HF Controls

HFC-6000 Control System

ERD1192 – Control System Qualification Project

Prudency Test Procedure Remote 01 SBC06

TP901-301-07 Rev B

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[XXXXXXXXXXXX]

Revision History

Date	Revision	Author	Changes
10/06/11	A0	R McClanahan	Initial Draft
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03/27/12	B	D. Briner	CR 2012-0141

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1.0 PURPOSE AND SCOPE

In the ERD1192 project, a HFC-6000 control system, Test Specimen, is configured for generic qualification as a commercially available control system for safety-related applications in nuclear power plants. The following set of Prudency tests will be performed following completion of system integration and burn-in:

- **Burst of Events Test** - This test will consist of the simultaneous activation of a significant proportion of input and output channels in accordance with EPRI TR-107330 paragraph 5.4.A. These tests will be automated and will typically run as a continuous background operation for selected qualification tests.

- **Serial Port Failure Test** – The Test Specimen has two redundant serial communication links. For each redundant link, this test will impose three simulated failures on one cable at a time: link open, transmit line shorted to ground, and transmit line shorted to receive line. (EPRI TR-107330 paragraph 5.4 Item B)

- **Serial Port Noise Test** - This test will introduce a white noise signal on each of the serial links one port at a time. (EPRI TR-107330 paragraph 5.4 Item C)

- **Fault Simulation Test** – This test covers introduction of a simulated failure condition to trigger failover from the primary to the secondary controller. The intent of this test is covered by the Failover Operability test (TP901-301-05) and will not be duplicated in this test procedure.

The entire Prudency test will be conducted during the pre-qualification phase of testing to establish a performance base line. During subsequent qualification tests, the Burst of Events (BOE) and the other tests will be repeated at various points to identify any performance degradation from the performance baseline.

2.0 REFERENCES

2.1 INDUSTRY STANDARDS

This test procedure constitutes part of the pre-qualification testing for the HFC-6000 control system. These tests have been developed to document the baseline performance of the control system Test Specimen prior to the start of qualification stress testing.

EPRI TR-107330	Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants, 1996

2.2 RELATED PLANS AND PROCEDURES

TP901-301-02	ERD1192 Integration Test Procedure, Rev. B
TP901-301-05	ERD1192 Operability Test Procedure Remote 1, Rev. A

VV901-300-02	ERD1192 Master Test Plan, Rev. A
VV901-304-01	ERD1192 Master Configuration List, Rev. A
VV901-304-02	ERD1192 Test Specimen Design Specification, Rev. A
UG004-000-16	MCRT User's Guide, Rev C

2.3 SUPPORT DOCUMENTATION

500620-01	ERD1192 Remote Loop Layout, Rev. E
500621-01	ERD1192 Power Distribution, Rev. C
500633-01	ERD1192 TSAP Schematic Wiring Diagrams Remote 1, Rev. B
500638-01	ERD1192 HPAT Schematic Wiring Diagrams Remote 2, Rev. B

2.4 HFC INTERNAL STANDARDS AND PROCEDURES

QPP 17.1	Quality Records
WI-ENG-003	Configuration Management
WI-ENG-205	Develop Software/Firmware Test Procedure

2.5 SPECIAL TERMS, ABBREVIATIONS, AND ACRONYMS

BOE	Burst of Events
CPC	Communication Protocol Controller
CSM	Control Switch Module
HAS	Historical Archiving System
HPAT	HFC Plant Automated Tester
FOT	Fiber-Optics Transmitter
M/A	Manual/Automatic
PCC	Peripheral Communication Controller
SOE	Sequence of Events
Test Specimen	A specific combination of hardware and software components to be subjected to specified test conditions
TSAP	Test Specimen Application Program

