



BHEL-ISG  
BENGALURU

5X800 MW TSGENCO YADADRI TPS,

TECHNICAL ENQUIRY SPECIFICATION FOR ASH SLURRY  
DISPOSAL PUMPS

DOCUMENT  
NUMBER  
IS-4-ES-699-300-  
M002



5x800 MW YADADRI THERMAL POWER STATION, TELANGANA

TECHNICAL ENQUIRY SPECIFICATION  
OF  
ASH SLURRY DISPOSAL PUMPS FOR ASH HANDLING SYSTEM



BHARAT HEAVY ELECTRICALS LIMITED  
INDUSTRIAL SYSTEMS GROUP  
BANGALORE

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### 1.0 PROJECT INFORMATION:

The specification has been prepared for supply of **Ash Slurry Disposal Pumps** for **TSGENCO 5X800 MW Yadadri TPS, Telangana** for which **TCS, Bangalore** is the consultant for the customer **TSGENCO**. BHEL is the principal contractor who is responsible for the establishment of the power project for 5X800 MW Yadadri TPS. **Industrial Systems Group (ISG)** of BHEL located at Bengaluru will be executing the Ash Slurry Disposal System of TSGENCO 5X800 MW Yadadri TPS. Project information for TSGENCO 5X800 MW Yadadri TPS is as per enclosed Annexure-I (Sheet 1 & 2).

### 2.0 SCOPE OF SUPPLY and WORKS:

The scope of supply and works includes design, manufacture, supply, assembly & testing at shop, inspection at manufacturer's work, delivery at site and pre-commissioning and commissioning at site. Bidder's commissioning experts shall be required to make visit to site for pre-commissioning and commissioning (as required by BHEL) for system integration with the ash handling without any cost implication to BHEL. Bidder's scope also includes deputing their experts or their sub-vendor's experts for any issue reported during guarantee/warranty period of the items supplied by them without any cost implication to BHEL. Apart from above works specified, if any other visit along with mandays of their experts or their sub-vendor's experts as desired by BHEL shall be payable by BHEL as per the price quoted by bidder in the price format which shall be valid till end of the contract.

**The slurry pumps shall be supplied with required companion flanges with nuts & bolts and gaskets, V-belts, belt guards, coupling guards, pump and motor side pulleys, flexible coupling between pump & gear box, common/split base frame for slurry pump, gear box, variable speed fluid coupling with manual scoop and motor along with alignment nuts and bolts, foundation bolts with nuts and washers, equipment mounting bolts for pumps and motor, and shaft keys for the pumps.**

**There shall be 3 nos. slurry pumps in each series. The duty point head of each ash slurry pump shall be 40 MWC. However, bidder shall provide the additional pulleys and belts for 2<sup>nd</sup> stage and 3<sup>rd</sup> stage of Ash Slurry Pumps to run the pump at 30 MWC. Refer enclosed GA of Ash Slurry Pump Houses, which indicate that initially the pump shall run with two pumps in a series and later on the 3<sup>rd</sup> pump shall be put in series by replacing the required larger/smaller dia pulleys in 2<sup>nd</sup> and 3<sup>rd</sup> pump in the series.**

**There are total 3 nos. Ash Slurry Pump Houses. Bidder shall match the equipment base frame as per foundation details provided in enclosed GA of Ash Slurry Pump House. The pockets for the fixing the base frames within the specified size of the foundations shall be decided by the bidder.**

The variable speed fluid coupling with manual scoop shall be supplied with all equipment/accessories like fusible plug, differential pressure switch across the filter, pressure switch, pressure gauge, SS mesh Y-Strainer, Temperature gauge, temperature element, isolation valves, oil circulation pump with motor, shell and tube type heat exchanger with copper tubes, shaft input and output side multi disc flexible coupling with nuts and bolts and spacer plates (as applicable), oil level gauge, hose pipe (oil service), drain plug etc. as per this Specification. Fluid Coupling manufacturer shall make their own arrangement for testing of Fluid Coupling at shop floor.



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The gear boxes shall be supplied with all required accessories, oil level indicator/gauge etc. as per this specification.

The required lubricating oil/grease for Ash Slurry Pumps, Fluid Coupling and Gear Box shall be supplied as commissioning spares.

The pump, gearbox and fluid coupling manufacturers shall make their own arrangement for testing of ash slurry pump- equipment at shop floor with test motor.

**Bidder to note that the efficiency of pump with ash slurry shall not be less than 72%.**

**Bidder to refer data sheet of HT motor attached with this specification and select their fluid coupling and gear box as per the TS/GD2 value mentioned in the motor data sheet.**

Items and accessories, which are not mentioned specifically but are essential for the best performance of the equipment shall be supplied by bidder without any cost implication to BHEL.

Bidder shall co-ordinate with other agencies of BHEL during commissioning of bidder's supplied equipment's.

