Enclosure
Attachment 6
PG&E Letter DCL-11-104

Diablo Canyon Power Plant Units 1 & 2 Process Protection System Replacement Conceptual Design Document (CDD), Revision 4 (LAR Reference 27)

Pacific Gas & Electric Company
Diablo Canyon Power Plant
Units 1 & 2

Process Protection System (PPS) Replacement
Conceptual Design Document

Rev 4

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ALTRAN SOLUTIONS

REVISION HISTORY

Revision Number	Affected Item	Reason for Revision
1	All	Initial Issue
2	Figure 2-3	Updated
	2.3	Updated Replacement Scope description
	Figure 2-6	Revised per Westinghouse comment
	2.2.1	Updated
	2.2.2	Deleted – Information not conceptual.
	2.2.3	Updated items 1-5; added new item 10
	2.2.4	Added discussion of alternative Thot averaging schemes.
	Figure 2-8	Added new figure; renumbered remaining figures in section
	Figure 2-9	Updated
	2.2.4.2	Updated Section Title
	2.3.1 2.3.2	Updated Rack assignments and physical modifications
	2.3.2.2	Added description of Feedwater Flow signals and Steam Flow/Feedwater Flow Mismatch alarm functions and field wiring to be deleted from PPS.
	2.3.3	Added new section to describe external interfaces; renumbered remaining sections.
	2.3.4 through 2.3.11	Deleted non conceptual information; updated sections; ALS data link isolation is performed by fiber optic media converters.
	Figure 2-9	Revised per Westinghouse comment
	Figure 2-14 through Figure 2-20	Added new Figure 2-14 (Diversity Architecture), Figure 2-15 (OOS Switches), updated and renumbered remaining figures
	Table 2-1	Added new table
	2.4	Revised entire section
	3.1	Added references; updated titles Deleted Westinghouse/CSI Proprietary references
	4.1	Added new section for Tricon Configuration Items; renumbered remaining sections
	4.2	Added new section for ALS Configuration Items; renumbered remaining sections
	Entire Document	Clarified safety-related and non-safety-related classifications
3	Entire Document	Changed MVDU to Maintenance Workstation
	Entire Document	Clarified Electrical Class 1E (IEEE 308) vs. Instrument Class IA, IB, II per DCM T-19 and T-24. Clarified Protection Set numbering
	2.2.3.4	Initial values for m, b constants
	2.3.3.2	Clarified PS description to conform to FRS and IRS
	2.3.3.4, 2.3.3.6	Corrected typo
	2.3.3.7, 2.3.3.9	Change Tricon energize to trip outputs to 24 VDC for SDO
	2.3.4	Clarified Tricon Communication Module (TCM); clarified NRC approval of Net Optics port aggregator tap
	2.3.5	Revised testing features description per current concept
	2.3.6	Clarified that qualified isolators are provided by PG&E
	Table 2-1	New table clarifies failed RTD detection concept
	2.4.1	DCPP D3 Topical Report has received USNRC Safety Evaluation Report; Table clarified per SER
	Figure 2-9	Deleted DTTA alarms from ALS; Tricon function only Updated ALS communications links per Topical Report
	Figure 2-10	Added new figure to illustrate trip output loopback
	Figure 2-13, Figure 2-14, Figure 2-16 through Figure 2-21	Updated Figures per current OOS concept; added new Figure 2-21
	3.1.30, 3.1.36 3.2.3, 3.2.4	Updated references
	4	Updated scope

REVISION HISTORY, continued

Revision Number	Affected Item	Reason for Revision
4	2.1	Misc. editorial changes
	2.2	Updated scope description
	Figure 2-1 Figure 2-2 Figure 2-3	Updated figures
	Figure 2-4	Added New Figure
	Table 2-1	Deleted table – more detail than needed in CDD
	2.3.2.3	Updated description
	2.3.2.4	Added port aggregator communication test
	2.3.3.2	Deleted power supply voltage
	Figure 2-9	Updated figure
	2.3.4	• Misc editorial changes • Updated per ALS Topical Report
	2.3.5	Updated per FRS and Function Block Diagrams
	2.3.5.2	Updated per ALS discussions
	2.4.1	Deleted non-conceptual information.
	Figure 2-11 Figure 2-12	Added figures per ALS discussions
	Figure 2-13	Updated Figure
	Figure 2-14	Updated figure; added explanation
	3.1	IEEE STD 603 is 1991 Added IEEE 7-4.3.2 2003
	Global (Not marked)	Changed Maintenance Video Display unit (MVDU) to Maintenance Workstation (MWS)
	Global (Not marked)	Deleted proprietary information designations

CONTENTS

TABLES

FIGURES

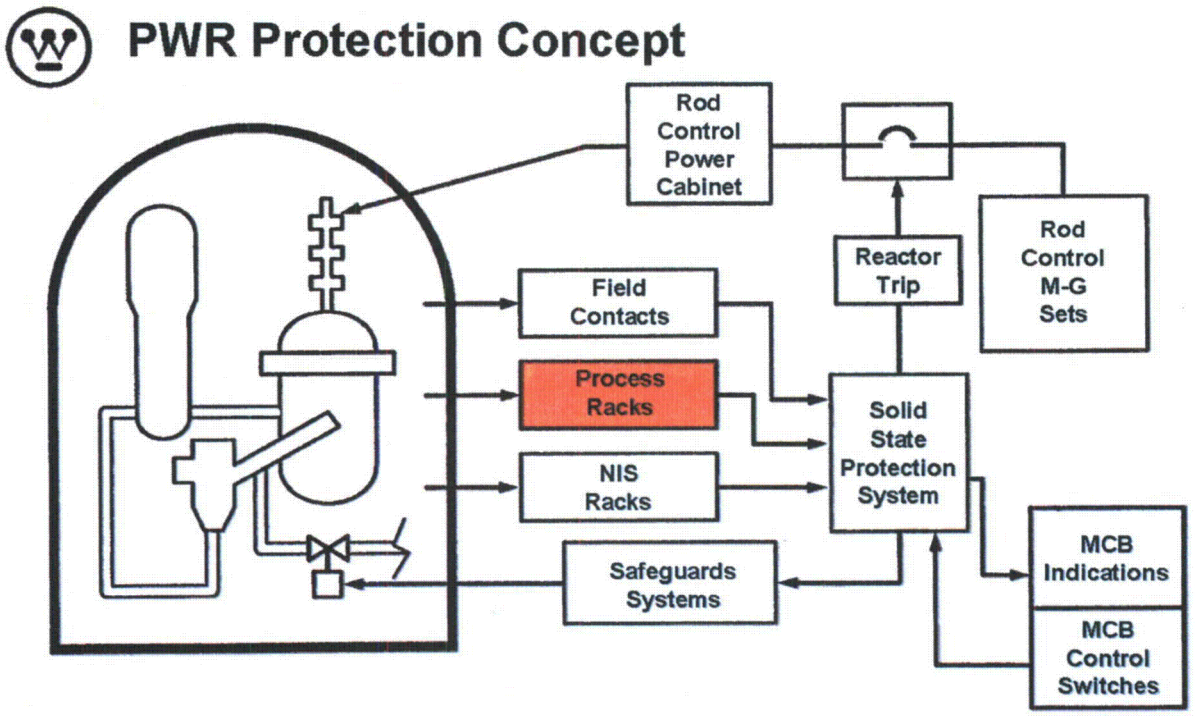
1 Introduction

1.1 Background

This document describes the concept for replacement of the Eagle 21 Process Protection System (E21 PPS) equipment for Diablo Canyon Power Plant Units 1 and 2. The project will replace the Westinghouse Eagle 21 protection sets currently housed in Protection Racks 1 – 16 in the Cable Spreading Room.

The scope of the replacement concept is illustrated by the shaded area in Figure 1-1:

Figure 1-1 Westinghouse PWR Protection Scheme



1.2 Definitions

The following definitions apply for this document:

TERM	DEFINITION
Channel	An arrangement of components, modules, and software as required to generate a single protective action signal when required by a generating station condition. A channel loses its identity where single action signals are combined.

TERM	DEFINITION
Module	Any assembly of interconnected components that constitutes an identifiable device, instrument, or piece of equipment. A module can be disconnected, removed as a unit, and replaced with a spare. It has definable performance characteristics that permit it to be tested as a unit. A module can be a card or other subassembly of a larger device, provided it meets the requirements of this definition.
Components	Items from which the system is assembled (such as resistors, capacitors, wires, connectors, transistors, tubes, switches, and springs).
Protection Set	A protection set is a physical grouping of process channels with the same Class I electrical channel designation (I, II, III, or IV). Each of the four redundant protection sets is provided with separate and independent power feeds and process instrumentation transmitters. Thus, each of the four redundant protection sets is physically and electrically independent of the other sets.
Protective Function	A protective function is the sensing of one or more variables associated with a particular generating station condition, signal processing, and the initiation and completion of the protective action at values established in the design bases.
Type Tests	Tests made on one or more units to verify adequacy of design of that type of unit.
Diversity and Defense-In-Depth (D&D-in-D or D3)	Requirement imposed on the Protection System design to ensure that required protective actions will occur to protect against Anticipated Operational Occurrences and Design Basis Accidents (as described in the FSARU) concurrent with a common cause failure (usually assumed to be software) that disables one or more echelons of defense.
Electrical Class 1E [3.2.3]	Design Class I electrical systems, components and equipment perform safety-related functions. Instrument Class IA and IB Category 1 devices below are considered to serve Class 1E functions. All other instrument classes are considered to serve non-Class 1E functions.
Instrument Class IA [3.2.4]	Instrument Class IA instruments and controls are those that initiate and maintain safe shutdown of the reactor, mitigate the consequences of an accident, or prevent exceeding 10 CFR 100 off-site dose limits.
Instrument Class IB [3.2.4]	Instrument Class IB instruments and controls are those that are required for post-accident monitoring of Category 1 and 2 variables in accordance with Regulatory Guide 1.97, Revision 3 [3.1.21].
Instrument Class II [3.2.4]	Instrument Class II components are Design Class II devices with non-safety-related functions. However, certain Class II components are subjected to some graded quality assurance requirements.

2 Process Protection System Replacement Concept

2.1 EXISTING SYSTEM

The Process Protection System (PPS) monitors plant parameters, compares them against setpoints and provides signals to the Solid State Protection System (SSPS) if the setpoints are exceeded. The SSPS evaluates the signals and performs Reactor Trip System (RTS) and Engineered Safety Feature Actuation (ESFAS) functions to mitigate the event that is in progress.

There are four separate PPS rack sets. Separation of redundant process channels begins at the process sensors and is maintained in the field wiring, containment penetrations, and process protection racks to the two redundant trains in the SSPS logic racks. Redundant process channels are separated by locating the electronics in different PPS rack sets.

A process channel is defined as an arrangement of components, modules and software as required to generate a single protective action signal when required by a generating station condition. [FSAR Section 7.1]

The original Westinghouse/Hagen 7100 analog protection sets were replaced in 1R6 and 2R6 with the existing Westinghouse Eagle 21 PPS. A conceptual depiction of the Eagle 21 PPS is provided in Figure 2-1.

The functional relationship of Eagle 21 with the other components of the overall Reactor Protection System (RPS) is illustrated in Figure 2-2.

Figure 2-1 Existing DCPP Reactor Protection System Concept with Eagle 21 PPS

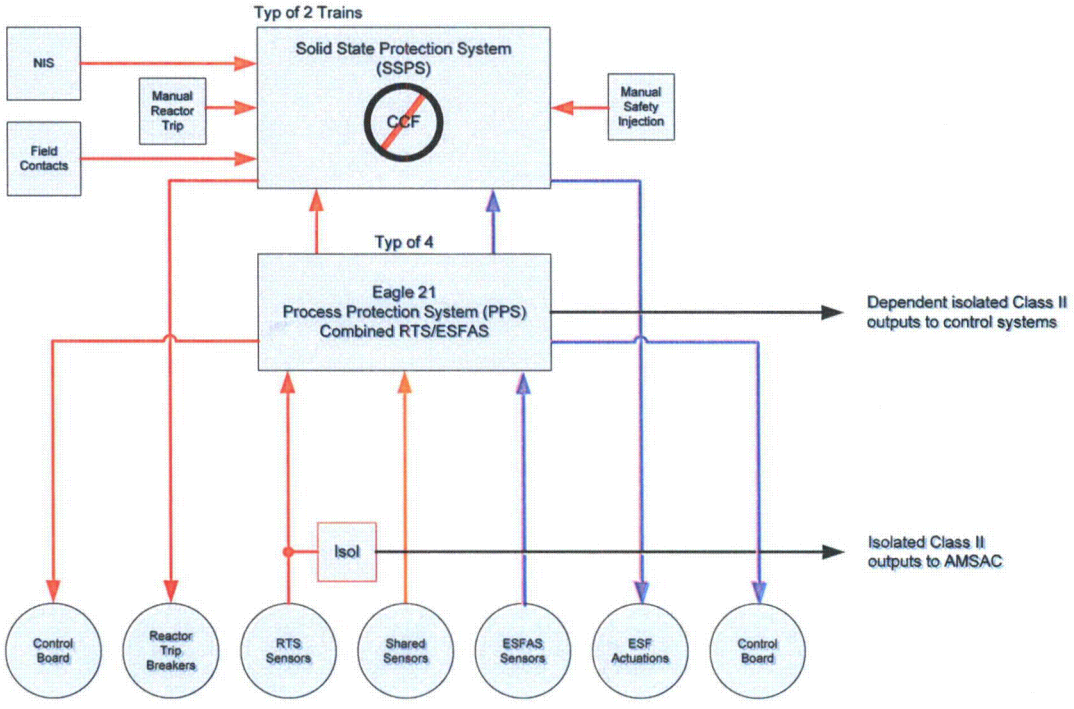
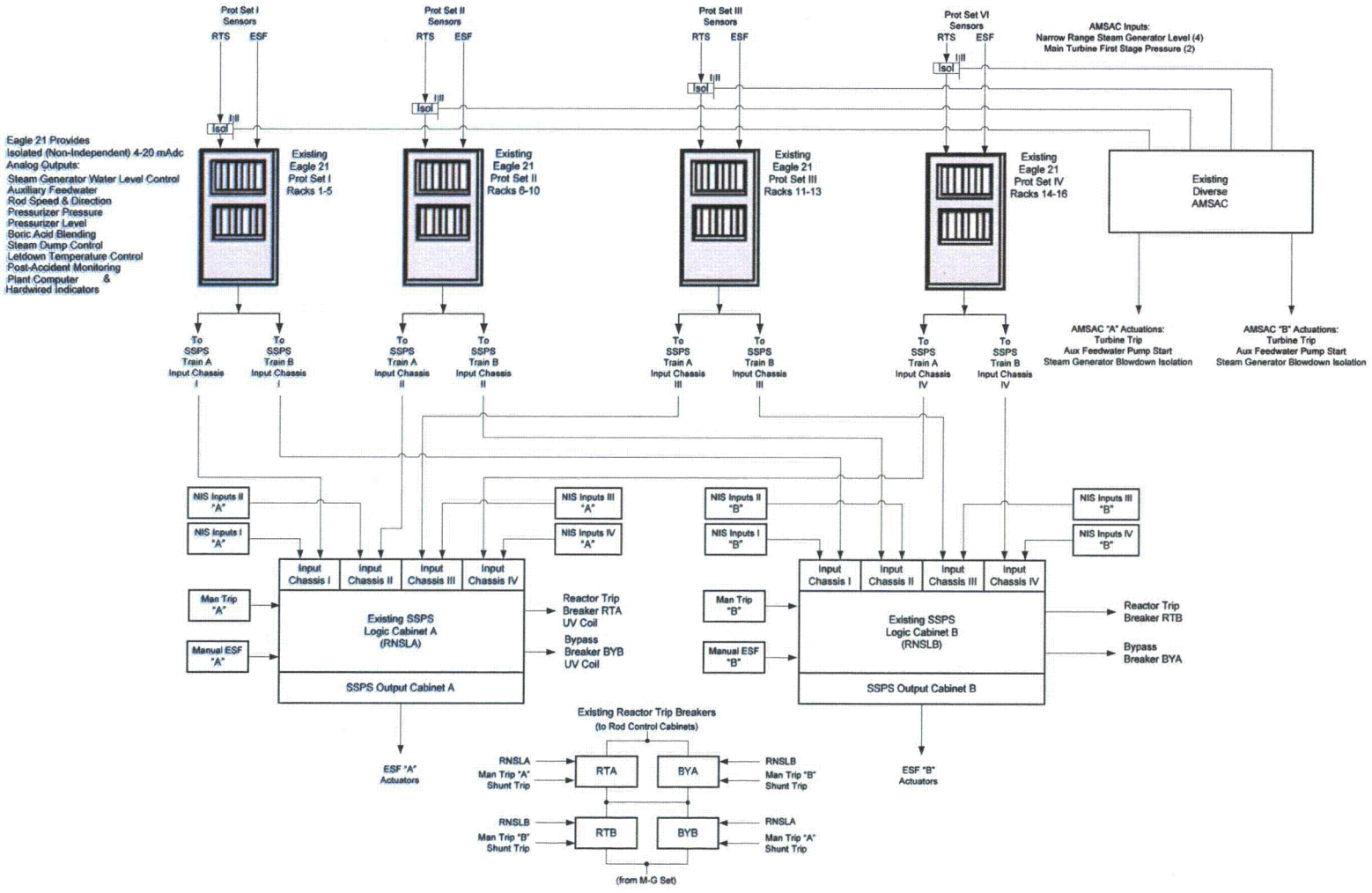


Figure 2-2 Simplified Existing PPS Architecture with Eagle 21



2.2 REPLACEMENT SCOPE

The proposed replacement PPS concept shown in Figure 2-3 implements the Diversity and Defense-in-Depth strategy described in Section 2.4 and the PPS Replacement Diversity and Defense in Depth Topical Report [3.2.1]. The project will replace the Westinghouse Eagle 21 protection sets currently housed in Protection Racks 1 – 16 shown in the shaded portion of Figure 2-4.

Replacement PPS protective functions will be implemented in four (4) redundant protection sets, each using a software-based Triconex Tricon processor [Figure 2-5] to mitigate events where existing safety analysis [3.1.18] has determined that diverse and independent automatic mitigating functions are available to mitigate the effects of postulated Common Cause Failure (CCF) concurrent with FSAR Chapter 15 events. For the events where existing analyses credit manual mitigative action, automatic protective functions will be performed in a diverse safety-related Westinghouse CS Innovations, LLC Advanced Logic System (ALS) [Figure 2-6].

