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		COPY RIGHT AND CONFIDENTIAL THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED . IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY. PURCHASE SPECIFICATION FOR TURBINE SUPERVISORY SYSTEM (TSS) AND ANALYSIS & DIAGNOSTIC PROJECT: 4x210MW TYPICAL CUSTOMER: NA					
		REVISION :00			APPROVED		
					(S.PATRA)		
					PREPARED	ISSUED	DATE
					(BRB)	409	08/01/21

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GENERAL INSTRUCTIONS & PRE-QUALIFICATION REQUIREMENTS(PQR)

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04

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PURCHASE SPECIFICATION FOR TSS FOR MAIN TURBINE and ANALYSIS & DIAGNOSTIC SYSTEM (A&D)FOR TSS & PLANT AUXILIARIES

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		SECTION-I GENERAL INSTRUCTIONS & PRE-QUALIFICATION REQUIREMENTS (PQR) PROJECT: 4x210MW TYPICAL CUSTOMER: N/A					
		REVISION :00			APPROVED		
					(S.PATRA)		
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					(BRB)	409	08/01/21

PROJECT SYNOPSIS: 4X210MW TYPICAL

Location: India

AA. GENERAL INSTRUCTIONS TO BIDDERS AND PQR:

1.0 ALL REQUIRED DOCUMENTS AGAINST THIS TENDER / SPECIFICATION SHALL BE SUBMITTED IN ENGLISH ONLY.

2.0 Bidders are required to offer Turbo Supervisory System (TSS) for Steam Turbine & Generator of rating 210 MW or above along with Analysis and Diagnostics system for both TSS and plant auxiliaries of BOP area. Vendor shall offer the system in-line with detailed Technical specification for above area kept in Section-II of this purchase specification.

3.0 In order to accept the Technical offers / proposals from Bidders for the projects mentioned in this Specification certain Pre-qualification criteria are required to be met by Bidder. Pre-qualification requirements are given below:

3.1 Bidder to submit reference list of projects wherein offered system is supplied & commissioned, along with details of machines & similar measurements and year of commissioning of system. Reference list shall contain name of end user, latest contact email id and contact telephone number..

3.2 Bidder to submit evidence of satisfactory performance of the offered system for at least 2 years as on date of opening of bid, from at least 2 end users of two different thermal power plant with steam turbine of coal-fired boiler plant of rating 200MW or above, for similar measurements mentioned in this specification.

3.3 The following documents are required for acceptance of proven track record:-

-Minutes of meeting with end user for commissioning and handing over.

-Un priced purchase order copy.

-Certificate issued by end user mentioning the date of installation, model number of the supplied system and date of issue of end user certificate.

Note : If BHEL is unable to verify the Proven Track Record(PTR) furnished, with end user contact details provided above, the offer will be rejected.

4.0 If bidder offers improved version of previous version, following criteria is to be fulfilled;

4.1 Evidence of satisfactory performance of earlier version of the system for at least two years, from at least two end users of Thermal Power Plants with Steam turbine of rating of 200 MW or above for similar monitoring, analysis & diagnostics system for projects mentioned in this specification.

4.2 Bidders shall submit a tabulation of features w.r.t to earlier model and offered model along with improvements made. This shall be stamped and signed from OEM. This document shall be submitted in Original if requested.

4.3 Technical improvements w.r.t. in earlier version shall be supported with published documents (Company's newsletters / Website updates etc.).

4.4 If the system offered is with experience with a different brand name / company supporting documents indicating such changes shall be submitted. Also Bidder to indicate the changes carried out on the earlier brand.

4.5 In case, improved version being offered Vendor shall provide additionally,

- 4.5.1 10% or 5 numbers of all types of sensors along with drivers whichever is more and 5 % or 2 numbers of all types of electronic modules whichever is more as commissioning spares for each project of this RFQ / Specs.
- 4.5.2 Two years of extended warranty over and above warranty requirements of this RFQ / Specs.

5.0 If the offer is made by channel partner/business associates etc. , the responsibility of complete system including Engineering, selection of components, and Erection and commissioning shall be with original TSS manufacturer. OEM shall submit a letter of authorization and indicating assurance of technical support , availability of service, spares for a minimum of 10 years after supply. This Authorization letter provided by OEM to Bidder shall indicate the Type and Duration of the agreement.

6.0 Submit List of Project/s (rating of > or = 200 MW Power Plants) for which Erection & Commissioning has been carried out by Subsidiary / Authorised Indian representative for last two years & at least for two systems. Bidder has to submit signed commissioning protocol from the end-user/s, in support of the same.

7.0 Vendors who are making offer for this tender shall have authorized representatives in India with relevant work experience for support related to Documentation, Erection, Commissioning and any other co-ordination work.

8.0 Name & registered address of the Indian branch office or Indian representative for support of Erection & Commissioning and after sales service, with Organization chart for information.

9.0 Details of Manufacturing, testing & inspection facility for information.

10.0 Bidder shall have facility in India for Engineering activities, preparation of Documents, Field Servicing of offered System, etc.. Submit these details for information.

Important note : In case Bidder does not submit details mentioned in above clauses or meet the requirements of Pre-qualification requirements, Offers will be summarily Rejected and Bidder's Technical offers/proposals will not be Evaluated.

11.0 **Evaluation methodology:** BHEL shall initially open Bidder's PQR documents only as per This Section of this specification for review & acceptance. Only after acceptance of PQR documents, BHEL shall open Bidder's Technical offers as mentioned under Section-II of this specification. In the event of acceptance of Bidder's technical offers, the names of such Bidders along with details provided by them for PQR and details of Technical offers , shall be submitted to End-users/Customers for their acceptance/approval. Commercial bids of only accepted/approved Bidders by End-users/Customers, shall be considered by BHEL for further processing. Any other related information ,documents , details or support etc. required during this process shall be provided by bidder immediately.

