

NTPC-DARLIPALLI STPP (2x800 MW)
AUXILIARY BOILER
TECHNICAL SPECIFICATION FOR BOILER FEED WATER PUMP

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1.0 SCOPE OF SUPPLY

- 1.1 2 Nos. of Boiler feed water pump set with drive motor and associated accessories.
- 1.2 The detailed scope of supply of the pump
- 1.2.1 2 Nos. of Boiler feed pumps. It shall be driven by electric motor.
- 1.2.2 2 Nos. of common base frame for pump & drive motor.
- 1.2.3 2 sets of foundation bolts and accessories.
- 1.2.4 2 sets of counter flanges of weld neck type matching with suction, discharge side of the pump, suction strainer and all other flanged terminal connections of the pumps complete with nuts, bolts and gaskets as required.
- 1.2.5 2 sets of complete instrumentation necessary (along with instrument tubing, fittings, isolation and drain valves) for the safe and reliable operation of the pump to be mounted on a local gauge rack fixed to the pump base of the unit (Refer clause 4.17 for the minimum instrumentation required to be supplied per pump). All the instruments contacts shall be terminated in a junction box.
- 1.2.6 2 Nos. of coupling with spacer and non-sparking coupling guard etc., between pump and driver as specified in clause 6.2 of this specification are to be supplied.
- 1.2.7 1 set of erection & commissioning spares as recommended by supplier (to be included in main offer).
- 1.2.8 1 set of 2 years normal operation spares as recommended by supplier (to be furnished separately).
- 1.2.9 The mandatory spares are to be supplied as recommended by purchaser.
- 1.3 The pump shall be supplied with suction strainer with SS-316 internals. The strainer should be of removable type with free flow area of 4 times the flow area of pipe. Strainer size & rating shall be same as BHEL suction pipe size as indicated in General Datasheet.
- 1.4 Cooling water if required will be provided. The terminal point of vendor shall include counter flanges on supply and return header pipes.
- 1.5 The warming up arrangement, if required, shall be provided by the bidder. The scope of supply shall include valves, orifices, piping etc.
- 1.6 Details of balance leak off line if required, shall be provided by bidder for connecting it to deaerator.
- 1.7 MANDATORY SPARES (Required per pump) – To be quoted separately
1. BFP Pump Bearings – 1 set
 2. BFP Motor Bearings – 1 set

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2.0 TECHNICAL REQUIREMENTS OF THE PUMP

2.1 SCOPE

This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the VENDOR /SUB-VENDOR works.

2.2 CODES AND STANDARDS

The design, material, construction, manufacture, inspection and performance testing of Horizontal centrifugal pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in these specifications shall be construed to relieve the VENDOR of his responsibility. The equipment supplied shall comply with the latest applicable Indian, American, British standards. Other National Standards are acceptable, if they are established to be equal or superior to the Indian, American, British standards. Pumps used for fire protection services shall conform to the requirements of fire protection manual of Tariff Advisory Committee.

- 2.3 No deviation or exception from this specification shall be permitted without written approval from BHEL. Intended deviations shall be listed by the bidders separately and sent along with the bids and supported by reasons for the same, to be considered by BHEL for acceptability. Also bidder shall confirm categorically that their bid completely complies with the specification except for the deviation as listed.

3.0 DESIGN REQUIREMENTS.

- 3.1 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be interchangeable.
- 3.2 Pump shall run smooth without undue noise vibration. Noise level produced individually or collectively (pump and motor) shall not exceed 85dB (A) measured at distance of 1.5 meters from outline of equipment source in any direction. The magnitude of peak to peak vibration shall be as per hydraulic institute standards.
- 3.3 Pump of selected category shall be suitable for pumping hot water up to 120 Deg C.
- 3.4 Cooling water if required will be provided for cooling pump parts. Vendor shall specify cooling water requirement based on the conditions specified.
- 3.5 The pump must be made suitable for outdoor installation without a roof.
- 3.6 The pump shall be designed to have constant minimum re-circulation flow. This minimum flow requirement to avoid rapid temperature rise and re-circulation quantity shall be indicated.
- 3.7 Tolerance on performance values shall be as per HIS standard.
- 3.8 Both the feed water pumps shall be capable of running in parallel.

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- 3.9 The temperature of the working fluid will vary from 105 deg C to ambient temperature without thermal stresses causing warping, buckling, misalignment, rubbing or other damaging effects. Pumps shall be capable of handling cold water.
- 3.10 Pump sets shall be capable of continuously delivering the rated output for the voltage variation of +/- 10% and frequency variation of +/- 5% occurring separately or combined voltage and frequency variation of +/- 10%.
- 3.11 Internal design clearances shall be adequate to account for pump shaft deflection.
- 3.12 The pumps shall be designed for intermittent duty and shall be designed to accommodate the quantity of starts & stops as recommended by the ANSI/NEMA MG-1.
- 3.13 The pumps shall be designed to operate satisfactorily up to and including 110% of design speed.
- 3.14 The pump shall be designed with a head capacity characteristic which rises steadily pump maximum (run out) capacity to minimum flow. The pump head at shutoff shall be a minimum of 110% of the design head capacity.
- 3.15 Motors shall be rated for 415V (10%), 3 phase, 50 Hz, AC supply and shall generally comply with the enclosed motor specification.
- 3.16 Characteristics curves:
- 3.16.1 The seller shall submit pump characteristic curves. Preliminary pump characteristic curves shall be submitted with seller's proposal. Curves shall indicate total head, efficiency, brake horsepower, and required net positive suction head, (basis 3% reduction in pump head) as ordinates, with capacity in cubic meters per hour as the abscissa. Final pump characteristic curves are required after award.
- 3.16.2 These curves shall be submitted for maximum and minimum impeller designs, which may be fitted to the pump casing and for the actual impeller design being provided.
- 3.16.3 Speed torque and motor performance curves shall also be submitted.

