Package 1	Material code	Short Description	Long Description	QTY	UOM
P a n k i	L17281SR30001001	DILUTION AIR FAN WITH AC MOTOR	CONSTANT SPEED DILUTION AIR FAN WITH AC MOTOR 415 V AC, 3 PHASE AND 50 HZ, 1500 RPM WITH MOUNTING FRAME AND OTHER ACCESSORIES AS PERTECHNICAL SPECIFICATION TSR:002 WITH ANNEXURES 1-7.	2.000	NO
	L17281SR30001002	ANTI VIBRATION PADS	REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	12.000	NO
	L17281SR30001003	OUTLET TRANSITION PIECE	OUTLET TRANSITION PIECE WITH FASTENERS FITTED SUITABLY TO MATCH NB 500 PIPE.REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	SET
	L17281SR30001004	FIXBOLTS,NUTS,WASHERS W/FASTENERS FITTED	ALL ITEMS NECESSARY TO MOUNT THE FAN & MOTOR ONTO BOILER FLOOR AND TO MATCH WITH BHEL	2.000	SET
	L17281SR30001005	EXPANSION/VIBRATION ISOLATOR - I/L	EXPANSION JOINT/VIBRATION ISOLATOR MS OR CANVAS BETWEEN FAN INLET AND TRANSITION PIECE.REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	NO
	L17281SR30001006	EXPANSION/VIBRATION ISOLATOR - O/L	EXPANSION JOINT/VIBRATION ISOLATOR MS OR CANVAS BETWEEN FAN OUTLET AND TRANSITION PIECE.REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	NO
	L17281SR30001007	SILENCER, FILTER & DUCTING	FAN INLET SILENCER WITH BIRD SCREEN, CORRESPONDING FILTER AND DUCTING FROM FAN TO SILENCER.REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	SET
	L1728SSR99701001	SPARE SET- BLOWER	BLOWER/DILUTION AIR FAN SET (WITHOUT EXTRA IMPELLER) THAT IS ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY OF DILUTION AIR FAN ASSEMBLY OFFERED AGAINST MATERIAL CODE L17281SR30001001.	1.000	NO

Package 2	Material code	Short Description	Long Description	QTY	UOM
Sagardighi	L17311SR30001001	DILUTION AIR FAN WITH AC MOTOR	CONSTANT SPEED DILUTION AIR FAN WITH AC MOTOR 415 V AC, 3 PHASE AND 50 HZ, 1500 RPM WITH MOUNTING FRAME AND OTHER ACCESSORIES AS PER TECHNICAL SPECIFICATION TSR:002 WITH ANNEXURES 1-7.	2.000	NO
	L17311SR30001002	ANTI VIBRATION PADS	REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	12.000	NO
	L17311SR30001003	OUTLET TRANSITION PIECE	OUTLET TRANSITION PIECE WITH FASTENERS FITTED SUITABLY TO MATCH NB 500 PIPE. REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	SET
	L17311SR30001004	FIXBOLTS,NUTS,WASHERS W/FASTENERS FITTED	ALL ITEMS NECESSARY TO MOUNT THE FAN & MOTOR ONTO BOILER FLOOR AND TO MATCH WITH BHEL TERMINAL POINT - NB 500 PIPE.	2.000	SET
	L17311SR30001005	EXPANSION/VIBRATION ISOLATOR - I/L	EXPANSION JOINT/VIBRATION ISOLATOR MS OR CANVAS BETWEEN FAN INLET AND TRANSITION PIECE. REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	NO
	L17311SR30001006	EXPANSION/VIBRATION ISOLATOR - O/L	EXPANSION JOINT/VIBRATION ISOLATOR MS OR CANVAS BETWEEN FAN OUTLET AND TRANSITION PIECE. REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	NO
	L17311SR30001007	SILENCER, FILTER & DUCTING	FAN INLET SILENCER WITH BIRD SCREEN, CORRESPONDING FILTER AND DUCTING FROM FAN TO SILENCER. REFER SECTION 2.0 OF ANNEXURE-4 IN SPECIFICATION TSR-002	2.000	SET
	L1731SSR99705001	MOTOR	MOTOR SHALL BE ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY OF DILUTION AIR FAN & MOTOR ASSEMBLY ENQUIRED VIDE MATERIAL CODE L17311SR30001001.	1.000	NO
	L1731SSR99705006	END SHIELD FOR DRIVE & NON DRIVE END	MOTOR END SHIELD SHALL BE ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY DILUTION AIR FAN & MOTOR ASSEMBLY ENQUIRED VIDE MATERIAL CODE L17311SR30001001.	1.000	SET
	L1731SSR99705007	HEATERS	MOTOR HEATERS SHALL BE ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY OF DILUTION AIR FAN & MOTOR ASSEMBLY ENQUIRED VIDE MATERIAL CODE L17311SR30001001.	2.000	SET
	L1731SSR99705008	BEARINGS FOR DRIVE & NON DRIVE END	MOTOR BEARINGS OF DRIVE END AND NON-DRIVE END SHALL BE ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY OF DILUTION AIR FAN & MOTOR ASSEMBLY ENQUIRED VIDE MATERIAL CODE L17311SR30001001.	2.000	SET

	L1731SSR99705009	COOLING FAN FOR MOTOR	MOTOR COOLING FAN SHALL BE ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY OF DILUTION AIR FAN & MOTOR ASSEMBLY ENQUIRED VIDE MATERIAL CODE L17311SR30001001.	1.000	SET
	L1731SSR99705010	DUST SEAL AND GASKETS	MOTOR DUST SEAL & GASKETS SHALL BE ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY OF DILUTION AIR FAN & MOTOR ASSEMBLY ENQUIRED VIDE MATERIAL CODE L17311SR30001001.	1.000	SET
	L1731SSR99705011	MOTOR TERMINAL BLOCK	MOTOR TERMINAL BLOCK SHALL BE ONE TO ONE REPLACEABLE WITH THE MAIN SUPPLY OF DILUTION AIR FAN & MOTOR ASSEMBLY ENQUIRED VIDE MATERIAL CODE L17311SR30001001.	1.000	NO

ANNEXURE-7

BHARAT HEAVY ELECTRICALS LIMITED
AC MOTOR DATASHEET

PO NO. :

PROJECT :

SNO	DESCRIPTION	
A.	**GENERAL**	
1.	Manufacturer & Country of origin.	
2.	Equipment driven by motor/Application	
3.	Motor type	
B	**DESIGN AND PERFORMANCE DATA**	
4.	Frame size	
5.	Type of duty	
6.	Type of enclosure /Method of cooling/ Degree of protection	
7.	Applicable standard to which motor generally conforms	
8.	Efficiency class as per IS 12615	
	(a)Whether motor is flame proof	Yes/No
	(b)If yes, the gas group to which it conforms as per IS:2148	
9.	Type of mounting	
10.	Direction of rotation as viewed from DE END	
11.	Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)	
12.	Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)	

