System Level Requirements Traceabilty Matrix (RTM)

Document No. 15-0681-RTM-001
Revision 0

Nuclear Safety-Related

Prepared for:

Pacific Gas & Electric Co.
Diablo Canyon Power Plant Units 1 & 2
Process Protection System Replacement

March, 2016

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Process Protection System Replacement

Client: Pacific Gas & Electric Co. Facility: Diablo Canyon Power Plant Units 1 & 2

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☒ Design review as documented on the following sheet or 15-0681-VR-002, Rev. 0

☐ Alternate calculation as documented in attachment or

☐ Qualification testing as documented in attachment or

Independent Reviewer:

APPROVAL FOR RELEASE:

LEAD ENGINEER: Date: 04-12-2016

Rev. No.	Revision Description
0	Initial Release Requirements from FRS (Reference 7), IRS (Reference 8), and TFS (Reference 9 are integrated in this document to provide a single Requirements Traceability Matrix (RTM). This RTM covers the Implementation Phase 1 of the PPS Replacement Project. Additional Phases will generate a revision to the document.

Diablo Canyon Power Plant
Process Protection System Replacement
Requirements Traceability Matrix

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Diablo Canyon Power Plant
Process Protection System Replacement
Requirements Traceability Matrix

1. INTRODUCTION

The existing Process Protection System (PPS) Eagle 21 equipment will be replaced with a microprocessor-based Invensys (Tricon) subsystem and an independent and diverse field programmable gate array (FPGA) based Westinghouse Advanced Logic System (ALS) subsystem.

2. SCOPE

The purpose of this document is to visually tabulate how the FRS, IRS and TFS link to the SRS (Tricon), SDD (Tricon) and SDS (Westinghouse), and where those requirements are validated. The Process Protection System (PPS) Functional Requirements Specification (FRS - Reference (1), Interface Requirements Specification (IRS - Reference 2), and Transfer Function Design Input Specification (TFS - Reference 3) are the source documents for this Requirements Traceability Matrix (RTM), as traced in the Invensys Project Traceability Matrix (PTM - Reference 7) and the Westinghouse Requirements Traceability Matrix (Reference 8).

This RTM does not validate the Invensys PTM and Westinghouse RTM against the source documents.

3. RTM TABLE STRUCTURE

Attachments 1 – 3 list requirements from the source documents, and show the corresponding FRS, IRS and TFS section number. The applicable sections of the Triconex Software Requirements Specification (SRS - Reference 4), and Software Design Description (SDD - Reference 5 and 6), and the Westinghouse (ALS) Software Design Specification (SDS - Reference 9) are listed in their respective columns.

One or more of the following inspection methods is placed in the verification column:

DCP *Design Change Package* – These requirements are PG&E's responsibility to fulfill and will be verified as part of the PG&E Design Change Process per CF3.ID9.

PI *Physical Inspection* – These requirements are not testable but can be verified by physical inspection, code inspection, reference to vendor documents, drawings, or by demonstrations conducted for or by the Verification and Validation (V&V) staff.

T *Testable* – These requirements are testable functions that can be demonstrated during the software validation process.

S *Support* – These requirements are not demonstrated explicitly but are demonstrated by a verifiable or testable requirement. The verifiable or testable requirement should be identified by item number.

O *Other* – These requirements are not testable in these activities but included as information only.

The actual test reference for the "SAT Ref" column of the matrix will be populated when the draft SAT is written and verified/updated on completion of the SAT.

4. ABBREVIATIONS AND ACRONYMS

Abbreviation & Acronyms	Definition
A/D	Analog to Digital
AFW	Auxiliary Feedwater (Control System)
ALS	Advanced Logic System
AMSAC	ATWS Mitigation System Actuation Circuitry
ANS	American Nuclear Society
ANSI	American National Standards Institute
ATWS	Anticipated Transient Without Scram
ASU	ALS Service Unit
CDER	Customer Deviation/Exception Request
D/A	Digital to Analog
DCM	Design Criteria Memorandum
DCP	Design Change Package
DCPP	Diablo Canyon Power Plant
DFWCS	Digital Feedwater Control System
DTTA	Delta-T / Tavg
ERFDS	Emergency Response Facility Data System
ESFAS	Engineered Safety Features Actuation System
FRS	Functional Requirements Specification
GDC	General Design Criteria
HSI	Human System Interface
I&C	Instrumentation and Controls
LCO	Limiting Condition for Operation
LTOPS	Low Temperature Overpressure Protection System
MAS	Main Annunciator System
MCR	Main Control Room
MWS	Maintenance Work Station
NIS	Nuclear Instrument System
NRC (USNRC)	(United States) Nuclear Regulatory Commission

Abbreviation & Acronyms	Definition
OOS	Out-of-Service
OPDT	Overpower Delta-T
OTDT	Overtemperature Delta-T
PL	Power Level
PG&E (PGE)	Pacific Gas & Electric Company
PORV	Power Operated Relief Valve
PT	Preset Time
PPC	Plant Process Computer
PL	Power Level
PPS	Process Protection System
PZR	Pressurizer
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RTD	Resistance Temperature Detector
RTS	Reactor Trip System
RVLIS	Reactor Vessel Level Indication System
S/G	Steam Generator
SQA2	Sensor Quality Algorithm 2-Input
SQA3	Sensor Quality Algorithm 3-Input
SSPS	Solid State Protection System
STP	Surveillance Test Procedure
TD	Time Delay
TTD	Trip Time Delay

5. REFERENCES

1. 08-0015-SP-00, Pacific Gas & Electric Co. Diablo Canyon Power Plant Units 1 & 2, “Process Protection System (PPS) Replacement Functional Requirements Specification”(FRS), PG&E document number 663195-44, Rev. 9
2. Pacific Gas & Electric Co. Diablo Canyon Power Plant Units 1 & 2, “Process Protection System (PPS) Replacement Interface Requirements Specification” (IRS), Rev. 9,
3. SAP Specification No. 110000000552, Pacific Gas & Electric Co. Diablo Canyon Power Plant Units 1 & 2, “PPS Controller Transfer Function Design Input Specification”(TFS) Westinghouse document number 6116-00017, Rev. 4
4. 993754-11-809, Invensys Software Requirements Specification (SRS), Rev 4
5. 993754-11-810, Invensys Software Design Description (SDD), (Protection SET I), Rev. 7
6. 993754-12-810, Invensys Software Design Description, (Protection SET II, III and IV), Rev. 3
7. 993754-1-804, Invensys Project Traceability Matrix, Rev.12
8. 6116-00059, Westinghouse Requirements Traceability Matrix, Rev. 7
9. 6116-00011, Westinghouse ALS System Design Specification, Rev. 9

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
Section 1 Introduction									
Section 2 General System Description									
Section 2.1 System Context									
Section 2.2 System Modes and States									
1.	2.2.1 Operating Modes	There are no special operating modes associated with the PPS. It is an instrumentation system that continuously monitors the plant parameters identified in Section 1.5 and provides status indication to the main control room and partial trip inputs to the SSPS whenever protection channel setpoints are exceeded.	N/A	N/A	N/A	N/A	N/A	N/A	For information Only
2.2.2 Manual Trip Switches									
2.	2.2.2.1	Manual trip switches independent of the PPS instrumentation shall be provided for each PPS comparator reactor trip and safeguards actuation output to the SSPS in accordance with Section3.2.1.3.4.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Manual Trip Switches are provided by PG&E
3.	2.2.2.2	The manual trip switches shall be configured to match the TRIP/ACTUATE action (de-energize or energize to TRIP/ACTUATE) of the associated PPS comparator output.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Manual Trip Switches are provided by PG&E

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4.	2.2.2.3	The manual trip switches shall be functional at all times including when the channel is in a bypass condition.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Manual Trip Switches are provided by PG&E
2.2.3 Manual Bypass Switches									
5.	2.2.3.1	Manual bypass switches independent of the PPS instrumentation shall be provided for each Containment High-High Pressure (Containment Spray) comparator output to facilitate on-line maintenance and testing.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Manual Trip Switches are provided by PG&E
6.	2.2.3.2	Manual bypass switches independent of the PPS instrumentation shall be provided for each Turbine Impulse Pressure High (P-13) comparator output to facilitate on-line maintenance and testing.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Manual Trip Switches are provided by PG&E
7.	2.2.3.3	The manual bypass switches shall be configured to maintain the normal non-tripped status (energized or de-energized) of the associated PPS comparator output.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Manual Trip Switches are provided by PG & E
2.3 Major System Capabilities									
2.3.1 Signal Validation									
8.	2.3.1.1	Signal validation is required for the DTTA channels as described in Sections 3.2.5.1.5 and 3.2.5.1.6. Signal validation other than range checking per Section 2.3.1.2 is not required for any other PPS channel.	3.3.2.4	3.7.1.9.4.7, 3.7.1.9.4.9, 3.7.1.9.4.10	N/A	N/A	T (Triconex)	N/A	

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			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
9.	2.3.1.2	Input signal range checking is required for all PPS channel input signals. Alarming of Out-of-Range High or Out-of-Range Low input signals is required. Unless otherwise specified, Out-of-Range (OOR) setpoints shall be as follows:	3.3.2.4	SET I & II 3.10.1.9.1, 3.10.2.9.1, 3.10.3.9.1, 3.10.4.9.1, 3.11.1.9.1, 3.12.1.9.1, 3.4.1.9.1, 3.4.2.9.1, 3.4.3.9.1, 3.4.4.9.1, 3.7.1.9.1, 3.7.1.9.7, 3.8.1.9.1, 3.8.2.9.1, 3.9.1.9.1, 3.9.2.9.1, 3.9.3.9.1, 3.9.4.9.1 SET III 3.11.1.9.1, 3.6.1.9.1, 3.6.2.9.1, 3.7.1.9.1, 3.7.1.9.7, 3.8.1.9.1, 3.8.2.9.1, 3.8.3.9.1, 3.8.4.9.1, 3.9.2.9.1, 3.9.3.9.1 SET IV 3.5.1.9.1, 3.6.3.9.1, 3.6.4.9.1, 3.7.1.9.1, 3.7.1.9.7, 3.8.1.9.1, 3.8.2.9.1, 3.8.3.9.1, 3.8.4.9.1, 3.9.1.9.1, 3.9.4.9.1	N/A	N/A	T (Triconex)	N/A	
10.	2.3.1.2.1	OOR Low: -5% span, reset: -2.5% span	3.3.2.4		SDS-0111, 0111.1, 0111.2, 0280, 0280.1, 0280.2	N/A	T (Triconex) T (Westinghouse)	T	Westinghouse exception: The ALS-321 boards have a built-in OOR flag at -6.875% (2.9 mA) with a reset at -5.625% (3.1 mA) that WEC chose to use rather than program logic to this requirement. Exception documented in CDER FRS R9.
11.	2.3.1.2.2	OOR High: 105% span, reset: 102.5% span	3.3.2.4		SDS-0112, 0112.1, 0112.2, 0281, 0281.1, 0281.2	N/A	T (Triconex) T (Westinghouse)	T	Westinghouse exception: The ALS-321 boards have a built-in OOR flag at 106.875% (21.1 mA) with a reset at 105.625% (20.9 mA) that WEC chose to use rather than program logic to this requirement. Exception documented in CDER FRS R9.
12.	2.3.1.2.3	Input OOR alarms per Section 2.3.1.2 shall be suppressed (or cleared) when the affected input is placed in an out of service condition.	3.3.2.1.1	SET I & II 3.10.1.9.7, 3.10.2.9.7, 3.10.3.9.7, 3.10.4.9.7, 3.11.1.9.7, 3.12.1.9.7, 3.3.1.9, 3.4.1.9.7, 3.4.2.9.7, 3.4.3.9.7, 3.4.4.9.7, 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, SET I 3.9.1.9.7, 3.9.2.9.7, 3.9.3.9.7, SET II 3.9.1.9.6, 3.9.2.9.6, 3.9.3.9.6, SET III	SDS-0319.1, 0320.1, 0321.1, 0094.2, 0095.2, 0096.2	N/A	T (Triconex) T (Westinghouse)	T	

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				3.11.1.9.7, 3.3.1.9, 3.6.1.9.7, 3.6.2.9.7, 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.8.3.9.7, 3.8.4.9.7, 3.9.2.9.6, 3.9.3.9.6 SET IV 3.3.1.9, 3.5.1.9.7, 3.6.3.9.7, 3.6.4.9.7, 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.8.3.9.7, 3.8.4.9.7, 3.9.1.9.6, 3.9.4.9.6					
2.3.2 System Level Diagnostics									
13.	2.3.2.1	The PPS processing instrumentation shall be provided with sufficient diagnostic capability to isolate system faults to the card/module level.	3.3.1.1	3.13.1.9.6.2, 3.2.1.9.2	SDS-0706-0714	N/A	T (Triconex) T (Westinghouse)	T	
14.	2.3.2.2	MCR alarms and annunciators (PPS Failure and Trouble) are actuated by signals from the PPS when PPS diagnostics detect conditions that are indicative of degraded performance or failure of some system component. Conditions requiring alarming are identified in Section 3.2.1.5.	3.3.1.2.2	3.13.1.9.6.1, 3.13.1.9.6.2	SDS-0706-0714	N/A	T (Triconex) T (Westinghouse)	T	
2.3.3 Testability at Power									
15.	2.3.3.1	The capability for testing while at power shall be provided for all PPS channels as required by 10CFR50, Appendix A, GDC 21. Refer to Section 3.2.1.15 for guidance.	2.2.2(3)	2.3.3	N/A	N/A	N/A	T	
2.4 Major System Conditions									

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2.5 Major System Constraints									
2.6 User Characteristics									
16.	2.6.1	Operations The primary user of the PPS is Operations. Operations will require access to Human System Interface (HSI) displays with the exception of displays dedicated to system maintenance activities.							Title Information
17.	2.6.2	I&C Maintenance I&C Maintenance will require access to all displays and functions associated with the PPS HSI and processing instrumentation for purposes of performing Technical Specification [Reference 1.4.3.1] mandated surveillance testing and for maintaining the system. Maintenance display access will require security access measures for any maintenance function that has the capability of changing system configuration.							Title information
18.	2.6.3	Engineering Engineering will require access to all displays and functions associated with the PPS HSI and processing instrumentation to facilitate configuration control of the system.							Title information
2.7 Assumptions and Dependencies									
2.8 Operational Scenarios									
Section 3 System Capabilities, Conditions, Constraints									

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3.1 Physical									
19.	3.1.1 Construction	The PPS instrumentation will be installed within 16 equipment racks (per unit) located in the Cable Spreading Rooms at elevation 128 of the Auxiliary Building.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	PPS Instrumentation will be installed
20.	3.1.1.1	The PPS equipment racks are divided into four separate Protection Sets which are physically separated and electrically isolated from each other.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	PPS Instrumentation will be installed
21.	3.1.1.1.1 Protection Set I	a) Protection Set I shall consist of five (5) racks.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Rack 1 – Safety ALS Components Rack 2 – Not used Rack 3 – Class II Equipment Rack 4 – Safety Tricon Chassis Rack 5 – Not used
		b) One rack shall be dedicated to Class II PPS equipment.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
22.	3.1.1.1.2 Protection Set II	a) Protection Set I shall consist of five (5) racks.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Rack 6 – Safety ALS Components Rack 7 – not used Rack 8 – Class II equipment Rack 9 – Safety Tricon Chassis Rack 10 – Not used
		b) One rack shall be dedicated to Class II PPS equipment.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
23.	3.1.1.1.3 Protection Set III	a) Protection Set III shall consist of three (3) racks.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Rack 11 – Class II Equipment Rack 12 – Safety ALS Components Rack 13 – Safety Tricon Chassis
		b) One rack shall be dedicated to Class II PPS equipment.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	

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			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
24.	3.1.1.1.4 Protection Set IV	a) Protection Set IV shall consist of three (3) racks.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Rack 14 – Class II Equipment Rack 15 – Safety ALS Components Rack 16 – Safety Tricon Chassis
		b) One rack shall be dedicated to Class II PPS equipment.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
25.	3.1.1.2	PPS instrumentation shall be accessible via full length front and rear cabinet doors.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Information Only
26.	3.1.1.3	Required physical separation shall be maintained between Class 1E and non-Class 1E circuits as required by DCM T-19	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Physical separation will be provided
27.	3.1.1.4	Each PPS Protection Set will be powered from a separate 120 VAC vital bus via a Class 1E uninterruptible power supply.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Using the existing Vital Bus power distribution scheme
28.	3.1.1.5	Each PPS Protection Set will be provided with a 120 VAC control grade (non-vital) utility power source.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Using the existing Lighting Panel power distribution scheme
29.	3.1.1.6	Each PPS Protection Set will be provided with redundant loop power supplies capable of powering all 4-20 mA instrument loops associated with that Protection Set.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Redundant Loop PS will be provided
30.	3.1.1.6.2	The initial full load design current for each loop power supply should not exceed 75% of rated power supply capacity to provide margin for future expansion.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Loop power supply load will be evaluated
31.	3.1.1.6.3	Failure of a loop power supply shall be alarmed	3.3.1.2.3	3.13.1.9.1, 3.13.1.9.6.1.7	SDS-0305, 0305.1, 0318, 0332	N/A	T (Triconex) T (Westinghouse)	T	Vendors tested for alarms generated by their individual applications. Power Supplies were not shared between the two platforms except for the loop power supplied to the PZR Pressure Transmitters. Since the loop power is provided from the Rack associated with the Tricon platform, only the

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			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
									Invensys application monitors that power supply failure directly
32.	3.1.1.7	Non-vital 125 VDC from the Main Annunciator will be provided for interrogation of alarm output contacts.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	MAS AP (Alarm Power) is rated at 125 VDC
33.	3.1.1.7.1	Output contacts provided for interrogation by the MAS shall be rated at 125 Vdc, 50 mA (minimum).	N/A	N/A	SDS-0409	PG&E Scope	DCP	N/A	Vendor HW to meet requirements
34.	3.1.1.8	The HSI equipment is Instrument Class II and shall be isolated from the PPS processing instrumentation as required by General Design Criteria (GDC) 24 Refer to DCM T-24 for guidance.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
35.	3.1.1.9	PPS processing instrumentation will be qualified and installed to satisfy Seismic Category I requirements applicable to DCPP. Refer to Section 3.1.5 for guidance.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
36.	3.1.1.10	The PPS HSI equipment will be seismically supported to prevent damage to or loss of operability of the safety related PPS instrumentation should a seismic event occur. Refer to Section 3.1.5 for guidance.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
37.	3.1.2 Durability	The PPS equipment shall be capable of continuous operation in the environment specified in Section 3.1.4.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Vendor EQ to meet requirements, all PG&E provided equipment to be qualified as required
38.	3.1.3 Adaptability	The PPS is a mature system and it is not anticipated that many changes to processing instrumentation or inputs and outputs will be required over the life of the system. However, it is desirable that the system have the capability for additional inputs/outputs within the existing environs so that any required changes to system function can be readily accommodated.						N/A	Information Only
39.	3.1.3.1	There shall be adequate rack space available to accommodate at least 10% additional inputs of each type used within the system for future use	N/A	N/A	N/A	PG&E Scope	DCP	N/A	PG&E selected the design parameters of the vendor hardware

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40.	3.1.3.2	There shall be adequate rack space available to accommodate at least 10% additional outputs of each type used within the system for future use	N/A	N/A	N/A	PG&E Scope	DCP	N/A	PG&E selected the design parameters of the vendor hardware
3.1.4 Environmental Conditions									
41.	3.1.4	The Cable Spreading Rooms at DCPP are considered to be a mild environment						N/A	Information Only
42.	3.1.4.1.1, 3.1.4.1.2, 3.1.4.1.3, 3.1.4.1.4)	The PPS instrumentation shall be qualified for the following conditions which define this environment:	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	Vendor EQ to meet requirements, provided equipment to be qualified as required.
		1. Temperature: 40 to 104°F	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	
		2. Relative Humidity: 0 to 95% (non-condensing)	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	
		3. Pressure: Atmospheric	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	
		4. Radiation: N/A (mild environment)	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	
3.1.5 Seismic Requirements									

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
43.	3.1.5.1 Seismic Response Spectra	The seismic inertial loads acting on the PPS are defined in DCM C-17, DCM C-25, and DCM C-30. The seismically induced inter- and intra- structural displacements are defined in DCM C-28.	N/A	N/A	N/A	N/A	N/A	N/A	Information Only
44.	3.1.5.2 Seismic Qualification	Design Class I PPS equipment and components shall meet the design bases for seismic qualification in accordance with DCM T-10 (Seismic Qualification of Equipment). Non-Class 1E (Class II) PPS equipment is not subject to the seismic requirements of Section 3.1.5. The Class II equipment shall be mounted and supported in such a fashion that it cannot become a missile during a seismic event and possibly damage or disable a safety-related structure, system, or component.	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	Vendor EQ to meet requirements, provided equipment to be qualified as required. Non-Class 1E equipment will be mounted and supported in such a fashion that it cannot become a missile during a seismic event
3.1.6 Electromagnetic Compatibility									
45.	3.1.6.1	Susceptibility: The PPS shall be qualified by test, analysis, or a combination thereof, to function without fault or error in an electromagnetic environment in accordance with the guidance of Regulatory Guide 1.180	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	Vendor EQ to meet requirements, provided equipment to be qualified as required
46.	3.1.6.2	Emissions: the PPS equipment shall be qualified by test, analysis or a combination thereof, to not create an electromagnetic environment that will adversely affect the operation of safety-related Class 1E equipment operating in the same location (cable spreading room). The qualification shall follow the guidance of Regulatory Guide 1.180, as above.	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	Vendor EQ to meet requirements, provided equipment to be qualified as required
47.	3.1.6.3	Grounding: the PPS equipment shall support the grounding methods described in IEEE Std. 1050 and endorsed by Regulatory Guide 1.180 to limit adverse effects of susceptibility and emissions (both radiated and conducted)	N/A	N/A	N/A	N/A	Other – Qualification Reports	N/A	Vendor EQ to meet requirements, provided equipment to be qualified as required
3.2 System Performance Characteristics									
48.	3.2.1 Requirements Applicable to All PPS Channels	The following requirements are applicable to all PPS channels. Requirements specific to a particular channel will be identified in the specific Section (3.2.2 through 3.2.13) dealing with that channel.	N/A	N/A	N/A	N/A	N/A	N/A	Information Only

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
49.	3.2.1.1 Functional Description	Refer to the "Functional Description" requirement Section associated with each individual PPS channel.	N/A	N/A	N/A	N/A	N/A	N/A	Information Only
50.	3.2.1.2 Special Environmental Requirements	This Specification applies only to the PPS instrumentation that is located in the Unit 1 and Unit 2 Cable Spreading Rooms at DCPP (elevation 128). These areas are considered to be a mild environment. See Section 3.1.4 for specific environmental conditions applicable to these areas.	N/A	N/A	N/A	N/A	N/A	N/A	Information Only
51.	3.2.1.3 Indicators, Status Lights, and Controls	The following status requirements are applicable to all PPS channels:	N/A	N/A	N/A	N/A	N/A	N/A	Information Only
52.	3.2.1.3.1	Status indication (ON/OFF) shall be provided locally at the PPS instrumentation racks for all comparator outputs.	N/A	N/A	N/A	N/A	O(Triconex)) (Westinghouse)	T	LEDs on board edges provide indication
53.	3.2.1.3.2	For energize to trip/actuate comparator outputs, feedback shall be provided to the PPS to facilitate detection of open circuits, short circuits, or actual output not matching command unless specified otherwise in Sections 3.2.2 through 3.2.13 of this document.	3.1.4.3.1	SET I, II, III 3.4.4.9.1, SET IV 3.6.2.9.1	SDS-0309, 0309.1	N/A	T (Triconex) T (Westinghouse)	T	
54.	3.2.1.3.3	Signals for status indication to satisfy the requirements of Regulatory Guide 1.47 shall be provided to the MCR from each protection set for indication that a protection channel has been placed in an inoperable condition (e.g., bypassed)	3.3.2.2.1	3.13.1.9.6.3	SDS-0119.2, 0130.3, 0161.3, 0192.3, 0224.2, 0236.3, 0259.3, 0288.2, 0297.3, 0337.1, 0342, 0343, 0344.1, 0349, 0350, 0351, 0352, 0353	N/A	T (Triconex) T(/Westinghouse)	T	
55.	3.2.1.3.4	Manual trip switches shall be provided locally at the PPS instrumentation racks for all de-energize to trip comparator outputs except for those provided for alarm purposes only. This Specification does not require nor does it preclude the use of manual trip switches for energize to trip comparator outputs. Where used on energize to trip circuits the requirements of this section shall apply.	N/A	N/A	N/A	N/A	N/A	N/A	Information Only
		a) These manual trip switches shall provide an independent trip capability that will override the PPS comparator output.	N/A	N/A	N/A	PG&E Scope	N/A	T	PG&E provides the Manual Trip Switches

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		b) Channel status downstream of the manual trip switch shall be determinable by the PPS.	SET I &II 3.11.1.9.1, 3.12.1.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.9.1.9.1, 3.9.2.9.1, 3.9.3.9.1, 3.9.4.9.1SET II, III & IV 3.5.1.9.1, 3.6.1.9.1, 3.6.2.9.1, 3.6.3.9.1, 3.6.4.9.1	3.1.4.3.1	SDS-0308, SDS-0308.1	N/A	T (Triconex) T (Westinghouse)	T	
		c) Exceptions to this requirement for a particular comparator output will be identified in the "Trips and Trip Logic" subsection of the Section (3.2.2 thru 3.2.13) associated with that comparator.						N/A	Information Only
56.	3.2.1.3.5	Manual bypass switches shall be provided for each Containment High-High Pressure (Containment Spray) comparator output	N/A	N/A	N/A	PG&E Scope	DCP	N/A	PG&E provides the Manual Bypass Switches
		a) When in bypass, these switches shall maintain the normal (non-tripped) condition of the comparator output independent of the PPS.	N/A	N/A	See 3.2.1.5.3 (Item 63)	PG&E Scope	DCP	T	Applicable to the ALS Platform only
		b) Indication of Bypass shall satisfy the requirements of Section 3.2.1.5.3.	N/A	N/A	See 3.2.1.5.3 (Item 63)	N/A	N/A	T	Applicable to the ALS Platform only
57.	3.2.1.3.6	Manual bypass switches shall be provided for each Turbine Impulse Pressure High (P-13) comparator output	N/A	N/A	N/A	PG&E Scope	DCP	N/A	PG&E provides the Manual Bypass Switches Applicable to the Tricon Platform only
		a) When in bypass, these switches shall maintain the normal (non-tripped) condition of the comparator output independent of the PPS.	2.1.1.1.7, 3.1.1.1.7	N/A	N/A	PG&E Scope	DCP	T	Applicable to the Tricon Platform only

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		b) Indication of Bypass shall satisfy the requirements of Section 3.2.1.5.3	N/A	See 3.2.1.5.3 (Item 63)	N/A	N/A	T See 3.2.1.5.3 (Item 63)	T	Applicable to the Tricon Platform only
58.	3.2.1.3.7	A method shall be provided for placing a PPS channel out-of-service (e.g. manual OOS switch) for the purpose of performing maintenance activities (e.g., parameter updates) without requiring that a Protection Set be declared inoperable.	3.3.2.1.1	SET I, II, III, IV 3.3.1.9, 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.7, 3.3.1.9.8, 3.3.1.9.9 3.3.1.9.3 (SET III & IV) 3.3.1.9.2 (SET IV)	SDS-0119, 0161, 0192, 0192.3, 0224, 0224.2, 0259, 0288	PG&E provides the manual OOS Switches	T (Triconex) T (Westinghouse)	T	Tricon uses Manual OOS Switches, ALS uses software functions
		a) Indication of Out-of-Service shall satisfy the requirements of Section 3.2.1.5.5 (Item 65)	3.1.4.3.3	2.3.3	N/A	N/A	T (Triconex)	T	Applicable to the Tricon Platform only
		b) An alternative indication of Out-of-Service shall be provided.	N/A	N/A	SDS-0119.2, 0161.3, 0224.2, 0259.3, 0288.2, 0337.1, 0342, 0343	N/A	DCP T (Westinghouse)	T	Manual switches applicable to the Tricon Platform only. ALS platform has an OOS alarm, but it is not associated with a switch condition
59.	3.2.1.4 Outputs for Monitoring, Indication, Recording, and Control	Analog outputs shall be capable of driving an impedance of up to 1000 ohms without loss of accuracy. Refer to the "Outputs for Monitoring, Indication, Recording, and Control" requirement Section associated with each individual PPS channel. Note: "Outputs" includes: outputs processed through the PPS instrumentation (e.g., RCS Flow); and outputs processed through qualified hardware isolation devices on the sensor input loop (e.g., PZR Level to process control).	N/A	N/A	SDS-0405 (See comments)	PG&E Scope	DCP O(Triconex)(*) O (Westinghouse)	T	Westinghouse exception: ALS boards are only capable of driving up to 800 ohms. Exception documented in CDER FRS R9. DCP must apply hardware per vendor specifications (*)Verified per Triconex hardware Design Description (Section 6.4)(Doc # 993754-11-9170)
60.	3.2.1.5 Alarms and Annunciators	The following system level alarms and annunciators will be provided for each Protection Set. Separate input signals shall be provided to these alarms from processing instrumentation for each Protection Set. Refer to PPS System Level Alarm drawings: Protection Set I, Protection Set II, Protection Set III, and Protection Set IV.	3.3.1.2.2	3.13.1.9.6.1 3.13.1.9.6.1.8 3.13.1.9.6.2	SDS-0311, 0325, 0344	N/A	T (Triconex) T (Westinghouse)	T	
61.	3.2.1.5.1 PPS Failure [Output to MAS De-energizes to Alarm with	System failure conditions determined to impact a safety function that results in a Technical Specification Limiting Condition for Operation (LCO) entry shall provide signals to actuate a "PPS Failure" annunciator in the Main Control Room (MCR).	3.3.1.2.2	3.13.1.9.6.2,	SDS-0311, 0311.1, 0312, 0312.1, 0315,	N/A	T (Triconex) T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
	Reflash capability]	The following system level conditions are to be alarmed:							
		a) Failure to set trip on demand (condition exists for longer than 1 second) with the exception of alarm comparators and the C-3, C-4, and C-5 control interlock comparators	3.3.1.2.2	SET I 3.9.1.9.7, 3.9.2.9.7, 3.9.3.9.7, 3.9.4.9.7 SET II 3.9.1.9.6, 3.9.2.9.6, 3.9.3.9.6, 3.9.4.9.6 SET I& II 3.11.1.9.7, 3.12.1.9.7, 3.13.1.9.6.2.3, 3.4.4.9.7, 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, SET III 3.11.1.9.7, , 3.6.2.9.7, 3.9.2.9.6, 3.9.3.9.6 SET IV 3.6.4.9.7, 3.9.1.9.6, 3.9.4.9.6 SET III & IV 3.13.1.9.6.2.3 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.8.3.9.7, 3.8.4.9.7,	SDS-0322, 0322.1, 0323, 0323.1	N/A	T (Triconex) T (Westinghouse)	T	
		b) Critical component failure or failures that result in entry into a Technical Specification LCO Channel specific inputs to the PPS Failure alarm are identified in Sections 3.2.2.5 through 3.2.13.5	3.3.1.2.2	3.13.1.9.6.2.4	SDS- 0319, 0319.1, , 0321, 0321.1	N/A	T (Triconex) T (Westinghouse)	T	
62.	3.2.1.5.2 PPS Trouble [Output to MAS	System failure conditions that do not impact a safety function that results in a Technical Specification LCO entry shall provide signals to actuate a “PPS Trouble” annunciator in the MCR. The following system level conditions are to be alarmed:	N/A	N/A	N/A	N/A	N/A	N/A	Title Info

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
	De-energizes to Alarm with Reflash capability]	a) Trip output set without a demand (condition exists for longer than 1 second) with the exception of alarm comparators and the C-3, C-4, and C-5 control interlock comparators	3.3.1.2.3	SET I 3.8.2.9.7, 3.9.1.9.7, 3.9.2.9.7, 3.9.3.9.7, 3.9.4.9.7, SET II 3.8.4.9.7, 3.9.1.9.6, 3.9.2.9.6, 3.9.3.9.6, 3.9.4.9.6 SET I & II 3.11.1.9.7, 3.12.1.9.7, 3.13.1.9.6.1.6, 3.7.1.9.7, 3.8.1.9.7, SET III 3.11.1.9.7, , 3.6.2.9.7, 3.9.2.9.6, 3.9.3.9.6 SET IV 3.6.4.9.7, 3.9.1.9.6 3.9.4.9.6 SET III & IV 3.13.1.9.6.1.6 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.8.3.9.7, 3.8.4.9.7,	SDS-, 0333, 0334	N/A	T (Triconex) T (Westinghouse)	T	
		b) Loss of one critical instrument power supply (redundant supply working)	3.3.1.2.3	3.13.1.9.6.1.1 3.13.1.9.6.1.7	SDS-^{E}, 0330^{E}, 0331^{E}, 0332^{E}	N/A	T (Triconex) T (Westinghouse)	T	Westinghouse exception: Trouble Contact is activated on loss of one critical instrument power supply independent of the status of the redundant supply to prevent nuisance alarms during startup. Exception documented in CDER FRS 9.
		c) Loss of one or both non-critical instrument power supplies	3.3.1.2.3	3.13.1.9.6.1.7	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		d) Component failures that do not result in entry into a Technical Specification LCO	3.3.1.2.3	SET I, II 3.12.1.9.7 SET I, II,III, IV 3.13.1.9.6.1, 3.2.1.9.5, 3.7.1.9.7	SDS-0706, 0707	N/A	T (Triconex) T (Westinghouse)	T	
		Channel specific inputs to the PPS Trouble alarm are identified in Sections 3.2.2.5 through 3.2.13.5						N/A	Information Only
63.	3.2.1.5.3 PPS Channel in Bypass [Output to MAS Energizes to Alarm with Reflash capability]	[Output to MAS Energizes to Alarm with Reflash capability]	N/A	N/A	SDS-0344, 0344.1, 0345, 0345.1, 0348	PG&E Scope	DCP		Bypass Alarm contacts are normally open, close on actuation
		a) Actuation of any comparator Bypass switch in a Protection Set will provide a signal to the MAS for alarming the Bypassed condition in the Main Control Room	3.3.1.2.4	SET I, II, III, IV 3.13.1.9.6.3, 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.9, SET I, II, III 3.3.1.9.8, SET III IV 3.3.1.9.3	SDS-0130.3, 0236.3, 297.3, 0306, 0306.1, 0349, 0350, 0351, 0352, 0353	N/A	T (Triconex) T (Westinghouse)	T	Bypass Alarm contacts are normally open, close on actuation
		b) Where utilized, external comparator manual Bypass switches shall be provided with two (2) separate and independent output contacts.	N/A	N/A	N/A	PG&E scope	DCP	T	Manual Bypass Switches are provided
		1. One contact will be used to physically bypass the comparator trip/actuation output maintaining the non-tripped/non-actuated state.	N/A	N/A	N/A	PG&E scope	DCP T (Westinghouse)	T	Manual Bypass Switches are provided
		2. The other contact will be for use in satisfying Bypassed indication requirements per part a) of Section 3.2.1.5.3.	3.3.11.2.3	3.12.1.9.1, 3.13.1.9.6.3	SDS-0344 SDS-0344.1	N/A	T (Triconex) SET I, II T (Westinghouse)	T	Manual Bypass Switches are provided