"The drawing/document review by TSGENCO/TCE/BHEL may not indicate a thorough review of all dimensions, quantities and details of the equipment's, materials, any devices or items indicative of the accuracy of the information submitted. This review and/ or approval by the TSGENCO/TCE/BHEL shall not be construed by the Bidder, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements specified under these specifications and documents."

**For scope related to Electrical and C&I, refer Annexure-A, B, C & D.**

### 3.0 SPECIFICATION FOR ASH SLURRY PUMP, FLUID COUPLING AND GEAR BOX:

S.	Description	Technical Particulars
3.01	Type	Horizontal Centrifugal, Double Casing, close non-clog, Ash Slurry Pump.
3.02	Applicable codes	ISO 1940 Balancing
		ISO 9906/IS 5120/ IS 9137 Performance tests
		Any other relevant International / DIN standard.
<b>3.03</b>	<b>Ash Slurry Pump Parameters</b>	
i)	Capacity	980 cub.m/hr
ii)	Rated Head	Discharge pressure – 40 MWC
iii)	Quantity	45 Nos. (3 pumps in one series). Total No. of series shall be 15 (2W+1SB)
3.04	Drive transmission arrangement	<ul style="list-style-type: none"><li>1st stage by variable speed fluid coupling &amp; Gear box. The range of speed variation of the pump shall be (-) 45% to (+) 10% of the rated rpm of slurry pump.</li><li>2nd stage and 3<sup>rd</sup> stage by V-belt and fixed pitch pulley driven.</li></ul>
3.05	Duty	Continuous-24 hrs /day



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3.06	Design Conditions	<ul style="list-style-type: none"> <li>• Pump shall handle highly abrasive ash slurry.</li> <li>• Suitable to handle min.40 mm size ash clinkers.</li> <li>• 60 deg. C temperature for ash slurry.</li> <li>• <b>Pump operating range shall be 50% to 120% of rated flow.</b></li> </ul>
3.07	Max. Rated Speed (At 50 Hz) at duty point	1000 rpm
3.08	Impeller Blade Tip Speed at duty point	1676m/min
3.09	Suction Condition	Flooded Suction with suction lift of 2m
3.010	<b>Gear box Parameters</b>	
i)	Type	Helical- Single Stage Reduction Gear Box
ii)	Duty	Continuous-24 hrs /day
iii)	Location	Indoor
iv)	Applicable codes	As per manufacturer's standard
v)	Quantity	15 (10W+5SB) Nos.
vi)	Type of loading	Continuous designed for Heavy Shock Loading
vii)	Mechanical Rating	Based on 250 KW motor rating
viii)	Type of Cooling	Air cooled
ix)	Gear Box Ratio	<p>For calculating the gear ratio, the following may please be considered:</p> <ul style="list-style-type: none"> <li>a) The motor speed shall be considered as 1484 rpm</li> <li>b) Slip at fluid coupling shall be considered as 3%.</li> <li>c) Pump speed shall be 110% of the rpm at duty point.</li> </ul> <p>Hence Gear ratio shall be (0.97 X 1484) divided by rpm of pump at 110% of duty point</p>
3.011	<b>Fluid coupling Parameters</b>	
i)	Type	Variable Speed with manual scoop-controlled actuator
ii)	Duty	Continuous-24 hrs /day
iii)	Location	Indoor
iv)	Applicable codes	As per manufacturer's standard
v)	Quantity	15 (10W+5SB) Nos.
vi)	Range of Speed Regulation Provided	(+) 10% to (-) 45 %
vii)	KW/RPM Rating of Motor	250 kW/ 4 Pole/50Hz



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viii)	Maximum Slip Permissible	3%
ix)	Mounting Arrangement	Horizontal- Foot Mounted
x)	Noise Level	85 dBA at 1.0 mtr from equipment.
xi)	Selection criteria	The fluid coupling shall be selected to suit to 250 KW motor. In no case the fluid coupling shall be selected at shaft power of pump (at duty point).