13.	Maximum continuous load demand of driven equipment in KW		
14.	Rated Voltage (volts)		
15.	Permissible variation of :		
	a. Voltage (Volts)		
	b. Frequency (Hz)		
	c. Combined voltage and frequency		
16.	Rated speed at rated voltage and frequency (RPM)		
17.	At rated Voltage and frequency:		
	a. Full load current		
	b. No load current		
18.	Power Factor at		
	a. 100% load	b. No Load	c. Starting
19.	Efficiency at rated voltage and frequency,		
	a.100% load	b. 75% Load	c. 50% load
20.	Starting current (amps) at		
	a. 100 % voltage	b. At 85 % Voltage	c. At 80% Voltage
21.	Minimum permissible starting Voltage (Volts)		
22.	Starting time with minimum permissible voltage		
	a. Without driven equipment coupled		

	b. With driven equipment coupled		
23.	Safe stall time with 100% and 110% of rated voltage	At Rated Voltage (100%)	At 110% of Rated Voltage
	a. From hot condition		
	b. From cold condition		
24.	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 at lowest permissible starting voltage		
	e. Rated torque (kg.m)		
25.	Stator winding resistance per phase (ohms at 20 Deg.C.)		
26.	GD2 value of motors		
27.	No of permissible successive starts when motor is in hot condition		
28.	Locked Rotor KVA Input		
29.	Locked Rotor KVA/KW		
30.	Vibration limit :Velocity (mm/s)		
31.	Noise level limit (dBA)		
C	**CONSTRUCTIONAL FEATURES**		
32.	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	
33.	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 in purchase enquiry)	
	e. Fault level (MVA),Fault level duration(sec)	
	f. Cable glands & lugs details (shall be suitable for power cable)	
34.	Type of DE/NDE Bearing	
35.	Motor Paint shade	
36.	Weight of	
	a. Motor stator (KG)	
	b. Motor Rotor (KG)	
	c. Total weight (KG)	
D	**LIST OF ACCESSORIES**	
37.	Space Heaters (Nos./Power in watts/supply voltage)	
38.	Terminal Box for Space Heater (Yes/No)	
39.	Speed switch (Yes/No) No of contacts and contact ratings of speed switch	
40.	Insulation of bearing (Yes/No)	

41.	Noise reducer(Yes/No)	
42.	Grounding pads	
	i) No and size on motor body	
	ii) Nos on terminal Box	
43.	Any other fitments	
E	**LIST OF CURVES**	
44.	Torque speed characteristic of the motor	
45.	Thermal withstand characteristic	
46.	Starting. current Vs. Time	
47.	Starting. current Vs speed	
48.	P.F. and Effi. Vs Load	

ANNEXURE-5

Controls & Instrumentation/Fossil Boilers
Project Specific Transmittal for LT AC motors and DC motors

Transmittal Ref.: TR: LT AC-DC MOTOR: 1731, Rev. 00

Project Details:

Project/Rating : SAGARDIGHI TPS 1 X 660 MW
Customer Number : 1731

The project specific transmittal has to be referred along with the technical specification of the motor.

a) Efficiency Class of LT motor and Cable Entry Details of LT AC Motor and DC Motor

Energy efficient level: IE3 as per IS 12615 – 2018 (For LT AC Motors).

Table - 1, Power cable size for LT AC motors: -

Vendor to provide the cable entry and supply cable-glands, lugs as per the technical specification requirement suitable for the power cable sizes as indicated below. The cable sizes indicated below are tentative. The actual power cable size based on the cable run length will be intimated during technical evaluation stage, before placement of purchase order.

Sl. No.	From (KW)	To (KW)	Power Cable size in sq. mm. (#)
1.	2.21	7.5	3C-16mm^2(AL)
2.	7.51	11.00	3C-16mm^2(AL)/3C-25 mm^2(AL)
3.	11.10	18.50	3C-25mm^2(AL)/3C-50 mm^2(AL)
4.	18.51	45.00	3C-50mm^2(AL)/3C-95 mm^2(AL)
5.	45.01	75.00	3C-95mm^2(AL)/3C-150 mm^2(AL)/3C-240 mm^2(AL)
6.	75.01	110.00	3C-150 mm^2(AL)/3C-240 mm^2 (AL)

Table-2 (Power cable size for DC motors): -

Vendor to provide the cable entry and supply cable-glands, lugs as per the technical specification requirement and suitable for the power cable sizes as indicated below.

Sl. No.	Full Load current (Amp)	Power Cable, Armoured
1.	30-50	2C-70 mm^2 or 2C-95mm^2 (Al)
2.	50-90	2Runs of 2C-95mm^2 (Al)

b) Relevant sheets of the contract specification.

The contract specification will supersede the respective clauses of the technical specification, if the requirements are spelt in both technical specification (TCI:141, Rev. 12) and contract specification.

VOLUME: II-F/1

SECTION-II

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

CONTENT

ATTACHMENT

SECTION - II

A.C. & D.C. MOTORS

1.00.00 SCOPE

1.01.00 This specification covers the general requirements of the electric motors for plant auxiliary equipment except for special application like crane, lift, submersible pump etc., motors for which are covered in individual equipment specifications.

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 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 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.

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will 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 of this specification.

3.03.00 For motor installed outdoor and exposed to direct sun rays, 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 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.

4.01.03 All motors shall be rated for continuous duty. 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 IE2 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 respectively.~~

4.01.05 The motor name-plate rating at 50°C 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.

This clause is applicable if enquiry calls or supply of motor along with load like pump/fan

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 (If applicable)

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS-60034 part17 & 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 coordinated 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**

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.

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current at rated voltage for LT motors shall be 6 times of full load current plus IS tolerance. For 3.3KV and 11KV motor except BFP, starting current shall be maximum 6 times of full load current inclusive IS tolerance. For Boiler feed pump motor, starting current shall be limited to 4.5times of full load current plus IS tolerance.

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 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals without exceeding acceptable winding temperature.

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.

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 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 For motors with starting time upto 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 Enclosures for the motor and the cable box shall conform to the degree of protection IP-55 unless otherwise specified.

6.01.02 Motors like circulating water pumps of large output ratings, 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.

6.01.03 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv. as detailed below:

a) Fuel Oil area : Group IIB
b) Hydrogen generation plant area : Group IIC (or Group-I, Div-II as per NEC or Class-1, Gr-B, Div-II as per NEMA/IEC60034)

Separate Canopy shall be provided for LT motors located in outdoor or semi-outdoor area.

6.02.00 **Cooling**

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

6.02.02 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.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 HT motors shall have Class F insulation with winding temperature limited to 120ºC. 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.

6.03.03 LT motors shall have Class F or higher insulation with temperature limited to 120ºC.

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 hardware shall be corrosion resistant.

