

b) Equipment/Device :

21.0 SPACE HEATER/PLUG SOCKET

21.1 Cubicle Heater

a) Thermostat controlled :

b) Wattage :

c) Voltage :

21.2 Plug Socket

a) Type :

b) Rating :

21.3 Motor Heater

a) Provision made for motor heater supply :

b) Separate contactor furnished :

c) If so, contactor rating :

21.4 Cubicle heater, motor heater & Plug socket circuit provided with Individual MCCB unit? :

22.0 A.C./D.C. SUPPLY

22.1 Isolating switch fuse unit for incoming Supply

a) A.C. - type & rating :

b) D.C. - type & rating :

22.2 Isolating switch fused unit at Each cubicle

a) A.C. - type & rating:

b) D.C. - type & rating :

23.0 TROPICAL PROTECTION

23.1 Any special treatment for tropical protection :

23.2 Screens are of corrosion resistant materials :

24.0 PAINTING

24.1 Finish -

a) Inside :

b) Outside :

25.0 NO.OF ACCESSORIES FURNISHED

25.1 Breaker lifting/handling truck :

25.2 Device for slow opening & Closing of breaker :

25.3 Test cabinet with coupling cables for testing the breaker :

25.4 Racking in/out handle :

26.0 DRAWINGS/DATA

26.1 Typical drawings furnished for :

a) General Arrangement :

b) Foundation Plan :

c) Breaker Control Schematic :

26.2 Bill of Material :

26.3 G.A. Drawing of each board Furnished Yes/No :

27.0 D.C. STARTER

27.1 Make :

27.2 Type :

27.3 Enclosure :

27.4 Degree of Protection :

27.5 Starter furnished with all materials and accessories as per drawing? :

27.6 Resistor -

a) Make :

b) Type :

c) Enclosure :

d) Degree of Protection :

5. TECHNICAL SPECIFICATION

VOLUME: II-F

SECTION-VI

415V PCC/PMCC/MCC, 415V AC AND 220V DC DB

CONTENTS

VOLUME: IIF

SECTION-VI

415V PCC/PMCC/MCC, 415V AC AND 220V DC DB

1.00.00 SCOPE

1.01.01 This specification is intended to cover design, engineering, manufacture, assembly, shop testing, inspection, packing, delivery to site, erection, testing and commissioning of following with all fittings and accessories for efficient & trouble free operation:-

i) 415V Power Control Centre (PCC)
ii) 415V Motor Control Centers (MCC)
iii) 415V Motor cum Power Control Centre (PMCC)
iv) 415V Distribution Boards (DB)
v) DC Distribution Board
vi) AC Fuse Board

1.01.02 The base channel frame with hardware and lifting angles.

1.01.03 One set of special tools and tackles.

1.01.04 Recommended spare parts for three (3) years of operation in addition to mandatory spares parts.

1.01.05 Mandatory spares as given in elsewhere.

1.01.06 All relevant drawings, data and instruction manuals.

2.00.00 GENERAL REQUIREMENTS

2.01.00 **Codes and Standards**

2.01.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.01.02 Equipment and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 DESIGN CRITERIA

3.01.00 PMCC/ MCC/ DB

3.01.01 The PMCC will be used to supply auxiliary power for normal and start-up operation of FGD system.

The MCCs/DBs will be used to provide power, control and protection for 415/240V A.C. and 220V D.C. auxiliary services (Motors & Feeders) of FGD System.

3.01.02 For PMCC Duty involves direct-on-line starting of large induction motors and also under certain emergency conditions automatic transfer of loads from one source of supply to other.

Motor starting current varies from 6 to 8 times full load current at very low power factor (0.2 to 0.3) with maximum of 3 starts per hour.

For MCC/ DB Duty involves direct-on-line starting of large squirrel cage motors upto 110 KW. The starting current varies from 6 to 8 times rated current at very low power factor.

3.01.03 The equipment will be located in a hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.

3.01.04 Equipment ratings and quantities are detailed in the enclosed drawings and annexure. Equipment shall be furnished in strict compliance with the same.

3.01.05 For continuous operation at specified ratings, the temperature rise of various equipment/components shall be limited to the permissible values stipulated in relevant standards and/or this specification.

3.01.06 All equipment and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of the materials.

3.01.07 Circuit breaker shall not produce any harmful over voltage during switching off induction motors. If required, surge protective devices shall be included in the scope of supply to limit over-voltage.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 **Construction**

4.01.01 The PMCCs/ MCCs/ DBs shall be indoor, metal-clad, air insulated, floor mounting type. All PMCCs/ MCCs shall be fully draw out type and DBs shall be fixed type. The design and construction shall be such as to allow extension at either end.

4.01.02 Unless otherwise noted, DB shall be of single front construction, front wired and front connected, suitable for mounting against the building wall. PMCCs/

MCCs shall be double front construction and suitable for floor mounting. Breaker panels of PMCCs/ MCCs shall be single front construction.

4.01.03 PMCC/MCC/DB enclosure shall be dust and splash proof, conforming to a degree of protection IP-52. Minimum thickness of sheet metal used shall be 2 mm.

