THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED (WBPDCL)

1X660 MW SAGARDIGHI TPP, PHASE-III (UNIT-5)

TECHNICAL SPECIFICATION
FOR
MISCELLANEOUS PUMPS

Specification No.: PE-TS-445-100-N001 Rev 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BLDG., SEC-16A, PLOT NO. 25
NOIDA – 201301 (UP)

	TITLE: **TECHNICAL SPECIFICATION** **FOR MISCELLANEOUS PUMPS**	SPEC. NO.: **PE-TS-445-100-N001** SECTION: SUB-SECTION: REV. NO. **00** DATE 20.12.2021 SHEET **1** OF **1**

INDEX

THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

CONTENTS

Notes:

1) For detailed list of documents to be submitted by bidder in their technical offer, please refer cl. no. 15.00.00 of Section-IIA.

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

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

SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

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

SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

	TECHNICAL SPECIFICATIONS	Specification No. : PE-TS-445-100-N001, Rev0			
	MISCELLANEOUS PUMPS	SECTION:			IA
	SPECIFIC TECHNICAL REQUIREMENTS	REV. NO.	0	DATE:	20.12.2021

1.0 SCOPE

1.1 This enquiry covers the design, manufacture, assembly, inspection and testing at manufacturer's and/or his sub-contractors works, proper packing for delivery and installation checks and supervision of replacement of gland packing with Mechanical Seal arrangement (if applicable) at site for Miscellaneous Pumps along with mandatory spares complete with all accessories as per the requirements specified in this specification, PG test at site and any other services, etc. if called for in the succeeding sections of the specification for following project:

A. 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5)-----WBPDCL

1.2 The miscellaneous pumps covered under this specification shall be grouped under various group as under:

i. Horizontal Pumps
ii. Vertical Pumps

NOTE:-

1. The bidder shall include complete supplies for Pump Group as above in his scope. Part supplies offered for the Pump Group shall disqualify the bidder's offer for that Pump Group.

2. Pump details shall be as per Data Sheet-A at Section-ID.

3. If stated specifically in NIT, bidder shall include complete supplies for Project/Group as above in his scope. Part supplies offered for the Project/Group shall disqualify the bidder's offer for that Project/Group.

1.3 The miscellaneous pumps and drives covered under this specification for various projects are as per Annexure-1 of this section. HT drives, wherever applicable and irrespective of motor ratings, shall be issued free of cost by BHEL. The details of pumps with HT drives shall be as per Annexure-2 of this section.

1.4 The Capacity, Head, Materials of construction, Mandatory spares and other particulars of these pumps, are detailed in Data Sheet-A at Section-ID of the specification.

1.5 For detailed scope of supply & services for Horizontal pumps, refer Standard technical Specification for Horizontal Centrifugal pumps specified under Section-II of this specification.

1.6 For detailed scope of supply & services for Vertical pumps , refer Standard technical Specification for Vertical pumps specified under Section-II of this specification.

1.7 Electrical scope between BHEL and Vendor for Miscellaneous pumps and drives of this specification shall be as per Annexure-1 of Section-IB of this specification.

LT drives shall be energy efficient as per subsequent clauses mentioned elsewhere in the specification. **However whereever IE2 or EFF1 compliant motors are applicable same shall be provided with IE3 compliance.**

1.8 DELIVERY AND DOCUMENTATION:

Delivery and documentation schedule of miscellaneous pumps shall be as per NIT requirement.

1.9 Evaluation and LD criterion w.r.t. Auxiliary Power is defined at clause 4.0 of Section IIA of this specification. In case bidder quotes Aux. power less than Benchmark Auxiliary Power, then quoted Aux. power shall be replaced with Benchmark Auxiliary Power for both evaluation as well as LD purposes.

2.0 Additional requirements for Pumps:

2.0.1 End Customer specific requirements are indicated as Annexure-3 In this section, same are also to be complied. In case of any contradiction with other clauses of Section-IA, the stringentmost requirement is to be complied.

2.0.2 All the Pumps with HT Drives shall be provided with RTDs for each Pump bearing temperature monitoring / tripping. Two (2) nos. Duplex type RTDs shall be provided for Bearing Temperature measurement for each HT Motor Driven Pumps. Specification for RTD are attached at Section-1C.

2.3 For Horizontal Pumps:

2.3.1 For Horizontal Pumps, in case, shaft sleeve is threaded, a water slinger shall be provided on the Pump Shaft to avoid ingress of leaked water (if any due to failure of sealing arrangement for shaft sleeve) to Bearing.

2.3.2 In case of axial split casing Multistage pumps, minimum factor of safety of '2' times shall be considered for Pump bearing capacity selection and pump design.

2.4 For Vertical Pumps:

2.4.1 All Vertical pump motors shall be designed/capable of withstanding max. run away speed during reverse flow.

2.4.2 For Vertical pumps no thrust block is being provided. Bidder to design the pump foundation system (base plate/ sole plate, discharge head, foundation bolts etc.) capable of transferring the pump thrust to the concrete pump foundation itself.

2.4.3 For Vetical pump (ACW pump) -Provision shall be provided to prevent damage due to reverse rotation of the pump motor assembly such as: Non-reversible ratchet mechanism and reverse rotation indicator will be provided to prevent motor switching 'ON' while rotating in reverse direction. Alarm will be provided in owners TFT based monitor. Specification for Reverse rotation indicator is attached at Section-1C.

3.0 Vibration, Noise and Parallel run test (as applicable) for all pumps shall also be conducted by bidder at site as per approved PG Test Procedure, inline with Cl no. 3.04 of Secton-IIA of this specification. Mechanical run test along with Performance test shall be carried out on all pumps to determine the vibration levels, noise levels etc. at Vendor works. However, test value at site shall be used for the acceptance of the equipment. Pump vendor shall bring necessary instruments for conductance of site performance test. If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL.

4.0 Additional Dispatch Requirements:

MDCC after final inspection shall be provided to vendor on the basis of following:-

4.1 List of items packed in each box with description & quantity.

4.2 Photograph of each box in open & closed condition.

4.3 Bidder to include handling instructions in engineering drg/doc and packing to be done in such a way to avoid damage of items in transit and long storage at site and same shall be approved in contract stage by BHEL/Customer

5.0 Drawing/Document Submission Schedule:

MISC. PUMPS (HORIZONTAL)	PE-V7-445-100-N001	TDS AND PERFORMACE CURVES- MISC. PUMPS
	PE-V7-445-100-N002	GENERAL ARRANGEMENT AND CROSS SECTIONAL-PUMPS
	PE-V7-445-100-N003	TDS AND CURVES OF MOTORS FOR MISC. PUMPS
	PE-V7-445-100-N004	QP-MISC PUMPS
	PE-V7-445-100-N005	QP- MOTORS
	PE-V7-445-100-N006	MOTOR TYPE TEST DOC (if applicable)
	PE-V7-445-100-N007	O& M MANUAL -HORZ. PUMPS
	PE-V7-445-100-N008	PG TEST PROCEDURE -HOR. PUMPS

MISC. PUMPS (VERTICAL)	PE-V6-445-100-N001	TDS AND PERFORMACE CURVES- MISC. PUMPS
	PE-V6-445-100-N002	GENERAL ARRANGEMENT AND CROSS SECTIONAL-PUMPS
	PE-V6-445-100-N004	QP-MISC PUMPS
	PE-V6-445-100-N007	O & M MANUAL -VERT. PUMPS
	PE-V6-445-100-N008	PG TEST PROCEDURE -VERT. PUMPS

Drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

6.0 BIDDER TO COMPLY FOLLOWING AFTER PLACEMENT OF PO :

1) Supplier to submit detailed ‘ Bill of Material ‘ (BOM) at the time of drawing/document submission after placement of PO. Each item of the BOM to be uniquely identified with item code no. or item serial no.
2) Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BOM.
3) Supplier to also give the following undertaking in the BOM :

   “ The BOM provided herewith completes the scope (in content and intent) of material supply under PO No. ……., dated ……..
   Any additional material which may become necessary for the intended application of the supplied item(s)/package will be supplied free of cost in most reasonable time. ”

Annexure-1

List of Miscellaneous Pumps and drives for :

A. 1X660 MW SAGARDIGHI, PHASE-III (UNIT-5)-----WBPDCL

Sl. No.	Pump Description	Total Qty.
	Horizontal Pumps	
1	DMCW TG AUX. PUMPS	3 Nos.
2	DMCW SG AUX. PUMPS	2 Nos.
3	CYCLE MAKE UP PUMPS	1 No.
	Vertical Pumps	
1	ACW PUMPS	2 Nos.

Annexure-2

Following HT drives, irrespective of Motor ratings shall be issue free, by BHEL:

HORIZONTAL PUMPS:		
1	DMCW TG AUX. PUMP DRIVE	3 Nos.
2	DMCW SG AUX. PUMP DRIVE	2 Nos.

VERTICAL PUMPS:		
1	ACW PUMP DRIVE	2 Nos.

SECTION-II

HORIZONTAL CENTRIFUGAL PUMPS

1.00.00 **GENERAL INFORMATION**

1.01.00 This section presents the general guidelines and details of horizontal centrifugal pumps to be procured under the scope of this section and shall not be limited to the pumps specified under clause no. 3.00.00 below. For other horizontal centrifugal pumps in the scope of this specification, these general guidelines as specified hereinafter shall be followed.

2.00.00 **CODES AND STANDARDS**

2.01.00 The design, manufacture and performance of the horizontal centrifugal pumps as specified hereinafter, shall comply with the requirements of the following codes and standards and shall include all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01	IS-6595 Part-2/1993	:	Horizontal Centrifugal pumps for clear, cold and fresh water.
2.01.02	IS-5120/1977	:	Technical requirements for Rotodynamic special Purpose pumps.
2.01.03	IS-5639/1970	:	Pumps for handling chemicals & corrosive liquids.
2.01.04	IS-5659/1970	:	Pumps for process water.
2.01.05	IS-6536/1972	:	Pumps for handling volatile liquids.
2.01.06	IS-9137/1978	:	Code for acceptance tests for centrifugal, mixed flow and axial flow pumps - Class 'C'.
2.01.07	ISO 3555/1977 BS 5316/1977 Part 2	:	Acceptance tests for centrifugal, mixed flow and axial flow pumps - Class 'B' tests.
2.01.08	ISO 2548/1973 BS 5316/1976 Part 1	:	- Do - Class 'C' tests.
2.01.09	API-610/1989	:	Centrifugal pumps for general refinery services.

2.01.10 Standards of the Hydraulic Institute of USA (1983).

2.01.11 PTC 8.2/1965 : Power Test Codes - Centrifugal pumps.

2.02.00 In case of any contradiction with the above standards and annexures, the stipulations in the annexures shall prevail and shall be binding to the Bidder.

3.00.00 **SCOPE OF WORKS**

3.01.00 **Scope of Supply**

3.01.01 The scope of supply under this section shall be as below. Items specifically not mentioned but deemed necessary by the Tenderer for making the system completely reliable and efficient shall also be included.

a) Equipment

i) DMCW Pumps (TG) — Three (3) nos. Horizontal Centrifugal Pumps and drives complete with all accessories as specified in this section and in the annexures attached to this section.

ii) DMCW Pumps (SG) — Two (2) nos. Horizontal Centrifugal Pumps and drives complete with all accessories as specified in this section and in the annexures attached to this section.

iii) Cycle make-up Pumps — One (1) nos. Horizontal Centrifugal Pumps and drives complete with all accessories as specified in this section and in the annexures attached to this section.

iv) Any other horizontal centrifugal pump included by the Bidder within the scope of this section.

b) Equipment Accessories

Each pump set for all the above groups shall be supplied with the following accessories:

i) Couplings of approved design to connect pump shaft directly with the motor shaft.

ii) Sets of base plates, support plates, grounding pads, lifting lugs, eye bolts, nuts etc for each pump and motor set.

iii) Slip-on type drilled steel flanges of proper rating for both suction and discharge connections of each pump set. All the counter-flanges shall be complete with requisite number of bolts, nuts, gaskets etc.

iv) Air release cocks and drain plugs for each pump set.

3.02.00 For details regarding scope of services and works Volume-IIA of this specification shall be referred to.

4.00.00 **PERFORMANCE REQUIREMENTS**

4.01.00 Performance requirements for the pumps shall be as guided in Section-I of this volume and by the Annexures enclosed with this section.

4.02.00 Pumps shall preferably be designed to have the best efficiency at the specified duty point. The pumps shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated in the annexures attached with this section.

4.03.00 Pumps shall preferably have a continuously rising head-capacity characteristics from the specified duty point towards shut-off point, the maximum being at shut-off to enable parallel operation.

Under all circumstances, the 'range of operation' of the pumps shall exclude any unstable operating zone of the head - capacity curve.

4.04.00 Wherever specified in the annexures attached to this section, pumps of each category shall be suitable for parallel operation. The head vs. capacity, the BHP vs. capacity characteristics etc. shall be identical to ensure equal load sharing and trouble-free operation of any pump when the other pumps working in parallel with it trip.

4.05.00 The pump set along with the drive motor shall run smooth without undue noise and vibration. Acceptable peak to peak vibration limits shall be generally guided by the Hydraulic Institute Standards of USA.

5.00.00 **DESIGN AND CONSTRUCTION**

5.01.00 **Pump Casing**

5.01.01 Pump casing shall be provided with adequate number of vents and priming connections with valves unless the pump is made self- venting and priming. Casing drain, as required, shall be provided complete with drain valves.

5.01.02 Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

5.01.03 In cases where an expansion joint is located at pump discharge, the pump assembly will be subjected to an additional thrust which will be transmitted to the foundation. This additional thrust shall be taken into the consideration of pump design.

5.02.00 **Impeller**

5.02.01 The rotor assembly shall be dynamically balanced and designed with critical speed substantially above the operating speed.

5.03.00 **Wearing Rings**

5.03.01 Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing.

5.04.00 **Shaft**

5.04.01 Shaft size shall be selected considering that the critical speed shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

5.05.00 **Shaft Sleeves**

5.05.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the other faces of gland packing or seal end plate so as to distinguish between the leakage past shaft and shaft sleeve and that past the seals/glands.

5.05.02 Shaft sleeves shall be properly fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

5.06.00 **Bearings**

5.06.01 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each of the bearing housing.

5.06.02 Heavy duty sleeve/ball/roller type bearings shall be provided to take care of the radial loads.

5.06.03 In case of sleeve type radial bearings, axial thrust shall be absorbed in suitable hydraulic devices and/or thrust bearings.

5.06.04 Bearings and hydraulic devices (if provided for balancing axial thrust) shall be of adequate design for taking the entire pump load arising from all probable conditions of continuous operation, as specified in the annexures. Life of the bearings shall be guided by the design standard of the pump or as specified in annexures. Thrust bearing shall be capable of running continuously at maximum load.

5.06.05 The bearings shall be oil/grease lubricated. Suitable lubricating arrangement for the bearings shall be furnished with the pump complete all accessories like pump, filters, piping, fittings, valves, interlocking and supervising instruments etc. as necessary and specified in the Annexures. The design shall be such that the bearing lubricant does not contaminate the liquid being pumped.

5.07.00 **Stuffing Boxes**

5.07.01 Stuffing box design shall permit replacement of packing without removing any part other than the gland.

5.07.02 Stuffing boxes shall be sealed /cooled by the fluid being pumped/external clear water, as specified in the Annexures. All necessary pumps, piping, fittings, valves, instruments etc. as required for safe and trouble-free operation of the pumps and as specified in the Annexures shall be included in the scope of supply.

5.08.00 **Mechanical Seals**

5.08.01 Mechanical seals shall be provided if specified in the Annexures. The pump supplier shall co-ordinate with the seal maker in establishing the circulation rate for maintaining a stable film at the seal face in the chamber. The seal piping system shall form an integral part of the pump assembly.

5.08.02 When handling liquids near their boiling point, suitable arrangement for external cooling shall be provided so as to prevent flashing at the seal faces.

5.08.03 For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure, even when the pumps are not operating.

5.09.00 **Drive Unit**

5.09.01 The pumps shall be driven by electric motor or other driving equipment like diesel engine etc. directly coupled or through a gear box/belt drives, as specified in the Annexures. A heavy duty coupling along with coupling guard shall be provided between the pump and drive unit (except for belt drives). Belt guard shall be provided for all belt drives.

5.09.02 Unless otherwise specified in Annexures, drive unit power rating shall be the maximum of the following requirements.

a) 15% (for LT motor) or 10% (for HT motor) margin over the pump shaft input power at the rated duty point.

b) 5% margin over the maximum pump shaft input power required within the 'Range of Operation'.

c) Pump shaft input power required considering the overloading of the pump assuming single pump operation in the event of tripping of one or more of the pumps operating in parallel.

6.00.00 **INSPECTION AND TESTING**

6.01.00 The Bidder shall carry out the following specific tests and inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good engineering practice.

a) Identification and Testing

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standards and test certificates shall be made available to the Owner.

ii) Tests for each pump included under this section shall include but not be limited to the following :

- The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165-65.
- Shaft shall be subjected to Dye Penetration and Ultrasonic Tests.
- Wearing rings shall be subjected to Dye Penetration Test.
- Verification of material, witnessing of pouring, casting and inspection of finalized fabricated/cast castings.

