

Attachments 9-11 to the Enclosure contain Proprietary Information - Withhold Under 10 CFR 2.390

Enclosure
Attachment 3
PG&E Letter DCL-12-069

**PG&E Document "Diablo Canyon Power Plant Units 1 & 2 Process Protection
System Replacement Interface Requirements Specification (IRS), Revision 6"**

Attachments 9-11 to the Enclosure contain Proprietary Information
When separated from Attachments 9-11 to the Enclosure, this cover sheet is decontrolled.


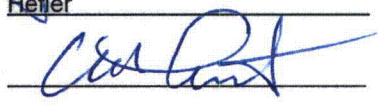
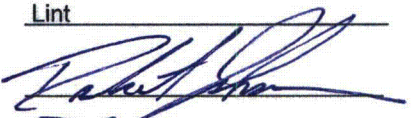
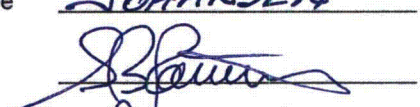


**Pacific Gas and Electric
Company
Diablo Canyon Power Plant
Units 1 & 2**

**Process Protection System (PPS) Replacement
Interface Requirements Specification**

Nuclear Safety-Related

Rev 6

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REVISION HISTORY

Revision Number	Affected Pages	Reason for Revision
1	All	Initial Issue
2	1.4.4.8	Added STP I-33
	1.4.5.4	ALS Topical Report is Rev 1
	1.5.2	Revised Tricon PLC description
	1.5.3.1	Deleted STB and COM boards – not used
	1.5.3.2	Clarified ASU capability
	1.5.3.3	Added section and new Figure 1-1 to clarify ALS A and ALS B connections to SSPS
	1.5.5	Revised section to clarify signal characteristics and open RTD detection
	1.5.5.6	Revised TCM communications description
	1.5.7	Added PPS Gateway Computer Scope and CC4 system health HMI unit
	1.5.8	Added Response Time Allocation
	Figure 1 2 through Figure 1 21	Clarified PRXM and RRXM chasses notation Reassigned safety-related OOS switches to safety-related PRXM Chassis Replaced Class 2 PS Failure contact inputs to Class 2 RRXM with safety-related + 24 Vdc PS output to safety-related PRXM chassis Removed FW flows from Class 2 RRXM
	Appendix 3.1 (I/O List)	General revision
	2.1.1	Clarified ALS input loop power supply. Clarified PTC Thermistor terminology.
	2.1.2	Deleted reference to Fig 2-2 through Fig 2-4
	2.3.3	Added new section - one-way communications link from ALS to Maintenance Workstation. Renumbered remaining sections.
	2.3.6.3	Protocol is Ethernet based
	Appendix 3.1 (All sheets)	General revision Clarified "Safety-Related" and "Non-Safety-Related" items
	Entire Document	Changed MVDU to Maintenance Workstation
3	1.3.1	Added Electrical Class 1E definition, clarified instrument class definitions.
	1.4.4.9, 1.4.5.5, 1.4.5.6, 1.4.5.7	Added references
	1.5.7	Clarified port aggregator tap description and scope
	1.5.8	ALS response time is 150 ms for temperature channels per ALS comment.
	Figure 1 1 through Figure 1 21	Added loopback from trip switch load side; port aggregator tap is PG&E scope; Figure 1-14, Figure 1-19 corrected typos in descriptions
	Figure 1 22	Updated figure per ALS topical report
	2.1	Clarified I/O power supply requirements and scope
	Figure 2 2	Clarified TE-413A and TE-423 for illustration only.
	2.3 2.7.1	Updated communications
	Figure 2 1 Figure 2 3	Added new figures per ALS coordination meeting 05/17-18/2011

REVISION HISTORY, continued

Revision Number	Affected Pages	Reason for Revision
4	1.5.3.3 Figure 1 1	Updated per ALS design documentation
	1.5.7	Updated isolation per ALS design documentation
	1.5.8	Updated response time per ALS documentation
	Figure 1 2 Figure 1 3 Figure 1 7 Figure 1 8 Figure 1 12 Figure 1 13 Figure 1 17 Figure 1 18	Updated figures to illustrate ALS Line Sense Modules and external Trip Switches
	Figure 1 6 Figure 1 11 Figure 1 16 Figure 1 21	Updated figures to include Class II power supply failure discrete inputs
	Figure 1 22	Corrected class break
	2.1.2	Clarified Triconex AI cards
	Figure 2 1 Figure 2 2	Reformatted
	2.1.4	Added LSM description
	Figure 2 4 Figure 2 5	Added figures
	2.7.2.3	Updated per ALS design documentation
	Global (not marked)	Deleted proprietary information designations
5	1.4.3.4	Added reference
	1.4.4.4	Deleted reference to SCM – not relevant to this document
	1.5.5	Revised section title for clarity
	1.5.6	Clarified: Maintenance Workstation is not used to configure the Tricon Discussed TAB connection to ALS.
	1.5.7	Editorial
	Figure 1 2 through Figure 1 22	Updated and replaced
	2.1	Moved Figures to end of Section.
	2.2	Updated
	2.1.1	Revised Item 5 and 6 –Power supply output voltage will be determined in the detailed design. Moved item 4 from 2.1.2 to Item 4 in this section and renumbered. Updated Item 7
	2.1.2	Updated Editorial corrections Removed unused items – not requirements

REVISION HISTORY, continued

Revision Number	Affected Pages	Reason for Revision
5, continued	Figure 2 2 Figure 2 3	Updated per Triconex Field Termination Guide
	2.3.2.1	Editorial corrections
	2.3.6	Updated description –There are two TCM cards in the Tricon Main Chassis.
	2.3.6.1	Updated communications
	2.3	Updated section per vendor hardware descriptions
	2.3.1	I/O power supply locations determined by detailed design
6	1.1	Removed "...Later..." discussion – Later items resolved at this revision
	1.3.2	Updated acronym list
	1.5.4	Updated Isolation device description
	Figure 1-1	Updated Title
	Figures 1-2, 1-3, 1-5, 1-6	Updated Prot Set I instrument tags and power supplies
	Figures 1-7, 1-8, 1-10, 1-11	Updated Prot Set II instrument tags and power supplies
	Figures 1-12, 1-13, 1-15, 1-16	Updated Prot Set III instrument tags and power supplies
	Figures 1-17, 1-18, 1-20, 1-21	Updated Prot Set IV instrument tags and power supplies
	2.7.1	Deleted descriptive sections; information not needed here - contained in other documents.
	2.7.2	Updated section title Vendor CS Innovations Deleted descriptive sections; information not needed here - contained in other documents.
	2.8	Added new alarm interface requirements section

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1 Introduction

1.1 Purpose

This document specifies the requirements imposed on the Process Protection System (PPS), its subsystems, and other system components to achieve interfaces among these entities that are required for the PPS to perform its design function.

This document is intended to be revised as the PPS replacement design progresses.

1.2 Scope

The PPS is comprised of Tricon equipment provided by Invensys/Triconex and Advanced Logic System (ALS) equipment provided by Westinghouse CS Innovations, LLC. This Interface Requirement Specification (IRS) provides: (1) requirements for the interfaces between external field devices such as process transmitters and the Tricon and the ALS; (2) electrical and communication interfaces between the Tricon and ALS and their associated peripheral devices; and (3) other interfacing Diablo Canyon Power Plant (DCPP) systems such as the Plant Process Computer (PPC), Main Annunciator System (MAS), Safety Parameter Display System (SPDS) and the Safety-Related 120 Vac and 125 Vdc Power Systems.

All external interface requirements for each of these systems will be defined.

1.3 Definitions and Acronyms

1.3.1 Definitions

The following definitions are used in 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.
Electrical Class 1E [1.4.4.9]	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 [1.4.4.6]	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 [1.4.5.2] off-site dose limits.
Instrument Class IB [1.4.4.6]	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 [1.4.3.2].
Instrument Class IC [1.4.4.6]	Instrument Class IC instruments and controls have the passive function of maintaining the pressure boundary integrity of PG&E Design Class I piping systems.
Instrument Class ID [1.4.4.6]	Instrument Class ID instruments and controls are components that have certain Design Class I attributes, but do not require conformance with all Class IA, IB, or IC requirements.

TERM	DEFINITION
Instrument Class II [1.4.4.6]	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.
Protection Set	The physical grouping of process channels with the same channel designation. Each of the four redundant protection sets is provided with a separate and independent power feed and process instrumentation transmitters. Thus, each of the four redundant protection sets is physically and electrically independent from the other sets.

1.3.2 Acronyms

ACRONYM	DEFINITION
ALS	Advanced Logic System
AMSAC	ATWS Mitigation System Actuation Circuitry
ASU	(ALS) Auxiliary Service Unit
ATWS	Anticipated Transient Without Scram
CDD	Conceptual Design Document
CLB	Core Logic Board
COM	Communications Board
DCM	Design Criteria Memorandum
DDE	Dynamic Data Exchange
DCPP	Diablo Canyon Power Plant
DFWCS	Digital Feedwater Control System
FRS	Functional Requirements Specification
I&C	Instrumentation and Controls
IEEE	Institute of Electrical and Electronic Engineers
I/O	Input/Output
IPB	(ALS) Input Board
IRS	Interface Requirements Specification
LLC	Limited Liability Corporation
MAS	Main Annunciator System
MCR	Main Control Room
NQEL	Nuclear Qualified Equipment List
NR	Narrow Range
NRC (USNRC)	(United States) Nuclear Regulatory Commission
OPB	(ALS) Output Board
OPDT	Overpower Delta T
OTDT	Overtemperature Delta T
PG&E (PGE)	Pacific Gas & Electric Company
PCS	Process Control System
PLC	Programmable Logic Controller
PPC	Plant Process Computer
PPS	Process Protection System
PRXM	Primary Remote Expansion Module
PSU	(ALS) Power Supply Unit
RCS	Reactor Cooling System
RNARA	Auxiliary Relay Rack A

ACRONYM	DEFINITION
RNASA	Auxiliary Safeguards Rack A
RNPxy	PPS Racks X = 1-4 (Protection Sets I – IV) Y = A, B, C, D, E (Protection Sets I, II) Y= A, B, C (Protection Sets III, IV)
RNSIA/RNSIB	SSPS Input Relay Cabinet Train A/Train B
RRXM	Remote RXM
RTD	Resistance Temperature Detector
RXM	Remote Expansion Module
RVLIS	Reactor Vessel Level Indication System
SCM	Software Configuration Management
SPDS	Safety Parameter Display System
SRS	Software Requirements Specification
SSPS	Solid State Protection System
STB	(ALS) Service and Test Board
TCM	Triconex Communication Module
TMR	Triple Modular Redundant
TSAP	TriStation 1131 Application Project
WR	Wide Range

1.4 Referenced Documents

1.4.1 General References and Standards

The following codes, standards, and regulations referenced in this Section are totally or partially applicable to the activities covered by this Specification:

1.4.2 Institute of Electrical and Electronics Engineers (IEEE)

1.4.2.1 IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations"

1.4.2.2 IEEE Standard 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations"

1.4.3 United States Nuclear Regulatory Commission (USNRC) Regulatory Guides

1.4.3.1 Regulatory Guide 1.75, Rev. 2, "Physical Independence of Electric Systems"

1.4.3.2 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"

1.4.3.3 Regulatory Guide 1.180, Rev. 1, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems"

1.4.3.4 U.S. Nuclear Regulatory Commission, Digital Instrumentation and Controls, Revision 1, "DI&C-ISG-04, Task Working Group #4: Highly-Integrated Control Rooms - Communications Issues (HICRc)," March 6, 2009 (ADAMS Accession No.ML083310185)

1.4.4 Implementing Documents

- 1.4.4.1 Process Protection System Replacement Conceptual Design Document (CDD)
- 1.4.4.2 Process Protection System Replacement Functional Requirements Specification (FRS)
- 1.4.4.3 Process Protection System Replacement System Software Requirements Specification (SRS)
- 1.4.4.4 Deleted
- 1.4.4.5 DCM S-38A, Plant Protection System
- 1.4.4.6 DCM T-24, DCPD Instrumentation and Controls
- 1.4.4.7 DCM S-65, 120 VAC System
- 1.4.4.8 STP I-33, Reactor Trip Time Test Program
- 1.4.4.9 DCM T-19, Electrical Separation and Isolation
- 1.4.5 Other References
 - 1.4.5.1 Triconex Corporation Nuclear Qualified Equipment List (NQEL), latest version
 - 1.4.5.2 Title 10 Code of Federal Regulations Part 100, Reactor Site Criteria
 - 1.4.5.3 Letter No. NRC-V10-09-01, J. Polcyn (Invensys) to NRC, "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," dated September 9, 2009
 - 1.4.5.4 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)
 - 1.4.5.5 6002-00301, CS Innovations ALS Topical Report and Supporting Documents Submittal, July 29, 2010 (ADAMS Accession No. ML102160471)
 - 1.4.5.6 6002-31002, CS Innovations, ALS 321 Design Specification
 - 1.4.5.7 9700052-019, Field Terminations Guide for Tricon v9-10 Systems

1.5 Identification

This section identifies the systems, interfacing entities, and other interfaces to which this document applies.

