BHARAT HEAVY ELECTRICALS LIMITED
HEAVY POWER EQUIPMENT PLANT
RAMACHANDRAPURAM :: HYDERABAD-502032 (INDIA)

PUMPS DIVISION
(web site : www.bhel.com)

Notice inviting

EXPRESSION OF INTEREST

For geared, variable speed Hydraulic Couplings

Suitable to drive Boiler Feed Pumps of Thermal Power Projects.

(This document contains 14 sheets)

Due date for Response to this EOI : 14-8-2017

Contact Person at BHEL for correspondence on this EOI:
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Notice inviting EXPRESSION OF INTEREST (E.O.I)
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SECTION-1 : SUMMARY OF REQUIREMENTS OF THIS EOI

1.1 ABOUT BHEL

Bharat Heavy Electricals Limited (BHEL), a Government of India Undertaking, is one of the largest engineering and manufacturing enterprises in India. BHEL is engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products and services for the core sectors of the economy, viz. Power, Transmission, Industry, Transportation, Renewable Energy, Oil &Gas and Defense, with over 180 products offerings to meet the needs of these sectors.

1.2 ABOUT PUMS DIVISION OF BHEL HYDERABAD

Pumps Division of BHEL Hyderabad unit, is engaged in the design and manufacture of various important types of pumps required for the thermal power plants like the Boiler Feed Pump, Boiler Feed Booster Pump, Condensate Extraction Pump and Condenser Cooling Water Pump, catering to power plant unit ratings up to 1000MW

1.3 ABOUT THIS E.O.I.

The AC Motor Driven Boiler Feed Pumps used in thermal power plants are high speed centrifugal pumps, and they are provided with geared, variable speed hydraulic couplings for step-less regulation of pump speed to suit the unit operational requirements.

The objective of this EOI is to elicit responses from leading, experienced original equipment manufacturers (OEMs) of such “Geared Variable Speed Hydraulic Couplings”, to meet the power and torque transmission requirements of Boiler Feed Pumps for thermal power plants of various unit ratings from 110MW to 600MW Sub-Critical sets and 660MW & above rating Super Critical sets.

The requirement of Hydraulic Couplings is segregated into following three Product Material Directory (PMD) categories, based on their size:

a) **Category-1 :** (F.SD.126) – Suitable for BFPs of 110MW to 270MW sets

b) **Category-2** : (F.SD.018) – Suitable for 50% duty BFPs of 500 & 600MW sub-critical sets and 30% duty BFPs of 660MW & 800MW super critical sets

c) **Category-3** : (F.SD.121) – Suitable for 50% duty BFPs of 660MW and 800MW sets

Details of the typical rated design parameters required for the hydraulic couplings of each of these three categories are indicated in the technical requirements section of this EOI.

1.4 RESPONSE TO THE E.O.I

Eligible OEMs are requested to submit their response to this EOI along with all supporting documents, to the following address :

Sri Ch.Rajesh,
Dy Manager / Pumps Engg,
BHEL, Ramachandrapuram,
Hyderabad 502032
Telangana, India

(e-mail : chrajesh@bhel.in , Telephone : +91 2318 4738)

Soft copies of the EOI response documents may please be sent by e-mail and hard copies by courier post.

The EOI response shall contain all the required information pertaining to :

a) Pre-Qualification Requirements (PQR) detailed at Section-2,
b) Technical Specification Requirements (TSR) detailed at Section-3,
c) Financial details and other particulars of the company, as specified in this document.

Only the respondents fully meeting the specified Pre-Qualification Requirements (PQR) and Technical Specification Requirements (TSR) will be eligible for further evaluation.

The eligible manufacturers from these responses will be evaluated in detail and the OEMs meeting all the requirements will be enlisted in the respective category of BHEL standard Product Material Directory (PMD) for sending limited tender enquiries for these equipment, with due approval of end customers.

