TSGENCO

1X800MW KOTHAGUDEM TPS UNIT-12, TELANGANA

VOLUME -IIB

TECHNICAL SPECIFICATION
FOR
MISCELLANEOUS PUMPS

Specification No. : PE-TS-410-100-N001 (REV. 0)

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

1.0 The tender document contains three (3) volumes. The bidder shall meet the requirements of all the three volumes.

1.1 Volume I - CONDITIONS OF CONTRACT

This consists of four parts as below:

Volume - I A : This part contains instructions to bidders for making bids to BHEL.

Volume - I B : This part contains general commercial conditions of the tender and include provision that vendor shall be responsible for the quality of item supplied by their sub-vendors.

Volume - I C : This part contains special conditions of contract.

Volume - I D : This part contains commercial conditions for erection and commissioning site work, as applicable.

1.2 Volume II - TECHNICAL SPECIFICATIONS

Technical requirements are stipulated in Volume II which comprises of:

Volume - II A : General Technical Conditions

Volume - II B : Technical specification including drawings, if any

1.2.1 Volume - II B :

This volume is sub-divided into following sections:

Section - A : This section outlines the scope of enquiry.

Section - B : This section provides “Project Information”

Section - C : This section indicates technical requirements specific to the contract, not covered in Section-D.

Section - D : This section comprises of technical specifications of equipments complete with data sheet A, B & C.

Data sheet - A specifies data and other requirements pertaining to the equipment.
Data sheet - B specifies data to be filled by the bidder (Data Sheet B is contained in Volume - III)
Data sheet - C indicates data documents to be furnished after the award of contract as per agreed schedule by the vendor (as applicable).

1.2.2 Volume - III TECHNICAL SCHEDULES

This volume contains technical schedules and Data Sheets - B, which are to be duly filled by the bidder and the same shall be furnished with the technical bid as per checklist,sec B7 in vol III.

2.0 The requirements mentioned in Section C/Data Sheets-A of Section-D shall prevail and govern in case of conflict between the same and the corresponding requirements mentioned in the descriptive portion in Section - D.

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SECTION A

SCOPE OF ENQUIRY

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 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 also include Sump Model test at shop for all vertical pumps (except ACW Pump) and any other services, etc. if called for in the succeeding sections of the specification for following project:

1X800 MW KOTHAGUDEM TPS UNIT-12, TELANGANA

The above project is referred as '1X800 MW KOTHAGUDEM TPS U-12' elsewhere in the Specification for ease of reference.

1.2 The miscellaneous pumps covered under this specification shall be Horizontal Pumps (Group-I) & Vertical Pumps (Group-II).

NOTE:-

a) The bidder shall include complete supplies for the Project/Group as above in his scope as per NIT. Part supplies offered for the Project/Group shall disqualify the bidder's offer for that Project/Group.

1.3 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. Replacement of gland packing with Mechanical Seal (If applicable) as per Cl. No. 2.0 of Section C1 & Cl. No. 9.08.04 of section D of this volume. The charges for these shall be included by bidder in his offer.

1.4 The miscellaneous pumps and drives covered under this specification for various projects are as per Annexure I. 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 II.

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

1.5 For detailed scope of supply & services refer clause 3.00.00 of Standard technical Specification for Horizontal Centrifugal pumps & Vertical Pumps specified under Section-D of this volume.

1.6 Electrical scope between BHEL and Vendor for Miscellaneous pumps and drives of this specification shall be as per annexure I of section C-2 of this volume.

2.0 GENERAL TECHNICAL INSTRUCTIONS

2.1 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.

2.2 The ommission 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.

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

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

2.5 ***In case of any deviation from this technical specification (Vol.IIB) and General Technical Conditions (Vol.II A), the same shall be indicated in the schedule of deviations enclosed in Vol.III. In the absence of duly filled schedules it will be assumed that the bid strictly conforms to the specifiation.***

2.6 Unpriced copy of the price bid shall be furnished alongwith the technical bid.

Annexure I

List of Miscellaneous Pumps and drives for :

A. 1X800 MW KOTHAGUDEM TPS U-12

Sl. No.	Pump Description	Total Qty.	Type of Pumps
	Horizontal Pumps (Group I)		
1	DMCW TG AUX. PUMPS	3 nos.	Horizontal
2	DMCW SG AUX. PUMPS	2 nos.	Horizontal
3	HOTWELL MAKE UP PUMPS	2 nos.	Horizontal
4	DM TRANSFER PUMPS	2 nos.	Horizontal
5	BOILER FILL PUMPS	2 nos.	Horizontal

Sl. No.	Pump Description	Total Qty.	Type of Pumps
	Vertical Pumps (Group II)		
1	RAW WATER PUMPS	3 nos.	Vertical
2	ACW PUMPS	3 nos.	Vertical
3	CW MAKE-UP PUMPS	2 nos.	Vertical
4	SERVICE WATER PUMPS	2 nos.	Vertical
5	APH/ESP WATER WASHING PUMPS	2 nos.	Vertical

Annexure II

Following HT drives for 1X800 MW KOTHAGUDEM TPS U-12, irrespective of Motor ratings shall be issue free, by BHEL:

Horizontal Pumps (Group I):

1 DMCW TG AUX. PUMPS
2 BOILER FILL PUMPS

Vertical Pumps (Group II):

1 RAW WATER PUMPS
2 ACW PUMPS
3 APH/ESP WATER WASHING PUMPS

SECTION B

PROJECT INFORMATION

PROJECT SYNOPSIS AND GENERAL INFORMATION

CONTENT

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 SOURCE OF WATER

Source of water (total quantity of water is 2192 m^3/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 ASH DISPOSAL AREA

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL		:	89 m
Monthly highest temperature		:	44.9 ºC
Monthly lowest temperature.		:	12.9 ºC
Rainfall			
	Average.	:	1031 mm
	Max.	:	100 mm/ hr
Mean Wind speed		:	5.8 kmph
Relative Humidity			
	Max	:	82%
	Min	:	35%
Seismic Zone		:	Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].

SECTION C

SPECIFIC TECHNICAL REQUIREMENTS

C1: SPECIFIC TECHNICAL REQUIREMENTS FOR PUMPS

C2: SPECIFIC TECHNICAL REQUIREMENTS FOR MOTORS

C3: SPECIFIC TECHNICAL REQUIREMENTS FOR C&I INSTRUMENTS

SECTION C1

SPECIFIC TECHNICAL REQUIREMENTS FOR PUMPS

1.0 SPECIFIC TECHNICAL REQUIREMENTS:

DELIVERY:

Delivery of miscellaneous pumps shall be as per NIT requirement.

2.0 Horizontal Pumps:

2.1 Horizontal Pumps with Mechanical seal shall be supplied with gland packing arrangement 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 despatched alongwith 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.

2.2 In addition to HT motor driven pump, Vibration monitoring and analysis system (VMAS) KEYPHASOR mounting provision shall also be provided for DMCW-SG pumps.

3.0 Vertical Pumps:

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

3.2 There are no thrust block for countering pump thrust and pump base plate shall be adequately designed to take the unbalanced forces and moments.

3.3 Following provision shall be provided to prevent damage due to reverse rotation of the pump motor assembly for all Vertical Pumps:

a) Non-reversible ratchet mechanism

b) Necessary switch to detect reverse rotation will be provided to prevent motor switching 'ON' while rotating in reverse direction.

3.4 For ACW Pumps: Suction strainer are required.

3.5 Sump model test at shop is required for all vertical pumps except ACW Pump.

Dimensions of pump chamber/ sump in the Pump house shall be fixed up initially by BHEL based on Hydraulic Institute Standard (Layout shall be furnished during detail engineering). The dimensions shall be confirmed by Pump Vendor by conducting a Hydraulic Model Study at a recognised Institute/ hydraulic research laboratory(subject to BHEL/End Customer Approval). Scale of the model shall be 1:10. The hydraulic model study shall be conducted to study water level in the pump sump, flow conditions in the pump sump for different discharges & different depths of water, different combinations of pump operations to study velocity distribution in pump bays, etc.

The model shall be based on Froude's law of similitude and shall also be tested for following two more flow conditions, viz.

a. At twice the prototype maximum Froude number, i.e., the Froude number of the model is two times that of the prototype.

b. At equal velocity criterion, i.e., the velocity is same both in the model and prototype.

The final recommendation shall be based on 2F condition. Based on recommendations of the hydraulic model study, necessary modifications shall be made in the pump sump, forebay & channel, additional structural features required such as flow straighteners, baffle walls, mesh screens, grid walls, guide vanes, floor splitters, anti - swirl cone etc. for elimination of non - uniform velocity distribution, swirls and vortices in the model etc.

Pump Vendor shall furnish procedure for Sump Model Study within One (1) month from LOI. BHEL and/or End Customer shall review/approve the Procedure for Sump Model Study and physical test conductance shall be intimated by the Pump vendor in advance for witness of Sump Model Study by BHEL/End Customer as per Approved Procedure.

4.0 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 shall also be conducted at site as per approved PG Test Procedure. 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.

