3x660 MW NTPC NORTH KARANPURA STPP-FGD SYSTEM PKG.
4x270 MW TSGENCO BHADRADRI TPP- FGD SYSTEM PKG.
2x500 MW NTPL TUTICORIN –TPP- FGD SYSTEM PKG.

TECHNICAL SPECIFICATION
FOR
FRP COOLING TOWER

Specification No. : PE-TS-440/441/483-165-N001 (REV. 0)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA - 201301

TITLE:	SPEC. NO.: **PE-TS-440/441/483-165-N001**
TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SECTION: **I**
	SUB-SECTION: IA
	REV. NO. **0** DATE 27.07.2021
SPECIFIC TECHNICAL REQUIREMENTS	SHEET 1 OF **1**

INDEX

THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

CONTENTS

Notes:
1) For detailed list of documents to be submitted by bidder in their technical offer, please refer cl. no. 6.00 of Section-IIA.

2) For detailed list of documents to be submitted by vendor after award of contract, please refer Datasheet-C of Section-IIA.

3) In case there is conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

TITLE:	SPEC. NO.: **PE-TS-440/441/483-165-N001**
TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SECTION: **I**
	SUB-SECTION: IA
	REV. NO. **0** DATE 27.07.2021
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SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA - Specific Technical Requirements (Mechanical)
SUB-SECTION IB - Specific Technical Requirements (Electrical)
SUB-SECTION IC - Specific Technical Requirements (C & I)
SUB-SECTION ID – Datasheet-A

SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

TITLE:	SPEC. NO.: **PE-TS-440/441/483-165-N001**
TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SECTION: **I**
	SUB-SECTION: **IA**
	REV. NO. **0** DATE 27.07.2021
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1.00 INTENT OF SPECIFICATION:

1.01 This specification is intended to cover the design, manufacture, inspection & testing at manufacturer's and/or his sub-vendor's works, properly packed to avoid any damage during transportation & long storage at site, transportation to site, assembly at site (if supplied in knocked down condition), erection & commissioning at site and performance testing at site of Induced draft type FRP Cooling Tower for **FGD system packages, of following projects** including complete Electrical and C&I as specified and as necessary:

1) 3x660 MW NTPC NORTH KARANPURA STPP –FGD
2) 4X270 MW TSGENCO BHADRADRI TPP –FGD
3) 2X500 MW NTPL TUTICORIN -FGD

The performance parameters and other particulars of Cooling Towers are detailed in Data Sheet-A.

2.00 SCOPE OF EQUIPMENTS & WORKS UNDER THIS SPECIFICATION:

The equipment and works to be provided under this specification shall be as detailed below and as indicated in relevant portion of enclosed documents.

The items not specifically mentioned but deemed necessary to make the cooling tower complete in all respects, as self-contained package for reliable and efficient operation shall also be deemed to have been included in the scope of the bidder. In case this is not clear to bidder, the bidder may seek clarifications to same, failing which the specification intent shall be binding on bidder.

The scope of supply/ works as a complete package includes complete works between the terminal points which are stated or unstated but required as per the system requirements except for items specifically mentioned in exclusion list of works. Scope of works includes preparation of design and drawings, obtaining necessary approvals, materials, execution as per latest codes, specification, best Engineering practices and to the satisfaction of BHEL/ Owner for all mechanical, architectural, structural, electrification etc. BHEL will not bear any liability for any extra work, which might not have been perceived by the bidder but functionally required. The cost of such work will be entirely borne by the bidder.

The bidder shall furnish list of items/ services not included in his scope, otherwise the complete package shall be deemed to be in bidder's scope & Purchaser's interpretation in this regard shall be final & binding on the bidder.

The brief scope of supply, services & works for Cooling tower, complete with all other equipments and accessories as mentioned herein after. It is not the intent to list all details herein; scope of supply listed is in brief.

Each Cooling Tower shall be complete with following:

2.01 Scope (Mechanical):

a) The cooling tower shall be induced draft type in FRP construction as per Data Sheet –A of Sub-Sec. ID of this volume. The air inlet design W.B. temperature will be as specified in the Data Sheet-A.

b) The cooling tower shall be provided with Cooling tower fan assembly complete with weather proof motor, drive shaft, lubrication system, gearbox (as applicable), couplings, coupling guards & weather proof canopy hood. The fan & all rotating parts shall be protected by guard.

c) Access ladder shall be provided for the cooling tower.

e) The cooling tower shall be provided with louvers, tower fills & fill supports, drifts eliminator including all supporting structures, fastening arrangements & accessories.

f) Strainer at water outlet, Bird screen on top of tower shall be provided for the cooling tower.

g) All necessary supports, hangers, base plates, foundation plates, anchor bolts, sleeves, inserts, bolts, nuts for all equipments supplied & as necessary for mounting the assembled cooling tower on civil foundation.

h) Counter flanges, bolts, nuts & gaskets for all piping connections in the scope of bidders and also at terminal points.

i) Bidder shall provide Ball-Float valve matching with make-up water line size

j) Cooling tower structure shall be designed to withstand wind load as specified, per IS-875 part3 / as specified under End customer specification in this section IA.

k) Supply & application of final painting at site.

2.02 **Scope (Electrical):** shall be as per Sub-section IB & IIB of this volume.

2.03 **Scope (C & I):** shall be as per Sub-section IC & IIC of this volume.

2.04 The following are also included in bidder's scope:

a) One set of special tools & tackles required for maintenance of equipments & accessories in the cooling towers.

b) Various drawings, datasheets, calculation, test reports/ certificates, operation & maintenance manuals including "As built drawings" etc. as specified & as necessary.

c) Supply of first fill of lubricants for all equipments under this package including second fill/ replenishment as necessary after commissioning & handing over of the cooling tower.

d) Supply of Erection & commissioning spares on as required basis.

e) Scope of services shall include transportation of equipments & material to site, assembly at site (if supplied in knocked down condition), erection & commissioning at site and performance testing of cooling towers at site. Supply of all labour including supervision personnel, materials, erection tools & tackles etc. as necessary for expeditious execution of works etc. are also included in bidder's scope. It shall be the responsibility of the bidder to arrange all items at site required for the execution of complete job including erection, commissioning & Testing at site.

f) Recommended spares for 3 years operation – bidder to furnish list with item wised prices. These prices not to be included in the base price but to be furnished separately.

3.00 **Equipment & Services to be provided by Purchaser:**

a. Supply and erection of incoming hot water piping up to cooling tower Hot water inlet nozzle/flange outside cooling tower.

b. Complete civil works including CT basin.

c. Cold-water outlet, Make-up water, drain & overflow piping from/to cooling tower basin.

d. For Electrical and C&I refer Sub-Sections IB/ IIB and IC/IIC respectively enclosed herein.

e. For equipment(s) & material supplied by bidder to site, loading/unloading of material at site, storage at site & movement of material at site shall be provided by Purchaser.

4.00 **Successful bidder in the event of award of contract shall furnish the GA Drg of CT basin within 6 weeks of LOI date incorporating relevant dimensional details for all the major points like Foundation details of CT structure, overflow piping, drain piping, hot water inlet to CT, cold water outlet from CT and make-up water to CT.**

5.00 The cooling tower shall comply with complete specification. In case of any conflict in different clauses of specification, most stringent clause (as decided by BHEL / end customer) shall be followed, if no specific deviation is taken by bidder and accepted by BHEL during tender stage in that regard.

6.00 **DRAWINGS, CURVES AND INFORMATION REQUIRED:**

6.01 **The following documents only shall be furnished by the bidder with his offer:**

a) Compliance certificate duly signed and stamped (enclosed in Section III).
b) General arrangement drawing for cooling tower. (Only for reference purpose)
c) Guarantee Schedule duly signed and stamped (Format enclosed in Section III)
d) Technical deviation schedule ('NIL or NO DEVIATION" to be indicated in case of No Deviation (Format as per NIT).
e) Unpriced copy of the Price Schedule (indicating "Quoted" for the listed items).

Apart from above no other drgs./docs./datasheets etc. are required to be submitted at bid stage and even if furnished shall not be taken cognizance of.

Note: **The GA drawing shall be only for reference purpose; same shall not be reviewed/ commented by purchaser at this stage and shall be subject to approval only during contract.**

7.00 It is mandatory for the bidders to furnish along with the bid, the deviation(s), if any, whether major or minor in the '**Schedule of Deviations**' only. In the absence of the deviations listed in the '**Schedule of Deviations**', the offer shall be deemed to be in full conformity with the specification not withstanding anything else stated elsewhere in the offer, data sheets etc. **The hidden deviations or stated/ implied deviations in the offer shall not be acceptable and binding on the purchaser**.

8.00 **PERFORMANCE GUARANTEES AND LIQUIDATED DAMAGES:**

a) Performance testing of cooling tower shall be done to demonstrate the guaranteed cooling water temperature at rated duty point. The cold-water temperature as specified in the specification shall be guaranteed by bidder for the design conditions of Cooling Water flow, range, ambient WBT as specified.

In case the test cold-water temperature as determined from the PG test is higher than the predicted value (based on the performance curves). Owner reserves the right to reject the tower.
The successful bidder shall demonstrate the above guarantees during performance testing at site.

b) The bidder shall guarantee the following, apart from other performance guarantees of the complete package.
• Total Fan Power consumption (KW) per Cooling Tower, for the cooling tower fans at fan motor inlet terminals.

c) The successful bidder shall demonstrate the above guarantees during performance testing at site.

The liquidated damages at the rate specified in Datasheet-A for each one (1) KW power consumption or fraction thereof shall be levied in the event of failure of bidder demonstrating the respective guaranteed values of KW power consumption.

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9.00 BID EVALUATION CRITERIA:
Fan Power Consumption (KW) and ACW Pumping Head (MWC):

a) Total Fan power consumption (KW) per Cooling Tower, for the cooling tower fans at fan motor inlet terminal indicated in Guarantee schedule by bidder shall not exceed the respective maximum limits specified in Data Sheets A. In the event of total fan power consumption (KW) offered being more than maximum limits specified in Data Sheets A, then for every KW difference in power consumption of fan, loading at the rate given in Data Sheet-A shall be considered.

b) Bidder shall submit the ACW pumping head (MWC) in his technical offer. Any offer with pumping head more than as specified in Data sheet- A will be summarily rejected.

c) No technical advantage shall be given to any bidder for total fan power consumption (KW) and ACW pumping head (MWC) offered less than maximum limits specified in Datasheet-A.

