Project:	TRICON v10 NUCLEAR QUALIFICATION PROJECT

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CLASS 1E TO NON-1E ISOLATION TEST REPORT

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1	04/30/08	Revised Reference 9.22 in response to NUPIC audit corrective action (Reference CAR 2528-1). Updated References 9.1 and 9.11 accordingly.	F. Kloer

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Attachment 1: Example Plots of TUT Normal Operating Data

1.0 EXECUTIVE SUMMARY

The TRICON v10 Nuclear Qualification Project Class 1E to Non-1E Isolation Test was performed on April 5 to 16, 2007 at National Technical Systems (NTS) Laboratories in Boxborough, Massachusetts. As required by Triconex Document No. 9600164-500, "Master Test Plan," (Reference 9.1), the Class 1E to Non-1E Isolation Test was executed to demonstrate the capability of selected TRICON v10 Programmable Logic Controller (PLC) modules to act as electrical isolation devices between the designated safety related hardware of the PLC and non-safety related field circuit connections.

MPR Procedure No. 9600164-509, "Class 1E to Non-1E Isolation Test Procedure," (Reference 9.2) was developed in accordance with the requirements of EPRI TR-107330, "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants," (Reference 9.3), IEEE Standard 384-1981, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits," (Reference 9.4), Triconex Document No. 9600164-500, "Master Test Plan," (Reference 9.1), and Triconex Document No. 9600164-002, "Nuclear Qualification Quality Plan," (Reference 9.5). The procedure included steps to direct: 1) proper setup of the TRICON-Under-Test (TUT) and test system prior to testing, 2) application of electrical fault conditions to the TUT components, 3) acquisition of TUT operational parameters during testing, and 4) evaluation of acceptable TUT performance during testing. The TUT executed a verified and validated Test Specimen Application Program (TSAP) throughout Class 1E to Non-1E Isolation Testing. The TSAP revision used was "V10_TSAP_REV_0". Class 1E to Non-1E Isolation Testing was performed by MPR certified Project Test Engineers and witnessed by Triconex Project Quality Assurance.

Triconex Drawing No. 9600164-100, "TRICON v10 Nuclear Qualification Project TRICON-Under-Test, General Arrangement," (Reference 9.6), shows the basic configuration of the TUT components for Class 1E to Non-1E Isolation Testing.

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a, b

The following TRICON v10 PLC components were tested for electrical fault isolation capability as indicated:

120 VAC/VDC Relay Output Module Model 3636T, Relay Output Point

- 600 VAC and 250 VDC for 30 seconds, Line-to-Line, Output Point Open
- 600 VAC and 250 VDC for 30 seconds, Line-to-Line, Output Point Closed
- 600 VAC and 250 VDC for 30 seconds, Line-to-Ground, Output Point Open
- 600 VAC and 250 VDC for 30 seconds, Line-to-Ground, Output Point Closed

TRICON Communication Module (TCM) Model 4352A, MODBUS Serial Port

- 250 VAC and 250 VDC for 30 seconds, Receive-to-Transmit Pins
- 250 VAC and 250 VDC for 30 seconds, All Pins to Ground

The Class 1E to Non-1E Isolation Test results demonstrate that the Model 3636T Relay Output Module and the Model 4352A TRICON Communication Module provide adequate electrical isolation per IEEE 384-1981 (Reference 9.4) between the safety related portions of the TRICON v10 PLC and connected non-safety related field circuits.

The TRICON v10 PLC Model 4201 Remote RXM fiber optic module is considered an acceptable Class 1E to Non-1E isolation device by design, and was not tested. The fiber optic cables are incapable of transmitting electrical faults from the remote Non-1E RXM module to the primary RXM module (which would be installed in the safety related TRICON chassis), and therefore meet IEEE 384-1981 (Reference 9.4) electrical isolation requirements

2.0 PURPOSE

The purpose of this test report is to summarize the results of Class 1E to Non-1E Isolation Testing of the TRICON v10 Nuclear Qualification Project TRICON-Under-Test (TUT) to meet the requirements of Section 6.3.6 of EPRI TR-107330 (Reference 9.3). The format of this test report conforms to Section 8.3.(4) of IEEE Standard 323-1974, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," (Reference 9.7).

