

Project:	TRICON v10 NUCLEAR QUALIFICATION PROJECT
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<p>TEST REPORT</p> <p>OPERABILITY TEST PROCEDURE</p> <p>PERFORMANCE PROOF TEST</p> <p>(Run ID 3.7)</p>	
<p>Document No: 9600164-566</p> <p>Revision 0</p> <p>July 26, 2007</p>	

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Project:

TRICON v10 NUCLEAR QUALIFICATION PROJECT

TEST REPORT

OPERABILITY TEST PROCEDURE

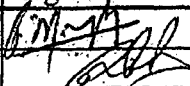
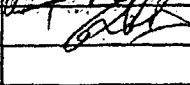
PERFORMANCE PROOF TEST

(Run ID 3.7)

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Revision 0

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Revision History

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0	07/26/06	Initial Issue.	Hariprasad Parthasarathy

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1.0 EXECUTIVE SUMMARY

The Tricon v10 Nuclear Qualification Project Operability Test Procedure (9600164-503), Performance Proof Test (Run ID: 3.7) was conducted on May 7th, 8th, 9th and 10th of 2007 at Invensys Triconex, Irvine, CA. As required by the Master Test Plan (MTP), the Operability Test Procedure, Performance Proof Test (Run ID: 3.7) was executed to establish the performance data on the Tricon-Under-Test (TUT) after being subjected to all qualification tests. Prior to test execution, the following documents were approved and listed in the Master Configuration List (MCL) (Reference 9.4) in accordance with the requirements of the Nuclear Qualification Quality Plan (NQQP) (Reference 9.3):

1. Master Test Plan
2. Nuclear Qualification Quality Plan
3. System Setup & Checkout Procedure
4. Operability Test Procedure

Note: Throughout this Test Report reference is made to the requirements of EPRI TR-107330. All statements regarding EPRI TR-107330 are understood to include the exceptions noted in Equipment Qualification Summary Report, Appendix A, EPRI TR-107330 Requirements Compliance and Traceability Matrix (Reference 9.8).

The Operability Test Procedure was developed based on the applicable requirements of the EPRI TR-107330 (Reference 9.1), the MTP and the NQQP. The procedure was designed to demonstrate that the TUT will perform basic functionality in accordance with Invensys Triconex published specifications and/or EPRI TR-107330 specifications.

The Operability Test Procedure, Performance Proof Test (Run ID: 3.7) was executed following the successful completion of the System Setup & Checkout Procedure, Pre-Performance Proof Test (Run ID: 3.11). The Operability Test Procedure was executed by certified Project R&D Engineers and witnessed by the Project Quality Assurance Engineer (PQAE).

During execution of the test, no Qualification Project Anomaly Reports (QPAR) were generated specific to this Run ID of the Operability Test Procedure.

All acceptance criteria specified in the Operability Test Procedure, Performance Proof Test (Run ID: 3.7) were satisfied. The TUT was functioning properly and performance data for the TUT were established.

2.0 PURPOSE

This test report documents the results of the Operability Test Procedure, Performance Proof Test (Run ID: 3.7) of the TUT to meet the requirements of EPRI TR-107330 and/or Invensys Triconex published specifications after being subjected to all qualification tests.

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3.0 TEST OBJECTIVE

The objective of the Operability Test Procedure, Performance Proof Test (Run ID: 3.7) was to ensure that performance data for the TUT were achieved in accordance with the Invensys Triconex published specifications and/or EPRI TR-107330 specifications after being subjected to all qualification tests and that all acceptance criteria stated in the procedure were met.

4.0 TEST DESCRIPTION

The Operability Test Procedure provides a systematic approach to test the TUT against the acceptance criteria stated in the procedure. The procedure is broken into 11 sections and each section is broken into multiple steps to test the TUT. In addition, the procedure provides information about the list of various operability tests conducted to verify acceptable performance of the TUT in accordance with Invensys Triconex published specifications and/or EPRI TR-107330 specifications. The test results are recorded in each step of the corresponding section and the results are summarized at the end of each section.

