

**UPRVUNL
1x660 MW PANKI TPS EXTENSION**

**TECHNICAL SPECIFICATION
FOR
MISCELLANEOUS PUMPS**

Specification No. : PE-TS-426-100-N001 (REV. 0)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
PPEI BUILDING, SECTOR 16 A
NOIDA - 201301**



TITLE:
**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**
SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**
SECTION:
SUB-SECTION:
REV. NO. **00** DATE 17.04.2019
SHEET **1** OF **1**

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THIS TECHNICAL SPECIFICATION CONSISTS OF FOLLOWING SECTIONS:

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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.



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SECTION - I

SPECIFIC TECHNICAL REQUIREMENTS

- SUB-SECTION IA** - Specific Technical Requirements (Mech.)
- SUB-SECTION IB** - Specific Technical Requirements (Electrical)
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**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **I**

SUB-SECTION: **IA**

REV. NO. **00** DATE 17.04.19

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SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

	TECHNICAL SPECIFICATIONS		Specification No. : PE-TS-426-100-N001, Rev0	
	MISCELLANEOUS PUMPS		SECTION:	
	SPECIFIC TECHNICAL REQUIREMENTS		REV. NO.	DATE:
		0	17.04.2019	

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 and PG Test at site for Miscellaneous Pumps along with mandatory spares complete with all accessories as per the requirements specified in this specification and any other services, etc. if called for in the succeeding sections of the specification for following project:

A. 1X660 MW PANKI TPS (UPRVUNL)

The above project is referred as '1X660 MW PANKI' elsewhere in the Specification for ease of reference.

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

A. Horizontal (Group-I)

- i. Horizontal Pumps - Type-I (Design Flow $\leq$ 300 Cu.M/Hr.)
- ii. Horizontal Pumps - Type-II (Design Flow $>$ 300 Cu.M/Hr.)
- iii. Vertical Pumps - Type-I (Design Flow $\leq$ 1000 Cu.M/Hr.)
- iv. Vertical Pumps - Type-II (Design Flow $>$ 1000 Cu.M/Hr.)

NOTE:-

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

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 Type- I & II, 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 Type- I & II, 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 wherever IE2 compliant motors are applicable same shall be provided with IE3 compliance.**

1.8 **DELIVERY:**
Delivery of miscellaneous pumps shall be as per NIT requirement.

2.0 Additional requirements for Pumps:

2.1 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.

2.2 For Vertical Pumps:

2.2.1 For ACW pump - Pump shall be provided with an approved mechanical device to prevent reverse rotation on loss of drive motor power and failure of discharge valve to close. Bidder shall furnish full details of his previous experience on such nonreverse ratchets in similar installations. However, the pump and motor (complete assembly) should be designed for withstanding the runaway speed attained with reverse rotation caused by reverse flow continuously when the other working pumps in parallel are in simultaneous operation. Necessary speed switches to detect reverse rotation shall be provided to prevent motor switching on while rotating in reverse direction. The indication shall also be provided for this purpose and specification for reverse rotation switch are attached at Section-1C.

2.2.2 ACW Pumps shall be provided with duplex temperature elements for thrust bearing temperature monitoring / tripping. 3 (three) nos RTDs are to be provided per Pump for this purpose and the specification for RTD are attached at Section-1C.

2.2.3 DMCW pumps (both TG and SG) have been indicated with two alternative at Hor Pumps - Type-II (Design Flow $>$ 300 Cu.M/Hr.) package, as per data sheet-A of section-ID. Bidder to quote for both the alternatives. However alternative-1 or alternative-2 for both DMCW Pumps (TG and SG) shall be selected and informed by BHEL before opening of price bid.

2.2.4 Forced water lubrication system is applicable for Raw Water Intake Pumps, Raw Water Pumps and Ash Water make-up Pumps under Vertical Pumps - Type-II (Design Flow $>$ 1000 m3/hr). Same shall be provided in line with Cl no. 5.21.02 of Standard Technical Specification for Vertical Pumps at Section-IIA. Bidder to note that Raw Water Pumps and Ash Water make-up Pumps are housed in a common Pump house (Raw Water Pump House) therefore common forced water lubrication system may be provided for these Pumps. The O/H tank for forced water lubrication system shall be of 3.0 m3 and 5.0 m3 capacity respectively at the roof of Raw Water Intake pump house and Raw Water Pump House.

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- Horizontal Pumps - Type-II (Design Flow $>$ 300 Cu.M/Hr.)
- Vertical Pumps - Type-I (Design Flow $\leq$ 1000 Cu.M/Hr.)
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NOTE:-

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

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2.3 For Horizontal Pmps:

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.

3.0 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. **Vibration, Noise and Parallel run test for all pumps shall also be conducted by bidder at site as per approved PG Test Procedure, inline with CI no. 3.04 of Section-IIA of this specification.** 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 ontract stage by BHEL/Customer

5.0 Drawing/Document Submission Schedule:

MISC. PUMPS (HORIZONTAL)-Type-I	Primary Documents			
	PE-V7-426-100-N001	TDS AND PERFORMACE CURVES- MISC. PUMPS (H-1)	R-0 within 20 days from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.	
	PE-V7-426-100-N002	GENERAL ARRANGEMENT AND CROSS SECTIONAL-PUMPS (H-1)		
	PE-V7-426-100-N003	TDS AND CURVES OF MOTORS FOR MISC. PUMPS (H-1)		
	PE-V7-426-100-N004	QP-MISC PUMPS (H-1)		
	PE-V7-426-100-N005	QP- MOTORS (H-1)		
	Secondary Documents			
	PE-V7-426-100-N006	MOTOR TYPE TEST DOC (if applicable) (H-1)	R-0 within 20 days of Cat-I(or)II approval on motor document.	
	PE-V7-426-100-N007	O& M MANUAL -HORZ. PUMPS (H-1)	Within 30 days from MDCC	
	PE-V7-426-100-N008	PG TEST PROCEDURE -HOR. PUMPS (H-1)	R-0 within 20 days of Cat-I(or)II approval on pump document.	

MISC. PUMPS (HORIZONTAL)-Type-II	Primary Documents			
	PE-V7-426-100-N011	TDS AND PERFORMACE CURVES- MISC. PUMPS (H-2)	R-0 within 20 days from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.	Pump Cross Section drawing in case of HT motor driven pump, preliminary(R-0) within 15 days from LOI/PO & final a/w Pump GA within 10 days of receipt of motor GA from BHEL.
	PE-V7-426-100-N012	GENERAL ARRANGEMENT AND CROSS SECTIONAL-PUMPS (H-2)		
	PE-V7-426-100-N014	QP-MISC PUMPS (H-2)		
	Secondary Documents			
	PE-V7-426-100-N017	O& M MANUAL -HORZ. PUMPS (H-2)	Within 30 days from MDCC	
	PE-V7-426-100-N018	PG TEST PROCEDURE -HOR. PUMPS (H-2)	R-0 within 20 days of Cat-I(or)II approval on pump document.	

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MISC. PUMPS (VERTICAL)-Type-I	Primary Documents				
	PE-V6-426-100-N001	TDS AND PERFORMACE CURVES- MISC. PUMPS (V-1)	R-0 within 20 days from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.	Pump Cross Section drawing in case of HT motor driven pump, preliminary(R-0) within 15 days from LOI/PO & final a/w Pump GA within 10 days of receipt of motor GA from BHEL.	
	PE-V6-426-100-N002	GENERAL ARRANGEMENT AND CROSS SECTIONAL-PUMPS (V-1)			
	PE-V6-426-100-N003	TDS AND CURVES OF MOTORS FOR MISC. PUMPS (V-1)			
	PE-V6-426-100-N004	QP-MISC PUMPS (V-1)			
	PE-V6-426-100-N005	QP- MOTORS (V-1)			
	Secondary Documents				
	PE-V6-426-100-N006	MOTOR TYPE TEST DOC (if applicable) (V-1)	R-0 within 20 days of Cat-I(or)II approval on motor document.		
	PE-V6-426-100-N007	O& M MANUAL -VERT. PUMPS (V-1)	Within 30 days from MDCC		
	PE-V6-426-100-N008	PG TEST PROCEDURE -HOR. PUMPS (V-1)	R-0 within 20 days of Cat-I(or)II approval on pump document.		
MISC. PUMPS (VERTICAL)-Type-II	Primary Documents				
	PE-V6-426-100-N011	TDS AND PERFORMACE CURVES- MISC. PUMPS (V-2)	R-0 within 20 days from LOI/PO & subsequent revisions within 10 days of comments received from BHEL.	Pump Cross Section drawing in case of HT motor driven pump, preliminary(R-0) within 15 days from LOI/PO & final a/w Pump GA within 10 days of receipt of motor GA from BHEL.	
	PE-V6-426-100-N012	GENERAL ARRANGEMENT AND CROSS SECTIONAL-PUMPS (V-2)			
	PE-V6-426-100-N014	QP-MISC PUMPS (V-2)			
	Secondary Documents				
	PE-V6-426-100-N017	O& M MANUAL -VERT. PUMPS (V-2)	Within 30 days from MDCC		
	PE-V6-426-100-N018	PG TEST PROCEDURE -HOR. PUMPS (V-2)	R-0 within 20 days of Cat-I(or)II approval on pump document.		

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Annexure-1

List of Miscellaneous Pumps and drives for :

A. 1X660 MW PANKI TPS (UPRVUNL)

Sl. No.	Pump Description	Total Qty.	Type of Pumps
	Horizontal Pumps (Type-I)		
1	HOTWELL MAKEUP PUMPS	2 nos.	Horizontal-Type-I
2	DM MAKEUP PUMPS	2 nos.	Horizontal-Type-I
3	BOILER FILL PUMPS	2 nos.	Horizontal-Type-I
	Horizontal Pumps (Type-II)		
1	DMCW TG AUX'S PUMPS	3 nos.	Horizontal-Type-II
2	DMCW SG AUX'S PUMPS	2 nos.	Horizontal-Type-II
	Vertical Pumps (Type-I)		
1	CW MAKEUP PUMPS	3 nos.	Vertical-Type-I
2	APH/ ESP WASH PUMPS	2 nos.	Vertical-Type-I
3	AHP/CHP PUMPS	2 nos.	Vertical-Type-I
4	SERVICE WATER PUMP	2 nos.	Vertical-Type-I
5	FGD MAKEUP PUMPS	2 nos.	Vertical-Type-I
	Vertical Pumps (Type-II)		
1	ACW PUMPS	2 nos.	Vertical-Type-II
2	RAW WATER INTAKE PUMPS	2 nos.	Vertical-Type-II
3	RAW WATER PUMPS	2 nos.	Vertical-Type-II
4	ASH WATER MAKE UP PUMPS	2 nos.	Vertical-Type-II

**TECHNICAL SPECIFICATIONS**

Specification No. : PE-TS-426-100-N001, Rev0

MISCELLANEOUS PUMPS**SPECIFIC TECHNICAL REQUIREMENTS**

SECTION:

IA

REV. NO.

0

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Annexure-2

Following HT drives for 1X660 MW PANKI TPS (UPRVUNL), irrespective of Motor ratings shall be issue free, by BHEL:

Horizontal Pumps (Type-I):

NIL

Horizontal Pumps (Type-II):

- 1 DMCW TG AUX'S PUMPS
- 2 DMCW SG AUX'S PUMPS

Vertical Pumps (Type-I):

- 1 APH/ ESP WASH PUMPS

Vertical Pumps (Type-II):

- 1 ACW PUMPS
- 2 RAW WATER INTAKE PUMPS
- 3 RAW WATER PUMPS
- 4 ASH WATER MAKE UP PUMPS

34.0 GENERAL REQUIREMENTS HORIZONTAL AND VERTICAL WATER SERVICE PUMPS**34.1 SCOPE**

General requirements in respect of design, material, constructional features, manufacture, inspection, testing the performance at the Vendor's/ Sub-Vendor's works and delivery to site erection, field testing and commissioning of Horizontal Centrifugal Pumps.

34.2 CODES AND STANDARDS

Design, material, construction manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment supplied shall comply with the latest applicable Indian standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

34.2.1 List of Applicable Standards

- i) IS : 1520 - Horizontal Centrifugal Pumps for clear cold fresh water.
- ii) IS : 5120 - Technical requirements of roto-dynamic special purpose pumps
- iii) API - 610 - Centrifugal pumps for general refinery service.
- iv) IS : 5639 - Pumps Handling Chemicals & corrosion liquids.
- v) IS : 5659 - Pumps for process water
- vi) HIS - Hydraulic Institute Standards; USA
- vii) ASTM-I-165-65 - Standards Methods for Liquid Penetration Inspection.
- ix) IS-1710/1989 - Vertical Turbine Pumps for Clear, Cold and Fresh Water.

In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

34.3 DESIGN REQUIREMENTS

The maximum efficiency of pumps shall be preferably within + 10% of the rated design flow indicated in data sheets.

Total head capacity curve shall be continuously rising from the operating point towards shut - off without any zone of instability and with a minimum shut off head of 15% more than design head.

Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation.

Speed	Antifriction bearing	Sleeve bearing
1500 rpm and below	75.0 micron	75.0 micron
3000 rpm	50.0 micron	65.0 micron

The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1M from the equipment surface.

The pumps shall be capable of starting with discharge valve fully open and close condition.

34.4 DESIGN CONSTRUCTION

34.4.1 Horizontal Pumps

Pump casing shall have radially/axially split type construction. The casing shall be designed to withstand the maximum shut - off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pr. Gauge as standard feature.

Impeller

Impeller shall be closed or semi-closed as specified elsewhere and designed in conformance with the detailed analysis of the liquid being handled. The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying pinning or lock rings.

Impeller/ Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations pumps. Suitable method of locking the wearing ring shall be used.

Shaft

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

Shaft Sleeves

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

Bearings

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble - free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Anti-friction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hours of continuous operation at maximum axial and a radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided such that lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearing assembly.

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

Stuffing Boxes

Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standard. If external gland sealing is required, it shall be done from the pump connection.

Mechanical Seals:

Wherever specified in pump data sheet, mechanical seals shall be provided. The sealing face should be highly lapped surfaces of material known for their low frictional co-efficient & resistance to corrosion against the liquid being pumped.

Pump and Motor Shaft Coupling

The Pump and motor shaft shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor.

Base Plate

A common base plate mounting both for the pump and motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, suitable ribbed and reinforced.

Assembly and Dismantling

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

34.4.2 For Vertical Pumps

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

Bowl Assembly

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 the handling fluid.

Pump(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.

Discharge Head

Pump(s) shall be either above floor or below floor discharge type, as specified in the specification, attached to this section.

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.

Column pipe

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

In case the specification asks for the pump with 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.

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 Contractor under this section. The Contractor shall also submit a write-up describing clearly the procedure of handling the pump.

Impeller shaft, line shaft and head shaft

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 and in no case shall lie between 90% and 110% of the rated speed.

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 be chamfered at the edges.

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.

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

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.

Seal rings

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

Bearings**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 Specification.

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

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 specification or as per the recommendation of the pump manufacturer (and approved by Purchaser).

Reverse Rotation

If the specification calls for, the pump impeller and other rotating components shall be designed for reverse rotation, when subject to reverse flow at rated pump discharge head.

34.5 Drive Motor (Prime Mover)

The KW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps is specified, the actual motor rating is to be selected considering overloading of the pump in the event of tripping of operating pumps. Continuous motor rating (at 50 deg. Cent, ambient) for pump shall be at least 15% above the maximum load demand of the driven equipment in the complete range.

FOR FORCED WATER LUBRICATION SYSTEM

DATA SHEET FOR AUTOMATIC SELF CLEANING STRAINERS

Description	Unit	Values
Quantity and location	Nos.	2 (1W+1S) For RWI Pumps 2 (1W+1S) common For Raw Water and Ash Water make-up Pumps
Filter type		On line/ Continuous
Flow rate	m ³ /hr	By Bidder
Inlet Size	NB	By Bidder
Outlet Size	NB	By Bidder
Liquid Handled		Raw Water
Type of cover		Quick opening/ bolted
Type of suspended matter likely to enter the Strainer		Typical debris encountered in raw water.
Screen Opening Area		6 times of the inlet pipe cross section area
DP Measurement System		DP Switch & DP Transmitter
Degree of Filtration	mm	2
Material of construction		
Body		CS IS 2062 Gr B
Basket		CS IS 2062 Gr B
Cover Flange/ Slipon Flange		CS IS 2062 Gr B
Filter		SS 316
Connection Pipe		MS
Connection Flange		CS IS 2062 Gr B
Filter Screen		SS 316
Gasket		Rubber
Fasteners		SS 316

Section M4 : Equipment Cooling Water System

	TEST / CHECKS ITEM / COMPONENTS	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit Up	Visual & Dimensional Check	UT	RT	Hydraulic / Water Fill	Balancing	Type Test	Performance Test	Other Test
A	PLATE TYPE HEAT EXCHANGER		Y	Y ³	Y	Y			Y				
A.1	Heat Transfer Plates	Y ¹		Y ²		Y	Y ^{5a}						Y 7
A.2	Gaskets	Y				Y							
A.3	Cover Plates (Front & Rear)	Y ¹				Y	Y ^{5a}						
A.4	Tie Rods	Y ¹		Y ⁴			Y ^{5b}						
B	HORIZONTAL / VERTICAL CENTRIFUGAL PUMP				Y	Y						Y 1 0	
B.1	Casing	Y ¹		Y ⁴		Y			Y				
B.2	Impeller	Y ¹		Y ⁴		Y				Y 9			
B.3	Shaft	Y ¹		Y		Y	Y ^{5b}			Y 9			
B.4	Fabricated Components	Y ¹	Y	Y ³	Y	Y	Y ^{5a}	Y 6	Y 8				

Notes:

1.	One per heat / HT batch
2.	DP Test shall be conducted for 10% of the lot of HT plates. However, in case of any defect, entire lot shall be tested and only defect free plates shall be accepted
3.	100% DP Test shall be conducted on butt welds and 10% DPT on fillet weld after final run
4.	100% DPT shall be carried out on machined surfaces
5a.	UT shall be done on plates with thickness 25 mm or above
5b.	UT shall be done on shaft / tie rod with diameter 50 mm or above
6.	RT shall be conducted on butt joints having plate thickness above 10 mm. Quantum of RT shall be based on pressure rating
7.	Each Plate after pressing shall be subject to either of the following tests, as per Manufacturer Practice a) Light Box Test b) Vacuum Test c) Air Chamber Test
8.	All pressure retaining parts shall be hydrostatically tested at 200% of pump rated head or 150% of shut – off head, whichever is higher, for at least 30 minutes. No leakage is allowed





TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **I**

SUB-SECTION: **IB**

REV. NO. **00** DATE **17.04.19**

SHEET **1** OF **1**

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
MISC. PUMPS
1X660 MW UPRVUNL PANKI TPS

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION :

REV NO. **00** : DATE : 17.04.19

SHEET : 1 OF 3

TECHNICAL SPECIFICATION
FOR
MISC. PUMPS
(ELECTRICAL PORTION)

	TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR MISC. PUMPS 1X660 MW UPRVUNL PANKI TPS	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION :
		REV NO. 00 : DATE : 17.04.19
		SHEET : 2 OF 3

1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

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

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

Refer “Electrical Scope between BHEL and Vendor”.

