BHARAT HEAVY ELECTRICALS LIMITED

TIRUCHIRAPPALLI-620014

Fuel Systems/PE(FB)

Title Sheet

Technical Purchase Specification for

Agitator / Stirrer along with motor and other accessories

Specification No.: **TSR:021** Revision No.: 01

1	08.04.2021	-	General Revision	GS	VSN	VSN
Rev No.	***Rev. Date***	***Clause***	***Description***	***Prepared***	***Checked***	***Approved***

	Name	***Signature***	***Date***
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	Specification for **Agitator / Stirrer along with motor and other accessories**	**TSR : 021** **Revision No.: 01**

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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 agitator / stirrer along with motor, their auxiliaries and other accessories. The vendor is solely responsible for correct design, engineering, construction and installation of this scope of supply.
- In the event of conflicts between codes, standards, this specification and the customer specifications, the more stringent requirements shall apply and the conflict between these shall be submitted to BHEL in writing. Vendor shall comply with all customer specifications (if applicable) unless BHEL approves the exceptions requested by vendor in writing.
- No deviation or exception from this specification shall be permitted without the written approval of BHEL. Intended deviations shall be separately listed by the vendor and supported by reasons for consideration of BHEL.
- Compliance with this specification shall not relieve the vendor of the responsibility of furnishing equipment and accessories of proper design, materials and workmanship to meet the specified operating conditions.

1.2 Equipment, Materials and services by Vendor

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

- Equipment and ancillaries as defined in datasheets for agitators, including impellers, shafts, gearboxes, belts, couplings, guards, motors, base plates and instrumentation.
- Dimensioned outline drawings of the agitator assemblies showing equipment weights, nozzle loads and locations and sizes of all mechanical and electrical connections.
- Miscellaneous items such as stainless steel tagging, lifting lug, etc.
- Equipment datasheets are to be completed by the vendor in order to inform the BHEL as to the specifics of the equipment being supplied.
- Special tools required for installation, start-up, operation and maintenance. For example, if a special lifting device is required during shop fabrication, that device must be available at the construction site for installing that piece of equipment.
- Manuals and instructions for storage, installation, commissioning, operating and maintenance, shall be delivered during the supply stage to meet the Drawing and Data Transmittal Schedule (DDTS) requirements.
- Detailed procedures on the handling and storage at the jobsite of all vendor supplied material.
- Vendor shall provide complete engineering drawings and calculations related to the mounting and stresses imposed during the operation of this equipment for BHEL's review. BHEL's review of calculation shall not relieve the vendor of his responsibility in any manner. The fabrication drawings and other documents shall also be submitted in accordance with the bid document.

1.3 Equipment, Materials and Services by Others

The scope of supply by others shall be:

- Unloading and storage at the job site.
- Mounting nozzles and anchor bolts.
- Installation.
- Monorails and hoists.
- Structural support steel.
- Electrical wiring, conduits, trays, push buttons and starters external to vendor supplied equipment.
- Control interface and remote alarms.

1.4 Performance Guarantees

Unless otherwise specified in General Purchase Conditions (GPC) regarding guarantee, the following shall govern.

- The equipment provided by the vendor shall operate as a minimum in accordance with the performance data in the datasheet(s) and the noise requirements for a period as 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 guarantee the equipment for design, materials, workmanship and specified performance for a period as specified in GPC. Defects/ short falls, if any, shall be rectified by the vendor at his cost by repair and/or replacement without any delay.
- BHEL and/or customer may conduct field performance tests during startup and after commercial operation of the installation for a period determined by the terms and conditions of purchase.
- Review of design/drawing by BHEL or release of equipment for shipping in no way release or relieve the vendor of any responsibility for making the supplies in accordance with all provisions of this specification.

