

EMI, SEISMIC AND ENVIRONMENTAL QUALIFICATION TEST PROCEDURE

for

Core Protection Calculator No. 1

Core Protection Calculator No. 2

DEVAR Register N-46474

COMBUSTION ENGINEERING, P. O. 9873222/13172

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Prepared by L. Geanuracos Date 3-11-80

L. Geanuracos, Cognizant Engineer

Approved by A. Gura Date 3-11-80

A. Gura, Director of Engineering

Approved by E. Upton Date 3-11-80

E. Upton, Quality Control Manager

Independently  
Reviewed by A. Ruscito Date 3-11-80

A. Ruscito, Production Manager

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PDR ADDCK 05000389  
A PDR

NO.	DATE	Pages Involved	Prepared by	Independently Review. by	APPROVAL
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## APPLICABLE REFERENCES

Project Engineering Specification for Core Protection Calculators  
for Florida Power and Light - St. Lucie Plant - Unit 2  
Specification No. 13172-ICE-3025, Rev. 01

Norden Test Procedure No. 2176S 0001 Rev. A for EMI Susceptibility Tests.

Stanford Technology Corp Test Procedure ST-1833 Rev. 01 for Temperature/  
Humidity Test.

Dayton T. Brown Test Procedure DTB P79 Rev. B for Seismic Qualification  
Tests.

## 1.0 Object:

This procedure is designed to verify proper operation of Core Protection Calculators No. 1 and No. 2 before, during and after the EMI Susceptibility Tests, the Environmental Qualification Test and the Seismic Qualification Tests.

## 2.0 Prerequisites:

- 2.1 Core Protection Calculator No. 1 and No. 2 manufacture complete in accordance with Specification 13172-ICE-3025.
- 2.2 19-506-4 Cycle Life Qualification in accordance with DEVAR Relay Module Cycle Test Procedure.
- 2.3 Core Protection Calculator No. 1 acceptance in accordance with Specification No. 13172-ICE-3701.
- 2.4 Core Protection Calculator No. 2 acceptance in accordance with Specification No. 13172-ICE-3702.
- 2.5 Test Data Sheets (Appendix A) shall be available to record and tabulate the monitored terminal data and test conditions. Data sheets also provide monitored channel base readings and a record of the recording equipment used during the tests.
- 2.6 Provision shall be made to apply inputs to the calculators and monitor selected terminals of the calculators.
- 2.7 All input and monitored terminal measurements shall be made within an accuracy of  $\pm 0.1$  mV.
- 2.8 All terminal voltage readings shall be made with an accurate, high impedance, input digital voltmeter, such as a Keithley Model 191 Multimeter or equivalent.
- 2.9 Terminal voltages shall be recorded, during Seismic and EMI Testing, using a Consolidated Electrodynamics, Type 5-124, Recording Oscilloscope or equivalent.
- 2.10 Continuity tests shall be made without exceeding 12 VDC or 100 mA through the specified terminals.
- 2.11 Arrangements shall be made with testing laboratories to perform the EMI Susceptibility, Environmental Qualification, and the Seismic Qualification Tests.

### 3.0 CPC-1 Static Test Procedure

#### 3.1 Initial Conditions

3.1.1 Adjust the calculator potentiometers as follows; and lock in position:

<u>Location</u>	<u>Label</u>	<u>Dial Setting*</u>
B1-1	K <sub>Beta</sub>	0.245
B1-2	K <sub>Gamma</sub>	0.232
C1-1	Bias	0.500
C1-2	DYN RESP <sub>a</sub>	0.648
D1-1	Press S.P. P <sub>min</sub>	0.200
G1-1	Break Q <sub>11</sub>	1.000
G1-2	Slope 1-S <sub>11</sub>	0.400
H1-1	Break Q <sub>12</sub>	0.900
H1-2	Slope S <sub>11</sub> -S <sub>12</sub>	0.088
J1-1	Break Q <sub>13</sub>	0.000
J1-2	Slope S <sub>13</sub> -S <sub>12</sub>	0.000

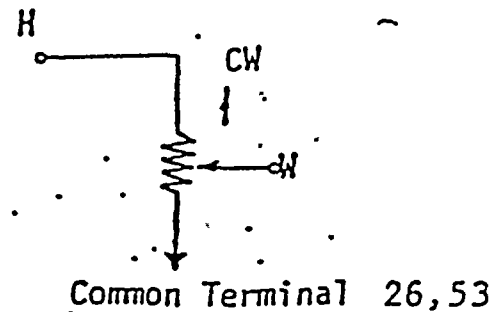
\*Potentiometer dial settings are expressed in fractions of full scale.