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
64.	3.2.1.5.4 PPS RTD Failure [Output to MAS Energizes to Alarm with Reflash capability]	The following conditions shall actuate an “RTD Failure” annunciator in the MCR:	3.3.1.2.5	3.13.1.9.6.5	N/A	N/A	N/A	N/A	Title Information
		a) Input deviation - SQA2	3.3.1.2.5, 3.3.5.4.1	3.13.1.9.6.5, 3.7.1.9.7	N/A	N/A	T (Triconex)	T	Tricon function only
		b) Two bad inputs - SQA2	3.3.1.2.5, 3.3.5.4.1	3.13.1.9.6.5, 3.7.1.9.7	N/A	N/A	T (Triconex)	T	Tricon function only
		c) Less than two good inputs – SQA3A and SQA3B	3.3.1.2.5, 3.3.5.4.1	3.7.1.9.7	N/A	N/A	T (Triconex)	T	Tricon function only
		d) The alarms per a), b), and c) shall be suppressed when the DTTA channel is out of service	3.3.1.2.5	3.13.1.9.6.5	N/A	N/A	T (Triconex)	T	Tricon function only
65.	3.2.1.5.5 PPS Out of Service [Output to MAS Energizes to Alarm with Reflash capability]	Where utilized, external Channel Out-of-Service (OOS) switches shall be provided with two (2) separate and independent output contacts [Contacts Close on OOS].	N/A	N/A	N/A	PG&E Scope	DCP	T	Tricon function only
		a) One contact without reflash capability will be provided for use by the MAS (independent of the PPS instrumentation) to indicate that a manual OOS switch has been actuated and a channel OOS permissive has been set.	N/A	N/A	N/A	PG&E Scope	DCP	T	Tricon function only
		b) The other contact will be for use in establishing the proper HMI HSI/PPS interfaces for performing maintenance and parameter/setpoint updates. A signal shall be provided for use by the MAS to indicate the channel OOS condition once it is confirmed and established.	3.3.2.1.1	3.13.1.9.6.4, 3.3.1.9	N/A	N/A	T (Triconex)	T	Tricon function only
66.	3.2.1.6 Interlocks and Permissives	Refer to the “Interlocks and Permissives” requirement Section associated with each individual PPS channel.	N/A	N/A	N/A	N/A	N/A	N/A	Information Only

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
67.	3.2.1.7 Trips and Trip Logic	PPS comparators determine when established setpoints have been exceeded and provide outputs for use by other systems such as the RTS and ESFAS. Refer to the "Trips and Trip Logic" requirements Section associated with each individual PPS channel for comparator requirements associated with that channel.	N/A	N/A	N/A	N/A	N/A	N/A	Information Only
68.	3.2.1.8 Accuracy	A statistical analysis of PPS rack accuracy allowances, including a detailed description of the methodology used to determine rack accuracy allowance value(s), shall be performed by the equipment supplier and provided for use to evaluate the need for changes to PPS setpoints. Section 3.2.1.8.1 includes typical rack allowances that shall be considered. This is a non-inclusive list and may be supplemented depending on the type of equipment utilized.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
69.	3.2.1.8.1 Typical Rack Allowances include the following:	a) Rack Calibration Accuracy (RCA): The reference (calibration) accuracy rating for a process loop string. A process loop includes all modules in a specific channel. It is assumed that the individual modules are calibrated to a particular tolerance and that the process loop is verified to be calibrated to a specific tolerance.	N/A	N/A	SDS-0901-0907, SDS-0910	PG&E	DCP	N/A	
70.	3.2.1.8.1.a.1 The following tolerances for input signal conditioning shall be applicable:	i. 4-20 mA input signal conditioning accuracy tolerance shall not exceed: ± 0.13% span	See Comments (R-792)	N/A	SDS-0904	N/A	O (Triconex) T (Westinghouse)	T	Invensys exception documented in CD-ER-993754-03 Also refer to Triconex Topical Report and Application Guide 7286-545-1 and 9600164-534, Triconex System Accuracy Specification
71.	3.2.1.8.1.a.1.ii RTD input signal conditioning accuracy tolerance shall not exceed :	• ± 0.375 °F (narrow range)	See Comments (R-792)	N/A	SDS-0901	N/A	O (Triconex) T (Westinghouse)	T	For Triconex see Item 70
72.		• ± 1.05 °F (wide range)	See Comments (R-792)	N/A	SDS-0901	N/A	O (Triconex) T (Westinghouse)	T	For Triconex see Item 70
73.	3.2.1.8.1.a.2	4-20 mA analog output signal accuracy tolerance shall not exceed ± 0.5% of span unless otherwise specified.	See Comments R-792)	N/A	SDS-0907	N/A	O (Triconex) T (Westinghouse)	T	For Triconex see Item 70

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
74.	3.2.1.8.1.b Rack Comparator Setting Accuracy (RCSA): The reference calibration) accuracy of the instrument loop comparator (bistable).	1) For a single input bistable the tolerance shall not exceed ± 0.2% span	See Comments (R-792)	N/A	SDS-0910	N/A	O (Triconex) O (Westinghouse)	N/A	For Triconex see Item 70
75.		2) For a dual input bistable the tolerance shall not exceed ± 0.5% span	See Comments (R-792)	N/A	N/A	N/A	N/A	N/A	For Triconex see Item 70
76.		3) No uncertainty is included for this term for channels that do not have an electronic comparator	See Comments (R-792)	N/A	N/A	N/A	N/A	N/A	For Triconex see Item 70
77.	3.2.1.8.1.c Rack Temperature Effects (RTE): The change in input-output relationship for the process rack module string due to a change in the ambient environmental conditions	1) For an analog system the tolerance shall not exceed ± 0.5% span	N/A	N/A	N/A	N/A	N/A	N/A	Application is a Digital System
78.		2) As applicable, for a digital system the following tolerances shall be applicable						N/A	Information Only/Title
79.		2) i. 4-20 mA input signal conditioning temperature effects shall not exceed: ± 0.25% span	See Comments (R-796)	N/A	SDS-0905	N/A	O (Westinghouse)	N/A	See Triconex Topical Report and application Guide 7286-545-1 and 9600164-534, Triconex System Accuracy Specification
80.		2) ii. RTD input signal conditioning temperature effects shall not exceed: ± 1.2 °F (narrow range)	N/A	N/A	SDS-0902	N/A	O (Westinghouse)	N/A	
81.		2) ii. RTD input signal conditioning temperature effects shall not exceed: ± 5.6 °F (wide range)	(N/A	N/A	SDS-0902	N/A	O (Westinghouse)	N/A	
82.	3.2.1.8.1.d Rack Drift (RD): The change in input-output relationship over a period of time	1) For an analog system the tolerance shall not exceed ± 1.0% span	N/A	N/A	N//A	N/A	N/A	N/A	Application is a Digital System

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
83.	3.2.1.8.1.d.2 As applicable, for a digital system the tolerance shall not exceed:	i. 4-20 mA input signal conditioning rack drift tolerance shall not exceed: ± 0.2% span	See Comments (R-797)	N/A	SDS-0906	N/A	O (Westinghouse)	N/A	RTD inputs are processed by ALS See Triconex System Accuracy Specifications document 9600164-534
84.		ii. RTD input signal conditioning rack drift tolerance shall not exceed: ± 0.3 °F (narrow range)	N/A	N/A	SDS-0903	N/A	O (Westinghouse)	N/A	RTD inputs are processed by ALS
85.		ii. RTD input signal conditioning rack drift tolerance shall not exceed: ± 1.4 °F (wide range)	N/A	N/A	SDS-0903	N/A	O (Westinghouse)	N/A	RTD inputs are processed by ALS
86.	3.2.1.8.1.d.3	The drift requirements per this Section shall be valid for a period of 30 calendar months (minimum).	See Comments (R-799)	N/A	SDS-0903, SDS-0906	N/A	O (Westinghouse)	N/A	See Triconex System Accuracy Specifications document 9600164-534
87.	3.2.1.8.2	As applicable (digital system), Processor Time Base (Loop Cycle Time) Where input and output signals are updated on a time-dependent cyclic basis, a method for verifying the time base shall be provided. The measurable time base shall have an accuracy of ± 0.1% of the utilized time base (e.g., for a 100 msec time base this would be ± 0.1 msec).	See Comments (R-800, R-801)	N/A	SDS-0700 SDS-0700.1 SDS-0704	N/A	O (Westinghouse)	N/A	See Triconex Topical Report and application Guide 7286-545-1, , Triconex System Accuracy 9600164-534Specification and Planning and installation Guides 9720077-013

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
88.	3.2.1.9 Range (for Inputs, Calculated Values, and Outputs) Instrument Range requirements are function dependent. Refer to the "Range (for Inputs, Calculated Values, and Outputs)" requirements Section associated with each individual PPS channel.	1) Analog inputs shall be provided with the capability to adjust input scaling.	3.3.5.8.1 3.3.3.8.1	3.7.1.9.1	SDS-0110, 0154 0184, 0213, 0252, 0279	N/A	T (Westinghouse)	T	Tested by Westinghouse under IRS (2.9.6.7). No evidence of verification by Triconex.
89.	3.2.1.10 Time Response	The time response of the PPS processing instrumentation (from input signal conditioner to conditioned output signal) shall not exceed 0.409 seconds. The time delay mentioned above is defined as the elapsed time following a step change at the signal conditioner input from 5% below (above) to 5% above (below) the comparator setpoint with all externally adjustable transfer functions set to 1 (as applicable) and all externally adjustable time delays set to 0.0 (as applicable).	99374-1-817 Maximum TSAP Scan Time	N/A	SDS-1001, 1002, 1003,1011	N/A	T (Westinghouse)	T	The time response requirement for some trip functions will include both ALS and Tricon together. The allocated response time for the Tricon will be dependent upon several factors, including the size and complexity of the TSAP. Invensys Operations Management does not anticipate any issues with meeting the allocated response time for the Tricon, but this will be determined during detailed design and verified during the installation phase
90.	3.2.1.11 Overload and Recovery Characteristics	Overload (overrange) of any instrument channel or component in an affected protection system shall result only in the saturation of the affected components in the direction of the overload.	See Comments (R-1232)	N/A	SDS-0714, 714.1, 715, 715.1	N/A	O (Triconex) T (Westinghouse)	N/A	The overload (overrange) and return from overload condition were tested during PPS-IV hardware validation.

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
91.	3.2.1.11.1	After the out-of-range signal causing the overload returns from the overload condition, all component units of the system shall recover from the saturated condition and return to their correct output values (within nominal accuracy limits) within 1 second. Note: The 1 second recovery time specified need be met only when all externally adjustable time delays are set to 0.0.	See Comments (R-1233)	N/A	SDS-0714.2 SDS-0715.3	N/A	O (Triconex) T (Westinghouse)	N/A	Triconex-The overload (overrange) and return from overload condition were tested during PPS-IV hardware validation. Westinghouse exception: Requirement to verify recovery of all components units, and processes, instead to monitor only the analog input signal. Requirement of component units to recover from saturated condition and return to their correct output values within one or less than 1 second, instead to verify , via the TxB2 communication link, that the analog input signals return to their correct value in less or equal to 2.0 seconds from the time of removal of the OOR condition. Exception documented in CDER FRS R9.
92.	3.2.1.11.2	During recovery from overload, the output of all affected component units shall progress smoothly from the saturated value to the correct value without oscillation or overshoot larger than 1% (peak-to-peak) of channel range exclusive of the theoretical amplification of lead/lag and rate/lag units. Note: The requirements on oscillation and overshoot should be met even with all externally adjustable time delays set to 0.0.	See Comments (R-1234)	N/A	SDS-0714.2 SDS-0715.3	N/A	O (Triconex) T (Westinghouse)	N/A	Triconex-The overload (overrange) and return from overload condition were tested during PPS-IV hardware validation. Westinghouse exception: Requirement to verify recovery of all components units, and processes, instead to monitor only the analog input signal. Requirement of component units to recover from saturated condition and return to their correct output values within one or less than 1 second, instead to verify , via the TxB2 communication link, that the analog input signals return to their correct value in less or equal to 2.0 seconds from the time of removal of the OOR condition. Exception documented in CDER FRS R9.

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
93.	3.2.1.12 Noise Levels	For analog inputs, an adjustable low pass filter with a cutoff frequency range of 0 – 15 Hz (minimum bandwidth) shall be provided. Filter attenuation requirements: • 10 Hz = -20 dB minimum • 60 Hz = -45 dB minimum	See Comments (R1234)	N/A	SDS-0113, 0158, 0188, 0216, 0256, 0282	N/A	O (Westinghouse)	N/A	Invensys exception documented in 993754-08 CD-ER
94.	3.2.1.13 Controller Transfer Functions	Refer to the "Controller Transfer Functions" requirement Section associated with each individual PPS channel for channel specific transfer functions.						N/A	Narrative Text
95.	3.2.1.13.1	All PPS instrumentation shall have the capability to provide a hysteresis/ deadband setting for comparator setpoints as follows:						N/A	Narrative Text
96.		a. Comparator reset for increasing signal trips shall be 1% of input span below trip setpoint.	3.3.2.9	SET I and II 3.12.1.9.2, 3.8.1.9.2, 3.8.2.9.2, 3.9.1.9.2, 3.9.2.9.2, 3.9.3.9.2, 3.9.4.9.2, SET III 3.6.2.9.2, 3.7.1.9.2, 3.8.1.9.2, 3.8.2.9.2, 3.8.3.9.2, 3.9.2.9.2, SET II, III, IV 3.8.4.9.2, SET IV 3.6.4.9.2, 3.7.1.9.2, 3.8.1.9.2, 3.8.2.9.2, 3.8.3.9.2, 3.8.4.9.2, 3.9.1.9.2, 3.9.4.9.2	SDS-0227.1, 0229, 0293	N/A	T (Triconex) T (Westinghouse)	T	
97.		b. Comparator reset for decreasing signal trips shall be 1% of input span above trip setpoint.	3.3.2.9	SET I, II, III 3.11.1.9.2, SET I, II, III, IV 3.7.1.9.2, SET III 3.9.3.9.2	SDS-0124, 0230	N/A	T (Triconex) T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
98.	3.2.1.13.2	All PPS analog inputs must be provided with the capability to adjust scaling.	3.3.3.8.1	Set I, II 3.10.1.9.1, 3.10.2.9.1, 3.10.3.9.1, 3.10.4.9.1, 3.11.1.9.1, 3.12.1.9.1, 3.4.1.9.1, 3.4.2.9.1, 3.4.3.9.1, 3.4.4.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.9.1.9.1, 3.9.2.9.1, 3.9.3.9.1, 3.3.4.9.1 Set III 3.11.1.9.1, 3.6.1.9.1, 3.6.2.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.8.3.9.1, 3.8.4.9.1, 3.9.2.9.1, 3.9.3.9.1 Set IV 3.5.1.9.1, 3.6.3.9.1, 3.6.4.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.8.3.9.1, 3.8.4.9.1, 3.9.1.9.1, 3.9.4.9.1	SDS-0117, 0154 0184, 0213, 0220, 0252, 0279, 0286,	N/A	T (Triconex)	T	Tested by Westinghouse under IRS (2.9.6.7).
99.	3.2.1.14 Setpoints and Tunable Parameters (Range of Setting)	1. All comparator setpoints shall be capable of being entered and changed locally under administrative controls.	3.3.2.1.1.6.2	SET I, II, III, IV 3.3.1.9, 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, SET I, II, III 3.3.1.9.8 SET I, II 3.3.1.9.9,	SDS-0122.1, 0227.3, 0291.1	N/A	T (Triconex) T (Westinghouse)	T	PG&E administrative control by procedures
		2. All tunable parameters shall be capable of being entered and changed locally at the PPS instrumentation racks under administrative controls.	3.3.2.1.1.6.1	SET I, II, III, IV 3.3.1.9, 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.7, 3.3.1.9.8, 3.3.1.9.9 SET III 3.3.1.9.3, 3.3.1.9.8 SET IV 3.3.1.9.2, 3.3.1.9.3,	SDS-0117.1, 0152.1, 0154.1, 0182.1, 0184.1, 0220.1, 0222.2, 0250.1, 0252.1, 0286.1,0522	N/A	T (Triconex) T (Westinghouse)	T	PG&E administrative control by procedures

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
100.	3.2.1.15 Test and Calibration	The capability must be provided for PPS channel calibration and test at power as required by IEEE Std. 338 [Reference 1.4.1.1.5] with the following constraints:						N/A	Narrative Text
101.		1. The capability shall be provided for testing at power in either Test in Bypass mode (where the partial trip/actuation outputs associated with the channel in test are maintained in the non-tripped/non-actuated condition) or Test in Trip mode (where the partial trip/actuation outputs associated with the channel in test are maintained in the tripped/actuated condition).	3.3.2.1.1 3.3.5.14.4 3.3.2.1.1.5 3.3.9.14.4 3.3.10.14.4	3.3.1.9	SDS-0130, 0131, 0236, 0237, 0297, 0298	N/A	T (Triconex) T (Westinghouse)	T	
102.		2. In the case of 1/N (one-out-of-N) logic, a bypass shall (must) be provided to prevent the actuation of a protection system during a channel test.	3.3.2.1.1.5	SET I & II 3.11.1.9.3, 3.12.1.9.3, 3.4.4.9.1, 3.4.4.9.3, 3.7.1.9.3, 3.8.1.9.3, 3.8.2.9.3, 3.9.1.9.3, 3.9.2.9.3, 3.9.3.9.3, 3.9.4.9.3 SET III & IV 3.7.1.9.3, 3.8.1.9.3, 3.8.2.9.3, 3.8.3.9.3, 3.8.4.9.3, SET III 3.11.1.9.3, 3.6.2.9.3, 3.9.2.9.3, 3.9.3.9.3 SET IV 3.6.4.9.3, 3.9.1.9.3, 3.9.4.9.3	SDS-0236	N/A	T (Triconex) T (Westinghouse)	T	
103.		3. As applicable, the capability to verify that all analog-to-digital (A/D) conversions are calibrated independently of each other shall be provided	3.3.2.1.1.1	3.3.1.9	SDS-0108, 0150, 0180, 0211, 0248, 0277, 0554	N/A	T (Triconex) T (Westinghouse)	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
104.		4. As applicable, the capability to verify that digital-to-analog (D/A) conversions are calibrated independently of the A/Ds shall be provided (i.e., the inputs to the D/As are independently verifiable from the inputs to the A/Ds for calibration purposes).	3.3.2.1.1.1	SET I & II 3.3.1.9, 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.7, 3.3.1.9.9 SET III & IV 3.3.1.9, 3.3.1.9.4 SET IV 3.3.1.9.2,	SDS-0141, 0171, 0203, 0269, 0554	N/A	T (Triconex) T (Westinghouse)	N/A	
105.		5. Overlap test capability shall be provided for both periodic and time response testing	Not in SRS (R-814)	N/A	SDS-0705		T (Triconex) T (Westinghouse)	T	Triconex PTM lists Set I FAT
106.		6. Periodic testing shall not require the need for the use of temporary jumpers or lifting of leads.	Not in SRS (R-815)	N/A	N/A	PG&E Scope	T (Triconex)	T	Triconex PTM lists Set I FAT
107.		7. A method shall be provided for verification of allowed changes to setpoints and/or tuning constants prior to and following initiation of the change	3.3.2.1.1.6	3.3.1.9	SDS-0117.6, 0122.5, 0152.7, 0154.5, 0182.7, 0184.5, 0379.4, 0220.5, 0222.6, 0227.6, 0250.6, 0252.5, 0380.4, 0286.5, 0291.4, 0378.4,	N/A	T (Triconex) T (Westinghouse)	T	
108.	3.2.1.16 Failure Mode Requirements	3. De-energize to Trip comparator outputs shall be designed such that upon loss of electrical power, the resultant output is the tripped (De-energized) condition.	See Comments (R-819)	N/A	SDS-0126, 0136, 0242, 0294, 0303, 0305, 0305.1	N/A	O(Triconex) T (Westinghouse)	T	Planning and Installation Guide (9720077-013). Upon loss of power, outputs default to the safe state per Triconex PTM.
109.		4. Energize to Trip comparator outputs shall be designed such that upon loss of electrical power, the resultant output is the non-tripped (De-energized) condition.	See Comments (R-1203)	N/A	SDS-0243, 0295, 0305, 0305.1, 0304	N/A	O(Triconex) T (Westinghouse)	T	Containment Spray actuation is not within Invensys operation management scope of supply.

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
110.		5. Detectable failures that could result in loss of ability to perform a required safety function should result in affected De-energize to Trip comparators being placed in the tripped (De-energized) condition. This requirement does not apply to functions that are out of service.	3.3.2.1.4	SET II & III 3.11.1.9.3, 3.12.1.9.3, 3.2.1.9.4, 3.7.1.9.3, 3.8.1.9.3, 3.8.2.9.3, 3.9.1.9.3, 3.9.2.9.3, 3.9.3.9.3, 3.9.4.9.3 SET III & IV 3.7.1.9.3, 3.8.1.9.3, 3.8.2.9.3, 3.8.3.9.3, 3.8.4.9.3, SET III 3.11.1.9.3, 3.2.1.9.4, 3.9.2.9.3, 3.9.3.9.3 SET IV 3.2.1.9.4, 3.9.1.9.3, 3.9.4.9.3	SDS-0126.1, 0126.2, 0136, 0231.1, 0231.2, 0231.3, 0242, 0294.1, 0294.2, 0294.3, 0303	N/A	T (Triconex) T (Westinghouse)	T	Triconex exception taken per CD-ER 993754-28. Also see CD-ER 993754-16
111.		6. Detectable failures that could result in loss of ability to perform a required safety function should result in affected Energize to Trip comparators being placed in the non-tripped (De-energized) condition. This requirement does not apply to functions that are out of service.	R-1161	3.3.2.14	SDS-0233.1, 0233.2, 0233.3, 0243, 0295.1, 0295.2, 0295.3, 0304	N/A	T (Triconex) T (Westinghouse)	T	Exception taken per CD-ER 993754-28
112.		7. The capability shall be provided to transit from Test in Bypass to Test in Trip for any channel to support Technical Specification requirements.	3.3.2.1.1	3.3.1.9	SDS- 0239	N/A	T (Triconex) T (Westinghouse)	T	
113.		8. The capability shall be provided to transit from Test in Trip to Test in Bypass for any channel to support Technical Specification requirements.	3.3.2.1.1	3.3.1.9	SDS-0240	N/A	T (Triconex) T (Westinghouse)	T	
3.2 System Performance Characteristics									
3.2.2 Specific Requirements for Reactor Coolant Flow The following specific requirements apply to the Reactor Coolant Flow channels and are in addition to the requirements specified in Section 3.2.1.									

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
114.	3.2.2.1 Functional Description Reactor Coolant Flow channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								
115.	3.2.2.1.1 Reactor Coolant Flow, Loops 1 thru 4 (Protection Set I): Reference 1.4.2.2.1, 1.4.2.2.2								
116.	3.2.2.1.2 Reactor Coolant Flow, Loops 1 thru 4 (Protection Set II): Reference 1.4.2.2.23, 1.4.2.2.24								
117.	3.2.2.1.3 Reactor Coolant Flow, Loops 1 thru 4 (Protection Set III): Reference 1.4.2.2.45, 1.4.2.2.46								
118.	3.2.2.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
119.	3.2.2.3 Indicators, Status Lights, and Controls	No additional requirements to those identified in Section 3.2.1.3.	N/A	N/A	N/A	N/A	N/A	N/A	
120.	3.2.2.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Reactor Coolant Flow channels:	1. Reactor Coolant Flow Loop 1 (Protection Sets I, II, III) a) MCR Indication b) PPC Monitoring	N/A	N/A	SDS-0137	N/A	T (Westinghouse)	T	ALS Scope Only
121.		2. Reactor Coolant Flow Loop 2 (Protection Sets I, II, III) a) MCR Indication b) PPC Monitoring	N/A	N/A	SDS-0137	N/A	T (Westinghouse)	T	ALS Scope Only
122.		3. Reactor Coolant Flow Loop 3 (Protection Sets I, II, III) a) MCR Indication b) PPC Monitoring	N/A	N/A	SDS-0137	N/A	T (Westinghouse)	T	ALS Scope Only

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
123.		4. Reactor Coolant Flow Loop 4 (Protection Sets I, II, III) a) MCR Indication b) PPC Monitoring	N/A	N/A	SDS-0137	N/A	T (Westinghouse)	T	ALS Scope Only
124.	3.2.2.5 Alarms and Annunciators The following alarm outputs shall be provided for the Reactor Coolant Flow channels:	1. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) Input sensor out of range	N/A	N/A	SDS-0111, 0111.1, 0111.2 , 0112, 0112.1, 0112.2, 0319, 0094	N/A	T (Westinghouse)	T	ALS Scope Only
125.		2. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: a) No additional requirements to those identified in Section 3.2.1.5.2	N/A	N/A	N/A	N/A	N/A	N/A	
126.	3.2.2.6 Interlocks and Permissives There are no interlocks or permissives associated with PPS Reactor Coolant Flow channel processing.								
127.	3.2.2.7 Trips and Trip Logic The following comparator outputs shall be provided by the Reactor Coolant Flow channels:	1. Reactor Coolant Loop 1 Flow Low (Protection Sets I, II, III) For use by the SSPS Low Reactor Coolant Flow Reactor Trip logic [De-energize to Trip].	N/A	N/A	SDS-0115, 0122, 0129	N/A	T (Westinghouse)	T	ALS Scope Only
128.		2. Reactor Coolant Loop 2 Flow Low (Protection Sets I, II, III) For use by the SSPS Low Reactor Coolant Flow Reactor Trip logic [De-energize to Trip]	N/A	N/A	SDS-0115, 0122, 0129	N/A	T (Westinghouse)	T	ALS Scope Only
129.		3. Reactor Coolant Loop 3 Flow Low (Protection Sets I, II, III) For use by the SSPS Low Reactor Coolant Flow Reactor Trip logic [De-energize to Trip].	N/A	N/A	SDS-0115, 0122, 0129	N/A	T (Westinghouse)	T	ALS Scope Only
130.		4. Reactor Coolant Loop 4 Flow Low (Protection Sets I, II, III) For use by the SSPS Low Reactor Coolant Flow Reactor Trip logic [De-energize to Trip].	N/A	N/A	SDS-0115, 0122, 0129	N/A	T (Westinghouse)	T	ALS Scope Only
131.	3.2.2.8 Accuracy No additional requirements to those identified in Section 3.2.1.8.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
132.	3.2.2.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be scaled as follows:	1. Input Variables: a) Reactor Coolant Flow: 4 – 20 mA = 0 to 100 XMTR dp%	N/A	N/A	SDS-0105, SDS-0116	N/A	T (Westinghouse)	T	ALS Scope Only
133.		2. Calculated Variables: Refer to Section 3.2.2.13.	N/A	N/A	N/A	N/A	N/A	N/A	
134.		3. Output Variables: a) Reactor Coolant Flow: 0 to 100 XMTR dp% = 4 – 20 mA Note: equivalent to 0 to 120% of normalized flow.	N/A	N/A	SDS-0125, 0137	N/A	T (Westinghouse)	T	ALS Scope Only
135.	3.2.2.10 Time Response No additional requirements to those identified in Section 3.2.1.10								
136.	3.2.2.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
137.	3.2.2.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
138.	3.2.2.13 Controller Transfer Functions The following controller transfer functions are used in the processing of Reactor Coolant Flow channels: 3.2.2.13.1 Reactor Coolant Flow Normalization Ranges for tuning constants associated with this function are provided in Section 3.2.2.14.2.								
139.	3.2.2.14 Setpoints and Tunable Parameters	1. Reactor Coolant Flow Low Reactor Trip: 40.000 to 70.000 normalized dp%	N/A	N/A	SDS-0122.2	N/A	T (Westinghouse)	T	ALS Scope Only