10.00 TERMINAL POINTS:

a) Mechanical: Hot Water Inlet Nozzle/Flange (outside cooling tower).
(Matching Counter flange in bidder scope).
b) Electrical: Motor Terminal Box.
c) C&I: Junction Box/LCP.
d) Civil: Top of Basin Curb wall

11.00 Successful bidder in the event of award of contract shall furnish the drawings/ documents as listed in Data Sheet-C. Distribution of various documents & submission schedule shall be as per NIT.

12.00 Additional Dispatch Requirements:

MDCC after final inspection shall be provided to vendor subject to submission of following documents along with meeting the other requirements stated in NIT :-

a) List of items packed in each box with description & quantity.
b) Photograph of each box in open & closed condition.

Bidder to include handling instructions on Packed Box of each item & in Engineering drg/doc/O&M Manual and packing to be done in such a way to avoid damage of items in transit and long storage at site and same shall be approved during contract stage by BHEL/Customer.

13.00 Following to be complied by the bidder:

a. Supplier to submit detailed 'Bill of Material' (BoM) at the time of drawing/document submission after placement of PO. Each item of the BoM to be uniquely identified with item code no. or item serial no.
b. Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BoM.
c. Supplier to give following undertaking in the BoM"
"The BoM provided herewith completes the scope (in content and intent) of material supply under PO no.----------, dated ----------.
Any additional material which may become necessary for the intended application of the supplied items(s)/package will be supplied free of cost in most reasonable time."

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SUB-SECTION – ID

DATA SHEET – A

DATA SHEET - A

FRP COOLING TOWER

		PROJECTS		
		3x660 MW NTPC NORTH KARANPURA STPP –FGD PROJECT	**4X270 MW TSGENCO BHADRADRI TPP –FGD PROJECT**	**2X500 MW NTPL TUTICORIN -FGD PROJECT**
Sl. No.	**DESCRIPTION**			
1.0	**General Requirement**			
1.1	Type	Induced Draft Cooling Tower in FRP/GRP Construction , Counter or Cross Flow	Induced Draft Cooling Tower in FRP/GRP Construction , Counter or Cross Flow	Induced Draft Cooling Tower in FRP/GRP Construction , Counter or Cross Flow
1.2	Total number of Cooling Tower(s) for Project	1 (One)	4 (FOUR)	1 (One)
1.3	Number of Cells per tower	To be decided by Bidder	To be decided by Bidder	To be decided by Bidder
1.4	Service	Cooling of Auxilairy cooling water (ACW)	Cooling of Auxilairy cooling water (ACW)	Cooling of Auxilairy cooling water (ACW)
1.5	Liquid Handled (refer water analysis enclosed herein)	Clarified water	Clarified water	Desalinated water
1.6	Installation Location	Outdoor-Near ECW-ACW Pump House	Outdoor-Near ECW-ACW Pump House	Roof Top of ECW-ACW Pump House or Outdoor Near ECW-ACW Pump House
1.7	Duty	Continuous	Continuous	Continuous
1.8	Specific gravity (liquid handled)	1	1	1
1.9	System Design pressure (kg/sq. cm), g	7.5	7.5	7.5
1.10	Mechanical Design Temperature (°C)	60	60	60
2.0	**DESIGN PERFORMANCE PARAMETERS FOR EACH COOLING TOWER**			
2.1	Design capacity (water flow rate total for each Tower), M^3/hr	315	270	150
2.2	Design Ambient air wet bulb temperature (Deg. C)	28	28	28
2.3	Design inlet air wet bulb temperature (Deg. C) (including re-circulation allowance)	28.4	28.4	28.4
2.4	Design Cooling Range (Deg. C)	6	6	6
2.5	Design Cold water temperature at Cooling Tower outlet (Deg. C)	33	33	33
2.6	Approach	4.6 degC w.r.t inlet WBT and 5 degC w.r.t Amb. WBT	4.6 degC w.r.t inlet WBT and 5 degC w.r.t Amb. WBT	4.6 degC w.r.t inlet WBT and 5 degC w.r.t Amb. WBT
2.7	Fan Motor rating	Continuous Motor rating (at 50 deg. C ambient) shall be at least Fifteen percent (15%) above the maximum power requirement of fan when the fan is operating at its test block condition as required at gear box input end.		
2.8	Performance/Design Standard	ATC-105	ATC-105	ATC-105
2.9	Maximum permissible ACW Pumping Head (MWC) at design capacity (viz. Static lift from top of basin curb wall up to Centre of Hot water Inlet Pipe Nozzle/Flange of Cooling tower (including all loses).	4.0	4.0	3.5
2.10	Maximum limit on total power consumption per cooling tower for the cooling tower fans at fan motor inlet terminals (KW)	25.0	15.0 (Total for 4 towers = 15x4 = 60KW)	10.0
2.11	LD/Bid evaluation Rate on Auxiliary power consumption	US $ 3275 / KW (If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date 31.07.2018)	INR 2.52 Lacs/KW	INR 4.065 Lacs/KW
2.12	Gear Box Service factor	3 (minimum)	3 (minimum)	3 (minimum)
2.13	Factor of safety for drive shaft	2 (minimum) over the torque to be transmitted at design duty condition	2 (minimum) over the torque to be transmitted at design duty condition	2 (minimum) over the torque to be transmitted at design duty condition
3.0	**CONSTRUCTION FEATURES / ACCESSORIES**			
3.1	Basin (Common for all cells/Towers in case of multiple cells/Towers)	Purchaser scope (In RCC Construction)	Purchaser scope (In RCC Construction)	Purchaser scope (In RCC Construction)
3.2	Make up water connection	Purchaser scope	Purchaser scope	Purchaser scope
3.3	Drain connection with isolation valve.	Purchaser scope	Purchaser scope	Purchaser scope
3.4	Overflow connection	Purchaser scope	Purchaser scope	Purchaser scope

DATA SHEET - A

FRP COOLING TOWER

		PROJECTS		
		3x660 MW NTPC NORTH KARANPURA STPP –FGD PROJECT	**4X270 MW TSGENCO BHADRADRI TPP –FGD PROJECT**	**2X500 MW NTPL TUTICORIN -FGD PROJECT**
Sl. No.	**DESCRIPTION**			
3.5	Access door in louvers/fan deck.	Bidder's scope	Bidder's scope	Bidder's scope
3.6	Internal Diameter of Distribution pipes	To suit max. design velocity of 2.0 m/sec	To suit max. design velocity of 2.0 m/sec	To suit max. design velocity of 2.0 m/sec
3.7	Valve (if applicable) & Size of Valve.	Bidder's scope (Same as that of pipe size)	Bidder's scope (Same as that of pipe size)	Bidder's scope (Same as that of pipe size)
3.8	Ball-float Valve & Size of Valve.	Bidder's scope (Same as that of pipe size)	Bidder's scope (Same as that of pipe size)	Bidder's scope (Same as that of pipe size)
3.9	Supports & supporting structure	Bidder's scope	Bidder's scope	Bidder's scope
3.10	Canopy Rain protection for motor	Bidder's scope	Bidder's scope	Bidder's scope
3.11	Access Ladder	Bidder's scope	Bidder's scope	Bidder's scope
3.12	Suitable Guard for rotating parts	Bidder's scope	Bidder's scope	Bidder's scope
3.13	All necessary supports, hangers, Base plates, foundation plates, anchor bolts,sleeves, inserts, bolts, nuts for all equipments supplied.	Bidder's scope	Bidder's scope	Bidder's scope
4.0	**MATERIALS OF CONSTRUCTION**			
4.1	Casing/Body	Fibre Reinforced Plastic (FRP) /Glass reinforced plastic (GRP)	Fibre Reinforced Plastic (FRP) /Glass reinforced plastic (GRP)	Fibre Reinforced Plastic (FRP) /Glass reinforced plastic (GRP)
4.2	Fan	Cast Aluminum / FRP Propeller type and multi-blade aerofoil construction with adjustable pitch	Cast Aluminum / FRP Propeller type and multi-blade aerofoil construction with adjustable pitch	Cast Aluminum / FRP Propeller type and multi-blade aerofoil construction with adjustable pitch
4.3	Fan Hub	Heavily Galvanised M.Steel with SS hardware	Heavily Galvanised M.Steel with SS hardware	Heavily Galvanised M.Steel/Cast Iron with SS hardware
4.4	Fan drive shaft & Coupling	SS-304	SS-304	SS-304
4.5	Gears	Alloy steel/equivalent	Alloy steel/equivalent	Alloy steel/equivalent
4.6	Fill	Non combustible PVC or equivalent	Non combustible PVC or equivalent	Non combustible PVC or equivalent
4.7	Louvers	F.R.P. /PVC/ Aluminum.	F.R.P. /PVC/ Aluminum.	F.R.P. /PVC/ Aluminum.
4.8	Nozzles	Brass with chrome plating / Polypropylene	Brass with chrome plating / Polypropylene	Brass with chrome plating / Polypropylene
4.9	Drift Eliminators	PVC (UV Stablised), In removable sections to reduce the drift loss to 0.2% of water flow	PVC (UV Stablised), In removable sections to reduce the drift loss to 0.2% of water flow	PVC (UV Stablised), In removable sections to reduce the drift loss to 0.2% of water flow
4.10	Supporting structure	Mild steel with spray galvanization or epoxy painting	Mild steel with spray galvanization or epoxy painting / Pultruded FRP	Mild steel with spray galvanization or epoxy painting / Pultruded FRP
4.11	Access Ladder	Mild steel with spray galvanization or epoxy painting	Mild steel with spray galvanization or epoxy painting	Mild steel with spray galvanization or epoxy painting
4.12	Strainer at water outlet	Plate strainer made of GI/SS wire mesh of 16 gauge	Plate strainer made of GI/SS wire mesh of 16 gauge	Plate strainer made of GI/SS wire mesh of 16 gauge
4.13	Bird screen on top of tower	25 mm square made of GI/SS wire mesh of 16 gauge	25 mm square made of GI/SS wire mesh of 16 gauge	25 mm square made of GI/SS wire mesh of 16 gauge
4.14	Distribution Pipe (if any)	Galvanised MS pipe/PVC	Galvanised MS pipe/PVC	Galvanised MS pipe/PVC
4.15	Fasterners	Hot dip galvanized steel / SS	Hot dip galvanized steel / SS	Hot dip galvanized steel / SS
4.16	Wetted Fasterners	SS	SS	SS
4.17	Valve (if any)	Forged/cast carbon steel	Forged/cast carbon steel	Forged/cast carbon steel
4.18	Connecting Pipe material (for deciding counterflange material)	Carbon Steel to IS 1239 (Heavy Grade) / IS:2062 GR. E 250B, Plates rolled & welded as per IS 3589.	Carbon Steel to IS 1239 (Heavy Grade) / IS:2062 GR. E 250B, Plates rolled & welded as per IS 3589.	Carbon Steel to IS 1239 (Heavy Grade) / IS:2062 GR. E 250B, Plates rolled & welded as per IS 3589.
5.0	**MANDATORY SPARES**	**NIL**	**NIL**	**NIL**