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



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
MISC. PUMPS
1X660 MW UPRVUNL PANKI TPS

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION :

REV NO. **00** : DATE : 17.04.19

SHEET : 3 OF 3

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 :

- a) Electrical scope between BHEL & vendor
- b) Quality plan for motors
- c) Datasheet A (Annexure- I)
- d) Customer (M/s DCPL) specification for Motors
- e) Datasheet-C
- f) Electrical Load data format (Annexure –II)
- g) BHEL cable listing format (Annexure –III)



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
MISC. PUMPS
1X660 MW UPRVUNL PANKI TPS

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION :

REV NO. **00** : DATE : 17.04.19

SHEET : 1 OF 3

TECHNICAL SPECIFICATION
FOR
MISC. PUMPS
(ELECTRICAL PORTION)



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
MISC. PUMPS
1X660 MW UPRVUNL PANKI TPS

SPECIFICATION NO.
VOLUME NO. : II-B
SECTION :
REV NO. 00 : DATE : 17.04.19
SHEET : 2 OF 3

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

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

Refer “Electrical Scope between BHEL and Vendor”.

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



TITLE :
ELECTRICAL EQUIPMENT SPECIFICATION
FOR
MISC. PUMPS
1X660 MW UPRVUNL PANKI TPS

SPECIFICATION NO.

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SHEET : 3 OF 3

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- e) Datasheet-C
- f) Electrical Load data format (Annexure –II)
- g) BHEL cable listing format (Annexure –III)

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGE: MISC. PUMP (Supply Package)****PROJECT: 1X660 MW UPRVUNL PANKI TPS**

<u>S.NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
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. OR (DE to select the choice applicable for their project)) 415 V AC, 3 phase, 3 wire supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the 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.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: MISC. PUMP (Supply Package)

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.

DATA SHEET A		
SL NO.	DESCRIPTION	
		1X660 MW UPRVUNL PANKI TPS EXT.
A	General	
1	Manufacturer & country of origin	DURING DETAILED ENGINEERING
2	Motor type	SQUIREL CAGE INDUCTION MOTOR
3	Efficiency class	IE3
4	Type of starting	DOL
5	Maximum acceptable kW rating of LV motor	200
6	Rating up to which Single phase motors permitted.	
7	Installation (Indoors/ Outdoors)	indoor/outdoor
8	Degree Of Protection	IP55 WITH CANOPY FOR OUTDOOR IP55 FOR INDOOR
9	Name of the equipment driven by motor & Quantity	DURING DETAILED ENGINEERING
10	Maximum Power requirement of driven equipment	DURING DETAILED ENGINEERING
11	Rated speed of Driven Equipment	As per system requirement
12	Design ambient temperature (Degree Celcius)	50 deg C
B	Design and Performance Data	
1	Frame size & type designation	DURING DETAILED ENGINEERING
2	Type of duty	AS PER REQUIREMENT
3	Rated Voltage	240/415 V
4	Rated Frequency	50 Hz
5	System fault level at rated voltage	50kA for 1 sec
6	LV System grounding	solidly grounded
7	Permissible variation for	
a	Voltage	+/-10%
b	Frequency	+/-5%
c	Combined voltage & frequency	10%
8	Rated output at design ambient temp (by resistance method)	as per requirement
9	Synchronous speed & Rated slip	as per requirement

10	Minimum permissible starting voltage	80% of rated voltage
11	TYPE OF STARTER PROVIDED IN MCC	As per system requirement
12	Starting time in sec with mechanism coupled	
a	At rated voltage	As per system requirement
b	At min starting voltage	
13	Locked rotor current as percentage of FLC (including IS tolerance)	The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) (a) Below 110KW : 10.0 (b) From 110 KW & upto 200 KW : 9.0
14	Torque	
a	Starting	a) Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.
b	Maximum	B) Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
15	Permissible temp rise at rated output over ambient temp & method	Thermal class 155 (F) insulation, temperature rise limited to class-B.
16	Noise level in (dB)	85 (dB) at 1 M
17	Amplitude of vibration	As per IS-12075/IEC-60034-14
18	Efficiency & P.F. at rated voltage & frequency	
a	At 100% load	Efficiency as per IS 12615, IEC: 60034-30 (Latest

b	At 75% load	revision), P.F. as per requirement.
c	At starting	Efficiency as per IS 12615, IEC: 60034-30 (Latest revision), P.F in line with starting requirement as per relevant standard.
C	Constructional Features	
1	Method of connection of motor driven equipment	As per system requirement
2	Applicable Standard	as per relevant standard
3	DOP of Enclosure	IP55 WITH CANOPY FOR OUTDOOR IP55 FOR INDOOR
4	Method of cooling	IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA).
5	Class of insulation	All motors shall have class F insulation but limited to class B temperature rise
6	Main terminal box	
a	Type	Refer Specific technical requirement for motors
b	Power Cable details (Conductor, size, armour/unarmour)	1.1 kV XLPE armour cable, size shall be provided during detailed engineering
c	Cable Gland & lugs details (Size, type & material)	Refer Specific technical requirement for motors
d	Permissible Fault level (kArms & duration in sec)	
e	Degree of Protection	
7	Earth Conductor Size & Material	Refer Specific technical requirement for motors
8	Space heater details (30KW & ABOVE) (Voltage & watts)	Refer Specific technical requirement for motors
9	Flame proof motor details (if applicable)	During detailed engineering
a	Enclosure	
b	suitability for hazardous area	
i	Zone O / I / II	
ii	Group IIA / IIB / IIC	
c	Degree of Protection	
9	No. of Stator winding	As per system requirement
10	Winding connection	As per system requirement
11	Kind of rotor winding	As per system requirement
12	Kind of bearings	Refer Specific technical requirement for motors
13	Direction of rotation when viewed from NDE	Motor shall be bi-directional

14	Paint Shade & type	Glossy light grey finish no 631 of IS 5, for details refer Specific technical requirement for motors
15	Net weight of motor	DURING DETAILED ENGINEERING
16	Outline mounting drawing No (To be enclosed as annexure)	DURING DETAILED ENGINEERING
D	Characteristic curves/ drawings	
1	(To be enclosed for motors of rating >55KW)	DURING DETAILED ENGINEERING
2	Torque speed characteristic	
3	Thermal withstand characteristic	
4	Current vs time	
5	Speed vs time	
E	Tests on motors	As applicable (As per QAP/For Project specific requirement if any refer Specific technical requirement for motors)

CHAPTER 17 : AC & DC MOTORS**1.00 MOTORS****1.1 SCOPE**

This specification is intended to cover design, manufacture, assembly and testing of AC Squirrel Cage Induction Motors for use in Thermal Power Plants and is supplement to the driven equipment specifications under which these motors are being procured for the project.

SITE CONDITIONS

Site conditions are covered in 'Project Data', contained in specification of the driven equipment.

1.2 Gases, Fumes & Dust Particles

1.2.01 General - Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical, conducive to fungus growth.

1.2.02 Dust Particles

1 Outdoor locations - Heavily dusty with abrasive dust and coal particles of size five (5) to hundred (100) microns present in atmosphere in large quantity.

2 Indoor Locations.

2.1 Coal conveyors - As for outdoor as per clause 1.02.02.1 above.

2.2 Other locations - Lightly dusty with abrasive dust and coal particles of size five (5) to twenty (20) microns present in atmosphere.

1.2.03 Special Fumes

1 Water treatment plant and acid cleaning room - Acid and alkali fumes present.

2 Fuel oil pumping areas & Hydrogen generation plant - Explosive fumes (flameproof motors required).

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

1.3 LOCATION OF MOTOR - As required

1.4 **SPECIFICATIONS & STANDARDS**.....Motors shall comply with the latest revisions of all relevant standards of BIS (IS-325, IS-900, IS-996, IS-1231, IS-1885, IS-2148, IS-2223, IS-2253, IS-2254, IS-2848, IS-3202, IS-4029, IS-4691, IS-4722, IS-4728, IS-4889, IS-6362, IS-7816, IS-8223, IS-8789, IS: 12615, IS:3177 and IEC : 60034 3Φ Induction motor) except as modified herein or in driven equipment specification.

Motors conforming to BS or IEC Publications, which ensure equivalent quality shall also be acceptable. In case of any difference between IS Specification/International Standards (IEC; NEMA etc.), this motor specification prevails.

1.5 TYPE

1.5.1 AC Motors:

- a) Squirrel cage induction motor suitable for direct-on-line starting.
- b) Continuous duty LT motors upto 160 KW Output rating (at 50 deg. C ambient temperature), shall be **Efficiency class-IE2**, conforming to IS 12615, or IEC:60034-30.
- c) Crane duty motors shall be slip ring/ squirrel cage Induction motor as per the requirement.

1.5.2 DC Motors Shunt wound.

1.6 VOLTAGE (NOMINAL)

1.6.1 LV Motors

For motors upto and including 200 KW - Four hundred fifteen (415) V.

1.6.2 MV MOTORS

For motors above 200kW upto and including 1500kW, Three point three (3.3) kV.

For CHP conveyors motor above 160 kW, 3.3 kV, AC supply is to be used. However all the motors on stacker reclaimer shall be on 415 V AC only.

1.6.3 HV Motors

For motors above 1500kW - eleven(11) KV

1.6.4 All motors are to be designed for system grounding described in "System Particulars" under site information of the Driven Equipment Specification.

1.7 FREQUENCY (NOMINAL) - fifty (50) Hertz

1.8 NUMBER OF PHASES - Three (3)

1.9 SPEED - As required by the driven equipment

1.10 TYPE OF STARTING :

Direct on-line (VFD/Soft-starter/star/delta starting in special cases)

1.11 DUTY

1.11.1 Continuous motor rating shall be arrived at considering 15% margin over the duty point input or 10% over the maximum demand of the driven equipment,



- | | |
|--------|--|
| 1.11.2 | All HT motors shall have vibration pads for mounting vibration detectors. |
| 1.11.3 | All motors shall be designed to withstand hundred twenty (120) percent of rated speed without any mechanical damage for two (2) minutes. |
| 1.11.4 | Motors shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment atleast twenty five (25) percent above or below, preferably above the motor operating speed (to avoid resonance in vibration over the operating speed) range. |
| 1.11.5 | All LV motors rated 0.37kW and higher with S1 duty shall be compulsorily be of energy efficiency level IE 2 as per IS 12615:2011. |
| | Motors rated above 37kW shall have efficiency higher than 0.92 and high power factor of atleast 0.88. |

1.12 SUPPLY VARIATIONS

Motors shall be capable of running continuously at full load under following variations in power supply:

- 1.12.1 All equipments shall be suitable for rated frequency of 50 Hz with a variation of (+) 3% and (-)5%, voltage variation of ($\pm$) 6% for 11 kV & 3.3 kV and ($\pm$)10% for 415V and 10% (absolute sum) combined variation of voltage and frequency unless specifically brought out in the specification.

1.13 ABNORMAL CONDITIONS CAPABILITY

Motor shall have following capabilities as specified design ambient temperature:

- 1.13.1 The motors shall also be capable of running up again after voltage collapse to about 40% for approximate duration of 0.5 sec. Subsequent rise in voltage to 70% and further to 80% and 100%, the total duration not exceeding 20 sec.

- ### 1.13.2 Low Voltage Running :

Motor shall be capable of running satisfactorily at seventy five (75) percent nominal voltage for five (5) minutes.

- ### 1.13.3 Momentary Low Voltage Withstanding :

Motor, when running at full load, shall not stall when voltage drops down to seventy (70) percent nominal voltage for one (1) minute.

1.14 STARTING CAPABILITY

- ### 1.14.1 Low Voltage Starting :

Motor shall be capable of starting and accelerating to full speed at full load (including loaded equipment e.g. mills and conveyors etc) at eighty (80)

percent nominal voltage at motor terminals. Mill motors may be permitted to start with terminal voltage not below 90%.

1.14.2 Cold Motor Starting Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment eg mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

1.14.3 Hot Motor Starting Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment e.g. mills and conveyors etc) of driven equipment. No additional start will be made till lapse of further thirty (30) minutes.

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

1.14.5 Break-away Starting Current Breakaway starting current as percent of full load current for various motor ratings shall not exceed the values given below:

1.14.5.1 Motors above 1500 KW upto 4000kW 600% without any positive tolerance except for ID Fan Motor.

1.14.5.2 Motors above 4000 KW 450%. Not subject to any positive tolerance.

1.14.5.3 For D.C. Motors the starting current shall be limited to 2 times full load current.

1.14.5.3 **Starting voltage requirement**

a) All Motors (except Mill Motors)

- 80% of rated voltage for Motors upto 4000 kW
- 75% of rated voltage for Motors above 4000 kW

b) For Mill Motors:

- 85% of rated voltage for Motors above 1000 kW
- 90% of rated voltage for Motors below 1000 kW

Except AOP & JOP motors running on D.G emergency supply, starting voltage shall be 80%.

1.14.5.4 **Starting Time**

1.14.5.4.1 For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

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

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



1.14.5.5 Torque Requirements:-

- 1.14.5.5.1 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10%. Motor full load torque.
- 1.14.5.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty Motors.

1.15 SAFE STALL TIME

- 1.15.1 To avoid problem in selecting standard protective relays without using speed switches, safe stall time under hot conditions (corresponding to 110% nominal voltage at motor terminals) shall be more than the accelerating time (corresponding to 80% nominal voltage at motor terminals) by the following minimum values :
- 1.15.1.01 Two (2) seconds, where accelerating time (at 80% nominal voltage) does not exceed 20 seconds.
- 1.15.1.02 Three (3) seconds, where accelerating time (at 80% nominal voltage) exceeds 20 seconds.
- 1.15.1.03 At no stage, speed switch shall be provided to achieve the above requirements mentioned under Clause No. 1.14.5.4

1.16 CLASS OF INSULATION

- 1.16.1 LV Motors Class F.
- 1.16.2 MV & HV Motors Class F
- 1.16.03 However temperature rise shall be restricted to limits corresponding to Class 'B' insulation for both HT & LT motors. The temperature under abnormal running conditions shall be limited to 5°C above class 'B' limits.
- 1.16.04 The value of the polarization index for motors above 200kW should not be less than 2 when determined according to IS: 7816.
- 1.17 **TEMPERATURE RISE UNDER NORMAL CONDITIONS.....** Temperature rise over specified design ambient temperature when motor is running with full load at nominal supply voltage & frequency shall not exceed the values given below:

S.No.	Specified Design Ambient Temperature	Thermometer Method	Resistance Method
1.17.01	50°C	60°C	70°C
1.17.02	45°C	65°C	75°C
1.17.03	40°C	70°C	80°C

1.18 BUS TRANSFER WITHSTAND CAPABILITY

Motors will be connected to an automatic bus transfer system and hence may be subjected to one hundred and fifty (150) percent of the nominal voltage during changeover of buses due to the vector difference between the residual voltage and incoming supply voltage and the duration of this condition may be one second. Motors shall be capable of withstanding the voltage and torque stresses developed under such conditions without damage. The manufacturer/vendor shall indicate the special precautions taken to meet the above requirements and confirm.

- 1.18.01 That about 5000 bus transfers, in lifetime of motor, shall not puncture its insulation.
- 1.18.02 That motor shall be capable of withstanding heavy inrush transient current caused by such bus transfers without damage.
- 1.18.03 That the motor windings shall be adequately braced to satisfactorily withstand mechanical stresses under these conditions.
- 1.18.04 The motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torques under these conditions.

1.19 TYPE OF ENCLOSURE

- 1.19.01 Outdoor Motors IP 55 (Additional canopy to be provided by EPC contractor.
- 1.19.02 Indoor Motors IP 55
- 1.19.03 IP-55 degree of protection shall be achieved without application of any compound, putty etc.
- 1.19.04 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).

1.20 METHOD OF COOLING

- 1.20.1 Method of cooling shall be IC 411 (TEFC), IC 511 (TETV) or IC 611 (CACA). However, motors rated 3000kW or above can be closed air circuit water cooled (CACW).
- 1.20.2 Large capacity motors not available with above types of cooling may be accepted with IC 81 W for IC 91 W (CACW) cooling subject to the approval of the Owner.

1.21 TYPE OF MOUNTING As required for the driven equipment.**1.21 MAXIMUM MECHANICAL VIBRATIONS**

- 1.21.01 Noise level for all the motors shall be limited to 85dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits



prescribed in IS: 12075 / IEC 60034-14. Motors shall withstand vibrations produced by driven equipment. HT motor bearing housings shall have flat surfaces, in both X and Y directions, suitable for mounting 80mmX80mm vibration pads.

1.21.02 Noise level

The noise level of motors shall not exceed 85 db (A) at 1m from operating motor measured in accordance with IS: 10265.

1.21.03 Motor body shall have two earthing points on opposite sides.

1.21.04 11 KV motors shall be offered with Separate Insulated Connector (Elastimould or Equivalent make) as per IEEE 386. The offered Elastimould terminations shall be provided with protective cover and trifurcating sleeves. Elastimould termination kit shall be suitable for fault level of 25 KA for 0.17 seconds.