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
140.	(Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Reactor Coolant Flow channels:	2. Tunable Parameters a) Input scaling m (normalizing constant) 0.5000 to 1.9000 b) Input scaling b (offset) -10.000 to 10.000 dp%	N/A	N/A	SDS-0117.2, 0117.3, 0117.4	N/A	T (Westinghouse)	T	ALS Scope Only
141.	3.2.2.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15.	N/A	N/A	N/A	N/A	N/A	N/A	
142.	3.2.2.16 Failure Mode Requirements	No additional requirements to those identified in Section 3.2.1.16.	N/A	N/A	N/A	N/A	N/A	N/A	
3.2.3 Specific Requirements for Wide Range Reactor Coolant Temperature The following specific requirements apply to the Wide Range Temperature channels and are in addition to the requirements specified in Section 3.2.1.									
143.	3.2.3.1 Functional Description Wide Range Temperature channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								
144.	3.2.3.1.1 Wide Range Temperature, Reactor Coolant Loops 1 and 2 (Protection Set I): Reference 1.4.2.2.3								
145.	3.2.3.1.2 Wide Range Temperature, Reactor Coolant Loops 3 and 4 (Protection Set II): Reference 1.4.2.2.25								
146.	3.2.3.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
147.	3.2.3.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3.	N/A	N/A	N/A	N/A	N/A	N/A	
148.	3.2.3.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Wide Range Temperature channels:	1. Hot Leg Temperature Loop 1 (Protection Set I) a) MCR Recording b) ERFDS Monitoring c) RVLIS Train B Monitoring d) PPC Monitoring	3.3.3.3.1	3.4.1.9.5, 3.4.1.9.6	SDS-0602	N/A	T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
149.		2. Hot Leg Temperature Loop 2 (Protection Set I) a) MCR Recording b) ERFDS Monitoring c) RVLIS Train B Monitoring d) PPC Monitoring	3.3.3.3.2	3.4.3.9.5 3.4.3.9.6	SDS-0602	N/A	T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
150.		3. Hot Leg Temperature Loop 3 (Protection Set II) a) MCR Recording b) ERFDS Monitoring c) RVLIS Train A Monitoring d) PPC Monitoring	3.3.3.3.5	3.4.3.9.5	SDS-0602	N/A	T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
151.		4. Hot Leg Temperature Loop 4 (Protection Set II) a) MCR Recording b) ERFDS Monitoring c) RVLIS Train A Monitoring d) PPC Monitoring	3..3.3.3.6	3.4.1.9.5 3.4.1.9.6	SDS-0602	N/A	T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
152.		5. Cold Leg Temperature Loop 1 (Protection Set I) a) MCR Recording b) ERFDS Monitoring c) PPC Monitoring	3.3.3.3.3	3.4.2.9.5 3.4.2.9.5	SDS-0602	N/A	T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
153.		6. Cold Leg Temperature Loop 2 (Protection Set I) a) MCR Recording b) ERFDS Monitoring c) PPC Monitoring	3.3.3.3.4	3.4.4.9.5 3.4.4.9.5	SDS-0602	N/A	T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
154.		7. Cold Leg Temperature Loop 3 (Protection Set II) a) MCR Recording b) ERFDS Monitoring c) PPC Monitoring	3.3.3.3.7	3.4.4.9.5 3.4.4.9.6	SDS-0602	N/A	T (Triconex) T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
155.		8. Cold Leg Temperature Loop 4 (Protection Set II) a) MCR Recording b) ERFDS Monitoring c) PPC Monitoring	3.3.3.3.8	3.4.2.9.5 3.4.2.9.6	SDS-0602	N/A	T (Triconex) T (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
156.	3.2.3.5 Alarms and Annunciators The following alarm outputs shall be provided for the Wide Range Temperature channels:	1. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) Input sensor out of range	3.3.3.4	3.4.1.9.7 3.4.2.9.7 3.4.3.9.7 3.4.4.9.7	N/A	N/A	T (Triconex)	T	
		2. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: a) No additional requirements to those identified in Section 3.2.1.5.2.	N/A	N/A	N/A	N/A	N/A	N/A	
157.	3.2.3.6 Interlocks and Permissives There are no interlocks or permissives associated with PPS Wide Range Temperature channel processing.								
158.	3.2.3.7 Trips and Trip Logic	The following comparator outputs shall be provided by the Wide Range Temperature Channels:						N/A	Title information
159.		1. Cold Leg Temperature Low Loop 2 (Protection Set I) For use by the LTOPS [Energize to Trip].	3.3.3.6	3.4.4.9.2, 3.4.4.9.3	N/A	N/A	T (Triconex)	T	ALS – RTD Input Triconex – Output Scaling
160.		2. Cold Leg Temperature Low Loop 3 (Protection Set II) For use by the LTOPS [Energize to Trip].	3.3.3.6	3.4.4.9.2, 3.4.4.9.3	N/A	N/A	T (Triconex)	T	ALS – RTD Input Triconex – Output Scaling
161.	3.2.3.8 Accuracy No additional requirements to those identified in Section 3.2.1.8.								
162.	3.2.3.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be scaled as follows:	1. Input Variables a) Wide Range Temperature Hot Leg: i. [4-wire 200 ohm platinum RTD] = 0 to 700ºF (minimum range) b) Wide Range Temperature Cold Leg: i. [4-wire 200 ohm platinum RTD] = 0 to 700ºF (minimum range)	3.3.3.8.1	3.4.1.9.1,3.4.3.9.1 3.4.2.9.1 3.4.4.9.1 3.4.2.9.5	SDS-0146, 0152	N/A	T (Triconex) T (Westinghouse) O (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
163.		2. Calculated Variables: None	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
164.		3. Output Variables: a) Wide Range Temperature Hot Leg: i. 0 to 700ºF = 4 – 20 mA b) Wide Range Temperature Cold Leg: i. 0 to 700ºF = 4 – 20 mA	3.3.3.8.1	3.4.2.9.1 3.4.4.9.1	SDS-0146, 0152	N/A	T (Triconex) T (Westinghouse) O (Westinghouse)	T	ALS – RTD Input Triconex – Output Scaling
165.	3.2.3.8 Accuracy No additional requirements to those identified in Section 3.2.1.8.								
166.	3.2.3.10 Time Response No additional requirements to those identified in Section 3.2.1.10.								
167.	3.2.3.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
168.	3.2.3.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
169.	3.2.3.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
170.	3.2.3.13 Controller Transfer Functions The following controller transfer functions are used in the processing of Wide Range Temperature channels: .								
171.	3.2.3.13.1 RTD Resistance to Temperature Calculation	Refer to Reference 1.4.3.18 for details	N/A	N/A	N/A	N/A	N/A	N/A	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform
172.	3.2.3.14 Setpoints and Tunable Parameters	1. Cold Leg Temperature Low LTOPS (Protection Sets I, II): 0.000 to 700.000°F	3.3.3.13.1	3.4.4.9.2	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
173.	(Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Wide Range Temperature channels:	2. Tunable Parameters a) Input scaling m (gain) 0.5000 to 1.9000 b) Input scaling b (offset) -70.000 to 70.000 °F c) RTD a constant 150.000 to 250.000 ohms d) RTD b constant 0.200000 to 0.600000 ohms/°F RTD c constant -0.500000E-04 to -0.100000E-04 ohms/(°F*°F)	3.3.3.13.2	3.3.1.9.1	SDS-0152.2, 0152.3, 0152.4, 0152.5, 0154.2, 0154.3	N/A	T (Triconex) T (Westinghouse)	T	Westinghouse exception: (b). Uses one digit after decimal (-70.0 to 70.0 °F) instead of (-70.000 to 70.000 °F) (d). Use range of 0.300000 to 0.600000 ohm/°F instead of 0.200000 to 0.600000 ohm/°F Exception documented in CDER FRS R9.
174.	3.2.3.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15.	N/A	N/A	N/A	N/A	N/A	N/A	
175.	3.2.3.16 Failure Mode Requirements	1) Detected RTD failures shall result in a low-going signal (failed low).	N/A	N/A	SDS-0166, 0166.1	N/A	T (Westinghouse)	T	
3.2.4 Specific Requirements for Wide Range Reactor Coolant Pressure The following specific requirements apply to the Wide Range Pressure channels and are in addition to the requirements specified in Section 3.2.1.									
176.	3.2.4.1 Functional Description Wide Range Pressure channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								
177.	Wide Range Pressure, Reactor Coolant Loop 4 (Protection Set III): Reference 1.4.2.2.47								
178.	Wide Range Pressure, Reactor Coolant Loops 3 and 4 (Protection Set IV): Reference 1.4.2.2.60								
179.	3.2.4.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
180.	3.2.4.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3.	N/A	N/A	N/A	N/A	N/A	N/A	
181.	3.2.4.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Wide Range Pressure channels:	1. Wide Range Pressure Loop 4 [PT-403] (Protection Set III) a) MCR Recording b) ERFDS Monitoring c) RVLIS Train B Monitoring d) PPC Monitoring	3.3.4.3.1	3.6.1.9.6	N/A	PG&E Scope	DCP T (Triconex)	T	PGE (a-c) Invensys: 3.2.4.4.1 (d) only
182.		2. Wide Range Pressure Loop 4 [PT-403A] (Protection Set III) a) MCR Indication b) ERFDS Monitoring c) PPC Monitoring	3.3.4.3.2	3.6.2.9.6	N/A	PG&E Scope	DCP T (Triconex)	T	PGE (a-b) Invensys: 3.2.4.4.2 (c) only
183.		3. Wide Range Pressure Loop 3 [PT-405] (Protection Set IV) a) MCR Indication b) ERFDS Monitoring c) PPC Monitoring d) RVLIS Train A Monitoring	3.3.4.3.3	3.6.3.9.6	N/A	PG&E Scope	DCP T (Triconex)	T	PGE (a, b, d) Invensys: 3.2.4.4.3 (c) only
184.		4. Wide Range Pressure Loop 4 [PT-405A] (Protection Set IV) a) MCR Indication b) PPC Monitoring c) ERFDS Monitoring	3.3.4.3.4	3.6.4.9.6	N/A	PG&E Scope	DCP T (Tricon)	T	PGE (a, c) Invensys: 3.2.4.4.4 (b) only
185.	3.2.4.5 Alarms and Annunciators The following alarm outputs shall be provided for the Wide Range Pressure channels:	1. Reactor Coolant Pressure Hi, Loop 4 [PT-403A] (Protection Set III) Input to RHR Valve 8702 Not Isolated alarm circuit (RHR Interlocks, see Section 3.2.4.6.3).	3.3.4.4.1	3.6.2.9.2 3.6.2.9.3	N/A	N/A	T (Triconex)	T	Invensys Exception: CD-ER 993754-26
186.		2. Reactor Coolant Pressure Hi, Loop 4 [PT-405A] (Protection Set IV) Input to RHR Valve 8701 Not Isolated alarm circuit (RHR Interlocks, see Section 3.2.4.6.4).	3.3.4.4.1	3.6.4.9.2 3.6.4.9.3	N/A	N/A	T (Triconex)	T	Invensys Exception: CD-ER 993754-26
187.		3. The following conditions shall produce an output to actuate the “PPS Failure” annunciator in the MCR: a) Input sensor out of range	3.3.4.4	3.6.1.9.7, 3.6.2.9.7 3.6.3.9.7, 3.6.4.9.7 3.13.1.9.6.2.6	N/A	N/A	T (Triconex)	T	
188.		4. The following conditions shall produce an output to actuate the “PPS Trouble” annunciator in the MCR: a. No additional requirements to those identified in Section 3.2.1.5.2.	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
189.	3.2.4.6 Interlocks and Permissives The following comparator outputs shall be provided by the Wide Range Pressure channels:	1. Reactor Coolant Pressure Low, Loop 4 (Protection Set III) For use by the RHR system interlocks Valve 8702 control circuit [Energize to Trip].	3.3.4.5.1	3.6.2.9.2, 3.6.2.9.3	N/A	N/A	T (Triconex)	T	
190.		2. Reactor Coolant Pressure Low, Loop 4 (Protection Set IV) For use by the RHR system interlocks Valve 8701 control circuit [Energize to Trip]. The Wide Range Pressure Low Loop 4 comparator output to the RHR Valve 8701 Interlock circuit shall be interlocked with the Pressurizer Vapor Space Temperature Low comparator output. A graphical presentation is shown on References 1.4.2.2.60 and 1.4.2.2.65.	3.3.4.5.1	3.6.4.9.2, 3.6.4.9.3	N/A	N/A	T (Triconex)	T	
191.		3. Reactor Coolant Pressure High, Loop 4 (Protection Set III) For use by the RHR system interlocks Valve 8702 alarm circuit (see Section 3.2.4.5.1) [De-energize to Trip].	3.3.4.4.1	3.6.4.9.3	N/A	N/A	T (Triconex)	T	
192.		4. Reactor Coolant Pressure High, Loop 4 (Protection Set IV) For use by the RHR system interlocks Valve 8701 alarm circuit (see Section 3.2.4.5.2) [De-energize to Trip].	3.3.4.4.1	3.6.2.9.2, 3.6.2.9.3	N//A	N/A	T (Triconex)	T	
193.	3.2.4.7 Trips and Trip Logic The following comparator outputs shall be provided by the Wide Range Pressure channels:	1. Reactor Coolant Pressure High, Loop 4 (Protection Sets III, IV) For use by LTOPS [Energize to Trip].	3.3.4.6.1	3.6.4.9.2, 3.6.4.9.3	N/A	N/A	T (Triconex)	T	
194.	3.2.4.8 Accuracy No additional requirements to those identified in Section 3.2.1.8.								
195.	3.2.4.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables	1. Input Variables: a) Reactor Coolant Wide Range Pressure: 4 – 20 mA = 0 to 3000 psig	3.3.4.8.1	3.6.1.9.1, 3.6.2.9.1 3.6.3.9.1, 3.6.4.9.1	N/A	N/A	T (Triconex)	T	
196.		2. Calculated Variables: None	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
197.	shall be scaled as follows:	3. Output Variables: a) Reactor Coolant Wide Range Pressure: 4 – 20 mA [0 to 3000 psig] = 4-20 mA (input loop Class IA/II isolator)	N/A	N/A	N/A	PG&E Scope	DCP	T	Indicators are on the input loop
198.	3.2.4.10 Time Response No additional requirements to those identified in Section 3.2.1.10.								
199.	3.2.4.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
200.	3.2.4.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
201.	3.2.4.13 Controller Transfer Functions	No additional requirements to those identified in Section 3.2.1.13.	N/A	N/A	N/A	N/A	N/A	N/A	
202.	3.2.4.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Wide Range Pressure channels:	1. Reactor Coolant Wide Range Pressure High LTOPS (Protection Sets III, IV): 0.00 to 3000.00 psig	3.3.4.13.1	3.6.4.9.2 3.6.4.9.3	N/A	N/A	T (Triconex)	T	
203.		2. Reactor Coolant Wide Range Pressure High RHR Interlocks (Protection Sets III, IV): 0.00 to 3000.00 psig	3.3.4.13.2	3.6.4.9.2 3.6.4.9.3	N/A	N/A	T (Triconex)	T	
204.		3. Reactor Coolant Wide Range Pressure Low RHR Interlocks (Protection Sets III, IV): 0.00 to 3000.00 psig	3.3.4.13.3	3.6.2.9.2	N/A	N/A	T (Triconex)	T	
205.		4. Tunable Parameters a) Input scaling m (gain) 0.5000 to 1.9000 b) Input scaling b (offset) -300.00 to 300.00 psig	3.3.4.13.4	3.3.1.9.3	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
206.	3.2.4.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15	N/A	N/A	N/A	N/A	N/A	N/A	
207.	3.2.4.16 Failure Mode Requirements	No additional requirements to those identified in Section 3.2.1.16	N/A	N/A	N/A	N/A	N/A	N/A	
3.2.5 Specific Requirements for DTTA The following specific requirements apply to the DTTA channels and are in addition to the requirements specified in Section 3.2.1.									
208.	3.2.5.1 Functional Description DTTA channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic). The following sub-sections provide information regarding the development of the Thot, Tcold, Tavg, and Delta-T signals used in calculating the Thermal Overpower and Overtemperature Protection trip setpoints. The information is presented in a "per DTTA channel" basis. The same process shall be performed in all four DTTA channels. Each DTTA channel is associated with a particular reactor coolant loop (e.g., DTTA channel 1 is for reactor coolant loop 1).								
209.	3.2.5.1.1 DTTA Reactor Coolant Loop 1 (Protection Set I): Reference 1.4.2.2.4, 1.4.2.2.5								
210.	3.2.5.1.2 DTTA Reactor Coolant Loop 2 (Protection Set II): Reference 1.4.2.2.26, 1.4.2.2.27								
211.	3.2.5.1.3 DTTA Reactor Coolant Loop 3 (Protection Set III): Reference 1.4.2.2.48, 1.4.2.2.49								
212.	3.2.5.1.4 DTTA Reactor Coolant Loop 4 (Protection Set IV): Reference 1.4.2.2.61, 1.4.2.2.62								
213.	3.2.5.1.5 Tcold Signal Development	A filtered Tcold average (Tfcavg) signal shall be calculated from the two (2) Tcold RTD inputs configured for use in a single DTTA channel for use in the DTTA channel protection function calculations. The following constraints apply:	3.3.5.1.1	3.7.1.9.4.7	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
214.		a) All Tcold inputs shall be processed through a Lag Filter per Section 3.2.5.13.1.	3.3.5.1.1	3.7.1.9.1	N/A	N/A	T (Triconex)	N/A	
215.		b) Only Tcold signals that have been validated by the Sensor Quality Algorithm (SQA2) [Reference Section 3.2.5.13.8] shall be used in the Tfcavg calculation.	3.3.5.1.1	3.7.1.9.4.7	N/A	N/A	T (Triconex)	N/A	
216.		c) Alarm conditions and outputs associated with the SQA2 are provided in Reference 1.4.3.18.	3.3.5.1.1	3.7.1.9.4.7	N/A	N/A	T (Triconex)	T	
217.		d) The Tfcavg shall be the output of the SQA2 Algorithm	3.3.5.1.1	3.7.1.9.4.4 3.7.1.9.4.5	N/A	N/A	T (Triconex)	N/A	
218.	3.2.5.1.6 Thot Signal Development	A filtered Thot average (Tfhavg) signal shall be calculated from the six (6) Thot RTD inputs configured for use in a single DTTA channel for use in the DTTA channel protection calculations.	3.3.5.1.2	3.7.1.9.4.11	N/A	N/A	T (Triconex)	N/A	
219.		a) All Thot inputs shall be processed through a Lag Filter per Section 3.2.5.13.1.	3.3.5.1.2	3.7.1.9.1	N/A	N/A	T (Triconex)	N/A	
220.		b) Each Thot input shall be compensated by application of a Thot streaming factor determined per Section 3.2.5.13.10.	3.3.5.1.2	3.7.1.9.4.10 3.7.1.9.4.9	N/A	N/A	T (Triconex)	N/A	
221.		c) The SQA3A algorithm [Reference Section 3.2.5.13.9] shall be used to calculate a Tfhavg value for the three (3) Thot “A” inputs.	3.3.5.1.2	3.7.1.9.4.11	N/A	N/A	T (Triconex)	N/A	
222.		d) The SQA3B algorithm [Reference Section 3.2.5.13.9] shall be used to calculate a Tfhavg value for the three (3) Thot “B” inputs.	3.3.5.1.2	3.7.1.9.4.11	N/A	N/A	T (Triconex)	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
223.		e) Only Thot signals that have been validated by the SQA3A or SQA3B algorithm shall be used in the Tfhavg calculation for that group.	3.3.5.1.2	3.7.1.9.4.9 3.7.1.9.4.10 3.7.1.9.4.11	N/A	N/A	T (Triconex)	N/A	
224.		f) Alarm conditions and outputs associated with the SQA3A, SQA3B, and SQA3 are provided in Reference 1.4.3.18.	3.3.5.1.2	3.7.1.9.4.8	N/A	N/A	T (Triconex)	T	
225.		g) The Tfhavg for the DTTA channel shall be calculated from the outputs of the SQA3A and SQA3B algorithms.	3.3.5.1.2	3.7.1.9.4.11, 3.7.1.9.4.4, 3.7.1.9.4.5, 3.7.1.9.4.8	N/A	N/A	T (Triconex)	T	
226.	3.2.5.1.7 Delta-T Signal Development	Delta-T (calculated loop differential temperature, °F) shall be determined for each DTTA channel [Reference Section 3.2.5.13.4].	3.3.5.1.3	3.7.1.9.3	N/A	N/A	T (Triconex)	T	
227.	3.2.5.1.8 Tavg Signal Development	Tavg (calculated average loop temperature, °F) shall be determined for each DTTA channel [Reference Section 3.2.5.13.4].	3.3.5.1.4	3.7.1.9.4.12 3.7.1.9.4.13 3.7.1.9.4.4	N/A	N/A	T (Triconex)	T	
228.	3.2.5.1.9 Normalized Power (PB) Signal Development	PB (calculated value for normalized power, unitless) shall be determined for each DTTA channel [Reference Section 3.2.5.13.11].	3.3.5.1.5	3.7.1.9.4.5	N/A	N/A	T (Triconex)	T	
229.	3.2.5.1.10 Overtemperature Delta-T (OTDT) Setpoint	An Overtemperature Delta-T (OTDT) Setpoint shall be determined for each DTTA channel (Reference Section 3.2.5.13.11].	3.3.5.1.6	3.7.1.9.4.12	N/A	N/A	T (Triconex)	T	
230.	3.2.5.1.11 Overpower Delta-T (OPDT) Setpoint	An Overpower Delta-T (OPDT) Setpoint shall be determined for each DTTA channel [Reference Section 3.2.5.13.11].	3.3.5.1.7	3.7.1.9.4.13	N/A	N/A	T (Triconex)	T	
231.	3.2.5.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
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			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
232.	3.2.5.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3	N/A	N/A	N/A	N/A	N/A	N/A	
233.	3.2.5.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the DTTA channels:	1. Calculated Delta-T (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) a) MCR Indication b) MCR Recording c) Delta-T Auctioneering Circuit d) PPC Monitoring e) Associated Steam Generator Level Channel (Trip Time Delay)	3.3.5.3.1	3.7.1.9.5, 3.8.3.9.3.1	N/A	N/A	T (Triconex)	T	
234.		2. Calculated Tavg (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) a) MCR Indication b) Alarming (Deviation Alarm Circuit) c) PPC Monitoring d) To Control (Tavg Auctioneered - High to Rod Speed and Direction, Steam Dumps, Pressurizer Level)	3.3.5.3.2	3.7.1.9.5	N/A	N/A	T (Triconex)	T	
235.		3. Calculated Overpower Setpoint (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) a) MCR Indication b) MCR Recording c) PPC Monitoring	3.3.5.3.3	3.7.1.9.5	N/A	N/A	T (Triconex)	T	
236.		4. Calculated Overtemperature Setpoint (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) a) MCR Indication b) MCR Recording c) PPC Monitoring	3.3.5.3.4	3.7.1.9.5	N/A	N/A	T (Triconex)	T	
237.	3.2.5.5 Alarms and Annunciators The following alarm outputs shall be provided for the DTTA channels:	1. Tcold sensor(s) failed as determined by the SQA2 algorithm (see Section 3.2.5.13.8). (Actuation input to “RTD Failure” annunciator).	3.3.5.4.1	3.13.1.9.6.5 3.7.1.9.5	N/A	N/A	T (Triconex)	T	
238.		2. Thot sensor(s) failed as determined by the SQA3 algorithm (see Section 3.2.5.13.9). (Actuation input to “RTD Failure” annunciator).	3.3.5.4.1	3.13.1.9.6.5 3.7.1.9.4.11	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
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			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
239.		3. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
240.		4. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) Power Range Flux input out of range b) Power Range Flux input is open circuit (as constrained by Section 3.2.5.5.4 e)) c) Pressurizer Pressure sensor input is out of range (as constrained by Section 3.2.5.5.4 d)) d) Pressurizer Pressure out of range alarm shall be disabled when Tavg is less than or equal to 530°F and enabled when Tavg is greater than 531°F. e) Power Range Flux input open circuit alarm shall be disabled when the associated DTTA channel is out of service.	3.3.5.4.1	3.13.1.9.6.2.6 3.7.1.9.7	d) SDS-0190[E], 0320.2[E], 0320.3[E], 0320.4[E], 0320.5[E], 0095.3[E]	N/A	T (Triconex) T (Westinghouse	T	Westinghouse exception: d), in lieu of Tavg, WEC uses 2 of 3 NR Thots < 530, resets at 531. Tavg is not calculated by ALS. Documented in CDER FRS R9. Exception documented in CDER FRS R9.
241.		5. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: a) Tcold temperature input signal out of range b) Thot temperature input signal out of range c) Thot temperature deviation as determined by SQA3A or SQA3B algorithm d) Alarms per subsection c) shall be disabled when the DTTA function is out of service.	3.3.5.4.1	3.7.1.9.7 3.13.1.9.6.1.5 3.7.1.9.4.10 3.7.1.9.4.9 3.7.1.9.7	N/A	N/A	T (Triconex)	T	
242.	3.2.5.6 Interlocks and Permissives The following comparator outputs shall be provided by the DTTA channels:	1. OPDT Interlock C-4 (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) For use by Interlock C-4 logic [De-energize to Trip]. Note: Comparator output voltage provided externally from RNARA	3.3.5.1	3.7.1.9.3	N/A	N/A	T (Triconex)	T	
243.		2. OTDT Interlock C-3 (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) For use by Interlock C-3 logic [De-energize to Trip]. Note: Comparator output voltage provided externally from RNARA.	3.3.5.5	3.7.1.9.3	N/A	N/A	T (Triconex)	T	
244.		3. Low-Low Tavg Permissive P-12 (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) For use by SSPS Protection Interlock P-12 logic [De-energize to Trip].	3.3.5.5	3.7.1.9.3	N/A	N/A	T (Triconex)	T	

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			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
245.	3.2.5.7 Trips and Trip Logic The following comparator outputs shall be provided by the DTTA channels:	1. Overpower Delta-T (OPDT) Reactor Trip (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) For use by the SSPS OPDT Reactor Trip logic [De-energize to Trip].	3.3.5.6.1	3.7.1.9.3	N/A	N/A	T (Triconex)	T	
246.		2. Overtemperature Delta-T (OTDT) Reactor Trip (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) For use by the SSPS OTDT Reactor Trip logic [De-energize to Trip].	3.3.5.6.1	3.7.1.9.3	N/A	N/A	T (Triconex)	T	
247.		3. Low Tavg Feedwater Isolation (Protection Set I [Loop 1], Protection Set II [Loop 2], Protection Set III [Loop 3], Protection Set IV [Loop 4]) For use by SSPS Feedwater Isolation logic [De-energize to Trip].	3.3.5.6.1	3.7.1.9.3	N/A	N/A	T (Triconex)	T	
248.	3.2.5.8 Accuracy No additional requirements to those identified in Section 3.2.1.8.								
249.	3.2.5.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be scaled as follows:	1. Input Variables a. Thot (Th): [4-wire 200 ohm platinum RTD] = 350 to 650°F (minimum range) b. Tcold (Tc): [4-wire 200 ohm platinum RTD] = 350 to 650°F (minimum range) c. Pressurizer Pressure 4 – 20 mA = 1250 to 2500 psig d. Lower Flux, NIS Power Range: 0 – 10 VDC = 0 to 60% (power) e. Upper Flux, NIS Power Range: 0 – 10 VDC = 0 to 60% (power)	3.3.5.8.1	3.7.1.9.3	SDS-0176, 0182, 0413	N/A	T (Triconex) T (Westinghouse) O (Westinghouse)	T	
250.		2. Calculated Variables a. Power Range Axial Flux Difference [Calculated] = -60 to +60% (power) b. PB (Normalized Power Factor) [Calculated] = 0 to 1.5 c. Delta-T (ΔT): [Calculated] = 0 to 150% (power) d. OPDT Setpoint [Calculated] = 0 to 150% (power) e. OTDT Setpoint [Calculated] = 0 to 150% (power) f. Tavg: [Calculated] = 530 to 630°F	3.3.5.8.2	3.7.1.9.4.12 3.7.1.9.4.13 3.7.1.9.4.4 3.7.1.9.4.5 3.7.1.9.4.6	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
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			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
251.		3. Output Variables a. Tavg: 530 to 630°F = 4-20 mA (low limited to 530°F) b. Delta-T (ΔT): 0 to 150% (power) = 4 – 20 mA (as constrained by Section 3.2.5.9.3 e)) c. OPDT Setpoint 0 to 150% (power) = 4 – 20 mA d. OTDT Setpoint 0 to 150% (power) = 4 – 20 mA e. Delta-T output shall be set to zero when Tavg is less than or equal to 530oF and set equal to calculated value of Delta-T when Tavg is greater than 531°F	3.3.5.8.3	3.7.1.9.5	N/A	N/A	T (Triconex)	T	
252.	3.2.5.10 Time Response No additional requirements to those identified in Section 3.2.1.10.								
253.	3.2.5.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11								
254.	3.2.5.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
255.	3.2.5.13 Controller Transfer Functions The following controller transfer functions are used in the processing of DTTA channels:	1. Lag Units Lag units shall be provided for each of the loop Thot and Tcold input signals used for OTDT and OPDT Protection. Lag units shall be provided for each of the loop Thot Streaming Factor calculated outputs. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.1	3.7.1.9.4.1 3.7.1.9.1	N/A	N/A	T (Triconex)	T	OTDT, OPDT and Streaming Factors are processed by the Tricon platform only and do not apply to the ALS platform Triconex exception taken per CDER 993754-29
256.		2. Lead/Lag Units Lead/Lag units shall be provided for each of the measured loop Tavg and ΔT signals used for OTDT and OPDT Protection. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.2	3.7.1.9.2 3.7.1.9.4.12 3.7.1.9.4.2	N/A	N/A	T (Triconex)	T	OTDT and OPDT are processed by the Tricon platform only and do not apply to the ALS platform

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
257.		3. Rate/Lag Units A Rate/Lag unit shall be provided for each of the loop Tavg signals used for OPDT Protection. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.3	3.7.1.9.4.13 3.7.1.9.4.3	N/A	N/A	T (Triconex)	T	OPDT is processed by the Tricon platform only and do not apply to the ALS platform
258.		4. Tavg and Delta-T Calculations The loop average temperature (Tavg) and temperature delta between hot and cold legs (ΔT) shall be calculated by each DTTA channel. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.4	3.7.1.9.4.4 3.7.1.9.4.6	N/A	N/A	T (Triconex)	T	Tavg and ΔT are processed by the Tricon platform only and do not apply to the ALS platform
259.		5. RTD Resistance to Temperature Calculation Refer to Reference 1.4.3.18 for details.	N/A	N/A	N/A	N/A	N/A	N/A	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform
260.		6. OTDT Setpoint Calculation The OTDT Setpoint shall be calculated for each DTTA channel. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.5	3.7.1.9.4.12	N/A	N/A	T (Triconex)	T	
261.		7. OPDT Setpoint Calculation The OPDT Setpoint shall be calculated for each DTTA channel. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.6	3.7.1.9.4.13	N/A	N/A	T (Triconex)	T	
262.		8. Sensor Quality Algorithm 2 (SQA2) The SQA2 Algorithm shall be used in development of the average filtered Tcold signal in each DTTA channel. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.7	3.7.1.9.4.7	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
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			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
263.		9. Sensor Quality Algorithms 3A and 3B (SQA3A/SQA3B) The SQA3A and SQA3B Algorithms shall be used in development of the average filtered Thot signal in each DTTA channel. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.8	3.7.1.9.4.11	N/A	N/A	T (Triconex)	T	
264.		10. Thot Streaming Factor Calculation A temperature streaming correction factor shall be calculated for each Thot RTD as constrained by the following: a) The streaming factors (for each group) that are made available to the HSI (output of lag filters) shall be set to zero until the following validation checks are satisfied: i. The sum of the streaming factors (output from lag filters) for the group is 0.0 ± 0.2ºF ii. The streaming factors for the group (output from calculation) are not equal to zero for more than six time constants (Thot lag filter streaming constant) [Section 3.2.5.14.7 ff)]. Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.9 3.3.5.14.8	3.7.1.9.4.8 4.5.1.3.1	N/A	N/A	T (Triconex)	T	
265.		11. Normalized Power (PB) Calculation Normalized Power (PB) shall be calculated for each DTTA Channel as constrained by the following: a) PB shall be set to 0.0 whenever Tavg is less than or equal to 530°F b) PB shall be the calculated value of PB whenever Tavg is greater than 531°F Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.5.14.	3.3.5.12.10	3.7.1.9.4.5, 3.7.1.9.4.8	N/A	N/A	T (Triconex)	T	
266.	3.2.5.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to	1. OPDT Turbine Runback (OPTR): -20.000 to 20.000 percent (usually negative)	3.3.5.13.1	3.7.1.9.2	N/A	N/A	T (Triconex)	T	
267.		2. OTDT Turbine Runback (OTTR): -20.000 to 20.000 percent (usually negative)	3.3.5.13.1	3.7.1.9.2	N/A	N/A	T (Triconex)	T	

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			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
268.	the comparator setpoints and tunable parameters of the DTTA channels:	3. OPDT Reactor Trip: -20.000 to 20.000 percent (usually zero)	3.3.5.13.1	3.7.1.9.2	N/A	N/A	T (Triconex)	T	
269.		4. OTDT Reactor Trip: -20.000 to 20.000 percent (usually zero)	3.3.5.13.1	3.7.1.9.2	N/A	N/A	T (Triconex)	T	
270.		5. LOW Tavg Feedwater Isolation: 530.000 to 630.000°F	3.3.5.13.1	3.7.1.9.2	N/A	N/A	T (Triconex)	T	
271.		6. LOW-LOW Tavg P-12: 530.000 to 630.000°F	3.3.5.13.1	3.7.1.9.2	N/A	N/A	T (Triconex)	T	
272.		7. Tunable Parameters: a. f1(ΔI)A (OTDT Flux Imbalance) 0.000 to -50.000% b. f1(ΔI)B (OTDT Flux Imbalance) -0.010000 to -0.030000/percent c. f1(ΔI)C (OTDT Flux Imbalance) 0.000000 to 1.000000 d. f1(ΔI)D (OTDT Flux Imbalance) 0.000 to 50.000% e. f2(ΔI)F (OPDT Flux Imbalance) 0.000 to -50.000% f. f2(ΔI)H (OPDT Flux Imbalance) 0.000000 to 1.000000 g. f2(ΔI)I (OPDT Flux Imbalance) 0.000 to 50.000% h. f2(ΔI)J (OPDT Flux Imbalance) 0.010000 to 0.030000/percent i. f1(ΔI)N (OTDT Flux Imbalance) 0.010000 to 0.030000/percent j. f1(ΔI)Q (OTDT Flux Imbalance) 0.000000 to 1.000000 k. f2(ΔI)V (OPDT Flux Imbalance) -0.010000 to -0.030000/percent l. f2(ΔI)W (OPDT Flux Imbalance) 0.000000 to 1.000000 m. P° (OTDT Setpoint) 1700.00 to 2500.00 psig n. ΔT° (PB Calculation) 30.000 to 80.000°F o. T°avg (OTDT Setpoint) 540.000 to 590.000°F p. T′avg (OPDT Setpoint) 540.000 to 590.000°F q. DELTAC (Tcold SQA2 Algorithm) 0.000 to 10.000°F r. DELTAH (Thot SQA3A(B) Algorithm) 0.000 to 25.000°F s. K1 (OTDT Setpoint) 0.700 to 1.500 t. K2 (OTDT Setpoint) 0.010000 to 0.030000/°F u. K3 (OTDT Setpoint) 0.000350 to 0.001000/psig v. K4 (OPDT Setpoint) 0.700 to 1.500	3.3.5.13.2	3.7.1.9.4.12 3.7.1.9.4.13 3.7.1.9..4.7 3.7.1.9.4.10 3.7.1.9.4.9 3.7.1.9.4.2 3.7.1.9.4.3 3.7.1.9.1 3.7.1.9.4.8 3.3.1.9.4 3.7.1.9.4.5	SDS-0182.2 SDS-0182-3 SDS-0182-4 SDS-0182-5 SDS-0184-2, SDS-0184-3	N/A	T (Triconex) T (Westinghouse)	T	Westinghouse exception: (ll). Use range of 150.000-250.000 ohm instead of 50.000-250.000 ohm (Tcold RTD constant) (qq). Use range of 150.000-250.000 ohm instead of 50.000-250.000 ohm (Thot RTD constant) (mm & rr). Use range of 0.300000 to 0.600000 ohm/°F instead of 0.200000 to 0.600000 ohm/°F (kk & pp). Uses one digit after decimal (-12.0 to 12.0 °F) instead of (-12.000 to 12.000 °F) Exception documented in CDER FRS R9.

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		w. K5 (OPDT Setpoint) 0.010000 to 0.030000/°F x. K6 (OPDT Setpoint) 0.001000 to 0.003000/°F y. τ1 Lead Constant (Tavg Lead/Lag) 0.000 to 60.000 seconds z. τ2 Lag Constant (Tavg Lead/Lag) 0.000 to 60.000 seconds aa. τ3 Rate and Lag Constant (Tavg Rate/Lag) 0.000 to 30.000 seconds bb. τ4 Lead Constant (ΔT Lead/Lag) 0.000 to 60.000 seconds cc. τ5 Lag Constant (ΔT Lead/Lag) 0.000 to 60.000 seconds dd. τ6 Lag Constant (Thot Lag) 0.000 to 30.000 seconds ee. τ7 Lag Constant (Tcold Lag) 0.000 to 30.000 seconds ff. τ8 Lag Constant (Thot Streaming Lag) 0.000 to 600.000 seconds gg. SXY Calculated Thot Streaming Factor -20.000 to 20.000°F Note: X = 1, 2, or 3; Y = A or B hh. P_{LOW} P_B Threshold (User entered constant) 0.000 to 1.000 ii. SCAL FLUX CALIB f1(ΔI)/f2(ΔI) (User entered constant) 1.000000 to 10.000000 jj. m Tcold input scaling (gain) 0.5000 to 1.9000 kk. b Tcold input scaling (offset) -12.000 to 12.000°F ll. a Tcold RTD constant 50.000 to 250.000 mm. b Tcold RTD constant 0.200000 to 0.600000 ohms/°F nn. c Tcold RTD constant -0.500000E-04 to -0.100000E-04 ohms/(°F*°F) oo. m Thot input scaling (gain) 0.5000 to 1.9000 pp. b Thot input scaling (offset) -12.000 to 12.000°F qq. a Thot RTD constant 50.000 to 250.000 rr. b Thot RTD constant 0.200000 to 0.600000 ohms/°F ss. c Thot RTD constant -0.500000E-04 to -0.100000E-04 ohms/(°F*°F) tt. m Power Range Flux input scaling (gain) 0.5000 to 1.9000 uu. b Power Range Flux input scaling (offset) -6.0000 to 6.0000% vv. m Pressurizer Pressure input scaling (gain) 0.5000 to 1.9000 ww. b Pressurizer Pressure input scaling (offset) -125.00 to 125.00 psig							

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
273.		8. All displays of measured ΔT and ΔT setpoints shall be in percent of full power ΔT with scales reading 0 – 150%.	N/A	N/A	N/A	PG&E Scope	DCP	T	
274.		9. During initial plant operation, the ΔT channels will be calibrated to indicate 100% at 100% power such that the channels do not reflect minor flow variations between loops or minor variations from design flow. Provisions to allow this calibration shall be available in each channel before the ΔT signal is used for any alarm or protective function.	3.3.5.13.2	3.3.1.9.4	N/A	N/A	T (Triconex)	T	
275.		10. It is recommended that different tuning constants be used in the OTDT and OPDT setpoint calculations (T° avg and T/avg respectively) to represent the nominal Tavg at rated thermal power so that they can be set and changed independently should the need arise in the future. In most applications, both constants will have the same range setting.	N/A	N/A	N/A	N/A	N/A	N/A	Not a requirement
276.	3.2.5.15 Test and Calibration The following shall apply to all DTTA channels	1. The capability shall be provided to locally monitor the following variables from all DTTA channels in addition to those that are manually entered: a) Filtered T_{hot} for all T_{hot} sensors b) Filtered T_{cold} for all T_{cold} sensors	3.3.5.14.7	3.7.1.9.4.8 3.7.1.9.4.7	N/A	N/A	T (Triconex)	T	
277.		2. The capability shall be provided for determining the RTD element resistance without lifting field terminations:	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Hardware supplied by PG&E, wiring determined by PG&E

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
278.		3. The capability shall be provided to transmit the following variable quantities from all DTTA channels to the PPC for recording and storage: a) Deleted b) Deleted c) Deleted d) Deleted e) Filtered Thot values (refer to Section 3.2.5.1.6 a) f) Filtered Tcold values (refer to Section 3.2.5.1.5 a) g) Thot Inputs (refer to Section 3.2.5.9.1 a) h) Tcold Inputs (refer to Section 3.2.5.9.1 b) i) PB (refer to Section 3.2.5.1.9) j) Filtered Thot Average value (refer to Section 3.2.5.1.6 g) k) Filtered Tcold Average value (refer to Section 3.2.5.1.5 d) l) Filtered Thot Streaming Factor values (refer to Section 3.2.5.13.10) m) Lead/Lag compensated value of □T (refer to Section 3.2.5.13.2) n) Lead/lag compensated value of Tavg (refer to Section 3.2.5.13.2) o) Rate/Lag compensated value of Tavg (refer to Section 3.2.5.13.3) p) Thot-EST values (refer to Section 3.2.5.1.6 b) q) SQA3A Filtered Thot Average value (refer to Section 3.2.5.1.6 c) r) SQA3B Filtered Thot Average value (refer to Section 3.2.5.1.6 d)	3.3.5.14.8	3.7.1.9.4.8 3.7.1.9.6	SDS-0602	N/A	T (Triconex) T (Westinghouse)	T	
279.	3.2.5.16 Failure Mode Requirements	Detected RTD failures shall result in a low-going signal (failed low).	N/A	N/A	SDS-0198, 0198.1	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
3.2.6 Specific Requirements for Pressurizer Level The following specific requirements apply to the Pressurizer Level channels and are in addition to the requirements specified in Section 3.2.1.									
280.	3.2.6.1 Functional Description Pressurizer Level channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								
281.	3.2.6.1.1 Pressurizer Level (Protection Set I) Reference 1.4.2.2.6								
282.	3.2.6.1.2 Pressurizer Level (Protection Set II) Reference 1.4.2.2.28								
283.	3.2.6.1.3 Pressurizer Level (Protection Set III) Reference 1.4.2.2.50								
284.	3.2.6.1.4	Isolated signals (not processed by the PPS) from all Pressurizer Level channel sensors shall be provided for use by the Pressurizer Level Control System.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
285.	3.2.6.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
286.	3.2.6.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3.	N/A	N/A	N/A	N/A	N/A	N/A	
287.	3.2.6.4 Outputs for Monitoring, Indication, Recording, and Control The following	1. Pressurizer Level (Protection Sets I, II) a) MCR Indication b) PPC Monitoring c) Hot Shutdown Panel Indication d) Pressurizer Level Control (Control Set I) e) Pressurizer Level Control (Control Set II) f) ERFDS Monitoring	3.3.6.3	3.11.1.9.6	N/A	PG&E Scope	DCP T (Triconex)	T	PG&E (a,c-f) Invensys: PPC Monitoring only