Figure 2-3 PPS Replacement Design Concept

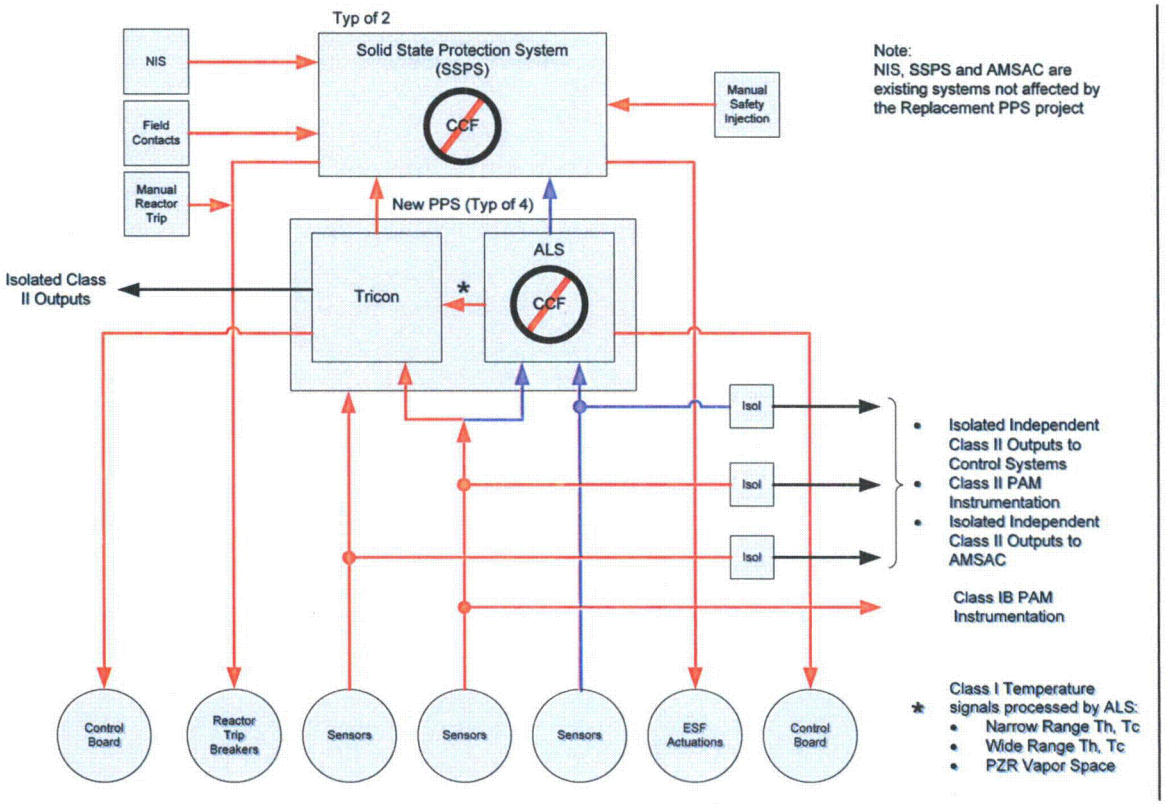


Figure 2-4 Simplified PPS Replacement Architecture

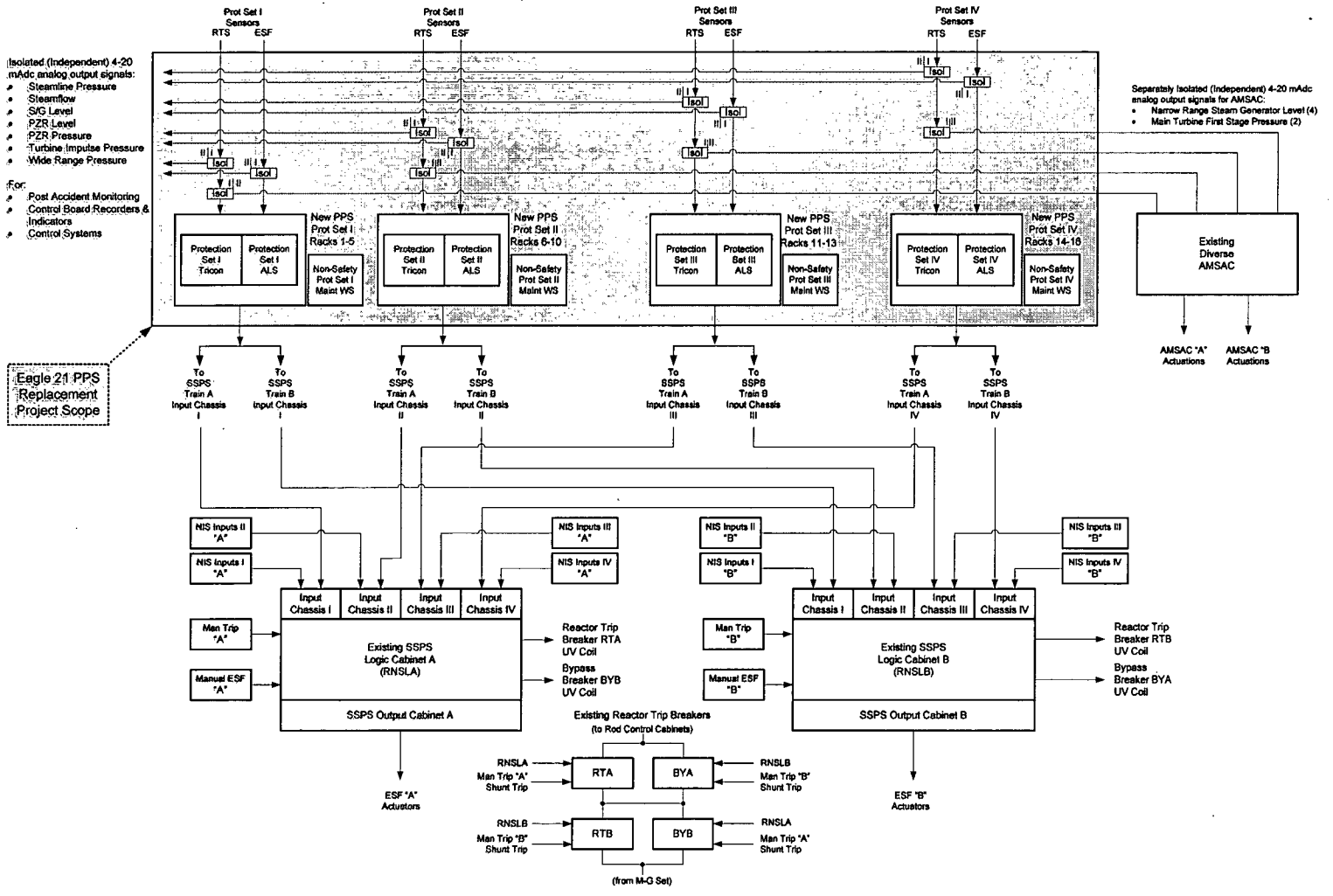


Figure 2-5 Tricon Triple Modular Redundant Architecture

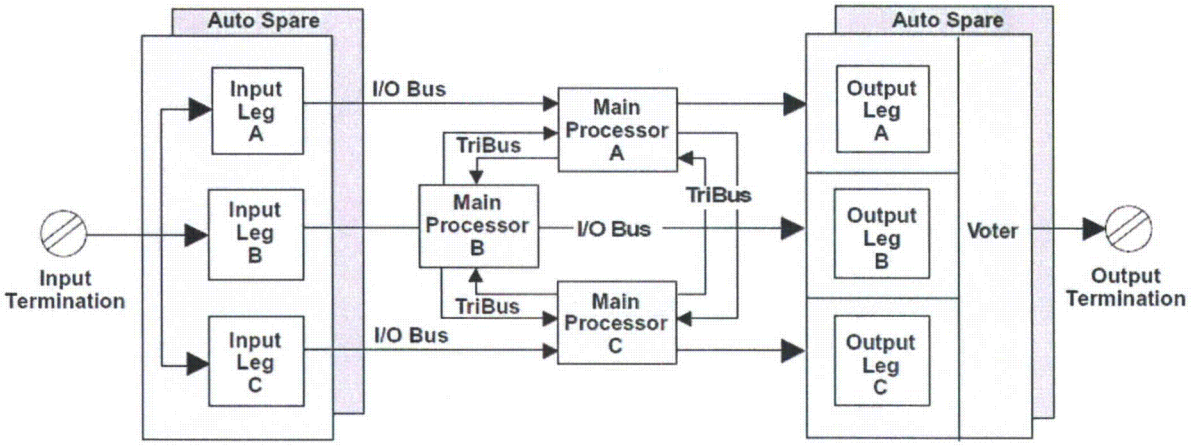
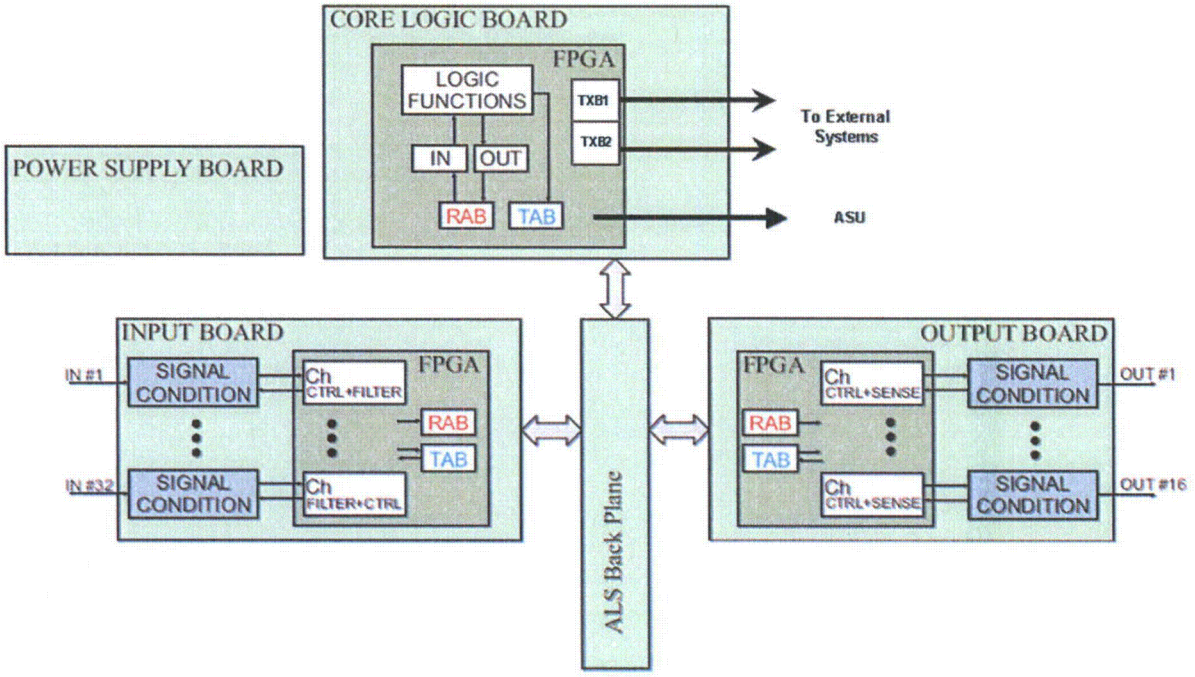


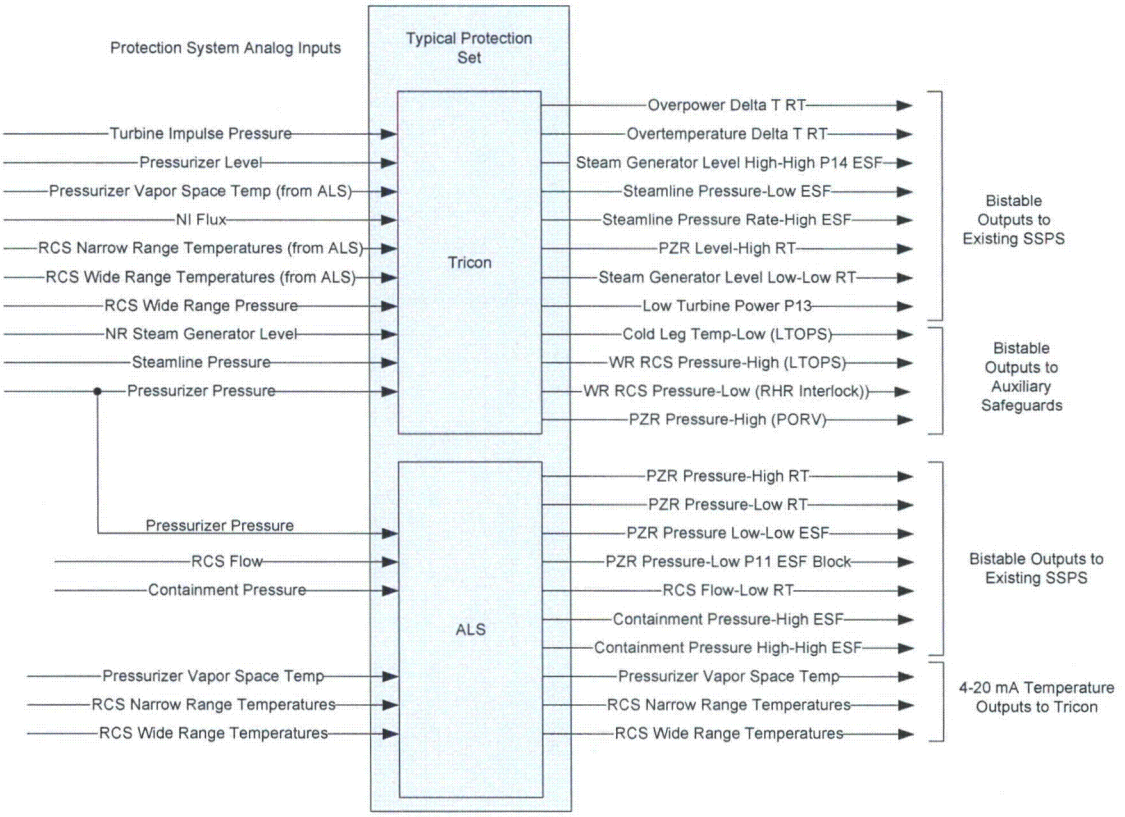
Figure 2-6 Generic ALS Architecture



2.2.1. Replacement PPS Functions

Typical replacement PPS Functions are illustrated in the following figure. Input and output details are provided in Section 4. The functions performed by the replacement PPS are identical to those of the existing Eagle 21 PPS.

Figure 2-7 Typical PPS Safety Functions



2.2.2. Deleted

2.2.3. Enhancements

1. In the existing Eagle 21 PPS, the operator must take manual action to mitigate certain FSARU Chapter 15 events should the event occur with a concurrent Common Cause Failure (CCF). In the replacement PPS, these events will be mitigated automatically. Refer to Section 2.4 for details.
2. The replacement PPS provides a Supervised Digital Output (SDO) that enables the PPS to monitor the external circuit for continuity. If the external circuit is broken, the PPS will generate an alarm.
3. The ALS subsystem in the replacement PPS provides built-in diversity by utilizing diverse "A" and "B" logic groups, such that a command output from either logic group will initiate the safety function. Additional details are provided in the ALS Topical Report [3.1.30].
4. All PPS analog inputs will be provided with a mx+b function to enable on-line rescaling. Initial values will be m=1.0, b=0.0, unless specified otherwise.
5. Analog outputs from the replacement PPS to critical control systems (Main Turbine Control System, Pressurizer Pressure Control, Pressurizer Level Control, and Digital Feedwater Control System) will be isolated at the front end of the replacement PPS [Figure 2-3 and Figure 2-9] to improve diversity as discussed in the D3 Topical Report [3.2.1]. The DFWCS application must be modified to provide the Steam Flow pressure compensation [2.3.3.3].
6. Analog outputs from the replacement PPS to Reg. Guide 1.97 Post Accident Monitoring recorders and indicators will be independent from the replacement PPS as determined to be necessary by the D3 evaluation. Independence will be implemented either (1) by dedicated qualified isolation devices; or (2) by obtaining the signal directly off the transmitter loop as discussed in the next item.
7. Figure 2-3 and Figure 2-9 illustrate the concept in which certain Post Accident Monitoring (PAM) functions obtain their signals directly from the input loop. No isolation is necessary because the input loop is the correct classification. The signals to which this concept is applicable are listed in Section 4.
8. In the existing system, the Thot and Tcold signals are processed in separate racks for the DTTA trip functions and the Steam Generator Low-Low Level Trip Time Delay (TTD) functions. In the replacement system, the calculation will be performed only once to be utilized for both functions.
9. The DCPP RCS contains three thermo-wells in each hot leg that are radially spaced 120° apart. Each thermowell contains two redundant narrow range RTD's. The RTD signals are processed by the PPS to determine a group average hot leg bulk temperature value (Thot) for the loop. In the existing Eagle 21 PPS, one of the elements in each hot leg thermowell is an installed spare. A wiring change is required if the spare RTD is to be used. In the replacement PPS, all six (6) hot leg RTD's in a loop will be permanently wired into the PPS.

   The Eagle 21 methodology uses streaming factors to normalize the three loop Thot input values to the loop average Thot. The streaming factors are updated manually on a quarterly basis. Following normalization, the Eagle 21PPS calculates the Thot group

value based on the available number of good input values. Invalid input signals[1] are removed automatically from the group average. If more than one input signal is invalid, the loop average Thot is considered inoperable.

The sensor validation scheme for Thot RTD sensors will be updated to use both RTD's in each thermowell to take advantage of the accuracy improvement obtained from using additional sensors and to make the Thot determination more fault-tolerant. Streaming is a manifestation of physical hot-leg stratification, and not an electrical phenomenon; therefore, the streaming factors will continue to be calculated per thermowell and applied to both "A" and "B" RTD signals in the well. Thus, three streaming factors per RCS loop will be calculated similarly to the Eagle 21 streaming factors.

The "A" and "B" RTD's in each thermowell are processed by the "A" and "B" ALS groups to provide diverse input processing. The ALS transmits processed 4-20 mA "A" and "B" temperature information to the protection set Tricons. The Tricons calculate the average ThotA of the three "A" RTD's in a loop using methodology similar to that used by Eagle 21 that automatically identifies and rejects invalid values or values that deviate excessively from ThotA. The average ThotB of the three "B" RTD's in the loop will be calculated similarly. The loop average Thot Is the average of valid ThotA and ThotB.

The streaming factors will be updated semi-automatically, with manual action required to confirm that the constants to be updated are correct. Reduction of maintenance effort and potential for human error during update are minimized by the semi-automatic process.

This methodology is more accurate than the existing scheme because it uses more RTD's to calculate the average. It is also more fault tolerant than the existing scheme, which allows one failed RTD in a loop. In the proposed scheme, all "B" ("A") RTD's could fail (which would cause the ThotB (ThotA) to be automatically removed from the average) in addition to one failed "A" ("B") RTD. The loop Thot would then be based on two valid "A" ("B") RTD signals, equivalent to the existing Eagle 21 scheme.

10. Open RTD Detection

The ALS will provide down-scale open RTD protection. If the ALS detects an open or failed RTD, it will output an analog signal which is less than the Tricon signal failure threshold. If the actual temperature is below the low scale value the ALS shall output the low scale value (4 mA). If the actual temperature is above the high scale value the ALS shall output the high scale value (20 mA).

This allows the Tricon to provide an alarm on RTD failure 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. In the latter case, the actual temperature will be available from the ALS via the Gateway computer. This feature allows RTD cross-calibration to be performed during startup using data obtained directly from the PPC, without the need to lift leads and connect external instrumentation.

[1] Invalid signals are those (1) that have been disabled; or (2) for which the signal processing electronics has detected a failure; or (3) deviate excessively from the average or from each other.

11. Feedwater Flow Signals

    The Feedwater Flow signals and the Steam Flow/Feedwater Flow Mismatch alarms will be removed from the PPS. The flow signals are non-safety-related and will be input to the Digital Feedwater System (DFWCS), which will then generate the Steam Flow/Feedwater Flow Mismatch alarms.

2.2.4. Discussed but Omitted from PPS Replacement Scope

1. Calculate the average of all six (6) (two per well) Thot RTD's as inputs, eliminating the Eagle 21 streaming factors. This option reduces the maintenance effort required to track and maintain the streaming factors and the potential for human error when updating the streaming constants manually. However, this arrangement does not automatically remove a deviating input signal from the group average Thot and is thus less fault-tolerant than the existing system.
2. Another averaging arrangement was proposed that would input all six values to a single averaging/validation algorithm using streaming factors to normalize the input values to the average Thot. Invalid or deviating values would be rejected automatically. After discussion, this arrangement was not pursued further because the complexity of the algorithm and the effort required to validate it do not appear to be justified by the additional degree of fault tolerance to be gained over the proposed configuration.

