Letter No. NRC-V10-12-003

February 10, 2012

United States Nuclear Regulatory Commission
Mr. Jonathan Rowley, Project Manager
M/S 12D2
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

Subject: Nuclear Safety Related Qualification of the Tricon TMR Programmable Logic Controller (PLC) – Update to Qualification Summary Report Submittal and "Application for Withholding Proprietary Information from Public Disclosure" (TAC NO. ME2435)

References:

1. Letter, J. Polcyn (Invensys) to NRC, June 1, 2009, subject: NRC Safety Evaluation Report, "Review of Triconex Corporation Topical Reports 7286-545, Qualification Summary Report, and 7286-546, Amendment 1 to Qualification Summary Report, Revision 1", Letter No. NRC-V10-09-001.
2. Letter, NRC (J. R. Jolicoeur) to B. Haynes (Invensys), dated December 23, 2011, subject: "Draft Safety Evaluation for Invensys Operations Management 'Triconex Topical Report' (TAC NO. ME2435)"
3. Letter, B. Haynes (Invensys) to NRC, dated January 10, 2012, subject: "Nuclear Safety Related Qualification of the Tricon TMR Programmable Logic Controller (PLC) – Update to Qualification Summary Report Submittal and 'Application for Withholding Proprietary Information from Public Disclosure' (TAC NO. ME2435)," Letter No. NRC-V10-12-001.
4. Letter, B. Haynes (Invensys) to NRC, dated February 7, 2012, subject: "Nuclear Safety Related Qualification of the Tricon TMR Programmable Logic Controller (PLC) – Update to Qualification Summary Report Submittal and 'Application for Withholding Proprietary Information from Public Disclosure' (TAC NO. ME2435)," Letter No. NRC-V10-12-002.

Reference 2 provided the staff's formal draft of the Tricon V10 Safety Evaluation Report (SER) to Invensys Operations Management (Invensys) for review. In the transmittal letter the staff requested that, within 10 working days of the date of the letter, Invensys provide comments on proprietary aspects of the draft SER, and after an additional 20 working days to comment on any factual errors or clarity concerns. Reference 3 is the request from Invensys to withhold the draft SER from the public based on proprietary information contained in the draft SER. Reference 4 provided Invensys comments on the draft SER regarding clarity and factual errors, including revised documents containing the proposed changes. This letter provides the final set of Invensys technical documents to support the proposed changes to the V10 Tricon Topical Report and draft SER.

Attachment 1 to this letter contains the following:

1) System Accuracy Specification, 9600164-534, Revision 3. This document revision incorporates results of the engineering analysis of drift over time of the V10 Tricon reference accuracy;
2) Failure Modes & Effects Analysis, 9600164-531, Revision 1. This document revision incorporates results of the analysis of failures due to drift over time of the V10 Tricon reference accuracy; and
3) EMI/RFI Test Report, 9600164-527, Revision 3. This document revision addresses issues with certain portions of the V10 Tricon Qualification Project test suite.

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The two CDs enclosed contain some documents listed on Attachment 1 that were previously submitted to the NRC and for which revisions are now being provided. These revised files are being resubmitted to reflect additional information and clarifications. The new files in Enclosure 2 supersede in their entirety the documents previously submitted as shown in the table below:

Table 1. Superseded files.

New File:	*Replaces Old File:*	*Old File Transmittal Letter*
[098R1_SysAccSpec.pdf]	*[098_SysAccSpec.pdf]*	*NRC-V10-10-003*
[046R1_FMEARep_P.pdf	*[046_FMEARep_P.pdf]*	*NRC-V10-09-007*
[047R1_FMEARep_NP.pdf]	*[047_FMEARep_NP.pdf]*	*NRC-V10-09-007*
[028R3_EMIRep_P.pdf]	*[028R2_EMIRep_P.pdf]*	*NRC-V10-10-001*
[029R3_EMIRep_NP.pdf]	*[029R2_EMIRep_NP.pdf]*	*NRC-V10-10-001*

A comprehensive listing of documents submitted to the staff is provided in this submittal as Attachment 2 to ensure a common understanding of the current documents and versions under review by the staff.

Invensys is also providing this letter as our "Application for Withholding" pursuant to the provisions of 10 CFR Part 2.390, Paragraph (b)(1). This submittal contains commercial strategic information proprietary to Invensys and customarily held in confidence. As previously identified in this letter, the proprietary material for which this withholding is requested has been specifically identified. In accordance with 10 CFR Part 2.390, Affidavit No. TCXNRC-12-02 accompanies this transmittal and sets forth the basis for which the identified proprietary information may be withheld from public disclosure. Accordingly, it is respectfully requested that the specified information which is proprietary to Invensys be withheld from public disclosure in accordance with 10 CFR Part 2.390.

Invensys has given its best effort to address all of the staff's comments and questions pertinent to the V10 Tricon TMR PLC to ensure an expeditious safety evaluation. If we can assist in resolving any further questions, please do not hesitate to contact me.

Correspondence with regard to this transmittal should be directed to the following:

Mr. Brian Haynes
Project Manager
Invensys
26561 Rancho Parkway South
Lake Forest, California 92630

If there are any questions on this submittal or any of its enclosures, please contact me at (949) 638-8052.