1.21.05 3.3 KV motors shall be offered with dust tight phase separated double walled (metallic as well as insulated barrier) Terminal box. Suitable termination kit shall be provided for the offered Terminal box. The offered Terminal Box shall be suitable for fault level of 250 MVA for 0.12 sec. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided.

1.21.06 The spacing between gland plate & centre of terminal stud shall be as per Table-I.

TABLE - I

DIMENSIONS OF TERMINAL BOXES FOR LV MOTORS

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

Above 125 KW-upto 200 KW 203

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

1.21.07 All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

1.21.08 For motors rated 1500 KW & above, neutral current transformers of PS class shall be provided on each phase in a separate neutral terminal box.

1.21.09 The ratio of locked rotor KVA at rated voltage to rated KW shall not exceed the following (without any further tolerance) except for BFP motor.

(a)	Below 110KW	:	10.0
(b)	From 110 KW & upto 200 KW	:	9.0
(c)	Above 200 KW & upto 1000KW	:	10.0
(d)	From 1001KW & upto 4000KW	:	9.0
(e)	Above 4000KW	:	6 to 6.5

1.22 WINDING & INSULATION

- (a) Type : Non-hygroscopic, oil resistant, flame resistant
- (b) Starting duty : Two hot starts in succession, with motor initially at normal running temperature.
- (c) 11kV & 3.3 kV : Thermal class 155 (F) insulation.
AC motors
The winding insulation process shall be total Vacuum Pressure Impregnated i.e resin poor method. The lightning Impulse & interturn insulation surge withstand level shall be as per IEC-60034 part-15
- (d) 240VAC, 415V : Thermal Class(B) or better
AC & 220V
DC motors

1.23 DIRECTION OF ROTATION

1.23.1 As needed by driven equipment.

1.23.2 The 3 phase motor shall, however, be suitable for operation in both directions of rotation. A plate showing direction of rotation as determined by the phase sequence on the terminals marking shall be screwed at non-driving end of the body of the motor.

1.23.3 If, in the case of HT motors, fan is suitable for only one direction of rotation, the fan shall be so designed that with the slight modification work, it can be made suitable for other direction of rotation also. No extra material shall be required for doing above modification work.

1.24 BEARINGS



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- 1.24.1 General Greased ball, roller and/or sleeve bearing shall be rated for minimum standard life of 20,000 hours taking bearing and driven equipment loads into account. Loss of grease shall be scarce and it shall not creep along shaft into motor housing.
- Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated.
- If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
- Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
- For MV & HV motors, the bearings shall be insulated wherever necessary to prevent damage to motor bearings from shaft current.
- When pressure oiling is required for horizontal motors, bearings shall be sleeve type arranged for pressure oiling supplied from lubrication system of driven machine, with ring oiling for starting and emergency duty. Ring oiling system shall be adequate for starting and continuous operation of motor for at least half an hour, without pressure oiling system in operation. Oil sight flow gauges shall be provided to indicate oil flow through each bearing.
- Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.
- Sleeve bearings for use with motors having flexible coupling with limited end play, shall have adequate axial end play to prevent transmission of thrust from driven equipment to motor bearings.
- Bearings shall be of reputed make subject to the approval of the Owner/Consulting Engineer.
- 1.24.2 Large motors Large motors shall preferably have spherically seated babitted, ring forced, feed lubricated, water-cooled bearings. If anti-friction bearings are provided, these shall be roller bearings rated for a minimum standard life of 30000 hours taking all bearing and driven equipment loads into account.
- 1.25 **SHAFT EXTENSION** Key slotted bare shaft extension of required length with key on driving end.
- 1.26 **DRAIN HOLES** Two (2) drain holes with plugs, one (1) on either end of motor at the bottom most point.
- 1.27 **LIFTING DEVICES** Motors shall be provided with eyebolts, lugs or other means to facilitate safe lifting.
- 1.28 **DOWEL PINS**..... It shall be possible to drill holes vertically inclined through motor feet or mounting flange for installing dowel pins after assembling motor and driven equipment, before despatch (for completed driving + driven

equipment assembly) or at site after erection (for separate supplies of above equipment).

1.29 **CENTERING SPIGOT**..... Flange mounted motor shall have centering spigot to match driven equipment socket.

1.30 **EASE OF MAINTENANCE**..... Motor shall be so constructed that it can be de-assembled and reassembled with ease.

1.31 **NAMEPLATES**..... Motor shall have nameplate(s) showing diagram of connections, all particulars as per IS: 325 and following additional information:

In addition, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate direction of rotation of motor.

1.31.1 Temperature rise under normal/abnormal conditions.

1.31.2 Type of bearing and recommended lubricants.

1.32 **FINISH**..... Motor shall have glossy, light grey finish No. 631 as per IS: 5 for withstanding site conditions as per Clause 1.00 above.

All sharp edges and scales shall be removed from the surface, which shall then be thoroughly degreased, de-rusted and given two (2) coats of primer and two (2) coats of finish paint. It is preferred that a phosphate coat is given to motor prior to application of primer coat. Motors for water treatment plant shall have Zinc Chromate base with acid resistant Epilex 4 paint.

1.33 **TERMINAL BOXES**

1.33.1 GeneralMotors shall be provided with separate terminal boxes for main, space heaters, embedded temperature detectors, bearing temperature indicators and moisture detectors terminals. When it is not possible to provide LT motors with separate terminal box for space heater terminals, space heater terminals shall be adequately segregated from the main terminals in the single box. Terminal boxes shall be weatherproof and water-tight confirming to minimum IP-55 degree of protection with removable front cover for making connections. IP-55 degree of protection shall be achieved without application of compound. Space between and around terminals shall be adequate for easily connecting aluminium conductor cables. Terminal box arrangement shall be to the approval of the Owner /Consulting Engineer. All terminal boxes shall be suitable for proper termination of the type and tentative size of cables specified in Clause 1.34 below, however, exact size of cables shall be furnished by Owner during engineering stage.

The terminal boxes shall be complete with cable glands and termination accessories as required. Suitable non-magnetic material construction shall be adopted for terminal boxes where single core cables are to be terminated. All HT motors shall be provided with phase segregated terminal box.

Terminal bushings and clamps shall be non-absorbent, non- inflammable, insulated material for connecting with cable.

1.33.2 **Main Terminal Box**



1.33.2.1 LV Motors Main terminal box shall be capable of being turned through 360 degrees in steps of 90 degrees.

1.33.2.2 MV & HV Motors Motor shall be provided with two (2) terminal boxes for stator terminals. One (1) terminal box shall be for phase terminals while other one for forming star connection. These should be interchangeable to facilitate cable routing.

Neutral terminal box for HT motors rated above 1500 KW shall be suitable for mounting of three (3) Nos. wound/bar primary/ring type cast resin insulated current transformers for differential protection. These transformers shall be supplied and mounted in the motor terminal box. In addition to above, 3 Nos. of identical current transformers shall be supplied loose for mounting in the switchgear. Stator phase terminal box may either be phase segregated or standard terminal box suitable for both top and bottom entry of cables (i.e. they should be capable of being turned through 180 Degrees). The terminal box shall be designed for termination of XLPE cables using heat shrinkable or push on type terminating Kit. Terminal leading shall be stud type or leading wire type.

1.33.2.3 Cable End Boxes.....Terminal Boxes shall be provided with cable end boxes having cable lugs and cable glands for cables of sizes as specified in Clause 1.34 below.

Cable box shall be suitable for glanding the cables; and shall have adequate space between cable glands terminating studs to allow suitable bends of cable inside the cable box for all 3 phases of relevant cable sizes specified.

1.33.2.4 The terminal boxes shall be capable of withstanding at the terminals the system fault level (as indicated below) without rupture for a duration of atleast 0.25 seconds.

Min. fault level for MV Motors - 40 KA

Min. fault level for LV & HV Motors - 50 KA

1.33.2.5 **PHASE TO PHASE/ PHASE TO EARTH AIR CLEARANCE:**

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

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

1.33.2.6 Terminal Accessories.....Each terminal end shall be furnished with bimetallic washers, spring washers, nuts and crimp type aluminium (preferably tinned) lugs suitable for cables of sizes as specified in Clause 1.34 below.

1.34 **TYPE AND SIZE OF CABLES**

1.34.1 **Space Heaters**



- 1.34.1.1 For LV Motors: Two point five (2.5) mm², two (2) core copper conductor PVC insulated, armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable to IS: 1554 (Part-I).
- 1.34.1.2 For MV & HV Motors: Six (6) mm² two core aluminium conductor PVC insulated armoured and FRLS PVC sheathed heavy duty 650/1100V grade cable to IS: 1554 (Part-I).
- 1.34.2 For Embedded Temperature Detectors two sets of six (6) Twisted triad 0.5 mm² ATC copper conductor armoured, shielded cable, 650/1100 V Grade IS: 1554 (Part-I). For bearing temperature, RTDS, two (2) sets of four (4) twisted triad 0.5 mm², ATC copper conductor armoured shielded 650/1100 V Grade, IS: 1554 (Part-I).
- 1.34.3 Bearing Temperature Indicators - For each indicator, 0.5 mm² six (6) tarnished triad ATC copper conductor, PVC insulated, shielded armoured and FRLS PVC sheathed heavy duty 650/1100 V grade cable as per IS: 1554 Part-I. Two (2) cables one (1) for each bearing temperature indicator.
- 1.34.4 For Moisture Detectors.....As for space heaters as per Clause 33.01.01 above.
- 1.34.5 **For Main Terminals**

LT Motors

1. Three (3) core cablesStranded aluminium conductor, XLPE insulated, colour coded, laid up, PVC sheathed, GI wire / strip armoured, FRLS PVC jacketed overall, 650 / 1100V grade, heavy-duty cables as per IS: 1554 (Part-I).
2. Single core cablesStranded aluminium conductor, XLPE insulated, hard drawn aluminium wire/ strip armoured FRLS PVC jacketed overall, 650 / 1100V grade, heavy duty cable as per IS: 1554 (Part-I).

HT Motors

1. Three (3) core cables stranded aluminium conductor, XLPE insulated, screened colour coded, laid up, PVC sheathed, GI wire/strip armoured FRLS PVC jacketed overall, 6.6 KV / 11 KV grade, heavy duty cables as per requirement for unearthed system as per IS: 7098 (Part-II).

The size and no. of cable to be intimated to the successful bidder during detailed engineering and the contractor shall provide terminal box, cable gland and lugs suitable for the same.

Cable size may be increased in some cases because of large number of cables in under-ground ducts or because of voltage drop consideration. The supplier shall supply with terminal box and cable accessories suitable for higher size of cable at no extra cost.

1.35 **EARTHING**

- 1.35.01 General..... Two (2) grounding terminals one (1) on either side at the bottom suitable for connecting mild steel/GI flat/GI wire grounding conductor, size of grounding conductor shall be decided during detailed engineering.



- 1.35.02 LV Motors.....At each earthing point, two (2) drilled and tapped holes with hexagonal head bolts, plain washers, spring washers and tinned lugs (for motors upto 5.5 KW) for size of conductor specified shall be provided.
- 1.35.03 MV & HV Motors.....Non-corrodible metallic grounding pad shall be welded or brazed at each earthing point. The size of grounding pad shall be 75x65x25 mm. Grounding pad shall have 40 mm apart two (2) drilled and tapped holes with hexagonal head bolts, plain washers and spring washers for size of conductor specified. In addition, one suitable earthing terminal shall be provided inside the stator phase terminal box for earthing metallic shield of XLPE cables.
- 1.36 **EMBEDDED TEMPERATURE DETECTORS**.....HT motor shall be provided with six (6) Nos. duplex resistance temperature detectors (RTDs) embedded in stator winding at locations where high temperatures are expected. In addition one (1) duplex type RTD shall be provided in each bearing. The RTDs shall be 3 wire duplex platinum resistance type having a value of 100 ohms at 0 Deg.C
- 1.37 **BEARINGS TEMPERATURE INDICATORS**..... HT motors shall be provided with dial type two (2) bearing temperature indicators and will have two (2) sets of contacts, each set having 2 NO + 2 NC contacts rated for 5A at 240V AC and 0.5A at 220V DC. One set will be set to operate at lower value to give alarm and other set at a higher value to trip the motor.
- 1.38 **SPACE HEATERS**.....Valve / Damper actuator motors; and Motors above 30 KW shall be provided with one (1) or two (2) space heaters suitable for 240V, 50 Hertz single phase AC supply and of adequate capacity to maintain motor internal temperature above dew point to prevent moisture condensation or deterioration of insulation during shut down. Heaters shall be mounted inside the motor in accessible locations so that their removal and replacement is simple. Motors upto 30 kW shall have stator windings suitable for connections to 24V, 50 Hz AC supply for space heating.
- Motors upto 30 kW shall have stator windings suitable for connection to 24V, 50 Hz ac supply for space heating
- The terminals of space heaters shall be brought out to a separate totally enclosed dust proof and weatherproof terminal box.
- 1.39 **HOT AIR TEMPERATURE DETECTOR**
- If the motor is of CACA or CACW enclosure, a thermometer with alarm contracts in hot air circuit shall be provided.
- 1.40 **WATER FLOW INDICATOR**
- If the motor is of CACW enclosure a provision shall be made for visual indication of water flow and flow switch shall also be provided with alarm contacts. Thermometers shall be provided in water inlet and outlet circuits.
- 1.41 **MOISTURE DETECTORS**.....Motors with type of cooling 1C 81W or 1C 91 W shall be provided with moisture detectors for raising alarm in the event of water tube failure.

1.42 **BED PLATE**.....Whenever motor is supplied with driven equipment the Supplier shall ensure that bed plate suits both motor and driven equipment and is adequately braced to keep vibration and misalignment within allowable limits to the approval of driven equipment and motor manufacturers.

1.43 **OTHER ACCESSORIES**..... Motor shall be supplied with all accessories and parts other than those, specified above which are necessary and/or useful for efficient operation.

1.44 **TYPE TEST**

1.44.01 **HT MOTORS**

- a) The contractor shall carry out the type tests as listed in this specification on the equipment to be supplied under this contract. The bidder shall indicate the charges for each of these type tests separately. The type tests charges shall be paid only for the test(s) actually conducted successfully under this contract.
- b) The type tests shall be carried out in presence of the Purchaser's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Purchaser's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.
- c) In case the contractor has conducted such specified type test(s) within last five years as on the date of bid opening, he may submit during detailed engineering the type test reports to the Purchaser's for waiver of conductance of such test(s). These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. The Purchaser's reserves the right to waive conducting of any or all the specified type test(s) under this contract. In case type tests are waived, the type test charges shall not be payable to the contractor.
- d) Further the Contractor shall only submit the reports of the type tests as listed in "LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED" and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client. However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the Purchaser's either at third party lab or in presence of client representative and submit the reports for approval.

e) **LIST OF TYPE TESTS TO BE CONDUCTED**



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The following type tests shall be conducted on each type and rating of HT motor

- i) No load saturation and loss curves upto approximately 115% of rated voltage
- ii) Measurement of noise at no load.
- iii) Momentary excess torque test (subject to test bed constraint).
- iv) Full load test(subject to test bed constraint)
- v) Temperature rise test at rated conditions. During heat run test, bearing temp., winding temp., coolant flow and its temp. shall also be measured. In case the temperature rise test is carried at load other than rated load, specific approval for the test method and procedure is required to be obtained. Wherever ETD's are provided, the temperature shall be measured by ETD's also for the record purpose.

f) LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

The following type test reports shall be submitted for each type and rating of HT motor

- i) Degree of protection test for the enclosure followed by IR, HV and no load run test.
- ii) Terminal box-fault level withstand test for each type of terminal box of HT motors only.
- iii) Lightning Impulse withstand test on the sample coil shall be as per clause no. 4.3 IEC-60034, part-15
- iv) Surge-withstand test on interturn insulation shall be as per clause no. 4.2 of IEC 60034, part-15

1.44.02

LT Motors

- a) LT Motors supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Purchaser's approval the reports of all the type tests as listed in this specification and carried out within last five years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.
- b) However if the contractor is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the Purchaser's shall conduct all such tests under this contract at no additional cost to the Purchaser either at third party lab or in presence of client representative and submit the reports for approval.

1.44.03

LIST OF TESTS FOR WHICH REPORTS HAVE TO BE SUBMITTED

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The following type test reports shall be submitted for each type and rating of LT motor of above 50 KW only

- i) Measurement of resistance of windings of stator and wound rotor.
- ii) No load test at rated voltage to determine input current power and speed.
- iii) Open circuit voltage ratio of wound rotor motors (in case of Slip ring motors)
- iv) Full load test to determine efficiency power factor and slip .
- v) Temperature rise test.
- vi) Momentary excess torque test.
- vii) High voltage test.
- viii) Test for vibration severity of motor.
- ix) Test for noise levels of motor(Shall be limited as per clause no 1.21.01 of this section)
- x) Test for degree of protection and
- xi) Over speed test.
- xii) Type test reports for motors located in fuel oil area having flame proof enclosures as per IS 2148 / IEC 60079-1

1.44.04 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

1.45 INFORMATION WITH PROPOSAL

1.45.1 AC Motor Data Sheet.

1.45.2 Dimension Drawing/Foundation load details of motor and driven equipment.
1.45.03 Manufacturer's catalogue showing constructional details.

1.46.00 **INFORMATION ON AWARD OF CONTRACT**.....Within six (6) weeks from the date of award of the Contract, following shall be furnished:

1.46.01 Motor Data Sheet.

1.46.02 Certified binding dimension drawing of motor complete with all accessories and fittings specifically showing terminal boxes, terminal spacing and sizes, earthing connections and sizes thereof, mounting details, lifting lugs, final foundation loads and dimensions with tolerances of centering spigot (where needed), shaft extension and key.

1.46.03 Following characteristics curves:

1.46.03.01 Torque-speed curves for motor at eighty (80), hundred (100) and hundred ten (110) percent rated voltage as well as torque-speed curve for driven equipment.

1.46.03.02 Current-speed curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage

1.46.03.03 Current-time curves at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.

1.46.03.04 Thermal withstand curves for hot and cold at eighty (80), hundred (100) and hundred ten (110) percent rated voltage.