3.1.2 Adjust screws on dynamic response module C2,3 for a 2.0 minute time constant (Remove screws for 0.8 and 0.2, and insure the screws for 0.4 and 0.1 are tightened down.)

Connect and set pots as shown in table below;  
External Potentiometers are to be set to proper values  
using a Digital Voltmeter.

### 10 K $\Omega$ Potentiometers

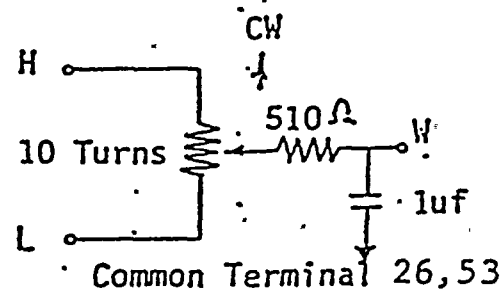
<u>Connection</u>		<u>Setting</u>	<u>Label</u>
<u>H</u>	<u>W</u>		
19	18	0.821	18
40	41	0.500	41
57	55	0.240	55
57	56	0.280	56



### 3.2.2 10 K $\Omega$ Potentiometers with Filter

Connect and set pots as shown in table below:

<u>H</u>	<u>L</u>	<u>W</u>	<u>Setting</u>	<u>Label</u>
4	26,53	5	1.000	5
29	26,53	21	0.278	21
23	26,53	27	0.250	27
16,70	17,71	28	0.327	28



### 3.3 EXTERNAL INPUTS

Connect voltages to terminals as shown in table below:

<u>Terminal</u>	<u>Voltage Range</u>		<u>Terminal</u>	<u>Voltage Range</u>	
63	3.016	3.022	58	-7.283	-7.277
64	4.016	4.022	9	0.000	
1	-2.734	-2.728	20	-0.003	0.003
47	.206	.212	22	-0.003	0.003
61	-6.497	-6.503	62	-0.003	0.003

3.3.1 Apply power to calculator and allow to stabilize (minimum 1/2 hr.)

### 3.4 COMPLETE STATIC READINGS

3.4.1 Insure Terminal No. 11 has no external connections. Verify the following terminal readings.

<u>Terminal</u>	<u>Voltage Range</u>	
4	.235	.382
11	-.006	+.006
23	7.518	7.554
29	2.788	3.235
45	-2.691	-2.152
49	-1.900	-1.732





#### 4.0 CPC-2 Static Test Procedure

##### 4.1 Initial Conditions

4.1.1 Adjust Core Protection Calculator No. 2 internal potentiometers as follows and lock in position:

<u>Location</u>	<u>Label</u>	<u>Dial Setting*</u>
A1-1	Mult Ay	0.500
A1-2	Add By	0.750
B1-1	Break Q <sub>21</sub>	0.800
B1-2	Slope 1-S <sub>21</sub>	0.750
C1-1	Break Q <sub>22</sub>	0.400
C1-2	Slope S <sub>22</sub> -S <sub>21</sub>	0.250
D1-1	Break Q <sub>23</sub>	0.200
D1-2	Slope S <sub>23</sub> -S <sub>22</sub>	0.500
E1-1	Break Q <sub>24</sub>	0.500
E1-2	Slope S minus	0.400
F1-1	New Limit Yon	0.800
F1-2	Limit Ratio Yop/Yon	0.750
G1-1	Power Band Q <sub>b</sub>	0.800
G1-2	Pretrip Margin	0.800

\*Potentiometer dial settings are expressed in fractions of full scale.

##### 4.2 External Inputs and Connections

4.2.1 Connect voltages to terminals as shown in table below:

<u>Terminal</u>	<u>Voltage Range</u>	
1	2.997	3.003
9	-4.997	-5.003
22	5.997	6.003
46	3.997	4.003
58	-14.910	-15.090
59	14.910	15.090
26	4.997	5.003
27	3.997	4.003
37	-9.997	-10.003
38	-9.997	-10.003
70	0.997	1.003
71	1.997	2.003

4.2.2 Connect 100 ft. of twisted shielded pair to Terminals Nos. 61 and 62 with other end connected across N.O. contacts of a switch (momentary push button), hereafter known as Reset P.B.

