TECHNICAL SPECIFICATIONS OF GROUNDING BRUSH MONITORING SYSTEM

Based on own experience.

1.0 APPLICATION :

The Grounding Brush Monitoring (GBM) system is used for continuous monitoring of shaft voltage and shaft leakage current to the ground for ascertaining proper brush contact with the generator shaft as well as healthiness of the grounding circuit. Schematic diagram of a typical machine is as per fig-1. The offered system shall be preferably be micro processor based.

2.0 PRINCIPLE OF OPERATION :

During operation of TG sets shaft voltages are induced due to various reasons. If a closed path can be established through any of the bearings, there will be a flow of current or the sparking which may cause damage to the bearing surface/ liner. To avoid this situation, the generator pedestal is insulated. However, this insulation is liable to get damaged due to vibrations or external contamination.

Static charges are developed in low pressure stage of the steam turbine due to impinging of wet steam on turbine blade at high speeds. The DC voltage generated due to these static charges could be of the order of 50 volts and it shall try to discharge through the thin oil film, damaging the bearing. Hence it becomes essential to ground the shaft through brushes. Since the brush contact also deteriorates over a period of time, it becomes necessary to continuously monitor the good contact of brushes as well as healthiness of bearing insulation. Two number current brushes installed in X-Y planes are connected in parallel to ensure connectivity of earthing brushes.

Figure no. 2 indicates the schematic diagram of voltage and current monitoring circuits. A low impedance shunt resistor of 0.1 Ohms value is connected in the ground path. The current flowing through the circuit is calculated by measuring the voltage drop across this shunt. If the RMS value of the current exceeds the preset limits, it energizes alarm circuit.

Shaft voltage is continuously monitored with the help of independent brush as it is important to keep a watch on earthing brushes proper contacts with the shaft. To achieve this, the shaft voltages (both positive and negative peaks) are compared with the set values. If set values are crossed, the LED glows. If the values still increase and crosses another set value and persist for 5 secs, the internal hooter shall get energized for warning. The warning and alarm values are adjustable and can be set as per standard guidelines or history of the machine.

(Compliance with national / internation standard. :- Nil).

					नाम NAME	दिनांक एवं हस्ताक्षर SIGNATURE & DATE
				अनुवादक TRANSLATED BY		
TSX	Virendra	30.3.07		निर्माणकर्ता WORKED BY	SATISH KUMAR	Satish
QAX	S.K.CHAUHAN			जांचकर्ता CHECKED BY	M.R.BHARDWAJ	
सहमत विभाग AGREED DEPTT	नाम NAME	दिनांक एवं हस्ताक्षर DATE & SIGNATURE		पर्यवेक्षणकर्ता SUPERVISED BY	M.R.BHARDWAJ	
SUPERSEDES OLD STD. UNDER SAME NUMBER.				स्वीकृति APPROVED : AGM (CIE)		GR.No 8.10
REV.NO. 01				निर्माण PREPARED : TGE	जारी ISSUED : TSX	दिनांक DATE: 9.12.93
Dt. 28/03/07						

हस्ताक्षर एवं दिनांक SIGN & DATE: 21.3.07

सामग्री सूची संख्या INVENTORY NO.: P-5981

सामग्री सूची संख्या को अधिक्रमित SUPERSEDES INVENTORY NO.

दिनांक एवं हस्ताक्षर SIGN & DATE

3.0 SCOPE OF SUPPLY:

This scope includes supply of:

- A field mounted Detector Unit (IP54 or better protection class) which shall be located about 5 meters away from the generator. Typical layout of detector unit is as per fig-4.
- A flush mounted electronic unit in control room (about 100 meters away from the generator).
- All control/signal/power cables required for interconnections
- Commissioning of the system at site in India (or as specified).

4.0 SPECIFICATIONS OF GBM :

4.1 POWER SUPPLY :

240 VAC +-10%, 50Hz+- 5%, 1 phase or as indicated in enquiry / order. The power switching ON/OFF button is to be made available on front side of the electronic unit (mounted in control room) with LED to display power ON condition.

