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स्वत्वाधिकार एवं गोपनीय

#### मानक (डीप - हरिद्वार) उत्पाद

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Page 1 of

HG 55064

# PRODUCT STANDARD (HEEP-HARDWAR)

Based On: Own Experience

## ON-LINE (Continuous) CONDITION MONITORING SYSTEM FOR HYDROGENERATOR

#### 1.0 GENERAL:

This specification covers the requirements for design, supply, installation & commissioning of a on-line system to continuously monitor salient parameters (i.e. shaft vibrations in the vicinity of guide bearing journals and air gap in between stator & rotor etc.) of hydro generators in the powerhouse complete in all respects with sensors/ probes/ detectors, control unit, time delay relays, monitors with recorder output, alarm, level detectors, level relays etc. The complete system & the sensors offered by the supplier must be in line with equipment already installed and proven for satisfactory performance in the field for at least 5 years after commissioning. Installation & commissioning charges shall be quoted separately.

The system must be complete in itself & should provide software to measure & display the parameters being monitored, storage & post processing of the measured data, its analysis & trending to monitor the condition of the generator. It should also provide complete diagnostic analysis with polar view of rotor inside stator from the measurements for air gap.

## 2.0 DETAIL OF THE EQUIPMENT:

The supplier shall design, supply, permanently install & commission a complete system (hardware & software) comprising of monitor with recorder output for data acquisition, data processing, data storage, trending, alarm, level detectors and level relays etc.; colour display & printing unit; all the accessories for on-line condition monitoring system for Shaft vibrations in the vicinity of guide bearing journals generally as per BHEL Specification HG55036 (Rev.02) and Air Gap in between stator & rotor generally as per BHEL Specification HG55035 (RevO<sub>2</sub>) of hydro generator in the powerhouse, complete in all respects with detectors, pre-amplifiers, control unit, power supply, time delay relays; all interconnecting & field cables etc.

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#### मानक (हीप - हरिद्वार) उत्पाद

HG 55035 पष्ठ

Page 1 of

# PRODUCT STANDARD (HEEP-HARDWAR)

Based On: Own Experience

# ON-LINE AIR GAP MONITORING SYSTEM FOR HYDROGENERATOR

#### 1.0 GENERAL:

This specification covers the requirements for design, supply, installation & commissioning of a complete system for on-line monitoring of air gap in between stator & rotor of hydro generator in the powerhouse. The complete system & the air gap sensors offered by the supplier must be in line with equipment already installed and proven for satisfactory performance in the field for at least 5 years. Installation & commissioning charges shall be quoted separately.

The system should provide dynamic air gap measurements as required and permit static measurements to monitor the condition of generator air gap without requiring a shutdown of the machine. System offered should be such that the measurements taken by it are not affected / altered by the magnetic field, dust, oil and carbon particles found in the air gap. System installation shall be done at site during erection / commissioning of the generator at site or during a routine shutdown for inspection. The installation of the system sensors and cabling must be possible when the generator rotor is in position. The system shall not compromise with the reliability and safety of the generator.

The system must be complete in itself & should provide software for complete diagnostic analysis with polar view of rotor inside stator.

# 2.0 DETAIL OF THE EQUIPMENT:

Air gap monitoring unit shall consist of air gap sensors, rotor pole reference probe, sensor/ reference probe cables/leads, wall mounted enclosures & air gap monitoring system, computer, printer etc. Detail of the equipment furnished below provides a general guideline to the

Relevant data pertaining to the power station & generator in which the system is required to be installed is given in Annexure-I.

## 2.1 AIR GAP SENSORS:

The air gap sensors shall be of capacitive type with one plate of the capacitor being the air gap sensor and the other plate being the rotor poles. The capacitive air gap sensor is permanently installed in the air gap on the stator core packets. Number of sensors shall correspond to the bore diameter & height/length of the stator core (ref. Annexure-I). The frequency response of the sensors should be 0 to 1000 Hz for static and dynamic air gap measurements and shall have interchangeability better than or equal to ±5%.

