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HYDRAULIC COUPLING FOR 25% AND 30% DUTY MHI DESIGN BFPs OF 660MW & 800MW SUPER CRITICAL POWER PLANTS

1.0.0 INTENT OF SPECIFICATION:

This specification is intended to cover the technical requirements of the hydraulic coupling required between Boiler Feed Pump and its drive motor for achieving variable speed drive.

2.0.0 SCOPE OF SUPPLY:

2.1.0 Design Engineering, manufacture, inspection, testing, packing and forwarding the hydraulic coupling and accessories to site.

2.2.0 Each hydraulic coupling shall be supplied with following accessories.

a. 2 x 100% working oil coolers and 2 x 100% lube oil coolers (duplex type) along with change-over device on oil side.

b. 1 No. AC motor driven auxiliary lube oil pump to cater for external lubrication.

c. An electrical actuator and linkages along with the necessary power amplifier unit shall be provided by the Bidder to operate the fluid coupling scoop tube. The time required by the actuator to operate the scoop from its minimum position to the maximum position shall be indicated in the Bid. The actuator and the power amplifier unit shall be compatible with microprocessor based Distributed Digital Control & Monitoring system (DDCMIS) procured by Owner.

d. Instrumentation as specified at Cl.No. 6.0.0.

e. 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 shall be included in the scope. 40 meters of pipe and 30 Nos. of elbows per straight run per cooler shall be supplied.

f. Duplex strainer in lube oil line.

g. Holding down bolts to secure Hydraulic coupling to common foundation frame.(Applicable for Var-01 only)

h. Foundation rails with suitable foundation bolts and holding down bolts etc as required for civil foundation.(Applicable for all Variants except Var-01)

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

j. J-type foundation bolts & nuts for coolers.

k. Rapid start device to accelerate the pump from stand by condition to normal running speed, within 15 seconds. Solenoid valves of rapid start device shall be suitable for 24 V, DC power supply.

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

3.0.0 TECHNICAL PARAMETERS (AT 50 Hz) :

(Powers & speeds as per cl.no. 15.0.0)

Input speed (RPM)	:	1495
Direction of rotation of BFP seen from drive end:		CW
GD sq. Value of BP (kg. Sq.m)	:	8.4

4.0.0 SPECIFIC REQUIREMENTS:

4.1.0 Hydraulic Coupling:

Hydraulic coupling shall be of full duty, generously designed, infinitely variable, remote controlled and totally enclosed type. It shall be adequately rated to meet the requirement of the boiler feed pump characteristics during start-up and load fluctuations. Operating range on lower side shall be upto 20% of the maximum output speed.

The hydraulic coupling shall be complete with Stainless steel impellers & casing, and Kingsbury or Michell Tilting pad, type thrust bearings for input output shafts. An enclosing steel housing with removable covers, oil sump, duplex filters to remove all particle upto 5 microns, oil temperature and pressure gauges, control pump for oil regulation if provided, regulating valves, stainless steel scoop tube, oil coolers etc., shall be furnished to from a centralised lubrication system for the total pump set. Bidder shall also state in their offer the effect on fluid coupling if a reversal of pump rotation occurs through the failure of the non return valve.

The starting time from minimum scoop position to 100% scoop position shall be less than 15 seconds after receipt of starting signal by motor, which operating single or in parallel with another Boiler Feed Pump. A quick start device shall be incorporated to meet the above requirement for auto stand by operation of Motor Driven Boiler Feed Pump.

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4.2.0 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 specifically designed for continuous service at the speeds required by the application. Precision and accuracy of manufacture is essential in order to minimize problems of vibration. Impact-stresses, noise distortion and lubrication.

Double helical gears cut by the 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

These two gear boxes shall be in accordance with AGMA 420 and 421, as applicable. 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.

4.3.0 <u>Bearings</u>:

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.

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4.4.0 Lubrication & Working Fluid System:

Each hydraulic coupling shall be provided with built in lubrication system to also cater for external lubrication of 300 lpm. 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 the Owner's specification for electrical motors annexed to this specification. 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 seamless sch. 80 and shall be supplied in pickled condition.

4.5.0 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 and shall have the necessary arrangements for change over the cooler without interrupting the oil flow.

Both the coolers (Lubricating oil and working oil) 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

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indicators shall be provided on the inlet and outlet branches of the water side and also on the shell side of each heat exchanger.