- Inspection of finished castings for impeller and verification of materials.
- Inspection of pump shaft and verification of material.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940.
- Complete Inspection of assembled pump.

b) Hydrostatic Testing

The pump casing shall be hydrostatically tested at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than thirty (30) minutes. While arriving at the above values maximum suction pressure shall be taken into account.

c) Performance Test at Shop

i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard but the tolerances on head discharge and power shall be as specified in HIS, USA.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexures. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished.

iv) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions, if specified in the pump Annexures.

v) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

SECTION-III

VERTICAL PUMPS

1.00.00 GENERAL INFORMATION

1.01.00 This section presents the general guidelines and details of vertical wet pit pumps to be procured under the scope of this section and shall not be limited to the pumps specified under clause no. 3.00.00 below. For other vertical pumps in the scope of this specification, these general guidelines as specified hereinafter shall be followed.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out in Volume-IIA of this specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01	IS 1710/1989	:	Vertical Turbine Pumps for Clear, Cold and Fresh Water.
2.01.02	IS 5120/1977	:	Technical requirements - Rotodynamic special purpose pumps.
2.01.03	IS 5639/1970	:	Pumps for handling chemical and corrosive liquids.
2.01.04	IS 5659/1970	:	Pumps for process water.
2.01.05	IS 6536/1972	:	Pumps handling volatile liquids.
2.01.06	IS 9137/1978	:	Code for acceptance for centrifugal, mixed flow and axial flow pumps - Class `C'
2.01.07	BS 5316	:	Acceptance tests for Centrifugal, mixed flow Part-I/1976 and axial flow pumps - Class 'C' Tests (ISO 2548/1973)
2.01.08	BS 5316	:	Acceptance tests for Centrifugal, mixed flow Part-II/1977 and axial flow pumps - Class 'B' Tests (ISO 3555/1977)
2.01.09	ANSI B 73.2M/ 1984	:	Vertical inline centrifugal pumps for chemical process

2.01.10 API 610/1989 : Centrifugal pumps for general refinery services.

2.01.11 Hydraulic Institute Standards of USA (1983)

2.01.12 PTC 8.2/1965 : Power Test Codes - Centrifugal pumps.

2.02.00 In case of any contradiction between the above standards and Annexure attached to this section, the stipulations in the Annexure shall prevail and shall be binding on the Bidder.

6.00.00 **DESIGN AND CONSTRUCTION FOR VERTICAL WET PIT PUMPS**

Pumps shall be of vertical shaft, complete with bowl, intermediate bearings, column pipe, discharge head and base plate with all accessories.

General design and constructional features of the pumps shall be as follows:

6.01.00 **Bowl Assembly**

6.01.01 This will be either a single or multi-stage centrifugal, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of fluid handled.

6.01.02 Pumps shall have provision for adjustment of impellers in vertical direction from an accessible location, preferably at the housing (where separate thrust bearing for the pump is provided). The adjustment mechanism must take into consideration the extension of the line shaft due to hydraulic down thrust, weight of the shaft and impeller.

6.02.00 **Discharge Head**

6.02.01 Pumps shall be either above floor or below floor discharge type, as specified in the annexure, attached to this section.

6.02.02 In case, expansion joint is to be used at the pump discharge, pump base plate shall either be adequately designed to take the unbalanced forces and moments from the use of such expansion joint or a separate thrust block at the pump discharge head shall be provided to transmit these forces to the external supporting structure. Calculation of thrust load shall be done considering the highest pressure seen by the pump and internal diameter of the arch of the expansion bellow.

6.03.00 **Column Pipe**

6.03.01 Column pipe shall be flanged and have bolted connection. Column pipes shall be designed for full internal vacuum.

6.03.02 If below floor discharge and the water level is at or above the discharge valve level, the column pipe piece located at the intermediate floor level shall be provided with suitable floor sealing device.

6.03.03 In case of multi-piece column pipe and shaft assembly, the design shall permit raising/lowering of the pump assembly piece by piece without any difficulty. Any fixtures, clamps, etc. necessary for such purpose shall be supplied by the Bidder under this section. The Bidder shall also submit a write-up describing clearly the procedure of handling the pump.

6.04.00 **Impeller Shaft, Line Shaft and Head Shaft**

6.04.01 Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft.

Critical speed of the shaft shall be sufficiently away from the pump operating speed. The first critical speed of the pump shall be at least 125% or greater of the maximum operating speed.

6.04.02 Impeller shaft shall be guided by bearings provided in each bowl or above 6and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall be chamfered at the edges.

6.04.03 Line shaft may be of single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacturer. For screwed coupling, screw directions shall permit tightening of the joint during pump operation.

6.04.04 Replaceable shaft sleeves shall be furnished at applicable locations, particularly under stuffing box and at other locations, as considered necessary.

6.05.00 **Stuffing box**.

Stuffing box design shall permit replacement of packing without removing any part other than the gland.

The Pump stuffing box shall be compression packed to lessen the downtime & improving the process performance.

6.06.00 **Shaft enclosing Tube**

Shaft enclosing tube shall be required, unless self lubricated (and cooled) type of shaft bearings is asked for. Length of the shaft enclosing tube shall be in conformity with the shaft piece lengths.

6.07.00 **Seal Rings**

Replaceable seal/wear rings both on impeller and on casing shall be provided in case it is asked for in the annexures.

6.08.00 **Bearings**

6.08.01 Shaft bearings

Adequate number of properly designed bearings shall be provided for smooth and trouble-free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self lubricated as specified in the Annexure.

In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump. If the annexure calls for pre-lubrication of the shaft bearings, pre-lubrication tank and other accessories shall be within the scope of supply of the Bidder.

6.08.02 Thrust Bearing

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load.

Thrust bearings shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system.

Cooling of the thrust bearing if necessary, shall be done by the handling fluid/external water, depending on the fluid handled.

Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement of annexure or as per the recommendation of the pump manufacturer (and approved by Owner).

6.08.03 Guaranteed life of bearing shall be minimum 30,000 hours.

6.09.00 **Reverse Rotation**

Following provision shall be provided to prevent damage due to reverse rotation of the pump motor assembly:

1. Non-reversible ratchet mechanism

2. Necessary switch to detect reverse rotation will be provided to prevent motor switching ‘ON’ while rotating in reverse direction. Alarm will be provided in owners TFT based monitor.

6.10.00 **Drive Unit**

6.10.01 The pump will be driven by electric motor as specified in annexure. A heavy duty coupling shall be provided between the drive unit and the driven equipment (except for belt drive).

6.10.02 Unless otherwise specified in annexure, drive element power rating shall be the maximum of the following requirements.

a) 15% (for LT motor) or 10% (for HT motor) margin over the pump shaft input power at the rated working condition.

b) 5% margin over the maximum pump shaft input power required within its operating range including the shut off point.

c) Pump shaft input power required considering overloading of the pump assuming single pump operation in the event of tripping of the other pump(s) operating in parallel.

6.10.03 The drive equipment shall preferably be air cooled. In case the pumping fluid is water, free of abrasive and corrosive matter, the same can be used for cooling purpose. The arrangement shall be within the scope of the supplier.

7.00.00 INSPECTION AND TESTING

7.01.00 The Bidder shall carry out the following specific tests and inspections to ensure that the equipment furnished lies in strict conformance with the specification and in accordance with codes/standards and good engineering practice.

a) Material identification and testing shall include, but shall not be limited to the following components:

i) Bowls and suction bells.

ii) Impeller and wearing rings.

iii) Shafts and shaft sleeves.

iv) Couplings.

v) Bearings.

vi) Column pipes.

vii) Discharge heads.

viii) Bowl Assembly.

b) Test shall also include but shall not be limited to the following :

i) The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM-E-165.

ii) Shaft shall be subject to dye penetration and ultrasonic test.

iii) Wearing rings shall be subjected to Dye Penetration Test.

iv) Witnessing of NDT/review of NDT reports.

v) Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO-1940.

vi) Complete Inspection of assembled pump.

c) Hydrostatic test shall be done for the following components (as minimum) at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour. While arriving at the above values, maximum suction pressure shall be taken into account.

i) Bowls/Suction bells.

ii) Column pipe.

iii) Discharge head.

iv) Any other applicable pressure parts.

d) Performance Test at Shop

i) Each pump shall have to be tested to determine performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard but the tolerances on head discharge and power shall be as specified in HIS, USA.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 140% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation specified. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished.

iv) The Bidder shall submit in his proposal the facilities available at his works to conduct performance testing.

v) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions, if specified in the pump Annexure.

vi) All rotating components of the pumps shall be subjected to static and dynamic balancing tests. The assembled rotor will be subjected to dynamic balancing tests.

vii) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

viii) Reports and test certificates of above tests shall be submitted to the Owner for approval.

Sl No	Description	ACW Pumps
20.	Inspection and Testing	
	a) Material testing of casing, impeller and shafts	YES
	b) Hydrostatic testing	YES
	c) Dynamic balancing test	Required
	d) Sump model test at shop	Required
	e) Tests on casing/shaft	Yes, Radiography/ UT Test for above 50 mm dia. DP test/ MPI for below 50 mm dia.
	f) Test on impeller	Dye penetration Test
	g) Vibration and noise measurement	YES
	h) Performance Tests	YES
	i) Performance test to be done on	Proto type at full speed
	j) Performance test required for determining	Head Vs. capacity, BHP Vs. capacity, Efficiency Vs. capacity, submergence Vs. capacity curves
	k) Field performance test required	YES
	l) Other tests as per applicable clauses of this specification	YES

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

	ELECTRICAL EQUIPMENT SPECIFICATION FOR MISCELLANEOUS PUMPS SAGARDIGHI THERMAL POWER PROJECT 1 x 660 MW UNIT NO. 5, PHASE – III	SPECIFICATION NO.
		VOLUME NO.: **II-B**
		SECTION: **I**
		REV NO.: **00** DATE: 20.11.21
		SHEET : 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS: ELECTRICAL

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER/ PURCHASER

b) Services and equipment as per "Electrical Scope between BHEL and Vendor".

c) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

d) Supply of mandatory spares as specified in the specifications of mechanical equipments.

e) Electrical load requirement for MISCELLANEOUS PUMPS.

f) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

g) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

h) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

i) Motor shall meet minimum requirement of motor specification.

j) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

k) Cable BOQ worked out based on routing of cable listing provided by the vendor for "both end equipment in vendor's scope" shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

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

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

4.0 LIST OF ENCLOSURES

4.1 Electrical Scope Between BHEL & Vendor.
4.2 Electrical Load Data Format.
4.3 Cable Schedule Format.
4.4 Data Sheet-A.
4.5 Data Sheet-C.
4.6 Technical Requirements-Motors.
4.7 Standard Quality Plan.
4.8 Motor Sub Vendor List

REV: 0 DATE: 25.03.2015

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: MISCELLANEOUS PUMP

PROJECT: 1X660MW SAGARDIGHI TPP

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1.	415 V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2.	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motors.
3.	Power cables, control cables and screened control cables	BHEL	BHEL	Incoming cable from BHEL supplied MCC will be informed by BHEL. Screened control cable between DCS & field equipment will also be informed by BHEL. Vendor shall provide lugs & glands accordingly.
4.	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
5.	Cable glands and lugs for equipments supplied by Vendor	Vendor	BHEL	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
6.	Conduit and conduit accessories for cabling between equipments supplied by vendor	BHEL	BHEL	
7.	Equipment grounding & lightning protection	BHEL	BHEL	
8.	Below grade grounding	BHEL	BHEL	
9.	LT Motors with base plate and foundation hardware	Vendor	BHEL	Makes shall be subject to BHEL approval at contract stage.
10.	Mandatory spares	Vendor	-	Vendor to quote as per specification.
11.	Recommended O & M spares	Vendor	-	As per specification
12.	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	BHEL	
13.	Electrical equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipments/items supplied shall be reputed make & shall be subject to approval of BHEL after award of contract.
2. All QPs shall be subject to approval of BHEL after award of contract without any commercial implication.

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.

IE3

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.

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^{o}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

BHEL	**LV MOTORS** **DATA SHEET-A** **SAGARDIGHI THERMAL POWER PROJECT** **1 x 660 MW UNIT NO. 5, PHASE – III**	SPECIFICATION NO. VOLUME II B SECTION I REV NO. 00 DATE 11.11.2021 SHEET 1 OF 1

1.0 Design ambient temperature : 50 °C

2.0 Maximum acceptable kW rating of LV motor : Up to & Including 160KW

3.0 Installation (Indoors/ Outdoors) : As required

4.0 Details of supply system

a) Rated voltage (with variation) : 415V ± 10%
b) Rated frequency (with variation) : 50 Hz (Variation: +5% TO –5%)
c) Combined voltage & freq. variation : 10% (sum of absolute values)
d) System fault level at rated voltage : 50 kA for 1 sec
e) Short time rating for terminal boxes
***** Above 90 kW up to & including 160kW (Breaker Controlled): 50 KA for 0.25 sec.
***** Rated up to & including 90 kW (Contactor Controlled): 50 KA protected by MCCB

f) LV System grounding : Solidly

5.0 Class of insulation : Class 'F', with temp rise limited to class B.

6.0 Minimum voltage for starting : 80% of rated voltage

7.0 Power cables data : Shall be given during Detailed engineering.

8.0 Earth Conductor Size & Material : Shall be given during Detailed engineering.

9.0 Space heater supply **(30KW & ABOVE)** : 240 V, 1Φ , 50 Hz

10.0 Rating up to which Single phase motor : Acceptable below 0.20 Kw

11.0 Locked rotor current
a) Limit as percentage of FLC : As per IS 12615

12.0 Makes : BHEL/ Customer approval (Package owner to take care)

13.0 Paint shade : RAL 7032

15.0 Additional tests : As per QP

14.0 Degree of protection for motor/ terminal box: IP 55

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

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

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

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

09.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.10.00 Passing condition of various drain valves shall be monitored by measuring drain pipe metal temperature at the downstream of the drain valves. Also Drum, SH, RH metal temperature measurement shall be provided. Necessary thermocouples shall be provided as per the following specification.

01.	Measuring medium	:	Metal temperature
02.	Metal of thermocouple element	:	Chromel-Alumel Type-K
03.	Type of thermocouple ungrounded type.	:	Duplex with separate hot junctions,
04.	Insulation	:	Mineral insulation Magnesium Oxide
05.	Thermocouple wirer gauge	:	16 AWG
06.	Protective Sheath	:	SS 321
07.	Protective Sheath Dia	:	8 mm O.D.
08.	Characteristics of thermocouple	:	Special limits of error as in ANSI MC 96.01.1975
09.	Mounting Accessories	:	1/2" BSP SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS 310.
10.	Cold end sealing	:	SS pot seal with colour coded PTFE headed sleeve insulated flexible tails. Sealing compound - Epoxy resin
11.	Minimum Bending Radius	:	30 mm
12.	Length of T/C	:	30 mtrs. (minimum)

1.11.00 Resistance Temperature Detector

01.	Type	:	Platinum (Duplex), Ungrounded
02.	Resistance	:	100 ohm at $0^{O}C$
03.	Base	:	Wound on ceramic (anti-inductive)
04.	Wiring	:	3 /4 Wire

05.	Protecting Tube :-			
	i)	O.D.	:	8 mm
	ii)	Material	:	SS-316, Seamless
	iii)	Filling	:	Magnesium oxide (Purity above 99.4%).
06.	Response time		:	a) < 20 seconds for measurement. b) < 10 seconds for control.
07.	Calibration		:	DIN 43760
08.	Accuracy		:	± 0.5% of range
09.	Head		:	
	i)Type		:	IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
	ii) Material		:	Die cast aluminum or better
	iii)Terminal blocks		:	Nickel plated Brass-screw type / silver plated
	iv) Cable connection		:	½" NPT gland and grommet.
	v) Others		:	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shal be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
10.	Accessories		:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code. Process connection M33x2 (M) in general or 11/2"flanged for flue gas/Furnace/air etc. application. Material of construction of thermowell: 1) SS 316: in general 2) Inconel: For flue gas application

3) Tungsten carbide: For coal mill application.

11.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.12.00 Pressure Switch

01.	Type	:	i) Piston for high pressure application (above 40 bar) ii) Bellow /Diaphragm for low pressure application (below 40 bar)
02.	Sensing element material	:	AISI SS-316. All other wetted part SS316.
03.	Case Material	:	Die-cast aluminum alloy with neoprene gasket.
04.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
05.	Over range	:	150 % of maximum pressure
06.	Adjustments	:	a) Internal Set Point b) Differential adjustment
07.	End Connection	:	1/2" NPT (M) bottom connected
08.	Switch configuration	:	Two SPDT
09.	Switch Rating	:	240V, 5A AC/220V, 0.5A DC
10.	Switch Type	:	Snap acting, shock & vibration proof
11.	Terminal Block	:	Suitable for full ring lugs for cable connection.
12.	Elect connection	:	Plug in socket
13.	Enclosure Class	:	IP-65 weather and dust proof (Explosion proof for NEC Class-1, Division 1 area).
14.	Performance	:	a) Repeatbility ± 0.5% of full range b) Accuracy of Setting Indication of ± 1.5%
15.	Ambient temperature	:	0 – 50^{O}C

2.16.06 REVERSE ROTATION INDICATOR (RRI)

For each of CW pumps & ACW pumps, a reverse rotation indicator comprising of proximity sensors, processing electronics with output of 4-20mA (corresponding to speed) interconnecting cables, speed display in rpm, normal, reverse indication and required channel alarm contact shall be provided. The contact rating shall be 60 VDC, 6VA (or more if required by Control system). The exact details of the RRI shall be strictly as approved by Owner during detailed engineering.

