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<u>PURCHASE SPECIFICATION OF AXIAL SHAFT SEAL</u> <u>FOR HYDRO TURBINE APPLICATION</u>		

1. APPLICATION

Shaft seal in a hydro-turbine is one of the key components of the turbine system. The primary purpose of a shaft seal is to control / minimize the leakage from top cover within acceptable limit. Functional requirements of such seals is to ensure effective seal operation, long wear life and minimum maintenance. Major challenges in a shaft seal design are that the seal must provide high wear resistance against abrasives in the water and it must be able to operate satisfactorily at high rubbing velocities with low water leakage past top cover during operation.

This specification is for spring (stainless steel) loaded axial shaft seal with parameters given below. The shaft seal design shall take care that assembly, installation and maintenance must be user friendly.

2. INPUT DATA

For project specific technical details refer attached **Annexure-A** and tender drawing furnished along with enquiry

3. SCOPE OF WORK

3.1 SHAFT SEAL ASSEMBLY

Each Shaft seal assembly shall have at least following items:-

- a. **Complete shaft seal** as per description of equipment at Sl. No. 4 and dimensional details and material of construction as specified in tender drawing, with each seal comprising of -
- Wear indicator of Mechanical type locally mounted on shaft seal
 - Wear indicator of Electronic type for wear indication at shaft seal panel and SCADA.
 - Seal interface temperature sensor / RTD / DTT with feedback on shaft seal panel and SCADA.
 - Air release valve of sufficient size to ensure quick air release after air is released from turbine top cover. (Required only if synchronous condenser mode is applicable. Refer Annexure - A). It must be suitable to hold compressed air during water depression.
 - Pressure transducer for seal housing pressure measurement and feedback at shaft seal panel.
 - Leakage water temperature sensor of RTD / DTT type.
 - An isolating seal of inflatable type for maintenance purpose.

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- b. A shaft seal indicator and control panel** mounted on a skid and comprising of -
- An indication panel with display of critical parameters like flow rate, pressure, temperature, wear etc.
 - Display for differential pressure across strainers / filters, pressure before and after strainer / filter and booster pumps.
 - Provision for adjusting duty cycle of pumps.
 - Provision for adjusting backwash timing of strainers / filters.
 - Pressure gauges with isolating valve wherever required for visual indication on skid.
 - Set of isolating valves, non-return valve, flow control valve, flowmeters / flow switch with indicator and contacts, Stainless steel pipe and pipe-fittings, flowmeter & equipments for supply of cooling water to shaft seal.
 - Set of isolating valves, non-return valve, flow control valve, pressure reducing valve, Stainless steel pipe and pipe-fittings & equipments for supply of compressed air inflatable type isolating seal of shaft seal.
 - Pressure transmitters for water and air supply.
 - Pressure regulating valves.
 - **One Main and one standby booster pump and motor set** along with starter panel (part of main control panel)
 - **One main and one standby filtration system (strainers)** with manual and auto backwash arrangement and MOC for element as stainless steel to SS 304 / 316 and minimum 50 microns filtration, along with its control on shaft seal control panel. Filtration area of filters shall be sufficiently high to avoid frequent choking of elements.
 - **Flexible hoses for supply of water** from shaft seal skid placed outside of turbine pit to main seal interface and seal housing of shaft seal assembled on turbine shaft inside turbine pit. **Flexible hoses required for return water** line from shaft seal assembly to skid / drain shall also be in **vendor scope**. Length of each hose shall be minimum **10 meter**. Actual length will be finalized during drawing approval stage in event of order.
 - **Flexible hoses for supply of compressed air** from shaft seal skid placed outside of turbine pit to shaft seal assembly inside turbine pit. Length of each hose shall be minimum **10 meter**. Actual length will be finalized during drawing approval stage in event of order.
 - **Cable and cable accessories** for inter-connection between shaft seal control panel and shaft seal assembly to be used for indication and feedback on control panel. This shall be

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used to obtain contacts like pressure, temperature, flow etc. from shaft seal assembly on to control panel. Length of each cable shall be minimum **10 meter**. Actual length will be finalized during drawing approval stage in event of order.