4.6.0 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 signaling 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 atleast 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 prelubricated, regreasable, antifriction bearings having minimum life rating of 40,000 hours shall be furnished. Motor leads shall be terminated in the limit switch compartment.

5.0.0 MATERIALS OF CONSTRUCTION:

The materials of construction shall be as mentioned in this spec. 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 atleast 5 years. Material standards shall be indicated in the quality plans.

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6.0.0 INSTRUMENTATION & CONTROL:

6.1.0 General:

The controls and instrumentation shall meet the following requirements.

6.1.1 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.

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

6.1.3 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.

6.1.4 Supplier shall furnish detailed information for each & every type of instrument included in his offer with their make, model, technical literature for BHEL/Owner's review and approval. Measuring instruments and sub-systems offered by the Supplier shall be reputed & experienced manufactures, whose guaranteed and trouble free performance has been proven for atleast two years.

6.1.5 All **Electronic Pressure Transmitters** shall be suitable for 24V, DC±10% power supply.

6.1.6 **RTDs** shall be cabled and terminated on junction boxes.

6.1.7 Out put signal and power supply wiring of **Electronic Pressure Transmitters** shall be terminated on separate junction box.

6.1.8 Stainless steel tags shall be fastened to each instrument. Instrument tag nos. as indicated by Customer/BHEL shall be punched on these tags before dispatch.

6.1.9 Pr Gauges, DP Gauges, Temp gauges, RTDs, Electronic transmitters and Level gauges as per attached specification and shall comply as per Annexure-I.

6.2.0 Resistance Temperature Detectors:

All resistance temperature detectors shall be ungrounded, duplex, 4 wire type, Platinum one hundred ohm at 0 deg.C and shall conform to DIN 43760.

6.3.0 Temperature Gauges:

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.

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6.4.0 Pressure Gauges:

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.

6.5.0 INSTRUMENTS:

The following instrumentation shall be included in the scope of supplying. However, any additional instrumentation required for the safe operation of the equipment shall also be included.

Customer approved vendor list for instruments shall be followed.

a) 3 nos. of Electronic Pressure Transmitters in the lubrication oil supply piping down stream of filter shall be provided for interlocks & annunciation for AOP Motor & BFP Drive Motor operation.

b) 1 No. Pressure indicator on lube oil supply header downstream of filter.

c) 1 No. Pressure indicator for control oil.

d) 3 Nos. Electronic Pressure transmitters for control oil.

e) Capillary dial thermometers at all journal bearings and thrust bearings.

f) 4 Wire type temperature elements (Duplex RTDS) for each journal and thrust bearing.

g) 1 No. Capillary dial thermometer at lube oil inlet to cooler.

h) 1 No. Capillary dial thermometer at lube oil outlet from cooler.

i) 1 No. 4 wire duplex RTD at lube oil inlet to cooler.

j) 3 Nos. 4 wire duplex RTDs at lube oil outlet from cooler.

k) 1 No. Capillary dial thermometer at working oil inlet to cooler.

l) 1 No. Capillary dial thermometer at working oil outlet from cooler.

m) 3 Nos. 4 wire duplex RTDs at working oil inlet to cooler.

n) 1 No. 4 wire duplex RTD at working oil outlet from cooler.

o) 1 No. differential pressure indicator across oil filter.

p) 1 No. differential pressure transmitter across oil filter.

q) 1 No. Level gauge on oil tank for local indication.

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r) 1 No. Level transmitter (non-contactive type) on oil tank for annunciation.

s) Position feed back transmitter (In actuator).

t) Signaling contacts (In actuator) suitable for giving 4-20 mA galvanically isolated position feedback signal.

u) 3 nos of speed transducers with necessary accessories to give galvanically isolated 4-20ma DC out put signal for owners DDCMIS (Distributed digital control, monitoring and information system)

v) Limit switch for 0% scoop tube position.

w) 01 No. Temperature and 01 no. pressure indicators shall be provided on the inlet and outlet branches of the shell side of each heat exchanger.