1.5 Detailed Requirements of Equipment

1.5.1 General

- All agitator components subjected to process conditions are to be constructed of materials compatible with the process conditions.
- All agitators shall be direct, or belt driven depending upon customer specification (if applicable).
- The material of agitator should not be of copper, zinc, an alloy of zinc or copper. No galvanizing material should be present either.
- Operation of an agitator shall not overload any component of the agitator assembly while running when the liquid level in the vessel is at any point from minimum to full.
- Vendor shall state minimum operating liquid level for all agitators.
- Vendor shall provide a detailed description of any special lifting and/or installation requirements.
- Each agitator shall include:
  - ❖ Mounting plate or flange and complete support system.
  - ❖ Other equipment and material as required to provide a complete unit, including any

support legs or supports necessary to maintain equipment mounting.

- Vendor shall design the agitator tip speed low enough to be suitable for the intended service. Tip speeds and shaft speeds shall be based on vendor's successful operating experience.
- The agitator shaft diameter shall be sized for two times the calculated diameter.
- Impellers and impeller shafts shall meet the following requirements:
  - ❖ Impeller thrust shall not be transmitted to the motor.
  - ❖ Top mounted agitators shall not use steady bearings within the tank.
  - ❖ Lubricant leakage into the vessel shall be prevented by a dry-well seal for top-entry units.
- Vendor shall be determine if tank baffles are required for proper flow pattern.
- 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's must be received before equipment is delivered to the jobsite.
- Lifting eye bolts shall be provided for driver, gear box, etc. for ease of lifting and shall be located at the centre of gravity of the part.
- Vendor shall provide proper dowelling between motor and base plate, gear box and mounting stool/base plate for ease of assembly of the agitator unit. Tapered dowels shall be provided.
- Vendor shall provide suitable arrangement for supporting the agitator shaft with impellers during removal of gear box for maintenance and details of such arrangement shall be furnished.
- Vendor shall provide a detailed description of any special lifting and/or installation requirements.
- Vendor shall provide a detailed documentation on the required location of the oxidation air lance to be mounted in the discharge area of the impellers.
- Instructions for assembly and lubrication must accompany each shipment.
- Vendor shall provide detailed documentation with each shipment of the procedures for handling and storage prior to installation and then from installation to commissioning.

1.5.2 Gear Units

- In case where reduction of speed is required, the vendor shall incorporate helical or worm gear reduction unit. Use of V-belt/chain drive shall require the approval of BHEL. Minimum design life of V-belt shall be 25000 hours.
- The gear box rating shall be selected based on minimum gear service factor of 1.5 over the driver's name plate rating. The gear box shall be of heavy duty type and the bearings shall be capable of withstanding maximum radial cum thrust loading which may occur during operation.
- The reduction unit shall be procured from a reputed manufacturer and shall conform to BS: 721 (latest edition) / AGMA or equivalent specification. The accuracy shall be to class A limits of the above specification.

1.5.3 Impellers and Seals

- Impellers with small diameter shall be one piece construction. Impellers with large diameter blades shall be of bolted construction.
- All impellers shall be dynamically balanced.
- Seals, when specified shall be of standard manufacturing range and shall be procured form a reputed manufacturer.

1.5.4 Bearing housing and bearings

- The bearing housing shall be designed with a span suitable for the maximum radial cum thrust loadings used for the design of the shaft. The housing shall be bolted to the mounting stool and be provided with a precision machined step facing to make a corresponding facing on the stool for the purpose of maintaining alignment and interchangeability.
- All bearings shall be designed for the maximum radial cum thrust loading and any shock loadings expected during operation. The bearings shall have a trouble free operating life of 30,000 hours minimum.

1.5.5 Materials

- Vendor shall indicate the materials of construction for the various parts on the data sheet. However, the vendor shall adhere to the materials as specified by BHEL in the datasheets or elsewhere in the specification and shall quote accordingly. IS, BS, ASTM or other international standards shall be used to specify exact material designations.
- Castings used for any part of agitator assembly ordered under these specifications shall be sound and devoid of shrink or blow holes, scale, blisters and other similar casting defects.
- Unless otherwise specified in the datasheets, material test certificates (chemical analysis and mechanical properties) shall be supplied for impeller, shaft, mounting flange and coupling.

1.5.6 Electric Drives

- Unless stated otherwise, the driver shall be in the scope of agitator vendor. The driver shall conform to the corresponding specifications listed in the enquiry document.
- The electric motor shall be suitable for the electrical area classification indicated in the specification/datasheets.