Bidders are required to submit offers as detailed below:

- aa. Documents pertaining to Pre-Qualification requirement (CI AA of Section-I of this Specification) shall be in a separate cover / soft-folder with reference no. "CI AA of Section-I" marked on it.

bb. Technical offers/ proposals for Project, whose requirements are mentioned in Section-II will be submitted in a separate cover / soft-folder with Project name & Reference marked on it.

Note 1:-Whenever required during evaluation of PQR and Technical offers/bids, vendor is required to be present at BHEL Electronic Division, Bangalore, for discussions. Further in the event of order, during approval of the vendor documents by End users/Customers, vendor shall accompany BHEL representative for discussions.

Note 2:- Any change in scope / specification, during technical evaluation of the offers, will be communicated only to the participating bidders for this tender. Deviations (if any) shall be discussed with only those bidders who quote for this tender.

Note 3:- Bidder to confirm/indicate deviation for each clause/ sub-clause of the specification individually without that offer will not be considered for evaluation.

Note 4:- Vendors need to offer all components/accessories required to meet the intent of the specification. If it is found, at any stage of procurement / commissioning, that some components / accessories have not been offered / supplied, same shall be supplied without any cost / time implication to BHEL to meet the system / product requirement.

		 A4-10	Purchase Specification for Turbo Supervisory System (TSS) and Analysis & Diagnostic For Typical 4X210MW Projects		PS4092111/S-II REV. : 00 PAGE : 01 of 12				
COPY RIGHT AND CONFIDENTIAL THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED . IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.		<u>SECTION-II</u> PURCHASE SPECIFICATION FOR TURBINE SUPERVISORY SYSTEM (TSS) AND ANALYSIS & DIAGNOSTIC FOR TYPICAL (4 X 210 MW) PROJECTS							
				Revision: 00		APPROVED S.PATRA <table border="1" style="width: 100%;"> <tr> <td data-bbox="778 1816 1174 1960" style="text-align: center;">PREPARED BRB</td> <td data-bbox="1174 1816 1334 1960" style="text-align: center;">ISSUED CE-ENGG</td> <td data-bbox="1334 1816 1535 1960" style="text-align: center;">DATE 08/01/2021</td> </tr> </table>			PREPARED BRB
PREPARED BRB	ISSUED CE-ENGG	DATE 08/01/2021							

Project Synopsis in brief : (4x210 MW)Typical Project

Location: India

AA SCOPE: Vendor shall offer Turbine Supervisory System (TSS) for Turbine-Generator for Typical (4X210MW) Coal based thermal Power plant. **Technical requirements for the above machines are as per Cl. BB of this Purchase specification.** Scope of Supply shall include Engineering, Manufacturing & Testing and Erection & Commissioning activities as per this specification.

BB Technical Requirements:

1.0 Turbine Supervisory System (TSS) :

Measurement required for TSS shall be as per Table-1

Vendor to indicate the IP class to which the sensors are complied.

1.1 Absolute Bearing Vibration Measurement:

For measurement of Vibration, Piezo-Velocity type sensor complete with connecting leads, terminal connectors are to be provided at all bearing. as per Annexure-1. The sensors shall meet at least following specifications: -

- Freq.range : 5 Hz to 5 KHz
 - Operating temp. : 0 – 120 Deg . C
 - Environmental Protection : Hermetically sealed
 - Sensitivity : 100mV /inch/sec, $\pm 5\%$
- Sensor should have M6 Mounting Stud to mount on clamping Tube Adapter

The Mounting Blocks / Pads required to fix these sensors on Generator Bearings are also to be included in the Offer. Vendor to mention Quantity of such Mounting Blocks/Pads required to be supplied. The mounting arrangement for Turbine Bearings shall be in line with the Diagram as per Annexure – 2. (This mounting arrangement for Bearing 1,2,3,4 is supplied by BHEL , NOT in Vendor's scope.) The Mounting arrangement for Generator i.e bearing 5,6 to be supplied by Vendor as per typical drawing in a Annexure-3. The length of the cable from Sensor up to nearest local junction box (JB also included in the scope of vendor) shall be equal to 9 meters. The Sensor integral cable and the extension cable shall be Teflon insulated and to meet the high operating temperature $> 205^{\circ}\text{C}$ requirement of the respective sensor.

1.2 Relative Shaft Vibration Measurement :

For measurement of Relative Shaft Vibration, Non-contact type sensors with connecting leads and terminal connectors are to be provided at bearing no.1 to 4&7 as per Annexure-1.

The sensors shall meet at least the following specifications: -

- Type : Non-contact eddy current
- Location of the sensor : Inside Bearing Casing
- Temp. range : $0 - 177^{\circ}\text{C}$
- Environmental protection : Encapsulated/ Hermetically sealed.
- Frequency Range : 10 Hz to 10 KHz.
- Sensitivity : 8 mV/microns, $\pm 5\%$ or better
- Sensor Integral cable : 1meter

Reverse mount sensors: For Turbine Bearings (Brg 1, 2,3, 4&7)

Typical Dimension of Sensor: Thread Size M10 x 1
Threaded Length : 30 mm
Sensor Tip Diameter: 8 MM
Unthreaded Length: 0MM

The sensors shall be capable of operation in an atmosphere of oil fumes. The casing of the sensor shall be made of stainless steel and the measurement shall not be affected by the presence of oil in the air gap.

The Sensor integral cable and the extension cable shall be Teflon insulated.