6.6.0 Tests on various instruments shall be as per the standards indicated below.

Pressure Gauge	:	IS 3624
Temperature Gauge	:	BS 5235
Pressure Transmitters	:	IEC 770
RTD	:	DIN 43760
Electrical actuator	:	IS 9334

7.0.0 **QUALITY ASSURANCE AND INSPECTION:**

7.1.0 **General:**

A quantity plan detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment / component shall be furnished in the format suggested by BHEL / Owner and abide by the same without any extra cost. If required, supplier shall depute his representative for discussions and finalization of quality plans with BHEL and Customer.

Quality plan furnished for review / approval of Owner shall include all the reference documents such as material specifications, heat treatment procedure and acceptance norms, Balancing procedure, pressure test procedures and performance test procedure.

Supplier shall abide by all decisions made during finalization of quality plans.

Test certificates shall be furnished as per the finalized quality plans. BHEL / Owner shall be given reasonable notice of the tests which are identified as customer hold points during finalization of quality plans and shall have right to witness such tests and shall have access to the works of the Supplier and his Sub-contractor. The performance tests on hydraulic couplings can be witnessed by Customer and BHEL engineers.

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BHEL / Owner will identify the Customer hold points of the final quality plan beyond which work shall not proceed without BHEL / Owner's consent in writing. Supplier shall furnish vendor details for actuators, strainers, coolers castings and forgings and instruments for BHEL / Owner's approval.

"Owner" mentioned in the above para is a customer of BHEL and ultimate owner of the equipment.

Routine test reports of all instruments after duly calibrated at the factory shall be submitted. It should include insulation testing as applicable. Routine test reports for electrical actuators and AC motors of aux. oil pump shall be submitted.

7.2.0 An indicative program of inspection / tests envisaged, is given below:

7.2.1 Material shall be checked for chemical composition, mechanical properties for major components like gears, pinions, primary & secondary wheels, shell, shafts and cooler tubes etc.

7.2.2 Fully machined shafts, gear / pinion rims, primary / secondary wheels and shell be subjected to magnetic particle test.

7.2.3 Dimensional conformity and Interchangeability to be checked.

7.2.4 Hydraulic pressure testing of the coupling body, oil tank, main oil and lubricating oil coolers shall be carried out.

7.2.5 Dynamic balancing of rotating elements and all rotor assemblies shall be carried out.

7.2.6 Backlash of gear wheels and pinions and teeth contact before and after functional testing.

7.2.7 Conditions of the bearings after functional test shall be checked.

8.0.0 <u>PERFORMANCE TESTS</u>:

The tests on each hydraulic coupling shall include the following:

- 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.

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- Check for smooth operation of aux. oil pump motor.
- Check for proper functioning of actuator.

9.0.0 DRAWINGS AND DATA TO BE ENCLOSED ALONG WITH OFFER:

- Slip percentage
- Mechanical and slip losses for rated parameters
- Mechanical and slip losses and torque slip characteristics at various scoop positions
- AOP motor rating
- Materials of construction of hydraulic coupling and coolers
- Standard followed for design of gears
- Expected vibration & noise levels at supplier's test bed & at site.
- Cooling water requirement of coolers
- List of instrumentation
- Data of the actuators and their accessories
- Assy. Plan of hydraulic coupling.
- Assy. Plan of working oil cooler
- Assy. Plan of lube oil cooler
- P & I diagram of lube system
- Quality plan
- Test procedure

10.0.0 DOCUMENTS TO BE FURNISHED AFTER AWARD OF CONTRACT:

10.1.0 Eight copies each of the following drawings / documents shall be furnished.

- Sectional assly. Drg. of hydraulic coupling
- Sectional assly. Drg. of working oil cooler
- Sectional assly. Drg. of lube oil cooler
- Scheme drawing showing instrumentation
- List of instrumentation
- Technical data of the actuator
- Quality plan

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- Test procedure
- Thermal load calculations for coolers
- Logic diagrams
- Technical catalogues for all instruments, Speed indicator, Level indicator or switch and power amplifier.
- Write Up on rapid start device
- O & M instruction manuals
- List of despatchable items with quantities (shall include all minor items also)

10.2.0 Two reproducible transparencies for each of the following drawings / documents shall be furnished.

- Assy. plan of hydraulic coupling
- Assy. plan of working oil cooler
- Assy. Plan of lube oil cooler
- Scheme drawing showing instrumentation
- List of instrumentation

10.3.0 Vendor shall submit the order confirmation copy with in 2 weeks after award of contract.

11.0.0 TEST CERTIFICATES:

5 Copies of documentation package shall be furnished. This shall include material certificates & test certificates as per agreed quality plan & test procedure.