- Latest update version of Software program to be installed during commissioning.
- c. **Consumables required** for assembly of all shaft seals at site to be supplied with each shaft seal set respectively. Vendor shall ensure that **expiry date of all consumable shall be at least 2 years from the date of supply. Expiry date of consumables to be clearly mentioned in shipping / packing list.**
Consumables shall consists of -
 - Thread locking fluid.
 - Joint sealants / gaskets etc.
 - Any special adhesives required for joining rubber seals / maintenance seal.
 - Water repellent grease, heat paste etc. wherever applicable
- d. Following drawings and documents are also to be supplied by vendor
 - Erection and commissioning manual - 6 sets
 - Operation & Maintenance manual - 6 sets
 - General Arrangement drawing of Shaft Seal - 6 sets
 - P&I Diagram and electrical wiring diagram – 6 sets
 - General Arrangement drawing of Shaft Seal control panel – 6 sets
 - Shipping list to be supplied with each Shaft Seal set
 - Soft copy of

3.2 **TOOLS FOR ASSEMBLY AND DISMANTLING OF SHAFT SEAL ASSEMBLY**

Tools including manual, hydraulic and any other special tools required for erection shall be supplied along with shaft seal. These tools shall be used during erection of shaft seal performed at site and therefore all required tools are to be covered in this list.. Vendor shall ensure complete tool set are supplied along with seal and no surprises shall pop up during erection work. One set of tools shall comprise of at least the following–

- Spanners of all applicable sizes required for shaft seal assembly
- Adjustable wrench (manual) to suit all applicable sizes.
- Allen key for all Allen type screw.
- Hydraulic torque wrench including power pack for all applicable sizes.
- Male / Female Sockets to be used along with torque wrench.

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- Screw drivers
 - Any special tools required for cutting / joining of rubber seals including maintenance seal.
 - Any special tools required for joining of maintenance seal.
 - Guide screws, jacking screws, compression tools, spirit level gauge etc.
 - Wire and cable cutters.
 - Any special chemical required for bonding.
- If any of the above tools gets damaged during the installation or is found faulty shall have to be replaced by vendor free of cost.

A detailed tool list covering all above tools and any other additional tooling required has to be submitted by vendor along with the technical offer

3.3 **ERECTION AND COMMISSIONING**

Scope of work at project site

- Pre-assembly of shaft seal components.
 - Pre erection checks.
 - Assembly of shaft seal over top cover and nut guard.
 - Assembly of instrumentation over the housing.
 - Alignment check of assembly.
 - Connecting hoses and electrical cables from control panel upto shaft seal.
 - Connecting air and water supply line (BHEL scope) with the filtration system skid.
 - Commissioning of control panel and filtration system skid and integration with BHEL input supply.
 - Testing and Commissioning of shaft seal system.
- Vendor shall submit **lump sum offer** for erection and commissioning of each seal, considering above mentioned scope of work to be carried at project site **(For project site location and commissioning schedule refer Annexure - A)**. Hydro projects may get delayed due to unforeseen reasons, vendor may note this factor while submitting offer.
- **The offer per visit shall include all erection and commissioning activities, Lodging and Boarding at project location and travel charges.**
- **Tooling cost (for tools against clause no. 3.2) shall not be considered in price bid for erection and commissioning.** All tools required for assembly and dismantling shall be considered as a separate indent item being procured by BHEL and are to be supplied along with shaft seal as per clause. No. 3.2 of the specification.

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- Manpower required for erection and commissioning of shaft seal within the stipulated time frame shall be deployed by vendor. Tools supplied by vendor against clause no 3.2 are to be used for erection at site. If any of the above tools gets damaged during the installation or is found faulty shall have be replaced by vendor free of cost.
- **Price bid for erection and commissioning of seal in any form other than the lump sum amount, shall not be acceptable and will be rejected.**
- Vendor shall prepare a checklist for ascertaining site readiness before deputation. The requirements laid down in the checklist will be verified at site to ensure readiness when vendor arrives.

3.4 SPARES FOR SHAFT SEAL

Spares shall be supplied as per details in Annexure-B. Vendor shall quote item wise price for spare items in the price bid.

3.5 Note - Evaluation of L1 vendor will be done on total quoted price i.e. after summation of price quoted by vendors against scope of work at clause no. 3.1, 3.2, 3.3 and 3.4.