4.01.04 The PMCC shall comprise a continuous line up of single/multi-tier cubicles. The installations of circuit breakers however shall be limited to the bottom two tiers only.

MCC/DB assembly shall comprise a continuous line up of dead front, free-standing vertical sections, housing the control modules in multitier formation.

All MCCs/ DBs shall be front wired and front connected.

4.01.05 The design shall be fully compartmentalized with metal/insulating partitions between compartments. The working height shall be limited within 450 mm to 1800 mm from floor level.

4.01.06 Each breaker/ control module shall be housed in a separate compartment, complete with an individual front access door. Each vertical section shall have a removable back cover.

All doors and covers shall be gasketed.

4.01.07 All switches, lamps and indicating instruments shall be flush mounted on the respective cubicle door whereas relays and other auxiliary devices may be mounted on a separate cubicle.

4.01.08 For single front assemblies a full height vertical cable chamber with cable supports shall be provided in each section to facilitate unit wiring. The chamber shall be liberally sized to accommodate all cables and shall have removable cover at the front for access.

4.01.09 A horizontal wireway, extending the entire length, shall be provided at the top for inter panel wiring.

4.01.10 Breaker cubicle shall be so sized as to permit closing of the front access door when the breaker is pulled out to ISOLATED position. The breaker can be operated both in service & test position with door closed.

4.02.00 **Bus and Bus Taps**

4.02.01 The main buses and connections shall be of high conductivity Aluminium/Aluminium alloy, sized for specified current ratings with maximum temperature limited to 85°c (Temperature rise based on maximum ambient temperature).

4.02.02 Vertical busbars shall be designed for minimum current rating of 200 A.

4.02.03 All bus connections shall be silver plated. Adequate contact pressure shall be ensured by means of two bolt connection with plain and spring washers and locknuts.

Bimetallic connector shall be furnished for connection between dissimilar metals.

4.02.04 Busbars and connections shall be fully insulated for working voltage with adequate phase/ground clearances. Insulating sleeves for busbars and shrouds for joints shall be provided.

Bus insulators shall be flame retardant, track-resistant type with high creepage surface.

4.02.05 Busbars shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.

4.02.06 Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear when viewed from the front of the assembly.

4.02.07 Bolted disconnect links shall be provided for all incoming and outgoing feeders for isolation of neutral, if necessary.

4.03.00 **Circuit Breaker**

4.03.01 Circuit Breaker shall be three poles, single throw, air break type with stored energy, trip free mechanism and shunt trip.

4.03.02 Circuit breakers shall be drawout type, having SERVICE, TEST & ISOLATED positions with positive indication for each position.

4.03.03 Circuit breakers of identical rating shall be physically and electrically interchangeable.

4.03.04 Circuit breakers marked E shall have motor wound spring charged mechanism and those marked M shall have hand operated spring charged mechanism.

4.03.05 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.

4.03.06 Mechanical safety interlock shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.

4.03.07 Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

4.03.08 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter and mechanism charge/discharge indicator.

4.03.09 In addition to the auxiliary contacts required for normal breaker operation and indication, each breaker shall be provided with following for interlocking purpose :-

a. Position/cell switch with 4NO + 4NC contacts.

b. Auxiliary switch, with 6NO + 6NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding level from the breaker in SERVICE position.

4.03.10 Limit/auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa.

4.04.00 **MCC/ DB Control Modules**

4.04.01 Draw-out type control module shall have self-aligning power/control disconnects. All disconnects shall be silver plated to ensure good contacts.

4.04.02 The design shall be such as to permit easy withdrawal/reinsertion of the unit with guide rails to ensure correct alignment.

4.04.03 Control Module shall house the control components for a circuit such as switch, fuse, contactors, relays, push buttons, lamps etc.

4.04.04 The equipment layout shall provide sufficient working space in between the components and subject to Owner's approval.

4.04.05 Various module/compartment sizes shall be multiple of one basic unit to facilitate modifications at site. Suitable provision for this purpose should also be incorporated in the vertical bus bars.

4.04.06 Drawout type control modules of same size and type shall be electrically and physically interchangeable.

4.05.00 **Switches**

4.05.01 Switches shall be triple pole, air break, AC23 motor duty for motor feeders and AC22 heavy duty for other feeders.

Motors duty switches shall be capable of safely making and breaking the locked rotor current of the associated motor circuit.

4.05.02 The switch shall have a quick-make, quick-break mechanism operated by a suitable external handle, complete with position indicator. This handle shall have provision for padlocking in ON and OFF position.

4.05.03 The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing this interlock at any time.

4.05.04 Switches shall be capable of withstanding the let-through fault current of back-up fuses or circuit breakers.

4.05.05 If two incoming switches are specified for any MCC/DB incomer, these switches shall be mechanically/key interlocked so as to ensure that only one switch can be closed at a time.

4.05.06 All incoming and outgoing feeders shall be provided with bolted disconnect link for isolation of neutral if necessary.

4.06.00 **Fuses**

4.06.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the listed Short Circuit Current.

4.06.02 Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element.

Visible indication shall be provided on blowing of the fuse.