SUB-SECTION – ID

DATASHEET-A

633258/2022/PS-PEM-MSE

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-445-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL)		REV. NO.: 00	DATE : 20.12.2021
	1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) (WBPDCL)		SECTION:	I D
Sl. No.	DESCRIPTION	DMCW TG AUX. PUMPS	DMCW SG AUX. PUMPS	CYCLE MAKE UP PUMPS
1.0	**SERVICE**			
1.1	Total no. of pumps for Project	3	2	1
1.2	No. of working & standby pumps	2W+1S	1W+1S	1W+0S
1.3	Liquid Handled (ref. water analysis enclosed herein)	pH corrected DM Water	pH corrected DM Water	DM Water
1.4	Location (Indoor / Outdoor)	Indoor	Indoor	Indoor
1.5	Duty	Continuous	Continuous	Intermittent
1.6	No. of pumps working in parallel	2	-	-
1.7	Specific gravity	1	1	1
1.8	System design pressure (kg/sqcm), (g)	10	10	10
2.0	**DESIGN PARAMETERS**			
2.1	Design capacity each, M^3/hr	1680	571	120
2.2	Total dynamic head (MWC)	40	55	50
2.3	Suction Pressure(MWC)	25.5	25.5	Flooded Suction
2.4	Design Temperature (°C)	60	60	50
2.5	Maximum permissible speed of pump (RPM)	1500	1500	1500
2.6	Max. limit on shut off head Corresponding to pump TDH (MWC) at 51.5 Hz	Not to exceed 70 MWC	Not to exceed 72 MWC	Not to exceed 70 MWC
2.7	Operating range	30% to 130% of rated capacity		
2.8	Motor rating	Unless otherwise specified in Annexures, drive unit power rating (at 50 deg. C ambient) shall be the maximum of the following requirements. a) 15% (for LT motor) or 10% (for HT motor) margin over the pump shaft input power at the rated duty point. b) 5% margin over the maximum pump shaft input power required within the 'Range of Operation'. c) Pump shaft input power required considering the overloading of the pump assuming single pump operation in the event of tripping of one or more of the pumps operating in parallel.		
2.9	Permissible tolerance in rated capacity & TDH	no negative tolerance / As per IS:6595		
2.10	Permissible tolerance in efficiency at rated capacity(%)	no negative tolerance		
2.11	Performance/Design Standard	Hydraulic Institute Standard /IS-5120/ Equivalent Standard		
3.0	**CONSTRUCTION FEATURES**			
3.1	Pump type	Horizontal centrifugal type Between Bearing Pump		Horizontal centrifugal type Pump
3.2	Impeller type	Closed		
3.3	Casing type	Horizontally Axial split type		To be decided by bidder
3.4	Coupling type	Flexible type		
3.5	Sealing arrangement	Gland packing initially & Mechanical seal finally after commisioning		
3.6	Type of Lubrication	Self Liquid		
3.7	Pump characteristics	Non Overloading type & stable		
3.8	Drain Connection with Valve, Vent with 3-way SS Isolating valve, Priming Connection with 3-way SS Isolating Valve(with diaphragm seal), Pump-motor Coupling Guard, Bearing Lubrication and Cooling Arrangement, Suction and Discharge Companion Flanges with Bolts, Nuts & Gaskets, Eye-bolts, Lifting Tackle etc.	YES		
4.0	**MATERIALS OF CONSTRUCTION**			
4.1	Casing/Casing Liner/Diffuser	ASTM-A296 Gr. CF8M		
4.2	Impeller	ASTM-A296 Gr. CF8M		
4.3	Shaft	Stainless Steel SS-410		
4.4	Shaft Sleeves	ASTM-A276 Type 316		
4.5	Wearing rings (If applicable)	ASTM-A296 Gr. C440		

633258/2022/PS-PEM-MSE

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-445-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL)		REV. NO.: 00	DATE : 20.12.2021
	1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) (WBPDCL)		SECTION:	I D
Sl. No.	**DESCRIPTION**	**DMCW TG AUX. PUMPS**	**DMCW SG AUX. PUMPS**	**CYCLE MAKE UP PUMPS**
4.6	Wetted Fastners	Stainless Steel AISI-304		
4.7	Gland / Seal Cover	SS-304		
4.8	Lantern Ring	SS-304		
4.9	Mechanical seal	As per Manufacturer's Standard		
4.10	Gland Packing	Braided Impregnated Teflon (Asbestos Free)		
4.11	Base Plate	MS fabricated IS-2062 (min. thk.-10 mm) Epoxy Coated		
4.12	Stuffing Box	ASTM-A296 Gr. CF8M		
4.13	Coupling	SS		
4.14	Connecting Pipe material (for deciding counterflange material)	SS 304		
4.15	Non Wetted Fastner/Bolts & Nuts	High Tensile Steel / SS		
5.0	**MANDATORY SPARES FOR PUMP-MOTOR SET**	**Yes Applicable, As per Annexure-1H attached after this page**		
6.0	**BID EVALUATION RATE**			
6.1	Bid evaluation rate	Rs.4.62 Lacs/KW	Rs.4.62 Lacs/KW	NA
6.2	Maximum permissible efficiency for Bid evaluation			
6.2.1	Pump Efficiency	85	84	-
6.2.2	Motor Efficiency	95	95	-
Notes :				
1	Material of construction for other components not specified above shall be similarly selected in line with the above for the duty intended and subject to approval.			
2	For items stated as not applicable by bidder, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.			
3	For all HT motor driven pumps (wherever applicable), bidder shall provide flat surface with dimensions 60 MM x 60 MM on bearing Housing for mounting vibration measuring block and a key slots of dimensions 30MM (L) X 15 MM (W) X 3 MM (D) on each pump shaft or some other suitable location which shall be confirmed during detail engineering by BHEL for Phase Marker.			
4	Wherever SS material is coming in contact with non SS material, suitable isolation (rubber etc.) shall be provided to avoid galvanic corrosion.			

Mandatory spares list for Pump & Motor Sets					Annexure-1H
S.No.	**Description**	**UOM**	**QUANTITY**	**QUANTITY**	**QUANTITY**
A.	**Spares for Pumps**		**DMCW TG AUX. PUMPS**	**DMCW SG AUX. PUMPS**	**CYCLE MAKE UP PUMPS**
1	Complete Impeller Assembly	Set	1 Set	1 Set	1 Set
2	Key for impeller	No.	1 No.	1 No.	1 No.
3	Pump shaft	No.	1 No.	1 No.	1 No.
4	Bearings	Set	1 Set	1 Set	1 Set
5	Wear Ring for Shaft & Impeller	Set	1 Set	1 Set	1 Set
6	Mechanical seal with Sleeves	Sets	2 Sets	2 Sets	2 Sets
7	Shaft Sleeves	Set	1 Set	1 Set	1 Set
8	Sleeve nuts and O-rings	Set	1 Set	1 Set	1 Set
9	Gland & Gland Packing (if applicable)	Sets	2 Sets	2 Sets	2 Sets
10	Fastners	Set	1 Set	1 Set	1 Set
11	Complete set of Coupling	Set	2 Set	2 Set	2 Set
B.	**Electrical Spares as applicable as per the Electrical List (415 Volt Motor)**				
1	Motor of each type and rating	No.	NA	NA	10% of the installed quantity or minimum 1 number whichever be higher
2	End Shield Cover Driving & Non-Driving End	Set	NA	NA	1 set for each type and rating of Motor
3	Heaters	Set	NA	NA	2 sets for each type and rating of motor
4	Bearings (DE and NDE) for each type and rating of motor	Set	NA	NA	2 sets
5	Cooling Fan for all type and rating of LT motors	Set	NA	NA	One (1) set
6	Dust seals and gaskets for each type of motors	Set	NA	NA	1 Set
7	Motor Terminal Block	No.	NA	NA	1 no. for each type and rating of Motor
C.	**Field Instruments & Others as applicable as per the C&I List**				
1	RTD	Nos.	10% of each type and length used in one unit.	10% of each type and length used in one unit.	NA
2	Thermo-well for RTD	Nos.	2(Two) nos. for each type and rating/length used in the system	2(Two) nos. for each type and rating/length used in the system	NA

Note:

1. Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number. For pump spares, One (1) set means complete replacement for one pump. For motors spares, 1 set means for each type and rating of motor.
2. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed and the break up for these shall be furnished in the bid.
3. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as above.
4. Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

	DATA SHEET - A	SPECIFICATION NO.:	PE-TS-445-100-N001
	MISCELLANEOUS PUMPS (Vertical Pumps)	REV. NO.: 00	DATE : 20.12.2021
	1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) (WBPDCL)	SECTION:	I D

Sl. No.	DESCRIPTION	ACW PUMPS
1.0	**SERVICE**	
1.1	Total no. of pumps for Project	2
1.2	No. of working & standby pumps	1 Working +1 Standby
1.3	Liquid Handled (Refer Annexure-2 for water analysis)	Clarified Water
1.4	Location	CW & ACW Pump House
1.5	Indoor / Outdoor	Indoor
1.6	Duty	Continuous
1.7	Specific gravity	1
1.8	No. of pumps working in parallel	-
1.9	System design pressure (kg/sqcm)	7.5
2.0	**DESIGN PARAMETERS**	
2.1	Design capacity each, M^3/hr	4505
2.2	Total dynamic head (MWC) (At Bowl, excluding Pumps Internal frictional losses upto discharge)	42
	· Suction Pressure(MWC)	Submerged Suction
	· Floor Level- for Pump Mounting	EL (+) 0.70 M
	· Min. W.L	EL (-) 1.95 M
	· Max. W.L.	EL (-) 0.30 M
	· Sump Invert Level	EL (-) 5.5 M
	· Crane Hook Level	EL (+) 8.2 M
	· Crane Capacity Available	8 Ton
2.4	Design Temperature (°C)	60
2.5	Maximum permissible speed of pump (RPM)	1500
2.6	Max. limit on shut off head Corresponding to pump TDH (MWC) at 51.5 Hz	Not to exceed 65 MWC
2.7	Pump Discharge - above floor / below floor	Above Floor
2.8	Discharge pipe (OD X THK), (mm x mm)	813 X 10
2.9	Operating range	Preferably between 70% to 130% of rated capacity
2.10	Motor rating	Unless otherwise specified in annexure, drive element power rating shall be the maximum of the following requirements. 10% (for HT motor) margin over the pump shaft input power at the rated working condition. b) 5% margin over the maximum pump shaft input power required within its operating range including the shut off point. c) Pump shaft input power required considering overloading of the pump assuming single pump operation in the event of tripping of the other pump(s) operating in parallel.
2.11	Permissible tolerance in rated capacity & TDH	No negative tolerance
2.12	Permissible tolerance in efficiency at rated capacity(%)	No negative tolerance
2.13	Performance/Design Standard	HIS/IS-1710
2.14	Suction specific speed	Shall be limited to 8500 US units
2.15	Noise level	85 dBA (max) at 1m from the equipment
3.0	**CONSTRUCTION FEATURES**	
3.1	Pump type	Vertical Wet Pit, Turbine Pump
3.2	Impeller type	Closed
3.3	Casing type	Vertical type
3.4	Coupling type	Flexible
3.5	Type of gland lubrication and sealing	By Self Water
3.5	Gland lubrication and sealing	By Self Water
3.6	Bearing cooling	By Grease/Self Water

	DATA SHEET - A	SPECIFICATION NO.:	PE-TS-445-100-N001
	MISCELLANEOUS PUMPS (Vertical Pumps)	REV. NO.: 00	DATE : 20.12.2021
	1X660 MW SAGARDIGHI, PHASE-III (UNIT-5) (WBPDCL)	SECTION:	I D

Sl. No.	DESCRIPTION	ACW PUMPS
3.7	Pump characteristics	Non Overloading type & stable
3.8	Reverse flow through pump to be considered for pump design	YES
3.9	Sole plate, Foundations bolts, nuts, sleeves etc., Discharge flanges with nuts, bolts and gaskets, Gland sealing/ cooling and bearing cooling/ lubrication system complete with pipes, valves, fittings and instruments as required, Eye bolts, lifting tackle/lugs etc., Vent with isolating cock, drain Plug, Pump motor coupling and guard, all other accessories & services etc.	YES
3.10	Thrust bearing to be designed for pump shut off operation	YES
3.11	Head at reverse flow	Bidder to indicate
3.12	Location of thrust bearing	Separate for pump and motor
4.0	**MATERIALS OF CONSTRUCTION**	
4.1	Casing & Suction Bell	2% Ni-CI as per IS-210, FG-260
4.2	Column Pipe / Discharge Elbow	IS-2062-Gr. B (Min. 10 mm thick)
4.4	Impeller	ASTM-A-351 Gr.CF8M
4.5	Impeller Shaft / Line Shaft	AISI-410
4.6	Shaft Sleeves	AISI-410 (Hardened)
4.7	Shaft Coupling	AISI-410 (Hardened)
4.8	Gland / cover plate	SS-316
4.9	Wearing rings	SS-316
4.10	Wetted fasteners	SS-316
4.11	Non wetted fasteners	SS-316
4.12	Stuffing Box	2% Ni CI IS 210 Gr. FG 260
4.13	Lantern Ring	SS-316
4.14	Intermediate stage bearings/shaft bearing	Cutless Rubber
4.15	Gland Packing (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)
4.16	Base/ Sole Plate	IS-2062-Gr. B (Min. 10 mm thick)
4.17	Connecting Pipe material (for deciding counterflange material)	Piping shall be Carbon Steel (IS:2062, Gr B), rolled and welded conforming to IS:3589 .
4.17	Companion flange	IS-2062-Gr.B
5.0	**MANDATORY SPARES**	Yes applicable, as per Annexure-1 V, attached after this page
7.0	**Bid Evaluation**	
7.1	Bid evaluation rate	Rs.4.62 Lacs/KW
7.2	Maximum permissible efficiency for Bid evaluation	
7.2.1	Pump Efficiency	85
7.2.2	Motor Efficiency	95
Notes :		
1	Material of construction for other components not specified above shall be similarly selected in line with the above for the duty intended and subject to approval.	
2	For items stated as not applicable by bidder, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.	
3	For all HT motor driven pumps (wherever applicable), bidder shall provide flat surface with dimensions 60 MM x60 MM on bearing Housing for mounting vibration measuring block and a key slots of dimensions 30MM (L) X 15 MM (W) X 3 MM (D) on each pump shaft or some other suitable location which shall be confirmed during detail engineering by BHEL for Phase Marker.	
4	Wherever SS material is coming in contact with non SS material, suitable isolation (rubber etc.) shall be provided to avoid galvanic corrosion.	

Mandatory spares list for ACW Pump			Annexure-1 V
S.No.	**Description**	**UOM**	**QUANTITY**
A.	**Spares for Pumps**		**ACW PUMP**
1	Complete Bowl Assembly	Set	1 Set
2	Set of Impellers	Set	1 Set
3	Set of shafts	Set	1 Set
4	Casing wear rings	Set	1 Set
5	Impeller wear rings	Set	1 Set
6	Shaft sleeves	Set	1 Set
7	Shaft coupling	Set	1 Set
8	Shaft nuts and keys	Set	1 Set
9	Pins (for non-reversible ratchet)	Set	1 Set
10	Lantern rings	Set	1 Set
11	Bell mouth liner	Set	1 Set
12	Bearings Various types as applicable	Set	Complete 1(One) Set (one set means total requirements for one Pump)
13	Coupling set (between pump and motor) with accessories	Set	2 Set (one set means total requirements for one Pump)
14	Non Reversible Ratchet		1 Set (one set means complete replacement for one pump)
B.	**Field Instruments & Others as applicable as per the C&I List**		
1	RTD	Nos.	10% of each type and length used in one unit.
2	Thermo-well for RTD	Nos.	2(Two) nos. for each type and rating/length used in the system

Mandatory Spare Note:

1. Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.
2. Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed and the break up for these shall be furnished in the bid.
3. In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as above.
4. Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

DESIGN CLARIFIED WATER ANALYSIS

CONSTITUENTS	As	CONTENT
Calcium	$CaCO_3$	105 ppm
Magnesium	$CaCO_3$	52 ppm
Sodium and Potassium	$CaCO_3$	138 ppm
Hydrogen (FMA)	$CaCO_3$	--
TOTAL CATIONS	$CaCO_3$	295 ppm
Bicarbonate	$CaCO_3$	196.5 ppm
Carbonate	$CaCO_3$	-
Chloride	$CaCO_3$	41 ppm
Sulphate	$CaCO_3$	57.5 ppm
Nitrate	$CaCO_3$	-
TOTAL ANIONS	$CaCO_3$	295 ppm
M.O. Alkalinity	$CaCO_3$	196.5 ppm
P. Alkalinity	$CaCO_3$	
Total Hardness	$CaCO_3$	157 ppm
Carbon-di-oxide	CO_2	3.5
Dissolved Silica	SiO_2	20 ppm
Total Iron	Fe	1 ppm
pH Value	-	7.9 – 8.0
Turbidity, NTU	-	20
Organic Matter Content in terms of Oxygen in absorbed from ($KMnO_4$ (4 Hrs.)		5 ppm

DESIGN DM WATER ANALYSIS

Sl. No.	Description	Max. Limit
1.00	Total Electrolyte	0.1 ppm, max.
2.00	Total SiO_2	0.01 ppm, max.
3.00	Iron as Fe	Nil
4.00	Free CO_2 ppm as CO_2	Nil
5.00	Total Hardness	Nil
6.00	pH value at 25 Deg.C	6.8 – 7.2
7.00	Conductivity, micro mho/cm	Less than 0.1 at 25 Deg. C

SUB-SECTION - II

STANDARD TECHNICAL SPECIFICATION

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

- **STANDARD TECHNICAL SPECIFICATION FOR MISC. PUMPS (HORIZONTAL AND VERTICAL) INCLUDING DATASHEET-C**

- **STANDARD QUALITY PLANS**

	TITLE:	SPECIFICATION NO. PES-179-06	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 1 of 16	

1.00.00 GENERAL INFORMATION

1.01.0 The general guidelines as illustrated in the subsequent clauses of this section shall be applicable for horizontal centrifugal pumps to be procured under the scope of this package.

1.02.0 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/Owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.

1.03.0 The omission of specific reference to any component/accessory necessary for the proper performance of Miscellaneous Pumps and drives shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of equipment at quoted prices.

1.04.0 BHEL's / Customer's representative shall be given full access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.

1.05.0 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/Customer.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out elsewhere in the specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01	IS-1520/1980:	Horizontal Centrifugal pumps for clear, cold and fresh water.
2.01.02	IS-5120/1977:	Technical requirements for Rotodynamic special Purpose pumps.
2.01.03	IS-5639/1970:	Pumps for handling chemicals & corrosive liquids.
2.01.04	IS-5659/1970:	Pumps for process water.
2.01.05	IS-6536/1972:	Pumps for handling volatile liquids.
2.01.06	IS-9137/1978:	Code for acceptance tests for centrifugal, mixed flow and axial flow pumps- Class 'C'.