12.0.0 PACKAGING AND TRANSPORTATION:

12.1.0 All the equipment shall be suitably protected, coated covered or boxed and crated to prevent damage or deterioration during transit, handling the storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken into account of. The details of various wagons normally available with Indian Railways for transportation's of heavy equipment are enclosed as Appendix 1 to this section. The contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing.

12.2.0 Appendix 1 to this section also indicates the dimensions, which can be normally transported on the wagons without infringement of the moving gauge. This is not indicative of the consignments which can be carried out with infringement of moving gauge duly authorized and approved by the India Railways.

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There may be difference between the moving gauge and the fixed structure gauge and consignments infringing the moving gauge can be moved after investigation regarding possible infringement with the fixed structures.

As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly bought out in the proposal wherever transport of over dimensioned equipment is involved.

12.3.0 Packing should be seaworthy

12.4.0 Protection:

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and piping's and conduit equipment connections shall be properly sealed with parts which are likely to get rusted, due exposure to weather should also be properly treated and protected in a suitable manner. EMI / static charge proof packaging should be used for PLC / Electronic hardware.

13.0.0 PRESERVATIVE SHOP COATING:

13.1.0 All exposed metallic surface to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shell before hand be treated and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scale oxide and other coatings and prepared in the shop, the surfaces that are to be finish painted after installation or require corrosion protection until installation, shall be shop painted with atleast two coats of primer. Transformers and other electrical equipment, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards to be selected and specified by the Engineer at a later stage.

13.2.0 Shop primer for all steel surfaces which will be exposed to operating temperature below 95ºC shall be selected by the Contractor. Special high temperature primer shall be used on surface exposed to temperature higher than 95ºC.

13.3.0 All other steel surface which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Engineer.

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14.0.0 RATING PLATES, NAME PLATES AND LABELS:

14.1.0 Each main and auxiliary item of plant is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufactures name, equipment, type or serial number together with details of the loading conditions under which the item of plant in question has been designed to operate and such diagram plates as may be required by the Engineer.

14.2.0 Each item of plant is to be provided with name plate or label designating the service of the particular equipment. The inscriptions are to be approved by the Engineer or as detailed in the appropriate sections of the Technical Specifications.

14.3.0 Such name plates or labels are to be of white non-hygroscopic material with engraved black lettering or alternatively in the case of indoor circuit breakers,

14.4.0 starters, etc. of transparent plastic material with suitably colored lettering engraved on the back.

14.5.0 Terms of plant such as valves and dampers which are subject to handling are to be provided with an engraved chromium plated or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSIB 16.34 as a minimum.

14.6.0 Housing shall be painted with 2 coats of epoxy primer and 2 coats of suitable finish paint of sea green colour of ISL No. 217 conforming to IS-15 which shall with stand the surface temperatures of Hydraulic coupling during operation.

14.7.0 Packing shall be done with suitable quality of wood which can withstand transport by sea and storage at site for minimum period of 18 months. Packing case shall be stiffened adequately to avoid the transport damage. Moisture absorbents (like silicagel) shall be put in liberal quantities to avoid corrosion.

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15.0.0 VARIANT TABLE:

Var.No.	Technical Parameters	Material Code
01	For 660MW (25% BFP) (BARA) Direction of rotation of Motor seen from BP end : CW GD sq. Value of BFP (kg. Sq.m) : 20 GD sq. Value of coupl. between BFPand HC (kg.sq.m) : 4.04 Oil quantity required for external lubrication : 300 lpm GD² Value of drive motor (Kg.Sq.m) : 2040 Max. Output speed (RPM) : 6100 Max. Input power to BFP (KW) : 6350	FP9760207010
02	For 660MW (30% BFP) (MAUDA-II) Direction of rotation of Motor seen from BP end : CW GD sq. Value of BFP (kg.Sq.m) : 20 GD sq. Value of coupl. between BFPand HC (kg.sq.m) : 4.04 Oil quantity required for external lubrication (lpm) : 300 GD² Value of drive motor (Kg.Sq.m) : 2150 Max. Output speed (RPM) : 6370 Max. Input power to BFP (KW) : 8250	FP9760207028
03	For 800MW (30% BFP) (GADARWARA) Direction of rotation of Motor seen from BP end : CCW GD sq. Value of BFP (kg.Sq.m) : 21.5 GD sq. Value of coupl. between BFP and HC (kg.sq.m) : 5.0 Oil quantity required for external lubrication : 350lpm GD² Value of drive motor (Kg.Sq.m) : 3000 Max. Output speed (RPM) : 5600 Max. Input power to BFP (KW) : 10225	FP9760207036
04	For 660MW (30% BFP) (BANHARPALLI) Direction of rotation of Motor seen from BP end : CW GD sq. Value of BFP (kg. Sq. m) : 19.5 GD sq. Value of coupl. between BFP and HC (kg.sq.m) : 5.0 Oil quantity required for external lubrication : 330 lpm GD² Value of drive motor (Kg.Sq.m) : 2500 Max. Output speed (RPM) : 5400 Max. Input power to BFP (KW) : 9172	FP9760207044