4.06.03 Motor fuse characteristics and ratings shall be chosen to ride over starting period without blowing. The fuse on incoming feeder, if specified, shall be chosen to provide discrimination with motor/feeder fuses.

4.07.00 **Moulded Case Circuit Breaker**

4.07.01 Moulded Case Circuit Breaker shall be three pole, single throw, air break type having trip free mechanism with quick make quick break contacts. Moulded Case Circuit Breakers shall be used for feeders of MCC/MCCB Boards and for outgoing feeder from PMCCs.

4.07.02 Moulded case circuit breakers shall have current limiting design.

4.07.03 Moulded Case Circuit breakers of identical rating shall be physically and electrically interchangeable.

4.07.04 Moulded case circuit breakers shall be provided with 1 NO and 1 NC electrically separate auxiliary contacts.

4.07.05 MCCB used for 50 kW and above motor rating shall have additional E/F protection

4.08.00 **A.C. Starter**

4.08.01 **Contactors**

a. The contactors shall be three pole, air break type designed for duty class III - Category AC3 with non-bouncing silver/ silver alloy contacts.

b. Each contactor shall be provided with two (2) normally open and two (2) normally closed auxiliary contacts rated 10 A at 240V A.C.

c. Reversing contactors shall be electrically and mechanically interlocked.

d. Contactors with delayed dropout feature shall be provided for some essential auxiliaries if so detailed in the annexure. These contactors shall not dropout on power failure if the voltage is restored within 3 seconds.

4.08.02 **Protection**

a. Thermal overload relays shall be three element, positive acting, ambient temperature compensated with adjustable settings.

b. Single phase preventer relay shall be provided, preferably as an inbuilt feature of thermal overload.

c. Relays shall be manual reset type with one changeover contact. Resetting of relays shall be possible with compartment door closed.

d. Relays may be direct acting or C.T. operated, depending on current rating. C.T.s shall be included in the scope of supply.

e. Earth fault relays with adjustable settings and time delays fed from core balance CT shall be provided.

f. Numerical / Digital Motor protection relay with short circuit, over load, earth fault, locked rotor and unbalance (NPS) load protection functions shall be provided for motor rated above 90 kW.

4.09.00 **Control & Indication**

4.09.01 The circuit breaker shall be wired up for local & remote operation. Each breaker cubicle shall be equipped with following :-

4.09.02 One (1) TEST-NORMAL-TRIAL selector switch stay put type with pistol grip handle and key interlock for breaker marked 'E'.

4.09.03 Two (2) heavy duty, oil-tight, push buttons for TRIP & CLOSE.

4.09.04 Five (5) indicating lights on front of compartment :-

Breaker open	-	GREEN
Breaker closed	-	RED
Breaker charged	-	BLUE
Breaker Trip Circuit Healthy	-	WHITE

Breaker Trip - AMBER

4.09.05 Lamps shall be low watt, filament type with series resistor. Lamp and lens shall be replaceable from the front.

4.09.06 The general scheme of connections for control, interlock and protection is shown in the enclosed drawings. Detailed requirements of individual circuits will be intimated later to the successful Contractors, who shall develop and furnish the schemes accordingly.

4.09.07 Push button shall be heavy duty, oil tight, push to actuate type with integral escutcheon plate marked with its function.

4.09.08 Each push button shall have one (1) normally open and one (1) normally closed contacts rated 10 A at 240 V A.C.

4.09.09 One (1) NORMAL-TRIAL selector switch shall be provided for all motor feeders.

4.09.10 Lamps shall be LED type. LED lamps shall be made in accordance with InP technology (Aluminium Indium Gallium Phosphide Technology). The body shall be made of Poly Carbonate with unbreakable Lens. LED shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection.

LED circuit shall be PCB mounted. Intensity shall be greater than 200 mcd. All Push Button lamp shall be as per LED indicating lamp.

4.09.11 For control supply the Contractor shall provide 415/110V, +/- 5% in steps of 2.5% control transformers with 100% standby arrangement. But for Service voltage it shall be 415V/240V AC.

4.10.00 **Meters**

4.10.01 All indicating instruments (96 x 96 mm) shall be switchboard type, with 250 degree scale, anti-glare glass and accuracy class of ± 2% full scale. Each meter shall have zero adjuster on the front.

4.10.02 Motor ammeter shall have an extended suppressed end-scale range to indicate starting current (6 to 8 times full load current).

4.10.03 Watt-hour meter shall be provided in drawout cases with built-in test facilities. Alternatively, they may have test block to facilitate testing of meter without disturbing C.T. or V.T. secondary connections.

4.11.00 **Current Transformer**

4.11.01 Current Transformers shall be cast-resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.

4.11.02 Accuracy class of the current transformers shall be :-

a. Class PS for differential

b. Class 5P20 for other relaying.

c. Class 1.0, ISF < 5 for metering.

4.12.00 **Voltage Transformer**

4.12.01 Voltage transformers shall be cast-resin, drawout type and shall have an accuracy class of 1.0. Voltage transformer mounted on breaker carriage is not acceptable.