5.0 **Additional Dispatch Requirements:**

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

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

5.2 Photograph of each box in open & closed condition.

5.3 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

VOLUME: IIIA

SECTION-III

VERTICAL WET PIT PUMPS

APPLICABLE FOR ACW PUMP

CONTENT

VOLUME: IIIA

SECTION-III

VERTICAL WET PIT PUMPS

1.00.00 GENERAL INFORMATION

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

2.00.00 CODES AND STANDARDS

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

2.01.01	IS 1710/1989	:	Vertical Turbine Pumps for Clear, Cold and Fresh Water.
2.01.02	IS 5120/1977	:	Technical requirements - Rotodynamic special purpose pumps.
2.01.03	IS 5639/1970	:	Pumps for handling chemical and corrosive liquids.
2.01.04	IS 5659/1970	:	Pumps for process water.
2.01.05	IS 6536/1972	:	Pumps handling volatile liquids.
2.01.06	IS 9137/1978	:	Code for acceptance for centrifugal, mixed flow and axial flow pumps - Class `C'
2.01.07	BS 5316	:	Acceptance tests for Centrifugal, mixed flow Part-I/1976 and axial flow pumps - Class 'C' Tests (ISO 2548/1973)
2.01.08	BS 5316	:	Acceptance tests for Centrifugal, mixed flow Part-II/1977 and axial flow pumps - Class 'B' Tests (ISO 3555/1977)
2.01.09	ANSI B 73.2M/ 1984	:	Vertical inline centrifugal pumps for chemical process
2.01.10	API 610/1989	:	Centrifugal pumps for general refinery services.

2.01.11 Hydraulic Institute Standards of USA (1983)

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

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

3.00.00 SCOPE OF WORKS

3.01.00 Scope of Supply

3.01.01 The scope of supply under this section and pertaining to 1 x 800 MW supercritical Unit shall be as below. Items not specifically mentioned but deemed necessary by the Bidder for making the system completely reliable and efficient shall also be included.

a) Equipment

i) ACW Pumps : Three (3) nos. (Two working and one standby) Vertical Wet Pit type Auxiliary Cooling Water (ACW) Pumps complete with electric motor drives together with all other accessories as specified and corresponding to the ratings obtained in strict conformance with the guidelines specified in Section-I of this Volume.

ii) CW pumps : Four (4) nos. (Three working and one standby) Vertical Wet Pit type Circulating Water (CW) Pumps complete with electric motor drives together with all other accessories as specified and corresponding to the ratings obtained in strict conformance with the guidelines specified in Section-I of this Volume.

iii) Any other vertical pump to be installed by the Contractor under this specification.

b) Equipment Accessories

Each pump set for all the above groups shall be supplied with the following accessories, as applicable.

i) Heavy duty couplings of approved design to connect the pump shaft directly with the motor shaft.

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

iii) Slip on type drilled steel counter flanges of proper rating to suit the discharge flange of each pump set. All the counter flanges shall be complete with requisite number of bolts, gaskets etc.

iv) Thrust pads, if required, for pump discharge head complete with all necessary fixing and bolting arrangement, fasteners etc.

v) One (1) pressure indicator with isolating cocks at the discharge side of each pump; two (2) additional stubs with isolating root valves for pressure tappings and two (2) thermowells for temperature tappings at the discharge side of each pump for performance testing. Thrust bearing shall be furnished with dial type thermometer, temperature switch for high temperature annunciation and oil level gauge.

vi) Vibration monitoring and analysis system (VMAS) KEYPHASOR mounting provision shall be provided

vii) Vibration monitoring system for CW Pump-Motor bearing including cabling upto local junction box. For details refer Volume-VI of this specification.

viii) All internal/integral piping with valves, fittings and instruments for lubrication, cooling and sealing, if applicable, shall be tapped off from respective pump discharge.

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

4.00.00 PERFORMANCE REQUIREMENTS

4.01.00 Performance requirements for the pumps shall be guided by the stipulations as specified in annexure enclosed with this section.

4.02.00 Pumps shall preferably be designed to have the best efficiency at the specified duty point. Further, the pumps shall be suitable for continuous operation at any point within its `range of operation' as specified in annexure enclosed with this section.

4.03.00 Pumps shall preferably have continuously rising Head-capacity characteristics, with maximum head at pump discharge shut-off, to enable parallel operation.

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

4.04.00 For parallel operation of the pumps, pumps shall have identical characteristics to ensure equal load sharing and shall ensure trouble-free operation of any pump when the other pumps working in parallel with it trip.

5.00.00 DESIGN AND CONSTRUCTION

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

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

5.01.00 **Bowl Assembly**

5.01.01 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.

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

5.02.00 **Discharge Head**

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

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

5.03.00 **Column Pipe**

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

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

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

5.04.00 **Impeller Shaft, Line Shaft and Head Shaft**

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

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

5.04.02 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 be chamfered at the edges.

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

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

5.05.00 Stuffing box.

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

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

5.06.00 **Shaft enclosing Tube**

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

5.07.00 **Seal Rings**

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

5.08.00 **Bearings**

5.08.01 Shaft bearings

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

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

5.08.02 Thrust Bearing

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating components. Life of the thrust bearing shall be guided

by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load.

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

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

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

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

5.09.00 **Reverse Rotation**

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

1. Non-reversible ratchet mechanism

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

5.10.00 **Drive Unit**

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

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

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

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

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

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

6.00.00 **INSPECTION AND TESTING**

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

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

i) Bowls and suction bells.

ii) Impeller and wearing rings.

iii) Shafts and shaft sleeves.

iv) Couplings.

v) Bearings.

vi) Column pipes.

vii) Discharge heads.

viii) Bowl Assembly.

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

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

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

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

iv) Witnessing of NDT/review of NDT reports.

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

vi) Complete Inspection of assembled pump.

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

i) Bowls/Suction bells.

ii) Column pipe.

iii) Discharge head.

iv) Any other applicable pressure parts.

d) Performance Test at Shop

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

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 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 specified. After completion of performance test, all pumps shall be stripped down for inspection of internals.

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

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

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

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

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

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

7.00.00 DRAWINGS, DATA, CURVES AND INFORMATION

7.01.00 Following drawings, data and information for the equipment are required to be submitted by the Bidder along with his formal proposal.

7.01.01 Drawings/Data

a) Determination of pump head and capacity as per guidelines of this specification. Detailed calculations shall be submitted by the Bidder.

b) Outline drawings of the pump showing the various dimensions, suction and discharge locations.

c) Typical cross section drawing of the pump to be supplied, showing various components, bearings, seal rings etc. and materials of construction for all items.

d) Lubrication arrangement drawings for external lubrication.

7.01.02 Anticipated performance curves and test curves for:

a) Capacity Vs Head

b) Capacity Vs. Power & Efficiency

c) Capacity Vs. NPSH requirement

d) System resistance curves.

e) Speed Vs. torque requirement of the pump (for pump sets with drive motor rating of 100 KW or more) together the drive motor speed-torque characteristic.

7.01.03 Completely filled up schedules enclosed under Volume-IX of this specification.

7.01.04 A write-up describing clearly the procedure for installing the pump with its column pipe, piece by piece and also for overhauling the pump in a like manner. A diagram showing the required pump house crane hook lift above the pump operating floor has also to be furnished.

7.02.00 The drawings/data asked against the clause nos. 7.01.01 and 7.01.02 above shall also be furnished in a finalized form by the successful Bidder (after the contract is awarded to him), for the approval of the Owner/his Consultant. In addition, he will also submit the following for Owner's/ Consultant's approval.

7.02.01 Principal dimensions of the pump sump indicating clearance dimensions for the suction bell from back wall and side walls, minimum submergence required for the pump etc.

7.02.02 Pump foundation details, with static and dynamic loads.

7.02.03 Pump and drive sealing, bearing lubrication and cooling arrangement drawing.

7.02.04 Drive data.

7.02.05 Reports on shop tests and test certificates.

7.02.06 All other drawings, data and documents specified in Volume-IIA of this specification.

VOLUME: IIIA

SECTION-II

HORIZONTAL CENTRIFUGAL PUMPS

APPLICABLE FOR HORIZONTAL PUMPS
(EXCEPT FOR DM TRANSFER PUMP)

CONTENT

VOLUME: IIIA

SECTION-II

HORIZONTAL CENTRIFUGAL PUMPS

1.00.00 GENERAL INFORMATION

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

2.00.00 CODES AND STANDARDS

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

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

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

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

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

3.00.00 SCOPE OF WORKS

3.01.00 Scope of Supply

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

a) Equipment

i) DMCW Pumps — Three (3) nos. Horizontal Centrifugal Pumps and drives. (If Bidder adopts separate DMCW systems for Boiler and TG auxiliaries, then Clause no. 3.01.07 of Section-1 of this Volume shall be referred to)

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

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

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

b) Equipment Accessories

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

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

ii) Vibration monitoring and analysis system (VMAS) KEYPHASOR mounting provision shall be provided for DMCW pumps.

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

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

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

vi) Discharge line pressure gauge and suction line pressure/vacuum gauges complete with isolating cocks for each pump set.

vii) All internal/integral piping with valves, fittings, and pressure gauges for lubrication, cooling and sealing, wherever applicable, shall be tapped of directly from respective pump discharge.

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

4.00.00 PERFORMANCE REQUIREMENTS

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

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

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

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

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

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

5.00.00 DESIGN AND CONSTRUCTION

5.01.00 Pump Casing

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

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

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

5.02.00 **Impeller**

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

5.03.00 **Wearing Rings**

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

5.04.00 **Shaft**

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

5.05.00 **Shaft Sleeves**

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

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

5.06.00 **Bearings**

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

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

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

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

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

5.07.00 **Stuffing Boxes**

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

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

5.08.00 **Mechanical Seals**

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

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

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

5.09.00 **Drive Unit**

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

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

a) 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.