#### **4.0 MATERIAL OF CONSTRUCTION/DESIGN FEATURES:**

<b>S. No.</b>	<b>Description</b>	<b>Technical Particulars</b>
4.01	<b>Pump Casing</b>	
4.01.01	Casing	
A	Outer casing	Cast Steel as per ASTM A216 Gr. WCB OR Ductile iron as per ASTM 536 65-45-12
B	Inner casing / Volute Liner	Chrome nickel cast iron (composition to Ni hard-IV) of min. 550 BHN. Or 24% chromium cast iron of min. 550BHN
4.02	Impeller	Chrome nickel cast iron (composition to Ni-hard IV) of min. 550 BHN or 24% chromium cast iron of min. 550 BHN.
4.03	Back Liner/Wear plate/Wear Ring	Chrome nickel cast iron (composition to Ni-hard IV) of min. 550 BHN or 24% chromium cast iron of min. 550 BHN
4.04	Shaft	Carbon steel to AISI -1040 / EN-8
4.05	Shaft Sleeve	Hardened and ground stainless steel (min 550 BHN)
4.06	Stuffing Box	Cast Iron FG 260
4.07	Bolts, Nuts, Fasteners (Both Non-Wetted and Wetted parts)	Grade 4.6 as per IS 1363 for Non-Wetted parts and SS 304 for Wetted parts
4.08	Bearing make	SKF/FAG/TIMKEN
4.09	Noise level	85 dBA at 1 mtr from equipment.
4.010	Drive Motor Speed	Not exceeding 1500 rpm
4.011	Drive Motor Rating	15% margin over and above the maximum load demand in the entire operating range of pump at 50 Deg. C.
4.012	Pump testing standard	IS 5120 / IS 9137 / ISO 9906
4.013	<b>Gear Box</b>	



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A	Casing	Cast Iron FG-260 to IS:210
B	Gear and Pinion	Case Hardened Alloy Steel (EN353, BS:970)
C	Output Shaft	EN-24, BS 970
D	Input shaft	Case Hardened Alloy Steel (EN 19, BS 970)
4.014	<b>Variable Speed Fluid coupling</b>	
A	Impeller	Aluminium Alloy LM4/LM6 BS 1490
B	Runner	Aluminium Alloy LM4/LM6 BS 1490
C	Scoop Housing	Cast iron FG-200 to IS:210/MS Fabricated
D	Scoop Housing Bracket	MS Fabricated
E	Coupling Box & Cover	IS 2062 GR-B Fabricated
F	Shaft	IS 1875 CL4/ EN 8 to BS 970 /C-40
G	Scoop Casing	Aluminium Alloy/ LM6 BS 1490
H	Back Casing	Aluminium Alloy/ LM6 BS 1490
4.015	<b>Oil Cooler</b>	
A	Type	Water operated oil cooler, Shell and Tube type Heat exchanger
B	Shell	ERW Pipe
C	Tubes	SS/Copper
D	<b>Oil Circulation Pump and motor</b>	Gear Pump with relief valve/ As per proven standard of manufacturer.
E	<b>Accessories as applicable -</b> Pressure & temperature gauge, Pressure switch, Temperature Element (Duplex Type), DP gauge and switch, RTD Isolation valve, Y-Strainer, orifice, fusible plug, oil level indicator, shaft input and output side multi disc flexible coupling with nuts and bolts.	As per Specification/ Approved Drg/Doc
4.016	<b>JB (Control)</b>	JB shall be supplied for terminating Fluid coupling system field instruments/devices.

**Notes: Temperature Element shall be consider for oil temperature monitoring.**

**5.0 DESIGN & CONSTRUCTION FEATURES:**

**Pumps:**

- 5.1 Bidder shall follow the enclosed Ash Handling Specification (Annexure-03) also for other details.





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- 5.2 There shall be three (3) pumps in each series and each pump shall be interchangeable and casing for all the pumps shall be designed for the total discharge head of the series i.e. 120 MWC for Yadadri TPS.
- 5.3 Pumps shall be essentially slow RPM pumps with 1676m/min (Max) tip speed for the impeller suitable for highly abrasive slurry application.
- 5.4 Dynamic balancing test, static balancing test & visual inspection shall be conducted at works in the presence of purchaser.
- 5.5 Life of oil lubricated anti-friction type bearings shall be at least 40,000 running hours. Pump Bearings shall be of SKF/FAG/TIMKEN make.
- 5.6 Hydro test of complete pump assembly shall be done at 2 times the rated head or 1.5 times the shut off pressure of the last pump in series whichever is higher.
- 5.7 During inspection, the performance test (for head, capacity and power) of pump shall be carried out at reduced speed with calibrated test bed motor and readings for performance curve shall be taken on different points from shut off head to 120% of the rated flow (including rated flow).
- 5.8 The rotational speed of the impeller at design point shall not exceed 1000 rpm.
- 5.9 Bearing temperature shall be within 90° C including maximum ambient temperature under normal operating condition.
- 5.10 Material Test Certificate shall be provided for Impeller & impeller ring, Casing & casing ring, shaft and shaft sleeve. However, Compliance certificate for wet end parts which are proprietary in nature for pump manufacturers shall also be acceptable.
- 5.11 Ultrasonic Test shall be conducted for Shaft.
- 5.12 Dye Penetration Test shall be conducted for Shaft and Shaft Sleeve.
- 5.13 The stage inspections for above tests and final inspection shall be done by BHEL, Customer/ Consultant as per approved QAP of successful bidder.
- 5.14 Vibration level of each ash slurry pump shall be limited to as per the VDI-2056/BS 4675 standards.
- 5.15 The ash slurry sump geometry and configuration shall be such as to minimize Ash settlement, formation of vortices and air entrainment in the slurry as this may affect the operation of the slurry disposal pumps.
- 5.16 All centrifugal pumps shall have a drooping characteristics curve, with the head continuously increasing with decreasing flow to maximum head and the pumps shall preferably be non-overloading type beyond rated duty point.
- 5.17 The ash slurry pump shall be such that the noise level requirement as stated below can be complied with: -  
“Maximum noise level shall not exceed 85 dB (A) when measured at 1m away from noise emission source.  
Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment Protection Rules, 1986, schedule III, ‘Ambient Air Quality Standards’ in respect of Noise.  
Any Statutory changes in stipulations regarding noise limitation that may occur in future according to Central Pollution Control Board or Environment & Forest regulation during tenure of the Contract, the Supplier shall comply with the requirement”.