LIST OF DOCUMENTS TO BE SENT ALONG WITH EOI

1. Covering letter in response to our EOI request, along with following :
2. Specific, Point-wise confirmations to the Pre-qualification Requirements (PQR)with supporting documents, **as per Section-2**
3. Specific, Point-wise confirmations to the Technical Specification Requirements (TSR) with supporting documents **as per Section-3.7**
4. Company Financial Particulars & Contact Persons details **as per Section-4**

SECTION-2 : PRE-QUALIFICATION REQUIREMENTS (PQR)

S.NO.	PRE-QUALIFICATION REQUIREMENT	ACCEPTANCE CRITERIA TO QUALIFY	SUPPORTING DOCUMENTS REQUIRED
1	Design, manufacture and shop testing Capability	Capabilities for in-house design, manufacture and shop testing of the specified size original equipment	Details of the in-house design, manufacture and shop testing facilities available
2	Compliance to the technical specification requirements	Conformance to all the requirements as per BHEL technical specification	Point-wise confirmations to BHEL technical specification along with supporting technical documents
3	Experience Record of similar or higher size equipment supplied so far.	Supply of similar or bigger power rating hydraulic couplings for Boiler Feed Pumps to at-least two thermal power stations, and which are in satisfactory operation for a minimum period of one year each.	a) Reference List of supplies made so far b) Un-priced PO copies of the two reference supplies c) End-user certificates of the two reference stations
4	Meeting the After Sales Service requirements	Availability of service center and technical experts to meet the after sales service requirements for the supplied equipment at project sites.	Details of the service centers and technical experts

For geared, variable speed Hydraulic Couplings

Suitable to drive Boiler Feed Pumps for 660-800MW Super Critical Power Projects.

SECTION-3 : TECHNICAL SPECIFICATION REQUIREMENTS (TSR)

3.1 TECHNICAL PARAMETERS FOR 110MW, 270MW & 600MW SETS

S.NO.	TECHNICAL PARAMETER	110MW	270MW	500MW	600MW
		50% duty	50% duty	50% duty	50% duty
1	Drive Motor speed (RPM)	1485	1485	1485	1485
2	Type of Drive Motor	4 Pole, AC, SQIM	4 Pole, AC, SQIM	4 Pole, AC, SQIM	4 Pole, AC, SQIM
3	Maximum output speed required (RPM)	4500	5300	6000	6500
4	Design Point speed of BFP (RPM)	4300	5000	5200	5500
5	Maximum Power Transmitted (KW)	3000	4000	7500	9500
6	BFP Drive Motor Rating (KW)	3500	4600	10000	12000
7	Grid Frequency for AC supply (Hz)	50 +/- 5%	50 +/- 5%	50 +/- 5%	50 +/- 5%
8	Oil supply quantity required for external lubrication (LPM)	200	200	250	300
9	Maximum ambient temperature (Deg.C)	50	50	50	50
10	Maximum CW temperature (Deg.C)	45	45	45	45
11	Maximum Relative Humidity (%)	95	95	95	95

SECTION-3 : TECHNICAL SPECIFICATION REQUIREMENTS (TSR)

3.2 TECHNICAL PARAMETERS FOR 660MW & 800MW SETS

S.NO.	TECHNICAL PARAMETER	FOR 660MW SETS		FOR 800MW SETS	
		30% duty	50% duty	30% duty	50% duty
1	Drive Motor speed (RPM)	1485	1485	1485	1485
2	Type of Drive Motor	4 Pole, AC, SQIM	4 Pole, AC, SQIM	4 Pole, AC, SQIM	4 Pole, AC, SQIM
3	Maximum output speed required (RPM)	6700	6300	6000	6000
4	Design Point speed of BFP (RPM)	6500	5800	5500	5400
5	Maximum Power Transmitted (KW)	9500	13500	10500	16500
6	BFP Drive Motor Rating (KW)	12000	17500	14000	22000
7	Grid Frequency for AC supply (Hz)	50 +/- 5%	50 +/- 5%	50 +/- 5%	50 +/- 5%
8	Oil supply quantity required for external lubrication (LPM)	350	350	350	350
9	Maximum ambient temperature (Deg.C)	50	50	50	50
10	Maximum CW temperature (Deg.C)	45	45	45	45
11	Maximum Relative Humidity (%)	95	95	95	95

SECTION-3 : TECHNICAL SPECIFICATION REQUIREMENTS (TSR)

3.2 SCOPE OF HYDRAULIC COUPLING AND ITS ACCESSORIES :

The Hydraulic Coupling shall be provided with the following accessories.

a. 2 x 100% Working oil coolers and 2 x 100% Lube oil coolers (that is, duplex type) along with change-over device on oil side.

b. 1 No. AC motor driven auxiliary lube oil pump to provide external lubrication oil to the bearings of Boiler Feed Pump and its Drive Motor.

c. 1 No. electrical actuator and linkages along with the necessary power amplifier unit, to operate the fluid coupling scoop tube.