1.5.1 Protection Sets

The PPS consists of sixteen (16) racks (per DCPD 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. Figure 1-1 illustrates the hardware that comprises the sixteen (16) protection sets.

Protection Set I is comprised of Racks 1 thru 5 (RNP1A, RNP1B, RNP1C, RNP1D, and RNP1E).

Protection Set II is comprised of Racks 6 thru 10 (RNP2A, RNP2B, RNP2C, RNP2D, and RNP2E).

Protection Set III is comprised of Racks 11 thru 13 (RNP3A, RNP3B, and RNP3C).

Protection Set IV is comprised 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.

1.5.2 Triconex Tricon Programmable Logic Controllers (PLC)

The Tricon PLC shown in the following figures comprises 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.

1.5.3 CS Innovations Advanced Logic System (ALS)

1.5.3.1 A typical ALS rack configuration as shown in the following figures contains two sets of the following components (See Reference 1.4.5.5 for additional details):

- ALS CLB – Core Logic Board
- ALS IPB – Input Board
- ALS OPB – Output Board
- ALS PSU – Power Supply Unit

1.5.3.2 ALS ASU – Auxiliary Service Unit

The ASU shown in Figure 1-22 is a dedicated piece of test equipment which can be connected to the ALS rack during diagnostics or testing by plant personnel. The ASU 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 also provides post-event analysis information about the system to plant personnel for evaluation of an event after it has occurred.

The ASU can modify setpoints and tuning constants, but cannot alter functional programming (i.e., alter the algorithm) of the CLB.

In the PPS Replacement project, the Maintenance Workstation will perform the functions of the ASU.

1.5.3.3 The ALS A and ALS B conceptual architecture to provide 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 2-4 and Figure 2-5.

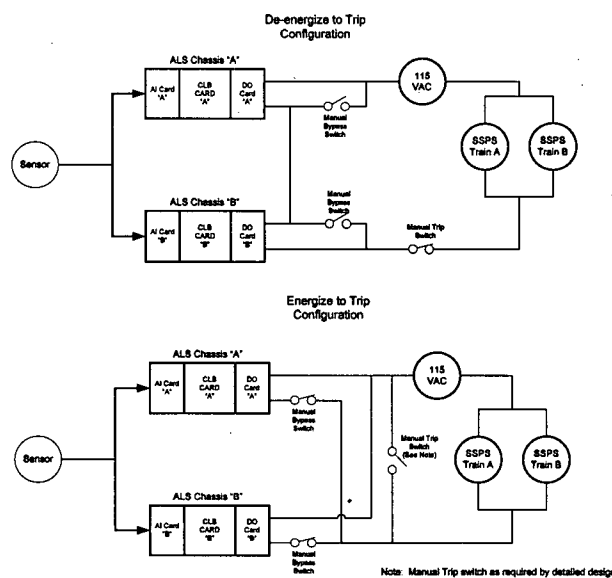
The manual bypass switches in Figure 1-1 allow one ALS diversity Group (i.e., ALS-A or ALS-B) to be bypassed and removed from service without tripping the channel.

The manual trip switch is used to trip the channel in the unlikely event that both ALS diversity groups are inoperable.

1.5.4 Isolation Devices

The isolation devices shown in Figure 1-3, Figure 1-8, Figure 1-13, and Figure 1-18 are safety-related components powered from the Class II 24 Vdc I/O power supplies provided by PG&E. The isolation devices are separate and independent from both the Tricon and the ALS. All isolation devices are 4-20 mA DC input and 4-20 mA DC output. Input and output range information is provided in the I/O List [Appendix 3.1]. The qualified isolation devices 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.

Figure 1-1 ALS Diversity Architecture Concept



1.5.5 ALS Signal Conditioning

- 1.5.5.1 The ALS shall provide signal conditioning and isolation for the Reactor Coolant System (RCS) non-safety-related flow analog output signals with capability to normalize the scaling periodically.
- 1.5.5.2 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 for the RCS Wide Range Temperature and Pressurizer Vapor Space Temperature RTD signals.
- 1.5.5.3 The ALS shall convert the RTD signals from resistance to temperature. The ALS shall provide capability to update the resistance to temperature conversion coefficients periodically. Analog temperature signal input and output range information is provided in the I/O List [Appendix 3.1].
- 1.5.5.4 Temperatures shall be transmitted from the ALS to the Tricon via 4-20 mA analog signals scaled per Appendix 3.1.

- 1.5.5.5 All temperatures shall be transmitted from the ALS to the Gateway computer via RS-422 signals scaled for the full input range per Appendix 3.1.
- 1.5.5.6 The ALS shall provide down-scale open RTD protection. If the ALS detects an open or failed RTD, it shall output an analog signal below the Tricon signal failure threshold, which is -5% of span = 3.20 mA per the FRS [6]. If the actual temperature is below the low scale value provided in Appendix 3.1, the ALS shall output the low scale value, or 0% of span = 4.00 mA. 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. In the latter case, the actual temperature shall be available from the ALS via the Gateway computer.

1.5.6 Maintenance Workstation

The non-safety-related Maintenance Workstation shown in Figure 1-22 is used to maintain the Tricon and the ALS and also to view data from both.

The Tricon will be isolated from the Maintenance Workstation by the qualified safety-related Triconex Communications Module (TCM). Fiber optic cable electrically isolates the Tricon from external non-safety-related devices.

The ALS broadcasts data to the Maintenance Workstation via isolated one-way RS-422 data links so that a single Maintenance Workstation may be used to view data from both the ALS and the Tricon in a given Protection Set.

TAB communications between the ALS and the MWS take 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 open 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].

A Maintenance Workstation may access data only within its own protection set. Communication with other protection sets is not permitted.

1.5.7 Plant Process Computer Gateway and Other Non-Safety-Related Communications Interfaces

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 Core Logic Board (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.

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.

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.

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 409 ms [1.4.4.8].

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.

The preliminary worst case (deterministic) OTDT and OPDT PPS response time allocations are as follows:

ALS:	175 ms for RTD processing
Tricon:	200 ms
Contingency:	34 ms
Total PPS Allocation:	409 ms

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.

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.