1.5.7 Terminal Points

The Vendor shall furnish the equipment ready to connect to the BHEL's mounting flanges and electrical conduits.

1.6 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.
- Pressure containing parts and mounting flanges shall be designed, fabricated, tested and inspected in accordance with the ASME codes, unless otherwise specified.
- 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 BHEL. In general, the most stringent requirement shall govern.
  - ❖ American Society of Civil Engineers(ASCE)
  - ❖ American National Standard Institute (ANSI)
  - ❖ American Society Of Testing And Materials (ASTM)
  - ❖ American Society of Mechanical Engineers (ASME)
  - ❖ American Gear Manufacturers Association (AGMA)
  - ❖ Anti-friction Bearing Manufacturers Association (AFBMA)

- ❖ Institute of Electrical and Electronic Engineers (IEEE)
- ❖ International Organization For Standardization (ISO)
- ❖ National Electrical Code (NEC)
- ❖ National Electrical Manufacturer's Association (NEMA)
- ❖ American Welding Society (AWS)
- ❖ Occupational Safety and Health Administration (OSHA)
- ❖ Underwriters Laboratories (UL)
- ❖ Petroleum and Explosive Safety Organization (PESO)

1.7 Inspection and Testing

1.7.1 Hydrostatic test

Each pressure part stuffing box jacket or seal reservoir of a unpressurized/pressurized sealing lubrication system, etc., shall be hydrostatically tested with water at a pressure not less than one and a half times the maximum operating pressure. The duration of the test shall be 30 minutes. Criteria of acceptance shall be of no leaks.

1.7.2 Mechanical Run Test (in air)

Each agitator unit shall be given a 4 hour mechanical run test in air at vendor's shop. Agitator unit shall be mounted in the same manner as it will operate in the field. During this test, the record shall be made of:

i. Shaft run out at the free end.
ii. Dynamic shaft deflection adjacent to the mechanical seal/packing/vapor seal.
iii. Gear box oil temperature and temperature of bearing housing.
The temperature of gear box oil shall not exceed ambient plus 40 °C and that of bearing housing shall not exceed room temperature plus 20 °C after the temperatures have stabilized.
iv. Bearing housing vibration check shall be carried out. The maximum acceptable vibration velocity shall be 6 mm/sec.
v. Noise levels shall be checked and shall be as per clause 1.7.
vi. Agitator shaft rpm and motor rpm.
vii. Check of satisfactory operation of shut off and retracting arrangement.

1.7.3 Mechanical Run Test (in water)

If specified in the datasheets, the agitator unit shall be given a load test in water at the vendor's shop. The duration of the test shall be 4 hours unless agreed otherwise between BHEL and the vendor. The following parameters shall be recorded during the test:

i. Dynamic shaft deflection adjacent to the mechanical seal/packing/ vapor seal
ii. Gear box oil temperature and temperature of bearing housing.
The temperature of gear box oil shall not exceed ambient plus 40 °C and that of bearing housing shall not exceed room temperature plus 20 °C after the temperatures have stabilized.
iii. Bearing housing vibration check shall be carried out. The maximum acceptable vibration velocity shall be 6 mm/sec.
iv. Electrical power input to the motor.
v. Noise levels shall be checked and shall be as per clause 1.7.

vi. Agitator shaft rpm and motor rpm.

vii. Check of satisfactory operation of shut off and retracting arrangement.

1.8 Noise Requirements

- The noise level of unit when measured at 1 meter distance, shall not exceed 85 dBA. In this regard, the vendor shall submit noise emission data for the proposed unit. In a case where the noise levels are not met during the actual testing, the vendor shall suggest the corrective action required and additional cost that will incurred to satisfy the requirement for 85 dBA. This shall be submitted along with the bid document.
- Measurement to be made using the sound measuring criteria specified in the Occupational Safety and Health Administration (OSHA) Standards 29 CFR 1910.95 titled Occupational Noise Exposure.

1.9 Operating Sequences/Duration

The agitators will operate intermittently in conjunction with acid dosing pumps and in a start/stop cycling mode not to exceed the cycles specified by the motor manufacturer.