2.3 REPLACEMENT SYSTEM DESIGN

2.3.1. PPS Rack assignments and electrical location codes are listed below:

Protection Set I (Racks 1-5):

RNP1A, RNP1B, RNP1C, RNP1D, RNP1E

Protection Set II (Racks 6-10):

RNP2A, RNP2B, RNP2C, RNP2D, RNP2E

Protection Set III (Racks 11-13)

RNP3A, RNP3B, RNP3C

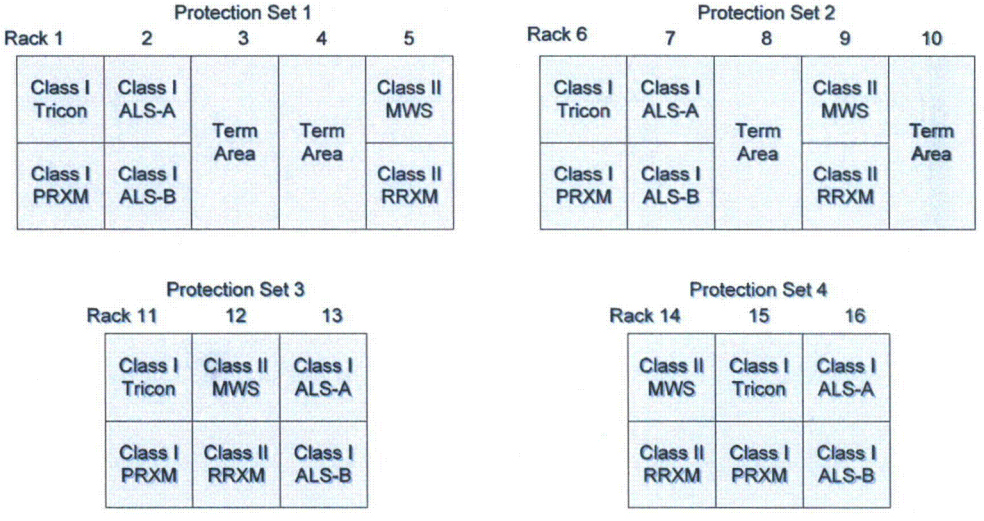
Protection Set IV (Racks 14-16)

RNP4A, RNP4B, 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:

Figure 2-8 PPS Equipment Rack Assignment Concept



Note: Equipment distribution subject to change per detailed design

2.3.2. Physical Modifications

1. Protection Racks 1-16
   - Remove all equipment
   - Rework structure of existing cabinets to support new Tricon and ALS chasses and field termination panels and to satisfy the seismic requirements
   - Install new protection set electronics and I/O power supplies
   - Install isolators for signals that require independence from the replacement PPS (See Section 2.2.3)
   - Install network switches, media converters, Net Optics port aggregator network taps, hubs, gateway computers and maintenance terminals/system printers
   - Install Maintenance Workstation (MWS) in each Protection Set
   - Remove Main Annunciator System ac/dc converters from PPS alarm outputs.

2. PPS Field Wiring
   - Remove Feedwater Flow signals from PPS. These signals are non-safety-related and will be input to the Digital Feedwater System (DFWCS) to provide the Steam Flow/Feedwater Flow Mismatch alarms.
   - Remove Steam Flow/Feedwater Flow Mismatch alarms from PPS. These alarms will be generated in the non-safety-related DFWCS.
   - Bistable wiring to SSPS Train A and Train B Input cabinets 1-4 will not be changed.
   - 120 Vac power wiring to Racks 1-16 will not be changed
   - Install other 120 Vac power wiring as needed
   - Install Ethernet Cable from port aggregator media converter to Gateway computer network hub

3. Operator Interface
   - PPS uses existing hardwired devices located on the Main Control Room Vertical Boards and Control Console.
   - The PPS will share a Maintenance Workstation (MWS) on CC4 that will be installed by the Process Control System (PCS) replacement project for system health displays.

4. Special Tests
   - During SAT, verify that information flowing between NetOptics port aggregator network tap Ports A and B are copied to Port 1 and that no communications are permitted to take place from Port 1 to either Port A or Port B.
   - During PMT, measure as-found and as-left Total Harmonic Distortion (THD) on power supply at the PPS 120 Vac power supply input terminals before and after installation of equipment powered from the vital busses. Refer to USNRC Reg. Guide 1.180 for guidance [3.1.26].

2.3.3. External System Interfaces

1. Power Supply
   - Each PPS Protection Set will be powered from a separate 120 VAC vital bus via a Class 1E uninterruptible power supply.
   - Each PPS Protection Set will be provided with a 120 VAC control grade (non-vital) utility power source.
2. I/O Power Supplies
   - Each PPS Protection Set will be provided with adjustable redundant loop power supplies capable of powering all 4-20 mA instrument input loops associated with that Protection Set. Operating voltage will be selected to power instrument loops without exceeding voltage limitations of instrument loop sensors (transmitters) being utilized for the higher loop resistances resulting from addition of isolators and input signal taps.
   - Analog 4-20 mA output loops will be powered by redundant 24 Vdc power supplies.
   - All Discrete inputs and outputs will be powered by redundant 24 Vdc power supplies separate from those used for analog output loops.
   - Failure of any power supply will be alarmed
3. Digital Feedwater Control System (DFWCS)
   - The existing PPS provides a pressure-compensated Steam Flow signal to the DFWCS. The replacement PPS will provide an isolated, uncompensated steam flow signal to the DFWCS directly from the PPS transmitter input loop. The DFWCS application must be modified to provide Steam Flow pressure compensation.
4. Main Annunciator System Interface
   - The Main Annunciator provides non-vital 125 VDC for interrogation of alarm output contacts.
   - Existing PPS outputs to the MAS will be modified to dry contacts. The existing ac/dc converters on the PPS outputs to the MAS will be deleted.
   - Additional outputs to the MAS will be provided as described in the FRS and IRS
5. Operator Interface
   - The existing operator interface using control panel mounted switches and indicators will be maintained.
6. Maintenance Interface

   Each safety division is provided with a dedicated non-safety-related Maintenance Workstation (MWS) for this purpose. Details regarding safety-related/non-safety-related communications are provided in Section 2.3.4.
7. Solid State Protection System Interface

   As determined by the detailed design change process, certain 120 Vac SSPS input relays (including, but not limited to Turbine Impulse Pressure Interlock P13 and input relays fed from the ALS) may be replaced with 24 VDC devices.

8. Nuclear Instrumentation System Interface

   Existing interfaces with the Nuclear Instrumentation System are unaffected by this change.

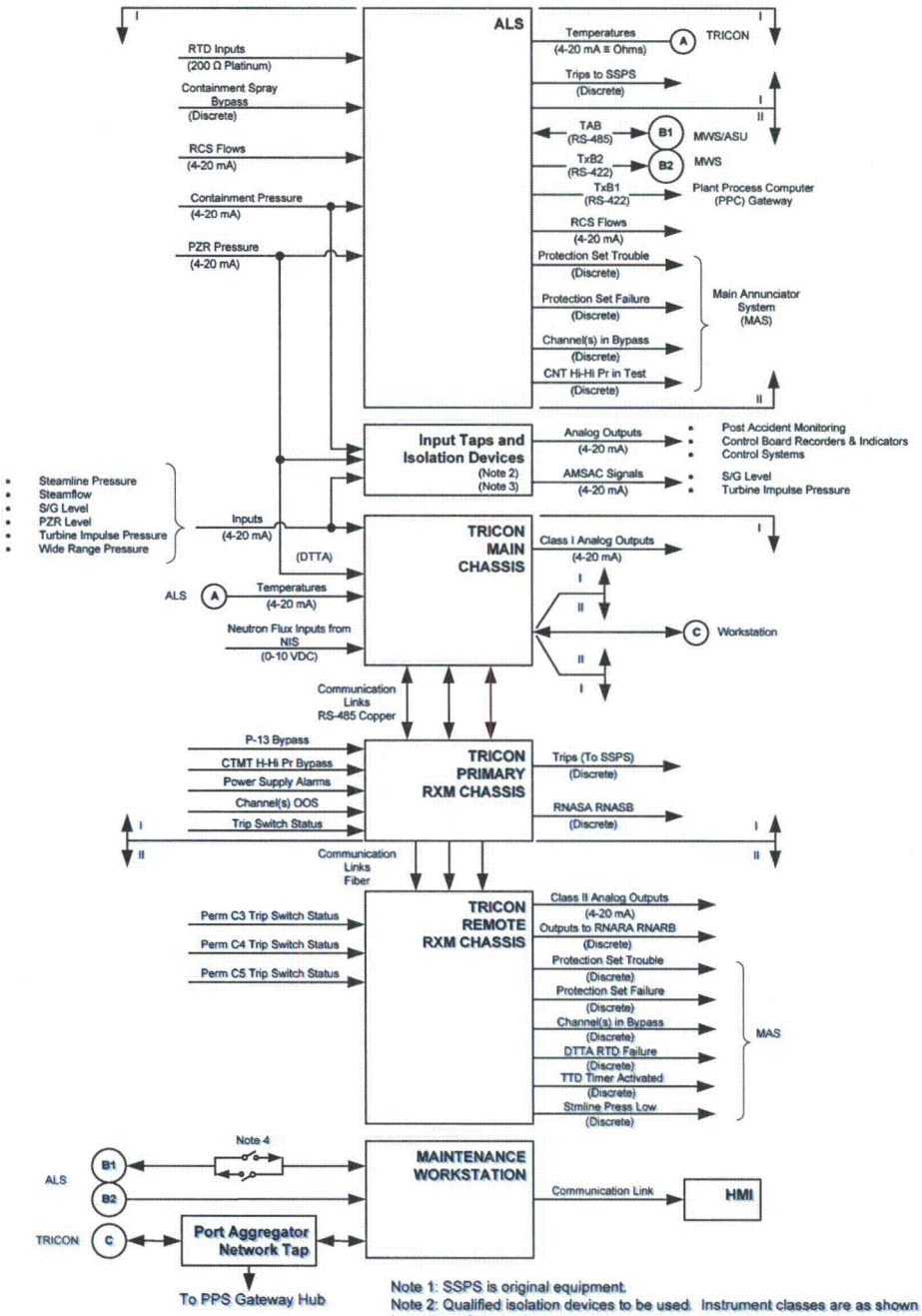
9. Auxiliary Safeguards Cabinets (RNASA/RNASB) Interface

   Existing interfaces with the Auxiliary Safeguards Cabinets are unaffected by this change except that it may be necessary to replace 120 VAC energize to trip relays with 24 VDC devices for Triconex outputs because Triconex does not provide a 120 VAC supervised digital output (SDO) module.

10. Auxiliary Relay Cabinets (RNARA/RNARB) Interface

    Existing interfaces with the Auxiliary Relay Cabinets are unaffected by this change.

Figure 2-9 PPS Replacement Architecture Concept



Note 1: SSPS is original equipment.
Note 2: Qualified isolation devices to be used. Instrument classes are as shown on Instrument Schematics.
Note 3: Several Class IB PAM functions obtain their signals directly from the Class I input loop. No isolation is necessary because the input loop is the correct classification. Details are provided in the IRS.
Note 4: The hardwired TAB Enable switch prevents the ALS Service Unit (ASU) function (performed in the PPS replacement MWS) from communicating with the ALS except when the switch is activated.

2.3.4. PPS Data Communications

USNRC DI&C ISG 4 [3.1.16] defines interdivisional communications as communications among different safety divisions or between a safety division and a non-safety entity such as the MWS. Bidirectional communications among safety divisions and between safety and non-safety equipment is acceptable provided certain restrictions are enforced to ensure that there will be no adverse impact on safety systems.

Figure 2-13 illustrates a communications architecture that meets the intent of USNRC DI&C ISG 4 Staff Position 1, Interdivisional Communications. When used with the typical function block logic in Figure 2-16, the proposed architecture ensures that communications between a safety division and non-safety equipment that resides within the division adhere to the guidance described in the ISG 4 Staff Position. No data is communicated between redundant safety divisions. The non-safety-related Maintenance Workstation (MWS) within a redundant safety division communicates only with the safety-related controllers within that division.

The Tricon is isolated from the Gateway computer by the qualified safety-related Triconex Communications Module (TCM). Fiber optic cable electrically isolates the Tricons from external non-safety-related devices. An additional data isolation device such as a NetOptics network port aggregator tap permits two-way communications between the Maintenance Workstation belonging to a specific protection set and the Tricon in that protection set, and ensures only one-way communication to the Gateway computer. Additional details are provided in the Triconex Topical Report [3.1.33].

The NetOptics port aggregator device shown in Figure 2-13 isolates the Gateway computer from the Tricon controllers. The NRC approved the device previously for a similar application in the Oconee RPS [3.1.34] . The device acts as a "data diode" or one-way tap that copies all traffic between its bidirectional ports to the read-only output port and prevents the flow of information from the output port back to either input ports. The Gateway computer is a server that reads the information so copied, reformats it, and makes it available to the PPC.

The TxB1 ALS communication channel to the Gateway computer is serial, one-way and isolated by the CLB. It broadcasts data to the non-safety-related Gateway computer, which is common to all four protection sets, and does not receive any data, handshaking, or instructions from the Gateway computer. The TxB2 communication channel that transmits data to the non-safety-related Maintenance Workstation is also serial, one-way with no handshaking, and isolated at the CLB. A third serial communications channel enables Test ALS Bus (TAB) functions between Auxiliary Service Unit (ASU) maintenance software in the Maintenance Workstation and the ALS controller. This communication path is normally one-way, with two-way communications permitted only when a hardwired switch is activated to complete the communications circuit between the Maintenance Workstation and the ALS-A or ALS-B chassis. Additional details are provided in the ALS Topical Report [3.1.30].

2.3.5. Bypass and Test Features

The Process Protection System will permit any channel to be maintained in a bypassed condition, and when required, tested during power operation without initiating a protective action at the system level. This is accomplished without lifting electrical leads or installing temporary jumpers. The PPS will permit periodic testing during reactor power operation without initiating a protective action from the channel under test.

External trip switches are provided on PPS trip and actuation outputs per the detailed design. The switches may be used for SSPS input relay testing or to trip or actuate the channel manually if needed. Activation of the external trip switches is indicated in the control room through the SSPS partial trip indicators.

1. Tricon Features

On-line testing is controlled by safety processor logic enabled via an external safety-related hardwired Out of Service (OOS) switch. When the switch is activated, the safety-related function processor allows the associated instrument channel to be taken out of service while maintaining the remainder of the safety division operable. Features to limit inadvertent modification include, but are not limited to:

- Approved procedures are required to perform testing operations.
- Operation of the hardware switch alone will not place the channel out of service. At least two specific actions are also required at the Maintenance Workstation to perform the maintenance functions. In order to perform any test operation from the maintenance workstation, the user must:
  - Activate the OOS switch for the specific loop to be tested
  - Log in as a maintenance user on the maintenance workstation
  - Open the maintenance screen for the specific loop being tested
  - On the maintenance screen, request the action to be taken
  - On the maintenance screen, confirm the requested action (Loop is placed OOS only after the requested action is confirmed)
- Feedback is provided to the user on the maintenance workstation that the hardware OOS switch for the loop to be tested has been activated.
- Continuous indication is provided in the control room that a loop is OOS.
- If the safety-related hardware out of service switch is not activated, non-safety-related actions or failures can not adversely affect the safety-related function.
- An instrument loop is not permitted to be bypassed if external trip switch is in the trip position. The user may test in trip in this condition following request and confirmation as described above..

The block diagrams in Figure 2-15 through Figure 2-20 illustrate implementation of the Triconex test and bypass features described above.

The above methodology may be used to update parameters such as tuning constants that require periodic adjustment. Refer to Figure 2-21 for an example of the proposed parameter update logic.

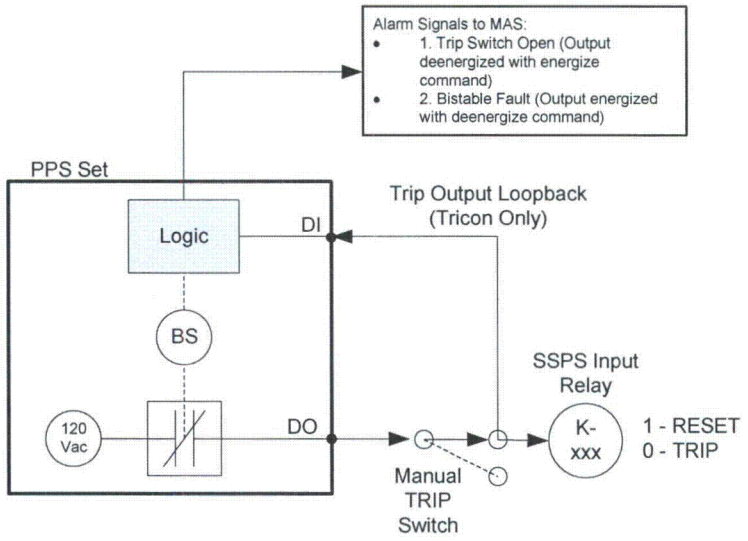
- The parameter values to be updated are limited by the software application to pre-determined ranges.
- The Maintenance Workstation software application will request operator confirmation that the parameter update process is complete prior to saving the new tuning constant.

Tricon trip setpoints may be changed following this procedure but with a different login priority

Figure 2-10 illustrates a DO loopback feature implemented in the Triconex portion of the PPS replacement, which enables the PPS to determine if the external trip switch is open, or if the DO channel is producing an erroneous output.

- A PPS trouble alarm is generated if the comparator output is true (commanding an energized output) and the de-energize to trip DO loopback is sensed as de-energized unless the instrument loop is OOS.
- A PPS failure alarm is generated if the de-energize to trip DO loopback is sensed as energized and the comparator output is false (commanding a de-energized output), whether or not the instrument loop is OOS.

Figure 2-10 Triconex Trip Loopback Concept (Typical for Deenergize to Trip Outputs)



2. ALS Features

ALS bypass and test functions are accomplished through ALS Service Unit (ASU) software implemented in the MWS. The Test ALS Bus (TAB) Enable switch shown in Figure 2-13 must be activated to allow two-way communications on the TAB between the ALS chassis and the MWS.

External bypass switches are provided for the ALS-A and ALS-B partial trip outputs to enable one ALS diversity group to be bypassed for maintenance or testing without initiating a false trip or actuation, yet allowing the other ALS diversity group to initiate the trip or actuation if it is required while the other diversity group is bypassed.

The partial trip outputs from the ALS-A and ALS-B chassis are logically OR'd to drive the SSPS input relays. An external Line Sense Module (LSM) is used by the ALS logic to perform continuous error check for detecting the following conditions:

- Failure to Trip on Demand
- Trip without Demand
- Failure to Bypass
- Illegal Bypass

Configuration of the LSM for use in an Energize to Trip (ETT) or Deenergize to Trip (DTT) circuit is done through field wiring terminations on the LSM and does not require any

modification of any electrical properties of the LSM itself. Thus, a single LSM can be used in an ETT or DTT circuit without the need to electrically configure the module for the trip circuit type before use. This allows a single part number to be used to provide spares for both ETT and DTT circuit configurations.

Figure 2-11 illustrates a DTT Configuration concept using LSM, and Figure 2-12 provides an overview of how the LSM is used in an ETT circuit configuration.

The manual bypass switches allow one ALS diversity Group (ALS-A or ALS-B) to be bypassed and removed from service without tripping the channel. The manual trip switch is used to trip the channel in the unlikely event that both ALS diversity groups are inoperable.