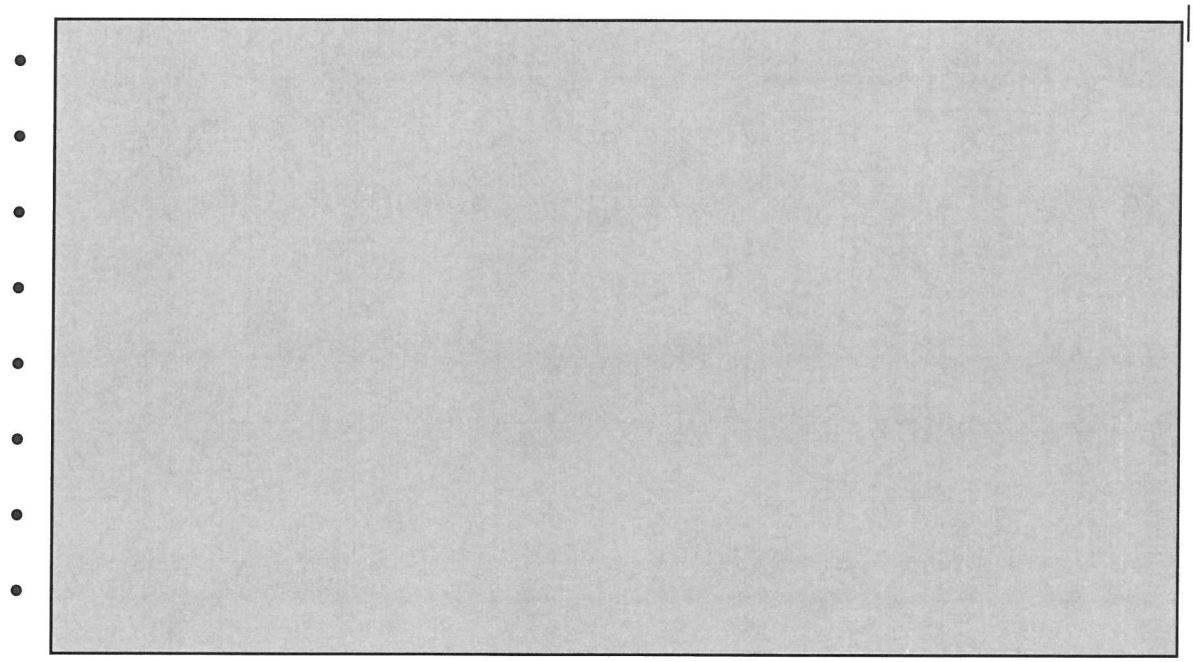
3.0 PREREQUISITES

The following paragraphs identify the test equipment, test environment, and setup requirements for running each of the Prudency tests. Individual Prudency tests may be running concurrently with the Operability tests (procedure TP901-301-05). The Burst of Events (BOE) test will be configured to run automatically under control of the HPAT tester. The other Prudency tests generally will require manual intervention and control.

3.1 EQUIPMENT REQUIRED

A detailed listing of hardware and software components of the Test Specimen are provided in the Master Test Configuration for the project, VV901-301-02. The TSAP configuration drawing, 500633-01, provides an overview of the Test Specimen arrangement.

The following equipment and facilities will be required during performance of this test. Test personnel shall verify that all test and measuring equipment are capable of producing the level of accuracy required by the specific test being performed and that the calibration for the M&T to be used is current.



3.2 ENVIRONMENTAL CONDITIONS

This test will be conducted under various conditions of temperature and humidity. During pre-qualification testing, the test will be conducted under normal operating conditions for the Test Specimen, as indicated below. During the qualification tests, required environmental conditions are stipulated within in the procedures governing those tests.

Temperature	50 deg F to 104 deg F
Relative Humidity	7% to 90% non-condensing

3.3 TEST PERSONNEL

The set of Prudency tests will be conducted at the in-house test facility of HFC as part of the final acceptance testing of the Test Specimen and at the test facilities of qualification test laboratories during qualification testing. Qualified HFC test engineers will be responsible for conducting all Prudency tests both at the HFC facility and at qualification test laboratories.

3.4 PRECAUTIONS

WARNING

Certain I/O circuits are energized with high voltages and may carry potentially hazardous current loads. Exercise caution whenever working around exposed terminals or circuitry.

3.5 RED-LINE POLICY

The HFC policy for entering red-line corrections into a test procedure are presented in paragraph 2.6.2 of VV901-300-02, "ERD1192 Master Test Plan". Such entries may be used to correct errors of content and procedural sequence in test documents or in engineering drawings to prevent disruption of a test in progress.

3.6 EQUIPMENT SETUP

Prerequisites for beginning the Prudency test are as follows:

1. Verify that the copy of the Prudency Test Procedure in hand is a controlled copy of the current revision according to Document Control records.

2. During the pre-qualification testing phase, the Integration (Setup and Checkout) Procedure is successfully completed in accordance with TP901-301-02.

3. Test Specimen configuration has been validated in accordance with TP901-301-03.

4. During the qualification phase of testing, Test Specimen Setup and Checkout is completed in accordance with requirements of the individual qualification tests.

5. Use attachment 7.1 to record test equipment used.

Validation that equipment setup is complete: _____
Name/Date

4.0 TEST PROCEDURE

Each of the Prudency tests provides a separate evaluation for a specific aspect of the Test Specimen performance and operation. Except as noted in a particular test procedure, no fixed sequence of execution is assumed or implied by the order of specific tests in this document.

Before executing the test, mark the test condition for this prudency test to be executed in the following:

Test Condition

☐ Pre-Qualification / Baseline

☐ Environment ☐ High Temp/RH ☐ Low Temp/RH ☐ Post Stress

☐ Seismic ☐ During ☐ Post

☐ EMI/RFI

☐ Post ESD

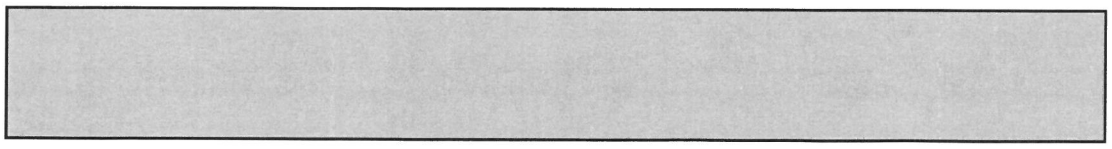
☐ Other _____

4.1 BURST OF EVENTS TEST

Paragraph 5.4 of the EPRI TR-107330 specifies the following minimum number of points and signal types for the Burst of Events Test:

- Toggling 15 each 120 vac discrete inputs and 8 each 24-vdc discrete inputs once per second.
- Toggling 8 each 120 vac discrete outputs and 4 each 24-vdc discrete outputs once per second.
- Driving 4 voltage and 4 current AI signals from 10% to 90% of full scale at 1 Hz.
- Driving 2 voltage and 2 current AO signals from 10% to 90% of full scale at 1 Hz.
- Transmitting a message over the main processor serial port that indicates the read in status of the inputs and the values to which the outputs were set.