Sincerely,

for

Brian Haynes
Project Manager
Invensys

cc: Mr. John Jolicoeur, Branch Chief – NRR
Mr. James Thorpe, Branch Chief – NRR
Mr. Clayton Scott – Invensys – Letter Only
Mr. Christopher Wiegand – Invensys – Letter Only
Mr. Richard Lilleston – Invensys – Letter Only

Attachment/Enclosures: as stated

ATTACHMENT 1
Enclosure Listing – CD 28 & 29 Content

Enclosure Description	*CD28**	*CD29*	*[filename] [size MB]*
Enclosure 1 - Affidavit #TCXNRC-12-02	X	X	*[164_Affidavit12_2.pdf] [1.2]*
Enclosure 2 – Support Document Revisions for draft SER Comments			
System Accuracy Specification, 9600164-534, Rev 3	X	X	*[098R1_SysAccSpec.pdf] [0.2]*
EMI/RFI Test Report, 9600164-527, Rev 3*	X	---	*[028R3_EMIRep_P.pdf] [1.2]*
EMI/RFI Test Report, 9600164-527, Rev 3**	X	X	*[029R3_EMIRep_NP.pdf] [0.7]*
Failure Modes & Effects Analysis, 9600164-531, Rev1*	X	---	*[046R1_FMEARep_P.pdf] [0.9]*
Failure Modes & Effects Analysis, 9600164-531, Rev1**	X	X	*[047R1_FMEARep_NP.pdf] [0.6]*

*) Document Contains Invensys Proprietary material
**) Non-Proprietary version of Proprietary document (redacted)

Notes:
(a) CD#28 contains Proprietary Documents (among all files). CD#29 contains only Non-Proprietary Documents (Publicly Available).
(b) Non-Proprietary versions of the EMI/RFI Test Report and Failure Modes & Effects Analysis are being provided.

ATTACHMENT 2

Document Submittals to the NRC

(02/10/12)(Current document file status - sorted by filename number)

(bold=most recent change)

Document Description	*Prop CD**	*Public CD*	*[filename] [size MB]*	*Trans Letter (s)*	*Date sent, final*
- Affidavit #TCXNRC-09-01	1c	2c	*[001E1_Affidavit.pdf] [0.3]*	(-001, -002) -003	[10/5/09]
			----(002 Deleted – see History)		
Differences between the Tricon V9.5.3 and the Tricon V10.2.1 System – NTX-SER-09-05, Rev 2*	12		*[003R2_DiffV9V10_P.pdf] [1.2]*	-10-004	[04/09/10]
EQ Summary Report 9600164-545, Rev 3*	8		*[004R2_EQSummaryRep_P.pdf] [1.4]*	-10-001	[01/05/10]
- Appendix A	3c	4c	*[005R1_EQSR_AppA.pdf] [0.9]*	(-004) -007	[11/17/09]
- Appendix B	3c	4c	*[006R1_EQSR_AppB.pdf] [0.4]*	(-004) -007	[11/17/09]
- Appendix C	3c	4c	*[007R1_EQSR_AppC.pdf] [0.4]*	(-004) -007	[11/17/09]
Software Qualification Report (SQR) – 9600164-535, Rev 1*	8		*[008R2_SQR_P.pdf] [1.7]*	-10-001	[01/05/10]