Figure 1-2 Replacement PPS Architecture – Set I ALS-A

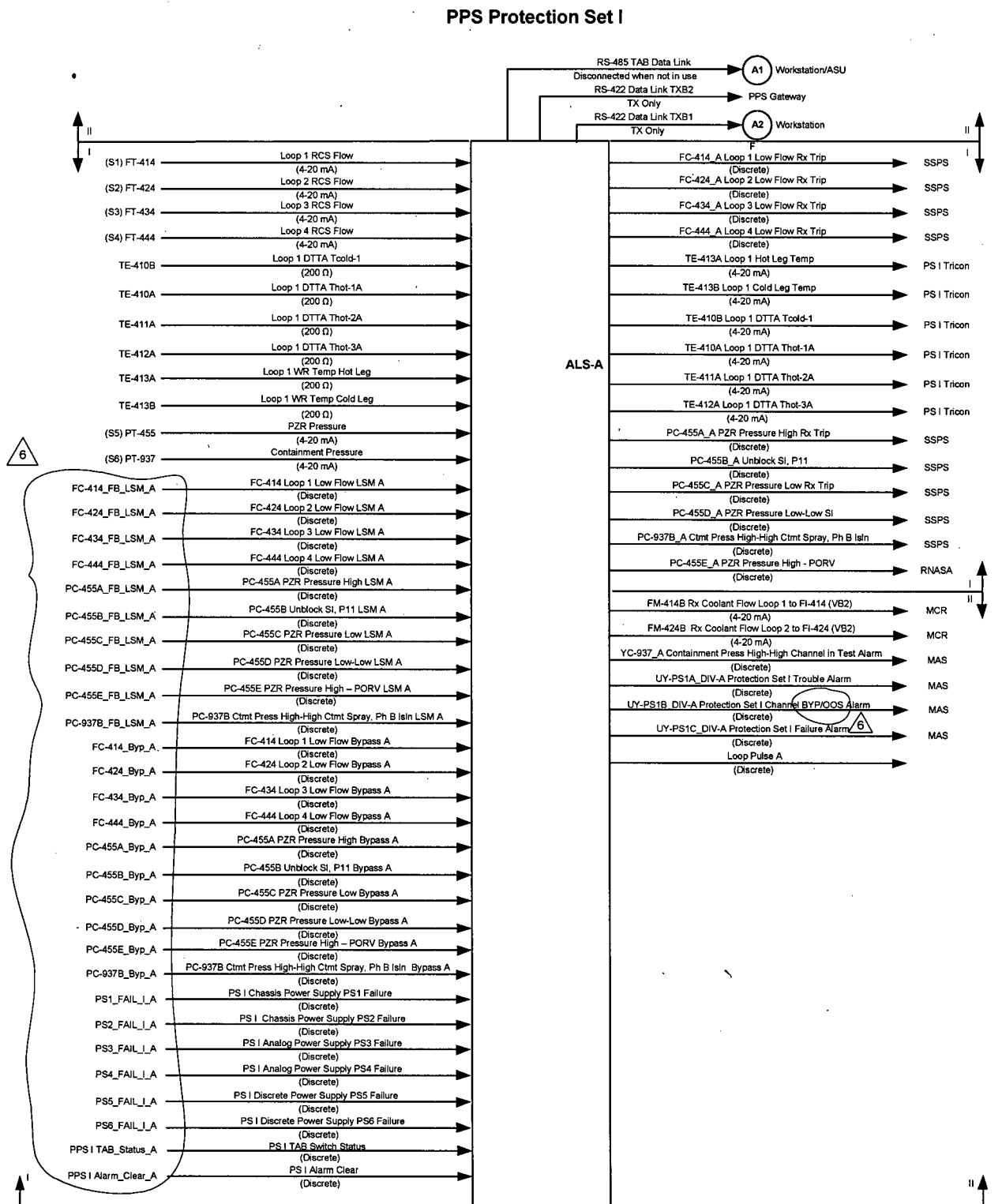


Figure 1-3 Replacement PPS Architecture – Set I ALS-B and Isolation Devices

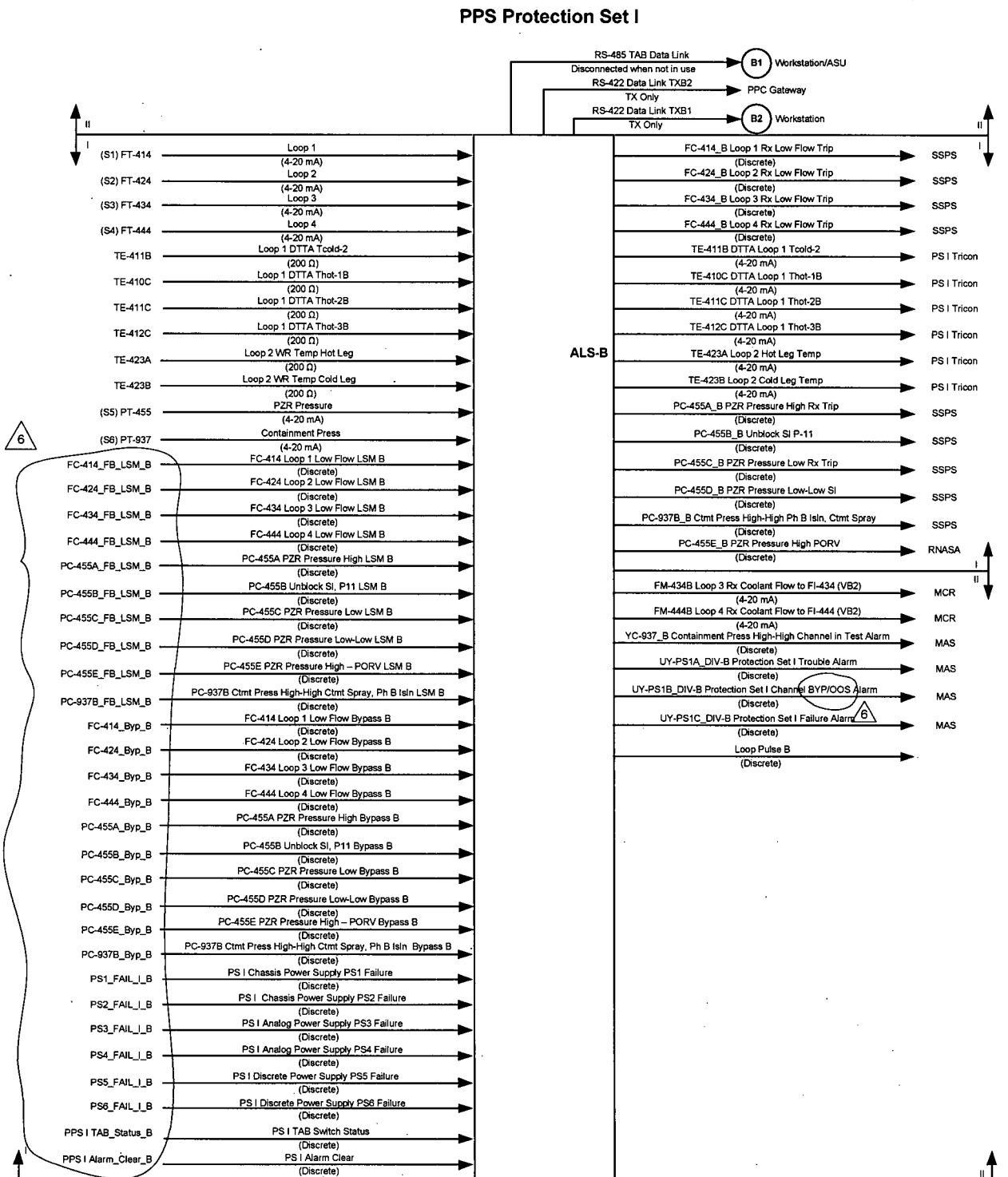


Figure 1-3, continued

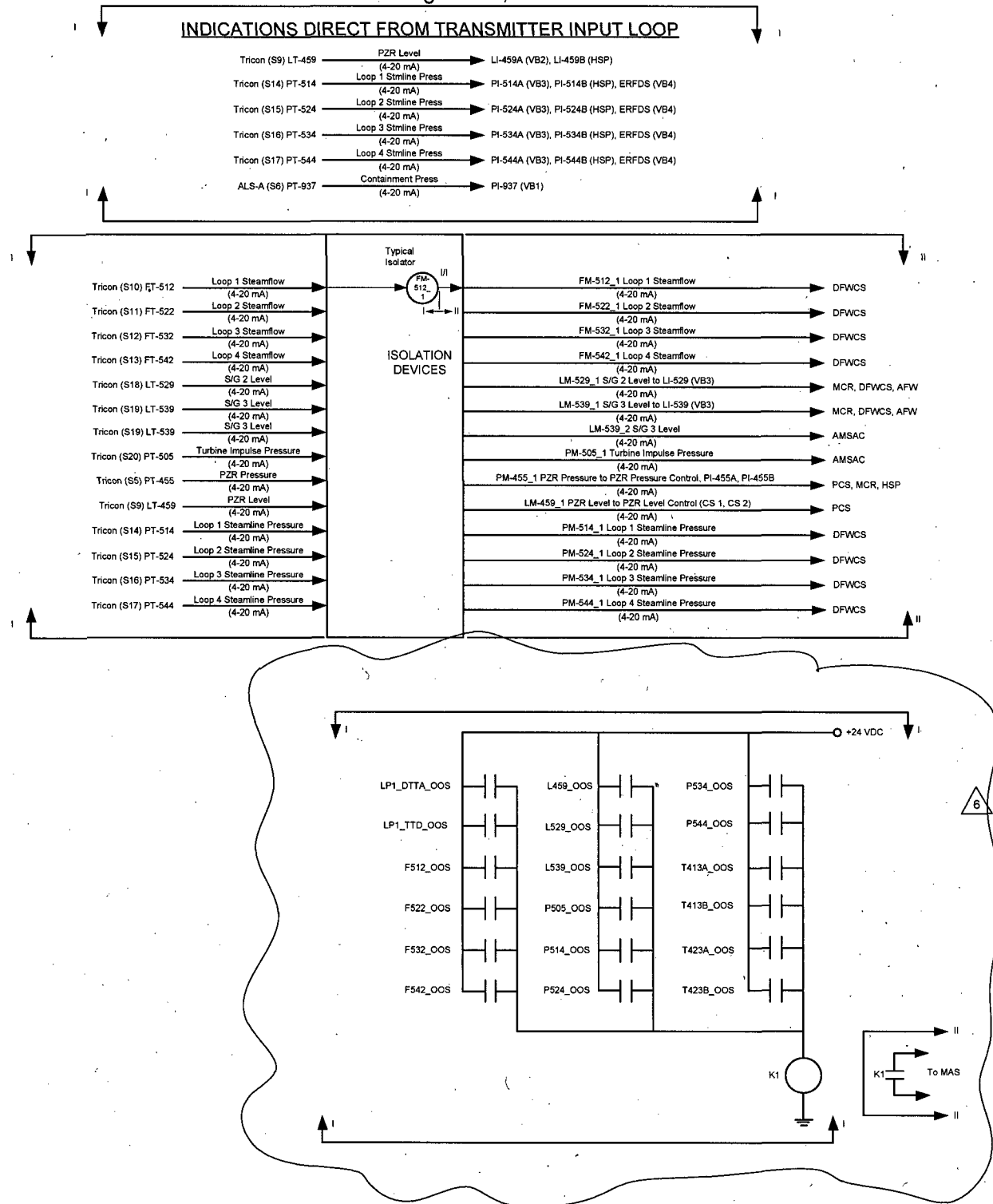
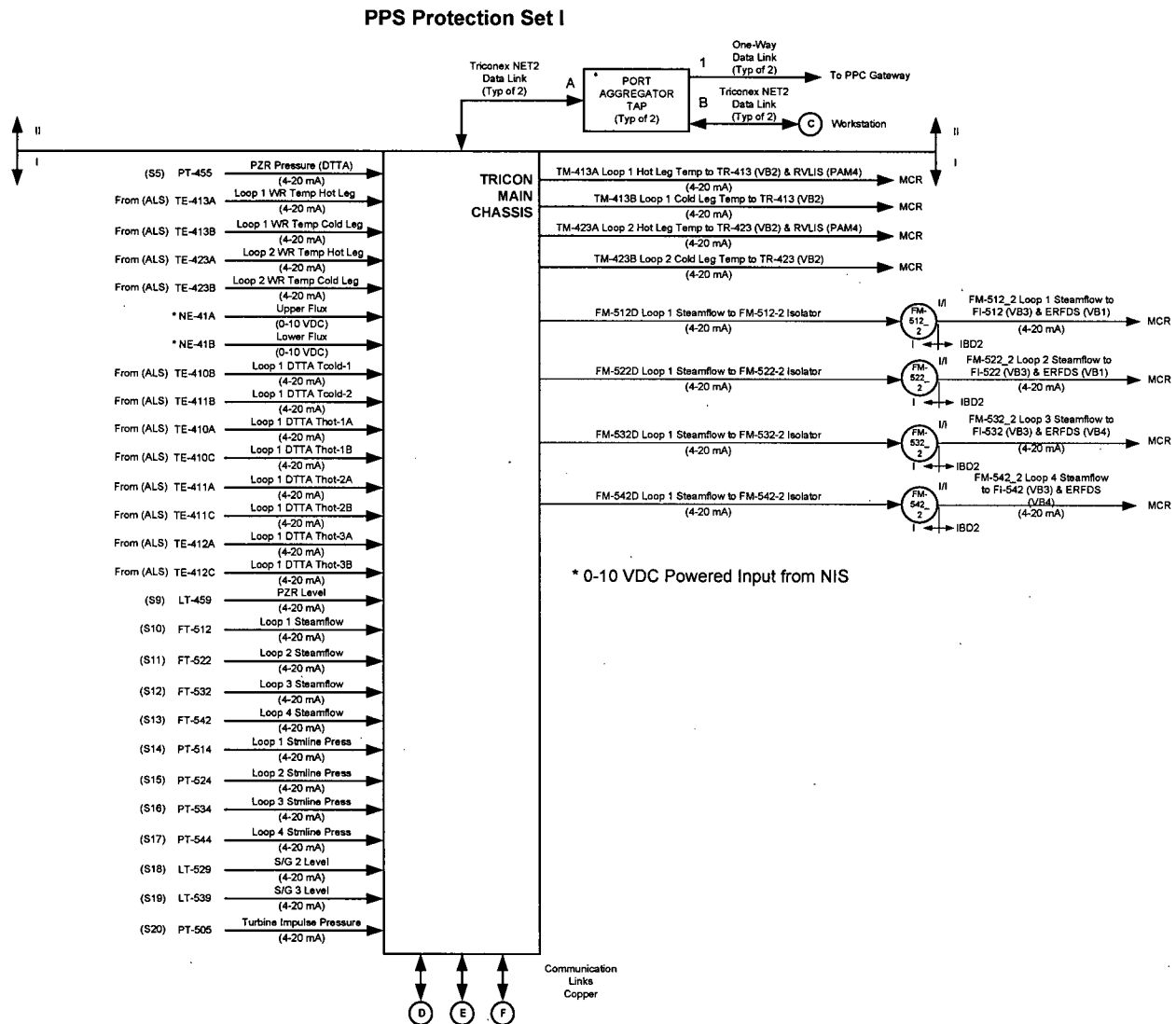


Figure 1-4 Replacement PPS Architecture - Set I Safety-Related Tricon Main Chassis