The mounting arrangement at Turbine Bearings shall be in line with the Diagram as per Annexure – 2. (The mounting arrangement NOT in Vendor's scope). The length of the cable from Sensor up to nearest local junction box (JB also included in the scope of vendor) shall be equal to 9 meters.

1.3 Absolute Shaft Vibration Measurement :

The necessary Computation Circuitry(part of electronics transmitter module) for the calculation of the Absolute Shaft Vibration with the Absolute Bearing Vibration and Relative Shaft Vibration at each location for Bearing 1 to 4&7 is to be provided. The Details of such computation is to be furnished for HPT(F),HPT(R),IPT(R) & LPT(R) bearing .

1.4 Differential Rotor Expansion HPT & IPT :

Type	:	Non-contact eddy current
Temp. Range	:	0 – 177 ⁰ C.
Environmental protection	:	Encapsulated/ Hermetically sealed
Location of the sensor	:	Inside the bearing casing.
Sensitivity	:	0.4 V/mm +/-5% or better
Sensor Integral cable	:	1meter

Typical dimension of Sensor shall be as follows

Thread Size	:	M24 x1.5
Threaded Length	:	30 MM
Unthreaded Length	:	0MM
Sensor tip Diameter	:	Suitable to measuring range
Overall Body Length (Threaded + Unthreaded + Sensor tip etc.)	:	not to exceed 125 MM for Sensor

The sensors shall be capable of operation in an atmosphere of oil fumes. The casing of the sensor shall be made of stainless steel and the measurement shall not be affected by the presence of oil in the air gap. The Sensor integral cable and the extension cable shall be Teflon insulated. Mounting Bracket required shall be in scope of Vendor. Mounting details for sensor bracket will be furnished to vendor during detail engineering. Due to Space Limitation, only one sensor measurement is possible for HPT and for IPT two sensors measurement is possible.

1.5 Overall expansion HPT and IPT:

Type	:	LVDT.
Temp. Range	:	0 – 120 ⁰ C.
Environmental protection	:	Weatherproof Enclosure.
Location of the sensor	:	Outside the bearing casing.
Linearity	:	0.6% of FSD or better.

The mounting bracket required shall be included in the scope of vendor. The Sensor integral cable and the extension cable shall be Teflon insulated.

1.6 Differential Expansion LPT :

Type	:	Non-contact eddy current.
Temp. Range	:	0 – 177 ⁰ C.
Environmental protection	:	Encapsulated/ Hermetically sealed
Location of the sensor	:	Inside the bearing casing.
Sensitivity	:	0.4 V/mm +/-5%
Sensor Integral cable	:	1meter
Typical dimension of sensor	:	Thread size M30 x 1.5
	:	Thread Length 40 MM
	:	Tip Diameter 25 MM
	:	Unthreaded Length 0MM

Overall body length of sensor (Threaded + unthread + sensor tip etc) shall not exceed 110 mm.

The sensors shall be capable of operation in an atmosphere of oil fumes. The casing of the sensor shall be made of stainless steel and the measurement shall not be affected by the presence of oil in the air gap. The Sensor integral cable and the extension cable shall be Teflon insulated.

Mounting bracket for LPDE shall be in scope of Vendor and mounting details for sensor bracket will be furnished to vendor during detail engineering.

1.7 Axial Shift :

Type	:	Non-contact eddy current.
Temp. Range	:	0 – 177 ⁰ C.
Environmental protection	:	Encapsulated/Hermetically sealed
Location of the sensor	:	Inside the bearing casing.
Sensor Integral cable	:	1meter
Sensitivity	:	4mV/microns +/- 5% or better
Typical Dimension of sensor	:	Thread Size M14 x 1.5
	:	Thread Length 25 MM
	:	Tip Diameter : 11.0 MM
	:	Unthreaded Length 0MM

Overall Body length of, sensor (Threaded + unthread + sensor tip etc) shall not exceed 110 MM

The sensors shall be capable of operation in an atmosphere of oil fumes. The casing of the sensor shall be made of stainless steel and the measurement shall not be affected by the presence of oil in the air gap. The mounting bracket required shall be included in the scope of vendor and Mounting details for sensor bracket will be furnished to vendor during detail engineering. The Sensor integral cable and the extension cable shall be Teflon insulated.

LIST OF MEASUREMENT FOR TSS : TABLE-1

Sl No	Measurement	Type	No. of Measurements	Range of Measurement	Remarks
01	Turbine (HP(F),HP(R),IP(R),LP(R)) Absolute Bearing Pedestal Vibration for X&Y	Seismic/velocity	8	0-320 μ peak to peak	(tag:MAD11/12 /13/14CY051)
02	Turbine HP(F),HP(R), IP(R), LP(R) Brg Relative Shaft Vibration for X&Y	Non-contact	8	0-800 μ peak to peak	(tag:MAD11/12 /13/14CY041 & MKD21CY041)
03	Generator Absolute Bearing Vibration F&R bearing for X&Y	Seismic/velocity	4	0-320 μ peak to peak	(tag:MKD11/12 /21CY021)
04	Reference Phase	Non-contact	1		(tag:MAD12CY001)
05	Overall Expansion-HP Casing	LVDT	1	0 -40 mm	(tag:MAD11CY001)
06	Overall Expansion – IP Casing	LVDT	1	0 -40 mm	(tag:MAD12CY001)
07	HP diff expansion	Non-contact	1	-5/0/+16 mm	single Sensor (tag:MAD11CY011)
08	IP diff expansion	Non-contact	1	-5/0/+16 mm	Two Sensors (tag:MAD13CY011)
09	LP Differential Expansion	Inductive/ Non contact	1 **	-10/0/+32 mm	Two Sensor (tag:MAD11CY011)
10	Axial Shift	Non contact	3	-0.5/0/+0.5 mm	(tag:MAD12CY011/12/13)

** A Conical Collar with Dual Ramp measuring surface at an angle of 14.3 Deg to Horizontal is provided. Three axial shifts shall be allocated in three separate measuring loop as these are used for turbine protection.