Critical Digital Review (CDR) – 9600164-539, Rev 1*	1c		*[009E3_CDR_P.pdf][1.8]*	(-001, -002) -003	[10/5/09]
SER Maintenance Process – NTX-SER-09-020, Rev 1	12	13	*[010R1_SERMaint.pdf] [0.2]*	-10-004	[04/09/10]
Nuclear System Integration Program Manual – NTX-SER-09-21, Rev 1*	16		*[011R1_NSIPM_P.pdf][0.9]*	-10-006	[07/11/10]
Compliance with NRC Interim Guidance ISG-2 and ISG-4 – NTX-SER-09-010, Rev 3**	26	27	*[012R3_ISG24Rev3_NP.pdf [1.2]*	-12-002	[02/07/12]
Invensys Conformance to Reg Guide 1.152 Rev 2 – NTX-SER-10-14,Rev 0	16	17	*[013R1_RG1152.pdf] [0.7]*	-10-006	[07/11/10]
			----(014 Deleted- see History)		
Differences between the Tricon V9.5.3 and the Tricon V10.2.1 System – NTX-SER-09-05, Rev 2 **	12	13	*[015R2_DiffV9V10_NP.pdf] [0.9]*	-10-004	[04/09/10]
EQ Summary Report 9600164-545, Rev 3**	8	9	*[016R2_EQSummaryRep_NP.pdf] [2.0]*	-10-001	[01/05/10]
			-----(017,018,019 Deleted)		
- Software Qualification Report (SQR) – 9600164-535, Rev 1**	8	9	*[020R2_SQR_NP.pdf] [3.3]*	-10-001	[01/05/10]
- Nuclear System Integration Program Manual – NTX-SER-09-21, Rev 1**	16	17	*[021R1_NSIPM_NP.pdf][0.7]*	-10-006	[07/11/10]
			----(022 Deleted by 013R1)	-10-006	[07/11/10]
Enclosure 1: - Affidavit #TCXNRC-09-02	3c	4c	*[023_Affidavit2.pdf] [3.0]*	(-004) -007	[11/17/09]
Environmental Test Report 9600164-525, Rev 0*	8		*[024R1_EnvTestRep_P.pdf] [1.6]*	-10-001	[01/05/10]
Environmental Test Report 9600164-525, Rev 0**	8	9	*[025R1_EnvTestRep_NP.pdf] [1.9]*	-10-001	[01/05/10]
Seismic Test Report 9600164-526, Rev 0*	8		*[026R1_SeisTestRep_P.pdf] [1.3]*	-10-001	[01/05/10]
Seismic Test Report 9600164-526, Rev 0**	8	9	*[027R1_SeisTestRep_NP.pdf] [0.7]*	-10-001	[01/05/10]
EMI/RFI Test Report 9600164-527, Rev 3*	**28**		***[028R3_EMIRep_P.pdf] [1.2]***	**-12-003**	**[02/10/12]**
EMI/RFI Test Report 9600164-527, Rev 3**	**28**	**29**	***[029R3_EMIRep_NP.pdf] [0.7]***	**-12-003**	**[02/10/12]**
Surge Withstand Test Report9600164-528, Rev 1*	8		*[030R1_SurgeRep_P.pdf] [1.5]*	-10-001	[01/05/10]
Surge Withstand Test Report9600164-528, Rev 1**	8	9	*[031R1_SurgeRep_NP.pdf] [2.5]*	-10-001	[01/05/10]
1E Isolation Test Report 9600164-529, Rev 1*	8		*[032R1_1EISORep_P.pdf] [145]*	-10-001	[01/05/10]
1E Isolation Test Report 9600164-529, Rev 1**	8	9c	*[033R1_1EISORep_NP.pdf] [2.5]*	-10-001	[01/05/10]