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- 5.18 The belt guard for belt driven pumps and coupling guards for directly driven pumps shall be provided by bidder.
- 5.19 The characteristics curves of each set of pumps shall match each other for equal load sharing in case of parallel operation and such pumps shall be identical and all parts shall be fully interchangeable. **Standard type pumps with a proven record of reliability shall only be provided.**
- 5.20 Complete technical data from pump supplier regarding head drop v/s mixture concentration and clearance diagram for impeller and casing and complete information shall be furnished.
- 5.21 Painting shall be as per attached painting requirements (14 Sheets) by TSGENCO.
- 5.22 Bidder shall submit the GA drawing of 1<sup>st</sup>, 2<sup>nd</sup> & 3<sup>rd</sup> stage ash slurry pumps with arrangement of suction and discharge of the pumps.
- 5.23 Pulleys shall be designed to withstand up to 250 kW Rating of Motor. Bidder shall furnish the calculations for selection of the pulley & no. of grooves in the pulley and V-belt selection.
- 5.24 Pump Bearings shall be designed to withstand up to 250 kW shaft power.
- 5.25 **Ash Slurry Pumps shall be provided with mounting pads/Notch provision for mounting of vibration detectors and Key Phasor.**

**Gear box:**

- 5.26 The maximum rise of oil temperature shall not be more than ambient +45 deg.
- 5.27 No oil leakage from gear box during inspection and testing is permissible.
- 5.28 Material Test Certificate (Chemical analysis, Tensile. Yield Stress. Elongation and Hardness) shall be provided for Casing, Gear & Pinion, output shaft, input shaft and Test certificate shall be provided for bearings.
- 5.29 The gear box shall be such that the noise level requirement as stated below can be complied with: -  
"Maximum noise level shall not exceed 85 dB (A) when measured at 1.5 m away from noise emission source.  
Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment Protection Rules, 1986, schedule III, 'Ambient Air Quality Standards' in respect of Noise.
- 5.30 Any Statutory changes in stipulations regarding noise limitation that may occur in future according to Central Pollution Control Board or Environment & Forest regulation during tenure of the Contract, the Supplier shall comply with the requirement"
- 5.31 DP test shall be performed for Gear and Pinion, input and output shaft. No crack or linear indication is acceptable.
- 5.32 NDT-UT shall be performed on Input, Output shaft and gear and pinion for sub surface defect as per ASTM - A 388.
- 5.33 No leakage is permissible in Leak test for Casing. The type of test shall be kerosene leak test.



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- 5.34 Vibration level of Gear Box shall not exceed 75 microns or shall be accepted as per VDI 2056 / BS 4675.
- 5.35 No deviation shall be acceptable regarding Standards/MOC of Gear Box from those given in this specification.
- Fluid Coupling:**
- 5.36 The operating pressure of clarified water or DMCW water of fluid coupling cooler shall be 6.0 Kg/cm<sup>2</sup>(g). The oil cooler shall be tested to withstand min. 10 Kg/cm<sup>2</sup> (g) water pressure during inspection.
- 5.37 Oil cooler shall be designed to withstand hydro test pressure of 1.5 times the working pressure of the liquid.
- 5.38 Ultrasonic test for shaft shall be carried out as per ASTM 388 and the log report shall be submitted during final stage inspection.
- 5.39 The Material test certificates/lab report/supplier's TC for mechanical and chemical properties of raw materials like impeller, runner, back casing, scoop casing, shaft, oil cooler tubes, parts of oil pump, bearing, oil pump motor, scoop tube, HT bolts, fabrication box shall be submitted.
- 5.40 The stage inspections which shall be carried out by the manufacturer shall include Balancing of impeller, runner, back casing as per ISO 1940 GR 6.3, DP test for shaft, runner, impeller etc for surface defect. The manufacturer shall submit the log report/inspection report for stage inspection tests during final stage inspection.
- 5.41 The final stage inspection shall be witnessed by BHEL/customer/customer's consultant at manufacturer's factory. The witness shall include the check of overall dimensions, temperature rise, oil leak test, performance test (torque Vs Slip Regulation), Run test (free running for noise and vibration), Overspeed test for soundness, hydro test for the cooler.
- 5.42 Pressure switches, pressure gauges, temperature gauges and temperature element shall be weather and dust proof as per IP65. Certificate for the same shall be submitted for review during inspection.
- 5.43 The dial size of the pressure/temperature gauge shall be 150 mm with white background and black lettering.
- 5.44 The model no. and maximum operating range of pressure gauges/switches shall be as per manufacturer's standard. The over range protection for gauges/switch shall be 150% of the maximum design pressure. The maximum operating temperature shall be as per system requirement.
- 5.45 Performance test certificates shall be submitted for oil circulating feed pump and the motor.
- 5.46 Vibration level of fluid coupling shall not be exceeded 75 microns or shall be accepted as per VDI 2056 / BS 4675.
- 5.47 Maximum noise level shall not exceed 85 dB (A) when measured at 1.5m away from noise emission source.