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

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

6.00.00 **INSPECTION AND TESTING**

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

a) Identification and Testing

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

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

- The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165-65.
- Shaft shall be subjected to Dye Penetration and Ultrasonic Tests.
- Wearing rings shall be subjected to Dye Penetration Test.
- Verification of material, witnessing of pouring, casting and inspection of finalized fabricated/cast castings.
- Inspection of finished castings for impeller and verification of materials.
- Inspection of pump shaft and verification of material.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940.
- Complete Inspection of assembled pump.

b) Hydrostatic Testing

The pump casing shall be hydrostatically tested at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour. While arriving at the above values maximum suction pressure shall be taken into account.

c) Performance Test at Shop

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

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

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

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

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

7.00.00 DRAWINGS, DATA, CURVES AND INFORMATION

7.01.00 The Bidder shall submit the following along with his formal proposal besides the different information plate required as indicated elsewhere in this section.

7.01.01 Drawings

a) General arrangement drawings showing the principal dimensions, weight and location of the suction and discharge connections of the pumps offered. Details of lubrication and sealing arrangement shall be included.

b) Typical cross-section drawing showing various components of the pumps offered materials of construction etc.

7.01.02 Data and Curves

a) Determination of pump total dynamic head and rated capacity as per guidelines specified in Section-I of this Volume. Detailed calculations shall be shown by the Bidder.

b) Anticipated performance curves showing the following characteristics :

i) Capacity vs. head

ii) Capacity vs. power

iii) Capacity vs. efficiency

iv) Capacity vs. NPSH required

v) System resistance curves

c) Speed vs. torque curve of the pump corresponding to recommended mode of pump starting superimposed on speed vs. torque curves of the drive unit corresponding to 80%, 90%, 100% of the rated voltage (applicable only in the cases of pumps with drive motor power rating of 100 KW and above).

d) Completely filled-in Technical particulars enclosed under Volume-IX of this specification.

7.02.00 The successful Bidder shall furnish the following drawings/data for Purchaser/Engineer's approval after award of the contract.

7.02.01 Final versions of all the drawings, documents as specified in clause no. 7.01.00 above.

7.02.02 Pump foundation details along with all design loads, direction and points of application.

7.02.03 Test reports, test certificates and other particulars.

7.02.04 All other applicable drawings and documents as specified in Volume-IIA of this specification.

d) Adequate provision shall be made in each of the pump sumps so as to facilitate insertion of isolation gates as and when required. Gates shall be fabricated of mild steel, shall be of watertight type and shall preferably be of identical size/dimensions to facilitate interchangeability. Sump gates shall generally be accessible by the pump house overhead crane.

e) The respective pump house shall also accommodate the following equipment/facilities, as applicable.

i. All auxiliary equipment related to pump sets such as discharge piping complete with valves and specialties, electric motor drives etc.

ii. Ventilation system for the entire pump house.

iii. Separate bays for unloading and maintenance.

iv. All necessary electrical equipment and accessories as required for this system.

v. Overhead Crane complete with all accessories, as specified in Volume-IIIF,, Section-II of this specification.

vi. Sump pumps, as specified in Volume-IIIF, Section-I of this specification.

vii. Fixed Screens and accessories located suitably.

viii. Necessary toilets and operator's cabins with drinking water facility.

f) Other general layout criteria as specified in Volume IIA of this specification shall also be adhered to while designing the pump house.

5.14.00 All Horizontal and Vertical Pumps of Plant Water System shall have 10% margin on capacity and 20% margin on Total Dynamic Head.

6.00.00 **DESIGN AND CONSTRUCTION**

6.01.00 **Horizontal Pumps**

APPLICABLE FOR:
1) DM TRANSFER PUMP (HORIZONTAL)

6.01.01 Pump Casing

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.

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

In cases where an expansion joint is located at pump discharge, the pump assembly will be subjected to an additional thrust which will be transmitted to

the foundation. This additional thrust shall be taken into consideration during pump design.

6.01.02 Impeller

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

6.01.03 Wearing Rings

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

6.01.04 Shaft

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

6.01.05 Shaft Sleeves

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.

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

6.01.06 Bearings

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

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

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

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. Thrust bearing shall be capable of running continuously at maximum load.

6.01.07 The bearings shall be oil/grease lubricated. Suitable lubricating arrangement for the bearings shall be furnished with the pump complete with all accessories like pump, filters, pipings, 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.

6.01.08 Stuffing Boxes

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

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

6.01.09 Mechanical Seals

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

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

6.01.10 Drive Unit

The pumps shall be driven by electric motor directly coupled. A heavy duty flexible coupling along with coupling guard shall be provided between the pump and drive unit. For details regarding specification of drive unit Volume-V of this specification will be referred.

Unless otherwise specified drive unit power rating shall be the maximum of the following requirements.

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

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

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

6.02.00 **Vertical Pumps**

APPLICABLE FOR:
1) VERTICAL PUMPS (EXCEPT ACW PUMP)

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:

6.02.01 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.

6.02.02 Discharge Head

Pump(s) shall be either above floor or below floor discharge type, as specified in the annexure, 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.

6.02.03 Column pipe

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

In case the annexure ask 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.

6.02.04 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.

6.02.05 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.

6.02.06 Seal rings

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

6.02.07 Bearings

a) Shaft bearings

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

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

b) Thrust Bearing

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

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

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

Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement of annexure or as per

the recommendation of the pump manufacturer (and approved by Purchaser).

6.02.08 Reverse Rotation

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

1. Non reversible ratchet mechanism

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

6.02.09 Drive Unit

a) The pump will be driven by electric motor.

A heavy duty coupling shall be provided between the drive unit and the driven equipment (except for belt drive).

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

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

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

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

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

~~6.03.00 For design and construction of piping, Section-IV and Section-V of Volume IIIE shall be referred to.~~

~~6.04.00 For design and construction of tanks, Section-IV of Volume IIIE of this volume shall be referred to.~~

~~6.05.00 For design and construction of reservoirs, Volume-VII shall be referred to.~~

7.00.00 **CONTROL & INSTRUMENTATION**

Complete instrumentation and control system including all accessories shall be provided for safe, reliable and trouble-free operation of the plant. For details Bidder shall refer to volume VI, Specification for Controls & Instrumentation.

8.00.00 **INSPECTION AND TESTING**

8.01.00 The Contractor shall carry out the following specific tests and inspections to ensure that the equipment furnished shall conform to the requirements of this section and in accordance with relevant codes and standards. Test certificates for all tests shall be submitted to the Owner for approval.

8.02.00 **Horizontal Pumps**

8.02.01 Material Identification and Testing

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standards. Components on which material test has been done shall be stamped for identification.

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

- The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165-65.
- Shaft shall be subjected to Dye Penetration and Ultrasonic Tests.
- Wearing rings shall be subjected to Dye Penetration Test.
- Verification of material, witnessing of pouring, casting and inspection of finalised fabricated/cast castings.
- Inspection of finished castings for impeller and verification of materials.
- Inspection of pump shaft and verification of material.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940.
- Complete inspection of assembled pump

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8.02.02 Hydrostatic Testing

The pump casing and all other applicable pressure parts shall be hydrostatically tested at 150% of the pump shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour. While arriving at the

above values maximum suction pressure shall be taken into account.

8.02.03 Dynamic Balancing

All rotating components shall be statically and dynamically balanced. Dynamic balancing tests shall be carried out at a speed not less than the rated rpm of the pump. Test procedure and acceptance limits shall be guided by the relevant testing codes and standards.

8.02.04 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 Purchaser's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS EN ISO 9906) or any other equivalent standard but the tolerances on head, discharge and power shall be as specified in HIS, USA. Prior to performance test, the pump supplier shall furnish the procedures and methods of testing to the Purchaser for approval.

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

iii) Tests shall be conducted at the rated rpm.

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.

8.03.00 **Vertical Pumps**

8.03.01 Material Identification and Testing

i) 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.
- Any other components in the pump assembly.

ii) Tests shall also include but shall not be limited to the following:

- The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM-E-165.
- Shaft shall be subject to Dye penetration and Ultrasonic test.
- Wearing rings shall be subjected to Dye Penetration Test.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO-1940.
- Complete inspection of assembled pump.

8.03.02 Dynamic Balancing

Rotating components of the pump shall be statically and dynamically balanced. Dynamic balancing tests shall be carried out for the impeller at a speed not less than the rated rpm of the pump. Test procedure and acceptance limits shall be guided by the relevant testing codes and standards.

8.03.03 Hydrostatic Testing

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

- Bowls/Suction bells.
- Column pipe.
- Discharge head.
- Any other applicable pressure parts.

8.03.04 Performance Test at Shop

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

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity upto pump shut-off condition. A minimum of five (5) combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation specified. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted at the rated rpm.

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

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

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

9.00.00 **DRAWINGS, DATA, CURVES AND INFORMATION**

The Bidder shall submit the following along with his formal proposal besides the different information plate required as indicated elsewhere in this specification

9.01.00 Piping and instrumentation diagram of Plant water system.

9.02.00 General arrangement drawing of Jackwell pump house, raw water transfer pump house, clarified water pump house.

9.03.00 General arrangement of clarified water reservoir.

9.04.00 General Arrangement drawing of service water, potable water tank, DM water storage tank and condensate storage tank.