	TITLE:	SPECIFICATION NO. PES-179-06	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 2 of 16	

2.01.07	ISO 3555/1977: BS 5316/1977 Part 2	Acceptance test for centrifugal, mixed flow and axial flow pumps - Class 'B' tests.
2.01.08	ISO 2548/1973: BS 5316/1976 Part 1	- Do - Class 'C' tests.
2.01.09	API-610/1989:	Centrifugal pumps for general refinery services.
2.01.10	HIS	Hydraulic Institute Standards, USA
2.01.11	PTC 8.2/1965:	Power Test Codes - Centrifugal pumps.
2.01.12	ASTM-1-165-55	Standard Methods for Liquid Penetration Inspection.

2.02.00 In case of any contradiction with the above standards and annexure, the stipulations in the annexure shall prevail and shall be binding on the bidder.

3.00.00 SCOPE OF SUPPLY & SERVICES:

3.01.00 The miscellaneous pumps and drives scope shall be as specified in Data Sheet A /Section IA.

3.02.00 The Capacity, Head, Materials of construction and other particulars of pumps are detailed in Data Sheet A of the specification.

3.03.00 Accessories:

All the pumps under this specification shall be complete with following standard/special accessories.

3.03.01 Standard accessories:

a) LT Electric drives/motors (as applicable) with cable gland and lugs at motor end. (The bare HT drive motors and LT motors not in bidder's scope of supply, wherever required supplied as free issue by BHEL refer Cl. 5.08.00).

b) Pump motor coupling along with coupling guard.

c) Common base plate for pumps and motor.

d) Self contained lubrication system along with all internal piping, valves, fittings, specialties etc. as required.

e) Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets.

f) Anchor bolts, nuts, seating steel works, shims etc. as necessary for mounting the pump-motor unit on civil foundations.

g) Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ accessories.

h) Suitable drain connections with isolating valves as applicable.

i) Supply of first fill of lubricants with toping requirements for one year of operation after commissioning and handing over of equipment.

j) Set of “Special” Tools & Tackles for Pumps and motors, if any.

k) Erection and commissioning spares, “on as required” basis.

l) Bidder shall provide various drawings, data, calculations, test reports/ certificates, operation and maintenance manuals, As-built drawings, etc. as specified and as necessary.

m) Mandatory spares as specified in respective Data Sheet-A of this section.

3.04.00 Services included in Bidder’s Scope:

3.04.01 The pumps shall be guaranteed to meet the performance requirements specified vide Data Sheet -A and also for trouble free operation after commissioning. Schedule of performance guarantees (Section-IIIA) duly filled and signed shall be furnished with the bid.

3.04.02 Pumps with Mechanical seal shall be supplied with gland packing arrangement initially to site and gland packing arrangement shall be replaced by vendor with mechanical seal arrangement at site after commissioning of the pumps with gland packing. However Mechanical seal shall be dispatched along with main supply for this purpose. Shaft sleeve and any other item required for satisfactory operation of Mechanical seal after replacement at site shall be provided by the pump supplier without any cost implication to BHEL.

3.04.03 The pumps erected by the purchaser shall be checked by the bidder for correctness of their installation, alignment, etc. at site prior to their commissioning.

3.04.04 After commissioning of pumps at site, site performance test for Noise, vibration and parallel running of pumps of all pumps for each unit/project shall be conducted by pump vendor at project site to ensure that the pumps meet the specified requirements. Pump vendor shall bring necessary instruments for conductance of site performance test.

If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL

Note: Applicability of conducting PG test at site by vendor as per above clause shall be applicable if indicated in Section-1A.

If conductance of PG test of pumps at site for Noise, vibration and parallel running of pumps of all pumps for each unit/project is not in bidders scope and same is conducted by BHEL/ customer. In such cases also, if the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL.

3.04.05 Performance Guarantees for pumps shall stand valid till the satisfactory completion of performance testing by BHEL and its acceptance by purchaser / customer.

3.05.00 Works excluded from Bidder's Scope:

a) All HT motors and those LT Motors which are specifically excluded.
b) Civil foundation
c) Suction/ discharge pipe works
d) MCC/ Switchgear/Power supply
e) Power and Control Cables, unless specifically specified in Electrical/ Systems portion of the specification.
f) Erection of equipments.

4.00.00 BID EVALUATION CRITERIA & LIQUIDATED DAMAGES FOR SHORTFALL:

4.01.00 The bids received shall be evaluated for power consumption at inlet to the motors, in respect of pumps specified in Data Sheet-A (working pump only viz. not the standby), for the purpose of price comparisons as briefed below:

The bid evaluation shall be done at the rate as specified in Data Sheet A per one (1) KW Power consumption, per working pump as follows.

$$KW = \frac{Q \times H \times S}{P \times M \times 367.2}$$

Where Q = Rated capacity M^3/hr
H = Rated TDH, MWC
P = Pump Efficiency
M = Motor Efficiency.
S = Specific Gravity of fluid handled

4.02.00 The efficiencies for pumps and motors for arriving at benchmark power for Bid Evaluation shall be as indicated in Data Sheet A for various pumps.

No advantage shall be given to the bidder for Aux. Power quoted lower than the Bench mark values calculated with KW calculation formula at Cl. 4.01.00 *above, considering the bid evaluation efficiencies for pump and motor as indicated in Data Sheet-A*. However the bids shall be evaluated as above if the Aux. Power quoted are higher than Bench mark values.

NOTE:

1. Efficiencies for HT motors and LT motors not in bidder's scope, for bid evaluation purpose shall be taken based on the maximum value as furnished in Data Sheet A.
2. During contract stage the Guaranteed power consumption of Pumps with BHEL supplied drives (HT/LT) for successful bidder shall be reworked by BHEL as below:

Revised guarantee power consumption shall be as per KW calculation formula at Cl. 4.01.00 *above, where P = pump efficiency guaranteed by bidder and M = motor efficiency as per approved datasheet of the supplied HT/LT motor.*

4.03.00 Liquidated damages for shortfall in Guaranteed KW

The above guaranteed power consumption shall be demonstrated by the successful bidder during performance testing at works/ site.

For pumps with BHEL supplied drives, the power consumption shall be compared with the reworked guarantee power consumption, defined as per note no. 2 of Cl. 4.02.00 above for the purpose of shortfall.

The liquated damages @ twice the bid evaluation rate as above per KW per working pump shall be levied in the event of failure of bidder to demonstrate the guaranteed power consumption.

5.00.00 TECHNICAL REQUIREMENTS:

5.01.00 The pumps shall meet the technical requirements of Section-I as well as Section-II. In the event of any contradiction of Section-II with Section-I, the Section-I will prevail.

5.02.00 The pumps shall be Electric motor driven.

5.03.00 The Pumps shall conform to HIS. It is bare minimum requirement, however, any other equivalent or stringent standard is also acceptable, if, all the requirements of HIS are also met.

5.04.00 The horizontal pumps shall be Horizontal split casing type with speeds not exceeding 1500 RPM or as indicated in Data Sheet-A.

5.05.00 No negative tolerance shall be permitted in rated capacity & TDH.

5.06.00 No negative tolerance shall be permitted in efficiency at rated capacity.

	TITLE:	SPECIFICATION NO. PES-179-06	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 6 of 16	

5.07.00 The shut off head of pumps shall be more than pump rated TDH and percentage variation may vary depending on the specific speed of the pump as under:

i. 10-15% for pumps of specific speed up to 1000 US units,
ii. 15-20% for pumps of specific speed in the range of 1000 to 2000 US units,
iii. 20-40% for pumps of specific speed in the range of 2000 to 4000 US units,
iv. Above 50% for pumps of specific speed in the range of 4000 to 7000 US units.

5.08.00 All HT motors and those LT motors which are not in bidder's scope of supply: bare motors only, shall be supplied as free issue by BHEL through BHEL, based on ratings and TS (Torque - Speed) curve selected and furnished by the bidders along with their un-priced bid. The responsibility for satisfactory operation for combined performance of pumps & motors shall rest with the bidder only as if, the drive motors also have been supplied by the bidder.

Couplings, base plate, foundation bolts, any other fittings, etc. as required shall be supplied by the bidders only. BHEL shall supply one number of each type of drive motors (where drive motor is not in bidder's scope of supply) for shop testing of pumps with job motors. All other motors shall be dispatched by BHEL directly to project sites.

5.09.00 For all HT motor driven pumps, BHEL has envisaged vibration-monitoring system in their own scope. The bidder shall make provisions for mounting following on the pump/ pump shaft:

- Purchaser’s probes in both DE/NDE bearings of pumps
- Key slots on pump shaft and flat surface on bearing housing for mounting vibration measuring block with dimensions as specified in Data Sheet A.
- Other components as finalized during detailing.
- For mounting of above on the HT motors & specifically excluded LT motors, same shall be taken care by BHEL.

5.10.00 The pumps shall be capable of developing the required total head at rated capacity for continuous operation. The pumps shall operate satisfactorily at any point on the Q-H characteristic curve over a range of 0% to 130% capacity and shall be suitable for continuous operation between 30% to 130% capacity.

5.11.00 Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.

5.12.00 The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.

5.13.00 The pumps shall be capable of running over the entire range of NPSH conditions required without any noise, vibration or cavitations.

The prevailing suction pressures for various pumps are indicated in Data Sheet-A for suitable mechanical design of pumps.

	TITLE:	SPECIFICATION NO. PES-179-06	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 7 of 16	

5.14.00 The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the maximum static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.

5.15.00 Pumps and motors shall run smooth without undue noise and vibration.

The vibration shall be within vibration norms for testing as per American National Standard for 'Rotodynamics Pump' for Vibration Measurement and allowable values, Doc. ANSI/ HIS 9.6.4-2009. The applicable vibration limits for each pump, shall be indicated in the Technical Data sheet to be furnished by the successful bidder after award of LOI/ PO.

The noise level shall be limited to 85 dB at distance of 1.0M.

5.16.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be interchangeable.

5.17.00 After installation, the guaranteed values of noise, vibration and parallel operation of pumps shall be tested and verified. If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, at his own cost.

5.18.00 High reliability of the pumps is an essential requirement and therefore it gets weightage over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.

5.19.00 The offered pumps shall be of proven design meeting the experience-qualifying requirement of their operation at two sites for a minimum period of one year or as specified in technical PQR. Any deviation to this criterion shall be suitably highlighted in the deviations schedule.

5.20.00 The bearings shall be self-water lubricated, no external water supply shall be available. The cooling/ lubrication water for bearings, etc. shall be tapped from the pump discharge and supplied thru' bidder's integral pipe work.

If water handled by pump is dirty/ not suitable for lubrication/ cooling, the bidder shall provide requisite strainer/ filters, tanks, motorized valves, etc. after the tap off for the required service, the arrangement provided shall be subject to Purchaser's approval.

6.00.00 MANDATORY SPARES:

6.01.00 Bidder to provide the Mandatory spares listed vide Data Sheet-A. Unit price of mandatory spares shall be furnished in price Schedule.

6.02.00 Bidder shall include the cost of Mandatory Spares, unless specified otherwise in Sec-IA of the specification or NIT.

	TITLE:	SPECIFICATION NO. PES-179-06	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 8 of 16	

7.00.00 OTHER REQUIREMENTS:

7.01.00 The quality of water handled by various pumps shall be as per Data Sheet-A.

7.02.00 The materials of construction for various components specified are the minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

7.03.00 The makes of various bought out items of bidder (i.e. motor, bearings, mechanical seal etc.) shall be subject to purchaser's approval in the event of order.

7.04.00 Painting for Pumps

a) The surface of SS, Gun metal, brass, bronze and non-metallic component shall not be applied with any painting.

b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.

c) For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness DFT of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness DFT of 50 microns shall be applied. The top coat shall consist of two coats each of min. thickness DFT of 50 microns of synthetic enamel paint and thus total DFT shall be min. 200 microns.

d) For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of min. thickness DFT of 50 microns followed up with under coat of chlorinated rubber paint of min. thickness DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with min. thickness DFT of 50 microns and top coat shall consist of two coats each of min. thickness DFT of 50 microns of chlorinated rubber paint shall be provided. Total DFT of paint system shall be min. 200 microns.

7.05.00 It is mandatory for the bidder to submit along with the bid, the deviations if any – whether major or minor in the schedule of deviations only. In the absence of deviations listed in the "Schedule of deviations, the offer shall be deemed to be full conformity with the specification, "not-withstanding" anything else stated elsewhere in bidder's offer. The implied/indirect deviations shall not be binding on the purchaser.

	TITLE:	SPECIFICATION NO. PES-179-06	
BHEL	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	VOLUME:	
		SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 9 of 16	

8.00.00 **PERFORMANCE REQUIREMENTS**

8.01.00 Performance requirements for the pumps shall be as guided in Data sheet - A enclosed with Section-I.

8.02.00 Pump(s) shall preferably be designed to have the best efficiency at flow within ± 10% of the specified duty point flow. The pumps shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated in the Data Sheet - A attached with Section-I.

8.03.00 Pump(s) shall preferably have a continuously rising head-capacity characteristics from the specified duty point towards shut-off point, the maximum being at shut-off to enable parallel operation.

Under all circumstances, the 'range of operation' of the pumps shall exclude any unstable operating zone of the head-capacity curve.

8.04.00 Wherever specified in the Data Sheet - A, pumps of each category shall be suitable for parallel operation. The head vs. capacity, the BHP vs. capacity characteristics etc. shall be identical to ensure equal load sharing and trouble-free operation of any pump when the other pump(s) working in parallel with it trip.

8.05.00 The pump set along with drive motor shall run smooth without undue noise and vibration. Acceptable vibration limits shall be guided by the HIS of USA. Refer clause 5.15.00 above for permissible limits.

9.00.00 **DESIGN AND CONSTRUCTION**

9.01.00 **Pump Casing**

9.01.01 Pump casing shall be provided with adequate number of vents and priming connections with valves unless the pump is made self-venting and priming. Casing drain, as required, shall be provided complete with drain valves. It shall be provided with a connection for suction and discharge pressure gauge as standard feature.

9.01.02 Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

9.01.03 In case where an expansion joint is located at pump discharge, the pump assembly will be subjected to an additional thrust which will be transmitted to the foundation. This additional thrust shall be taken into the consideration of pump design.

9.02.00 **Impeller**

9.02.01 The Impeller assembly shall be dynamically balanced and designed with critical speed substantially above the operating speed.

	TITLE:	SPECIFICATION NO. PES-179-06	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 10 of 16	

9.03.00 **Wearing Rings**

9.03.01 Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing.

9.04.00 **Shaft**

9.04.01 Shaft size shall be selected considering that the critical speed shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall be at least 30% higher than the rated speed.

9.05.00 **Shaft Sleeves**

9.05.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the other faces of gland packing or seal end plate so as to distinguish between the leakage past Shaft and shaft sleeve and that past the seals/glands.

9.05.02 Shaft sleeves shall be properly fastened to the shaft to prevent any leakage or loosening. Shaft sleeve assembly should ensure concentric rotation.

9.06.00 **Bearings**

9.06.01 Bearings shall be easily accessible without disturbing the pump assembly. A drain shall be provided at the bottom of each bearing housing.

9.06.02 Heavy-duty sleeve/ball/roller type bearings shall be provided to take care of the radial loads.

9.06.03 In case of sleeve type radial, axial thrust shall be absorbed in suitable hydraulic devices and/or thrust bearings.

9.06.04 Bearings and hydraulic devices (if provided for balancing axial thrust) shall be of adequate design for taking the entire pump load arising from all probable conditions of continuous operation. Life of the bearings shall be guided by the design standard of the pump. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 20,000 hrs. of continuous operation at maximum axial and radial loads at rated speed. Thrust bearing shall be capable of running continuously at maximum load.

9.06.05 The bearing shall be oil/grease lubricated. Suitable lubricating arrangement for the bearings shall be furnished with the pump complete with all accessories like pump, filters, piping, fittings, valves, interlocking and supervising instruments etc. as necessary. The design shall be such that the bearing lubricant does not contaminate the liquid being pumped.

9.06.06 Bearing housing for HT motor driven pumps shall have provision for mounting temperature measuring device.

9.06.07 Bearings of reputed makes are to be provided, same shall be indicated in Technical Data sheet to be furnished by the successful bidder after award of LOI/ PO, subject to acceptance of BHEL/ end customer, without any price implication to BHEL.

9.07.00 **Stuffing Boxes**

9.07.01 Stuffing box design shall permit replacement of packing without removing any part other than the gland.

9.07.02 Stuffing boxes shall be sealed/cooled by the fluid being pumped/external clear water, as specified in the Annexure. All necessary pumps, piping, fittings, valves, instruments etc. as required for safe and trouble-free operation of the pumps and as specified in the Annexure shall be included in the scope of supply.

9.08.00 **Mechanical Seals**

9.08.01 Mechanical seals (cartridge type) shall be provided if specified in the Data Sheet-A of this section. The pump supplier shall co-ordinate with the seal maker in establishing the direct circulation rate for maintaining a stable film at the seal in the chamber. The seal piping system shall form an integral part of the pump assembly.

9.08.02 When handling liquids near boiling point, suitable arrangement for external cooling shall be provided so as to prevent flashing at the seal faces.

9.08.03 For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure, even when the pumps are not operating.

9.08.04 Pumps with Mechanical seal shall be supplied with gland packing arrangement initially to site and gland packing arrangement shall be replaced by vendor with mechanical seal arrangement at site after commissioning of the pumps with gland packing. However Mechanical seal shall be dispatched along with main supply for this purpose. The special tools (if any) required for above shall be arranged by bidder.