4.2 INPUT :

Following inputs are to be terminated through the socket or TBs.

a) Voltage input : 0-20 V rms, AC/DC from voltage monitoring brush.
b) Current input : 0-5 Amps AC/DC from current grounding brushes.
c) Ground input : From the system ground.
d) Insulation resistance measuring input from bearing.

The required filters will be installed in the circuits to minimize effect of the electromagnetic surges /electrical noise.

4.3 OUTPUTS :

Banana receptacles for voltage & current outputs to be made available for external use for monitoring on CRT etc.

a) Display : 3 ½ digit digital display on the front of electronic unit for 20 V RMS (max.) corresponding to the position of rotary switch to set limit values and to see actual values as detailed below.

b) Set limit values :
   (i) Voltage warning (+ peak) DC
   (ii) Voltage warning (- peak) DC
   (iii) Voltage alarm AC rms /DC
   (iv) Current warning AC rms /DC
   (v) Current alarm AC rms/DC
   (vi) Insulation impedance warning VDC
   (vii) Continuity resistance VDC
   (viii) Dummy

c) Actual values :
   (i) Shaft voltage AC rms / DC
   (ii) Shaft current AC rms /DC
   (iii) Insulation impedance VAC rms
   (iv) Continuity resistance VDC

4.4 WARNING / ALARMS :

4.4.1 Two types of signals will be generated; one for visual warning (indication) and another for visual & hooter alarm. The corresponding set values shall be adjustable within the following ranges, through potentiometers (provided inside the instrument) :-

a) Voltage limits range:
   i) Warning .....0-20 V rms
   ii) Alarm .....0-20 V rms

b) Current limits range:
   i) Warning .... 0-5 AMPS
   ii) Alarm ..... 0-5 AMPS

c) Limits of continuity resistance:
   i) Warning 0-300Ohms

4.4.2 Following alarms(LEDs) shall be provided on the front panel for indication purpose.
   i) Voltage exceeding preset value
   ii) Current exceeding preset value
   iii) Indication of continuity break down in the path (resistance exceed preset value) when continuity check is carried out during shut down of machine.
   iv) Indication when there is drop in insulation impedance.

4.4.3 Following LEDs shall be provided on the front panel on electronic unit for indication purpose.
   v) Voltage exceeding preset level
   vi) Current exceeding preset level

4.4.4 HOOTER ALARM :
   i) Continuous buzzer alarm for voltage /current exceeding preset values . There shall be feature to silence the hooter from front to block the hooter, if desired in line with specific requirements of a site.
   ii) One no. potential free contact for above alarms shall be provided for repeat annunciation on remote panel. This contact shall be wired up to the terminal block of the equipment and shall be shown suitably in schematic diagram.

4.4 MONITOR CONTINUITY :

A 3 position selector switch shall be provided to facilitate connection of the instruments to;
a) Monitor mode.
b) Current brush continuity mode.
c) Voltage brush continuity mode.

5.0 INTERCONNECTIONS :

Connections between the main instrument and detector unit (near brushes) shall be done through 1.5 mm2 , multi core, multicolour, multistrands, copper cables with pair / individual core shielding. The cables will be of armoured type with overall sheathing by PVC having FRLS properties. This cable shall be in vendor's scope of supply. The distance between field mounted detector unit and main electronic unit in control room will be approximately 100 m.

6.0 DESIGN :

The system shall be designed in accordance with the block diagram as shown in fig.3

7.0 EQUIPMENT LAYOUT ;

7.1 Layout of instruments shall be generally as per figure 2. Detector unit containing shunt resistor shall be installed near grounding brushes. It shall be suitable for wall mounting. near the generator. It shall conform to IP54 protection class.

7.2 The output from the detector unit (red cable) is fed to the current input (red socket) of the main instrument. The other brush marked "a" is used for voltage monitoring . The cable from this brush (blue cable) is routed through the detector unit and is connected to the voltage input (blue socket) of the main instrument. The system ground is connected through a blank cable to the ground input (black socket) of the instrument.