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Model or more	A synchro rotor near t	POLE REFERENCE nization probe used f the shaft in the upper to nce probe shall be a pr	or rotor pole i pracket.						
COPYRIGHT AND CONFIDENTIAL The information on this documents, in the processy of theure Heavy Electrical Londoll manned to be calmed directly or automative in any way deformed in the capture.	2.3 SENSOR and terminated lead distant generator denclosure so The leads for size. The leads for size and the conduit. All the call probes/ sen quality of so wherever use All leads/ of the leads/ of the conduit.	& REFERENCE PRofer sensor may be tricin a wall-mounted ended between the sensor that (ref. Anneaxure-I) shall be routed in a liquid or the synchronization ands from the probe to bles shall be capable asors. Cables may be signal transmission. Cosed with cable leads sleables shall be suitably	axial cables of nelosure. Each ors & the wa . The triaxial could seal tight could probe shall be the wall moun of withstand treated for noise able connector hall correspond y labeled to sho	suitable size.  sensor should l ll-mounted enc able leads from adult.  shielded twiste ted enclosure sh ing the operatir se level reductions for microdot enc to the size & ty ow the associate	have one cable the sensors to depair of coppall also be rounded as a connectors/pe of cable.	le only. correspond the wall per wire a sted in a specifie ry, to ma microdo	The nd i nd i no of su prot ed fi ninta t co	cable to the ounted nitable tective or the ain the ouplers	e e e e e e
स्वत्याधिकार एवं गोपनीय इस प्रेस में में मुक्त स्वयं स्थाप कर्म हैं हैं होती, बल्ड के बन्धीन हैं इस्त उन्हार एवं अहारत हन है किसी में इन प्रयोग में हि मानी से हिट में स्थेपकार हो में किस जाए	the general prevent the 2.4 WALL-M The wall-rinternation monitoring leads and A shall be rig matching leads and the ensure supplie	closure shall be mour that it doesn't interfer or shall also ensure nents installed in the	URE:  all be oil and  nensions shall  le leads. Protect  rigidly fixed  generator earth  atted on the out  we with normal  the suitability	dust tight as per sized to the enclosure, sing bus with a correction & may of conditioni	stator frame of the generat  per NEMA 4 accommodate r sensor lead The air gap copper lead of erator barrel. sintenance of ng units for	or its e e on-lin s, refere monitori f suitable The supp the gene	ruct equi e a nce ng s siz plier	valent dir-gap probe system e with r shall r. The	t o
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#### PRODUCT STANDARD (HEEP - HARDWAR)

## 2.5 AIR GAP MONITORING SYSTEM (AGMS):

The system shall operate with a compatible computer and a printer. It shall measure the static and dynamic air gaps and shall be controlled by a user friendly software package to display the results in a suitable form say polar, rectangular & tabular.

The AGMS shall provide a polar view of the rotor shape inside the generator stator complete with rotor & stator circularity and centre off set values. For this, the system should be capable of monitoring all parameters simultaneously in order to properly correlate data to the specific moment in time. The system should have provision of sensitivity setting for each probe/ probe amplifier. It should be user settable in software with provision to soft lock it. The AGMS should provide a software / hardware alarm when the air gap reaches set alarm levels and shall store automatically at least 20 turns before and after an alarm occurred event. The system must be capable of accepting externally triggered events to be able to take measurements during machine trips.

The system shall also provide a communication inter-phase that allows the data being monitored by AGMS to be linked with SCADA system capable of receiving analog DC signals of 4-20mA.

Communication from AGMS of individual units - proposed to be installed on the outer wall of the generator barrel - shall be connected to the computer of each generator. The computer shall be mounted on a cabinet that can be placed on floor. It shall be located in consultation with powerhouse authority. Communication from AGMS to the computer should be highly reliable. All the communication links (preferably opto-isolated) required between the AGMS and the computer shall be provided by the supplier.