PPS Protection Set I

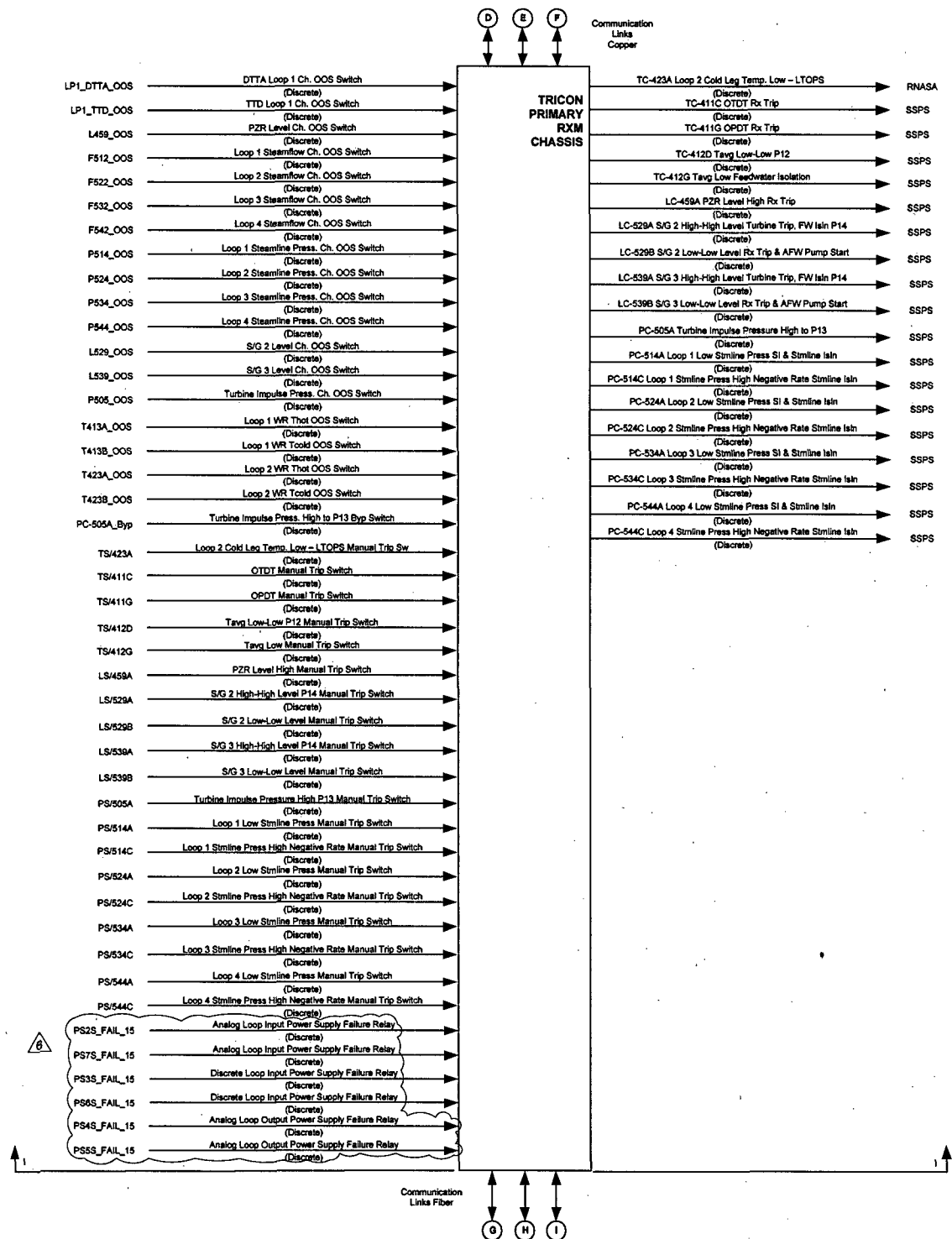


Figure 1-6 Replacement PPS Architecture – Set I Non-Safety-Related Tricon Remote RXM Chassis

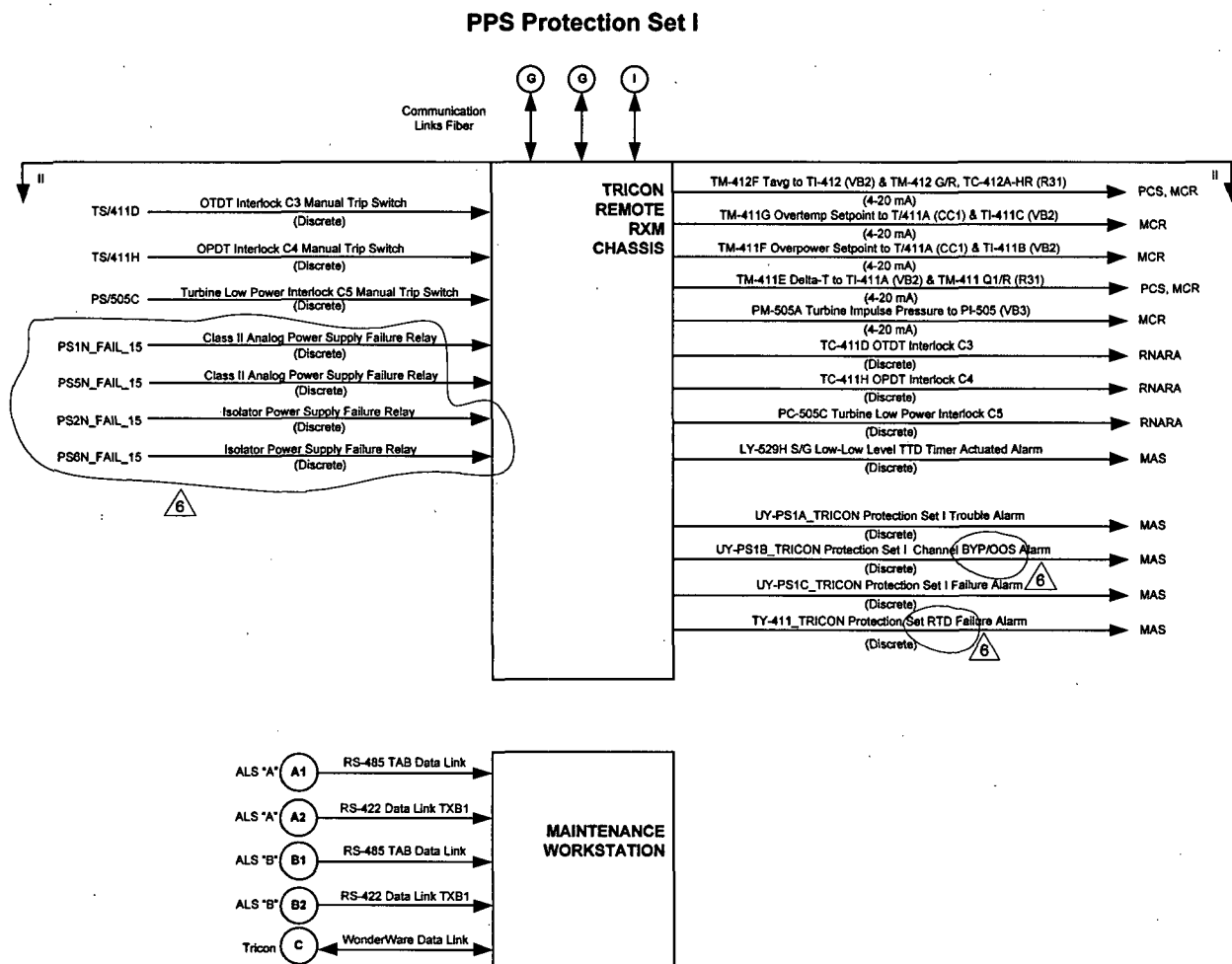
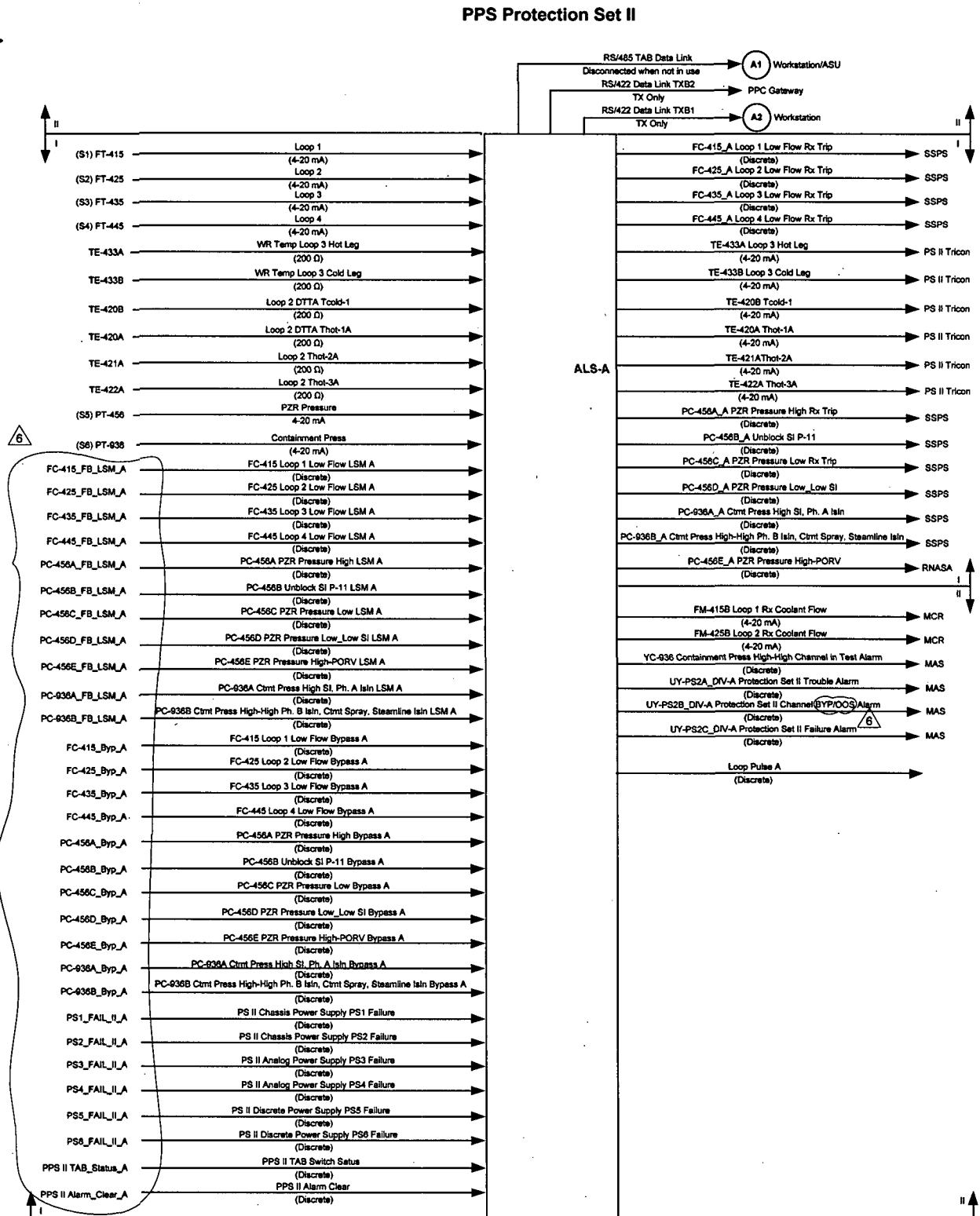