Figure 2-11 ALS-A and ALS-B Deenergize to Trip OR Configuration Concept

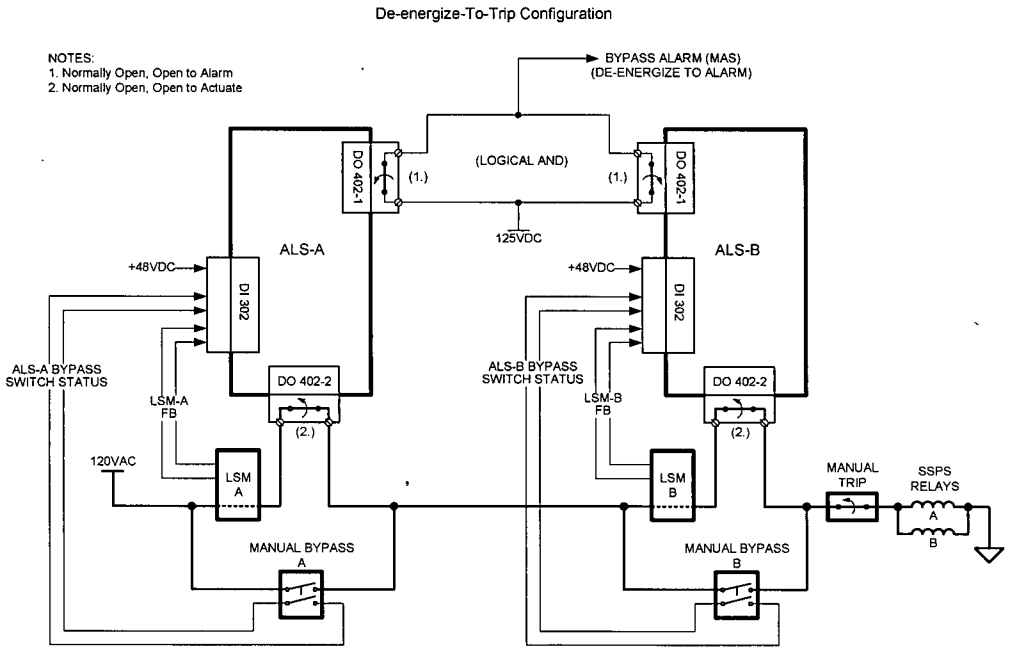
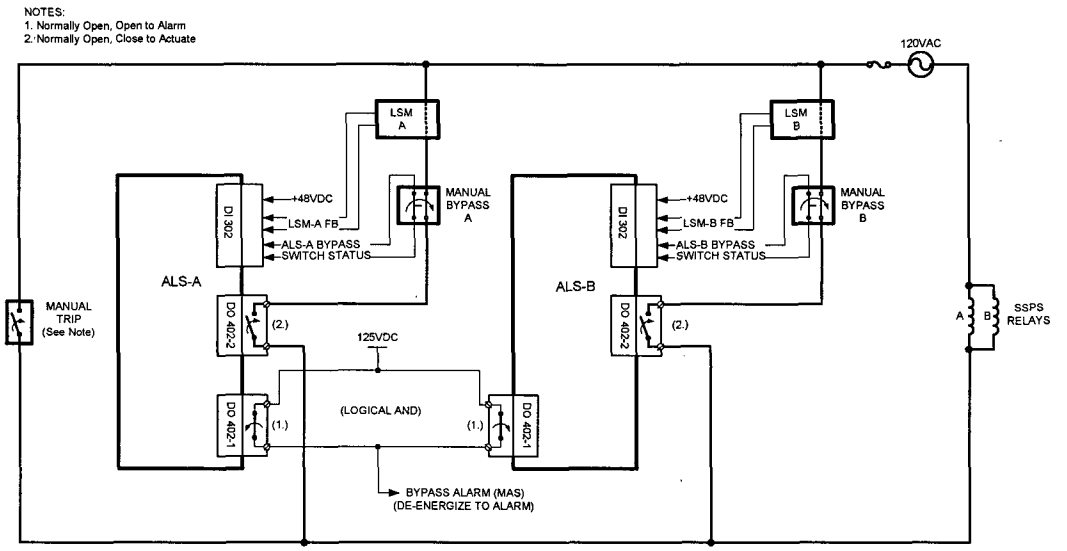


Figure 2-12 ALS-A and ALS-B Energize to Trip OR Configuration Concept



Note: Manual Trip switch as required by detailed design

2.3.6. System Classification

The Plant Protection System is classified as safety-related Instrument Class IA, PG&E Design Class I, Diablo Canyon Quality Class Q per DCM S-38A [3.2.2] and DCM T-24 [3.2.4]. The PPS provides outputs to non-safety-related control systems and indication instruments through qualified isolators to be provided by PG&E. Class IA instruments are analogous to electrical devices designated as Electrical Class 1E per IEEE-308-1971.

2.3.7. Software Integrity Level (SIL)

The replacement PPS application software is assigned Software Integrity Level (SIL) 4 [IEEE 1012-1998 Reference 3.1.4] because it is directly associated with nuclear-safety-related Reactor Trip and Engineered Safety Features functions.

2.3.8. Application Software Development and Configuration Management

PPS application software will be developed by the subsystem suppliers, Invensys/Triconex and Westinghouse/CSI under their approved QA programs. Software configuration management during development will be performed according to their approved procedures. Details are provided in the respective Topical Reports [3.1.30] and [3.1.31].

2.3.9. Seismic and Environmental Qualification

The Triconex Tricon Programmable Logic Controller (PLC) will be qualified per the Topical Report [3.1.31] issued in September 2009 that was updated for the Version 10 Tricon as well as addressing current regulatory issues. The Topical Report is currently under NRC review.

The Westinghouse/CSI Advanced Logic System (ALS) will be qualified per the Topical Report [3.1.30], which describes generic qualification of the ALS for safety-related applications in nuclear power plants. The ALS Topical Report is currently under NRC review.

PG&E will design the installation to ensure that the response spectra to which the equipment is subjected do not exceed seismic qualification levels.

2.3.10. Electromagnetic Compatibility

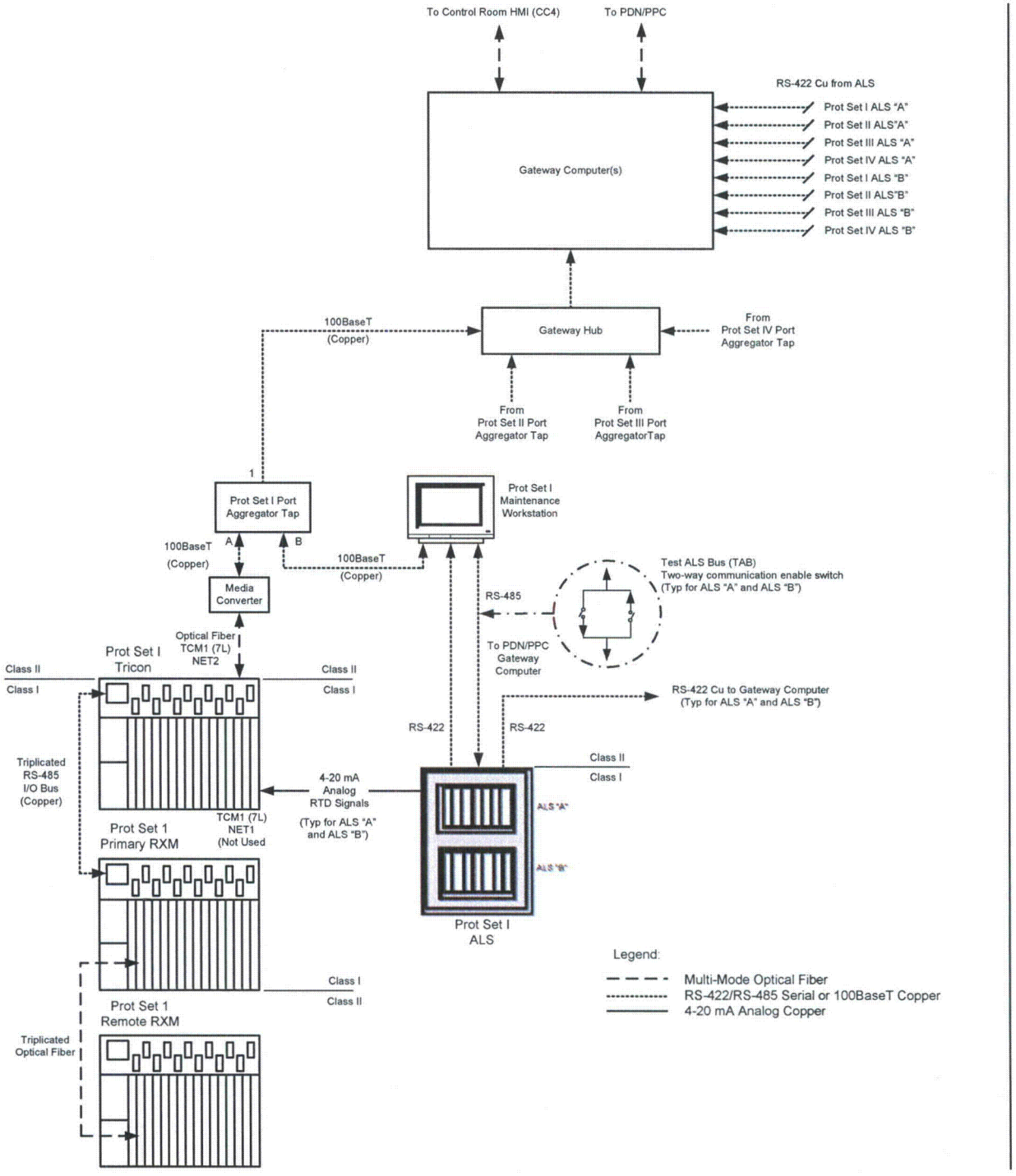
The Tricon and Westinghouse/CSI portions of the replacement PPS will be qualified for the electromagnetic environment (Emissions and susceptibility, including grounding methods) as described in the respective Topical Reports.

2.3.11. Secure Development Environment

PPS application software will be developed by the subsystem suppliers, Invensys/Triconex and Westinghouse/CSI under their approved QA programs. Maintenance of a secure development environment is described in the respective Topical Reports.

Safety division software is protected from alteration while the safety division is in operation as discussed in the Triconex and ALS Topical Reports.

Figure 2-13 Eagle 21 Replacement PPS Class II Communications Architecture



2.4 DIVERSITY AND DEFENSE-IN-DEPTH (D3)

2.4.1. Diversity & Defense-in-Depth Strategy

The PPS Replacement Diversity and Defense in Depth Topical Report (TR) [3.2.1] reevaluated DCPP FSAR Chapter 15 events where the Eagle 21 SER took credit for the Eagle 21 PPS for both primary and backup protection. The D3 Topical Report identified sufficient available automatic means to prevent software CCF from adversely affecting the mitigation of all concurrent FSAR Chapter 15 accidents or events were identified, with three exceptions. These events required manual action by the operator to mitigate the event [3.1.18]. The exceptions are:

1. Loss of forced reactor coolant flow in a single loop above P-8 as indicated by two out of three (2oo3) reactor coolant flow channels indicating low;

2. RCS depressurization, including Steam Generator Tube Rupture (SGTR), Steam Line Break (SLB) and Loss of Coolant Accident (LOCA) indicated by low Pressurizer pressure; and

3. Large Break LOCA and SLB indicated by high containment pressure.

The USNRC position regarding D3 is documented in BTP HICB-19 [3.1.12]. Digital I&C (DI&C) Interim Staff Guidance (ISG) document DI&C-ISG-02 [3.1.15] discusses acceptable methods for implementing diversity and defense-in-depth in digital I&C system designs involving the reactor protection system. Staff Position 1 in ISG-02 states that the use of automation for protective actions is considered to provide a high-level of licensing certainty, compared to reliance on manual operator actions.

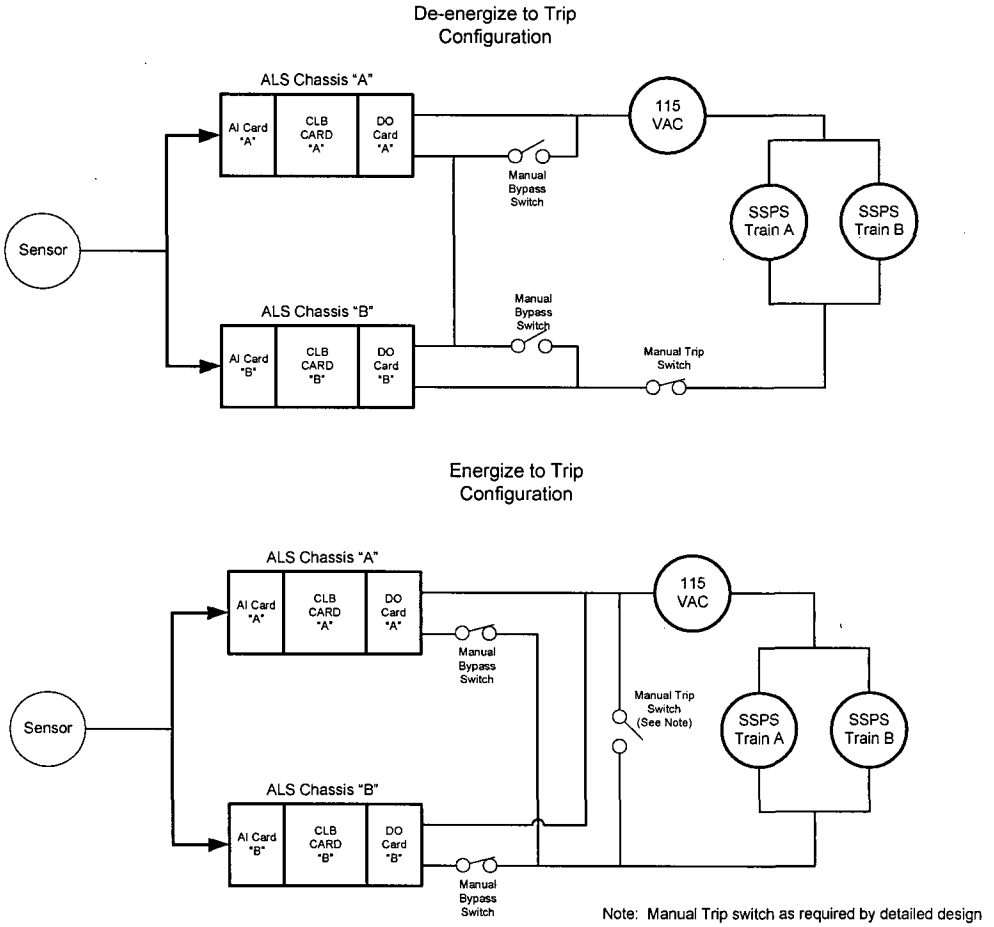
For each event that the Eagle 21 SER credited manual operator actions for accident mitigation in the presence of a concurrent CCF, Table 2-1 identifies the PPS functions that will be performed automatically by the ALS subsystem. The built-in diversity of the ALS subsystem ensures that the replacement PPS will perform these functions automatically in the presence of a postulated CCF without an adverse impact on the operator's ability to diagnose the event or perform previously credited manual actuation activities.

Each protection set in the proposed PPS provides two complete and diverse execution paths "A" and "B" comprised of the Core Logic Boards (CLB), input boards and output boards shown in Figure 2-14. The paths are developed by independent design teams and verified and validated by independent V&V teams.

The "A" and "B" execution path outputs are combined in hardwired logic as shown in Figure 2-14 to ensure that the protective action is taken if directed by either path. A single failed path cannot prevent a protective action. Either CLB will identify itself as failed and sets its outputs to a fail-safe state before halting operation if it detects a mismatch between the outputs of its diverse logic cores. Refer to the ALS Topical Report [3.1.30] for additional information.

NRC approved the above approach in the SER for the Diablo Canyon D3 Topical report, [3.1.36]. The SER identifies some additional areas that PG&E should address in its related license amendment request to support the digital upgrade of the DCPP PPS.

Figure 2-14 ALS Built In Diversity Architecture



The figures above illustrate how the partial trip outputs from the ALS-A and ALS-B chassis are logically OR'd to drive the SSPS input relays. Section 2.3.5 provides information regarding the external Line Sense Module (LSM) used in the ALS subsystem to simplify field wiring, perform continuous error checks, and to facilitate maintenance and testing functions.

Table 2-1 Primary Protection System Functions Performed by ALS Sub-System

DCPP FSARU Section	Event	Low PZR Pressure SI	High PZR Pressure RT	SI/RT	High Cont. Pressure SI (Note 1)	Cont. Isolation A	Cont. Isolation B	Cont. Spray	RCS Low Flow RT
15.2.5	Loss of Forced RCS Flow								x
15.2.13	RCS Depressurization			x					
15.3.1 15.4.1	SBLOCA / LBLOCA	x		x	x	x	x	x	
15.4.2.1	Steam Line Break	x				x	x	x	
15.4.2.2	Main Feed Pipe Rupture		x		x	x			
15.4.3	SG Tube Rupture	x		x					

Note1: Automatic Reactor Trip occurs on safety injection due to low pressurizer pressure or high containment pressure

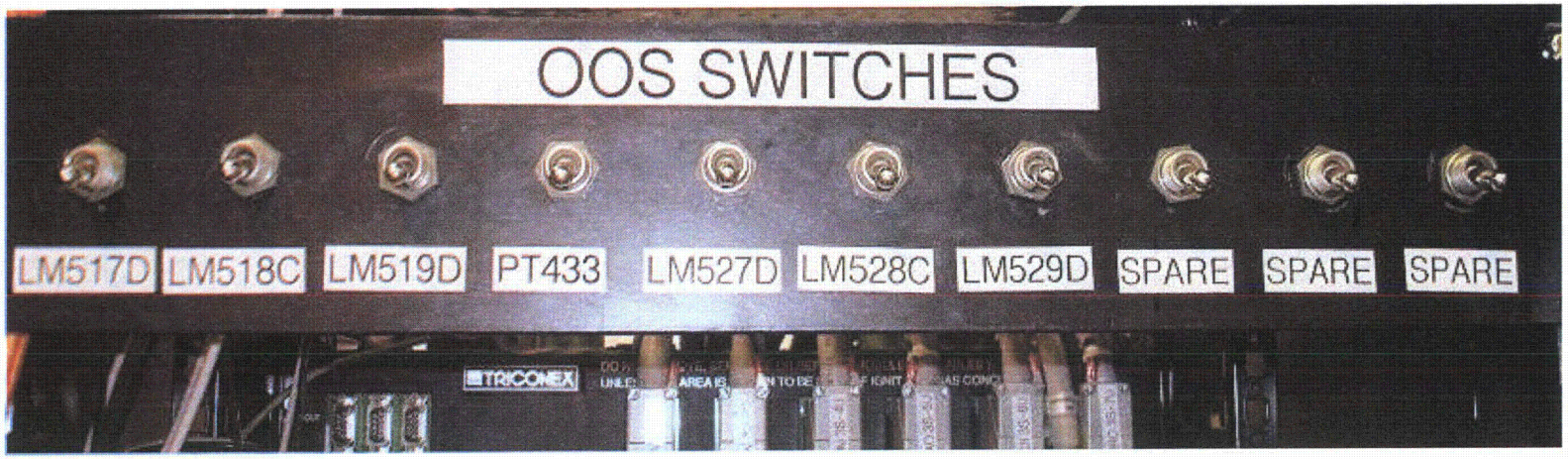
2.4.2. Elimination of Potential Protection/Control Interaction

The proposed replacement PPS utilizes separate qualified isolation devices that are independent from the PPS for post-accident monitoring and inputs to the non-safety-related control systems to prevent a common cause failure in the software-based replacement PPS from causing a control system excursion that requires mitigation from the failed protection system. Refer to Figure 2-3 and Figure 2-9. These measures improve defense-in-depth and minimize likelihood that failure in one system could affect other systems.

The four loop Tavg signals are exceptions to the prohibition against digital processing of signals in the replacement PPS prior to their being used in a control system. The Thot and Tcold RTD signals are processed by the ALS because Triconex does not supply a qualified RTD input board. The ALS provides self-diagnostic functions as well as more stable and accurate signal processing than is available with stand-alone signal converter modules. Isolated analog Thot and Tcold signals are transmitted from the ALS to the Tricon by 4-20 mAdc analog signals. The Tricon uses these signals internally for the DTTA trip functions and also distributes them through qualified isolation devices to the reactor control system.

In accordance with 10 CFR 50.62 [3.1.19], inputs to the AMSAC are independent of any digital signal processing prior to their being used by the AMSAC. When the AMSAC is replaced, the replacement system will be diverse from the proposed replacement PPS in accordance with the requirements of 10CFR50.62 [3.1.19].