The specific I/O channels included with the Test Specimen supports a different combination of signal types. The following combination of signals has been selected to provide an equivalent level of processing activity.

- 
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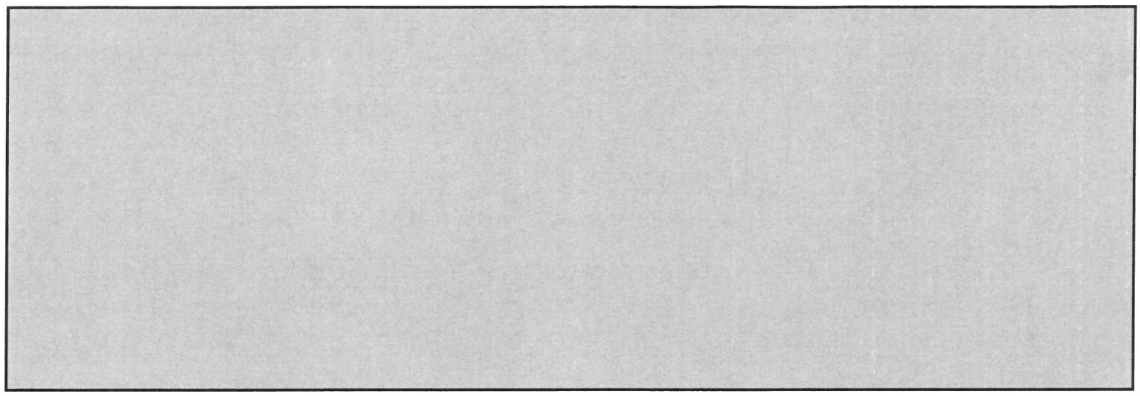
- 

Table 1 lists the specific combination of points used to implement this test. The BOE test is designed to run automatically under control of the HPAT. Once started, the HPAT generates both analog and digital test waveforms, and these signals pass through the TSAP back to the input interface of the HPAT. The HAS logger will be used to record signal levels for the analog signals; and an SOE logger will be used to record the logic levels and transition times of the digital points.

4.1.1 BOE Setup Requirements

The BOE test will be controlled by logic of the TSAP and the application programs running in the HPAT. No software configuration beyond creation and validation of these application programs will be required. All hardware configuration requirements consist in completing the cable interconnections between the Test Specimen I/O and the HPAT I/O terminals. (Refer to paragraph 3.4.) However, before the BOE test is run for the first time, the HAS and SOE loggers must be configured to record the data being generated, and a graphic interface shall be configured to facilitate starting, stopping, and monitoring the test.

4.1.1.1 Automated Logging Utilities

This project will use both the HAS and the SOE utilities to log I/O status. The SOE controller will be configured as Remote 2, HPAT. The HAS will operate on the PC workstation and will monitor the status of approximately 100 separate points via DDB broadcast over the C-Link. Test procedure TP901-301-05 provides instructions for configuring the HAS, SOE points. Table 1 lists all I/O points that are controlled by the BOE algorithm. Point designations printed in bold indicate those points that are logged either by the SOE or by the HAS utility.

1. Verify that SOE configuration is completed in accordance with TP901-301-05.

2. Verify that HAS configuration is completed in accordance with TP901-301-05.

Validation that HAS setup is complete: _____
Name/Date

Table 1 – TSAP and HPAT Points Configured for Burst of Events Testing

HPAT	**TSAP**				**HPAT**
Output Point	Input Point	Signal Rating	Output Point	Signal Rating	Input Point

4.1.1.2 BOE Graphic Interface

The BOE graphic interface is a display page for the MCRT that permits on/off control of the overall test and visual status monitoring of test operation. As a minimum, configure the BOE graphic interface as follows.

1. At the PC workstation, open the Graphic Editor. (Refer to the UG004-000-16, MCRT User's Manual.)

2. Verify that a display graphic page exists to control the Burst Of Events Test during system setup.

3. Verify that the graphic provides control buttons to START and STOP the BOE test.

4. As a minimum, verify that the graphic provides visual displays for the following points:

   - 2,DO,124 and 2,DO,125 – BOE digital timer output signals
   - 1,DI,604 and 1DI,605 – BOE digital timer input signals to TSAP
   - 2,DI,141 and 2,DI,248 – representative BOE digital return signals from the TSAP

5. As a minimum, create the following value displays on the graphic:

   - 2,AO,82 (2,BL,286) – BOE analog control output to TSAP
   - 2,AI,70 (2,BL,213) – representative analog BOE signal returned from TSAP

6. Verify that system status graphic page displays each I/O card installed in the Test Specimen and in the HPAT card racks. (Refer to the UG004-000-16, MCRT User's Guide.)

Validation that graphic interface setup is complete: _____
Name/Date

4.1.2 BOE Test Execution

After initial configuration requirements for the BOE test is complete, test execution consists of triggering SOE and HAS loggers and then using the graphic interface to start the BOE test. The test shall be allowed to run for a minimum period of 1 minute during the pre-qualification phase of testing. Test duration during an individual qualification test will be specified by the test procedure governing that test.