1.10 Instrumentation and Controls

Instruments and controls are to be supplied as indicated in the datasheet for agitators (if applicable).

1.11 Surface Preparation and Painting

- Unless otherwise specified, equipment constructs of carbon steel shall be surface prepared per SSPC and painted per Vendor's standard on all exposed surfaces, with primer and finish paint, to protect against rust and corrosion during shipping, installation and operation of the equipment.
- Vendor shall finish paint all carbon steel surfaces not to be insulated.
- Materials not subject shall left unpainted.

1.12 Field Service

- At the request of the BHEL, vendor shall depute a field engineering expert to provide technical assistance during construction/installation and commissioning. BHEL will give the vendor sufficient notice prior to the site requirement for field service.
- Vendor stipulations that require a field service engineer or technician, such as inspection prior to equipment startup, shall be indicated in writing.
- The agitator shall be located at a maximum possible distance from the acid dosing pumps.

1.13 Spare Parts

- Vendor shall provide a list of recommended spare parts along with a schedule of replacement of the parts based on the operation and service condition specified.
- Purchase price shall include one full set of construction and commissioning spares plus all special tools required for construction, installation, startup and maintenance to be shipped with the original equipment.
- Vendor shall submit the offers including and excluding the price of the above items.

	Specification for **Agitator / Stirrer along with motor and other accessories**	**TSR : 021** **Revision No.: 01**

DATA SHEET OF Agitator

BHEL Material Code: L81001SR15006001

Enquiry No.

	DESCRIPTION	**Units**	**BHEL**	**Vendor**
	No of agitators		1	
1	**Design conditions**			
1.1	Agitator Type		Top Entry	
1.2	**Tank**			
a	Volume (Total)	m^3	10.5	
b	Height	m	2.85	
c	Length by Width	m	3.5X2	
d	Liquid Level Height (Maximum)	m	1.5	
e	Liquid Level Height (Minimum)	m	Seller Fill-in	
f	Baffles (Quantity & Size)	-	Seller Fill-in	
1.3	**Liquid Properties**			
a	Density	kg/m^3	992	
b	Solids Content	Wt %	0	
c	Temperature	°C	50	
d	pH Range		5 to 9	
e	Maximum Chloride Content	ppm	0	
f	Viscosity	cp	1	
g	Fluid handled	-	Mixture of NH_3, H_2O & H_2SO_4	
1.4	Oxidation Air Flow (Total to Abs. Reaction Tank)	Nm^3/hr	NA	
1.5	Power Supply	V-AC / Ph / Hz	415 / 3 / 50	
2	**GUARANTEED PERFORMANCE**			
2.1	No Load Impeller Speed	rpm	*	
2.2	Motor Power Under Load	kW	*	
2.3	On-stream availability	%	*	
2.4	Maximum Noise Level	dBA @ 1 m	<85 dBA	
3	**Design**			
3.1	Model of agitator	-	*	
3.2	Agitator Speed	rpm	*	
3.3	Shaft Diameter	mm	*	
3.4	Shaft Length (Total)	mm	*	
3.5	Shaft (Number of Pieces)	#	*	
3.6	Shaft Material	-	*	
3.7	Impeller Quantity	#	*	
3.8	Impeller Material & Type	-	*	
3.9	Impeller Diameter	mm	*	
4	Gearbox Manufacturer		*	
4.1	Gearbox Model Number		*	
5	Mounting Flange (Size and Type)		*	
6	Gearbox Lubrication Type		*	
6.1	Motor type and model			
7	**Special Requirements**			
			BHEL	**VENDOR**
	Prepared		Preetam	
	Checked & Approved		MCHS gangadhar	

* Vendor to fill

This datasheet shall be read along with the general specification for agitator.