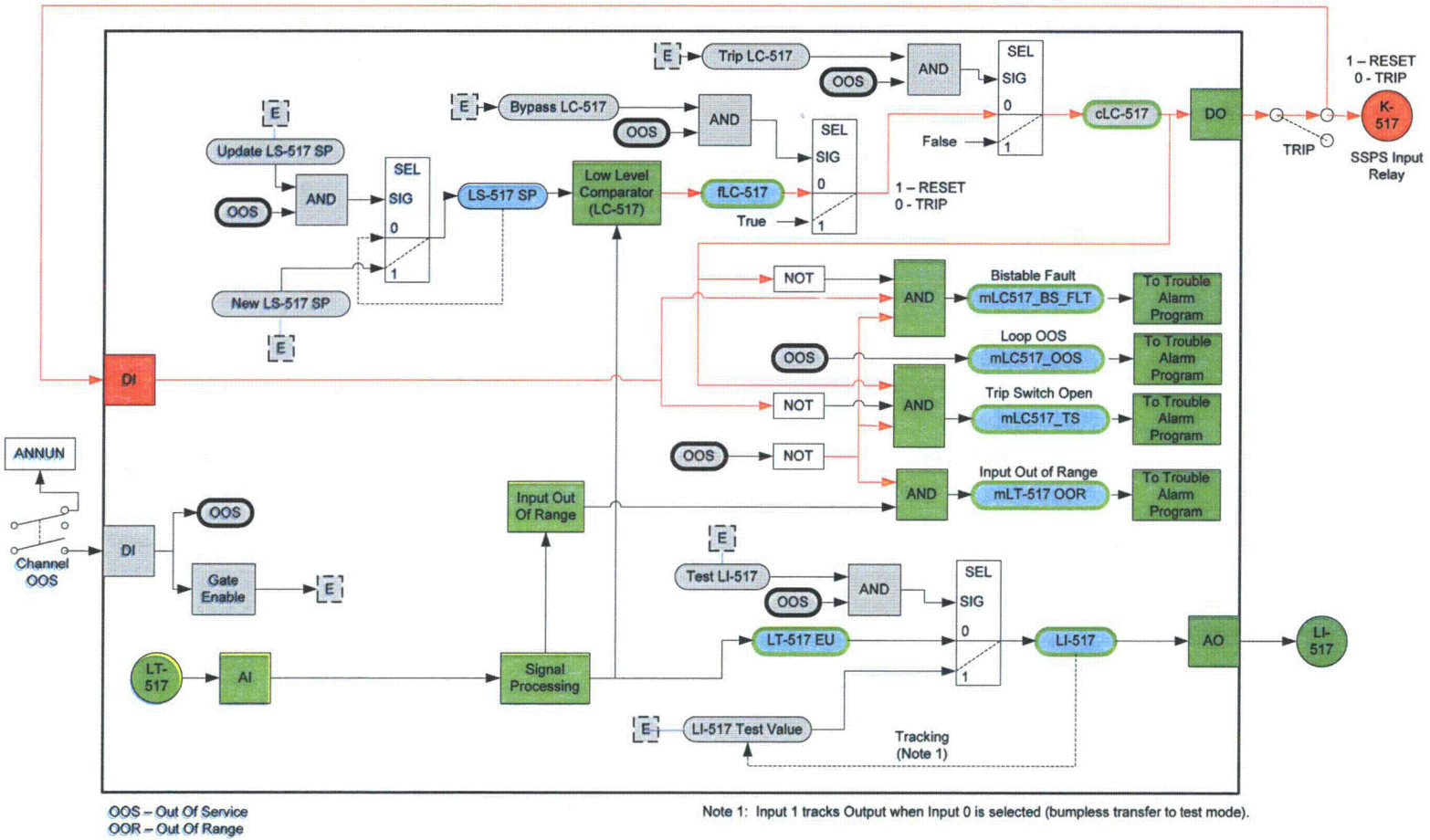
Figure 2-15 Out of Service Switches



Note: The switches shown are for the prototype Process Control System. The switches in the production systems will be provided with protective covers to prevent inadvertent operation.

Figure 2-16 Typical PPS Replacement Loop Pseudo Function Block Diagram – Loop in Service

(Not applicable to ALS subsystem)



OOS – Out Of Service
OOR – Out Of Range

Note 1: Input 1 tracks Output when Input 0 is selected (bumpless transfer to test mode).

Figure 2-17 Loop Out of Service – No Request from MWS
(Not applicable to ALS subsystem)

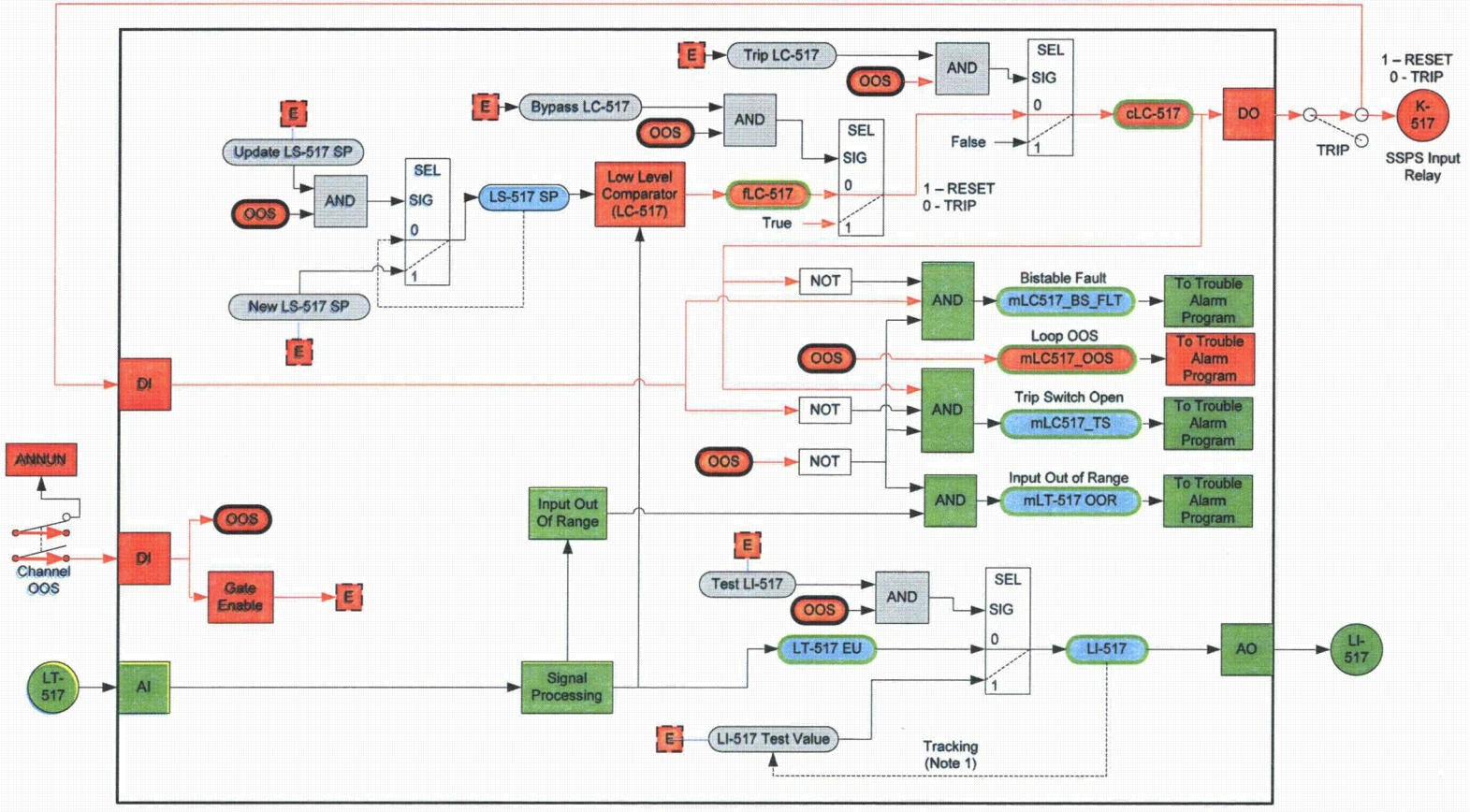
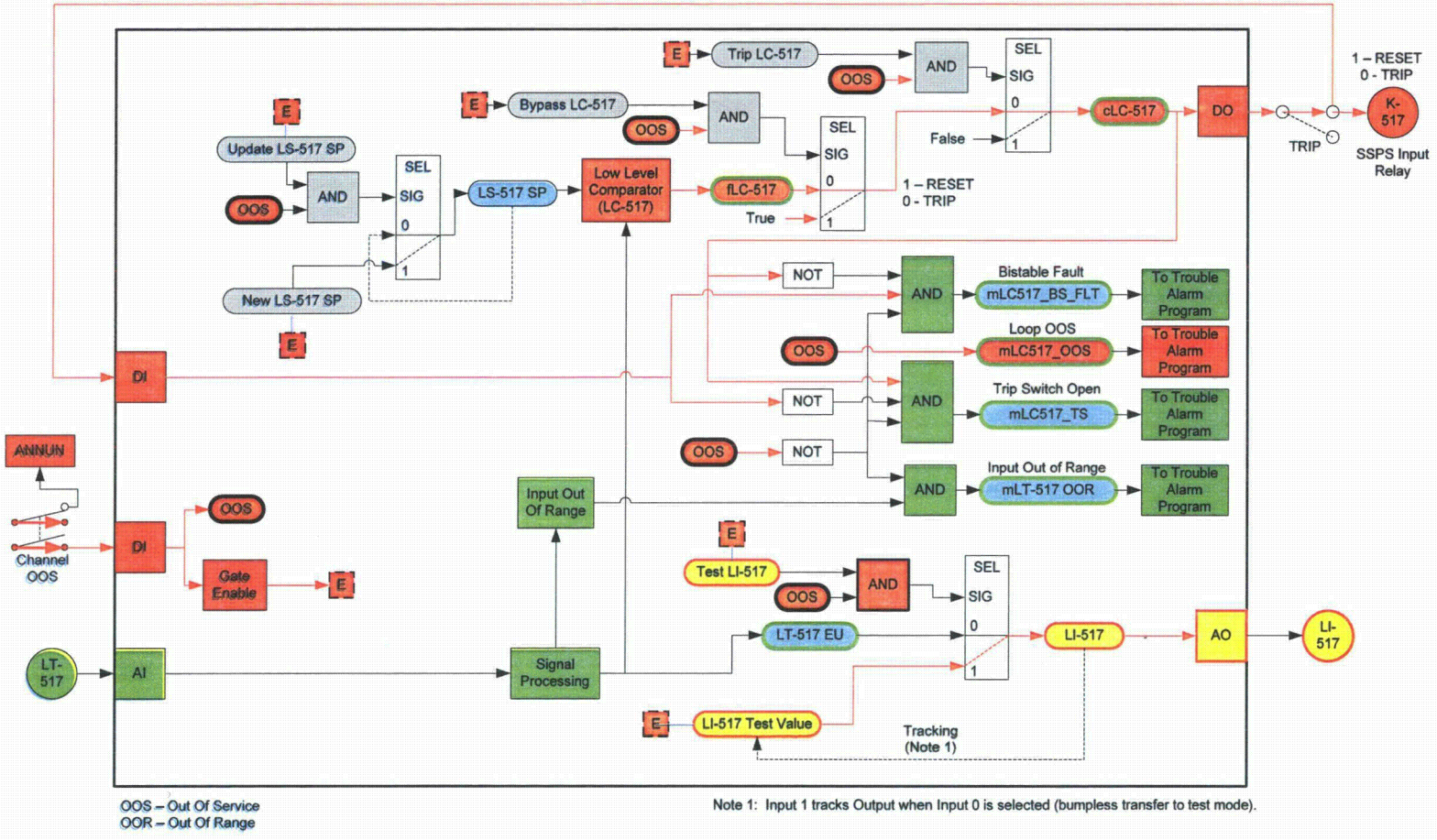


Figure 2-18 Analog Output in Test from MWS
(Not applicable to ALS subsystem)

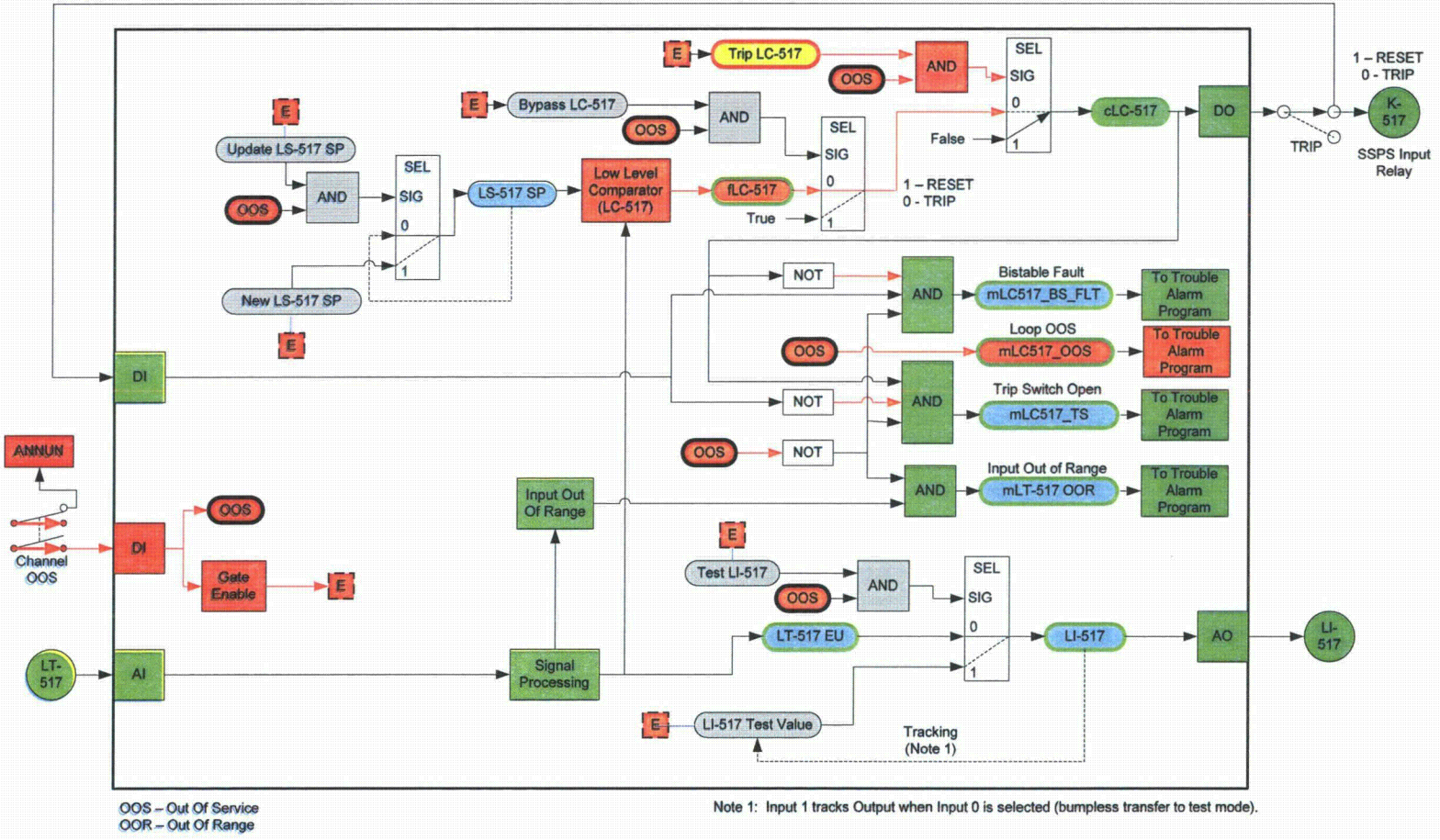


OOS – Out Of Service
OOR – Out Of Range

Note 1: Input 1 tracks Output when Input 0 is selected (bumpless transfer to test mode).

Figure 2-19 Discrete Output Test in Trip from MWS

(Not applicable to ALS subsystem)

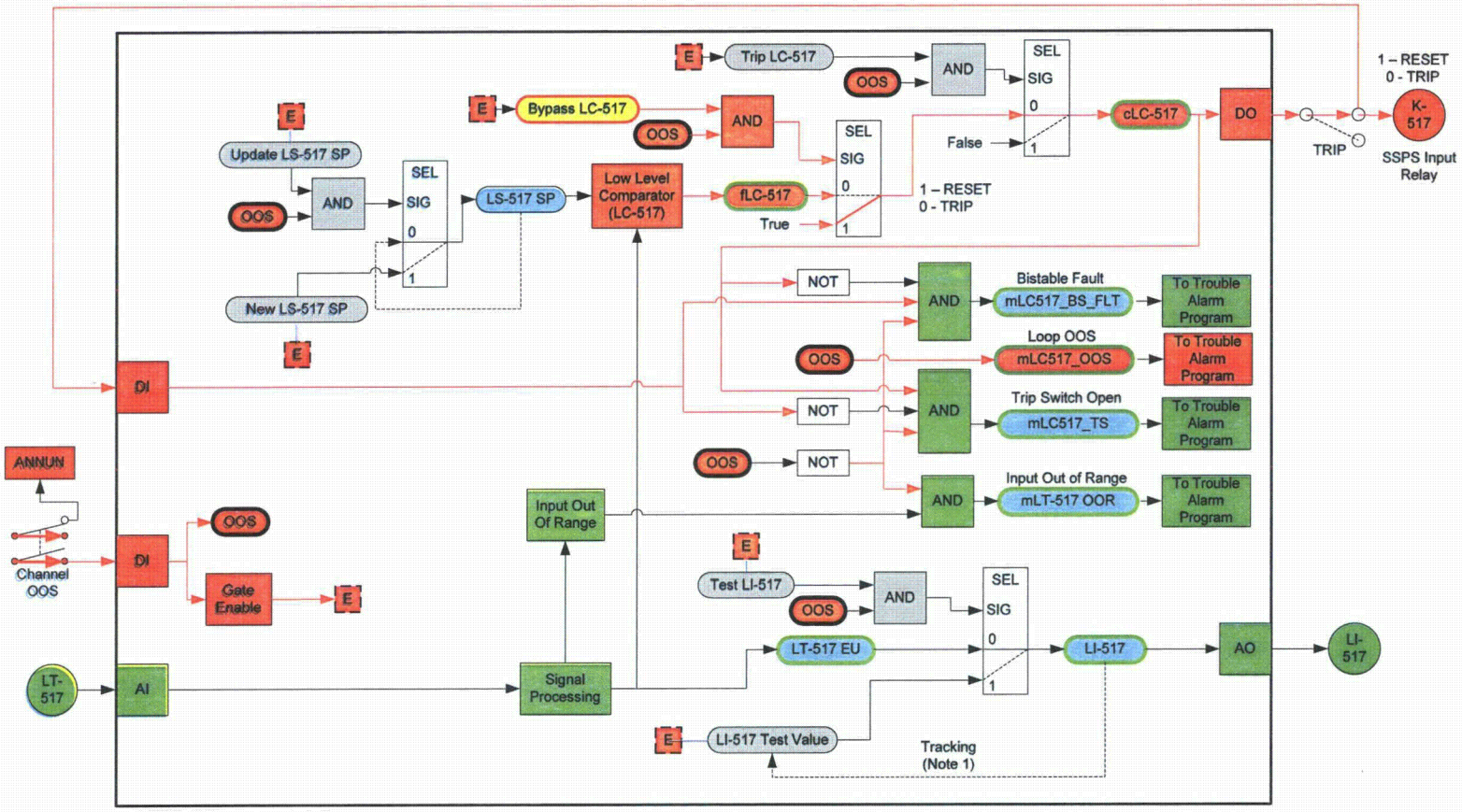


OOS – Out Of Service
OOR – Out Of Range

Note 1: Input 1 tracks Output when Input 0 is selected (bumpless transfer to test mode).