1. Verify that equipment setup (paragraph 3.6) and all test setup requirements (paragraph 4.1.1) are completed. _____

2. On the EWS workstation, verify that Alarm Process program has already been started as an automatic service. Otherwise, start the program. _____

3. Ensure SOE Trigger and HAS logging are enabled. _____

4. On the MCRT graphic, actuate the START button for the BOE test. _____

   Start Time (YYMMDDhhmm): _____ _____

5. Use the MCRT displays to verify that the HPAT produces continuous analog and digital BOE test waveforms. _____

   The digital waveform is a symmetric 0.5-Hz (one second on, one second off) square wave. The analog waveform is shown in Figure 1.

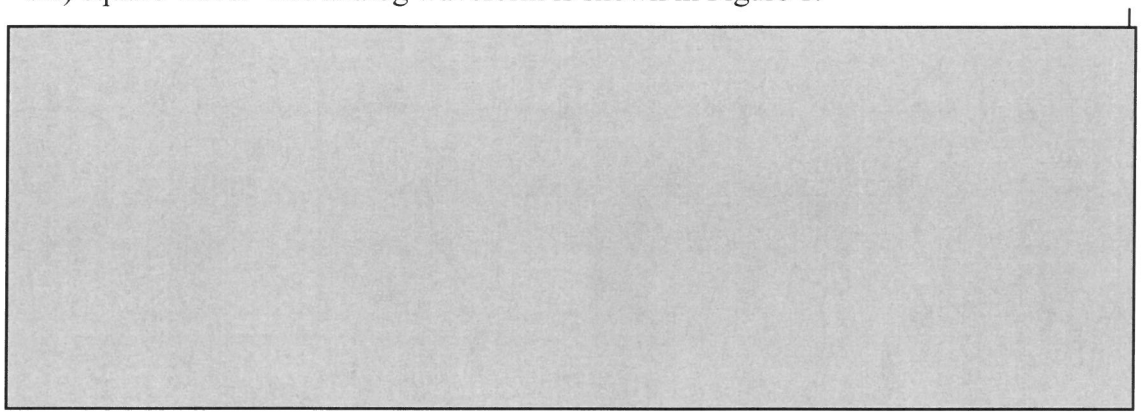


Figure 1 – Algorithm for Analog BOE Test

6. After the required test period has expired, click on the STOP button to halt generation of the test waveforms. _____

   Stop Time (YYMMDDhhmm): _____ _____

7. Record the SOE files using attachment 7.2. _____

4.1.3 Correction Factors for Analog BOE Channels

The analog BOE algorithm switches between 10% and 90% of full scale, but the signal is transferred to the Test Specimen via signals from separate AO channels of the HPAT. The following procedure measures the actual output signal produced by each of these channels, and these values should be used as correction factors for evaluating the results logged during automated testing.

1. Ensure SOE Trigger and HAS Logging are enabled. _____

2. Identify the physical location of the terminals for following HPAT AO signals: 2,AO,82, 2,AO,85. _____

3. Disconnect the signal line for 2,AO,82 from the HPAT bezel, and connect an ammeter in line. _____

4. Start the BOE algorithm. _____

   Start Time (YYMMDDhhmm): _____ _____

5. Record the output signal level corresponding to the 10% and the 90% level of the algorithm in Table 2. _____

6. Stop the BOE algorithm. _____

   Stop Time (YYMMDDhhmm): _____ _____

7. Record the SOE files using attachment 7.2 _____
8. Reconnect the signal line for 2,AO,82 to the HPAT bezel. _____

9. Repeat steps 2 through 8 for each of the other AO channels associated with the BOE algorithm. _____

Table 2 – BOE AO Channel Current Levels

Level	2,AO,82	2,AO,85
10%		
90%		

4.2 SERIAL PORT FAILURE TESTS

The Test Specimen includes three different types of serial communication ports:

- Redundant C-Link serial port that enables communication between all controllers within a system and between the controllers and external workstations.
- Redundant Intercommunication Links (ICL) that enable communication between the HFC-SBC06 controller and all other cards associated with a particular remote. If a controller consists of a single rack, this link exists only as traces on the backplane of that rack. When a controller includes more than one rack, the ICL traces on each rack are daisy-chained together to form a single link for all cards configured in the remote.
- A separate serial link to each control switch module (CSM) or M/A station.

Each of these serial communication links will be subjected to a Serial Port Failure test. The test for the C-Link and ICL will impose failure conditions on one of the redundant pair. The test for the control module interface will impose failure conditions on any one of the configured control module channels. The purpose of this test is to demonstrate that the system response is not materially impacted by failure of single serial port.

4.2.1 C-Link Failure Test

4.2.1.1 Test Setup

1. Verify that equipment setup is complete.
2. Check Primary/Secondary status of the two HFC-SBC06 controllers. If controller A is not primary (A PRI LED off), press the red failover switch on the HFC-DPM06 card to force failover.
3. Replace one of the two cables connected to the front panel of controller A (slot 1) with a breakout cable.
4. SOE log points for the BOE test will be used to detect any disturbance in system response to the test waveforms during this test.

