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## NUCLEAR QUALIFICATION OF TRICON PLC SYSTEM v10

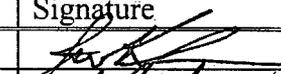
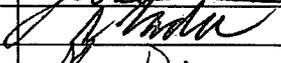
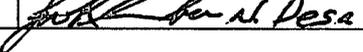
# SUPPLEMENTAL TEST PLAN

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INVENSYS TRICONEX, IRVINE CALIFORNIA

	Name	Signature	Title
Author:	Frank Kloer		R&D Engineer
Reviewer:	Steve Landas		Independent Review Engineer
Approval	Shawn Dwire		PQAE
Approval:	Naresh Desai		Project Manager

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**REVISION HISTORY**

Rev	Date	Change Description
0	01/11/08	Initial Issue

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## **1 INTRODUCTION**

EPRI Specification TR-107330 and NRC R.G. 1.180 define the requirements for testing to be performed in connection with the qualification of a generic PLC platform. Testing of a sample PLC system was undertaken as described in Master Test Plan 9600164-500 and reported in the EQ Summary Report, 9600164-545. This testing was performed at the NTS (National Technical Systems) test facility in Boxborough, Massachusetts during April, 2006.

This Supplemental Test Plan (STP) provides an overview of the supplemental testing to augment the Triconex V10 Nuclear Qualification Testing Program. The supplemental qualification testing is intended to determine the causes for susceptibility of the Models 3503E and 3625 digital input and digital output modules to IEC 61000-4-16, Common-Mode Disturbances. This Plan identifies equipment to be tested, tests to be performed, and procedures for conducting the testing. The results of the tests will be evaluated against acceptance criteria and provide a basis for qualifying the generic equipment configuration. The data taken during testing will also provide configuration and qualification envelope information. This will be included in a revision to the final summary report to be used as a basis for evaluating specific applications of the equipment in nuclear power plants. The nuclear industry needs have been identified previously in Marketing Requirements Document No. 5001-0033-68.

### **1.1 BACKGROUND**

The Tricon v10 Programmable Logic Controller (PLC) system has been generically qualified for safety-related applications in nuclear power plants. The basis for qualification is compliance with EPRI TR-107330, and USNRC Regulatory Guide 1.180, Revision 1. EMI/RFI susceptibility testing of the Tricon-Under-Test (TUT) included conducted susceptibility testing done to IEC 61000-4-16, "Conducted Susceptibility, Common-Mode Disturbances (0 Hz to 150 kHz), Power and Signal Leads," as specified in Section 4 of NRC RG 1.180, Rev. 1. Threshold levels were determined for Common-Mode Disturbances, DC, Signal Leads.

A major customer has requested Triconex resolve this issue to satisfy a specific application. Triconex does not believe that the conducted susceptibility threshold levels (DC, common-mode) of the DI/DO modules that were experienced during IEC 61000-4-16 testing are credible. This is based on the inherent design of the modules which have opto-isolators on the inputs/outputs. During testing at NTS, time constraints did not allow for troubleshooting of this problem, therefore in order to satisfy our customer's needs Triconex has undertaken this supplementary testing. Additional testing is being performed in order to duplicate and troubleshoot the susceptibilities.

### **1.2 DESCRIPTION**

The same qualification test specimen qualified under Master Test Plan 9600164-500, the TUT, will be subjected to the supplemental testing. In general, the system consists of a standard Tricon PLC system configured with a selection of modules needed to encompass a variety of applications. The existing TUT equipment layout drawings, wiring diagrams, and other diagrams define the configuration of the test system.

Test procedures provide specific details on hardware mounting and interfaces used in the supplemental qualification testing. Existing procedures will be modified in scope to encompass only those points found to have been susceptible during IEC 61000-4-16 testing. The existing test specimen application program will be utilized with the equipment. Detailed configuration information such as serial numbers, software versions, etc., has been provided as part of the V10 Nuclear Qualification Project documentation, and there is no change to this information.

1.3 SUMMARY

The safety functions to be demonstrated by the test program include functioning during and after exposure to EMC conditions as stipulated in IEC 61000-4-16, "Conducted Susceptibility, Common-Mode Disturbances (Short Duration), Power and Signal Leads," for the Model 3503E and 3625 Modules.