6.05.00 **Bearings**

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

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

6.06.00 **Noise & Vibration**

6.06.01 Noise level shall not exceed 85 db (A) except for BFP motor for which the maximum limit shall be 90 db (A).

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

6.07.00 **Motor Terminal Box**

6.07.01 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.

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

6.07.03 Terminal box for all LT motors shall be diagonally split type 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 suitable sized HT 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.

6.07.05 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 HT 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 Owner's cable. All threads shall be ISO metric thread only.

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

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:

Motor above 90 kW	50 x 6 mm GI Flat
Motor above 30 kW upto 90 kW	35 x 6 mm GI Flat
Motor above 5 kW upto 30 kW	25 x 3 mm GI Flat
Motor upto 5 kW	8 SWG GI Wire

The above sizes shall be superseded by different sizes if so indicated in the relevant clause of the General Electrical Specification.

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

6.09.00 **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 ^{o}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 50 Hz 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 HT 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 Each bearing of HT shall be provided with minimum 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°C.

7.04.00 Indicator/Switch

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

a) HT 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 0.5 A at 220V D.C. and 5A at 240V A.C.

7.05.00 Current Transformer for Differential Protection

7.05.01 Motor above 1000 kW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Matching three (3) numbers PS class CTs shall be mounted on the switchgear end.

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 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 eye bolt 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. The paint shade shall be as specified in the Annexure.

8.00.00 TESTS

8.01.00 Upon completion, each HT & LT motor shall be subject to routine tests as per Schedule-C of Section -I. 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 despatch of the motors from works.

8.03.00 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.

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.

8.03.04 The following type tests shall be performed on a representative sample of 11000V and 3300V motor of each type & rating, even if type test certificates of these tests are submitted by the Bidder for Purchaser's approval:

a. Measurement of stator resistance (and rotor resistance on slip ring motors).

b. No load test at rated voltage to determine voltage, current, power input and speeds.

c. Locked rotor reading of voltage, current, power input and values of torque of motor.

d. Full load test to determine efficiency, power factor and slip.

e. Temperature rise test. During heat run test, bearing temperature, Winding temperature, core temperature, coolant flow and its temperature shall be recorded. In case temperature rise test is carried at any load other than rated load, specific approval for test procedure and method has to be obtained.

f. Momentary overload test.

g. Test for noise level of motor.

9.00.00 SPARE

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

10.00.00 DRAWINGS, DATA & MANUALS

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

10.01.00 Along with the bid

a) List of the motors
b) Individual motor data sheet as per Annexures
c) Scheme & write up on forced lubrication system, if any.
d) Type test report

10.02.00 After Award of Contract for Information (I)/ Approval (A)

a) Dimensional General Arrangement drawing (I)
b) Foundation Plan & Loading (I)
c) Cable end box details.(I)
d) Space requirement for rotor removal (I)
e) Thermal withstands curves hot & cold (I)
f) Starting and speed torque characteristics at 80%, 100% & 110% voltage (A)
g) Complete motor data sheet (A)
h) Erection & Maintenance Manual (I)

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 1500 kW
H.T. Supply	3.3 kV, 3 Ø/, 3W, 50 Hz Non-effectively earthed Fault level 40 KA symm. for 3 second.	Motors above 160kW upto 1500 kW.
L.T. Supply	415V, 3 Ø/, 3W, 50 Hz Effectively earthed Fault level 50 KA symm. for 1 seconds.	Motors above 200W upto 160 kW
	240V, 1 Ø/, 2W, 50 Hz Effectively earthed	Motors below 200W Lighting, space heating, A.C. control protective devices
D.C. Supply	220V, 2W, unearthed Fault level 25* KA for 1 second (Min.)	D.C. alarm, control protective devices

* However actual value shall be substantiated by the bidder through calculation.

2.0 RANGE OF VARIATION

A.C. Supply

Voltage : ±10%

Frequency : ±5%

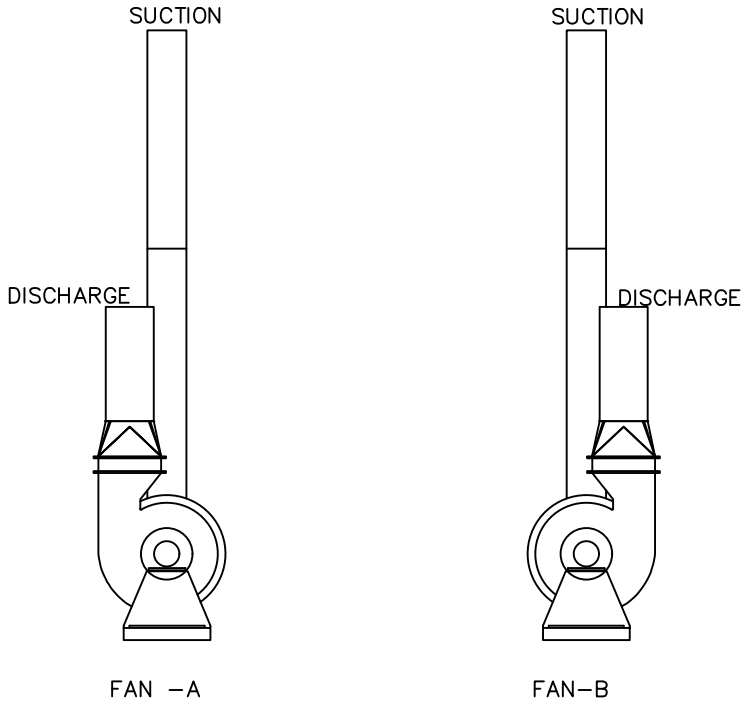
Combined Volt & frequency : 10% (absolute sum)