1.8 Reference Phase Measurement :

For phase reference measurement, one Non-contact eddy current type sensor and matching converter shall be supplied. The converter will be located near the TG set. The sensor will be mounted in bearing No 2 of the turbine. A key phasor slot of 2mm-depth and 26 mm width is made on a collar provided in bearing No 2. The casing of the sensor shall be made of stainless steel and the measurement shall not be affected by the presence of oil in the air gap. The exact sensor mounting arrangement will be finalised after award of contract. The mounting bracket required shall be included in the scope of vendor.

The sensors shall meet at least the following specifications: -

- Type	:	Non-contact eddy current
- Location of the sensor	:	Inside Bearing Casing
- Temp. range	:	0 – 177 ⁰ C
- Environmental protection	:	Encapsulated/ Hermetically sealed.
- Frequency Range	:	10 Hz to 10 KHz.
- Sensitivity	:	8 mV/um, $\pm$ 5% or better
- Sensor Integral cable	:	1meter
- Mounting Type	:	Forward mount sensors

Typical Dimension of Sensor : Thread Size M10 x 1

Threaded Length : 30 mm, Sensor Tip Diameter: 8 MM, Unthreaded Length: 0MM

1.9 Other items :

Following shall be offered: Sensor Mounting blocks, Fasteners, Junction box with terminals, flexible conduits...etc..

1.9.1 Measuring Attachment (Proximiter/Transducer/Signal Conditioner):

The Measuring Attachment Unit shall be suitable for mounting near the turbine. The operating temperature range shall be 0 to 85 Deg C and environment protection class of IP 55 or better.

The connection between the sensor and measuring attachment will be made with a cable, which forms an integral part of the sensor. The length of such a cable shall be at least 9 meters (1 meter Integral+8 meter extension). Suitable protection for the cable like Protective hose/ Armoring to be provided the size of which shall meet the cable seal Requirements as per CI 1.9.8. The connectors to be protected from the Environment & Electrical isolation and to prevent oil & other liquids from leaking out of the machine through cable's interior. Silicon Tape shall not be used for this application.

1.9.2 Local Junction Box (FRP):

Required No. of Local JB's 4mm thick Fiberglass Reinforced Polyester are to be included in the scope of supply. The JB's shall be of Standard Design of Vendor and conform to IP 65 class of protection and shall be provided with adequate No. of cable glands and Terminal Blocks. Separate JB for each of the Bearing shall be provided. The JB arrangement drawing is to be furnished. JB color shall be Exterior = RAL 7035 . Type Test for IP-65 to be included.

1.9.3 Electronic Racks:

- (i) The Electronic Transmitter modules, to drive the various sensors as detailed in Table-1 above shall be housed in adequate No of Instrument racks. The hardware design shall allow online replacement of monitors without isolation/disconnection of input/output cable connections. The Instrument racks and necessary power supply module shall be installed in the **standing cabinet to be supplied by BHEL**

- (ii) Power Supply:

The equipment shall work with 230V +/-10%V AC 50Hz , single phase ,dual redundant power supply feeder. The Common Power Supply to electronic rack shall be Redundant power

supply module in each rack such that on failure of one power supply, the other power supply shall cater to the requirement of the equipment. All the components required to achieve this shall be supplied, mounted and necessary wiring to be done. Any deviation/ alternate scheme proposed to be clearly brought out in the offer.

- (iii) The Microprocessor based Electronic Transmitter modules shall not have more than 4 Channels per module. Two nos. raw signals shall be provided for each of the measurement. The Transmitter modules shall receive the sensor signals and give 4 - 20mA signal FOR EACH CHANNEL AND COMPUTATION CHANNEL for hardwired link to DCS

Transmitter module shall have in built indication to show at least

- Alarm indication
- Module Healthy / Fault indication.
- The transmitter module shall have facility to set the Measuring Range
- No separate alarm contacts are envisaged for individual measurement.
- One no each potential free contacts to be provided for system failure,(rack wise or system wise as per manufactures standard practice) power supply OK/failure for hooking up the status to DDCMIS. The rating of the contact shall be 60V DC, 3 Watts.
- Vendor to indicate the available feature in their system for indication of measured values on rack/module.
- 4-20 mA signal output shall be less than 4 mA for related sensor failure.

1.9.4 Calibration/ Configuration Equipment:

- a) One common set of Calibration Kit and Portable Shaker suitable for all sensors offered for all four units shall be included in the offer. The Calibration Kit shall have Integrated a built-in sine wave generator, Power amplifier and Electrodynamic shaker with digital display.

Any software required for configuration of the system shall be part of offer. Licensed copy of same shall be supplied along with the system.

1.9.5 The Instrument rack shall have 10% of wired Rack Space free for any future expansion.

1.9.6 Spare **10% or 2 nos** (whichever is more) channels of each variety of module shall be provided in the TSS.

1.9.7 Cables:

Between Sensor and JB:

Integral cable 0.5 sqmm (catalogue item) as per vendor standard suitable for intended Turbine application shall be part of offer..

Cables between sensors to JB's, heat resistant hose, converters and extender cables are in Vendor's scope

Between JB and System Rack:

Suitable 2/4 Pair 0.5sqmm Shielded FRLS PVC cable will be provided by BHEL. Special requirement, if any, shall be indicated in the offer.