4. DESCRIPTION OF EQUIPMENT

Sl. No.	Description	Vendor's response & Deviation if any
1.	The stainless steel springs shall be designed for creating axial pressure to control leakage of water in turbine mode and compressed air during synchronous condenser mode of operation. See Annexure - A for synchronous operation.	
2.	Provision to adjust the spring compression to cope up with wear of main seal shall be built in.	
3.	The material of the main seal shall be resistant to abrasion (Without permanent damage against compressed air / silt laden river water) and should be robust enough to withstand vibrations. It should be unbreakable and shall have the capability to accommodate axial and radial shaft movement. The main seal shall be spring loaded (adjustable) and shall remain pressed against rotating stainless steel seat ring clamped with the turbine shaft.	

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4.	<u>Shelf life of main seal shall be minimum 4 years from date of supply and packing shall be provided accordingly to ensure the same.</u>	
5.	All hardware like bolts, nuts, screws, adaptors etc. shall be of stainless steel.	
6.	Suitable lifting holes shall be made in components. Lifting eye bolts, guide pins, jacking screws etc. shall be provided for erection of the shaft seal components.	
7.	An inflatable maintenance shaft seal shall be provided to prevent ingress of water from below the shaft seal into the shaft seal during maintenance or stand still. <u>The maintenance seal shall be operated manually by compressed air at 7 kg/cm²</u> (Nominal value). Vendor to suggest the minimum pressure of compressed air required to inflate the seal.	
8.	All threaded piping connections should be 'BSP'- Parallel Male / Female. BSP Taper and NPT threads are not acceptable.	
9.	Rubber cords chosen should be from the following standard sizes Ø6,Ø8,Ø10,Ø12,Ø16,Ø20.	
10.	<u>Vendor shall furnish guarantee for minimum 12000 hours of operation (in turbine / synchronous condenser mode) without replacement of main sealing element of shaft seal.</u>	
11.	Vendor to guarantee at least 5 minutes dry operation of main sealing element i.e. with no cooling water supply.	

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12.	Wear indicators (visual as well as electronic) shall be supplied to monitor the wear life of the seal. This shall be fitted on the seal itself. Provision for local and remote indication of wear shall also be there. Continuous wear indication at remote location shall be provided. This shall be a continuous analogue (4-20 mA) signal for logging to BHEL supplied SCADA system. The accuracy of the wear indicator to be furnished in offer.	
13.	Provision shall be there to hydrostatically feed clean filtered water directly into the main seal / seat ring interface to achieve optimum performance. All necessary equipments shall be supplied by vendor. Degree of filtration for strainer shall be decided by vendor for trouble-free operation of shaft seal.	
14.	2 PT 100 ohm probes to detect high temperature (alarm) of the shaft seal shall also be supplied. Additionally DTT for measurement of shaft seal temperature shall also be supplied.	
15.	A water flow meter of suitable make with adjustable alarm contacts suitable for operation at 220V DC / 240V AC shall be provided in the feed water supply piping to the seal. These contacts shall be wired to terminal blocks in the turbine terminal box. One additional potential free contact (changeover contact not acceptable) shall be provided to operate and indication light in the gauge panel to indicate that shaft seal water is 'on'. 4-20 mA signal shall be provided for remote logging in scada system. A duplex pressure gauge shall be provided to indicate the pressure beneath the seal and in the supply line.	

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16.	From pressure transmitter and flowmeter the aux. (alarm & status) contact shall be first taken to booster pump control / starter panel and suitably multiply for more contacts. One set of contact of each type/relay/instrument shall be reserved for further cabling to scada system.	
17.	Necessary cabling from shaft seal to display unit located approximately 10 m away and other inter-connecting equipment's shall be provided by supplier. Moreover any special cable shall also be in vendor's scope of supply .	
18.	Filtration system shall be equipped with 415 V / 50 HZ AC driven motor for backwashing and automatic solenoid operated drain valve (230V/ 50 HZ single phase AC) for flushing. System shall be equipped with time setting option for back washing in addition to backwashing initiated by pressure drop (using DP switch). Filtration system shall also be equipped with auto switching option between main and standby systems.	
18.	Both the booster pumps will operate from locally (auto as well as manual) and from remote through scada. For auto operation switching devices like flow meter and pressure transmitter to be provided in the system at the outlet of pump. Local manual operation will be through push buttons provided in the booster pump control / starter panel (in vendor's scope). Contacts from the switching devices shall be first taken to the starter panel for multiplication of contacts for local auto operation, indication & alarm by the supplier & further extending to scada system supplied by BHEL.	