4.12.02 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully drawout position.

4.12.03 Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.

4.13.00 **Relays**

4.13.01 Relays shall be numerical type of drawout design with built-in testing facilities. Small auxiliary relays may be in non-drawout execution.

4.13.02 Relays shall be rated for operation on 1A secondary current and 110V secondary voltage; number and rating of relay contacts shall suit the job requirements.

4.13.03 The Contractor shall furnish, install & co-ordinate all relays to suit the requirements of protection, interlock and bus transfer scheme as broadly indicated in the annexures and drawings.

4.14.00 **Secondary Wiring**

4.14.01 The MCC/PMCC/DB shall be fully wired at the factory to ensure proper functioning of control, protection and interlocking schemes.

4.14.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, push buttons and other devices shall be wired upto terminal blocks.

4.14.03 Wiring shall be done with flexible, 1100V grade, PVC insulated FRLS type switchboard wires with stranded Copper conductors of 2.5 mm^2 for control & current circuits and 1.5 mm^2 for voltage circuits.

4.14.04 Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per Contractor's wiring diagrams.

4.14.05 Wire terminations shall be made with crimping type connector with insulating sleeves. Wires shall not be spliced between terminals.

4.15.00 **Terminal Blocks**

4.15.01 Terminal blocks shall be 1100V grade, box-clamp type with marking strips similar to ELMEX 10 mm^2 or equal. Terminals for C.T. secondary leads shall have provision for shorting.

4.15.02 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished.

4.15.03 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

4.16.00 **Cable Terminations**

4.16.01 MCC/ DB shall be designed for cable entry both from top and bottom. PMCC shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection.

4.16.02 Cables shall be PVC insulated, armoured, PVC overall sheathed with 2.5 mm^2 stranded Copper conductor for controls and motors upto 5.5 KW and stranded Aluminium conductor for rest-of power circuits as detailed in annexure.

4.16.03 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cable supports, crimp type tinned Copper/Aluminium lugs, brass compression glands with tapered washer (Power Cables only) and Terminal blocks.

4.16.04 Gland plates shall be minimum - 4 mm thick. The gland plate and supporting arrangement for single core power cables shall be such as to prevent flow of eddy current.

4.17.00 **Bus Duct Connection**

4.17.01 Bus duct connections when specified on drawings/annexures shall be furnished along with transition panel if required. Bus duct connection shall be generally from the top.

4.17.02 All connecting bus work shall have the same continuous current rating as associated PMCC/ MCC/DB bus and shall be fully braced for the listed short circuit current.

4.17.03 All provisions such as matching flange and other accessories shall be furnished for connection to bus duct being supplied by others. Necessary details for this purpose will be furnished later.

4.18.00 **Ground Bus**

4.18.01 A Cu / Al ground bus rated to carry the maximum fault current, shall extend full length of the assembly.

4.18.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts & nuts at each end to receive 50 x 6 mm G.I. flats.

4.18.03 All stationary units shall be directly connected to the ground bus for effective grounding.

The frame of each circuit breaker and drawout V.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

The frames of drawout module shall be ground at all times except when the power disconnects are separated by a safe distance.

4.18.04 Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.

4.18.05 C.T. & V.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing others.

4.19.00 **Nameplate**

4.19.01 Nameplate of approved design shall be provided for each cubicle, at the top of the assembly at each instrument & device mounted on or inside the cubicle.

4.19.02 The material shall be lamicoid or approved equal, 3 mm thick with white letter on black background.

4.19.03 The name plate shall be held self-tapping screws. Name plate size shall be minimum 20 x 75 mm for instrument/devices & 40 x 150 mm for panels.

4.19.04 Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

4.20.00 **Control supply for MCC modules**

4.20.01 Each motor feeder of MCC shall be provided with suitably rated 415/110V control transformer, for arranging control supply for the module. All the necessary auxiliary and main contactors shall be provided suitable for this control supply.

4.20.02 In test position module control supply shall be disconnected and provision shall be available to test the control circuit through test bus, obtained from separate control transformer provided for this purpose.

4.20.03 **Control supply for ACBs of PCC and PMCC modules**

a) Two 220V DC feeders shall be provided in each board for power supply of control, shunt tripping and annunciation purpose.

b) Control supply shall have supervision facility, alarm shall be provided for non-availability of any one of the control supply.

c) MCCBs/MCBs shall be provided on incoming sides of supplies. Control buses of two sections shall be connected through auto changeover scheme.

d) LEDs shall be provided for the indication purpose.

e) Isolation arrangement shall be provided on each panel to facilitate fault location and testing. Separate fuses shall be provided for spring charging motors, for indication lamps and for closing / Tripping circuits of each cubicle

4.20.04 **TEST Control Transformers**

For TEST control supply control transformers of adequate rating (min. 2 KVA rating) shall be provided.

For motor space heating supply, the transformers of adequate rating (min. 2 KVA rating) with 100% standby shall be provided.

All the control transformers shall be placed in spacious compartments to have proper air circulation and keep lower temperature of transformer and its module.