1.9.8 Cable Seals:

Necessary Cable seals meeting suitable environment conditions of medium, temperature and pressure (at least 25 psi) shall be included for Routing the cables from inside the bearing to outside. The Seals shall be suitable for M12x1.5 tapped hole of length 25 mm provided on the Bearing Casing. Also any other items required to complete the equipment /system shall be included by the vendor. This item is required for following measurements.

- Axial Shift
 - Differential expansion of HPT & IPT
 - LPDE
-

1.9.9 Panel : TSS Panel will be for above racks as per below details :

Rack and modules to be supplied by vendor will be mounted by BHEL **inside the panel being provided by BHEL**. All dimensional and mounting details of the components to be mounted shall be part of offer. Any special requirement for this shall be clearly specified in the offer.

1.9.10 Mandatory Spare :

10% or 2 nos. (whichever is more) for total quantity used in total four units of each type electronic module , power supply module ,field sensor , extension cable & PCB interface/Driver to be included as mandatory spare . Ethernet switches: 10% of total quantity used or minimum 2nos.

- Note:**
1. Unit prices of each item shall be indicated separately
 2. Calculation shall be based on overall quantity of 4 Units
 3. In case of decimals value, next higher integer value shall be considered

1.9.11 Link to DCS:

All the measured signals and the other Related Parameters shall be hooked up to the DCS to be supplied by BHEL through Dual redundant Ethernet / Modbus communication must be provided for integration

2.0 Bought out items to be sourced from the following vendors:

- 2.1 Junction Box (FRP)** - 1. Manisha Enterprises 2. Suchitra Industries
3. KS Instruments 4. Devi Polymers
5. Hensel 6. Baliga Lightings
7.Ficom Engg.

- 2.2 PC/Server & TFT Monitor - DELL**
HP/Compaq
IBM/LENOVA
Siemens Fujitsu, Germany

- 2.3 Printer (Laser)** - HP/ Canon/ Xerox/ IBM/EPSON

3.0 Analysis Requirements :

Scope: Vendor shall offer **unified Analysis and Diagnostics system (A&D)** for Main Turbine & raw, buffered signals of vibration measurements from the Vibration Monitoring System for the following Plant Auxiliaries as per the table below and perform analysis and diagnosis Plant auxiliaries as listed in Table-2

TABLE-2

Sl.No	Name of the Auxiliaries	Measurement	Qty Per Unit	No. of Measurement per Drive	Total measurements per unit	No of ref phase detector signals	Measurement Range	Remarks
1	ID-A&B (Fan+Motor)	Abs Bearing Vibn. (X & Y)	2	8	16	2	0-25 mm/sec	
2	FD-A&B (Fan+Motor)	Abs Bearing Vibn. (X & Y)	2	6	12	2	0-25 mm/sec	
3	PAF-A-F (Fan+Motor)	Abs Bearing Vibn. (X & Y)	6	8	48	6	0-25 mm/sec	
4	CEP-A&B (Pump+Motor)	Abs Bearing Vibn. (X & Y)	2	6	12	2	0-25 mm/sec	
5	BFP –A,B,C	Shaft Vibn. (Proximity Probe)	3	4	12	3	0-200 mic-mtr	

The technical requirement of the unified Analysis and Diagnostics system is specified in clause 3.1-3.64 of this section of the purchase specification.

The number of points for analysis & diagnostics system shall be referred from Table-1 & Table-2

Scope of Supply shall include Engineering, Manufacturing & Testing, and Erection & Commissioning activities as per this specification

3.1 Microprocessor/ Computer based Analysis Unit , with required software, is to be offered to achieve the following functions as minimum.

- Storage and comparative analysis of vibrations
- Spectrums and Spectral Alarms
- Generation / analysis of bode plot
- Orbit plot & Polar plot
- Time waveform
- Nyquist plot
- Shaft center line plot for TG
- Cascade
- Waterfall plots
- Transient data (during Start-up and Shut-down)

Vendor shall furnish the List of process signals required for further analyzing vibration data and include necessary hardware and software for accepting such signals from BHEL system.

3.2 The FFT analyzer units shall have a frequency range from 1Hz to 20 kHz, Spectrum resolution of 800 lines minimum. Provision for selecting high and low resolution display shall be provided. The scan rate shall be specified by vendor.

3.3 The FFT analyzer offered may be an independent unit or a part of Monitor rack/s housing input modules ..etc. (discussed in Clauses 1.0 of this Specs.) and in-line with the manufacturer's practice.

3.4 The output from FFT analyzer unit and/or Monitor rack/s above shall be connected to a computer system to perform analysis of the Vibration data of the machine/s (discussed in Clauses 1.0 of this Specs.).

3.5 The Computer for analyzer unit shall consist at-least of following configuration.

- PC/server of reputed make (with 29" TFT colour monitor) and Latest model and version.
- Intel Xeon /Quad Core Processor
- Minimum 4 GB RAM
- Min 1TB hard disc with mirroring type hard disc to ensure data integrity.
- Combo Drive, DVD R/W 16x or higher
- Redundant hot swappable power supply
- Master Slave Card for Time synchronization in IRIG-B protocol
- Colour Laser printer upto A4 printing. Ref Models (XEROX Phaser 6500 & equivalent or better)
- Network card (2 Nos.)
- Necessary Cables with accessories for inter connecting and connecting to TSS / VMS Panels and DCS/ DAS Panel/s. Software CDs with License/s.
- Anti-Virus Package (like Norton System Works latest version) to be included

Vendor shall clearly bring out in his offer the configuration proposed. Vendor shall ensure that the capacity of the analyzer unit is sufficient to meet the specification requirements of the points being monitored. Also a spare capacity of 20% points of measurement, for future expansion shall be provided in the Analysis software only. Vendor shall specify the type of communication between the offered FFT unit and Analyzer unit. Vendor shall clearly bring out in their offer the Data Backup and Security procedures. Necessary no. of Ethernet hubs,

cables, etc., shall be included in the offer. All items required to make the system complete shall be included in the offer.

