



HF CONTROLS

HFC-6000 Control System

Prudency Test Procedure

HFC-SBC04A Single Loop Controller

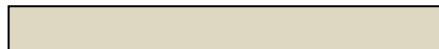
TP901-203-05 Rev B

Effective Date 5/18/2010

Author/Title Jonathan Taylor

Reviewer/Title Ivan Chow

Approval/Title Ed Herchenrader



Copyright© 2010 HF Controls Corporation

Revision History

Date	Revision	Author	Changes
4/26/10	A	J Taylor	Review Comments
5/17/10	B	J Taylor	Revise per CR 2010-0107

Table of Contents

Section	Title	Page
1.0	PURPOSE AND SCOPE	3
2.0	REFERENCES	3
2.1	Industry Standards	3
2.2	Related Plans and Procedures	3
2.3	Support Documentation	3
2.4	HFC Internal Standards and Procedures	4
2.5	Special Terms, Abbreviations, and Acronyms	4
3.0	PREREQUISITES.....	5
3.1	Equipment Required	5
3.2	Environmental Conditions	5
3.3	Test Personnel.....	5
3.4	Precautions.....	5
3.5	Red-Line Policy	6
3.6	Equipment Setup.....	6
4.0	TEST PROCEDURE	6
4.1	Serial Port Tests	6
4.1.1	Test Execution	6
4.1.2	Acceptance Criteria.....	7
4.2	Serial Port Noise Test	7
4.2.1	Test Procedure	8
4.2.2	Acceptance Criteria.....	9
5.0	QA RECORDS	10
6.0	ATTACHEMENTS.....	10

List of Figures

Number	Title	Page
Figure 1.	Noise Signal Waveform	9

1.0 PURPOSE AND SCOPE

The Single Loop Controller (SLC) consists of one HFC-SBC04A controller and one HFC-AC36FD analog I/O module housed in an eight-inch rack. The application of this controller is configured to support a subset of the Operability and Prudency tests defined by EPRI TR-107330 Section 5. The purpose of the Prudency test is to verify operation of a system under test under highly dynamic conditions. Section 5.4 of EPRI TR-107330 defines the following set of Prudency tests:

- **Serial Port Failure Test** – the intent of this test is to introduce mechanical failures into serial communication links associated with the controller. System response characteristics shall not vary by more than $\pm 10\%$ while the fault is present. (Section 5.4.B of EPRI TR-107330)
- **Serial Port Noise Test** – the intent of this test is to inject a noise signal into a serial communication channel. System response shall not vary by more than $\pm 10\%$ while the noise signal is present. (Section 5.4.C of EPRI TR-107330)

2.0 REFERENCES

2.1 INDUSTRY STANDARDS

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

2.2 RELATED PLANS AND PROCEDURES

VV901-300-01	ERD111/ERD921 Qualification Program, Master Test Plan, Rev B
VV901-301-02	ERD921 SLC System, Master Configuration List, Rev A
TP901-200-00	ERD111/ERD921 Qualification Program, Pre-Qualification Test Plan, Rev A
TP901-200-02	ERD111/ERD921 Qualification Program, Environmental Stress Test Procedure, Rev A
TP901-200-04	ERD111/ERD921 Qualification Program, Seismic Test Procedure, Rev A
TP901-200-05	ERD111/ERD921 Qualification Program, EMI/RFI Test Procedure, Rev A

2.3 SUPPORT DOCUMENTATION

UG004-000-01	EWS User's Guide Rev E
UG004-000-16	MCRT User's Guide Rev B
UG004-000-03	HAS User's Guide Rev E

2.4 HFC INTERNAL STANDARDS AND PROCEDURES

QPP 5.1	Review and Approval of Quality Documents, Rev G
QPP 5.2	Preparation of Procedures, Rev M
QPP 11.1	Test Control, Rev H
WI-ENG-003	Configuration Management, Ref E
WI-ENG-205	Develop Software/Firmware Test Procedure, Rev B

2.5 SPECIAL TERMS, ABBREVIATIONS, AND ACRONYMS

2oo3	Two-out-of-Three
AC	Alternating Current
AI	Analog Input
AO	Analog Output
BOE	Burst of Events
CPC	Communication Protocol Controller
DC	Direct Current
DDB	Dynamic Database
DMR	Dual Module Redundant
DI	Digital or Discrete Input
DO	Digital or Discrete Output
EWS	Engineering Workstation
FOT	Fiber-Optics Transmitter
HAS	Historical Archiving System
HPAT	HFC Plant Automated Tester
HFC	Doosan HF Controls
ICL	Intercommunication Link
I/O	Input/Output
MCRT	HFC Interactive Operator CRT Workstation
PC	Personal Computer
SLC	Single Loop Controller
SOE	Sequence of Events
Test Specimen	A system under test consisting of control system hardware and software components along with any applicable system configuration data and supporting hardware
TSAP	Test System Application Program

3.0 PREREQUISITES

The following sections identify the test equipment, test environment, and setup requirements for running each of the Prudency tests. The two Prudency tests to be run both require manual intervention and cannot be automated.