Notes :

1. Material of construction for other components not specified above shall be similarly selected in line with the above for the duty intended and subject to approval.
2. For items stated as not applicable by bidder, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.
3. For Flanged end connections, matching counter flanges (complete with nuts,bolts,gaskets) will be in bidder's scope of supply. Flanges shall be as per ANSI B 16.5.
4. Wherever SS material is coming in contact with non SS material, suitable isolation (rubber etc.) shall be provided to avoid galvanic corrosion.
5. For every KW difference in power consumption of fan, loading at the rate given in Data Sheet-A shall be considered.
6. Please refer Project information attached of Each project for other details/site conditions.

ANNEXURE-III

RAW WATER ANALYSIS

Sl. No.	Constituent	as	mg per litre
1.	Calcium	CaCO3	65
2.	Magnesium	CaCO3	41
3.	Sodium	CaCO3	98
4.	Potassium	CaCO3	5
5.	Total Cations	CaCO3	209
6.	Total Alkalinity	CaCO3	150
7.	Chloride	CaCO3	25
8.	Sulphate	CaCO3	34
9.	Total Anions	CaCO3	209
9.	Silica (Reactive)	SiO2	9
11.	Iron	Fe	1.2
12.	pH Value	-	7.6-8.2
13.	Turbidity	NTU	200
14.	Organics(As per $KMnO_4$ method)	Number	2

CLARIFIED WATER ANALYSIS

Sl. No.	Constituent	Value	Unit
1	Iron	<0.3	mg/L as Fe
2	Turbidity	<10	NTU
3	Organics (as per $KMnO_4$ method)	<0.05	mg/L
4	Gravity Filter Outlet (Effluent Turbidity)	<2	NTU
5	Gravity Filter Inlet (Turbidity)	10	NTU

CLAUSE NO.	PROJECT INFORMATION	एनटीपीसी NTPC

ANNEXURE – II

CLIMATOLOGICAL TABLE

CLIMATOLOGICAL TABLE

स्टेशन : हज़ारीबाग STATION : Hazaribagh — अक्षांश LAT 23°59′ N — देशांतर LONG 85°22′ E — समुद्री तल माध्य से ऊँचाई HEIGHT ABOVE M. S. L. 611 मीटर METRES

1951 से 1980 तक के प्रेक्षणों पर आधारित BASED ON OBSERVATIONS FROM 1951 TO 1980

MONTH (माह)		STATION LEVEL PRESSURE (hPa)	AIR TEMPERATURE – MEAN: DRY BULB (°C)	WET BULB (°C)	DAILY MAX (°C)	DAILY MIN (°C)	HIGHEST IN THE MONTH (°C)	LOWEST IN THE MONTH (°C)	EXTREMES: HIGHEST (°C)	DATE AND YEAR	LOWEST (°C)	DATE AND YEAR	HUMIDITY: RELATIVE HUMIDITY (%)	VAPOUR PRESSURE (hPa)	CLOUD AMOUNT (Oktas of sky): ALL CLOUDS	LOW CLOUDS	RAINFALL: MONTHLY TOTAL (mm)	NO. OF RAINY DAYS	TOTAL IN WETTEST MONTH WITH YEAR (mm)	TOTAL IN DRIEST MONTH WITH YEAR (mm)	HEAVIEST FALL IN 24 HOURS (mm)	DATE AND YEAR	MEAN WIND SPEED (Kmph)
जनवरी JAN	I	947.6	14.7	10.9	22.6	9.3	26.7	4.6	30.6	31 1881	0.9	07 1980	62	10.4	1.4	0.5	23.5	1.7	113.0 1919	0.0	68.1	06 1945	6.2
	II	944.5	18.9	12.8									49	10.4	1.6	0.5							
फरवरी FEB	I	945.7	17.9	12.3	25.7	12.0	30.5	6.9	33.6	22 1967	1.7	08 1974	52	10.3	1.3	0.4	16.2	1.4	117.3 1907	0.0	63.5	23 1927	7.3
	II	942.6	22.6	14.4									39	10.4	1.4	0.6							
मार्च MAR	I	944.0	23.4	15.0	30.8	16.6	35.6	11.4	38.9	27 1892	6.7	04 1898	39	10.8	1.5	0.3	18.4	1.7	164.3 1905	0.0	44.2	20 1946	7.9
	II	940.6	27.8	16.3									29	10.2	1.9	0.5							
अप्रैल APR	I	941.0	28.6	18.2	35.7	21.3	39.3	16.4	41.7	22 1956	10.6	01 1968	36	13.3	1.8	0.3	17.0	1.4	81.6 1952	0.0	60.5	22 1925	8.6
	II	937.1	32.4	18.8									26	11.8	2.2	0.7							
मई MAY	I	937.0	30.7	21.1	37.8	24.0	41.5	19.3	43.9	18 1897	15.6	22 1977	43	18.1	2.5	0.3	43.4	2.9	187.2 1936	0.0	84.1	27 1887	9.1
	II	933.4	34.3	21.2									32	15.7	2.9	0.7							
जून JUN	I	933.4	28.4	23.3	34.1	24.1	40.1	21.0	46.6	14 1975	18.3	02 1975	67	25.0	5.3	1.8	177.1	9.2	774.5 1911	0.5 1905	249.2	24 1911	8.7
	II	930.4	30.4	23.5									60	23.8	5.8	2.5							
जुलाई JUL	I	933.1	25.6	23.8	29.5	23.0	33.2	21.4	39.6	08 1975	19.3	18 1975	86	28.2	6.5	3.8	310.0	16.2	693.2 1930	99.8 1911	221.7	06 1953	7.9
	II	930.5	26.8	24.1									80	28.1	6.4	3.7							
अगस्त AUG	I	934.5	25.2	23.7	29.1	22.7	31.5	21.3	34.2	03 1972	20.0	29 1967	88	28.3	6.4	3.8	320.1	16.2	708.1 1943	83.8 1928	180.1	17 1868	7.6
	II	931.6	26.4	24.3									84	28.7	6.4	3.5							
सितम्बर SEP	I	938.2	25.1	23.1	29.0	22.2	31.5	20.4	33.3	24 1960	17.8	29 1950	85	26.8	5.1	2.9	260.9	11.6	530.9 1893	40.7 1966	167.4	28 1963	7.3
	II	935.1	26.0	23.5									81	27.2	5.6	2.9							
अक्तूबर OCT	I	943.6	23.9	20.4	28.5	18.9	31.3	14.3	34.0	04 1966	9.7	12 1972	73	21.4	2.4	1.2	80.6	4.1	378.6 1963	0.0	149.4	24 1963	5.2
	II	940.6	24.9	20.7									68	21.3	2.9	1.3							
नवम्बर NOV	I	947.0	20.2	15.5	25.8	13.3	28.3	9.0	31.7	01 1896	4.4	25 1879	60	14.3	1.2	0.4	5.5	0.4	160.0 1924	0.0	95.0	08 1924	4.8
	II	943.9	21.4	16.0									56	14.2	1.6	0.5							
दिसम्बर DEC	I	948.2	15.7	11.8	23.1	9.3	26.2	5.1	29.4	20 1950	0.5	24 1961	62	11.1	1.1	0.2	5.2	0.4	81.3 1885	0.0	39.4	13 1885	5.3
	II	945.1	18.7	13.1									52	11.1	1.2	0.2							
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	941.1	23.3	18.3	29.3	18.1	41.9	3.8	46.6		0.5		63	18.2	3.0	1.3	1277.9	67.2	2146.0	739.6	249.2		7.2
	II	938.0	25.9	19.1									55	17.7	3.3	1.5			1893	1966			
वर्षों की सं NUMBER OF YEARS	I	28	27	27	27	28	27	28	83		83		27	27	29	23	29	29	99	99	99		23
	II	28	28	28									28	27	30	22							

CLAUSE NO.	TECHNICAL REQUIREMENTS

ANNEXURE-B

CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures shall be designed for wind forces in accordance with IS: 875 (Part-3) and as specified in this document. See Annexure – B for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a)	Welded steel structures	1.0%
b)	Bolted steel structures	2.0%
c)	Reinforced concrete structures	1.6%
d)	Steel stacks	As per IS:6533 & CICIND Model Code whichever is more critical.

CLAUSE NO.	TECHNICAL REQUIREMENTS

ANNEXURE-B

SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a)	The basic wind speed "V_b" at ten metres above the mean ground level	47 metres/second
b)	The risk coefficient "K_1"	1.07
c)	Category of terrain	Category-2

TITLE	SPECIFICATION NO.
	PE-TS-411-156A-A001
4 X 270 MW BHADRADRI TPS	VOLUME: II B
TECHNICAL SPECIFICATION FOR	REV 00
PRE- TREATMENT PLANT (ANNEXURE-II)	SHEET 1 of 20

RAW WATER ANALYSIS

Sr.No	Parameters	Unit	Results
1.	Physical characteristics		
	Colour	Hazen	8.0
	pH at 25 °C	--	7.79
	Conductivity at 25 °C	µs/cms	400
	Dissolved solids	ppm	282
2.	Cations		
	Calcium Hardness	ppm as CaCO3	96
	Magnesium Hardness	ppm as CaCO3	52
	Sodium + Potassium	ppm as CaCO3	76.6
	Iron	ppm as CaCO3	**Traces**
	Total Cations	ppm as CaCO3	**224.6**
3.	Anions		
	M- Alkalinity	ppm as CaCO3	136.0
	Chlorides	ppm as CaCO3	72.0
	Sulphate	ppm as CaCO3	15.0
	Nitrates	ppm as CaCO3	**1.6**
	Total Anions	ppm as CaCO3	**224.6**
4.	Total Hardness	ppm as CaCO3	148
5.	P - Alkalinity	ppm as CaCO3	Nil
6.	Dissolved Silica	ppm as SiO2	1.1
7.	Colloidal Silica	ppm as SiO2	2.0
7.	Turbidity	NTU	250
8.	Total suspended solids	ppm	500

Note: Other parameters not indicated in Raw Water Analysis shall be considered as Nil

CLARIFIED WATER ANALYSIS

Sl.No.	Constituent	Units	Values
1.	Total Suspend Solids at outlet of clarifier.	ppm	10
2.	Turbidity	NTU	10

Note: The other parameters in Clarified water shall be remaining unchanged as present in Raw Water.

