**Invensys Operations Management Document "993754-1-916,
V10 Tricon Reference Design Change Analysis, Revision 0"**

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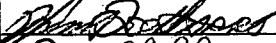# NUCLEAR SAFETY-RELATED PROCESS PROTECTION SYSTEM REPLACEMENT DIABLO CANYON POWER PLANT

V10 TRICON REFERENCE DESIGN CHANGE ANALYSIS

Document No. 993754-1-916

Revision 0

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0	03/19/12	Initial issue.	G. McDonald

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1. Introduction

1.1   Purpose

The purpose of this document is to address the impact of recent changes in the version of the Tricon platform used for the Diablo Canyon Power Plant (DCPP) Process Protection System (PPS) Replacement. Documents being submitted for NRC licensing review have been prepared based on Tricon version 10.5.1 (V10.5.1), which was initially expected to be the licensing basis version. The most current version qualified (and being sold) by Invensys Triconex is V10.5.3, which is now intended to be installed and licensed for the PPS Replacement instead of V10.5.1. The differences between V10.5.1 and V10.5.3 are discussed below.

1.2   Background

The Triconex Topical Report 7286-545-1, revision 4 [Ref. 1.3.1], and other Tricon platform documents prepared for the PPS Replacement describe use of the Tricon V10.5.1 platform. This is also the version for which the NRC is providing the baseline Tricon V10 SER for generic nuclear industry approval.

As with any complex digital product, the Tricon platform continues to undergo periodic changes as part of maintenance of the product line, evolutionary product enhancements, and resolution of platform software issues as they are identified. As of the date of this document, the Tricon V10.5.3 is the most current nuclear qualified product, subsequent to two maintenance releases (V10.5.2 and V10.5.3). This document identifies and characterizes the platform changes that have occurred since V10.5.1 and evaluates the significance of the changes as they relate to other documents under review for the PPS Replacement System.

1.3   References

1.3.1   Triconex Topical Report, 7286-545-1
1.3.2   Product Discrepancy Report (PDR) IRTX#21105
1.3.3   Technical Advisory Bulletin (TAB) 183
1.3.4   Engineering Project Plan (EPP) V10.5.2, 9100346-001
1.3.5   Tricon V10.5.2 V&V Test Report
1.3.6   Software Release Definition (SRD) V10.5.2, 6200003-226
1.3.7   Nuclear Qualified Equipment List (NQEL), 9100150-001
1.3.8   PDR IRTX#22481
1.3.9   Product Alert Notice (PAN) 25
1.3.10   Engineering Project Plan (EPP) Tricon PAN 25 Fix, 9100428-001
1.3.11   Tricon PAN25 Master Test Report
1.3.12   Software Release Definition (SRD) V10.5.3, 6200003-230
1.3.13   Product Alert Notice (PAN) 22
1.3.14   Product Alert Notice (PAN) 24
1.3.15   Technical Advisory Notice (TAB) 147

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1.3.16 Engineering Project Plan (EPP) TriStation V4.9 & Safety View Apps, 9100359-001

1.3.17 TriStation 1131 V4.9.0 Master Test Report

1.3.18 Software Release Definition (SRD) TriStation 1131 V4.9.0, 6200097-038

1.4 Abbreviations and Acronyms

AI	Analog Input
AO	Analog Output
DCPP	Diablo Canyon Nuclear Plant
DI	Digital Input
DO	Digital Output
EPP	Engineering Project Plan
I/O	Input / Output
MOL	Maintenance of Line
MP	3008N Main Processor
NGAI	Next-Generation I/O module – Analog Input
NGDO	Next-Generation I/O module – Digital Output
NRC	U.S. Nuclear Regulatory Commission
NQEL	Nuclear Qualified Equipment List
PAN	Product Alert Notice
PDR	Product Discrepancy Report
PPS	Plant Protection System
SER	Safety Evaluation Report
SRD	Software Release Definition
TAB	Technical Advisory Bulletin
TR	Topical Report

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2. System Level Differences Between V10.5.1 and V10.5.3

No changes were made to the architecture of the Tricon system. As defined in Invensys Engineering Procedures, a change to the third digit in the Version number (e.g., V10.5.1 to V10.5.2) indicates a minor maintenance release that does not impact the architecture or Main Processor operating software.