D.C. Supply

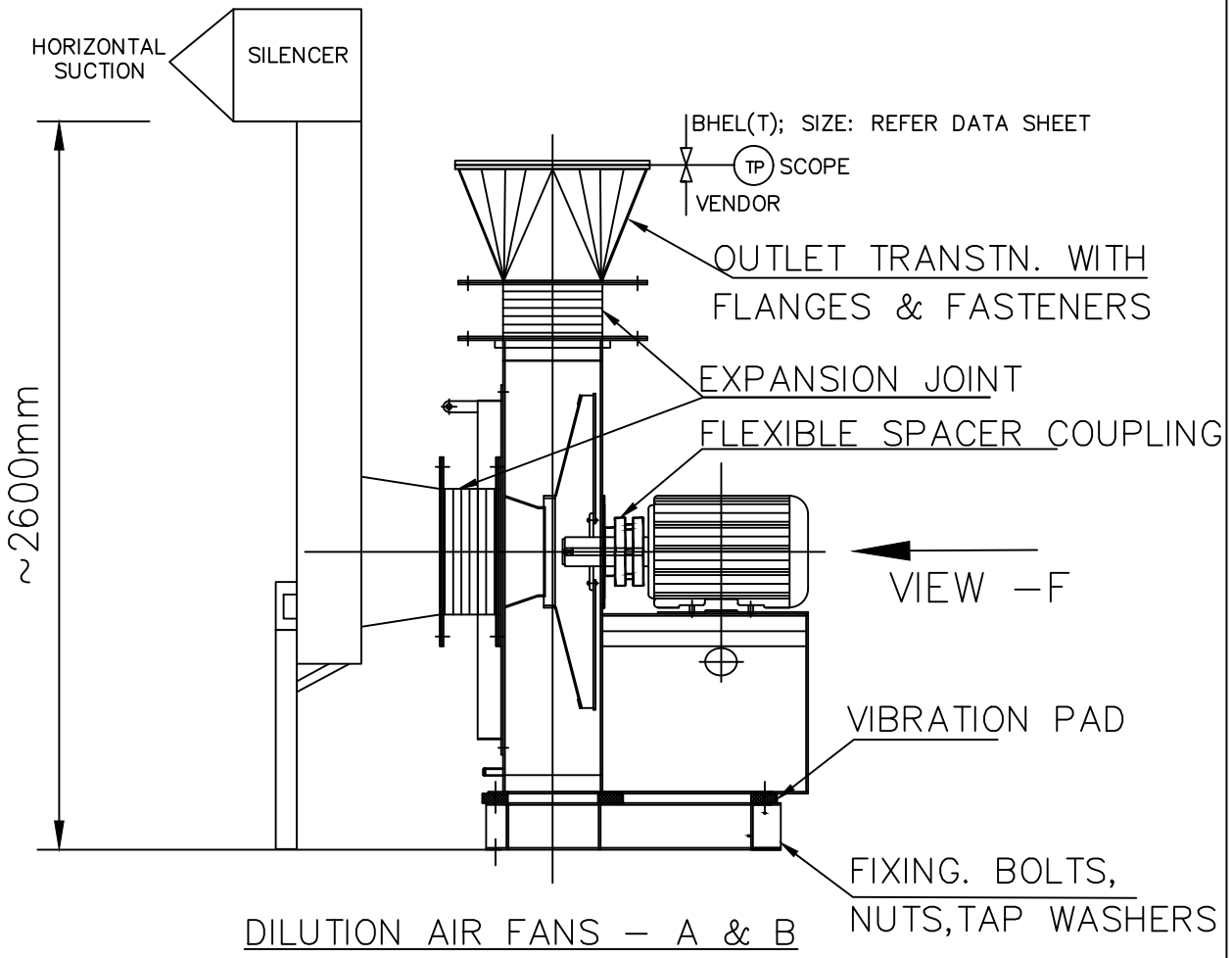
Voltage : 190 to 240 Volt

3.0 Paint Shade : RAL 7032

ANNEXURE–4
Section 2.0 TYPICAL CONSTRUCTIONAL FEATURES



VIEW –F



DILUTION AIR FANS – A & B

NOTE: FAN–B DISCHARGE SHALL BE MIRROR IMAGE OF FAN–A
TP– TERMINAL POINT

ANNEXURE-6

BHARAT HEAVY ELECTRICALS LIMITED

HIGH PRESSURE BOILER PLANT, TIRUCHIRAPALLI-620 014

CONTROLS & INSTRUMENTATION/FB

TECHNICAL SPECIFICATION OF

LT AC MOTORS (SAFE AREA)

SPECIFICATION REFERENCE – TCI : 140, Rev. 13

Revision History

Rev. No.	Date	Description	Prepared & Reviewed	Approved
01 -12		Earlier Revisions	-Sd-	-Sd-
13	05-03-22	General Revisit	M. Muruga Jothi	D. Kavitha 8/3/2022

Sl. No.	Description	Requirement
1	Site Conditions :-	
	Altitude above MSL	500 meters
	Ambient temperature	50° C
	Relative Humidity	100 %
	Atmosphere	Tropical, dusty, salty, corrosive and highly polluted environment.
2	Motor type	Squirrel cage type induction motor suitable for direct on line starting through any type of breaker.
3	Applicable Standards	IS-325, IS 12615, IS/IEC-60034, IS-12065, IS-12075, IS 15999, IS/IEC-60529, IS 4029, IS-1231, IS-6362, IS-2253. (Latest version of relevant standards shall be referred).
4	Type of Enclosure and degree of protection	Totally Enclosed Fan Cooled (TEFC), IP-55 as per IS/IEC-60529
5	Duty Cycle	Continuous, S1
6	Energy Efficiency Class	IE2/IE-3 as per IS-12615/IEC 60034-30. Refer project specific transmittal furnished along with enquiry for applicable energy efficiency class.
7	Rated Voltage & Tolerance	415 V AC, 3 Phase, ± 10 %.
8	Rated Frequency & Tolerance	50 Hz, ± 5 %
9	Combined voltage & frequency tolerance	10 % (absolute sum)
10	General Requirements	a. All motors shall be so designed that maximum inrush currents, locked rotor and pull out torque, developed at the extreme voltage and frequency variations do not endanger the motor and driven equipment. b. Motor shall be designed to keep the torsional and rotational natural frequencies of vibration, at least 25 percent above the motor rated speed ranges to avoid resonant vibration over the operating speed range of the motor and driven equipment.

Sl. No.	Description	Requirement
		c. Maximum continuous rating (MCR) of the motor shall have at least 15 % margin over the maximum load demand of the driven equipment including voltage and frequency variation. (Applicable only if vendor supplies motor along with the driven equipment or load).
11	Torque requirements	Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% of motor full load torque. Pull Out torque at rated voltage shall not be less than 205 % of full load torque.
12	Requirements during Starting & Running	• Motor shall start with rated load and accelerate to full speed with 80 % rated voltage at motor terminals • The motor shall be capable of withstanding the stresses imposed if started at 110 % rated voltage. • The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75 % rated voltage at motor terminals.
13	Momentary Overload withstanding capability	The motor shall be designed to withstand momentary over-load of 60% of full load torque for 15 seconds without any damage.
14	Momentary Over speed Withstanding capability	The motor shall be designed to withstand 120 % of rated speed for 2 minutes without any mechanical damage.
15	Hot thermal withstand curve	Margin of at least 10% over the full load current
16	Class of Insulation	Class-F insulation with temperature rise limited to Class-B. Temperature rise of the motor shall be limited to 70° C (by resistance method) over an ambient temperature of 50° C.
17	Stress withstanding capability during Bus Transfer	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.
18	Capacity to restart for rated voltage	a. Two successive starts from cold condition. b. Three equally spread starts per hour. c. Two hot starts in succession, with motor initially running at normal temperature.