9.05.00 **Horizontal Pumps**

9.05.01 Drawings

a) General arrangement and outline drawings showing the principal dimensions, weight and location of the suction and discharge connections of the pumps offered. Details of lubrication and sealing arrangement shall also be included.

b) Typical cross-section drawing showing various components of the pumps offered, materials of construction etc.

9.05.02 Data and Curves

a) Determination of pump total dynamic head at rated capacity as per guidelines specified in Section-I of this Volume. Detailed calculations for computing static head and frictional lossed shall be furnished by the Bidder.

b) Anticipated performance curves showing the following characteristics:

i. Capacity vs. head
ii. Capacity vs. power
iii. Capacity vs. efficiency
iv. System resistance curves

c) Speed vs. torque curve of the pump corresponding to recommended mode of pump starting superimposed on speed vs. torque curves of the drive unit corresponding to 80%, 90%, 100% of the rated voltage (applicable only in the cases of pumps with drive motor power rating of 100 KW and above).

d) Completely filled-in Technical Proposal Particulars enclosed under Volume-IX of this specification.

e) Details of manufacturing and testing facilities in pump manufacturer's works and illustrative literature regarding the pumps offered.

9.06.00 **Vertical Pumps**

9.06.01 Drawings/Data

a) Determination of respective pump total dynamic head and capacity as per guidelines of this specification. Detailed calculations for obtaining static head and frictional losses shall be submitted by the Bidder.

b) Outline drawings of the pump showing the various dimensions, suction and discharge locations.

c) Typical cross sectional drawing of the pump to be supplied, showing various components, bearings, seal rings etc. and materials of construction for all items.

d) Lubrication arrangement drawings for external lubrication.

9.06.02 Anticipated performance curves and test curves for:

a) Capacity Vs Head.

b) Capacity Vs. Power & Capacity Vs. Efficiency.

c) System resistance curves.

d) Speed Vs. torque requirement of the pump (for pump sets with drive motor rating of 100 KW or more) together the drive motor speed-torque characteristic.

9.07.00 Completely filled up schedules enclosed under Volume-IX of this specification.

9.08.00 Descriptive and illustrative literature regarding the pumps offered.

9.09.00 A comprehensive write-up or brochure regarding the details of manufacturing and testing facilities in the shop of the manufacturer.

9.10.00 A write-up describing clearly the procedure for installing the pump with its column pipe - piece by piece and also for overhauling the pump in a like manner. A diagram showing the required pump house crane hook lift above the pump operating floor has also to be furnished.

9.11.00 The successful Bidder shall furnish the following drawings/data/ manuals for Purchaser/Engineer's approval after award of the contract.

9.11.01 Final versions of all the drawings, documents as specified in the clauses above.

9.11.02 Principal dimensions of the pump sump indicating clearance dimensions for the suction bell from back wall and side walls, minimum submergence required for the pump etc.

9.11.03 Pump foundation details along with all design loads with static and dynamic loads, direction and points of application.

9.11.04 Pump and drive sealing, bearing lubrication and cooling arrangement drawing.

9.11.05 Drive data.

9.11.06 Test reports, test certificates, performance curves and other particulars.

9.11.07 Instruction Manuals.

9.11.08 Any other applicable drawings and documents as specified in Volume-IIA of this specification.

SECTION C2

SPECIFIC TECHNICAL REQUIREMENTS FOR MOTORS

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. Mandatory spares are applicable.
d) Erection and Commissioning spares.
e) Erection & Maintenance tools & tackles.
f) Electrical load requirement for Miscellaneous Pumps.
g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
h) 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
i) 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.

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 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this two signed and stamped copies of the following shall be furnished by the bidder as technical offer:

a) A copy of this sheet "Electrical equipment Specification for Miscellaneous Pumps" and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
b) List of Erection and Commissioning spares.
c) List of Erection & Maintenance tools & tackles.
d) Electrical load requirement

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.

REV: 0 DATE: 17.06.2015

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

PACKAGE: MISCELLANEOUS PUMP

PROJECT: 1X800MW KOTHAGUDEM TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1.	415 V MCC	BHEL	BHEL	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: MISCELLANEOUS PUMP

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.

VOLUME: V-A

SECTION-II

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

1.00.00 SCOPE

1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.

1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 CODES & STANDARDS

2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.

2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:

i) IS-325

ii) IS-12615

iii) IEC-60034

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.

4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

4.01.05 Motors efficiency class shall be IE3 as per latest version of IEC-60034.

4.02.00 **D.C. Motors**

4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.

4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.

Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 **PERFORMANCE**

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.

5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.

5.02.00 **Starting Requirements**

Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-

Motors up to 1500kW	-	600% subject to IS tolerance of plus 20%.
Motors above 1500kW	-	450% not subject to any positive tolerance.

5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.

5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.

b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.

5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.

5.03.00 **Stress During Bus Transfer**

5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.

5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

6.00.00 **SPECIFIC REQUIREMENTS**

6.01.00 **Enclosure**

6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.

6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.

6.02.00 **Cooling**

6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.

6.03.00 **Winding and Insulation**

6.03.01 All insulated winding shall be of copper.

6.03.02 All motors shall have class F insulation but limited to class B temperature rise.

6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.

6.04.00 **Tropical Protection**

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardwares shall be corrosion resistant.

6.05.00 **Bearings**

6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.

6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.

6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.

6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.

6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.

6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.

6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.

6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.

6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.

6.06.00 **Noise & Vibration**

6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.

6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.

6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.

6.07.00 **Motor Terminal Box**

6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation

6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.

6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.

6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

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

6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor		Minimum Ph-Ph & Ph-Earth clearance
0.415 kV	:	25 mm
3.3 kV	:	65 mm
11.0 kV	:	140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating			Conductor Size
Above	Up to		
-------	5.5 kW	:	8 SWG GI Wires.
5.5 kW	22 kW	:	25mm X 4mm GS Flat.
23 kW	55 kW	:	40mm X 6mm GS Flat.
56kW	174kW	:	50mm X 8mm GS Flat.
175kW	ABOVE	:	75mm X 10mm GS Flat.

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

6.09.00 **Minimum Cable Size for LT & HT Motors shall as be as follows-**

a) For 415V, 3-Ph, LT Motors-

Rating			Cable Size
Above	Up to		
-------	5.5 kW	:	1R X 3C X 6 Sq.mm
5.5 kW	11 kW	:	1R X 3C X 10 Sq.mm
11 kW	22 kW	:	1R X 3C X 35 Sq.mm
22 kW	37.5 kW	:	1R X 3C X 70 Sq.mm.
37.5kW	55 kW	:	1R X 3C X 150 Sq.mm
55 kW	75 kW	:	1R X 3C X 300 Sq.mm
75 kW	110kW	:	2R X 3C X 150 Sq.mm
110 kW	175kW	:	2R X 3C X 300 Sq.mm

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating			Cable Size
Above	Up to		

175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection.

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

i) For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).

ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.

7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.

7.04.00 **Indicator/Switch**

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

a) 11000 V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.

7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner’s cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

For paint shade finish, refer Section-X of Volume: II-A : Lead Specification.

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition,any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.

c. Polarization Index Test as per IS: 7816 as routine test

d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.

e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.

f. Test for noise level as routine test.

g. Test for vibration as routine test.

h. Tan delta measurement on coils.

i. Surge withstand test for inter turn insulation.

j. Test to diagnose rotor bar failure during manufacture.

k. Over speed test as routine test.

l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be Submitted with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write-up on forced lubrication system, if any

d) Type test report

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

CABLE SIZES

Following sizes are given as a general guideline. Standard sizes as per IEC/IS shall be adopted.

Sl. No.	Cable Size	Conductor	Insulation
1.0	**H. T. CABLES (11kV)**		
1.1	1 core 1000 sq.mm	AL	XLPE (FRLS)
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 400 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	1 core 70 Sq.mm	AL	XLPE (FRLS)
1.0	**H. T. CABLES (3.3kV)**		
1.1	1 core 630 Sq.mm	AL	XLPE (FRLS)
1.2	3 core 300 Sq.mm	AL	XLPE (FRLS)
1.3	3 core 240 Sq.mm	AL	XLPE (FRLS)
1.4	3 core 185 Sq.mm	AL	XLPE (FRLS)
1.5	1 core 70 Sq.mm	AL	XLPE (FRLS)
2.0	**L. T. POWER CABLES**		
2.1	3 core 2.5 Sq.mm	CU	XLPE (FRLS)
2.2	2 core 16 Sq.mm	AL	XLPE (FRLS)
2.3	3 core 16 Sq.mm	AL	XLPE (FRLS)
2.4	4 core 16 Sq.mm	AL	XLPE (FRLS)
2.5	2 core 35 Sq.mm	AL	XLPE (FRLS)
2.6	3 core 35 Sq.mm	AL	XLPE (FRLS)
2.7	4 core 35 Sq.mm	AL	XLPE (FRLS)
2.8	3 core 70 Sq.mm	AL	XLPE (FRLS)