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
288.	outputs shall be provided by the Pressurizer Level channels:	2. Pressurizer Level (Protection Set III) a) MCR Indication b) PPC Monitoring c) Pressurizer Level Control (Control Set I) d) Pressurizer Level Control (Control Set II) e) ERFDS Monitoring	3.3.6.3	3.11.1.9.6	N/A	PG&E Scope	DCP T (Triconex)	T	PG&E (a, c-d) Invensys: PPC Monitoring only(b)
289.	3.2.6.5 Alarms and Annunciators The following alarm outputs shall be provided for the Pressurizer Level channels:	1. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) Input sensor out of range	3.3.6.4	3.11.1.9.7	N/A	N/A	T (Triconex)	T	
290.		2. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: a) No additional requirements to those identified in Section 3.2.1.5.2.	N/A	N/A	N/A	N/A	N/A	N/A	
291.	3.2.6.6 Interlocks and Permissives There are no interlocks or permissives associated with PPS Pressurizer Level channel processing.								
292.	3.2.6.7 Trips and Trip Logic The following comparator outputs shall be provided by the Pressurizer Level channels:	1. Pressurizer Level High Reactor Trip (Protection Sets I, II, III) For use by the SSPS Pressurizer Level High Reactor Trip logic [De-energize to Trip].	3.3.6.6	3.11.1.9.2 3.11.1.9.3	N/A	N/A	T (Triconex)	T	
293.	3.2.6.8 Accuracy No additional requirements to those identified in Section 3.2.1.8.								
294.	3.2.6.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and	1. Input Variables: a) Pressurizer Level: 4 – 20 mA = 0 to 100%	3.3.6.8.1	3.11.1.9.1	N/A	N/A	T (Triconex)	T	
295.		2. Calculated Variables: None	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
296.	output variables shall be scaled as follows:	3. Output Variables: a) Pressurizer Level: 4 – 20 mA [0 to 100%] = 4 – 20 mA (from input loop) b) Pressurizer Level: 4 – 20 mA [0 to 100%] = 4 – 20 mA (input loop Class IA/II isolator)	N/A	N/A	N/A	PG&E Scope	DCP	T	Indicators are on the input loop
297.	3.2.6.10 Time Response No additional requirements to those identified in Section 3.2.1.10								
298.	3.2.6.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
299.	3.2.6.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
300.	3.2.6.13 Controller Transfer Functions No additional requirements to those identified in Section 3.2.1.13								
301.	3.2.6.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Pressurizer Level channels:	1. Pressurizer Level High Reactor Trip: 40.000 to 100.000%	3.3.6.13.1	3.11.1.9.2	N/A	N/A	T (Triconex)	T	
302.		2. Tunable Parameters a) Input scaling m (gain) 0.5000 to 1.9000 b) Input scaling b (offset) -10.000 to 10.000%	3.3.6.13.2	3.3.1.9.8	N/A	N/A	T (Triconex)	T	
303.	3.2.6.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15.	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
304.	3.2.6.16 Failure Mode Requirements	No additional requirements to those identified in Section 3.2.1.16.	N/A	N/A	N/A	N/A	N/A	N/A	
3.2.7 Specific Requirements for Pressurizer Pressure The following specific requirements apply to the Pressurizer Pressure channels and are in addition to the requirements specified in Section 3.2.1.									
305.	3.2.7.1 Functional Description Pressurizer Pressure channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								
306.	3.2.7.1.1 Pressurizer Pressure (Protection Set I) Reference 1.4.2.2.7, 1.4.2.2.8								
307.	3.2.7.1.2 Pressurizer Pressure (Protection Set II) Reference 1.4.2.2.29, 1.4.2.2.30								
308.	3.2.7.1.3 Pressurizer Pressure (Protection Set III) Reference 1.4.2.2.51, 1.4.2.2.52								
309.	3.2.7.1.4 Pressurizer Pressure (Protection Set IV) Reference 1.4.2.2.63, 1.4.2.2.64,								
310.	3.2.7.1.5	Each Pressurizer Pressure channel shall provide a Pressurizer Pressure signal for use by the DTTA channel processed in the same Protection Set.	3.1.1.1.3.2 3.3.5.8.1	3.7.1.9.1	N/A	N/A	T	T	ALS and Tricon share transmitter loop
311.	3.2.7.1.6	Isolated signals (not processed by the PPS) from all Pressurizer Pressure channel sensors shall be provided for use by the Pressurizer Pressure Control System.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Input loop to provide signal to PCS

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
312.	3.2.7.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
313.	3.2.7.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3.	N/A	N/A	N/A	N/A	N/A	N/A	
314.	3.2.7.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Pressurizer Pressure channels:	1. Pressurizer Pressure (Protection Set I): a) MCR Indication b) PPC Monitoring – Pressurizer Pressure c) Hot Shutdown Panel Indication d) Pressurizer Pressure Control e) PPC Monitoring – Pressurizer Pressure Lead/Lag	N/A	N/A	SDS-0602	PG&E Scope	DCP T (Westinghouse)	T	PG&E (a, c-e) Westinghouse: PPC Monitoring only (b)
315.		2. Pressurizer Pressure (Protection Sets II, III, IV): a. MCR Indication b. PPC Monitoring – Pressurizer Pressure c. Pressurizer Pressure Control d. PPC Monitoring – Pressurizer Pressure Lead/Lag	N/A	N/A	SDS-0602	PG&E Scope	DCP T (Westinghouse)	T	PG&E (a,c-d) Westinghouse: PPC Monitoring only (b)
316.	3.2.7.5 Alarms and Annunciators The following alarm outputs shall be provided for the Pressurizer Pressure channels:	1. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) No additional requirements to those identified in Section 3.2.1.5.1. b) Pressurizer Pressure input sensor out of range will be per Section 3.2.5.5.4. Note: Pressurizer Pressure sensor input is provided to DTTA channel and Pressurizer Pressure channel. The alarming function for out of range required by Section 2.3.1.2 will be performed by the DTTA channel.	N/A	N/A	N/A	N/A	N/A	N/A	See #240
317.		2. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: a) No additional requirements to those identified in Section 3.2.1.5.2	N/A	N/A	N/A	N/A	N/A	N/A	
318.	3.2.7.6 Interlocks and Permissives	1. Pressurizer Pressure High P-11 Interlock (Protection Sets I, II, III) For use by the SSPS P-11 Interlock logic [De-energize to Trip].	N/A	N/A	SDS-0218, 0227, 0227.1, 0227.4, 0235	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
319.	The following comparator outputs shall be provided by the Pressurizer Pressure channels:	2. Pressurizer Pressure High PORV Control (Protection Sets I, II, III, IV) For use by the PORV Control logic [Energize to Trip].	N/A	N/A	SDS-0218, 0227, 0227.1, 0227.4, 0235	N/A	T (Westinghouse)	T	
320.	3.2.7.7 Trips and Trip Logic (RTS and ESFAS) The following comparator outputs shall be provided by the Pressurizer Pressure channels:	1. Pressurizer Pressure Low Reactor Trip (Protection Sets I, II, III, IV) For use by the SSPS Pressurizer Pressure Low Reactor Trip logic [De-energize to Trip].	N/A	N/A	SDS-0218, 0227, 0227.2, 0227.4, 0235	N/A	T (Westinghouse)	T	
321.		2. Pressurizer Pressure Low-Low Safety Injection (SI) (Protection Sets I, II, III, IV) For use by the SSPS Pressurizer Pressure Low-Low SI logic [De-energize to Trip].	N/A	N/A	SDS-0218, 0227, 0227.2, 0227.4, 0235	N/A	T (Westinghouse)	T	
322.		3. Pressurizer Pressure High Reactor Trip (Protection Sets I, II, III, IV) For use by the SSPS Pressurizer Pressure High Reactor Trip logic [De-energize to Trip].	N/A	N/A	SDS-0218, 0227, 0227.1, 0227.4, 0235	N/A	T (Westinghouse)	T	
323.	3.2.7.8 Accuracy No additional requirements to those identified in Section 3.2.1.8								
324.	3.2.7.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be as follows:	1. Input Variables: a) Pressurizer Pressure:4 – 20 mA = 1250 to 2500 psig	N/A	N/A	SDS-0208, 0219,	N/A	T (Westinghouse)	T	
325.		2. Calculated Variables: a) Pressurizer Pressure Compensated: [Calculated] = 1250 to 2500 psig	N/A	N/A	SDS-0222.7	N/A	O (Westinghouse)	T	
326.		3. Output Variables: a) Pressurizer Pressure: 4 – 20 mA [1250 to 2500 psig] = 4 – 20 mA (input loop Class IA/II isolator)	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
327.	3.2.7.10 Time Response No additional requirements to those identified in Section 3.2.1.10.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
328.	3.2.7.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
329.	3.2.7.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12								
330.	3.2.7.13 Controller Transfer Functions The following controller transfer functions are used in the processing of Pressurizer Pressure channels:	1. Lead-Lag for Pressurizer Low Pressure Reactor Trip Compensation Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.7.14.	N/A	N/A	N/A	N/A	N/A	N/A	Title Information
331.	3.2.7.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Pressurizer Pressure channels:	1. Pressurizer Pressure Low Reactor Trip: 1700.00 to 2250.00 psig	N/A	N/A	SDS-0227.4	N/A	O (Westinghouse)	T	
332.		2. Pressurizer Pressure Low-Low SI Actuation: 1700.00 to 2250.00 psig	N/A	N/A	SDS-0227.4	N/A	O (Westinghouse)	T	
333.		3. Pressurizer Pressure High Reactor Trip: 2250.00 to 2500.00 psig	N/A	N/A	SDS-0227.4	N/A	O (Westinghouse)	T	
334.		4. Pressurizer Pressure High P-11 Permissive: 1700.00 to 2250.00 psig	N/A	N/A	SDS-0227.4	N/A	O (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
335.		5. Pressurizer Pressure High PORV: 1250.00 to 2250.00 psig	N/A	N/A	SDS-0227.4	N/A	O (Westinghouse)	T	Westinghouse exception: 5) Use 1250.00-2500.00 psig adjustable range instead of 1250.00 – 2250.00 psig. Exception documented in CDER FRS R9.
336.		6. Tunable Parameters a) Lead Time Constant 0.000 to 60.000 seconds b) Lag Time Constant 0.000 to 10.000 seconds c) Input scaling m (gain) 0.5000 to 1.9000 d) Input scaling b (offset) -125.00 to 125.00 psig	N/A	N/A	(a) SDS-0222.3 (b) SDS-0222.4 (c) SDS-0220.2 (d) SDS-0220.3 SDS-0222.8	N/A	T (Westinghouse)	T	Westinghouse exception: (a). Uses adjustable range of 0.0 seconds and 0.1-60.0 seconds (b). Uses adjustable range of 0.0 seconds and 0.5 -6.0 seconds Exception documented in CDER FRS R9.
337.	3.2.7.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15.	N/A	N/A	N/A	N/A	N/A	N/A	
338.	3.2.7.16 Failure Mode Requirements	Rev 9 FRS deleted fail as-is requirement; 3.2.1.16 provides requirement	N/A	N/A	N/A	N/A	N/A	N/A	
3.2.8 Specific Requirements for Pressurizer Vapor Temperature The following specific requirements apply to the Pressurizer Vapor Temperature channel and are in addition to the requirements specified in Section 3.2.1.									
339.	3.2.8.1 Functional Description The Pressurizer Vapor Temperature channel is presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. This drawing identifies all inputs, outputs, and external interfaces and provides a simplified representation of the channel functionality (logic).								
340.	3.2.8.1.1 Pressurizer Vapor Temperature (Protection Set IV): Reference 1.4.2.2.65								
341.	3.2.8.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
342.	3.2.8.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3.	N/A	N/A	N/A	N/A	N/A	N/A	
343.	3.2.8.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Pressurizer Vapor Temperature channel:	1. Pressurizer Vapor Temperature (Protection Set IV) a) MCR Indication b) PPC Monitoring	3.3.7.3	3.5.1.9.5	SDS-0602	PG&E	T (Triconex) T (Westinghouse)	T	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform PG&E(a) Westinghouse(b)
344.	3.2.8.5 Alarms and Annunciators The following alarm outputs shall be provided for the Pressurizer Vapor Temperature channel:	2. The following conditions shall produce an output to the "PPS Failure" annunciator in the MCR: a) No additional requirements to those identified in Section 3.2.1.5.1.	N/A	N/A	N/A	N/A	N/A	N/A	
345.		3. The following conditions shall produce an output to the "PPS Trouble" annunciator in the MCR: a) Input sensor out of range	3.3.7.4	3.5.1.9.7	N/A	N/A	T (Triconex)	T	ALS does not alarm temperature sensor out of range
346.	3.2.8.6 Interlocks and Permissives The following interlocks and/or permissives are applicable to the Pressurizer Vapor Temperature channel:	1. Pressurizer Vapor Temperature Low (Protection Set IV) For use by the RHR Valve 8701 Interlock Circuit [Energize to Trip]. The Pressurizer Vapor Space Temperature Low comparator output shall be interlocked with the Wide Range Pressure Low Loop 4 comparator output to the RHR Valve 8701 Interlock circuit. A graphical presentation is shown on References 1.4.2.2.60 and 1.4.2.2.65.	3.3.7.5	3.5.1.9.2 3.6.4.9.3	N/A	N/A	T (Triconex)	T	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
347.	3.2.8.7 Trips and Trip Logic The following comparator outputs shall be provided by the Pressurizer Vapor Temperature channel: None								
348.	3.2.8.8 Accuracy No additional requirements to those identified in Section 3.2.8.8.								
349.	3.2.8.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be scaled as follows:	1. Input Variables: a. Pressurizer Vapor Temperature: [3-wire 200 ohm platinum RTD] = 100 to 700ºF (minimum range)	3.3.7.8.1	3.5.1.9.1	SDS-0244, 0250, 0414	N/A	T (Triconex) T (Westinghouse)	T	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform
350.		2. Calculated Variables: None	N/A	N/A	N/A	N/A	N/A	N/A	
351.		3. Output Variables: a. Pressurizer Vapor Temperature: 100 to 700°F = 4 – 20 mA	3.8.7.8.3	3.5.1.9.5	N/A	N/A	T (Triconex)	T	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform
352.	3.2.8.10 Time Response No additional requirements to those identified in Section 3.2.1.10.								
353.	3.2.8.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
354.	3.2.8.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
355.	3.2.8.13 Controller Transfer Functions	1. RTD Resistance to Temperature Calculation Refer to Reference 1.4.3.18 for details.	N/A	N/A	SDS-0152 SDS-0182. SDS-0250	N/A	O (Westinghouse) (See RTM-TFS Item 8)	T	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
356.	3.2.8.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Pressurizer Vapor Temperature channel:	1. Pressurizer Vapor Temperature Low (RHR Interlock): 100.000 to 700.000ºF	3.3.7.13.1	3.3.1.9.2 3.5.1.9.2	N/A		T (Triconex)	T	RTD conversion is processed by the ALS platform only, the Tricon platform receives a 4-20 mA scaled signal from the ALS platform
357.		2. Deleted 3. Tunable Parameters a. Input scaling m (gain) 0.5000 to 1.9000 b. Input scaling b (offset) -60.000 to 60.000°F c. RTD a constant 150.000 to 250.000 ohms d. RTD b constant 0.200000 to 0.600000 ohms/°F e. RTD c constant -0.500000E-04 to -0.100000E-04 ohms/(°F*°F)	3.3.7.13.2	3.3.1.9.2	SDS-0252.2 SDS-0252.3[E] SDS-0250.2 SDS-0250.3[E] SDS-0250.4		T (Triconex) T (Westinghouse)	T	Westinghouse exception: (b) Decimal precision to 3 decimals is not supported by the application. Westinghouse proposes to use a precision of one (1) decimal. The range -60.0 to 60.0 proposed by Westinghouse is acceptable to PG&E (d) Values for scaling constant b from 0.200000 to 0.300000 produce invalid results in the RTD conversion calculation. The valid range 0.300000 to 0.600000 proposed by Westinghouse is acceptable to PG&E. Exception documented in CDER FRS R9. SAT: Triconex (a, b) Westinghouse (a, b, c, d, e)
358.	3.2.8.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15	N/A	N/A	N/A	N/A	N/A	N/A	
359.	3.2.8.16 Failure Mode Requirements	Detected RTD failures shall result in a low-going signal (failed low).	N/A	N/A	SDS-0264, 0264.1	N/A	T (Westinghouse)	T	ALS sets 4-20 mA signal to 0 mA on RTD failure; Tricon provides alarm on sensor OOR low.
3.2.9 Specific Requirements for Steamflow The following specific requirements apply to the Steamflow channels and are in addition to the requirements specified in Section 3.2.1.									
360.	3.2.9.1 Functional Description Steamflow channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
361.	3.2.9.1.1 Steamflow Loops 1 thru 4 (Protection Set I): References 1.4.2.2.9 thru 1.4.2.2.12								
362.	3.2.9.1.2 Steamflow, Loops 1 thru 4 (Protection Set II): References 1.4.2.2.31 thru 1.4.2.2.34								
363.	3.2.9.1.3	The Steamline Pressure signal used for Steamflow compensation shall be from the Steamline Break Protection channel processed in the same Protection Set (see Section 3.2.10).	3.3.8.12.1	3.10.1.9.4, 3.10.2.9.4 3.10.3.9.4, 3.10.4.9.4	N/A	N/A	T (Triconex)	T	
364.	3.2.9.1.4 The following isolated signals (not processed by the PPS) shall be provided for use by the Digital Feedwater Control System (DFWCS): a) Steamflow channel sensor input, Steam Generators 1, 2, 3, 4 (Protection Sets I, II)								
365.	3.2.9.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
366.	3.2.9.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3.	N/A	N/A	N/A	N/A	N/A	N/A	
367.	3.2.9.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided from the Steamflow channels:	1. Steamflow Steam Generator 1, 2, 3, 4 (Protection Set I) a) [Compensated] MCR Indication b) [Compensated] ERFDS Monitoring c) DFWCS d) [Compensated] PPC Monitoring	3.3.8.3.1	3.10.1.9.5, 3.10.2.9.5 3.10.3.9.5, 3.10.4.9.5 3.10.1.9.6 3.10.2.9.6 3.10.3.9.6	N//A	PG&E Scope	T (Triconex)	T	PG&E (c) Triconex (a, b, d)
368.		2. Steamflow Steam Generator 1, 2, 3, 4 (Protection Set II) a) [Compensated] MCR Indication b) [Compensated] ERFDS Monitoring c) DFWCS d) d) [Compensated] PPC Monitoring	3.3.8.3.1	10.1.9.5, 3.10.2.9.5 3.10.3.9.5, 3.10.4.9.5 3.10.1.9.6, 3.10.2.9.6 3.10.3.9.6	N/A	PG&E Scope	T (Triconex)	T	PG&E (c) Triconex (a, b, d)
369.	3.2.9.5 Alarms and Annunciators	1. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) No additional requirements to those identified in Section 3.2.1.5.1.	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
370.	The following alarm outputs shall be provided for the Steamflow channels:	2. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: a) Input sensor out of range	3.3.8.4	3.10.1.9.7 3.10.2.9.7 3.10.3.9.7 3.10.4.9.7	N/A	N/A	T (Triconex)	T	
371.		3. The following conditions shall produce an output to actuate the "PPS Out Of Service" annunciator in the MCR: a) A Steam Flow Indicator (FI) out of service alarm condition shall be set any time the associated Steamline Pressure channel (Section 3.2.9.1.3) is out of service.	3.3.9.2.4	SET I, II 3.10.1.9.7 3.10.2.9.7 3.10.3.9.7 SET I 3.9.1.9.7 3.9.2.9.7 3.9.3.9.7 3.9.4.9.7 3.10.4.9.7 SET II 3.9.1.9.6 3.9.2.9.6 3.9.3.9.6 3.9.4.9.6 3.10.4.9.8	N/A	N/A	T (Triconex)	T	
372.	3.2.9.6 Interlocks and Permissives There are no interlocks or permissives associated with Steamflow channel processing.								
373.	3.2.9.7 Trips and Trip Logic The following comparator outputs shall be provided by the Steamflow channels: None								
374.	3.2.9.8 Accuracy No additional requirements to those identified in Section 3.2.1.8.								
375.	3.2.9.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables	1. Input Variables: a. Steamflow: 4 – 20 mA = 0 to 100 XMTR dp%	3.3.8.8.1	SET I & II 3.10.1.9.1 3.10.2.9.1 3.10.3.9.1 SET I 3.10.4.9.1 SET II 3.10.4.9.2	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
376.	shall be scaled as follows:	2. Calculated Variables: a. Steamflow (compensated): Refer to Section 3.2.9.13.	3.3.8.8.2	SET I & II 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 SET I 3.10.4.9.4 SET II 3.10.4.9.5	N/A	N/A	T (Triconex)	T	
377.		3. Output Variables: a. Steamflow (compensated): 0 to 4.5 million pounds per hour = 4 – 20 mA b. Steamflow: 4 – 20 mA [0 to 100 XMTR dp%] = 4 – 20 mA (input loop Class IA/II isolator)	3.3.8.8.3	SET I & II 3.10.1.9.5 3.10.2.9.5 3.10.3.9.5 SET I 3.10.4.9.5 SET II 3.10.4.9.6	N/A	N/A	T (Triconex)	T	
378.	3.2.9.10 Time Response No additional requirements to those identified in Section 3.2.1.10								
379.	3.2.9.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
380.	3.2.9.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
381.	3.2.9.13 Controller Transfer Functions	1. Steamflow Compensation Algorithm Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.9.14.	3.3.8.12.1	SET I & II 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 SET I 3.10.4.9.4 SET II 3.10.4.9.5	N/A	N/A	T (Triconex)	T	
382.		2. Steamflow Normalization Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.9.14.1.	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
383.	3.2.9.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Steamflow channels:	1. Tunable Parameters The following tunable parameters are applicable to the Steamflow Compensation Algorithm: c. SFmin Value equivalent to user-desired SFDP value between 0.000 and 1.000% of full scale DP d. A (Used in Steam Density Calc) 0.002230 to 0.002540 lb/ft3/psig e. B (Used in Steam Density Calc) -0.263000 to 0.000000 lb/ft3 f. (Steam Density)ref 1.570000 to 2.520000 lb/ft3 g. Input scaling m (gain) 0.5000 to 1.9000 h. Input scaling b (offset) -10.000 to 10.000 %DP	3.3.8.13.2	SET I & II 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 3.3.1.9.7 SET I 3.10.4.9.4 SET II 3.10.4.9.5	N/A	N/A	T	T	
384.	3.2.9.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15.	N/A	N/A	N/A	N/A	N/A	T	
385.	3.2.9.16 Failure Mode Requirements	No additional requirements to those identified in Section 3.2.1.16.	N/A	N/A	N/A	N/A	N/A	T	
3.2.10 Specific Requirements for Steamline Break Protection The following specific requirements apply to the Steamline Break Protection channels and are in addition to the requirements specified in Section 3.2.1.									
386.	3.2.10.1 Functional Description Steamline Break Protection channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic):								
387.	3.2.10.1.1 Steamline Break Protection Loops 1, 2, 3, 4 (Protection Set I) References 1.4.2.2.13 thru 1.4.2.2.16								
388.	3.2.10.1.2 Steamline Break Protection Loops 1, 2, 3, 4 (Protection Set II) References 1.4.2.2.35 thru 1.4.2.2.38								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
389.	3.2.10.1.3 Steamline Break Protection Loops 2, 3 (Protection Set III) References 1.4.2.2.53 and 1.4.2.2.54								
390.	3.2.10.1.4 Steamline Break Protection Loops 1, 4 (Protection Set IV) References 1.4.2.2.66 and 1.4.2.2.67								
391.	3.2.10.1.5 The following isolated signals (not processed by the PPS) shall be provided for use by the Digital Feedwater Control System (DFWCS):	a) Steamline Pressure channel sensor input, Steam Generators 1, 2, 3, 4 (Protection Sets I, II, III, IV)	N/A	N/A	N/A	PG&E	DCP	T	DFWCS signal provided by the input loop
392.	3.2.10.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
393.	3.2.10.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3	N/A	N/A	N/A	N/A	N/A	N/A	
394.	3.2.10.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Steamline Break Protection channels:	1. Steamline Pressure Loops 1, 2, 3, 4 (Protection Set I) a) MCR Indication b) ERFDS Monitoring c) Hot Shutdown Panel Indication d) DFWCS e) PPC Monitoring – Steamline Pressure f) PPC Monitoring – Steamline Pressure Lead/Lag g) PPC Monitoring – Steamline Pressure Rate/Lag	3.3.9.3	3.9.1.9.6, 3.9.2.9.6 3.9.3.9.6	N/A	PG&E	T (Triconex)	T	Invensys: e, f, g only PG&E a-d indication provided by the input loop
395.		2. Steamline Pressure Loops 1, 2, 3, 4 (Protection Set II) a) MCR Indication b) ERFDS Monitoring c) DFWCS d) PPC Monitoring – Steamline Pressure e) PPC Monitoring – Steamline Pressure Lead/Lag f) PPC Monitoring – Steamline Pressure Rate/Lag	3.3.9.3	3.9.1.9.5, 3.9.2.9.5 3.9.3.9.5	N/A	PG&E	T (Triconex)	T	Invensys: d-f only PG&E a-c indication provided by the input loop

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
396.		3. Steamline Pressure Loops 2, 3 (Protection Set III) a) MCR Indication b) DFWCS c) PPC Monitoring – Steamline Pressure d) PPC Monitoring – Steamline Pressure Lead/Lag e) PPC Monitoring – Steamline Pressure Rate/Lag	3.3.9.3	3.9.2.9.5, 3.9.3.9.5	N/A	PG&E	T (Triconex)	T	Invensys: c-e only PG&E a-b Indication provided by the input loop
397.		4. Steamline Pressure Loops 1, 4 (Protection Set IV) a) MCR Indication b) DFWCS c) PPC Monitoring – Steamline Pressure d) PPC Monitoring – Steamline Pressure Lead/Lag e) PPC Monitoring – Steamline Pressure Rate/Lag	3.3.9.3	3.9.1.9.5 3.9.4.9.5	N/A	PG&E	T (Triconex)	T	Invensys: c-e only PG&E a-b Indication provided by the input loop
398.	3.2.10.5 Alarms and Annunciators The following alarm outputs shall be provided for the Steamline Break Protection channels:	1. Steamline Loop 1 Pressure Low (Protection Set IV); alarm output to be suppressed when channel is out of service	3.3.9.4.1	3.9.1.9.3	N/A	PG&E	T (Triconex)	T	
399.		2. Steamline Loop 2 Pressure Low (Protection Set III); alarm output to be suppressed when channel is out of service	3.3.9.4.2	3.9.2.9.3	N/A	PG&E	T (Triconex)	T	
400.		3. Steamline Loop 3 Pressure Low (Protection Set III); alarm output to be suppressed when channel is out of service	3.3.9.4.3	3.9.3.9.3	N/A	PG&E	T (Triconex)	T	
401.		4. Steamline Loop 4 Pressure Low (Protection Set IV); alarm output to be suppressed when channel is out of service	3.3.9.4.4	3.9.4.9.3	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
402.		5. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) Input sensor out of range; alarm output to be suppressed when channel is out of service	3.3.9.4	SET I 3.9.1.9.7 3.9.2.9.7 3.9.3.9.7 3.9.4.9.7 SET II 3.9.1.9.6 3.9.2.9.6 3.9.3.9.6 3.9.4.9.6 SET III 3.9.2.9.6 3.9.3.9.6 SET IV 3.9.1.9.6 3.9.4.9.6	N/A	N/A	T (Triconex)	T	
403.		6. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: No additional requirements to those identified in Section 3.2.1.5.2.	N/A	N/A	N/A	N/A	N/A	N/A	
404.	3.2.10.7 Trips and Trip Logic The following comparator outputs shall be provided by the Steamline Break Protection channels:	1. Steamline Pressure Low Loop 1 (Protection Sets I, II, IV) For use by the SSPS Low Steamline Pressure Safety Injection (SI) and Steamline Isolation logic [De-energize to Trip].	3.3.9.6.1	3.9.1.9.2 3.9.1.9.3	N/A	N/A	T (Triconex)	T	
405.		2. Steamline Pressure Low Loop 2 (Protection Sets I, II, III) For use by the SSPS Low Steamline Pressure SI and Steamline Isolation logic [De-energize to Trip].	3.3.9.6.2	3.9.2.9.2 3.9.2.9.3	N/A	N/A	T (Triconex)	T	
406.		3. Steamline Pressure Low Loop 3 (Protection Sets I, II, III) For use by the SSPS Low Steamline Pressure SI and Steamline Isolation logic [De-energize to Trip].	3.3.9.6.3	3.9.3.9.2 3.9.3.9.3	N/A	N/A	T (Triconex)	T	
407.		4. Steamline Pressure Low Loop 4 (Protection Sets I, II, IV) For use by the SSPS Low Steamline Pressure SI and Steamline Isolation logic [De-energize to Trip].	3.3.9.6.4	3.9.4.9.2 3.9.4.9.3	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
408.		5. Steamline Pressure High Negative Rate Loop 1 (Protection Sets I, II, IV) For use by the SSPS Steamline Isolation logic [De-energize to Trip].	3.3.9.6.5	3.9.1.9.2 3.9.1.9.3	N/A	N/A	T (Triconex)	T	
409.		6. Steamline Pressure High Negative Rate Loop 2 (Protection Sets I, II, III) For use by the SSPS Steamline Isolation logic [De-energize to Trip].	3.3.9.6.6	3.9.2.9.2 3.9.2.9.3	N/A	N/A	T (Triconex)	T	
410.		7. Steamline Pressure High Negative Rate Loop 3 (Protection Sets I, II, III) For use by the SSPS Steamline Isolation logic [De-energize to Trip].	3.3.9.6.7	3.9.3.9.2 3.9.3.9.3	N/A	N/A	T (Triconex)	T	
411.		8. Steamline Pressure High Negative Rate Loop 4 (Protection Sets I, II, IV)	3.3.9.6.8	3.9.4.9.2 3.9.4.9.3	N/A	N/A	T (Triconex)	T	
412.	3.2.10.8 Accuracy No additional requirements to those identified in Section 3.2.1.8								
413.	3.2.10.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be as follows:	1. Input Variables a) Steamline Pressure: 4 - 20 mA = 0 to 1200 psig	3.3.9.8.1	SET I & II 3.9.1.9.1, 3.9.2.9.1 3.9.3.9.1, 3.9.4.9.1 SET III 3.9.2.9.1, 3.9.3.9.1 SET IV 3.9.1.9.1, 3.9.4.9.1	N/A	N/A	T (Triconex)	T	
414.		2. Calculated Variables: None	N/A	N/A	N/A	N/A	N/A	N/A	
415.		3. Output Variables: a) Steamline Pressure: 4 – 20 mA [0 to 1200 psig] = 4 - 20 mA (from input loop) b) Steamline Pressure: 4 – 20 mA [0 to 1200 psig] = 4 - 20 mA (input loop Class IA/II isolator)	N/A	N/A	N/A	PG&E Scope	DCP	T	Indication provided by the input loop

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
416.	3.2.10.10 Time Response No additional requirements to those identified in Section 3.2.1.10								
417.	3.2.10.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11								
418.	3.2.10.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
419.	3.2.10.13 Controller Transfer Functions The following controller transfer functions are used in the processing of Steamline Break Protection channels:	1. Steamline Pressure Lead/Lag Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.10.14.	3.3.9.12.1	SET I & II 3.9.1.9.1 3.9.2.9.1 3.9.3.9.1 3.9.4.9.1 SET III 3.9.2.9.1 3.9.3.9.1 SET IV 3.9.1.9.1 3.9.4.9.1	N/A	N/A	T (Triconex)	T	
420.		2. Steamline Pressure Rate/Lag Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.10.14.	3.3.9.12.2	SET I & II 3.9.1.9.1 3.9.2.9.1 3.9.3.9.1 SET I 3.9.4.9.1 SET III 3.9.2.9.1, 3.9.3.9.1 SET IV 3.9.1.9.1	N/A	N/A	T (Triconex)	T	
421.	3.2.10.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to	1. Steamline Pressure Low SI and Steamline Isolation: 385.000 to 885.000 psig	3.3.9.13.1	SET I & II 3.9.1.9.2, 3.9.2.9.2 3.9.3.9.2, 3.9.4.9.2 SET III 3.9.2.9.2, 3.9.3.9.2 SET IV 3.9.1.9.2, 3.9.4.9.2	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
422.	the comparator setpoints and tunable parameters of the Steamline Break Protection channels:	2. Steamline Pressure High Negative Rate Steamline Isolation: 5.000 to 200.000 psig	3.3.9.13.2	SET I & II 3.9.1.9.2, 3.9.2.9.2 3.9.3.9.2, 3.9.4.9.2 SET III 3.9.2.9.2, 3.9.3.9.2 SET IV 3.9.1.9.2, 3.9.4.9.2	N/A	N/A	T (Triconex)	T	
423.		3. Steamline Pressure Low Alarm: 0.00 to 1200.00 psig	3.3.9.13.3	SET III & IV 3.9.2.9.3, 3.9.3.9.3	N/A	N/A	T (Triconex)	T	
424.		4. Tunable Parameters a) Lead Time Constant (Lead/Lag function) 0.000 to 60.000 seconds b) Lag Time Constant (Lead/Lag function) 0.000 to 10.000 seconds c) Rate Time Constant (Rate/Lag function) 0.000 to 200.000 seconds d) Lag Time Constant (Rate/Lag function) 0.000 to 200.000 seconds e) Input scaling m (gain) 0.5000 to 1.9000 f) Input scaling b (offset) -120.00 to 120.00 psig	3.3.9.13.4	SET I & II 3.9.1.9.1, 3.9.2.9.1 3.9.3.9.1, 3.9.4.9.1 3.3.1.9.6 SET III 3.9.2.9.1, 3.9.3.9.1, 3.3.1.9.6 SET IV 3.9.1.9.1, 3.9.4.9.1, 3.3.1.9.6	N/A	N/A	T (Triconex)	T	
425.	3.2.10.15 Test and Calibration	No additional requirements to those identified in Section 3.2.1.15	N/A	N/A	N/A	N/A	N/A	N/A	
426.	3.2.10.16 Failure Mode Requirements	No additional requirements to those identified in Section 3.2.1.16	N/A	N/A	N/A	N/A	N/A	N/A	
3.2.11 Specific Requirements for Steam Generator Narrow Range Level The following specific requirements apply to the S/G Narrow Range Level channels and are in addition to the requirements specified in Section 3.2.1									
427.	3.2.11.1 Functional Description S/G Narrow Range Level channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
428.	3.2.11.1.1 Steam Generator Narrow Range Level, Loops 2 and 3 (Protection Set I): Reference 1.4.2.2.17								
429.	3.2.11.1.2 Steam Generator Narrow Range Level, Loops 1 and 4 (Protection Set II): Reference 1.4.2.2.39								
430.	3.2.11.1.3 Steam Generator Narrow Range Level, Loops 1 thru 4 (Protection Set III): Reference 1.4.2.2.55								
431.	3.2.11.1.4 Steam Generator Narrow Range Level, Loops 1 thru 4 (Protection Set IV): Reference 1.4.2.2.68								
432.	3.2.11.1.5	Isolated signals (not processed by the PPS) from all S/G Narrow Range Level channel sensors shall be provided for use by the DFWCS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	DFWCS signal is provided by the input loop, independent of any processing
433.	3.2.11.1.6	Isolated signals (not processed by the PPS) from all S/G Narrow Range Level channel sensors shall be provided for use by the AFW control system.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	PCS (AFW) signal is provided by the input loop, independent of any processing
434.	3.2.11.1.7	Isolated signals (not processed by the PPS) from S/G Narrow Range Level channel sensors shall be provided for use by the AMSAC system as follows: a. S/G Narrow Range Level – Loop 1 (Protection Set IV) b. S/G Narrow Range Level – Loop 2 (Protection Set III) c. S/G Narrow Range Level – Loop 3 (Protection Set I) d. S/G Narrow Range Level – Loop 4 (Protection Set II)	N/A	N/A	N/A	PG&E Scope	DCP	N/A	AMSAC signal is provided by the input loop, independent of any processing
435.	3.2.11.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
436.	3.2.11.3 Indicators, Status Lights and Controls No additional requirements to those identified in Section 3.2.1.3.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
437.	3.2.11.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Steam Generator Narrow Range Level channels	1. Steam Generator Narrow Range Level Loop 1 (Protection Set II) a) MCR Indication b) DFWCS c) AFW	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, DFWCS and PCS (AFW) signals are provided by the input loop, independent of any processing
438.		2. Steam Generator Narrow Range Level Loop 1 (Protection Set III) a) MCR Indication b) ERFDS Monitoring c) DFWCS d) AFW	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, ERFDS, DFWCS and PCS (AFW) signals are provided by the input loop, independent of any processing
439.		3. Steam Generator Narrow Range Level Loop 1 (Protection Set IV) a) MCR Indication b) ERFDS Monitoring c) DFWCS d) AFW e) AMSAC	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, ERFDS, DFWCS, PCS (AFW) and AMSAC signals are provided by the input loop, independent of any processing
440.		4. Steam Generator Narrow Range Level Loop 2 (Protection Set I) a) MCR Indication b) DFWCS c) AFW	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, DFWCS and PCS (AFW) signals are provided by the input loop, independent of any processing
441.		5. Steam Generator Narrow Range Level Loop 2 (Protection Set III) a) MCR Indication b) ERFDS Monitoring c) DFWCS d) AFW e) AMSAC	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, ERFDS, DFWCS, PCS (AFW) and AMSAC signals are provided by the input loop, independent of any processing
442.		6. Steam Generator Narrow Range Level Loop 2 (Protection Set IV) a) MCR Indication b) ERFDS Monitoring c) DFWCS d) AFW	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, ERFDS, DFWCS and PCS (AFW) signals are provided by the input loop, independent of any processing
443.		7. Steam Generator Narrow Range Level Loop 3 (Protection Set I) a) MCR Indication b) DFWCS c) AFW d) AMSAC	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, DFWCS, PCS (AFW) and AMSAC signals are provided by the input loop, independent of any processing