Details regarding the performance and results of the Class 1E to Non-1E Isolation Testing are recorded in the completed MPR Procedure No. 9600164-509, "Class 1E to Non-1E Isolation Test Procedure," (Reference 9.8). Conclusions from the Class 1E to Non-1E Isolation Testing are provided in Section 8.0 of this test report.

3.0 TEST OBJECTIVE

Appendix 8 of Triconex Document No. 9600164-500 (Reference 9.1) states that Class 1E to Non-1E Isolation Testing is conducted to demonstrate the electrical isolation capability of the TUT as required in EPRI TR-107330 (Reference 9.3). Section 4.6.4 of EPRI TR-107330 requires that Class 1E to Non-1E Isolation Testing be performed to demonstrate conformance to the instrumentation and control requirements for Class 1E to Non-1E connections given in IEEE 384-1981 (Reference 9.4). IEEE-384-1981 requires that Class 1E to Non-1E isolators protect the Class 1E hardware when a fault condition occurs in the Non-1E equipment. MPR Procedure No. 9600164-509 (Reference 9.2) reiterates this test objective.

The qualification of the TRICON v10 PLC is based on a system design which connects Non-1E input/output circuits to modules installed in one or more separate chassis which are interfaced to the Class 1E portion of the PLC by fiber optic cables (through Model 4200 and 4201 Remote RXM modules). This design provides electrical isolation of the Non-1E input/output circuits because the fiber optic cables are incapable of transmitting electrical faults. Based on this system design, only the communication modules, which can not be installed in fiber optically interfaced expansion chassis, are required to provide Class 1E to Non-1E electrical isolation capability (if these module are used to interface to Non-1E communication equipment). The TUT was configured with TCM communication modules in Chassis 1 and 2. Each of these communication modules includes a MODBUS serial communication interface to simulated Non-1E equipment. The Chassis 2 TCM Module MODBUS serial communication interface was tested to demonstrate Class 1E to Non-1E electrical isolation capability. In addition, the TRICON v10 Model 3636T relay output module was tested for electrical isolation capability. This allows interface to Non-1E circuits (such as alarms or annunciators) without having to install a separate, fiber-optically isolated chassis. A Model 3636T relay output module was installed in Chassis 3, Slot 5 of the TUT.

4.0 DESCRIPTION OF TEST SPECIMEN

The equipment tested consists of four TRICON v10 PLC chassis populated with selected main processor, input, output, communication, chassis interface and chassis power supply modules. The tested equipment also includes external termination panels (ETPs) provided for connection of field wiring to the TRICON v10 input and output modules, and interfacing cable assemblies for connection of the ETPs to the TRICON v10 chassis and for interconnection of the TRICON v10 chassis.

Triconex Drawing No. 9600164-100 (Reference 9.6), shows the basic configuration of the TUT components for Class 1E to Non-1E Isolation Testing. Triconex Drawing No. 9600164-103, "TRICON v10 Nuclear Qualification Project System Block Diagram," (Reference 9.9), shows the general arrangement and interconnection of the TUT chassis. Triconex Document No. 9600164-541, "TRICON v10 Nuclear Qualification Project, System Description," (Reference 9.10), provides an overview and description of the TUT and test system. A detailed identification of the tested equipment is provided in Triconex Document No. 9600164-540 (Reference 9.11).

During testing, the TUT was executing a Test Specimen Application Program (the TSAP) developed specifically for the qualification project and designed to support the test procedures, which demonstrate the functionality of the TUT during all phases of qualification testing. Requirements for operation of the TSAP are defined in Triconex Document No. 9600164-517, "Test Specimen Application Program (TSAP) Software Requirements Specification (SRS)," (Reference 9.12). The completed MPR Procedure No. 9600164-509 (Reference 9.8) identifies the TSAP revision used during this testing as "V10_TSAP_REV_0". Triconex Document No. 9600164-540 (Reference 9.11) identifies the revision level of all TUT firmware.

5.0 TEST SETUP AND INSTRUMENTATION

The following sections describe the setup of the TUT during Class 1E to Non-1E Isolation Testing, the instrumentation used to generate and measure the applied Class 1E to Non-1E Isolation test conditions, and the instrumentation used to measure TUT performance during and after testing. The TUT setup is documented in the completed MPR Procedure No. 9600164-509 (Reference 9.8). Specifications for test instrumentation supplied by NTS Laboratories are included in NTS Test Procedure No.TP62987-07N-EMI, "Test Procedure for EMI/RFI Testing of the TRICON v10 Nuclear Qualification Project TRICON-Under-Test," (Reference 9.13).