**Notes:**

- i. The bidder shall be OEM (Original Equipment Manufacturer) or their authorized distributor. In case, the offer is submitted by their authorized distributor, the OEM shall furnish undertaking on their letter head stating that "The OEM shall be responsible and stand guarantee for the quality of material, timely execution of the order and



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- submission of drawings/documents for approval for the order placed on their distributors. The OEM must clearly state the role of their distributor regarding their distributor to participate in the technical discussion and price negotiations. The OEM shall also confirm that the equipment and spares supplied through their distributor will be under their standard guarantee/warranty and OEM shall be liable for the services, repairs and replacements of the equipment/spares, if any.
- ii. The Make of offered Ash Slurry Disposal Pumps, Gear box and Variable speed fluid coupling with manual scoop and other accessories shall be subjected to approval by Customer / Customer's consultant. The bidder whose make is not approved by customer/ customer's consultant will not be considered for evaluation of their offer.

#### **6.0 ACCESSORIES:**


**Bidder shall include following items/accessories as part of ash slurry pump in their scope:**

- 6.1 V-belt and Pulleys along with Belt guard for 30 nos. pumps and motors.
- 6.2 Additional pulleys and belts for 2<sup>nd</sup> stage and 3<sup>rd</sup> stage of Ash Slurry Pumps to run the pump at 30 MWC.
- 6.3 Flexible Coupling between pump & gear box.
- 6.4 Coupling guards for couplings between pump & gear box, gear box & fluid coupling and fluid coupling & motor.
- 6.5 Pump shaft keys.
- 6.6 Suction and discharge gaskets, commissioning spares (as required), and all other accessories, which are not mentioned specifically but are essential for sound performance of the equipment.
- 6.7 HT bolts for ash slurry pumps and motors.
- 6.8 Base frame with foundations bolts, V-belt guard, anti-vibration pads, eye bolts etc. as required for the ash slurry pump and drive.
- 6.9 All necessary instruments to ensure smooth and satisfactory operation of the ash slurry pump and also for the safe and reliable operation of the pump.
- 6.10 Tool kit for operation and maintenance of the ash slurry pump.
- 6.11 Lubrication fittings as necessary for proper and easy lubrication of the equipment.
- 6.12 Base frames (15 sets) for 1<sup>st</sup> pump, Fluid Coupling, Gear Box and motors of each series shall be supplied by pump manufacturer. The 1<sup>st</sup> pump shall be direct motor driven along with fluid coupling and gear box in between pump and motor.
- 6.13 Base frames (30 sets) for balance pumps and motors in the series shall be supplied by pump manufacturer. The balance pumps of the series shall be V-belt motor driven.
- 6.14 **All the above pump accessories shall be dispatched along with pumps from Bidder's manufacturing works.**

**Bidder shall include following items/accessories as part of Gear Box in their scope:**

- 6.15 Lubricating Oil.
- 6.16 HT Bolts, nuts and washers for fitting the gear box on base frame.
- 6.17 Tool kit for operation and maintenance of the gear box.