Document Description	*Prop CD**	*Public CD*	*[filename] [size MB]*	*Trans Letter (s)*	*Date sent, final*
EFT Test Report 9600164-521, Rev 1*	8		*[034R1_EFTRep_P.pdf] [1.5]*	-10-001	[01/05/10]
EFT Test Report 9600164-521, Rev 1**	8	9	*[035R1_EFTRep_NP.pdf] [2.5]*	-10-001	[01/05/10]
ESD Test Report 9600164-522, Rev 1*	8		*[036R1_ESDRep_P.pdf] [1.7]*	-10-001	[01/05/10]
ESD Test Report 9600164-522, Rev 1**	8	9	*[037R1_ESDRep_NP.pdf] [1.5]*	-10-001	[01/05/10]
Performance Proof Test – Operation 9600164-566, Rev 0*	8		*[038R1_PPOpsRep_P.pdf] [2.3]*	-10-001	[01/05/10]
Performance Proof Test – Operation 9600164-566, Rev 0**	8	9	*[039R1_PPOpsRep_NP.pdf] [7.9]*	-10-001	[01/05/10]
Performance Proof Test – Prudency 9600164-573, Rev 0*	8		*[040R1_PPPruRep_P.pdf] [2.2]*	-10-001	[01/05/10]
Performance Proof Test – Prudency 9600164-573, Rev 0**	8	9	*[041R1_PPPruRep_NP.pdf] [6.2]*	-10-001	[01/05/10]
Radiation Test Report 9600164-533, Rev 2*	8		*[042R1_RadRep_P.pdf] [1.1]*	-10-001	[01/05/10]
Radiation Test Report 9600164-533, Rev 2**	8	9	*[043R1_RadRep_NP.pdf] [1.3]*	-10-001	[01/05/10]
Reliability/Availability Report 9600164-532, Rev 0*	3c		*[044_ReliabilityRep_P.pdf] [6.4]*	(-004) -007	[11/17/09]
Reliability/Availability Report 9600164-532, Rev 0**	3c	4c	*[045_ReliabilityRep_NP.pdf] [19.3]*	(-004) -007	[11/17/09]
Failure Modes and Effects Analysis 9600164-531, Rev 1*	**28**		***[046R1_FMEARep_P.pdf] [0.9]***	**-12-003**	**[02/10/12]**
Failure Modes and Effects Analysis 9600164-531, Rev 1**	**28**	**29**	***[047R1_FMEARep_NP.pdf] [0.6]***	**-12-003**	**[02/10/12]**
Maximum Response Time Calculation 9600164-731, Rev 0*	3c		*[048_MaxRespTime_P.pdf] [1.1]*	(-004) -007	[11/17/09]
Master Test Plan 9600164-500, Rev 5*	8		*[049R1_MTP_P.pdf] [4.7]*	-10-001	[01/05/10]
Master Test Plan 9600164-500, Rev 5**	8	9	*[050R1_MTP_NP.pdf] [6.7]*	-10-001	[01/05/10]
Nuclear Qualification Quality Plan 9600164-002, Rev 3	3c	4c	*[051_NQQP.pdf] [1.6]*	(-004) -007	[11/17/09]
TUV Type Approval Report and Certificate (V10.2.1)	3c	4c	*[052_TUVCert_10_2_1.pdf] [1.0]*	(-004) -007	[11/17/09]
Planning & Installation Guide 9700077-012 (Feb 009)		5c	*[053_PandIGuide_NP.pdf] [5.0]*	(-005) -008	[11/18/09]
Users Manual for Field Term. 9700052-018 (Feb 2009)		5c	*[054_FTGuide_NP.pdf] [9.0]*	(-005) -008	[11/18/09]
TRICON Comm. Guide 9700088-008 (Feb 2009)		5c	*[055_ComGuide_NP.pdf] [2.2]*	(-005) -008	[11/18/09]
Developers Guide,TS1131 V4.1 9700100-003 (Aug 2006)		5c	*[056_DevGuide_NP.pdf] [4.7]*	(-005) -008	[11/18/09]
Triconex Training Manual 9750002-001 (Rev 1.2)		5c	*[057_TrainMan_NP.pdf] [6.7]*	(-005) -008	[11/18/09]
TRICON Product Guide, V10.2.1 9791007-013 (Aug 2006)		5c	*[058_TechProdGuide_NP.pdf] [3.4]*	(-005) -008	[11/18/09]
Enclosure 1: - Affidavit #TCXNRC-09-03	6	7	*[059_Affidavit3.pdf] [3.0]*	-006	[11/13/09]
Supplemental Test Plan 9600164-800 Rev 0*	6		*[060_SupTest_4_16_P.pdf] [0.8]*	-006	[11/13/09]
Supplemental Test Plan 9600164-800 Rev 0**	6	7	*[061_SupTest_4_16_NP.pdf] [0.7]*	-006	[11/13/09]
Master Configuration List 9600164-540 Rev 22*	8		*[062R1_MCL_P.pdf] [1.0]*	-10-001	[01/05/10]
Master Configuration List 9600164-540 Rev 22**	8	9	*[063R1_MCL_NP.pdf] [2.3]*	-10-001	[01/05/10]
Software Quality Assurance Plan 9600164-537 Rev 0	6	7	*[064_SQAP.pdf] [1.1]*	-006	[11/13/09]
System Description 9600164-541, Rev 0*	6		*[065_SysDesc_P.pdf] [2.2]*	-006	[11/13/09]
System Description 9600164-541, Rev 0**	6	7	*[066_SysDesc_NP.pdf] [3.1]*	-006	[11/13/09]
EFT Test Procedure 9600164-514, Rev 0*	8		*[067R1_EFTTestPro_P.pdf] [1.7]*	-10-001	[01/05/10]
ESD Test Procedure 9600164-512, Rev 1*	6		*[068_ESDTestPro_P.pdf] [1.7]*	-006	[11/13/09]
Radiation Exposure Test Procedure 9600164-511, Rev 0*	6		*[069_RadExpTestPro_P.pdf] [1.5]*	-006	[11/13/09]
Seven Day Elevated DC Voltage Report 9600164-557, Rev 0	6	7	*[070_7DayDCTestRep.pdf] [3.6]*	-006	[11/13/09]
TSAP Software V&V Plan 9600164-513, Rev2*	6		*[071_TSAP_SVVP_P.pdf] [2.3]*	-006	[11/13/09]
TSAP Software V&V Plan 9600164-513, Rev2**	6	7	*[072_TSAP_SVVP_NP.pdf] [1.5]*	-006	[11/13/09]
TSAP V&V Report 9600164-536, Rev 0	6	7	*[073_TSAP_V&VRep.pdf] [1.1]*	-006	[11/13/09]
Independent Tricon V10 Equipment Qualification Assessment	6	7	*[074_IndAssess.pdf] [0.2]*	-006	[11/13/09]