9.08.05 Mechanical seals of reputed makes are to be provided, same shall be indicated in Technical Data sheet to be furnished by the successful bidder after award of LOI/ PO, subject to acceptance of BHEL/ end customer, without any price implication to BHEL.

9.09.00 **Drive Unit**

9.09.01 The pumps shall be driven by electric motor directly coupled as specified in the Data Sheet-A of this section. A heavy duty coupling along with coupling guard shall be provided between the pump and drive unit.

9.09.02 Unless otherwise specified in Data Sheet-A of this section, drive unit power rating shall be the maximum of the following requirements.

a) 16% margin over the pump shaft input power at the rated duty point.

b) 10% margin over the maximum pump shaft input power required within the 'Range of Operation'.

c) Pump shaft input power required considering the overloading of the pump assuming single pump operation in the event of tripping of one or more of the pumps operating in parallel.

9.10.00 **Coupling for pump & Motor Shaft**

9.10.01 The pump and motor shafts shall be connected with adequately sized flexible coupling of proven design with spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guard shall be provided.

9.10.02 No. of coupling holes for joining coupling hubs shall be even in number and preferably in multiples of four.

10.00.00 **INSPECTION AND TESTING**

10.01.00 The Quality Plans enclosed in the specification are for bidder's guidance only. The bidder shall comply with these and other minimum requirements specified in the specification and shall furnish his own quality plan in the event of order based on the guidance given as above, for approval by BHEL/Customer.

10.02.00 The Bidder shall carry out the following specific tests inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good engineering practice.

a) **Identification and Testing**

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standard and test certificates shall be made available to the Owner.

ii) 100% PMI (Positive Material Identification) inspection for material grade of pump casing, shaft and impeller shall be done by vendor & certification shall be submitted for review of BHEL. Further BHEL reserves the right to conduct random & independent PMI inspection on pump casing, shaft and impeller to ascertain the grade of material during inspection at vendor works.

iii) Tests for each pump included under this section shall include but not be limited to the following:

- The entire surface of the impeller / casing / diffuser castings shall be subjected to Dye Penetration Test as per ASTM Specification no.:1-165-65.

- Shaft coupling & other active components shall be subjected to Dye Penetration and Ultrasonic Tests.

- Wearing rings, shaft sleeves shall be subjected to Dye Penetration Test.

- Fabricated components of pumps shall be subjected to Dye Penetration test on weld.

- Verification of material, witnessing of pouring, casting and inspection of finished fabricated/castings.

- Inspection of finished castings for impeller and verification of materials.

- Inspection of pump shaft and verification of material.

- Witnessing of NDT/review of NDT reports.

- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940 to grade 6.3 or better.

- Complete Inspection of assembled pump.

b) **Hydraulic Testing**

The pump casing shall be hydrostatically tested at maximum of the following:

i. 2 times the TDH (Total Dynamic Head) at rated capacity (or)
ii. 1.5 times the shut-off pressure (or)
iii. System Design pressure indicated in Data Sheet-A of Section-I.

The HT pressure shall be maintained for a period of not less than 30 minutes. During testing there should not be any pressure drop & leakage.

c) **Performance Test at Shop**

i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps at rated speed. These shall be carried out to span 130% of rated capacity up to pump shut-off condition. A minimum of five combinations of

head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexure. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished.

iv) NPSH tests are to be conducted for each type at 3% head drop conditions, if specified in the pump approved QP.

v) All rotating components of the pumps shall be subjected to static and dynamic balancing tests. The assembled rotor will be subjected to dynamic balancing tests.

vi) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

10.03.00 Inspection of Mandatory/ Recommended spares shall be in line with approved QP for main supply.

11.00.00 DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE

11.01.00 After award of LOI, the successful bidder shall submit drawings/documents as per Data Sheet-C.

11.02.00 The no. of drawings/documents to be submitted shall be as per Data Sheet-C.

12.00.00 The various Sections-I's & II's along with Data Sheets attached in this specification together with the specification for Miscellaneous Pumps shall be complied with by the bidders.

13.00.00 Bidder to submit all drawing/ documents in soft as well as hard copy in the event of order as per schedule indicated in section-IA.

Within one (1) week of receipt of BHEL comments a technical representative from Bidder's works shall come for meeting with BHEL along with revised documents to resolve all issues and incorporate all comments in the soft copy here only for further submission to customer.

Further on receipt of customer's comments on the documents a technical representative from Bidder's works shall come for meeting with Customer to resolve all issues and incorporate all comments in the soft copy here only and further resubmission of same to Customer. The representative shall be available here till Category-I approval of all the drawings and documents.

	TITLE:	SPECIFICATION NO. PES-179-06	
BHEL	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	VOLUME:	
		SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 15 of 16	

14.00.00 Guarantee for all pumps shall at least remain valid for 18 months from the Unit commissioning date or as specified in NIT.

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

a) Compliance certificate duly signed and stamped (enclosed at Section-IIIB).
b) GA drawings of pumps and motors with following: (shall be only for reference purpose, same shall not be reviewed/commented by purchaser at this stage and shall be subject to approval only during contract).
   - Civil static & dynamic loads.
   - Foundation details.
c) Guarantee Schedule duly signed and stamped (enclosed at Section-IIIA).
d) Technical deviation schedule (if reqd.) (enclosed at Section-IIIC).
e) Data for drive Motor (HT/LT- which is not in bidder's scope of supply - as applicable): Load torque speed curves of the pumps, selected motor rating, rpm, GD^2 of driven equipment.
f) Unpriced copy of the price bid shall be furnished along with the technical bid.

Apart from above no other Drgs./Docs./Data sheets etc. are required to be submitted at bid stage and even if furnished shall not be taken cognizance of.

In case of any deviation from this technical specification, the same shall be indicated in the schedule of deviations as per Section-IIIC or NIT. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.

	TITLE:	SPECIFICATION NO. PES-179-06	
BHEL	STANDARD TECHNICAL SPECIFICATION HORIZONTAL PUMPS	VOLUME:	
		SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 16 of 16	

DATA SHEET – C

Drawings / documents distribution schedule to be followed by successful Bidder:

1.0 Drawings/documents submission schedule, shall be as per Section-IA.
The successful bidder shall submit at least following drawings/ documents:

1.1 Fully dimensioned outline general arrangement drawings of the pump and motor assembly. This drawing should include foundation base plate/sole plate details as applicable, civil foundation, anchor bolt details, loading data (Static and Dynamic), points of connections of external piping, cables and mounting of devices furnished by the supplier and details for Gap between Coupling Shafts, Float & details for axial/radial tolerance allowed etc. which are required for erecting agency during erection of pump.

1.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction with standard applicable codes.

1.3 Technical datasheet as per Datasheet-B (Section-IIID) including characteristic curves of pumps showing the following:

a) Flow Vs Head
b) Flow Vs Power
c) Flow Vs Efficiency
d) Flow Vs NPSHR/ minimum submergence

1.4 QAP for pump and QAP for motors (if applicable).

1.5 GA, Datasheet, Curves etc. for drive motor (as applicable).

1.6 Operation and maintenance manual.

1.7 Lubrication arrangement drawings for external lubrication (if applicable).

1.8 PG test procedure as per clause 3.04.04 (if applicable).

1.9 Motor type test document (if applicable).

2.0 Within the stipulated time period as per vendor's drawings/ documents schedule as per NIT, the O&M Manual comprising of minimum following shall be submitted:
a) Drawings of components & details as deemed necessary.
b) Instruction manual for erection, operation & maintenance.
c) Storage instruction.

3.0 Before dispatch of the equipment the bidder shall furnish the following.
a) Material test certificates.
b) Shop test reports & certificates.
c) Fulfilment of packing instructions as indicated in Section-IA of this specification.

4.0 Distribution of drawings / documents for all projects:

The no. of copies of drawing/ documents to be submitted by the successful bidder, after the award of the contract shall be as per Section-IA or as specified in NIT.

	TITLE:	SPECIFICATION NO. PES-179-07	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION VERTICAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 1 of 18	

1.00.00 GENERAL INFORMATION

1.01.0 The general guidelines as illustrated in the subsequent clauses of this section shall be applicable for vertical pumps to be procured under the scope of this package.

1.02.0 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship, and shall be capable of performing the required duties in a manner acceptable to Engineer/Owner who will interpret the meaning of drawings and specifications and shall be entitled to reject any component or material, which in his judgement is not in full accordance herewith.

1.03.0 The omission of specific reference to any component/accessory necessary for the proper performance of Miscellaneous Pumps and drives shall not relieve the bidder of the responsibility of providing such facilities to complete the supply of equipment at quoted prices.

1.04.0 BHEL's / Customer's representative shall be given full access to the shop in which the equipment are being manufactured or tested and all test records shall be made available to him.

1.05.0 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/Customer.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out elsewhere in the specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01	IS-1710/1989:	Vertical Turbine Pumps for Clear, Cold and Fresh Water.
2.01.02	IS-5120/1977:	Technical requirements for Rotodynamic special purpose pumps.
2.01.03	IS-5639/1970:	Pumps for handling chemicals & corrosive liquids.
2.01.04	IS-5659/1970:	Pumps for process water.
2.01.05	IS-6536/1972:	Pumps for handling volatile liquids.
2.01.06	IS-9137/1978:	Code for acceptance tests for centrifugal, mixed flow and axial flow pumps- Class 'C'.

	TITLE:	SPECIFICATION NO. PES-179-07	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION VERTICAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 2 of 18	

2.01.07	BS 5316	Acceptance tests for Centrifugal, mixed flow Part-I/1976 and axial flow pumps - Class 'C' Tests (ISO 2548/1973)
2.01.08	BS 5316	Acceptance tests for Centrifugal, mixed flow Part-II/1977 and axial flow pumps - Class 'B' Tests (ISO 3555/1977)
2.01.09	ANSI B 73.2M 1984	Vertical inline centrifugal pumps for chemical process
2.01.10	API-610/1989:	Centrifugal pumps for general refinery services.
2.01.11	HIS	Hydraulic Institute Standards, USA
2.01.12	PTC 8.2/1965:	Power Test Codes - Centrifugal pumps.
2.01.13	ASTM-1-165-55	Standard Methods for Liquid Penetration Inspection.

2.02.00 In case of any contradiction with the above standards and annexure, the stipulations in the annexure shall prevail and shall be binding on the bidder.

3.00.00 SCOPE OF SUPPLY & SERVICES:

3.01.00 The miscellaneous pumps and drives scope shall be as specified in Data Sheet-A /Section IA.

3.02.00 The Capacity, Head, Materials of construction and other particulars of pumps are detailed in Data Sheet-A of the specification.

3.03.00 Accessories:

All the pumps under this specification shall be complete with following standard/special accessories.

3.03.01 Standard accessories:

a) LT Electric drives/motors (as applicable) with cable gland and lugs at motor end. (The bare HT drive motors and LT motors not in bidder's scope of supply, wherever required supplied as free issue by BHEL refer Cl. 5.08.00).

b) Pump motor coupling along with coupling guard.

c) Common base/sole plate for pumps and motor.

d) Thrust block assembly (Thrust pads, attachments) for transferring the pump thrust to concrete thrust block (concrete thrust block in purchaser scope), as per clause 5.23.00.

e) Thrust bearing temperature measurement devise to be provided.

f) Self contained lubrication system along with all internal piping, valves, fittings, specialties etc. as required.

g) Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets.

h) Anchor bolts, nuts, seating steel works, shims etc. as necessary for mounting the pump-motor unit on Civil foundations.

i) Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ accessories.

j) Suitable drain connections with isolating valves as applicable.

k) Supply of first fill of lubricants with toping requirements for one year of operation after commissioning and handing over of equipment.

l) Set of “Special” Tools & Tackles for Pumps and motors, if any.

m) Erection and commissioning spares, “on as required” basis.

n) Bidder shall provide various drawings, data, calculations, test reports/ certificates, operation and maintenance manuals, As-built drawings, etc. as specified and as necessary.

o) Mandatory spares as specified in respective Data Sheet-A of this section.

3.04.00 Services included in Bidder’s Scope:

3.04.01 The pumps shall be guaranteed to meet the performance requirements specified vide Data Sheet -A and also for trouble free operation after commissioning. Schedule of performance guarantees (Section-IIIA) duly filled and signed shall be furnished with the bid.

3.04.02 The pumps erected by the purchaser shall be checked by the bidder for correctness of their installation, alignment, etc. at site prior to their commissioning.

3.04.03 After commissioning of pumps at site, site performance test for Noise, vibration and parallel running of pumps of all pumps for each unit/project shall be conducted by pump vendor at project site to ensure that the pumps meet the specified requirements. Pump vendor shall bring necessary instruments for conductance of site performance test.
If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL.

Note: Applicability of conducting PG test at site by vendor as per above clause shall be applicable if indicated in Section-1A.

If conductance of PG test of pumps at site for Noise, vibration and parallel running of pumps of all pumps for each unit/project is not in bidders scope and same is conducted by BHEL/ customer. In such cases also, if the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, without any commercial implication to BHEL.

3.04.04 Performance Guarantees for pumps shall stand valid till the satisfactory completion of performance testing by BHEL and its acceptance by purchaser / customer.

3.05.00 Works excluded from Bidder's Scope:

a) All HT motors and those LT Motors which are specifically excluded
b) Civil foundation
c) Suction/ discharge pipe works
d) MCC/ Switchgear/Power supply
e) Power and Control Cables, unless specifically specified in Electrical/ Systems portion of the specification.
f) Erection of equipments.

4.00.00 BID EVALUATION CRITERIA & LIQUIDATED DAMAGES FOR SHORTFALL:

4.01.00 The bids received shall be evaluated for power consumption at inlet to the motors, in respect of pumps specified in Data Sheet-A (working pump only viz. not the standby), for the purpose of price comparisons as briefed below:

The bid evaluation shall be done at the rate as specified in Data Sheet A per one (1) KW Power consumption, per working pump as follows.

$$KW = \frac{Q \times H \times S}{P \times M \times 367.2}$$

Where Q = Rated capacity M^3/hr
H = Rated TDH, MWC
P = Pump Efficiency
M = Motor Efficiency.
S = Specific Gravity of fluid handled

4.02.00 The efficiencies for pumps and motors for arriving at benchmark power for Bid Evaluation shall be as indicated in Data Sheet A for various pumps.

No advantage shall be given to the bidder for Aux. Power quoted lower than the Bench mark values calculated with KW calculation formula at Cl. 4.01.00 *above, considering the bid evaluation efficiencies for pump and motor as indicated in Data Sheet-A*. However the

bids shall be evaluated as above if the Aux. Power quoted are higher than Bench mark values.

NOTE:
1. Efficiencies for HT motors and LT motors not in bidder's scope, for bid evaluation purpose shall be taken based on the maximum value as furnished in Data Sheet A.
2. During contract stage the Guaranteed power consumption of Pumps with BHEL supplied drives (HT/LT) for successful bidder shall be reworked by BHEL as below:

Revised guarantee power consumption shall be as per KW calculation formula at Cl. 4.01.00 *above, where P = pump efficiency guaranteed by bidder and M = motor efficiency as per approved datasheet of the supplied HT/LT motor.*

4.03.00 Liquidated damages for shortfall in Guaranteed KW

The above guaranteed power consumption shall be demonstrated by the successful bidder during performance testing at works/ site.

For pumps with BHEL supplied drives, the power consumption shall be compared with the reworked guarantee power consumption, defined as per note no. 2 of Cl. 4.02.00 above for the purpose of shortfall.

The liquidated damages @ twice the bid evaluation rate as above per KW per working pump shall be levied in the event of failure of bidder to demonstrate the guaranteed power consumption.

5.00.00 TECHNICAL REQUIREMENTS:

5.01.00 The pumps shall meet the technical requirements of Section-I as well as Section-II. In the event of any contradiction of Section-II with Section-I, the Section-I will prevail.

5.02.00 The pumps shall be Electric motor driven.

5.03.00 The Pumps shall conform to HIS. It is bare minimum requirement, however, any other equivalent or stringent standard is also acceptable, if, all the requirements of HIS are also met.

5.04.00 The type of Vertical pumps shall be as follows (if specifically not indicated otherwise in Data Sheet-A):
a) Vertical turbine type pumps with 1500rpm. (if no. of stages <=5) shall be preferred.
b) If stages of vertical turbine pumps are more than 5, then sump pump construction shall be preferred with 1500 rpm speeds.
c) For pumps with maximum speed 3000rpm, sump pump construction is also acceptable.

5.05.00 No negative tolerance shall be permitted in rated capacity & TDH.

5.06.00 No negative tolerance shall be permitted in efficiency at rated capacity.

5.07.00 The shut off head of pumps shall be more than pump rated TDH and percentage variation may vary depending on the specific speed of the pump as under:

i. 10-15% for pumps of specific speed up to 1000 US units,
ii. 15-20% for pumps of specific speed in the range of 1000 to 2000 US units,
iii. 20-40% for pumps of specific speed in the range of 2000 to 4000 US units,
iv. Above 50% for pumps of specific speed in the range of 4000 to 7000 US units.

5.08.00 All HT motors and those LT motors which are not in bidder's scope of supply: bare motors only, shall be supplied as free issue by BHEL through BHEL, based on ratings and TS (Torque - Speed) curve selected and furnished by the bidders along with their un-priced bid. The responsibility for satisfactory operation for combined performance of pumps & motors shall rest with the bidder only as if, the drive motors also have been supplied by the bidder.

Couplings, base plate, foundation bolts, any other fittings, etc. as required shall be supplied by the bidders only. BHEL shall supply one number of each type of drive motors (where drive motor is not in bidder's scope of supply) for shop testing of pumps with job motors. All other motors shall be dispatched by BHEL directly to project sites.

5.09.00 For all HT motor driven pumps, BHEL has envisaged vibration-monitoring system in their own scope. The bidder shall make provisions for mounting following on the pump/ pump shaft:

- Purchaser’s probes in both DE/NDE bearings of pumps
- Key slots on pump shaft and flat surface on bearing housing for mounting vibration measuring block with dimensions as specified in Data Sheet A.
- Other components as finalized during detailing.
- For mounting of above on the HT motors & specifically excluded LT motors, same shall be taken care by BHEL.