3.1 EQUIPMENT REQUIRED

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 test and measurement equipment to be used is current.

- PC workstation with EWS, MCRT, and HAS software installed
- Fluke 187 Multimeter or equivalent
- HFC-6000 I/O Extender Card
- HPAT
- HP 8116A Pulse/Function Generator
- Oscilloscope
- Variable AC power source capable of producing an output signal having the following range: 60 to 300 VAC, 40 to 65 Hz.

3.2 ENVIRONMENTAL CONDITIONS

Prudency testing 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 environmental qualification testing, required environmental conditions are stipulated within the procedures governing those tests.

Temperature	Ambient
Relative Humidity	Ambient

3.3 TEST PERSONNEL

The set of Prudency tests will be conducted by qualified HFC test engineers.

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 is presented in HFC document WI-ENG-815. 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 prior to Prudency Testing 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 HFC Document Control records
2. Verify that the hardware configuration of the test cabinet has been satisfactorily completed.

Validation that equipment setup is complete: _____
Name/Date

4.0 TEST PROCEDURE

The Prudency tests will be executed during the prequalification phase of testing and at specified points during the qualification tests. No fixed sequence of execution is assumed or implied by the order of specific tests in this document.

4.1 SERIAL PORT TESTS

The SLC has one redundant Intercommunication Link (ICL) and one non redundant ICL. The redundant ICL is connected to Remote 4 (DMR), which is physically located in Rack 7 of the test cabinet. The non redundant ICL enables communication with all I/O modules that are configured for operation with the SLC. Because the non redundant ICL is configured as traces on the backplane of the ICL chassis, only the redundant ICL will be subjected to test..

4.1.1 Test Execution

1. Place the SBC04A on the extender card and turn off the secondary SBC06 in Remote 4 (DMR). _____
2. Set power source for the cabinet to 90 vac and 57 Hz. _____
3. Use card-edge LEDs to verify that the SLC is communicating with the DMR through the extender card. _____
4. Use the MCRT to start the SLC response time test. _____
5. Allow the test to run approximately 60 seconds and then stop the response time test. _____

6. Verify that the SOE subsystem automatically generates a report. Record the report file name and time/date of test execution in attachment 6.2. _____
7. **Failure 1.** Short the transmit line (P1-A11 for A or P1-A13 for B) to chassis ground. _____
8. Start the response time test, allow it to run for approximately 60 seconds, and then stop it. _____
9. Verify that the SOE subsystem automatically generates a report. Record the report file name and time/date of test execution in attachment 6.2. _____
10. **Failure 2.** Short the transmit line (P1-A11 for A or P1-A13 for B) to the receive line (P1-11 for A or P1-C13 for B) _____
11. Start the response time test, allow it to run for approximately 60 seconds, and then stop it. _____
12. Verify that the SOE subsystem automatically generates a report. Record the report file name and time/date of test execution in attachment 6.2. _____
13. Remove all jumpers from the extender card. _____
14. Start the response time test, allow it to run for approximately 60 seconds, and then stop it. _____
15. Verify that the SOE subsystem automatically generates a report. Record the report file name and time/date of test execution in attachment 6.2. _____

4.1.2 Acceptance Criteria

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

- Every transition detected for both the analog accuracy test and response time test.
- Response time characteristics of the test signal with the fault conditions imposed on the serial port do not deviate by more than $\pm 10\%$ from those with no fault condition.

4.2 SERIAL PORT NOISE TEST

Section 5.4.C of EPRI TR-107330 requires that the transmit line of the serial communication link be subjected to a 2.5 Vrms white noise source in the 30- to 100-kHz range for at least one minute. The intent of this test will be met using a noise signal consisting of a 100 kHz sawtooth signal at 2.5 Vrms with frequency modulation.

4.2.1 Test Procedure

1. Verify that the ICL is connected between the SLC and DMR controllers, verify that no jumper or open signal line is present and verify that the SBC04A is on an extender card.
2. Ensure that the power source has been set to 90 vac at 57 Hz.
3. Configure the function generator to produce a 100 kHz sawtooth signal having the control parameter listed below. Figure 1 shows the resultant signal characteristics.
 - a. Frequency 100 kHz
 - b. OFS 1.00 v
 - c. AMP 2.50 v
 - d. Sawtooth waveform
 - e. DTY 90%
 - f. SWT 50.0 ms
 - g. STA 1 kHz
 - h. FM enabled
 - i. I.SWP enabled
 - j. No external trigger
4. Connect the probe from the pulse generator to the transmit line (P1-A11 for A or P1-A13 for B). Make sure that the noise signal is disabled.
5. Start the response time tests, and allow the waveforms to run for approximately 30 seconds.