Figure 2-20 Discrete Output Test in Bypass from MWS

(Not applicable to ALS subsystem)

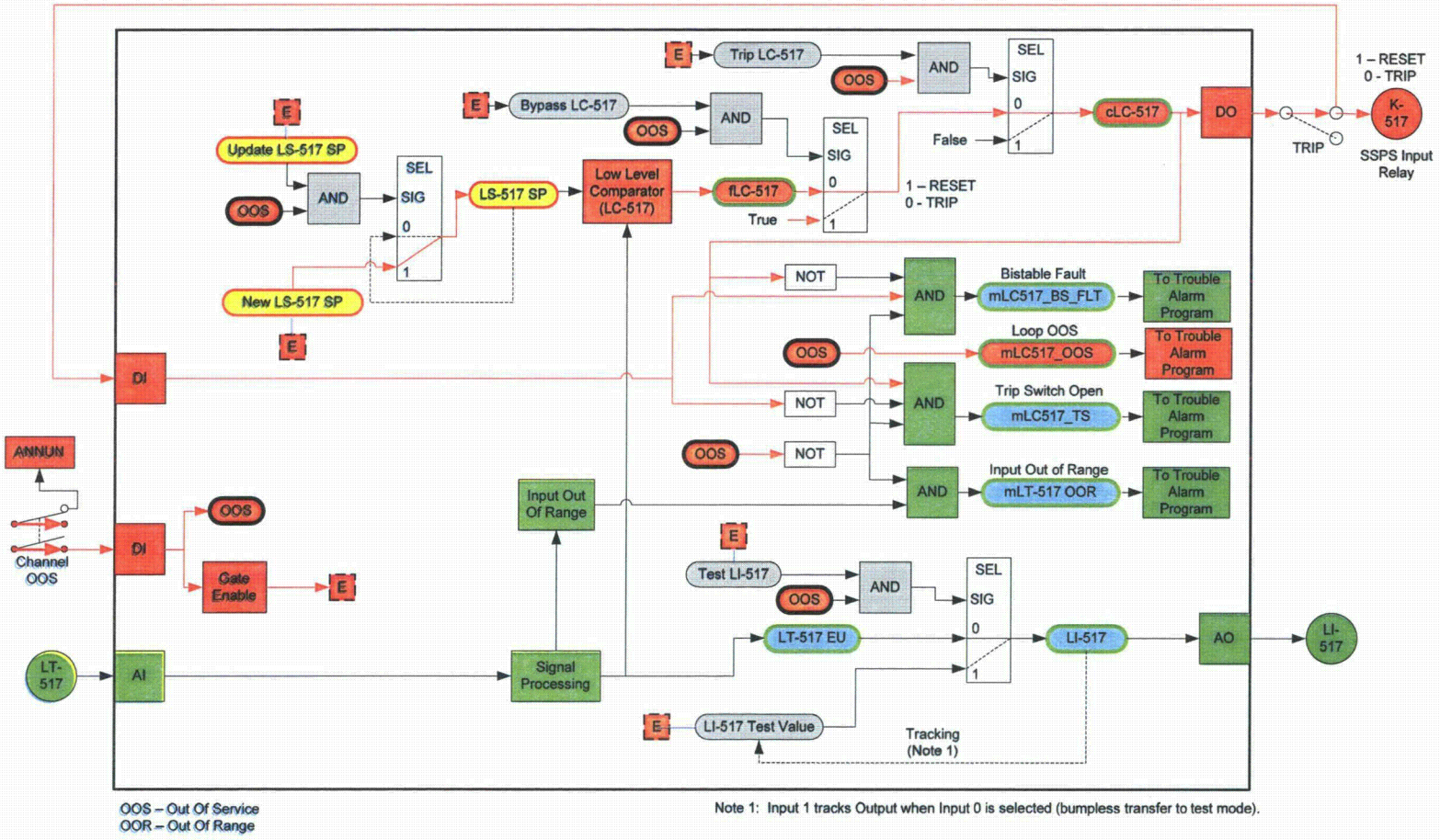


OOS – Out Of Service
OOR – Out Of Range

Note 1: Input 1 tracks Output when Input 0 is selected (bumpless transfer to test mode).

Figure 2-21 Parameter Update from MWS

(Not applicable to ALS subsystem)



OOS – Out Of Service
OOR – Out Of Range

Note 1: Input 1 tracks Output when Input 0 is selected (bumpless transfer to test mode).

3 References

3.1 INDUSTRY STANDARDS AND REGULATORY GUIDANCE

3.1.1. 10 CFR 50 Appendix B	Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants
3.1.2. IEEE STD 279-1971	Criteria for Protection Systems for Nuclear Power Generating Stations
3.1.3. IEEE STD 603-1991	IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations
3.1.4. IEEE STD 1012-1998	Standard for Software Verification and Validation
3.1.5. IEEE STD 1050-1996	Guide for Instrumentation and Control Equipment Grounding in Generating Stations
3.1.6. IEEE STD 7-4.3.2-2003	Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations
3.1.7. NUREG 0800	Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std. 603"
3.1.8. NUREG 0800, HICB-11	Isolation Devices
3.1.9. NUREG 0800, HICB-14	Software Reviews
3.1.10. NUREG 0800, HICB-17,	Self-Test and Surveillance Test Provisions
3.1.11. NUREG 0800, HICB-18,	Programmable Logic Controllers
3.1.12. NUREG 0800, HICB-19,	"Guidance for Evaluation of Defense-in-Depth and Diversity in Digital Computer-Based Instrumentation and Control Systems"
3.1.13. NUREG 0800, HICB-21,	Real-Time Performance
3.1.14. NUREG/CR-6303	Method for Performing Diversity and Defense-in-Depth Analyses of Reactor Protection Systems
3.1.15. NRC DI&C ISG-02	United States Nuclear Regulatory Commission (USNRC) Digital Instrumentation and Controls Task Working Group #2, "Diversity and Defense-in-Depth Issues Interim Staff Guidance," (2008).
3.1.16. NRC DI&C ISG-04	United States Nuclear Regulatory Commission (USNRC) Digital Instrumentation and Controls Task Working Group #4, "Highly Integrated Control Rooms Digital Communications Systems (HICRc), Rev 1, March 2009
3.1.17. WCAP 7306	Westinghouse Electric Corporation, "Reactor Protection System Diversity in Westinghouse Pressurized Reactors," (1969) Non-Proprietary Class 3
3.1.18. USNRC	Safety Evaluation Report Eagle 21 Reactor Protection System Modification With Bypass Manifold Elimination, PG&E, Diablo Canyon Power Plant, (October 7, 1993)

3.1.19. 10 CFR 50.62	Requirements for Reduction of Risk from Anticipated Transients without Scram (ATWS) Events for Light-Water-Cooled Nuclear Power Plants
3.1.20. USNRC	Safety Evaluation Report for Wolf Creek Nuclear Operating Company (WCNOC) Main Steam and Feedwater Isolation System (MSFIS), Accession Number ML090610317
3.1.21. USNRC, Regulatory Guide 1.97, Rev. 3	Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident
3.1.22. EPRI, TR-107330	Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants, February 1998
3.1.23. EPRI, TR-1000799	Generic Qualification of the Triconex Corporation Tricon Triple Modular Redundant Programmable Logic Control System for Safety-Related Application s in Nuclear Power Plants, November 2000
3.1.24. EPRI, TR-1003114	Safety Evaluation Report, issued by Nuclear Regulatory Commission to Triconex on the Triconex Platform, December 12, 2001
3.1.25. USNRC, RG 1.152	Criteria for Digital Computers in Safety Systems of Nuclear Power Plants
3.1.26. USNRC, RG 1.180, Rev 1	Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems
3.1.27. USNRC, RG 1.168	Verification, Validation, Reviews and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants
3.1.28. USNRC, RG 1.169	Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants
3.1.29. USNRC, RG 1.171	Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants
3.1.30. CS Innovations	6002-00301, CS Innovations ALS Topical Report and Supporting Documents Submittal, July 29, 2010 (ADAMS Accession No. ML102160471)
3.1.31. Triconex Corporation	Topical Reports 7286-545, "Qualification Summary Report" and 7286-546, "Amendment 1 to Qualification Summary Report," Revision 1 published as EPRI TR-1000799, "Generic Qualification of the Triconex Corporation TRICON Triple Modular Redundant Programmable Logic Controller System for Safety-Related Applications in Nuclear Power Plants," November 2000

3.1.32. USNRC	Letter from Stuart A. Richards (NRC) to Troy Martel (Triconex Corporation), "Review of Triconex Corporation Topical Reports 7286-545, "Qualification Summary Report" and 7286-546, "Amendment 1 to Qualification Summary Report," Revision 1" December 11, 2001 published as EPRI TR-1003114 ADAMS Accession Number ML013470433
3.1.33. Invensys/Triconex	"Nuclear Safety-Related Qualification of the Tricon TMR Programmable Logic Controller (PLC) – Update to Qualification Summary Report Submittal and "Application for withholding Proprietary Information from Public Disclosure," September, 2009
3.1.34. USNRC	Oconee, Units 1, 2 & 3, Issuance of Amendment Nos. 366, 368, and 367, Reactor Protective System and Engineered Safeguard Protection System Digital Upgrade.
3.1.35. 10 CFR 100	Reactor Site Criteria
3.1.36. USNRC	Diablo Canyon Power Plant, Unit Nos. 1 and 2 - Safety Evaluation for Topical Report, "Process Protection System Replacement Diversity & Defense-In-Depth Assessment" (TAC Nos. ME4094 And ME4095), dated April 19, 2011 (ADAMS Accession No. ML110480845)

3.2 PG&E DOCUMENTS

3.2.1. PG&E Topical Report	Process Protection System Replacement Diversity & Defense-in-Depth Assessment, Rev 1, August, 2010
3.2.2. PG&E DCM S-38A	Plant Protection System
3.2.3. PG&E DCM T-19	Design Criteria for Electrical Separation and Isolation
3.2.4. PG&E DCM T-24	Design Criteria for DCPP Instrumentation and Controls

3.3 PRIMARY (DESIGN BASIS) DRAWING REFERENCES

Protection Set I

Instr. No.	Description	Existing Unit 1 Instr. Schematic	Existing Unit 2 Instr. Schematic
FT-414	Reactor Coolant Flow Loop 1	102032-17A	108032-17A
FT-424	Reactor Coolant Flow Loop 2	102032-17D	108032-17D
FT-434	Reactor Coolant Flow Loop 3	102032-17G	108032-17G
FT-444	Reactor Coolant Flow Loop 4	102032-17J	108032-17J
FT-510	Loop 1 Feedflow	102036-3D	108036-3D
FT-512	Loop 1 Steamflow	102036-3S	108036-3S

Protection Set I

Instr. No.	Description	Existing Unit 1 Instr. Schematic	Existing Unit 2 Instr. Schematic
FT-520	Loop 2 Feedflow	102036-3E	108036-3E
FT-522	Loop 2 Steamflow	102036-3T	108036-3T
FT-530	Loop 3 Feedflow	102036-3F	108036-3F
FT-532	Loop 3 Steamflow	102036-3U	108036-3U
FT-540	Loop4 Feedflow	102036-3G	108036-3G
FT-542	Loop 4 Steamflow	102036-3V	108036-3V
LT-459	PZR Level	102036-7C	108036-7C
LT-529	S/G 2 Level	102036-4P	108036-4P
LT-539	S/G 3 Level	102036-4Q	108036-4Q
NE-41A	DTTA Loop 1 Upper (Neutron) Flux	102036-29G	108036-29G
NE-41B	DTTA Loop 1 Lower (Neutron) Flux	102036-29G	108036-29G
PT-455	Loop 1 PZR Pressure	102036-7	108036-7
PT-505	Turbine Impulse Pressure	102036-4U	108036-4U
PT-514	Loop 1 Steamline Pressure	102036-3S	108036-3S
PT-524	Loop 2 Steamline Pressure	102036-3T	108036-3T
PT-534	Loop 3 Steamline Pressure	102036-3U	108036-3U
PT-544	Loop 4 Steamline Pressure	102036-3V	108036-3V
PT-937	Containment Pressure	102034-12B	108034-12B
TE-410A	DTTA Loop 1 Thot-1A	102036-7L	108036-7L
TE-410B	DTTA Loop 1 Tcold-1	102036-7L	108036-7L
TE-410C	DTTA Loop 1 Thot-1B	102036-7L	108036-7L
TE-411A	DTTA Loop 1 Thot-2A	102036-7L	108036-7L
TE-411B	DTTA Loop 1 Tcold-2	102036-7L	108036-7L
TE-411C	DTTA Loop 1 Thot-2B	102036-7L	108036-7L
TE-412A	DTTA Loop 1 Thot-3A	102036-7L	108036-7L
TE-412C	DTTA Loop 1 Thot-3B	102036-7L	108036-7L
TE-413A	WR Temperature Loop 1 Hot Leg	102035-6D	108035-6D
TE-413B	WR Temperature Loop 1 Cold Leg	102035-6D (1)	108035-6D
TE-423A	WR Temperature Loop 2 Hot Leg	102035-6E	108035-6E
TE-423B	WR Temperature Loop 2 Cold Leg	102035-6E	108035-6E

Notes:
(1) per T-MOD 50229619

Protection Set II

Instr. No.	Description	Existing Unit 1 Instr. Schematic	Existing Unit 2 Instr. Schematic
FT-415	Reactor Coolant Flow Loop 1	102032-17B	108032-17B
FT-425	Reactor Coolant Flow Loop 2	102032-17E	108032-17E
FT-435	Reactor Coolant Flow Loop 3	102032-17H	108032-17H
FT-445	Reactor Coolant Flow Loop 4	102032-17K	108032-17K
FT-511	Loop 1 Feedflow	102036-3H	108036-3H
FT-513	Loop 1 Steamflow	102036-3W	108036-3W

Protection Set II

Instr. No.	Description	Existing Unit 1 Instr. Schematic	Existing Unit 2 Instr. Schematic
FT-521	Loop 2 Feedflow	102036-3I	108036-3I
FT-523	Loop 2 Steamflow	102036-3X	108036-3X
FT-531	Loop 3 Feedflow	102036-3J	108036-3J
FT-533	Loop 3 Steamflow	102036-3Y	108036-3Y
FT-541	Loop4 Feedflow	102036-3K	108036-3K
FT-543	Loop 4 Steamflow	102036-3Z	108036-3Z
LT-460	PZR Level	102036-7G	108036-7G
LT-519	S/G 1 Level	102036-4O	108036-4O
LT-549	S/G 4 Level	102036-4R	108036-4R
NE-42A	DTTA Loop 2 Upper (Neutron) Flux	102036-29I	108036-29I
NE-42B	DTTA Loop 2 Lower (Neutron) Flux	102036-29I	108036-29I
PT-456	Loop 2 PZR Pressure	102036-7H	108036-7H
PT-506	Turbine Impulse Pressure	102036-4V	108036-4V
PT-515	Loop 1 Steamline Pressure	102036-3W	108036-3W
PT-525	Loop 2 Steamline Pressure	102036-3X	108036-3X
PT-535	Loop 3 Steamline Pressure	102036-3Y	108036-3Y
PT-545	Loop 4 Steamline Pressure	102036-3Z	108036-3Z
PT-936	Containment Pressure	102034-12C	108034-12C
TE-420A	DTTA Loop 2 Thot-1A	102036-7P	108036-7P
TE-420B	DTTA Loop 2 Tcold-1	102036-7P	108036-7P
TE-420C	DTTA Loop 2 Thot-1B	102036-7P	108036-7P
TE-421A	DTTA Loop 2 Thot-2A	102036-7P	108036-7P
TE-421B	DTTA Loop 2 Tcold-2	102036-7P	108036-7P
TE-421C	DTTA Loop 2 Thot-2B	102036-7P	108036-7P
TE-422A	DTTA Loop 2 Thot-3A	102036-7P	108036-7P
TE-422C	DTTA Loop 2 Thot-3B	102036-7P	108036-7P
TE-433A	WR Temperature Loop 3 Hot Leg	102035-6F	108035-6F
TE-433B	WR Temperature Loop 3 Cold Leg	102035-6F	108035-6F
TE-443A	WR Temperature Loop 4 Hot Leg	102035-6G	108035-6G
TE-443B	WR Temperature Loop 4 Cold Leg	102035-6G	108035-6G

Protection Set III

Instr. No.	Description	Existing Unit 1 Instr. Schematic	Existing Unit 2 Instr. Schematic
FT-416	Reactor Coolant Flow Loop 1	102032-17C	108032-17C
FT-426	Reactor Coolant Flow Loop 2	102032-17F	108032-17F
FT-436	Reactor Coolant Flow Loop 3	102032-17I	108032-17I
FT-446	Reactor Coolant Flow Loop 4	102032-17L	108032-17L
LT-461	PZR Level	102036-7J	108036-7J
LT-518	S/G 1 Level	102036-4	108036-4
LT-528	S/G 2 Level	102036-4A	108036-4A
LT-538	S/G 3 Level	102036-4B	108036-4B
LT-548	S/G 4 Level	102036-4C	108036-4C
NE-43A	DTTA Loop 3 Upper (Neutron) Flux	102036-29K	108036-29K
NE-43B	DTTA Loop 3 Lower (Neutron) Flux	102036-29K	108036-29K

Protection Set III

Instr. No.	Description	Existing Unit 1 Instr. Schematic	Existing Unit 2 Instr. Schematic
PT-403	Wide Range Pressure Loop 4	102034-7A	108034-7A
PT-403A	Wide Range Pressure Loop 4	102034-7C	108034-7C
PT-457	Loop 3 PZR Pressure	102036-7I	108036-7I
PT-526	Loop 2 Steamline Pressure	102036-5F	108036-5F
PT-536	Loop 3 Steamline Pressure	102036-5G	108036-5G
PT-935	Containment Pressure	102034-12D	108034-12D
TE-430A	DTTA Loop 3 Thot-1A	102036-7T	108036-7T
TE-430B	DTTA Loop 3 Tcold-1	102036-7T	108036-7T
TE-430C	DTTA Loop 3 Thot-1B	102036-7T	108036-7T
TE-431A	DTTA Loop 3 Thot-2A	102036-7T	108036-7T
TE-431B	DTTA Loop 3 Tcold-2	102036-7T	108036-7T
TE-431C	DTTA Loop 3 Thot-2B	102036-7T	108036-7T
TE-432A	DTTA Loop 3 Thot-3A	102036-7T	108036-7T
TE-432C	DTTA Loop 3 Thot-3B	102036-7T	108036-7T

Protection Set IV

Instr No.	Description	Existing Unit 1 Instr Schematic	Existing Unit 2 Instr Schematic
LT-517	S/G 1 Level	102036-4I	108036-4I
LT-527	S/G 2 Level	102036-4J	108036-4J
LT-537	S/G 3 Level	102036-4K	108036-4K
LT-547	S/G 4 Level	102036-4L	108036-4L
NE-44A	DTTA Loop 4 Upper (Neutron) Flux	102036-29M	108036-29M
NE-44B	DTTA Loop 4 Lower (Neutron) Flux	102036-29M	108036-29M
PT-405	Wide Range Pressure Loop 3	102034-7B	108034-7B
PT-405A	Wide Range Pressure Loop 4	102034-7D	108034-7D
PT-474	Loop 4 PZR Pressure	102036-7B	108036-7B
PT-516	Loop 1 Steamline Pressure	102036-5E	108036-5E
PT-546	Loop 4 Steamline Pressure	102036-5H	108036-5H
PT-934	Containment Pressure	102034-12E	108034-12E
TE-440A	DTTA Loop 4 Thot-1A	102036-7X	108036-7X
TE-440B	DTTA Loop 4 Tcold-1	102036-7X	108036-7X
TE-440C	DTTA Loop 4 Thot-1B	102036-7X	108036-7X
TE-441A	DTTA Loop 4 Thot-2A	102036-7X	108036-7X
TE-441B	DTTA Loop 4 Tcold-2	102036-7X	108036-7X
TE-441C	DTTA Loop 4 Thot-2B	102036-7X	108036-7X
TE-442A	DTTA Loop 4 Thot-3A	102036-7X	108036-7X
TE-442C	DTTA Loop 4 Thot-3B	102036-7X	108036-7X
TE-454	Pressurizer Vapor Temperature	102035-7B	108035-7B

4 PPS Racks and Channels

4.1 TRICON HARDWARE CONFIGURATION ITEMS

4.1.1. Safety-Related Triconex Configuration Items

1. Main Chassis
2. Deleted
3. RXM Chassis
4. MRXM, Primary Module
5. Main Processor Module
6. Power Supply Module (120 VDC/115 VAC)
7. Communications Module (TCM-FO)
8. Discrete Input Module 115VAC/DC
9. Discrete Input Module 24 VAC/DC
10. Discrete Output Module 115 VAC, Unsupervised
11. Deleted
12. Analog Input Module, Isolated
13. Analog Input Module, Differential
14. Analog Output Module
15. Deleted
16. Supervised Discrete Output Module, 24 VDC (Energize to trip outputs only)
17. External Termination Panels (ETP) and interconnection cables for above I/O Modules
18. AC power line filters

4.1.2. Non-Safety-Related Triconex Configuration Items

1. RXM Chassis
2. MRXM Remote Module
3. Power Supply Module (120VDC/115 VAC)
4. Deleted
5. Discrete Output Module 115 VAC, Unsupervised
6. Deleted
7. Analog Output Module
8. Relay Output Module
9. Discrete Input Module 115VAC/DC
10. Discrete Input Module 24 VAC/DC
11. External Termination Panels (ETP) for above I/O Modules
12. Media converter (TCM output to port aggregator tap)
13. AC power line filters

