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TESTING PROCEDURE
AIR QUALITY CONTROL SYSTEMS
BHEL : RANIPET

TP:109:REV 04

TITLE : FUNCTIONAL TEST PROCEDURE FOR ELECTRONIC CONTROLLER HIGH VOLTAGE TRANSFORMER RECTIFIER

ITEM : EC - HVR

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1.0.0 INTRODUCTION

This testing procedure describes the procedure for functional testing of ELECTRONIC CONTROLLER (EC) and HIGH VOLTAGE TRANSFORMER RECTIFIER (HVR). For testing all HVR's one EC can be used. Similarly for testing of all ECs, one HVR can be used.

2.1.0 OPEN CIRCUIT TEST (HVR)

This test shall be conducted on the HVRs with VARIAC. A fuse of suitable rating, shall be connected in series with HVR input terminals for protection purpose. A 0-500V voltmeter shall be connected across the input terminals of the HVR. An ammeter of suitable range shall be connected in series with the input terminals of the HVR. Initially the voltage at the output of VARIAC (Which is input to HVR), shall be kept at zero and shall be increased to the rated voltage at primary winding of the TRANSFORMER. Observe for no primary current shoot up in the HVR (current to be measure with the ammeter), during this test. If the primary current shoots up suddenly / the fuse blows, the HVR is considered to be defective. It shall be noted that during this open circuit test, the secondary of HVR shall be kept in 'OPEN CONDITION'. The no load loss and current shall be recorded at 0%, -10% and +10% of the rated primary voltage.

2.2.0 HIGH VOLTAGE AND INSULATION RESISTANCE TEST

2.2.1 INSULATION RESISTANCE TEST: (For HVR)

Short the input terminals of the HVR together.
Short the output terminals of the HVR together.

Measure the IR of HVR at the following groups, using 2000V DC MEGGER. The following shall be the acceptable values.

Between input & earth	:	Minimum 50 Meg. Ohms
Between output & earth	:	Minimum 500 Meg. Ohms
Between input & output	:	Minimum 500 Meg. Ohms

2.2.2 HIGH VOLTAGE TEST: (For HVR)

With secondary (output) terminals of HVR kept shorted, apply 3KV (rms) for 1 minute between the input (both terminals shorted) and earth terminals of HVR. The HVR shall withstand the above test.

2.2.3 INDUCED OVER VOLTAGE TEST : (For HVR)

With secondary (output) terminals of HVR kept open, apply a power supply having two times the rated transformer primary voltage at twice the rated frequency, for 1 minute, between primary terminals of HVR. The HVR shall withstand this test.

2.2.4 INSULATION RESISTANCE TEST : (For EC)

The input & output Power terminals shall be shorted together. The secondary terminals of all the transformers shall be shorted together. The connections to Electronic Circuits like hooter, Firing Card & BAPCON/ Equivalent controller shall be removed.

Measure the IR between the following groups with 500V DC Megger and ensure that all the groups withstand this test.

Between Power Terminal Group and earth	: Minimum 5 Meg. ohms
Between Secondary Terminals of transformer and earth	: Minimum 5 Meg. Ohms
Between Power Terminals and Secondary terminals of Transformer	: Minimum 5 Meg. Ohms

2.2.5 HIGH VOLTAGE TEST : (For EC)

The input & output Power Terminals shall be shorted together. The secondary terminals of all the transformers shall be shorted together. The connections to electronic circuits like hooter, firing card & BAPCON / Equivalent controller shall be removed. Apply high voltage for 1 minute between the following groups and ensure that all the groups withstand this test.

Between Power Terminal Group and earth	: 2 KV
Between Secondary Terminals of transformer and earth	: 1.5KV
Between Power Terminals and secondary terminals of transformer	: 1.5 KV

2.3.0 RESISTANCE AND CAPACITIVE LOAD TEST FROM 0 TO RATED LOAD

This test shall be conducted with HVR & EC fitted with BAPCON / Equivalent controller collected from BHEL / Ranipet. Ensure the following settings.

0	Maximum Current	:	100%
1	Set Current	:	0%
2	Step Control	:	5%
3	T Control	:	20%
4	Stabilisation Time	:	30%
5	Under Voltage	:	10%
6	Charge Ratio	:	1
7	Pulse Current Limit	:	200%
8	Repetition Time	:	20%
9	Address	:	1
P	Base Charge	:	0%

Connect rated Resistive and rated Capacitive load to HVR (the rated

$$\text{Resistive load in M}\Omega = \frac{\text{RATED KV (AVERAGE)}}{\text{RATED mA (AVERAGE)}}$$

, The rated capacitance load in pf = K x rated average mA. (The value of K is between 100 to 200).

The value of the resistance and capacitance shall be recorded. The EC &HVR shall be tested with R separately and R+C load connected in parallel separately. The test shall be carried out at the Set currents 0%, 10%,25%,50%,75% &100% . In all cases, record the Primary voltage, Primary current, Secondary voltage & Secondary current.

2.4.0 TIME OVER RIDE TEST:

With the above set up, switch off power supply to EC. Connect 100% of Resistive load & 100% of Capacitance load at the Secondary of HVR. Keep the set current at 100 %. Apply 415 V at the input terminals of EC. Switch ON power supply to EC. Then press HT ON / OFF key provided in the BAPCON/ Equivalent controller Observe that, the secondary current increases initially at a faster rate for 5 seconds (approximate) and then the secondary current increases at a slower rate until the secondary current reaches the set current. During this test, there shall be no Tripping or Alarm occurs.