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
444.		8. Steam Generator Narrow Range Level Loop 3 (Protection Set III, IV) a) MCR Indication b) ERFDS Monitoring c) DFWCS d) AFW	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, ERFDS, DFWCS and PCS (AFW) signals are provided by the input loop, independent of any processing
445.		9. Steam Generator Narrow Range Level Loop 4 (Protection Set II) a) MCR Indication b) DFWCS c) AFW d) AMSAC	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, DFWCS, PCS (AFW) and AMSAC signals are provided by the input loop, independent of any processing
446.		10. Steam Generator Narrow Range Level Loop 4 (Protection Set III, IV) a) MCR Indication b) ERFDS Monitoring c) DFWCS d) AFW	N/A	N/A	N/A	PG&E Scope	DCP	T	MCR, ERFDS, DFWCS and PCS (AFW) signals are provided by the input loop, independent of any processing
447.	3.2.11.5 Alarms and Annunciators The following alarms and annunciator outputs shall be provided by the Steam Generator Narrow Range Level channels:	1. Steam Generator Low-Low Level Loop 2 or Loop 3 Trip Time Delay Timer Actuated (Protection Set I); alarm output to be suppressed when TTD is out of service	3.3.10.4.1	3.8.3.9.6	N/A	N/A	T (Triconex)	T	
448.		2. Steam Generator Low-Low Level Loop 1 or Loop 4 Trip Time Delay Timer Actuated (Protection Set II); alarm output to be suppressed when TTD is out of service	3.3.10.4.1	3.8.5.8.6	N/A	N/A	T (Triconex)	T	
449.		3. Steam Generator Low-Low Level Loop 1, Loop 2, Loop 3, or Loop 4 Trip Time Delay Timer Actuated (Protection Set III); alarm output to be suppressed when TTD is out of service	3.3.10.4.1	3.8.5.8.6	N/A	N/A	T (Triconex)	T	
450.		4. Steam Generator Low-Low Level Loop 1, Loop 2, Loop 3, or Loop 4 Trip Time Delay Timer Actuated (Protection Set IV); alarm output to be suppressed when TTD is out of service	3.3.10.4.1	3.8.5.8.6	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
451.		5. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) Input sensor out of range; alarm output to be suppressed when Steam Generator Narrow Range Level channel is out of service	3.3.10.4	SET I 3.8.1.9.7, 3.8.2.9.7 SET II 3.8.1.9.7, 3.8.4.9.7 SET III & IV 3.8.1.9.7, 3.8.2.9.7 3.8.3.9.7, 3.8.4.9.7	N/A	N/A	T (Triconex)	T	
452.		6. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: No additional requirements to those identified in Section 3.2.1.5.2.	N/A	N/A	N/A	N/A	N/A	N/A	
453.	3.2.11.6 Interlocks and Permissives The following interlocks and/or permissives are applicable to the Steam Generator Narrow Range Level channels:								
454.	3.2.11.6.1 Steam Generator Low-Low Water Level Trip Time Delay (TTD) All S/G Low-Low Water Level Reactor Trip signals shall be interlocked with a TTD timer that functions as follows:	a) Low-Low Water Level detected in any S/G shall generate a signal which will start an elapsed time trip delay timer.	3.3.10.12.2	SET I 3.8.3.9 SET II, III, IV 3.8.5.8	N/A	N/A	T (Triconex)	T	
455.		b) The allowable TTD shall be based upon the prevailing power level (PL) at the time the Low-Low Water Level Reactor Trip setpoint is reached.	3.3.10.12.2	3.8.3.9.3.2	N/A	N/A	T (Triconex)	T	
456.		c) The PL shall be determined from the Delta-T signal calculated in the DTTA channel of the same Protection Set	3.3.10.12.2	3.8.3.9.3.1	N/A	N/A	T (Triconex)	T	
457.		d) PL will be used to calculate the allowable time delays for Low-Low Water Level in a single S/G (TD).	3.3.10.12.2	3.8.3.9.3.2	N/A	N/A	T (Triconex)	T	
458.		e) Partial trip actuation shall not occur until the elapsed time is greater than or equal to the allowable TTD	3.3.10.12.2	3.8.3.9	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
459.		f) Logic and interlocks shall be provided to delay transmission of the S/G Low-Low Water Level signal according to the following: i. PL □ PHL (PHL = Power High Limit): Time Delay = TD ii. PL >PHL: Time Delay = No Delay	3.3.10.12.2	3.8.3.9.3.2	N/A	N/A	T (Triconex)	T	
460.		g) The TD delay shall be selected when the Low-Low Water Level setpoint is reached in any S/G.	3.3.10.12.2	3.8.3.9.3.2	N/A	N/A	T (Triconex)	T	
461.		h) Should PL increase at any time after TD has been calculated, TD shall be recalculated and the newer (shorter) TTD shall be applied	3.3.10.12.2	3.8.3.9.3.2	N/A	N/A	T (Triconex)	T	
462.		i) Should PL decrease after TD has been calculated, there shall be no change in the TD TTD.	3.3.10.12.2	3.8.3.9.3.2	N/A	N/A	T (Triconex)	T	
463.		j) In any Protection Set, restoration of all S/G water levels to a level above the Low-Low Water Level setpoint shall result in termination of the TTD (without trip) and all trip logic signals shall be reset	3.3.10.12.2	3.8.3.9.3.2	N/A	N/A	T (Triconex)	T	
464.	3.2.11.6.2	Steam Generator Level High-High Loop 1 (Protection Set II, III, IV) For use by the SSPS P-14 Permissive logic [De-energize to Trip].	3.3.10.5.1	SET II, III, IV 3.8.1.9.2	N/A	N/A	T (Triconex)	T	
465.	3.2.11.6.3	Steam Generator Level High-High Loop 2 (Protection Set I, III, IV) For use by the SSPS P-14 Permissive logic [De-energize to Trip].	3.3.10.5.2	SET I 3.8.1.9.2, 3.8.1.9.3 SET III & IV 3.8.1.9.2, 3.8.1.9.3, 3.8.2.9.2, 3.8.2.9.3, 3.8.3.9.3, 3.8.4.9.2, 3.8.4.9.3	N/A	N/A	T (Triconex)	T	
466.	3.2.11.6.4	Steam Generator Level High-High Loop 3 (Protection Set I, III, IV) For use by the SSPS P-14 Permissive logic [De-energize to Trip].	3.3.10.5.3	SET I, III & IV 3.8.2.9.2, 3.8.2.9.3	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
467.	3.2.11.6.5	Steam Generator Level High-High Loop 4 (Protection Set II, III, IV) For use by the SSPS P-14 Permissive logic [De-energize to Trip].	3.3.10.5.4	SET II, III, IV 3.8.4.9.2	N/A	N/A	T (Triconex)	T	
468.	3.2.11.7 Trips and Trip Logic The following comparator outputs shall be provided by the Steam Generator Narrow Range Level channels:	1. Steam Generator Low-Low Level Loop 1 (Protection Set II, III, IV) For use by the SSPS Low-Low Level Reactor Trip and Auxiliary Feedwater (AFW) Pump Start logic [De-energize to Trip]. The Steam Generator Low-Low Level Trip is constrained by the TTD function described in Section 3.2.11.6.1.	3.3.10.6.1	SET II, III, IV 3.8.1.9.2, 3.8.5.8	N/A	N/A	T (Triconex)	T	
469.		2. Steam Generator Low-Low Level Loop 2 (Protection Set I, III, IV) For use by the SSPS Low-Low Level Reactor Trip and AFW Pump Start logic [De-energize to Trip]. The Steam Generator Low-Low Level Trip is constrained by the TTD function described in Section 3.2.11.6.1.	3.3.10.6.2	SET I 3.8.1.9.2, 3.8.1.9.3 3.8.3.9 SET III & IV 3.8.1.9.2, 3.8.1.9.3, 3.8.2.9.2, 3.8.2.9.3, 3.8.3.9.2, 3.8.3.9.3, 3.8.4.9.2, 3.8.4.9.3	N/A	N/A	T (Triconex)	T	
470.		3. Steam Generator Low-Low Level Loop 3 (Protection Set I, III, IV) For use by the SSPS Low-Low Level Reactor Trip and AFW Pump Start logic [De-energize to Trip]. The Steam Generator Low-Low Level Trip is constrained by the TTD function described in Section 3.2.11.6.1.	3.3.10.6.3	SET I 3.8.2.9.2, 3.8.2.9.3 3.8.3.9 SET III & IV 3.8.3.9.2, 3.8.4.9.3 3.5.5.8	N/A	N/A	T (Triconex)	T	
471.		4. Steam Generator Low-Low Level Loop 4 (Protection Set II, III, IV) For use by the SSPS Low-Low Level Reactor Trip and AFW Pump Start logic [De-energize to Trip]. The Steam Generator Low-Low Level Trip is constrained by the TTD function described in Section 3.2.11.6.1.	3.3.10.6.4	SET II, III & IV 3.8.4.9.2 3.8.5.8	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
472.	3.2.11.8 Accuracy The following accuracy requirements are applicable to the Steam Generator Narrow Range Level channels:	1. The accuracy of the effective time delay for the TTD circuit shall be within ±1% of adjustable range	3.3.10.7	SET I 3.8.3.9.3.1 SET II, II, IV 3.8.5.8.3.1	N/A	N/A	T (Triconex)	T	
473.	3.2.11.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be scaled as follows:	1. Input Variables: a) Steam Generator Narrow Range Level: 4 - 20 mA = 0 to 100%	3.3.10.8.1	SET I 3.8.1.9.1, 3.8.4.2.1 SET II 3.8.1.9.1, 3.8.4.9.1 SET III & IV 3.8.1.9.1, 3.8.2.9.1 3.8.3.9.1, 3.8.4.9.1	N/A	N/A	T (Triconex)	T	
474.		2. Calculated Variables: a) Delta-T: Calculated in associated DTTA channel per Section 3.2.5.13.4 = 0 to 150% power b) Low-Low Level TTD (TD): Calculated per Section 3.2.11.6.1 = 0 to 700 seconds	3.3.10.8.2	SET I 3.8.3.9.3.1 SET II, III & IV 3.8.5.8.3.1	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
475.		3. Output Variables: a) Steam Generators 2, 3 Narrow Range Level (Protection Set I): 4 – 20 mA [0 to 100%] = 4 – 20 mA (from input loop Class IA/II isolator) b) Steam Generators 1, 4 Narrow Range Level (Protection Set II): 4 – 20 mA [0 to 100%] = 4 – 20 mA (input loop Class IA/II isolator) c) Steam Generator 3 Narrow Range Level (Protection Set I): 4 – 20 mA [0 to 100%] = 4 – 20 mA (input loop Class IA/II isolator to AMSAC) d) Steam Generator 4 Narrow Range Level (Protection Set II): 4 – 20 mA [0 to 100%] = 4 – 20 mA (input loop Class IA/II isolator to AMSAC) e) Steam Generator 1, 2, 3, 4 Narrow Range Level (Protection Sets III and IV): 4 – 20 mA [0 to 100%] = 4 – 20 mA (from input loop) f) Steam Generator 1, 2, 3, 4 Narrow Range Level (Protection Sets III and IV): 4 – 20 mA [0 to 100%] = 4 – 20 mA (input loop Class IA/II isolator) g) Steam Generator 2 Narrow Range Level (Protection Set III): 4 – 20 mA [0 to 100%] = 4 – 20 mA (input loop Class IA/II isolator to AMSAC) h) Steam Generator 1 Narrow Range Level (Protection Set IV): 4 – 20 mA [0 to 100%] = 4 – 20 mA (input loop Class IA/II isolator to AMSAC)	N/A	N/A	N/A	PG&E Scope	DCP	T	SG Level signals are provided by the input loop, independent of any processing
476.	3.2.11.10 Time Response No additional requirements to those identified in Section 3.2.1.10.								
477.	3.2.11.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
478.	3.2.11.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
479.	3.2.11.13 Controller Transfer Functions The following	1. The delay units provided for the Steam Generator Low-Low Water Level signals shall have the following transfer function:	3.3.10.12.1	SET I 3.8.3.9.3.1 SET II, III & IV 3.8.5.8.3.1	N/A	N/A	T (Triconex)	T	FRS 3.2.11.13.1 shows a graphic for the requirement

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
480.	controller transfer functions are used in the processing of Steam Generator Narrow Range Level channels:	2. Upon loss of signal to the delay unit, the output of the unit must reset to its initial state	3.3.10.12.1	SET I 3.8.3.9.3.1 SET II, III & IV 3.8.5.8.3.1	N/A	N/A	T (Triconex)	T	
481.		3. Trip Time Delay Algorithm Refer to Reference 1.4.3.18 for details. Ranges for tuning constants associated with this function are provided in Section 3.2.11.14	N/A	N/A	N/A	N/A	N/A	N/A	Algorithm is in the TFS
482.	3.2.11.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Steam Generator Narrow Range Level channels:	1. Steam Generator Water Level Low-Low Reactor Trip: 0.000 to 45.000% of Narrow Range Span Note: Percent of Narrow Range Span refers to percent of span as measured from the narrow range level tap	3.3.10.13.1	SET I 3.8.1.9.2, 3.8.2.9.2 SET II 3.8.1.9.2, 3.8.4.9.2 SET III & IV 3.8.1.9.2, 3.8.2.9.2 3.8.3.9.2, 3.8.4.9.2	N/A	N/A	T (Triconex)	T	
483.		2. Steam Generator Water Level High-High Turbine Trip and Feedwater Isolation: 45.000 to 90.000% of Narrow Range Span Note: Percent of Narrow Range Span refers to percent of span as measured from the narrow range level tap.	3.3.10.13.2	SET I 3.8.1.9.2, 3.8.2.9.2 SET II 3.8.1.9.2, 3.8.4.9.2 SET III & IV 3.8.1.9.2, 3.8.2.9.2 3.8.3.9.2, 3.8.4.9.2	N/A	N/A	T (Triconex)	T	
484.		3. Tunable Parameters a) (TTD) Power High Limit (PHL) 0.000 to 100.000% of Rated Thermal Power b) (TTD) A 0.000000 to -0.010000 c) (TTD) B 0.000000 to 1.000000 d) (TTD) C 0.000 to -100.000 e) (TTD) D 0.00 to 1000.00 f) Input scaling m (gain) 0.5000 to 1.9000 g) Input scaling b (offset) -10.000 to 10.000%	3.3.10.13.3	SET I 3.8.3.9.3.1 SET II, III & IV 3.8.5.8.3.1	N/A	N/A	T (Triconex)	T	
485.	3.2.11.15 Test and Calibration The following	1. For the purpose of testing the Delta-T signal that provides input for the TTD logic, the design shall automatically enable a zero second allowable trip delay for all narrow range level channels in the affected Protection Set.	3.3.10.12.1	SET I 3.8.3.9.3.1 SET II, III & IV 3.8.5.8.3.1	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
486.	Test and Calibration requirements are applicable to the Steam Generator Narrow Range Level channels:	2. For the purpose of testing the TTD function, the design shall automatically enable a zero second allowable trip delay for all narrow range level channels in the affected Protection Set.	3.3.10.12.1	SET I 3.8.3.9.3.1 SET II, III & IV 3.8.5.8.3.1	N/A	N/A	T (Triconex)	T	
487.		3. For the purpose of testing a steam generator narrow range level channel, the design shall automatically disable the steam generator low-low level trip input to the TTD algorithm.	3.3.10.12.2	SET I 3.8.3.9 SET II, III & IV 3.8.5.8	N/A	N/A	T (Triconex)	T	
488.	3.2.11.16 Failure Mode Requirements The following Failure Mode requirements are applicable to the Steam Generator Narrow Range Level channels:	1. Failures (other than loss of power or isolation device) within the PPS processing instrumentation shall not affect the operability of the AMSAC system	N/A	N/A	N/A	PG&E Scope	DCP	N/A	AMSAC signal is provided by the input loop, independent of any processing
3.2.12 Specific Requirements for Turbine Impulse Chamber Pressure The following specific requirements apply to the Turbine Impulse Chamber Pressure channels and are in addition to the requirements specified in Section 3.2.1.									
489.	3.2.12.1 Functional Description Turbine Impulse Chamber Pressure channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								
490.	Turbine Impulse Chamber Pressure (Protection Set I): Reference 1.4.2.2.18								
491.	Turbine Impulse Chamber Pressure (Protection Set II): Reference 1.4.2.2.40								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
492.	3.2.12.1.3	Isolated signals (not processed by the PPS) from all Turbine Impulse Chamber Pressure channel sensors shall be provided for use by the following: a) AMSAC	N/A	N/A	N/A	PG&E Scope	DCP	N/A	AMSAC signal is provided by the input loop, independent of any processing
493.	3.2.12.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
494.	3.2.12.3 Indicators, Status Lights and Controls	No additional requirements to those identified in Section 3.2.1.3	N/A	N/A	N/A	N/A	N/A	N/A	
495.	3.2.12.4 Outputs for Monitoring, Indication, Recording, and Control The following outputs shall be provided by the Turbine Impulse Chamber Pressure channels:	1. Turbine Impulse Chamber Pressure (Protection Set I): a) MCR Indication b) PPC Monitoring c) AMSAC	3.3.11.3	3.12.1.9.5	N/A	PG&E Scope	DCP T (Triconex)	T	Invensys: b only PG&E (a, c) AMSAC signal is provided by the input loop, independent of any processing
496.		2. Turbine Impulse Chamber Pressure (Protection Set II): a) MCR Indication b) PPC Monitoring c) AMSAC	3.3.11.3	3.12.1.9.5	N/A	PG&E Scope	DCP T (Triconex)	T	Invensys: b only PG&E (a, c) AMSAC signal is provided by the input loop, independent of any processing
497.	3.2.12.5 Alarms and Annunciators The following alarm outputs shall be provided for the Turbine Impulse Chamber Pressure channels:	1. The following conditions shall produce an output to actuate the “PPS Failure” annunciator in the MCR: a) Input sensor out of range	3.3.11.4	SET I & II 3.12.1.9.7	N/A	N/A	T (Triconex)	T	
498.		2. The following conditions shall produce an output to actuate the “PPS Trouble” annunciator in the MCR: No additional requirements to those identified in Section 3.2.1.5.2.	N/A	N/A	N/A	N/A	N/A	N/A	
499.	3.2.12.6 Interlocks and Permissives	1. Turbine Impulse Pressure High (Protection Sets I, II): For use by the SSPS P-13 Permissive logic [De-energize to Trip].	3.3.11.5	3.12.1.9.2	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
500.	The following comparator outputs shall be provided by the Turbine Impulse Chamber Pressure channels:	2. Turbine Impulse Pressure Low (Protection Set I) For use by the Turbine Low Power Interlock C-5 logic [De-energize to Trip]. Note: Comparator output voltage provided externally from RNARA	3.3.11.5	3.12.1.9.2 3.12.1.9.3	N/A	N/A	T (Triconex)	T	
501.	3.2.12.7 Trips and Trip Logic The following comparator outputs shall be provided by the Turbine Impulse Chamber Pressure channels: None								
502.	3.2.12.8 Accuracy No additional requirements to those identified in Section 3.2.1.8								
503.	3.2.12.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and output variables shall be scaled as follows:	1. Input Variables: a) Turbine Impulse Chamber Pressure: 4 - 20 mA = 0 to 110% of Turbine Power	3.3.11.8.1	3.12.1.9.1	N/A	N/A	T (Triconex)	T	
504.		2. Calculated Variables: None	N/A	N/A	N/A	N/A	N/A	N/A	
505.		3. Output Variables: a) Turbine Impulse Chamber Pressure: 0 to 110% of Turbine Power = 4-20 mA b) Turbine Impulse Chamber Pressure: 4 - 20 mA [0 to 110% of Turbine Power] = 4 - 20 mA (input loop Class IA/II isolator)	3.3.11.8.3 (a)	3.12.1.9.5	N/A	N/A	T (Triconex)	T	
506.	3.2.12.10 Time Response No additional requirements to those identified in Section 3.2.1.10.								
507.	3.2.12.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
508.	3.2.12.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
509.	3.2.12.13 Controller Transfer Functions No additional requirements to those identified in Section 3.2.1.13.								
510.	3.2.12.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Turbine Impulse Chamber Pressure channels:	1. Turbine Impulse Pressure High to P-13: 5.000 to 20.000%.	3.3.11.13.1	3.12.1.9.2	N/A	N/A	T (Triconex)	T	
511.		2. Turbine Impulse Pressure Low to C-5: 5.000 to 20.000%.	3.3.11.13.1	3.12.1.9.2	N/A	N/A	T (Triconex)	T	
512.		3. Tunable Parameters a) Input scaling m (gain) 0.5000 to 1.9000 b) Input scaling b (offset) -11.000 to 11.000%	3.3.11.13.2	3.3.1.9.9	N/A	N/A	T (Triconex)	T	
513.	3.2.12.15 Test and Calibration	A manual bypass switch shall be provided for the Turbine Impulse Pressure High to P-13 comparator output to facilitate test and calibration. When in Bypass, the switch shall maintain the non-tripped condition of the comparator.	N/A	N/A	N/A	PG&E scope	DCP	T	Manual Bypass Switches are provided Indication of bypass to be verified
514.	3.2.12.16 Failure Mode Requirements The following Failure Mode requirements are applicable to the Turbine Impulse Pressure channels:	1. Failures (other than loss of power or isolation device) within the PPS processing instrumentation shall not affect the operability of the AMSAC system.	N/A	N/A	N/A	PG&E scope	DCP	T	AMSAC signal is provided by the input loop, independent of any processing

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
3.2.13 Specific Requirements for Containment Pressure The following specific requirements apply to the Containment Pressure channels and are in addition to the requirements specified in Section 3.2.1.									
515.	3.2.13.1 Functional Description Containment Pressure channels are presented graphically in the PPS Functional Block Diagrams [Reference 1.4.2.2]. These drawings identify all inputs, outputs, and external interfaces and provide a simplified representation of the channel functionality (logic).								
516.	3.2.13.1.1 Containment Pressure (Protection Set I): Reference 1.4.2.2.19, 1.4.2.2.20								
517.	3.2.13.1.2 Containment Pressure (Protection Set II): Reference 1.4.2.2.41, 1.4.2.2.42								
518.	3.2.13.1.3 Containment Pressure (Protection Set III): Reference 1.4.2.2.56, 1.4.2.2.57								
519.	3.2.13.1.4 Containment Pressure (Protection Set IV): Reference 1.4.2.2.69, 1.4.2.2.70								
520.	3.2.13.2 Special Environmental Requirements No additional requirements to those identified in Section 3.2.1.2.								
521.	3.2.13.3 Indicators, Status Lights and Controls No additional requirements to those identified in Section 3.2.1.3.								
522.	3.2.13.4 Outputs for Monitoring, Indication, and Control The following	1. Containment Pressure (Protection Sets I, IV) a. MCR Indication b. PPC Monitoring	N/A	N/A	SDS-0602	PG&E scope	DCP T (Westinghouse)	T	MCR indication is provided on the input loop and is PG&E scope only. PPC monitoring is provided via the TxB1 to the Gateway computer. PG&E (a) Westinghouse (b)

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
523.	outputs shall be provided by the Containment Pressure channels:	2. Containment Pressure (Protection Sets II, III) a. MCR Indication b. PPC Monitoring c. ERFDS Monitoring	N/A	N/A	SDS-0602	PG&E scope	DCP T (Westinghouse)	T	MCR and ERFDS indication is provided on the input loop and scope only. PPC monitoring is provided via the TxB1 to the Gateway computer. PG&E (a, c) Westinghouse (b)
524.	3.2.13.5 Alarms and Annunciators The following alarm outputs shall be provided for the Containment Pressure channels:	2. The following conditions shall produce an output to actuate the "PPS Failure" annunciator in the MCR: a) Input sensor out of range	N/A	N/A	SDS-0280, 0280.1, 0280.2, 0281, 0281.1, 0281.2, 0321, 0096	N/A	T (Westinghouse)	T	
525.		3. The following conditions shall produce an output to actuate the "PPS Trouble" annunciator in the MCR: No additional requirements to those identified in Section 3.2.1.5.2.	N/A	N/A	N/A	N/A	N/A	N/A	
526.	3.2.13.6 Interlocks and Permissives There are no interlocks or permissives associated with PPS Containment Pressure channel processing.								
527.	3.2.13.7 Trips and Trip Logic The following comparator outputs shall be provided by the Containment Pressure channels:	1. Containment Pressure High (Protection Sets II, III, IV) For use by SSPS SI and Phase A Containment Isolation logic [De-energize to Trip].	N/A	N/A	SDS-0284, 0291, 0291.2, 0296	N/A	T (Westinghouse)	T	
528.		2. Containment Pressure High-High (Protection Sets I, II, III, IV) For use by SSPS Phase B Containment Isolation, Containment Spray, and Steamline Isolation logic [Energize to Trip].	N/A	N/A	SDS-0284, 0291, 0291.2, 0296	N/A	T (Westinghouse)	T	
529.	3.2.13.8 Accuracy No additional requirements to those identified in Section 3.2.1.8								
530.	3.2.13.9 Range (for Inputs, Calculated Values, and Outputs) Ranges for input, calculated, and	1) Input Variables: a. Containment Pressure: 4 - 20 mA = -5 to 55 psig	N/A	N/A	SDS-0274, 0285	N/A	T (Westinghouse)	T	
531.		2) Calculated Variables: None	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
532.	output variables shall be scaled as follows:	3) Output Variables: a. Containment Pressure: 4 – 20 mA [-5 to 55 psig] = 4 - 20 mA (from input loop)	N/A	N/A	N/A	PG&E Scope: a	DCP: a	T	Containment Pressure Indications are on the input loop and not processed by the ALS platform; PG&E scope only
533.	3.2.13.10 Time Response No additional requirements to those identified in Section 3.2.1.10								
534.	3.2.13.11 Overload and Recovery Characteristics No additional requirements to those identified in Section 3.2.1.11.								
535.	3.2.13.12 Noise Levels No additional requirements to those identified in Section 3.2.1.12.								
536.	3.2.13.13 Controller Transfer Functions No additional requirements to those identified in Section 3.2.1.13								
537.	3.2.13.14 Setpoints and Tunable Parameters (Range of Setting) The following shall apply to the comparator setpoints and tunable parameters of the Containment Pressure channels:	1) Containment Pressure High SI, Phase A Isolation: 0.0000 to 10.0000 psig	N/A	N/A	SDS-0291.2[E]	N/A	T (Westinghouse)	T	Westinghouse exception: The ALS platform cannot support 4 decimal places precision, decimal precision is to two places = 0.00 to 10.00 psig for offset range. Documented in CDER FRS R9.
538.		2) Containment Pressure High-High Phase B Isolation, Containment Spray, Steamline Isolation: 0.0000 to 40.0000 psig	N/A	N/A	SDS-0291.2[E]	N/A	T (Westinghouse)	T	Westinghouse exception: The ALS platform cannot support 4 decimal places precision, decimal precision is to two places = 0.00 to 40.00 psig for offset range. Documented in CDER FRS R9.
539.		3) Tunable Parameters a. Input scaling m (gain) 0.5000 to 1.9000 b. Input scaling b (offset) -6.0000 to 6.0000 psig	N/A	N/A	SDS-0286.2, 0286.3[E]	N/A	T (Westinghouse)	T	Westinghouse exception: (b) The ALS platform cannot support 4 decimal places precision, decimal precision is to two places = -6.00 to 6.00 psig for offset range. Documented in CDER FRS R9.

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
540.	3.2.13.15 Test and Calibration	A manual bypass switch independent of the PPS shall be provided for the Containment Pressure High-High comparator output to facilitate test and calibration. When in Bypass, the switch shall maintain the non-tripped condition of the comparator.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Manual Bypass Switches are provided, independent of the vendors
541.	3.2.13.16 Failure Mode Requirements	No additional requirements to those identified in Section 3.2.1.16	N/A	N/A	N/A	N/A	N/A	N/A	
3.3 System Security									
542.	3.3 System Security	Access to the PPS will be administratively controlled by the end user(s). The following features shall be available to support configuration control/management of the system and shall be described in the Configuration Management Plan for the system.	N/A	N/A	N/A	PG&E SCOPE	DCP	N/A	Local access and physical barriers are PG&E scope only, the vendors provide the hardware platforms only for PG&E to install and control
543.	3.3.1 Physical Security	The PPS processing instrumentation shall have provisions for accommodating physical security devices such as keylocks, cabinet locks, etc. to ensure that only appropriate personnel have access to the PPS processing instrumentation.	N/A	N/A	N/A	PG&E SCOPE	DCP	N/A	Local access and physical barriers scope only, the vendors provide the hardware platforms only for PG&E to install and control
544.	3.3.2 System Logon Protection	Access to the PPS processing instrumentation will be administratively controlled using physical security and/or password logon security measures (as applicable).	N/A	N/A	N/A	PG&E SCOPE	DCP	N/A	Local access and physical barriers scope only, the vendors provide the hardware platforms only for PG&E to install and control
545.	3.3.3 Communications With External (Non-PPS) Systems	All communications between external systems/devices and the PPS instrumentation shall be read only by the external system	3.7.4.3	2.2	N/A	PG&E	DCP	T	
3.4 Information Management There are no information management requirements imposed on the PPS.									
3.5 System Operations									

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
546.	3.5.1 System Human Factors	1. The PPS HSI design should follow the guidance provided in the DCPP HSI Development Guidelines Document.	N/A	N/A	N/A	PG&E Scope (MWS/ASU)	DCP	N/A	WEC ASU does not follow the DCPP HSI guidelines Also, HSI development is outside the scope of the safety-related PPS Tricon development project. Separate documentation will be provided by Invensys Operations Management for this portion of the PPS project.
547.	3.5.2 System Maintainability	1. The PPS processing instrumentation shall have the capability for removal and replacement of all cards/modules at power (hot swap capability) with the system on-line without adverse effect to any protection function.	See comments (R-1127)	N/A	N/A	N/A	O (Triconex) O (Westinghouse	T	ALS and V10 Tricon has the capability to hot-swap modules.
548.		2. System power supplies shall provide hot swap capability	See Comments (R-1128)	N/A	N/A	PG&E Scope	DCP (ALS)	T	V10 Triconex has the capability to hot swap power supply; ALS power supplies are outside Westinghouse scope.
549.		3. Test and Calibration requirements are identified in Section 3.2.1.15	N/A	N/A	N/A	N/A	N/A	N/A	
550.		4. The capability shall be provided to place and maintain multiple channels Out of Service (trip or bypass).	3.7.5	2.323	SDS-0102, SDS-0103, SDS-0104	N/A	T (Triconex) T (Westinghouse)	T	
551.	3.5.3 System Reliability	System diagnostics and self-testing features shall be incorporated in the design to provide automatic detection (where possible) of component failures or degradation of operability	3.3.1	3.2.1.9.1	SDS-0517 SDS-0520 SDS-0521	N/A	T (Triconex) T (Westinghouse)	T	
3.6 Policy and Regulation Section 1.4 provides a listing of References that are utilized in the development of the PPS and all changes thereto to ensure that system design bases requirements are satisfied and the PPS will function as required within the Plant Protection System to ensure that the health and safety of the general public is not jeopardized by the operation of DCPP. The listed References include documents defining design requirements, documents providing guidance for implementation of design requirements, and licensing documents that provide definitive direction for ensuring that operation of the PPS will be maintained within design requirements.									
3.7 System Life Cycle Sustainment This Section is only applicable if the PPS equipment subject to this FRS is digital and requires software to be developed for its use.									