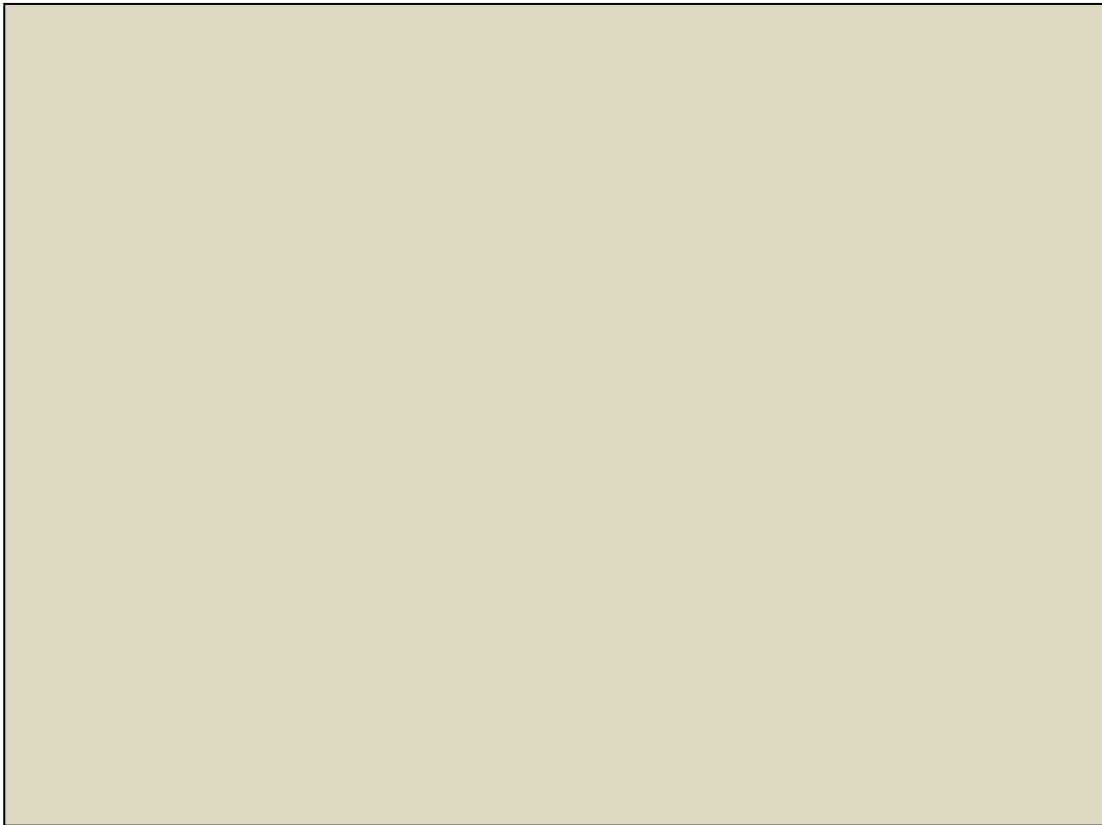


Figure 1. Noise Signal Waveform

6. Enable injection of the noise signal into the transmit line. Allow the test to run for approximately 30 seconds more. _____
7. Stop the response time test and disable the noise signal. _____
8. Verify that the SOE subsystem automatically generates a report file. Record the name of the report file and the date/time in attachment 6.2. _____
9. Remove the SBC04A from the extender card and reinstall it in the rack. _____

Serial Link Noise test is complete: _____
Name/Date

4.2.2 Acceptance Criteria

The test data records system response for normal conditions in step **1** and for the fault condition in step **3**. Acceptance criteria for the control module link failure are as follows:

- Every transition detected for both the accuracy and the response time test.
- Response time characteristics of the test signal with the fault conditions imposed on the serial port do not deviate by more than $\pm 10\%$ from those with no fault condition.

5.0 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 the Project Quality Plan. The test data will be recorded in SOE circular memory buffers and in the HAS database while the tests are being run. Following completion of each test, an SOE report file must be generated to ensure reliable recovery of the test results. The name of the SOE report file for each test shall be recorded in the test record and stored in an appropriate folder of the EWS PC. After test completion, both the SOE reports and the HAS database volumes shall be copied to CD to provide a permanent, unchangeable record of test results for subsequent analysis.

6.0 ATTACHEMENTS

The following forms are attached to this document:

Attachment	Description	Page
6.1	Test Equipment Log	11
6.2	Test Record	12

Attachment 6.1

Test Equipment Log

[illegible]

Test Engineer/Date

Attachment 6.2
Prudency Test Log

All test results will be recorded automatically in SOE and HAS logger files. Record the file name, date and time for each test run. All data generated during any particular test will be transferred to CD. Record the ID label assigned to the CD containing these files.

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

Test Engineer _____ Date _____