Sl. No.	Cable Size	Conductor	Insulation
2.9	3.1/2 core 70 Sq.mm	AL	XLPE (FRLS)
2.10	3 core 95 Sq.mm	AL	XLPE (FRLS)
2.11	3.1/2 core 95 Sq.mm	AL	XLPE (FRLS)
2.12	3 core 185 Sq.mm	AL	XLPE (FRLS)
2.13	3.1/2 core 185 Sq.mm	AL	XLPE (FRLS)
2.14	3 core 240 Sq.mm	AL	XLPE (FRLS)
2.15	3.1/2 core 240 Sq.mm	AL	XLPE (FRLS)
2.16	3 core 300 Sq.mm	AL	XLPE (FRLS)
2.17	3.1/2 core 300 Sq.mm	AL	XLPE (FRLS)
2.18	1 core 630 Sq.mm	AL	XLPE (FRLS)
3.0	**CONTROL CABLE**		
3.1	2 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.2	3 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.3	5 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.4	7 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.5	9 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.6	12 core 2.5 Sq.mm	CU	HRPVC (FRLS)
3.7	20 core 2.5 Sq.mm	CU	HRPVC (FRLS)
4.0	**FS POWER CABLES**		
4.1	3 core 2.5 Sq.mm	CU	EPR
4.2	2 core 16 Sq.mm	CU	EPR
4.3	3 core 16 Sq.mm	CU	EPR
4.4	4 core 16 Sq.mm	CU	EPR
4.5	2 core 35 Sq.mm	CU	EPR

Sl. No.	Cable Size	Conductor	Insulation
4.6	3 core 35 Sq.mm	CU	EPR
4.7	4 core 35 Sq.mm	CU	EPR
4.8	3 core 95 Sq.mm	CU	EPR
4.9	3.1/2 core 95 Sq.mm	CU	EPR
5.0	**FS CONTROL CABLE**		
5.1	2 core 2.5 Sq.mm	CU	EPR
5.2	3 core 2.5 Sq.mm	CU	EPR
5.3	5 core 2.5 Sq.mm	CU	EPR
5.4	7 core 2.5 Sq.mm	CU	EPR
5.5	9 core 2.5 Sq.mm	CU	EPR
5.6	12 core 2.5 Sq.mm	CU	EPR

SECTION C3

SPECIFIC TECHNICAL REQUIREMENTS FOR C&I (INSTRUMENTATION)

1 x 800 MW KOTHAGUDEM STTP

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

SECTION D

STANDARD TECHNICAL SPECIFICATIONS

D1: STANDARD TECHNICAL SPECIFICATIONS FOR PUMPS

D2: STANDARD TECHNICAL SPECIFICATIONS FOR MOTORS

SECTION D1

STANDARD TECHNICAL SPECIFICATIONS FOR HORIZONTAL PUMPS NO. PE TS-179-06

STANDARD TECHNICAL SPECIFICATIONS FOR VERTICAL PUMPS NO. PE TS-179-07

DATA SHEET A ALONGWITH LIST OF MANDATORY SPARES & WATER ANALYSIS

DATA SHEET C

QUALITY PLAN

1.00.00 GENERAL INFORMATION

1.01.00 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.

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'.
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 A.

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

3.03.00 Accessories:

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

3.03.01 Standard accessories:

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

b) Pump motor coupling along with coupling guard.

c) Common base plate for pumps and motor.

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

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

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

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

h) Suitable drain connections with isolating valves as applicable.

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

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

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

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

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

3.04.00 Services included in Bidder's Scope:

3.04.01 The pumps shall be guaranteed to meet the performance requirements specified vide Data Sheet -A and also for trouble free operation after commissioning. Schedule of performance guarantees (enclosed in Volume-III) 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.

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 will be conducted by BHEL at project site to ensure that the pumps meet the specified requirements. In case of any deficiency, the vendor shall rectify the same at site at no additional cost to BHEL.

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

3.05.00 Works excluded from Bidder's Scope:

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

4.00.00 BID EVALUATION CRITERIA & LIQUIDATED DAMAGES FOR SHORTFALL:

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

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

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

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

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

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

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

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

4.03.00 Liquidated damages for shortfall in Guaranteed KW

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

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

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

5.00.00 TECHNICAL REQUIREMENTS:

5.01.00 The pumps shall meet the technical requirements of section “D” as well as Data Sheet - A. Wherever there is contradiction between Section D and Data Sheet-A, the latter shall prevail. In the event of any contradiction of section “D” with Section-C, the Section-C 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.

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 with dimensions as specified in Data Sheet A.
- Other components as finalized during detailing.
- For mounting of above on the HT motors, same shall be taken care by BHEL - Bhopal.

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.

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 two years. 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 in the base price of the pump, unless specified otherwise in Sec-C 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.

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

7.04.00 Painting for Pumps

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

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

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

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

microns of chlorinated rubber paint shall be provided. Total DFT of paint system shall be min. 200 microns.

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

8.00.00 **PERFORMANCE REQUIREMENTS**

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

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 this section.

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

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

9.07.00 **Stuffing Boxes**

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

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

9.08.00 **Mechanical Seals**

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

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

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

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

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

9.09.00 **Drive Unit**

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

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

a) 15% margin over the pump shaft input power at the rated duty point.

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

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

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:

- 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 this section.

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

c) **Performance Test at Shop**

i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute

of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard.

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

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

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

v) 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 Annexure to Data Sheet-C.

12.00.00 The various Sections-C's & D'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 within 2 weeks from placement of LOI's in the event of order.

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.

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 Vol. III of specn.).
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 Vol. III of specn.).
d) Technical deviation schedule (if reqd.) (enclosed at Vol. III of specn.).
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.

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.

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 A.

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

3.03.00 Accessories:

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

3.03.01 Standard accessories:

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

b) Pump motor coupling along with coupling guard.

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

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

e) Thrust bearing temp. 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 (enclosed in Volume-III) 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 will be conducted by BHEL at project site to ensure that the pumps meet the specified requirements. In case of any deficiency, the vendor shall rectify the same at site at no additional cost to BHEL.

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

3.05.00 Works excluded from Bidder's Scope:

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

4.00.00 BID EVALUATION CRITERIA & LIQUIDATED DAMAGES FOR SHORTFALL:

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

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

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

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

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

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

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

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

4.03.00 Liquidated damages for shortfall in Guaranteed KW

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

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

The 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 “D” as well as Data Sheet - A. Wherever there is contradiction between Section D and Data Sheet-A, the latter shall prevail. In the event of any contradiction of section “D” with Section-C, the Section-C 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 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.

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

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

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

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

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

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

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

- Purchaser's probes in both DE/NDE bearings of pumps
- Key slots on pump shaft with dimensions as specified in Data Sheet A.
- Other components as finalized during detailing.
- For mounting of above on the HT motors, same shall be taken care by BHEL - Bhopal.

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.

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 two years. 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 If water handled by pump is sea water/ dirty/ not suitable for lubrication/ cooling:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.22.00 For Vertical pumps no thrust block is being provided except for pumps of projects, specified in Sec-C1 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-C1 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 in the base price of the pump, unless specified otherwise in Sec-C 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.

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 this section.

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 this section.

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

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

9.00.00 **DESIGN AND CONSTRUCTION**

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

9.01.00 **Bowl Assembly**

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

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

9.02.00 **Discharge Head**

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

9.03.00 **Column pipe**

9.03.01 Column pipe shall be flanged and of bolted connection. Column pipes shall be designed

for full internal vacuum.

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

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

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

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

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

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

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

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

9.05.00 **Shaft enclosing tube**

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

9.06.00 **Seal rings**

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

9.07.00 **Bearings**

9.07.01 **Shaft bearings**

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

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

9.07.02 **Thrust Bearing**

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

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

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

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

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

9.08.00 **Reverse Rotation**

9.08.01 If indicated at Section-C 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) 15% margin over the pump shaft input power at the rated duty point.

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

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

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.

- 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 & 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 this section.

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

c) **Performance Test at Shop**

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

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps at rated speed. These shall be carried out to span 130% of rated

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

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

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

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

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

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

11.00.00 DRAWINGS/ DOCUMENTS DISTRIBUTION SCHEDULE

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

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

12.00.00 The various Sections-C's & D'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 within 2 weeks from placement of LOI's in the event of order.

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.

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 Vol. III of specn.).
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 Vol. III of specn.).
d) Technical deviation schedule (if reqd.) (enclosed at Vol. III of specn.).
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.

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.