5.1 TRICON-Under-Test Mounting

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The grounding configuration described above meets the requirements of Section 6.3.6 of EPRI TR-107330 (Reference 9.3). Section 6.3.6 of EPRI TR-107330 requires that the test specimen be mounted on a non-metallic vertical surface at a height of six feet to the bottom of the test specimen chassis.

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5.2 TRICON-Under-Test Chassis and Module Configuration

Section 4.0 above describes the general arrangement of the TUT which was maintained throughout all of the qualification testing. Chassis configurations for Class 1E to Non-1E Isolation Testing are documented in Triconex Document No. 9600164-540 (Reference 9.11).

5.3 TRICON-Under-Test Power Supply and Wiring Configuration

EPRI TR-107330 does not include specific requirements for configuration of equipment power supplies or wiring during Class 1E to Non-1E Isolation Testing.

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5.4 NTS Instrumentation

NTS provided the test instrumentation for generating, applying, and monitoring the Class 1E to Non-1E Isolation Test signals. NTS also provided instrumentation for measuring temperature

and relative humidity inside the anechoic test chamber during Class 1E to Non-1E Isolation Testing. These instruments are identified in NTS Test Report No. TR62987-07N-EMI (Reference 9.22).

5.5 Triconex and MPR Instrumentation

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5.6 Instrument Calibration

All tests were performed using calibrated test instruments. Calibration certifications are held by NTS, MPR and Triconex. NTS Test Report No. TR62987-07N-EMI (Reference 9.22) documents the calibration status of the test instrumentation used by NTS. The completed MPR Procedure No. 9600164-509 (Reference 9.8) documents the calibration status of the test instrumentation used by MPR. The completed Triconex Procedure No. 9600164-502 (Reference 9.24) documents the calibration status of the test instrumentation used by Triconex.

6.0 TEST PROCEDURES

Class 1E to Non-1E Isolation Testing of the TUT was performed to the requirements of EPRI TR-107330 (Reference 9.3), which invokes IEEE Standard 384-1981 (Reference 9.4). The testing was performed on the communication module ports and relay output module identified in Section 3.0 of this test report. The following sections describe the approach to satisfying the requirements of the referenced documents during Class 1E to Non-1E Isolation Testing of the TUT. The test procedure used by NTS to perform Class 1E to Non-1E Isolation Testing of the TUT is NTS Test Procedure No. TP62987-07N-EMI (Reference 9.13). The test procedure used by MPR to perform Class 1E to Non-1E Isolation Testing of the TUT is MPR Procedure No. 9600164-509 (Reference 9.2).

6.1 Test Sequence

Figure 2 of Triconex Document No. 9600164-500 (Reference 9.1) shows the sequence of qualification testing performed on the TUT. In accordance with the test sequence shown in Figure 2, Class 1E to Non-1E Isolation Testing was performed after Radiation Exposure, Environmental, Seismic, EMI/RFI, Electrical Fast Transient, Surge Withstand and Electrostatic Discharge Testing.

6.2 Test Method

Section 4.6.4 of EPRI TR-107330 (Reference 9.3) specifies that Class 1E to Non-1E Isolation Testing of the PLC under qualification demonstrate that the isolation features conform to the instrumentation and control requirements for Class 1E to Non-1E connections given in IEEE 384-1981 (Reference 9.4). Section 7.2.2.1 of IEEE 384-1981 requires that (a) the isolation device prevents shorts, grounds and open circuits on the Non-1E side from degrading unacceptably the operation of the circuits on the 1E side, and (b) the isolation device prevents application of the maximum credible voltage on the Non-1E side from degrading unacceptably the operation of the circuits on the 1E side.

Communication port fault testing performed as part of Triconex Procedure No. 9600164-504, "Prudency Test Procedure," (Reference 9.25) addresses the item (a) isolation requirements for the TRICON v10 communication modules. This testing subjects the TUT communication ports to simulated faults of the receive line (the transmit line of the connected device) including open circuits, short circuits to ground, short circuits to the transmit line, and superimposed "white" noise. During this testing, the TUT response time is monitored and shown not to degrade. The results of communication port fault testing performed during Prudency Testing are summarized separately in Triconex Report No. 9600164-530, Performance Proof Test Report (Reference 9.26).