4.0 FEATURES OF CONSTRUCTION

Pumps shall be of horizontal, centrifugal, ring section type with required number of stages suitable for the service conditions.

- 4.1 Impellers shall be made in one piece and securely keyed to the shaft. Means shall be provided to prevent loosening during operation including rotation in reverse direction. Impeller fastening nuts (if provided) shall be of cap type and shall be tightened in the direction of normal rotation.
- 4.2 Fabricated impellers are not acceptable. Impellers for multistage pumps shall be individually secured against axial movement in either direction along shaft.
- 4.3 Wearing rings shall be of renewable type. Opposed wear surfaces of hardened material shall have a hardness difference of at least 50 BHN. The rotary components shall have higher Brinell hardness.

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- 4.4 The design of the shaft shall also take into consideration the critical speed of the shaft, which shall be at least 20 percent above the operating speed.
- 4.5 Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing boxes.
- 4.6 Stuffing boxes shall be of such design that they can be housed without removing any part other than the gland and lantern ring. Packing shall be of mechanical seal.
- 4.7 Pump bearing shall be antifriction bearing.
- 4.8 The axial thrust of the pump shall be balanced by the balancing disc/drum. Balancing device consists of balancing disc / drum which is keyed to the shaft and bearing disc fitted to high pressure cover by means of tightening flange, studs nuts and washer. The axial sealing gap i.e., gap between bearing disc and balancing disc shall be approximately 0.1 mm. Balance leak off line shall be connected back to makeup water tank.
- 4.9 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing. Heavy-duty bearings shall be provided to take care of radial loads.
- 4.10 Pumps shall be furnished complete with an approved type of metallic flexible coupling. Couplings shall permit dis-assembling the pump without removing the pipe connections.
- 4.11 Suction and discharge connections shall be flanged as specified in section 1.2.4. If companion flanges are included in the scope of supply of the VENDOR, the suction and discharge connections shall be flanged and drilled as per MANUFACTURER's standard practice.
- 4.12 All accessories as called for in section-6 and any other accessory required for proper and safe operation shall be furnished with the pumps.
- 4.13 All incidentals piping (including valves) required for pump shall be furnished by the supplier.
- 4.14 Casing shall be provided with drain connection with nipple, threaded and seal welded and provided with a blind flange terminated at edge of base plate. For multi stage pumps with more than one drain point, block valves at each drain point shall be provided. The piping shall then be blind flange terminated at the edge of the base plate. Unless made self venting design, vent connections shall also be provided with a nipple threaded and seal welded and terminated with a blind flange.
- 4.15 The common base plate for pump and motor shall be in one piece and it shall be made of the material specified in the data sheet A. Suitable holes shall be provided for grouting and they shall be located so that the base can be grouted in place without disturbing the pump and motor. All pumps and motors shall be properly aligned, bolted and dowelled to the base plates by VENDOR. Adequate space shall be provided between pump drain connections and base plate for installation of minimum 15 mm drain piping.
- 4.16 Prime mover if electric driven shall conform to the enclosed specification for induction motor. Motor KW selection shall be at least 15% more than the required one at the design point.

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4.17 Instrumentation:

4.17.1 Instrument rack with all indicating instruments mounted on it to be located on the base of the unit.

- i) Pressure gauges: - Balance leak off pressure of BFP (if applicable)
- ii) Temp. gauge - Suction temp. of BFP
- Discharge temp. of BFP

4.17.2 The following shall be wired up to junction box (JB) in instrument rack

- i) RTD (Duplex) - For anyone of the following bearings
 - (a) DE Bearing of Pump
 - (b) NDE Bearing of Pump
 - (c) DE Bearing of Motor
 - (d) NDE Bearing of Motor

4.17.3 All instruments shall be completed with root valves, impulse lines & required mounting accessories etc.

5.0 DYNAMICS

5.1 Complete rotor assembly shall be dynamically balanced.

6.0 PUMP ACCESSORIES

All accessories shall be sourced from approved vendor list.

6.1 Driver

6.1.1 Motor shall be strictly in accordance with electric motor specification enclosed herewith. In motor nameplate, rating percentage of brake horsepower to be mentioned.

6.2 Coupling & guards

6.2.1 Coupling shall be forged steel and of non-lubricated, laminated disc type, with stainless steel / monel laminations. The selected coupling shall have a service factor not less than 1.5 over motor name plate rating. A spacer coupling (127 mm) minimum normal length, shall be used unless otherwise specified. The spacer length shall permit the removal of coupling, bearings, seal and/or rotor as applicable without disturbing the driver or the suction and discharge piping.

Pump vendor to obtain BHEL approval for the selected coupling, its make and rating.

6.2.2 Coupling shall be dynamically balanced.

6.3 Mounting plates

6.3.1 The length shall be at least equal to the overall length of the pump and motor assembly.

6.3.2 Unless otherwise specified, base plate for all sizes of pump shall be grouted.

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- 6.3.3 A heavy duty grouted base plate shall be provided.
- 6.3.4 Levelling screws shall be provided.
- 6.3.5 The supports for the pump and engine shall be welded to structural members and not to flat plates.

7.0 QUALITY ASSURANCE, TESTING AND INSPECTION

As per BHEL approved quality plan. Vendor to furnish QP of pump & motor.

8.0 DRAWINGS / DATA TO BE FURNISHED ALONG WITH OFFER

- 8.1 Design characteristic curves showing flow vs head, power, efficiency and NPSH(R).
- 8.2 Filled in data sheet (given at Annexure-B of this specification).
- 8.3 Cross sectional drawing of pump.
- 8.4 General arrangement drawing giving overall dimensions, foundation details, loading and details of suction/ discharge nozzles.
- 8.5 Allowable forces and moments on suction & discharge nozzles.
- 8.6 Part list and material of construction.
- 8.7 Cooling water requirements with quantity and pressure if required.
- 8.8 Minimum re-circulation flow for the safe operation of Boiler Feed Pumps.
- 8.9 Speed Vs torque curve (Superimposed curves)
- 8.10 GD sq. value (moment of inertia)
- 8.11 Quality plan
- 8.12 List of special tools
- 8.13 Catalogues
- 8.14 Schematic diagram of the pump.
- 8.15 List of spare parts along with identification of the same on cross sectional drawing enclosed with offer.
- 8.16 List of instruments
- 8.17 Specific, point wise confirmation on all clauses of this specification. Deviations, if any, to be furnished
- 8.18 List of sub vendors of major items.