7.3 The cage clamp type terminal blocks shall be provided at convenient location in the unit. The connection arrangement shall be as follows.

Terminal no. 1 – To connect voltage brush(a) from the holder to the voltage input of the main instrument.

Terminal no. 2 – To connect ground brush(b) to the shunt resistor in detector unit.

Terminal no. 3 - To connect detector unit output to the current input of main instrument

Terminal no. 4 –Connects shunt resistor's other end (c) from detector unit to Turbine ground

Terminal no. 5 &6 - To connect power supply to detector circuit (taken from main unit in control room).

Terminal no. 7&8 – Connect two points from insulation impedance circuit from bearing pedestal

Additional terminals for power supplies shall be supplied as required.

Layout of sub units/components shall generally be done to achieve miniaturization is achieved. The approximate dimensions with layout arrangement of the main electronic unit and detector unit will be furnished along with the offer. The electronic unit will be flush mountable . The maximum depth of the unit may extend up to 300mm.

7.4 Layout of front panel of main unit shall be as detailed below (Alternate better arrangement with the help of membrane type switches shall also be acceptable. :

a) ON/OFF toggle switch : This connects the instrument to 240/110 V , 50Hz AC mains when put in on position.

b) AC/DC toggle switch : At selected position (AC/DC), the Digital Panel Meter (DPM) will display the respective values corresponding to rotary switch position.

c) LEDs
- i) Yellow LED --- indicates power ON
- ii) Red LED --- indicates voltage warning
- iii) Red LED --- for current warning indication
- iv) Red LED --- indicates break in continuity in the voltage and current monitoring circuits when the monitoring switch is placed in respective continuity mode.

d) Monitor switch :- This shall be a three position switch with ;

Central position :- Marked monitor in the normal mode.
Left position :- Marked voltage brush continuity.
Right position :-Marked current brush continuity.

e) DIGITAL INDICATOR :- This is a 3 ½ digit display for indicating voltage values corresponding to rotary switch and toggle switch positions, the set values (DC voltage) and actual values (AC or DC) will be displayed. When actual voltage is beyond 20 volts the power meter shall not give any indication (will shown blank) or may show all 9s.

f) ROTARY SWITCH :- This 6 position rotary switch is meant for indication of set values and actual values on panel meters as detailed in clause no. 4.3 above.

g) OUTPUT SOCKETS :-
Sockets to monitor/measure voltage & current signal values on CRT / multi meter etc.

8.0 **OPERATING CONDITIONS** :
The instrument design shall be suitable for trouble free operation in thermal power station. The system shall be suitable for continuous operation at ambient temperatures ranging from 0-50 Degree Cel (the field mounted detector unit to be suitable for 0-55 Degree Cel) and relative humidity up to 95% with annual average value of 75%. The equipment to be suitable for storage with ambient temp range from 5 to 55 Degree Cel and relative humidity up to 98%.

9.0 **TESTS :**

9.1 TYPE TESTS :

Type tests report will be furnished (not older than 5 years from the date of the offer) for the following tests along with the offer. Alternatively, the bidder will perform these tests on at least one instrument in accordance with IEC 60068/IS9000 (relevant parts) either at supplier's works or at an approved test house, at supplier's cost. These tests shall be as listed below :

i) Dry heat test.
ii) Damp test.
iii) Surge with stand test as per ANSI 37.90 a
iv) Free fall test (bump test)

9.2 ROUTINE TESTS :

Routine tests shall be conducted at supplier's works free of cost. Following minimum (but not limited to) tests shall be conducted;

i) IR TEST : Insulation resistance shall be at least 20 Mega Ohms between measuring terminals and ground when measured by a 500 V megger.
ii) HV TEST: HV test shall be conducted at 2 KV (rms) for one second without failure (excluding electronics).
iii) SIMULATION TEST: Each instrument shall be tested to demonstrate output signals, LED indications and digital indications for given set values and actual values. For this purpose, actual values for each input condition shall be simulated.
iv) BURN-IN TEST:- At elevated temp of 55 degre Cel for 48 hours in energised condition at mutually agreed test cycle. The test will follow the simulation test again to demonstrate satisfactory performance after this test.