Figure 1-7 Replacement PPS Architecture – Set II ALS-A



PPS Protection Set II

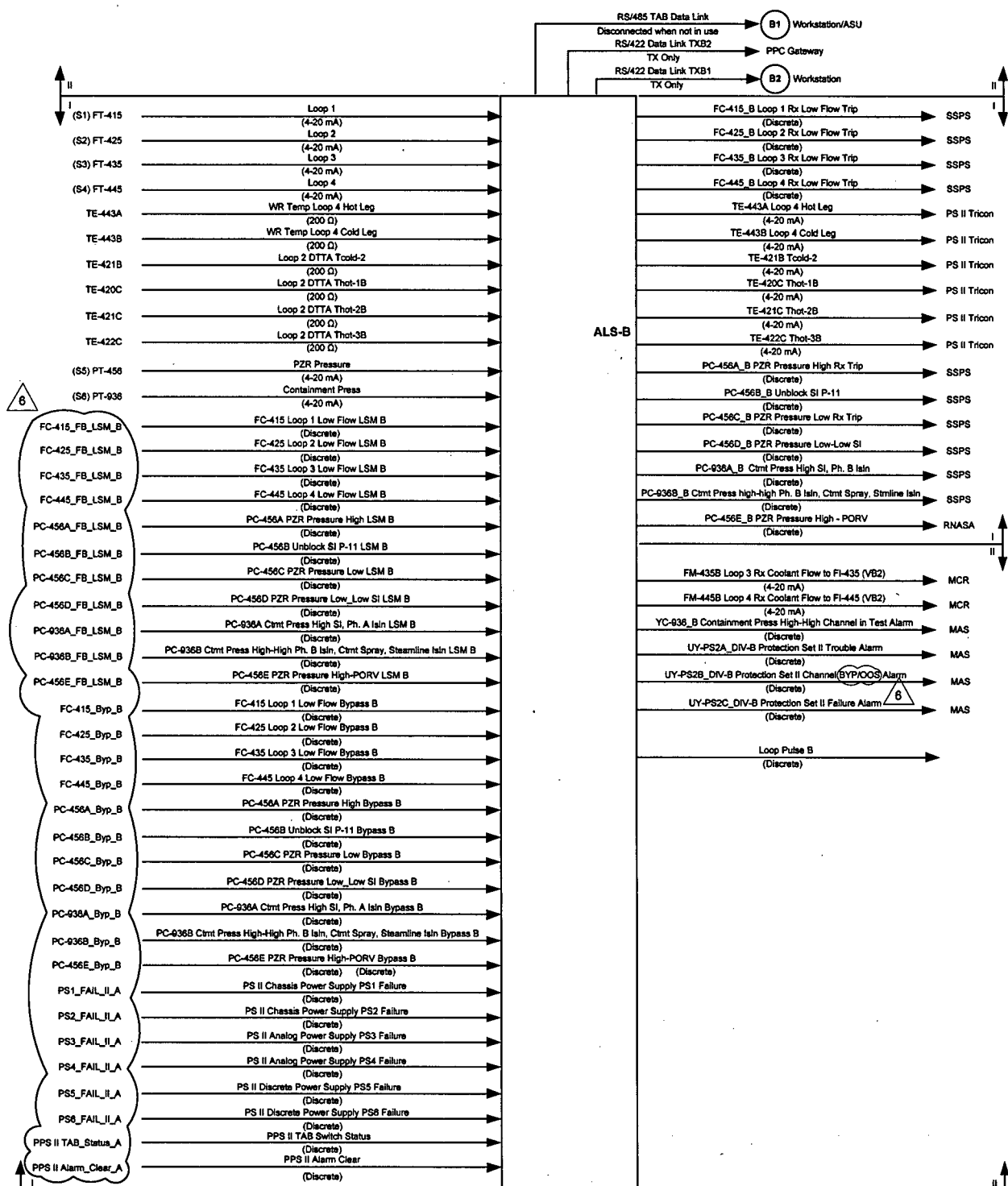


Figure 1-8, continued

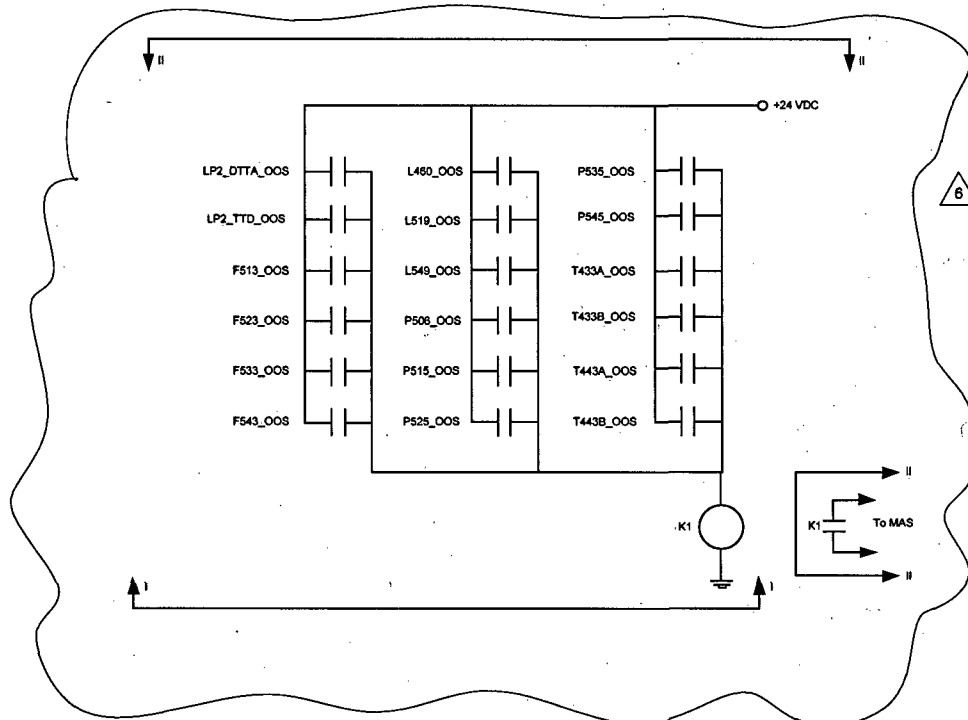
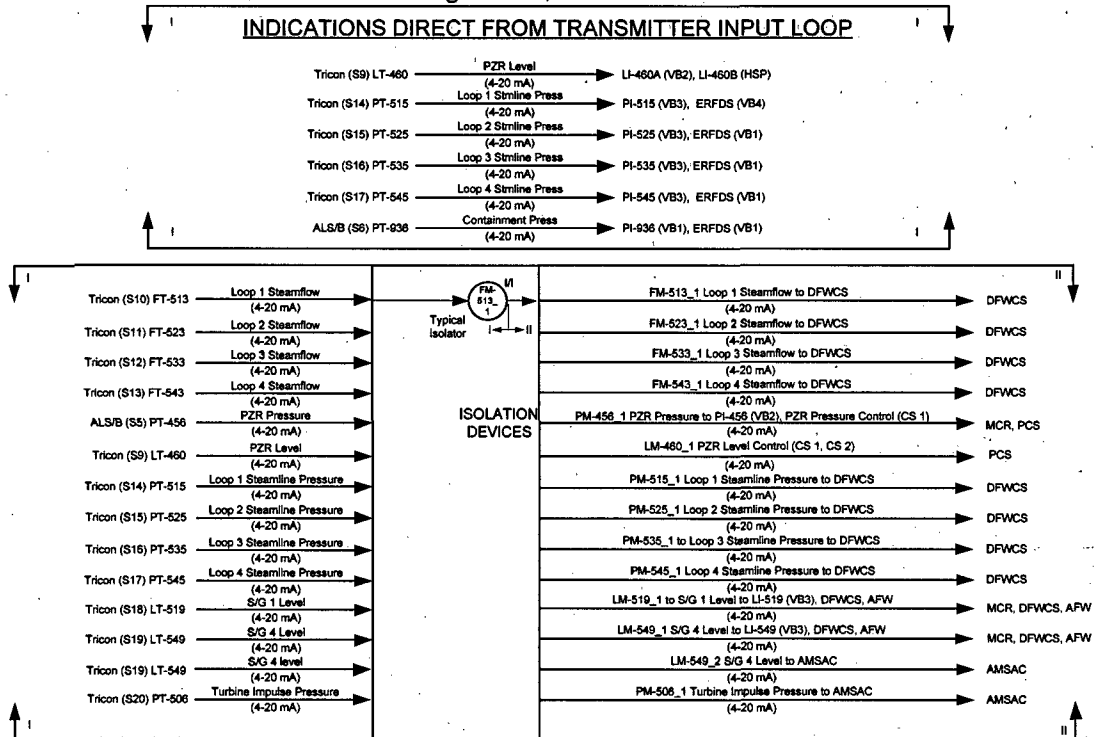


Figure 1-9 Replacement PPS Architecture – Set II Safety-Related Tricon Main Chassis

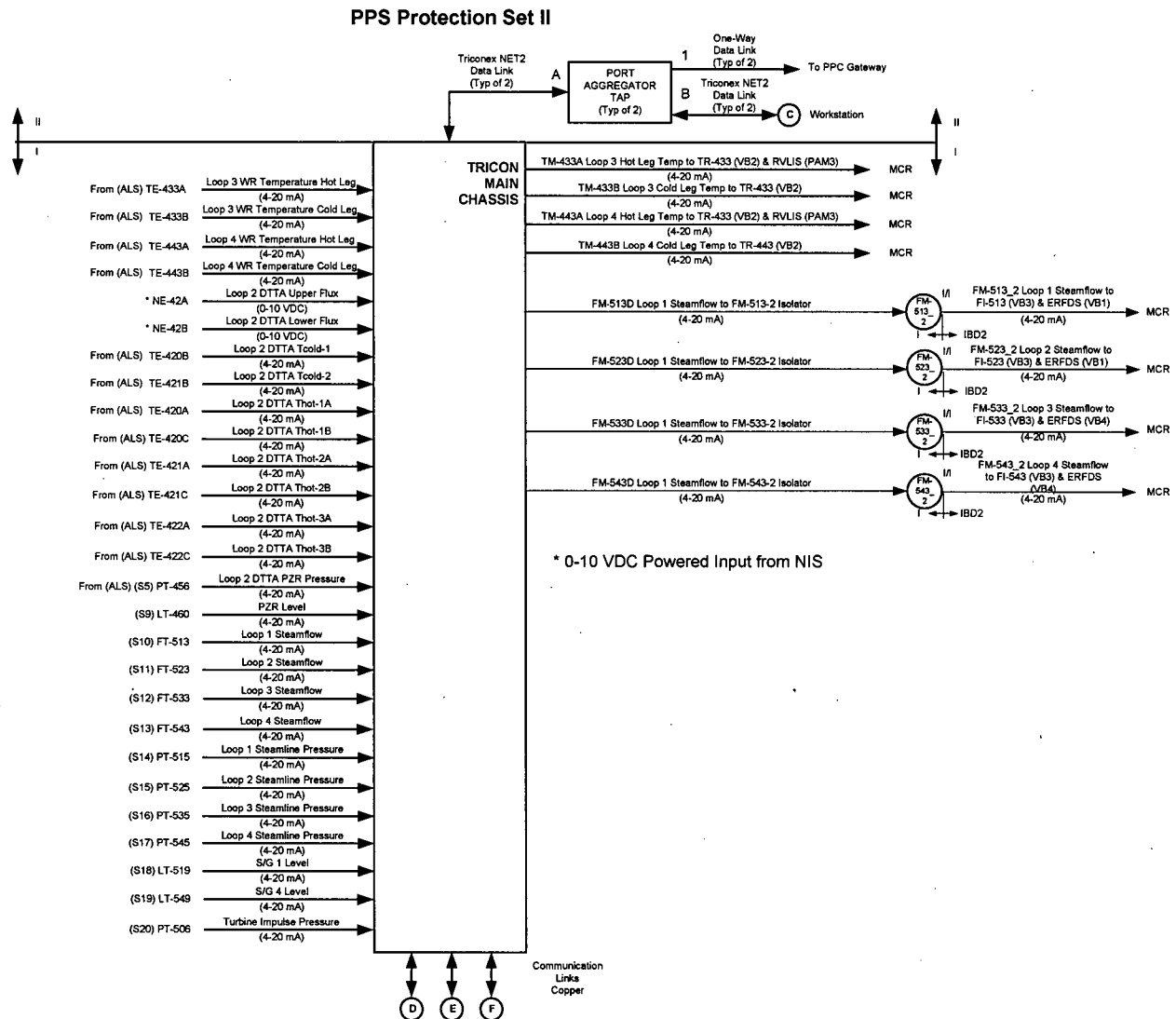


Figure 1-10 Replacement PPS Architecture – Set II Safety-Related Tricon Primary RXM Chassis