	DATA SHEET - A				SPECIFICATION NO.:	PE-TS-410-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - GROUP-I				REV. NO.: 00	DATE : 17/06/2015
	1X800MW KOTHAGUDEM TPS UNIT-12				VOLUME : II B	SECTION : D
Sl. No.	**DESCRIPTION**	**DMCW TG AUX'S PUMPS**	**DMCW SG AUX'S PUMPS**	**HOTWELL MAKE-UP PUMPS**	**DM TRANSFER PUMPS**	**BOILER FILL PUMPS**
		HORIZONTAL PUMPS (GROUP-I)				
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) for Station	(1W+1S) for Station	(1W+1S) for Station	(1W+1S) for Station	(1W+1S) for Station
1.3	Liquid Handled (ref. water analysis enclosed herein)	pH corrected DM Water	pH corrected DM Water	DM Water	DM Water	DM Water
1.4	Location (Indoor / Outdoor)	Indoor	Indoor	Indoor	Indoor	Indoor
1.5	Duty	Continuous	Continuous	Intermittent	Intermittent	Intermittent
1.6	No. of pumps working in parallel	2	-	-	-	-
1.7	Specific gravity	1	1	1	1	1
1.8	System design pressure (kg/sqcm), g	10	12	10	8	22
2.0	**DESIGN PARAMETERS**					
2.1	Design capacity each, M^3/hr	1510	600	80	45	200
2.2	Total dynamic head (MWC)	40	56	60	50	170
2.3	Suction Pressure(MWC)	28	28	Flooded suction	Flooded suction	Flooded suction
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 65 MWC	Not to exceed 85 MWC	Not to exceed 90 MWC	Not to exceed 70 MWC	Not to exceed 200 MWC
2.7	Operating range	----------30-130% of design duty point flow----------				
2.8	Motor rating	Drive Motor shall be rated, at an ambient temp. Of 50 Deg C, with a margin of at least 15 % over the shaft requirement at the duty condition or 10 % above the maximum load demand in the operating range whichever is higher including voltage and frequency variation.				
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 / IS 5120				
3.0	**CONSTRUCTION FEATURES**					
3.1	Pump type	Horizontal centrifugal type Between Bearing Pump	Horizontal centrifugal type Between Bearing Pump	Horizontal centrifugal type	Horizontal centrifugal type	Horizontal centrifugal type
3.2	Impeller type	Closed	Closed	Closed	Closed	Closed
3.3	Casing type	Horizontal axial split type	Horizontal axial split type	To be decided by Bidder	To be decided by Bidder	To be decided by Bidder
3.4	Coupling type	Flexible type	Flexible type	Flexible 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	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	Self Liquid	Self Liquid	Self Liquid	Self Liquid	Self Liquid
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, lifting lugs, priming connection	Required				
4.0	**MATERIALS OF CONSTRUCTION**					
4.1	Casing	ASTM A-351 CF8M	ASTM A-351 CF8M	SS-316	SS-316	SS-316
4.2	Impeller	SS316/ SS ASTM – A351 – CF8M	SS316/ SS ASTM – A351 – CF8M	SS-316	SS-316	SS-316
4.3	Shaft	SS ASTM A 276 Gr. 316	SS ASTM A 276 Gr. 316	SS-316	SS 316	SS 316
4.4	Shaft Sleeves	SS ASTM A 276 Gr. 410	SS ASTM A 276 Gr. 410	SS-410	SS-410	SS-410
4.5	Impeller Wearing rings	SS 410	SS 410	SS-410	SS-410	SS-410
4.6	Bolts & Nuts	SS-316	SS-316	SS-316	SS 316	SS 316
4.7	Gland/Seal Cover	SS-316	SS-316	SS-316	SS-316	SS-316
4.9	Lantern Ring	SS-316	SS-316	SS-316	SS 316	SS 316
4.10	Mech. seal	Manufacturer standard	Manufacturer standard	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)	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	SS-316	SS-316	SS-316	SS-316	SS 316

Sl. No.	DESCRIPTION	DMCW TG AUX'S PUMPS	DMCW SG AUX'S PUMPS	HOTWELL MAKE-UP PUMPS	DM TRANSFER PUMPS	BOILER FILL PUMPS
4.13	Casing Wearing rings (If applicable)	SS 410	SS 410	SS 410	SS 410	SS 410
4.14	Coupling	SS-316	SS-316	SS 316	SS 316	SS 316
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	ASTM-A-312 TP 304, ERW	ASTM-A-312 TP 304, ERW	ASTM-A-312 TP 304, ERW
5.0	**MANDATORY SPARES**					
5.1	Shaft	-	-	-	1 No.	-
5.2	Shaft Sleeve	-	-	-	2 Nos.	-
5.3	Impeller	-	-	-	1 No.	-
5.4	Impeller locking nut and bolt	-	-	-	4 Nos.	-
5.5	Impeller wear ring	-	-	-	4 Nos.	-
5.6	Casing wear ring	-	-	-	4 Nos.	-
5.7	Oil Seal	-	-	-	4 Nos.	-
5.8	Oil Deflector	-	-	-	3 Nos.	-
5.9	Oil Ring	-	-	-	3 Nos.	-
5.10	Gland Packing	-	-	-	4	-
5.11	Lantern Ring	-	-	-	3 Nos.	-
5.12	Mech Seal Assembly	-	-	-	1 No.	-
5.13	Stationary/CarbonPackingandO"RingforMechanical Seal"	-	-	-	3 Sets	-
5.14	Oil Level Gauge	-	-	-	3 Nos.	-
5.15	Coupling	-	-	-	2 Nos.	-
5.16	Rubber Bush for Coupling	-	-	-	2 Nos.	-
5.17	O" Rings "	-	-	-	2 Sets	-
5.18	Suction Strainers Element	-	-	-	3 Nos.	-
5.19	Bearing for Pump Motor	-	-	-	2 Sets	-
5.20	Complete Impeller Assembly	1 Set for each application and ratings of Pumps	1 Set for each application and ratings of Pumps	1Set	-	1Set
5.21	Diffuser with guide vanes for 1st Stage	-	-	1Set	-	1Set
5.22	Keys for impeller	1 No. for each application and ratings of Pumps	1 No. for each application and ratings of Pumps	1Set	-	1Set
5.23	Pump shaft	1 No. for each application and ratings of Pumps	1 No. for each application and ratings of Pumps	1No.	-	1No.
5.24	Bearings (comprising of Drive & Non-drive end)	1 Set for each application and ratings of Pumps	1 Set for each application and ratings of Pumps	1Set	-	1Set
5.25	Wear Ring for Shaft & Impeller	1 Set for each application and ratings of Pumps	1 Set for each application and ratings of Pumps	1Set	-	1Set
5.26	Bearing Housing (comprising of DE & NDE)	-	-	1Set	-	1Set
5.27	Complete Set of Mechanical seal	-	-	1Set	-	1Set
5.28	Shaft Sleeves (Suction & Disc Side)	-	-	1Set	-	1Set
5.29	Coupling Bolt, Nut & Bush	-	-	1Set	-	1Set
5.30	Coupling	1 No. for each application and ratings of Pumps	1 No. for each application and ratings of Pumps	1No.	-	1No.
5.31	Drive Motor	-	1 No. for each application and ratings of Pumps	1No.	-	-
5.32	Mechanical seal with Sleeves	1 Set for each application and ratings of Pumps	1 Set for each application and ratings of Pumps	-	-	-
	LT Motors					
5.33	End Shield Cover Driving & Non-Driving End (applicable for motors above 30KW)	-	1 Set for each type and rating of Motor	1 Set for each type and rating of Motor	1 Set for each type and rating of Motor	-