4.2 ALS CONFIGURATION ITEMS

4.2.1. Safety-Related ALS Configuration Items (Typical for Logic Path A & B)

1. ALS CLB – Core Logic Board
2. ALS IPB – Input Board
3. ALS OPB – Output Board
4. ALS Rack and Cables

4.2.2. Non-Safety-Related ALS Configuration Items

1. ASU Software

4.3 PG&E CONFIGURATION ITEMS

1. Maintenance Video Display Unit and Software (Except ASU software provided by ALS)
2. Net Optics Port Aggregator Network Taps
3. OOS Toggle Switches
4. Manual Trip Toggle Switches
5. Bypass Toggle Switches
6. Media Converters (except Tricon TCM output to port aggregator tap by IOM)
7. Nominal 24 Vdc adjustable power supply for Tricon DI and DO loops
8. Nominal 24 Vdc adjustable power supply for Tricon AO loops
9. Nominal 40 Vdc adjustable power supply for Tricon AI loops
10. Nominal 24 Vdc adjustable 24-45 Vdc I/O power supply for ALS AI loops (except Pressurizer pressure, which is shared with the Tricon and powered by the Tricon loop PS). The ALS loops may use a combination of power supplies such as Items 8 and/or 9 as determined by the detailed design.
11. 48 Vdc ALS logic power supplies

4.4 PROTECTION SET I FUNCTIONS AND INSTRUMENT CLASSES

Table 4-1 Protection Set I Analog Output Functions

PROTECTION SET I ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
LT-459 Input	IB,A,1	Note (1)	PZR Level to LI-459A (VB2), LI-459B (HSP)
PT-514 Input	IB,A,1	Note (1)	LP 1 Steamline Press to PI-514A (VB3), PI-514B (HSP), ERFDS (VB4)
PT-524 Input	IB,A,1	Note (1)	LP 2 Steamline Press to PI-524A (VB3), PI-524B (HSP), ERFDS (VB4)
PT-534 Input	IB,A,1	Note (1)	LP 3 Steamline Press to PI-534A (VB3), PI-534B (HSP), ERFDS (VB4)
PT-544 Input	IB,A,1	Note (1)	LP 4 Steamline Press to PI-544A (VB3), PI-544B (HSP), ERFDS (VB4)
PT-937 Input	IB,A,1	Note (1)	Containment Pressure to PI-937 (VB1)
TE-410A	IA	ALS-A	DTTA Loop 1 Thot-1A (to PS I Tricon)
TE-410B	IA	ALS-A	DTTA Loop 1 Tcold-1 (to PS I Tricon)
TE-411A	IA	ALS-A	DTTA Loop 1 Thot-2A (to PS I Tricon)
TE-412A	IA	ALS-A	DTTA Loop 1 Thot-3A (to PS I Tricon)
TE-413A	IB,A,1	ALS-A	Loop 1 Hot Leg Temp (to PS I Tricon)
TE-413B	IB,A,1	ALS-A	Loop 1 Cold Leg Temp (to PS I Tricon)
FM-414B	II	ALS-A	Reactor Coolant Flow Loop 1 to FI-414 (VB2)
FM-424B	II	ALS-A	Reactor Coolant Flow Loop 2 to FI-424 (VB2)
TE-410C	IA	ALS-B	DTTA Loop 1 Thot-1B (to PS I Tricon)
TE-411B	IA	ALS-B	DTTA Loop 1 Tcold-2 (to PS I Tricon)
TE-411C	IA	ALS-B	DTTA Loop 1 Thot-2B (to PS I Tricon)
TE-412C	IA	ALS-B	DTTA Loop 1 Thot-3B (to PS I Tricon)
TE-423A	IB,A,1	ALS-B	Loop 2 Hot Leg Temp (to PS I Tricon)
TE-423B	IA	ALS-B	Loop 2 Cold Leg Temp (to PS I Tricon)
FM-434B	II	ALS-B	Reactor Coolant Flow Loop 3 to FI-434 (VB2)
FM-444B	II	ALS-B	Reactor Coolant Flow Loop 4 to FI-444 (VB2)
FM-512_1	II	Isolator Out	Loop 1 Steamflow to DFWCS
FM-512_2	IB, D, 2	Isolator Out	Loop 1 Steamflow to FI-512 (VB3) & ERFDS (VB1)
FM-522_1	II	Isolator Out	Loop 2 Steamflow to DFWCS
FM-522_2	IB, D, 2	Isolator Out	Loop 2 Steamflow to FI-522 (VB3) & ERFDS (VB1)
FM-532_1	II	Isolator Out	Loop 3 Steamflow to DFWCS
FM-532_2	IB, D, 2	Isolator Out	Loop 3 Steamflow to FI-532 (VB3) & ERFDS (VB4)
FM-542_1	II	Isolator Out	Loop 4 Steamflow to DFWCS
FM-542_2	IB, D, 2	Isolator Out	Loop 4 Steamflow to FI-542 (VB3) & ERFDS (VB4)
LM-459_1	II	Isolator Out	PZR Level to PZR Level Control (Control Set 1, Control Set 2)
LM-529_1	II	Isolator Out	S/G 2 Level to LI-529 (VB3), DFWCS, AFW
LM-539_1	II	Isolator Out	S/G 3 Level to LI-539 (VB3), DFWCS, AFW
LM-539_2	II	Isolator Out	S/G 3 Level to AMSAC
PM-455_1	II	Isolator Out	PZR Pressure to PZR Pressure Control Set 1, PI-455A (VB2), PI-455B (HSP)
PM-505_1	II	Isolator Out	Turbine Impulse Pressure to AMSAC
PM-514_1	II	Isolator Out	Loop 1 Steamline Pressure to DFWCS

PROTECTION SET I ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
PM-524_1	II	Isolator Out	Loop 2 Steamline Pressure to DFWCS
PM-534_1	II	Isolator Out	Loop 3 Steamline Pressure to DFWCS
PM-544_1	II	Isolator Out	Loop 4 Steamline Pressure to DFWCS
TM-413A	IB,A,1	Tricon	Loop 1 Hot Leg Temp to TR-413 (VB2) & RVLIS (PAM4)
TM-413B	IB,A,1	Tricon	Loop 1 Cold Leg Temp to TR-413 (VB2)
TM-423A	IB,A,1	Tricon	Loop 2 Hot Leg Temp to TR-423 (VB2) & RVLIS (PAM4)
TM-423B	IB,A,1	Tricon	Loop 2 Cold Leg Temp to TR-423 (VB2)
FM-512D	IA	Tricon	Loop 1 Steamflow to FM-512_2 (Isolator)
FM-522D	IA	Tricon	Loop 2 Steamflow to FM-522_2 (Isolator)
FM-532D	IA	Tricon	Loop 3 Steamflow to FM-532_2 (Isolator)
FM-542D	IA	Tricon	Loop 4 Steamflow to FM-542_2 (Isolator)
PM-505A	II	Tricon	Turbine Impulse Pressure to PI-505 (VB3)
TM-411E	II	Tricon	Delta-T to TI-411A (VB2) & TM-411Q1/R (R31)
TM-411F	II	Tricon	Overpower Setpoint to T/411A (CC1) & TI-411B (VB2)
TM-411G	II	Tricon	Overtemperature Setpoint to T/411A (CC1) & TI-411C (VB2)
TM-412F	II	Tricon	Tavg to TI-412 (VB2) & TM-412G/R, TC-412A-H/R (R31)
Deleted			
Deleted			
Deleted			
Deleted			

Note:
(1) From analog sensor input loop, isolation not required [Section 2.3.3]

Table 4-2 Protection Set I Discrete Output Functions

PROTECTION SET I DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
FC-414_A	IA	ALS-A	Loop 1 Low Flow Rx Trip (SSPS)
FC-424_A	IA	ALS-A	Loop 2 Low Flow Rx Trip (SSPS)
FC-434_A	IA	ALS-A	Loop 3 Low Flow Rx Trip (SSPS)
FC-444_A	IA	ALS-A	Loop 4 Low Flow Rx Trip (SSPS)
PC-455A_A	IA	ALS-A	PZR Pressure High Rx Trip (SSPS)
PC-455B_A	IA	ALS-A	Unblock SI, P11 (SSPS)
PC-455C_A	IA	ALS-A	PZR Pressure Low Rx Trip (SSPS)
PC-455D_A	IA	ALS-A	PZR Pressure Low-Low SI (SSPS)
PC-455E_A	IA	ALS-A	PZR Pressure High - PORV (RNASA)
PC-937B_A	IA	ALS-A	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS1A_DIV-A	II	ALS-A	PS I Trouble Alarm (MAS)
UY-PS1B_DIV-A	II	ALS-A	PS I Channel in Bypass Alarm (MAS)
UY-PS1C_DIV-A	II	ALS-A	PS I Failure Alarm (MAS)

PROTECTION SET I DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
YC-937_A	II	ALS-A	Containment Press High-High Channel in Test Alarm (MAS)
FC-414_B	IA	ALS-B	Loop 1 Low Flow Rx Trip (SSPS)
FC-424_B	IA	ALS-B	Loop 2 Low Flow Rx Trip (SSPS)
FC-434_B	IA	ALS-B	Loop 3 Low Flow Rx Trip (SSPS)
FC-444_B	IA	ALS-B	Loop 4 Low Flow Rx Trip (SSPS)
PC-455A_B	IA	ALS-B	PZR Pressure High Rx Trip (SSPS)
PC-455B_B	IA	ALS-B	Unblock SI, P11 (SSPS)
PC-455C_B	IA	ALS-B	PZR Pressure Low Rx Trip (SSPS)
PC-455D_B	IA	ALS-B	PZR Pressure Low-Low SI (SSPS)
PC-455E_B	IA	ALS-B	PZR Pressure High - PORV (RNASA)
PC-937B_B	IA	ALS-B	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS1A_DIV-B	II	ALS-B	PS I Trouble Alarm (MAS)
UY-PS1B_DIV-B	II	ALS-B	PS I Channel in Bypass Alarm (MAS)
UY-PS1C_DIV-B	II	ALS-B	PS I Failure Alarm (MAS)
YC-937_B	II	ALS-B	Containment Press High-High Channel in Test Alarm (MAS)
LC-459A	IA	Tricon	PZR Level High Rx Trip (SSPS)
LC-529A	IA	Tricon	S/G 2 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-529B	IA	Tricon	S/G 2 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-539A	IA	Tricon	S/G 3 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-539B	IA	Tricon	S/G 3 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
PC-505A	IA	Tricon	Turbine Impulse Pressure High to P13 (SSPS)
PC-514A	IA	Tricon	Loop 1 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-514C	IA	Tricon	Loop 1 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-524A	IA	Tricon	Loop 2 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-524C	IA	Tricon	Loop 2 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-534A	IA	Tricon	Loop 3 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-534C	IA	Tricon	Loop 3 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-544A	IA	Tricon	Loop 4 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-544C	IA	Tricon	Loop 4 Steamline Press High Negative Rate Steamline Isolation (SSPS)
TC-411C	IA	Tricon	OTDT Rx Trip (SSPS)
TC-411G	IA	Tricon	OPDT Rx Trip (SSPS)
TC-412D	IA	Tricon	Tavg Low-Low P12 (SSPS)
TC-412G	IA	Tricon	Tavg Low Feedwater Isolation (SSPS)
TC-423A	IA	Tricon	Loop 2 Cold Leg Temp. Low - LTOPS (RNASA)
Deleted			
Deleted			
Deleted			
Deleted			
LY-529H	II	Tricon	PS I S/G Low-Low Level TTD Timer Actuated Alarm (MAS)
Deleted			
PC-505C	II	Tricon	Turbine Low Power Interlock C5 (RNARA)

PROTECTION SET I DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
TC-411D	II	Tricon	OTDT Interlock C3 (RNARA)
TC-411H	II	Tricon	OPDT Interlock C4 (RNARA)
TY-411_TRICON	II	Tricon	PS I DTTA RTD Failure Alarm (MAS)
UY-PS1A_TRICON	II	Tricon	PS I Trouble Alarm (MAS)
UY-PS1B_TRICON	II	Tricon	PS I Channel in Bypass Alarm (MAS)
UY-PS1C_TRICON	II	Tricon	PS I Failure Alarm (MAS)

4.5 PROTECTION SET II FUNCTIONS AND INSTRUMENT CLASSES

Table 4-3 Protection Set II Analog Output Functions

PROTECTION SET II ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
LT-460 Input	IB,A,1	Note (1)	PZR Level to LI-460A (VB2), LI-460B (HSP)
PT-515 Input	IB,A,1	Note (1)	Loop 1 Steamline Pressure to PI-515 (VB3), ERFDS (VB4)
PT-525 Input	IB,A,1	Note (1)	Loop 2 Steamline Pressure to PI-525 (VB3), ERFDS (VB1)
PT-535 Input	IB,A,1	Note (1)	Loop 3 Steamline Pressure to PI-535 (VB3), ERFDS (VB1)
PT-545 Input	IB,A,1	Note (1)	Loop 4 Steamline Pressure to PI-545 (VB3), ERFDS (VB1)
PT-936 Input	IB,A,1	Note (1)	Containment Pressure to PI-936 (VB1), ERFDS (VB1)
TE-420A	IA	ALS-A	DTTA Loop 2 Thot-1A (to PS II Tricon)
TE-420B	IA	ALS-A	DTTA Loop 2 Tcold-1 (to PS II Tricon)
TE-421A	IA	ALS-A	DTTA Loop 2 Thot-2A (to PS II Tricon)
TE-422A	IA	ALS-A	DTTA Loop 2 Thot-3A (to PS II Tricon)
TE-433A	IB,A,1	ALS-A	Loop 3 Hot Leg Temp (to PS II Tricon)
TE-433B	IA	ALS-A	Loop 3 Cold Leg Temp (to PS II Tricon)
FM-415B	II	ALS-A	Reactor Coolant Flow Loop 1 to FI-415 (VB2)
FM-425B	II	ALS-A	Reactor Coolant Flow Loop 2 to FI-425 (VB2)
TE-420C	IA	ALS-B	DTTA Loop 2 Thot-1B (to PS II Tricon)
TE-421B	IA	ALS-B	DTTA Loop 2 Tcold-2 (to PS II Tricon)
TE-421C	IA	ALS-B	DTTA Loop 2 Thot-2B (to PS II Tricon)
TE-422C	IA	ALS-B	DTTA Loop 2 Thot-3B (to PS II Tricon)
TE-443A	IB,A,1	ALS-B	Loop 4 Hot Leg Temp (to PS II Tricon)
TE-443B	IB,A,1	ALS-B	Loop 4 Cold Leg Temp (to PS II Tricon)
FM-435B	II	ALS-B	Reactor Coolant Flow Loop 3 to FI-435 (VB2)
FM-445B	II	ALS-B	Reactor Coolant Flow Loop 4 to FI-445 (VB2)
FM-513_1	II	Isolator Out	Loop 1 Steamflow to DFWCS
FM-513_2	IB, D, 2	Isolator Out	Loop 1 Steamflow to FI-513 (VB3) & ERFDS (VB1)
FM-523_1	II	Isolator Out	Loop 2 Steamflow to DFWCS
FM-523_2	IB, D, 2	Isolator Out	Loop 2 Steamflow to FI-523 (VB3) & ERFDS (VB1)
FM-533_1	II	Isolator Out	Loop 3 Steamflow to DFWCS
FM-533_2	IB, D, 2	Isolator Out	Loop 3 Steamflow to FI-533 (VB3) & ERFDS (VB4)

PROTECTION SET II ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
FM-543_1	II	Isolator Out	Loop 4 Steamflow to DFWCS
FM-543_2	IB, D, 2	Isolator Out	Loop 4 Steamflow to FI-543 (VB3) & ERFDS (VB4)
LM-460_1	II	Isolator Out	PZR Level to PZR Level Control (Control Set 1, Control Set 2)
LM-519_1	II	Isolator Out	S/G 1 Level to LI-519 (VB3), DFWCS, AFW
LM-549_1	II	Isolator Out	S/G 4 Level to LI-549 (VB3), DFWCS, AFW
LM-549_2	II	Isolator Out	S/G 4 Level to AMSAC
PM-456_1	II	Isolator Out	PZR Pressure to PI-456 (VB2), PZR Pressure Control (Control Set 1)
PM-506_1	II	Isolator Out	Turbine Impulse Pressure to AMSAC
PM-515_1	II	Isolator Out	Loop 1 Steamline Pressure to DFWCS
PM-525_1	II	Isolator Out	Loop 2 Steamline Pressure to DFWCS
PM-535_1	II	Isolator Out	Loop 3 Steamline Pressure to DFWCS
PM-545_1	II	Isolator Out	Loop 4 Steamline Pressure to DFWCS
TM-433A	IB,A,1	Tricon	Loop 3 Hot Leg Temp to TR-433 (VB2) & RVLIS (PAM3)
TM-433B	IB,A,1	Tricon	Loop 3 Cold Leg Temp to TR-433 (VB2)
TM-443A	IB,A,1	Tricon	Loop 4 Hot Leg Temp to TR-443 (VB2) & RVLIS (PAM3)
TM-443B	IB,A,1	Tricon	Loop 4 Cold Leg Temp to TR-443 (VB2)
FM-513D	IA	Tricon	Loop 1 Steamflow to FI-513_2 (Isolator)
FM-523D	IA	Tricon	Loop 2 Steamflow to FI-523_2 (Isolator)
FM-533D	IA	Tricon	Loop 3 Steamflow to FI-533_2 (Isolator)
FM-543D	IA	Tricon	Loop 4 Steamflow to FI-543_2 (Isolator)
PM-506A	II	Tricon	Turbine Impulse Pressure to PI-506 (VB3)
TM-421E	II	Tricon	Delta-T to TI-421A (VB2) & TM-411Q2/R (R31)
TM-421F	II	Tricon	Overpower Setpoint to T/411A (CC1) & TI-421B (VB2)
TM-421G	II	Tricon	Overtemperature Setpoint to T/411A (CC1) & TI-421C (VB2)
TM-422F	II	Tricon	Tavg to TI-422 (VB2) & TM-422G/R, TC-422A-H/R (R31)
Deleted			
Deleted			
Deleted			
Deleted			

Note:
(1) From analog sensor input loop, isolation not required [Section 2.3.3]

Table 4-4 Protection Set II Discrete Output Functions

PROTECTION SET II DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
FC-415_A	IA	ALS-A	Loop 1 Low Flow Rx Trip (SSPS)
FC-425_A	IA	ALS-A	Loop 2 Low Flow Rx Trip (SSPS)
FC-435_A	IA	ALS-A	Loop 3 Low Flow Rx Trip (SSPS)
FC-445_A	IA	ALS-A	Loop 4 Low Flow Rx Trip (SSPS)
PC-456A_A	IA	ALS-A	PZR Pressure High Rx Trip (SSPS)