WIND & SEISMIC LOADS FOR BHADRADRI FGD

1. WIND LOAD

Wind loading will be in accordance with Indian Standard Code IS:875 (Part 3) for a basic wind speed of 44 m/sec. upto a height of 10 metres above mean ground level. Terrain Category-2 shall be considered for all structures. Risk coefficient (k1) shall be considered as 1.07 for all structures

2. SEISMIC LOADS

The lateral forces will be established in accordance with the recommendations of IS:1893-1984 of Indian Code of practice. The site falls in Zone- III as identified in the map in IS:1893-2002. Analysis and design of structures shall be carried out accordingly taking into consideration the factors related to soil characteristics and importance of the structure together with the basic seismic co-efficient as per provision of Indian code. Importance factor and response reduction factor shall be taken as per IS:1893(part I & IV).

Response spectrum method shall be used for seismic analysis as per IS : 1893.

TABLE-II

TREATED WATER/ FGD PROCESS WATER QUALITY

Sr. Number	Item	Unit	Value
1.	**TDS of permeate from Desalination RO System**	ppm	<500
2.	Total Suspended solids	ppm	Nil
3.	Iron as Fe	ppm as Fe	<0.1
4.	Reactive Silica as SiO2	ppm as SiO2	<1.0
5.	Chloride as Cl	ppm as Cl	<200
6.	Sodium	ppm as Na	<150
7.	pH at 25 deg C	---	6.0-7.0

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 ASH DISPOSAL AREA

Fly ash is taken by consumer for further utilization. Balance ash is disposed off by HCSD method to the ash dumping area.

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 ºC maximum 20.8 ºC minimum
b)	Extreme Ambient temperature	:	36.4 ºC maximum (Annual) 24.1 ºC 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

TITLE:	SPEC. NO.: **PE-TS-440/441/483-165-N001**
TECHNICAL SPECIFICATION **FRP COOLING TOWER**	SECTION: **I**
	SUB-SECTION: IB
	REV. NO. **0** DATE 27.07.2021
SPECIFIC TECHNICAL REQUIREMENTS	SHEET 1 OF **1**

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

2x500 MW NLC Tamil Nadu Power Ltd.
Tuticorin, Tamil Nadu-FGD Package

3x660 MW NORTH KARANPURA FGD PROJECT

4x270 MW BHADRADRI FGD PROJECT

FRP COOLING TOWER
TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT,
NOIDA, U.P., INDIA

BHEL	TITLE: **ELECTRICAL EQUIPMENT SPECIFICATION FOR FRP COOLING TOWER** 3x660 MW NORTH KARANPURA FGD PROJECT 4x270 MW BHADRADRI FGD PROJECT **2X500 MW NTPL TUTICORIN FGD PROJECT**	SPECIFICATION NO. VOLUME NO. : **II-B** SECTION : **I** REV NO. : **00** DATE: 19/07/2021 SHEET: 1 OF 1

CONTENTS

The requirements mentioned in Section-I shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section-II.

	TECHNICAL SPECIFICATION FOR FRP COOLING TOWER 3x660 MW NORTH KARANPURA FGD PROJECT 4x270 MW BHADRADRI FGD PROJECT 2X500 MW NTPL TUTICORIN FGD PROJECT	SPECIFICATION NO. VOLUME NO. : **II-B** SECTION : **I** REV NO. : **00** DATE: 19/07/2021 SHEET : 1 OF 3

SPECIFIC TECHNICAL REQUIREMENTS

FOR LV MOTORS (ELECTRICAL)

SECTION-I

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".
b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
c) Supply of mandatory spares as specified in the specifications of mechanical equipment's.
d) Electrical load requirement for FRP COOLING TOWER.
e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc. shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
h) Motor shall meet minimum requirement of motor specification.
i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
j) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer "Electrical Scope between BHEL and Vendor" Annexure - I.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc., is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

	TECHNICAL SPECIFICATION FOR FRP COOLING TOWER 3x660 MW NORTH KARANPURA FGD PROJECT 4x270 MW BHADRADRI FGD PROJECT 2X500 MW NTPL TUTICORIN FGD PROJECT	SPECIFICATION NO. VOLUME NO. : **II-B** SECTION : **I** REV NO. : **00** DATE: 19/07/2021 SHEET : 3 OF 3

4.0 List of enclosures:

a) Electrical scope between BHEL & vendor (Annexure –I)
b) Customer specification for motors (3x660 MW NORTH KARANPURA FGD PROJECT, 4x270 MW BHADRADRI FGD PROJECT and 2X500 MW NTPL TUTICORIN FGD PROJECT).
c) Customer cabling spec (to be referred by vendor for their scope of work (as per Electrical scope between BHEL & vendor)). (2X500 MW NTPL TUTICORIN FGD PROJECT)
d) Quality plan for motors & Customer quality assurance plan format
e) Datasheet-A (3x660 MW NORTH KARANPURA FGD PROJECT, 4x270 MW BHADRADRI FGD PROJECT and 2X500 MW NTPL TUTICORIN FGD PROJECT)
f) Datasheet-C for LT motors.
g) Electrical Load data format (Annexure –II)
h) BHEL cable listing format (Annexure –III)
i) Typical details of cable trays and accessories

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR REV-0, DATE: 25.03.2015

PACKAGE : COOLING TOWER FRP
SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT
PROJECT :

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor. OR (DE to select the choice applicable for their project)) 415 V AC, 3 phase, 3 wire supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre Optic cables etc.	Vendor	Vendor	
6	Cabling material (Cable trays, accessories & cable tray supporting system)	Vendor	Vendor	1. Layout details between vendors supplied equipment & installation dwgs by vendor. 2. BHEL will provide cable trench/cable racks/cable padestals along with cabling material up to the terminal point approx. 10 m away from cooling tower. Further cabling (supply and E&C) shall be in vendor's scope.
7	Cable glands ,lugs, and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
[redacted]				

Shweta 25/03/15

Pravin Dube 25/3/15

PACKAGE : COOLING TOWER FRP
SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
				[redacted].
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
10	LV Motors with base plate and foundation hardware (in case applicable for NDCT)	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	
13	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
14	**Engineering activities** during detailed engineering stage, including those listed below: a. Electrical load data submission in PEM format b. Electrical equipment GA drawings and layout drawings c. Cable trench/ tray layout drawings d. Control & Instrumentation cable schedules showing routing details [including cables supplied by PEM for CT equipment]. e. Grounding and lightning protection system layouts f. Cable termination/ interconnection details (diagram)/ Cable block diagram	Vendor	--	1. Documentation shall be submitted as per project schedule for BHEL/ customer approval. 2. Vendor shall be responsible for necessary coordination with BHEL for required engineering interfacing during contract stage. 3. Any approval required from electrical inspection authority for electrical equipment shall be arranged by vendor.

Shweta 25/03/15

Pavan Dixit 25/3/2015

PACKAGE : COOLING TOWER FRP

SCOPE OF VENDOR: SUPPLY, CIVIL WORKS, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

Shweta
25/03/15

25/3/15

A.C. & D.C. MOTORS

1.00.00SCOPE

1.01.0 This specification covers the general requirements of the electric motors for Limestone based flue gas de-sulphurisation system.

1.02.00Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

1.04.00 Recommended spare parts for three (3) years operation in addition to mandatory spares

2.00.00CODES & STANDARDS

2.01.00All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and materials 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.

3.00.00SERVICE CONDITIONS

3.01.00The motors shall be installed in hot, humid and tropical atmosphere, highly polluted area.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00**A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) or closed air water

cooled (CACW) type. Temperature rise shall be limited to 70 deg C by resistance method for class F insulation.

4.01.03 All motors shall be rated for continuous duty (S1). They shall also be suitable for long period of inactivity.

4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 power factor respectively.

4.01.05 The motor name plate rating at 50^0C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.02.00 **AC motor for VFD application**

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS- 60034 part 17 & part 25 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self-ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage

boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies.

4.02.08 The motor shall be provided with insulated bearing on one side.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be co-ordinated with VSD requirement.

4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

4.03.00 **D.C. Motors (If applicable)**

4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.

4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. The mill motors shall be suitable for operating at 75% of rated voltage for one (1) minute

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 600% of full load current (subject to IS tolerance of 20%) for HT motors rated upto 1000kW. For HT motors above 1000kW upto 3000kW starting current shall not exceed 600% of full load current without any positive tolerance. For HT motors above 3000kW starting current shall not exceed 450% of full load current without any positive tolerance.

For LT motors the starting current shall be as per the limit mentioned in the relevant standard with IE-3 efficiency class. For D.C. Motors the starting current shall be limited to 2 times full load current.

5.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.03 All motors (except mill motors) shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals Mill motors shall start with rated load and accelerate to full speed with 85% of rated voltage.

5.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

Cold Motor Starting

Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(b) Hot Motor Starting

Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(c) Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

5.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

5.03.00 **Stress During Bus Transfer**

5.03.01 Motors subjected to bus transfer shall be suitable for sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 For motors with starting time up to 20 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5 secs.

For motors with starting time more than 20 secs. and upto 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5 secs.

For motors with starting time more than 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time.

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted

on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

5.05.00 Torque Requirements

5.05.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.05.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 **Enclosure**

6.01.01 All motor enclosures and terminal boxes shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

Motors, located inside a building and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.02 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

6.03.00 **Cooling**

6.03.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.03.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.