The feasibility of providing a common multiplexed monitor-cum-controller-cum data acquisition system for all the units in the power house to be located centrally may be examined. If found feasible, it may be offered as alternate option along with its technoeconomic advantages/ disadvantages vis-à-vis independent system for each unit.

#### 2.6 GENERAL:

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ख्ददाधिकार एव गोपनीय

- The supplier shall include all field cables i.e. from sensor to probe amplifier to processor to monitor/ controller in their scope of supply.
- Alarm output contacts shall be potential free and rated for a current of 5A, 240 volts AC 50 Hz. or 0.5A 220 V DC. All alarm output should be fuse protected.
- The system shall have the provision of a 12V buffered rotor pole reference probe signal out put, to be used for testing purposes / in vibration monitoring system.
- The supplier shall give frequency response curve along with roll-off characteristics.
- The system shall have a design feature to reject & reduce line frequency & Electro magnetic interference (EMI).
- The supplier shall provide a complete installation; test & operation guide with the AGMS for the operating personnel. It will include the circuit diagram of individual units.
- The system shall be suitable for mains operation (240V ±10%, 50Hz AC). Also there should be provision of UPS of compatible rating with 30minutes of backup
- If the system is capable of providing Creep Detection facility, it may be offered as an optional

If the system is capable of pro-	viding Creep Detection facility, it		ered as an o	ptional
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- with all the accessories for on-line monitoring of air gap in between stator & rotor of generator in the power house. Accordingly, the supplier shall quote for design, manufacture, testing at works, despatch to site, installation & successful commissioning of the AGMS in all the
- para 1.0 & 2.0 above. Any accessories or equipment that has not been mentioned in the specification but are required as a part of the system are to be specified and included in the
- 3.4 The supplier shall indicate accuracies / error of individual items like sensors, measuring system
- 3.5 The supplier may additionally provide & offer measurement for rotor flux in the air gap as
- In case any fixture is required for it, the same should be included in the scope of supply
- commissioning of the equipment in the powerhouse. The commissioning team will carry with them all the necessary test equipment required to verify the proper operation of the AGMS. Supplier shall provide a complete diagnostic procedure guide including its interpretation part for the operating personnel. The supplier's team shall have adequate experience in interpreting the air gap readings obtained by AGMS and shall submit a report giving assessment of stator & rotor air gap, independent form of stator & rotor and overall behavior of the generator. To appreciate AGMS capability w.r.t. interpreting the data, the supplier should submit one case

Type / routine tests shall be carried on the equipment at works before despatch to site. However, the tenderer in his offer shall list out all the tests to be carried out on the components of the system at works to prove the equipment. The procedure for these tests and

4.1.2 Preliminary functionality tests of electronic components. Certificate of compliance to be

Three stage temperature-cycling functionality test of assembled electronic items (signal conditioners, data acquisition units, monitors etc.) a. before b. during. & c. after 16 hrs. -

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# उत्पाद मानक (हीप - हरिद्वार)

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## PRODUCT STANDARD (HEEP-HARDWAR)

Based On: Own Experience

# ON-LINE VIBRATION MONITORING SYSTEM FOR HYDROGENERATORS

## 1.0 GENERAL:

This specification covers the requirements for design, supply, installation & commissioning of on-line vibration monitoring system for hydro generators in the powerhouse, complete in all respects with detectors, control unit, time delay relays, monitors with recorder output, alarm, level detectors and level relays etc. The probes will be mounted on locations best suited to detect vibration of rotating and stationary components. The gap variation between vibration probe and shaft will give signal to a signal sensor, which will amplify it to an indicating instrument mounted on racks that shall be installed on the outer wall of generator barrel. The instrument will be solid state device and equipped with adjustable setting on display rack for alarm and trip contacts.

The complete system & the vibration probes/ detectors must be in line with equipment already installed and proven for satisfactory performance on a vertical shaft hydro generator in the field for at least 5 years.

