





	PROJECT-KHU'RJA 2X660 MW	DRAWING NO-418150F9002 REV 00 DATE-11.10.2021	
	Blade Vibration Monitoring System Mandatory Spares		
Sl No.	Description of Items	Units of item	Quantity
1	Sensors	No.	20 % of full set or minimum 2, whichever is more
2	Brackets, Fixtures	No.	20 % of full set or minimum 2, whichever is more
3	Internal cabling	Length,M	20 % of full set or minimum 1 run of each type, corresponding to maximum length used in the system
4	External Cabling	Length,M	20 % of full set or minimum 1 run of each type, corresponding to maximum length used in the system
5	Special conduits/ vacuum pass thr	Length,M	20 % of full set or minimum 1 run of each type, corresponding to maximum length used in the system
6	Input card	No.	10 % of full set or 1 number, whichever is more
7	Output Card	No.	10 % of full set or 1 number, whichever is more
NOTE:-1. One Full set of BVMS means instrumentation etc for Four Nos LP Turbines for L0 stage.One LP Turbine includes 2 nos of L0 stage.			
2.During Calculation if offered Spare Quantity comes to fraction,Then it should be rounded to next Higher Integer.			


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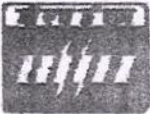


प्रमाणित करने वाला SIGN & DATE SUPERSEDES INVENTORY NO. जारी करने वाले अधिकारी का नाम		उत्पाद मानक PRODUCT STANDARD		ST 51027	
				पृष्ठ 8 का 1 Page 1 of 8	
BLADE VIBRATION MONITORING SYSTEM (BVMS)					
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स्वामित्व अधिकार एवं गोपनीयता इस दस्तावेज़ में दी गई सूचना भारत भारती इलेक्ट्रिकल्स लिमिटेड की संपत्ति है। इस सूचना को किसी भी रूप में बिना लिखित अनुमति के प्रसारित नहीं किया जा सकता है।					
जारी करने वाला INVENTORY NO. P-6464	जारी करने की तिथि SIGN & DATE 19/3/15	TSX QAX Member PSC STE AGREED DEPT. नाम DATE & SIGNATURE	LALIT KUMAR S K CHAUHAN V K CHAUHAN AKASH SHUKLA नाम DATE & SIGNATURE	अनुवाद TRANSLATED BY कार्य WORKED BY जांच CHECKED BY निरीक्षण SUPERVISED BY	नाम NAME AKG BSR KBB APPROVED : K.B.BATRA, AGM (CIE & TCX) PREPARED : CIE ISSUED : TSX
				हस्ताक्षर एवं तिथि SIGNATURE & DATE 19/3/15	तिथि DATE 17/3/15


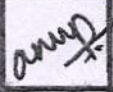
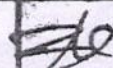
ST 51027 पृष्ठ 8 का 2 Page 2 of 8		उत्पाद मानक PRODUCT STANDARD	
SUPERSEDES INVENTORY NO.		BLADE VIBRATION MONITORING SYSTEM (BVMS FOR LP TURBINE AT THERMAL POWER PLANTS)	
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electricals Limited. It must not be used directly or indirectly in any way detrimental to the interest of this company.		<p>1.0 Objective: This specification covers the design, supply & erection/ execution of BVMS system for Steam Turbines of various ratings.</p> <p>2.0 Scope of supply: The scope of supply of BVMS system shall be as per the details given in this specification. However, project specific details will be covered in project data sheets which include</p> <ul style="list-style-type: none"> (i) Project rating (ii) LP turbine drawings & details for mounting purpose. (iii) Blade (operational data) detail and its Axial/radial movement range. <p>Project details shall be furnished along with enquiry.</p> <p>3.0 Applicable codes & standards:</p> <p>BHEL experience and Product catalogues.</p> <p>4.0 Application Range:</p> <p>Operating temperature Range for</p> <ul style="list-style-type: none"> a) Probes: 0 to 200° C b) Preamplifiers: 0 to 90° C c) Data acquisition system: 0 to 60° C <p>Rotor Speed: 3000 rpm (Over speed 3750 RPM)</p> <p>Deflections: 3 μm to 30 mm</p> <p>Blade count: Refer project data sheet</p> <p>5.0 System Components: The system consists of sensors, preamplifiers, data acquisition system, software package, operator interface, rack, interconnecting cables and mounting accessories. All equipment to make the system completely functional as per the requirements of this specification and to be provided by the bidder irrespective of whether it is explicitly specified or not.</p> <p>5.1 Sensors and Mounting Accessories: Sensors are required for blade tip timing which should sustain harsh, humid, low pressure, maximum 200° C temperature environment existing at LP Turbine last stage blades along with suitable cables and BNC connectors. Selection of sensor type, numbers & locations suitable for this application to be determined by bidder and shall be subject to BHEL approval depending upon functional requirements. Vendor to provide appropriate details in support of selected type of probes.</p>	
REV.00		WORKED BY AKG	
INVENTORY NO. P-6464		CHECKED BY BSR	