Validation that C-Link Failure test setup is complete: _____
Name/Date

4.2.1.2 Test Procedure

1. Ensure that SOE Trigger is enabled. _____
2. At the MCRT actuate the button to start the BOE test. _____

   Start Time (YYMMDDhhmm): _____ _____
3. Verify that the breakout cable is configured with all jumpers installed. Allow the system to log data for a minimum of 30 seconds. _____
4. Stop the BOE test to mark this transition in the test. _____

   Stop Time (YYMMDDhhmm): _____ _____
5. Record the SOE files using attachment 7.2. _____
6. Start the BOE test. _____

   Start Time (YYMMDDhhmm): _____ _____
7. Open the transmit line (pin 1 of the breakout cable) and allow the line to float. Allow the system to log data for 5 to 10 seconds. _____
8. Stop the BOE test to mark this transition in the test. _____

   Stop Time (YYMMDDhhmm): _____ _____
9. Record the SOE files using attachment 7.2. _____

10. Reconnect the transmit line of the breakout cable, and then start the BOE test. _____

Start Time (YYMMDDhhmm): _____ _____

11. Short the transmit line (pin 1 or pin 2 of the breakout cable) to chassis ground. Allow the system to log data for 5 to 10 seconds. _____

12. Stop the BOE test to mark this transition in the test. _____

Stop Time (YYMMDDhhmm): _____ _____

13. Record the SOE files using attachment 7.2. _____

14. Disconnect the jumper to ground, and then start the BOE test. _____

Start Time (YYMMDDhhmm): _____ _____

15. Short the transmit line (pin 1 or pin 2 of the breakout cable) to the receive line (pin 3 or pin 6 of the breakout cable). Allow the system to log data for 5 to 10 seconds. _____

16. Stop the BOE test to mark this transition in the test. _____

Stop Time (YYMMDDhhmm): _____ _____

17. Record the SOE files using attachment 7.2. _____

18. Disconnect the breakout cable and reconnect the normal C-Link cable. Start the BOE test and allow the system to log data for a minimum of 20 seconds. _____

Start Time (YYMMDDhhmm): _____ _____

19. Stop the BOE test to mark this transition in the test. _____

Stop Time (YYMMDDhhmm): _____ _____

20. Record the SOE files using attachment 7.2. _____

4.2.2 ICL Failure Test

4.2.2.1 Test Setup

- Verify that equipment setup is complete.

Validation that ICL Link Failure test setup is complete: _____
Name/Date

4.2.2.2 Test Procedure

1. Ensure SOE Trigger is enabled. _____

2. Use the MCRT to start the BOE test. _____

   Start Time (YYMMDDhhmm): _____ _____

3. Stop the BOE test to mark this transition in the test. _____

   Stop Time (YYMMDDhhmm): _____ _____

4. Start the BOE test. _____

   Start Time (YYMMDDhhmm): _____ _____

5. Disconnect Rack 3's Lnk_0 pin 1 wire and allow the line to float. Allow the system to log data for 5 to 10 seconds. _____

6. Stop the BOE test to mark this transition in the test. _____

   Stop Time (YYMMDDhhmm): _____ _____

7. Reconnect Rack 3's LNK_0 pin 1 wire, and then start the BOE test. _____

   Start Time (YYMMDDhhmm): _____ _____

8. Short Rack 3's LNK_0 Pin1 wire to chassis ground (any metal screw in cabinet). Allow the system to log data for 5 to 10 seconds. _____

9. Stop the BOE test to mark this transition in the test. _____

   Stop Time (YYMMDDhhmm): _____ _____

10. Disconnect the jumper from chassis ground, and then start the BOE test. _____

    Start Time (YYMMDDhhmm): _____ _____

11. Short the two signal lines (Rack 3's LNK_0 pin 1 to pin 2) together. Allow the system to log data for 5 to 10 seconds. _____

12. Stop the BOE test to mark this transition in the test. _____

    Stop Time (YYMMDDhhmm): _____ _____

13. Remove the short between pin 1 and pin 2. Start the BOE test and allow the system to log data for 5 to 10 seconds. _____

    Start Time (YYMMDDhhmm): _____ _____

14. Stop the BOE test to mark this transition in the test. _____

    Stop Time (YYMMDDhhmm): _____ _____

21. Record the SOE files using attachment 7.2. _____

4.2.3 Control Module Link Failure Test

Each CSM or M/A station communicates with the HFC-6000 control system via a separate serial port of the HFC-PCC06 card. This card provides eight serial ports that can be configured to communicate with either CSMs or M/A stations. However, the communication protocols for the two devices are incompatible with one another; so once a channel has been configured for a CSM, it can only communicate with a CSM, and vice versa.

4.2.3.1 Test Setup

1. Verify that equipment setup is complete.

2. Select CSM HS-035, and install a breakout cable for connection to the interface cable between the HFC-PCC06 card and that CSM with a breakout cable.

3. Select M/A station FIK-135 for test, and install a breakout cable to the interface cable between the HFC-PCC06 card and the M/A station with a breakout cable.