All the control transformers shall be provided with selector switch, fuses, indicating lamps. Each control transformer shall feed to its control buses of respective bus section during normal operation. In case of failure of one of the control transformer, provision shall be made to tap the control supplies from other bus section control transformer by auto changeover using aux. relays contacts/switch. Contractor has to develop scheme accordingly. This logic shall be made applicable for space heating and winding heating control transformer also.

All control transformer shall conform to IS: 12021.

Control transformer shall have OCTC tap range of ±5% in steps of 2.5% per tap.

4.21.00 **Space Heaters and Plug Sockets**

4.20.01 Each vertical section shall be provided with thermostat controlled space heater and 5A, 3 pin plug socket.

4.20.02 In addition, motor feeder 30 KW and above cubicle shall be wired-up for feeding the motor space heater through suitably rated breaker (or contactor) auxiliary "OFF" contact .

4.20.03 Cubicle heater, Motor heater, Plug-socket circuit shall have individual switch fuse units.

4.21.00 **A.C./D.C. Power Supply**

4.21.01 The following power supplies will be made available to each PMCC :

A.C. supply : Single feeder

D.C. supply : Double feeder

4.21.02 Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 4-pole, single throw for A.C. and 2-pole, double throw for D.C.

4.21.03 Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch-fuse units shall be provided at each cubicle for A.C./D.C. supplies.

4.21.04 A.C. load shall be so distributed as to present a balance loading on three-phase supply system.

4.22.00 **Tropical Protection**

All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.

Screens of corrosion resistant material shall be furnished on all ventilating louvres to prevent the entrance of insects.

4.23.00 **Painting**

4.23.01 All steel surfaces shall be sand blasted, grounded and pickled as required to produce a smooth, clean surface free of scale, grease & rust.

4.23.02 After cleaning, the surfaces shall be given a phosphate coating followed by two coats of high quality primer and stoved after each coat.

4.23.03 PMCC/ MCCs/DBs shall be finished in light grey (IS:631) with two coats of synthetic enamel paint.

Sufficient quantity of touch-up paint shall be furnished for application at site.

4.23.04 Caution notice plate shall be affixed at the back of each vertical panel.

Minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm.

4.24.00 **Accessories**

4.24.01 The following accessories shall be furnished along with the switchgear :

a. Breaker lifting and handling truck.

b. Device for slow opening and closing of breaker.

c. Test cabinet with coupling cables for testing the breaker in drawout position.

d. Breaker racking in/out handle (if required).

5.00.00 TESTS

5.01.00 All equipment shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

5.02.00 **Routine Test**

The tests shall include but not necessarily limited to the following :-

a. Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.

b. All wiring and current carrying part shall be given appropriate High Voltage Test.

c. Primary current & voltages shall be applied to all instrument transformers.

d. Routine test shall be carried out on all equipment such as circuit breakers, switch-fuse, contactors, relays meters etc.

5.03.00 **Test Witness**

All tests shall be performed in presence of Owner's representatives, if so desired by the Owner. The Contractor shall give at least seven (7) days advance notice of the date when tests are to be carried out shall be given.

5.04.00 **Test Certificate**

5.04.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

5.04.02 The equipment shall be despatched from works only after receipt of Owner's written approval of the test reports.

5.04.03 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

6.00.00 SPECIAL TOOLS & TACKLES

6.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

6.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

7.00.00 SPARES

7.01.00 The Contractor shall quote and supply **mandatory spare parts** as per the tentative list. The final quantity shall be decided during placement of order.

7.02.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

8.00.00 DRAWINGS, DATA & MANUALS

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

8.02.00 **To be submitted with the bid** :-

a. General arrangement drawing showing constructional features, space required in front for withdrawals, power & control cable entry points etc.

b. Typical foundation plan

c. Typical control schematic

d. Bill of materials

e. Type test reports on circuit breaker

f. Technical leaflets on :-

i) Circuit breaker
ii) Switch-fuse units
iii) Contactors
iv) Relays, meters, push buttons, selector switches etc.
v) Glands/terminals blocks

8.03.00 **To be submitted for Approval & Distribution:**

a. Outline dimensional drawing showing general arrangement, space requirements and bus duct/cable entry points.
b. Cross-section with parts list.
c. Foundation plan & loading.
d Consolidated bill of materials
e. Control schematics.
f. Diagrams.
g. Instruction manuals of MCC/DB and individual equipment.

The manual shall clearly indicate the installation method, check-up and tests to be carried out before commissioning of the equipment.