d. Set of Instrumentation for the operation and control

e.. Duplex strainer in lube oil line.

f. Complete lube oil piping, working oil piping and vent piping to be connected between hydraulic couplings and coolers and drain piping with a valve to drain the oil from oil tank of hydraulic coupling. All necessary flanges, packings, reducers, elbows, bolts and nuts required in these lines are included in the scope.

g. Holding down bolts to secure Hydraulic coupling to common foundation frame and J-type foundation bolts & nuts for coolers

h. Counter flanges, bolts, nuts & gaskets for cooling water flanges.

i. Rapid start device (if required) to accelerate the pump from stand by condition to normal running speed, within 15 seconds.

j. Vibration pads shall be provided on bearing housings, for mounting the vibration probes

3.3 DESIGN & CONSTRUCTION REQUIREMENTS :

3.3.1 Hydraulic Coupling :

Hydraulic coupling shall be designed for continuous operation, infinitely variable speed over the entire range, remote controlled and totally enclosed type. It shall meet the maximum power and speed requirements of the BFP. Operating range on lower side shall be up to 20% of the maximum output speed.

The hydraulic coupling shall be complete with Stainless Steel impellers & casing, sleeve type journal bearings and tilting pad type thrust bearings (of Kingsbury / Michell / equivalent make) for input and output shafts. The coupling internals shall be enclosed in carbon steel housing with removable covers.

A centralized lubrication oil system shall be provided integral with the hydraulic coupling, comprising oil tank, duplex type oil filters to remove solid particles up to 5 microns, control pump for oil regulation, regulating valves, stainless steel scoop tube, working oil coolers, lube oil coolers, oil temperature and pressure gauges, etc. A separate AC Motor driven auxiliary oil pump shall be provided.

The total time taken by the coupling to accelerate from minimum scoop position to the maximum (100%) scoop position shall be less than 15 seconds after receipt of starting signal from the Drive Motor. If required, a quick start mechanism/device shall be incorporated in the hydraulic coupling to meet the above starting time requirement.

3.2.2 Step-Up Gear Unit :

Gear boxes shall be totally enclosed and oil lubricated. Positive lubrication shall be provided to all the bearings and particularly to the working surfaces of the gear teeth.

The gear unit shall be designed for continuous service at the speeds required by the application.

Applicable Gear design standard shall be AGMA 420, 421 / API / equivalent international standard

The gears shall be of double helical type, manufactured by hobbing process, or approved equal, and dynamically balanced shall be used. The high speed pinion shall be of heat treated forged steel with integral shaft. The low speed gear shall be of forged steel securely keyed to the input shafts. Bidders shall submit detailed specification of the materials used including factor of safety etc.

The gearing shall be enclosed in an oil and dust proof gear case made of close grained cast iron or fabricated steel.

The gear case shall be horizontally split and stress relieved before machining. The faces of adjoining sections shall be accurately machined to provide oil tight joints. Two oil level gauges,

drain, fill vent, thermometer dipstick and other required connections equipped with approved mountings, valves and fittings shall be furnished for the gear casing.

The housing shall be generously proportioned and of rigid construction to provide permanent alignment of rotating parts and protection from possible external vibration. The arrangement shall be such that it will be possible to lift gear case cover without disturbing the alignment of shaft, gear and pinion.

Service factors for the gearing shall not be less than the following values :-

Motor driven pumps (Combined gearing/Hydraulic coupling) …1.4

The gearing and bearing shall be pressure lubricated with oil supplied from the central lubrication system of the respective pump sets.

The gear box shall be provided with separate thrust bearings of conservative design to meet the worst duties under transients.

3.2.3 Bearings :

The bearings shall be amply proportioned and designed to withstand all operating conditions. They shall be of split sleeve type, bronze/steel backed with high grade centrifugally cast tin base babbit lining. Bearings shall be accurately machined to assure perfect alignment. Gear journal bearings shall have babbited thrust faces next to the gear to act as locating surfaces for the gear train.

3.2.4 Lubrication system & Working oil System :

Each hydraulic coupling shall be provided with built in lubrication system to also cater for external lubrication of BFP and its Drive Motor bearings. It shall comprise oil reservoir, main oil pump, auxiliary oil pump, duplex oil filter, and oil coolers with interconnecting piping and fittings.

The main oil pump shall be driven by the motor shaft and shall be capable to supply lube oil for external requirement also.