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. 12

Revision History

Rev. No.	Date	Description	Prepared	Reviewed	Approved
01 -11		Earlier Revisions	-Sd-	-Sd-	-Sd-
12	22-08-19	General Revisit			

Sl. No.	Description	Requirement
1	Site Conditions :-	
	Altitude above MSL	500 metres
	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-1231, IS-6362, IS-2253, IS-5572, IS-12065, IS-12075, IS/ IEC-60079, IS-12615, IS/ IEC-60529 & IEC-60034. (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	IE-3 as per IS-12615/ IEC 60034-30.
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)

Sl. No.	Description	Requirement
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. 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. • The motor shall be designed to withstand momentary over-load of 60% of full load torque for 15 seconds without any damage. • The motor shall be designed to withstand 120 % of rated speed for 2 minutes without any mechanical damage.
13	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.

Sl. No.	Description	Requirement
14	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.
15	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.
16	Starting Current	The starting current (% of FLC) shall be limited as per the standard IS-12615.
17	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 < 110KW : 11
18	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.
19	Type of balancing of rotor	Dynamic balancing
20	Method of cooling	IC-0411 as per IS-6362
21	Direction of cooling air flow	NDE side to DE Side

Sl. No.	Description	Requirement
22	Winding wire	Enameled Copper Wire, Grade-2, as per IS-13730, Part-3. Windings shall be non-hygroscopic, oil resistant and flame resistant.
23	Treatment on Winding Insulation	Winding Insulation shall be given tropical and fungicidal treatment for operation of motor in hot, humid & tropical climate.
24	Noise level	Noise level shall be limited to 85 dB at 1 metre distance.
25	Vibration level	The peak amplitude of vibration shall be as per IS-12075 (Limits of Severity-Normal grade shall be followed).
26	Shaft extension	Motor shall be provided with key slotted bare shaft extension, with key at the drive end.
27	Terminal box	Weather proof terminal box shall be provided as per IS/IEC-60079. 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 IS60529. 1 No. Earth terminal shall be provided inside the terminal box. Minimum Distance between centre of the terminal stud & the gland plate and Minimum inter-phase/phase-earth air clearance shall be provided as per IS standards. 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.
28	Cable Entries, Cable Glands & Lugs	Cable entries, Cable glands and Lugs shall be provided suitable for the power cable size as indicated in the annexure (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.

Sl. No.	Description	Requirement
29	Terminals	Separate Terminals for Space heaters and Windings with suitable connecting links shall be supplied.
30	Body Earth	Shall have 2 Nos. of earth points (Threaded hole with suitable GI Bolt) at appropriate location (in motor base frame).
31	Space heater for motors rated 30 KW and above	Separate space heater suitable for 240 V AC, Single Phase supply shall be provided.
32	Lifting device	Eye bolt.
33	Project specific requirements	Vendor to take care of the project specific requirements indicated in the annexure - "Project specific transmittal".
34	Name Plates	Motor shall have name plate as per relevant IS and in addition, Manufacture's name, frame size, Energy Efficiency class, Insulation class shall also be indicated.
35	Quality assurance, Inspection & Testing	Motors up to 30 KW, Inspection by Vendor meeting the IS/ IEC standard requirements, as applicable. Routine & type test reports shall be submitted for review and acceptance by BHEL. For Motors >30 KW, Inspection by BHEL/ Third party Inspection TPI agency as per BHEL/ Customer approved VQP/ RQP. Routine tests will be witnessed by BHEL/ TPI. Type test reports shall be submitted for review and acceptance by BHEL. 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
36	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.
37	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.
38	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.
39	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.

Sl. No.	Description	Requirement
40	Painting	Paint shade shall be as per the purchase enquiry. The finish shall be corrosion resistant, epoxy based paint.

ATTACHMENT TO TENDER SPECIFICATION

Controls & Instrumentation/Fossil Boilers

Document Title	: **Project Specific Transmittal for LT AC motors**	
Transmittal Reference	: **TR: LT AC-DC MOTOR: 8100**	
Project Details	: **NALCO CPP – SCR package/Customer No. : 8100**	
Prepared & Checked – M. MURUGA PRABU/sd		Approved – ASWINI KUMAR PANDA/sd

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

Efficiency Class of LT motor and Cable Entry Details of LT AC Motor

Energy efficient level : IE3 as per IS 12615 – 2018.