The instrument / system shall be rack mounted programmable digital processor based unit to provide continuous display of channels indicating dynamic relative shaft & bearing bracket vibration measurements as required to frequently and randomly monitor the condition of rotating shafts & bearing brackets while the machine is operating. The system shall be such that the measurements taken by it are not affected / altered by the electro-magnetic field, residual magnetism, moist air, oil/oil vapors and other foreign particles generally found in an operating set. System installation shall be done at site during erection / commissioning of the generator or during a routine shutdown for inspection. It shall not compromise with the reliability and safety of the generator.

The system must be complete in itself along with requisite software.

### 2.0 DETAILS OF THE EQUIPMENT:

Details of the equipment furnished below provide a general guideline to the supplier. In case the supplier wishes to offer an alternative proven equipment that meets the functional requirements of the system and is fully compatible with the operating conditions of the generator provided in this specification. However, in that case, the points of departure shall be listed giving relative merits of each of them. This should provide sufficient information in respect of operating principle, material used, relevent specification/ standards etc., if any, along with the offer.

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The reformation control document is the property of Betast Party Electrical Limited Limited Limited Limited Streetly or indirectly in any way destinated to the internal of the company.		Hz. or 0 The sup spectrur It shall I probes v The sys circuits An intui The tend with the The syst magneti The syst Part of perform	stem shall have a dic interference (EMI) tem shall have provision the system that shall satisfactorily under imperature 0 - 55% (For the	alarm output shouly provide & offed when required. I gap voltage on the field. I gap to a calibrating the field of calibrating the field puts accordingly hall provide help tency response collesign feature to be installed of following environce. It is the collowing environce of the following environce. It is the following environce of the follo	Id be fus er the opt he displa- tself to o based on menus for reject & post pro- ntside of nmental midity be install	e prote tional by of the check the resordation treducessing gener condition upled with	feature for defeature for defeature for defeature for defeature for defeature for the drift sults of the defeature defeature from the data.  The defeature from the data and defeature for defeature for the data defeature for the	isplay of or non co s in the alibration play. ier of eac quency & should b	vibinitac	t type tronic cle. annel
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क्षा प्रतिक न में गर्न मुक्त भारत की हर्नीक्षिणका की मन्द्रीत है इसका प्रकट एवं अवस्था कर में किसी भी गर्म प्रतिक में कि कार्यों में किस है इसीकारक हो न मिया। एक्ष्		installed measure is system shalled the mid bandwidt 5% error. calibratio amplifier. Power su installatio bearing in To detect permanent	t the vibration of rat or near each guid radial vibration at each all have a measuring point of the measuring point of the measuring the problem of the problem of the problem of the processing ply requirement, it is not details required to the machine, as for the vibration of atty installed on each ealed construction. I	e bearing in the rich guide bearing in the rich guide bearing in grange of 2 mm uring range. The breet inter-change insensitive to cause. Option of ving circuit shall be from any, for the profor permanently eseen by the vene bearing brackets in bracket. These	nachine. and shall with sig probe if eability of ble lengt ariable if preferred bles shall mounting for, shall , one (1) shall be	Two (  I be pl  gnal re  frequent  f the ph  h chan  d  l be ir  g the  form a  no.) a  of delt	2nos.) probe aced 90° from peatability be never responsionables. The verse cut-off from probes at one a part of his accelerometer a shear designation.	es shall be omeach of petter that e shall of neur no rendor shall requency es system. In near easupply, er probe- ign and s	e us ther n ±1 cove nore l pro in e Sui shall	ed to The % at r the than ovide either itable guide ll be have