Sl. No.	Description	Requirement
19	Starting Current	The starting current (% of FLC) shall be limited as per the standard IS-12615.
20	Locked Rotor Condition	The ratio of Locked Rotor KVA at rated voltage to rated KW shall not exceed as indicated below (without any further tolerance) For Motor rating from 50 KW and up to 110 KW: 11
21	Locked Rotor with-stand time	For motor with starting time up to 20 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 seconds more than starting time.
		For motor with starting time more than 20 seconds but not exceeding 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 seconds more than the starting time.
		For motor with starting time more than 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be 10% more than the starting time
		Vendor to provide Speed switches mounted on the motor shaft in case the above requirement is not met with.
22	Type of balancing of rotor	Dynamic balancing
23	Method of cooling	IC-0411 as per IS-6362
24	Direction of cooling air flow	NDE side to DE Side
25	Winding wire	Enameled Copper Wire, Grade-2, as per IS-13730, Part-3. Windings shall be non-hygroscopic, oil resistant and flame resistant.
26	Treatment on Winding Insulation	Winding Insulation shall be given tropical and fungicidal treatment for operation of motor in hot, humid & tropical climate.

Sl. No.	Description	Requirement
27	Bearing	Deep Groove Ball Bearing or Roller bearing as per the motor design, properly sealed to protect against the ingress of dust and water. Lubrication : Grease.
28	Noise level	Noise level shall be limited to 85 dB at 1 meter distance.
29	Vibration level	The peak amplitude of vibration shall be as per IS-12075 (Limits of Severity-Normal grade shall be followed).
30	Shaft extension	Motor shall be provided with key slotted bare shaft extension, with key at the drive end.
31	Terminal box	Weather proof terminal box shall be provided. The terminal box shall be capable of being turned through 360° in steps of 180° or 90°. Shall meet IP 55 protection class requirements as per IS 60529. Minimum Distance between center of the terminal stud & the gland plate and Minimum inter-phase/phase-earth air clearance shall be provided as per IS/IEC standards. Refer Project Specific transmittal for project specific requirements of dimensions. Terminal box shall have adequate space to terminate the Power cable applicable to the motor by using suitable lugs. Connection diagram shall be marked inside the terminal box. The terminal box shall be capable of withstanding a fault level of 50 kA rms for 1 second (Voltage : 415 V) at the terminals.
32	Cable Entries, Cable Glands & Lugs	Cable entries, Cable glands and Lugs shall be provided suitable for the power cable size, which will be indicated after PO placement during datasheet approval. Tentative sizes are indicated in the project specific transmittal. Double Compression type, brass with nickel plated, weather proof cable glands shall be provided – Quantity to be matched with the number of entries. 6 Nos. of Tinned Copper Lugs shall be provided.
33	Terminals	Separate Terminals for Space heaters and Windings with suitable connecting links shall be supplied.

Sl. No.	Description	Requirement
34	Earthing provisions	Earthing provisions shall be provided on motor body (2 nos. at opposite locations) and in terminal boxes as per the standard.
35	Space heater for motors rated 30 KW and above	Separate space heater suitable for 240 V AC, Single Phase supply shall be provided.
36	Lifting device	Eye bolt.
37	Project specific requirements	Vendor to take care of the project specific requirements indicated in the annexure - “Project specific transmittal”.
38	Name Plates	Motor shall have name plate as per relevant IS and in addition, Manufacture’s name, frame size, Energy Efficiency class, Insulation class, Bearing details, year of manufacture shall also be indicated.
39	Type test reports	Type test reports shall be produced for the following tests as per the requirements spelt in the standards, • Measurement of resistance of windings of stator. • No load test at rated voltage to determine input current power and speed • Full load test to determine efficiency, power factor and slip. • Temperature rise test. • Momentary excess torque test. • High voltage test. • Test for vibration severity of motor. • Test for noise levels of motor. • Test for degree of protection. • Over speed test. • Energy Efficiency test. In case the vendor is not able to submit report of the type test(s) conducted within last 5 years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the vendor shall conduct all such tests either in an independent laboratory or at manufacturer’s works in presence of Owner’s representative under this contract, free of cost to the Owner and submit the reports for approval.

Sl. No.	Description	Requirement
40	Confirmation and Documents to be submitted by the vendor, during Purchase Enquiry.	Vendor to indicate the references of the technical specification, project specific annexure and indicate "No Deviation" in the Sub-Delivery Enquiry deviation form. Any deviation shall only be indicated in the Sub-Delivery Enquiry deviation form. Deviations indicated elsewhere in the offer will not be considered.
41	Documents to be submitted by the vendor for approval by BHEL/Customer, after placement of purchase order.	3 Sets of the following: - a. Final technical Data sheet as per the format submitted by BHEL. b. Motor GA drawing indicating details of foundation, shaft dimensions and terminal box arrangement with complete dimensions. c. Motor Characteristic curves (Torque Vs. Speed, Current Vs. Speed, Speed Vs. time, Current Vs. time, Efficiency and PF Vs. load, Thermal withstand characteristic) d. O & M manuals.
42	Packing	The packing shall be suitable for safe transport, safe delivery at site and shall avoid damages due to environmental conditions during storage at site.
43	Painting	Paint shade shall be as per the purchase enquiry. The finish shall be corrosion resistant, epoxy based paint.

Taking care of the above indicated technical requirements in full, vendor to submit Sub-delivery enquiry deviation (SDED) format sent along with the purchase enquiry, without any deviations. Any deviation/clarification in the technical requirements has to be indicated only in the SDED format. Other than the SDED format, hidden deviations indicated elsewhere in the offer will not be considered.

BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI-620 014

FUEL SYSTEMS/PE(FB)

Title Sheet

Specification for

DILUTION AIR FAN & MOTOR ASSEMBLY

Specification Number: TSR: 002 Revision No.: 03

03	07.11.2022	Note number 4 added	Sairam N	Srinivasu Arugula
02	03.09.2021	Vibration switch removed. Indian standards added.	Preetam kumar	MCHS Gangadhar
01	10.06.2021	Clauses corrected:1.2, 1.4.2 & 1.4.3 Clauses added: 1.4.12, 1.4.13	Noorul Fazil	Srinivasu Arugula
Rev. No.	Date	Revision statement	**Revised**	**Checked & Approved**

	Name	Signature	Date
Prepared	N Sairam	-sd-	18.01.2021
Checked	Shankar Naik V	-sd-	19.01.2021
Approved	G Saravanakumar	-sd-	20.01.2021

1.0 Technical Specification

1.1 Scope

This specification defines the minimum requirements for the design, manufacture, testing, preparation for shipment and delivery of materials, engineering documentation, technical direction for construction/installation, and startup service for this equipment. The supplier is solely responsible for correct design, engineering, construction and supply of intended item.

Equipment furnished shall be the Vendor's standard design and proven.