- 1.46.03.05 Efficiency, power factor, current and speed versus power output curves.
- 1.46.03.06 Speed-time curves at eight (80), hundred (100) and hundred ten (110) percent rated voltage.
- 1.46.03.07 Negative phase sequence current withstand characteristics.

1.47 COMMISSIONING CHECK LIST (HT MOTORS)

A PRELIMINARY CHECKS

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box
6. Checking stator (motor air gap) Check – Grease lubrication (for ball or roller bearing) is adequate if the motor was in storage for very long period replace the grease, by fresh grease after flushing the bearing clean. Excess grease in the bearing (housing ... is overheat of bearings) Check the free rotation of the rotor in decoupled condition. Check the air gap between stator and rotor at four positions 90o apart at driving and non-driving end. Compare the recorded values with factory results. For slip ring motors : with starting resistances.
 - a) Check the variation of resistance
 - b) Check brush lifting and slip ring short.

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Measure resistance of motor winding (in case of large motors)
4. Control and interlocks should be checked
5. Motor protection relay to be calibrated
6. Phase sequence and direction of rotation
7. Other than DOL scheme to be checked example trafo starts
9. Measure starting current starting timer and no load current
10. On load operations starting and running currents (observed vibrations, temperatures of bearings and body)
11. On load operation, starting and running currents (observed vibrations, temperatures of bearings and body)
12. In case of forced water cooling of start or check winding temperatures as ready by built in RTDs.
13. Water level (start up cooling) low to be checked for limit switch operation.

1.48 COMMISSIONING CHECK LIST (LT MOTORS)**A PRELIMINARY CHECKS**

Check the following:

1. Check the name plate details according to specification. Discrepancies, if any, to be satisfactorily resolved.
2. Check tightness of all bolts, clamps and connecting terminals.
3. Check body earthing
4. Check whether bearing lubrication is adequate
5. Check clearance inside terminal box

B COMMISSIONING CHECKS

1. Meggar tests of motor winding and cables
2. Continuity check of motor windings control and power cables
3. Over load and short circuit relay tests and settings
4. Control and interlocks should be checked
5. Phase sequence and direction of rotation
6. Operation of timer in case of star delta starting
7. Measure starting current starting timer and no load current
8. On load operations starting and running currents

1.49 DC MOTOR SPECIFICATION

DC Motor will be of continuous duty type totally enclosed fan cooled (TEFC) having IP-54 degree of protection suitable for 220 V DC supply. DC motor will be shunt wound type having high torque characteristic suitable for Bi-directional rotation at rated speed and output. The general constructional features and details of DC motor will be in line with details/ particulars stipulated in the specification for AC squirrel cage induction motors.

Contractor will furnish the data in respect of DC motors.

DATASHEET

	Auxiliary power supply	
1.1	HV supply	
	11kV, 3Φ, 3W, 50 Hz non effectively earthed	Motors rated above 1500 kW
	Fault level	50 kA for 1 second
1.2	MV supply	
	3.3kV, 3Φ, 3W, 50 Hz non effectively earthed	Motors above 200kW upto and including 1500kW
	Fault level	40 kA for 1 second
1.3	LV supply	
	415V, 3Φ, 3W, 50 Hz effectively earthed	Motors below and including 200kW
	Fault level	50kA for 1 second
	110V, 1Φ, 2W, 50 Hz effectively earthed	Lighting, space heating, AC control and protective devices
1.4	DC supply	
	220V, 2W, unearthed	DC alarm, control and protective devices.
	Fault level	25 kA for 1 second
2	Range of variation	As indicated in the specification
2.1	AC supply	
	voltage	-----
	Frequency	-----
	Combined voltage & frequency	-----
2.2	DC supply	198 to 240 V
Note: During starting of largest motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.		



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **I**

SUB-SECTION: **ID**

REV. NO. **00** DATE **17.04.19**

SHEET **1** OF **1**

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C&I)

Specifications of Reverse Rotation Monitoring System		
A)	Specifications for Indicator	
1	Service	Reverse Rotation Monitor
2	Speed Range	0 – 1500 RPM
3	Indicator Electronics	The Indicator will have cards like signal conditioner cards power supply cards, microprocessor cards using latest state of the art microcontroller technology and will be replaceable individually by the user at site.
4	Power Supply	240 V AC
5	Front Plate Indication	Digital Indication of the rotation speed, Digital Indication of Normal, Reverse and Power On
6	No. of Contacts	4 NO + 4 NC
7	Rating Contacts	5 Amps at 240 V AC 50 Hz
8	Outputs	4-20mA corresponding to the speed of the rotation range
9	Casing	Metallic Panel Mounting Type
10	Dimensions	Casing : 192 mm x 96 mm x 160 mm Cutout : 188 mm x 92 mm x 160 mm
	Vendor will provide a complete user and troubleshooting Manual of the indicator containing brief write up about the system features and working principle along with details of the cards	
B)	Specification for Probes	
1	No. of Probes	3 Nos. (For each Reverse Rotation Monitor)
2	Type of Probe	Non contact type probes which can sense the reverse rotation Within 30 degrees of motion
3	Probe dia	M 30 x 1.5 with optional accessories of mounting arrangements
4	Probe length	65 mm
5	Power Supply	Each Probe is powered from the remotely mounted indicator with +12V DC
6	Sensitivity of the Probes	The probes will be capable of sensing the shaft rotation in a gap of 2 or 8 mm
7	Extension Cable	Cable of 3 meters will be supplied with each probe for Connection of the probe with the local Junction Box

8	Junction Box	A local Junction Box suitable for installation in harsh coastal environment will be provided by vendor. The Junction will have terminals suitable for connection of the Cable from remotely mounted indicator and the cables from the Proximity Sensors. Necessary glands, sealing will be provided to prevent entry of insects, dust, ash, etc.
9	Probe Construction	The probe will be suitable for working in harsh coastal environment
10	Mounting of the Probe	The probe will be mounted suitably using locknuts suitable for the probe
11	Target hole / key projection	Pump supplier should provide hole / slot/ projection on the shaft for Proximeter sensing and size of the hole / projection should be informed to vendor

(e)	Power Supply	UPS 240V AC $\pm 10\%$, 50 HZ $\pm 5\%$ / 24 V DC, to be arranged by the bidder.
(f)	Protection class	IP-65
(g)	flange material, Measuring tube & electrode material	SS 316
(h)	Liner material.	Teflon.
(i)	Features	zero stability, zero and span field adjustable, suitable for process medium with ≤ 5 micron Siemens conductivity.

The flow meter shall provide local indication for instantaneous flow. It should also be possible to get local display for daily and monthly discharge. The flow meter shall indicate totaliser / integrator to get the daily and monthly discharge as stated above.

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. The power supply of RRI is to be arranged by the Bidder from UPS.

2.16.07 Non - Nucleonic (Vibration) Type Density Meter (For DM & AHP Plant):-

Application : Liquid Density measurement

Detector

1. Orientation : As per requirement.
2. Case Material : SS 316L/ Cast Aluminum alloy
3. Wetted part material : SS 316L
4. Operating Principle : Vibration Density measurement

Convertor

1. Output : 4-20 mA DC isolated.
2. Electrical Connection : $\frac{1}{2}$ " NPT
3. Enclosure Class : IP 65
4. Local Display : Digital 5 digit, density display with temp. compensation.
5. Accuracy : $\pm 1\%$
6. Response time : < 1 minute.
7. Power Supply : 230 V AC, $\pm 10\%$, 50 Hz. From

In general, double cable entry shall be provided, wherever available, unused cable entry shall be provided with blind metal plug. All the field instruments shall also be provided with SS tag nameplate. Counter and mating flange (SS316 material), fastener, gaskets, Nuts, bolts etc. shall also be included wherever required with the field instruments.

- 2.00.07 In general, front draw out type instruments with plug-in facility at the rear for connecting cables for power supply and signal shall be provided unless otherwise specified like for Explosion proof area, Flame proof area and high vibration prone area. Separate plugs & socket connection shall be provided for connecting power supply cables and signal cables.

The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.

Signal and Electrical connection shall be screwed connection with double compression type Nickel-plated brass/SS316 cable glands (Material as decided by owner) for Explosion proof area, Flame proof area and high vibration prone area.

- 2.00.08 The quantity of secondary instruments etc. to be provided by Bidder shall be adequate to meet the requirements of Technical Specifications. Any other additional quantity of secondary instruments envisaged by Bidder as per system and process requirements shall also be supplied without any cost implication.

2.01.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

2.01.01 SPECIFICATION FOR ELECTRONIC TRANSMITTER FOR PRESSURE, DIFF. PRESSURE AND DP BASED FLOW, LEVEL MEASUREMENTS

Sl. No.	Features	Essential/Minimum Requirements
1	Type of Transmitter	Microprocessor based 2 wire type, Hart protocol compatible
2	Accuracy	± 0.1% of calibrated span (minimum) (upto turn down ratio of 10:1).
3	Output signal range	4-20 mA DC (Analog) along with superimposed digital signal (based on HART protocol)
4	Turn down ratio	10:1 for vacuum/very low pressure applications. 5:1 for very high pressure application. 30:1 for other applications.
5	Stability	± 0.1% of calibrated span for six months for Ranges up to and including 70Kg/cm ² . ± 0.25% of calibrated span for six months for Ranges more than 70Kg/cm ² .
6	Zero and span drift	+/- 0.015% per deg.C at max span.

		+/- 0.011% per deg.C at min. span.
7	Load impedance	500 ohm (min.)
8	Housing	Weather proof as per IP-65 with durable corrosion resistant coating.
9	Over Pressure	150% of max. Operating pressure.
10	Connection (Electrical)	Plug and socket type
11	Process connection	1/2 inch NPT (F)
12	Span and Zero	Continuous, tamper proof, Remote as well as adjustability manual from instrument with zero suppression and elevation facility
13	Material	Die cast Aluminum with epoxy coating/SS316 for body. SS316 for Diaphragm.
14	Accessories	-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition. - LCD/TFT digital integral Indicators with scale of Engg. Units. -2 valve SS316 manifold for absolute & Gauge pressure transmitters, 3-valve SS316 manifold for vacuum pressure transmitters & where DP transmitters are being used for pressure measurement and 5 valve SS316 manifold for DP/Level/Flow applicable. Transmitters should not be mounted directly on the manifold; Manifold shall be non integral type only. - Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. -For hazardous area, explosions proof enclosure as described in NEC article 500.
15	Diagnostics	Self Indicating feature
16	Power supply	24V DC $\pm$ 10%.
17	Adjustment/calibration From hand held calibrator/centralized OWS based system n/maintenance (as applicable).	From hand held calibrator/centralized OWS based system

Notes

For primary air/ secondary air/flue gas applications, DP type transmitters shall be provided for pressure measurement.

LVDT type is not acceptable.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.

2.02.00 Specification for Pressure Gauge, D.P Gauge, Temperature Gauge and Level Gauge

s. no.	Features	Essential minimum requirements		
		Pr. Gauge/DP Gauge/Draught gauges	Temperature gauge	Level Gauge
1	Sensing Element and Material	Bourdon for high pressure, Diaphragm/ Bellow for Low pr. Of SS 316	Mercury in Steel/Bimetallic type for below 450°C and inert gas actuated for above 450°C of SS bulb and capillary	Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type.
2	Body Material	Die Cast Aluminum with stoved enamel black finish /SS316	Die Cast Aluminum with stoved enamel black finish /SS316	Forged carbon steel/SS 304
3	Dial Size	150 mm with toughened shatter proof glass	150 mm with toughened shatter proof glass	Tubular covering entire range
4	End Connection	½ inch NPT (M)	¾" NPT (M)	Process connection as per ASME PTC and drain/vent 15 NB
5	Accuracy	+/- 1% span	+/- 1% span	+/- 2%
6	Scale	Linear, 270° arc graduated in metric units	Linear, 270° arc graduated in °C	Linear vertical
7	Range Selection	Cover 125% of max. of scale	Cover 125% of max. of scale	Cover 125% of max. of scale

8	Over range test	Test pr. For the assembly shall be 1.5 to the max. Design pr. At 38°C		
9	Housing	Weather and dust proof as per IP-65	Weather and dust proof as per IP-65	CS/304 SS leak proof.
10	Zero/span Adjustment	Provided	Provided	-
11	Identification	Engraved with service legend or laminated phenolic name plate		
12	Accessories	Blow out Disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve	SS316 Thermowell	Gasket for all KEL-F shield for transparent type vent and drain valves of steel/SS as per CS/ alloy process requirement.
13	Material of Bourdon/ movement	SS 316	SS 316	

Notes –

*Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.

Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.

Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with inert liquid suitable for the application.

2.03.00**GUIDED WAVE RADAR TYPE LEVEL TRANSMITTER**

Guided wave radar type level transmitters shall be provided for level measurements of the vessel under vacuum or low pressure applications as specified in Part-A.	
Type	Guided wave Radar
Principle	TDR (Time domain reflectometry)
Probe Type & Material	Coaxial, SS316/316L. If required, probe shall be suitable for overfill prevention.
Connection type and material	Flanged and SS316/316L.
Signal o/p	4-20mA with HART signal suitable for overfill prevention.
Display	Integral
Power supply	24 VDC



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		integrator convert this signal into time based flow rate indication & provide totalized flow also.
Sensing plate	:	316 SS
Sensing head	:	Sensing mechanism shall be mounted outside the process flow line.
Enclosure	:	316 SS
Enclosure protection	:	IP 67)/ Explosion proof for NEC Class-1/2, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Class		
Accuracy	:	+/-1% of measured value.
Repeatability	:	+/- 0.1%
Drift	:	Both zero & span + 2% / month
Output	:	4-20mA DC isolated, load 600 ohm (min)
Digital communication (HART) facility	:	yes
Power supply	:	230 V AC, 50Hz. UPS
Ambient condition	:	Temperature -600 C, RH-95% Environment – Highly Dusty
Accessories	:	Shall be complete with all the accessories including digital display for flow rate, integral vents, baffles for air separation, etc. whichever required for satisfactory operation.

Note:-

- The above on line flow meter shall not create any obstruction on flow.
- User's list shall be submitted to support on proven satisfactory performance for similar process application.

2.13.00 PROCESS ACTUATED SWITCHES

Sr No.	Features	Essential/Minimum Requirements		
		Pressure/Draft Switches/ DP Switches	Temperature switches	Level switches
1	Sensing Element	Piston actuated for high pressure and diaphragm or bellows for low pr./ vacuum	Vapor pressure sensing, liquid filled bellow type with SS bulb and capillary (10 m minimum)	Capacitance types for oil and dirty medium, water, condensate application. Float type for applications as

				decided by owner during detailed engineering. Capacitance/Conductivity/Ultrasonic type for acid and alkali application. RF/ Ultrasonic type for ash hopper, ash slurry application. Detailed spec are also included below.
2	Material of sensing element & movement.	316 SS	Bulb 316 SS/ capillary 304 SS	316 SS
3	End connection	½ inch NPT (F)	½ inch NPT (F)	Manufacturer standard
4	Over range proof pressure	150% of max. design pr	-	150% of max. design pressure
5	Repeatability	± 0.5% of full range		
6	No. of contacts	2 Nos. +2NC. SPDT snap action dry contact. Auto reset with internal Adjustable snap action micro switch.		
7	Rating of contacts	60 V DC, 6 VA (or more if required by DDCMIS/PLC)		
8	Elect. Connection	Plug in socket		
9	Set point	Provided over full range. Differential shall be adjustable.		
10	Dead band adjustment	Adjustment upto 10% at set points.		
11	Enclosure	Die cast Aluminum with stoved enamel black finish/SS316, Weather and dust proof as per IP-65. Epoxy painting shall be provided for corrosive atmosphere.		
12	Accessories	Siphon, snubber, chemical, pulsation dampers as required by process.	Thermo well of 316 SS and packing glands	All mounting accessories
13	Mounting	Suitable for enclosure/rack mounting or direct mounting	Suitable for rack mounting or direct mounting	-
14	Power Supply (wherever	24 V DC, to be arranged by Bidder except for Ash Level Switches, where the same shall be as per Bidder's Standard practice.		

	Required)	
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Notes:-

- 1) Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.
- 2) Pressure / Diff Pressure switches for very low pressure / DP measurements can have sensor material other than SS316 e.g. silicon etc., if the offered material is suitable for that application and the offered product is standard product of the manufacturer for very low pressure applications.
- 3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.

2.13.01 Conductivity Type Level Switch

Type	:	Conductivity discrimination.
Mounting	:	Flanged – on standpipe.
Probe MOC	:	Stainless steel with high purity ceramic.
Probe rating	:	> Maximum design pressure of vessel.
Input	:	Four independent channel with selectable switching threshold for water conductivity.
Relay Output	:	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
Contact type & rating	:	2SPDT or 1 DPDT @ 5A 30V DC.
Faults Detection	:	Power Fail/Electrode Connection Open circuit/short circuit to ground, Ground failure. In built Fail Safe Logic.
Indicator	:	One Red LED for steam/ one Green LED for water/ Two no. LED one each for Process & system fault.
Power supply	:	Dual 230V AC, 50 Hz, 1Ph from UPS.



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	4) Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided by owner during detailed engineering. Separate Sensor unit & electronics unit with LCD display to be provided for the applications, which will be decided during detailed engineering by owner.
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2.05.00**HART Hand Held calibrator**

Hand held calibrator shall be provided for adjustment/calibration/maintenance of the HART compatible transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

HART hand held calibrator shall be provided with following minimum accessories per set:-

- i. Soft carrying case with adjustable shoulder straps & lead compartments.
- ii. HART lead set.
- iii. Rechargeable batteries.
- iv. Battery charger.
- v. Power adaptor.
- vi. Universal plug kit for power adaptor.
- vii. Load resistor.
- viii. Interfacing cables of each type as per requirements.
- ix. Protective boot.
- x. Standard banana jack.
- xi. Operation manual & software CD.

The quantity of HART hand held calibrator to be provided by Bidder is listed in Appendix- I to Vol.V, Table IV, Part A of Technical Specifications.