Operability testing involves exposing the TUT to various normal and abnormal conditions of input/output operation and source power. EPRI TR-107330 section 5.3 describes the specific criteria to be met for operability tests. In addition, the operability test included power quality testing as specified in EPRI TR-107330, section 6.4.3.

5.0 TEST SETUP

The nuclear qualification test system setup for operability tests included successful completion of the System Setup & Checkout Procedure (Run ID: 3.11) to ensure proper assembly, configuration, integration and functioning of the nuclear qualification test system. In addition, the TUT was adjusted during performance of the following sections of the procedure:

- Discrete Output Test: The test setup included installing variable rheostats to the nuclear qualification test system for the conduct of this test.

6.0 TEST PROCEDURE

The Operability Test Procedure, Performance Proof Test (Run ID: 3.7) was performed in accordance with the requirements of Sections 5.3 and 6.4.3 of EPRI TR-107330 (Reference 9.1) and as described in Appendix 3 of the Master Test Plan (Reference 9.2).

Each section is described below indicating the applied test conditions and associated acceptance criteria. In addition, the rationale for determining acceptability of each applied section is discussed.

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The Operability Test Procedure, Performance Proof Test (Run ID: 3.7) is divided into 11 sections and associated subsections. Each subsection is designed to test one criteria of the TUT. The operability tests performed and the associated Section numbers are:

- Section 1 – General Overview: This section was performed on the TUT in accordance with Seismic Test Procedure to adjust the TUT for subsequent operability tests.
- Section 2 – Analog Input/Output Accuracy Test: This test was performed in accordance with EPRI TR-107330, Section 5.3.A on one channel of the each analog input module and analog output module installed in the TUT using a minimum five-point accuracy check.

a

The acceptance criteria are that the overall accuracy of each analog input and output module shall meet Invensys Triconex published specifications.

- Section 3 – Response Time Test: This test was performed in accordance with EPRI TR-107330, Section 5.3.B to calculate the response times of different input and output modules.

a

- Section 4 – Discrete Input Test: This test was performed in accordance with EPRI TR-107330, Section 5.3.C on one channel of each digital input module installed in the TUT to demonstrate that the trip and reset points of the channel are within the Invensys Triconex published specifications for OFF to ON and ON to OFF voltage switching levels. The acceptance criteria are that the OFF to ON and ON to OFF voltage switching levels of each tested digital input module point shall meet Invensys Triconex published specifications.

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- Section 5 – Discrete Output Test: This test was performed in accordance with EPRI TR-107330, Section 5.3.D on one channel of each digital output module installed in the TUT to demonstrate that the voltage and current drive capability are within Invensys Triconex published specifications.

a

The

acceptance criteria are that the maximum current driven with maximum and minimum voltage of each tested digital output module point shall meet Invensys Triconex published specifications.

- Section 6 – Timer Test: This test was performed in accordance with EPRI TR-107330, Section 5.3.G on the application software timer function to determine the accuracy of the 1 minute and 5 minute timers.

a

- Section 7 – Failover Test: This test was performed in accordance with EPRI TR-107330, Section 5.3.I to simulate different failures of the TUT components including a MP module failure, a primary RXM module failure, a secondary RXM module failure, an RS-485 input/output interface cable failure between chassis 1 and 2, and between chassis 3 and 4, and power supply module failures in each chassis.

a

- Section 8 – Loss of Power/Failure to Complete Scan Detection Test: This test was performed in accordance with EPRI TR-107330, Sections 5.3.H and 5.3.J on the TUT. During this test, all AC and DC power to the TUT chassis power supplies was manually interrupted for at least 30 seconds. The acceptance criteria is that during the simulated loss of power, the TSAP shall cease operation, all monitored discrete output points shall open, all monitored analog output points shall go to zero, and all communications with connected test system peripheral devices shall cease. On restoration of power, the TUT shall pass all start-up hardware diagnostics and shall automatically resume normal operation. All discrete and analog output points shall resume normal operation in accordance with the TSAP,

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and all communications with connected test system peripheral devices shall resume normal operation in accordance with the TSAP.