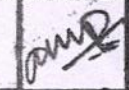
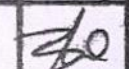
दिनांक एवं हस्ताक्षर SIGN & DATE		उत्पाद मानक PRODUCT STANDARD	ST 51027 पृष्ठ 8 का 3 Page 3 of 8			
सुपरसेडिंग INVENTORY NO.	भारतीय भारी विद्युत यंत्रों की संपत्ति का संकेत	Additional requirements: <ol style="list-style-type: none"> 1. Dimensional details of blades will be given in project datasheets. 2. The sensors should withstand the last stage LP steam, vacuum and temperature environment which are typically from 0.1 to 0.2 Kg/cm² absolute. 3. The speed of rotation of the blades shall be from zero to 3000 RPM with 25% over speed 4. Integral cable shall be provided with sensors of minimum length of 20 m from sensor to preamplifier. 5. Multiple sensors with redundancy for mid chord measurements to be provided, catering to both the stages of the turbine 6. Conduited cables to be provided to protect from steam environment with Vacuum sealing at every outlet from Turbine casing. 7. Suitable holders and shims to be provided for holding sensors and conduited cables onto the casing to be provided to with stand vacuum pulling force. 8. Vacuum sealing provision at casing penetration. 9. Required tools and fixtures for installation of sensors, conduited cables and other peripherals up to the main system installed in control room. 10. The sensors should withstand without any signal distortion, the magnetic field of at least 10 Gauss prevailing near the LP turbine. Suitable test reports to be submitted after order placement. 				
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भारतीय भारी विद्युत यंत्रों की संपत्ति का संकेत	भारतीय भारी विद्युत यंत्रों की संपत्ति का संकेत	5.2 Preamplification: Suitable number of Preamplifiers to process the signals from sensors. These shall be suitable for field installation near the turbine. Integral cable shall run upto these preamplifiers. Protection class shall be IP 65 or better.				
दिनांक एवं हस्ताक्षर SIGN & DATE	दिनांक एवं हस्ताक्षर SIGN & DATE	5.3 Data Acquisition system: <ol style="list-style-type: none"> 1. System is required to take the analog signals from the preamplifiers and convert them into timing data which can be further analysed for useful information and software processing. 				
भारतीय भारी विद्युत यंत्रों की संपत्ति का संकेत INVENTORY NO.	भारतीय भारी विद्युत यंत्रों की संपत्ति का संकेत INVENTORY NO.	REV.00	निर्माणकर्ता WORKED BY	AKG		19/2/15
			जांचकर्ता CHECKED BY	BSR		18/2/15