**Each fluid coupling to include following minimum accessories as part of each fluid coupling.**

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<p>6.18</p> <p>6.19</p> <p>6.20</p> <p>6.21</p> <p>6.22</p> <p>6.23</p>	<p>Companion couplings (gear box side and motor side) along with nuts &amp; bolts and spacer plates (as applicable).</p> <p>HT bolts for fixing fluid coupling on base frames.</p> <p>All necessary instruments to ensure smooth and satisfactory operation of the fluid coupling and also for the safe and reliable operation of the equipment.</p> <p>Tool kit for operation and maintenance of the fluid coupling.</p> <p>Lubrication fittings as necessary for proper and easy lubrication of the equipment.</p> <p>Commissioning spares and all other accessories, which are not mentioned specifically but are essential for sound performance of the equipment.</p>
<p><b>7.0 TECHNICAL INPUTS TO BE FURNISHED/ CONFIRMED ALONG WITH THE OFFER:</b></p> <p>Following documents are to be necessarily enclosed for each type of Pump, Gear Box and Fluid Coupling by the bidder as a part of the Offer:</p> <ol style="list-style-type: none"> <li>1. Catalogues for the offered model.</li> <li>2. GA &amp; Sectional assembly drawing for Pump, Gear Box and Variable speed Fluid Coupling.</li> <li>3. Performance Curves.</li> <li>4. GD<sup>2</sup> Value of all rotating Parts</li> <li>5. Torque Speed Curve</li> <li>6. Bidder to specify the design standard followed for design of Fluid coupling and also specify the equivalent Indian Standard/MOC for foreign standards</li> <li>7. <b>Bidder shall submit signed copy of all the pages of enquiry specification.</b></li> </ol>	
<p><b>8.0 DRAWINGS/DOCUMENTS REQUIRED WITHIN 10 DAYS AFTER RECEIVING L.O.I.:</b></p> <p style="text-align: center;"><b>Successful bidder shall furnish the following in proper drawing/document format:</b></p> <ol style="list-style-type: none"> <li>8.0 GA, Sectional assembly with Technical data Sheet of Ash slurry pump complete with bill of material and its part numbers.</li> <li>8.1 GA, Sectional assembly with Technical data Sheet of Fluid Coupling complete with bill of material and its part numbers</li> <li>8.2 GA, Sectional assembly with Technical data Sheet of Gear Box complete with bill of material and its part numbers</li> <li>8.3 GA Drawing of Ash Slurry Pump Drive Arrangement (With V Belt Drive and Scoop type Fluid coupling and gear box drive)</li> <li>8.4 Performance curve and Torque Speed Curves</li> <li>8.5 Operational and Maintenance manual.</li> <li>8.6 Storage and Installation Manual</li> <li>8.7 Sizing calculations of pulley and V-belt selection.</li> <li>8.8 Selection calculations of mechanical and thermal ratings of gearbox and catalogues for the offered models.</li> <li>8.9 Lubrication schedule.</li> <li>8.10 QAP for BHEL/Customer/customer's Consultant approval.</li> <li>8.11 Painting Schedule for approval.</li> </ol>	



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**5X800 MW TSGENCO YADADRI TPS,**

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- 8.12 Load Data for designing Civil Foundation.
- 8.13 GA drawings of base frames, companion flange, pump and motor side pulleys, flexible coupling between pump and gear box.
- 8.14 Any other relevant document which may be felt necessary during execution of Contract.
- 8.15 Successful bidder shall submit all the above with proper title block within a week of receipt of LOI. Bidder's LD on account of delay on submission and revised submission of these documents/drawings shall not be entertained.
- 8.16 The approval time for Drawings/Documents from BHEL/Customer shall be considered by bidder as three weeks for their planning of supply of equipment within time frame.

#### **9.0 PAINTING:**

Painting of Ash Slurry Disposal Pumps shall be according to customer's (TSGENCO) painting requirements.

#### **10.0 INSPECTIONS & TESTING:**

1. All Quality plans shall be submitted in soft copy for BHEL/Customer/customer's Consultant approval. The inspection of Ash Slurry Pump, Fluid Coupling and Gear Box shall be done as per approved QAP.
2. Bidder shall give 15 days' advance written notice of equipment being ready for testing. Such tests shall be to bidder's account. The customer/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within 15 days of the date on which the equipment is notified as being ready.
3. Type & routine test report / certificates shall include details of standard to which the tests are performed, test parameters, acceptance criteria, test set up etc. used during the testing along with the test piece details/rating and the detailed test record and final test result.
4. All inspection, measuring and test equipment used by the contractor shall be calibrated periodically. Bidder shall maintain all relevant records of periodic calibration, instrument identification, and shall provide for inspection by bidder wherever asked specifically; bidder shall calibrate measuring / testing equipment in the presence of employer.
5. The details of the checks to be carried out for various components (MQP) are to be submitted within one month from the date of Purchase order by bidder for customer approval.
6. Dynamic balancing of Impeller (1 No per type) shall be witnessed by BHEL/TSGENCO/TCE/Third Party during in process inspection.
7. Pump assembly. Performance/Run Test, Strip Test (In case of Abnormal Sound) shall be witnessed by BHEL/TSGENCO/TCE/Third Party during final inspection.
8. Overall dimensions, temperature rise, oil leak test, Performance test (Torque Vs Slip Regulation), Run test (free running for noise and vibration), hydro test for the cooler shall be checked/verified during inspection of fluid coupling. However, the inspection shall be done as per approved QAP.
9. Bidder shall maintain strict quality norms and standards for Bought out/ self manufactured items through its wide network of quality departments throughout the country who carryout stage and final inspection of the product as per quality standards agreed by engineering/quality specialists

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10. All brought out items shall be as per TSGENCO approved Vendor List.
11. After completion of inspection the material will be treated as cleared for dispatch by BHEL/ Customer/customer's Consultant inspector, if inspection is OK as observed by Inspection Engineers.