Power cable size for LT AC 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. The cable sizes indicated below are tentative. The actual power cable size based on the 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.	0.01	3.70	3C-2.5mm^2(CU)
2.	3.8	11	3C-10mm^2(AL)/ 3C-16 mm2 (AL)/3C-25mm^2(AL)
3.	11.1	22	3C-25mm^2(AL)/ 3C-50mm^2(AL)
4.	22.1	45	3C-50mm^2(AL)/ 3C-95 mm^2(AL)
5.	45.1	75	3C-95 mm^2(AL)/ 3C-150 mm^2(AL)
6.	75.1	90	3C-150 mm^2(AL)/ 3C-185 mm^2(AL)
7.	90.1	110	3C x 240 mm^2(AL)

Relevant sheets of the contract specification.

1. The contract specific requirements/sheets are annexed with this document. If the requirements are spelt in both the technical specification of motor and contract specification, then the contract specification will supersede the respective clauses of the technical specification.
2. For Special type of motors coming under SCR applications, the applicability of the clauses in the contract specification, shall be as per the motor design and suitable requirements are to be care of by the vendor.

TABLE-4

SPECIFICATION FOR GENERAL PURPOSE 415 V AC MOTORS
(NOTE: TENDERER TO CONFIRM CLAUSE-WISE)

Sl. No.	Description	Requirement	Confirmation by Tenderer
1.0	**General**	General Purpose 415V Motors, Energy efficient type, generally rated up to 180 KW, with robust industrial design, fully de-rated for the ambient and duty conditions specified and fully conforming to Indian standards for Design, Construction and Testing features	
2.0	**Applicable Standards**		
2.1	Flame proof enclosure for electrical apparatus	IEC: 60079-1, 2007	
2.2	Permissible limits of noise level by rotating electrical machines	IS: 12065, 1987 (2009)	
2.3	Mechanical vibration of rotating electrical machines	IS: 12075, 2008	
2.4	Dimensions of 3-phase foot/flange mounted induction motors / vertical shaft motors	IS: 1231 / IS: 2223 / IS: 2254	
2.5	Energy Efficient 3 phase squirrel cage induction motors.	IS: 12615, 2011	
2.6	Method of determination of Efficiency of rotating electrical machines	IS: 4889	
2.7	Designation of methods of cooling of rotating electrical machines	IS: 6362, 1995 (2017)	

Section-III, Table-4 (cont'd)

Sl. No.	Description	Requirement	Confirmation by Tenderer
2.8	Rotating Electrical Machines - Rating & Performance	IS/IE:- 60034, Part-1 2004	
2.9	Degree of protection provided by enclosure for rotating electrical machinery.	IS/IEC: 60034, Part-5, 2000 (2007)	
2.10	Terminal marking and direction of rotation for electrical machines	IS/IEC: 60034, Part-8, 2002	
2.11	Methods of measuring temperature rise of electrical equipment	IS: 9678, 1980 (2009)	
2.12	Safety	Central Electricity Authority (CEA), I.E. Rules and guidelines of statutory authorities of Odisha State Government.	
3.0	**Environment**		
3.1	Voltage/System	415V $\pm$ 10%, Frequency 50 Hz $\pm$5%, 3 Phase, 4 wire System, solidly grounded neutral	
3.2	System Short circuit level	36 MVA	
3.3	Altitude/Temperature/RH	Less than 1000 m above MSL / 50 Deg C/ 100% RH	
3.4	Special requirements	Based on actual site requirements/ higher ambient where required	
3.5	Starting requirements for Direct On Line (DOL) starting	All DOL start motors shall be capable of starting and accelerating the coupled loads with 75% of the rated voltage at the motor terminals without injurious heating, within the rated hot thermal withstand time of the motor.	