2.06.00 Temperature Elements and accessories**2.06.01 Thermocouples**

S.No.	Features	Essential/Minimum Requirements
1.	Type of Thermocouple	16 AWG wire of Chromel-Alumel (Type K) or 24 AWG wire Pt-Rhodium Pt (Type S/R) depending on operating temperature Range (ungrounded type).
2.	No. of element	Duplex
3.	Housing/Head	IP-65/Die cast Aluminum. Head of TE to be provided with sufficient space and arrangement to head

		mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection.
4.	Sheathing of Thermocouple	Swaged type magnesium oxide insulation
5.	Calibration and accuracy	As per IEC-751/ANSI-C-96.1(special class) for T/C
6.	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value
7.	Accessories	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well.
8.	Standard	ANSI C 96.1 for Thermocouple and ASME PTC-19.3 (latest edition) for Thermo-well.
9.	Sheath Material/ Insulation	316SS/Compacted Magnesium Oxide.
	Sheath O D	8 mm.
10.	Response Time	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
11.	Instrument Connection	1/2 " NPT (F).
12.	Electrical connection	Gold plated Plug in type. Double entry, one unused entry with blind plug.
13.	Enclosure Class	IP-65 or better.
14.	Process Connection	i) M33 x 2 ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.
15.	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
16.	Extension neck length	Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.

Notes

1. Extension cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills

itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

2. Thermocouples provided for steam services like super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.
3. The specification for thermocouples of bearings metal and winding temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.

2.06.02 Resistance Temperature Detector (RTD)

S.No.	Features	Essential/Minimum Requirements
1.	Type of RTD	Four /Three wire, Pt-100 (100 Ohms resistance at zero degree Centigrade).
2.	No. of element	Duplex
3.	Housing/Head	IP-65/Diecast Aluminum. Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable). Plug in connectors are to be provided for external signal cable connection.
4.	Sheathing of RTD	Metal sheathed, ceramic packed
5.	Calibration and accuracy	As per DIN-43760/IEC 60751 Class-A for RTD
6.	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value.
7.	Accessories	Thermo well (as specified below) and shall be spring loaded for positive contacts with the well
8.	Standard	DIN-43760/IEC 60751 for RTD and ASME PTC-19.3 (latest edition) for Thermo-well.
9.	Sheath Material/ Insulation	316SS/Compacted Magnesium Oxide.



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	Sheath O D	8 mm.
	Gauge	18 SWG
10.	Response Time	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
11.	Instrument Connection	1/2 " NPT (F).
12.	Electrical connection	Gold plated Plug in type. Double entry, one unused entry with blind plug.
13.	Enclosure Class	IP-65 or better.
14.	Process Connection	i) M33 x 2 ii) Flanged for Air & Gas systems with mating flanges, fastner, gasket etc.
15.	Extension	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
16.	Extension neck length	Minimum 100 mm above Insulation of pipe and Minimum 160 mm when there is no insulation on pipe.

NOTES:

- 1) The specifications for RTDs of winding/ bearings of motor/ pump can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However the type of RTD shall be PT100.

2.06.03 Metal Temperature Thermocouples

S.No.	Features	Essential/Minimum Requirements
1.	Measuring Medium	Metal Temperature
2.	Material of Thermocouple	Chromel Alumel Type K
3.	Type of Thermocouple	Duplex with separate hot junctions, ungrounded Insulation Mineral Insulation Magnesium Oxide.
4.	Thermocouple wire gauge	16 AWG
5.	Protective sheath	SS 321
6.	Protective sheath dia	8 mm O.D
7.	Characteristics of Thermocouple	Special limits of error as in ANSI thermocouple MC 96.01, 1975
8.	Mounting accessories	1/2" BSP SS sliding end connector, weld pad, clamps of heat resistant steel SS310



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		or as per OEM design
9.	Cold end sealing	SS pot weal with colour coded PTFE headed sleeve Insulated flexible tails. Sealing compound- Epoxy resin
10.	Minimum bending radius	30 mm
11.	Length of T/C	30 Mtr. (minimum)

Notes:

- 1) The specification for thermocouples of bearings metal and winding temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However type of thermocouples shall be K-type.
- 2) For boiler metal temperature applications considering the location of installation and response time, manufacturers standard and proven specification for metal temperature measurement can also be a accepted subject to OWNER approval. The manufactures shall submit adequate supporting documents for establishing their standard and proven practice.

2.06.04 Thermo well (for all process temp. elements) - (As per ASME PTC 19.3, latest edition)

- a. Shall be one piece solid bored type of 316 SS/F11/F22/F91 of step-less tapered design for water and steam Services depending upon process parameters.
- b. For Mill classifier outlet long life solid sintered tungsten carbide material of high abrasion resistance shall be provided.
- c. For Air & Flue gas 316 SS protecting tube with welded cap. (However bidder shall provide better material for Flue gas service if required based on the specified boiler design parameters).
- d. For furnace zone, impervious ceramic protecting tube of suitable material along with Incoloy supporting tubes and adjustable flanges.
- e. Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 (latest edition).

"All Thermowells in high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safer size and design of Thermowells".

2.06.04 Void

2.06.05 TEST THERMOWELLS (TW)



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Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection		
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with SS chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

2.07.00 TEMPERATURE TRANSMITTER

Following types of 2-wire temperature transmitter (directly powered from 4-20mA input cards of DDCMIS/PLC) shall be provided. The temperature transmitter shall be fully compatible with thermocouples and RTDs being provided by the bidder as well as Owner. Temperature compensation of the thermocouples shall be performed in the temperature transmitter itself.

a. Single Input Head mounted Temperature Transmitter

These shall be suitable for mounting in the head of temperature element itself. The protection class of head of thermo well along with its plug-in connector shall be min. IP65.

b. Single Input DIN-rail mounted Temperature Transmitter

These shall be suitable for mounting on DIN-rails in JB's. The specifications of the JB's shall be same as indicated in Subsection INST CABLE with additional DIN-rails and IP 65 Protection class. This temperature transmitter shall be the ones which are especially designed for DIN-rail mounting with IP 20 protection class. These shall have terminals for input/output provided on front side when mounted on DIN-rail.

Head mounted temperature transmitter with clamps to make it suitable for DIN-rail mounting shall not be acceptable under this category.

c. Dual-input Temperature Transmitter with Indicator:



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These shall be suitable for mounting on pipes/ support. Indicator shall be provided with these transmitters. These transmitters shall have bump less change over facility to second sensor in case first sensor fails. This change-over is to be alarmed. Protection class shall be IP65 minimum.

The exact applications for which this type of transmitter is to be provided shall be finalized by owner during detailed engineering.

- d. Common requirements for each of the above type of temperature transmitters.
- | | | |
|-------------------------------|---|---|
| Output | : | 2-wire (power supply from input card of Control System) with 4-20mA output with superimposed HART protocol signal. |
| Input | : | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K&R types (input type to be selectable at site through HART terminal) |
| Isolation | : | Min. 500 V AC |
| EMC compatibility | : | as per EN 61326 |
| Operating ambient temperature | : | 0 to 85 deg C (without indicator)
0 to 70 deg C (with indicator) |
| Power supply | : | Compatible with input module of Control System |
| Accessories | : | Mounting arrangements including Clamps etc. |
| Composite Accuracy | : | (a) For head mounted and DIN-rail mounted type Refer note-2
RTD = <0.4% of 0-250 deg C span
T/C-K type = <0.4% of 0-600 deg C span
T/C-R type = <0.4% of 0-1000 deg C span

(b) For dual-input type:
RTD = <0.25% of 0-250 deg C span
T/C-K type = <0.2% of 0-600 deg C span |

- e. Field bus compatible temperature transmitters
- Temperature transmitters of this category shall be field mounting type & shall be capable of withstanding operating ambient temperature upto 85 deg C. These modules shall be connected to DDCMIS through field bus such as Profibus, Foundation Field bus etc directly from the transmitter. Maximum Number of inputs per such temperature transmitter shall be eight. These shall be mounted in cabinets in non-AC areas.



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As an alternate, these signals from temperature transmitters can be connected to DDCMIS through standard remote I/O modules of the DCS, in which case, the temperature transmitter signals will be acquired through 4-20mA input modules in the remote I/O cabinet for connecting to DDCMIS through remote I/O bus.

Notes (Common for a to e above):-

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures.

2.08.00 IMPACT HEAD TYPE FLOW ELEMENT

The impact head type element shall be tubular insert type with four impact ports facing upstream direction, located precisely for determination of average flow velocity and shall be of SS 316 L.

Accuracy shall be 1.0% of actual value or better. Repeatability shall be $\pm 0.1\%$ of actual value or better.

The elements shall be supplied complete with mounting hardware; end support plugs and SS316 valve manifold (1/2" NPT connection) for instrument connections. All pertinent data including Owner's instrument tag no. for the flow element shall be punched on a stainless steel plate and affixed to the element.

Flushing arrangement shall be provided.

Dual path transit time clamp-on Ultrasonic Flow meter may also be used for measurement of CW flow.

2.09.00 FLUE GAS ANALYSER

The following flue Gas analyzers are envisaged:-

- i) Flue Gas analyzers for control and monitoring – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.
- ii) Flue Gas Dust Emission analyzer for each ESP (at each Path) – quantities as indicated in Vol. V, Appendix I, Sr. no. G1, Part A.





SPECIFICATION FOR MOTORISED VALVE ACTUATOR

SPECIFICATION NO.:

VOLUME II B

SECTION D

REV. NO. 00 DATE: 26.02.18

SHEET 1 OF 4

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

GENERAL*	* PROJECT	1 x 6600 MW PANKI Thermal Power Project	
	OFFER REFERENCE		
	* TAG NO. SERVICE		
	* DUTY	☐ ON / OFF	☐ INCHING
	* LINE SIZE (inlet/outlet): MATERIAL		
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY	
	* OPENING / CLOSING TIME		
	* WORKING PRESSURE		
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF -20 to 70 DEG C AND RELATIVE HUMIDITY OF 0-95%	
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY	
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY	
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY	
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68	
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL	
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.	
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.	
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR REGULATING SERVICE - 150 STARTS/HR MINIMUM OR REQUIRED CYCLES WHICHEVER IS HIGHER..	
HANDWHEEL	* REQUIRED	☒ YES ☐ NO	
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED	
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.		
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY	
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY	
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE	
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☒ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram	
	COLOUR SHADE	☒ RAL 7032	
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐	
	SHAFT RPM	BIDDER TO SPECIFY	
	OLR SET VALUE	BIDDER TO SPECIFY	
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY	
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY	
	@ PWR SUPP TO MTR / STARTER	415V +/- 10%, 3 Phase, 3 Wire 50HZ +/-5%	
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☒ 110 V	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.:		
		VOLUME	II B	
		SECTION	D	
		REV. NO.	00	DATE: 26.02.18
		SHEET	2	OF 4

Data Sheet A & B

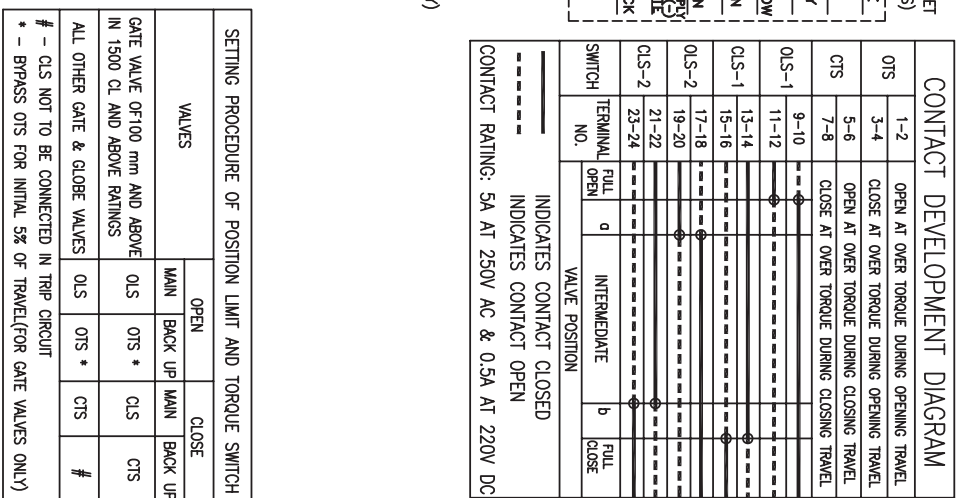
DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
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	@ ENCLOSURE CLASS OF MOTOR	☐ IP 67 ☐ FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS(Reversing type) ☐ THYRISTORS		
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	IF SMART			
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED		
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐		
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC		
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED		
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐		
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED		
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP		
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED		
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED		
	OPEN-STOP-CLOSE PB(running open/close LED) THREE POSITION SELECTOR SWITCH	☒ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED		
	LOCAL-OFF- REMOTE S/S(THREE POSITION SELECTOR SWITCH)	☒ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED		
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (MOTOR THERMOSTAT TRIP/O/L RELAY OPERATED, CONT. /POWER SUPPLY FAILED, S/S IN LOCAL/OFF MODE, TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD.)		
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☒ OPTO COUPLER ☐ EITHER		
	QUANTITY	☒ 2 NOs. ☐ 3 NOs.		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☐ 1 No. ☒ 2Nos. / ☐ 1 No. ☒ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 250V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	☒ 2 Nos. 2 nos(adj) 1 No.	☒ 2Nos.	
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 250V AC AND 0.5A 220V DC		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.:		
		VOLUME	II B	
		SECTION	D	
		REV. NO.	00	DATE: 26.02.18
		SHEET	3	OF 4
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	REQUIRED for regulating/inching duty only.	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) contactless inductive type	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	$\pm 1\%$ FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☒ IP 68 @ ☐ NEMA6	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	☒ REQUIRED ☐ NOT REQUIRED ☒ 2 NOS. ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----	
	@ SPACE HEATER CABLE GLAND	SIZE:-----	
	OTHER CONTROL CABLE GLANDS-1	☐ 1No. for BFV of CW PUMP (Cable size 2Px1.5mm ²)	
	OTHER CONTROL CABLE GLANDS-2	1 no suitable for 8P X 0.5 sq mm Additional 1 no suitable for 2P X 0.5 sq mm (inching duty only)	

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:	
			VOLUME II B	
			SECTION D	
			REV. NO. 00	DATE: 26.02.18
			SHEET 4	OF 4
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.	
NOTES: SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED. - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. - THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS. - IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR. - POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL - WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM. - THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE AND RUNNING AT 80 PERCENT OF RATED VOLTAGE AT RATED TORQUE AND 85 PERCENT RATED VOLTAGE AT 33 PERCENT EXCESS RATED TORQUE FOR A PERIOD OF 5 MINUTES EACH. - THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE. - ALL SIX (6) LIMIT SWITCHES SHALL BE CHANGEOVER TYPE AND ADJUSTABLE BESIDES HAVING THE SNAP FACILITY. - THE INTEGRAL STARTER WHICH SHALL HAVE SOPHISTICATED ELECTRONIC CONTROLS WITH FIELD PROGRAMMING FEATURE. IT SHALL BE DESIGNED FOR REMOTE CONTROL FROM DCS/RESPECTIVE CONTROL SYSTEM. REQUIRED INTERPOSING RELAYS FOR RECEIVING OPEN/CLOSE/STOP COMMAND FROM DCS/RESPECTIVE CONTROL SYSTEM SHALL BE PROVIDED. POTENTIAL FREE CONTACTS AND TRANSDUCERS SHALL BE PROVIDED TO PROVIDE STATUS INDICATION AT REMOTE DCS/RESPECTIVE CONTROL SYSTEM. - THE REMOTE COMMAND SIGNAL (OPEN-STOP-CLOSE) FROM DCS/RESPECTIVE CONTROL SYSTEM/CONTROL PANEL SHALL BE ISOLATED FROM CONTROL ELECTRONICS THROUGH OPTO-ISOLATOR. - THE FOLLOWING INDIVIDUAL STATUS ANNUNCIATION LED'S (COLOUR-GREEN) SHALL BE PROVIDED LOCALLY (INTEGRAL TO ACTUATOR) TO ANNUNCIATE THE FOLLOWING FOR EASY LOCAL MONITORING. ACTUATOR IN LOCAL MODE ACTUATOR IN REMOTE MODE ACTUATOR RUNNING IN OPEN DIRECTION ACTUATOR RUNNING IN CLOSE DIRECTION ACTUATOR IN INCHING MODE. ACTUATOR IN SELF-RETAINING MODE LIMIT SWITCH OPEN TRIP LIMIT SWITCH CLOSE TRIP CONTROL VOLTAGE AVAILABILITY				
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ELECTRICAL				



CLOSE DIRECTION TO BE DONE INTERNALLY.