10.0 **ACCEPTANCE NORMS :** Meeting requirements of clause 9.0

11.0 **TEST AND GUARANTEE CERTIFICATES :**

Three copies of tests certificates for routine & type tests and guarantee certificates shall be furnished along with the equipment.

11.0 **DOCUMENTS :**

11.1 CATALOGUES :

2 copies of descriptive literature in English giving sectional details and technical particulars like maximum load burden. Power consumption, dimensional and cut-out details, external terminal details for customers inter connections etc. shall be furnished along with the offer.

11.2 DRAWINGS :

The schematic diagram and wiring diagram along with PCB layout of the equipment, inter connection diagram giving terminal details shall be furnished along with the offer.

11.3 O & M MANUALS :

Complete O & M manuals in English language giving details circuit diagrams, trouble shooting and servicing instruction etc shall be furnished. One copy of O & M manual shall be supplied along with the offer. Additional copies as specified in the enquiry/order shall be furnished with the consignment at the time of despatch of equipment.

12.0 **PACKING** :

The units shall be packed individually in thermocole box placed in a carton or case with adequate cushioning materials to minimise movement of instrument and to ensure that equipment is capable of withstanding transit jerks with out any damage. The packing shall be adequate to withstand loading/unloading jerks and transit movement by rail/road.

13.0 **MARKING** :

13.1 The manufacture's identification number of the instrument shall be marked at suitable location and the same shall be mentioned in test certificates of the instrument.

13.2 Bilingual, metallic name plates inscribing service details shall be affixed on the cover of the equipment.

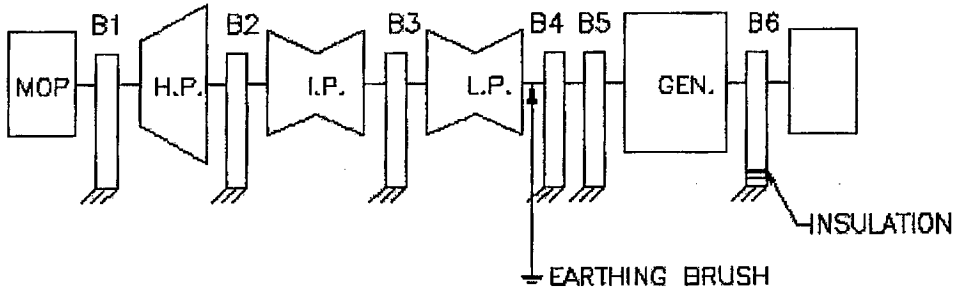
13.3 Following details shall be marked on each packing case;

a) Manufacture's name.
b) BHEL purchase order number.
c) BHEL specification number.

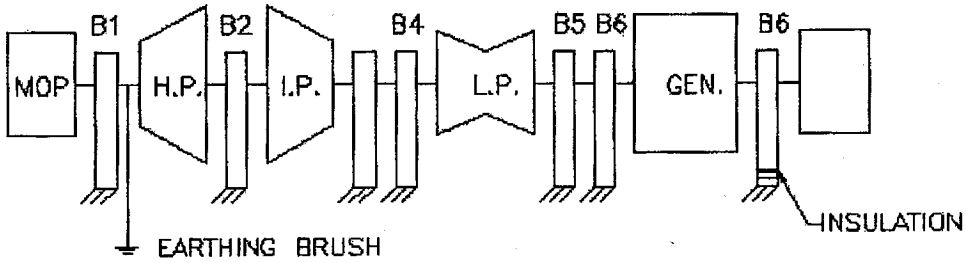
14 INSPECTION :

BHEL reserves its rights to depute BHEL / Clients representatives during testing and inspection at supplier's works. The supplier shall arrange this inspection without any additional financial implications.