2.1 Hardware Changes

Tricon system hardware is unchanged between V10.5.1 and V10.5.3. No new hardware was added in either maintenance release V10.5.2 or V10.5.3.

2.2 Software Changes

No new software modules were added to the Tricon system in maintenance release V10.5.2 or V10.5.3. However, three existing software modules in Tricon V10.5.1 have revised versions in V10.5.3:

1) AI firmware used in the NGAI Analog Input Module (3721N)
2) DO firmware used in the NGDO Digital Output Module (3625N)
3) TriStation 1131 Programming Software (TS 1131)

All other software remains unchanged from V10.5.1.

For the PPS Replacement, the 3721 NGAI Analog Input Module is utilized for processing safety-related analog inputs, and TS1131 is the engineering tool for developing the safety-related application program.

2.3 Triconex Processes

Tricon V10.5.3 was developed under the same 10CFR50 Appendix B Quality Program and development processes as V10.5.1. Basic processes previously reviewed by the NRC for V10.5.1 remain unchanged.

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3. Specific Software Changes – V10.5.1 to V10.5.3

Differences in the Tricon V10.5.3 software are discussed in more detail below. Table 1 shows the progression of software changes for the two maintenance upgrades that have been made to the Tricon system, i.e., V10.5.2 and V10.5.3.

Table 1. V10.5.1 to V10.5.3 Software Module Revisions

TYPE	IDENTIFICATION	VERSION (for V10.5.1)	VERSION (for V10.5.2)	VERSION (for V10.5.3)	USED IN
Main Processor	ETSX	6271	6271	6271	3008N
	IOCCOM	6054	6054	6054	3008N
Communication Module	TCOM	6276	6276	6276	4352AN, 4325BN
I/O Modules	AI/NITC	5661	5661	5661	3701N2
	EIAI/ITC	5916	5916	5916	3703EN (AI), 3708EN (TC)
	AI	6256	**6285**	6285	**3721N**
	DO	6255	**6284**	**6293**	**3625N**
	PI	5647	5647	5647	3511N
	EDI	5909	5909	5909	3501TN2, 3502EN2, 3503EN2
	EAO	5897	5897	5897	3805HN
	EDO	5781	5781	5781	3601TN, 3607EN
	ERO	5777	5777	5777	3636TN
	TSDO/HVDO	6273	6273	6273	3603TN
	TSDO2	5940	5940	5940	3623TN
	RXM	3310	3310	3310	4200N, 4201N
Application Program Development Software	**TriStation 1131,** Developer's Workbench Suite	4.7.0, or **4.9.0**	4.7.0, or **4.9.0**	4.7.0, or **4.9.0**	**TriStation Workstation**

Bold indicates changes from V10.5.1 version

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3.1   I/O module operating firmware

The Tricon operating software (firmware) in V10.5.3 was revised in two I/O modules, as follows:

NGAI Analog Input Module (3721N)

- AI firmware version 6256 was replaced by AI version 6285 as part of the V10.5.2 maintenance release.

NGDO Digital Output Module (3652N)

- DO firmware version 6255 was replaced by DO version 6284 as part of the V10.5.2 maintenance release.
- The V10.5.3 maintenance release subsequently revised this module firmware, replacing version 6284 with DO version 6293.

No other operating software was changed from V10.5.1 to 10.5.3.

3.1.1   Maintenance Release V10.5.2

Purpose: The V10.5.2 upgrade was initiated as a Maintenance-of-Line (MOL) project to resolve an internal diagnostic anomaly on selected I/O modules. The condition, noted in the field, caused random indication of a fault condition in the module that did not affect the safety function of the modules, but was a source of nuisance alarms. The condition was documented in Product Discrepancy Report (PDR) IRTX#21105 [Ref. 1.3.2] and Technical Advisory Bulletin (TAB) 183 [Ref. 1.3.3].

Engineering Project Plan (EPP) 9100346-001 [Ref. 1.3.4] was prepared to correct the problem and revise software for the 3625N (digital output module) and the 3721N (analog input module). Software modules AI 6285 and DO 6284 were developed and released in accordance with approved Triconex development process procedures. Validation of V10.5.2 software changes is documented in the Tricon V10.5.2 V&V Test Report [Ref. 1.3.5].