1.2 Equipment, Materials and Services by Vendor

The Vendor's scope of supply includes, but is not necessarily limited to:

- The Vendor Shall supply skid mounted constant speed Dilution Air fans including Motors, Silencers with bird screen and filter as per datasheets enclosed in annexure 1, 2, 3& 4. The fans shall be rated at 100% of the Dilution airflow. The fans shall be designed with split housing, inspection door, shaft seal, shaft and coupling guards. Vendor shall supply Fans with an integral base for motor mounting complete with the evase at the fan discharge.
- Vibration Isolation (Fan is mounted on structural steel) inlet & Outlet
- Flexible spacer coupling with coupling guard.
- Outlet expansion joint
- Discharge transition piece (if required), flanges and counter flanges along with required fasteners and non- asbestos gaskets to match with the pipe sizes specified.
- Motor as per Annexure 5, 6 & 7.
- The Vendor shall provide all new material, components and purchased items, which shall satisfy the Purchaser's requirements as described in this specification.
- Equipment Annexures are to be filled by the Vendor in order to inform the Purchaser as to the specifics of the equipment being supplied.
- Special tools if any.

1.3 Performance Guarantees

The equipment provided by the Vendor shall operate in accordance with the performance data in the Annexure-2 included and Noise Requirements for a period as determined by the terms and conditions of purchase.

The Purchaser and/or Owner may conduct Field tests during startup and after commercial operation of the installation for a period determined by the terms and conditions of purchase.

The equipment shall meet all applicable code requirements so that all required inspections are passed and permits obtained.

Vendor shall provide minimum Airflow possible with the fan selected.

The Vendor's fan shall be capable of continuous operation at all the specified air flow demands noted on Annexure-2 Performance Data as noted in this document without encountering surge or stall or other undesirable operating conditions.

This fan is not equipped with an inlet or discharge air flow vane or damper control and must supply airflow in response to the system resistances as stated on the above referenced Annexure-2.

1.4 Detailed Requirements of Equipment

1.4.1 Equipment Description

The fan is the start of the system. Downstream of the dilution air fan is an air heater (steam or electric) that heats air for the vaporization and dilution of anhydrous ammonia. Typically, this

air is heated to a constant temperature of 150 °C, but may vary based on project. This warm air then proceeds to the anhydrous ammonia injection, which cools it to a constant temperature, typically around 94 to 121 °C, then splits into one or more streams to supply each SCR reactor. Finally, at each SCR inlet duct it is split into multiple injection lances and is injected to a duct.

As fans are constant volume machines, normally the system resistance curve will remain unchanged through different ambient conditions. The fan performance curves will shift up and down with density resulting in a varying mass flowrate. However, in this configuration the air is being heated after it goes through the fan, so a change in ambient density and thus a change in mass flowrate will cause the volumetric flowrate downstream of the air heaters to vary. This results in different system resistance curves for each ambient condition as well as different fan performance curves for each ambient condition.

1.4.2 General

- The general design and technical requirements are listed in Annexures
- Vendor must provide Material Safety Data Sheets (MSDS) for all coatings, paints, lubricants, preservatives, or chemicals that will be brought onto the jobsite by the Vendor for whatever reason. The MSDS must be delivered before equipment is delivered on the jobsite.
- The evase or fan outlet flange shall be minimum 12mm thick with ANSI Class 150 Drilling pattern.
- Vendor shall make all necessary allowances for pressure losses of components i.e. Silencer, Screen, Inlet Box etc. in Vendor's scope of supply.
- Equipment shall be designed in accordance with all applicable codes, standards, and accepted practices, utilizing proven technology and materials.
- Vendor shall include fan/motor base isolators, if required. The rotor base material, weld heat affected zone and the weld should have minimum Charpy V-notch impact energy values of 27 Joule at the minimum specified ambient site temperature.
- The fan rotor shall be designed to a minimum of 10° C above specified maximum operating or test block temperature.
- Complete fan assembly must have shop mechanical run test with recorded bearing vibration and temperature. The fan bearing should have minimum L-10 life equal to 50,000 hours.
- The maximum average stresses of the impeller components shall not exceed fifty (50%) of the material yield strength at the maximum operating temperature.
- Hub to shaft connection must have key and interference fit. Welding to the shaft is not permitted.
- The fans must meet all specified points of operation without airflow control (unless specified).
- The Vendor shall quote and provide a constant speed motor not greater than 1500 rpm, with space heater (if required) for each fan assembly.
- The motor drive shall be suitable for electrical conditions in accordance with Annexure 6.
- Fan shall be shop run and tested

1.4.3 Terminal Points

The Vendor shall furnish all equipment and services necessary to connect the equipment to the Purchaser's system. Connections will include, but are not limited to the following as required by this specification:

- Electrical inlet junction box.

- Evase supplied and supported by the Vendor, any losses associated with non-ideal evase dimensions to be accounted for in the fan performance. Vendor shall review Purchaser's discharge pipe/ duct configuration and provide suitable transition requirement to meet the Purchaser's outlet pipe/duct.

1.4.4 Industry Reference Documents (Codes and Standards)

At a minimum, all work performed and materials provided by the Vendor must be in accordance with all applicable Central, State and local laws, ordinances, and regulations.

The equipment will comply with the applicable portions of the following Codes and Standards. The applicable revision of each of these Codes and Standards will be the current edition with addenda or the edition adopted by the controlling jurisdiction at the time of the purchase order. In the event of a conflict between these documents and the specification, the Vendor shall submit a written request for an interpretation by Purchaser. In general, the most stringent requirement shall govern.

- American National Standard Institute (ANSI)
- American Society of Testing and Materials (ASTM)
- American Society of Mechanical Engineers (ASME)
- Air Moving & Control Association (AMCA)
- American Gear Manufacturers Association (AGMA)
- Anti-Friction Bearing Manufacturers Association (AFBMA)
- Institute of Electrical and Electronic Engineers (IEEE)
- Insulated Power Cable Engineers Association (IPCEA)
- International Organization for Standardization (ISO)
- Steel Structures Painting Council (SSPC)
- National Electrical Code (NEC)
- National Electrical Safety Codes (NESC)
- National Electrical Manufacturer's Association (NEMA)
- American Welding Society (AWS)
- Occupational Safety and Health Administration (OSHA)
- British Standard (BS)
- Indian Standard (IS)
- IS 325 Three-phase induction motors.
- IS 4691 Degrees of protection provided by enclosures for rotating electrical machinery.
- IS 2074 Ready mixed paint air drying red oxide-zinc chrome, priming
- IS 2932 Enamel synthetic, exterior (a) under coating. (b) finishing
- IS 4894 Specification for centrifugal fans
- IS 2062 Hot rolled structural steel.
- IS 12744 Ready Mixed Paint, air Drying, Red Oxide Zinc Phosphate, Priming specific:at1on
- IS 1231 Dimensions of Three-phase Foot-mounted Induction Motors
- IS 4722 Rotating Electrical Machines- Specification
- IS 6362 Designation of Methods of Cooling of Rotating Electrical Machines
- IS 2253 Designation for types of construction and mounting arrangement of rotating
- electrical machines
- IS 12065 Permissible limits of no1se level for rotating electrical machines
- IS 12075 Mechanical Vibration of Rotating Electrical Machines with Shaft Heights 56 mm
- and Higher - Measurement, Evaluation and Llm1ts of Vibration Seventy
- IS 5 Colours for Ready Mixed Paints and Enamels
- ISO 1940 Balance quality of rotating rigid bod1es.
- BS 848 part - I Methods of testing performance

1.4.5 Noise Requirements

The Vendor shall provide silencers and/or acoustic insulation for equipment to operate with a maximum noise emission level of 85 dBA at 1 meter from source.