Document Description	*Prop CD**	*Public CD*	*[filename] [size MB]*	*Trans Letter (s)*	*Date sent, final*
Triconex QA Manual	6	7	*[075_QAM.pdf] [1.2]*	-006	[11/13/09]
Analog I/O Machine Count Calc 9600164-730, Rev 0*	6		*[076_AIO_Calc_P.pdf] [1.1]*	-006	[11/13/09]
ETP Interface Cable Similarity Analysis 9600164-538, Rev 0*	6		*[077_CableSimAnalysis_P.pdf] [1.0]*	-006	[11/13/09]
Change Impact Analysis 9600164-542, Rev 0*	6		*[078_ChangeImpactAnalysis_P.pdf] [1.9]*	-006	[11/13/09]
Enclosure 1: - Affidavit #TCXNRC-09-04	8	9	*[079_Affidavit4.pdf] [3.0]*	-10-001	[01/05/10]
MDM 12.1, Production Order Tag Report*	10		*[080_MDM_12_1_P.pdf] [0.5]*	-10-003	[04/06/10]
QPM 2.1, Quality Planning*	10		*[081_QPM_2_1_P.pdf] [0.5]*	-10-003	[04/06/10]
QPM 13.2, Product Discrepancies*	10		*[082_QPM_13_2_P.pdf] [0.5]*	-10-003	[04/06/10]
EDM 11.03, Process and Product Quality Assurance*	10		*[083_EDM_11_03_P.pdf] [0.5]*	-10-003	[04/06/10]
EDM 12.00, Product Development Process*	10		*[084_EDM_12_00_P.pdf] [0.7]*	-10-003	[04/06/10]
EDM 12.10, Project Planning*	10		*[085_EDM_12_10_P.pdf] [0.6]*	-10-003	[04/06/10]
EDM 12.50, Requirements Management*	10		*[086_EDM_12_50_P.pdf] [0.6]*	-10-003	[04/06/10]
EDM 20.00, Configuration Management*	10		*[087_EDM_20_00_P.pdf] [0.6]*	-10-003	[04/06/10]
EDM 21.30, Change Impact Analysis*	10		*[088_EDM_21_30_P.pdf] [0.6]*	-10-003	[04/06/10]
EDM 24.00, Software Configuration and Change Control*	10		*[089_EDM_24_00_P.pdf] [0.5]*	-10-003	[04/06/10]
EDM 74.00, Nuclear Qualification of Triconex Products*	10		*[090_EDM_74_00_P.pdf] [0.7]*	-10-003	[04/06/10]
EDM 76.00, Dedication of Products for Nuclear Service*	10		*[091_EDM_76_00_P.pdf] [0.6]*	-10-003	[04/06/10]
EDM 90.00, Product Verification*	10		*[092_EDM_90_00_P.pdf] [0.6]*	-10-003	[04/06/10]
EDM 90.10, Product Validation (New since V9 SER)*	10		*[093_EDM_90_10_P.pdf] [0.6]*	-10-003	[04/06/10]
EDM 90.30, Control of Tools and Test Software*	10		*[094_EDM_90_30_P.pdf] [0.6]*	-10-003	[04/06/10]
9100055-001, Nuclear Dedicated Parts List*	10		*[095_NDPL_P.pdf] [0.8]*	-10-003	[04/06/10]
9100055-103, DPE-03*	10		*[096_DPE03_P.pdf] [0.8]*	-10-003	[04/06/10]
9100055-105, DPE-05*	10		*[097_DPE05_P.pdf] [0.4]*	-10-003	[04/06/10]
9600164-534, System Accuracy Specifications, Rev 3	**28**	**29**	***[098R1_SysAccSpec.pdf] [0.2]***	**-12-003**	**[02/10/12]**
9100112-001, Safety Concepts*	10		*[099_SafetyConcepts_P.pdf] [1.9]*	-10-003	[04/06/10]
9100042-002, NGIO System Architecture Specification*	10		*[100_NGIOSysArch_P.pdf] [1.4]*	-10-003	[04/06/10]
6200152-002, TCM System Architecture Specification*	10		*[101_TCMSysArch_P.pdf] [1.0]*	-10-003	[04/06/10]
6200106-001, ETSX Software Architecture Specification*	10		*[102_ETSXSArch_P.pdf] [1.0]*	-10-003	[04/06/10]
9100113-001, Safety Requirements*	10		*[103_SafetyReqmts_P.pdf] [0.6]*	-10-003	[04/06/10]
7100222-001, Tricon Main Processor Hardware Design Spec*	10		*[104_MPHWDesSpec_P.pdf] [3.9]*	-10-003	[04/06/10]
9100042-001, NGIO System Requirements Specification*	10		*[105_NGIOSysReq_P.pdf] [0.7]*	-10-003	[04/06/10]
6200152-001, TCM System Requirements Specification*	10		*[106_TCMSysReq_P.pdf] [0.8]*	-10-003	[04/06/10]
6200156-001, NGIO Core Software Architecture and Des Spec*	10		*[107_NGIOCoreArch_P.pdf] [1.0]*	-10-003	[04/06/10]
6200152-004, TCOM Software Design Specification*	10		*[108_TCOMSWDes_P.pdf] [1.9]*	-10-003	[04/06/10]
9100046-001, NGIO EPP, Engineering Project Plan*	10		*[109_NGIOEPP_P.pdf] [0.7]*	-10-003	[04/06/10]
6200155-001, NGIO Core Software Reqmts Specification*	10		*[110_NGIOCoreSRS_P.pdf] [0.9]*	-10-003	[04/06/10]
6200152-003, TCOM Software Requirements Specification*	10		*[111_TCOMSRS_P.pdf] [0.7]*	-10-003	[04/06/10]
6200033-001, TriStation 1131 Software Requirements Spec*	10		*[112_TS1131SRS1_P.pdf] [1.0]*	-10-003	[04/06/10]
6200033-002, TriStation 1131 V4.1 Software Reqmts Spec*	10		*[113_TS1131SRS2_P.pdf] [0.4]*	-10-003	[04/06/10]
9100098-001, NGIO Core H/W Requirements Specification*	10		*[114_NGIOCoreHRS_P.pdf] [0.6]*	-10-003	[04/06/10]
9100098-002, NGIO Core H/W Design Specification*	10		*[115_NGIOCoreHDS_P.pdf] [0.9]*	-10-003	[04/06/10]