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05	For 660MW (30% BFP) (NORTH KARANPURA) Direction of rotation of Motor seen from BP end : CW GD sq. Value of BFP (kgm^2) : 20 GD sq. Value of coupl. between BFP and HC (kgm^2) : 4.04 Oil quantity required for external lubrication (lpm) : 300 GD^2 Value of drive motor (kgm^2) : 2300 Max. Output speed (RPM) : 6650 Max. Input power to BFP (KW) : 9286	FP9760207052
06	For 660MW (25% BFP) (MAITREE BANGLADESH) Direction of rotation of Motor seen from BP end : CW GD sq. Value of BFP (kgm^2) : 20 GD sq. Value of coupl. between BFP and HC (kgm^2) : 4.04 Oil quantity required for external lubrication (lpm) : 300 GD^2 Value of drive motor (kgm^2) : 2300 Max. Output speed (RPM) : 6600 Max. Input power to BFP (KW) : 8672	FP9760207060
07	For 800MW (35% BFP) (PATRATU) Direction of rotation of Motor seen from BP end : CCW GD sq. Value of BFP (kgm^2) : 20 GD sq. Value of coupling between BFP and HC (kgm^2) : 5.0 Oil quantity required for external lubrication (lpm) : 350lpm GD^2 Value of drive motor (kgm^2) : 4020 Max. Output speed (RPM) : 6000 Max. Input power to BFP (KW) : 10975	FP9760207079

OPERATING CONDITIONS	MDBFP SPEED (RPM)	MDBFP SHAFT POWER (KW)
DESIGN POINT	5679	9868
90% UNIT LOAD	5285	7987
RUN OUT POINT	4545	5518
BEP	5421	8184
EMERGENCY POINT	5870	10585
UNDER FREQUENCY-1	5926	10975
UNDER FREQUENCY-2	5856	10498

08	For 660MW (30% BFP) (BHUSAWAL MAHAGENCO) Direction of rotation of Motor seen from BP end : CW GD sq. Value of BFP (kgm^2) : 20 GD sq. Value of coupl. between BFP and HC (kgm^2) : 4.04 Oil quantity required for external lubrication (lpm) : 300 GD^2 Value of drive motor (kgm^2) : 2030 Max. Output speed (RPM) : 6250 Max. Input power to BFP (KW) : 7400	FP9760207087

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Note for variant No. 06:

The gear boxes design shall be in accordance with AGMA 420 and 421 (or) other international standard, as applicable.

Note for variant No. 07:

- The gear boxes design shall be in accordance with AGMA 420 and 421(latest).
- The starting time from minimum scoop position to 100% scoop position shall be less than 7 seconds after receipt of starting signal by motor, which operating single or in parallel with another Boiler Feed Pump.