#### **11.0 TESTING PARAMETER:**

1. Hydro test of Casing shall be done at 2 times the rated head or 1.5 times the shut off pressure of the last pump of the series whichever is higher.
2. During inspection, the performance test (for head, capacity and power) of pump shall be carried out at reduced speed with calibrated test bed motor and readings for performance curve shall be taken on different points from shut off head to 120% of the rated flow (including rated flow).
3. Bearing temperature shall be within 90° C including maximum ambient temperature under normal operating condition.

#### **12.0 OPERATION & MAINTENANCE MANUAL**

O & M manual shall contain the following.

1. Principle of operation of the equipment.
2. Details of preventive / repair maintenance for equipment and accessories used.
3. Details about the general specifications, design capacities of equipment, their function.
4. Equipment Bidder's address, telephone nos., contacts person details to be furnished.
5. Required Dismantling devices, tools etc.,
6. List of DO's and DO NOT's.
7. Test certificates.
8. All drawings.
9. Calculations.
10. O& M Manual for Slurry Pump.
11. O& M Manual for Fluid coupling.
12. O& M Manual for oil circulating pump and motor.
13. O& M Manual for oil cooler.
14. O& M Manual for Gear Box.
15. Storage and erection instructions.
16. Proper procedures & sequence of operation.
17. Details of consumable.

#### **Note:**

- (a) All manuals shall be supplied in proper bound books or in folders, preferably in A4 size.
- (b) The volume and section number shall be intimated by the Bidder.
- (c) Prospective Bidder will submit the regular progress reports for self-manufacturing & their bought-out item's equipment ordering /manufacturing status, drgs status once in fifteen days.
- (d) Bidder shall directly send O&M Manuals to BHEL-ISG HQ as per distribution schedule given below in Clause 15.0 with covering letter copy to Project Manager, BHEL-ISG,





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Bengaluru. BHEL Project Manager shall co-ordinate and ensure submission to Customer/customer's Consultant for the equipments as per BHEL standard practice.

### 13.0 MANDATORY SPARES:

Spares shall be dispatched in pre-decided lots in containers/secure boxes. The containers/secure boxes should only contain spares and no other items which are part of main supply. All boxes/containers shall be distinctly marked in red colour with boldly written "S" mark on each face of the containers/secure boxes as indication of items to be directly handed over to customer. BBU number should be put on the items in a durable manner (Punching/painting, etc.) so that the items can be easily linked with approved BBU for ease of handing over to customer. Expiry date for short shelf life items (oils, chemicals, insulation materials, etc.) should be put on the item as well as the packing box.

The list of Mandatory spares is following: -

S. No.	ITEM DESCRIPTION	QTY	Units
<b>5.01</b>	<b>For Ash Slurry Pump</b>		
1	Complete set of Ash Slurry Pump	2	No.
2	Impeller with wearing parts	4	No.
3	Casing liners	4	Sets
4	Liners (Suction side and gland side)	4	Sets
5	Gland Packing	6	Sets
6	Pump bearings	4	Sets
7	Shaft sleeves	4	Sets
8	Pump shaft	2	No.
9	<b>Gear box</b>		
A	Fan for Gear box	2	Set
10	<b>Fluid Coupling</b>		
A	Resilient Plate for Fluid coupling (As applicable)	8	Nos.
B	Fusible Plug for Fluid coupling	8	Nos.
11	<b>Motors</b>		
A	Driving End & Non-Driving End Bearing	6	Set for each type and rating of Motor
B	Cooling Fan	4	No. for each type and rating of Motor
C	Motor Terminal Block	10	No. for each type and rating of Motor
D	Complete Set of Coupling	2	Set
12	<b>Field Instruments</b>		
A	Transmitters/ Gauges/Switches etc. along with relevant accessories	20	% of total (or at least 4), for each type along with accessories (whichever is higher).
B	Temperature Element (RTD/Thermocouple) with thermowell	20	
C	Junction Box	20	





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C.1	Terminals in Terminal blocks	20	Nos of each type
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#### 14.0 COMMISSIONING SPARES:

**The required commissioning spares shall be included in bidder's scope.** The list of commissioning spares for Pump, fluid coupling and gear box shall be furnished along with offer. These commissioning spares shall be supplied in three lots within three months of intimation by BHEL. The lot size of the three lots shall be decided during detail engineering.