Document Description	*Prop CD**	*Public CD*	*[filename] [size MB]*	*Trans Letter (s)*	*Date sent. final*
6200159-001, NGIO Core Software Test Plan*	10		*[116_NGIOCoreSTP_P.pdf] [0.5]*	-10-003	[04/06/10]
6500155-000, TCM Software Test Plan*	10		*[117_TCMSTP_P.pdf] [0.5]*	-10-003	[04/06/10]
TCM A Traceability Report.doc*	10		*[118_TCMATrace_P.pdf] [0.9]*	-10-003	[04/06/10]
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TRICON V10 System Accuracy Specification

9600164-534
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Prepared by Frank Kloer
Kurt Otto

Document Change History			
Revision	**Date**	**Change**	**Author**
0	7/26/07	Initial Issue	Frank Kloer
1	01/26/10	Revision to correct typographical error in Date field of document header (Reference ARR 711).	Frank Kloer
2	07/18/11	Revised statement regarding drift in response to a customer inquiry. Corrected Reference 3.7. Ref E07683	Frank Kloer
3	02/12	Revised proof test interval to 30 months in Table 5-1 and Section 5.3 as supported by Reference 3.22. E07908	Frank Kloer

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1.0 PURPOSE

EPRI TR-107330, (Reference 3.1), requires that information be provided to support an application specific setpoint analysis per ISA RP 67.04, (Reference 3.2). Section 4.2.4 of the EPRI TR identifies the specific information to be provided.

The purpose of this report is to provide a single concise listing of the accuracy specifications of the Triconex TRICON control system. The specifications documented are those typically used by nuclear industry users for calculating instrument measurement uncertainties and establishing critical control setpoints.

2.0 SCOPE

This report documents the accuracy specifications for the Triconex TRICON PLC system included in the TRICON V10 Nuclear Qualification Project (i.e. the Tricon-Under-Test, or TUT). The specifications cover all components and modules that were subjected to performance and qualification testing. These specific components and modules are identified in the Master Configuration List (Reference 3.3).

3.0 REFERENCES

3.1 EPRI TR-107330, "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants," December 1996.
3.2 ISA RP 67.04.02-2000, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation."
3.3 Master Configuration List, Triconex Document 9600164-540.
3.4 Radiation Test Report, Triconex Document 9600164-533.
3.5 TRICON Planning & Installation Guide, Triconex Document 9700077-011
3.6 TRICON User's Manual for Field Terminations, Triconex Document 9700052-001, August 2006.
3.7 Performance Proof Test Report, Triconex Document 9600164-566.
3.8 Environmental Test Report, Triconex Document 9600164-525.
3.9 Seismic Test Report, Triconex Document 9600164-526
3.10 EMI / RFI Test Report, Triconex Document 9600164-527

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3.12 IEEE 381-1977 Standard Criteria for Type Tests of Class 1E Modules Used in Nuclear Power Generating Stations.
3.13 IEEE 344-1987 Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.
3.14 1600024-010 Data Sheet
3.15 1600024-020 Data Sheet
3.16 1600024-030 Data Sheet
3.17 1600024-040 Data Sheet
3.18 1600081-001 Data Sheet
3.19 1600082-001 Data Sheet
3.20 1600083-200 Data Sheet
3.21 1600083-600 Data Sheet
3.22 Tricon Analog I/O and Time Base Accuracy Including Drift Over Time for V10 Nuclear-Qualified Products, Triconex Document 9600460-001.

4.0 SETPOINT ANALYSIS REQUIREMENTS

EPRI TR-107330, Section 4.2.4 requires that the following effects on the accuracy of the equipment be addressed by this specification:

- Calibrated Accuracy, including hysteresis and non-linearity.
- Repeatability.
- Temperature Sensitivity.
- Drift Over Time.
- Power Supply Variation Effects.
- Arithmetic Operations Error (based on two additions plus a multiplication on an input value plus a comparison for both integer and floating point calculations).
- Vibration Effect.
- Radiation Effect.
- Relative Humidity Effect.

5.0 PERFORMANCE SPECIFICATIONS

The TRICON is a state-of-the-art fault tolerant programmable logic controller based on a Triple-Modular Redundant (TMR) architecture. The TMR uses three isolated, parallel control systems and extensive online diagnostics integrated into one system. The system uses voting to provide high integrity, error free, uninterrupted process operation with no single point of failure.

The Triple-Modular Redundant architecture of the TRICON along with its continuous diagnostics and self-calibration features eliminates many of the typical error sources found in standard instrumentation. Component / module failure, channel failures, or communication failures at the Input, Output, or Main Processor Module level will be

corrected / compensated for by the system's ability to detect transient/steady state errors, and to take appropriate corrective actions online through the system's hardware and software voting mechanisms.

Each channel on the analog output module has two independent current loopback circuits per point that is readable by all other channels. The information from these circuits is used as part of the hardware voting process. The first circuit verifies the accuracy and presence of the analog signal for each point, independent of the load presence or channel selection. The second circuit verifies the actual current flow for each point from the selected channel. If a current flow is detected from any point on a non-selected channel, that channel is immediately shutdown. The Load alarm status indicator is annunciated if the module cannot drive current from any point—for example, by an open load.