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
552.	3.7.1 PPS Software	Software shall be maintained in accordance with the Software Quality Assurance Plan developed for the PPS as required by IDAP CF2.ID9	N/A	N/A	N/A	PG&E Scope	DCP	N/A	After delivery, SQA and SCM are the responsibility of PG&E
4 System Interfaces									
553.	4.1 External Interfaces	The PPS has external interfaces with the following systems. The exchange of information is strictly from the PPS to the identified system. There is no return of information from the receiving system							Information Only
554.	4.1.1 Plant Process Computer (PPC)	The PPS will interface with the PPC to provide monitoring and status information	N/A	N/A	N/A	PG&E Scope	DCP	T	External to the vendor responsibility
555.	4.1.1.1	Appropriate signal isolation shall be provided between the PPS and PPC	N/A	N/A	N/A	PG&E Scope	DCP	T	External to the vendor platforms; PG&E responsibility;
556.	4.1.2 Main Annunciator System (MAS)	The PPS will provide contact outputs where needed to interface with the MAS	N/A	N/A	N/A	PG&E Scope	DCP	T	External to the vendor responsibility
557.	4.1.2.1	The MAS will provide the contact interrogation voltage	N/A	N/A	N/A	PG&E Scope	DCP	N/A	MAS is a PG&E system only, Interrogation voltage is a function of the MAS
558.	4.1.2.2	Appropriate signal isolation shall be provided between the PPS and MAS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility
559.	4.1.3 Main Control Panels	The PPS will provide appropriately qualified analog outputs and/or appropriately qualified isolation devices to interface with the main control panels in the MCR for purposes of indication and status monitoring (i.e., indicators, recorders, ERFDS, etc.).	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
560.	4.1.3.1	Appropriate signal isolation shall be provided between the PPS and main control panel devices.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor platforms; PG&E responsibility
561.	4.1.4 Hot Shutdown Panel	The PPS will provide analog outputs from Pressurizer Level, Pressurizer Pressure, and Steamline Pressure channels to interface with the Hot Shutdown Panel.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility on the input loops
562.	4.1.4.1	Appropriate signal isolation shall be provided between the PPS and the Hot Shutdown Panel	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
563.	4.1.5 Solid State Protection System (SSPS)	The PPS will provide partial trip outputs to interface with the SSPS as shown on the Functional Block Diagrams	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility
564.	4.1.6 AMSAC	The PPS will provide shared signals from the S/G Narrow Range Level and Turbine Impulse Chamber Pressure channel sensor inputs to interface with the AMSAC. Refer to Sections 3.2.11 and 3.2.12.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
565.	4.1.6.1	These signals shall be from the raw sensor input and shall not be processed by the PPS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
566.	4.1.6.2	Appropriate signal isolation shall be provided between the PPS and the AMSAC	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
567.	4.1.7 Digital Feedwater Control System (DFWCS)	The PPS will provide signals from the S/G Narrow Range Level, Steamflow, and Steamline Pressure channel sensor inputs to interface with the DFWCS. Refer to Sections 3.2.11, 3.2.9, and 3.2.10.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
568.	4.1.7.1	These signals shall be from the raw sensor input and shall not be processed by the PPS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
569.	4.1.7.2	Appropriate signal isolation shall be provided between the PPS and the DFWCS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
570.	4.1.8 Rod Speed and Direction	The PPS will provide analog outputs from the DTTA channels to interface with Rod Speed and Direction in the Process Control System (PCS). Refer to Section 3.2.5. Note: The alternative of sharing RTD input signals is not considered a feasible option with today's technology but would be allowable should the technology become available	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility
571.	4.1.8.1	Appropriate signal isolation shall be provided between the PPS and the PCS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility
572.	4.1.9 Pressurizer Pressure Control	The PPS will provide signals from the Pressurizer Pressure channel sensor inputs to interface with Pressurizer Pressure Control in the PCS. Refer to Section 3.2.7	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
573.	4.1.9.1	These signals shall be from the raw sensor input and shall not be processed by the PPS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
574.	4.1.9.2	Appropriate signal isolation shall be provided between the PPS and the PCS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
575.	4.1.10 Pressurizer Level Control	The PPS will provide signals from the Pressurizer Level channel sensor inputs to interface with Pressurizer Level Control in the PCS. Refer to Section 3.2.6	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
576.	4.1.10.1	These signals shall be from the raw sensor input and shall not be processed by the PPS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
577.	4.1.10.2	Appropriate signal isolation shall be provided between the PPS and the PCS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
578.	4.1.11 Auxiliary Feedwater (AFW) Control	The PPS will provide signals from the S/G Narrow Range Level sensor inputs to interface with AFW Control in the PCS. Refer to Section 3.2.11	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
579.	4.1.11.1	These signals shall be from the raw sensor input and shall not be processed by the PPS.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
580.	4.1.11.2	Appropriate signal isolation shall be provided between the PPS and the PCS.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
581.	4.1.12 Reactor Vessel Level Indicating System (RVLIS)	Outputs from the PPS Wide Range Temperature and Wide Range Pressure channels will be provided to interface with the RVLIS. Refer to Sections 3.2.3 and 3.2.4	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Analog Outputs to RVLIS are from Tricon only for WR Temperatures
582.	4.1.12.1	The PPS Wide Range Temperature (hot leg) channels will provide analog outputs to interface with the RVLIS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Analog Outputs to RVLIS are from Tricon only for WR Temperatures
583.	4.1.12.2	The PPS Wide Range Pressure channels (reactor coolant loops 3 and 4) will provide raw sensor input signals not processed by the PPS to interface with the RVLIS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
584.	4.1.12.3	Appropriate signal isolation shall be provided between the PPS and the RVLIS	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility. There is no signal isolation to RVLIS from the Tricon AOs for WR Temperature nor from the input loops for WR Pressures
585.	4.1.13 Low Temperature Overpressure Protection System (LTOPS)	Outputs from the PPS Wide Range Temperature and Wide Range Pressure channels will be provided to interface with the LTOPS. Refer to Sections 3.2.3 and 3.2.4	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
586.	4.1.13.1	The PPS Wide Range Temperature (cold leg) channels will provide comparator outputs to interface with LTOPS via isolation relays in the Aux Safeguards (RNASA) relay rack	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
587.	4.1.13.2	The PPS Wide Range Pressure channels will provide comparator outputs to interface with LTOPS via isolation relays in the Aux Safeguards (RNASA) relay rack.	N/AR	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
588.	4.1.14 Pressurizer Power Operated Relief Valve (PORV) Control System	The PPS will provide comparator outputs from Pressurizer Pressure channels to interface with the PORV Control System via isolation relays in the Aux Safeguards (RNASA) relay rack. Refer to Section 3.2.7	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
589.	4.1.15 Residual Heat Removal (RHR) Interlocks	The PPS will provide comparator outputs from Wide Range Pressure channels to interface with the RHR system RHR suction valve (V-8701 and V-8702) “OPEN” actuation logic and alarming circuits via isolation relays in the Aux Safeguards (RNASA and RNASB) relay racks. Refer to Section 3.2.4	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
590.	4.1.16 Pressurizer Level Control	The PPS will provide analog outputs from the DTTA channels to interface with Pressurizer Level Control in the Process Control System (PCS). Refer to Section 3.2.5. Note: The alternative of sharing RTD input signals is not considered a feasible option with today’s technology but would be allowable should the technology become available.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor responsibility, on the input loops
591.	4.1.17 Steam Dump Control	The PPS will provide analog outputs from the DTTA channels to interface with Steam Dump Control in the Process Control System (PCS). Refer to Section 3.2.5. Note: The alternative of sharing RTD input signals is not considered a feasible option with today’s technology but would be allowable should the technology become available	N/A	N/A	N/A	PG&E Scope	DCP	N/A	External to the vendor platforms, is PG&E responsibility, on the input loops
4.2 Human System Interface									

Requirements Traceability Matrix (RTM), Functional Requirements Specification									
RTM #	FRS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
592.	4.2	A Human System Interface (HSI) shall be provided that will provide the primary interface between plant personnel and the PPS instrumentation for purposes of testing, maintenance, and troubleshooting	N/A	N/A	N/A	PG&E Scope (MWS/ASU)	DCP	N/A	Hardware is the responsibility of PG&E to provide. Vendors are responsible for the application.

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
Section 1 Introduction									
Note: 1.1-1.4 are information only and provide no requirements that are traceable or testable									
1.5 Identification This section identifies the systems, interfacing entities, and other interfaces to which this document applies									
1.	1.5.1 Protection Sets	The PPS consists of sixteen (16) racks (per DCPP Unit) of instrumentation located in the Cable Spreading Rooms (Auxiliary Building, elevation 128). The sixteen racks are divided into four Protection Sets; five racks each for Protection Sets I and II, three racks each for Protection Sets III and IV. Each Protection Set is physically separated and electrically isolated from the other sets. Protection Set I consists of Racks 1 thru 5 (RNP1A, RNP1B, RNP1C, RNP1D, and RNP1E). Protection Set II consists of Racks 6 thru 10 (RNP2A, RNP2B, RNP2C, RNP2D, and RNP2E). Protection Set III consists of Racks 11 thru 13 (RNP3A, RNP3B, and RNP3C). Protection Set IV consists of Racks 14 thru 16 (RNP4A, RNP4B, and RNP4C). Physical equipment will be assigned to specific PPS racks during detailed design. The existing Eagle 21 HMI units are located in Racks 5 (RNP1E), 9 (RNP2D), 12 (RNP3B) and 14 (RNP4A). These racks are expected to house the replacement PPS Maintenance Workstation and communications equipment.							
2.	1.5.2 Triconex Tricon Programmable Logic Controllers (PLC)	The Tricon PLC shown in the following figures is composed of the Main Chassis and two Remote Expansion Chassis (RXMs), all within a given protection set. The Main Chassis is connected to a “Primary” RXM via triplicated copper I/O expansion bus cables. The Primary RXM (PRXM) is connected to a “Remote” RXM chassis using multimode fiber-optic cables. The Remote RXM (RRXM) chassis allows extending the I/O bus over longer distances than copper cables can support, and to provide electrical isolation for non-safety-related I/O signals, as required. Refer to the Triconex licensing Topical Report [1.4.5.3] for additional information							
3.	1.5.3 Westinghouse Advanced Logic System (ALS)	1) A typical ALS rack configuration as shown in the following figures contains two sets of the following components: ALS-102 – Core Logic Board (CLB) ALS-302 – Digital Input Board ALS-311 – Analog Input Board (Temperature) ALS-321 – Analog Input Board ALS-402 – Digital Output Board ALS-421 – Analog Output Board							
4.		2) ALS Service Unit (ASU) The ASU is a dedicated software application that is installed on the ALS Maintenance Workstation (MWS) described in Section 1.5.6 and shown in Figure 1-22. The ASU application is connected to the ALS during maintenance or testing by plant personnel. The ASU application provides non-intrusive diagnostic tools that allow plant personnel to access detailed status and configuration information of the system while the system is online. The ASU application also provides post-event analysis information about the system to plant personnel for evaluation of an event after it has occurred. The ASU application may be used to modify setpoints and tuning constants, but shall not be capable of altering functional programming (i.e., alter the algorithm) of the CLB							
5.		3) The ALS A and ALS B conceptual architecture, which provides built-in diversity and defense in depth per the D3 evaluation approved by NRC [1.4.5.4], is illustrated in Figure 1-1. Wiring details are illustrated In Figure 2-5 and Figure 2-6. The manual bypass switches in Figure 1-1 allow one ALS diversity Group (i.e., ALS-A or ALS-B) to be bypassed and removed from service without tripping the channel. The manual trip switch may be used to initiate a partial channel trip independently of the ALS logic.							

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
6.	1.5.4 Isolation Devices	1. The isolation devices shown in Figure 1-3, Figure 1-8, Figure 1-13, and Figure 1-18 are safety-related components provided by Westinghouse.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	See Comment Line #7
7.		2. The isolation devices are separate and independent from both the Tricon and the ALS.	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Isolation Devices are external to the vendor platforms and are solely the responsibility of PG&E
8.		3. All isolation devices are 4-20 mA DC input and 4-20 mA DC output	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Isolation Devices are external to the vendor platforms and are solely the responsibility of PG&E
9.		4. The qualified isolation devices shall perform the required isolation function when powered from non-safety-related I/O power. That is, credible faults (short circuit, open circuit, application of fault potential) on the Class II terminals will not adversely affect the Class I circuit	N/A	N/A	N/A	PG&E Scope	DCP	N/A	Isolation Devices are external to the vendor platforms and are solely the responsibility of PG&E
10.	1.5.5 ALS Signal Conditioning	1. The ALS shall provide signal conditioning and isolation for the Reactor Coolant System (RCS) non-safety-related flow analog output signals	N/A	N/A	SDS-0125, 0138	N/A	T (Westinghouse)	T	Signal Isolation is external to the vendor platforms (PG&E). Signal conditioning is internal to the vendor platforms (Westinghouse)
11.		2. The ALS shall provide capability to normalize the RCS Flow scaling periodically by adjusting the gain and offset (i.e., mx+b) from within the ALS application via the ASU.	N/A	N/A	SDS-117.1	N/A	T (Westinghouse)	T	
12.		3. The ALS shall provide signal conditioning for the RCS narrow range Resistance Temperature Detector (RTD) safety-related signals to the Overpower Delta Temperature (OPDT) and Overtemperature Delta T (OTDT) reactor trip functions, and the RCS Wide Range Temperature and Pressurizer Vapor Space Temperature RTD signals. 1) The ALS shall convert the RTD signals from resistance to temperature. 2) The ALS shall provide the capability to update the resistance to temperature conversion coefficients (i.e., a, b, and c) periodically. 3) Analog temperature signal input range	N/A	N/A	SDS-0147, 0148, 0149, 0152, 0154, 0182, 0184, 0245, 0246, 0247, 0250 SDS-:0152.1, 0182.1, 0250.1, 0177, 0178, 179, 0252	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		information is provided in the following FRS Sections: a. 3.2.3.9 (WR Hot Leg and Cold Leg Temperatures), b. 3.2.5.9 (Tavg, ΔT, OPDT Setpoint, OTDT Setpoint), and c. 3.2.8.9 (PZR Vapor Temp).							
13.		4. Temperatures shall be transmitted from the ALS to the Tricon via safety related 4-20 mA analog signals scaled as follows: 1) Narrow Range Tcold: 510 – 630 deg F [FRS 3.2.5.9.1] 2) Narrow Range Thot: 530 – 650 deg F [FRS 3.2.5.9.1] 3) Wide Range Thot: 0 to 700°F [FRS 3.2.3.9.3.a] 4) Wide Range Tcold: 0 to 700°F [FRS 3.2.9.3.b] 5) Pressurizer Vapor Temperature: 100 to 700ºF [FRS 3.2.8.9.3.a] 6) The Tricon shall provide an mx+b filter on the 4-20 mA input signals per FRS 3.2.1.14.3.	3.3.2.8, 3.3.5.8.1, 3.3.3.8.1 3.3.2.8, 3.3.7.8.1	SET I, II 3.10.1.9.1, 3.10.2.9.1, 3.10.3.9.1, 3.11.1.9.1, 3.12.1.9.1, 3.4.1.9.1, 3.4.2.9.1, 3.4.3.9.1, 3.4.4.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.9.1.9.1, SET I 3.10.4.9.1, 3.8.2.9.1, SET II 3.10.4.9.2, 3.8.4.9.1, SET III, IV 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.8.3.9.1, 3.8.4.9.1, SET III 3.11.1.9.1, 3.6.1.9.1, 3.6.2.9.1, 3.9.2.9.1, 3.9.3.9.1 SET IV 3.5.1.9.1, 3.6.3.9.1, 3.6.4.9.1, 3.9.1.9.1, 3.9.4.9.1	SDS-0164, 0167, 0195, 0196 , 0199, 0262 , 0265	N/A	T (Westinghouse) T (Triconex	T	
14.		5. If the actual temperature is below the low scale output value defined in Section 1.5.5.4 the ALS shall output the low scale value, or 0% of span = 4.00 mA without initiating an Out of Range Low alarm	N/A	N/A	SDS-0164, 0195, 0196, 0262, 0708	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
15.		6. The ALS shall provide down-scale open RTD protection; that is, if the ALS detects an open or shorted RTD, it shall output a 0.0 mA analog signal.	N/A	N/A	SDS-0156, 0156.1, 0156.2, 0156.3, 0157, 0157.1, 0157.2, 0157.3, 0166, 0166.1, 0186, 0186.1, 0186.2, 0186.3, 0187, 0187.1, 0187.2, 0187.3, 0198, 0198.1, 0254, 0254.1, 0254.2, 0254.3, 0255, 0255.1, 0255.2, 0255.3, 0264, 0264.1	N/A	T (Westinghouse)	T	
16.		7. All temperatures shall be transmitted from the ALS to the Gateway computer via RS-422 signals scaled for the qualified range of the RTD input board	N/A	N/A	SDS-0602 0152, 0156.1, 0157.1, 0255.1	N/A	T (Westinghouse)	T	
17.		8. This allows the Tricon to provide RTD failure alarming and ensures that the Tricon does not indicate RTD failure when the temperature is below low scale but still functioning correctly, a condition that exists during plant shutdown	N/A	N/A	N/A	PG&E	See comments	T	Require system integrated test (Testing of item 1.5.4.8 by Triconex or Westinghouse cannot be verified)
18.		9. In the latter case, the actual temperature is available from the ALS via the Gateway computer via the TxB1 data stream	N/A	N/A	SDS-0602	N/A	T (Westinghouse)	T	
19.		10. Analog output signals shall fail low, if possible, upon detection of critical failure	N/A	N/A	SDS-0128, 0128.1, 0145, 0166, 0166.1, 0175, 0198, 0198.1, 0207, 0264, 0264.1, 0273	N/A	T (Westinghouse)	T	
20.	1.5.6 Maintenance Workstation	1. Separate and independent Maintenance Workstation computers [Section 2.7] shown in Figure 1-22 are provided for the Tricon and ALS subsystems, respectively, for each Protection Set to allow PPS information processing and display. The two MWS computers in each Protection Set share common HMI peripheral devices such as the keyboard, video display, mouse (KVM), and touchscreen interface through a KVM switch [Section 2.3.7].	N/A	N/A	N/A	PG&E SCOPE	DCP	T	Hardware is provided by PG&E, vendors are responsible for the application only

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
21.		2. The Tricon will be isolated from its dedicated Maintenance Workstation computer by the qualified safety-related Triconex Communications Module (TCM). Fiber optic cable electrically isolates the Tricon from external non-safety-related devices	N/A	N/A	N/A	PG&E	DCP	T	Tricon will provide TCM data link to maintenance work station
22.		3. The ALS broadcasts data to its dedicated Maintenance Workstation computer via the isolated one-way TxB2 RS-422 data links. TAB communications between the ALS and the MWS takes place via RS-485 data link. The TAB is physically disconnected from the MWS when the TAB is not in use. The TAB is connected and enabled only when maintenance is being performed on the ALS. It is disconnected at all other times. The TAB is enabled for short periods only when ALS maintenance is being performed, and maintenance will be performed under administrative controls by qualified individuals. This arrangement satisfies NRC DI&C ISG-04, Staff Position 10 of Section 1, Interdivisional Communications [1.4.3.4].	N/A	N/A	N/A	PG&E	DCP	T	
23.		4. A Maintenance Workstation computer may access data only within its own protection set subsystem (i.e., Tricon or ALS). Communication with other protection sets or between subsystems within a Protection Set shall not be possible	N/A	N/A	N/A	PG&E Scope	DCP	T	
24.	1.5.7 Plant Process Computer Gateway and Other Non-Safety-Related Communications Interfaces	1. The safety-related Tricon and ALS are connected to the non-safety-related PPC and workstation via the Gateway computer shown in Figure 1-22. The Gateway computer will be installed by PG&E in the Process Control System (PCS) replacement project. The ALS-102 CLB provides isolation for the TxB1 and TxB2 one-way EIA-422 communication links to the PPC Gateway and the Maintenance Workstation, respectively. The ALS transmits data to the non-safety-related Gateway computer, which is common to all four protection sets, and to the Maintenance Workstation using serial, unidirectional, one-way communications channels that do not require any handshaking	N/A	N/A	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
25.		2. The Tricon will be isolated from the Gateway computer by a data isolation device such as the port aggregator network tap shown in Figure 1-22, which permits two-way communications between the Maintenance Workstation belonging to a specific protection set and the Tricon in that protection set, yet allows only one-way communication to the PPC Gateway Computer. The port aggregator tap will be provided by PG&E	N/A	N/A	N/A	PG&E Scope	DCP	T	
26.		3. For system health displays, the PPS will share a HMI unit in the Control Room on CC4 that will also be installed by the Process Control System (PCS) replacement project	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
27.	1.5.8 Response Time The reactor trip response time is the time interval from when the monitored parameter exceeds its trip setpoint at the channel sensor, until loss of control rod stationary gripper coil voltage. The ESF response time is the time interval from when the monitored parameter exceeds its trip setpoint until the ESF equipment is capable of performing its safety function. The PPS is allocated a maximum response time of 0.409 seconds [1.4.4.8].								
28.	1.5.8.1	The ALS performs signal conditioning for the narrow range RTD's that support the Overtemperature ΔT (OTDT) and Overpower ΔT (OPDT) reactor trips, and the Tricon performs setpoint calculation and comparison and trip output. Therefore, the PPS time response allocation is shared between the ALS and Tricon portions of the PPS for these functions.	N/A	N/A	N/A	N/A	N/A	N/A	Narrative
29.	1.5.8.2	The preliminary worst case (deterministic) OTDT and OPDT PPS response time allocations shall be as follows: ALS: 0.175 seconds for RTD processing Tricon: 0.200 seconds Contingency: 0.034 seconds Total PPS Allocation: 0.409 seconds	3.3.2.5	2.8.2.2	SDS-1004 SDS-1005 SDS-1006 SDS-1007	N/A	T (Westinghouse) T (Triconex	T	
30.	1.5.8.3	The vendor shall provide means of verifying the actual response time if the system does not support deterministic methods of calculating worst case response time characteristics	N/A	N/A	SDS-1011	N/A	T (Westinghouse)	T	Triconex 993754817, "Maximum TSAP Scan Time"
31.	1.5.9 Accuracy	The FRS specifies existing Eagle 21 accuracy requirements with the intent to maintain currently licensed Channel Statistical Allowance (CSA) margins such that no setpoint changes are required. Accuracy allocation between the ALS and Tricon for the RCS temperature parameters will be determined during the detailed design	N/A	N/A	N/A	PG&E Scope	DCP	N/A	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
2 Interface Requirements This section specifies the requirements imposed on the systems, subsystems, configuration items, or other system components to achieve required interfaces among these entities.									
32.	2.1 Process Interface Requirements	The I/O List [Appendix 4.1 through Appendix 4.4] describes process inputs and outputs for the PPS replacement project. The I/O list contains the following information for each protection set. As noted below, some I/O list information is outside the scope of this interface specification	N/A	N/A	N/A	PG&E Scope	DCP HVT (Triconex)	T	
33.	2.1.1 I/O Power Supplies	1. Separate power supplies will be provided by PG&E for Triconex analog and digital I/O per the Triconex qualification	N/A	N/A	N/A	PG&E Scope	DCP	T	
34.		2. All Tricon discrete inputs and outputs will be powered by PG&E in accordance with the requirements provided in the I/O list	N//A	N/A	N/A	PG&E Scope	DCP	T	
35.		3. All ALS discrete inputs and outputs will be wetted by 48 Vdc supplied by PG&E	N/A	N/A	N/A	PG&E Scope	DCP	T	
36.		4. The Pressurizer pressure channels are shared among the ALS, Tricon, and the control system, via qualified isolator modules, and will be powered by the Tricon ETP as shown in Figure 2-3	N/A	N/A	N/A	PG&E Scope	DCP	T	
37.		5. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
38.		6. All 4-20 mA analog input signals are powered from power supplies located within the PPS cabinets. The 0-10 VDC analog signals from the Nuclear Instrumentation System (NIS) are powered by the NIS	N/A	N/A	N/A	PG&E Scope	DCP	T	
39.		7. PG&E will provide analog loop power supplies. Analog input loop power supply voltage should not exceed 40 Vdc, and may be as low as 24 Vdc based on the following considerations and assumptions a. Rosemount 1154 and 1154 Series H	N/A	N/A	N/A	PG&E Scope	DCP HVT (Triconex) (g, i, k)	T	(h) ALS input resistance , should be 400 ohms (200 each); input board should be ALS-321.

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		1) Max qualified power supply voltage: 45 Vdc 2) Max Design loop resistance at 45 Vdc input: 1575 ohms 3) Min Design loop resistance at 45 Vdc input: 500 ohms 4) Max Design loop resistance at 24 Vdc input: Approx. 700 Ohms 5) Min Design loop resistance at 24 Vdc input: 0 Ohms b. Rosemount 1153 Series B&D Output Code P 1) Max qualified power supply voltage: 40 Vdc 2) Max Design loop resistance at 40 Vdc input: 1325 ohms 3) Min Design loop resistance at 40 Vdc input: 500 ohms 4) Max Design loop resistance at 24 Vdc input: Approx. 600 Ohms 5) Min Design loop resistance at 24 Vdc input: 0 Ohms c. Rosemount 1153 Series B&D Output Code R 1) Max qualified power supply voltage: 45 Vdc 2) Max Design loop resistance at 45 Vdc input: 1575 ohms 3) Min Design loop resistance at 45 Vdc input: 500 Ohms 4) Max Design Loop Resistance at 24 Vdc input: Approx. 700 ohms 5) Min Design Loop Resistance at 24 Vdc input: 0 ohms d. Barton 763 max power supply voltage: 50 Vdc e. Barton 763 Max loop resistance at 40 Vdc input: Approx. 1250 ohms f. Barton 763 Min loop resistance at 40 Vdc input: Approx. 190 ohms g. Triconex 3805N Analog Output module OVP: 42.5 Vdc h. ALS input resistance is 200 ohms with both “A” and “B” 302 connected in series (i.e., Rs = 100 ohms). i. Triconex 9792-610N Reg. Guide 1.180 FTP Approx.							

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		input resistance: 1) When powered from the FTP (max 48 Vdc supply): (250 + 1/(1/250 + 1/3300)) =482 ohms ~ 500 ohms) 2) When externally powered: 250 ohms (i.e., temperature signals from the ALS) j. Resistances of external loop devices are (PG&E scope): 1) Isolator input 4-20 mA into 100 ohms (estimated) 2) Westinghouse VX-252 indicator: 5 ohms (including estimated wire resistance) 3) ERFDS: Loop-Specific (Usually 250 ohms or 50 ohms) 4) RVLIS: 250 ohms k. ALS 4-20 mA analog outputs are powered by the ALS. Therefore, temperature inputs to the Tricon shall not use the Positive Temperature Coefficient (PTC) thermistor for loop overcurrent protection and the input resistance for Tricon temperature inputs is 250 ohms.							
40.		8. Tricon Analog Output Power Supply a) Analog outputs in the safety-related Triconex Main Chassis will be powered by redundant 24 Vdc power supplies furnished by PG&E. b) Analog outputs in the non-safety related Triconex Remote RXM chassis will be powered by redundant 24 Vdc power supplies furnished by PG&E and mounted in the rack housing the RRXM chassis	N/A	N/A	N/A	PG&E Scope	DCP	T	
41.	2.1.2 Analog Inputs	1. PT-455 signal shared among Tricon (DTTA functions), ALS-A, ALS-B and an isolation device	N/A	N/A	N/A	PG&E Scope	DCP	T	
42.		2. LT-459 signal shared among Tricon, Control Board indicators and an isolation device	N/A	N/A	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
43.		3. PT-505 signal shared among the Tricon, and an isolation device	N/A	N/A	N/A	PG&E Scope	DCP	T	
44.		4. RCS Temperature signals are conditioned by ALS-A and ALS-B, respectively before they are input to the Tricon. Example wiring for these signals is shown in Figure 2-3	N/A	N/A	SDS-0164, 0195, 0196	PG&E Scope	DCP	T	Input Connection between ALS and Tricon is PG&E scope
45.		5. Tricon AI card type 3721N shall be configured for 14-bit resolution, unipolar. These cards are used for all 4-20 mA analog inputs to the PPS	3.3.2.8	2.8.1.4	N/A	N/A	T (Triconex)	T	
46.		6. Tricon AI cards 3703E (where used) and 3703EN shall be selected for 0-10 Vdc input, fail downscale. These cards are used for Nuclear Instrumentation (NI) inputs to the PPS	N/A	N/A	N/A	PG&E Scope	DCP HVT (Triconex)	T	
47.		7. Signals from redundant field devices shall be processed on separate input boards (Not applicable to ALS)	N/A	N/A	N/A	PG&E Scope	DCP	T	
48.	2.1.3 Discrete Inputs	Signals from redundant field devices shall be processed on separate input boards (Not applicable to ALS)	N/A	N/A	N/A	PG&E Scope	DCP	T	
49.	2.1.4 Discrete Outputs	Figure 2-5 and Figure 2-6 illustrate typical ALS discrete output signal wiring that implements the diversity architecture [Figure 1-1] using a Line Sense Module (LSM) to provide a hardwired OR configuration between Diversity Groups ALS-A and ALS-B and to enable the ALS to perform continuous error checks. Upon detecting the following conditions, noted actions shall be taken: 1. Failure to Trip on Demand Close ALS Failure contact 2. Trip without Demand Close ALS Trouble contact	N/A	N/A	0311.1[E], 0322[E], 0322.1[E], 0323[E], 0323.1[E], 0325.1 [E], 0333[E], 0333.1[E], 0334[E], 0334.1[E], 0428 [E]	N/A	T (Westinghouse)	T	Westinghouse has an exception to this. The Failure (SDS-0311.1) and Trouble (SDS-0325.1) contacts open to alarm. Documented in CDER IRS R9.

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
50.	2.2 Safety-Related ALS/Tricon Interface Requirements	1. ALS shall provide 4-20 mA analog Temperature channel inputs to Tricon [Refer to Section 1.5.5.4 for scaling information]	N/A	N/A	SDS-0167, 0199, 0265	N/A	T (Westinghouse)	T	ALS provides a 0-22 mA, scaled for the 4-20 mA required by the Tricon
51.		2. ALS 4-20 mA output signals shall be powered by ALS	N/A	N/A	SDS-0417	N/A	O (Westinghouse)	T	
52.	2.3 Data Communication Interface Requirements	As shown in in Figure 1-22, the Tricon portion of the PPS replacement will utilize two TCM cards in each main chassis (Slots 7L and 7R), as well as two Media converters, two Port Aggregator Network Taps, and two sets of associated media. This arrangement provides two non-safety-related communication paths to the MWS and the PPC Gateway Computer from each Protection Set to ensure continued communications if a single non-safety-related communication component fails	N/A	N/A	N/A	PG&E Scope	DCP	T	
53.	2.3.1	The PPS shall provide Non-Safety-Related Communications from Tricon to Port Aggregator Tap “A” (2-way)	N/A	N/A	N/A	PG&E Scope	DCP	T	
54.	2.3.1.1	Hardware: 100BaseT Ethernet optical fiber to copper media converters (2). Supplied by Triconex	N/A	N/A	N/A	PG&E Scope	DCP	T	
55.	2.3.1.2	Media: 100baseT Ethernet optical fiber from TCM1 and TCM2 to media converters. Supplied by Triconex	N/A	N/A	N/A	PG&E Scope	DCP	T	
56.	2.3.1.3	Hardware: Net Optics PA-CU 10/100BaseT Port Aggregator Taps (2). Supplied by PG&E.	N/A	N/A	N/A	PG&E Scope	DCP	T	
57.	2.3.1.4	Media: 100BaseT Ethernet copper from Media Converter to Port Aggregator Tap. Supplied by PG&E	N/A	N/A	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
58.	2.3.1.5	Data Interface Protocol: Triconex Standard Ethernet NET2	3.1.6.1	2.2	N/A	N/A	T (Triconex)	T	
59.	2.3.2	The PPS shall support Non-Safety-Related Communications from Port Aggregator Tap “B” to Tricon Maintenance Workstation Computer (2-way)	N/A	N/A	N/A	PG&E Scope	DCP	T	
60.	2.3.2.1	Hardware: Unmanaged Ethernet switch. Supplied by PG&E	N/A	N/A	N/A	PG&E Scope	DCP	T	
61.	2.3.2.2	Media: 100baseT Ethernet copper	N/A	N/A	N/A	PG&E Scope	DCP	T	
62.	2.3.2.3	Data Interface Protocol: Triconex Standard Ethernet NET2	3.1.6.1	2.2	N/A	N/A	T (Triconex)	T	
63.	2.3.3	The PPS shall support Non-Safety-Related Communications from Port Aggregator Tap “1” to Gateway computer (One-way)	N/A	N/A	N/A	PG&E Scope	DCP	T	
64.	2.3.3.1	Hardware: See Section 2.3.1.1	N/A	N/A	N/A	N/A	N/A	N/A	
65.	2.3.3.2	Media: 100baseT Ethernet + network hub supplied by PG&E	N/A	N/A	N/A	PG&E Scope	DCP	T	
66.	2.3.3.3	Data Interface Protocol: Ethernet-based	N/A	N/A	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
67.	2.3.4	The PPS shall include a unidirectional RS-422 Non-Safety-Related Communication link from each ALS chassis to the ALS Maintenance Workstation as follows:	N//A	N/A	SDS-0504, 0600	N/A	T (Westinghouse)	T	
68.	2.3.4.1	Description: Core Logic Board communication channel TxB2	N/A	N/A	SDS-0504, 0600	N/A	T (Westinghouse)	T	
69.	2.3.4.2	Media: RS-422 twisted pair copper to maintenance workstation	N/A	N/A	SDS-0426	PG&E Scope	DCP	N/A	
70.	2.3.4.3	Data Interface Protocol: TxB1/TxB2 Data Packet [Reference1.4.5.9, App A; 1.4.5.10, App A]	N/A	N/A	SDS-0604	N/A	T (Westinghouse)	T	
71.	2.3.4.4	Data transmitted via TxB2 shall display operational information including but not limited to: 1. Analog input and output values 2. Compensated analog values (e.g., LEAD/LAG PZR Pressure) 3. Discrete input state (i.e., ON, OFF) 4. Comparator input real values 5. Comparator raw output state (i.e., tripped, not tripped) 6. Channel Status (i.e., normal or OOS) 7. Discrete output state (i.e., ON, OFF) 8. Channel bypass status (i.e. bypassed or not bypassed) 9. LSM feedback status (i.e., ON, OFF) 10. Power supply status 11. TAB connection status 12. Alarm status; (i.e., active, clear) 13. Channel integrity status	N/A	N/A	SDS-0602, 0507, 0508, 0509, 0510, 0511, 0512, 0513, 0514, 0515, 0516, 0517, 0518, 0519, 0520, R0553	N/A	T (Westinghouse)	T	
72.	2.3.5	The PPS shall include a bi-directional RS-485 Non-Safety-Related Communications link from each ALS chassis Test ALS Bus (TAB) to the ALS Maintenance Workstation (physically disconnected when TAB is not in use) as follows (Refer to Figure 2-7 for TAB communication interface connections):	N/A	N/A	SDS-0606	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
73.	2.3.5.1	Description: TAB interface with ALS chassis	N/A	N/A	SDS-0606	N/A	T (Westinghouse)	T	
74.	2.3.5.2	Media: RS-485 twisted pair copper	N/A	N/A	SDS-0427	PG&E Scope	DCP	T	
75.	2.3.5.3	Data Interface Protocol: TAB [Reference 1.4.5.10, Section 5.2]	N/A	N/A	SDS-0607, 0608, 0505.5	N/A	T (Westinghouse)	T	
76.	2.3.6	The PPS shall include a unidirectional RS-422 Non-Safety-Related Communications link from each ALS chassis to the Gateway Computer as follows:	N/A	N/A	SDS-0601,	PG&E Scope	T (Westinghouse) DCP	T	
77.	2.3.6.1	Description: Core Logic Board communication channel TxB1	N/A	N/A	SDS-0601	N/A	T (Westinghouse)	T	
78.	2.3.6.2	Media: RS-422 twisted pair copper to Gateway computer	N/A	N/A	SDS-0426	PG&E Scope	T (Westinghouse) DCP	T	
79.	2.3.6.3	Data Interface Protocol: TxB1/TxB2 Data Packet [Reference1.4.5.9, App A; 1.4.5.10, App A]	N/A	N/A	SDS- 0604	N/A	T (Westinghouse)	T	
80.	2.3.6.4	Data transmitted on TxB1 shall be identical to the data transmitted on TxB2	N/A	N/A	SDS-0602.1	N/A	T (Westinghouse)	T	
81.	2.3.7	Keyboard, Video Display, and Mouse (KVM) Switch	N/A	N/A	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
82.	2.3.7.1 The KVM switch provided by PG&E enables sharing a video display and USB HMI peripheral devices between multiple computers	1. The KVM switch shall enable the Tricon MWS computer and the ALS MWS computer to be controlled from one single KVM console per protection set using analog VGA video links to a single VGA monitor.	N/A	N/A	N/A	PG&E Scope	DCP	T	
83.		2. The KVM switch shall permit only connections between the video display and USB interface devices and the single selected computer. Connection between the computers or to multiple computers shall not be permitted.	N/A	N/A	N/A	PG&E Scope	DCP	T	
84.		3. The USB HMI peripheral devices controlled by the KVM switch are limited to: a. Keyboard b. Mouse c. Touchscreen interface device d. Printer Printer functionality shall be limited to simple printing via hardwired USB interface only.	N/A	N/A	N/A	PG&E Scope	DCP	T	
85.		4. The KVM switch supports switching the video display and HMI interface devices between the connected computers via the following means: a. Keyboard hotkeys b. Front panel switch c. Mouse button	N/A	N/A	N/A	PG&E Scope	DCP	T	
86.		5. The KVM switch enables mouse and keyboard input devices to be switched instantaneously and reliably between the connected computers without requiring the devices to be enumerated upon transfer. Item 7, below explains enumeration.	N/A	N/A	N/A	PG&E Scope	DCP	T	
87.		6. The KVM switch includes two independently switchable, enumerated USB channels for other devices. The first channel (USB1) shall be used for the Touchscreen interface device. The second channel (USB2) shall be used to connect a printer to the workstation to support calibration, maintenance and surveillance test operations	N/A	N/A	N/A	PG&E Scope	DCP	T	
88.		7. The independently switchable USB channels provide enumerated switching, which requires the connected USB device to perform a full initiation process (i.e., enumeration) every time it is switched. The enumerated switch shall pass signals straight through the switch between the USB device and the computer without interpretation	N/A	N/A	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
89.		8. The switch utilizes the default switching mode, in which the video display, keyboard and mouse and the enumerated USB ports are all switched together	N/A	N/A	N/A	PG&E Scope	DCP	T	DCP to verify KVM switch configuration
90.		9. (deleted)							
91.		10. The PPS replacement application will not utilize the audio interface	N/A	N/A	N/A	PG&E Scope	DCP	T	DCP to verify KVM switch configuration
92.		11. PG&E will provide multiple KVM stations for the DCPP PPS Replacement application, one per protection set	N/A	N/A	N/A	PG&E Scope	DCP	T	
93.	2.3.7.2	Media: Copper	N/A	N/A	N/A	PG&E Scope	DCP	T	
94.	2.3.7.3	Data Interface Protocol: USB, Analog VGA	N/A	N/A	N/A	PG&E Scope	DCP	T	
95.	**2.4 System Power Supply**								
96.	2.4.1 I/O Power Refer to Section 2.1.1								
97.	2.4.2 Tricon System Power Supply	The Tricon portion of the PPS replacement will use the standard Triconex V10 AC power distribution design. An external independent vital 120 VAC 60 HZ power source will be provided by PG&E for each Protection Set. The single vital 120 VAC source for each Protection Set will	N/A	N/A	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		be connected in parallel to the dual input power supply for each Tricon V10 Protection Set. Power filters will reduce conducted noise to acceptable levels in accordance with USNRC Regulatory Guide 1.180, Rev 1							
98.	2.4.3 ALS System Power Supply	The ALS "A" and ALS "B" chassis in each Protection Set requires two safety related sources of 48 VDC power for the ALS chasses and the individual boards within the chasses. The power supplies and 120 VAC sources are provided by PG&E.	N/A	N/A	N/A	PG&E Scope	DCP	T	
99.	**2.5 Instrument Power Supply Locations** To be determined by detailed design								
100.	**2.6 System Power Sources Provided by PG&E**								
101.	2.6.1 The following power sources are available for the Process Protection System	1. 120 Vac vital instrument power [1.4.4.7]: Voltage: 120V ±10% Frequency: 60 HZ ±5%	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
102.		2. Non-safety-related 120 Vac utility power	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
103.	2.6.2 Harmonic Distortion Limitations	PG&E practices power supply quality monitoring. As-found and as-left Total Harmonic Distortion (THD) measurements will be performed on power supply at PPS 120 Vac power supply input terminals before and after installation of equipment powered from the 120 Vac vital instrument power supply. Refer to USNRC Reg. Guide 1.180 [1.4.3.3].	N/A	N/A	N/A	PG&E Scope	DCP	N/A	
104.	**2.7 Workstations**								