	DATA SHEET - A				SPECIFICATION NO.:	PE-TS-410-100-N001
	MISCELLANEOUS PUMPS (HORIZONTAL) - GROUP-I				REV. NO.: 00	DATE : 17/06/2015
	1X800MW KOTHAGUDEM TPS UNIT-12				VOLUME : II B	SECTION : D
Sl. No.	**DESCRIPTION**	**DMCW TG AUX'S PUMPS**	**DMCW SG AUX'S PUMPS**	**HOTWELL MAKE-UP PUMPS**	**DM TRANSFER PUMPS**	**BOILER FILL PUMPS**
5.34	Driving End & Non-Driving End Bearing	-	1 Set for each type and rating of Motor (for above 30KW) 3 Set for each type and rating of Motor (for upto 30KW)	1 Set for each type and rating of Motor (for above 30KW) 3 Set for each type and rating of Motor (for upto 30KW)	1 Set for each type and rating of Motor (for above 30KW) 3 Set for each type and rating of Motor (for upto 30KW)	-
5.35	Cooling Fan	-	1 No. for each type and rating of Motor (for above 30KW) 2 No. for each type and rating of Motor (for upto 30KW)	1 No. for each type and rating of Motor (for above 30KW) 2 No. for each type and rating of Motor (for upto 30KW)	1 No. for each type and rating of Motor (for above 30KW) 2 No. for each type and rating of Motor (for upto 30KW)	-
5.36	Motor Space Heater (applicable for motors above 30KW)	-	1 No. for each type and rating of Motor	1 No. for each type and rating of Motor	1 No. for each type and rating of Motor	-
5.37	Motor Terminal Block	-	1 No. for each type and rating of Motor (for above 30KW) 5 No. for each type and rating of Motor (for upto 30KW)	1 No. for each type and rating of Motor (for above 30KW) 5 No. for each type and rating of Motor (for upto 30KW)	1 No. for each type and rating of Motor (for above 30KW) 5 No. for each type and rating of Motor (for upto 30KW)	-
5.38	Complete Set of Coupling	-	1 Set for each Application	1 Set for each Application	1 Set for each Application	-
	Mandatory Spare Note: 1. In case if such items of spares indicated as “not applicable” by bidder in its offer, are found applicable at a later date during execution of the project, such items of spares are to be supplied within the ordered cost of the mandatory spares. 2. In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.					
6.0	**BID EVALUATION RATE**					
6.1	Bid evaluation rate	Rs. 2.0 Lacs/KW	Rs. 2.0 Lacs/KW	NA	NA	NA
6.2	Maximum permissible efficiency for Bid evaluation					
6.2.1	Pump Efficiency (%)	86	84	-	-	-
6.2.2	Motor Efficiency (%)	95	95.3	-	-	-
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-410-100-N001
	MISCELLANEOUS PUMPS (Vertical Pumps) - GROUP-II				**REV. NO.: 00**	**DATE :** 17.06.15
	1X800MW KOTHAGUDEM TPS UNIT-12	**VOLUME : II B**	**SECTION D**			
Sl. No.	**DESCRIPTION**	**RAW WATER PUMPS**	**ACW PUMPS**	**CW MAKE-UP PUMPS**	**SERVICE WATER PUMPS**	**APH/ESP WATER WASHING PUMPS**
1.0	**SERVICE**					
1.1	Total no. of pumps for Project	3	3	2	2	2
1.2	No. of working & standby pumps	(2W+1S) for station	(2W+1S) for station	(1W+1S) for station	(1W+1S) for station	(1W+1S) for station
1.3	Liquid Handled (ref. water analysis enclosed herein)	Raw Water (River water)	Clarified Water	Clarified Water	Clarified Water	Clarified Water
1.4	Location	Raw Water P/H	CW P/H	Clarified Water P/H	Clarified Water P/H	Clarified Water P/H
1.4.1	Indoor / Outdoor	Indoor	Indoor	Indoor	Indoor	Indoor
1.5	Duty	Continuous	Continuous	Continuous	Continuous	Intermittent
1.6	Specific gravity	1	1	1	1	1
1.7	No. of pumps working in parallel	2	2	-	-	-
1.8	System design pressure (kg/sqcm)	10	7.5	10	10	12
2.0	**DESIGN PARAMETERS**					
2.1	Design capacity each, M^3/hr	1500	2070	2050	300	950
2.2	Total dynamic head (MWC) **(At Bowl, excluding Pumps Internal frictional losses upto discharge)**	45	35	14	61	86
2.3	• Suction Pressure(MWC)	Submerged Suction	Submerged Suction	Submerged Suction	Submerged Suction	Submerged Suction
	• Floor Level- for Pump Mounting	RL (+) 105.3 M	RL (+) 103.2 M	RL (+) 106.5 M	RL (+) 106.5 M	RL (+) 106.5 M
	• Min. W.L	RL (+) 94.5 M	RL (+) 100.9 M	RL (+) 99.0 M	RL (+) 99.0 M	RL (+) 99.0 M
	• Max. W.L.	RL (+) 103.8 M	RL (+) 101.7 M	RL (+) 105.0 M	RL (+) 105.0 M	RL (+) 105.0 M
	• Sump Invert Level	RL (+) 92.0 M	RL (+) 98.4 M	RL (+) 96.5 M	RL (+) 96.5 M	RL (+) 96.5 M
	• Crane Hook Level	RL (+) 110.8 M	RL (+) 116.2 M	RL (+) 112.0 M	RL (+) 112.0 M	RL (+) 112.0 M
	• Crane Capacity Available	5 Ton	45 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 85 MWC	Not to exceed 65 MWC	Not to exceed 85 MWC	Not to exceed 85 MWC	Not to exceed 105 MWC
2.7	Pump Discharge - above floor / below floor	Above Floor				
2.8	Discharge pipe (ODXTHK),(mmxmm)	508 X 6.0	711 X 7.0	610 X 6.0	219.1 X 6.0	406.4 X 6.0
2.9	Operating range	----------30-130% of design duty point flow----------				
2.10	Motor rating	Motor rating shall be the maximum of the following requirements: a) 15% (for LT motor) or 10% (for HT motor) margin over the pump shaft input power at the rated duty point. b) 5% margin over the maximum pump shaft input power required within the "Range of Operation". c) Pump shaft input power required considering the overloading of the pump assuming single pump operation in the event of tripping of one or more of the pumps operating in parallel.				
2.11	Permissible tolerance in rated capacity & TDH	no negative tolerance				
2.12	Permissible tolerance in efficiency at rated capacity(%)	no negative tolerance				
2.13	Performance/Design Standard	HIS / IS1710				
2.14	Suction Specific Speed Limit (US Units)	9000	8500	9000	9000	9000
3.0	**CONSTRUCTION FEATURES**					
3.1	Pump type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type	Vertical Turbine Type
3.2	Impeller type	Closed	Closed	Closed	Closed	Closed
3.3	Casing 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	Reverse flow through pump to be considered for pump design	YES	YES	YES	YES	YES
3.9	Drain Plugs, vent, lifting lugs, etc.	To be Provided				
4.0	**MATERIALS OF CONSTRUCTION**					
4.1	Casing & Suction Bell	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260
4.2	Column Pipe	CS to IS 2062 Gr.B	CS to IS 2062 Gr.B	CS to IS 2062 Gr.B	CS to IS 2062 Gr.B	CS to IS 2062 Gr.B
4.3	Minimum column pipe thickness, mm	10 mm	10 mm	10 mm	10 mm	10 mm
4.4	Impeller	ASTM-A-351 Gr.CF8M	ASTM-A-351 Gr.CF8M	ASTM-A-351 Gr.CF8M	ASTM-A-351 Gr.CF8M	ASTM-A-351 Gr.CF8M
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)
4.7	Shaft Coupling	SS-410 (Hardened)	SS-410 (Hardened)	SS-410 (Hardened)	SS-410 (Hardened)	SS-410 (Hardened)
4.8	Wearing rings	SS-410	SS-410	SS-410	SS-410	SS-410
4.9	Wetted fasteners	SS-316	SS-316	SS-316	SS-316	SS-316
4.10	Fasteners (others)	SS-316	SS-316	SS-316	SS-316	SS-316
4.11	Stuffing Box	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260	2% Ni CI IS 210 Gr. FG 260
4.12	Lantern Ring	SS-316	SS-316	SS-316	SS-316	SS-316
4.13	Intermediate stage bearings	Cutless rubber	Cutless rubber	Cutless rubber	Cutless rubber	Cutless rubber
4.14	Mech. seal	N/A	N/A	N/A	N/A	N/A
4.15	Gland Packing (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)	Braided Impregnated Teflon (Asbestos Free)
4.16	Base/ Sole Plate	MS to IS 2062 Gr. B				
4.17	Connecting Pipe material (for deciding counterflange material)	Piping shall be Carbon Steel (IS:2062), rolled and welded conforming to IS:3589 (internally painted with Coal tar epoxy paint for 450NB and above).				
5.0	**MANDATORY SPARES**					
5.1	Complete Bowl Assembly	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.2	Set of Impellers	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.3	Set of shafts	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.4	Casing wear rings	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.5	Impeller wear rings	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.6	Shaft sleeves	1 Set for each type	2 Sets	1 Set for each type	1 Set for each type	1 Set for each type
5.7	Shaft coupling	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.8	Shaft nuts and keys	2 Sets for each type	2 Sets	2 Sets for each type	2 Sets for each type	2 Sets for each type
5.9	Pins (for non-reversible ratchet)	2 Sets for each type	2 Sets	2 Sets for each type	2 Sets for each type	2 Sets for each type
5.10	Lantern rings	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.11	Bell mouth liner	1 Set for each type	1 Set	1 Set for each type	1 Set for each type	1 Set for each type
5.12	Bearings Various types as applicable	Complete 1(One) Set (one set meanstotal requirements for one Pump) for each type	Complete1(One)Set(one set means total requirements for one Pump)	Complete 1(One) Set (one set meanstotal requirements for one Pump) for each type	Complete 1(One) Set (one set meanstotal requirements for one Pump) for each type	Complete 1(One) Set (one set meanstotal requirements for one Pump) for each type
5.13	Coupling set (between pump and motor) with accessories	1 Set for each type	1 set	1 Set for each type	1 Set for each type	1 Set for each type
	LT Motors					
5.14	End Shield Cover Driving & Non-Driving End (applicable for motors above 30KW)	-	-	1 Set for each type and rating of Motor	1 Set for each type and rating of Motor	-
5.15	Driving End & Non-Driving End Bearing	-	-	1 Set for each type and rating of Motor (for above 30KW) 3 Set for each type and rating of Motor (for upto 30KW)	1 Set for each type and rating of Motor (for above 30KW) 3 Set for each type and rating of Motor (for upto 30KW)	-
5.16	Cooling Fan	-	-	1 No. for each type and rating of Motor (for above 30KW) 2 No. for each type and rating of Motor (for upto 30KW)	1 No. for each type and rating of Motor (for above 30KW) 2 No. for each type and rating of Motor (for upto 30KW)	-
5.17	Motor Space Heater (applicable for motors above 30KW)	-	-	1 No. for each type and rating of Motor	1 No. for each type and rating of Motor	-
5.18	Motor Terminal Block	-	-	1 No. for each type and rating of Motor (for above 30KW) 5 No. for each type and rating of Motor (for upto 30KW)	1 No. for each type and rating of Motor (for above 30KW) 5 No. for each type and rating of Motor (for upto 30KW)	-
5.19	Complete Set of Coupling	-	-	1 Set for each Application	1 Set for each Application	-
	Mandatory Spare Note: 1. In case if such items of spares indicated as "not applicable" by bidder in its offer, are found applicable at a later date during execution of the project, such items of spares are to be supplied within the ordered cost of the mandatory spares. 2. In respect of quantity mentioned as 'Set' means the total quantity of all the components/items used in particular equipment unless otherwise specified.					
6.0	**Bid Evaluation**					
6.1	Bid evaluation rate	Rs.2.0 Lacs/KW	Rs.2.0 Lacs/KW	Rs.2.0 Lacs/KW	Rs.2.0 Lacs/KW	-
6.2	Maximum permissible efficiency for Bid evaluation					
6.2.1	Pump Efficiency	86	87	86	82	-
6.2.2	Motor Efficiency	95	95	95.3	94.7	-

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–II

TREATED WATER QUALITY

(DESIGN ANALYSIS OF CLARIFIED WATER)
[After addition of 50 ppm Alum, 20 ppm Lime ,1 ppm Polyelectrolyte and 5 ppm Chlorine on 100% purity basis)]