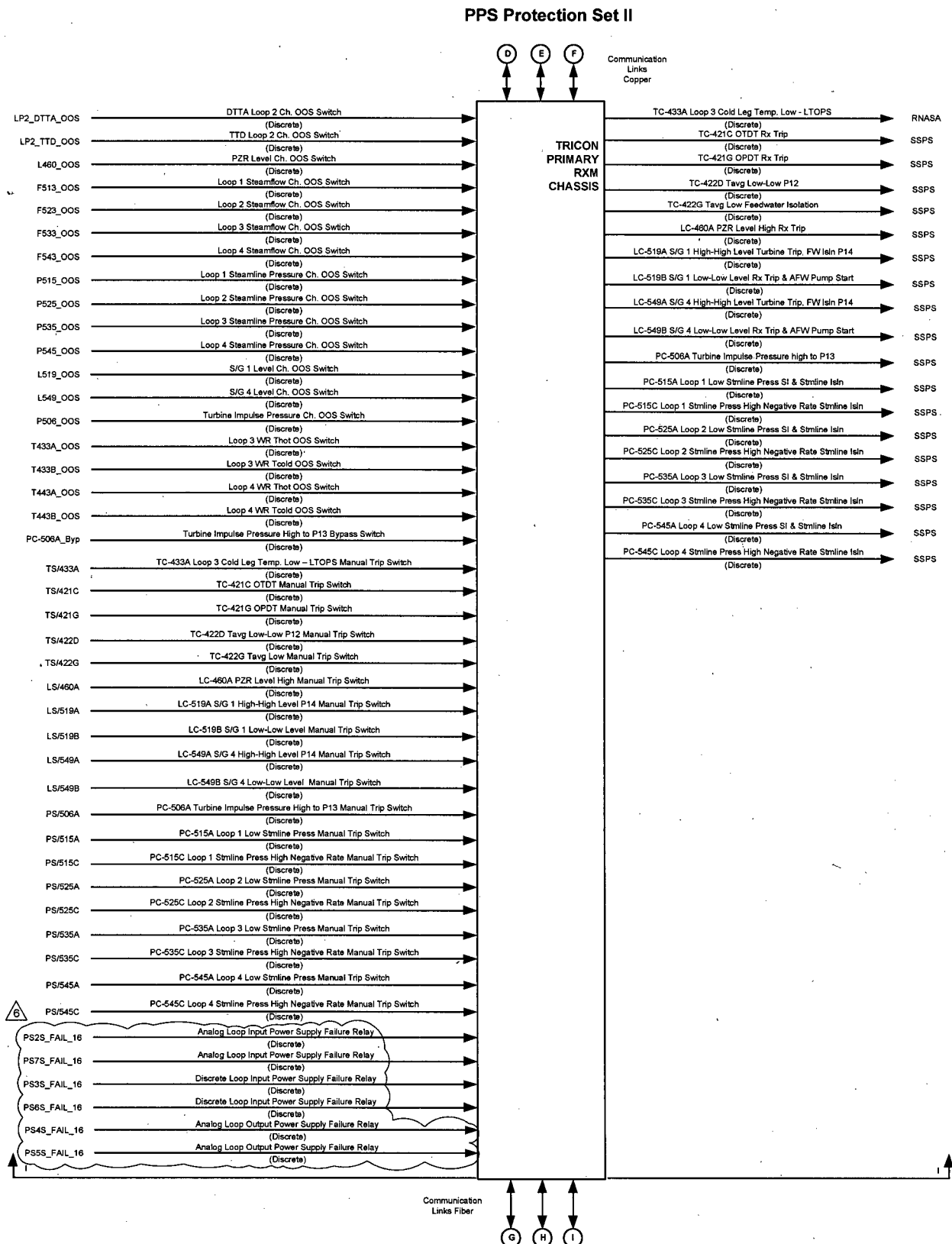


Figure 1-11 Replacement PPS Architecture – Set II Non-Safety-Related Tricon Chassis