**14.1** The following minimum commissioning spares for Slurry Pumps shall be included in bidder's scope:

- a) Required Oil/Grease for all the Ash Slurry Pumps-1 Lot

**During commissioning of the Ash Slurry Pump, fresh oil/grease supplied by bidder shall be used for slurry pump in presence of BHEL during commissioning of Slurry System at site.**

**14.2** The following minimum commissioning spares for the fluid couplings shall be included in bidder's scope:

- a) Required lubricating oil for all the fluid coupling and oil cooler-1 Lot
- b) Rubber spacer between couplings of oil pump and motor-8 Nos
- c) Fusible plug.-4 Nos.
- d) Multi disc coupling -4 Nos
- c) Pressure gauge of each type and size.-2 Nos
- d) Pressure switch of each type and size.- 2 Nos
- e) Temperature gauge of each type and size.- 2 Nos
- f) Temperature element of each type and size.-2 Nos
- g) Oil Seal-2 Sets\*
- h) O Ring - 2 Sets\*

\* Sets comprise fulfill the requirements of 1 No fluid coupling

**Firstly, lubricating oil present in Fluid Coupling (if required) shall be drained during pre-commissioning visit of the bidder's executive at site. During commissioning of the Fluid Coupling, fresh oil supplied by bidder shall be filled up to maximum level of fluid coupling in presence of BHEL during commissioning of Fluid Coupling at site.**

**14.3** The following minimum commissioning spares for Gear Box shall be included in bidder's scope:

- a) Required lubricating oil for all the Gear Boxes-1 Lot
- b) Oil seal for Gear box-2 Sets\*



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Firstly, lubricating oil present in Gear Box (if required) shall be drained during pre-commissioning visit of the bidder's executive at site. During commissioning of the Gear Box, fresh oil supplied by bidder shall be filled up to maximum level of Gear Box in presence of BHEL during commissioning of Gear Box at site.

#### 15.0 ESSENTIAL SPARES:

The Bidder shall furnish Essential Spares list required for initial three years for successful operation of the Ash Slurry Disposal Pump.

#### 16.0 TOOLS & TACKLE: -

The bidder shall supply with the equipment **three complete set** of special tools and tackle as required for the erection, assembly, dismantling & maintenance of the equipment. These special tools will also include special material handling equipment, jigs & fixtures for maintenance and calibration/ readjustment, checking & measurement aids etc. A list of such tools & tackle shall be submitted by the Bidder along with the offer.

However, minimum tools and tackles for Ash Slurry Pump in **one set** considered by bidder is as follows: -

SI No	Item Description	Quantity
1	DE spanner set up to 32	1 Set
2	Ring spanner set up to 32	1 Set
3	DE spanner - 50-46	1 No
4	Ring spanner - 50-46	1 No
5	Hit spanners - 75 (Ring)	1 No
6	Hit spanner - 65 (Ring & DE)	1 No
7	Slide wrench - Up to 18"	1 No
8	Pipe wrench - up to 18"	1 No
9	Ball pin Steel Hammers	1 No
10	22lbs Steel Hammers	1 No
11	Chisel	1 No
12	Tin cutter	1 No
13	Cutting plier	1 No
14	Nose plier	1 No
15	Cir clip player (In side & outside)	1 No
16	Center punch	1 No
17	Screw driver UP to 16"	1 No

Similarly, three complete set of tools and tackles shall be provided for fluid coupling and gear box also and the list of tools and tackles of slurry pump, fluid coupling and gear box shall be submitted along with offer. The list of tools and tackles shall be discussed and finalised.

#### 17.0 DISTRIBUTION OF DRGS/ DOCUMENT DURING DETAIL ENGINEERING:

- a) Distribution of drawings/ documents
- i) For Approval and Information category drgs :  
Initial submission – Soft copy (AutoCAD version and Pdf version)  
Commented copies back to the sender- Soft copy (Pdf version)



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Resubmission of revised drg – Soft copy (AutoCAD version and Pdf version).

- ii) Erection Drgs: Soft Copy
- iii) Instruction Manuals / O & M Manuals  
6 hard bound copies to BHEL HQ and soft copy also.
- iv) Test Certificates: Soft copies to BHEL HQ
- b) Considering the criticality of the project requirement, all out efforts shall be made to re-submit the drawings / documents as early as possible.
- c) Final distribution of copies of all Category 1 approved drawings/documents shall be submitted by successful Bidder to BHEL / Customer / customer's Consultant as per distribution schedule given above.

**18.0 DRAWINGS ATTACHED:**

1. ANNEXURE – 01 Project information
2. ANNEXURE - 02 GA of Ash Slurry Pump Houses
3. ANNEXURE – 03 Ash Handling Specification
4. ANNEXURE- 04 Painting Specifications (14 sheets).
5. ANNEXURE – 05 (Approved Sub Vendor List)
6. ANNEXURE – 06 (HSE Manual)
7. ANNEXURE – 07(Category of Inspection)
8. ANNEXURE- A & B Electrical & C& I Scope & Specifications
9. ANNEXURE- C-Electrical & C& I Vendor list