Section-III, Table-4 (cont'd)

Sl. No.	Description	Requirement	Confirmation by Tenderer
3.6	Derating	The motor as well as its various components shall be suitably derated for satisfactory operation for specified altitude, ambient temperature, relative humidity, voltage and frequency variations, derating for special requirements stated above.	
4.0	**Execution Options**		
4.1	Adoption of type of motor		
4.1.1	Squirrel cage induction motors	For continuous duty applications for centrifugal fans/pumps and compressor drives	
4.1.2	Inverter grade motors	For satisfactorily working with IGBT transistor based inverter supplies	
4.2	Location	Indoor / Outdoor	
4.3	Speed (no of Poles)	To suit mechanical equipment supplier's requirement.	
4.4	Type of Mounting	IM 1001 / IM 1002 / other types to suit mechanical equipment supplier's requirement	
4.5	Method of cooling	IC 410 / IC 411 (as per IS 6362)	
4.6	Duty	Continuous duty S1 / other intermittent duties like S2 / S3 / S4 or any other duty to suit driven equipment's requirement / process requirement.	
4.7	Type of Starting / Controls	DOL Starting / IGBT based Inverter Circuit for variable speed drives	
4.8	Type of braking	Type to suit the driven equipment's requirement.	
4.9	No of starts for continuous duty motors	4 cold starts or 3 hot starts on an hourly basis	
4.10	Overload requirement	To suit driven equipment's requirement.	

Section-III, Table-4 (cont'd)

Sl. No.	Description	Requirement	Confirmation by Tenderer
4.11	Over speed requirement	To suit driven equipment's requirement.	
4.12	Degree of protection	IP 54 for indoor. IP 55 for outdoor with additional removable canopy protection over the motor.	
4.13	Accessories	Brakes / Clutches /Geared Limit switches / encoders /Embedded temperature detectors etc., as may be required for individual application and control	
5.0	**Construction details**		
5.1	Frame Sizes	To conform to IS / IEC standard frame sizes.	
5.2	Energy Efficient motors for continuous duty applications	Shall conform to category, "IE2 for the VFD application and IE3 for other application as per IS: 12615.	
5.3	Ratings	Ratings shall be as per the preferred series and shall be based on design ambient temperature of 50 deg. C. The rating shall suit the driven equipment's requirement. Nevertheless, the rating of the motors including the over-load requirement selected shall be based on the class of duty and the load imposed by the equipment with a minimum reserve of 10% over the maximum load demand of the driven equipment at the design duty or any other duty that may arise during operation.	
5.4	Starting Current requirements	~~To be limited to 6 times the rated full load current in the case of squirrel cage motors when started directly on line.~~ **The Starting current shall be limited as per the requirements of IS 12615 : 2011**	
5.5	Starting Torque Requirements	To suit driven equipment's requirement and in conjunction with the selection of the speed – torque characteristics described in 5.6 below.	

Section-III, Table-4 (cont'd)

Sl. No.	Description	Requirement	Confirmation by Tenderer
5.6	Matching of Speed-Torque Characteristics	The speed-torque characteristics of the motor and its driven equipment shall be fully matched in order to obtain smooth acceleration without overheating of the motor and over-stressing of the mechanical parts of the driven equipment.	
5.7	Moment of Inertia	The motor inertia shall be taken into account along with that of the driven equipment to arrive at the starting time which shall be within the limit value set by the thermal withstand time (hot) specified for the motor.	
5.8	Pull out torque	Pull out torque as required by the driven equipment shall be considered. However, a minimum 200% at rated voltage and frequency for squirrel cage motors shall be considered.	
5.9	Construction aspects in brief		
5.9.1	Housing	Cast Iron / Fabricated steel	
5.9.2	Stator	Low loss, insulated CRGNO silicon steel	
5.9.3	Rotor	Die cast aluminium / copper bars	
5.9.4	Shaft	Carbon steel EN8 with open key ways as required	
5.9.5	End shield and bearing cover	Cast Iron	
5.9.6	Bearing and lubrication	Ball/roller bearing with Lithium complex based lubrication.	
5.9.7	Oil seal	Synthetic rubber	
5.9.8	Fan	Polypropylene / aluminum alloy, bi-directional and with aero-dynamic design	
5.9.9	Fan cover	Deep drawn steel	
5.9.10	Motor feet	To be integrated cast with the stator to prevent breakage from vibrations.	