5.10.00 The pumps shall be capable of developing the required total head at rated capacity for continuous operation. The pumps shall operate satisfactorily at any point on the Q-H characteristic curve over a range of 0% to 130% capacity and shall be suitable for continuous operation between 30% to 130% capacity.

5.11.00 Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.

5.12.00 The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.

5.13.00 The pumps shall be capable of running over the entire range of submergence/ NPSH requirement conditions required without any noise, vibration or cavitations.

	TITLE:	SPECIFICATION NO. PES-179-07	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION VERTICAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 7 of 18	

The prevailing suction pressures for various pumps are indicated in Data Sheet-A for suitable mechanical design of pumps.

5.14.00 The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the max. static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.

5.15.00 Pumps and motors shall run smooth without undue noise and vibration.

The vibration shall be within vibration norms for testing as per American National Standard for 'Rotodynamics Pump' for Vibration Measurement and allowable values, Doc. ANSI/ HIS 9.6.4-2009. The applicable vibration limits for each pump, shall be indicated in the Technical Data sheet to be furnished by the successful bidder after award of LOI/ PO.

The noise level shall be limited to 85 dB at distance of 1.0M.

5.16.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be interchangeable.

5.17.00 After installation, the guaranteed values of noise, vibration and parallel operation of pumps shall be tested and verified. If the site performance is found not meeting the requirements in any respect as specified, then the equipment shall be rectified or replaced by the vendor, at his own cost.

5.18.00 High reliability of the pumps is an essential requirement and therefore it gets weightage over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.

5.19.00 The offered pumps shall be of proven design meeting the experience-qualifying requirement of their operation at two sites for a minimum period of one year or as specified in technical PQR. Any deviation to this criterion shall be suitably highlighted in the deviations schedule.

5.20.00 The bearings shall be self-water lubricated, no external water supply shall be available. The cooling/ lubrication water for bearings, etc. shall be tapped from the pump discharge and supplied thru' bidder's integral pipe work.

5.21.00 <u>If water handled by pump is sea water/ dirty/ not suitable for lubrication/ cooling</u>:

5.21.01 The bearing lubrication/cooling may be specifically reviewed by bidders for the suitability with water analysis enclosed with Data Sheet-A of this section.

These pumps shall necessarily be provided with Thordan type line shaft bearings even if the other type of bearings are claimed suitable by the manufacturers.

The bidder's shall satisfactorily establish the adequacy of self water lubrication if provided, for similar rating pumps installed for the duty condition in the event of order. In absence of adequate documentary evidence to the satisfaction level of BHEL, the bidder shall provide force water lubrication as per clause 5.21.02 below without any cost implication.

5.21.02 In the event, the forced water lubrication is envisaged by the bidder, the following minimum requirements shall be complied with further details subject to Purchaser's approval during detailed engineering after the award of order.

One set of common water lubrication system shall be provided separately for each type of pumps. The lubricating system shall provide continuous lubrication to all the pumps during operation and the minimum requirements shall be as follows:

- 2X100 % duty self cleaning strainers of suitable size and mesh opening shall be installed on the common pump discharge and outlet shall be led to 1 no. 6 hrs. storage or min. 10 M3 capacity tank of carbon steel MOC, to be placed on roof of pump house .

- 2X100 % duty horizontal centrifugal lubricating pumps with TDH more than the shut off head of the subject pumps shall be provided. The capacity of each pump shall be sufficient to lubricate all of the subject pumps including 10% margin on capacity and head to suit requirement with 10 % margin with head.

- These horizontal pumps shall take suction from the overhead Sintex tank as explained above.

- Associated piping, fittings, Tank inlet motor operated valve, lubricating pumps suction & discharge isolating valves, motorised/ solenoid valves (as per purchaser's approval), lubricating pumps discharge check valves and lubricating pipe isolating valve at inlet to each of subject pump, etc. as required shall be provided.

- Instrumentation – Level Gauge, high level & low level switches for tank, pressure gauges at suction & discharge of each lubricating water pumps, low pressure switch on lubricating pipe at inlet to each of subject pump for subject pump start interlock, pressure switch on lubricating pipe at common discharge of subject pump for start up of stand by pump etc., as required subject to purchaser's approval shall be provided.

- Bidder shall supply any other equipment/ instrument required for proper functioning of the lubricating system, as deemed necessary during contract without any price implication to BHEL.

- Bidder shall also provide a relay based local control panel for proper functioning of the above system. The system shall be suitable for fully automatic operation as per approved write-up during detailed stage.

- Subject pumps shall be provided with shaft enclosing tube in the event above Lubrication system is envisaged by bidder. MOC for shaft enclosing tube shall be equivalent/ superior to MOC for column pipe for subject pump.

The complete forced water lubrication as above – if applicable, shall be in bidder's scope. Bidder to inform in schedule of deviation at bid submission stage, if fresh water is required for forced water lubrication system.

5.22.00 For Vertical pumps no thrust block is being provided except for pumps of projects, specified in Sec-IA of this specification. Bidder to design the pump foundation system (base plate/ sole plate, discharge head, foundation bolts etc.) capable of transferring the pump thrust to the concrete pump foundation itself.

5.23.00 If specified in Sec-IA of specification, thrust block assembly (Thrust pads, attachments) for transferring the pump thrust to concrete thrust block (concrete thrust block in purchaser scope) to be provided by bidder.

6.00.00 MANDATORY SPARES:

6.01.00 Bidder to provide the Mandatory spares listed vide Data Sheet-A. Unit price of mandatory spares shall be furnished in price Schedule.

6.02.00 Bidder shall include the cost of Mandatory Spares, unless specified otherwise in Sec-IA of the specification or NIT.

7.00.00 OTHER REQUIREMENTS:

7.01.00 The quality of water handled by various pumps shall be as per Data Sheet-A.

7.02.00 The materials of construction for various components specified are the minimum requirements and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

	TITLE:	SPECIFICATION NO. PES-179-07	
BHEL	STANDARD TECHNICAL SPECIFICATION VERTICAL PUMPS	VOLUME:	
		SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 10 of 18	

7.03.00 The makes of various bought out items of bidder (i.e. motor, bearings etc.) shall be subject to purchaser's approval in the event of order.

7.04.00 Painting for Pumps

a) The surface of SS, Gun metal, brass, bronze and non-metallic component shall not be applied with any painting.

b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.

c) For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness DFT of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness DFT of 50 microns shall be applied. The top coat shall consist of two coats each of min. thickness DFT of 50 microns of synthetic enamel paint and thus total DFT shall be min. 200 microns.

d) For all the steel surfaces exposed to (outdoor installation) atmosphere, a coat of chlorinated rubber based zinc phosphate primer of min. thickness DFT of 50 microns followed up with under coat of chlorinated rubber paint of min. thickness DFT of 50 microns shall be applied. Then, intermediate coat consisting of one coat of chlorinated rubber based paint pigmented with Titanium di-oxide with min. thickness DFT of 50 microns and top coat shall consist of two coats each of min. thickness DFT of 50 microns of chlorinated rubber paint shall be provided. Total DFT of paint system shall be min. 200 microns.

7.05.00 It is mandatory for the bidder to submit along with the bid, the deviations if any – whether major or minor in the schedule of deviations only. In the absence of deviations listed in the "Schedule of deviations, the offer shall be deemed to be full conformity with the specification, "not-withstanding" anything else stated elsewhere in bidder's offer. The implied/indirect deviations shall not be binding on the purchaser.

8.00.00 **PERFORMANCE REQUIREMENTS**

8.01.00 Performance requirements for the pumps shall be as guided in Data sheet - A enclosed with Section-I.

8.02.00 Pump(s) shall preferably be designed to have the best efficiency at flow within ± 10% of the specified duty point flow. The pumps shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated in the Data Sheet - A attached with Section-I.

8.03.00 Pump(s) shall preferably have a continuously rising head-capacity characteristics from the specified duty point towards shut-off point, the maximum being at shut-off to enable parallel operation.

Under all circumstances, the 'range of operation' of the pumps shall exclude any unstable operating zone of the head-capacity curve.

8.04.00 Wherever specified in the Data Sheet - A, pumps of each category shall be suitable for parallel operation. The head vs. capacity, the BHP vs. capacity characteristics etc. shall be identical to ensure equal load sharing and trouble-free operation of any pump when the other pump(s) working in parallel with it trip.

8.05.00 The pump set along with drive motor shall run smooth without undue noise and vibration. Acceptable vibration limits shall be guided by the HIS of USA. Refer clause 5.15.00 above for permissible limits.

9.00.00 **DESIGN AND CONSTRUCTION**

Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories. General design and constructional features of the pumps shall be as follows:

9.01.00 **Bowl Assembly**

9.01.01 This will be either a single or multi-stage centrifugal, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of handling fluid.

9.01.02 Pumps (s) shall have provision for adjustment of impellers in vertical direction from an accessible location, preferably at the housing (where separate thrust bearing for the pump is provided). The adjustment mechanism must take into consideration the extension of the line shaft due to hydraulic down thrust, weight of the shaft and impeller.

9.02.00 **Discharge Head**

9.02.01 Pump (s) shall have above/below floor discharge, as specified in the Data Sheet-A, attached to this section.

9.03.00 **Column pipe**

9.03.01 Column pipe shall be flanged and of bolted connection. Column pipes shall be designed for full internal vacuum.

9.03.02 In case of multi-piece column pipe and shaft assembly, the design shall permit raising/lowering of the pump assembly piece by piece without any difficulty. Any fixtures, clamps, etc. necessary for such purpose shall be supplied by the Bidder under this section.

The bidder shall also submit a write-up describing clearly the procedure of handling the pump.

9.04.00 **Impeller shaft, line shaft and head shaft**

9.04.01 Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft.

The critical speed shall be at least 30% higher than the rated speed.

9.04.02 Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall chamfered at the edges.

9.04.03 Line shaft may be single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacture. For screwed coupling, directions shall permit tightening of the joint during pump operation.

9.04.04 Replaceable shaft sleeves shall be furnished at applicable location, particularly under stuffing box and at other locations, as considered necessary.

9.05.00 **Shaft enclosing tube**

Shaft enclosing tube shall be required, unless self lubricated (and cooled) type of shaft bearings are asked for. Length of the shaft enclosing tube shall be in conformity with the shaft piece lengths.

9.06.00 **Seal rings**

Replaceable seal/wear rings both on impeller and on casing shall be provided in case it is asked for in this specification.

9.07.00 **Bearings**

9.07.01 **Shaft bearings**

Adequate number of properly designed bearings shall be provided for smooth and trouble free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self lubricated as specified in the Data Sheet-A of this section.

In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump. In case of forced water lubrication of the shaft bearings, the system and other accessories shall be in the scope of supply of Bidder as per clause 5.21.02.

9.07.02 **Thrust Bearing**

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load.

Thrust bearing shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handing fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system.

For thrust bearing, provision for temperature measurement shall be provided.

Cooling of the thrust bearing, if necessary, shall be done by the handing fluid/external water, depending on the fluid handled.

Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement indicated in this specifications or as per the recommendation of the pump manufacturer (and approved by Purchaser).

9.07.03 Bearings of reputed makes are to be provided, same shall be indicated in Technical Data sheet to be furnished by the successful bidder after award of LOI/ PO, subject to acceptance of BHEL/ end customer, without any price implication to BHEL.

9.08.00 **Reverse Rotation**

9.08.01 If indicated at Section-IA of the specification, the pump impeller and other rotating components shall be designed for reverse rotation, when subject to reverse flow at rated pump discharge head.

9.09.00 **Drive Unit**

9.09.01 The pumps shall be driven by electric motor directly coupled as specified in the Data Sheet-A of this section. A heavy duty coupling along with coupling guard shall be provided between the pump and drive unit.

9.09.02 Unless otherwise specified in Data Sheet-A of this section, drive unit power rating shall be the maximum of the following requirements.

a) 16% margin over the pump shaft input power at the rated duty point.

b) 10% margin over the maximum pump shaft input power required within the 'Range of Operation'.

c) Pump shaft input power required considering the overloading of the pump assuming

single pump operation in the event of tripping of one or more of the pumps operating in parallel.

9.09.03 All Vertical pump motors shall be designed/capable of withstanding max. run away speed during reverse flow through pump.

10.00.00 **INSPECTION AND TESTING**

10.01.00 The Quality Plans enclosed in the specification are for bidder's guidance only. The bidder shall comply with these and other minimum requirements specified in the specification and shall furnish his own quality plan in the event of order based on the guidance given as above, for approval by BHEL/Customer.

10.02.00 The Bidder shall carry out the following specific tests inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good engineering practice.

a) **Identification and Testing**

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standard and test certificates shall be made available to the Owner. Material identification and testing shall include, but shall not be limited to the following components:

- Bowls and suction bells
- Impeller and wearing rings
- Shafts and shaft sleeves
- Couplings
- Bearings
- Column pipes
- Discharge heads
- Bowl Assembly

ii) 100% PMI (Positive Material Identification) inspection for material grade of pump casing, shaft and impeller shall be done by vendor & certification shall be submitted for review of BHEL. Further BHEL reserves the right to conduct random & independent PMI inspection on pump casing, shaft and impeller to ascertain the grade of material during inspection at vendor works.

iii) Tests for each pump included under this section shall include but not be limited to the following:

- The entire surface of the impeller / casing / diffuser castings shall be subjected to Dye Penetration Test as per ASTM Specification no.:1-165-65.

- Shaft coupling & other active components shall be subjected to Dye Penetration and Ultrasonic Tests.

- Wearing rings, shaft sleeves shall be subjected to Dye Penetration Test.

- Fabricated components of pumps shall be subjected to Dye Penetration test on weld.

- Verification of material, witnessing of pouring, casting and inspection of finished fabricated/castings.

- Inspection of finished castings for impeller and verification of materials.

- Inspection of pump shaft and verification of material.

- Witnessing of NDT/review of NDT reports.

- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940 to grade 6.3 or better.

- Complete Inspection of assembled pump.

b) **Hydraulic Testing**

Bowls/ Suction bells, Columns pipe, Discharge head and any other applicable pressure parts shall be hydrostatically tested at maximum of the following:

i. 2 times the TDH (Total Dynamic Head) at rated capacity (or)
ii. 1.5 times the shut-off pressure
iii. System Design pressure indicated in Data Sheet-A of Section-I.

The HT pressure shall be maintained for a period of not less than 30 minutes. During testing there should not be any pressure drop & leakage.

c) **Performance Test at Shop**

i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps at rated speed. These shall be carried out to span 130% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexure. After

completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished.

iv) Minimum submergence/ NPSH required tests are to be conducted for each type at 3% head drop conditions, if specified in the pump approved QP.

v) All rotating components of the pumps shall be subjected to static and dynamic balancing tests. The assembled rotor will be subjected to dynamic balancing tests.

vi) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

10.03.00 Inspection of Mandatory/ Recommended spares shall be in line with approved QP for main supply.

11.00.00 DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE

11.01.00 After award of LOI, the successful bidder shall submit drawings/documents as per Data Sheet-C.

11.02.00 The no. of drawings/documents to be submitted shall be as per Data Sheet-C.

12.00.00 The various Sections-I's & II's along with Data Sheets attached in this specification together with the specification for Miscellaneous Pumps shall be complied with by the bidders.

13.00.00 Bidder to submit all drawing/ documents in soft as well as hard copy in the event of order as per schedule indicated in section-IA.

Within one (1) week of receipt of BHEL comments a technical representative from Bidder's works shall come for meeting with BHEL along with revised documents to resolve all issues and incorporate all comments in the soft copy for further submission to customer.

Further on receipt of customer's comments on the documents a technical representative from Bidder's works shall come for meeting with Customer to resolve all issues and incorporate all comments in the soft copy and further resubmission of same to Customer. The representative shall be available here till category I approval of all the drawings and documents.

14.00.00 Guarantee for all pumps shall at least remain valid for 18 months from the Unit commissioning date or as specified in NIT.

	TITLE:	SPECIFICATION NO. PES-179-07	
		VOLUME:	
	STANDARD TECHNICAL SPECIFICATION VERTICAL PUMPS	SECTION: IIA	
		REV. NO. 04	DATE: 01/07/2016
		SHEET 17 of 18	

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

a) Compliance certificate duly signed and stamped (enclosed at Section-IIIB).

b) GA drawings of pumps and motors with following: (shall be only for reference purpose, same shall not be reviewed/commented by purchaser at this stage and shall be subject to approval only during contract).

- Civil static & dynamic loads.
- Foundation details.
- Minimum Submergence required.
- Clearances - Side, Back & Bottom
- Min. Recommended crane capacity

c) Guarantee Schedule duly signed and stamped (enclosed at Section-IIIA).

d) Technical deviation schedule (if reqd.) (enclosed at Section-IIIC).

e) Data for drive Motor (HT/LT- which is not in bidder's scope of supply - as applicable): Load torque speed curves of the pumps, selected motor rating, rpm, GD^2 of driven equipment.

f) Unpriced copy of the price bid shall be furnished along with the technical bid.

Apart from above no other Drgs./Docs./Data sheets etc. are required to be submitted at bid stage and even if furnished shall not be taken cognizance of.

In case of any deviation from this technical specification, the same shall be indicated in the schedule of deviations as per Section-IIIC or NIT. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specification.

DATA SHEET – C

Drawings / documents distribution schedule to be followed by successful Bidder:

1.0 Drawings/documents submission schedule, shall be as per Section-IA.
The successful bidder shall submit at least following drawings/ documents:

1.1 Fully dimensioned outline general arrangement drawings of the pump and motor assembly. This drawing should include foundation base plate/sole plate details as applicable, civil foundation, anchor bolt details, loading data (Static and Dynamic), points of connections of external piping, cables and mounting of devices furnished by the supplier and details for Gap between Coupling Shafts, Float & details for axial/radial tolerance allowed etc. which are required for erecting agency during erection of pump.