6.04.00 **Winding and Insulation**

6.04.01 All insulated winding shall be of copper.

6.04.02 HT and LT motors shall have Class F insulation with winding temperature limited to 120°C. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.05.00 **Tropical Protection**

6.05.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.05.02 All fittings and hardwares shall be corrosion resistant.

6.06.00 **Bearings**

6.06.01 Motor rated above 1000kW shall have insulated bearings to prevent flow of shaft currents.

6.06.02 Vertical shaft motors shall be provided with thrust and guide bearings.

6.07.00 **Noise & Vibration**

6.07.01 The noise level shall not exceed 85 db (A) at 1.0 meters from the motor.

6.07.02 Peak amplitude of vibration shall be limited within the values prescribed in IS: 12075 / IEC 60034-14.

6.08.00 **Motor Terminal Box**

6.08.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base-plate / foundation.

6.08.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90 Deg., unless otherwise approved.

6.08.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. Terminal box for all LT motors shall be diagonally split type.

6.08.04 The terminal box shall have sufficient space inside for termination / connection of XLPE (11000V/3300V) or XLPE (415V) insulated armoured aluminium cables. Where the specified main cable size demands, adopter / extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.

6.08.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.08.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.08.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.08.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.08.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.08.10 The gland plate for single core cable shall be non-magnetic type.

6.08.11 Motors rated 1000kW and above shall be provided with neutral current transformers of PS class on each phase in a separate neutral terminal box for differential protection.

6.09.00 **Grounding**

6.09.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.09.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90KW	:	50 x 6 mm GS Flat
Motor above 30KW up to 90KW	:	25 x 6 mm GS Flat
Motor above 5KW up to 30KW	:	25 x 3 mm GS Flat
Motor up to 5KW	:	8 SWG GI Wire

6.09.03 The cable terminal box shall have a separate grounding pad.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection (IP No.).

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240V, 1 phase 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0 deg.C.

Leads of all duplex or simplex type motor winding RTDs and motor bearing RTDs shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDs shall be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor above and including 1000KW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Loose three (3) numbers matching PS class CT shall be supplied for mounting on switchgear.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match with the requirements of differential protection relay.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit required cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00**Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints.

8.00.00 TESTS

8.01.00 Upon completion, each motor shall be subject to standard routine tests as per IS. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Unless and otherwise stated, Six (6) copies of routine test certificates shall be submitted for approval prior to the dispatch of the motors from works.

8.03.00 The following type test reports shall be submitted for each type and rating of 11 kV & 3.3 kV motor:

a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

b) Fault level withstand test for each type of terminal box.

c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.

d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

SPARES

Recommended spares for three (3) years operation shall be quoted along with the bid clearly identifying the part numbers with recommended quantities.

09.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

09.01.00 **Along with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write up on forced lubrication system, if any

d) Type test report

09.02.00 **After Award of the Contract**

a) Dimensional General Arrangement drawing

b) Foundation Plan & Loading

c) Cable end box details

d) Space requirement for rotor removal

e) Thermal withstand curves hot & cold

f) Starting and speed torque characteristics at 80% & 100% voltage

g) Complete motor data

h) Erection & Maintenance Manual

i) Efficiency curves.

j) List of motors.

k) Test reports

DESIGN DATA

1.0 SERVICE CONDITIONS

Refer Vol-IIA of Specification for FGD package.

2.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000V, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm. for 3sec	Motors above 750kW
	3.3kV, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm for 3sec	Motors above 160kW up to & including 750kW
L.T. Supply	415V, 3Ø, 3W, 50 Hz, effectively earthed. Fault level 50kA symm for 1sec	Motors above 200W upto 160 kW
	240V, 1Ø, 2W, 50 Hz, effectively earthed.	Motors less than 200W, Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed. Fault level 25*kA for 1sec	D.C. alarm, control & protective devices

* Indicative only; actual value shall be decided by the Bidder, after substantiating the same by calculation.

3.0 RANGE OF VARIATION

A.C. Supply

Voltage: ± 10% Frequency: ± 5%

Combined Volt & frequency: 10%(absolute sum)

D.C. Supply

Voltage: (+10% to -15%)

SCHEDULE OF PRE-COMMISSIONING TESTS OF ~~TRANSFORMER &~~ ELECTRICAL EQUIPMENT

1.	**Power Transformer**	
	Pre-commissioning Tests	
a.	The following test shall be carried out a site as minimum requirements before energizing of a transformer. All tests which may not have been specifically mentioned here but necessary for commissioning and any tests, which have been specifically asked for by the purchaser shall be done by Bidder at no extra cost:	
b.	IR test on each winding to ground and between windings	
c.	Turns ratio test on each tap	
d.	Polarity and vector group test	
e.	Measurement of winding resistance of HV & LV windings for all taps by Kelvin bridge	
f.	IR, wiring and operational tests on all control devices in control cabinet, oil level indicator, winding and oil temp. indicators, cooling fan etc.	
g.	Checking of earthing with respect to transformer tank (flexible from top cover to tank) other parts, neutral and tank to electrodes of Las (for Las located near to transformer)	
h.	Testing of buchholz relay for alarm and trip conditions	
i.	For bushing CTs, tests applicable shall be as for current transformers.	
j.	Setting of oil/winding temperature indicators, level gauge and checking of alarm/trip circuits.	

9.	**AC Motors (including slip rings motor)**	
a	IR test of stator and rotor windings.	
b	Heating of both windings upto the permissible temp. limit from heating curve (only for HT motors).	
c	Ensure that checking / testing of associated switchboard, cables, relays / meter interlockings as mentioned in relevant chapters are completed.	
d	Check tightness of cable connection.	
e	Winding resistance measurement of stator and rotor.	
f	Checking continuity of winding.	
g	Check tightness of earth connections.	
h	Check space heaters and carryout heating of winding (if required).	
i.	Check direction of rotation in decoupled condition during kick start.	
j	Measure no load current for all phases.	
k	Measurement of temperature of body during No-load and load conditions.	
l	Check for tripping of motor from local / remote switches and from electrical / technological protection including differential protection.	
m	Checking of vibration (if required)	
n	Checking of noise level (if required).	
o	During load running, measurement of stator and bearing temperatures (if applicable) for every half an hour interval till saturation comes.	
p	Checking tightness of foundation bolts.	

q	Check operation of speed switch (if there).	
r	Check continuity of temp. detectors.	
s	Check alignment, paralleling of shafts, level of lubricating oil etc. as per manufacturer's manual.	
t	Check contact of slip ring brush and measure brush pressure (150-200 gm/sq.cm).	
u	For CACW drive check cooling water and system / piping, availability of pressure cleaning and pressure testing of pipelines etc.	
v	Check for polarisation index of stator windings R10 / R1 by motorised megger. (The value should not be less than 2.0). R60/R10 absorption co-efficient shall not be less than 1.5	
w	Dielectric test (only for HT motors).	
X	Measurement of open circuit rotor winding voltage for slip ring motor.	
10	**Motors (DC) If required**	
a	IR measurement and heating the winding as per heating curve.	
b	Check for earth connection.	
c	Winding resistance for field and armature.	
d.	Check running of drive at minimum and maximum specified voltage.	
e	Check auto start of drive on failure of AC supply (if applicable).	
f	Check operation of overload relay.	

g	Measure vibration.	
h	Check temperature rise on body of drive after required period of continuous running.	
i	Measure load currents and no load currents (if possible).	
j.	Check direction of rotation.	
k.	Check continuity of winding.	
l	Measurement of RPM.	
11	**For actuator drives following shall be checked / tested.**	
a	Visual and dimensional	
b	Hydraulic pressure for valves	
c	IR and operation of limit switches	
d	Winding resistance	
12	**CRANE/HOIST**	
a	Check IR of all drives, panels and other equipment	
b	Check & clean surface of shop leads(if there)	
C	Check earthing system and earthing of all metallic part	
d	Measurement of no load and load currents for all drives	
e	Observations on speed of hoisting/lowering for main and aux.hoists & brake.	
f	Measurement of deflection at full load and as per mechanical requirement at overload for main hoist.	
g	Checking for operations of all limit switches	

CLAUSE NO.	TECHNICAL REQUIREMENTS

MOTORS

1.00.00 GENERAL REQUIREMENTS

1.01.00 For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% (at 40 deg C) shall be considered. The equipment shall operate in a highly polluted environment.

1.02.00 All equipment's shall be suitable for rated frequency of 50 Hz with a variation of +3% & -5%, and 10% combined variation of voltage and frequency unless specifically brought out in the specification.

1.03.00 Contactor shall provide fully compatible electrical system, equipment's, accessories and services.

1.04.00 All the equipment, material and systems shall, in general, conform to the latest edition of relevant National and international Codes & Standards, especially the Indian Statutory Regulations.

1.05.00 Paint shade shall be as per RAL 5012 (Blue) for indoor and outdoor equipment.

1.06.00 The responsibility of coordination with electrical agencies and obtaining all necessary clearances for Contactors equipment and systems shall be under the Contactor scope.