PROTECTION SET II DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
PC-456B_A	IA	ALS-A	Unblock SI, P11 (SSPS)
PC-456C_A	IA	ALS-A	PZR Pressure Low Rx Trip (SSPS)
PC-456D_A	IA	ALS-A	PZR Pressure Low-Low SI (SSPS)
PC-456E_A	IA	ALS-A	PZR Pressure High - PORV (RNASA)
PC-936A_A	IA	ALS-A	Containment Press High SI, Ph A Isolation (SSPS)
PC-936B_A	IA	ALS-A	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS2A_DIV-A	II	ALS-A	PS II Trouble Alarm (MAS)
UY-PS2B_DIV-A	II	ALS-A	PS II Channel in Bypass Alarm (MAS)
UY-PS2C_DIV-A	II	ALS-A	PS II Failure Alarm (MAS)
YC-936_A	II	ALS-A	Containment Press High-High Channel in Test Alarm (MAS)
FC-415_B	IA	ALS-B	Loop 1 Low Flow Rx Trip (SSPS)
FC-425_B	IA	ALS-B	Loop 2 Low Flow Rx Trip (SSPS)
FC-435_B	IA	ALS-B	Loop 3 Low Flow Rx Trip (SSPS)
FC-445_B	IA	ALS-B	Loop 4 Low Flow Rx Trip (SSPS)
PC-456A_B	IA	ALS-B	PZR Pressure High Rx Trip (SSPS)
PC-456B_B	IA	ALS-B	Unblock SI, P11 (SSPS)
PC-456C_B	IA	ALS-B	PZR Pressure Low Rx Trip (SSPS)
PC-456D_B	IA	ALS-B	PZR Pressure Low-Low SI (SSPS)
PC-456E_B	IA	ALS-B	PZR Pressure High - PORV (RNASA)
PC-936A_B	IA	ALS-B	Containment Press High SI, Ph A Isolation (SSPS)
PC-936B_B	IA	ALS-B	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS2A_DIV-B	II	ALS-B	PS II Trouble Alarm (MAS)
UY-PS2B_DIV-B	II	ALS-B	PS II Channel in Bypass Alarm (MAS)
UY-PS2C_DIV-B	II	ALS-B	PS II Failure Alarm (MAS)
YC-936_B	II	ALS-B	Containment Press High-High Channel in Test Alarm (MAS)
LC-460A	IA	Tricon	PZR Level High Rx Trip (SSPS)
LC-519A	IA	Tricon	S/G 1 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-519B	IA	Tricon	S/G 1 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-549A	IA	Tricon	S/G 4 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-549B	IA	Tricon	S/G 4 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
PC-506A	IA	Tricon	Turbine Impulse Pressure High to P13 (SSPS)
PC-515A	IA	Tricon	Loop 1 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-515C	IA	Tricon	Loop 1 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-525A	IA	Tricon	Loop 2 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-525C	IA	Tricon	Loop 2 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-535A	IA	Tricon	Loop 3 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-535C	IA	Tricon	Loop 3 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-545A	IA	Tricon	Loop 4 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-545C	IA	Tricon	Loop 4 Steamline Press High Negative Rate Steamline Isolation (SSPS)
TC-421C	IA	Tricon	OTDT Rx Trip (SSPS)

PROTECTION SET II DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
TC-421G	IA	Tricon	OPDT Rx Trip (SSPS)
TC-422D	IA	Tricon	Tavg Low-Low P12 (SSPS)
TC-422G	IA	Tricon	Tavg Low Feedwater Isolation (SSPS)
TC-433A	IA	Tricon	Loop 3 Cold Leg Temp. Low - LTOPS (RNASA)
Deleted			
Deleted			
Deleted			
Deleted			
LY-519H	II	Tricon	PS II S/G Low-Low Level TTD Timer Actuated Alarm (MAS)
Deleted			
TC-421D	II	Tricon	OTDT Interlock C3 (RNARA)
TC-421H	II	Tricon	OPDT Interlock C4 (RNARA)
TY-421_TRICON	II	Tricon	PS2 DTTA RTD Failure Alarm (MAS)
UY-PS2A_TRICON	II	Tricon	PS2 Trouble Alarm (MAS)
UY-PS2B_TRICON	II	Tricon	PS2 Channel in Bypass Alarm (MAS)
UY-PS2C_TRICON	II	Tricon	PS2 Failure Alarm (MAS)

4.6 PROTECTION SET III FUNCTIONS AND INSTRUMENT CLASSES

Table 4-5 Protection Set III Analog Output Functions

PROTECTION SET III ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
LT-461 Input	IB,A,1	Note (1)	PZR Level to LI-461 (VB2)
LT-518 Input	IB,A,1	Note (1)	S/G 1 Level to LI-518 (VB3) & ERFDS (VB1)
LT-528 Input	IB,A,1	Note (1)	S/G 2 Level to LI-528 (VB3) & ERFDS (VB1)
LT-538 Input	IB,A,1	Note (1)	S/G 3 Level to LI-538 (VB3) & ERFDS (VB1)
LT-548 Input	IB,A,1	Note (1)	S/G 4 Level to LI-548 (VB3) & ERFDS (VB1)
PT-403 Input	IB,A,1	Note (1)	Loop 4 WR Press to PR-403 (VB2), RVLIS (PAM 4)
PT-526 Input	IB,A,1	Note (1)	Loop 2 Steamline Pressure to PI-526 (VB3)
PT-536 Input	IB,A,1	Note (1)	Loop 3 Steamline Pressure to PI-536 (VB3)
PT-935 Input	IB,A,1	Note (1)	Containment Pressure to PI-935 (VB1) & ERFDS (VB1)
TE-430A	IA	ALS-A	DTTA Loop 3 Thot-1A (to PS III Tricon)
TE-430B	IA	ALS-A	DTTA Loop 3 Tcold-1 (to PS III Tricon)
TE-431A	IA	ALS-A	DTTA Loop 3 Thot-2A (to PS III Tricon)
TE-432A	IA	ALS-A	DTTA Loop 3 Thot-3A (to PS III Tricon)
FM-416B	II	ALS-A	Reactor Coolant Flow Loop 1 to FI-416 (VB2)
FM-426B	II	ALS-A	Reactor Coolant Flow Loop 2 to FI-426 (VB2)
TE-430C	IA	ALS-B	DTTA Loop 3 Thot-1B (to PS III Tricon)
TE-431B	IA	ALS-B	DTTA Loop 3 Tcold-2 (to PS III Tricon)
TE-431C	IA	ALS-B	DTTA Loop 3 Thot-2B (to PS III Tricon)

PROTECTION SET III ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
TE-432C	IA	ALS-B	DTTA Loop 3 Thot-3B (to PS III Tricon)
FM-436B	II	ALS-B	Reactor Coolant Flow Loop 3 to FI-436 (VB2)
FM-446B	II	ALS-B	Reactor Coolant Flow Loop 4 to FI-446 (VB2)
LM-461_1	II	Isolator Out	PZR Level to PZR Level Control (Control Set 1, Control Set 2)
LM-518_1	II	Isolator Out	S/G 1 Level to DFWCS, AFW
LM-528_1	II	Isolator Out	S/G 2 Level to DFWCS, AFW
LM-528_2	II	Isolator Out	S/G 2 Level to AMSAC
LM-538_1	II	Isolator Out	S/G 3 Level to DFWCS, AFW
LM-548_1	II	Isolator Out	S/G 4 Level to DFWCS, AFW
PM-403A_1	II	Isolator Out	Loop 4 WR Press to PI-403A (VB2), ERFDS (VB4)
PM-457_1	II	Isolator Out	PZR Pressure to PZR Pressure Control (Control Set 1), PI-457 (VB2)
PM-526_1	II	Isolator Out	Loop 2 Steamline Pressure to DFWCS
PM-536_1	II	Isolator Out	Loop 3 Steamline Pressure to DFWCS
TM-431E	II	Tricon	Delta-T to TI-431A (VB2) & TM-411Q3/R (R31)
TM-431F	II	Tricon	Overpower Setpoint to T/411A (CC1) & TI-431B (VB2)
TM-431G	II	Tricon	Overtemperature Setpoint to T/411A (CC1) & TI-431C (VB2)
TM-432F	II	Tricon	Tavg to TI-432 (VB2) & TM-432G/R, TC-432A-H/R (R31)

Note:
1) From analog sensor input loop, isolation not required [Section 2.3.3

Table 4-6 Protection Set III Discrete Output Functions

PROTECTION SET III DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
FC-416_A	IA	ALS-A	Loop 1 Low Flow Rx Trip (SSPS)
FC-426_A	IA	ALS-A	Loop 2 Low Flow Rx Trip (SSPS)
FC-436_A	IA	ALS-A	Loop 3 Low Flow Rx Trip (SSPS)
FC-446_A	IA	ALS-A	Loop 4 Low Flow Rx Trip (SSPS)
PC-457A_A	IA	ALS-A	PZR Pressure High Rx Trip (SSPS)
PC-457B_A	IA	ALS-A	Unblock SI, P11 (SSPS)
PC-457C_A	IA	ALS-A	PZR Pressure Low Rx Trip (SSPS)
PC-457D_A	IA	ALS-A	PZR Pressure Low-Low SI (SSPS)
PC-457E_A	IA	ALS-A	PZR Pressure High - PORV (RNASA)
PC-935A_A	IA	ALS-A	Containment Press High SI, Ph A Isolation (SSPS)
PC-935B_A	IA	ALS-A	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS3A_DIV-A	II	ALS-A	PS III Trouble Alarm (MAS)
UY-PS3B_DIV-A	II	ALS-A	PS III Channel in Bypass Alarm (MAS)
UY-PS3C_DIV-A	II	ALS-A	PS III Failure Alarm (MAS)
YC-935_A	II	ALS-A	Containment Press High-High Channel in Test Alarm (MAS)
FC-416_B	IA	ALS-B	Loop 1 Low Flow Rx Trip (SSPS)

PROTECTION SET III DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
FC-426_B	IA	ALS-B	Loop 2 Low Flow Rx Trip (SSPS)
FC-436_B	IA	ALS-B	Loop 3 Low Flow Rx Trip (SSPS)
FC-446_B	IA	ALS-B	Loop 4 Low Flow Rx Trip (SSPS)
PC-457A_B	IA	ALS-B	PZR Pressure High Rx Trip (SSPS)
PC-457B_B	IA	ALS-B	Unblock SI, P11 (SSPS)
PC-457C_B	IA	ALS-B	PZR Pressure Low Rx Trip (SSPS)
PC-457D_B	IA	ALS-B	PZR Pressure Low-Low SI (SSPS)
PC-457E_B	IA	ALS-B	PZR Pressure High - PORV (RNASA)
PC-935A_B	IA	ALS-B	Containment Press High SI, Ph A Isolation (SSPS)
PC-935B_B	IA	ALS-B	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS3A_DIV-B	II	ALS-B	PS III Trouble Alarm (MAS)
UY-PS3B_DIV-B	II	ALS-B	PS III Channel in Bypass Alarm (MAS)
UY-PS3C_DIV-B	II	ALS-B	PS III Failure Alarm (MAS)
YC-935_B	II	ALS-B	Containment Press High-High Channel in Test Alarm (MAS)
LC-461A	IA	Tricon	PZR Level High Rx Trip (SSPS)
LC-518A	IA	Tricon	S/G 1 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-518B	IA	Tricon	S/G 1 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-528A	IA	Tricon	S/G 2 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-528B	IA	Tricon	S/G 2 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-538A	IA	Tricon	S/G 3 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-538B	IA	Tricon	S/G 3 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-548A	IA	Tricon	S/G 4 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-548B	IA	Tricon	S/G 4 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
PC-403A	IA	Tricon	Loop 4 WR Pressure Low to RHR V-8702 Open Ckt (RNSIA)
PC-403B	IA	Tricon	Loop 4 WR Pressure High to RHR Not Isolated Alarm Ckt (RNSIA)
PC-403D	IA	Tricon	Loop 4 WR Pressure High to LTOPS (RNASA)
PC-526A	IA	Tricon	Loop 2 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-526C	IA	Tricon	Loop 2 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-536A	IA	Tricon	Loop 3 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-536C	IA	Tricon	Loop 3 Steamline Press High Negative Rate Steamline Isolation (SSPS)
TC-431C	IA	Tricon	OTDT Rx Trip (SSPS)
TC-431G	IA	Tricon	OPDT Rx Trip (SSPS)
TC-432D	IA	Tricon	Tavg Low-Low P12 (SSPS)
TC-432G	IA	Tricon	Tavg Low Feedwater Isolation (SSPS)
LY-518H	II	Tricon	PS III S/G Low-Low Level TTD Timer Actuated Alarm (MAS)
Deleted			
Deleted			
Deleted			
PC-526B	II	Tricon	Loop 2 Steamline Pressure Low Alarm (MAS)
PC-536B	II	Tricon	Loop 3 Steamline Pressure Low Alarm (MAS)
TC-431D	II	Tricon	OTDT Interlock C3 (RNARA)

PROTECTION SET III DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
TC-431H	II	Tricon	OPDT Interlock C4 (RNARA)
TY-431_TRICON	II	Tricon	PS III DTTA RTD Failure Alarm (MAS)
UY-PS3A_TRICON	II	Tricon	PS III Trouble Alarm (MAS)
UY-PS3B_TRICON	II	Tricon	PS III Channel in Bypass Alarm (MAS)
UY-PS3C_TRICON	II	Tricon	PS III Failure Alarm (MAS)

4.7 PROTECTION SET IV FUNCTIONS AND INSTRUMENT CLASSES

Table 4-7 Protection Set IV Analog Output Functions

PROTECTION SET IV ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
LT-517 Input	IB,A,1	Note (1)	S/G 1 Level to LI-517 (VB3), ERFDS (VB4)
LT-527 Input	IB,A,1	Note (1)	S/G 2 Level to LI-527 (VB3), ERFDS (VB4)
LT-537 Input	IB,A,1	Note (1)	S/G 3 Level to LI-537 (VB3), ERFDS (VB4)
LT-547 Input	IB,A,1	Note (1)	S/G 4 Level to LI-547 (VB3), ERFDS (VB4)
PT-405 Input	IB,A,1	Note (1)	Loop 3 WR Press to PI-405 (VB2), ERFDS (VB4), RVLIS (PAM 3)
PT-516 Input	IB,A,1	Note (1)	Loop 1 Steamline Pressure to PI-516 (VB3)
PT-546 Input	IB,A,1	Note (1)	Loop 4 Steamline Pressure to PI-546 (VB3)
PT-934 Input	IB,A,1	Note (1)	Containment Pressure to PI-934 (VB1)
TE-440A	IA	ALS-A	DTTA Loop 4 Thot-1A (PS IV Tricon)
TE-440B	IA	ALS-A	DTTA Loop 4 Tcold-1 (PS IV Tricon)
TE-441A	IA	ALS-A	DTTA Loop 4 Thot-2A (PS IV Tricon)
TE-442A	IA	ALS-A	DTTA Loop 4 Thot-3A (PS IV Tricon)
TE-454	IA	ALS-A	PZR Vapor Temperature (PS IV Tricon)
TE-440C	IA	ALS-B	DTTA Loop 4 Thot-1B (PS IV Tricon)
TE-441B	IA	ALS-B	DTTA Loop 4 Tcold-2 (PS IV Tricon)
TE-441C	IA	ALS-B	DTTA Loop 4 Thot-2B (PS IV Tricon)
TE-442C	IA	ALS-B	DTTA Loop 4 Thot-3B (PS IV Tricon)
LM-517_1	II	Isolator Out	S/G 1 Level to DFWCS, AFW
LM-517_2	II	Isolator Out	S/G 1 Level to AMSAC
LM-527_1	II	Isolator Out	S/G 2 Level to DFWCS, AFW
LM-537_1	II	Isolator Out	S/G 3 Level to DFWCS, AFW
LM-547_1	II	Isolator Out	S/G 4 Level to DFWCS, AFW
PM-405A_1	II	Isolator Out	Loop 4 WR Press to PI-405A (VB2), ERFDS (VB4)
PM-474_1	II	Isolator Out	PZR Pressure to PI-474 (VB2), PZR Pressure Control (Control Set 1)
PM-516_1	II	Isolator Out	Loop 1 Steamline Pressure to DFWCS
PM-546_1	II	Isolator Out	Loop 4 Steamline Pressure to DFWCS
TM-441E	II	Tricon	Delta-T to TI-441A (VB2) & TM-411Q4/R (R31)
TM-441F	II	Tricon	Overpower Setpoint to T/411A (CC1) & TI-441B (VB2)
TM-441G	II	Tricon	Overtemperature Setpoint to T/411A (CC1) & TI-441C (VB2)
TM-442F	II	Tricon	Tavg to TI-442 (VB2) & TM-442G/R, TC-442A-H/R (R31)

PROTECTION SET IV ANALOG OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
TM-454A	II,D,3	Tricon	PZR Vapor Temp to TI-454 (VB2) & TC-454/R (Control Set 2)

Note:
(1) From analog sensor input loop, isolation not required [Section 2.3.3]

Table 4-8 Protection Set IV Discrete Output Functions

PROTECTION SET IV DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
PC-474A_A	IA	ALS-A	PZR Pressure Low Rx Trip (SSPS)
PC-474B_A	IA	ALS-A	PZR Pressure High - PORV (RNASA)
PC-474C_A	IA	ALS-A	PZR Pressure High Rx Trip (SSPS)
PC-474D_A	IA	ALS-A	PZR Pressure Low-Low SI (SSPS)
PC-934A_A	IA	ALS-A	Containment Press High SI, Ph A Isolation (SSPS)
PC-934B_A	IA	ALS-A	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS4A_DIV-A	II	ALS-A	PS IV Trouble Alarm (MAS)
UY-PS4B_DIV-A	II	ALS-A	PS IV Channel in Bypass Alarm (MAS)
UY-PS4C_DIV-A	II	ALS-A	PS IV Failure Alarm (MAS)
YC-934_A	II	ALS-A	Containment Press High-High Channel in Test Alarm (MAS)
PC-474A_B	IA	ALS-B	PZR Pressure Low Rx Trip (SSPS)
PC-474B_B	IA	ALS-B	PZR Pressure High - PORV (RNASA)
PC-474C_B	IA	ALS-B	PZR Pressure High Rx Trip (SSPS)
PC-474D_B	IA	ALS-B	PZR Pressure Low-Low SI (SSPS)
PC-934A_B	IA	ALS-B	Containment Press High SI, Ph A Isolation (SSPS)
PC-934B_B	IA	ALS-B	Containment Press High-High Containment Spray, Ph B Isolation (SSPS)
Deleted			
UY-PS4A_DIV-B	II	ALS-B	PS IV Trouble Alarm (MAS)
UY-PS4B_DIV-B	II	ALS-B	PS IV Channel in Bypass Alarm (MAS)
UY-PS4C_DIV-B	II	ALS-B	PS IV Failure Alarm (MAS)
YC-934_B	II	ALS-B	Containment Press High-High Channel in Test Alarm (MAS)
LC-517A	IA	Tricon	S/G 1 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-517B	IA	Tricon	S/G 1 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-527A	IA	Tricon	S/G 2 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-527B	IA	Tricon	S/G 2 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-537A	IA	Tricon	S/G 3 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-537B	IA	Tricon	S/G 3 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
LC-547A	IA	Tricon	S/G 4 High-High Level Turbine Trip, FW Isolation P14 (SSPS)
LC-547B	IA	Tricon	S/G 4 Low-Low Level Rx Trip & AFW Pump Start (SSPS)
PC-405A	IA	Tricon	Loop 4 WR Pressure Low to RHR V-8701 Open Ckt (SSPS)
PC-405B	IA	Tricon	Loop 4 WR Pressure High to RHR Not Isolated Alarm Ckt (RNSIB)
PC-405D	IA	Tricon	Loop 4 WR Pressure High to LTOPS (RNASA)
PC-516A	IA	Tricon	Loop 1 Low Steamline Press SI & Steamline Isolation (SSPS)

PROTECTION SET IV DISCRETE OUTPUT FUNCTIONS			
INST. NO.	INST. CLASS	PROCESSOR	DESCRIPTION
PC-516C	IA	Tricon	Loop 1 Steamline Press High Negative Rate Steamline Isolation (SSPS)
PC-546A	IA	Tricon	Loop 4 Low Steamline Press SI & Steamline Isolation (SSPS)
PC-546C	IA	Tricon	Loop 4 Steamline Press High Negative Rate Steamline Isolation (SSPS)
TC-441C	IA	Tricon	OTDT Rx Trip (SSPS)
TC-441G	IA	Tricon	OPDT Rx Trip (SSPS)
TC-442D	IA	Tricon	Tavg Low-Low P12 (SSPS)
TC-442G	IA	Tricon	Tavg Low Feedwater Isolation (SSPS)
Deleted			
LY-517H	II	Tricon	PS4 S/G Low-Low Level TTD Timer Actuated Alarm (MAS)
Deleted			
Deleted			
Deleted			
PC-516B	II	Tricon	Loop 1 Steamline Pressure Low Alarm (MAS)
PC-546B	II	Tricon	Loop 4 Steamline Pressure Low Alarm (MAS)
TC-441D	II	Tricon	OTDT Interlock C3 (RNARA)
TC-441H	II	Tricon	OPDT Interlock C4 (RNARA)
TY-441_TRICON	II	Tricon	PS4 DTTA RTD Failure Alarm (MAS)
UY-PS4A_TRICON	II	Tricon	PS IV Trouble Alarm (MAS)
UY-PS4B_TRICON	II	Tricon	PS IV Channel in Bypass Alarm (MAS)
UY-PS4C_TRICON	II	Tricon	PS IV Failure Alarm (MAS)

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