1.2 Cross sectional drawing of the equipment showing the details of assembly of components and their material of construction with standard applicable codes.

1.3 Technical datasheet as per Datasheet-B (Section-IIID) including characteristic curves of pumps showing the following:

a) Flow Vs Head
b) Flow Vs Power
c) Flow Vs Efficiency
d) Flow Vs NPSHR/ minimum submergence

1.4 QAP for pump and QAP for motors (if applicable).

1.5 GA, Datasheet, Curves etc. for drive motor (as applicable).

1.6 Operation and maintenance manual.

1.7 Lubrication arrangement drawings for external lubrication (if applicable).

1.8 PG test procedure as per clause 3.04.03 (if applicable).

1.9 Motor type test document (if applicable).

1.10 Test Procedure for Sump Model Study (if applicable).

2.0 Within the stipulated time period as per vendor's drawings/ documents schedule as per NIT, the O&M Manual comprising of minimum following shall be submitted:
a) Drawings of components & details as deemed necessary.
b) Instruction manual for erection, operation & maintenance.
c) Storage instruction.

3.0 Before dispatch of the equipment the bidder shall furnish the following.
a) Material test certificates.
b) Shop test reports & certificates.
c) Fulfilment of packing instructions as indicated in Section-IA of this specification.

4.0 Distribution of drawings / documents for all projects:

The no. of copies of drawing/ documents to be submitted by the successful bidder, after the award of the contract shall be as per Section-IA or as specified in NIT.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC NO.: PE-TS-XXX-100-N001	DATE	
BHEL		CUSTOMER:		QP NO.: PE-QP-999-100-N004	DATE	
		PROJECT :		PO NO.:	DATE	
		ITEM: MISC. PUMPS (HORIZONTAL/VERTICAL)	SYSTEM: CW/ACW/DMCW/PLANT/ COMMON	SECTION:	SHEET 1 OF 6	

S. No.	COMPONENT & OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY ** M	C	N	REMARKS
1	2	3	4	5	6 M C/N	7	8	9		10			11
1	RAW MATERIALS												
1.1	CASINGS (INCLUDING BOWLS,DIFFUSERS, STAGE BODIES, DISCH HEAD (IF CAST)), ETC. - (AS APPLICABLE) AND IMPELLER	MECHANICAL AND CHEMICAL PROPS	CR	MECHANICAL AND CHEM. ANALYSIS	ONE/HEAT/BATCH	APPROVED CS DRAWING/DATA SHEET	RELEVANT MATERIAL SPECN.	LAB REPORT/ MTC	√	P	V	V	
1.2	STUFFING BOX, SUCTION BELL, WEARING RINGS,NECK RINGS, SHAFT SLEEVES	MECHANICAL AND CHEMICAL PROPS	MA	MECHANICAL AND CHEM. ANALYSIS	ONE/HEAT/BATCH	APPROVED CS DRAWING/DATA	RELEVANT MATERIAL SPECN.	LAB REPORT/ MTC	√	P	V	V	
		HARDNESS DIFFERENCE BETWEEN CASING / IMPELLER AND WEARING RING	MA	LAB. TEST	100%	APPROVED CS DRAWING/ DATA SHEET	50 BHN MIN.	LAB. REPORT	√	P	V	V	
1.3	BARS/FORGINGS FOR SHAFTS, LINE SHAFTS	1.PHYSICAL & CHEMICAL PROPS	CR	1.MECHANICAL & CHEMICAL ANALYSIS.	1/CAST OR 1/BARS	APPROVED CS DRAWING/DATA SHEET	RELEVANT MATERIAL SPECN.	MILL T.C, OR LAB.REPORT	√	P	V	V	CORRELATION REQUIRED, IDENTIFICATION AS PER TC
		2.DIMENSIONS	CR	2.MEASURMENT	100%	MFR. DRAWING	MFR. DRAWING	INSP.REPORT	√	P	V	V	
		3.INTERNAL DEFECTS FOR 40MM & ABOVE DIA SHAFTS.	CR	3.ULTRA SONIC TEST	100%	ASTMA388 BACK WALL ECHO 100%	DEFECT ECHO MAX 20% OF B.W.E. LOSS OF BACK WALL ECHO 20% MAX	NDT CERTIFICATE	√	P	V	V	
1.4	STRESS RELIEVING/ HEAT TREATMENT OF CASTING OF ALL ABOVE (IF APPLICABLE) / SOLUTION ANNEALING OF SS CASTING	1. VARIFICATION OF HT CHART	MA	VERIFICATION OF SR/HT CHART	ALL BATCHES	RELEVANT MATERIAL SPECN.	RELEVANT MATERIAL SPECN.	CORRELATED SR/HT.CHARTS	√	P	V	V	
		2. IGC TEST FOR SS CASTING	MA	LAB. TEST	ONE SAMPLE/ HT BATCH	ASTM A 262	ASTM A 262 Gr A	LAB. REPORT	√	P	V	V	
1.5	SHAFT ENCLOSING TUBES, COLUMN PIPES & DISCHARGE ELBOW	1. MECHANICAL & CHEMICAL PROPS. 2. DIMENSIONS. 3. SURFACE FINISH	MA	1. MECH & CHEM TEST 2. MEASUREMENT 3. VISUAL EXAM	1/BATCH 100% 100%	APPROVED GA DRG./DATA SHEET	RELEVANT MATERIAL SPECN./MAFG./ APPROVED DOCS	MFR T.C OR LAB. REPORT	√	P	V	V	

BHEL					BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY				Doc No:			
	Sign & Date	Name		Sign & Date	Name	Sign & Date			Sign & Date	Name	Seal
Prepared by:	03/02/2020	TANUJ MATTA	Checked by:	03.02.20	MOHIT KUMAR	Seal		Reviewed by:			
Reviewed by:	3/2/20	AJAY JAIN	Reviewed by:	03/02/2020	RITESH KUMAR JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC NO.:PE-TS-XXX-100-N001	DATE	
	CUSTOMER		QP NO.: PE-QP-999-100-N004	DATE	
	PROJECT :		PO NO.:	DATE	
	ITEM: MISC PUMPS (HORIZONTAL/VERTICAL)	SYSTEM: CW/ACW/DMCW/PLANT/ COMMON	SECTION:	SHEET	2 OF 6

S. No.	COMPONENT & OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY ** M	AGENCY ** C	AGENCY ** N	REMARKS
1	2	3	4	5	6	7	8	9		10			11
					M C/N								
1.6	PLATE FLANGE, C/FLANGE	1. MECHANICAL & CHEMICAL PROS. 2. DIMENSIONS, 3. SURFACE FINISH	MA	1. MECH & CHEM TEST 2. MEASUREMENT 3. VISUAL EXAM	1/CAST 100% 100%	APPROVED GA DRG./DATA SHEET	RELEVANT MATERIAL SPECN./ MFR. DRG./ APPROVED DOC	MILL TC/ LAB REPORT	√	P	V	V	CORRELATION REQ. FOR MAT. OTHER THAN IS 2062
1.7	SUCTION STRAINER (IF APPLICABLE)	MECHANICAL & CHEMICAL PROS.	MI	MECH. & CHEMICAL TEST	1/HEAT	APPROVED GA DRG./DATA SHEET	RELEVANT MATERIAL SPECN./ MFR. DRG./ APPROVED DOC	MILL TC/ LAB REPORT	√	P	V	V	
1.8	MECHANICAL SEAL (IF APPLICABLE)	TYPE, SIZE, MFRS, NO., MAKE	MA	VISUAL EXAM	100%	APPROVED DATASHEET / GA MECH. SEAL	APPROVED DATASHEET		√	P	V	V	COMPLIANCE TC FOR APPROVED MAKE
* 1.9	PUMP BEARINGS	TYPE, SIZE, MFRS, NO., MAKE	MA	VISUAL EXAM	100%	APPROVED DATASHEET	APPROVED DATASHEET		√	P	V	V	COMPLIANCE TC FOR APPROVED MAKE
2.0	**IN PROCESS CONTROL**												
2.1	ALL COMPONENTS UNDER 1.00 ABOVE	VISUAL DEFECTS, DIMENSIONS	MA	VISUAL EXAM, MEASUREMENT	100%	MFG. DRAWING	MFG. DRAWING	COMPLIANCE TC	√	P	V	V	
2.2	IMPELLER	CLEANING AND DEBURRING	MA	VISUAL	100%	MFG. DRAWING	MFG. DRAWING		√	P	V	V	
	IMPELLER	DYNAMIC BALANCING	CR	DYNAMIC BALANCING	100%	ISO 1940	ISO1940 Gr 6.3	BALANCING CERTIFICATE	√	P	W	V	WTNESSING ONLY FOR SIZE GREATER THAN 10KW
2.3	IMPELLER-ALL ACCESSIBLE SURFACES, DIFFUSERS	DP TEST	MA	DP TEST ON M/CED AREA	100%	APPENDIX 8 OF ASME SEC. VIII DIV. 1		NDT CERTIFICATE	√	P	W	V	
2.4	WEARING RING, SHAFT SLEEVES, CASING	DP TEST	MA	DP TEST ON M/CED AREA	100%	APPENDIX 8 OF ASME SEC. VIII DIV. 1		NDT CERTIFICATE	√	P	V	V	
2.5	SHAFT	DP TEST	MA	DP TEST ON M/CED AREA	100%	ASTM E 165	NO RELEVANT INDICATION ALLOWED	NDT CERTIFICATE	√	P	W	V	
2.6	CASINGS/ BOWLS, STAGE BODIES, DISCHARGE HEAD (IF CAST), SUCTION HOUSING, COLUMN PIPE DISCHARGE PIPE ETC	LEAK TIGHTNESS	CR	VISUAL	100%	TECHNICAL DATA SHEET AND NOTE 2	NO LEAKAGE FOR TEST DURATION OF 30 MIN.	HT CERTIFICATE	√	P	W	V	HAMMERING OF CASTINGS WITH WOODEN/ RUBBER MALLET BEFORE HYDRO TEST

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
	ENGINEERING		QUALITY					Doc No:			
	Sign & Date	Name		Sign & Date	Name	Sign & Date			Sign & Date	Name	Seal
Prepared by:	03/02/2020	TANUJ MATTA	Checked by:	03.02.20	MOHIT KUMAR	Seal		Reviewed by:			
Reviewed by:	3/2/20	AJAY JAIN	Reviewed by:	03/02/2020	RITESH KUMAR JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC NO. PE-TS-XXX-100-N001	DATE	
	CUSTOMER:		QP NO.: PE-QP-999-100-N001	DATE	
	PROJECT		PO NO.:	DATE	
	ITEM: MISC. PUMPS (HORIZONTAL/VERTICAL)	SYSTEM: CW/ACW/DMCW/PLANT/ COMMON	SECTION:	SHEET 3 OF 6	

S. No.	COMPONENT & OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	* D	AGENCY ** M	C	N	REMARKS
1	2	3	4	5	6 M C/N	7	8	9		10			11
2.7	FABRICATED COMPONENTS												
2.7.1	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	EXAM.	100%	ASME SEC.IX	ASME SEC.IX	QW 482 OF ASME SEC.IX	√	P	V	V	WELDING PROCEDURE APPROVAL BY BHEL ALT. 3RD PARTY (LLYODS,BVQI OR EQ.) IS ACCEPTABLE.
2.7.2	WELDING PROCEDURE QUALIFICATION RECORD	WELD SOUNDNESS	MA	VISUAL,PHYS. TESTS RT (AS APPLICABLE)	100%	ASME SEC.IX	ASME SEC.IX	QW 483 OF ASME SEC.IX	√	P	V	V	
2.7.3	WELDER PERFORMANCE QUALIFICATION	WELD SOUNDNESS	MA	VISUAL,PHYS. TESTS RT (AS APPLICABLE)	100%	ASME SEC.IX	ASME SEC.IX	QW 484 OF ASME SEC.IX	√	P	V	V	
2.7.4	WELD FIT-UPS	DIMENSION & ALIGNMENT	MA	MEAS.VISUAL EXAM	100%	WPS, MFG . DRAWING	WPS, MFG . DRAWING	IR/LOGBOOK	√	P	V	V	
2.7.5	ROOT RUNS	SURFACE DEFECTS	MA	PENETRANT TEST	100%	ASTM E 165	NO SURFACE DEFECT	IR/LOGBOOK	√	P	V	V	
2.7.6	WELDMENTS	SURFACE DEFECTS	MA	PENETRANT TEST	100%	ASTM E 165	ASME-VIII,DIV I	INSPN REPORT	√	P	W	V	WITNESS BY BHEL & VERIFICATION BY CUSTOMER

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name				Sign & Date	Name	Seal
Prepared by:	03/02/2020	TANUJ MATTA	Checked by:	03.02.20	MOHIT KUMAR	Seal		Reviewed by:			
Reviewed by:	3/2/20	AJAY JAIN	Reviewed by:	03/02/2020	RITESH KUMAR JAISWAL			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC NO.:PE-TS-XXX-100-N001	DATE	
		CUSTOMER:		QP NO.. PE-QP-999-100-N004	DATE	
		PROJECT :		PO NO :	DATE	
		ITEM: MISC. PUMPS (HORIZONTAL/VERTICAL)	SYSTEM: CW/ACW/DMCW/PLANT/ COMMON	SECTION	SHEET 4 OF 6	

S. No.	COMPONENT & OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY **			REMARKS
										M	C	N	
1	2	3	4	5	6	7	8	9	* D	10			11
					M C/N								
2.7.7	BUTT WELDS	INTERNAL DEFECT	MA	UT/RT	100%	ASME SEC. V	ASME-VIII,DIV I	IR	√	P	W	V	WITNESSING OF U.T
2.7.8	DICHARGE HEAD, COLUMN PIPE, DISCHARGE PIPE, ETC.	1. LEAK TIGHTNESS 2. DIMENSION	CR	1. HYDROTEST 2. MEASUREMENT	100%	APPROVED DATA SHEET/ APPROVED QP APPROVED GA-CS DRG/MFR DRG.	1. NO LEAKAGE 2. MFR. DRAWING	IR	√	P	W	V	
3.0	SUB-ASSEMBLY CONTROL												
3.1	ROTOR ASSEMBLY	ECCENTRICITY	MA	MEASUREMENT	100%	APPROVED GA DRG/ MFR.DRAWING	APPROVED GA DRG/ MFR.DRAWING	IR/LOG BOOK	√	P	V	V	
3.2	ROTOR ASSEMBLY RESIDUAL UNBALACE	STATIC & DYNAMIC	CR	STATIC & DYNAMIC BALANCING	100%	ISO 1940	ISO1940 Gr 6.3	BALANCING CERTIFICATE	√	P	W	V	WTNESSING ONLY FOR SIZE GREATER THAN 10KW
3.3	COMPLETE PUMP ASSEMBLY	COMPLETENESS, CORRECTNESS, CLEANLINESS, CLEARANCES, FREENESS, ALIGNMENT	MA	VISUAL EXAM MEASUREMENT	100%	APPROVED DRG & MFG STANDARDS	APPROVED DRG & MFG STANDARDS	I.R. & CHECK LISTS	√	P	V	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name				Sign & Date	Name	Seal
Prepared by:	03/02/2020	TANUJ MATTA	Checked by:	03.02.20	MOHIT KUMAR	Seal		Reviewed by:			
Reviewed by:	3/2/20	AJAY JAIN	Reviewed by:	03/02/2020	RITESH KUMAR JAISWAL			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC NO. PE-TS-XXX-109-N001	DATE	
BHEL		CUSTOMER:		QP NO : PE-QP-999-100-N004	DATE	
		PROJECT :		PO NO	DATE	
		ITEM: MISC. PUMPS (HORIZONTAL/VERTICAL)	SYSTEM. CW/ACW/DMCW/PLANT/ COMMON	SECTION:	SHEET 5 OF 6	

S. No.	COMPONENT & OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY ** M	C	N	REMARKS
1	2	3	4	5	6	7	8	9	* D	10			11
					M C/N								
4	FINAL INSPECTION, TESTS & PACKING DESPATCH CONTROL												
4.1	PUMP WITH JOB/SHOP MOTOR ASSEMBLED ON INDIVIDUAL BASE FRAME	1. Q V/S HEAD, 2. Q V/S POWER, 3. Q V/S PUMP EFF. 4. VIBRATION 5. NOISE 6. BEARING TEMP. 7. LEAKAGES	CR	PERFORMANCE TEST	100%	APPD. PERFORMANCE TEST PROCEDURE/ APPD. DATA SHEET/APPD. CURVES FOR VIBRATIONS - AS PER ANSI/HIS 9.6.4-2009 (VALUES AS PER APPROVED DATA SHEET) FOR BEARING TEMP - BEARING HOUSING SHOULD NOT BE UNTOUCHABLY HOT. FOR LEACKAGE - MINOR LEKAGE (DROP BY DROP) IN CASE OF GLAND PACKING ARRANGEMENT.		I.R., PERF. TEST RECORD, PLOTED CURVES	√	P	W	W	* MINIMUM 7 POINTS FROM SHUT-OFF TO MAX. OPERATING FLOW COVERING ENTIRE OPERATION RANGE OF PUMP SHALL BE TAKEN. * CUSTOMER HOLD POINT
		NPSH REQUIRED	CR	NPSH TEST	1/MODEL	APPD. PERFORMANCE TEST PROCEDURE/ APPD. DATA SHEET/APPD. CURVES		IR. NPSH TEST RECORD, PLOTED CURVES	√	P	W	W	IF SPECIFIED or INSISTED BY CUSTOMER.
4.2	STRIP DOWN AFTER PERFORMANCE TEST	1UNDUE WEAR TEAR AND RUBBING	MA	VISUAL EXAM AFTER STRIPPING	1/MODEL	NO UNDUE WEAR TEAR & RUBBING ON IMPELLER & WEAR RING		INSP. REPORT	√	P	W	W	WITNESS REQUIRED ONLY WHEN ABNORMAL SOUND OBSERVED DURING PERFORMING TEST.
4.3	COMPLETE PUMP WITH UNIT MOTOR BASE FRAME, COUNTER FLANGES ETC. INCLUDING ALL ACCESSORIES AS PER SECTION C OF SPECN.	COMPLETENESS, CLEANLINESS, OVERALL DIMENSIONS ORIENTATION, WORKMANSHIP AND FINISH	MA	VISUAL EXAM MEASURMENT	100%	APPD. G.A DRAWING	APPD. G.A DRAWING	INSP. REPORT	√	P	W	V	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name				Sign & Date	Name	Seal
Prepared by:	03/02/2020	TANUJ MATTA	Checked by:	03.02.20	MOHIT KUMAR	Seal		Reviewed by:			
Reviewed by:	3.2.20	AJAY JAIN	Reviewed by:	03/02/2020	RITESH KUMAR JAISWAL			Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	QUALITY PLAN		SPEC NO.:PE-TS-XXX-100-N001	DATE	
		CUSTOMER:		QP NO.: PE-QP-999-100-N004	DATE	
		PROJECT :		PO NO .	DATE	
		ITEM: MISC PUMPS (HORIZONTAL/VERTICAL)	SYSTEM: CW/ACW/DMCW/PLANT/ COMMON	SECTION:	SHEET 6 OF 6	

S. No.	COMPONENT & OPERATION	CHARACTERISTIC	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY **			REMARKS
										M	C	N	
1	2	3	4	5	6	7	8	9	* D	10			11
					M C/N								
4.4	PAINTING	1.SURFACE FINISH, DFT, MARKINGS ETC.	MA	VISUAL EXAM MEASURMENT AESTHETIC	100%	APPD.DRG.	APPD.DOCS	IR.	√	P	V	V	
4.5	PACKING, MARKING	SOUNDNESS OF PACKING	MI	VISUAL AESTHETIC	100%	TECHNICAL SPECIFICATION/ MFG. STANDARD	TECHNICAL SPECIFICATION/ MFG. STANDARD	PHOTOGRAPHS	√	P	V		PHOTOGRAPHS OF PACKED MATERIAL TO BE VERIFIED BY BHEL BEFORE ISSUING MDCC

NOTES:

1.AS CAST HEAT MARKS SHALL BE PROVIDED ON CI CASTING LIKE TOP & BOTTOM CASING.