SPARES FOR HYDRAULIC COUPLING FOR 25% AND 30% DUTY MHI DESIGN BFPs OF 660MW & 800MW SUPER CRITICAL POWER PLANTS

VAR No.	ITEM DESCRIPTION	PROJECT	MATERIAL
51	AUXILIARY OIL PUMP MOTOR FOR HC-VAR 05	2 X 800 MW Gadarwara	FP9760207516
52	AUXILIARY OIL PUMP MOTOR FOR HC-VAR 03		FP9760207524
53	RTD FOR BERAING TEMP POS 34.1 VAR-03		FP9760207532
54	RTD&THERMOWEL OIL TEMP POS 34.21 VAR-03		FP9760207540
55	DPT FOR OIL FILTERS POS-37.3 OF VAR-03		FP9760207559
56	OIL LEVEL INDICATOR POS-40 OF VAR-03		FP9760207567
57	OIL LEVEL TRANSMITTER POS-40.2 OF VAR03		FP9760207575
58	PT 0-6 KG/WQCM FOR LO&WO PR HC-800MW		FP9760207583
59	AUXILIARY OIL PUMP MOTOR FOR HC-VAR 07	3 X 800 MW PVUNL Patratu	FP9760207591
60	AUX OIL PUMP ASSLY OF HC FOR VAR-07		FP9760207605
61	GEAR DRIVEN LO&WO PUMPS FOR VAR-07		FP9760207613
62	LO FILTER ELEMENTS ORINGS GASKETS VAR07		FP9760207621
63	OIL LEVEL TRANSMITTER OF VAR07		FP9760207630

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Annexure-I

Transmitters:

1) All transmitters shall have an impressed output signal of 4-20 mA corresponding to zero to full range input. However, digital communication shall also be acceptable.
2) Generally, 2-wire transmitters shall be used. If for some special purposes (e.g. analyzers) 230 V AC power supply is required, the output circuit shall be isolated.
3) As far as possible, all transmitters shall be of the SMART – type. This applies also to field mounted temperature transmitters.
4) All transmitters shall be fitted with a local analog indicator displaying appropriate physical units which may be read clearly from an easily accessible position.
5) Transmitters with accuracy class "0" or better must be used. The repeatability shall be within a range of ± 0.1 % of full span.
6) The output signal of all transmitters must be independent of the burden of the transmitter output circuit including cable resistance over a wide range.
7) The removable of connected devices must not open the transmitter output circuit or cause malfunction of this circuit. In the case of failure and return of the supply voltage within a measuring circuit, no false signals endangering the system shall be issued. All transmitters shall be individually fused. If not specified otherwise, local parameterization at eh transmitter or protocol shall be possible.
8) For the continuous remote position indication of valves, dampers etc. also transmitters with impressed output signal of 4-20 mA shall be employed.
9) All transmitters shall be suitable for field installation and shall have strong, moisture and dustproof cases of IP 65 or better according to EN 60529. This applies also for temperature transmitters when installed in the field.
10) Diaphragm seals shall be provided to serve as a barrier for corrosive process fluids, slurries or highly viscous oils. The seal shall be of the flanged type, suitable for the same conditions as those for the transmitter. The material selection shall be according to the requirements of the fluids to be measured. The seal shall be provided with a flushing connection.
11) Transmitters to be used in hazardous areas shall be explosion proof. Suitable intrinsically safe circuits are to be provided in accordance with EN 60079-11.
12) All transmitters potentially subjected to vacuum shall be capable of withstanding 100% vacuum without damage.
13) No stress shall be imposed through the connections between Plant and the transmitter. As far as possible, the transmitters shall be grouped together into enclosed racks or panels for easy access. Sunshades shall be provided for all outdoor panels.
14) Individually installed Transmitters shall have their own weather proof enclosure of robust construction and be suitable for the proposed environment. All field equipment terminals shall be wired to a terminal box using screwed connections.
15) Transmitters shall be provided with all necessary isolating, vent and blow-down valves and facilities shall be provided for the connection of test instruments at the input and output of each transmitter, to enable calibration to be carried out.

TEMPERATURE MEASUREMENTS:

1) Glass thermometers, bi-metallic and capillary remote thermometers are to be used for local temperature measurement. For both, class 1.0 shall be provided.
2) Glass thermometers are to be inserted into pockets provided for the purpose. The use of mercury is forbidden.
3) Capillary remote thermometers (Pt-100) in accordance with IEC 60751 shall be used for remote measurements. All resistance thermometers shall be wired according to the four-conductor principle.