U



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **I**

SUB-SECTION: **ID**

REV. NO. **00** DATE **17.04.19**

SHEET **2** OF **1**

SUB-SECTION – ID

DATASHEET-A

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE I)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
Sl. No.	DESCRIPTION	HOTWELL MAKE UP PUMPS	DM MAKEUP PUMPS	BOILER FILL PUMPS
		HORIZONTAL PUMPS (TYPE-I)		
1.0	SERVICE			
1.1	Total no. of pumps for Project	2	2	2
1.2	No. of working & standby pumps	1W+1S	1W+1S	1W+1S
1.3	Liquid Handled (ref. water analysis enclosed herein)	DM Water	DM Water	DM Water
1.4	Location (Indoor / Outdoor)	Outdoor	Outdoor	Outdoor
1.5	Duty	Continuous	Continuous	Intermittent
1.6	No. of pumps working in parallel	-	-	-
1.7	Specific gravity	1	1	1
1.8	System design pressure (kg/sqcm), g	10	10	25
2.0	DESIGN PARAMETERS			
2.1	Design capacity each, M ³ /hr	285	35	200
2.2	Total dynamic head (MWC)	65	50	150
2.3	Suction Pressure(MWC)	Flooded Suction	Flooded Suction	Flooded Suction
2.4	Design Temperature (°C)	60	60	60
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	90	90	225
2.7	Operating range	-----30-130% of design duty point flow-----		
2.8	Motor rating	Continuous motor rating (at 50 deg. C ambient) shall be 15% above the max power requirement at any condition of the entire characteristic curve of the pump (viz. 0-130%).		
2.9	Permissible tolerance in rated capacity & TDH	no negative tolerance		
2.10	Permissible tolerance in efficiency at rated capacity(%)	no negative tolerance		
2.11	Performance/Design Standard	HIS		
3.0	CONSTRUCTION FEATURES			
3.1	Pump type	Horizontal centrifugal between bearing Pump	Horizontal centrifugal between bearing Pump	Horizontal centrifugal between bearing Pump
3.2	Impeller type	Closed/ Semi open	Closed/ Semi open	Closed/ Semi open
3.3	Casing type	Preferably radially split type	Preferably radially split type	Preferably radially split type
3.4	Coupling type	As per Manufacturer's standard practice	As per Manufacturer's standard practice	As per Manufacturer's standard practice

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE I)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
Sl. No.	DESCRIPTION	HOTWELL MAKE UP PUMPS	DM MAKEUP PUMPS	BOILER FILL PUMPS
3.5	Sealing arrangement	Gland packing initially & Mechanical seal finally after commisioning	Gland packing initially & Mechanical seal finally after commisioning	Gland packing initially & Mechanical seal finally after commisioning
3.6	Type of Lubrication	Grease / self-water	Grease / self-water	Grease / self-water
3.7	Pump characteristics	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable
3.8	Drain Plugs, vent with valve, lifting lugs, priming connection	YES		
4.0	MATERIALS OF CONSTRUCTION			
4.1	Casing	ASTM A CF 8M	ASTM A CF 8M	ASTM A CF 8M
4.2	Impeller	ASTM A CF 8M	ASTM A CF 8M	ASTM A CF 8M
4.3	Shaft	SS 410	SS 410	SS 410
4.4	Shaft Sleeves	SS-410	SS-410	SS-410
4.5	Impeller Wearing rings (If applicable)	SS 316	SS 316	SS 316
4.6	Bolts & Nuts	Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel	Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel	Stainless steel for those coming in contact with water and for others, material shall be high tension carbon steel
4.7	Gland / Seal Cover	SS 316	SS 316	SS 316
4.8	Lantern Ring	Manufacturer standard	Manufacturer standard	Manufacturer standard
4.9	Mech. seal	Manufacturer standard	Manufacturer standard	Manufacturer standard
4.10	Gland Packing	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)
4.11	Base Plate	MS fabricated IS-2062 (min. thk.-10 mm) Epoxy Coated		
4.12	Stuffing Box	ASTM A CF 8M	ASTM A CF 8M	ASTM A CF 8M
4.13	Casing Wearing rings (If applicable)	SS 316	SS 316	SS 316
4.14	Coupling	SS	SS	SS
4.15	Connecting Pipe material (for deciding counterflange material)	SA 312 TP 304 (stainless steel)	SA 312 TP 304 (stainless steel)	SA 312 TP 304 (stainless steel)

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE I)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
Sl. No.	DESCRIPTION	HOTWELL MAKE UP PUMPS	DM MAKEUP PUMPS	BOILER FILL PUMPS
5.0	MANDATORY SPARES FOR PUMP-MOTOR SET			
5.1	Spares for Pumps			
5.1.1	IMPELLER	1 no. of each type & size	1 no. of each type & size	1 no. of each type & size
5.1.2	SHAFT	1 no. of each type & size	1 no. of each type & size	1 no. of each type & size
5.1.3	SHAFT SLEEVES	1 Set of each type & size	1 Set of each type & size	1 Set of each type & size
5.1.4	CASING AND IMPELLER WEARING RINGS	2 Sets of each type & size	2 Sets of each type & size	2 Sets of each type & size
5.1.5	BEARINGS FOR PUMPS	2 Sets of each type & size	2 Sets of each type & size	2 Sets of each type & size
5.1.6	THRUST BEARINGS	2 Sets of each type & size	2 Sets of each type & size	2 Sets of each type & size
5.1.7	SLEEVE NUTS AND BEARINGS	1 Set of each type & size	1 Set of each type & size	1 Set of each type & size
5.1.8	GLAND PACKING	2 Sets of each type & size	2 Sets of each type & size	2 Sets of each type & size
5.1.9	FASTENERS	1 Set of each type & size	1 Set of each type & size	1 Set of each type & size
5.1.10	COMPLETE COUPLING (PUMP & MOTOR)	1 Set of each type & size	1 Set of each type & size	1 Set of each type & size
5.1.11	MECHANICAL SEAL	1 Set of each type & size	1 Set of each type & size	1 Set of each type & size
5.2	Spares for Motors			
5.2.1	Terminal plates	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW
5.2.2	Heaters	2 sets	2 sets	2 sets
5.2.3	Greasing arrangements	4 sets each type of motor	4 sets each type of motor	4 sets each type of motor
5.2.4	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever be higher	10% of the installed quantity or minimum 1 number whichever be higher	10% of the installed quantity or minimum 1 number whichever be higher
5.2.5	Bearings (DE and NDE) for each type and rating of motors.	5 sets	5 sets	5 sets
5.2.6	Stator winding coils for all type of LT motors	One (1) set	One (1) set	One (1) set
5.2.7	Dust seals and gaskets for each type of motors	Three (3) sets	Three (3) sets	Three (3) sets

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE I)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
Sl. No.	DESCRIPTION	HOTWELL MAKE UP PUMPS	DM MAKEUP PUMPS	BOILER FILL PUMPS
	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.			
6.0	BID EVALUATION RATE			
6.1	Bid evaluation rate	Rs.5.84 Lacs/KW	Rs.5.84 Lacs/KW	NA
6.2	Maximum permissible efficiency for Bid evaluation			
6.2.1	Pump Efficiency	78	66	-
6.2.2	Motor Efficiency	94.7	90.5	-
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			
4	Wherever SS material is coming in contact with non SS material, suitable isolation (rubber etc.) shall be provided to avoid galvanic corrosion.			

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE II)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
Sl. No.	DESCRIPTION	DMCW TG AUX'S PUMPS	DMCW SG AUX'S PUMPS	
		HORIZONTAL PUMPS (TYPE-II)		
1.0	SERVICE			
1.1	Total no. of pumps for Project	3	2	
1.2	No. of working & standby pumps	(2W+1S) per unit	(1W+1S) per unit	
1.3	Liquid Handled (ref. water analysis enclosed herein)	pH corrected DM Water	pH corrected DM Water	
1.4	Location (Indoor / Outdoor)	Indoor	Indoor	
1.5	Duty	Continuous	Continuous	
1.6	No. of pumps working in parallel	2	-	
1.7	Specific gravity	1	1	
1.8	System design pressure (kg/sqcm), g	10	12	
2.0	DESIGN PARAMETERS			
		Alternative-1	Alternative-2	Alternative-1
2.1	Design capacity each, M³/hr	1575	2850	525
2.2	Total dynamic head (MWC)	40		57
2.3	Suction Pressure(MWC)	25.5		25.5
2.4	Design Temperature (°C)	60		60
2.5	Maximum permissible speed of pump (RPM)	1500		1500
2.6	Max. limit on shut off head Corresponding to pump TDH (MWC) at 51.5 Hz	Not to exceed 65 MWC		Not to exceed 88 MWC
2.7	Operating range	-----30-130% of design duty point flow-----		
2.8	Motor rating	Continuous motor rating (at 50 deg. C ambient) shall be 15% above the max power requirement at any condition of the entire characteristic curve of the pump (viz. 0-130%).		
2.9	Permissible tolerance in rated capacity & TDH	no negative tolerance		
2.10	Permissible tolerance in efficiency at rated capacity(%)	no negative tolerance		
2.11	Performance/Design Standard	HIS / EQUIVALENT		
3.0	CONSTRUCTION FEATURES			
3.1	Pump type	Horizontal centrifugal type Between Bearing Pump		Horizontal centrifugal type Between Bearing Pump
3.2	Impeller type	Closed		Closed

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE II)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
Sl. No.	DESCRIPTION	DMCW TG AUX'S PUMPS	DMCW SG AUX'S PUMPS	
3.3	Casing type	Horizontal split type	Horizontal split type	
3.4	Coupling type	Flexible type	Flexible type	
3.5	Sealing arrangement	Gland packing initially & Mechanical seal finally after commisioning	Gland packing initially & Mechanical seal finally after commisioning	
3.6	Type of Lubrication	Self Liquid	Self Liquid	
3.7	Pump characteristics	Non Overloading type & stable	Non Overloading type & stable	
3.8	Drain Plugs, vent with valve, lifting lugs, priming connection	Required		
4.0	MATERIALS OF CONSTRUCTION			
4.1	Casing	ASTM – A351 – CF8M	ASTM – A351 – CF8M	
4.2	Impeller	ASTM – A351 – CF8M	ASTM – A351 – CF8M	
4.3	Shaft	SS 316	SS 316	
4.4	Shaft Sleeves	SS 316	SS 316	
4.5	Impeller Wearing rings	SS 316	SS 316	
4.6	Bolts & Nuts	High tensile Steel / SS	High tensile Steel / SS	
4.7	Gland/Seal Cover	ASTM – A351 – CF8M	ASTM – A351 – CF8M	
4.9	Lantern Ring	As per Manufacturer standard	As per Manufacturer standard	
4.10	Mech. seal	As per Manufacturer standard	As per Manufacturer standard	
4.10	Gland Packing	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	
4.11	Base Plate	MS fabricated IS-2062 (min. thk.-10 mm) Epoxy Coated	MS fabricated IS-2062 (min. thk.-10 mm) Epoxy Coated	
4.12	Stuffing Box	ASTM-A-351 CF 8M with asbestos free packing.	ASTM-A-351 CF 8M with asbestos free packing.	
4.13	Casing Wearing rings (If applicable)	SS 316	SS 316	
4.14	Coupling	SS	SS	
4.15	Connecting Pipe material (for deciding counterflange material)	Carbon Steel as per IS:2062, Plates rolled & welded as per IS 3589	Carbon Steel as per IS:2062, Plates rolled & welded as per IS 3589	
4.16	Fasteners	AISI - 304	AISI - 304	

	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE II)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
Sl. No.	DESCRIPTION	DMCW TG AUX'S PUMPS	DMCW SG AUX'S PUMPS	
5.0	MANDATORY SPARES FOR PUMP SET			
5.1	IMPELLER	1 no. of each type & size	1 no. of each type & size	
5.2	SHAFT	1 no. of each type & size	1 no. of each type & size	
5.3	SHAFT SLEEVES	1 Set of each type & size	1 Set of each type & size	
5.4	CASING AND IMPELLER WEARING RINGS	2 Sets of each type & size	2 Sets of each type & size	
5.5	BEARINGS FOR PUMPS	2 Sets of each type & size	2 Sets of each type & size	
5.6	THRUST BEARINGS	2 Sets of each type & size	2 Sets of each type & size	
5.7	SLEEVE NUTS AND BEARINGS	1 Set of each type & size	1 Set of each type & size	
5.8	GLAND PACKING	2 Sets of each type & size	2 Sets of each type & size	
5.9	FASTENERS	1 Set of each type & size	1 Set of each type & size	
5.10	COMPLETE COUPLING (PUMP & MOTOR)	1 Set of each type & size	1 Set of each type & size	
5.11	MECHANICAL SEAL	1 Set of each type & size	1 Set of each type & size	
	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.			
6.0	BID EVALUATION RATE			
6.1	Bid evaluation rate	Rs.5.84 Lacs/KW		Rs.5.84 Lacs/KW
6.2	Maximum permissible efficiency for Bid evaluation			
6.2.1	Pump Efficiency	85	86	82
6.2.2	Motor Efficiency	94	94	94
Notes :				



	DATA SHEET - A		SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - (TYPE II)		REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS		SECTION:	I D
	Sl. No.	DESCRIPTION	DMCW TG AUX'S PUMPS	DMCW SG AUX'S PUMPS
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.			



DATA SHEET - A

SPECIFICATION NO.:

PE-TS-426-100-N001

MISCELLANEOUS PUMPS (Vertical Pumps) - (TYPE I)

REV. NO.: 00

DATE : 17/04/2019

1X660 MW PANKI TPS

SECTION:

I D

Sl. No.	DESCRIPTION	CW MAKEUP PUMPS	APH WASH PUMPS	AHP/CHP PUMPS	SERVICE WATER PUMPS	FGD MAKEUP PUMPS
1.0	SERVICE					
1.1	Total no. of pumps for Project	3	2	2	2	2
1.2	No. of working & standby pumps	2W+1S	1W+1S	1W+1S	1W+1S	1W+1S
1.3	Liquid Handled (ref. water analysis enclosed herein)	Clarified water	Clarified water	Clarified water	Clarified water	Clarified water
1.4	Location	Clarified water P/H				
1.4.1	Indoor / Outdoor	Indoor	Indoor	Indoor	Indoor	Indoor
1.5	Duty	Continuous	Intermitent	Continuous	Continuous	Continuous
1.6	Specific gravity	1	1	1	1	1
1.7	No. of pumps working in parallel	2	-	-	-	-
1.8	System design pressure (kg/sqcm), g	10	12	10	10	10
2.0	DESIGN PARAMETERS					
2.1	Design capacity each, M ³ /hr	725	850	450	100	90
2.2	Total dynamic head (MWC) (Developed Pump head at Min WL, excluding Pumps Internal frictional losses upto discharge)	4.2	80	38	62	32
2.3	• Suction Pressure(MWC)	Submerged Suction	Submerged Suction	Submerged Suction	Submerged Suction	Submerged Suction
	• Floor Level- for Pump Mounting	EL (+) 2.25 M	EL (+) 2.25 M	EL (+) 2.25 M	EL (+) 2.25 M	EL (+) 2.25 M
	• Min. W.L	EL (-) 1.75 M	EL (-) 1.75 M	EL (-) 1.75 M	EL (-) 1.75 M	EL (-) 1.75 M
	• Max. W.L.	EL (+) 1.45 M	EL (+) 1.45 M	EL (+) 1.45 M	EL (+) 1.45 M	EL (+) 1.45 M
	• Sump Invert Level	EL (-) 4.0 M	EL (-) 4.0 M	EL (-) 4.0 M	EL (-) 4.0 M	EL (-) 4.0 M
	• Crane Hook Level	EL (+) 7.75 M	EL (+) 7.75 M	EL (+) 7.75 M	EL (+) 7.75 M	EL (+) 7.75 M
	• Crane Capacity Available	6 Ton	6 Ton	6 Ton	6 Ton	6 Ton
2.4	Design Temperature (°C)	60	60	60	60	60
2.5	Maximum permissible speed of pump (RPM)	1500	1500	1500	1500	1500
2.6	Max. limit on shut off head Corresponding to pump TDH (MWC) at 51.5 Hz	Not to exceed 90 MWC	Not to exceed 114 MWC	Not to exceed 90 MWC	Not to exceed 90 MWC	Not to exceed 90 MWC
2.7	Pump Discharge - above floor / below floor	Above Floor				
2.8	Operating range	-----70-130% of design duty point flow-----				
2.9	Motor rating	Continuous motor rating (at 50 deg. C ambient) shall be 15% above the max power requirement at any condition of the entire characteristic curve of the pump (viz. 0-130%).				
2.10	Permissible tolerance in rated capacity & TDH	no negative tolerance				
2.11	Permissible tolerance in efficiency at rated capacity(%)	no negative tolerance				
2.12	Performance/Design Standard	HIS				
3.0	CONSTRUCTION FEATURES					
3.1	Pump type	Vertical Wet Pit Type	Vertical Wet Pit Type	Vertical Wet Pit Type	Vertical Wet Pit Type	Vertical Wet Pit Type
3.2	Impeller type	Closed/ Open/ Semi Open	Closed/ Open/ Semi Open	Closed/ Open/ Semi Open	Closed/ Open/ Semi Open	Closed/ Open/ Semi Open
3.3	Casing type	To be decided by bidder	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type
3.4	Coupling type	Flexible	Flexible	Flexible	Flexible	Flexible
3.5	Sealing arrangement	Self Water/Gland packing	Self Water/Gland packing	Self Water/Gland packing	Self Water/Gland packing	Self Water/Gland packing
3.6	Type of Lubrication	Self Water	Self Water	Self Water	Self Water	Self Water
3.7	Pump characteristics	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable
3.8	Drain Plugs, vent with valve, lifting lugs, etc.	To be Provided				
3.9	Thrust Bearing location	In Pump and Motor	In Pump and Motor	In Pump and Motor	In Pump and Motor	In Pump and Motor
4.0	MATERIALS OF CONSTRUCTION					
4.1	Casing & Suction Bell	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260
4.2	Column Pipe	MS as per IS-2062	MS as per IS-2062	MS as per IS-2062	MS as per IS-2062	MS as per IS-2062
4.3	Minimum column pipe thickness, mm	10 mm	10 mm	10 mm	10 mm	10 mm
4.4	Impeller	CF 8M	CF 8M	CF 8M	CF 8M	CF 8M
4.5	Shaft/ Line Shaft	SS-410	SS-410	SS-410	SS-410	SS-410
4.6	Shaft Sleeves	SS-410 (Hardened)	SS-410 (Hardened)	SS-410 (Hardened)	SS-410 (Hardened)	SS-410 (Hardened)