The completed MPR Procedure No. 9600164-509 (Reference 9.8) addresses the item (b) isolation requirements for the communication modules and both the item (a) and item (b) isolation requirements for the relay output module. Per Section 7.2.2.1 of IEEE 384-1981 (Reference 9.4), the maximum credible voltage is applied across the Non-1E side terminals (line-to-line) and across the Non-1E side terminals (lines) and ground.

As described in Section 3.0 of this test report, the Model 4201 Remote RXM fiber optic module is considered an acceptable Class 1E to Non-1E isolation device by design, and was not tested by MPR Procedure No. 9600164-509 (Reference 9.2). The fiber optic cables are incapable of transmitting electrical faults from the remote RXM module to the primary RXM module (which would be installed in the safety related TRICON v10 chassis), and therefore meet the item (a) and item (b) isolation requirements given above.

6.3 Test Levels

Section 4.6.4 of EPRI TR-107330 (Reference 9.3) requires that the PLC modules under qualification provide electrical isolation capability of at least 600 VAC and 250 VDC applied for 30 seconds. Per Section 7.2.2.1 of IEEE Standard 384-1981 (Reference 9.4), the highest voltage to which an isolation device Non-1E side is exposed shall determine the minimum voltage level that the device shall withstand across the Non-1E side terminals, and between the Non-1E terminals and ground.

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6.4 TRICON-Under-Test Operation

EPRI TR-107330 (Reference 9.3) does not include specific requirements for operation of the test PLC during Class 1E to Non-1E Isolation Testing. During Class 1E to Non-1E Isolation Testing,

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6.5 TRICON-Under-Test Performance Monitoring

Appendix 8 of Triconex Document No. 9600164-500 (Reference 9.1) and Section 6.6 of this test report list the Class 1E to Non-1E Isolation Test acceptance criteria. Appendix 8 states that monitoring of normal TUT operation during Class 1E to Non-1E Isolation Testing will demonstrate satisfaction of the acceptance criteria. To clarify the definition of normal operation, the following additional acceptance criteria from Section 4.3.7 of EPRI TR-107330 (Reference 9.3) were applied during Class 1E to Non-1E Isolation Testing:

i.) The main processors shall continue to function.
ii.) The transfer of I/O data shall not be interrupted.
iii.) The applied Class 1E to Non-1E Isolation electrical disturbances shall not cause the discrete I/O to change state.
iv.) Analog I/O levels shall not vary more than 3% (of full scale).

During Class 1E to Non-1E Isolation Testing, NTS Laboratories was responsible for generating and exposing the test system to the required levels of simulated electrical faults given in Section 6.3 of this test report. During Class 1E to Non-1E Isolation Testing, MPR and Triconex

were responsible for monitoring operation of the test system and determining the susceptibility of the TUT to the applied levels of simulated electrical faults. a

The status of the TUT Chassis 1 diagnostic indicating LED's was also reviewed and recorded to demonstrate continued correct operation or to detect system faults. The data recorded during Class 1E to Non-1E Isolation Testing is sufficient to demonstrate the TRICON v10 PLC performance criteria listed above.

6.6 Test Acceptance Criteria

The following Class 1E to Non-1E Isolation Test acceptance criteria are as given in Appendix 8 of Triconex Document No. 9600164-500 (Reference 9.1), and Section 4.3.7 of EPRI TR-107330 (Reference 9.3).

(a) The TUT shall operate as intended during and after application of the Class 1E to Non-1E Isolation Test simulated fault conditions. Evaluation of normal operating performance data (inputs, outputs and diagnostic indicators) shall demonstrate operation as intended, including the following specific operational performance from Section 4.3.7 of EPRI TR-107330 (Reference 9.3):

i.) The main processors shall continue to function.
ii.) The transfer of I/O data shall not be interrupted.
iii.) The applied Class 1E to Non-1E Isolation Test simulated fault conditions shall not cause the discrete I/O to change state.
iv.) Analog I/O levels shall not vary more than 3% (of full scale).

(b) Applying the Class 1E to Non-1E Isolation Test simulated fault conditions to the specified TUT interfaces will not damage any other module or device in the TUT, or cause disruption of the operation of the backplane signals or any other data acquisition signals.