3.6 Configuration Requirements:

3.6.1 The offered System for TSS with FFT analyzer for Main TG shall be located in Main Control equipment room.

3.6.2 Buffered signals of VMS as mentioned in Table-2 above shall be located in Main Control equipment room . Necessary cable and networking components shall be offered to acquire those buffered signals to the offered Analysis & Diagnostic system.

3.6.3 Offered Computer hardware for Analysis & Diagnostics system shall be located in Computer room near Main Control equipment room. The distance between Panels in Main Control equipment room (3.6.1) & Computer room is about 50 meters. Vendor shall offer redundant cable with necessary redundant networking hardware and other accessories between Panels (3.6.1) and Computer.

3.6.4 Vendor to propose a detailed configuration diagram of the equipment to be supplied along with a list of equipment, which shall be approved by BHEL.

4.0 Diagnostics / Expert System Requirements:

Vendor shall utilize the Vibration data, Process information and Analysis data to provide Diagnosis and recommendations for machinery management, effectively. It shall be an extensive and accurate knowledge base to enable quick determination of the condition of a machine by providing alarm notification or advisories of the machinery malfunction. The offered system shall be able to specifically evaluate the available data while checking for the presence of the most frequently occurring machine malfunctions such as,

- Imbalances
- Misalignment
- Bearing failure
- High synchronous vibration
- Shaft bow / crack
- Fluid induced instability (Whirl and Whip)
- Radial pre-load forces (including misalignment)
- Vector change
- Rotor rub
- Loose rotating parts
- Gear mesh problems, pump cavitations
- Analysis of generator overhang
- Alarm the abnormal conditions

Vibration analysis / diagnostics system shall be knowledge based with the capability of dynamic data analysis and provide complete information about machines and guidance for predictive maintenance. The related process parameters (Pr, Temp...etc) shall be integrated with the system through DCS. The system shall not require the intervention of vibration expert to determine the nature of the fault.

5.0 Quality Requirements:

5.1 Following minimum test requirements to be met :

- Calibration report of Sensors for the selected / approved Range with curves shall be furnished.
- For Vibration Sensors, Frequency response curves and for Proximity probes, Gap v/s voltage data to be furnished. Sample reports shall be included as a part of Quality plan.
- Calibration report for LVDT Sensors to be furnished
- Calibration of Monitors for the approved Range shall be submitted.

The above documents shall form part of Acceptance documentation.

5.2 TESTING & INSPECTION:

- The equipment covered under this specification shall be subject to vendor's Quality Plan to be approved by **Customer/End User** before start of manufacture. To ensure that quality is in-built in each equipment the Quality Assurance System manual & Quality Plan indicating the system followed by the vendor shall be submitted to purchaser for his review along with the offer.

The vendor shall give at least 15 days written advance notice to purchaser for witnessing the tests/inspection at various stages. The expenses for all such test/inspection shall be to Manufacturer's account except for the expenses of purchaser's representatives witnessing the test. The purchaser shall attend such test/inspection or advice that the manufacturer may proceed with the test, which shall be deemed to have in purchaser's presence and shall furnish relevant test result and test certificates to the purchaser for his review who will then issue Material Dispatch Clearance Certificate (MDCC) enabling supplier to dispatch the equipment.

5.3 TYPE TEST:

- The Vendor shall give the type test report for the TSS System and the test requirement shall cover CMRR , NMRR Verification . Submission of type test results and certificate shall be acceptable provided.
 - i) The same has been carried out by the Vendor on exactly the same model / rating of equipment.
 - ii) There has been no change in the components from the offered equipment & tested equipment.

5.4 SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS

The minimum type test reports, which are to be submitted for each of the major C&I systems shall be as indicated below:

- i) Surge Withstand Capability (SWC) for Solid State Equipments Systems

All solid state systems/equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472.Hence, all front end cards which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90.1/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of EN 61000-4-12 which is equivalent to ANS/37.90.1/IEEE-472 may also be adopted for SWC test.

- ii) Dry Heat test as per IEC-68-2-2 or equivalent.
- iii) Damp Heat test as per IEC-68-2-3 or equivalent.
- iv) Vibration test as per IEC-68-2-6 or equivalent.
- v) Electrostatic discharge tests as per EN 61000-4-2 or equivalent.

- vi) Radio frequency immunity test as per EN 61000-4-6 or equivalent.
- vii) Electromagnetic Field immunity as per EN 61000-4-3 or equivalent.

Test listed at item no. v, vi, vii, above are applicable for electronic cards only.

6.0 Documents :

- All documentation shall be in English language.
- Following documents shall be supplied along with offer.
 - a) Bill of material
 - b) Mounting details of the sensors, mounting blocks/pads and local junction boxes.
 - c) Configuration diagram of the system offered (rack layout & network diagram).
 - d) Specification / data sheets of all devices/components offered with dimensional and mounting details
 - e) Reference list of users for fossil fired Turbine generator set of similar rating.
- After award of contract, following documentation in no. of copies as mentioned below shall be supplied.
 - a) Quality plan
 - b) Storage instruction
 - c) Configuration diagram & Machine train diagram
 - d) Mounting details for sensors
 - e) BOM & Rack layout drg
Loop scheme and cable schedule
Mounting blocks and JB Drawings
Datasheet and technical literatures

In soft copy, within 1 weeks of placement of P.O

- f) Test certificate & test results
- g) Calibration results for sensors
- h) Test results for Cables
- i) Type test results

In soft copy After completion of tests

- j) Operation & maintenance manual for the system including wiring diagram, circuit diagrams, Sensor details, etc..