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
105.	2.7.1 Maintenance Workstations	Separate and independent Maintenance Workstation computers are provided for the Tricon and ALS subsystems in each Protection Set to allow independent processing and display of information from both Triconex and ALS portions of the PPS.	N/A	N/A	N/A	PG&E Scope	DCP	T	
106.	2.7.1.1	The Tricon shall interface (2-way) with the HMI application in the Tricon MWS computers. The TS1131 PPS application contains function blocks that allow WRITE-access to a limited set of parameters programmed into the application software with the Tricon keyswitch in the RUN position. Without these function blocks programmed into the application program parameters cannot be modified with the keyswitch in the RUN position. The unmanaged Ethernet switch shown in Figure 1-22 between each port aggregator network tap Port B and the two Tricon MWS computer network interface ports in each Tricon MWS computer will be provided to ensure continued Tricon multicast operation in the event of MWS network communication failure.	N/A	N/A	N/A	PG&E Scope	DCP	T	
107.	2.7.1.2	The ALS-A and ALS-B interface (1-way) shall communicate concurrently with the HMI application in the ALS MWS computer via the isolated TxB2 RS-422 data link [2.3.4].	N/A	N/A	N/A	PG&E Scope	DCP	T	
108.	2.7.1.3	The two MWS computers in each Protection Set will share peripheral devices through a KVM switch. Refer to Section 2.3.7 for details.	N/A	N/A	N/A	PG&E Scope	DCP	T	
109.	2.7.2 ALS Service Unit Application Software								
110.	2.7.2.1	The ASU software application shall be provided by Westinghouse to run on the ALS Maintenance Workstation	N/A	N/A	SDS-0503	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
111.	2.7.2.2	The ASU application utilizes a two-way RS-485 communication link to communicate with the Test ALS Bus (TAB) that is physically disconnected from the MWS computer when it is not in use [2.3.5].	N/A	N/A	N/A	N/A	N/A	T	See Line 72
112.	2.7.2.3	The activation of the TAB via connecting the TAB data link to the MWS computer shall not interfere with the ability of the ALS safety channels to perform their respective safety functions and the ALS shall remain operable during activation of the TAB.	N/A	N/A	SDS-0439,	N/A	T (Westinghouse)	T	
113.	2.7.2.4	Capability shall be provided to place Individual channels in bypass from the ASU for maintenance and the non-bypassed channels in the ALS chassis shall continue to be operable with respect to their safety function	N/A	N/A	SDS-0130, 0130.2, 0236, 0236.2, 0297, 0297.2	N/A	T (Westinghouse)	T	
114.	2.7.2.5	The TAB from ALS Chassis “A” and Chassis “B” will be provided with individual RS-485 ports on the ALS MWS computer	N/A	N/A	N/A	PG&E Scope	DCP	T	
115.	2.7.2.6	The ASU application shall ensure that the correct TAB is connected to the respective MWS RS-485 port. Note: To detect the TAB connection, the ALS-102 DI 2 needs to be connected to ALS-102 ‘Input.Rtn as shown in Figure 2-7 [Reference 1.4.5.8, Figure 4-2].	N/A	N/A	SDS-0505.3, 0505.4	N/A	T (Westinghouse)	T	See Line 129.
116.	2.7.2.7	The ASU application shall provide passive system status display(s)) of the information listed in Section 2.3.3.4 using one-way ALS-102 RS-422 Transmit Bus TxB2.	N/A	N/A	SDS-, 0507 through 0520	N/A	T (Westinghouse)	T	Westinghouse has an exception to display the information listed in section 2.3.3.4 and proposes, instead, to display the information listed in section 2.3.4.4. Documented in CDER IRS R9. (correct reference is 2.3.4.4)
117.	2.7.2.8	The ASU passive system status display(s) shall function without the TAB being connected	N/A	N/A	SDS-0506	N/A	T (Westinghouse)	T	
118.	2.7.2.9	The ASU application shall include the capability to modify adjustable parameters (comparator setpoints, calibration coefficients, and tuning constants).	N/A	N/A	SDS-0522, 0554, 0117.1, 0122.1, 0152.1, 0154.1, 0182.1, 0184.1,	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
					0220.1, 0222.2, 0227.3, 0250.1, 0252.1, 0286.1, 0291.1				
119.	2.7.2.10	The capability to modify adjustable parameters shall be available only via the TAB when the TAB is connected	N/A	N/A	SDS-0378.3, 0117.5, 0122.4, 0152.6, 0154.4, 0182.6, 0184.4, 0379.3, 0220.4, 0222.5, 0227.5, 0250.5, 0252.4, 0380.3, 0286.4, 0291.3, , 0505	N/A	T (Westinghouse)	T	
120.	2.7.2.11	The ASU application shall provide functions specified in the FRS that support periodic surveillance testing, including calibration requirements per Sections 2.9.6.1 through 2.9.6.5 of this specification. These functions include, as a minimum: 1. Set comparator outputs in the energized or deenergized state, independent of the application demand, 2. Force other discrete outputs (such as alarms) to the open or closed state independent of the application demand. 3. Force analog input or output values independent of the input signal or application demand.	N/A	N/A	SDS-0120, 0120.1, 0120.2, 0130, 0131, 0143, 0143.1, 0162, 0162.1, 0173, 0173.1, 0193, 0193.1, 0205, 0205.1, 0225, 0225.1, 0236, 0237, 0260, 0260.1, 0271, 0271.1, 0289, 0289.1, 0297, 0298, 0313, 0314, 0327, 0328, 0339, 0340, 0346, 0347	N/A	T (Westinghouse)	T	
121.	2.7.2.12	The ASU application shall be compatible with a Microsoft Windows XP (SP3 or later) operating system	N/A	N/A	SDS-0565	N/A	T (Westinghouse)		
122.	2.7.2.13	The ASU application shall include capability to log: 1. Tunable parameters 2. Setpoints 3. System diagnostic alarms	N/A	N/A	SDS-0560, 0562	N/A	T (Westinghouse)	T	
123.	2.8 Alarm Interface Requirements	The PPS shall provide the following alarm output signals from each Protection Set for connection to the Main Annunciator System (MAS) in the DCPP Main Control Room (MCR). Separate signals shall be provided for these alarms from each Protection Set per Section 3.2.1.5 of the FRS [1.4.4.2].	N/A	N/A	SDS-0311, 0325, 0337, 0344	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
124.	2.8.1 PPS Failure (Deenergize to Alarm with Reflash capability implemented in PPS)	The conditions listed in FRS Section 3.2.1.5.1 provide signals to initiate the PPS Failure alarm in the Main Control Room. In event of conflict with FRS Section 3.2.1.5.1 this Specification shall prevail	3.3.1.2.2	3.13.1.9.6.2	SDS-0311, 0311.1, 0312, 0312.1, 0315		T (Westinghouse) T (Triconex)	T	
125.	2.8.1.1	The TSAP alarm associated with the failure of both critical analog input power supplies or the failure of both critical analog output power supplies shall be suppressed if there is a loss of power to the digital input card [Section 2.8.2.3] associated with the power supply alarm inputs.	3.3.1.2.2	3.13.1.9.6.6	N/A	N/A	T (Triconex)	T	
126.	2.8.1.2	ALS temperature input and output channel integrity failure shall not activate the PPS Failure alarm contact. 1. The channel integrity status shall be provided in the TxB1 and TxB2 data streams [2.3.4 and 2.3.6]	N/A	N/A	SDS-0602, 0708, 0713	N/A	T (Westinghouse)	T	Westinghouse exception: Certain scenarios for failure of the analog input channel may not allow the Tricon to alarm the condition. Therefore, it is necessary that the channel integrity error alarm the condition directly. Documented in CDER IRS R9.
127.	2.8.2 PPS Trouble (Deenergize to Alarm with Reflash capability implemented in PPS)	The following platform-specific inputs to the Main Control Room PPS Trouble Alarm shall be provided in addition to those listed in FRS Section 3.2.1.5.2. Other alarms not listed here or in the FRS may be provided to meet platform diagnostic requirements. In event of conflict with FRS Section 3.2.1.5.2 this Specification shall prevail.	3.3.1.2.3	3.13.1.9.6.1	SDS-0325, 0325.1, 0326, 0326.1, 0329	N/A	T (Westinghouse) T (Triconex)	T	
128.	2.8.2.1	Controller keyswitch not in RUN condition detected (Tricon only)	3.3.1.2.3	3.13.1.9.6.1.8, 3.2.1.9.5	N/A	N/A	T (Triconex)	T	
129.	2.8.2.2	TAB communication enabled (ALS Only).	N/A	N/A	SDS-0310, 0310.1, 0335	PG&E	DCP T (Westinghouse)	T	
130.	2.8.2.3	Loss of power to the digital input card (See Figures 1-5, 1-10, 1-15, 1-20).	3.3.1.2.3	3.13.1.9.6.1.7	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
131.	2.8.2.4	The TSAP alarms associated with the failure of a pair of primary and secondary non-critical power supplies, or the failure of a single power supply shall be suppressed if there is a loss of power to the digital input card [Section 2.8.2.3] associated with the power supply alarm inputs	3.3.1.2.3	3.13.1.9.6.1.7	N/A	N/A	T (Triconex) See comments	T	This function is tested by Triconex per PTM, Rev 9 Item 536
132.	2.8.2.5	ALS temperature input and output channel integrity failure shall not activate the PPS Trouble alarm contact. 1. The channel integrity status shall be provided in the TxB1 and TxB2 data streams [2.3.4 and 2.3.6]	N/A	N/A	SDS-0602, 0708, 0713	N/A	T (Westinghouse)	T	
133.	2.8.3 PPS Channel in Bypass [Energize to Activate with Reflash capability implemented in PPS] The following ALS discrete output signals shall be provided in addition to those listed in FRS Section 3.2.1.5.3.	1. For deenergize to trip circuits, the PPS Channel in Bypass contact shall be activated if the output circuit is energized as detected by the LSM; and: 1. The ASU is used to place any ALS channel within a specific ALS chassis in Bypass status; 2. or The output to the SSPS from any ALS channel within a specific ALS chassis is bypassed using the manual bypass switch [Section 2.9.6.7.8]	N/A	N/A	SDS-130.3, 0236.3, 0297.3, 0306, 0308, 0349	N/A	T (Westinghouse)	T	
134.		2. For deenergize to trip circuits, the PPS Channel in Bypass contact shall be activated if the output circuit is not energized as detected by the LSM; and: 1. The ASU is used to place any ALS channel within a specific ALS chassis in Bypass status; or 2. The output to the SSPS from any ALS channel within a specific ALS chassis is bypassed using the manual bypass switch [Section 2.9.6.7.8]	N/A	N/A	SDS-0236.3^{E}, 0297.3^{E}, 0307^{E}, 0307.1^{E}, 0309^{E}, , 0350	N/A	T (Westinghouse)	T	Westinghouse exception; Tthe requirement applies to Energize-to-Trip, not to de-energize to trip. The IRS is incorrect, Documented in CDER IRS R9.
135.		3. PPS Channel in Bypass contact shall be activated if any partial trip or other function associated with an ALS channel within a specific ALS chassis is placed in Bypass status from the ASU; that is, if a channel contains multiple partial trip outputs, the PPS Channel in Bypass contact shall remain active while any associated partial trip within a specific ALS chassis is in Bypass status	N/A	N/A	SDS-130.3, 0236.3, 0297.3, , 0344.1, 0345, 0345.1, 0351	N/A	T (Westinghouse)	T	
136.	2.8.4 PPS Channel Out of Service [Energize to Alarm with Reflash capability]	1. [For Tricon] Manual Channel Out-of-Service (OOS) switches, where used, are provided with two (2) separate and independent output contacts. 1. One contact satisfies PPS functional logic requirements per FRS Section 3.2.1.5.5.b). 2. One contact for use by the MAS, independent of the PPS per FRS Section 3.2.1.5.5.a).	3.3.1.2.6	3.13.1.9.6.4	N/A	PG&E Scope	DCP	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
137.		2. [For ALS] The chassis "A" ("B") Out of Service output contact: 1. Shall be activated when any protection channel or function within the respective chassis has been defeated from the ASU. 2. Shall reflash when a subsequent channel or function within the chassis is defeated while any other channel or function in the respective chassis is out of service.	N/A	N/A	SDS-0119.2, 0161.3, 0192.3, 0224.2, 0259.3, 0288.2, 0337.1, 0338.1, , 0342, 0343	N/A	T (Westinghouse)	T	
138.	2.8.5 RTD Failure Alarm (MAS) [Energize to Alarm with Reflash capability] Requirements for the RTD Failure alarm are provided in FRS Section 3.2.1.5.4.								
139.	2.8.6 S/G Low-Low Level TTD Timer Actuated Alarm Requirements for the S/G Low-Low Level TTD Timer Actuated alarm are provided in FRS Section 3.2.11.5.								
140.	2.8.7	For the Tricon alarm conditions identified in Section 2.8.7.3 time delay off shall be applied to the alarm in the TSAP so as to provide adequate time for the alarm to be transmitted to and logged by the MWS	N/A	N/A	N/A	N/A	N/A	N/A	See item 143
141.	2.8.7.1	A time delay off shall be applied to the alarm in the TSAP so as to provide adequate time for the alarm to be transmitted to and logged by the MWS	3.3.1.2.1	3.13.1.9.6.6	N/A	N/A	T (Triconex)	T	
142.	2.8.7.2	Unless otherwise specified, the initial time delay off shall be set to 5 seconds	3.3.1.2.1	3.13.1.9.6.6	N/A	N/A	T (Triconex)	T	
143.	2.8.7.3 Tricon Alarm Conditions	1. Input OOR (FRS 2.3.1.2) 2. Failure to set Trip on Demand (FRS 3.2.1.5.1 a)) 3. Trip output set without demand (FRS 3.2.1.5.2 a)) 4. Loss of critical power supply (FRS 3.2.1.5.2 b)) 5. Loss of a non-critical power supply (FRS 3.2.1.5.2 c)) 6. Input deviation - SQA2 (FRS 3.2.1.5.4 a)) 7. Two bad inputs - SQA2 (FRS 3.2.1.5.4.b)) 8. Less than two good inputs - SQA3A and SQA3B (FRS 3.2.1.5.4.c)) 9. NI input open circuit (FRS 3.2.5.5.4 b)) 10. Thot input deviation (FRS 3.2.5.5.5 c))	3.3.1.2.1	3.13.1.9.6.1.5, 3.13.1.9.6.2.6 3.13.1.9.6.2.3 3.13.1.9.6.1.6 3.13..1.9.6.2.4 3.13.1.9.6.1.7 3.7.1.9.4.7, 3.7.1.9.7, 3.2.1.9.5	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		11. Loss of power to digital input card (IRS Section 2.8.2.3)							
144.	2.9 Software Constraints and Requirements	1. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
		2. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
145.	2.9.3 Tagname Convention	1. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
146.		2. ALS Service Unit (ASU) a. The tagname convention shown in Table 1 shall be used for display of PPS variables that are transmitted to the ALS MWS. (Tagnames are assigned in the ASU) b. The ALS MWS displays shall utilize the tagnames provided in the I/O List [Appendix 4.1 through Appendix 4.4].	N/A	N/A	SDS-0564	N/A	T (Westinghouse)	T	Tagname convention is not part of Westinghouse RTM
147.	2.9.4	Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
148.	2.9.5 Quality Codes	A method shall be provided to identify the validity of data being transmitted to the MWS and external systems for the purpose of displaying the status of displayed information	N/A	N/A	N/A	N/A	N/A	N/A	Narrative Text
149.	2.9.5.1 ALS	Channel integrity information shall be included in the TxB1/TxB2 data stream	N/A	N/A	SDS-0602	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
150.	2.9.5.2 Tricon	1. Provide read-only Modbus aliased Quality Code tagnames for analog input variables. The Quality Code (DINT) value shall be assigned per the following definitions: (Table 3)	3.3.1.3	3.2.1.9.6,	N/A	N/A	T (Triconex)	T	
151.		2. The Quality Code for the individual RTD inputs to DTTA shall be set to 5 if DTTA is OOS or if the individual RTD is removed from service	3.3.5.4.2	3.7.1.9.1.1	N/A	N/A	T (Triconex)	T	
152.		3. The Quality Code for the Pressurizer Pressure input to DTTA shall be set to 5 if DTTA is OOS	3.3.5.4.2	3.7.1.9.1.1	N/A	N/A	T (Triconex)	T	
153.		4. The Quality Code for the Pressurizer Pressure input to DTTA shall be set to 4 if the OOR alarm condition is true as constrained by FRS Section 3.2.5.5.4 d).	3.3.5.4.2	3.7.1.9.1.1	N/A	N/A	T (Triconex)	T	
154.		5. The Quality Code for the Power Range Flux inputs to DTTA shall be set to 5 if DTTA is OOS	3.3.5.4.2	3.7.1.9.1.1	N/A	N/A	T (Triconex)	T	
155.		6. The Quality Code for a Power Range Flux input to DTTA shall be set to 4 if the input is OOR or open circuit.	3.3.5.4.2	3.7.1.9.1.1	N/A	N/A	T (Triconex)	T	
156.	2.9.6 On-Line Maintenance and Test Interface								
157.	2.9.6.1	The PPS shall provide capability for maintenance bypass during power operation; that is, the PPS shall permit removal of the capability of an individual channel or channels to perform its protective action due to a requirement for replacement, repair, test, or calibration [GDC 21].	3.3.2.1.1	3.3.1.9	SDS-0130, 0236, 0297		T (Westinghouse) T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
158.	2.9.6.2	The maintenance and test functions shall be accomplished without lifting electrical leads or installing temporary jumpers	3.3.2.1.1	3.3.1.9	N/A	PG&E Scope	T (Triconex) See Comments	T	Hardware supplied by PG&E, wiring determined by PG&E Triconex – Tested under PTM item 3423
159.	2.9.6.3	The channel or channels subject to the maintenance bypass may remain in the bypassed condition within administrative time limits in accordance with DCPP technical specifications established to meet the single failure criterion per IEEE-603-1991 Sections 5.1 and 6.3.1	N/A	N/A	N/A	PG&E Scope	N/A	N/A	
160.	2.9.6.4	Capability to initiate protective action (i.e., to initiate partial trip or actuation) from an channel that has been removed from service for maintenance shall be provided per IEEE 603-1991 Section 6.3.2 and DCPP Technical Specifications	3.3.2.1.1	3.3.1.9,	SDS-0131, 0237, 0298	N/A	T (Westinghouse) T (Triconex)	T	
161.	2.9.6.5	Removing a PPS channel from service for maintenance shall not adversely affect the ability of channels in the same chassis that have not been removed from service to perform their safety function	3.3.2.1.1	3.3.1.9	SDS-0119.1, 0161.2, 0192.2, 0224.1, 0259.2, 0288.1	N/A	T (Westinghouse) T (Triconex)	T	
162.	2.9.6.6 Tricon PPS Subsystem Specific Requirements								
163.	2.9.6.6.1	Manual trip switches will be provided by PG&E on PPS partial trip and actuation outputs that de-energize to trip [FRS 3.2.1.3.4]. The switches may be used for SSPS input relay testing or to trip or actuate the channel manually if needed. Manual trip switches will not be provided for energize to trip outputs	N/A	N/A	N/A	PG&E Scope	DCP	T	Hardware supplied by PG&E, wiring determined by PG&E
164.	2.9.6.6.2	On-line testing shall be controlled by the safety-related Tricon processor enabled via a permissive from an safety-related hardwired manual Out of Service (OOS) switch	3.1.4.3.4	SET I, II 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.7, 3.3.1.9.8, 3.3.1.9.9 SET III 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.8, SET IV	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
				3.3.1.9.2, 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6					
165.	2.9.6.6.3	When the OOS switch is activated, the safety-related function processor shall allow the associated channel to be taken out of service while maintaining the remainder of the Protection Set operable. Features to limit inadvertently placing a channel OOS shall include, but not be limited to:	3.3.2.1.1	3.3.1.9	N/A	N/A	N/A	T	
166.		1. Approved PG&E procedures are required to perform testing operations.	N/A	N/A	N/A	PG&E Scope	N/A	N/A	
167.		2. Operation of the hardware OOS switch alone shall not place the channel out of service	3.1.4.3.4	3.3.1.9	N/A	N/A	T (Triconex)	T	
168.		3. More than one specific action shall be required at the Maintenance Workstation to perform the maintenance functions. In order to perform any test operation from the maintenance workstation, the user must: 1. Activate the OOS switch for the specific loop to be tested 2. Log in as a maintenance user on the maintenance workstation 3. Open the maintenance screen for the specific loop being tested a. On the maintenance screen, request the desired test mode b. On the maintenance screen, confirm the requested test mode (Loop logic in Tricon is placed OOS only after the requested mode is confirmed) c. Deleted d. Deleted e. If it is desired to change the test mode, repeat steps 3.(a) through 3.(d) while the channel is OOS; selecting a different test	3.3.2.1.1,3.1.4.3.4, 3.3.2.1.1 3.3.2.1.1	SET I, II, III, IV 3.3.1.9 SET I, II 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.7, 3.3.1.9.8, 3.3.1.9.9 SET III 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.8, SET IV 3.3.1.9.2, 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6	N/A	PG&E	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		mode alone shall not cause or require returning the channel to service. 4. The channel shall return to service: a. When the OOS switch is returned to its normal position; or b. When so commanded from the MWS							
169.		4. Feedback is provided to the user on the maintenance workstation that the hardware OOS switch for the loop to be tested has been activated	3.1.4.3.4	SET I, II 3.3.1.9, 3.3.1.9.1, 3.3.1.9.5, 3.3.1.9.7 SET III 3.3.1.9, 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.8 SET IV 3.3.1.9, 3.3.1.9.2, 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6	N/A	N/A	T (Triconex)	T	
170.		5. Continuous indication is provided in the control room that a loop is OOS.	3.1.4.3.3	SET I, II 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.7, 3.3.1.9.8, 3.3.1.9.9 SET III 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.8 SET IV 3.3.1.9.2, 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6	N/A	PG&E Scope	DCP	T	OOS switches will be provided by PG&E
171.		6. If the safety-related hardware out of service switch is not activated, non-safety-related actions or failures cannot adversely affect the safety-related function	3.1.4.3.4	SET I, II 3.3.1.9.1, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6, 3.3.1.9.7, 3.3.1.9.8, 3.3.1.9.9 SET III 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6,	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
				3.3.1.9.8, SET IV 3.3.1.9.2, 3.3.1.9.3, 3.3.1.9.4, 3.3.1.9.5, 3.3.1.9.6					
172.		7. A bistable is not permitted to be bypassed if the manual trip switch is in the trip position. The MWS shall advise the user that bypass is not permitted and shall allow the user to test in trip in this condition following request and confirmation as described above	3.3.2.1.1.5	3.3.19	N/A	N/A	T (Triconex)	T	
173.		8. (For PC-505A and PC-506A Turbine Impulse Pressure to P-13) If a bistable is being tested in trip mode and the manual trip switch is closed and the manual bypass switch is placed in the BYPASS position: (1) The logic for the associated bistable(s) shall transfer to Test in Bypass immediately and without confirmation from the MWS. (2) If the manual trip switch is open, the logic for the associated bistable(s) shall not transfer to Bypass and MAS control room bypass alarm referred to in FRS 3.2.1.5.3 shall be suppressed. (3) When the bypass switch is restored to the Normal condition with the manual trip switch closed, the bistable shall remain in Test in Bypass mode until (1) the channel is returned to service per 3.c.(4), above; or (2) the bistable test mode is changed per 3.c.(3), above	3.3.2.1.1.5	3.3.1.9.9	N/A	N/A	T (Triconex)	T	
174.		9. If a bistable is being tested in bypass mode and a manual trip switch is placed in the TRIP position, the logic for the associated bistable(s) shall transfer to Test in Trip mode immediately and without confirmation from the MWS. (1) When the trip switch is restored to the normal condition, the bistable shall remain in Test in Trip mode until (1) the channel is returned to service per 3.c.(4), above; or (2) the bistable test mode is changed per 3.c.(3), above.	3.3.2.1.1.4	3.3.1.9	N/A	N/A	T (Triconex)	T	

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RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
175.		10. For deenergize to trip outputs, the PPS Trouble Alarm due to trip output set without demand shall be suppressed when the bistable is being tested in trip or bypass mode	3.1.4.3.4	SET I 3.1.1.1.9.7, 3.12.1.9.7, 3.13.1.9.6.1.6, 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.9.1.9.7, 3.9.2.9.7, 3.9.3.9.7, 3.9.4.9.7 Set II 3.11.1.9.7, 3.12.1.9.7, 3.13.1.9.6.1.6, 3.7.1.9.7, 3.8.1.9.7, 3.8.4.9.7, 3.9.1.9.6, 3.9.2.9.6, 3.9.3.9.6, 3.9.4.9.6 SET III 3.11.1.9.7, 3.13.1.9.6.1.6 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.8.3.9.7, 3.8.4.9.7, 3.9.2.9.6, 3.9.3.9.6 SET IV 3.13.1.9.6.1.6, 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.8.3.9.7, 3.8.4.9.7, 3.9.1.9.6, 3.9.4.9.6	N/A	N/A	T (Triconex)	T	
176.		11. For energized to trip outputs, the PPS Trouble Alarm due to trip output set without demand shall not be suppressed when the bistable is being tested in trip or bypass mode	3.1.4.3.4	3.4.4.9.7	N/A	N/A	T (Triconex)	T	
177.		12. PPS Failure Alarm due to failure to set trip on demand shall not be suppressed when the bistable is being tested in trip or bypass mode, except that the P-13 Failure to set trip on demand MAS alarm shall be suppressed if the P-13 bistable bypass is initiated as in 2.6.6.3.h, above.	3.1.4.3.4	SET I, II 3.11.1.9.7, 3.12.1.9.7, 3.13.9.6.2 3.13.1.9.6.2.3, 3.7.1.9.7, 3.8.1.9.7 SET I 3.8.2.9.7, 3.9.1.9.7,	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
				3.9.2.9.7 SET II 3.8.4.9.7, 3.9.1.9.6, 3.9.2.9.6 SET III 3.11.1.9.7, 3.9.2.9.6 SET IV 3.9.1.9.6, 3.9.4.9.6 SET III, IV 3.13.1.9.6.2, 3.13.1.9.6.2.3, 3.7.1.9.7, 3.8.1.9.7, 3.8.2.9.7, 3.8.3.9.7, 3.8.4.9.7,					
178.	2.9.6.6.4	Maintenance modes allowable under 3.c.(3) above shall include: 1. Test in Bypass: The bistable trip output is maintained in the untripped condition while in this mode; that is, Test in Bypass mode shall override the output of the channel trip comparator to prevent generation of a partial trip from the channel being tested.	3.3.2.1.1	3.3.1.9	N/A	N/A	T (Triconex)	T	Invensys PTM is misnumbered for IRS requirements Exception taken per CD-ER 993754-25 per PTM item 3460 Exception taken per CD-ER 993754-31 per PTM item 3461
179.		2. Test in Trip: The bistable trip output is maintained in the tripped condition while in this mode; that is, Test in Trip mode shall override the output of the channel trip comparator to initiate partial trip or actuation from the channel being tested.	3.3.2.1.1	3.3.1.9	N/A	N/A	T (Triconex)	T	Invensys PTM is misnumbered for IRS requirements Exception taken per CD-ER 993754-31 per PTM item 3463
180.	2.9.6.6.5 Parameter Update: Capability to update parameters such as trip setpoints or tunable parameters	1. The parameter values to be updated are limited by the software application to pre-determined ranges	3.3.2.1.1.6	3.3.1.9	N/A	N/A	T (Triconex)	T	Invensys PTM is misnumbered for IRS requirements Exception taken per CD-ER 993754-25 per PTM item 3465
181.		2. The Maintenance Workstation software application shall request confirmation that the parameter update process is complete prior to saving the new tuning constant	3.3.2.1.1.6, 3.3.2.1.1.6.1, 3.3.2.1.1.6.2	3.3.1.9	N/A	N/A	T (Triconex)	T	

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RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
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			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
182.	2.9.6.6.6	Manual bypass switches will be provided per FRS Sections 3.2.1.3.6 and 3.2.1.5.3.	N/A	N/A	N/A	PG&E Scope	DCP	T	Invensys PTM is misnumbered for IRS requirements Exception taken per CD-ER 993754-25 per PTM item 3471
183.	2.9.6.6.7	Alarm outputs from the Tricon to the MAS shall be testable. If an OOS switch is placed in the OOS position, and a properly logged in user at the MWS commands a Test signal, the Tricon logic shall pulse the alarm output from the existing state to the opposite state for 3 seconds	3.3.2.1.1.2	3.13.1.9.6.1.8, 3.13.1.9.6.2.5, 3.13.1.9.6.3, 3.13.1.9.6.4, 3.13.1.9.6.5, 3.3.1.9	N/A	N/A	T (Triconex)	T	Invensys PTM is misnumbered for IRS requirements Exception taken per CD-ER 993754-25 per PTM item 3472
184.	2.9.6.7 ALS PPS Subsystem Related Requirements	1. ALS bypass and test functions shall be accomplished through the ASU application implemented in the ALS MWS as discussed in Section 2.7.2	N/A	N/A	0130, , 0131, 0143, 0173, 0193, 0205, , 0225, 0236, 0271, , 0289, 0297, 0298,	N/A	T (Westinghouse)	T	
185.		2. Placing a specific channel in bypass from the ASU shall not affect the safety function of other channels in the same ALS chassis that are not subject to the same bypass	N/A	N/A	SDS-0130.2, 0236.2, 0297.2	N/A	T (Westinghouse)	T	
186.		3. Placing an individual channel in bypass in one ALS chassis (e.g., Chassis “A”) from the ASU does not affect the safety function of any channels in the diverse ALS chassis (e.g., Chassis “B) in the same protection set	N/A	N/A	N/A	N/A	N/A	T	
187.		4. It shall be possible to place multiple channels in bypass concurrently within an ALS chassis. However, placing multiple channels in bypass shall require individual bypass actions for each channel. It shall not be possible to place multiple channels in bypass by a single action from the ASU	N/A	N/A	SDS-0130.2, 0236.2, 0297.2, 0524	N/A	T (Westinghouse)	T	
188.		5. The Test ALS Bus (TAB) must be physically connected to the MWS as shown in Figure 2-7 to allow two-way communications on the TAB between the ALS chassis and the MWS	N/A	N/A	SDS-R1605 (see comments)	PG&E Scope	DCP	T	TAB connection to MWS is PG&E responsibility per Westinghouse RTM (R1605)
189.		6. The ALS-A and ALS-B chassis partial trip outputs are connected to the SSPS input relays through an LSM that allows either ALS chassis to initiate a trip or actuation without affecting the ability of the other ALS chassis to initiate a trip or actuation [Section 2.1.4, Figure 2-5, and Figure 2-6].	N/A	N/A	N/A	N/A	N/A	N/A	See item 190

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			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
190.		7. The LSM shall not allow an ALS chassis to prevent the diverse ALS chassis from initiating a required trip or actuation	N/A	N/A	SDS-0430	N/A	T (Westinghouse)	T	
191.		8. Bypass switches on partial trip outputs, which allow removal of an ALS circuit board without initiating a false trip or actuation, will be provided by PG&E per FRS 3.2.1.3.5, 3.2.1,.3.6, and 3.2.1.5.3	N/A	N/A	N/A	PG&E Scope	DCP	T	
192.		9. Trip switches on partial trip and actuation outputs, which allow a channel to be tripped manually, will be provided by PG&E per FRS 3.2.1.3.4	N/A	N/A	N/A	PG&E Scope	DCP	T	
193.		10. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
194.		11. For deenergize to trip outputs, the PPS Failure contact closure due to bistable output failure to trip upon demand discrepancy shall be suppressed if a bypass is asserted from the ASU or from the manual bypass switch	N/A	N/A	SDS-0322.1[E] R0363	N/A	T (Westinghouse)	T	Westinghouse has an exception to this. The Failure contacts are normally closed and open to alarm. The IRS is incorrect; the correct state is to open for alarm. Documented in CDER IRS R9.
195.		12. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
196.		13. Deleted	N/A	N/A	N/A	N/A	N/A	N/A	
197.		14. The ASU shall be capable of storing 7 days of recent alarm log history. Oldest data shall be overwritten	N/A	N/A	SDS-0562.1, 0562.2	N/A	T (Westinghouse)	N/A	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
198.		15. The ASU shall be capable of receiving data from both ALS Chassis A and ALS Chassis B concurrently	N/A	N/A	SDS-0504	N/A	T (Westinghouse)	T	
199.		16. PG&E will provide administrative controls to prevent enabling the TAB on both ALS Chassis A and ALS Chassis B concurrently	N/A	N/A	N/A	PG&E Scope	N/A	N/A	PG&E procedural responsibility beyond scope of vendors
200.	2.9.7 Maintenance Tagnames (Tricon Only)	Read-only memory aliased global tagnames shall be provided for the following to facilitate maintenance, operations, and testing. 1. Calculated Trip Time Delay Setpoint (REAL) 2. Preset Time (PT) input to TTD Timer (REAL) 3. Trip Time Delay elapsed time when the TTD timer is activated - zero when the TTD timer is not activated (REAL) 4. SG Low-Low Level Input to TTD Timer 5. RCS Loop ΔT Equivalent to Power (PL: % RTP) 6. Raw (i.e., before TiT and TiB processing) output status of all comparators (BOOL) 7. Input to all Analog Output count conversion function blocks for display of output in engineering units (REAL) 8. User entered Thot Streaming Factors used to calculate Tfhjest (REAL) 9. Corrected Tfhjest values for the three SQA-3A Thot inputs for each RCS loop (REAL) 10. Corrected Tfhjest values for the three SQA-3B Thot inputs for each RCS loop (REAL) 11. Validated Tfhavg “A” value for the SQA-3A output for each RCS loop (REAL) 12. Validated Tfhavg “B” value for the SQA-3B output for each RCS loop (REAL) 13. Validated Tfhavg SQA-3 Output for each RCS loop (REAL) 14. Validated Tfcavg SQA-2 Output for each RCS loop (REAL) 15. Tavg for each RCS Loop (REAL) 16. (For OTDT) Lead/Lag compensated value of Tavg for each RCS loop (REAL) 17. (For OPDT) Rate/Lag compensated value of Tavg for	3.3.10.1.2.1, 3.3.10.12.2, 3.3.2.12, 3.3.5.14.8	SET I 3.8.3.9.5, 3.8.3.9.3.2, 3.8.3.9.5 SET II, III, IV 3.8.5.8.5, 3.8.5.8.3.2 3.7.1.9.6 SET I, II 3.10.1.9.6, 3.10.2.9.6, 3.10.3.9.6, 3.10.4.9.6, 3.12.1.9.6, 3.4.1.9.6, 3.4.2.9.6, 3.4.3.9.6, 3.4.4.9.6, 3.7.1.9.6 SET III 3.7.1.9.6 SET IV 3.5.1.9.6, 3.7.1.9.6	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		each RCS loop (REAL) 18. OTDT Setpoint for each RCS loop (REAL) 19. OPDT Setpoint for each RCS loop (REAL) 20. Process value inputs to OPDT and OTDT comparators for each RCS loop (REAL) 21. LEAD/LAG compensated value of ΔT for each RCS loop (REAL) 22. LEAD/LAG compensated Steamline Pressure (REAL) 23. RATE/LAG compensated Steamline Pressure (REAL) 24. Normalized Power (PB) (REAL) 25. Pressure Compensated Steam Flow (REAL) 26. Calculated Streaming Factors (FRS 3.2.5.13.10) output to MWS							
3 PPS Cyber Security									
201.	3.1 Secure Development and Operating Environment	Safety-related PPS Application software shall be developed in a secure development and operating environment (SDOE) per Reg. Guide 1.152 Rev 3 [1.4.3.5].	See comment	N/A	SDS-1300, 1301	N/A	PI (Westinghouse)		Invensys PTM does not trace requirement; referenced section provides general information.
202.	3.2 Technical Controls	This section is applicable to both the Tricon and the ALS Maintenance Workstations unless otherwise stated	N/A	N/A	N/A	N/A	N/A	N/A	Narrative text only
203.	3.2.1 Account Management	1. The Supplier should recommend which operating system accounts need to be active and those that can be disabled, removed, or modified	N/A	N/A	N/A	N/A	N/A	N/A	
204.		2. PG&E will approve the Supplier's recommendation in writing	N/A	N/A	N/A	N/A	N/A	N/A	
205.		3. Supplier shall identify all active accounts prior to delivery	N/A	N/A	N/A	N/A	N/A	N/A	

Requirements Traceability Matrix (RTM), Interface Requirements Specification

RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
206.	3.2.2 Access Enforcement	Authorizations for controlling access shall be in accordance with established policies and procedures	N/A	N/A	N/A	PG&E Scope	N/A	T	Invensys PTM does not trace these requirements; referenced section provides general information.
207.	3.2.2.1	Privileged functions shall be defined and documented	N/A	N/A	SDS-1308	N/A	PI (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information.
208.	3.2.2.2	For a defined access right or level, Least Privilege assigns the most restrictive set of rights/privileges or access needed by users for the performance of specified tasks	N/A	N/A	N/A	N/A	N/A	T	Narrative text only
209.	3.2.2.3	A user shall not be able to escalate privileges, under any circumstances, without logging into the administrator or developer access level first	N/A	N/A	SDS-1310, 1313, 1319, 1325	N/A	T (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information. Westinghouse has an exception to allow the administrator access level to escalate privilege, and proposes, instead, that escalation of privileges not to be permitted at all. Documented in CDER IRS R9.
210.	3.2.2.4	Documentation defining access and security permissions, user accounts, applications, and communication paths with associated access levels shall be provided	N/A	N/A	SDS-1306	N/A	T (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information.
211.	3.2.2.5 Access Levels	1. Access levels shall be job function (role) based with configurable access and permissions associated with the defined role	N/A	N/A	SDS-1305	N/A	T (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information.
212.		2. (Tricon MWS Only) At a minimum, there shall be four assigned access levels: a. GUEST Access limited to indication only screens; shall not be able to modify access level roles or passwords; shall not be able to acknowledge alarms. This access level does not require authentication.	3.7.4.1 See Comments	N/A	N/A	PG&E Scope	N/A	T	Invensys PTM does not trace these requirements; referenced section provides general information.