(c) Per Section 6.3.6 of EPRI TR-107330 (Reference 9.3), failures of one or more redundant devices are acceptable so long as the failures do not result in the inability of the TUT to operate as intended.

7.0 TEST RESULTS

This section summarizes the results of Class 1E to Non-1E Isolation Testing of the TUT. This section also discusses performance or data anomalies which were observed or recorded during the testing.

7.1 Class 1E to Non-1E Isolation Test Setup and Checkout Testing

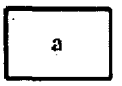
Triconex Procedure No. 9600164-502, "System Setup and Checkout Procedure," (Reference 9.27) directs setup of the TUT for the different qualification tests to be performed, and verifies proper operation of the TUT and test system prior to start of testing. Class 1E to Non-1E Isolation Testing of the TUT was performed following EMI/RFI Testing. The configuration of the test system for Class 1E to Non-1E Isolation Testing remained the same as that for EMI/RFI Testing. Therefore, the System Setup and Checkout Procedure was not required to be performed prior to start of Class 1E to Non-1E Isolation Testing.

7.2 Class 1E to Non-1E Isolation Testing

Class 1E to Non-1E Isolation Testing of the TUT was performed in accordance with MPR Procedure No. 9600164-509 (Reference 9.2) and NTS Test Procedure TP62987-07N-EMI (Reference 9.13). All testing was performed with the TUT energized and operating under control of the executing TSAP software.

The following output module was tested for capability to act as a Class 1E to Non-1E electrical isolation device:

- 120 VAC/VDC Relay Output Module (Model 3636T)



The following communication module ports were tested for capability to act as Class 1E to Non-1E electrical isolation devices:

- Model 4352A Tricon Communication Module (TCM) MODBUS serial communication ports

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7.3 TRICON-Under-Test Performance Monitoring

Data sheets included in the completed MPR Procedure 9600164-509 (Reference 9.8) provide a detailed listing of the TUT input, output and peripheral communication points that were monitored during Class 1E to Non-1E Isolation Testing, and document the results of analysis of the monitored operational data. Attachment 1 of this test report includes a set of figures showing the normal operation of the data points which were monitored.

The data analysis shows that the TUT continued to operate in accordance with the test acceptance criteria given in Section 6.6 of this test report during and after application of the Class 1E to Non-1E Isolation Test simulated electrical fault conditions. Specifically:

a) Application of the Class 1E to Non-1E Isolation Test simulated electrical fault conditions to the Model 3636T Relay Output Module did not result in damage to any other modules installed in the TUT, including the main processor modules, the RXM modules, other input/output modules and the communication modules.

b) Application of the Class 1E to Non-1E Isolation Test simulated electrical fault conditions to the Model 3636T Relay Output Module did not result in disruption of the operation of the TUT, including the ability to correctly acquire input signals and generate output signals.

c) Application of the Class 1E to Non-1E Isolation Test simulated electrical fault conditions to the Model 4352A TCM Module MODBUS serial communication ports did not result in damage to any other modules installed in the TUT, including the main processor modules, the RXM modules, the input/output modules and other communication modules.

d) Application of the Class 1E to Non-1E Isolation Test simulated electrical fault conditions to the Model 4352A TCM Module MODBUS serial communication ports did not result in disruption of the operation of the TUT, including the ability to correctly receive input signals to other communication module ports, and to transmit output signals to other communication module ports.

e) Evaluation of TUT normal operating performance data (inputs, outputs and diagnostic indicators) during and after each Class 1E to Non-1E Isolation Test demonstrated operation as intended, including the following specific operational performance from Section 4.3.7 of EPRI TR-107330 (Reference 9.3):

i.) The main processors continued to function.
ii.) The transfer of I/O data was not interrupted.
iii.) The applied Class 1E to Non-1E Isolation Test simulated fault conditions did not cause the discrete I/O to change state.
iv.) Analog I/O levels did not vary more than 3% (of full scale).

7.4 Communication Port Fault Testing

Communication port fault testing was performed as part of Triconex Procedure No. 9600164-504 (Reference 9.25) at several points throughout the qualification test program. The testing involved subjecting the TUT communication ports to simulated faults of the receive line (the transmit line of the connected device) including open circuits, short circuits to ground, short circuits to the transmit line, and superimposed "white" noise. During testing, the TUT response time was monitored for degradation. The results of communication port fault testing performed during Prudency Testing are summarized separately in Triconex Report No. 9600164-530 (Reference 9.26). Triconex reports that in all cases the test results show that the applied faults had no adverse effects on the TUT response time.