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- 8.19 Drawings/data to be furnished after the award of the contract:
- 8.20 All the drawings / data as called for during offer.
- 8.21 Schematic diagram for cooling water and seal water lines if applicable.
- 8.22 Sequential interlocking write-up of feed water Pump set including recommended list of protections, annunciations and trips.

9.0 FINAL DOCUMENTATION

<u>Sl No.</u>	<u>Item</u>	<u>No of copies</u>	
1.	Drawings	12	these documents shall be
2.	Reproducible		submitted one month
	O&M manuals	12	before schedule
3.	Data sheets	12	date of despatch
4.	Shop test certificates	12	of the BFPs
5.	Guarantee certificates	12	

10.0 PERFORMANCE GUARANTEE

- 10.1 Guarantee shall be for a minimum period of one year of operation after commissioning. Any defects/problems arising during this period due to defective design, material of manufacture shall be attended by the vendor without any cost implications.
- 10.2 Guarantee shall be given for
- a) Max capacity
 - b) Discharge pressure
 - c) Power consumption

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ANNEXURE-A
GENERAL DATA SHEET

1. Project : DARLIPALLI AUXILIARY BOILER
2. Customer : NTPC LTD.
3. No.of Pumps : 2 Nos. (1 working + 1 standby)
Each pump shall be of 100% capacity
4. Type : Single Suction, Multi stage, Horizontal, Centrifugal, motor driven, Ring section type
5. Location : Out door
6. Duty : Continuous, 100% duty
7. Fluid handled : Feed Water
8. a) Design flow capacity of one Pump : 70 T/Hr.
b) Normal flow capacity of one pump : 60 T/Hr.
b) Min. flow capacity of one pump : To be furnished by bidder
9. (i) Pressure values
a) Pump suction pressure : 0.9* Kg/cm² (g)
b) Pump discharge pressure : 35 Kg/cm² (g)
(ii) Connecting pipe sizes
a) Pipe size at pump suction : OD 168.3x7.11 mm
b) Pipe size at pump discharge : OD 88.9x5.49 mm
c) Flanged Eccentric reducer/expander at both suction and discharge sizes to match the pump terminals with the connecting pipe sizes as indicated above are in pump vendor scope.
d) Counter flanges along with fixing nut, bolt & Non-asbestos Gaskets as applicable are in pump vendor scope
10. Specific gravity of feed water : 0.95238
11. Temperature : 105° C
12. NPSH available : 7 M* of water column
- 13.0 Material of construction
- 13.1 Casing : ASTM A216WCB
- 13.2 Impeller : ASTM A743 CA6NM
- 13.3 Shaft : AISI 410
- 13.4 Wearing ring : ASTM A743 CA6NM

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- 13.5 Base plate : MS fabricated
- 14.0 Nozzle orientation : Top suction/top discharge

* Suction strainer drop is not considered while arriving at Feed Pump Suction pressure and NPSH available.

ANNEXURE - B
PUMP DATA SHEET (To be filled and submitted by bidder)

- 1.0 Model and type :
- 2.0 Quantity :
- 3.0 Capacity :
- 4.0 Total head :
- 5.0 Suction pressure :
- 6.0 Pump shut off head at cold :
Pump shut off head at hot :
- 7.0 NPSH (pump) required :
- 8.0 Fluid handled and :
Concentration :
- 9.0 Operating temperature :
- 10.0 Specific gravity of the fluid :
- 11.0 Nominal speed :
- 12.0 Nominal power :
- 13.0 Pump input power with :
Liquid at rated rpm :
- 14.0 Pump efficiency :
- 15.0 Motor rating :
- PUMP MINIMUM FLOW :
- 16.0 Pump construction
- a. Casing :
- b. No. of stages :
- c. Packing :

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- d. Type of coupling :
- e. Suction flange size and rating :
- f. Discharge flange size and rating :
- g. Flange standard :
- h. Cooling water requirement :
- i. Pump bearing type number :
- j. Impeller diameter :

17.0 Material of construction

- a. Casing :
- b. Impeller :
- c. Stuffing box cover :
- d. Shaft sleeve :
- e. Shaft :
- f. Wearing rings :
- g. Base plate :

18.0 Hydro test pressure of pump and testing standard :

19.0 Weight schedule

- a. Base pump :
- b. Motor :
- c. Base plate :
- d. Pump motor assembly mounted on base plate along with coupling, strainer etc. :

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20.0 Companion flange suction/discharge

- a. Size :
 - b. Type :
 - c. Rating :
 - d. Standard :
 - e. Flange material :
 - f. Bolt material :
 - g. Nut/gasket material :
- 21.0 Cooling water requirements :
- 22.0 Sealing data :
- 23.0 Coupling data :
- 24.0 Instrumentation data :
- 25.0 Strainer data :
- 26.0 Lube oil system data :
- 27.0 Warm up arrangement requirement :
- 28.0 Allowable forces and moments at pump nozzles :
- 29.0 Civil work data :

Note: Necessary drawings, catalogues, leaflets shall be submitted along with the filled up Annexure-B.



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Piping Centre Chennai-17

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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

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04					
03	11.08.15	Generally revised	B.Sumith	B.Sumith	R.Prabha
02	07.11.13	Generally revised	B.Sumith	B.Sumith	R.Prabha
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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

1.0 SCOPE

- 1.1 This standards specifies the requirement of HT & LT MOTORS for use in Utility/Captive Power Plants.
- 1.2 Wherever the specification requires information to be furnished by the tenderer / supplier, the same shall be furnished in the offer.