	DATA SHEET - A				SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (Vertical Pumps) - (TYPE I)				REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS				SECTION:	I D
Sl. No.	DESCRIPTION	CW MAKEUP PUMPS	APH WASH PUMPS	AHP/CHP PUMPS	SERVICE WATER PUMPS	FGD MAKEUP PUMPS
4.7	Shaft Coupling	SS	SS	SS	SS	SS
4.8	Wearing rings	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard
4.9	Wetted fasteners	SS-304	SS-304	SS-304	SS-304	SS-304
4.10	Fasteners (others)	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard
4.11	Gland plate	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260
4.12	Lantern Ring (if applicable)	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice
4.13	Intermediate stage bearings	Thordon Type / Cutless Nitrile rubber	Thordon Type / Cutless Nitrile rubber	Thordon Type / Cutless Nitrile rubber	Thordon Type / Cutless Nitrile rubber	Thordon Type / Cutless Nitrile rubber
4.14	Mech. seal	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice
4.15	Gland Packing (Asbestos Free)	Teflon Impregnated	Teflon Impregnated	Teflon Impregnated	Teflon Impregnated	Teflon Impregnated
4.16	Base/ Sole Plate	MS TO IS-2062 Epoxy Coating				
4.17	Thrust pad	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard
4.18	Connecting Pipe material (for deciding counterflange material)	Piping shall be Carbon Steel (IS:2062, Gr. B), rolled and welded conforming to IS:3589 .			Piping shall be Carbon steel ERW as per IS:1239 (heavy Grade)	
5.0	MANDATORY SPARES FOR PUMP-MOTOR SET					
5.1	Spares for Pumps					
5.1.1	IMPELLER	1 No of each type & size.	1 No of each type & size.	1 No of each type & size.	1 No of each type & size.	1 No of each type & size.
5.1.2	SHAFTS	1 No of each type & size.	1 No of each type & size.	1 No of each type & size.	1 No of each type & size.	1 No of each type & size.
5.1.3	SHAFT SLEEVES FOR PUMP	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.
5.1.4	CASING & IMPELLER WEARING RINGS	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.
5.1.5	BEARINGS FOR PUMP	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.
5.1.6	THRUST BEARINGS	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.
5.1.7	Sleeve nuts & bearings	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.
5.1.8	GLAND PACKING	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.	2 Sets of each type & size.
5.1.9	FASTENERS	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.
5.1.10	COMPLETE COUPLING (PUMP & MOTOR)	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.
5.1.11	MECHANICAL SEAL (IF APPLICABLE)	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.	1 Set of each type & size.
5.2	Spares for Motors					
5.2.1	Terminal plates	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW	NA	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW
5.2.2	Heaters	2 sets	NA	2 sets	2 sets	2 sets
5.2.3	Greasing arrangements	4 sets each type of motor	NA	4 sets each type of motor	4 sets each type of motor	4 sets each type of motor
5.2.4	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever be higher	NA	10% of the installed quantity or minimum 1 number whichever be higher	10% of the installed quantity or minimum 1 number whichever be higher	10% of the installed quantity or minimum 1 number whichever be higher
5.2.5	Bearings (DE and NDE) for each type and rating of motors.	5 sets	NA	5 sets	5 sets	5 sets
5.2.6	Stator winding coils for all type of LT motors	One (1) set	NA	One (1) set	One (1) set	One (1) set
5.2.7	Dust seals and gaskets for each type of motors	Three (3) sets	NA	Three (3) sets	Three (3) sets	Three (3) sets

	DATA SHEET - A				SPECIFICATION NO.:	PE-TS-426-100-N001
	MISCELLANEOUS PUMPS (Vertical Pumps) - (TYPE I)				REV. NO.: 00	DATE : 17/04/2019
	1X660 MW PANKI TPS				SECTION:	I D
Sl. No.	DESCRIPTION	CW MAKEUP PUMPS	APH WASH PUMPS	AHP/CHP PUMPS	SERVICE WATER PUMPS	FGD MAKEUP PUMPS
	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.					
6.0	Bid Evaluation					
6.1	Bid evaluation rate	Rs.5.84 Lacs/KW	NA	Rs.5.84 Lacs/KW	Rs.5.84 Lacs/KW	Rs.5.84 Lacs/KW
6.2	Maximum permissible efficiency for Bid evaluation					
6.2.1	Pump Efficiency	70	-	82	78	80
6.2.2	Motor Efficiency	91.3	-	94.5	92.9	91.3
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.					



DATA SHEET - A				SPECIFICATION NO.:	PE-TS-426-100-N001
MISCELLANEOUS PUMPS (Vertical Pumps) - (TYPE II)				REV. NO.: 00	DATE : 17/04/2019
1X660 MW PANKI TPS				SECTION:	ID
Sl. No.	DESCRIPTION	ACW PUMPS	RAW WATER INTAKE PUMPS	RAW WATER PUMPS	ASH WATER MAKE UP PUMPS
1.0	SERVICE				
1.1	Total no. of pumps for Project	2	2	2	2
1.2	No. of working & standby pumps	1W+1S	1W+1S	1W+1S	1W+1S
1.3	Liquid Handled (ref. water analysis enclosed herein)	Clarified water	Raw water	Raw water	Raw water
1.4	Location	CW/ACW P/H	Raw water Intake PH	Raw water PH	Raw water PH
1.4.1	Indoor / Outdoor	Indoor	Indoor	Indoor	Indoor
1.5	Duty	Continuous	Continuous	Continuous	Continuous
1.6	Specific gravity	1	1	1	1
1.7	No. of pumps working in parallel	-	-	-	-
1.8	System design pressure (kg/sqcm), g	7.5	10	10	10
2.0	DESIGN PARAMETERS				
2.1	Design capacity each, M ³ /hr	4100	2850	1975	1750
2.2	Total dynamic head (MWC) (Developed Pump head at Min WL, excluding Pumps Internal frictional losses upto discharge)	37	16	30	30
2.3	• Suction Pressure(MWC)	Submerged Suction	Submerged Suction	Submerged Suction	Submerged Suction
	• Floor Level- for Pump Mounting	EL (+) 1.15 M	EL (+) 0.0 M	EL (+) 4.25 M	EL (+) 4.25 M
	• Min. W.L	EL (-) 1.1 M	EL (-) 4.28 M	EL (-) 3.95 M	EL (-) 3.95 M
	• Max. W.L.	EL (-) 0.3 M	EL (-) 1.68 M	EL (+) 2.75 M	EL (+) 2.75 M
	• Sump Invert Level	EL (-) 4.6 M	EL (-) 7.28 M	EL (-) 6.95 M	EL (-) 6.95 M
	• Crane Hook Level	EL (+) 15.75 M	RL (+) 7.5 M	EL (+) 10.25 M	EL (+) 10.25 M
	• Crane Capacity Available	60 Ton	8 Ton	5 Ton	5 Ton
2.4	Design Temperature (°C)	60	60	60	60
2.5	Maximum permissible speed of pump (RPM)	The system suction specific speed (i.e. specific speed calculated with NPSH available) shall not be greater than 8500 US units at minimum water level.	1500	1500	1500
2.6	Max. limit on shut off head Corresponding to pump TDH (MWC) at 51.5 Hz	Not to exceed 67.5 MWC	Not to exceed 90 MWC	Not to exceed 90 MWC	Not to exceed 90 MWC
2.7	Pump Discharge - above floor / below floor	Above Floor			
2.8	Operating range	Pump shall be capable of operating from shut-off point to 120% of design duty point flow	Bidder to indicate. Preferably between 40-120% of rated duty point flow		
2.9	Motor rating	Continuous motor rating (at 50 deg. C ambient) shall be 115% of duty point requirement or 110% of the power requirement in the complete operating range (including run-out and shut off condition)	Continuous motor rating (at 50 deg. C ambient) shall be 15% above the max power requirement at any condition of the entire characteristic curve of the pump (viz. 0-130%).	Continuous motor rating (at 50 deg. C ambient) shall be 15% above the max power requirement at any condition of the entire characteristic curve of the pump (viz. 0-130%).	Continuous motor rating (at 50 deg. C ambient) shall be 15% above the max power requirement at any condition of the entire characteristic curve of the pump (viz. 0-130%).
2.10	Permissible tolerance in rated capacity & TDH	no negative tolerance			
2.11	Permissible tolerance in efficiency at rated capacity(%)	no negative tolerance			

2.12	Performance/Design Standard	HIS			
3.0	CONSTRUCTION FEATURES				
3.1	Pump type	Vertical Turbine Wet Pit Type	Vertical Wet Pit Type	Vertical Wet Pit Type	Vertical Wet Pit Type
3.2	Impeller type	Closed	Closed/Open/Semi open	Closed/Open/Semi open	Closed/Open/Semi open
3.3	Casing type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type
3.4	Coupling type	Flexible	Flexible	Flexible	Flexible
3.5	Sealing arrangement	Self Water with Gland packing	Gland packing	Gland packing	Gland packing
3.6	Type of Line Bearing Lubrication	Self Water	Forced Lubrication	Forced Lubrication	Forced Lubrication
	Liquid for Lubrication	Self Water	Water taken from Pump discharge (Storage Tank in bidder's scope)	Clarified water from O/H Tank (Tank in BHEL scope)	
3.7	Pump characteristics	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable	Non Overloading type & stable
3.8	Drain Plugs, vent with valve, lifting lugs, etc.	To be Provided			
3.9	Thrust Bearing location	In Pump and Motor	In Pump and Motor	In Pump and Motor	In Pump and Motor
4.0	MATERIALS OF CONSTRUCTION				
4.1	Casing & Suction Bell	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260
4.2	Column Pipe	Fabricated steel as per IS 2062 / IS 3589 with 300 micron epoxy coating inside and outside	Fabricated steel to IS-2062 with epoxy painting	Fabricated steel to IS-2062 with epoxy painting	Fabricated steel to IS-2062 with epoxy painting
4.3	Minimum column pipe thickness, mm	10 mm	10 mm	10 mm	10 mm
4.4	Impeller	ASTM-A-351 CF 8M	SS, CF 8M	SS, CF 8M	SS, CF 8M
4.5	Shaft/ Line Shaft	SS- AISI A 276 Gr.410	SS-410	SS-410	SS-410
4.6	Shaft Sleeves	SS-AISI A 276 Gr 410	SS-316	SS-316	SS-316
4.7	Shaft Coupling	SS- AISI A 276 Gr.410	SS-410	SS-410	SS-410
4.8	Wearing rings (if applicable)	SS-316 or eq casting grade	SS-316 or eq casting grade	SS-316 or eq casting grade	SS-316 or eq casting grade
4.9	Wetted fasteners	SS-316	SS-304	SS-304	SS-304
4.10	Fasteners (others)	SS-316	As per manufacturer's standard	As per manufacturer's standard	As per manufacturer's standard
4.11	Gland plate	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260	2.0 % Ni Cl to IS 210 Gr. FG 260
4.12	Lantern Ring (If applicable)	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice
4.13	Intermediate stage bearings	Cutless Bearing with bronze retainer for bearing below water level. Thordon type bearing for above water level.	Cutless rubber in SS shell	Cutless rubber in SS shell	Cutless rubber in SS shell
4.14	Mech. seal	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice	As per manufacturer's practice
4.15	Gland Packing (Asbestos Free)	Teflon Impregnated	Teflon Impregnated	Teflon Impregnated	Teflon Impregnated
4.16	Base/ Sole Plate	MS TO IS-2062 Epoxy Coating			
4.17	Thrust pad	Carbon Steel with White Metal Lining	Carbon Steel with White Metal Lining	Carbon Steel with White Metal Lining	Carbon Steel with White Metal Lining
4.18	Thrust bearing cooling system Piping & Valves	SS	SS	SS	SS
4.19	Connecting Pipe material (for deciding counterflange material)	Piping shall be Carbon Steel (IS:2062, Gr. B), rolled and welded conforming to IS:3589 .			
5.0	MANDATORY SPARES FOR PUMP SET				
5.1	IMPELLER	1 set	One No for each type	One No for each type	One No for each type
5.2	SHAFT (LINE SHAFT & VERTICAL SHAFT)	1 set	One set for each type	One set for each type	One set for each type
5.3	SHAFT SLEEVES FOR PUMP	2 sets	One No for each type	One No for each type	One No for each type
5.4	PUMP & MOTOR BEARINGS (Including thrust bearing if applicable)	1 set	One No for each type	One No for each type	One No for each type
5.5	Complete Line shaft Coupling	1 set	One set for each type	One set for each type	One set for each type
5.6	Wearing ring or equivalent for Impeller (if applicable)	1 set	One No for each type	One No for each type	One No for each type
5.7	Wearing ring or equivalent for Casing/ Bowl (if applicable)	1 set	-	-	-
5.8	Coupling between line shaft & head shaft	1 set	One set for each type	One set for each type	One set for each type

5.9	Mechanical seal or gland packing as applicable for the pumps	1 set	-	-	-
5.10	Pads of thrust bearing of each type	2 sets each	-	-	-
5.11	GASKETS	1 set	One set for each type	One set for each type	One set for each type
5.12	BUSHES for coupling	1 set	One set for each type	One set for each type	One set for each type
5.13	NUTS & BOLTS	1 set	One set for each type	One set for each type	One set for each type
	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.				
6.0	Bid Evaluation				
6.1	Bid evaluation rate	Rs.5.84 Lacs/KW	Rs.5.84 Lacs/KW	Rs.5.84 Lacs/KW	Rs.5.84 Lacs/KW
6.2	Maximum permissible efficiency for Bid evaluation				
6.2.1	Pump Efficiency	85	86	85	84
6.2.2	Motor Efficiency	94	94	94	94
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.				

ANNEXURE- I

RAW WATER ANALYSIS –UPSTREAM /DOWNSTREAM OF GANGA CANAL

S. No.	Description	Unit	Parameter
1	Physical characteristics		
	pH at 25°C	-	8.00
	Turbidity	Silica Scale	500
	Total Suspended solids	ppm	250
	Total Dissolved solids	ppm	241
	Colour	Hazen	< 5
2	Cations		
	Calcium Hardness	ppm as CaCO ₃	80
	Magnesium Hardness	ppm as CaCO ₃	40
	Sodium + Potassium	ppm as CaCO ₃	36
	Iron	ppm as CaCO ₃	1.5
	Total Cations	ppm as CaCO ₃	157.5
3	Anions		
	Bicarbonate	ppm as CaCO ₃	100
	Carbonate	ppm as CaCO ₃	0.95
	Hydroxyl	ppm as CaCO ₃	0.05
	Chlorides	ppm as CaCO ₃	20
	Sulphate	ppm as CaCO ₃	36
	Nitrate	ppm as CaCO ₃	0.5
	Total Anions	ppm as CaCO ₃	157.5
4	Carbon Di-oxide as CO ₂	ppm	1.97
5	Dissolved Silica	ppm as SiO ₂	10.0
6	Colloidal Silica	ppm as SiO ₂	0.5
7	Organic Matter	ppm as O ₂	4.0

The DM Plant shall be designed considering the following chemical dosing rates :-

NON FERRIC ALUM - 60 ppm (max)

LIME - 25 ppm (max)

POLYELETROLYTE - 2 ppm (max)

CHLORINE - 5 ppm (Max.)



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ANNEXURE-I: CLARIFIED WATER ANALYSIS

S. No.	Description	Unit	Parameter
1	Physical characteristics		
	pH at 25°C	-	7.59
	Turbidity	NTU	<15
	Conductivity	μs /cm	590
	Total Dissolved solids	ppm	285
	Total Suspended Solids	ppm	<15
2	Cations		
	Calcium Hardness	ppm as CaCO ₃	113.86
	Magnesium Hardness	ppm as CaCO ₃	40
	Sodium + Potassium	ppm as CaCO ₃	37.2
	Iron	ppm as CaCO ₃	0.3
	Total Cations	ppm as CaCO ₃	191.36
3	Anions		
	Bicarbonate	ppm as CaCO ₃	97
	Carbonate	ppm as CaCO ₃	0.34
	Hydroxyl	ppm as CaCO ₃	0.02
	Chlorides	ppm as CaCO ₃	27.1
	Sulphate	ppm as CaCO ₃	66.4
	Nitrate	ppm as CaCO ₃	0.5
	Total Anions	ppm as CaCO ₃	191.36
4	Carbon Di-oxide as CO ₂	ppm	5.54
5	Dissolved Silica	ppm as SiO ₂	10.0
6	Colloidal Silica	ppm as SiO ₂	0.5

DM Water Analysis

S.No.	Description		Outlet Parameters
1.	SAC Outlet	Sodium Leakage ppm as Na	<0.5
2.	Degasser Unit	CO ₂ Content ppm as CaCO ₃	<5.0
3.	SBA Outlet	Reactive Silica ppm as SiO ₂	<0.1
		Conductivity Micromho / cm	< 5
		Total Electrolyte ppm	< 1
4.	MB Outlet	Reactive Silica ppm as SiO ₂	<0.01
		Total Electrolyte ppm	<0.05
		Total Hardness	Nil
		Conductivity Micromho/ cm	≤ 0.1 at 25°C
		pH value at 25 Deg.C	6.8 – 7.2
5.	UF Outlet	Colloidal Silica ppb as SiO ₂ .	< 1
		Total silica ppb as SiO ₂ .	< 10

Passivated DM water shall have PH value of 8.5 to 9.5.



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TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

SPECIFIC TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **II**

SUB-SECTION: **IIA**

REV. NO. **00** DATE 17.04.19

SHEET **1** OF **1**

SUB-SECTION - IIA

STANDARD TECHNICAL SPECIFICATION (MECHANICAL)

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

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		VOLUME:	
		SECTION: IIA	
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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'.

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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.		

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	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 topping 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.		

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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 M³/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.		

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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 <i>above, considering the bid evaluation efficiencies for pump and motor as indicated in Data Sheet-A.</i> 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 <i>above, where P = pump efficiency guaranteed by bidder and M = motor efficiency as per approved datasheet of the supplied HT/LT motor.</i> 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.			

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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.		

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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.		

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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, “notwithstanding” anything else stated elsewhere in bidder’s offer. The implied/indirect deviations shall not be binding on the purchaser.		

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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.		

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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.		

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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.		

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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 (Process 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:			

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- 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			

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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.			

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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, GD² 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.

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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.

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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'.	

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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.		

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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.		



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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.

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

Where Q = Rated capacity M³/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



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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.

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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.		

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	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.		



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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.



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- 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.

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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.		

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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.		



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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



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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 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.

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

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 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

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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 (Process 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.

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- 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

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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.			



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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.



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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.