1.07.00 Degree of Protection

Degree of protection for various enclosures as per IEC60034-05 shall be as follows :-

i)	Indoor motors	-	IP 54
ii)	Outdoor motors	-	IP 55
iii)	Cable box-indoor area	-	IP 54
iv)	Cable box-Outdoor area	-	IP 55

2.00.00 CODES AND STANDARDS

1)	Three phase induction motors	:	IS/IEC:60034
2)	Single phase AC motors	:	IS/ IEC:60034
3)	Crane duty motors	:	IS:3177, IS/IEC:60034
4)	DC motors/generators	:	IS:4722, IS/IEC:60034
5)	Energy Efficient motors	:	IS 12615, IEC:60034-30

CLAUSE NO.	TECHNICAL REQUIREMENTS
3.00.00	**TYPE**
3.01.00	**AC Motors:**
	a) Squirrel cage induction motor suitable for direct-on-line starting.
	b) Continuous duty LT motors upto 200 KW Output rating (at 50 deg.C ambient temperature), shall be **Premium Efficiency class-IE3**, conforming to IS 12615, or IEC:60034-30.
	c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.
	d) Motor operating through variable frequency drives shall be suitable for inverter duty. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.
3.02.00	DC Motors Shunt wound.
4.00.00	**RATING**
	(a) Continuously rated (S1). However, crane motors shall be rated for S4 duty, 40% cyclic duration factor.
	(b) Whenever the basis for motor or driven equipment ratings are not specified in the corresponding mechanical specification sub-sections, maximum continuous motor ratings shall be at least 10% above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.
5.00.00	**TEMPERATURE RISE**
	Air cooled motors
	70 deg. C by resistance method for both thermal class 130(B) & 155(F) insulation.
	Water cooled
	80 deg. C over inlet cooling water temperature mentioned elsewhere, by resistance method for both thermal class 130(B) & 155(F) insulation.
6.00.00	**OPERATIONAL REQUIREMENTS**
6.01.00	**Starting Time**
6.01.01	For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.
6.01.02	For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

CLAUSE NO.	TECHNICAL REQUIREMENTS
6.01.03	For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
6.01.04	Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.
6.02.00	**Torque Requirements**
6.02.01	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
6.02.02	Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
6.03.00	**Starting voltage requirement** (a) Up to 85% of rated voltage for ratings below 110 KW (b) Up to 80% of rated voltage for ratings from 110 KW to 200 KW (c) Up to 85% of rated voltage for ratings from 201 KW to 1000 KW (d) Up to 80% of rated voltage for ratings from 1001 KW to 4000 KW (e) Up to 75 % of rated voltage for ratings above 4000KW
7.00.00	**DESIGN AND CONSTRUCTIONAL FEATURES**
7.01.00	Suitable single phase space heaters shall be provided on motors rated 30KW and above to maintain windings in dry condition when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided. However for flame proof motors, space heater terminals inside the main terminal box may be acceptable.
7.02.00	All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. However, motors rated 3000KW or above can be Closed air circuit water cooled (CACW). The method of movement of primary and secondary coolant shall be self-circulated by fan or pump directly mounted on the rotor of the main motor as per IEC 60034-6. However VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor. Motors and EPB located in hazardous areas shall have flame proof enclosures conforming to IS:2148 as detailed below (a) Fuel oil area : Group – IIB (b) Hydrogen generation : Group - IIC or (Group-I, Div-II as per plant area NEC) or (Class-1, Group-B, Div-II as per NEMA /IEC60034)

CLAUSE NO.	TECHNICAL REQUIREMENTS
7.03.00	Winding and Insulation (a) Type : Non-hygroscopic, oil resistant, flame resistant (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature. (c) 11kV & 3.3 kV AC motors : Thermal class 155 (F) insulation. The winding insulation process shall be total Vacuum Presure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15. (d) 240VAC, 415V AC & 220V DC motors : Thermal Class (B) or better
7.04.00	Motors rated above 1000KW shall have insulated bearings to prevent flow of shaft currents.
7.05.00	Motors with heat exchangers shall have dial type thermometer with adjustable alarm contacts to indicate inlet and outlet primary air temperature.
7.06.00	Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.
7.07.00	In HT motors, at least four numbers simplex / two numbers duplex platinum resistance type temperature detectors shall be provided in each phase stator winding. Each bearing of HT motor shall be provided with dial type thermometer with adjustable alarm contact and preferably 2 numbers duplex platinum resistance type temperature detectors.
7.08.00	Motor body shall have two earthing points on opposite sides.
7.09.00	11 KV motors shall be offered with Separable Insulated Connector (SIC) as per IEEE 386. The offered SIC terminations shall be provided with protective cover and trifurcating sleeves. SIC termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.
7.10.00	3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Employer shall provide termination kit for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

CLAUSE NO.	TECHNICAL REQUIREMENTS
7.11.00	The spacing between gland plate & centre of terminal stud shall be as per Table-I.
7.12.00	All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
7.13.00	The motors shall be suitable for bus transfer schemes provided on the 11kV, 3.3 kV /415V systems without any injurious effect on its life.
7.14.00	For motors rated 2000 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.
7.15.00	The size and number of cables (for HT motors) to be intimated to the successful Contactor during detailed engineering and the Contactor shall provide terminal box suitable for the same.
8.00.00	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance): (a) From 50KW & upto 110KW : 11.0 (b) From 110 KW & upto 200 KW : 9.0 (c) Above 200 KW & upto 1000KW : 10.0 (d) From 1001KW & upto 4000KW : 9.0 (e) Above 4000KW : 6 to 6.5
10.00.00	**TYPE TEST**
10.01.00	**HT MOTORS**
10.01.01	The Contactor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The Contactor shall indicate the charges for each of these type tests separately in the relevant schedule of Section - VII- (BPS) and the same shall be considered for the evaluation of the bids. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract and upon certification by the Employer's engineer.
10.01.02	The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the Contactor. The Contactor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set–up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
10.01.03	In case the Contactor has conducted such specified type test(s) within last ten years as on the date of bid opening, he may submit during detailed engineering

CLAUSE NO.	TECHNICAL REQUIREMENTS
	the type test reports to the Employer for waival of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the Contactor.
10.01.04	Further the Contactor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
10.01.05	**LIST OF TYPE TESTS TO BE CONDUCTED** **The following type tests shall be conducted on each type and rating of HT motor** (a) No load saturation and loss curves upto approximately 115% of rated voltage (b) Measurement of noise at no load. (c) Momentary excess torque test (subject to test bed constraint). (d) Full load test(subject to test bed constraint) (e) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp.,coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.
10.01.06	**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED** The following type test reports shall be submitted for each type and rating of HT motor (a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

CLAUSE NO.	TECHNICAL REQUIREMENTS
	(b) Terminal box-fault level withstand test for each type of terminal box of HT motors only. (c) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15 (d) Surge-withstand test on inter-turn insulation shall be as per clause no. 4.2 of IEC 60034, part-15
10.02.00	**LT Motors**
10.02.01	LT Motors supplied shall be of type tested design. During detailed engineering, the Contactor shall submit for Employer's approval the reports of all the type tests as listed in this specification and carried out within last *ten* years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
10.02.02	However if the Contactor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Contactor shall conduct all such tests under this contract at no additional cost to the Employer either at third party lab or in presence of client/Employers representative and submit the reports for approval.
10.02.03	**LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED** **The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only** 1. Measurement of resistance of windings of stator and wound rotor. 2. No load test at rated voltage to determine input current power and speed 3. Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors) 4. Full load test to determine efficiency power factor and slip 5. Temperature rise test 6. Momentary excess torque test. 7. High voltage test 8. Test for vibration severity of motor. 9. Test for noise levels of motor(Shall be limited as per clause no 7.06.00 of this section)

CLAUSE NO.	TECHNICAL REQUIREMENTS
	10. Test for degree of protection and 11. Overspeed test. 12. Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1
10.03.00	All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.
10.04.00	The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

Motor MCR in KW of	**Minimum distance between centre stud and gland plate in mm**
UP to 3 KW	**As per manufacturer's practice.**
Above 3 KW - upto 7 KW	85
Above 7 KW - upto 13 KW	115
Above 13 KW - upto 24 KW	167
Above 24 KW - upto 37 KW	196
Above 37 KW - upto 55 KW	249
Above 55 KW - upto 90 KW	277
Above 90 KW - upto 125 KW	331
Above 125 KW-upto 200 KW	203

For HT motors the distance between gland plate and the terminal studs shall not be less than 500 mm.

PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:

NOTE: Minimum inter-phase and phase-earth air clearances for LT motors with lugs installed shall be as follows:

Motor MCR in KW	**Clearance**
UP to 110 KW	10mm
Above 110 KW and upto 150 KW	12.5mm
Above 150 KW	19mm

	MANUFACTURER'S NAME & ADDRESS	QUALITY ASSURANCE PLAN				CUSTOMER	
ABB	ABB LTD. 32, INDUSTRIAL AREA N.I.T., FARIDABAD - 121001(HARYANA)	ITEM: LT Motors		QAP. NO : ABB-QAP- STD-01	Reviewed By VG/SSG	Reference Documents:	REVIEWED BY / APPROVED BY
		Frame 71-250	0.37kW-55kW	REV.: 11			
				PAGE 1 of 6	Approved By PEBP		
		SUB-SYSTEM		DATE : 26.5.12			
		INCOMING , INPROCESS & FINAL INSPECTION					

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		10		11
1)	**INCOMING INSPECTION**											
1.1	**COPPER WIRE** Enamelled – Part V	a) Resistance	Major	Electrical	As per norm	Temp. Index 155 (3GYN 962001) Temp. Index 200 (3GYN 962006)	Temp. Index 155 (3GYN 962001) Temp. Index 200 (3GYN 962006)	Suppl. Inspn. Report	P	-	-	
		b) Wire OD, Overall OD, Elongation, Spring Back, Jerk test, Peel test & Abrasion test	Critical	Mechanical	- do -	- do -	- do -	- do -	P	-	-	
		c) Heat shock & Cut-through tests	Critical	Thermal	- do -	- do -	- do -	- do -	P	-	-	
		d) Breakdown Voltage at room temperature	Critical	Electrical	- do -	- do -	- do -	- do -	P	-	-	
1.2	**STATOR FRAME**	a) Dimension	Major	Mechanical	B AQL-1.5%	Drawing	Drawing	Suppl. Inspn. Report	P	-	-	
		b) Visual check for defects	Major	Visual	100%	No casting defects	No casting defects	- do -	P	-	-	
		c) Mechanical properties	Major	Mechanical	Once in 3 months	For Grade 150-3GYN951001	For Grade 150-3GYN951001	Supplier TC	V	-	-	Tensile strength & Hardness once in Three months by supplier
		d) Chemical properties	Major	chemical	One per heat	For Grade 150-3GYN951001	For Grade 150-3GYN951001	- do -	V			

LEGEND :

** M: MANUFACTURER (ABB) C:CONTRACTOR (FLOWMORE) N: NOMINATED INSPECTION AGENCY" (BHEL/TPIA) P" PERFORM "V" VERIFICATION, W-WITNESS, R- REVIEW