2.0 CODES & STANDARDS

- 2.1 Three phase induction motors : IS :325
- 2.2 Single phase AC motors : IS : 996
- 2.3 Crane duty motors : IS : 3177
- 2.4 DC motors/generators : IS : 4722
- 2.5 Energy Efficient Motors : IS : 12615, IEC:60034-30



Motors conforming to equivalent international standards shall also be considered, provided the same ensures equal or better features compared to the standards listed above.

3.0 TYPE

- AC Motors : Squirrel cage induction motor suitable for direct on line (DOL) starting. Continuous duty LT motors upto 160 kW output rating (at 50 deg.C ambient temperature) shall be energy efficient motors, High Efficiency (IE2) as per IEC: 60034-30
- DC Motors : Shunt wound



4.0 TEMPERATURE RISE

- 4.1 Air cooled motors : 70 Deg.C by resistance method, over an ambient of 50 Deg.C (unless specified otherwise in Project Synopsis) for both class B & F Insulation.



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- 4.2 Water cooled motors with maximum 38 Deg.C : 77 Deg.C by resistance method for both cooling water temperature of class B & F insulation.
- 5.0 **RATING**  : Continuously rated (S1) unless specified otherwise. Crane duty motors – S4, 40% Cyclic duration factor.
- 5.1 Margin : Maximum continuous rating (MCR) shall have atleast ten percent (10%) margin over maximum load demand including voltage and frequency variation. MCR shall correspond to the above Temperature rise, and supply variations given in Annexure – A
- 6.0 **SUPPLY CONDITIONS** : Details given in Annexure – A. Motors shall be capable of withstanding the thermal, mechanical and electrical stresses when starting at extreme supply voltage and frequency limits.
- 6.1 Supply change over conditions : Motor shall be designed to withstand the Voltage and torque stresses corresponding to 150% of the rated voltage, during change over of buses.
- 7.0 **TORQUE REQUIREMENTS** : Motors for reciprocating compressors shall be designed to withstand the pulsating torque of the driven equipments.
- 7.1 Accelerating torque at minimum permissible voltage : Ten (10) percent in excess of the driven equipment torque requirement at any speed.
- 7.2 Pull out torque at rated voltage : 205 percent of full load torque. For crane duty minimum 275 percent of full load torque.



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

8.0 NUMBER OF STARTS : Two starts in succession under the specified conditions of load, torque and inertia with motor initially at it's normal running temperature.

9.0 STARTING CURRENT
The ratio of locked rotor KVA at rated voltage to rated KW (MCR corresponding to the specified temperature rise) shall not exceed the following. No further tolerance to be considered.

Sl.No.	MCR	Starting KVA/Rated KW
(a)	Up to 110 KW	6.0
(b)	Above 110 KW	5.5

Starting current of DC motors shall be limited to 200% of the rated current with starting resistors.

10.0 LOCKED ROTOR WITHSTAND TIME / STARTING TIME

Starting time at minimum starting Voltage	Up to 20 seconds	More than 20 seconds but less than 45 seconds	More than 45 seconds
Locked rotor with stand time at highest permissible voltage	2.5 seconds more than the starting time	5 seconds more than the starting time	Ten (10) percent more than the starting time.

Note: Where above requirements are not met, speed switches shall be mounted on motor shaft, with prior consent of purchaser.

11 CONTROL

11.1 H T Motors : Any type of circuit breaker including vacuum.



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11.2 L T Motors : Up to 160 KW contactor controlled.
Greater than 160 KW circuit breaker controlled.

Enclosure TEFC Method of Cooling- ICO141	Enclosure CACA Method of Cooling- ICO151	Enclosure CACA Method of Cooling- ICO161	Enclosure CACW Method of Cooling-ICW 37A 81	Enclosure SPDP Method of Cooling-ICO1
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LT Motors	HT Motors	HT Motors	This option is acceptable for HT Motors rated above 3000 kw	This option is acceptable for circulating water and cooling tower motors located indoors
HT Motors				

- | | |
|------|-----------------------------------|
| TEFC | - Totally enclosed fan cooled |
| CACA | - Closed air circuit air cooled |
| CACW | - Closed air circuit water cooled |
| SPDP | - Screen protected drip proof |

- : IP 55 for Outdoors.
- : IP 54 for Indoors.
- : IP 23 for SPDP Motors.
- : Flame proof as per relevant IS & NEC for hazardous areas.

02

: Within limits specified in IS : 12705 / BS : 4999 rt –142. Motors shall be designed to withstand the Vibration produced by the driven equipment.

: Within limits specified in IS : 12065



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16 CONSTRUCTIONAL FEATURES

- 16.1 Component interchangeability : To be ensured for motors of identical rating & design
- 16.2 Drain holes : To be provided for totally enclosed motors.
- 16.3 Cooling Fans
(a) Type : Shaft driven
(b) Direction of rotation : Preferably in either direction. Particularly where identical motors are used for opposite direction of rotation.
- 16.4 Lifting Lug/eye bolts : To be provided.
- 16.5 Rotors : To be dynamically balanced. Combined critical speed with driven equipment shall be away from the running speed by at least 20%.
- 16.6 Brush : Electrographic or metal graphite type. Brushes should run for three months without the need for replacement.
- 16.7 Commutator : Industrial Type
- 16.8 Space heater : Rated for 240 V AC, to be provided for motors rated above 30 KW

17.0 WINDING AND INSULATION

- 17.1 (a) Insulation for LT & DC Motors : Class B or better 
- (b) Insulation for HT motors : Non hygroscopic, preferably epoxy impregnated type. Class – F.
- (c) Stress control & anti-corona protection : To be provided for HT Motors.
- (d) Slot packing for HT Motors : To be impregnated with a conducting material.
- (e) Over hang winding support : Properly braced and blocked.



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

- (f) Cage winding : Joints to be braced or welded.
Thermal capacity should take care of starting duty specified.