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19.	Booster pump control/ starter panel shall be housed with incomer MCCBs with OFF/ON Aux. contact for each pump and suitable thermal over load relays, power contactors, timer, switches, lamps etc. anti-condensation heater, MCBs, transformer, fluorescent light, wiring, power control TB, indicating meters, push buttons, transducer, cubical heater, thermostat, illumination lamps, switches & sockets, control / power terminal block, paint and heat treatment details.	
20.	There will be two local auto operations auto 1 and 2. In auto 1 pump 1 will act as main and pump 2 will be in stand by and in auto 2 the operation will be vice versa.	
21.	The control system in the booster pump starter panel shall accept remote operation command from scada as the logic will also be made in such system for remote auto / manual operation.	
22.	Pressure transmitter with relay function for sufficient potential free contacts shall be provided by vendor	
23.	Termination to be made such that higher size cables are terminated for incoming and outgoing terminals. Internal and interconnecting wiring should be copper only.	
24.	For remote operation of booter pumps from scada the system the following contacts shall be made available in the booster pump starter panel by the vendor :- - Pump 1 on and off - Pump 2 on and off - Pump 1 thermal overload trip - Pump 2 thermal overload trip - Booster pump local, remote, auto 1 & auto 2 selector switch contacts. Pressure low, pressure normal, flow low and flow normal contacts.	

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5. INFORMATION REQUIRED FROM VENDOR ALONG WITH OFFER

Sl. No.	Description	Vendor's response & deviation
1.	Vendor to submit along with the offer, the general arrangement drg. of shaft seal, P&I diagram and Scheme of control panel and QAP.	
2.	Hydrostatic feed water required in LPM for the seal for normal & runaway speed.	
3.	Cooling water required in LPM for supply through suitable connections provided in shaft seal i.e. Labyrinth etc.	
4.	Details of electric supply required for control panel.	
5.	Type of indicators/ alarms provided for maintenance staff to adjust spring compression either due to wear or increase of inner top cover pressure.	
6.	Maximum guaranteed leakage of compressed air and water past the seal (in new and worn out condition) shall be furnished by vendor.	
7.	Procedure for replacement of worn out shaft seal.	
8.	Maximum permissible time which seal element can sustain without damage in absence of water supply to seal interface.	
9.	Minimum air pressure required for satisfactory functioning of maintenance seal.	
10.	Material of main seal element.	
11.	Shelf life of main seals.	
12.	Seal performance details/ wear curve of seal to be furnished by vendor along with the offer.	
13.	Number and size of BSP female connections for cooling water supply to sealing ring.	

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14.	For fixing drive ring to rotating nut guard (BHEL's scope) and for fixing maintenance seal housing to pump inner top cover, vendor to furnish the following :- Size, Number & pitch circle diameter of all bolts / screws. Size, pitch & depth of threaded holes required to be provided in BHEL's items (nut guard and inner top cover).	
15.	Size of seal grooves to be provided in BHEL supplied parts (if required) and parts in vendor's scope.	

6. INFORMATION REQUIRED FROM VENDOR AFTER PLACEMENT OF ORDER

- Final** general arrangement drg. of shaft seal with bill of material having item nos, quantity, material, weight of items, pipe & fittings details and proposed starter scheme with BOQ for approval . The circuit diagram for feed water shall be included in the drg. Drawing shall be submitted in Auto-Cad (latest version) as well as in hard copy. The drg. should show elevation and plan of seal with connections or cooling water inlet/ outlet and also for feed water.
- Detailed calculation of shaft seal.
- QAP for approval
- Tools list for approval
- Erection manual
- Operation and Maintenance manual

Manufacturing is to be started only after Drawing and QAP approval by BHEL.

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7. INSPECTION AND TESTING AT VENDOR'S WORK

GENERAL

Sl. No.	Description	Vendor's response & deviation
a.	All the shaft seal shall be inspected at vendor's work by BHEL / BHEL's – Customer / BHEL appointed representative. Vendor shall give BHEL at least 30 days' notice prior to commencement of final inspection and testing. Vendor shall carry out all tests and checks internally and after successful completion inspection call shall be raised. Vendor shall maintain desired log of tests and shall submit documentary proof of internal testing before final inspection.	
b.	Acceptance of shop test shall not constitute a waiver of requirement to supply equipment as per specification and / or to meet field requirement under operating condition, nor does inspection relieve the manufacturer of his responsibility in any way whatsoever.	
c.	BHEL / BHEL's – Customer / BHEL appointed representative shall have access to the vendor's manufacturing plant including sub vendors plants where assembly / disassembly work or testing of shaft seal / control panel etc. is being performed.	
d.	Vendor has to design and develop a test setup / test rig for testing of prototype seal (actual seal) at his works. The test set should have facility for hydro test of housings / housing cover plate etc. It shall also have provision for carrying out test for leakage across sealing elements under static condition.	
e.	A dummy arrangement that replicates shaft and nut guard shall be part of this test rig which would be used for testing of inflatable seal and main shaft seal.	