4.2.3 Connect Terminal 21 and 23 together.  
Connect Terminal 47 and 43 together.  
Connect Terminal 29 and 35 together.

4.2.4 Connect trip continuity tester between terminals 49 and 63.

4.2.5 Set adjustable coefficient located at D2, 3 to .5 (Tighten .1 and .4, remove .2 and .8).

4.2.6 Apply power to calculator and allow to stabilize (minimum 1/2 hr).

#### 4.3 Complete Static Readings

4.3.1 Depress reset pushbutton and verify the following terminal readings.

<u>Terminal</u>	<u>Voltage Range</u>	
7	-11.406	-11.594
16	-2.952	-3.048
21	5.381	5.419
28	5.781	5.819
30	-0.038	+0.038
55	3.940	4.060

#### 4.4 Trip Test

4.4.1 Verify the following Table:

<u>Test Condition</u>	<u>Terminal I Voltage Range</u>	<u>Trip Continuity</u>
A	0.000 -0.370	Short
B	-0.654 -0.643	Open

4.4.2 Return Terminal I voltage to  $3.000 \pm 0.003$  and verify base readings in Section 4.3.1 have not changed.



## 5.0 Environmental Qualification Test

- 5.1 Place calculators in the test chamber (ambient conditions) one above the other (CPC-1 on the bottom)
- 5.2 Extend all electrical cables required for Functional Testing through a chamber port and on to a test bench adjacent to the test chamber.
- 5.3 Complete Sections 3.0 and 4.0 (Static Test Procedures on CPC-1 and CPC-2)
- 5.4 Maintain signal inputs at levels set in 3.0 and 4.0 for the remainder of the test.
- 5.5 Maintain power to the calculator during the remainder of the test.
- 5.6 Do not depress Reset pushbutton on CPC-2 for the remainder of the test.
- 5.7 Record data base readings at ambient conditions, (Reference Sections 3.4 and 4.3) and list recording equipment on the test data sheet.
- 5.8 Temperature - humidity cycle per Figure 1 and Stanford Technology Corp. Procedure ST 1833.  
Note: No condensation shall form on the test item during the testing.

5.8.1 Seal the test chamber and start the test cycle.

5.8.2 Record data within one (1) hour after equipment has stabilized at the +80°F/95%RH plateau.

NOTE: A new data sheet shall be used whenever data is recorded. Number sheets sequentially as data is recorded. Enter date, time, signature, test conditions and serial number of calculator on data sheet.

If no changes are made in recording equipment, refer to list on first data sheet.

Use space provided under remarks on data sheets for comments on test conditions or data abnormalities.

5.8.3 Record data at the end of the +80°F/95% RH plateau.

5.8.4 Record data within one (1) hour after equipment has stabilized at the +130°F/Approx. 20% RH plateau.

5.8.5 Record data at the end of the +130°F/approx. 20% RH plateau.

5.8.6 Record data within one (1) hour after equipment has stabilized at the +40°F/uncontrolled humidity plateau.

- 5.8.7 Record data at the end of the +40°F/uncontrolled humidity plateau.
- 5.8.8 Record data after equipment has stabilized at ambient conditions and verify terminal readings have returned to base values.
- 5.8.9 Properly disconnect equipment and remove from chamber.



6.0 Seismic Qualification Test

- 6.1 Mount the calculators one above the other (CPC-1 on the bottom) in the mounting fixture.
- 6.2 Extend all electrical cables required for Functional Testing to a test bench adjacent to the Independent Biaxial Seismic Simulator.
- 6.3 Complete Sections 3.0 and 4.0 (Static Test Procedures on CPC-1 and CPC-2).
- 6.4 Maintain signal inputs at levels set in 3.0 and 4.0 for the remainder of the test.
- 6.5 Maintain power to the calculator during the remainder of the test.
- 6.6 Do not depress reset button on CPC-2 for the remainder of the test.
- 6.7 Record data base readings at ambient conditions (reference Sections 3.4 and 4.3) and list recording equipment on the test data sheet.
- 6.8 Seismic Qualification Test per Dayton T. Brown Test Procedure DTB\_\_P79

Note: CPC mounting hardware in the test fixture should not be touched between SSE'S.

- 6.9 Record data before, during, and after each Resonant Survey.

Note: A new data sheet shall be used whenever data is recorded.

Number sheets sequentially as data is recorded. Enter date, time, signature, test conditions and serial number of calculator on data sheet.

If no changes are made in recording equipment, refer to list on first data sheet.

Use space provided under remarks on data sheets for comments on test conditions or data abnormalities.

- 6.10 Record data before, during, and after each OBE and SSE.
- 6.10.1 Perform CPC-2 Trip Test during each OBE and SSE.
- 6.11 At completion of all testing, record data and verify readings have returned to base values.
- 6.12 Properly disconnect equipment and remove from Shake Table.