17.2 Winding Temperature detector for HT Motors

- (a) Type : Platinum resistance temperature detectors. resistance at Zero Degree C shall be 100 ohms. Simplex or duplex type.
- (b) Numbers : Six - Evenly distributed around the stator.
- (c) Insulation class of Temp : Same as stator winding insulation class. Detectors Protective covering to be provided on leads external to slot.

17.3 All HT motors : To be suitable for VFD operation.

18 BEARINGS

- 18.1 Type : Roller or other type to suit application. For vertical motors, thrust bearings may be kings bury tilting Pad type.
- 18.2 Lubrication : Self lubricated/Sump oil lubricated/forced oil lubricated.
- 18.3 Forced oil lubrication oil pumps : Two (2) numbers, each rated for 100% requirement. In case of failure of the forced lubricated system, ring oil system shall provide sufficient lubrication for coasting down of motor along with driven equipments.
- 18.4 Jacking oil pump : If provided , shall preferably meet jacking oil requirement of motor and driven equipment.
- 18.5 Bearing sump accessories : Drain plug, Filling hole and oil level indicator.



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

- 18.6 Lubricating oil temperature : 71 Degree C at bearing outlet.
- 18.7 Instrumentation (for HT motors) : Dial type thermometer with adjustable alarm
Contact & Resistance Temperature
Detectors. (RTD) for each bearing.
- RTD type : Duplex, Three wire. Hundred ohms at
zero deg.C.
- 18.8 Prevention of Shaft Current : For motors above 1000 KW
- (a) Bearing insulation : For pedestal mounted bearing, both
bearings to be insulated. Earth bonding link
at drive end bearing.
- (b) other measures : Water /oil pipe connections etc. to be
insulated as necessary.
: Insulation to be meggered at 500 volts.
- 19.0 HEAT EXCHANGERS** : To be provided with 15% excess tubes.
- 19.1 Air to air heat exchangers : For motors rated above 1000 KW, dial type
thermo meter with adjustable alarm
contacts shall be provided to measure
primary air inlet and outlet temperature.
- 19.2 Air to water heat exchanger : Cooler tubes of stainless steel 304 or
70/30 brass.
: Flow switch to be provided.
: Water leakage detector to be provided.
: Pipe flange connections, drain cock, air
release plug etc. shall be external to motor.
- 19.3 Hydraulic Pressure withstand : 1.5 times the maximum working pressure or
3.5 bar (g) whichever is higher.
- 20.0 TERMINAL BOX**
- 20.1 General : Separate terminal box for power and
instrumentation.



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- (a) Details of owner's Cables : Copper/Aluminium conductors. Exact details to be intimated to successful Bidder.
- (b) Glands : Single compression nicked chrome finish brass.
- (c) Lugs : Tinned copper lugs. For motors rated higher than 160 KW lugs shall conform to DIN 46329
- 20.2 For HT motors : Phase separated type, capable of being turned through 180 degree. OR provided with Elastimold-type termination kits.
- (a) Distance between gland Plate and terminal : Not less than 500 mm
- (b) Accessories if Elastimold : Complete accessories along with heat Offered shrinkable trifurcating sleeves for 3 core cable. Where two cables per phase is envisaged, six sets of apparatus bushing and elbow connectors are to be provided.
- : Metal enclosure with open bottom.
- 20.3 (A) For LT motors : Terminal box capable of being turned through 180 degree.

Distance between gland plate & Terminals : As follows

Motor MCR in KW	Cable Size	Minimum distance between center of stud and gland plate in MM
1	2	3
Up to 3 KW PVC insulated	3Cx2.5 Sq.mm (Cu)	As per manufacture's practice.



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Above 3 KW – up to 7 KW	3Cx6 Sq.mm (Al) PVC insulated	85	
Above 7 KW – up to 13 KW	3Cx16 Sq.mm (Al) PVC insulated	115	
Above 24 KW – up to 37 KW	3Cx70 Sq.mm (Al) PVC insulated	196	
Above 37 KW – up to 55 KW	3Cx120 Sq.mm (Al) PVC insulated	249	
Above 55 KW – up to 90 KW	3Cx150 Sq.mm (Al) XLPE insulated	277	
Above 90 KW – up to 110 KW	3Cx240 Sq.mm (Al) XLPE insulated	331	
Above 110 KW – up to 200 KW	3-1/2Cx300 Sq.mm (Al) XLPE insulated	203	
(B) For HT Motors : At the time of PO			

21.0

**NEUTRAL CURRENT
TRANSFORMERS (CTs)**



: Neutral CTs of PS class shall be provided on each phase, for motors rated 2000 kW and above. These shall be star connected.

21.1

Star formation

: In separate terminal box. Terminals to be brought out through bushings.

21.2

Location of CTs

: In above terminal box.

21.3

CT type

: Epoxy cast resin class PS. Parameters to be given to successful Bidder.

22.0

EARTHING TERMINALS

: Two numbers, on opposite side suitable for bolted connection.

23.0

RATING PLATE

: To be provided indicating KW rating at specified cooling medium with corresponding temperature rise.
: Bearing identification number.



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

: For ball/roller bearing, recommended lubricant.

24.0 PAINT & FINISH

: Minimum one coat of primer and two coats of finished enamel paint. Paint shade – 692 for indoors. 631 for outdoors.

* Details will be confirmed to successful bidder



25.0 FASTENERS

: Corrosion resistant material or cadmium plated.

: Current carrying fasteners shall be of stainless steel/high tensile brass/copper.

26.0 QUALITY ASSURANCE

26.1 All materials, components and equipments covered under this specification shall be procured, manufactured, erected, commissioned and tested as per a comprehensive quality assurance program to be approved by the owner. A complete quality plan shall be furnished for the motor rated above 50 KW. All welding and brazing operation shall be carried out as per approved welding and brazing procedure and by qualified welder/brazers.