DESIGN ANALYSIS OF CLARIFIED WATER:

CONSTITUENTS	As	CONTENT	
Calcium	$CaCO_3$	128.9	ppm
Magnesium	$CaCO_3$	53.52	ppm
Sodium	$CaCO_3$	73.44	ppm
Potassium	$CaCO_3$	1.02	ppm
Iron in Soln.	Fe	0.1	ppm
Hydrogen (FMA)	$CaCO_3$	-	ppm
TOTAL CATIONS (except iron)	$CaCO_3$	256.88	ppm
Bicarbonate	$CaCO_3$	143.4	ppm
Carbonate	$CaCO_3$	0.53	ppm
Hydroxide	$CaCO_3$	0.02	ppm
Sulphate	$CaCO_3$	59.85	ppm
Chloride	$CaCO_3$	50.82	ppm
Nitrate	$CaCO_3$	1.21	ppm
Phosphate	$CaCO_3$	-	ppm
Fluoride	$CaCO_3$	1.05	ppm
TOTAL ANIONS	$CaCO_3$	256.88	ppm
Reactive Silica	SiO_2	10	ppm
Total Suspended Solid	CaCO3	10 ppm for normal condition	15 ppm (overload condition)
Conductivity at 25 deg C		450	Microsiemens/cm (max)
pH value at 25^0 C	-	7.62	
Turbidity		Not to exceed 15	NTU (max) 10 NTU for normal condition

DM WATER ANALYSIS

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

Water Quality at the outlet of MB Exchanger:

Total Electrolyte	0.1 ppm, max.
Total SiO_2	0.01 ppm SiO_2, max.
Iron as Fe	Nil
Free CARBON DI-OXIDE ppm as CARBON DI-OXIDE	Nil
Total Hardness	Nil
pH value at 25^0C	6.8 - 7.2
Conductivity, micro mho/cm	< 0.1 at 25 ^{0}C

15.00.00 DEVIATION

15.01.00 Should the Bidder opt to deviate from this specification in anyway, specific notice to such deviation shall be drawn by the Bidder.

15.02.00 All such deviations along with reference clauses of the specification shall be clearly mentioned on the deviation sheet(s) as addressed under Bid Proposal Sheets under Schedule- IX-B of Volume-IX of the EPC Bid Document. The deviation listed elsewhere in the text of the Bid will not be considered by the Purchaser.

15.03.00 Unless the deviations are addressed in the deviation sheet(s) and submitted with Bid, it will be taken for granted that the Bid is in conformity with this specification in all respects.

ANNEXURE–I

DESIGN ANALYSIS OF RIVER WATER

CONSTITUENTS	As	CONTENT

Calcium	$CaCO_3$	101.89	ppm
Magnesium	$CaCO_3$	53.52	ppm
Sodium	$CaCO_3$	73.44	ppm
Potassium	$CaCO_3$	1.02	ppm
Iron in Soln.	Fe	0.1	ppm
Hydrogen (FMA)	$CaCO_3$	-	ppm
TOTAL CATIONS (except iron)	$CaCO_3$	229.87	ppm
Bicarbonate	$CaCO_3$	147.7	ppm
Carbonate	$CaCO_3$	1.5	ppm
Hydroxide	$CaCO_3$	0.05	ppm
Sulphate	$CaCO_3$	34.59	ppm
Chloride	$CaCO_3$	43.76	ppm
Nitrate	$CaCO_3$	1.22	ppm
Phosphate	$CaCO_3$	-	ppm
Fluoride	$CaCO_3$	1.05	ppm
TOTAL ANIONS	$CaCO_3$	229.87	ppm
Reactive Silica	SiO_2	10	ppm
Total Suspended Solid	CaCO3		250 ppm
Conductivity at 25 deg C		450	Microsiemens/cm (max)
pH value at 25^0 C	-	8.06	
Turbidity		500	NTU
Colour (Hazen Units)	-	30	

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

1.0 Drawings/documents submission schedule, shall be as per NIT. The successful bidder shall submit 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 Characteristic curves of pump showing the following:

a) Flow Vs Head
b) Flow VS Power
c) Flow Vs Efficiency
d) Flow Vs NPSHR/Min. Submergence

1.4 Operation and maintenance manual

1.5 Lubrication arrangement drawings for external lubrication (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 despatch 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 C1 of this specification.

4.0 Distribution of drawings / documents for all projects:

The no. of drawing/ documents to be submitted by the successful bidder, after the award of the contract shall be intimated after award of contract.

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 P	AGENCY W	AGENCY V	REMARKS
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	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.MEASURMENT	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. VARIFICATION 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

	Prepared By	Reviewed By	Approved By
NAME	AJAY JAIN	ASHWANI KHANNA	I. J. SINGH
SIGN.			
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 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 P	AGENCY W	AGENCY V	REMARKS
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		WTNESSING ONLY FOR SIZE GREATER THAN 10KW
2.3	IMPELLER-ALL ACCESSIBLE SURFACES, DIFFUSERS	DP TEST	MA	DP TEST ON M/CED AREA	100%	APPENDIX 8 OF ASME SEC. VIII DIV. 1		NDT CERTIFICATE	3/2.	2,1		WITNESS BY BHEL & VARIFICATION BY CUSTOMER
2.4	WERING 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 & VARIFICATION 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	
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	SIGNATURE		
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SIGN.			
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

SHEET 3 OF 6	SYSTEM	ITEM - CENTRIFUGAL PUMPS (HORIZONTAL / VERTICAL)
	BIDDER/VENDOR	QUALITY PLAN NUMBER
	CUSTOMER	PROJECT TITLE

S. No.	COMPONENT / OPERATION	CHARACTERISTIC CHECKED	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
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	

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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 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 UNBALACE	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	

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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 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 P	AGENCY W	AGENCY V	REMARKS
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 LEACKAGE - MINOR LEKAGE (DROP BY DROP) IN CASE OF GLAND PACKING ARRANGEMENT.	I.R., PERF. TEST RECORD, PLOTED 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, PLOTED CURVES	3/2.	2,1.		**IF SPECIFIED or INSISTED BY CUSTOMER.**
4.2	STRIP DOWN AFTER PERFORMANCE TEST	1UNDUE WEAR TEAR AND RUBBING	MA	VISUAL EXAM AFTER STRIPPING	1/MODEL	NO UNDUE WEAR TEAR & RUBBING ON IMPELLER & WEAR RING		INSP. REPORT	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 MEASURMENT	100%	APPD. G.A DRAWING	APPD. G.A DRAWING	INSP. REPORT	3/2.	1		

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

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SIGN.			
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 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		WTNESSING ONLY BY BHEL, CUSTOMER VARIFICATION ONLY BUT CHP
4.5	PAINTING	1.SURFACE FINISH, DFT, MARKINGS ETC.	MA	VISUAL EXAM MEASURMENT 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

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

SECTION D2

STANDARD QUALTY PLAN FOR MOTORS

	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT 1X800 MW KOTHAGUDEM TPS TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
	SHEET 1 OF 2		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 P	AGENCY W	AGENCY V	REMARKS
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	-	-	
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 TSPGCL			PROJECT TITLE 1X800 MW KOTHAGUDEM TPS			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
	SHEET 2 OF 2	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 P	AGENCY W	AGENCY V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**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.

Legends for Inspection agency

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	CUSTOMER TSPGCL			PROJECT TITLE 1X800 MW KOTHAGUDEM TPS			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 P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			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 TSPGCL			PROJECT TITLE 1X800 MW KOTHAGUDEM TPS			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	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 P	AGENCY W	AGENCY V	REMARKS
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	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		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**	
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	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT TITLE 1X800 MW KOTHAGUDEM TPS			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 P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			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	
		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	FOR MV MOTOR INSULA-TION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		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*	* 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.
		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	

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT TITLE 1X800 MW KOTHAGUDEM TPS			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 P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
1.10	BEARINGS	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	-	-	

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	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT TITLE 1X800 MW KOTHAGUDEM TPS			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
	SHEET 5 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	AGENCY W	AGENCY V	REMARKS
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 & CLEANNESS	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-	RELEVENT SPEC./ ASTM-E165	MANUFR'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	-	-	

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	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT TITLE 1X800 MW KOTHAGUDEM TPS			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 P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	
		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	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
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	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		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	THREE DIPS TO BE GIVEN
BHEL			**PARTICULARS**		**BIDDER/VENDOR**							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN	CUSTOMER TSPGCL	PROJECT TITLE 1X800 MW KOTHAGUDEM TPS	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 P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.8	BRAZING/COMPRESSION JOINT	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	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	VERIFICATION FOR MV MOTOR ONLY
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	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	

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	QUALITY PLAN	CUSTOMER TSPGCL	PROJECT 1X800 MW KOTHAGUDEM TPS 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 P	AGENCY W	AGENCY V	REMARKS
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

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	QUALITY PLAN		CUSTOMER TSPGCL			PROJECT 1X800 MW KOTHAGUDEM TPS 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			
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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.

Legends for Inspection agency

1. BHEL/CUSTOMER
2. VENDOR (MOTOR MANUFACTURER)
3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)

P. PERFORM
W. WITNESS
V. VERIFY

BHEL	**PARTICULARS**	**BIDDER/VENDOR**	
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	SIGNATURE		
	DATE		BIDDER'S/VENDORS COMPANY SEAL