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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		10		11
		e) Pressure Testing	Critical	Mechanical	100%	IS/IEC-60079-1	IS/IEC-60079-1	Record	P	-	-	Only for Flameproof motors
1.3	STATOR STACK	a) Dimensions (core length & ID)	Major	Mechanical	B AQL-1.5%	ABB Drawings	ABB Drawings	Suppl. Inspn. Report	P	-	-	
		b) Slot / Bore alignment	Major	Visual	-do-	No mismatch	No mismatch	- do -	P	-	-	
		c) Cleanliness	Major	Visual	-do-	No burr/foreign particles	- do -	- do -	P	-	-	
1.4	DIE CAST ROTOR	a) Dimensions (core length & ID)	Major	Mechanical	B AQL-1.5%	ABB Drawings	ABB Drawings	Suppl. Inspn. Report	P	-	-	.
		b) Casting defects	Major	Visual	-do-	No blow holes & crack etc.	Drawings	--do--	P	-	-	
		c) Aluminium Grade	Critical	Verify	Per Lot	3GT952001	3GT952001	--do--	V	-	-	
1.5	STAMPINGS	a) Dimension	Major	Mechanical	1 sample per coil	Drawings/ 3GT961001	Drawings/ 3GT961001	Suppl. Inspn. Report	V	-	-	
		b) Material	Major	Mechanical	-do-	As per IMO norm	As per IMO norm	--do--	V	-	-	
		c) Core loss	Critical	Electrical	-do-	--do--	--do--	--do--	V	-	-	
1.6	SHAFT MACHINED	a) Dimension	Major	Mechanical	B AQL-1.5%	Drawing	Drawing	Suppl. Inspn. Report	P	-	-	.
		b) Mechanical Properties	Critical	Mechanical	One per heat	C40: 3GT 951004 / EN 24: 3GT 951014	C40: 3GT 951004 / EN 24: 3GT 951014	- do -	V	-	-	

LEGEND :

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	Frame 71-250	0.37kW-55kW	REV.: 11			
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	SUB-SYSTEM		DATE : 26.5.12			
	INCOMING , INPROCESS & FINAL INSPECTION					

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		10		11
		c) Chemical composition	Major	Chemical	- do -	- do -	- do -	- do -	V	-	-	
		d) Flaws	Critical	Ultrasonic	-do-	ASTM-SA-388	ASTM-SA-388	TC	W/V	-	-	
2)	**INPROCESS INSPECTION**											
1.1	**WOUND STATOR**	a) Winding Resistance	Critical	Electrical	100%	Winding sheet	Winding sheet	Inspn.record	P	-	-	
		b) H.V. Test	Critical	Electrical	100%	IS325/ IS/IEC-60034-1	IS325/ IS/IEC-60034-1	- do -	P	-	-	
		c) Surge Test	Major	Electrical	100%			-do-	P	-	-	
1.2	**IMPREGNATION**	a) Viscosity	Major	Measure	Once daily	As Per temp vs viscosity chart	As Per temp vs viscosity chart	Inspn. record	P	-	-	
		b) Gel time	Major	Measure	- do -	WI/OP/07	WI/OP/07	- do -	P	-	-	
		c) Curing	Major	Thermal	-do-	- do -	- do -	graph	P	-	-	
		d) Vacuum pressure Impregnation	Major	-	Once daily	- do -	- do -	Register	P	-	-	VPI is done only on customer request as per purchase order
1.3	**ROTOR CORE ASSEMBLY**	a) Dynamic Balancing	Critical	Measure	100%	ISO1940 ,G2.5	ISO1940, G2.5	Recording on sample basis	P	-	-	

LEGEND :

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		Frame 71-250	0.37kW-55kW	REV.: 11			
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		SUB-SYSTEM		DATE : 26.5.12			
		INCOMING , INPROCESS & FINAL INSPECTION					

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	AGENCY** C	AGENCY** N	REMARKS
1	2	3	4	5	6	7	8	9		10		11
3)	**FINAL INSPECTION**											
3.1	**ASSEMBLED MOTOR**	a) Mounting dimensions (Shaft ,Centre height etc.)	Major	Mechanical	1 each type	Drawings	Drawings	Insp Report	P	-	R	
		b) Accessories fitment (Cable glands, no. of entries in terminal box, space heater assy, RTD/BTD, PTC –as reqd.) & completeness	Major	Visual/ Measure	100%	Drawings/ Approved data sheet	Drawings/ Approved data sheet	-	P	-	R	
		c) Terminal box location & phase identification inside terminal box	Major	Visual/	100%	Drawings/ Approved data sheet	Drawings/ Approved data sheet	--	P	-	R	
3.2	**ROUTINE TEST**	a) Name plate verification	Major	Visual	100%	Drawings/ Approved data sheet	Drawings/ Approved data sheet	-	P	-	W	In case of inspection by customer or nominated inspection agency, quantum of check will be one motor of each type
		b) Insulation resistance Before & after H.V. Test	Major	Electrical	100%	IS-325/ IS/IEC-60034-1	IS-325/ IS/IEC-60034-1	Test Record	P	-	W	
		c) H.V. test	Major	Electrical	100%	IS-325/ IS/IEC-60034-1	IS-325/ IS/IEC-60034-1	Test record	P	-	W	
		d) No load test at rated voltage	Major	Electrical	100%	IS-325/ IS/IEC-60034-1	IS-325/ IS/IEC-60034-1	Test record	P	-	W	rest record review by NTPC.

LEGEND :

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ABB LTD. 32, INDUSTRIAL AREA N.I.T., FARIDABAD - 121001(HARYANA)	ITEM: LT Motors		QAP. NO : ABB-QAP- STD-01	Reviewed By VG/SSG	Reference Documents:	REVIEWED BY / APPROVED BY
	Frame 71-250	0.37kW-55kW	REV.: 11			
	SUB-SYSTEM		PAGE 5 of 6	Approved By PEBP		
	INCOMING , INPROCESS & FINAL INSPECTION		DATE : 26.5.12			

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	AGENCY** C	AGENCY** N	REMARKS
1	2	3	4	5	6	7	8	9		10		11
	ROUTINE TEST (contd.)	e) Locked rotor test at reduced voltage	Major	Electrical	100%	IS-325/ IS/IEC-60034-1	IS-325/ IS/IEC-60034-1	Test Record	P	-	W	
		f) Space heater / RTD / BTD / Thermistor insulation resistance and H.V. test	Major	Electrical	100%	IS-325/ IS/IEC-60034-1	IS-325/ IS/IEC-60034-1	Test record	P	-	W	
		g) Reduced voltage running at no load	Major	Electrical	100%	IS-325/ IS/IEC-60034-1	IS-325/ IS/IEC-60034-1	Test record	P	-	W	
		h) Resistance of winding	Major	Electrical	100%	IS-325/ IS/IEC-60034-1	IS-325/ IS/IEC-60034-1	Test Record	P	-	W	
		i) Vibration	Major	Mechanical	100%	IS:12075/ IEC-60034-14	IS:12075/ IEC-60034-14	Test Record	P	-	W	
		g) Direction of rotation	Major	Visual	100%	Appd. Data Sheet	Appd. Data Sheet	--	P	-	W	
		k) Noise Level	Major	Mechanical	100%	IS:12065/ IEC-60034-9	IS:12065/ IEC-60034-9	Test Record	P	-	W	
3.3	TYPE TEST	a) Full load test	Major	Electrical	1each type	IS-325/ IS/IEC 60034-1	IS-325/ IS/IEC 60034-1	Test Certificate	P	-	R	Type test reports of similar type of motors will be offered for customer review
		b) Efficiency and PF at 100%, 75% and 50% load	Major	Electrical	1each type	IS/IEC-60034-1/ IS12615:2011	IS/IEC-60034-1/ IS 12615:2011	-do-	P	-	R	
		c) Temp rise test (full load method)	Major	Electrical	1each type	IS-325/ IS/IEC 60034-1	IS-325/ IS/IEC 60034-1	-do-	P	-	R	
		d) Momentary overload	Major	Electrical	1each type	IS-325/	IS-325/	-do-	P	-	R	

LEGEND :

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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY** M	C	N	REMARKS
1	2	3	4	5	6	7	8	9		10		11
		test				IS/IEC 60034-1	IS/IEC 60034-1					
	TYPE TEST (contd.)	e) Vibration	Major	Electrical	1each type	IS-325/ IS/IEC 60034-1	IS-325/ IS/IEC 60034-1	-do-	P	-	R	Type test will be done on one motor of each type on chargeable basis if mentioned in purchase order.
		f) Noise level	Major	Electrical	1each type	IS-325/ IS/IEC 60034-1	IS-325/ IS/IEC 60034-1	-do-	P	-	R	
		g) Over speed	Major	Electrical	1each type	IS-325/ IS/IEC 60034-1	IS-325/ IS/IEC 60034-1	-do-	P	-	R	
		h) Measurement of starting torque, starting current and full load torque	Major	Electrical	1each type	IS-325/ IS/IEC 60034-1	IS-325/ IS/IEC 60034-1	-do-	P	-	R	
3.4	**PAINTING**	a) Thickness	Minor	Measure	One per shift	60 -100 microns or as per appd. data sheet	60 -100 microns or as per appd. data sheet	Record	P	-	-	
		b) Shade	Minor	Visual	One per lot	Appd. Data sheet	IS-5/Shade Card	-	P	-	V	
4	**Statutory Approvals**	Submission of certificates a) CMRI/CCE/BIS Certificate (for indigenous Type N, Type Ex e and Ex d motors)	Major	Visual	100%	-	-	Certificate from statutory authorities	W/V	-	-	
		b) Degree of protection	Major	Visual	100%	IS 4691-1985	-	Certificate from statutory	W/V	-	R	

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SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY**			REMARKS
									M	C	N	
1	2	3	4	5	6	7	8	9		10		11
		of enclosure(IP55) of similar frame no				IS/IEC 60034-5		authorities				

LEGEND :

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VOLUME: V-A

SECTION-II

TECHNICAL SPECIFICATION FOR A.C. & D.C. MOTORS

CONTENT

VOLUME: V-A

SECTION-II

TECHNICAL SPECIFICATION FOR A.C. & D.C. MOTORS

1.00.00 **SCOPE**

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 **CODES & STANDARDS**

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:

i) IS-325

ii) IS-12615

iii) IEC-60034

3.00.00 **SERVICE CONDITIONS**

3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 **TYPE AND RATING**

4.01.00 **A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-

Motors up to 1500kW	-	600% subject to IS tolerance of plus 20%.
Motors above 1500kW	-	450% not subject to any positive tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.

5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.

b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.

6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.06.00 **Noise & Vibration**

6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.