Date of issue SIGN & DATE		उत्पाद मानक PRODUCT STANDARD	ST 51027 पृष्ठ 8 का 4 Page 4 of 8	
SUPPLIERS INVENTORY NO. जारी की तारीख DATE OF ISSUE	2. Data acquisition system shall be furnished in form of 19 inches rack mounted in suitable cabinet. Size of cabinet to be informed in the bid. Cabinet will be placed in control equipment room of power plant. 3. Protection class shall be IP 32 or better. 4. System shall be suitable for operation at 230 V UPS supply. Load details to be furnished by the bidder. 5. OPC interface to be provided for connection to BHEL's DCS. Details shall be finalised during project execution. One signal of phase measurement shall be provided by BHEL.			
COPYRIGHT 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.	5.4 Software Package: 5.4.1 Analysis - To monitor the following parameters for each blade: 1. Lean / deflection and tip clearance at leading edge, mid chord and trailing edge in mm 2. Twist (Between Leading Edge and Mid Chord, Mid chord and trailing edge and leading edge to trailing edge) in mm 3. Asynchronous component vibration amplitude, frequency and phase 4. Synchronous component vibration amplitude, frequency and phase 5. Inter Blade Spacing 6. Campbell Diagram			
स्वाधिकार एवं गोपनीय प्रकृति एवं प्रयोग के लिए अधिकार को सुरक्षित रखना है। इस दस्तावेज़ को बिना अनुमति के न प्रसारित करें।	5.4.2 Real Time Display: 1. Instantaneous raw sensor output plot with refresh rate not more than one Second. 2. Sensor health status as per minimum voltage settings of sensor output. 3. Date, Time and minimum five more user configurable operating parameters from OPC list on all displays. 4. Time Plots of Blade Lean, Twist, Synchronous and Asynchronous Vibration, Phase, Amplitude, Damping Factor and Resonance Hz./RPM 5. Blade frequency Spectrum of each blade showing vibration mode 6. Campbell diagram of each blade and all blades together 7. Menu to enable sensor trigger settings			
जारी की तारीख SIGN & DATE 19/3/15	REV.00			
जारी की तारीख INVENTORY NO. P-6464	REV.00		निर्दिष्टकर्ता WORKED BY AKG	19/7/15
			जांचकर्ता CHECKED BY BSR	07/2/15

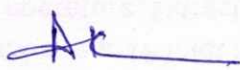
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Page of Sheet SIGN & DATE		उत्पाद मानक PRODUCT STANDARD	ST 51027 पृष्ठ 8 का 6 Page 6 of 8			
SUPPLIERS INVENTORY NO. वस्तु की संख्या सप्लायर द्वारा	7. The system should work on 230 V AC +/- 10% power supply @ 50Hz. 6.0 Tests: 6.1 Routine Tests: Following tests should be carried out by the vendor on each piece of sensor, preamplifier and data acquisition system. <ol style="list-style-type: none"> 1. Visual inspection and dimensional check 2. Functional test for sensor, preamplifier and data acquisition system 3. Burn in test for data acquisition system modules (for 48 hrs. at 55°C) 6.2 Type Tests: Type Test reports shall be furnished for the following additional tests on electronic modules as per IEC 60068 <ol style="list-style-type: none"> 1. Damp Heat Test 2. Temperature Cycle Test 3. Dry Heat Test 4. Vibration Test Degree of protection test as per IS 13947 shall be furnished for preamplifier and data acquisition system. 7.0 Test Certificate: Each piece of sensor/ preamplifier/ data acquisition system shall accompany with 3 copies of the tests certificate with: <ol style="list-style-type: none"> i) Name of equipment ii) Name of manufacturer iii) Serial no & model no of equipment iv) Date of testing 					
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स्वसाक्षिकार एवं गोपनीय इस दस्तावेज में दी गई सूचना सप्लायर द्वारा उपलब्ध कराई गई है। इस दस्तावेज को किसी भी प्रकार में प्रसारित करने से निषेध है।						
SIGN & DATE 19/12/15						
INVENTORY NO. 28484	REV.00		निर्माणकर्ता WORKED BY	AKG		19/12/15
			जांचकर्ता CHECKED BY	BSR		18/12/15