The V10.5.2 software was released in January 2011 with Software Release Definition (SRD) 6200003-226 [Ref. 1.3.6]. Tricon version 10.5.2 was subsequently added to the Nuclear Qualified Equipment List (NQEL) 9100150-001 [Ref. 1.3.7] for safety related nuclear applications.

3.1.2   Maintenance Release V10.5.3

Purpose: The V10.5.3 upgrade was initiated as a result of a potential safety issue that was discovered in Tricon digital output modules. A condition of spurious output transitions in the 3625 series digital output modules was reported under certain circumstances. The nuclear qualified module 3625N was one of the affected modules. The condition was documented in PDR IRTX#22481 [Ref. 1.3.8]. As required by the Triconex Quality Assurance program,

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Product Alert Notice (PAN) 25 [Ref. 1.3.9] was issued to alert customers to the condition and propose appropriate actions pending a final fix. A revision to the digital output module firmware was required to eliminate the cause of the potential spurious transitions.

Engineering Project Plan (EPP) 9100428-001 [Ref. 1.3.10] was prepared to correct the problem and release revised software for the 3625 series digital output module, including the 3625N. Software module DO 6293 was developed and released in accordance with approved Triconex development process procedures. Validation of V10.5.3 software changes is documented in the Tricon PAN25 Master Test Report [Ref. 1.3.11].

The V10.5.3 software was issued in September 2011 with Software Release Definition (SRD) 6200003-230 [Ref. 1.3.12]. Tricon version 10.5.3 was subsequently added to the Nuclear Qualified Equipment List (NQEL) 9100150-001 for safety related nuclear applications.

3.2   TriStation 1131 Application Programming Software

Tricon version V10.5.3 includes an updated version of the TriStation 1131 programming software. The Tricon V10.5.1 system was originally released with TriStation 1131, version 4.7.0. This programming software suite has since been upgraded to correct performance issues and has been made available as TriStation 1131 V4.9.0 for use in all V10 Tricon systems.

The TriStation version 4.9.0 upgrade was initiated as a Maintenance of Line (MOL) project to resolve accumulated PDRs and to add minor functional improvements to the TriStation and Safety Suite Applications product. The project included several high priority safety-significant PDRs for conditions noted in Product Alert Notices (PANs) 22 and 24 [Ref. 1.3.13 and 1.3.14], and Technical Advisory Bulletin (TAB) 147 [Ref. 1.3.15].

TriStation 1131 V4.9.0 did not add any new features, but provided enhancements to existing features. The V4.9.0 Engineering Project Plan, document 9100359-001 [Ref. 1.3.16], contains a complete list of deliverables for the project with regard to the software corrections (PDR resolutions) and enhancements. Software module revisions were developed and issued in accordance with approved Triconex development process procedures. Validation of TriStation 1131 V4.9.0 software changes is documented in the TriStation 1131 V4.9.0 Master Test Report [Ref. 1.3.17].

The revised TriStation 1131 software suite (V4.9.0) was released in September 2011 with Software Release Definition (SRD) 6200097-038 [Ref. 1.3.18]. TriStation V4.9.0 was subsequently added to the Nuclear Qualified Equipment List (NQEL) 9100150-001 for safety related nuclear applications.

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4. Impact of Differences on the Tricon Platform

Tricon Operating Firmware Changes to modules 3625N and 3721N

None. Revision of the DO and AI module firmware resolved bug fixes and necessary operational enhancements. While changes under V10.5.2 were relatively minor, the V10.5.3 changes had potential safety significance that required correcting. All existing functionality of the previous firmware was maintained. No major changes in structure or functionality were introduced. Revisions to the operating firmware for the V10.5.3 system provide improved reliability and performance and have no adverse impact on the Tricon platform.

TriStation 1131 Programming Software

None. Revision of the TriStation programming software resolved numerous software bug fixes and made operational enhancements. Most software performance issues were minor, but several were potentially safety significant. All existing functionality of the previous TriStation version was maintained. Adding the latest revision of TriStation software to the Tricon V10.5.3 system provides improved performance and has no adverse impact on the Tricon platform.

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5. Conclusion

Based on the nature of the maintenance changes to the software modules, Tricon V10.5.3 is considered equivalent to Tricon V10.5.1 and is fully represented by all previous documentation submitted for Tricon V10.5.1.