Section-III, Table-4 (cont'd)

Sl. No.	Description	Requirement	Confirmation by Tenderer
5.10	Windings and insulation for stator and rotor		
5.10.1	Windings	99.9% pure, electrolytic grade copper windings	
5.10.2	Insulation	Class F for DOL/RDOL application. Class H for VFD application.	
5.11	Temperature Rise	Limited to that of Class B.	
5.12	Terminal Boxes	The terminal boxes shall be of adequate size for terminating the required no. and size of XLPE insulated, armoured, stranded aluminium conductor cables. Adequate clearance shall be given between live terminals and covers. All six terminals shall be brought out in the terminal box for making star or delta connections as needed. Material: Pressed steel / Cast iron - Degree of Protection IP 55 and shall be possible to mount at top. Terminal Plate: DMC /Epoxy board with steel / brass studs. The orientation of the terminal boxes shall be changeable at site through rotation by 90 degrees.	
5.13	Number of shaft extensions	To suit driven equipment's requirement.	
5.14	Rating Plate / Lifting hooks/ lugs / drain holes with plugs / guards for free shaft ends and couplings	Standard arrangement to be provided.	
5.15	Anti-condensation Heaters	To be provided through separate terminal boxes. Indoor duty = 37 KW and above; Outdoor duty = 30 kW and above.	
5.16	Limits of vibration	The motor shall be dynamically balanced and shall satisfy the requirement specified in IS:12075.	

Section-III, Table-4 (cont'd)

Sl. No.	Description	Requirement	Confirmation by Tenderer
5.17	Limits of Noise level	The motor shall satisfy the requirement specified in IS: 12065 or lower values in specified cases / as per customer's requirement.	
5.18	*Temperature Detectors*	As required the motors shall have duplex type, two nos. per phase for winding temperature and two nos. for each bearing temperature, one for driven end & one for non driven end.	
5.19	*Special Requirement for Inverter grade Motors for satisfactory working in conjunction with IGBT Transistor based Inverters.*		
5.19.1	Increased insulation levels	For stator windings - turn to turn insulation, phase to phase insulation and ground insulation. (Insulation shall withstand a peak value of not less than 1600 V at the motor terminals)	
5.19.2	Formed coils	For higher frame sizes / kW ratings in place of wound coils	
5.19.3	Derating	Thermal derating due to reduced ventilation obtained in lower speeds for motors with IC 411 cooling. As an alternative, suitable separately powered cooling blowers mounted on the motor may be considered	
5.20	**Painting**	As per IS 5, Finish coat shall confirm to shade 632 for outdoor equipment and shade 631 for indoor equipment	
6.0	**Safety features**		
6.1	Earthing	The Motor body shall be provided with two (2) separate earthing terminals for earthing in compliance with I.E. Rules.	
6.2	Canopy for motor	To be provided for all outdoor installed motors.	

Section-III, Table-4 (cont'd)

Sl. No.	Description	Requirement	Confirmation by Tenderer
7.0	**Documents**		
7.1	Performance Curves	Tenderer to furnish the following Performance Curves 1) Matched speed-torque curves of the motors superimposed with those of the driven load. 2) Performance curves for Starting Current, Starting Time, Efficiency & Power Factor for each motor 3) Thermal withstand curves for both Hot and Cold condition.	
7.2	Calculation / data sheets supplied by drive manufacturer	Tenderer to furnish required data sheets for the Motor. Tenderer shall also furnish calculation for Motor Sizing.	

Annexure-Q
Minimum requirements of Quality plan for agitators

1. All raw material product forms viz. forgings, castings, etc. Supplier to include NDE requirements (like UT, MPI, etc.) for raw materials like shaft.

2. All the manufacturing stage shall be brought out clearly (viz. machining, welding, etc.) and the stage appropriate tests/inspections shall be specified in QAP.

3. As per technical specification TSR:021, Hydrostatic test (for each pressure part), Mechanical Run Test (in air), Mechanical Run Test (in water), Surface Preparation and Painting (as a separate clause), etc. are indicated. Supplier shall comprehensively bring out all the required tests/inspections given in the technical specification.

4. Testing Requirements of LT Motors as per Specification TCI:141, Rev-02 shall be included in QAP.

5. All required performance tests shall be included in QAP.

6. Supplier shall indicate manufacturing sequence of the agitator. The pertinent standards/reference documents (apart from drg.) that are used in each stage shall be mentioned in QAP.