7.0 Electromagnetic Interference (EMI) Susceptibility Tests

- 7.1 Mount the calculators one above the other (CPC-1 on the bottom) in the shielded enclosure.
- 7.2 Extend all electrical cables required for the Functional Testing to a test bench adjacent to the shielded enclosure.
- 7.3 Complete Sections 3.0 and 4.0 (Static Test Procedures on CPC-1 and CPC-2).
- 7.4 Maintain signal inputs at levels set in 3.0 and 4.0 for the remainder of the test.
- 7.5 Maintain power to the calculator during the remainder of the test.
- 7.6 Do not depress reset button on CPC-2 for the remainder of the test.
- 7.7 Record data base readings at ambient conditions (reference Sections 3.4 and 4.3) and list recording equipment on the test data sheet.
- 7.8 EMI Susceptibility Test per Norden Test Procedure No. 2176 S 0001.
- 7.9 Record data before; during, and after each Test (CS01, CS02, CS06, and RS03.)  
Outputs of the CPC's shall be compared against their base values during the EMI Tests. When the terminal readings deviate ( $\pm 10\text{mV}$ ) from their base values record data and test conditions on data sheets.

Note: A new data sheet shall be used whenever data is recorded.

Number sheets sequentially as data is recorded. Enter date, time, signature, test conditions and serial number of calculator on data sheet.

If no changes are made in recording equipment, refer to list on first data sheet.

Use space provided under remarks on data sheets for comments on test conditions or data abnormalities.

- 7.10 At completion of all testing, record data and verify readings have returned to base values.
- 7.11 Properly disconnect equipment and remove from shielded enclosure.

## 8.0 Detection of Spikes

- 8.1 During the performance of the Seismic Qualification and EMI Susceptibility Tests, the outputs of the calculators shall be monitored for the appearance of spikes. The voltage at Terminals 4, 11, 23, 29, 45 and 49 of CPC 1 and Terminals 7, 16, 21, 28, 30 and 55 of CPC 2 shall be recorded using a CEC Recording Oscillograph. The terminal voltages presented to the Recording Oscillograph shall be signal conditioned using DEVAR modules. The modules shall be calibrated such that a deviation in terminal voltage, extending beyond acceptable tolerances, shall be visible on the recording.

TEMP

130

80

40

RH=95%

NOTE 4

R.H. < 95% (NO HUMIDITY CONTROL)

$T_s$  8 HOURS  
130°F

$T_s$  8 HOURS  
80°F

AMB

AMB

$T_s$  8 HOURS  
40°F

NOTE 1:  $T_s$  = TIME TO STABILIZE TEST TEMPERATURE EXTERNAL TO TEST ITEM

2: NO CONDENSATION SHALL FORM ON THE TEST ITEM DURING OF THE TESTING

3: TEST TEMPERATURE EXTREME INCLUDES 15° MARGIN

4: TEMPERATURE VS. RELATIVE HUMIDITY RELATIONSHIP CORRESPONDING TO A FIXED MOISTURE CONTENT THAT PRODUCES 95% RH AT 80°F

DURATION



Time: \_\_\_\_\_  
Witness: \_\_\_\_\_  
Serial No. \_\_\_\_\_  
Page No.: \_\_\_\_\_

Test Data Sheets

P.O./Contract: 9873222/13

DEVAR: N-46474

Environmental:  
Temperature \_\_\_\_\_  
Relative Humidity \_\_\_\_\_

Seismic:  
Type Test \_\_\_\_\_  
Axis direction \_\_\_\_\_

EMI:  
Type Test \_\_\_\_\_  
Frequency \_\_\_\_\_  
Field Level \_\_\_\_\_

CPC-1 Terminals

CPC-2 Terminals

<u>Terminal</u>	<u>Base Reading</u>	<u>Test Reading</u>	<u>Deviation</u>	<u>Terminal</u>	<u>Base Reading</u>	<u>Test Reading</u>	<u>Deviation</u>
4				7			
11				16			
23				21			
29				28			
45				30			
49				55			

CPC-2 Trip Test (done during OBE's & SSE's of Seismic Testing)

	<u>Trip Continuity</u>	<u>Pretrip Continuity</u>
	<u>Short</u>   <u>Open</u>	<u>Short</u>   <u>Open</u>
A		
B		

REMARKS:

Record test equipment used during this procedure:

Instrument: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_  
Model: \_\_\_\_\_  
S/N: \_\_\_\_\_  
Last Cal date: \_\_\_\_\_  
Cal due date: \_\_\_\_\_