2. HYDRO TEST PRESSURE SHALL BE AT LEAST 2(TWO) TIMES THE DUTY POINT (OR) 1.S TIMES OF SHUT OFF HEAD (OR) SYSTEM DESIGN PRESSURE, WHICHEVER IS HIGHER.

3. THIS QAP IS ALSO APPLICABLE FOR SPARES.

4. NO WELD REPAIRS PERMISSIBLE ON CI CASTING.

5. MATERIAL SHALL BE AS PER APPROVED CROSS SECTION DRG./ DATA SHEET.

6. STRIP TEST- INCASE OF ABNORMAL NOISE OBSERVED DURING PERF. TEST, THOSE PUMP WILL BE STRIPPED DOWN FOR VISUAL INSPECTION OF IMPELLER & WEAR SHALL BE OFFERED FOR VISUAL INSPECTION FOR WEAR /RUBBING MARKS.

7. PUMPS WITH MECHANICAL SEAL ARRANGEMENT TO BE TESTED AND SUPPLIED WITH GLAND PACKING ARRANGEMENT. HOWEVER MANUFACTURER TO ENSURE DIMENTIONAL MATCHING OF MECHANICAL SEAL WITH PUMP GA DRAWING.

8. BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST IF REQUIRED.

9. PMI (POSITIVE MATERIAL IDENTIFICATION) INSPECTION WITNESS BY "C"/"N" FOR MATERIAL GRADE OF PUMP CASING/BOWL ASSEMBLY, SHAFT, SHAFT SLEEVE, IMPELLER AND COLUMN PIPE (FOR VERTICAL PUMPS) ON RANDOM SAMPLE BASIS. HOWEVER, VENDOR TO CONDUCT 100% PMI AND PROVIDE PMI CERTIFICATES FOR REVIEW BY "C"/"N" DURING INSPECTION AT VENDOR WORKS.

LEGEND : - * RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N:** CUSTOMER
P- PERFORM, **W**- WITNESS, **V**-VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL, **MTC** -Mill Test Certificate, **TC**-Test Certificate, **IGC**- Inter Granular Corrosion.
GA -GENERAL ARRANGEMENT DRAWING, **CS**-CROSS-SECTIONAL DRAWING

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name				Sign & Date	Name	Seal
Prepared by:	03/02/2020	TANUJ MATTA	Checked by:	03.02.20	MOHIT KUMAR	Seal		Reviewed by:			
Reviewed by:	3/2/20	AJAY JAIN	Reviewed by:	03/02/2020	RITESH KUMAR JAISWAL			Approved by:			

SUB-SECTION – IIB

STANDARD TECHNICAL REQUIREMENTS (ELECTRICAL)

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	M	C	N	
					M	C/ N								
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325//IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325//IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325//IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER

SECTION IIIA

GUARANTEE SCHEDULE
(TO BE SUBMITTED ALONG WITH THE BID BY ALL BIDDERS)

	SCHEDULE OF PERFORMANCE GUARANTEES	SPECN. NO.:	PE-TS-445-100-N001, Rev-00		
		VOLUME:	--	SECTION:	IIIA Sheet 1 of 2
	1X660 MW SAGARDIGHI, PHASE-III (UNIT-5)-----WBPDCL	REV. NO.	00	DATE:	20.10.2021

Following parameters are guaranteed for following pumps

Sl. No.	Pump Description	Guaranteed Capacity	Guaranteed TDH	Guaranteed Pump Eff.	Guaranteed Motor Eff.	Guaranteed Power consumption at inlet to motor terminals	Motor Rating	Pump GD^2 Value for HT motor only	Pump RPM	T/S Curve attached for HT motor
		(M3/Hr)	(MWC)	%	%	(KW)	(KW)			
	Horizontal pumps									
1	# DMCW-TG AUX. PUMPS	1680	40		95					
2	# DMCW-SG AUX. PUMPS	571	55		95					
3	CYCLE MAKE UP PUMP	120	50							

Note: 1 # Bid evaluation and LD is applicable for these pumps only as per clause 4.00.00 of Section-IIA, clause 1.9 of Section-1A & Data Sheet-A of Section-ID of Technical Specification for pumps.

We the undersigned hereby undertake to meet the performance guarantees as listed in the table above on the conditions as elsewhere specified. Any variation of the specified conditions during official tests will be taken in account by the customer

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE

NAME DESIGNATION SIGNATURE DATE COMPANY SEAL

		SPECN. NO.:	PE-TS-445-100-N001, Rev-00		
	SCHEDULE OF PERFORMANCE GUARANTEES	VOLUME:	--	SECTION:	IIIA Sheet 2 of 2
	1X660 MW SAGARDIGHI, PHASE-III (UNIT-5)-----WBPDCL	REV. NO.	00	DATE:	20.12.2021

Following parameters are guaranteed for following pumps

Sl. No.	Pump Description	Guaranteed Capacity	Guaranteed TDH	Guaranteed Pump Eff.	Guaranteed Motor Eff.	Guaranteed Power consumption at inlet to motor terminals	Motor Rating	Pump GD^2 Value for HT motor only	Pump RPM	T/S Curve attached for HT motor
		(M3/Hr)	(MWC)	%	%	(KW)	(KW)			
	Vertical pumps									
1	# ACW PUMPS	4505	42		95					

Note: 1 # Bid evaluation and LD is applicable for these pumps only as per clause 4.00.00 of Section-IIA, clause 1.9 of Section-1A & Data Sheet-A of Section-ID of Technical Specification for pumps.

We the undersigned hereby undertake to meet the performance guarantees as listed in the table above on the conditions as elsewhere specified. Any variation of the specified conditions during official tests will be taken in account by the customer

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE

NAME DESIGNATION SIGNATURE DATE COMPANY SEAL

SECTION IIIB

COMPLIANCE CERTIFICATE
(TO BE SUBMITTED ALONG WITH THE BID BY ALL BIDDERS)

	TECHNICAL SPECIFICATIONS	SPECN. NO.:	PE-TS-445-100-N001, Rev.0		
	MISCELLANEOUS PUMPS	VOLUME:	--	SECTION:	IIIB
	COMPLIANCE CERTIFICATE	REV. NO.	0	DATE:	20.12.2021

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnish same with the offer.

a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.

b) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.

QP will be subject to BHEL/ CONSULTANT/ CUSTOMER approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.

c) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/ CONSULTANT/ CUSTOMER approval.

d) There are no other deviation with respect to specification other than those furnished in the 'Schedule of Deviations'.

e) Bidder shall include the cost of Mandatory Spares, unless specified otherwise in Sec-IA of the specification or NIT.

Any mandatory spares stated as not applicable, shall have to be supplied without any cost implication to BHEL in the event they are found to be applicable during detail engineering stage.

f) The offered materials should be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty. All materials shall be subject to approval in the event of order.

g) Prices for recommended spares (if any) for 3 years operation shall be furnished separately & not included in the base price.

h) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

i) All sub vendors shall be as per BHEL/CONSULTANT/CUSTOMER approved list.

j) Tests for noise, vibration, parallel running etc. for pumps shall be conducted at site by Pump Vendor/BHEL as per cl. no. 3.04.00 of Section-IIA and if the site performance is found not meeting the requirements in any respect as specified, than the equipment shall be rectified or replaced by the vendor, at his own cost.

k) Any special tools & tackles, if required, shall be in bidder's scope.

l) All models offered have been supplied by bidder in the past and are meeting the experience qualifying criteria of BHEL/CONSULTANT/CUSTOMER (viz. offered model is successfully operating in two separate stations for at least one year or as specified in technical PQR). Any deviation to this criteria shall be suitably highlighted in deviation schedule.

m) All selected motor ratings have minimum margins as per Datasheet A, Section ID.

We the undersigned hereby undertake to meet the compliance requirements as listed above on the conditions as elsewhere specified.

PARTICULARS OF BIDDER/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL

BHEL	**TECHNICAL SPECIFICATION MISCELLANEOUS PUMPS** DOCUMENTS TO BE SUBMITTED BY BIDDER	SPEC. NO.: **PE-TS-445-100-N001** SECTION: **IIIC** SUB-SECTION: REV. NO. **00** DATE 20.12.2021 SHEET **1** OF **1**

SECTION IIIC

DEVIATION SCHEDULE (AS PER NIT FORMAT)
(TO BE SUBMITTED ALONG WITH THE BID BY ALL BIDDERS)

SECTION IIID

DATA SHEET – B FOR PUMPS

ELECTRICAL LOAD DATA FORMAT

CABLE SCHEDULE

MOTOR DATASHEET-C

(TO BE SUBMITTED BY SUCCESSFUL BIDDER AFTER AWARD OF CONTRACT)

PROJECT:
MISCELLANEOUS PUMPS
DATASHEET - B

SL.	DESCRIPTION	UOM	PUMP DATA
1.0	**GENERAL**		
1.1	Desgination of the Pump		
1.2	Manufacturer		
1.3	Model No.		
1.4	No. of pumps	Nos.	
1.5	System Design Pressure	Kg/cm^2	
1.6	Specific Gravity of fluid to be handled	-	
2.0	**PERFORMANCE PARAMETERS**		
2.1	Performance standard		
2.2	Rated capacity. (No negative tolerance)	M^3/hr	
2.3	Total Dynamic Head (TDH) at rated capacity (No negative tolerance)	MWC	
2.4	Shut off head	MWC	
2.5	Range of Operation of the Pump		
	a) Min.Flow	M^3/hr	
	b) Max.Flow	M^3/hr	
2.6	The pumps offered have continuously rising head capacity curves from the duty point towards shut off point.		
2.7	The pumps offered have stable rising H--Q curves within the "Range of Operation"		
2.8	Pump rated speed	RPM	
2.9	Vibration measurements (2.9.2 is applicable in addition to 2.9.1 for Pumps with speed less than 600 RPM)		
2.9.1	Max.value of vibration on any pump /motor bearing w.r.t. velocity (Vrms) as per ANSI/ HIS 9.6.4 for speed > 600 RPM		
	a) Guaranteed at manufacturer's works	mm/s	
	b) Guaranteed at site	mm/s	
2.9.2	Max.value of vibration on any pump /motor bearing w.r.t. peak to peak amplitude as per ANSI/ HIS 9.6.4 for speed <= 600 RPM		
	a) Guaranteed at manufacturer's works	microns	
	b) Guaranteed at site	microns	
2.10	Max. noise Level (Guaranteed at site)	dB	
2.11	Guaranteed Pump efficiency at rated head & rated capacity without -ve tolerance	%	
2.12	Power consumption		
	a) Guaranteed pump input power at duty point	KW	
	b) Guaranteed max. Pump input power within range of operation.	KW	
	c) Max. pump input power at shut off	KW	
	d) Guranteed power at motor input	KW	
2.13	NPSH required at rated capacity	MWC	
3.0	**DESIGN & CONSTRUCTION FEATURES**		
3.1	Type of pump casing		
3.2	Pump duty		
3.3	Type of Impeller		
3.4	Location		
3.5	Pump suitable for parallel operation		
3.6	Torque speed curve of the pump & drive motor furnished for pumps with drive motor rating of 100 KW and above.		
3.7	Pump number of stages		

PROJECT:
MISCELLANEOUS PUMPS
DATASHEET - B

SL.	DESCRIPTION	UOM	PUMP DATA
3.8	Specific speed N = RPM x (Flow in USGPM)$^{1/2}$ (Head in Ft.)$^{3/4}$		
3.9	Minimum suction head required in MLC for pump operation at maximum discharge point within the 'Range of Operation' specified (NPSHR at max. flow).		
3.10	Whether pump is suitable/designed so that pump internals can be attended without disturbing suction and discharge piping.		
3.11	Type of coupling between pump & motor		
3.12	Bearing (DE & NDE)		
	a) Type and manufacturer		
	b) Bearing no.		
	c) Type of lubrication		
	d) Design life (Hrs.)		
3.13	Shaft Sealing arrangement		
	a) Type and manufacturer		
	b) Sealing liquid		
	c) Requirement of external water if any		
	i) Quality		
	ii) Quantity/ Pump	M^3/hr	
3.14	In case separate oil/grease/water pump or any such equipment required for bearing lubrication/stuffing box gland sealing,furnish full technical details of these equipment and their drive.		
4.0	**MATERTIAL OF CONSTRUCTION (Indicate applicable code/ standard)**		
4.1	Casing		
4.2	Impeller		
4.3	Shaft		
4.4	Shaft sleeves		
4.5	Wear ring		
4.6	fasteners		
4.7	Gland		
4.8	Lantern ring		
4.9	Mechanical seals (faces)/		
	Gland packing		
4.10	Base plate		
5.0	**CONNECTIONS AND OTHER DIMENSIONAL DETAILS**		
5.1	Impeller diameter	mm	
6.0	**DRIVE DATA**		
6.1	Drive unit output at 50^{o}C ambient condition	KW/ P	
7.0	**INSPECTION & TESTING**		
7.1	Material test		
7.2	Hydrostatic test pressure	Kg/cm^2	
7.3	Hydrostatic test duration	Min.	
7.4	Performance test on pump at shop		
7.5	Dyanamic balance test		
8.0	**WEIGHT AND LOADING DATA**		
8.1	Weight of the pump & drive assembly	Kg	
8.2	Weight of the heaviest piece to be handled	Kg	

	PROJECT: MISCELLANEOUS PUMPS DATASHEET - B	

SL.	DESCRIPTION	UOM	PUMP DATA
8.3	Size of base plate (length x width)	mm	
9.0	**ADDITIONAL INFORMATION FOR VERTICAL PUMPS**		
9.1	Type of pump		
9.2	No. of stages for Vertical Turbine Pump	Nos.	
9.3	Bowl Head	MLC	
9.4	Bowl Efficiency	%	
9.5	Setting Length	m	
9.6	Column pipe OD X Thickness	mm X mm	
9.7	No of column pieces	Nos.	
9.8	No of intermediate shafts	Nos.	
9.9	No of bearings	Nos.	
9.10	Type & make of Bearing		
9.11	Sealing/lubrication arrangement of bearings		
9.12	Capacity of overhead forced lubrication tank	m^3	
9.13	Nos of forced lubrication pumps	Nos.	
9.14	Capacity of forced lubrication pumps	m^3/Hr	
9.15	TDH of forced lubrication pumps	MLC	

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

	LOAD DATA (ELECTRICAL)	JOB NO.	445	ORIGINATING AGENCY		PEM (ELECTRICAL)
		PROJECT TITLE	1X660MW SAGARDIGHI THERMAL POWER PROJECT	NAME		DATA FILLED UP ON
		SYSTEM / S	MISCELLANEOUS PUMPS	SIGN.		DATA ENTERED ON
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE

CABLE SCHEDULE FORMAT

ANNEXURE III **Section-I**

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
    a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
    b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
    e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
    f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
    g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
|	|	|	|
Cable Voltage Code (see B below)	No. of cores (e.g. 01,03,3H, 07)	Cable code (See C below)	Cable size (e.g. 035,185,2.5, 0.5)

(A) SYSTEM VOLTAGE CODES:
(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:
A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES

	TITLE	SPECIFICATION NO.
BHEL	LV MOTOR DATA SHEET - C	VOLUME II B SECTION II REV NO. 00 DATE SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

TITLE	SPECIFICATION NO.
LV MOTOR	VOLUME II B
	SECTION II
DATA SHEET - C	REV NO. 00 DATE
	SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		