1.4.6 Operating Sequences / Duration

Fans will operate continuously and will be located in the vicinity of an operating coal fired power plant.

When the boiler is shut down for a long period of time, the fan will also be shut down.

1.4.7 Instrumentation and Controls

Vendor shall furnish terminal boxes as part of fan/motor assembly

1.4.8 Pipe, Valves, and Fittings

Vendor shall include the necessary piping, valves etc. for drains, lubrication and cooling system if required.

1.4.9 Surface Preparation and Painting

- The equipment constructed of carbon steel shall be surface prepped and painted per Vendor's standard on all exposed surfaces to protect against rust and corrosion during the shipping, installation and operation of the equipment (primer and finish paint). Vendor will also comply with painting schedule applicable for this enquiry.
- Vendor shall finish paint all carbon steel surfaces not to be insulated.
- Materials not subject to rusting shall be provided unpainted.

1.4.10 Spare Parts

Vendor shall provide a list of recommended spare parts including start-up and commissioning spares and special tools if any, and a schedule of part replacements based on the operation and service conditions specified.

1.4.11 Vibration level

Vibration level shall be as per IS 10816

1.4.12 Documents to be furnished with the Proposal

1.0 Product catalogue and drawings in support of the offer shall be submitted with the quotation to evaluate the offer.

2.0 Filled in Annexures 1 to 7 of this specification (wherever applicable).

3.0 Fan and motor assembly general arrangement drawing. Refer section 2.0 of Annexure-4 to this specification.

4.0 Vendor to furnish the Silencer support (if applicable) and fan & motor foundation details.

5.0 Parts Catalogue with Bill of material (BOM) and weight particulars.

6.0 The supplier shall return a copy of this specification and note at the end of each paragraph if the offered equipment complies or not with this specification with supplier sign and seal.

7.0 The supplier shall fill & submit the Enquiry deviation sheet furnished along with this enquiry so as to indicate that they follow all the specification requirement without any deviation. If any deviations are listed, then the offer may be subject to rejection, unless acceptable by BHEL's evaluation team.

8.0 Recommended spare parts list.

1.4.13 Documents to be furnished after award of Contract

1.0 Packaging procedure detailing the list of components and Weight details shall be dispatched individually with identification.

2.0 All filled in Annexures 1 to 7, including G.A drawing with foundation details, Bill of material with weights and any additional design information shall be submitted to get approval from bidder / End user.

3.0 Operation & maintenance manual.

Attachments and Reference Documents

1.5 Design and Record Sheets (Annexures)

Document No.	Description
Annexure – 1	Site & Plant Information
Annexure – 2	Performance Data – Mechanical Draft Centrifugal Fans
Annexure – 3	Mechanical Draft Centrifugal Fan Selection
Annexure – 4	Fan Construction Features and Accessories
Annexure - 5	Project Specific Transmittal for LT AC motors and DC motors
Annexure - 6	TCI:140/Rev 13 – Technical specification of LT AC and DC Motors
Annexure - 7	AC Motor Datasheet

Annexure -1

Site & Plant information

Site & Plant Information

1. Ambient Temperature (Design and Guarantee of SG) : 27°C
2. Ambient Temperature range : 5°C – 50°C
3. Relative Humidity range : 60%-84%
4. Height above MSL : 34.0 m

5. Seismic zone : Zone III as per IS: 1893 latest edition
   Importance factor : As per Table-2 of IS: 1893 (latest version)

6. Wind Data : Mean wind speed: 47 m/s
   Risk co-efficient K1 : 1.07
   Terrain Classification : Category-2

Annexure -2

1.0 General Information **Material Code: L17311SR30001001**

Customer Name: WBPDCL		
Project : SAGARDIGHI THERMAL POWER PLANT 1X660 MW		
Customer No: 1731		
1.01	Equipment Name: Dilution air Fan	
1.02	Quantity:	2 No's (1 Working + 1 Standby)
1.03	Tag Number(s):	HSG10 AN001, HSG11 AN001
1.04	Indoor/Outdoor:	Outdoor

2.0 Design Criteria

		Units	Values
2.01	Type of fan	-	Centrifugal fan
2.02	Medium to be handled	--	Atmospheric Air
2.03	Elevation above mean sea level	m	34
2.04	Inlet Temperature range	°C	5 to 50
2.05	WR^2	kg/m^2	*

* Vendor to fill

3.0 Performance Data

		Units	Design point
3.01	Fans in Service	#	1
3.02	Air Flow Entering Each fan	m^3/s	2.3
3.03	Air Inlet Temperature	°C	5 to 50
3.04	Total head developed	mmWc	450
3.05	Suction side head	mmWc	-25
3.06	Discharge side head	mmWc	425
3.07	Rotor Speed	rpm	*
3.08	Tip Speed	fpm	*
3.09	BHP	--	*
3.10	Inlet Density [see Note 2]	kg/m^3	1.05
3.11	Inlet Velocity	m/s	*
3.12	Outlet Velocity	m/s	*
3.13	Fan Static Efficiency	%	*

*** - Vendor to fill.**

Notes:

1.0 Based on inlet grain loading of Fill-in g/m3, the fan rotor and scroll must be suitably protected from erosion for a period equal to the Fan Guarantee period as specified without having to shut down for erosion repair during such period

2.0 Corrected for elevation, temperature, and inlet static pressure. Fan Vendor to back check and notify "BHEL" of any discrepancy.

3.0 Static pressure at inlet is at the inlet of the silencer/piping upstream of the dilution air fan.

ANNEXURE - 3

MECHANICAL DRAFT CENTRIFUGAL FAN SELECTION

1.0 Arrangement

S.No	Description	Units	Value
1.01	Type of fan	-	Centrifugal fan
1.02	Number of Fans per SCR	#	2 No's (1 Working + 1 Standby)
1.03	Arrangement Type	-	Vendor to fill
1.04	Arrangement Configuration	(1, 2, 3, 4, 7, 8)	Vendor to fill
1.05	Rotation	(CW, CCW)	Vendor to fill
1.06	Inlet	(Vertical, Horizontal, Other)	Vendor to fill
1.07	Outlet	(Vertical, Horizontal, Other)	Horizontal
1.08	Wheel removal Direction	-	
1.09	Terminal point of Fan (refer note 2)	-	NB 500 (OD 508 X 6.4T)

2.0 Design Criteria

S.No	Description	Units	Value
2.01	Fan Location	(Indoor / Outdoor)	Outdoor
2.02	Maximum Fan Speed	rpm	1500
2.03	Drive	(Electric, Turbine, etc.)	Electric
2.04	Drive Supplier	(BHEL, Vendor, Other)	Vendor to fill
2.05	Fan Draft Loss Responsibility [see Note 1]	-	Vendor to fill

Notes:

1.The pressure losses for vendor supplied accessory items such as inlet and outlet dampers, silencers, screen and evase duct and breeching sections must be accounted for. Therefore, if the fan manufacturer supplies these items, the appropriate loss shall be added to system requirements and the fan selected for the sum of the overall pressure losses. The fan manufacturer shall also establish that the appropriate loss has been incorporated in the fan rating.