Validation that test setup is complete: _____
Name/Date

4.2.3.2 Test Procedure

1. Ensure SOE Trigger is enabled. _____

2. Verify that both breakout cables are configured without any jumpers installed. _____

3. Start the BOE test, and allow the system to log data for a minimum of 30 seconds. _____

   Start Time (YYMMDDhhmm): _____ _____ |

4. Stop the BOE test to mark this transition in the test. _____

   Stop Time (YYMMDDhhmm): _____ _____

5. Start the BOE test. Start Time (YYMMDDhhmm): _____ _____ |

6. Open the transmit line (pin 1 of the breakout cable) for the CSM and allow the line to float. Allow the system to log data for 5 to 10 seconds. _____

7. Stop the BOE test to mark this transition in the test. _____

   Stop Time (YYMMDDhhmm): _____ _____

8. Reconnect the transmit line, and then start the BOE test. _____

9. Short the transmit line (pin 1 of the breakout cable) for the CSM to chassis ground (pin 9 of the breakout cable). Allow the system to log data for 5 to 10 seconds. _____

   Start Time (YYMMDDhhmm): _____ _____

10. Stop the BOE test to mark this transition in the test. _____

    Stop Time (YYMMDDhhmm): _____ _____

11. Disconnect the jumper from chassis ground, and then start the BOE test. _____

    Start Time (YYMMDDhhmm): _____ _____

12. Short the two signal lines (pin 1 and pin 2 of the breakout cable) for the CSM together. Allow the system to log for 5 to 10 seconds. _____

13. Stop the BOE test to mark this transition in the test. _____

    Stop Time (YYMMDDhhmm): _____ _____

14. Remove the breakout cable, and reconnect the normal CSM cable. _____

15. Start the BOE test. _____

Start Time (YYMMDDhhmm): _____ _____

16. Open the transmit line (pin 1 of the breakout cable) for the M/A station and allow the line to float. Allow the system to log data for 5 to 10 seconds. _____

17. Stop the BOE test to mark this transition in the test. _____

Stop Time (YYMMDDhhmm): _____ _____

18. Reconnect the transmit line, and then start the BOE test. _____

Start Time (YYMMDDhhmm): _____ _____

19. Short the transmit line (pin 1 of the breakout cable) for the M/A station to chassis ground (pin 9 of the breakout cable). Allow the system to log data for 5 to 10 seconds. _____

20. Stop the BOE test to mark this transition in the test. _____

Stop Time (YYMMDDhhmm): _____ _____

21. Disconnect the jumper from chassis ground, and then start the BOE test. _____

Start Time (YYMMDDhhmm): _____ _____

22. Short the two signal lines (pin 1 and pin 2 of the breakout cable) for the M/A station together. Allow the system to log data for 5 to 10 seconds. _____

23. Stop the BOE test to mark this transition in the test. _____

Stop Time (YYMMDDhhmm): _____ _____

24. Remove the breakout cable, and reconnect the normal interface cable. Start the BOE test and allow the system to log response time data for a minimum of 30 seconds. _____

Start Time (YYMMDDhhmm): _____ _____

25. Stop BOE to mark the transition of this test.

Stop Time (YYMMDDhhmm): _____ _____

26. Record the SOE files using attachment 7.2 _____

4.3 SERIAL PORT NOISE TEST

This test should be performed prior to any qualification testing. The serial port noise test will superimpose a [XXXXXXXXXXX] noise signal on the transmit and receive signal lines of each serial port. The test for the C-Link and the ICL will inject the noise signal on one of the redundant pair. The test for the control module interface will impose failure conditions on any one of the configured control module channels. The purpose of the test is to demonstrate that overall performance of the control system is not materially impacted by white noise interference injected at a single serial port.

EPRI TR-107330 stipulates a 30 to 100 kHz white noise signal at 2.5 vrms. HFC will meet the intent of this test by using a function generator producing a [XXXX XXXXX] signal at [XXXX] with frequency modulation enabled. An oscilloscope image of the noise signal will be included as part of the test data records.

4.3.1 Test Setup

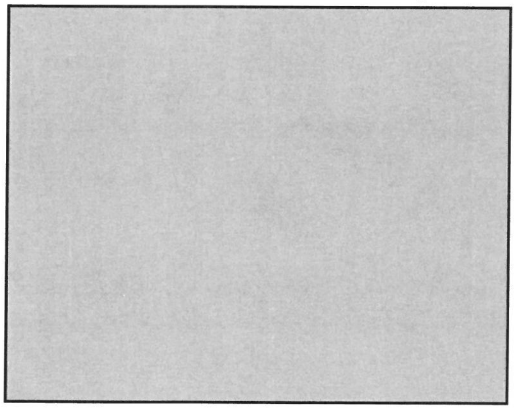
1. Verify that equipment setup is complete.

2. Replace one of the two cables connected to the front panel of controller A (slot 1) with a breakout cable.

3. Select CSM HS-035 for test, and install a breakout cable to the interface cable between the HFC-PCC06 card and that CSM with a breakout cable.

4. Select M/A station FIK-135 for test, and install a breakout cable to the interface cable between the HFC-PCC06 card and that M/A station with a breakout cable.

5. Configure the function generator to produce a [XXXXXXXX] signal having the control parameter listed below. Figure 2 shows the resultant signal characteristics.