दिनांक एवं हस्ताक्षर SIGN & DATE		उत्पाद मानक PRODUCT STANDARD	ST 51027 पृष्ठ 8 का 7 Page 7 of 8	
सुपरसेरीज INVENTORY NO.	जारी की गई तिथि आवृत्ति का क्रम	8.0 Training: <ol style="list-style-type: none"> 1. Training should be given at BHEL/Site for minimum FIVE working days on the hardware and software contents of BVMS along with a set of hard copy and soft copy of training manuals. 2. Vendor should enable BHEL Engineers to install and maintain the system independently. 3. For this all necessary installation and maintenance methodologies, debugging features to be provided. 4. Vendor should clearly bring out the methodology of estimating blade parameters like lean, twist, clearance, blade spacing, asynchronous vibration, synchronous vibration and Campbell diagram from raw sensor signal. 		
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स्वयंसेविकाएं एवं गोपनीय इस दस्तावेज में दी गई सूचना भारत भारी भारी विद्युत निगम की संपत्ति है इसका प्रयोग केवल भारत भारी भारी विद्युत निगम के अधिकारियों के लिए ही किया जा सकता है अन्यथा इस दस्तावेज को बिना अनुमति के प्रसारित करना गैर कानूनी है		10.0 Accessories & Cables: Offer shall include all the accessories required for normal operation of equipment. All types of special cables to be included in the offer. 11.0 Installation & Commissioning: Supervision of installation of sensors, cables and complete system shall be in vendor's scope. Commissioning of complete system shall be in vendor's scope. Charges for the same should be quoted separately. Vendor shall be responsible for satisfactory functioning of the system. Commissioning report to be generated and to be verified by BHEL Engineer.		
तैयार करने वाला SIGN & DATE 19/3/15				
जारी की गई तिथि INVENTORY NO. 166464	REV.00		निर्माता WORKED BY AKG	 19/3/15
			जांचकर्ता CHECKED BY BSR	 19/3/15

SIGN & DATE 	उत्पाद मानक PRODUCT STANDARD		ST 51027	
			पृष्ठ 8 का 8 Page 8 of 8	
SUPERSEDES INVENTORY NO. कार्य को करने से प्रतिस्थापन करें	12.0 Predispach inspection: <p>Inspection shall be carried out by BHEL Haridwar or their nominated agency. Vendor shall give minimum of 3 weeks notice for inspection along with internal test certificates. Manufacturer's Test Certificate required and shall be provided before dispatch. Material shall be dispatched by vendor only after getting clearance from BHEL.</p>			
COPYRIGHT AND CONFIDENTIAL The information on this document is the property of Bharat Heavy Electrical Limited. It must not be used directly or indirectly in any way detrimental to the interest of the company.	13.0 Documentation with and after bid: <p>Following documents to be furnished with bid-</p> <ol style="list-style-type: none"> 1) Details of sensor type and quantity of sensors 2) System overview showing sensors, preamplifier, data acquisition system, workstation etc. 3) Deviations from specifications, if any. 4) Experience list for similar systems. 5) Complete technical literature including sensor catalogue, system catalogues etc. <p>Datasheets & wiring diagram of complete system (including sensors, sensor cabling, preamplifier, data acquisition system, mounting arrangement, operator interfaces and remote connection provision etc.) shall be furnished for BHEL approval. Operation & maintenance manual shall be furnished before supply of equipment.</p>			
	14.0 Recommended spares: <p>Offer shall include recommended spares required for 2 years operation of equipment. These shall be quoted separately.</p>			
स्वामित्व का यह गोपनीय इस दस्तावेज में जो भी सूचना प्रदाता को उपलब्ध हो सकेगी वह केवल BHEL द्वारा प्रदान की गई जानकारी के लिए है। इस दस्तावेज को किसी भी अन्य उद्देश्य के लिए उपयोग नहीं किया जाना चाहिए।	15.0 Warranty: <p>All supplied items to be provided with warranty for 18 months from date of dispatch or 12 months from erection and commissioning whichever is later <i>earlier</i>.</p>			
	16.0 Cross referred standards: IS 13947 and IEC 60068			
SIGN & DATE 				
INVENTORY NO. 126664	REV.00	निर्माता WORKED BY AKG		19/2/15
		जांचकर्ता CHECKED BY BSR		20/2/15