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7.6 Test Anomalies

There were no TUT material condition, operational or performance anomalies observed during Class 1E to Non-1E Isolation Testing. The TUT experienced the following non-safety related component failures as a result of the applied simulated electrical fault conditions. The referenced Test Nos. are from MPR Procedure No. 9600164-509 (Reference 9.2).

- Test No. 1.1: ETP No. 3-5T, Relay Output Point No. 9, Blown Fuse
- Test No. 1.3: ETP No. 3-5T, Relay Output Point No. 11, Blown Fuse
- Test No. 2.1: TCM Communication Module 2-2R, Serial Port 2 Damaged
- Test No. 2.2: TCM Communication Module 2-2R, Serial Port 3 Damaged

The above non-safety related component failures were expected to occur as a result of the applied test conditions. The non-safety related component failures did not affect the operation of the safety-related TUT components.

8.0 CONCLUSIONS

1. Class 1E to Non-1E Isolation Testing of the TUT was performed in accordance with the applicable requirements of EPRI TR-107330 (Reference 9.3) as clarified in Section 5.1 of this test report, and IEEE Standard 384-1981 (Reference 9.4).

2. The TUT met the Test Acceptance Criteria given in Section 6.6 of this test report. Specifically, during Class 1E to Non-1E Isolation Testing:

   (a) Evaluation of normal operating data showed that the TUT operated as intended during and after exposure to the Class 1E to Non-1E Isolation Test levels specified in Section 6.3 of this test report. Specifically, in accordance with Section 4.3.7 of EPRI TR-107330 (Reference 9.3):

   i.) The main processors continued to function.
   ii.) The transfer of I/O data was not interrupted.
   iii.) The applied Class 1E to Non-1E Isolation Test voltages did not cause the discrete I/O to change state.
   iv.) Analog I/O levels did not vary more than 3% (of full scale).

(b) Applying the Class 1E to Non-1E Isolation Test voltages to the specified TUT interfaces did not damage any other module or device in the TUT, or cause disruption of the operation of the backplane signals or any other data acquisition signals.

3. The Class 1E to Non-1E Isolation Test results (together with the Prudency Test communication port fault tests) demonstrate that the TRICON v10 PLC Model 4352A TCM Module MODBUS serial communication ports provide adequate electrical isolation per IEEE 384-1981 (Reference 9.4) between the safety related portions of the TRICON v10 and connected non-safety related communication circuits. The testing demonstrated electrical isolation capability of the TCM MODBUS serial communication ports to applied voltages of 250 VAC and 250 VDC (at 10 amps maximum) for 30 seconds.

4. The Class 1E to Non-1E Isolation Test results demonstrate that the TRICON v10 PLC relay output module Model 3636T provides adequate electrical isolation per IEEE 384-1981 (Reference 9.4) between the safety related portions of the TRICON v10 and connected non-safety related field circuits. The testing demonstrated electrical isolation capability of the relay output points to applied voltages of 600 VAC (at 25 amps maximum) and 250 VDC (at 10 amps maximum).

5. The specific TRICON v10 PLC hardware which was tested (chassis, power supplies, modules, external termination assemblies and interconnecting cabling) is identified in Triconex Document No. 9600164-540 (Reference 9.11).

6. The TRICON v10 Model 4201 Remote RXM fiber optic module is considered an acceptable Class 1E to Non-1E isolation device by design, and was not tested by MPR Procedure No. 9600164-509 (Reference 9.2). The fiber optic cables are incapable of transmitting electrical faults from the remote Non-1E RXM module to the primary RXM module (which would be installed in the safety related TRICON chassis), and therefore meet IEEE 384-1981 (Reference 9.4) electrical isolation requirements.

9.0 REFERENCES

Note: Triconex qualification project documentation and hardware is configuration controlled under the Triconex Quality Assurance Program. Triconex Document No. 9600164-540, "Master Configuration List," (Reference 9.11) provides a record of the currently applicable revision level of all Triconex documents, procedures and drawings throughout performance of the qualification program. As recorded in the completed MPR Procedure No. 9600164-509 (Reference 9.8), Triconex Document No. 9600164-540, Rev. 15 was in effect at the start of Class 1E to Non-1E Testing.