8.04.00 The Contractor may note that the drawings, data and manuals listed herein are minimum requirements only. The Contractor shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

ANNEXURE-A

RATINGS & REQUIREMENTS

1.0 **GENERAL**

	Type	: Metal-clad, drawout (PMCC/MCC) Metal-clad, fixed (DB)	
	Service	: Indoor	
1.1	System	AC	DC
	Voltage	: 415V ± 10%	220V(+ 10% to -15%)
	Phase	: 3-phase and neutral	-
	Frequency	: 50 Hz +3 to -5%	-
	Combined voltage and frequency variation	: 10% (absolute sum)	-
	System grounding	: Solidly grounded Ungrounded	

1.2	Rated Current at 50°C ambient		
	Busbar	: To be decided by the Contractor	
	Circuit breaker	: - Do -	
	Switches	: 16A to 630A	
1.3	Short Circuit Rating	AC	DC
	Interrupting	: **(*) 50** KA	25** KA
	Short Time for 1 second	: **(*) 50** KA	25** KA
1.4	Hivoltage test for 1 minute (min.) : 2.5 KV		1.5 KV

** Indicative only ; actual value to be decided by the Contractor and to be substantiated by calculation .

1.5 A.C./D.C. Power Supply

Control Voltage for Circuit breaker : 220V DC (+ 10% to -15%)

ANNEXURE-A

	Control voltage for MCC modules	: 110V AC ± 5%, 1 Ph, 50 Hz +3 to -5%
	Service voltage	: 240V AC ± 10%, 1 Ph, 50 Hz +3 to -5%
2.0	**CIRCUIT BREAKER**	
2.1	Duty Cycle	: 0-3'-CO-3'-CO
2.2	Breaking Current	
	A.C. Symmetrical	: **(*) 50** KA
2.3	Making Current	: **(*) 105** KA Peak
2.4	Auxiliary Voltage	
	Closing	: 220V D.C. (85 - 110%)
	Tripping	: 220V D.C. (70 - 110%)
	Spring Charging	: 220V D.C. (85 - 110%)

ANNEXURE-B

MODULE SELECTION

A. MOTOR FEEDER (WITH MCCB)

Type	Motor Rating (kW)	MCCB Rating (A)	Contactor Rating (A)	Cable size
AU / AR	0 – 2.2	Note-2	16	3/C – 2.5 mm sq - Cu
BU / BR	2.3 – 3.7	-do-	16	3/C – 2.5 mm sq - Cu
CU / CR	3.8 – 5.5	-do-	32	3/C – 2.5 mm sq - Cu
DU / DR	5.6 – 7.5	-do-	32	3/C – 16 mm sq - Al
EU / ER	7.6 – 11	-do-	32	3/C – 16 mm sq - Al
FU / FR	11.1 – 22.5	-do-	80	3/C – 35 mm sq - Al
GU	22.6 – 37	-do-	80	3/C – 95 mm sq - Al
HU	37.1 – 45	-do-	95	3/C – 95 mm sq - Al
JU	45.1 – 75	-do-	140	3/C – 185 mm sq - Al
KU	75.1 – 90	-do-	225	2-3/C – 185 mm sq - Al
LU	90.1 - 110	-do-	265	2-3/C – 185 mm sq - Al

1. "U" stands for Unidirectional and "R" for Reversible drives
2. MCCB are to suitably selected maintaining Type-2 coordination as per IS: 13947
3. MCCB with E/F protection to be considered for motors above 50 kW.

B. OUTGOING FEEDER (WITH MCCB)

Type	MCCB Rating (A)	Cable size
AF	32	4/C – 16 mm sq - Cu
BF	63	4/C – 35 mm sq - Al
CF	100	3.5/C – 95 mm sq - Al
DF	200	3.5/C – 300 mm sq - Al
EF	400	4x1/C – 630 mm sq - Al
FF	630	7x1/C – 630 mm sq - Al
ACB	800	7x1/C – 630 mm sq - Al
ACB	1000/1250/1600	14x1/C – 630 mm sq - Al
ACB	2500	18x1/C – 630 mm sq - Al
ACB	3150	21x1/C – 630 mm sq - Al

ANNEXURE-C

Metering and Protection

The feeders shall have the following protections / metering required for the switchgear panels. The minimum protections / metering required for various typical feeders including ACB operated feeders are given below . For non ACB controlled feeders, the metering indicated shall be in-built.

1) ACB controlled feeders with numerical relays

A)	**Incomers**		
	Protections	**Metering (for remote)**	**Local Indication**
	Instantaneous over current protection 50	Current in all the three phases	Current in all the 3 phases
	IDMT over current protection 51	Voltage – Phase to phase, phase to neutral	Voltmeter with voltage selector switch
	Instantaneous earth protection 50N	kW	
	IDMT Earth fault protection 51N	kWH	
	Circuit breaker failure protection 50BF		
	Under voltage protection 27		
	Restricted earth fault protection 64R		
	Backup (Standby) earth fault protection 64S		
	Apart from above protection relays, each electrically operated breaker shall be provided with anti-pumping (94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and shall not be clubbed with numerical relay.		
	Check synchronizing 25 through relay mounted in bus coupler.		
B)	**Bus Couplers**		
	Protections	**Metering (for remote)**	**Local Indication**
	Instantaneous over current protection 50	Current in all the three phases	Current in all the three phases
	IDMT over current protection 51	Voltage – Phase to phase, phase to neutral	Voltmeter with voltage selector switch for Bus A
	Instantaneous earth protection 50N	kW	Voltmeter with