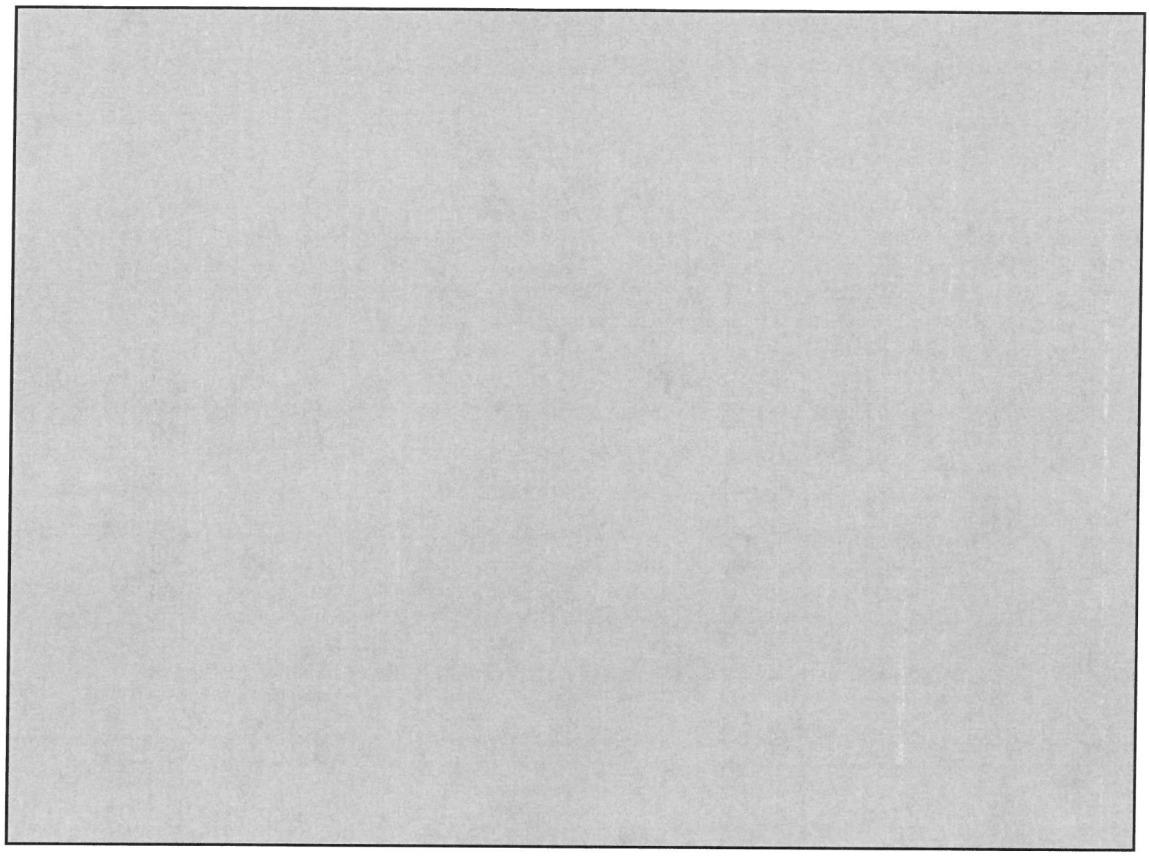


Figure 2 – Noise Signal Waveform

Validation that serial link noise test setup is complete: _____
Name/Date

4.3.2 Serial Link Noise Test

1. Ensure SOE Trigger is enabled. _____

2. Start the BOE test, and then inject the noise signal on either the RX+ or the RX- line of the C-Link cable. (Connect the "+" side of the noise source to pin 3 or 6 of the breakout cable and connect the "-" side of the noise source to pin 3 of the PT connector on the backplane). _____

   Start Time (YYMMDDhhmm): _____ _____

3. Allow the system to log data for a minimum of 1 minute. _____

4. Stop the BOE test to mark this transition in the test sequence, and disconnect the function generator from the C-Link. _____

   Stop Time (YYMMDDhhmm): _____ _____

5. Start the BOE test, and then inject the noise signal on either the RX+ or the RX- line of the ICL cable. (Connect the "+" side of the noise source to pin 1 or 2 of the breakout cable and connect the "-" side of the noise source to pin 3 of the PT connector on the backplane) _____

   Start Time (YYMMDDhhmm): _____ _____

6. Allow the system to log data for a minimum of 1 minute. _____

7. Stop the BOE test to mark this transition in the test sequence, and disconnect the function generator from the ICL. _____

   Stop Time (YYMMDDhhmm): _____ _____

8. Start the BOE test, and then inject the noise signal on either the RX+ or the RX- line of the CSM interface cable. (Connect the "+" side of the noise source to pin 1 or 2 of the breakout cable and connect the "-" side of the noise source to pin 3 of the PT connector on the backplane) _____

   Start Time (YYMMDDhhmm): _____ _____

9. Allow the system to log data for a minimum of 1 minute. _____

10. Stop the BOE test to mark this transition in the test sequence, and disconnect the function generator from the CSM cable. _____

    Stop Time (YYMMDDhhmm): _____ _____

11. Start the BOE test, and then inject the noise signal on either the RX+ or the RX- line of the M/A station interface cable. (Connect the "+" side of the noise source to pin 1 or 2 of the breakout cable and connect the "-" side of the noise source to pin 3 of the PT connector on the backplane) _____

    Start Time (YYMMDDhhmm): _____ _____

12. Allow the system to log data for a minimum of 1 minute. _____

13. Stop the BOE test to mark this transition in the test sequence, and disconnect the noise generator from the Test Specimen. _____

    Stop Time (YYMMDDhhmm): _____ _____

14. Start BOE test without any noise signal applied, and allow the system to log data for a minimum of 1 minute. _____

    Start Time (YYMMDDhhmm): _____ _____

15. Reconnect the normal interface cables. _____

    Stop Time (YYMMDDhhmm): _____ _____

16. Generate an SOE report covering this test. _____

4.3.3 Fault Simulation Test

The Fault Simulation Test covers introduction of a simulated failure condition to trigger failover from the primary to the secondary controller. Demonstration of the failover function is covered by the Failover Operability test in TP901-301-05.