2.5.0 CURRENT REGULATION TEST

2.5.1 LINE REGULATION TEST

Switch off power to EC. Apply 373V at the EC input terminals. With the above set up and at 100% Set current, switch HT ON/OFF key to switch on power to HVR. Record the secondary DC current when it reaches the steady value. This value should not deviate from the value, when the input voltage was 415V< BY more than 5%.

Switch off EC and apply 457V at the EC input terminals. Now switch HT ON/OFF key to switch on power to HVR. Record the secondary DC current when it reaches steady value. This value should not deviate from the rated value, by more than 5%.

2.5.2 LOAD REGUALTION TEST

With the above set up, switch off supply to EC. Connect 10% of rated resistive load and rated capacitance at the secondary of HVR . Apply 415V at the input terminals of EC. Switch on power to EC and set the Set current at 100%. Then press HT ON/OFF key in BAPCON / Equivalent controller. When the secondary DC current reaches the steady value, record the same. It should not deviate by more than 5% from the rated secondary current.

2.6.0 SEMIPULSE OPERATION AT DIFFERENT CHARGE RATIO

Switch off power to EC. Connect 100% of rated resistive load and rated capacitive load. With above set up, apply 415v to EC and switch on power to EC. Press HT ON/OFF in

BAPCON to switch on power to HVR. Change the charge ratio to 3, 31 & 159 and observe, in each charge ratio, for any trip or primary current shoot up. During the charge ratio mode from 3 to 159, if no trip occurs or no primary current shoots up, the HVR is considered to be withstood this test. Now make the charge ratio as 1.

2.7.0 S&T CONTROL TEST

Switch off power to EC. Connect spark gap across R+C load. Switch on power to EC. Change parameter 2 step control in BAPCON / Equivalent controller as 25% (approximate) and parameter 3 T control as 10% (approximate) by tuning corresponding potentiometer in the BAPCON / Equivalent controller. Press HT ON/OFF key in BAPCON / Equivalent controller to energize HVR. Spark will appear on load side of HVR as current rises. After each spark note that the secondary DC current drops by 25% (approximate) of maximum current before spark. Note the time between two consecutive sparks. It should be 15 seconds (approximate)

2.8.0 SPARK TEST

With the above set up, set parameter 2 step control and parameter 3 T control so that approximately 160 to 180 sparks per minute will appear on the load side of HVR. Continue this test for 3 minutes and ensure that the HVR withstand this test without any trip or primary current shoot up.

2.9.0 SPARK SIMULATION TEST

With the above set up change settings of parameter 2 S control at 5% and parameter 3 T control at 20%. Keep the DC secondary current at 25%, 50%, 75% and 100% each for 2 minutes, by tuning Is potentiometer and observe that no trip occurs.

2.10.0 FAULT ANNUNCIATION TEST ON HVR

For the following components individual test records shall be verified. After assembling with HVR, wiring continuity shall be checked.

i) BUCHOLZ RELAY
ii) OIL TEMPERATURE INDICATOR
iii) MAGNETIC OIL LEVEL GAUGE

2.11.0 FAULT ANNUNCIATION TEST ON EC

Simulate the following faults by shorting the respective terminals in the EC and check for alarm / trip as the case may be

i) Bucholz top float	Alarm
ii) TR temperature high	Alarm
iii) Bucholz bottom float	Trip
iv) TR temperature very high	Trip

v) Primary current very high	Trip
vi) Safety line broken	Trip
vii) TR oil level low	Trip
viii) Ash level high	Alarm & Trip

2.12.0 RESISTIVE LOAD TEST FROM 0 TO RATED LOAD

Switch off power to EC & HVR. Disconnect the capacitive load and spark gap. Keep only the resistive load at the secondary of HVR. Set the Is Potentiometer at 100%.

Switch on power to EC. Press HT ON/OFF key in BAPCON / Equivalent controller to switch on power to HVR. Observe that the secondary DC current raises slowly and record the secondary current when it reaches steady value. This value should not deviate from the rated current by more 2%. Turn Is potentiometer fully counter clockwise. Now record the secondary DC current. This value should not be more than 5% of rated DC current.

3.0.0 QUANTUM OF TESTS

Test following are the quantum of tests to be conducted on EC & HVRs.

01	OPEN CIRCUIT TEST	-	100%
02	IR & HV TEST	100%	100%
03	RESISTIVE & CAPACITIVE LOAD TEST	100%	100%
04	T/O TEST	5%	5%
05	CURRENT REGULATION TEST	1/Lot	1/Lot
06	SEMI PULSE OPERATION FOR DIFF. CHARGE RATIOS	5%	100%
07	S&T CONTROL TEST	1/L0t	1/Lot
08	SPARK TEST	1/Lot	1/Lot
09	SPARK SIMULATION TEST	1/Lot	1/Lot
10	FAULT ANNUNCIATION TEST	100%	100%
11	RESISTIVE LOAD TEST FROM 0 TO RATED LOAD	1/Lot	1/Lot