			voltage selector switch for Bus B
	IDMT Earth fault protection 51N	kWH	
	Circuit breaker failure protection 50BF		
	Under voltage protection 27		
	Check synchronizing 25		
	Apart from above protection relays, each electrically operated breaker shall be provided with anti-pumping (94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and shall not be clubbed with numerical relay.		
C)	**Motor Feeders (above 90KW)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Numerical Composite motor protection to cover a min. protections such as negative phase current (46), thermal over load (49), phase over current (50/51), earth fault (50N/51N), locked rotor (51LR), No. of starts per hour (66), breaker failure (50BF), under voltage (27 from PT)	Current in all the three phases	Current (Y phase) for feeders rated above 30 kW.
	Apart from above protection relays, each electrically operated breaker shall be provided with anti-pumping (94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and shall not be clubbed with numerical relay.	A, kW, kWH	
D)	**Outgoing Feeder (630A and above) (Breaker Operated)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Instantaneous over current protection 50	Current in all the three phases	Current (Y phase)
	IDMT over current protection 51	Voltage – Phase to phase, phase to neutral	
	Instantaneous earth protection 50N	kW	
	IDMT Earth fault protection 51N	kWH	
	Circuit breaker failure protection 50BF		
	Apart from above protection relays, each electrically operated breaker shall be provided with anti-pumping		

	(94), lockout (86) and trip circuit supervision (95) relays. Lockout relay shall be a hand reset type and shall not be clubbed with numerical relay.		

2) MCCB Controlled feeders rated below 630A.

A)	**Incomers (with motorized MCCB)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection	Current transducer (Y phase)	Current (Y phase)
	Short circuit protection		Voltmeter with voltage selector switch
B)	**Bus Couplers (with motorized MCCB)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection	Current transducer (Y phase)	Current (Y phase)
	Short circuit protection		
C)	**Outgoing Feeder (Below 630A) with MCCB (non-motorized)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection		Current (Y phase)
	Short circuit protection		
D)	**Incomers for ACDB/MLDB/PDB MCCB (non-motorized)**		
	Protections	**Metering (for remote)**	**Local Indication**
	Over current protection	Electronic energy meter with suitable communication protocol	Voltmeter with voltage selector switch
	Short circuit protection	Electronic energy meter suitable for communication with Modbus RS485.	

3) Other feeders

A)	**Bus PT / Line PT Modules**		
	Protections	**Metering (for remote)**	**Local Indication**
	Under voltage protection 27	Voltage – phase to phase, phase to neutral	
	Fuse failure protection		

B)	Motor feeders up to 18.5kW (MPCB with Contactors)		
	Protections	Metering (for remote)	Local Indication
	overload & short circuit protection.		
C)	Motor feeders above 18.5kW but upto 90KW (MCCB with Contactors)		
	Protections	Metering (for remote)	Local Indication
	Current measuring module and Overload, single phase preventer & short circuit protection.	Phase current (for motors of rating 30KW and above)	

4) DC System

A)	Incomer Breaker/MCCB		
	Protections	Metering (for remote)	Local Indication
	With indication only no protection with O/L alarm to BOP DDCMIS	Bus voltage	Load Voltage
			Bus Voltage
			Shunt with ammeter
B)	Outgoing Feeder		
	With indication only no protection with O/L alarm to BOP DDCMIS		Shunt with ammeter

Note: Fuse failure relay shall be provided on the secondary side of voltage transformer to monitor HV and LV fuses.

ANNEXURE-D

FITTINGS & ACCESSORIES

Each PMCC/ MCC shall be furnished complete with fittings and accessories as listed below :-

1. Operating mechanism complete with all accessories, fittings and tripping coil and closing coil, pole discrepancy feature, etc. as required.
2. Base frame and anchor bolts and nuts.
3. Auxiliary contacts and relays.
4. LOCAL/REMOTE Selector switch, TRIP/CLOSE Push Buttons.
5. Manual tripping devices with protective flap.
6. Mechanical ON-OFF indicator.
7. Operation counters.
8. Set of switch fuse units/MCCB for A.C. and D.C. supply.
9. Space heater with thermostat and ON-OFF switch.
10. Cubicle illumination lamp with ON-OFF switch.
11. 3 Pin 5A Socket with ON-OFF Switch.
12. Terminal blocks and internal wiring - lot as required.
13. Other standard accessories which are not specifically mentioned but supplied with breakers of similar type and rating for efficient and trouble-free operation.
14. Bimetallic terminal connectors.

ANNEXURE – D

RATINGS AND REQUIREMENTS OF LIGHTING TRANSFORMER

Type	:	Dry type, encapsulated VPI with nomex insulation
KVA rating (Minimum)	:	100 KVA
Voltage rating	:	415 V/415 V
Cooling	:	AN
P.V. Impedance	:	0.04 $\pm$ 10%
Voltage control	:	Off load tap switch/link with change of $\pm$ 5% in step of 2.5% tapping full capacity.
Vector Group	:	Dyn11
Class of Insulation	:	F (155^0C)
Maximum Temperature rise over 50 Deg C. ambient in winding by resistance	:	90^0C
Neutral	:	Solidly grounded.

The secondary neutral of the transformer shall be brought out for getting a grounded 4 wire supply. Each transformer shall be routine tested and one transformer shall be type tested in accordance with relevant standard.