Aux. Oil pump shall be driven by an AC motor mounted on the hydraulic coupling itself. AC motor shall be suitable for 415v, 3-phase, 50HZ supply. These motors shall comply with standard International Specifications

Discharge system shall be common for main oil pump and aux. Oil pump with suitable NRVs in each line. The oil to be used shall be the same for lubrication and torque transmission. Oil piping shall be of stainless material sch. 80 and shall be supplied in pickled condition.

3.2.5 Lubrication Oil Coolers & Working Oil Coolers :

Each hydraulic coupling set shall be provided with 2 x 100% working oil coolers and 2 x 100% lube oil coolers.

The coolers shall be adequately rated as per heat load calculations and shall have the necessary arrangements for change-over of the cooler without interrupting the oil flow.

Both the coolers (Lubricating oil and working oil coolers) shall be utilized in a closed loop system employing demineralized water of condensate quality as the cooling medium. The coolers shall be designed to accept the above system arrangement.

The shell of the coolers shall be of mild steel construction. Suitable corrosion allowance shall be added to all the carbon steel and cast iron parts including shell, flanges etc.

The tubes shall be of type 304 stainless steel. The tube bundle shall be of removable type. The tubes shall be roller expanded and flared at the ends. Provision for differential expansion shall be suitably incorporated.

The coolers shall be so designed that the cooling medium will flow in the tube side. Suitable fouling allowance shall be taken into the design consideration based on the relevant standards.

The design pressure of the coolers on the water side not be less than 10.0 kgs/sq.cm.

Provision shall be made for complete venting and draining of all the parts of the heat exchangers. Connections along with temperature and pressure indicators shall be provided on the inlet and outlet branches of the water side and also on the shell side of each heat exchanger.

3.2.6 Scoop Tube Actuator :

Electrical actuator shall be provided for positioning the scoop tube.

Following accessories shall be provided with the actuator :

a. Servo Motor
b. Position feed back transmitter.
c. Four signalling contacts.
d. Electronic power positioner with IP-55 enclosure and suitable for field mounting.
e. Transformer (if required)
f. Mains rectifier (if required)
g. Hand wheel arrangement to manually position the actuator.

The servomotor of the actuator should be designed for 240v, Single phase, 50HZ supply with possible variation of ±10% on voltage ±5% variation on frequency. If necessary, a transformer can be supplied to suit the actuator voltage requirement. The motor shall be capable of withstanding electrodynamic stresses and heating if started at 110% voltage. The motor shall be capable of running at 80% voltage for a period of at-least 5 minutes.

The actuator shall have IP55 enclosure. Position feed back transmitter shall be of 2 wire, 4-20 mA D.C output type and suitable for 24v D.C supply. Actuator shall have all metal gear trains self-linked gearing shall be provided. Electronic power positioner shall be suitable to accept 4-20 mA control signal.

Motors shall have class-B, non-hygroscopic insulation scaled with two additional dips and bakes of epoxy finish. Motors shall be furnished with totally enclosed self-ventilated, weather proof, dust tight enclosures suitable for outdoor service. Double shielded, grease pre-lubricated, re-greasable, antifriction bearings having minimum life rating of 40,000 hours shall be used. Motor leads shall be terminated in the limit switch compartment.

3.2.7 MATERIALS OF CONSTRUCTION :

The materials of construction shall be as mentioned in this specification, and where not specifically mentioned shall be those with which the Supplier has had previous successful operating experience in similar applications for a period of at-least 5 years. Material standards of all major component shall be indicated.

3.3 INSTRUMENTATION & CONTROL :

The Hydraulic Coupling is to be provided with required Instrumentation & Control for its safe operation and control. The instrumentation shall meet the following technical requirements.

1) All pressure and temperature instruments shall have metric scales, Graduation shall be in kg/sq cm for pressure instruments and in degree centigrade for temperature instruments.

2) All the instruments used shall be of the latest proven design for which performance and high availability have been demonstrated by a record of successful operation.

3) All instruments, devices must be capable of operating continuously under ambient temperature of 55 deg C and relative humidity of 95% without losing performance, accuracy etc.

4) Measuring instruments and sub-systems used with the hydraulic coupling shall be from reputed & experienced manufactures, whose guaranteed and trouble free performance has been proven for at-least two years.