The key in the Tricon design is its triplication of all critical processes. By performing continuous cross comparisons between the triplicated process, a true and full verification of actual input and output values is maintained.

5.1 APPLICABLE UNCERTAINTY TERMS

Tables 5-1 and 5-2 document the Reference Accuracy specifications, from References 3.5 and 3.6, for each of the analog I/O modules included in the Triconex Tricon PLC qualification program. Table 5-3 documents the Reference Accuracy specifications, from References 3.14 through 3.21.

Table 5-1 I/O Module Accuracy Specifications

I/O Module Type	Model Number	Reference Accuracy/Drift (Notes 1 - 4)
0-10V Analog Input	3701	< 0.15% of FSR, 0° to 60° C, (Note 3 & 4)
0-5V or 0-10V Analog Input (16 inputs)	3703E	< 0.15% of FSR, 0° to 60° C, (Note 3 & 4)
4-20 mA Analog Output	3805E	< 0.25% (in range of 4-20 mA) of FSR(0-21.2mA), 0° to 60° C
Thermocouple Input J,K,T,E	3708E	See Table 5-2
Pulse Input	3511	@ 1,000 Hz to 20,000 Hz = ± 0.01% @ 100 Hz to 999 Hz = ± 0.1% @ 20 Hz to 99 Hz = ± 1.0%
0-5V Analog Input or-5 to +5V Differential	3721	< 0.15% of FSR 0° to 60° C (Note 3 & 4)

Notes:

1. Reference Accuracy includes all the components of accuracy (repeatability, hysteresis non-linearity, and dead band). The manufacturer guarantees that the performance of the module meets specifications. This performance has been verified by testing performed on all modules during production. Typically, field application of the modules with respect to calibration accuracy's is more stringent than the specified accuracy. Therefore, Reference Accuracy values are considered to be a 95% or better probability value with a 95% or better confidence level.

2. The TRICON analog I/O modules have an auto-calibration feature which maintains the module accuracy rating. Over time the accuracy of the reference used to perform the auto-calibration can experience accuracy drift. To insure that specified accuracy is maintained over time Invensys recommends that the analog I/O modules should be periodically proof tested, at least every **30** months of continuous operation. System timing can also drift over time however; based on the detailed analysis of parameters that might impact system timing (Reference 3.22) it is concluded that the drift over time is negligible and therefore no proof test is needed on the time base of the main process. Accuracy analysis of the Tricon Nuclear products is included in (Reference 3.22).

3. On current loop inputs, a 0.01% precision resistor is used on the input termination to convert the current signal to a voltage reading (250 ohm for 0 -5 VDC or 500 ohm for 0-10 VDC). This is not included in the accuracy of the module.

4. FSR = Full Scale Range.

Table 5-2
Reference Accuracy of Model #3708E Thermocouple Input Module

TC Type	Temperature Range	Reference Accuracy (Notes 1 and 2) @0-60°C (32-140°F)	
		T_a=25°C (77°F)	T_a=0-60°C (32-140°F)
		Typical	Maximum
J	-150 to 0°C (-238 to 32°F) 0 to 760°C (>32 to 1400°F)	±1.7°C (±3.0°F)	±5.0°C (±9.0°F) ±3.1°C (±5.5°F)
K	-150 to 0°C (-238 to 32°F) 0 to 1251.1°C (>32 to 2284°F)	±2.3°C (±4.0°F)	±4.5°C (±8.0°F) ±3.9°C (±7.0°F)
T	-161 to 0°C (-250 to 32°F) 0 to 400°C (>32 to 752°F)	±1.7°C (±3.0°F)	±4.8°C (±8.5°F) ±2.5°C (±4.5°F)
E	-200 to 0°C (-328 to 32°F) 0 to 999°C (>32 to 1830°F)	±1.7°C (±3.0°F)	±4.5°C (±8.0°F) ±2.8°C (±5.0°F)

1. Reference Accuracy includes all the components of accuracy (repeatability, hysteresis, non-linearity, and dead band). The manufacturer guarantees that the performance of the module meets specifications. This performance has been verified by testing performed on all modules during production. Typically, field application of the modules with respect to calibration accuracy's is more stringent than the specified accuracy. Therefore, Reference Accuracy values are considered to be a 95% or better probability value with a 95% or better confidence level.

2. Accuracy specifications account for errors related to reference-junction compensation but do not account for errors caused by temperature gradients between the temperature transducers and thermocouple terminations. The user is responsible for maintaining a uniform temperature across the thermocouple termination module.