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Note

- Nut guard is in BHEL scope. After purchase order drawing of nut guard will be shared for design of test rig by vendor.
- All documents and test certificates shall mandatorily be in English.

RAW MATERIAL TESTS

- a. During inspection vendor shall produce during inspection chemical and mechanical test certificates of all raw material used in fabrication of all major components used in shaft seal assembly. For other non-major components vendor's conformance certificate shall be acceptable.
- b. Vendor shall carry out 100% NDT (RT / UT / MPI / DP) as per design requirement and the test reports shall be produced during inspection.
Note – Major and non-major components will be defined by BHEL during technical evaluation stage.

TESTS AT COMPONENT / SUB-ASSEMBLY STAGE.

- a. Vendor shall carry out 100% NDT of all weld joints (RT / UT / MPI / DP) and the test reports shall be produced during inspection.
- b. Vendor shall carry out dimensional check of components and produce record for verification during inspection.
- c. Vendor shall carry out visual check of components. Surface finish shall be recorded.
- d. Vendor shall verify mating dimensions / coupling details like no of holes and PCD / connection sizes for instrumentation etc. at this stage and record to be maintained.

SHAFT SEAL ASSEMBLY - FINAL INSPECTION

- a. Assembly and Dismantling of shaft seal shall be carried out in presence of BHEL / BHEL's – Customer / BHEL appointed representative.
- b. Dimensional inspection of all dimensions in approved drawings of shaft seal assembly shall be verified at vendors work. Additionally BHEL may ask for inspection of any dimension, threaded holes etc. critical from assembly point of view.
- c. All test reports / certificates generated at raw material and component stage shall be verified by BHEL / BHEL's – Customer / BHEL appointed representative.
- d. Functional test for control panel.

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- e. Verification of calibration certificates of test rig instruments like thermometer, pressure gauge and other equipments used in testing.
- f. **Seal static test / Performance –**
After the shaft seal assembly has been assembled as per design. Seal interface leakage test at maximum operating pressure of seal shall be carried out. The leakage from seal interface (main sealing and seat ring) shall be collected and recorded. Vendor shall mention the value of allowable leakage from seal interface during static testing in the shaft seal assembly drawing.
- g. **Hydraulic test –**
Increase the pressure to 1.5 times the maximum operating and maintain for 30 minutes. During hydro testing no leakage is allowed from O-seals, rubber cords, and joints of maintenance seal housing / main housing / housing cover plate.
- h. **Inflatable seal test –**
Inflatable seal shall be pressurized using air and the minimum pressure at which the seal makes full contact with dummy shaft shall be recorded. Further the Inflatable seal shall be tested by pressurizing upto 12 bar and holding the seal for a minimum period of 15 minutes. The pressure drop shall not exceed 1 bar.
- 8. PACKING, MARKING AND DISPATCH**
- PACKING**
- a. All items are to be packed and dispatched only after final inspection at vendors work.
- b. The components / assemblies / equipment need to be packed suitably to avoid physical damage and corrosion during transit and storage. In case of exports, Seaworthy packing of components / assemblies / equipment shall be ensured.
- c. The packing shall be suitable for various handling operations, including long distance sea or inland transportation.
- d. Machined faces and tapped holes for coupling and instrumentation shall be suitably protected.