6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.

6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.

6.07.00 **Motor Terminal Box**

6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation

6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.07.10 The gland plate for single core cable shall be non-magnetic type.

6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor		Minimum Ph-Ph & Ph-Earth clearance
0.415 kV	:	25 mm
3.3 kV	:	65 mm
11.0 kV	:	140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating			Conductor Size
Above	Up to		
-------	5.5 kW	:	8 SWG GI Wires.
5.5 kW	22 kW	:	25mm X 4mm GS Flat.
23 kW	55 kW	:	40mm X 6mm GS Flat.
56kW	174kW	:	50mm X 8mm GS Flat.
175kW	ABOVE	:	75mm X 10mm GS Flat.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Minimum Cable Size for LT & HT Motors shall as be as follows-**

a) For 415V, 3-Ph, LT Motors-

Rating			Cable Size
Above	Up to		
-------	5.5 kW	:	1R X 3C X 6 Sq.mm
5.5 kW	11 kW	:	1R X 3C X 10 Sq.mm
11 kW	22 kW	:	1R X 3C X 35 Sq.mm
22 kW	37.5 kW	:	1R X 3C X 70 Sq.mm.
37.5kW	55 kW	:	1R X 3C X 150 Sq.mm
55 kW	75 kW	:	1R X 3C X 300 Sq.mm
75 kW	110kW	:	2R X 3C X 150 Sq.mm
110 kW	175kW	:	2R X 3C X 300 Sq.mm

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating			Cable Size
Above	Up to		

175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

i) For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).

ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000 V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.

7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner’s cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

For paint shade finish, refer Section-X of Volume: II-A : Lead Specification.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition,any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

c. Polarization Index Test as per IS: 7816 as routine test

d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.

e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

f. Test for noise level as routine test.

g. Test for vibration as routine test.

h. Tan delta measurement on coils.

i. Surge withstand test for inter turn insulation.

j. Test to diagnose rotor bar failure during manufacture.

k. Over speed test as routine test.

l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 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'.

9.02.00 **To be Submitted with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write-up on forced lubrication system, if any

d) Type test report

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply		Description	Consumer
H.V. Supply		11000 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 44 kA symm. for 1 sec.	Motors 1500 kW & above
M.V. Supply		3300 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 40 kA symm. for 1 sec.	Motors 175 kW and Up to less than 1500 kW.
L.V. Supply	(i)	415V, 3Ø, 3W, 50 Hz effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW and below 175kW.
	(ii)	240V AC/415V AC	Motors upto 0.2kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, Space heating , A.C supply for Control & protective devices.
D.C. Supply		220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

Note-

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	± 10%
Frequency	:	+3% to -5%
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242 Volt

BHEL	ELECTRICAL EQUIPMENT SPECIFICATION FOR WASTE WATER TREATMENT PLANT 2x500 MW NLC Tamil Nadu Power Ltd.	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 12.07.2021
		SHEET : 1 OF 1

DATASHEET-A

ANNEXURE-I

1.0	Design ambient temperature		:	50 °C
2.0	Maximum acceptable kW rating of LV motor		:	160 KW *
3.0	Installation (Indoors/ Outdoors)		:	As required
4.0	Details of supply system			
	a)	Rated voltage (with variation)	:	415V ± 10%
	b)	Rated frequency (with variation)	:	50 Hz + 5 % to - 5%
	c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
	d)	System fault level at rated voltage	:	50 kA for 1 sec
	e)	Short time rating for terminal boxes		
		○ Above 90 kW (Breaker Controlled)	:	50 KA for 0.25 sec.
		○ 90 kW and below (Contactor Controlled)	:	50 KA protected by HRC fuse
	f)	LV System grounding	:	Solidly
5.0	Winding & Insulation		:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting (As percentage of rated voltage)		:	80%
7.0	Power cables data		:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material		:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)		:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor		:	Acceptable below 0.2 kW
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	As per IS 12615
12.0	Makes		: BHEL/ Customer approval (Package owner to take care)	
13.0	Paint shade		:	Blue (RAL 5015) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box		:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 23
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 23
iv) Cable Box-Outdoor area - IP 55

*** LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

TITLE	SPECIFICATION NO.
LV MOTORS	VOLUME II B
	SECTION I
DATA SHEET-A	REV NO. 00 DATE 25/06/2021
	SHEET 17 OF 42

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	≤200KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	As per NTPC motor spec. (enclosed)
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V ± 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	45 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 110kW & Above (Breaker controlled)	:	45 kA for 0.25 sec
	o Below 110kW (SFU+ Contactor controlled)	:	45 KA for 0.25 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 200kW
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per NTPC motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	class-IE3, conforming to IS 12615, or IEC:60034-30.

- **Also detailed NTPC spec. for Motors to be referred as enclosed with spec.**

TITLE	SPECIFICATION NO.
LV MOTORS	VOLUME II B
	SECTION I
DATA SHEET-A	REV NO. 00 DATE 25/06/2021
	SHEET 20 OF 34

1.0	Design ambient temperature	:	50 ^{o}C
2.0	Maximum acceptable kW rating of LV motor	:	Below 160KW
3.0	Installation (Indoors/ Outdoors)	:	As required
4.0	Degree Of Protection (Indoor/Outdoor)	:	As per Customer motor spec. (enclosed)
5.0	Type of Cooling	:	TEFC/CACA/TETV
6.0	Details of supply system		
	a) Rated voltage (with variation)	:	415V $\pm$ 10%
	b) Rated frequency (with variation)	:	50 Hz (Variation: +3% TO –5%)
	c) Combined voltage & freq. variation	:	10% (sum of absolute values)
	d) System fault level at rated voltage	:	50 kA for 1 sec
	e) Short time rating for terminal boxes		
	o 110kW & Above (Breaker controlled)	:	50 kA for 1 sec
	o Below 110kW (SFU+ Contactor controlled)	:	50 KA for 0.25 sec.
	f) LV System grounding	:	Solidly
7.0	Class of insulation	:	Class ‘F’, with temp rise limited to class B.
8.0	Minimum voltage for starting (As percentage of rated voltage)	:	85% for motor ratings below 110kW 80% for motor ratings from 110kW to 160kW
9.0	Power cables data	:	Shall be given during Detailed engg.
10.0	Earth Conductor Size & Material	:	Shall be given during Detailed engg.
11.0	Space heater supply	:	240 V, 1Φ , 50 Hz
12.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
13.0	Tests	:	As per customer motor spec. (enclosed)
14.0	Energy efficient/ Flame proof motor	:	IE3

- **Also detailed Customer spec. for Motors to be referred as enclosed with spec.**

CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The Scope of Work covers complete and efficient design, engineering, testing at manufacturers works, supply, transportation erection, testing and commissioning of lightning protection system, all cabling and electrical grounding works. The scope shall broadly cover, but not be limited to:

1. Limestone Handling Area

2. Gypsum Handling Area

3. Absorber Area

3. All auxiliary buildings (including electrical rooms of respective buildings) and structures within the FGD package like Limestone preparation building, Absorber pump house, Gypsum De-watering building, FGD Control building, etc. as detailed in the Lead Specification & Plot Plan.

4. Overhead cable trestle and pipe cum cable trestle, if any.

5. All electrical equipment as described in Volumes II-F.

The scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

2.01.00 The scope of supply shall include but not be limited to the followings:

2.01.01 Timely procurement and transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

These materials and miscellaneous items shall include but not be limited to the following:

a) Galvanized steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, etc.

b) Galvanised steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanised sheet steel junction boxes, cable fixing clamps, nuts & bolts etc. as required.

c) Cable termination and jointing kits as necessary.

d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.

e) Mild steel rods for grounding conductor, grounding electrode, column & structure grounding, risers etc.,

Mild steel rod for vertical air terminals,

Materials for electronic grounding,

Galvanized steel flats for horizontal air terminals, for down conductors and for large equipment grounding

Galvanized wire (8SWG) for small equipment grounding.

f) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the Bidder without any extra charge to the Purchaser.

Scope of Services

2.02.00 The scope of Cabling, Grounding and Lightning Protection Systems includes but is not limited to the following:

2.02.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work. Hydraulic jacks or motorized jacks necessary for lifting of heavy equipment shall be provided by the contractor.

2.02.02 Transport vehicles necessary for efficient transportation of equipment from stores to site of erection and excess materials back to stores.

2.02.03 A general list of the outdoor and indoor Electrical Equipment with accessories for complete assembly, erection and connection, testing and commissioning, putting into successful and satisfactory commercial operations by the contractor and as applicable in a FGD plant is given below. Since plant configuration varies from project to project, actual equipment and accessories shall also be guided by other specification documents.

a) 220/11.5/11.5kV Station Transformer

b) HT Aux. Transformers for FGD system

c) L.T. Transformers (dry)

d) Lighting Transformers

e) Neutral Grounding Resistor Cubicles

f) 3.3Kv & 11kV Busducts

g) 415 V Busduct

h) 11kV & 3.3kV Switchgears

i) 415 V Switchgears, Switchgear cum MCCs.

j) Motor Control Centres, A.C./D.C. Distribution boards, Main lighting distribution boards and miscellaneous items.

k) Battery and Battery Chargers, Uninterrupted Power Supply Panels

l) Electrical Control Desks/Panels, Relay Panels, Data logger Panels etc.

m) Miscellaneous Local Panels.

n) All electrical equipment and systems integral with mechanical equipment, systems and subsystems.

o) Any other equipment, not mentioned herein but required for the completing the Plant shall be deemed included in the scope.

2.02.06 Erection work of equipment shall be carried out in a neat and efficient way so as not to impair their normal functioning in any way.

2.02.07 Pre-commissioning checks as well as commissioning of different equipment shall be carried out as per guidance of actual manufacturer's supervisor and or as per written instructions in Erection Manuals. In case of any site related problem in commissioning activities, contractor shall seek advice of the OE.

2.02.08 All erection work under this specification shall be carried out strictly in accordance with the approved drawings.

2.02.09 Erection work shall also be performed with respect to the following items:

a) Cable trays and accessories

a) Power cables

b) Cables laid directly buried in ground

c) Control, instrument and special cables

2.03.00 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

2.04.00 Necessary drawings, data sheets and Technical leaflets on each piece of material.

3.00.00 GENERAL REQUIREMENTS