2 sets in soft copy along with the equipment + 1 soft copy to BHEL

Also one set of soft copy on CD ROM for all the datasheet/drawings/test reports are to be furnished to BHEL after placement of Purchase order.
The drawings under (a),(c),(d),(e),(f) & (i) will be for approval & others are for information & records.

7.0 Training :

Vendor shall provide necessary training on the operation & application to BHEL / End-User. The training shall cover the basic aspects of Vibration monitoring, details of the System supplied, Operation and Maintenance. Training shall be provided at site to approx. 10 End user/BHEL engineers for each unit.

8.0 Vendor to note that any Item / services required to complete the Equipment to meet the Specification requirement shall be taken care without any Cost implication to BHEL.

9.0 Blank

10.0 Erection & Commissioning (E & C) Scope :

10.1 Turbo Supervisory System portion:

10.1.1 Vendor shall give a separate offer for erection and commissioning of the complete Turbine Supervisory system and Analysis & Diagnostic System covered in this specification.

10.1.2 The total responsibility of erection and commissioning of the system supplied shall rest with the vendor. The important events are listed below:

- Collection of material from stores by vendor.
- Preparation of mounting surface and mounting arrangement to suit the surface of the machine by vendor
- Mounting of Sensors on the Machine by vendor.
- Mounting of local JB's and termination of cables between Sensor to local JB by vendor.
- Laying of instrumentation cable between Local JB and Control Panels will be by BHEL
- Erection of TSS panel in equipment room is by BHEL.
- Laying of power cable to TSS panel is by BHEL.
- Termination of instrumentation cables between local JB's to cabinet by BHEL
- Carrying out pre-commissioning checks, energizing Cabinets & PC/Laptop (as applicable) by BHEL.
- Commissioning of individual services by vendor.
- Installing various software packages on PC/laptop & establishing the operation (as applicable) by vendor.
- Checking for all functions of hardware and software when the plant is totally commissioned with all auxiliaries by vendor.
- Handing over the system to End-User by vendor.
- Training the operation personnel on operation and maintenance aspects by vendor.
- Rack mounting & Panel internal wiring(when TSS panel by BHEL) by BHEL.
- **Relevant documentation for commissioning of this system inline with specification requirement.. such as signed protocol with end user to be furnished along with calibration data.**

Note: The total responsibility of above activities on the offered system shall rest with the vendor. Vendor shall offer for above mentioned E&C activities on as required basis. Limitation of number of days / visit for E&C activities is not acceptable.

11.0 Packaging:-

1) Each component of imported item shall be packed as per the manufacturer's packing standard, then shall be secondarily packed in best – fit corrugated single box which is suitable for transportation by lorry and storage at site for extended period upto 24months shall be used.

The packing shall be separate for each unit of the project, TSS & mandatory spares separately.

2) For Junction Boxes, mounting pad/bracket, field cables etc (i.e. typically from Indian manufacturer) packing which is suitable for transportation by lorry and storage at site for extended period upto 24months shall be used. For this a reference standard ED490099 Rev08 clause 3.1.1 is attached. Bidders shall follow this standard. All other items shall be packed in one or two boxes maximum. The packing shall be separate for each unit of the project, TSS & mandatory spares shall be separately.



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PURCHASE SPECIFICATION
FOR
TURBINE SUPERVISORY SYSTEM

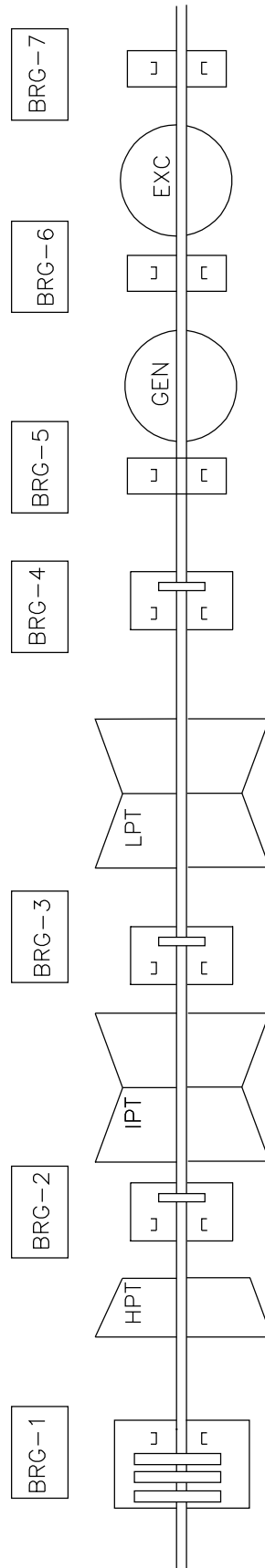
PS/409/2075 REV00
ANNEXURE-1

PAGE 01 OF 01

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TYPICAL BEARING ARRANGEMENT OF TG SET FOR <=520 MW



NOTES:-

- 1) BEARINGS ARE OF HYDRAULIC JOURNAL TYPE
- 2) BRG-2 IS COMBINED THRUST AND JOURNAL BEARING
- 3) RATED SPEED IS 3000 RPM AND POWER IS 520 MW