Rev. No.	Date of Rev.	Remarks	Approved  A.Mandal, AGM – HTE		
			Prepared  Navneet Dubey	Checked  Shivendra Kr.	Date of issue 30.07.19
			Saved in server as no. 42009900271		

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- e. Delicate components likely to be damaged e.g. gauges, electronic instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Also, suitable cushioning arrangement shall be provided in packing boxes.
- f. Use silica gel, VCI powder / tablets, desiccants, polyethylene air bubble film etc. for packing.
- g. Packing shall be suitable to sustain harsh climate condition (subzero temperature).
- h. Empty space in the packing box shall be filled with adequate cushioning material e.g. Thermocole Chips, Wood Wool etc. to avoid shocks during shipment. Alternatively put wooden blocks / batons wherever necessary.
- i. Packing cases shall be provided with bottom cleats to ensure clearance for handling by forklift.
- j. For packing more than one components in a box, mating items shall only be considered.
- k. Spares shall be packed separately and duly marked.
- l. Tools shall be packed separately and duly marked.
- m. All erection / operation manuals and one set of drawings shall be packed in water proof packing's and placed in Box. No. 01 of each seal assembly.

MARKING

The following details are to be marked on the packing cases.

- a. Address of Consignee
- b. Purchase order number
- c. Description of item or title of packing list
- d. Case identification number
- e. Gross weight
- f. Dimensions of box
- g. Marking showing upright position
- h. Marking showing sling position, wherever necessary
- i. Marking showing Umbrella (for components to be stored under covered storage)
- j. All cases containing fragile items are to be stenciled with red marking. Advice note shall be clearly marked on cases.

Following symbols may be used on packing boxes.

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Sl. No.	SYMBOL	INSTRUCTION	FUNCTION
1		THIS WAY UP	To indicate the correct upright position of the transport package
2		FRAGILE HANDLE WITH CARE	To indicate that the contents of the transport package are fragile and to be handled with care
3		KEEP DRY	To indicate that the transport package shall be kept in a dry environment
4		SLING HERE	To indicate where the slings shall be placed for lifting the transport package
5		KEEP AWAY FROM HEAT	To indicate that the transport package shall be kept away from heat
6		CENTRE OF GRAVITY	To indicate the center of gravity of the transport package

DISPATCH

- All items shall be thoroughly cleaned, dried prior to dispatch.
- All items are to be painted prior to dispatch.
- All items shall be matched with shipping list prior to dispatch.
- All consumables are to be verified for shelf life of minimum two years and expiry dates on the items are to be mentioned in shipping list.

9. ANNEXURES

Refer annexure- A, B and Checklist

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CHECK LIST**(To be filled in by the vendor and submitted along with the offer)****PROJECT NAME –****BHEL'S ENQUIRY NO. /****DATE. –**

Sl. No.	Description	Tick whichever applicable
1.	Offer is line with specification of shaft seal as per clause 4	Yes / No
2.	Scope of supply is in line with clause 3	Yes / No
3.	Quantity of supply (Main) is as per annexure-A	Yes / No
4.	Spares quantity is as per annexure-B	Yes / No
5.	O&M, Fitting & commissioning instructions manual and shipping lists will be prepared and submitted in case of ordering.	Yes / No
6.	QAP will be submitted after award of contract	Yes / No
7.	Deviations (if any). Attach a separate sheet if required	Yes / No
8.	Deviation list is submitted along with offer	Yes / No
9.	Manufacturing will be started only after approval of drawings and QAP from BHEL/Customer	Yes / No
10.	Vendor has to furnish reference of turbine / pump / pump turbines with water depression system where their shaft seals have been used. Supporting documents with references for leakage (compressed air/water) past sealing ring and selection of materials concerning the wear sectors and the steel plate opposite them shall be furnished. The reference list is submitted along with the offer.	Yes / No
11.	Shaft seal shall be designed for minimum 12000 hours of operation (in turbine / synchronous condenser mode) without replacement of any element. Guarantee certificate for the same will be furnished in case of ordering.	Yes / No
12.	General arrangement drawing of shaft seal, P&I diagram, proposed starter scheme, circuit diagram of feed water and all other details as per clause no. 5 are submitted with the offer.	Yes / No
13.	Details of electric supply required for filtration unit, visual and electronic indicators, other indicators /alarms / instruments are furnished in the offer.	Yes / No
14.	Detail of indicators/ alarms provided for maintenance staff to adjust spring compression either due to wear or increase of inner top cover pressure are furnished in the offer	Yes / No
15.	Value for maximum guaranteed leakage of compressed air and water past the seal (in new and worn out condition) is furnished in the offer.	Yes / No
16.	Value for minimum air pressure required for satisfactory functioning of maintenance seal is furnished in the offer.	Yes / No
17.	Procedure for replacement of worn out shaft seal is submitted along with the offer	Yes / No
18.	Material of main seal and shelf life of seal is furnished along with the offer	Yes / No
19.	Seal performance details / wear curve of seal is submitted along with the offer	Yes / No
20.	During evaluation of drawings & calculations submitted by the vendor for approval, modifications / additions which are required for satisfactory functioning of shaft seal and which are required in line with this purchase specification shall be carried out by the vendor without any price repercussion.	Agreed / Not Agreed