4) Otherwise, thermocouples with appropriate heat resistance in accordance with DIN IEC 60584-1 or equivalent may be used for remote measurements.
5) All thermocouples shall be of the quick response type, ungrounded and preferably of double element type.
6) Thermocouples shall be arranged in such a way that eh ambient temperature of the head is lower than 100 ˚C, and that the measuring inserts can easily be exchanged.
7) All thermocouples and extension leads shall be terminated with a suitable gland and the conductor to sheath resistance shall be greater than 100 M-Ohms when tested after termination.
8) Thermometers and thermocouples shall generally be fitted in protective wells. They shall be provided with weatherproof terminal heads and shall be installed so as to totally prevent the ingress of foreign matter.
9) High speed response pockets shall be provided for all applications involving control of critical process temperatures.
10) Where more than one temperature measurement e.g. for redundant loops, recording, indication, automatic control is to be made at one location, individual protective wells with sensors shall be provided at the common place of measurement. Protective wells for unoccupied test measuring points shall be arranged with the opening inclined downwards wherever possible and shall be provided with a screw-on protection cover.

For all remote temperature measurements (i.e. for RTDs and TCs) transmitters shall be installed locally in a transmitter protecting box on a DIN rail.

PRESSURE MEASUREMENTS:

1) Pressure gauges of class 1.6 or better must be used. The standard measuring ranges must be selected with regard to the maximum operating pressure.
2) A pressure instrument installed for measurement of steady pressure at varying pressure shall operate in a band centered on 60% of its maximum range.
3) When the pressure impulse line is liquid filled the measuring unit shall be compensated for static head. The head correction shall be stated on the unit.
4) Pressure gauges shall have a dial size of 160 mm and shall be located in such a way that they can be easily observed or shall be combined in groups on local gauge boards or cubicles.
5) Pressure gauges shall be resistant against against vibrations. Furthermore, pressure gauges shall be designed in such a way that the measured value may reach the end of the indicating range without affecting the calibration of the gauge.
6) Pressure measurement tapping points shall generally be in accordance with the specification for the pipeline in which they are installed and shall be equipped with one, and for high pressure installations (45 bar) two, isolating valves arranged directly at the tapping point.
7) Piping shall be of approved quality and sized for the particular service. In all cases the pipe size shall be chosen to ensure strength and freedom from blockage. Instrument impulse pipework shall be manufactured from a suitable grade of stainless steel to the approval of the Employer / Engineer.
8) Pressure transmitters for remote measurement shall not be mounted directly at the tapping point, but shall be arranged at a distance from the tapping point by means of enclosures. The impulse line between tapping point and transmitter shall be arranged in such a way as to form a siphon loop, when steam pressure measurements are involved.

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9) A valve combination or multiway cock shall be provided directly on each pressure gauge or transducer connection. They shall be equipped with a connection for test gauges, and it shall be possible to shut off the test connection without isolating the service pressure gauge at the same time.
10) Open blowdown / drain connections shall not be arranged within panels and local equipment. Instead it shall be led to a drain external to the panel. All valves shall be installed so that they are accessible for in-situ maintenance from a floor or permanent structure landing.
11) Stainless steel shall normally be used for all corrosive duties.

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RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised By	Approved By
01	21.03.13	Cl No: 2.2.0(e) Length & Qty of Pipes &. Bends corrected. At Cl No. 3.0.0 Technical Parameters i.e Speeds & Power deleted and added in Cl. No. 15.0.0. Var No. 02 added for 30% duty BFP.	MMR	P SRINIVAS
02	03.07.14	At Cl No. 3.0.0 Technical Parameters i.e GD sq value of BFP, Direction of Motor etc deleted and added in Cl. No. 15.0.0. Var No. 03 added for 30% duty BFP for 800 MW.	CH RAJESH	P SRINIVAS
03	12.11.14	Var No. 04 added for 35% duty BFP for 660 MW (BANHARPALLI) Cl no 2.2.0(g) and (h) are corrected. GD Sq value of BFP for Var-03 is corrected.	CH RAJESH	P SRINIVAS
04	20.03.15	Var No. 05 added for 30% duty BFP.	ROHIT.P	P SRINIVAS
05	27.10.17	Var No. from 51 to 58 added for Gadarwara spares Var No. 06 added for 25% duty BFP.	SATISH	KHRK
06	31.01.18	Power value revised for Variant no. 06 and annexure-I added	SATISH	KHRK
07	03.05.19	1. Var No. 07 & 08 are added. 2. Clause 6.5.0 (u) revised	KULDEEP	ASJK
08	15.10.19	Technical parameters for Var. 07 are modified. Note for Var.07 added.	CH.RAJESH	KHRK

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