PURCHASE SPECIFICATION
FOR
TURBINE SUPERVISORY SYSTEM

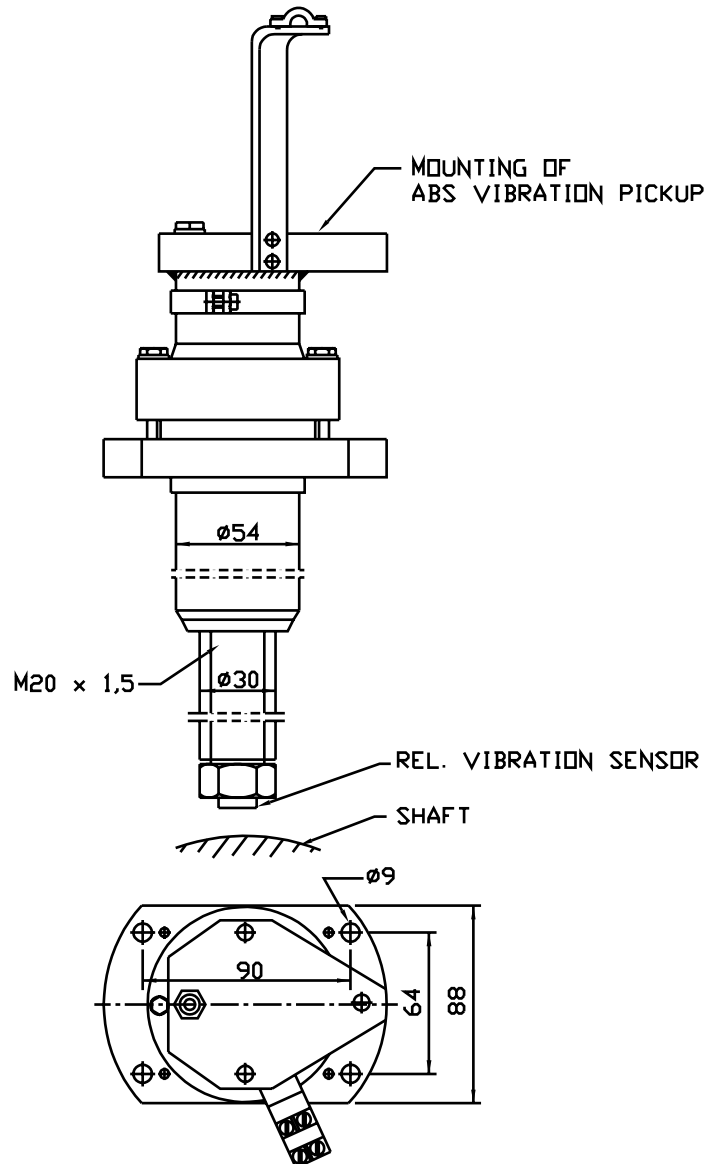
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ANNEXURE-2

PAGE 01 OF 01

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MIS/PROBE-YADU



DUAL PROBE HOUSING



PURCHASE SEPCIFICATION FOR TSS+VMS + ANALYSIS AND DIAGNOSTICS

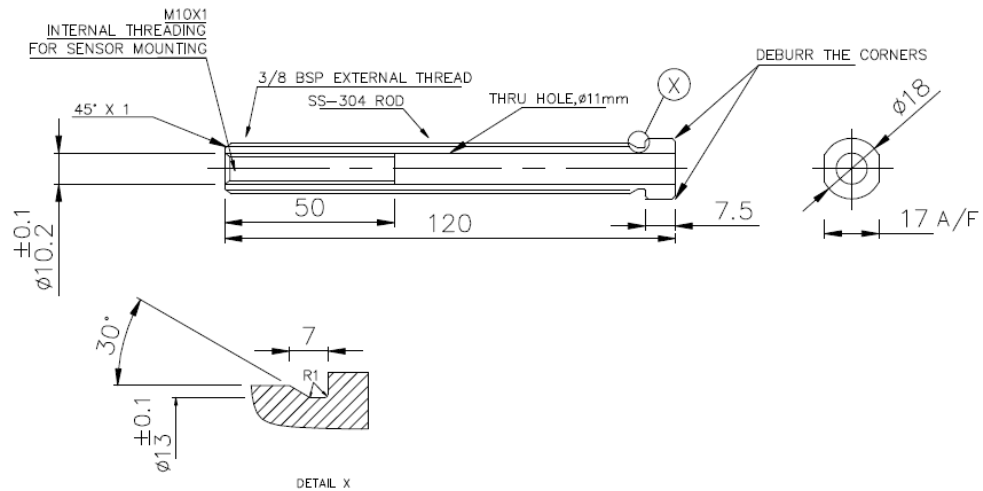
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REV. NO. 00

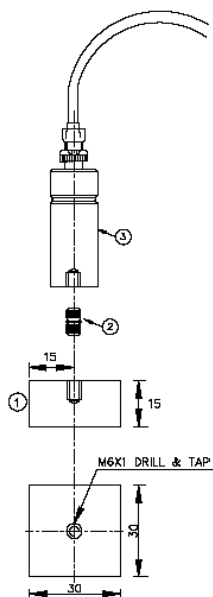
A4 - 10

PAGE 01 OF 1

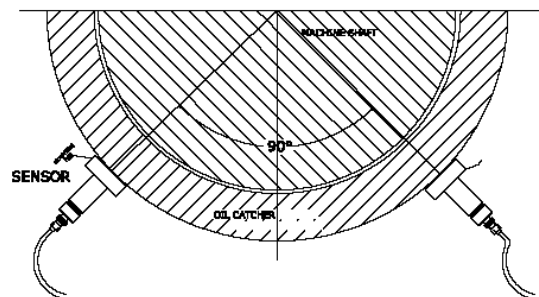
MOUNTING BRACKET FOR BEARING 5 & 6



MOUNTING ARRANGEMENT FOR BEARING 5&6



SENSOR MOUNTING INSTALLATION DETAILS FOR BRG. 5 & 6



MOUNTING PAD
SIZE - 30X30X15MM