Name / Stamp of vendor

Name and authorized signature

Date: _____

"ANNEXURE-A" TO HT 00271
INPUT DATA SHEET

PROJECT NAME – **ARUN – 3 HEP**

PROJECT LOCATION - **NEPAL**

BHEL'S PURCHASE INDENT NO. / DATE. - **240204313 dated 30.07.2020**

S.NO.	PARAMETER	DETAILS
1.	Type of Turbine	Vertical Francis
2.	BHEL Reference Drawing No. (for tender use)	02060220502 REV.00
3.	Diameter of Turbine shaft	Ø1020 (refer tender drawing for details)
4.	Tentative commissioning dates	Nov-Dec 2021 as per L2 schedule, Refer E&C clause 3.3 also.
5.	Direction of Rotation of Shaft viewed from generator end	Clockwise
6.	Synchronous condenser operation (YES or NO)	No
7.	Rated rpm	250
8.	Runway speed	400
9.	Shaft axial displacement (max.)	
	a) During operation of turbine	
	i) Upward (Abnormal condition	15 mm
	ii) Downward (Normal, due to deflection of generator thrust bearing bracket)	3 mm
	b) During maintenance	
	i) Downward for decoupling turbine of generator thrust bearing bracket	25 mm
	ii) Upward for the generator thrust bearing inspection	20 mm
10.	Shaft Radial displacement	upto 0.3 mm
11.	Medium	River water – (4°C to 30°C)
12.	Silt content	Upto 2000 ppm
13.	Control Voltage	With isolating transformer 415 / 240V- 50 Hz.
14.	Parameters of supplied water (under BHEL scope) to shaft seal panel	
	Flow	As per vendor's design and max. upto 250 lpm
	Pressure range	2 to 4 kg/cm ²
	Filtration level	100 microns filtration
15.	Any special requirement	➤ The maximum permissible leakage through main seal should not exceed 50 liters per minutes. Value to be guaranteed at site. ➤ Erection and commissioning at site to be done by vendor. ➤ Performance certificates of satisfactory axial shaft seal operation from at least 3 power plants (Turbine / Pump turbine / Lift irrigation pumps) and these seals should be in successful operation for at least 2 years between Feb 2011 to Feb 2018.
16.	Vendor Approval Requirement	Completely filled up Vendor/ Sub-vendor assessment form (F-060-01) of M/s SJVN along with the necessary documents required in support of claims. The form and supporting documents are to be compiled in one PDF file.

[Signature]
01/10/2020

[Signature]
01/10/2020
CA-TCHEM
Sr. Pgr/HTE

[Signature]
01/10/2020

[Signature]
01/10/2020
(A MANDAL)
AGM/HTE

"ANNEXURE-B" TO HT 00271

LIST OF ITEMS COVERED UNDER SPARE

Sl. No.	DESCRIPTION	QUANTITY (SET / NO)
1.	Main seal element (including its joining hardware)	4 set
2.	Stainless steel seat ring with joining hardware	1 set
3.	All Rubber cords, flexible seal and all other seals (items to finalized during approval)	1 set
4.	Maintenance seal	1 no.
5.	Labyrinths / bush, whichever is applicable in design	1 set
6.	Fasteners including stud, bolt, nut, washer, screw of all type.	1 set
7.	All fitting required for assembly of instrumentation	1 set
8.	Set of filter elements	1 set (2 nos.)
9.	Wear indicator (mechanical)	1 no.
10.	Wear indicator (electronic)	1 no.
11.	DTT / RTD/ Temperature and pressure transmitter	1 set
12.	Pressure gauge and pressure switches and DP switches	1 set
13.	Flow transmitters	1 set
14.	Valves	1 set

Note - Set means quantity required for one shaft seal assembly.

Narneet Dubey

Name of indenter


30/07/2020
नरनीत दुबे / NAVNEET DUBEY
उप प्रबंधक / Dy. Manager
एच.टी.ई. विभाग / HTE Division
बी.एच.ई.एल., भोपाल / BHEL, Bhopal
Signature / seal of indenter