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अस्तिमित कश्या है । रिप्तार प्राप्त भय	built i noise indivi 2.2.3 Cable design signal	ed on the steel surface n miniature co-axial co- cables. The frequence dually calibrated & its leads/ connectors for ned to provide high s -conditioning unit. T	onnector for ten cy range shall calibration certi r probes and a standard of sign hese cables sh	mination be 0-2 ificate su ssociate nal trans nall be	n of microd 000 Hz. E upplied alor d equipme smission to capable of	ot end com each accele ing with the int, if any, the instru- withstand	rometer supplies shall be mentatio ing the	sha sha e su n ra ope	y lov ill be itable ck of ratin	v e yrr
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र जार दशका पूर से स विकार प्राप्त ।	10,039	NSIBILITIES OF T		279.43	somer.					
स्यस्याधिकार एवं गोपनीय एक उरेख में तो प्रेमुक्ता मार हेरी इसेव्हिन्स की संबंधित है इगया। स्वत्स सर में किसे मान उत्तेग के कि सम्बंधि देश में हारिकारण हो	3.1 Sup & st the 1.0 d 3.2 The	plier shall quote for de accessful commissioni generators (ref. Annex & 2.0. equipment must be	esign, manufactoring of the on-lin cure-I) in the po-	ure, test e (conti- wer hou	nuous) vibrase as per the ects irrespe	ation monit ne details g ective of v	oring sy iven abo hatever	stem ve i has	in a n pa bec	all ra en
क् इस इन्द्रेश में वी पर्दे सूच अवस्ट्रेश कर में विमयी भी गा	that to be 3.3 The system	tioned in para 1.0 & has not been mentione e specified and include supplier shall give p em at site. In case an	ed in the specific d in the offer. procedure for p y fixture is req	eation b eriodic uired fo	ut are requicalibration or it, the sa	red as a par / functions me should	t of the	syste ing	em a	re he
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dustry graduat socialistics abserved a Nyterionny no	commiss will carry line (co installation	er shall include & sioning of the equipmy with them test equipmentinuous) vibration on & operating programual.  all be submitted in a	ipment in the powers ipment, if any requ monitoring system cedure, diagnostic	house. The in ired to verify tem. Supplie	stallation/ co the proper or r shall pro	ommission operation of ovide a c	ng tear f the or omplet	m n- te
COPYRIGHT AND CONFIDENTIAL.  The need receiver endrastive in the property of Blund Heavy Eletental Lemisotti emit ent the used receiver endrastive in the uney definite and the section of the compline.	Howeve compone and acce 4.1 Routine 4.1.1 Electrica 4.1.2 Prelimin given by 4.1.3 Calibrati 4.1.4 Tests for 4.2 Type Te Three st condition maximum	al continuity tests. Co pary functionality tests supplier. ion tests (i.e. Calibra r compliance to the s	tis offer shall list t works to prove to the submitted for appertificate of complists of electronic of tion curves) for all pecification.  cling functionality n units, monitors e	out all the the equipment opposed to BH ance to be given ponents. Components. Components. Components. Components. Components.	tests to be . The proced EL.  ven by suppl Certificate of  mbled electr b. during.	carried out dure for the ier. I complian- ronic items & c. after	on the ese test to be to be (sign: 6 hrs.	ne sts
entropolic	4.3 Aceptane	2) satisfactorily.  ce Test (at site): on of the complete tance to the specifical	system and ver			200 CO. 190 CO. 120 CO. 110		
स्टल्बाधिकार एवं गोपनीय १४ ५३५ में में पूर्वण का को इस्टिक्स्ट की त्याधि है इबस १४०था का विस्ति की तथ उपन जाने बन्धीय सिर्माणियाल है	5.1 Equipme Before d of the eq 5.2 Installati equipme powerho when rec 5.3 In order	Y & ERECTION Of the shall be delivered dispatch, test results a puipment shall be sultion / commissioning that in the powerhor buse for undertaking quired at site.	I to powerhouse si as per clause 4.0 sl bject to approval of g of the equipme use. As such, such g site activities at p at the time of ere	hall be sent to f these test res nt shall mat- cessful tende 1 month noti	BHEL for sults. ch the erecerer shall dice from the	approval, I tion of ge epute his purchaser the equipm	Despate neratin team t as an	eh ng to nd