- Section 9 – Power Interruption Test: This test was performed in accordance with EPRI TR-107330, Sections 5.3.H on all the chassis power supply modules of the TUT.

a

- Section 10 – Power Quality Tolerance Test: This test was performed in accordance with EPRI TR-107330, Section 6.4.3 on the TUT.

a

- Section 11 – Test System Restoration: This Section was performed to restore the nuclear qualification test system back to the as found settings recorded during the execution of Section 1.

7.0 TEST RESULTS

All prerequisites delineated in Subsection 6.0 of each Section of the Operability Test Procedure, Performance Proof Test (Run ID: 3.7) were satisfied and all M&TE were determined to be within its calibration cycle before entering into Subsection 10.0, Procedure, of each Section of the procedure.

All tests performed during execution of the procedure complied with the stated acceptance criteria. The individual results of each section are given below.

- Section 1 – No Acceptance Criteria associated with this Section.

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- Section 2, Subsections 10.1 thru 10.19 – Passed.
- Section 3, Subsection 10.1 – Passed.
- Section 4, Subsections 10.1 thru 10.4 – Passed.
- Section 5, Subsections 10.1 thru 10.7 – Passed.
- Section 6, Subsection 10.1 – Passed.
- Section 7, Subsections 10.1 thru 10.11 – Passed.
- Section 8, Subsections 10.1 thru 10.3 – Passed.
- Section 9, Subsections 10.1 and 10.2 – Passed.
- Section 10, Subsections 10.1 thru 10.4 – Not Applicable for this Run ID.
- Section 11 – No Acceptance Criteria associated with this Section.

8.0 CONCLUSIONS

The Operability Test Procedure, Performance Proof Test (Run ID: 3.7) successfully established performance data for the TUT in accordance with the Invensys Triconex published specifications and/or EPRI TR-107330 specifications and all acceptance criteria stated in the procedure were met.

In addition, the test results of the Operability Test Procedure, Pre-Qualification Test (Run ID: 3.1) and Operability Test Procedure, Performance Proof Test (Run ID: 3.7) were analyzed to determine any de-gradation in the performance of the TUT. The analyses established that the TUT performed in accordance with Invensys Triconex published specifications and/or EPRI TR-107330 specifications before and, after Qualification Tests and no de-gradation in the performance of the TUT were identified. Table 1 provides a comparison of Pre-Qualification and Performance Proof Operability test results.

Table 1

	Description	Pre-Qualification Test	Performance Proof Test	Comments
Section 2	Analog Input/Output Accuracy Test	Passed	Passed	No degradation in the TUT performance.
Section 3	Response Time Test	Passed	Passed	No degradation in the TUT performance.
Section 4	Discrete Input Test	Passed	Passed	No degradation in the TUT performance.
Section 5	Discrete Output Test	Passed	Passed	No degradation in the TUT performance.

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	Description	Pre- Qualification Test	Performance Proof Test	Comments
Section 6	Timer Test	Passed	Passed	No degradation in the TUT performance.
Section 7	Failover Test	Passed	Passed	No degradation in the TUT performance.
Section 8	Loss of Power / Failure to Complete Scan Detection test	Passed	Passed	No degradation in the TUT performance.
Section 9	Power Interruption Test	Passed	Passed	No degradation in the TUT performance.
Section 10	Power Quality Tolerance Test	Failed	N/A	This test is not applicable for this Run ID. QPAR 014 was issued to address the failed test.

9.0 REFERENCES

- 9.1 EPRI Technical Report TR-107330, Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants
- 9.2 9600164-500, Master Test Plan
- 9.3 9600164-002, Nuclear Qualification Quality Plan
- 9.4 9600164-500, Master Configuration List
- 9.5 9600164-502, System Setup & Checkout Procedure
- 9.6 9600164-503, Operability Test Procedure
- 9.7 9600164-731, Maximum Response Time Calculations
- 9.8 9600164-545, Equipment Qualification Summary Report, Appendix A, EPRI TR-107330 Requirements Compliance and Traceability Matrix

10.0 APPENDICES

None

11.0 ATTACHMENTS

None