26.2 The bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/ test and inspection procedure etc. for Owner's review/approval. In these approved quality plans, Owner shall identify customer hold points(CHP), which shall be carried out in the presence of the Owner's representative and beyond which work shall not proceed without the consent of Owner's representative in writing.

26.3 Owner reserves the right to witness any of the tests and verify the documents of the contractor and his sub contractor. No materials/equipments shall be dispatched from the manufacturer's works before the same is duly cleared for dispatch by the Owner.

26.4 All the sub vendors proposed by the Contractor for procurement of major bought out items including raw materials, semi- finished components shall be subject to Owner's approval.

26.5 The Contractor shall carry out an inspection and testing program during manufacture in his works, and that of his sub- contractor's to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials, parts and equipments. He shall carry out all tests/ inspection required to



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establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification , in addition to carry out tests as per the approved Quality plan.

26.6 Quality audit/ surveillance/ approval of the results of the test and inspection will not, however, exclude the right of the Owner to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities, and responsibilities of the contractor in ensuring complete conformance of the materials / equipments supplied to relevant specification, standard, data sheets, drawing etc.

26.7 Indicating tests/checks to be carried out for the motors rated above 50 KW during manufacturing are to be listed by manufacturer.

27.0 TESTS

- (a) All motors shall be subjected to routine tests. All LT motors shall be of type tested quality. For each type and rating of HT motor, type tests, shall be carried out.
- (b) The tests shall be carried out as per applicable standards including all special tests. The list of routine tests and type tests are given below:

27.1 Induction motors

27.2 Routine Test

For all the motors:

- (a) Visual check
 - (i) Marking on rating plates.
 - (ii) Appearance and painting
 - (iii) Location and details of terminal boxes and accessories
 - (iv) Check for phase sequence and terminal markings.
- (b) Dimensional check
- (c) Insulation resistance test for winding, space heater and RTD
- (d) Measurement of resistance of windings, space heater and RTD



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- (e) High voltage test on windings, space heater and RTD followed by insulation resistance test.
- (f) No load test.
- (g) Locked rotor test (For all the ratings of motors as per IS 4029)
- (h) Reduced voltage running test at no load.
- (i) Over speed test.
- (j) Vibration measurement at rated speed and rated voltage.
- (k) Degree of protection test for IP 54 & IP 55 enclosure (It shall not be possible to insert a feeler gauge of 0.1 mm thick in the enclosure or flange faces)

Additional routine tests for HT motors only

- (l) Shaft voltage measurement.
- (m) Tan delta tests on windings and also on individual phases. 
- (n) Polarization index measurement (The PI value with 2.5 KV shall be not less than 2.0)
- (o) Measurement of bearing temperature during steady state conditions.
- (p) Functional check on auxiliaries.

27.3

Type Tests

For all the motors.

- (a) All the tests as listed under routine tests.
- (b) Measurement of noise at no load.
- (c) Momentary overload test.
- (d) Full load test to determine efficiency, power factor and slip. 
- (e) Pull out torque measurement.



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- (f) Temperature rise test During test winding temperature, bearing temperature, core temperature, coolant flow and its temperature shall be recorded at various intervals In case the test is carried out at other than rated load specific approval for the test method and procedure shall be obtained. Wherever ETD's are provided the temperature shall be measured by ETD also.
- (g) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- (h) Fault level withstand test for terminal box. (For breaker controlled motors only).
- (i) Measurement of no load starting time & starting current.

Additional type tests for HT motors only.

- (j) No load saturation and loss curves (up to approximately 115% of rated voltage)
- (k) Surge withstand test for main insulation on a sample coil after placing it in stator
Core with at least five impulses on 1.2/50 micro sec. Wave at test voltages indicated in Annexure – A
- (l) Surge withstand test for inter turn insulation on each type of motor coil with at least five impulses of 0.3/3 micro sec. At test voltages indicated in Annexure–A This test shall be followed by one minute power frequency high voltage test on turn to turn insulation after cutting the coil and bringing out turns suitably. The test voltage shall be mutually agreed upon.
- (m) Determination of magnetic center (for pedestal mounted bearing motors only.)

27.4

When tests to determine the break away starting current of cage induction motors are taken at reduced voltage, due allowance shall be made for the effect of saturation and the estimated value of break away starting current at rated voltage shall be given on all test certificates.



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- 27.5 DC motors shall be subjected to all routine and type tests as per IS :4722. In addition following tests shall be carried out.
- (a) Noise level measurement as type test.
 - (b) Vibration measurement as routine test.
 - (c) Degree of protection test as per IS:4691 as type test.

28.0 COMMISSIONING CHECKS (If called for)

Commissioning checks should be carried out as per IS: 900 and other relevant standards.

29.0 DOCUMENTS REQUIRED

29.1 With bid (3 sets)

- (a) Filled in motor data sheet
- (b) Catalogue
- (c) Q.P
- (d) Compliance / Deviation list

29.2 With supplies (15 Sets)

- (a) Filled in motor data sheet
- (b) Catalogue
- (c) Q.P
- (d) Test report.



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

ANNEXURE - A

TECHNICAL PARAMETERS FOR MOTORS

	11KV SYSTEM	3.3/6.6 KV SYSTEM	415/380 V SYSTEM	220 V DC
1.0 Supply system a) Nominal system volt b) Voltage variation c) Frequency d) Frequency variation e) Combined voltage and frequency variation	11KV +/- 6% 50 Hz + 5 to -5% 10%	3.3/6.6 KV +/-10% 50 Hz + 5 to -5% 10%	415/380/240 V +/-10% 50 Hz +5 to -5% 10%	220 V 190 to 240V
2.0 Permissible rating in each voltage level.	> 1500 KW	> 160 KW (for coal handling & ash conveyor > 200 KW and up to 1500 KW (for other motors.)	< 0.2 KW (for 240 V) > 0.2 & up to 200 KW (for 415/380 V)	
3.0 Fault Level	40 kA rms for 1 sec	40 kA rms for 1 sec	45 kA rms for 1 sec	-
4.0 Minimum starting voltage available	75% (for more than 4000 KW) 80% (> 1500 KW & up to 4000 KW)	85% (for up to 1000 KW) 80% (> 1000 KW & up to 1500 KW 90% (for coal mill motor of < 1000 KW)	80% (for more than 110 KW) 85% (for up to 110 KW)	190 V
5.0 Class of insulation	Class F with B limits.	Class F with B limits.	Class B	Class B
6.0 1.2/50 micro sec impulse withstand level for main insulation	49 KV	19/36 KV	-	