5.0 ACCEPTANCE CRITERIA

5.1 BURST OF EVENTS (BOE) TEST

Acceptance criteria for the digital and analog points used in this test are as follows:

TSAP DI (TSAP memory image)	Every transition is detected. No link alarm condition is detected for DI cards in the Test Specimen. Each transition occurs within 1.0 ± 0.15 sec.
TSAP DO (HPAT memory image)	Every transition is detected. No link alarm condition is detected for DO cards in the Test Specimen. Each transition occurs within 1.0 ± 0.15 sec.
TSAP AI (TSAP memory image)	Each transition is detected and present in the resulting image signal. Averaged TSAP AI image accuracy at each level remains within ±0.32% of source signal (based on full span of 100%).
TSAP AO (HPAT memory image)	Each transition in the AI image is duplicated in the corresponding AO image. TSAP AO image duplicates source TSAP AI image. Averaged TSAP AO signal accuracy at each level remains within ±0.3% of source signal (based on full span of 100%).

5.2 C-LINK TEST

The test data records system response for two normal conditions (steps ***2*** and ***13*** in 4.2.1.2) and three abnormal (failure) conditions. Acceptance criteria for the C-Link port failure test are as follows:

Response time characteristics of the test signal with the fault conditions imposed on the serial port do not deviate by more than ±10% from those with no fault condition.

5.3 ICL TEST

The test data records system response for two normal conditions (steps ***2*** and ***13*** in 4.2.2.2) and three abnormal (failure) conditions. Acceptance criteria for the ICL-Link port failure test are as follows:

Response time characteristics of the test signal with the fault conditions imposed do not deviate by more than ±10% from those with no fault condition.

5.4 PCC06 TEST

The test data records system response for two normal conditions (steps ***2*** and ***23*** in 4.2.3.2) and three abnormal (failure) conditions for each link. Acceptance criteria for the control module link failure are as follows:

Response time characteristics of the test signal with the fault conditions imposed do not deviate by more than ±10% from those with no fault condition. (Failure to communicate over the link while a fault condition is imposed does not constitute a failure of the test.)

5.5 SERIAL PORT TEST

The test data records system response for normal conditions in step ***13*** in 4.3.2; each of the other test conditions includes injection of a noise signal on one of the system serial links. Acceptance criteria for the control module link failure are as follows:

Response time characteristics of the test signal with the fault conditions imposed do not deviate by more than ±10% from those with no fault condition. (Loss of communication over the serial channel while the noise signal is being applied does not constitute a failure of the test.)

6.0 QA RECORDS

All data generated by execution of the tests covered by this procedure will become QA records and will be filed in accordance with QPP 17.1 "Quality Records". The test data will be recorded in SOE circular memory buffers and in an HAS database while the tests are being run. Following completion of each test, SOE and HAS report files must be generated to ensure reliable recovery of the test results.

The following sequence of steps outlines the procedure for generating SOE and HAS report files after completion of any particular test.

1. The SQL server saves HAS data in HAS database files.

2. Open the SOE logger dialog window and initiate SOE report generation. The SOE logger utility will generate a report covering all transitions since the last SOE report. These reports will be preserved in a separate directory designated for SOE reports. (To prevent confusion, the SOE modules should be reset after generating an SOE report file.)

3. The Alarm Process program generates a separate text file for each day it is running and stores that file in the Job folder for Rem0. This text file is a log containing a record of all configured alarms generated during that day.

4. Periodically, the entire directory shall be saved on backup CDs to ensure that accumulated data is preserved.

5. After testing is complete, the HAS data can be exported to an Access database to facilitate searches and analysis of the test results.

6. The master copy of the HAS archive and the SOE report files shall be kept under document control.

7.0 ATTACHEMENTS

The following forms are attached to this document:

Attachment 7.1 – Test Equipment Log
Attachment 7.2 – Prudency Test File Records

Attachment 7.1 – Test Equipment Log

Test Equipment	Instrument ID	Calibration Due Date

Test Reviewer/Date

Attachment 7.2 – Prudency Test Data File Records

All test results will be recorded automatically in SOE and HAS logger files. Record the file name, date and time for each test run.

Test Conducted	File Name	Date and Time Created
Burst of Events Test		
C-Link Failure Tests		
ICL-Link Failure Tests		
Control Module Interface Failure Tests		
CSM		
M/A		

Test Engineer _____ **Date** _____

Attachment 7.2 – Prudency Test Data File Records (continued)

Test Conducted	File Name	Date and Time Created
C-Link Noise Test		
ICL-Link Noise Tests		
Control Module Noise Failure Tests		

Test Engineer _____ **Date** _____