BLADE VIBRATION MONITORING SYSTEM (BVMS)		
PROJECT- KHURJA - 2x660MW		
C & I ADDENDUM TO SPECIFICATION ST 51027		
DOCUMENT NO- 418150F9001 Rev 00		Date-11/10/2021
S. No.	Clause No.	Description
1	1.06.01 a(1)	The On-line integrated system shall consist of suitable number of Non-contact eddy current/inductive/magnetic sensors, including hardware, software for monitoring blade vibrations and health based on, but not confined only to blade vibration amplitude/frequency, for last stage and/or last but one stage free standing blades (both Turbine end & Generator end) of low pressure turbines.
2	1.06.01 a(2)	The required sensors suitable for steam environment should be mounted inside the turbine casing, directly seeing the free standing rotating blades in non-contact manner
3	1.06.01 a(3)	The system should be able to detect Synchronous and Asynchronous vibrations. The system should be able to track changes in amplitude, frequency of vibration of individual blade over the base level under various operating conditions including transient and steady state.
4	1.06.01 a(4)	The system should be helpful in identifying the individual blade having crack, prior to failure of blade (off-line analysis/assessment).
5	1.06.01 a(5)	The system should help in giving reliable and accurate blade health assessment to prevent unwanted shutting down of the unit for any corrective action based on above diagnostics.
6	1.06.01 a(6)	Processing of tip-timing data into easily understandable historical trends of blade vibration.
7	1.06.01 a(7)	Generation of reports on a schedule (preferably automatic) in minimum one week and reports to be sent to specified recipients via email.
8	1.06.01 a(8)	Report generation on demand into PDF or Microsoft Word and data export into Microsoft Excel.
9	1.06.01 a(9)	Importing plant process data (minimum 16 nos.) from OPC server, and displaying side-by-side with blade vibration data. In case this is not possible, the data shall be acquired through hardwiring using F type instrumentation cables from control cabinets located in Control Equipment Room.
10	1.06.01 a(10)	SUPPORT FOR 1 YEAR MONITORING AND BLADE ASSESSMENT REPORTS:To generate advisory report remotely, at least once a week and in case of change in behaviour/vibration pattern as per requirement., for the purpose of health assessment of blading and send report by email to NTPC, for a period not less than one (1) year from the date of commissioning of the integrated system.
11	1.06.01 a(11)	Display, analysis and data acquisition system at plant and enable display and analysis at Employer Corporate Centre.
12	1.06.01 a(12)	ADDITIONAL HARDWARE FOR REMOTE MONITORING, DISPLAY AND MULTI USER LICENCE:All hardware, software for display station at Site. For remote monitoring at Employer Corporate Centre, bidder shall supply the Software and Support (Hardware, Internet connection shall be provided by Employer). The data storage memory of the Hardware should be sufficient for at least six (6) months.


 ANJANI KUMAR
 Dy Manager / CIE



 AGH/CIE

13	1.06.01 a(13)	The system should have provision to display all required process parameters at least 16 number e.g. LP Inlet Steam Pressure and Temperature, Extraction-1 steam pressure, Temperature, Extraction-2 Steam pressure and Temperature, LP rotor differential expansion, Axial shift, Load MW,MVAR, Vacuum, LPT exhaust hood temperature, Generator Voltage etc., as input, so as to enable correlation with process parameters.
14	1.06.01 a(14)	The system output should not get affected by magnetic field due to any other sources e.g. static charging while in operation.
15	1.06.01 a(15)	The signal cable should be properly protected and shielded.
16	1.06.01 a(16)	It shall be possible to transfer major data over soft link to third party systems e.g. OSI/PI etc.
17	1.06.01 a(17)	System/Software should have Multi-user license including for Remote location.
18	1.06.01 a(18)	Bidder shall take necessary precautions in fixing of sensors and brackets/ fixtures if required for fixing of sensors and cabling so that these items don't get loosened when turbine is under operation.
19	1.06.01 a(19)	Sensors, fixtures, cables and any other fitting material used shall be suitable for working in wet steam environment.
20	1.06.01 a(20)	The Bidder shall supply one (1) set of mandatory spares e.g. full set of sensors, brackets/fixtures, Internal cabling, I/O cards etc. for all stages (TE,GE), required for maintenance of the integrated system.
21	1.06.01 a(21)	During the working of the system supplied by the Bidder, in no case it should touch/foul the rotating blades or disturb the aerodynamic flow.
22	1.06.01 a(22)	TRAINING TO CUSTOMERS ON OPERATION AND MAINTENANCE OF BVMS: Bidder shall provide the required training to at least six (6) Employer persons on working of the system, operation and maintenance, data analysis, interpretation towards health monitoring of blades and troubleshooting of the system.

Prepared By


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Checked By


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