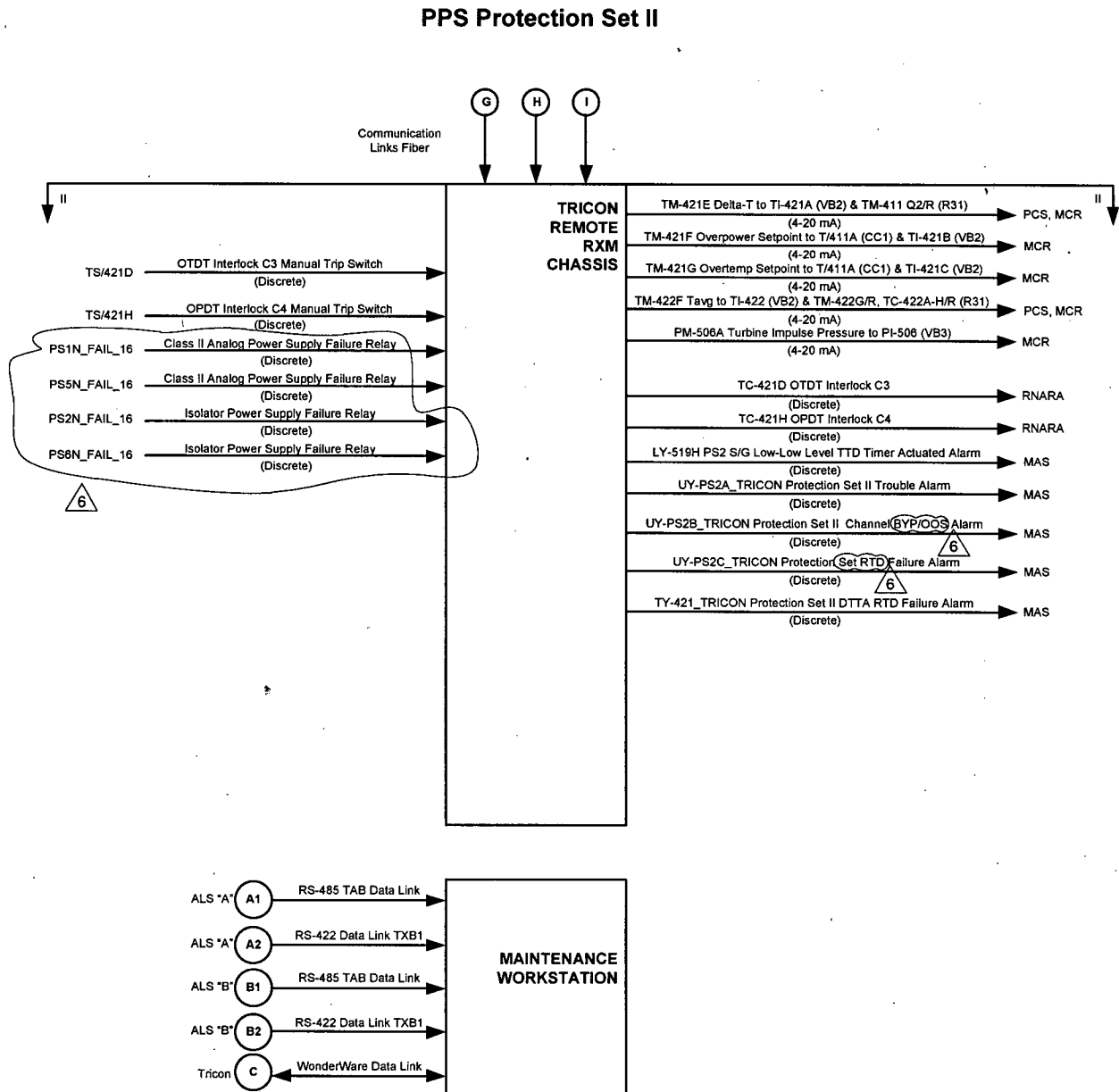


Figure 1-12 Replacement PPS Architecture – Set III ALS-A

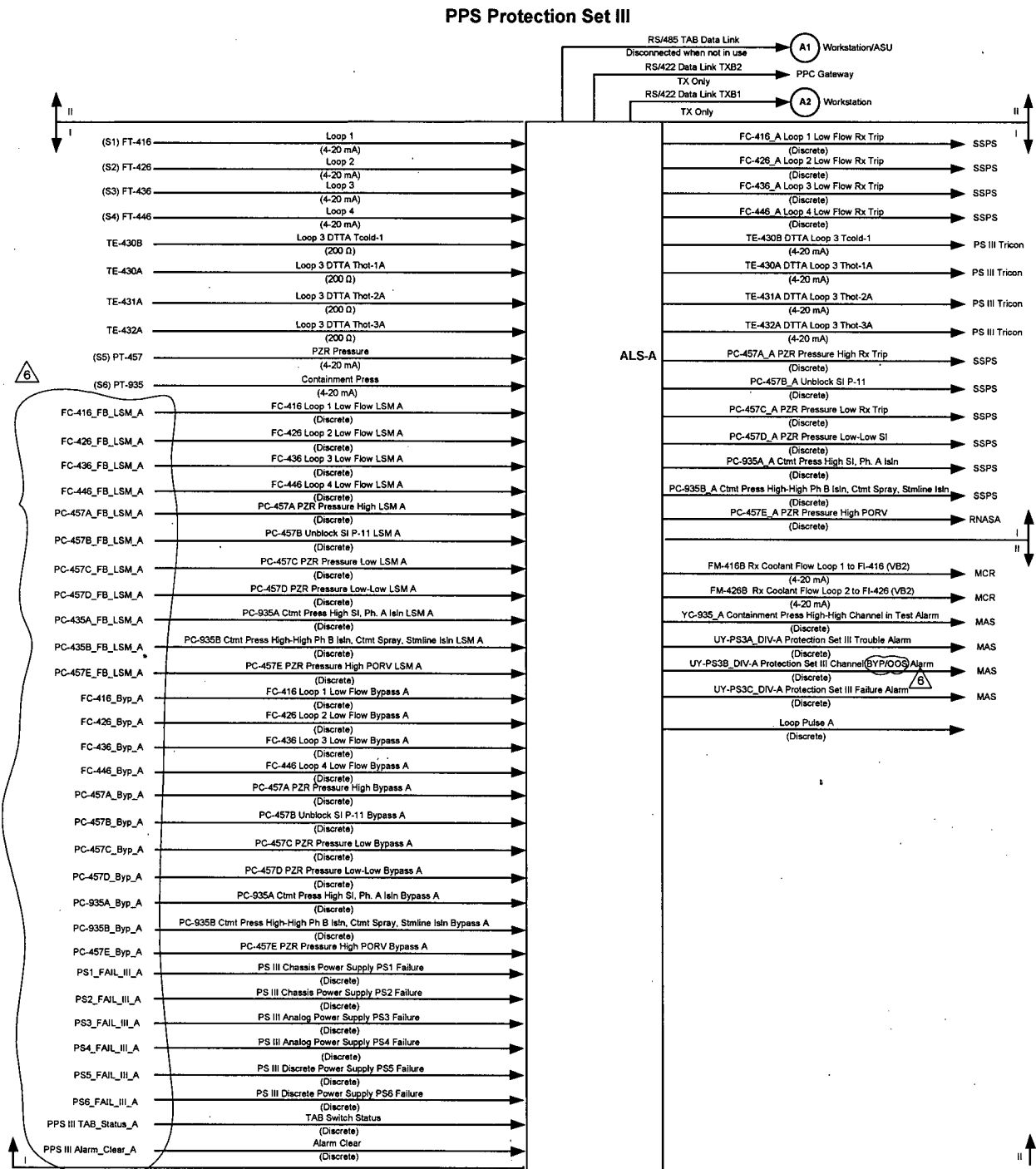


Figure 1-13 Replacement PPS Architecture – Set III ALS-B and Isolation Devices

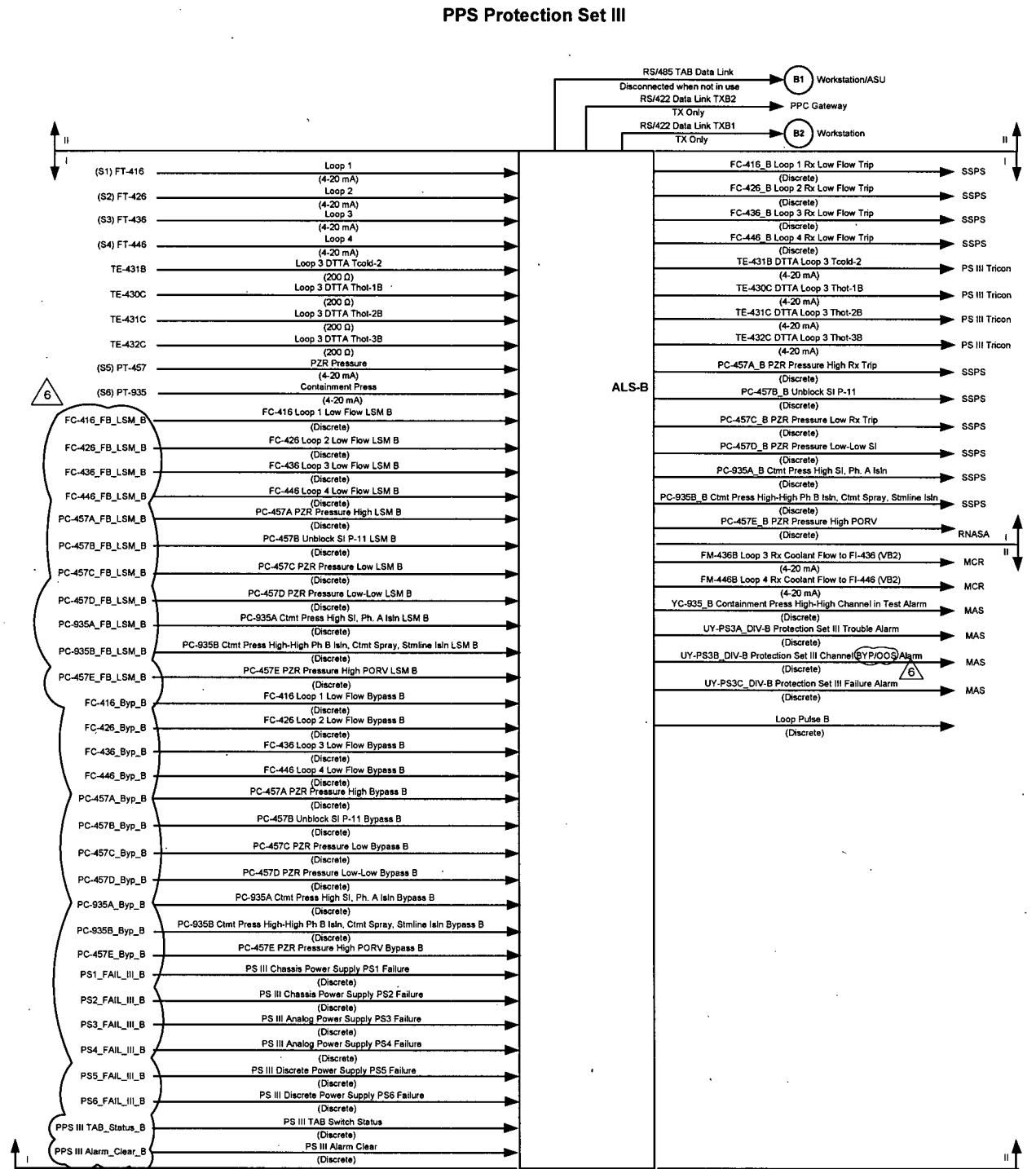


Figure 1-13, continued

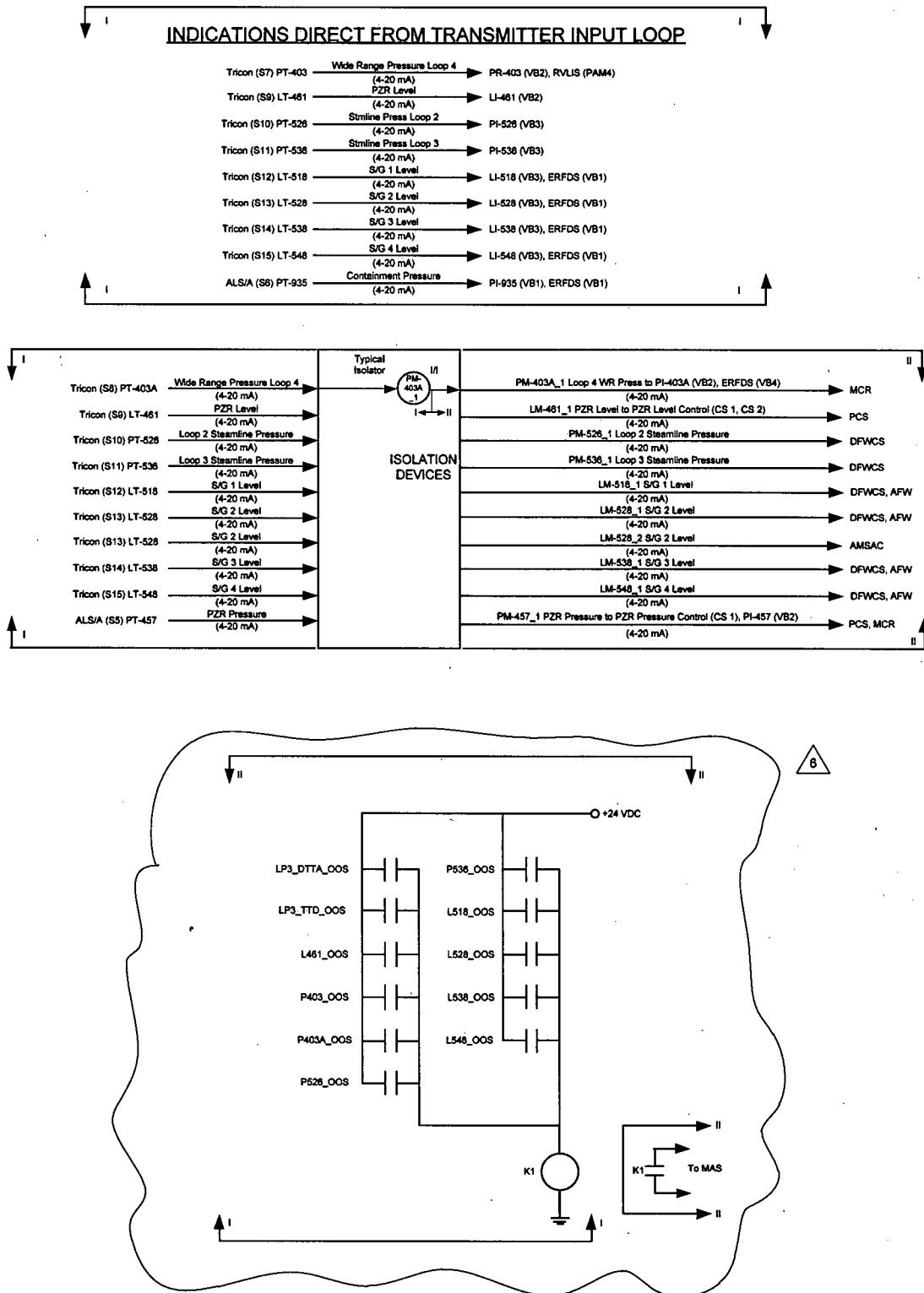


Figure 1-14 Replacement PPS Architecture – Set III Safety-Related Tricon Main Chassis

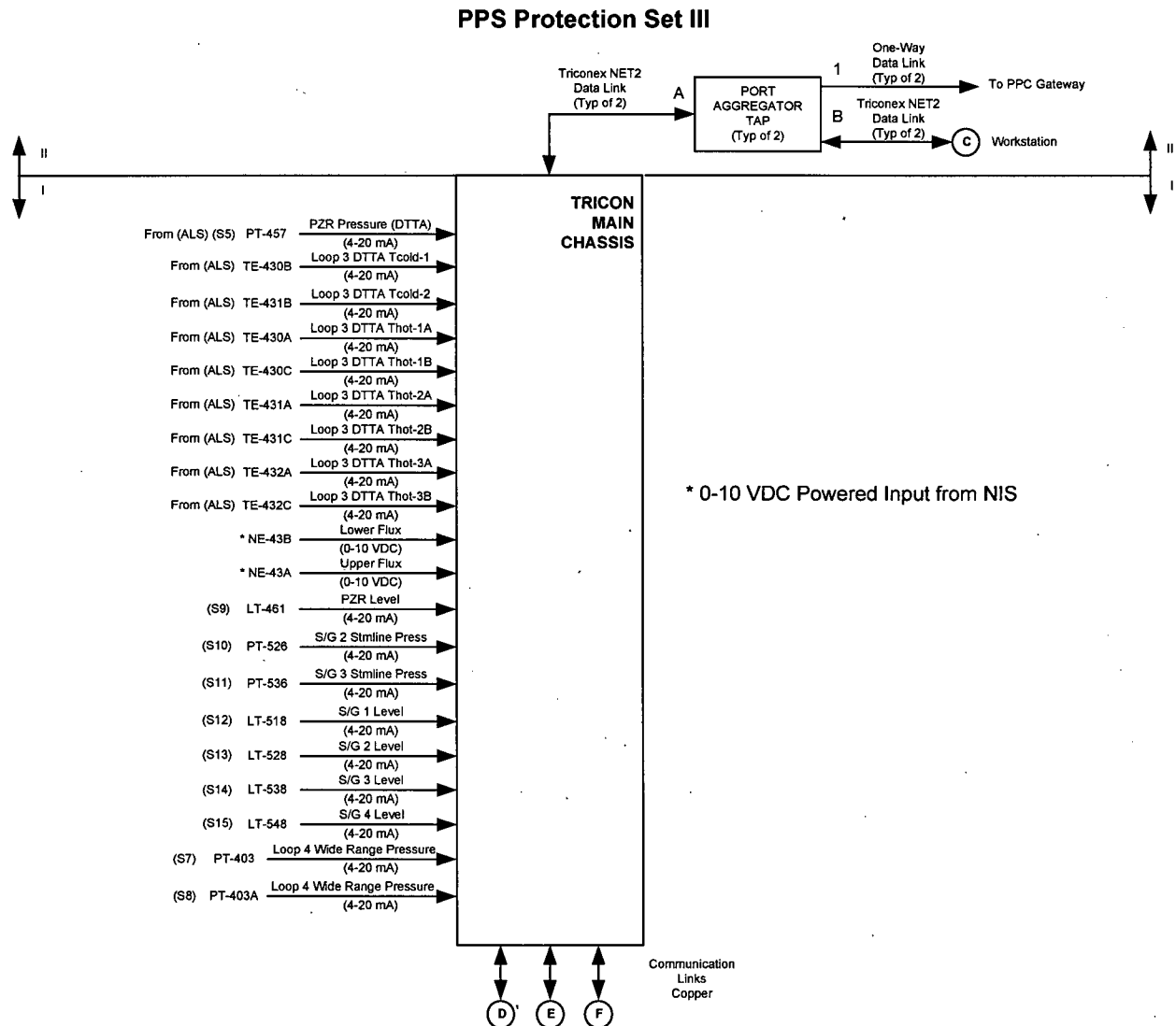


Figure 1-15 Replacement PPS Architecture – Set III Safety-Related Tricon Primary RXM Chassis