Table 5-3
Reference Accuracy of Analog Devices Signal Conditioners

Signal Conditioner Type	Model Number	Reference Accuracy (Note 1)
AD7B34CUSTOM, RTD Signal Converter, 200 ohm Pt., 0 – 600°C	1600083-600	+/- 0.11% span
AD7B34CUSTOM, RTD Signal Converter, 200 ohm Pt., 0 - 200°C	1600083-200	+/- 0.2% span
AD7B340401, RTD Signal Converter, 100 ohm Pt., 0 - 600°C	1600024-040	+/- 0.1% span
AD7B340301, RTD Signal Converter, 100 ohm Pt., 0 - 200°C	1600024-030	+/- 0.15% span
AD7B340201, RTD Signal Converter, 100 ohm Pt., 0 - 100°C	1600024-020	+/- 0.2% span
AD7B340101, RTD Signal Converter, 100 ohm Pt., -100 to +100°C	1600024-010	+/- 0.15% span
AD7B140201, SIGNAL CONDITIONER 7B14 NON-ISOLATED LINEARIZED RTD INPUT 10 OHM Cu., +0 to +120°C	1600081-001	+/- 1.0% span
AD7B300201, RTD Signal Converter, 0 – 100 mV	1600082-001	+/- 0.1% span

1. Reference Accuracy includes all the components of accuracy (repeatability, hysteresis, and non-linearity) (See References 3.14 thru 3.21).

5.2 NON-APPLICABLE UNCERTAINTY TERMS

As a result of the TRICON design and based on References 3.5, 3.6, 3.7, 3.8 and 3.9, the following uncertainty terms are considered **Not Applicable** to the TRICON and its modules, thereby establishing their error contribution as zero.

Temperature Sensitivity (i.e. Temperature Effect)

The TRICON has no known temperature induced inaccuracies over its rated temperature range. Per Reference 3.8, the TUT was subjected to environmental testing to meet the requirements of EPRI TR-107330 (Reference 3.1) and IEEE Standard 381-1977 (Reference 3.12). This testing sequence demonstrated that the TUT met all applicable performance requirements during and after application of the environmental profiles.

Power Supply Variation Effects (i.e. Power Supply Effect)

The TRICON has internal voltage regulation that eliminates the effects of voltage supply variations within the manufacturer's recommended ratings.

Arithmetic Operation Errors

All arithmetic operations are performed at a bit level that maintains resultant values well within the reference accuracy values. This determination is based on two additions plus a multiplication on an input value, plus a comparison for both integer and floating point calculations.

Vibration Effect (i.e. Seismic/Vibration Effect)

The TRICON has no known seismic or vibratory induced inaccuracies. Per Reference 3.9, the TUT was subjected to seismic testing to meet the requirements of EPRI TR-107330 (Reference 3.1) and IEEE Standard 344-1987 (Reference 3.13). This testing sequence demonstrated that the TUT met all applicable performance requirements during and after application of the seismic test vibration levels.

Radiation Effect

The TRICON has no known radiation induced error components that would prevent the TRICON from performing its function. Per Reference 3.4 the TUT was subjected to a radiation exposure of 1,000 Rads, plus margin.

Relative Humidity Effect (i.e. Humidity Effect)

The TRICON has no known humidity induced inaccuracies. Per Reference 3.8, the TUT was subjected to environmental testing to meet the requirements of EPRI TR-107330 (Reference 3.1) and IEEE Standard 381-1977. This testing sequence demonstrated that the Tricon Test Specimen met all applicable performance requirements during and after application of the environmental profiles. The TRICON's auto-calibration and diagnostic features ensure components maintain their Reference Accuracy rating.

5.3 ADDITIONAL CONSIDERATIONS

A/D and D/A Effects

The effects of analog to digital and digital to analog conversions are included in the reference accuracy values.

Digital Output Modules

Discrete output modules have no affect on the accuracy of programmed discrete outputs.

EMI/RFI Sensitivity

Per Reference 3.10, EMI/RFI effects should not be treated as a systematic, predictable source of instrument error that can be mathematically modeled in instrument uncertainty equations. EMI/RFI effects should be treated as an environmental condition under which the reliable operation of the instrumentation should be demonstrated. The TUT has been subjected to EMI / RFI testing per Reference 3.10.

Drift and Timer Accuracy

The TRICON analog I/O modules have an auto-calibration feature which maintains the module accuracy rating. Over time the accuracy of the reference used to perform the auto-calibration can experience accuracy drift. To insure that specified accuracy is maintained over time Invensys recommends that the analog I/O modules should be periodically proof tested, at least every **30** months of continuous operation. System timing can also drift over time, however based on the detailed analysis of parameters that might impact system timing (Reference 3.22) it is concluded that the drift over time is negligible and therefore no proof test is needed on the time base of the main process. The TUT has been subjected to output accuracy and timer accuracy testing per Reference (3.7).

6.0 SUMMARY / CONCLUSIONS

This report has defined the accuracy specifications for the Triconex TRICON PLC system included in the TRICON V10 Nuclear Qualification Project (i.e. the TUT). The specifications cover all components and modules that were subjected to performance and qualification testing. These specific components and modules are identified in the Master Configuration List (Reference 3.3). The information provided herein satisfies the requirements stated in Section 4.2.4 of TR-107330 (Reference 3.1).

The configuration of the system will be unique for each user depending on the plant specific application of the Triconex TRICON PLC system. The applicability of specified terms and approach to determining overall "system" uncertainty with respect to the data contained herein is the responsibility of the end user. Applicability of uncertainty terms

and the methodology for determination of uncertainty shall be in accordance with the plant specific setpoint and uncertainty programs or other administrative guidelines.