9.1 Triconex Document No. 9600164-500, "Master Test Plan," Rev. 45

9.2 MPR Procedure No. 9600164-509, "Class 1E to Non-1E Isolation Test Procedure," Rev. 0

9.3 EPRI TR-107330, "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants," Final Report dated December, 1996

9.4 IEEE Standard 384-1981, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits"

9.5 Triconex Document No. 9600164-002, "Nuclear Qualification Quality Plan," Rev. 3

9.6 Triconex Drawing No. 9600164-100, "TRICON v10 Nuclear Qualification Project TRICON Under Test - General Arrangement," Rev. 1

9.7 IEEE Standard 323-1974, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"

9.8 Completed MPR Procedure No. 9600164-509, "Class 1E to Non-1E Isolation Test Procedure," Rev. 0, MPR Review and Approval Dated July 18, 2007

9.9 Triconex Drawing No. 9600164-103, "TRICON v10 Nuclear Qualification Project System Block Diagram," Rev. 2

9.10 Triconex Document No. 9600164-541, "TRICON v10 Nuclear Qualification Project, System Description," Rev. 0

9.11 Triconex Document No. 9600164-540, "Master Configuration List," Rev. 1821

9.12 Triconex Document No. 9600164-517, "Test Specimen Application Program (TSAP) Software Requirements Specification (SRS)," Rev. 3

9.13 National Technical Systems Test Procedure No. TP62987-07N-EMI, "Test Procedure for Electromagnetic Compatibility Qualification of the TRICON v10 Nuclear Qualification Project TRICON-Under-Test," Rev. 0

9.14 Triconex Drawing No. 9600164-201, Sheets 1 and 2, "TRICON v10 Nuclear Qualification Project - Power Distribution Wiring Diagram," Rev. 1

9.15 Triconex Drawing No. 9600164-202, Sheet 1, "TRICON v10 Nuclear Qualification Project - Test Chassis #1 Power Distribution Wiring Diagram," Rev. 0

9.16 Triconex Drawing No. 9600164-203, Sheets 1 and 2, "TRICON v10 Nuclear Qualification Project - Test Chassis #2 Power Distribution Wiring Diagram," Rev. 0

9.17 Triconex Drawing No. 9600164-204, Sheets 1 and 2, "TRICON v10 Nuclear Qualification Project - Test Chassis #3 Power Distribution Wiring Diagram," Rev. 0

9.18 Triconex Drawing No. 9600164-205, Sheets 1 and 2, "TRICON v10 Nuclear Qualification Project - Test Chassis #4 Power Distribution Wiring Diagram," Rev. 2

9.19 Triconex Drawing No. 9600164-206, Sheet 1, "TRICON v10 Nuclear Qualification Project - Simulator Chassis #5 Power Distribution Wiring Diagram," Rev. 0

9.20 Triconex Drawing No. 9600164-207, Sheet 1, "TRICON v10 Nuclear Qualification Project - Simulator Chassis #6 Power Distribution Wiring Diagram," Rev. 0

9.21 Completed MPR Procedure No. 9600164-510, "EMI/RFI Test Procedure," Rev. 0, MPR Review and Approval Dated July 16, 2007

9.22 National Technical Systems Test Report No. TR62987-07N-EMI, "Test Report for Electromagnetic Compatibility Qualification of the TRICON v10 Nuclear Qualification Project TRICON-Under-Test," Rev. **1**

9.23 Triconex Document No. 9600164-700, "TRICON v10 Nuclear Qualification Project Wiring Schedule," Rev. 3

9.24 Completed Pre-EMI/RFI Testing Run No. 3.6 of Triconex Procedure No. 9600164-502, "System Setup and Checkout Procedure," Rev. 4

9.25 Triconex Procedure No. 9600164-504, "Prudency Test Procedure," Rev. 1

9.26 Triconex Report No. 9600164-530, "Performance Proof Test Report," Rev. 0

9.27 Triconex Procedure No. 9600164-502, "System Setup and Checkout Procedure," Rev. 4

10.0 ATTACHMENTS

Attachment 1: Example Plots of TUT Normal Operating Data

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ATTACHMENT 1

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