The transformer shall be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.

The transformer shall be mounted inside sheet steel enclosure, which shall be an integral part of Lighting Distribution Board.

2.11.05 **HV Switchgear (11kV and 3.3kV)** - Complete with breakers, busbars, instrument transformers, numerical relays, meters, transducers, interposing relays, terminal blocks, dummy panels, bus trunking & accessories for balance of plant loads. All 11 KV / 3.3kV switchgears to be provided with manual / auto closing of bus coupler and manual / auto live changeover with check synchronizing and other synchronizing equipment. The short circuit rating of 11 KV switchgear and its associated equipment shall be designed for 40KA for 3Sec and that of 3.3KV HT switchgear and its associated equipment shall be designed for 40KA for 3Sec. Numerical relays with dual redundant IEC 61850 ports, manageable switches / RTUs for establishing communication with PLC shall also be considered as per requirement. Numerical relay network shall be on IEC 61850 protocol. Accordingly all numerical relays shall be connected to the respective panel redundant Ethernet switches through suitable communication cable (RJ45). The groups of numerical relays shall be connected to the PLC. Multifunction meters (MFM) shall be connected in a loop to form RS485 network with Modbus or any industry standard open protocol. The RS485 network of MFMs shall be connected to industrial grade RS485 to TCP/IP converter via serial port. The RS485 to TCP/IP converter shall be connected to the respective panel redundant ethernet switches and further to the EMS. Redundant ethernet switches for respective HT SWGRs as indicated above shall be provided by the contractor and shall be housed in separate network panel which shall be either wall mounted or standalone as decided during detail engineering & further to be hooked up to Main Plant DDCMISs. A marshalling panel shall be provided on each bus of 3.3kV switchgear for interfacing with BOP.

2.11.06 **LV Switchgear (415V)** complete with breakers / contactors, busbars, instrument transformers, numerical relays, meters, transducers, interposing relays, terminal blocks, dummy panels, bus trunking & accessories for catering the loads of FGD package. All 415V PCC/ PMCC/MCC to be provided with manual / auto closing of bus coupler and auto/manual live changeover with check synchronizing. A marshalling module shall be provided on each bus of LV Switchgear for interfacing with PLC. Control of incomers and bus-coupler breakers of LV switchgears shall be possible from the PLC. The check synchronizing relay shall be housed in the respective switchboards. Dummy panels shall be integral part of the LV switchgear and of same size. Emergency MCC shall cater to the emergency loads of FGD package.

2.11.07 **Segregated Bus Ducts** – 3.3kV side of 11kV / 3.3kV Auxiliary Transformer will be connected with the associated switchgears through segregated-phase bus duct with required bends, supporting structures with related civil work. Phase Cross over, if required in 11kV/3.3kV shall be accommodated at the switchgear end in the rear dummy panel.

2.11.08 **Non-Segregated Bus Ducts** – Non-segregated Bus Duct (NSPBD) between 415V Service Transformer to LV service PCC/PMCC for FGD package with required bends, supporting structures with related civil work. Phase Cross over, if required in 415V systems shall be accommodated at the switchgear end in the rear dummy panel.

The auxiliary power supply system & equipment shall be designed for a voltage & frequency variations as given below under worst operating conditions:

AC System

(a)	Voltage variation	±10%
(b)	Frequency variation	+5% to -5%
(c)	Combined voltage & frequency variation	10% (absolute sum)

DC System

(a)	Voltage variation	-15% to +10%

4.07.00 All equipment covered under this contract shall be so designed as to withstand & work continuously with the above mentioned variation in AC/DC supplies without any deterioration in performance.

4.08.00 The system shall consist of required Service transformers and associated 11kV/3.3kV/415V switchgears to cater to FGD loads. The contractor shall mark out his own design as per the system requirement and the actual distribution shall be arranged by him as per load centre to be approved by the Owner. Any additional feeder requirement during detailed engineering shall be arranged by the contractor without any price implication.

4.09.00 All 11kV, 3.3kV buses shall have facility for auto/manual changeover facility. All 415V switchgears fed from transformers shall be provided with live manual changeover. Auto changeover to the reserve supply source shall be arranged for all 415V switchgears/MCCs to prevent the loss of unit or to ensure the equipment safety.

4.10.00 Design fault level shall be 50kA for 415V system. For higher voltage systems it shall be 40kA for 11kV systems and 3.3kV systems.

4.11.00 The nominal voltage of DC system shall be 220V for control, protection, annunciation and DC drives.

4.12.00 CT & PT secondary wiring shall be color coded i.e. wires or sleeves or ferules of Red, Yellow, Blue & Black colors shall be provided for respective phases & neutral.

4.13.00 The connections of CT secondary circuits shall be through drop out type links.

4.14.00 To minimize inventory of spare parts and ease of maintenance all 11kV & 3.3kV and 415V switchgear being supplied by package vendor shall be of same make (voltage wise).

4.15.00 For the purpose of design of equipment/systems, an ambient temperature of 50°C shall be considered. The equipment shall operate in a highly polluted (with dust and fly ash) and highly corrosive environment.