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		b. MAINT1 Access to all screens including maintenance screens; shall be able to remove and return channels to service except RTD channels that are input to DTTA; shall not be able to modify access level roles or passwords; shall be able to acknowledge alarms; shall be able to change the following tunable parameters. This access level requires authentication. 1) Steam Flow adjustment factor (m) (FRS 3.2.9.14.1.g)) 2) Full Power ΔT (FRS 3.2.5.14.7 n)) 3) Full Power Tavg (FRS 3.2.5.14.7 o) & p)) 4) Thot Streaming Factors (FRS 3.2.5.14.7 gg)) 5) Thot Input Deviation Setpoint (DeltaH) (FRS 3.2.5.14.7 r)) 6) Delta I Coefficient (SCAL FLUX) (FRS 3.2.5.14.7 ii)) c. MAINT2 Access to all Maint1 screens or functions; shall be able to change comparator setpoints and tunable parameters; shall be able to remove and return channels to service; shall be able to remove from service and return to service RTD channels that are input to DTTA; may acknowledge alarms; shall not be able to modify access level roles or passwords. This access level requires authentication. d. ADMINISTRATOR An Administrator access level shall be provided as the most privileged level with ability to change passwords. This access level requires authentication.							
213.		3. (ALS MWS Only) At a minimum, there shall be four assigned access levels: a. GUEST: Access limited to indication only screens; shall not be able to modify access level roles or passwords. This access level does not require authentication. b. MAINT1: Access to all screens including maintenance screens; shall be able to remove and return	N/A	N/A	SDS-1310, 1311, 1311.1, 1312, 1313, 1314, 1315, 1316, 1317, 1318, 1306, 1331, 1332, 1335, 1319, 1320, 1321, 1322, 1323, 1324, 1333, 1334, 1336, 1326, 1327, 1612, 1613	N/A	T (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information.

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		channels to service; shall not be able to modify access levels or passwords; shall be able to acknowledge alarms; shall be able to change the following tunable parameters. This access level requires authentication. 1)RCS Flow adjustment factor (m) (FRS 3.2.2.14.2 a)) 2)RCS WR Temperature RTD coefficients (a, b, & c) (FRS c), d) & e)) 3)RCS NR Temperature RTD coefficients (a, b, & c) (FRS ll), mm) & nn)) c. MAINT2: Access to all Maint1 screens or functions; shall be able to change comparator setpoints and tunable parameters; shall not be able to modify access level roles or passwords. This access level requires authentication. d. ADMINISTRATOR: An administrator access level shall be provided as the most privileged level with the ability to change passwords. This access level requires authentication.							
214.		4. Separation of functions through assigned access authorizations shall ensure independence in the responsibility and functions assigned to an access level.	N/A	N/A	N/A	PG&E/MWS	N/A	T	Invensys PTM does not trace these requirements; referenced section provides general information.
215.	3.2.3 System Use Notification								
216.	3.2.3.1	The Supplier shall supply a user configurable message on the display when the user logs on. This “System Use Notification” message should appear before granting system access to the user and should include: 1. The user is accessing a restricted system. 2. System usage may be monitored, recorded and subject to audit. 3. Unauthorized use is prohibited and subject to penalties	N/A	N/A	SDS-1302, 1304	PG&E/MWS	T (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information.(MWS Scope)

Requirements Traceability Matrix (RTM), Interface Requirements Specification									
RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
217.	3.2.3.2	The "System Use Notification" message shall remain on the display until the user takes explicit actions to log on or exit	N/A	N/A	SDS-1303	PG&E/MWS	T (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information.(MWS Scope)
218.	3.2.4 Password Requirements								
219.	3.2.4.1	The Supplier should provide a configurable account password management system that allows for: 1. Capability shall be provided to support complex passwords. 2. Capability shall be provided to change passwords on a routine frequency. 3. Authority to change passwords shall be limited to the most privileged (i.e., the Administrator) access level.	See TriStation Developer's Guide 9700100-012 on Managing User Access.	N/A	See Item 213	PG&E/MWS	N/A	T	Invensys PTM does not trace these requirements; SRS Section 3.7.4 provides general information.
220.	3.2.4.2	Password length and composition for authentication 1. Microsoft Security policies for length and complexity meet minimum requirements for definition. 2. Password shall ensure obscure feedback of authentication information (not transmitted in clear text) during the authentication process to protect the information from possible exploitation/use by unauthorized individuals.	See TriStation Developer's Guide 9700100-012 on Managing User Access.	N/A	N/A	PG&E/MWS	N/A	T	Invensys PTM does not trace these requirements; SRS Section 3.7.4 provides general information.
221.	3.2.4.3	Permitted actions without Identification or Authentication 1. Specific user actions (i.e., the Guest/Operator access level) that can be performed without identification or authentication shall be documented. 2. The Supplier shall identify the basis for such actions (adversely affecting safety, security, and emergency preparedness, etc.) to be performed without identification and authentication.	N/A	N/A	SDS-1309	PG&E/MWS	PI (Westinghouse)	T	
222.	3.2.5 System Hardening								
223.	3.2.5.1	Supplier shall provide documentation of required applications, utilities, system services, scripts, configuration files, databases, other software and the appropriate configurations, including firmware, revisions and/or patch levels for the associated system.	N/A	N/A	SDS-1328, SDS-1330,	PG&E/MWS	PI (Westinghouse)	N/A	

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RTM #	IRS Requirement (Ref 1)	Description	Scope Responsibility				Verification Method	SAT Ref (5)	Comments
			Invensys		Westinghouse	PG&E		PG&E Test Reference	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)				
		1. Such documentation shall include all third party software used in the software, including all libraries, frameworks, components, and other products, whether commercial, free, open-source, or closed-source							
224.	3.2.5.2	Supplier shall provide a listing of necessary ports and services required for normal and emergency operations 1. The listing shall include an explanation or cross reference to justify why a service is necessary for operation and those services and programs that are necessary for operation are allowed.	N/A	N/A	SDS-1329	PG&E/MWS	O	N/A	LAR 11-07 Supplement Commitment 4: “Unused MWS and KVM ports are addressed in accordance with the DCPP Cyber Security Plan.”
225.	3.2.5.3	Supplier shall remove and/or disable software components that are not required for the operation and maintenance prior to delivery. 1. Supplier shall document software components that were removed and/or disabled.	N/A	N/A	N/A	PG&E/MWS	O	N/A	Invensys PTM does not trace these requirements; referenced section provides general information (MWS).
226.	3.2.5.4	Supplier shall document the changing or disabling of access to files and functions (if any).	N/A	N/A	N/A	PG&E/MWS	O	N/A	Invensys PTM does not trace these requirements; referenced section provides general information.(MWS)
227.	3.2.5.5	The operating system administrator shall have the ability to re-enable devices if the devices are disabled by software	N/A	N/A	N/A	PG&E/MWS	N/A	T	Invensys PTM does not trace these requirements; referenced section provides general information.(MWS)
228.	3.2.6 MWS Startup Automatic Login	1. Upon boot up, the MWS computer shall automatically log into the required operating system account with no user interaction.	N/A	N/A	N/A	PG&E/MWS	N/A	T	Invensys PTM does not trace these requirements; referenced section provides general information.(MWS)
229.		2. Upon boot up supplier software interfaces shall automatically log into the least privileged access level with no user interaction	N/A	N/A	SDS-1307	PG&E/MWS	T (Westinghouse)	T	Invensys PTM does not trace these requirements; referenced section provides general information.(MWS)

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
1 Introduction									
2 Controller Transfer Function Requirements									
1.	**2.1 Overview**								
2.	**2.2 Transfer Function: Input Scaling**								
3.	2.2.1 Input Scaling Implementation	Scaling shall be implemented as follows: N = m*X + b	3.3.2.8	Set I, II 3.10.1.9.1, 3.10.2.9.1, 3.10.3.9.1, 3.10.4.9.1, 3.11.1.9.1, 3.12.1.9.1, 3.4.1.9.1, 3.4.2.9.1, 3.4.3.9.1, 3.4.4.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.9.1.9.1, 3.9.2.9.1, 3.9.3.91, 3.9.4.9.1 Set III 3.11.1.9.1, 3.6.1.9.1, 3.6.2.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.8.3.9.1, 3.8.4.9.1, 3.9.2.9.1, 3.9.3.9.1 Set IV 3.5.1.9.1, 3.6.3.9.1, 3.6.4.9.1, 3.7.1.9.1, 3.8.1.9.1, 3.8.2.9.1, 3.8.3.9.1, 3.8.4.9.1, 3.9.1.9.1, 3.9.4.9.1	SDS-0110, 0117, 0154, 0184, 0213, 0220, 0252, 0279, 0286	N/A	T (Triconex) T (Westinghouse)	T	
4.	2.2.2 Input Scaling capability shall be provided for the following PPS functions:	a) All analog inputs [PPS FRS 3.2.1.13.2] i. m (gain) shall be set to one (1) unless specific scaling requirements are specified in the PPS FRS ii. b (offset) shall be set to zero (0) unless specific scaling requirements are specified in the PPS FRS	N/A	SDS Appendix 11 (I/O List)	SDS-0110.1, 0110.2, 0154, 0154.2, 0154.3, 0184, 0184.2, 0184.3, 0213, 0213.1, 0213.2,	N/A	T (Westinghouse)	T	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
					0220, 0220.2, 0220.3, 0252, 0252.2, 0252.3, 0279, 0279.1, 0279.2, 0286, 0286.2, 0286.3				
5.		b) Reactor Coolant Flow [PPS FRS 3.2.2.13.1] i. Tunable Parameter ranges: [PPS FRS 3.2.2.14.2] ii. ii. Information: gain (m) and offset (b) values are determined per Scaling Calc SC-I-36-M.2 [1.4.1.5, 1.4.1.6]	N/A		SDS-0110, 0117	N/A	T (Westinghouse)	T	
6.		c) Steamflow [PPS FRS 3.2.9.13.2] i. Tunable Parameter ranges: [PPS FRS 3.2.9.14.1] ii. ii. Information: gain (m) and offset (b) values are determined per Scaling Calc SC-I-36-M.5 [1.4.1.7, 1.4.1.8]	3.3.8.13.2	3.10.1.9.4, 3.10.2.9.4, 3.10.3.9.4, 3.10.4.9.4	N/A	N/A	T (Triconex)	T	
7.	**2.3 Transfer Function: RTD Resistance to Temperature Conversion**								
8.	2.3.1 RTD Resistance to Temperature Conversion Implementation	Resistance to temperature conversion shall be implemented as follows: $RS(T) = a + bT + cT^2$ Where: RS(T) = resistance in ohms (actual measured reading) T = temperature in degrees F a, b, c = RTD constants from the RTD calibration curve (manually input for each RTD) Hence: $T = \frac{-b + \sqrt{b^2 - 4c(a - RS(T))}}{2c}$	N/A	N/A	SDS-0152, 0182, 0250	N/A	O (Westinghouse)	T	RTD scaling is performed in the ALS platform, the Tricon platform receives a 4-20 mA signal that is scaled for the required range of the RTD. The RTD coefficients are a property of the ALS-311 board NVM
9.	2.3.2 Resistance to temperature conversion shall be provided for the following PPS functions:	a) Wide Range Reactor Coolant Temperature [PPS FRS 3.2.3.13.1] i. a, b, c RTD constant Tunable Parameter ranges [PPS FRS 3.2.3.14.2] ii. Information: a, b, c RTD constant values per Scaling Calc SC-I-36-M3	N/A	N/A	SDS-0152	N/A	O (Westinghouse)	T	RTD scaling is performed in the ALS platform, the Tricon platform receives a 4-20 mA signal that is scaled for the required range of the RTD. The RTD coefficients are a property of the ALS-311 board NVM

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RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
10.		b) DTTA (Narrow Range Hot and Cold Leg Temperatures) [PPS FRS 3.2.5.13.5] i. a, b, c RTD constant Tunable Parameter ranges [PPS FRS 3.2.5.14.7] ii. Information: a, b, c RTD constant values per Scaling Calc SC-I-36-M.3 [1.4.1.9, 1.4.1.10	N/A	N/A	SDS-0182	N/A	O (Westinghouse)	T	RTD scaling is performed in the ALS platform, the Tricon platform receives a 4-20 mA signal that is scaled for the required range of the RTD. The RTD coefficients are a property of the ALS-311 board NVM
11.		c) Pressurizer Vapor Temperature [PPS FRS 3.2.8.13.1] i. a, b, c RTD constant Tunable Parameter ranges [PPS FRS 3.2.8.14.3] ii. Information: a, b, c RTD constant values per Scaling Calc SC-I-36-M [1.4.1.11, 1.4.1.12]	N/A	N/A	SDS-0250	N/A	O (Westinghouse)	T	RTD scaling is performed in the ALS platform, the Tricon platform receives a 4-20 mA signal that is scaled for the required range of the RTD. The RTD coefficients are a property of the ALS-311 board NVM
12.	**2.4 Transfer Function: Lead/Lag Filter**								
13.	2.4.1 Lead/Lag Filter Implementation	Lead/Lag filters shall be implemented as follows: Reference equation: Y(n) = C1* X(n) + C2 * X(n - 1) + C3 * Y(n - 1) Where: Y(n) = present output value (engineering units) X(n) = present input value (engineering units) X(n-1) = previous cycle input value (engineering units) [see Note 1] Y(n-1) = previous cycle output value (engineering units) [see Note 1] Note 1: to suppress transient on initialization, set = X(n) $Coefficient\ C1 = ((G * 2 * \tau_n + T)/(2 * \tau_d + T))$ $Coefficient\ C2 = \left(\frac{G * 2 * \tau_n - T}{2 * \tau_d + T}\right)$ $Coefficient\ C3 = \left(\frac{2 * \tau_d - T}{2 * \tau_d + T}\right)$	3.3.5.12.1	3.7.1.9.4.2 4.7.3	SDS-0222[E], 0222.1[E]	N/A	T (Westinghouse) T (Triconex)	T	WEC has an exception to this, since the Gain (G) for coefficient C1 and C2 is unity (1) they have not placed a value in the algorithm. This is accepted by PG&E as it would not have been a tunable parameter any way.
14.	2.4.2 Lead/Lag Filters shall be provided for the following	a) DTTA T_{avg} [PPS FRS 3.2.5.13.2] i. $Tavg_{LEAD/LAG}$ = Y (Lead/Lag filter output value per Section 2.4.1) ii. $T_{avg} - T_{avg}$ = X (Lead/Lag filter input per Section 2.4.1)	3.3.5.12.2	3.7.1.9.2, 3.7.1.9.4.12, 3.7.1.9.4.2	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
	functions	iii. Tunable Parameter ranges: [PPS FRS 3.2.5.14.7].							
15.		b) DTTA Delta-T [PPS FRS 3.2.5.13.2] i. $\Delta T_{LEAD/LAG}$ = Y (Lead/Lag filter output value per Section 2.4.1) ii. Calculated ΔT = X (Lead/Lag filter input value per Section 2.4.1) iii. Tunable Parameter ranges: [PPS FRS 3.2.5.14.7].	3.3.5.12.2	3.7.1.9.2 3.7.1.9.4.12 3.7.1.9.4.2	N/A	N/A	T (Triconex)	T	
16.		c) Pressurizer Pressure reactor trip compensation [PPS FRS 3.2.7.13.1] i. Tunable Parameter ranges: [PPS FRS 3.2.7.14.6, TFS 2.4.2.c].	N/A	N/A	SDS-0222, 0222.3	N/A	T (Triconex)	T	
17.		d) Steamline Pressure for SLB protection [PPS FRS 3.2.10.13.1] i. Tunable Parameter ranges: [PPS FRS 3.2.10.14.4]	3.3.9.13.4	SET I, II 3.9.1.9.1,3.9.2.9.1, 3.9.3.9.1, 3.9.4.9.1 SET III 3.9.2.9.1, 3.9.3.9.1 SET IV 3.9.1.9.1, 3.9.4.9.1	N/A	N/A	T (Triconex)	T	
18.	**2.5 Transfer Function: Lag Filter**								
19.	2.5.1 Lag Filter Implementation	The Lag Filter shall be implemented using the same format as the Lead/Lag Filter described in Section 2.4 with the lead time constant (τ_n) set to 0.0.	3.3.5.12.1	3.7.1.9.4.1 4.7.3	N/A	N/A	T (Triconex)	T	
20.	2.5.2 Lag filters shall be provided for the following PPS functions:	a) Additional low pass (Lag) filtering capability shall be provided for analog inputs as necessary to provide the filtering requirements per PPS FRS 3.2.1.12.2. i. Deleted ii. Lag filter (time constant) shall be adjustable with an allowable range of 0.0 to 5.0 seconds to provide attenuation of process noise. iii. Lag time constant shall be set to 0.0 if not	3.3.9.12.1	3.7.1.9.4.1	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
		iv. required for process noise attenuation. Adjustment of the Lag time constant will be per administrative procedure.							
21.		b) DTTA Narrow Range Tcold [PPS FRS 3.2.5.13.1] i. Each DTTA Tcold input shall be provided with a Lag Filter. ii. Tunable Parameter ranges: [PPS FRS 3.2.5.14.7]	3.3.5.1.1 3.3.5.12.1	3.7.1.9.4.1	N/A	N/A	T (Triconex)	T	
22.		c) DTTA Narrow Range Thot [PPS FRS 3.2.5.13.1] i. Each DTTA Thot input shall be provided with a Lag Filter. ii. Tunable Parameter ranges: [PPS FRS 3.2.5.14.7]	3.3.5.1.2 3.3.5.12.1	3.7.1.9.4.1	N/A	N/A	T (Triconex)	T	
23.		d) Calculated Thot Streaming Factor [PPS FRS 3.2.5.13.1] i. Each calculated Thot streaming factor output shall be provided with a Lag Filter. ii. Tunable Parameter ranges: [PPS FRS 3.2.5.14.7]	3.3.5.1.2 3.3.5.12.1	3.7.1.9.4.8 3.7.1.9.4.1	N/A	N/A	T (Triconex)	T	
24.	**2.6 Transfer Function: Rate/Lag Filter**								
25.	2.6.1 Rate/Lag Filter shall be implemented as follows:	Reference equation: Y(n) = C1* (X(n) - X(n - 1)) + C2 * Y(n - 1) Where: Y(n) = present output value (engineering units) X(n) = present input value (engineering units) X(n-1) = previous cycle input value (engineering units) [see Note 1] Y(n-1) = previous cycle output value (engineering units) [see Note 2] Note 1: to suppress transient on initialization, set = X(n) Note 2: to suppress transient on initialization, set = zero $Coefficient\ C1 = \left(\frac{G * 2 * \tau_n}{2 * \tau_d + T}\right)$ $Coefficient\ C2 = \left(\frac{2 * \tau_d - T}{2 * \tau_d + T}\right)$	3.3.5.12.3	3.7.1.9.4.3 4.6.3	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
26.	2.6.2 Rate/Lag filters shall be provided for the following functions:	a) Tavg input to DTTA OPSP calculation [PPS FRS 3.2.5.13.3] i. $Tavg_{RATE/LAG}$ = Y (Rate/Lag filter output value per Section 2.6.1) ii. Calculated T_{avg} = X (Rate/Lag filter input value per Section 2.6.1). iii. Tunable Parameter ranges: [PPS FRS 3.2.5.14.7]	3.3.5.12.3	3.7.1.9.4.3 3.7.1.9.4.13	N/A	N/A	T (Triconex)	T	
27.		b) Steamline Pressure [PPS FRS 3.2.10.13.2] i. Gain for steamline pressure Rate/Lag shall be = -1 ii. Tunable Parameter ranges: [PPS FRS 3.2.10.14.4]	3.3.9.12.2	3.9.1.9.1	N/A	N/A	T (Triconex)	T	
28.	**2.7 Transfer Function: DTTA Tavg Calculation**								
29.	2.7.1 DTTA Tavg Calculation Algorithm [PPS FRS 3.2.5.13.4]	DTTA T_{avg} shall be calculated as follows: $$Tavg = \frac{T^f havg + T^f cavg}{2.0}$$	3.3.5.12.4	3.7.1.9.4.4	N/A	N/A	T (Triconex)	T	
30.	**2.8 Transfer Function: Normalized Power (PB) Calculation**								
31.	2.7.1 DTTA Tavg Calculation Algorithm [PPS FRS 3.2.5.13.4]	DTTA T_{avg} shall be calculated as follows: $$Tavg = \frac{T^f havg + T^f cavg}{2.0}$$	3.3.5.12.4	3.7.1.9.4.4	N/A	N/A	T (Triconex)	T	
32.	**2.8 Transfer Function: Normalized Power (PB) Calculation**								
33.	2.8.1 Normalized Power calculation algorithm [PPS FRS 3.2.5.13.11]:	Normalized Power shall be calculated as follows: $$P_B = \frac{T^f havg - T^f cavg}{\Delta T^\circ}$$	3.3.5.12.10	3.7.1.9.4.5	N/A	N/A	T (Triconex)	T	
34.	**2.9 Transfer Function: DTTA Delta-T Calculation**								

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RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
35.	2.9.1 DTTA Delta-T Calculation Algorithm [PPS FRS 3.2.5.13.4]	DTTA Delta-T shall be calculated as follows: $\Delta T = P_B * 100$	3.3.5.12.4	3.7.1.9.4.6	N/A	N/A	T (Triconex)	T	
36.	**2.10 Transfer Function: Overtemperature Delta-T (OTDT) Setpoint Calculation**								
37.	2.10.1 DTTA OTDT Setpoint Calculation Algorithm [PPS FRS 3.2.5.13.6]	Note: Tech Spec requirement – no change to algorithm allowed. DTTA OTDT Setpoint shall be calculated as follows: $OTDT_{setpoint}\ \Delta T^{\circ} * [K1 - K2 * Tavg_{LEAD/LAG} + K3 * (P - P^{\circ}) - f_1(\Delta I)$	3.3.5.3.4 3.3.5.12.5	3.7.1.9.4.12 4.10.3	N/A	N/A	T (Triconex)	T	
38.	2.10.2	The input to the OTDT temperature comparator shall be: $\Delta T_{LEAD/LAG}$ -OTDTsetpoint $\Delta T_{LEAD/LAG}$ = see Section 2.4.2	3.3.5.6.1	3.7.1.9.2.	N/A	N/A	S	N/A	
39.	2.10.3	An OTDT Reactor Trip shall occur when: $\Delta T_{LEAD/LAG}$ > OTDTsetpoint $\Delta T_{LEAD/LAG}$ = see Section 2.4.2	3.3.5.6.1 3.3.5.13.1	3.7.1.9.2.e 3.7.1.9.3	N/A	N/A	T (Triconex)	T	
40.	2.10.4	An OTDT Turbine Runback shall occur when: $\Delta T_{LEAD/LAG}$ - OTDTsetpoint > OTTRsetpoint $\Delta T_{LEAD/LAG}$ = see Section 2.4.2	3.3.5.13.1	3.7.1.9.2.g 3.7.1.9.3	N/A	N/A	T (Triconex)	T	
41.	**2.11 Transfer Function: Overpower Delta-T (OPDT) Setpoint Calculation**								
42.	2.11.1 DTTA OPDT Setpoint Calculation Algorithm [PPS FRS 3.2.5.13.7]	DTTA OPDT Setpoint shall be calculated as follows: $OPDT_{setpoint}\ \Delta T^{\circ} * [K4 - K5 * Tavg_{RATE/LAG} - K6 * (Tavg - T'avg) - f2(\Delta I)]$	3.3.5.3.3 3.3.5.12.6	3.7.1.9.4.13 4.11.3	N/A	N/A	T (Triconex)	T	
43.	2.11.2	The input to the OPDT temperature comparator shall be: $\Delta T_{LEAD/LAG}$ -$OPDT_{setpoint}$ $\Delta T_{LEAD/LAG}$ = see Section 2.4.2	3.3.5.13.1	3.7.1.9.2.	N/A	N/A	S	N/A	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
44.	2.11.3	An OPDT Reactor Trip shall occur when: $\Delta T_{LEAD/LAG} > OPDT_{setpoint}$ $\Delta T_{LEAD/LAG}$ = see Section 2.4.2	3.3.5.6.1 3.3.5.13.1	3.7.1.9.2.a 3.7.1.9.3	N/A	N/A	T (Triconex)	T	
45.	2.11.4	An OPDT Turbine Runback shall occur when: $\Delta T_{LEAD/LAG}$ -$OPDT_{setpoint} > OPTR_{setpoint}$ $\Delta T_{LEAD/LAG}$ = see Section 2.4.2	3.3.5.13.1	3.7.1.9.2.c 3.7.1.9.3	N/A	N/A	T (Triconex)	T	
46.	**2.12 Transfer Function: Sensor Quality Algorithm 2 (SQA2)**								
47.	2.12.1 SQA2 Algorithm [PPS FRS 3.2.5.13.8] The SQA2 Algorithm shall be implemented per Steps “a” and “b” as follows:	The SQA2 algorithm is performed to determine the average temperature of a DTTA loop cold leg channel (Tfcavg).	3.3.5.12.7	3.7.1.9.4.7 4.12	N/A	N/A	S	N/A	Narrative text
48.		The diagnostic status (Pass/Fail) for each RTD input is an input to this transfer function.	3.3.5.12.7 3.3.5.1.1	3.7.1.9.4.7 4.12.3.1	N/A	N/A	T (Triconex)	T	
49.		The input status shall be set to Fail when the RTD input is detected Out of Range.	3.3.5.12.7 3.3.1.2.5 3.3.5.1.1	2.3.7 4.12.3.1 3.7.1.9.4.7	N/A	N/A	T (Triconex)	T	
50.		The Removed From Service (RFS Yes/No) for each RTD input is an input to this transfer function.	3.3.5.12.7, 3.3.5.1.1	2.3.7 4.12.3.1 3.7.1.9.4.7	N/A	N/A	T (Triconex)	T	
51.		The SQA2 Algorithm shall be implemented per Steps “a” and “b” as follows: a) Determine the SQA2 Case and perform the associated “Action” per Table 1	N/A	3.7.1.9.4.7 4.12.3.1	N/A	N/A	T (Triconex)	T	
52.		b) Perform the following SQA2 DELTAC Consistency Checks as directed by SQA2 Case Determination Table 1:	N/A	3.7.1.9.4.7 4.12.3.1	N/A	N/A	T (Triconex)	T	

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RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
53.	**2.13 Transfer Function: Sensor Quality Algorithm 3A and 3B (SQA3A/SQA3B)**								
54.	2.13.1 SQA3A/SQA3B Algorithms [PPS FRS 3.2.5.13.9] The SQA3 and SQA3B Algorithms shall be implemented per Steps “a” thru “e” as follows:	The SQA3A and SQA3B algorithms are performed to determine the average temperature of a DTTA loop hot leg channel (Tfhavg). Each determines a value and the two values (Tf havgA and TfhavgB) are combined to determine the Tfhavg for the DTTA channel.	3.3.5.12.8	3.7.1.9.4.11	N/A	N/A	S	N/A	Narrative text
55.		The SQA3A algorithm shall be used to determine the average hot leg temperature for the DTTA channel as developed from the three (3) “A” Thot RTDS (one per thermowell).	3.3.5.12.8	3.7.1.9.4.11	N/A	N/A	T (Triconex)	T	
56.		The SQA3B algorithm shall be used to determine the average hot leg temperature for the DTTA channel as developed from the three (3) “B” Thot RTDS (one per thermowell).	3.3.5.12.8	3.7.1.9.4.11	N/A	N/A	T (Triconex)	T	
57.		The diagnostic status (Pass/Fail) for each RTD input is an input to this transfer function.	3.3.5.12.8 3.3.5.1.2	3.7.1.9.4.11 4.13.3.1	N/A	N/A	T (Triconex)	T	
58.		The input status is set to Fail when the RTD input is detected Out of Range.	3.3.5.12.8 3.3.1.2.5 3.3.5.1.2	2.3.7 4.13.3.1 3.7.1.9.4.11	N/A	N/A	T (Triconex)	T	
59.		The Removed From Service (RFS Yes/No) for each RTD input is an input to this transfer function.	3.3.5.12.8	2.3.7 4.13.3.1 3.7.1.9.4.11	N/A	N/A	T (Triconex)	T	
60.		The SQA3 and SQA3B Algorithms shall be implemented per steps “a” thru “b” as follows: a) Determine the SQA3 Case and perform the associated “Action” per Table 3:	N/A	3.7.4.1.9.4.11 4.13.3.1.a)	N/A	N/A	T (Triconex)	T	
61.		For initial scan, if all Th inputs are OOS, then Tfhavg shall be set equal to Th3est value in SQA3A and SQA3B.	N/A	3.7.4.1.9.4.11 4.13.3.1	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
62.		b) Perform the following SQA3 DELTAH Consistency Checks as directed by the SQA3 Case Determination Table 1:	N/A	3.7.4.1.9.4.11 4.13.3.1.b)	N/A	N/A	T (Triconex)	T	
63.		c) Perform the following SQA3 DELTAH Consistency Checks as directed by the SQA3 Case Determination Table or the Delta Comparison Check Tables:	N/A	3.7.4.1.9.4.11 4.13.3.1.c)	N/A	N/A	T (Triconex)	T	
64.		d) Perform the following SQA3 Delta Comparison Checks as directed by the SQA3 Consistency Check 1 Table:	N/A	3.7.4.1.9.4.11 4.13.3.1.d)	N/A	N/A	T (Triconex)	T	
65.		e) Determine the Loop Tfhavg (from SQA3A and SQA3B results) by performing the following Actions as applicable after completion of Steps “a” thru “d” above for each SQA3:	N/A	3.7.4.1.9.4.11 4.13.3.2	N/A	N/A	T (Triconex)	T	
66.	**2.14 Transfer Function: Thot Streaming Factor Calculation**								
67.	2.14.1 Thot Streaming Factor Calculation Algorithm [PPS FRS 3.2.5.13.10]	The Thot streaming factor shall be determined per the Table 11 (FRS 3.2.5.13.10)	3.3.5.12.9	4.5.1.3.1	N/A	N/A	T (Triconex)	T	
68.	**2.15 Transfer Function: Steamflow Compensation**								
69.	2.15.1 Steam Density Calculation Algorithm:	Steam Density = A * (Steam Pressure in psig) + B	3.3.8.12.1	SET I 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 3.10.4.9.4 SET II 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 3.10.4.9.5	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
				4.9.3.1					
70.	2.15.2 Non-compensated Steamflow Calculation Algorithm:	$SF = \frac{(SteamDensity)*(SFDP-SFDP_{min})}{(SteamDensity_{ref})*(SFDP_{max}-SFDP_{min})}$ for SF ≥ SF_{min}	3.3.8.12.1	SET I 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 3.10.4.9.4 SET II 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 3.10.4.9.5 4.9.3.2	N/A	N/A	T (Triconex)	T	
71.	2.15.3 Steamflow Compensation Algorithm [PPS FRS 3.2.9.13.1]	The Steamflow Compensation Algorithm shall be implemented as follows: $SFC = (SFC_{max} - SFC_{min})*(SF)^{1/2} + SFC_{min}$	3.3.8.12.1	SET I 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 3.10.4.9.4 SET II 3.10.1.9.4 3.10.2.9.4 3.10.3.9.4 3.10.4.9.5 4.9.3.3	N/A	N/A	T (Triconex)	T	
72.	**2.16 Transfer Function: Steam Generator Low-Low Level Trip Time Delay**								
73.	2.16.1 Steam Generator Low-Low Level Trip Time Delay Algorithm [PPS FRS	The Steam Generator Low-Low Level Trip Time Delay Algorithm shall be implemented as follows: $TD = A(PL)^3 + B(PL)^2 + C(PL) + D$	3.3.10.12.1	SET I 3.8.3.9.3.1 SET II, III, IV 3.8.5.8.3.1 4.14.9.3.1	N/A	N/A	T (Triconex)	T	

Requirements Traceability Matrix (RTM), Controller Transfer Functions Design Input Specification

RTM #	TFS Requirement Ref (1)	Description	Scope Responsibility				Verification Method	Test References	Comments
			Invensys		Westinghouse	PG&E		PG&E	
			SRS Ref (2)	SDD Ref (3)	SDS Ref (4)			SAT Ref (5)	
74.	3.2.11.13.3]	Calculated TD shall be constrained by the requirements of FRS Section 3.2.11.6.1.	3.3.10.12.2	3.8.3.9, 3.8.3.9.3.2,	N/A	N/A	T (Triconex)	T	