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7.0 0.3/3 micro sec surge withstand level for interturn insulation	32.0 KV	12.0/24.0 KV	-	
--	---------	--------------	---	--

8.0 High frequency over voltage test value	27 KV	8/16 KV		
--	-------	---------	--	--

9.0 Terminal box				
a) Fault withstand level for 0.12 sec.	750 MVA	150/250 MVA	31 MVA (for > 125 KW)	
b) Clearance between bare live parts.	130 mm	70/110 mm*	12.5 mm 	10mm
c) Clearance between bare live parts & earth	120 mm	60/100 mm*	12.5 mm 	10 mm



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

ANNEXURE – B

PROFORMA OF MOTOR INFORMATION

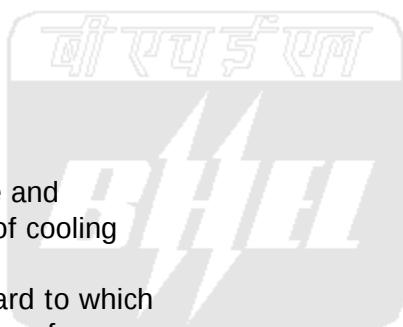
Bidder's name :

1 GENERAL

- (i) Manufacturer
- (ii) Equipment driven by motor
- (iii) Motor type

2 DESIGN AND PERFORMANCE DATA

- (i) Frame size
- (ii) Type of duty
- (iii) Type of enclosure and method of cooling
- (iv) Applicable standard to which motor generally conforms
- (v) Type of mounting
- (vi) Direction of rotation as viewed from non-driving end
- (vii) Standard continuous rating at 40deg.C ambient temperature as per Indian standard (KW)
- (viii) Derated rating for specified normal condition ie. 50deg.C ambient temperature (KW)
- (ix) Rated voltage (Volts)
- (x) Rated speed at rated voltage and frequency (r.p.m)





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- (xi) Full load current at rated voltage and frequency (Amp)
- (xii) Power factor at rated load
- (xiii) Efficiency of motor at rated voltage and frequency (without any tolerance) at
 - a) Design duty point (%)
 - b) 100% of full load (%)
- (xiv) Starting current (amps) at
 - a) 100% voltage
 - b) 85% voltage
 - c) 80% voltage (for boiler feed-pump only)
- (xv) Torques at
 - a) Starting (Kg-metre)
 - b) Pull up (Kg-metre)
 - c) Pull out (Kg-metre)
- (xvi) Stator winding insulation
 - a) Class & type
 - b) Tropicalised (Yes / No)
 - c) Temperature rise over specified ambient of 50deg.C (deg)
- (xvii) Stator winding connection
- (xviii) Number of stator terminals brought out



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

- (xix) Type of terminal box for
- a) Stator leads
 - b) Space heater
 - c) Temperature detector
- (xx) Space heaters
- a) Number
 - b) Location
 - c) Power requirement (KW)
- (xxi) Bearing type
- a) Driving end
 - b) Non driving end
- (xxii) Type of construction of rotor
- (xxiii) Weight of
- a) Motor stator (Kg)
 - b) Motor rotor (Kg)
 - c) Total weight (Kg)
- (xxiv) Motor starting time (sec)
- (xxv) Motor rated torque (Kg-met)
- (xxvi) Motor accelerating torque (Kg-met)

NOTE: INDICATE TOLERANCE VALUES AGAINST EACH DATA



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

ANNEXURE – C

PROFORMA OF DC MOTOR INFORMATION

Bidder's name :

1 GENERAL

- (i) Manufacturer
- (ii) Equipment driven by motor
- (iii) Motor type
- (iv) Country of origin

2 DESIGN AND PERFORMANCE DATA

- (i) Frame size
- (ii) Type of duty
- (iii) Type of enclosure and method of cooling
- (iv) Applicable standard to which motor generally conforms
- (v) Type of mounting
- (vi) Standard continuous rating at 40deg.C ambient temperature as per Indian standard (KW)
- (vii) Derated rating for specified normal condition ie. 50deg.C ambient temperature (KW)
- (viii) Rated voltage (Volts)
- (ix) Range of voltage between which from Volts to Volts the motor can develop rated torque



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TECHNICAL SPECIFICATION FOR HT & LT MOTORS

- x) Minimum permissible voltage at which motor can develop the required starting torque
- (xi) Current at
 - a) Starting at minimum permissible voltage
 - b) Rated load
- (xii) Armature winding
 - a) Class & type of insulation
 - b) Tropicalised (Yes / No)
 - c) Commutator material
- (xiii) Shunt winding
 - a) Class & type of insulation
 - b) Tropicalised (Yes / No)
- (xiv) Feature incorporated to ensure satisfactory communication during operation
- (xv) Type of terminal box
- (xvi) Motor starter (for motor 10 KW above)
 - a) Type
 - b) Make
- (xvii) Space heater (if provided)
 - a) Number
 - b) Location
 - c) Power requirement (KW)
- (xviii) Weight of motor (Kg)