1.3.1 MAJOR ACTIVITIES

Requirements for conducting testing activities are duplicated from previous testing during the V10 Nuclear Qualification Project. Three categories of tests will be conducted to satisfy the supplemental testing requirements in order to show qualification in accordance with IEC 61000-4-16:

- (1) **Pre-qualification tests** conducted prior to qualification testing to determine that the system operates correctly and to provide baseline data on equipment performance, and
- (2) **Qualification tests** to demonstrate compliance with specification requirements and suitability of equipment while subject to stress conditions
- (3) **Performance Proof tests** conducted at the Invensys Triconex facilities upon conclusion of all testing to confirm satisfactory operation after being subjected to Qualification test conditions. Performance proof tests are merely a repeat of selected pre-qualification baseline tests to identify any changes in equipment performance.

Selected portions of the Operability and Prudency tests will be performed. Since full Operability and Prudency Tests were performed subsequent to the TUT being returned to Irvine, only selected portions will be repeated for supplemental testing.

a, b

a, b

**Pre-qualification Tests include:**

1. System Set-up and Check-out Test (See attachment 1)
2. Selected portions of Operability and Prudency tests (See Attachments 2 and 3)

**Qualification Tests include:**

1. EMC testing of 3503E and 3625 modules in accordance with IEC 61000-4-16, Short Duration, DC (See Attachment 4)

**Performance Proof Tests include:**

1. Selected portions of Operability and Prudency tests (See Attachments 2 and 3)

**1.3.2 MAJOR MILESTONES**

<b>Project start</b>
Complete Supplemental Test Plan (STP)
Prepare Project Schedule
Formal Qualification Testing
Qualification Test Results
<b>EQ Summary Report Revision (Project ends)</b>

**1.3.3 MAJOR DELIVERABLES**

Supplemental Test Plan (STP)
Test Procedures/Reports
Test Impact Analysis
EQ Summary Report Revision

**2 INPUTS, STANDARDS & CERTIFICATION**

**2.1 RELATED DOCUMENTATION**

9600164-502	Setup & Checkout Test Procedure
9600164-503	Operability Test Procedure
9600164-504	Prudency Test Procedure
9600164-510	EMI/RFI Test Procedure
9600164-527	EMI/RFI Test Report
TP62987-07N-EMI, 0 COP-006 02-12-07	NTS Electromagnetic Compatibility Qualification Test Procedure
9600164-510	Completed MPR EMI RFI Test Procedure 9600164-510

**2.2 APPLICABLE STANDARDS**

EPRI TR-107330	Generic Requirements for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants
10CFR50, App B	Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants

NQA1-1994	Quality Assurance Requirements for Nuclear Facility Applications
USNRC R.G. 1.180, R1	Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems
IEC 61000-4-16	Conducted Susceptibility, Common-Mode Disturbances (15 Hz to 150 kHz), Power and Signal Leads,

**2.3 CERTIFICATION REQUIREMENTS**

The project deliverables will be available for US Nuclear Regulatory Commission inspection and/or review for conformance to EPRI TR-107330 and R.G. 1.180.

Quality Assurance

**2.4 PROGRAM REQUIREMENTS & DEVIATIONS**

Quality Program in accordance with Triconex Products Quality Assurance Manual.

**2.5 PROJECT SPECIFIC OR UNIQUE ISSUES**

The Tricon Nuclear Qualification Quality Plan, 9600164-002, provides additional instructions for administering test program activities.

**2.6 QA MONITORING**

The Tricon Nuclear Qualification Quality Plan, 9600164-002, provides additional instructions for administering test program activities.

**3 TRAINING REQUIREMENTS**

Triconex management will ensure that engineering staff participating in this project will have appropriate training on required development methodology and tools, including:

9600164-800	Supplemental Test Plan (Nuclear Qualification of Tricon PLC System v10 – Supplemental Testing)
9600164-002	Nuclear Qualification Quality Plan
QAM	Quality Assurance Manual
EDM-75.00	Maintenance of Nuclear 1E Qualification

**ATTACHMENT 1**

**System Setup and Checkout Procedure – Supplemental 61000-4-16 Testing**

a, b

**ATTACHMENT 2**

**Operability Test Procedure – Supplemental 61000-4-16 Testing**

a, b

**ATTACHMENT 3**

**Prudency Test Procedure – Supplemental 61000-4-16 Testing**

a, b

**ATTACHMENT 4**

**EMC Test Procedure – Supplemental 61000-4-16 Testing**

a, b