5) All electronic Pressure Transmitters shall be suitable for 24V DC power supply. Output signal and power supply wiring of electronic Pressure Transmitters shall be terminated on separate junction box

6) All Resistance Temperature Detectors (RTDs) shall be ungrounded, duplex, 4 wire type, Platinum one hundred ohm at 0 deg.C and shall conform to DIN 43760. RTDs shall be cabled and terminated on junction boxes.

7) The accuracy of the temperature gauges shall be ±1 %. All pipe thermometers shall be provided with thermowells . Contact rating of contact thermometers shall be 5A, 240V AC with 2xSPDT contacts.

8) Pressure gauges shall have sensing element as bourdan tube / bellows / diaphragm depending on the system pressure. The accuracy of pressure gauges shall be ± 1%. All

required accessories i.e. snubbers, pulsation dampers, syphons shall be provided with pressure gauges wherever required.

3.4 INSPECTION REQUIREMENTS :

The following minimum program of inspection / tests is to be followed :

1) Material inspection for chemical composition, mechanical properties for major components like gears, pinions, primary & secondary wheels, shell, shafts and cooler tubes etc.

2) Magnetic Particle Inspection of Fully machined shafts, gear / pinion rims, primary / secondary wheels.

3) Inspection for Dimensional conformity and Interchangeability

4) Hydraulic pressure testing of the coupling body, oil tank, main oil and lubricating oil coolers.

5) Dynamic balancing of rotating elements and all rotor assemblies

6) Measurement of backlash of gear wheels and pinions and teeth contact, before and after functional testing.

7) Inspection of the condition of the bearings after functional test

8) Routine tests for electrical actuators and AC motors of aux. oil pump

3.5 FUNCTIONAL REQUIREMENTS :

1) Bearing Metal Temperatures : < 100 DegC
2) Bearing Oil Temperatures : At inlet < 50 DegC and at outlet <70 DegC
3) External Lubrication oil - header pressure : 2 Kg/SqCm
4) Housing Vibration levels – as per ISO 2372
   Acceptable Limits :
   a) When mounted on rigid foundation : < 2.8 mm/sec (rms)
   b) When mounted on flexible (spring) foundation : < 4.5 mm/sec
5) Noise levels – as per design specification ISO 3740-2000
   To be measured at 1.5 m away from equipment and 1m above mounting floor
   Permissible limit : 85dBa

3.6 FUNCTIONAL PERFORMANCE TESTS AT WORKS:

The functional tests on each hydraulic coupling shall include the following checks:

- Check for smooth running of hydraulic coupling on no load.
- Check and set the oil flow rates.
- Check for smooth functioning of scoop tube positioning.
- Measure and record oil pressures, temperatures and bearing temperatures.
- Measure and record vibration and noise levels.
- Measure and record mechanical losses on no load.
- Check for smooth operation of aux. oil pump motor.
- Check for proper functioning of actuator.

3.7 TECHNICAL INFORMATION REQUIRED ALONG WITH E.O.I

Following technical information is to be furnished along with the EOI response :

1) Technical Catalogue / Brochure of the Hydraulic Coupling

2) Typical cross sectional assembly drawing indicating the major parts and their materials of construction

3) Typical outline drawing of the hydraulic coupling indicating overall dimensions and weight.

4) Technical data sheet of the hydraulic coupling indicating following technical data :

- Input and output speed
- Design value of minimum slip (percentage)
- Mechanical and slip losses of the coupling at the rated parameters
- AOP motor rating
- Materials of construction of hydraulic coupling and coolers
- Standard followed for design of gears
- External oil available for lubrication of BFP bearings
- Oil tank capacity
- Details of the lub oil and working oil coolers
- Cooling water requirement of lub oil and working oil coolers
- Details of the electrical actuators and their accessories
- List of instrumentation provided with the hydraulic coupling
- Expected vibration & noise levels at works and at site

SECTION-4 : DETAILS OF THE RESPONDING COMPANY

1. COMPANY PARTICULARS

A) Year of establishment of the company
B) Details of the company head quarters
C) Details of the registered manufacturing works
D) Details of world-wide branches, if applicable
E) Annual Production Capacity of such Hydraulic Couplings
F) Financial Information – Business turnover & Profit/loss statements for last 3 years
G) Details of company's Quality & Environmental Management Systems (ISO 9001, ISO 14001, OHSA 18001)

2. INFORMATION ABOUT CONTACT PERSONS

A) Name & particulars of Chief Executive of the company
B) Name & particulars of the Head of Marketing Division
C) Name & particulars of the Indian operations head
D) Name & particulars of the person nominated for this EOI correspondence