NOTE: INDICATE TOLERANCE VALUES AGAINST EACH DATA

Project: Darlipalli Aux

Sub: BFP - Motor C&I Check list

- a) LT Motors suitable for 415V, 3-Ph, 50 Hz supply with ratings limited to 110 kW / 125 kW / 132 kW
- b) Motor shall be High Efficiency Motor (IE2) as per IEC 60034-30
- c) Cable glands and lugs are included in motor vendor scope. Cable details for the same shall be furnished to the finalised Pump vendor. Refer Cl. No. 20.3 of Motor specification for tentative cable size. The terminal box of motor shall be suitable for selected cable size, easy termination and maintenance of cables.
- d) Motor shall be suitable for frequency of 50 Hz with variation of +5% and -5%
- e) Combined Voltage and Frequency variation shall be limited to 10 %
- f) Paint shade : RAL 5012 (Blue), Epoxy base
- g) Degree of protection : IP 55
- h) Noise level limitation : 85 dB(A)
- i) Motor Fault level shall be limited to 45 kA , RMS , one second .
- j) The ratio of **locked rotor kVA at rated voltage to rated kW** shall not exceed **9.0**
(Without any further tolerance)

k) Instruments as per clause 4.17 of pump specification to be supplied (Reproduced below)

4.17.1 Instrument rack with all indicating instruments mounted on it to be located on the base of the unit.

- i) *Pressure gauges: - Balance leak off pressure of BFP (if applicable)*
- ii) *Temperature gauge - Suction temperature of BFP*
- Discharge temperature of BFP

4.17.2 The following shall be wired up to junction box (JB) in instrument rack

- i) *RTD (Duplex) - For any one of the following bearings*
 - DE Bearing of Pump*
 - NDE Bearing of Pump*
 - DE Bearing of Motor*

NDE Bearing of Motor

4.17.3 All instruments shall be completed with root valves, impulse lines & required mounting accessories.

*l) Motor **kW rating and full load current** shall be furnished.*

m) Selected motor kW rating shall be with 15% margin over the duty point input or 10% over the maximum demand of the driven equipment, whichever is higher.

*n) **MOTOR MAKES:** M/s KEC (upto 90 kW only) / CGL / Marathon / Jyoti / BBL (upto 160 kW only) / LHP (upto 120 kW only) / ABB Bangalore / Siemens*

o) Vendor shall submit "duly filled in" motor data sheets, in the attached format in an event of order (Format Attached)

p) Documents of finalised vendor are subject to BHEL/NTPC approval .

	LT MOTORS	
A.	GENERAL	
1.	Manufacturer & Country of origin.	
2.	Equipment driven by motor	
3.	Motor type	
4.	Quantity	
B.	DESIGN AND PERFORMANCE DATA	
1.	Frame size	
2.	Type of duty	
3.	Type of enclosure /Method of cooling/ Degree of protection	
4.	Applicable standard to which motor generally conforms	
5.	Efficiency class as per IS 12615/IEC 60034-30	
6.	(a)Whether motor is flame proof	Yes/No
	(b)If yes, the gas group to which it conforms as per IS:2148	
7.	Type of mounting	
8.	Direction of rotation as viewed from DE END	
9.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)	
10.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	
11.	Maximum continuous load demand of driven equipment in KW	
12.	Rated Voltage (volts)	
13.	Rated Frequency(Hz)	
14.	Permissible variation of :	
	a. Voltage (Volts)	
	b. Frequency (Hz)	
	c. Combined voltage and frequency	
15.	Rated speed at rated voltage and frequency(RPM)	
16.	At rated Voltage and frequency:	
	a. Full load current	
	b. No load current	
17.	Power Factor at	

	a. 100% load	
	b. NO load	
	c. Starting.	
18.	Efficiency at rated voltage and frequency,	
	a.100% load	
	b. 75% load	
	c. 50% load	
19.	Starting current (amps) at	
	a. 100 % voltage	
	b. 85% voltage	
	c. 80% voltage	
20.	Minimum permissible starting Voltage (Volts)	
21.	Starting time with minimum permissible voltage	
	a. Without driven equipment coupled	
	b. With driven equipment coupled	
22.	Safe stall time with 100% and 110% of rated voltage	
	a. From hot condition	
	b. From cold condition	
23.	Torques :	
	a. Starting torque at min. permissible voltage(kg-mtr.)	
	b. Pull up torque at rated voltage.	
	c. Pull out torque	
	d. Min accelerating torque (kg.m) available	
	e.Rated torque (kg.m)	
24.	Stator winding resistance per phase (ohms at 20 Deg.C.)	
25.	GD ² value of motors	
26.	No of permissible successive starts when motor is in hot condition	
27.	Locked Rotor KVA Input	
28.	Locked Rotor KVA/KW	
29.	Vibration limit :Velocity (mm/s)	
30.	Noise level limit (dBA)	

C.	CONSTRUCTIONAL FEATURES	
1.	Stator winding insulation	
	a. Class & Type	
	b. Winding Insulation Process	
	c. Tropicalised (Yes/No)	
	d. Temperature rise over specified maximum ambient temperature of 50 deg C	
	e. Method of temperature measurement	
	f. Stator winding connection	
2.	Main Terminal Box	
	a. Type	
	b. Location(viewed from NDE side)	
	c. Entry of cables(bottom/side)	
	d. Recommended cable size(To be matched with cable size envisaged by owner)	
	e. Fault level (MVA),Fault level duration(sec)	
	f. Cable glands & lugs details (shall be suitable for power cable)	
3.	Type of DE/NDE Bearing	
4.	Motor Paint shade	
5.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	
D.	List of accessories.	
1.	Space Heaters (Nos./Power in watts/supply voltage)	
2.	Terminal Box for Space Heater (Yes/No)	
3.	Speed switch (Yes/No) No of contacts and contact ratings of speed switch	
4.	Insulation of bearing (Yes/No)	
5.	Noise reducer(Yes/No)	
6.	Grounding pads	
	i) No and size on motor body	
	ii) Nos on terminal Box	
7.	Vibration pads	

	i) Nos and size	
	ii) Location	
8.	Any other fitments	
E.	List of curves.	
1.	Torque speed characteristic of the motor	
2.	Thermal withstand characteristic	
3.	Starting. current Vs. Time	
4.	Starting. current Vs speed	
5.	P.F. and Effi. Vs Load	