15.0 CROSS REFERED STANDARD : IP54 (IS 13947) ,IS9000, IEC 60068,ANSI 37.90 a.



KWU DESIGN



RUSSIAN DESIGN

FIG.1: SCHEMATIC DIAGRAMS OF A TYPICAL TG THERMAL SET

निर्माणकर्ता WORKED BY	जांचकर्ता CHECKED BY
SATISH KUMAR	M.R.BHARDWAJ

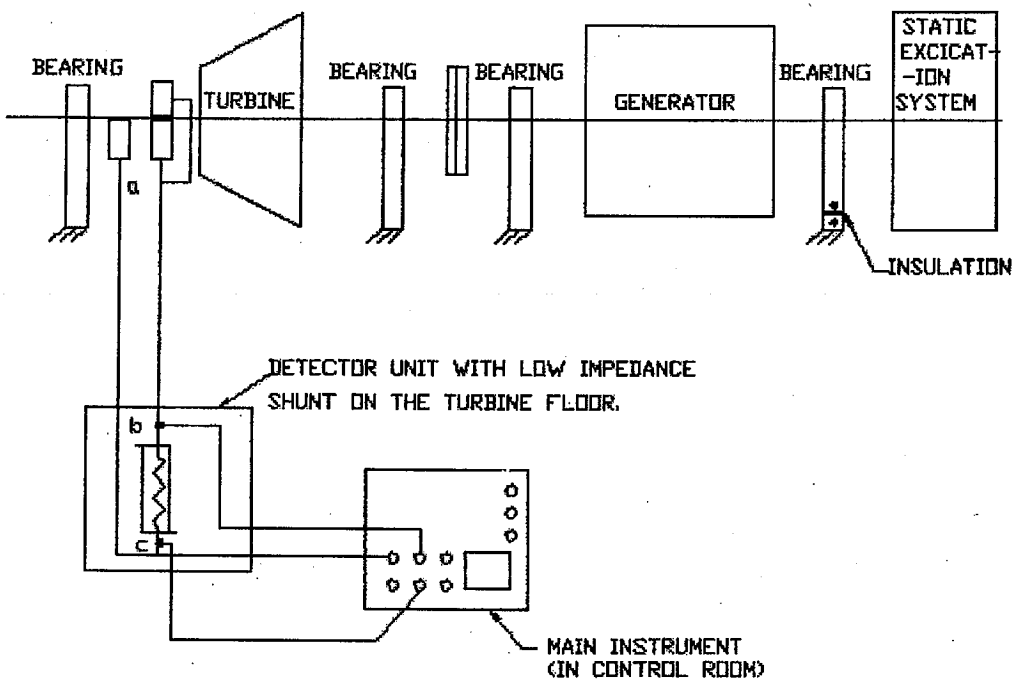


FIG.2 SCHEMATIC OF TG SET AND SIGNAL TAPPING POINT FOR GBM (APPLICABLE FOR ALL TYPE OF GENERATORS)

NOTE:- TWO CURRENT BRUSHES ARE PROVIDED IN X-Y PLANES FOR BETTER CONNECTIVITY.

निर्माणकर्ता
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SATISH KUMAR

जांचकर्ता
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Rev.no. 01
Date:- 28/03/07