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(A) I INVENTORY NI)	such supple condition	In be some time gap between delivery of the equipment at site & its lier shall take necessary measures to ensure that the equipment remails such time it is installed / commissioned.  GOF BHEL & CUSTOMER PERSONNEL: ection, testing & commissioning of the equipment at site, the support	iains i	n he	ealth	v		
AND THE	training	o BHEL. & customers personnel regarding smooth operation, tion to ensure proper utilisation of the equipment.	servic	ing	& c	lata		
COPYRIGHT AND CONTIDENTIAL The interference of the purpose of Share Retay Excepts. Unreafth and the builds directly constructly in they will determine the first of the free control to th	7.1 Supplie - Com comp - List of site ( - List of the mate - List the s - Sketo pane - List along syste - List diag 7.2 The su	r shall enclose following information with the tender: plete specification including detailed description and operating principonents forming a part of the vibration monitoring system as a whole, of tests to be carried out on the components of the system at works be Ref. Cl.4.0).  If items along with quantities that shall be supplied to complete instats of departure from specification shall be listed separately. Relative ese departures along with sufficient information in respect of openical used, relevant specifications / standards, if any, etc. shall also be for installation of comparable equipment that has been supplied & complier along with date of commissioning.  The giving proposed installation details of vibration monitoring equal of each unit/ common for all the units in powerhouse.  To activities to be carried out at site to install & commission the sign with list of testing equipment that shall be used to verify the part (ref. Clause 4.3 also).  The formation of the standards of the same directly to:  The shall supply 10 sets of technical documentation as agreed and of order along with a CD for the same directly to:	llation e meri rating be pro- ommis sipmen ystem serform	lispa its of privide privide sssion as an ancomance	f each to a ciple of the circle of the circle of	to  thee,  oy  over the countries of the		
एवं गीपनीय १५०० थे अभी १९४२ १९२		Head of Hydrogenerator Engineering ( 3 <sup>rd</sup> Floor, Old Engg. Bld HEEP, BHEL-HARDWAR (UA) - INDIA (PIN-249403)	l.)					
प्यत्याष्टिकार एवं गोपनीय इसएक वर्ग के कुसम पठन हुई हत्रीकृष्ट वर्ग में स्थापित है इस्प असक्त का में किसे टी सर इसम जा के कासी में पिन ने संज्ञानक के	- The nat dar - Spe dar	NG & TRANSPORT:  equipment shall be packed suitably for transportation keeping in varie of the equipment & mode of transportation. Supplier shall be respected to the equipment during transit.  I will care shall be taken to eliminate shock etc. to parts, which may mages. Fragile parts shall be carefully packed and shall bear suitable backage.	sponsil be sus	ble f	for ar	ny to		
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morth with thost at SUPERSELES athrefits arm 8 INVENTORY NO	9.0	The supple 18 mont handing replacing material	NTEE CERTIFICATION  plier shall guarantee the from the date of sover to the power high free of cost at site or in design within guarantee at the tests undertaken a	the performand shipment (or) 1 nouse authority any equipme tuarantee period	2 months fr , whichever nt or part t l.	om the is late hereof	date of co r. He shal that prove	mmissio l be resp defecti	ning pons ve e	g and sible sither	fo fo
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स्यत्याधिकार स्य गोपनीय इत प्रस्य के में युगा मात देव इनेविहासन की सर्पात है इत्या प्रस्य एड अस्टस कर ने देखी की ताह हथी। के दिन बर्गा के हैंग वे इनीकारक हो निवेश गाए ।	12.0	CROSS	- REFERRED STA	NDARDS:	-Nil-						
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COPPRICHT AND CONTINE OF THE AND	Refer Annexure-I of HG550  Type of Generator Type of Construction of Generator Rated/Run-away Speed/Frequency:  Z.Vibration Monitoring of rotating component (Shaft) near Guide Bear Generator Guide Bearings  Turbine Guide Bearing No. of Proximity Probes for Refer Annexure-I of HG550 Vibration measurement								
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