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
STANDARD QUALITY PLAN

Rev-01

QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER		PE-QP-999-100-N004 (For Hor. Pumps) PE-QP-999-100-N004 (For Ver. Pumps)				
SHEET 1 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1	MATERIALS CONTROL											
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	3/2.		2,1	
1.2	STUFFING BOX, SUCTION BELL, WEARING RINGS, NECK RINGS, SHAFT SLEEVES	DO-	MA	MECHANICAL AND CHEM. ANALYSIS	ONE/HEAT/BATCH	APPROVED CS DRAWING/DATA SHEET	RELEVANT MATERIAL SPECN.	LAB REPORT/ MTC	3/2.		2,1	
		HARDNESS DIFFERENCE BETWEEN CASING / IMPELLER AND WEARING RING	MA	LAB. TEST	100%	APPROVED CS DRAWING/DATA SHEET	50 BHN MIN.	LAB. REPORT	3/2.		2,1	
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	3/2.		2,1	CORRELATION REQUIRED, IDENTIFICATION AS PER TC
		2. DIMENSIONS	CR	2. MEASUREMENT	100%	MFR. DRAWING	MFR. DRAWING	INSP. REPORT	3/2.		2,1	
		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	3/2.		2,1	
1.4	STRESS RELIEVING/ HEAT TREATMENT OF CASTING OF ALL ABOVE (IF APPLICABLE) / SOLUTION ANNEALING OF SS CASTING	1. VERIFICATION OF HT CHART	MA	VERIFICATION OF SR/HT CHART	ALL BATCHES	RELEVANT MATERIAL SPECN.	DO-	CORRELATED SR/HT. CHARTS	3/2.		2,1	
		2. IGC TEST FOR SS CASTING	MA	LAB. TEST	ONE SAMPLE/ HT BATCH	ASTM A 262	ASTM A 262 Gr A	LAB. REPORT	3/2.		2,1	
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	3/2.		2,1	
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE					BIDDER/VENDOR SEAL			

NAME SIGN. DATE	Prepared By AJAY JAIN <i>Ajay</i> 23-07-2012	Reviewed By ASHWANI KHANNA <i>Ashwani</i> 23-07-2012	Approved By I. J. SINGH <i>I. J. Singh</i> 23-07-2012
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BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
STANDARD QUALITY PLAN

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QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 2 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECKED	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
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	3/2.		2,1	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	3/2.		2,1	
1.8	MECHANICAL SEAL (IF APPLICABLE)	TYPE, SIZE, MFRS, NO., MAKE	MA	VISUAL EXAM	100%	APPROVED DATASHEET / GA MECH. SEAL	APPROVED DATASHEET		3/2.		2,1	COMPLIANCE TC FOR APPROVED MAKE
1.9	PUMP BEARINGS	TYPE, SIZE, MFRS, NO., MAKE	MA	VISUAL EXAM	100%	APPROVED DATASHEET	APPROVED DATASHEET		3/2.		2,1	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	3/2.		2,1	
2.2	IMPELLER	CLEANING AND DEBURRING	MA	VISUAL	100%	MFG. DRAWING	MFG. DRAWING		3/2.		2,1	
	IMPELLER	DYNAMIC BALANCING	CR	DYNAMIC BALANCING	100%	ISO 1940	ISO1940 Gr 6.3	BALANCING CERTIFICATE	3/2.	2,1		WITNESSING 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	3/2.	2,1		WITNESS BY BHEL & VERIFICATION BY CUSTOMER
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	3/2.		2,1	
2.5	SHAFT	DP TEST	MA	DP TEST ON M/CED AREA	100%	ASTM E 165	NO RELEVANT INDICATION ALLOWED	NDT CERTIFICATE	3/2.	2,1		WITNESS BY BHEL & VERIFICATION BY CUSTOMER
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	3/2.	2,1		HAMMERING OF CASTINGS WITH WOODEN/ RUBBER Mallet BEFORE HYDRO TEST
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE					BIDDER/VENDOR SEAL			

NAME SIGN. DATE	Prepared By AJAY JAIN 23-07-2012	Reviewed By ASHWANI KHANNA 23-07-2012
	Approved By I. J. SINGH 23-07-2012	



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
STANDARD QUALITY PLAN

Rev-01

QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 3 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7	FABRICATED COMPONENTS											WELDING PROCEDURE APPROVAL BY BHEL ALT. 3RD PARTY (LLYODS, BVQI OR EQ.) IS ACCEPTABLE.
2.7.1	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	EXAM.	100%	ASME SEC.IX	ASME SEC.IX	QW 482 OF ASME SEC.IX	3/2.		2,1	
2.7.2	WELDING PROCEDURE QUALIFICATION	WELD SOUNDNESS	MA	VISUAL,PHYS. TESTS RT (AS APPLICABLE)	100%	ASME SEC.IX	ASME SEC.IX	QW 483 OF ASME SEC.IX	3/2.		2,1	
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	3/2.		2,1	
2.7.4	WELD FIT-UPS	DIMENSION & ALIGNMENT	MA	MEAS.VISUAL EXAM	100%	WPS, MFG . DRAWING	WPS, MFG . DRAWING	IR/LOGBOOK	3/2.			
2.7.5	ROOT RUNS	SURFACE DEFECTS	MA	PENETRANT TEST	100%	ASTM E 165	NO SURFACE DEFECT	DO.	3/2.		2, 1	
2.7.6	WELDMENTS	SURFACE DEFECTS	MA	PENETRANT TEST	100%	ASTM E 165	ASME-VIII,DIV I	INSPN REPORT	3/2.		2,1	
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE								

NAME	Prepared By	Reviewed By	Approved By
SIGN.	AJAY JAIN	ASHWANI KHANNA	I. J. SINGH
DATE	23-07-2012	23-07-2012	23-07-2012



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
STANDARD QUALITY PLAN

Rev-01

QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 4 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.7.7	BUTT WELDS	INTERNAL DEFECT	MA	UT/RT	100%			IR	3/2.		2.1	
2.7.8	DICHARGE HEAD, COLUMN PIPE, DISCHARGE PIPE, ETC.	1. LEAK TIGHTNESS 2. DIMENSION	CR	1. HYDROTEST 2. MEASUREMENT	100%	TECHNICAL SPEC/ DATA SHEET, MFR DRAWING	1. NO LEAKAGE 2. MFR. DRAWING	IR	3/2.	2.1		
3.0	SUB-ASSEMBLY CONTROL											
3.1	ROTOR ASSEMBLY	ECCENTRICITY	MA	MEASUREMENT	100%	MFR.DRAWING	MFR.DRAWING	IR/LOG BOOK	3/2.		1	
3.2	ROTOR ASSEMBLY RESIDUAL UNBALANCE	STATIC & DYNAMIC	CR	STATIC & DYNAMIC BALANCING	100%	ISO 1940	ISO1940 Gr 6.3	BALANCING CERTIFICATE	3/2.	2.1		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	3/2.		2.1	
BHEL				PARTICULARS		BIDDER / VENDOR						
				NAME								
				SIGNATURE								
				DATE					BIDDER/VENDOR SEAL			

NAME SIGN. DATE	Prepared By	Reviewed By	Approved By
	AJAY JAIN	ASHWANI KHANNA	I. J. SINGH
	23-07-2012	23-07-2012	23-07-2012



BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
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QUALITY PLAN FOR MISCELLANEOUS PUMPS				CUSTOMER		PROJECT TITLE						
				BIDDER/VENDOR		QUALITY PLAN NUMBER						
SHEET 5 OF 6				SYSTEM		ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)						
S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
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 LEAKAGE - MINOR LEAKAGE (DROP BY DROP) IN CASE OF GLAND PACKING ARRANGEMENT.	I.R., PERF. TEST RECORD, PLOTTED CURVES	3/2.	2,1.			* MINIMUM 7 POINTS FROM SHUT-OFF TO MAX. OPERATING FLOW COVERING ENTIRE OPERATION RANGE OF PUMP SHALL BE TAKEN.
		NPSH/ MIN. SUBMERGENCE REQUIRED	CR	NPSH TEST	1/MODEL	DO.	IR. NPSH/MIN. SUBMERGENCE TEST RECORD, PLOTTED CURVES	3/2.	2,1.			IF SPECIFIED or INSISTED BY CUSTOMER.
4.2	STRIP DOWN AFTER PERFORMANCE TEST	1. UNDUE WEAR TEAR AND RUBBING	MA	VISUAL EXAM AFTER STRIPPING	1/MODEL	NO UNDUE WEAR TEAR & RUBBING ON IMPELLER & WEAR RING	INSP. REPORT	3/2.	1			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 MEASUREMENT	100%	APPD. G.A DRAWING	APPD. G.A DRAWING	INSP. REPORT	3/2.	1		
BHEL				PARTICULARS			BIDDER / VENDOR					
				NAME								
				SIGNATURE								
				DATE						BIDDER/VENDOR SEAL		

NAME SIGN. DATE	Prepared By AJAY JAIN 23-07-2012	Reviewed By ASHWANI KHANNA 23-07-2012	Approved By I. J. SINGH 23-07-2012
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BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
STANDARD QUALITY PLAN

Rev-01

QUALITY PLAN FOR MISCELLANEOUS PUMPS

CUSTOMER

PROJECT TITLE

BIDDER/VENDOR

QUALITY PLAN NUMBER

SHEET 6 OF 6

SYSTEM

ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)

S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
4.4	COMPLETION OF ALL STAGES	1.COMPLETION	MA	VERIFICATION OF IR/T.C.ETC.	100%	MFG. DRG./TECHNICAL DOCS.	APPD. MFG. DRG./TECHNICAL DOCS	IR.	3/2.	2,1		WITNESSING ONLY BY BHEL, CUSTOMER VERIFICATION ONLY BUT CHP
4.5	PAINTING	1.SURFACE FINISH, DFT, MARKINGS ETC.	MA	VISUAL EXAM MEASUREMENT AESTHETIC	100%	APPD.DRG.	APPD.DOCS	IR.	3/2.		2	
4.6	PACKING, MARKING	SOUNDNESS OF PACKING	MI	VISUAL AESTHETIC	100%	MFG. STANDARD	MFG. STANDARD		3/2.		2	

MTC -Mill Test Certificate, MA-Major, MI-Minor, TC-Test Certificate, CR-Critical, IGC- Inter Granular Corrosion

- 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) 1.5 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.

LEGEND : 1- BHEL OR BHEL NOMINATED THIRD PARTY /END CUSTOMER OF BHEL,
2- VENDOR,
3-SUB-VENDOR

P- PERFORM, W- WITNESS, V-VERIFICATION

BHEL	PARTICULARS	BIDDER / VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER/VENDOR SEAL

NAME	Prepared By	Reviewed By	Approved By
SIGN.	AJAY JAIN	ASHWANI KHANNA	I. J. SINGH
DATE	23-07-2012	23-07-2012	23-07-2012



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **II**

SUB-SECTION: **IIB**

REV. NO. **00** DATE 17.04.19

SHEET **1** OF **1**

SUB-SECTION - IIB

STANDARD TECHNICAL SPECIFICATION (ELECTRICAL)



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

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

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 1 OF 4

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.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
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		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4
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 minimum 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: 4691 and 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.		

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 3 OF 4
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	

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 4 OF 4
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.		

QUALITY PLAN FOR MOTORS BELOW 55 KW (LV)

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 1 OF 2		VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	NOTE -1 & NOTE-3
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

	QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :			
			BIDDER/ :			TITLE			NUMBER :			
	SHEET 2 OF 2		VENDOR			NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION :			
		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

QUALITY PLAN FOR MOTORS 55 KW & ABOVE

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 1 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
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	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVENT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVENT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN			SPECIFICATION :			
SHEET 2 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNEC- TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 4 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 5 OF 9		VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE					
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
		SHEET 6 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-		(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-		
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1		
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-		
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		FOR MV MOTOR
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-		
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 7 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		VERIFICATION FOR MV MOTOR ONLY
2.8	BRAZING/COMPRESSION JOINT	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
2.9	COMPLETE ROTOR ASSEMBLY	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1		
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1		
2.10	ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1		
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1		
		1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-		
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-		
6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1				
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE					BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN				CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
						BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 8 OF 9				SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS		
									P	W	V			
1	2	3	4	5	6	7	8	9	10			11		
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1		
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2		
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-			
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2		
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2		
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3		
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2		
BHEL			PARTICULARS			BIDDER/VENDOR								
			NAME											
			SIGNATURE											
			DATE											
												BIDDER'S/VENDORS COMPANY SEAL		



		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P W V			REMARKS
1	2	3	4	5	6	7	8	9	10			11
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 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, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **III**

SUB-SECTION:

REV. NO. **00** DATE 17.04.19

SHEET **1** OF **1**

SECTION III

DOCUMENTS TO BE SUBMITTED BY BIDDER



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **IIIA**

SUB-SECTION:

REV. NO. **00** DATE 17.04.19

SHEET **1** OF **1**

SECTION IIIA

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

**SCHEDULE OF PERFORMANCE GUARANTEES****1X660 MW PANKI TPS (UPRVUNL)**

SPECN. NO.:

PE-TS-426-100-N001, Rev-00

VOLUME:

--

SECTION:

IIIA Sheet 1 of 4

REV. NO.

00

DATE:

17.04.2019

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	Pump model	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 (Type-I)										
1	#HOTWELL MAKEUP PUMPS	285	65								
2	#DM MAKEUP PUMPS	35	50								
3	BOILER FILL PUMPS	200	150								

Note: 1 # Bid evaluation and LD is applicable for these pumps only as per clause 4.00.00 of Section-IIA & 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

**SCHEDULE OF PERFORMANCE GUARANTEES****1X660 MW PANKI TPS (UPRVUNL)**

SPECN. NO.:

PE-TS-426-100-N001, Rev-00

VOLUME:

--

SECTION:

IIIA

Sheet 2 of 4

REV. NO.

00

DATE:

17.04.2019

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	Pump model	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 (Type-II)										
1	# DMCW TG AUX'S PUMPS (Alternative-1)	1575	40		94						YES
2	# DMCW TG AUX'S PUMPS (Alternative-2)	2850	40		94						YES
3	# DMCW SG AUX'S PUMPS (Alternative-1)	525	57		94						YES
4	# DMCW SG AUX'S PUMPS (Alternative-2)	720	57		94						YES

Note: 1 # Bid evaluation and LD is applicable for these pumps only as per clause 4.00.00 of Section-IIA & 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

	SCHEDULE OF PERFORMANCE GUARANTEES					SPECN. NO.:		PE-TS-426-100-N001, Rev-00			
						VOLUME:		--	SECTION:		IIIA
	1X660 MW PANKI TPS (UPRVUNL)					REV. NO.		00	DATE:		17.04.2019
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	Pump model	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 (Type-I)										
1	# CW MAKEUP PUMPS	725	4.2								
2	APH WASH PUMPS	850	80		94						YES
3	# AHP/CHP PUMPS	450	38								
4	# SERVICE WATER PUMPS	100	62								
5	# FGD MAKEUP PUMPS	90	32								
Note: 1 # Bid evaluation and LD is applicable for these pumps only as per clause 4.00.00 of Section-IIA & 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			

	SCHEDULE OF PERFORMANCE GUARANTEES					SPECN. NO.:	PE-TS-426-100-N001, Rev-00				
						VOLUME:	–	SECTION:	IIIA	Sheet 2 of 2	
	1X660 MW PANKI TPS (UPRVUNL)					REV. NO.	00	DATE:	17.04.2019		

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	Pump model	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 (Type-II)										
1	# ACW PUMPS	4100	37		94						YES
2	# RAW WATER INTAKE PUMPS	2850	16		94						YES
3	# RAW WATER PUMPS	1975	30		94						YES
4	# ASH WATER MAKE UP PUMPS	1750	30		94						YES

Note: 1 # Bid evaluation and LD is applicable for these pumps only as per clause 4.00.00 of Section-IIA & 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
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TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426-100-N001**

SECTION: **IIIB**

SUB-SECTION:

REV. NO. **00** DATE 17.04.19

SHEET **1** OF **1**

SECTION IIIB

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

	TECHNICAL SPECIFICATIONS	SPECN. NO.:	PE-TS-426-100-N001, Rev.0		
	MISCELLANEOUS PUMPS	VOLUME:	--	SECTION:	IIIB
	COMPLIANCE CERTIFICATE	REV. NO.	0	DATE:	17.04.2019

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

- 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.
- 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.
- All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/ CONSULTANT/ CUSTOMER approval.
- There are no other deviation with respect to specification other than those furnished in the 'Schedule of Deviations'.
- 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.
- 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.
- Prices for recommended spares (if any) for 3 years operation shall be furnished separately & not included in the base price.
- 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).
- All sub vendors shall be as per BHEL/CONSULTANT/CUSTOMER approved list.
- 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.
- Any special tools & tackles, if required, shall be in bidder's scope.
- 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.
- 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



TITLE:

**TECHNICAL SPECIFICATION
MISCELLANEOUS PUMPS**

STANDARD TECHNICAL REQUIREMENTS

SPEC. NO.: **PE-TS-426 -100-N001**

SECTION: **IIIC**

SUB-SECTION:

REV. NO. **00** DATE 17.04.19

SHEET **1** OF **1**

SECTION IIIC

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

	TITLE		* SCHEDULE OF DEVIATIONS TECHNICAL		SPECIFICATION NUMBER PE-TS-426-100-N001
					SECTION-III C
					SHEET OF
We the undersigned hereby certify that the above mentioned are the only deviations.					
PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE					COMPANY SEAL
NAME	DESIGNATION	SIGNATURE	DATE		



TITLE: TECHNICAL SPECIFICATION MISCELLANEOUS PUMPS STANDARD TECHNICAL REQUIREMENTS	SPEC. NO.: PE-TS-426-100-N001	
	SECTION: IIID	
	SUB-SECTION:	
	REV. NO. 00	DATE 17.04.19
	SHEET 1	OF 1

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	Designation 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 $N = \frac{\text{RPM} \times (\text{Flow in USGPM})^{1/2}}{(\text{Head in Ft.})^{3/4}}$		
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	MATERIAL 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°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

ANNEXURE-II

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)/ CUSTOMER											
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.	426			ORIGINATING AGENCY			PEM (ELECTRICAL)												
		PROJECT TITLE	1X660MW PANKI			NAME			DATA FILLED UP ON												
		SYSTEM	MISC. PUMPS			SIGN.			DATA ENTERED ON												
		DEPTT. / SECTION	MSE			SHEET 1 OF 1		REV. 00		DE'S SIGN. & DATE											

[illegible]

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		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 MOTOR DATA SHEET - C	SPECIFICATION NO.
		VOLUME II B
		SECTION D
		REV NO. 00 DATE 29/08/2005
		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 $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			