2. The fan discharge end shall be provided with transition piece (if required), flanges and counter flanges along with required fasteners and non- asbestos gaskets to match with the pipe sizes specified.

3. The Fan suction side is completely under vendor scope.

4. All duct portions of the fan shall be minimum 5 mm thick and the blades minimum 3 mm thick.

ANNEXURE - 4

Fan Construction Features and Accessories

Material Code: L17311SR30001001 to 007

Section 1.0 Technical Data

S.No	Description	Units	Value
1.01	Fan model	-	*
1.02	Fan arrangement	-	
1.03	Resonant speed	rpm	*
1.04	Critical speed	rpm	*
1.05	Rotor inertia	kgm^2	*
1.06	Rotor weight	kg	*
1.07	Fan Moment of inertia	kgm^2	*
1.08	Maximum unbalance force	kg	*
1.09	Wheel blade tip diameter	mm	*
1.10	Wheel inlet diameter	mm	*
1.11	Wheel width	mm	*
1.12	Blades		
1.12.01	Blade type	-	*
1.12.02	Number of blades per side	-	*
1.12.03	Blade material	-	*
1.12.04	Blade thickness	mm	*
1.12.05	Blade liner material	-	*
1.12.06	Blade liner thickness	mm	*
1.12.07	Blade solid nose piece material	-	*
1.13	Hub design: bolted, welded, integral	-	*
1.14	Bolts number and size	-	*
1.15	Hub/cone material	-	*
1.16	Center plate scalloped	Yes / No	*
1.17	Center plate liner material	-	*
1.18	Center plate liner thickness	mm	*
1.19	Back/center plate material	-	*
1.20	Back/center plate thickness	mm	*
1.21	Shroud/flange/side plate material	-	*
1.22	Shroud/flange/side plate thickness	mm	*
1.23	Shaft dual extension	Yes / No	*
1.24	Shaft max./min. diameters	mm	*
1.25	Shaft material	-	*
1.26	Bearing		
1.26.01	Centers	mm	*
1.26.02	Type	-	*
1.26.03	Size	mm	*
1.26.04	Water cooling	lpm	*
1.26.05	Lubrication	-	*
1.26.06	Re-lubrication requirements	-	*

1.27	Cut-off modification	Yes / No	*
1.28	Fan housing		

1.28.01	Material	-	*
1.28.02	Thickness	mm	*
1.28.03	Stiffener size	-	*
1.28.04	Liner material	-	*
1.28.05	Fan housing liner thickness	mm	*
1.29	Fan outlet transition piece	Yes / No	*
1.30	Fan discharge size (of transition piece to match BHEL terminal point)	mm	*
1.31	Fan outlet flange, counter flange, gasket and fasteners provided?	Yes / No	*
1.32	Evase length, if required	mm	*
1.32	Evase discharge size, if required	mm	*
1.33	Inlet cone	Yes / No	*
1.34	Pedestal & soleplate	Yes / No	*
1.35	Fan bearing/motor base thickness	mm	*
1.36	Fan / Fan bearings / Motor common base	Yes / No	*
1.37	Shaft seal type/size	-	*
1.39	Shaft seal material	-	*
1.40	Coupling type and size	-	*
1.41	Coupling service factor	-	*
1.42	Vibration level at casing		< 4.5mm/s as per ISO 10816 -1
1.43	Isolator base	Yes / No	*
1.44	Silencer	Yes	*
1.45	Insulation required	Yes / No	*
1.46	Inlet filter	Yes	*
1.47	Inlet screen	Yes / No	*
1.48	Flexible connections	Yes / No	*
1.49	Fan starting Torque	Kgm	*
1.50	Fan Full load torque	Kgm	*
1.51	Efficiency of Fan		*
1.52	Noise level	dBA	<85dBA @1m distance
1.53	Weight per assembly	Kg	*
1.54	Inspection & Testing		
1.54.01	Performance test	-	*
1.54.02	Vibration test	-	*
1.54.03	Running test	-	*
1.55	Painting	-	*
1.56	Packing	-	*
1.57	Documents	-	*
1.58	Guarantee	-	*

*** Vendor to fill.**

Technical Pre-Qualification Requirement (PQR) for

Dilution Air Fan & Motor assembly with accessories

1. The vendor shall be an established **Dilution air fan** supplier having adequate Engineering, Manufacturing, testing and servicing facilities and shall furnish technical backup documents in proof for above requirements.
2. The vendor shall have experience of having supplied **dilution air fan & motor assembly** as per the technical specification for power plant application or applications of similar severity. Supply reference list with details of PO, PO date, customer name shall be submitted.
3. The **dilution air fan & motor assembly** offered shall be from the existing regular supply range of the vendor. Vendor shall provide the product catalogue.
4. Proven track record is required. Minimum One end user certificate for the satisfactory operational performance of their product supplied meeting requirements specified in enquiry specification or greater.

   (Or)

   Successfully executed two POs for same item meeting requirements specified in enquiry specification or greater.

   Vendor to submit the corresponding datasheets / drawings / technical documents of supplied item as per POs / end user certificate.
5. In case of ordering, the Vendor shall have the responsibility for the following and same to be confirmed point wise.
   i) Vendor should have the component replacement responsibility in case of defect / failure.
   ii) Experts from Vendor's side shall associate in commissioning activities at site, if required.
   iii) Vendor should ensure the product performance during erection & commissioning and ensure performance guarantee.
6. Backup document checklist to meet PQR to the fullest satisfaction of BHEL:

To meet Clause	Document Acceptable	Check list
1	i) ISO or Other third Party certification about the engineering, manufacturing, testing and servicing facilities in the name of Vendor as applicable. The certificate shall be specific for the product quoted by the vendor. ii) List of manufacturing, testing and servicing facilities available (like machinery/equipment) in the letterhead of Vendor as applicable.	☐
2	Supply reference list with details of PO, PO date, customer name, application severity/type in the form of a table	☐
3	Product Catalogue in the name of supplier as applicable	☐
4	Min. one end user certificate (or) Two POs in the name of supplier as applicable	☐
5	Signed copy of this technical PQR document	☐

Vendor's Sign with Seal