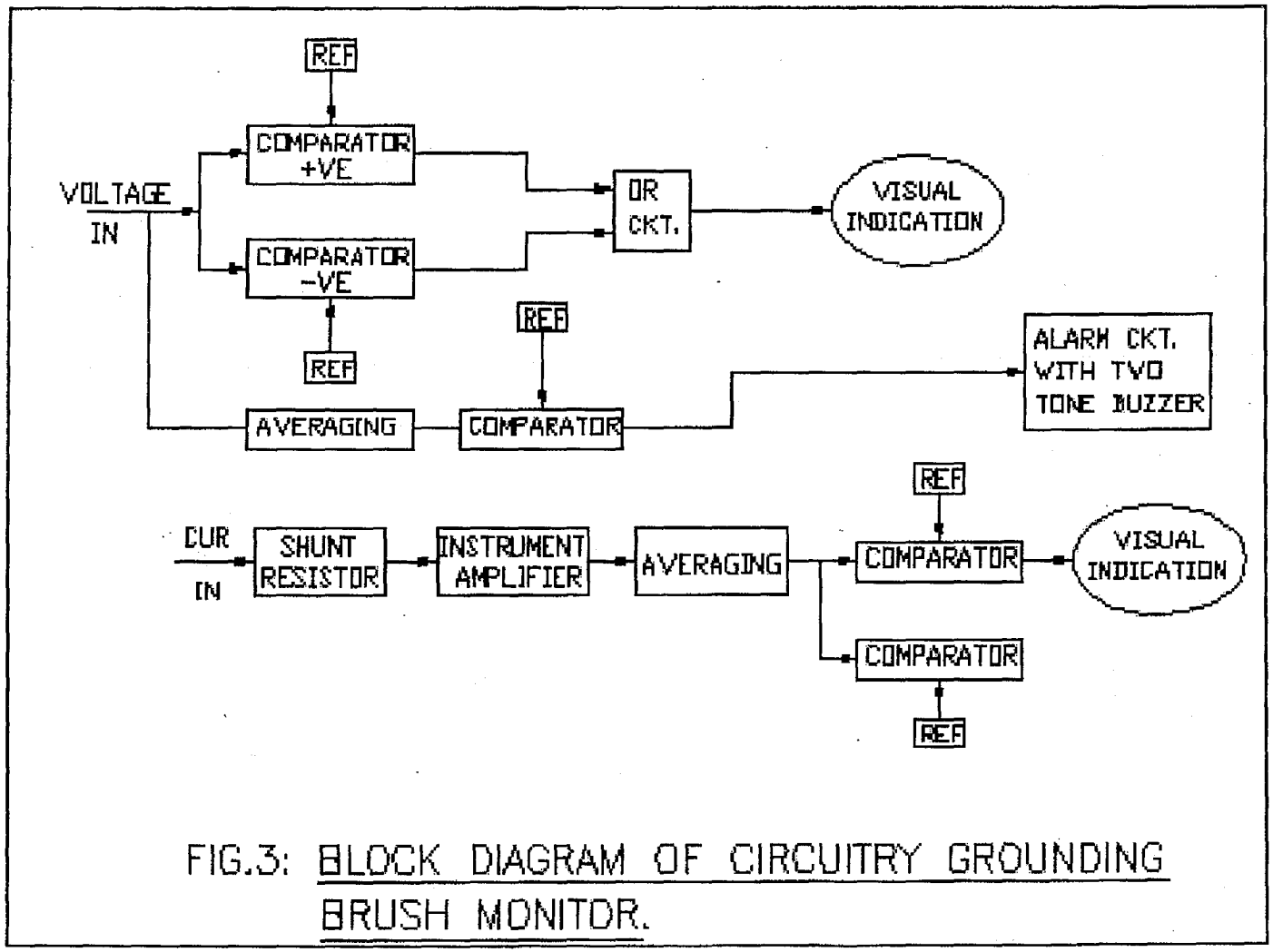

FIG.3: BLOCK DIAGRAM OF CIRCUITRY GROUNDING BRUSH MONITOR.

निर्माणकर्ता WORKED BY	जांचकर्ता CHECKED BY
SATISH KUMAR	M.R.BHARDWAJ

उत्पाद मानक (क्षैप्र – हरिद्वार)
PRODUCT STANDARD (HEEP - HARDWAR)

TG60461
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FIG.4: DETECTOR UNIT

सामग्री सूची संख्या INVENTORY NO. P-5981	Rev.no. 01 Date:- 28/03/07		
		निर्माणकर्ता WORKED BY	SATISH KUMAR
		जांचकर्ता CHECKED BY	M.R.BHARDWAJ