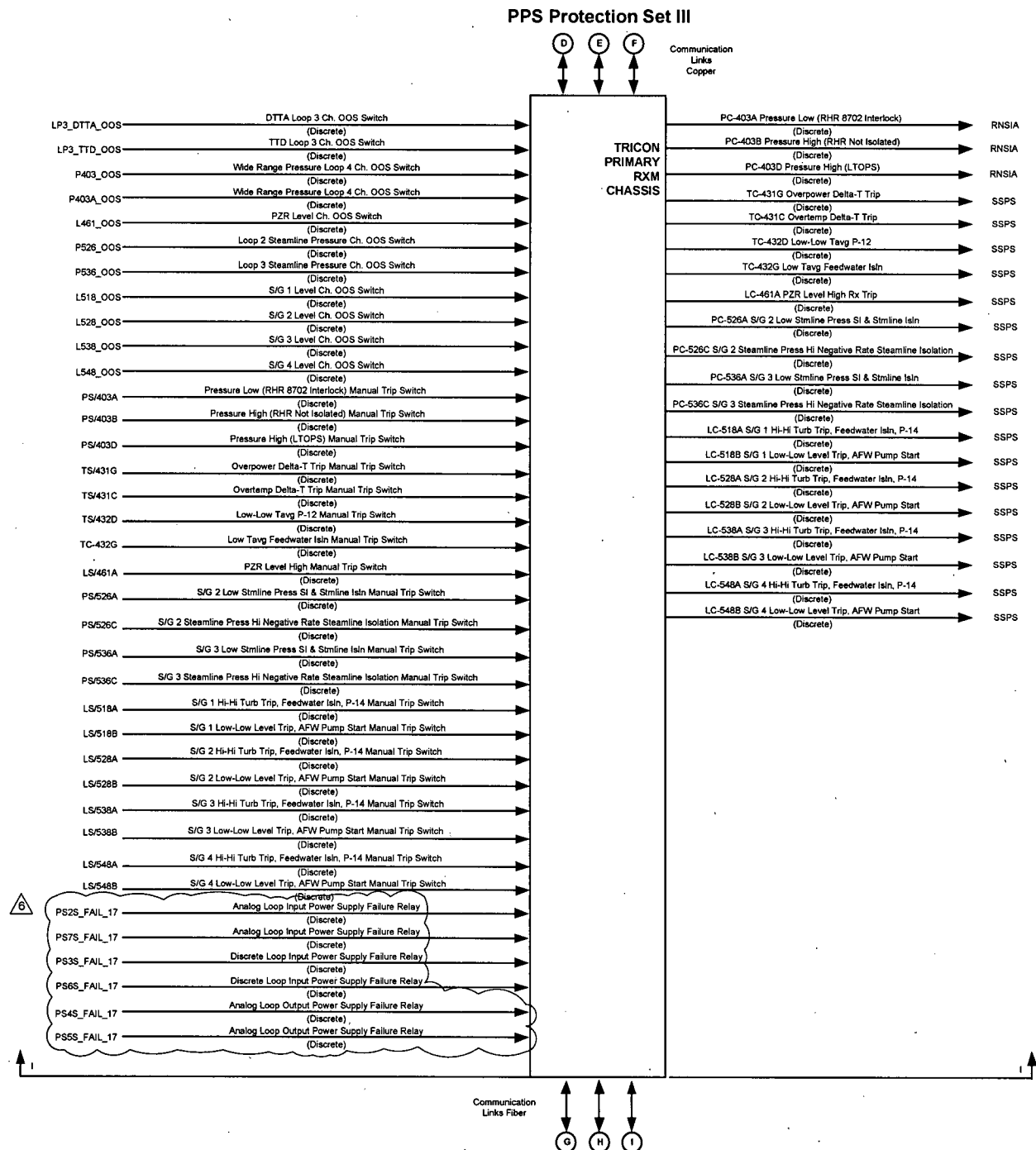


Figure 1-16 Replacement PPS Architecture – Set III Non-Safety-Related Tricon Chassis

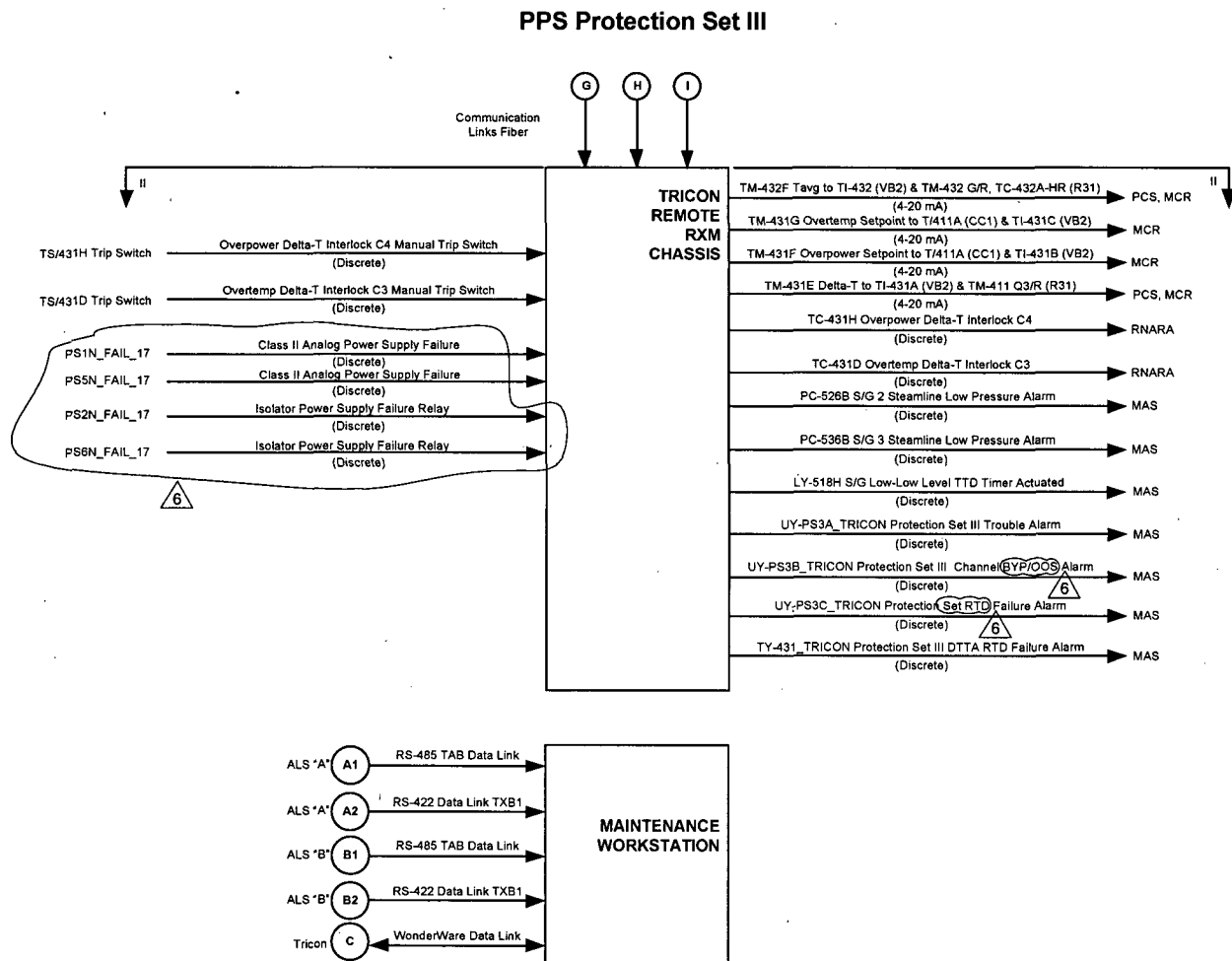


Figure 1-17 Replacement PPS Architecture – Set IV ALS-A

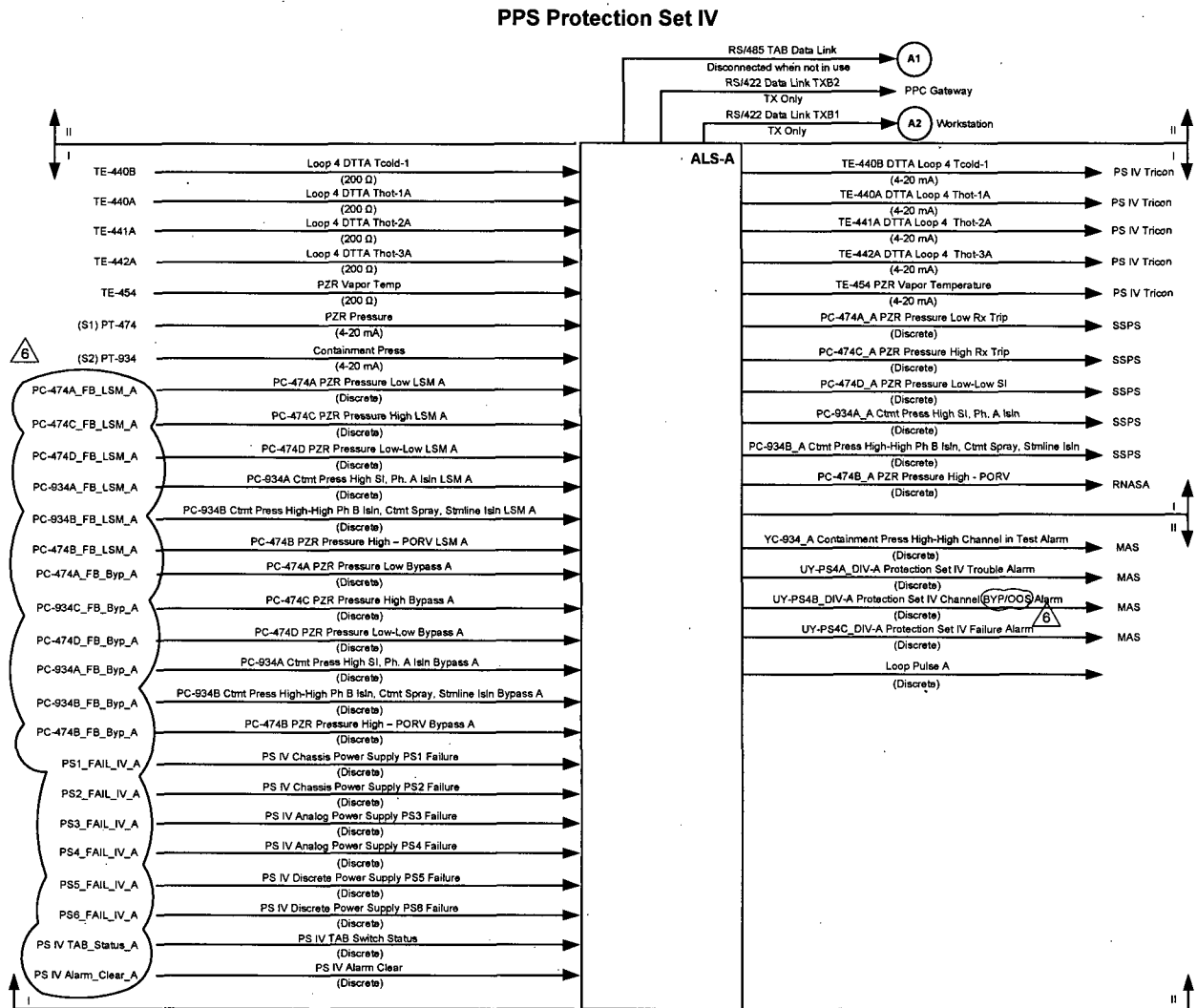


Figure 1-18 Replacement PPS Architecture – Set IV ALS-B and Isolation Devices

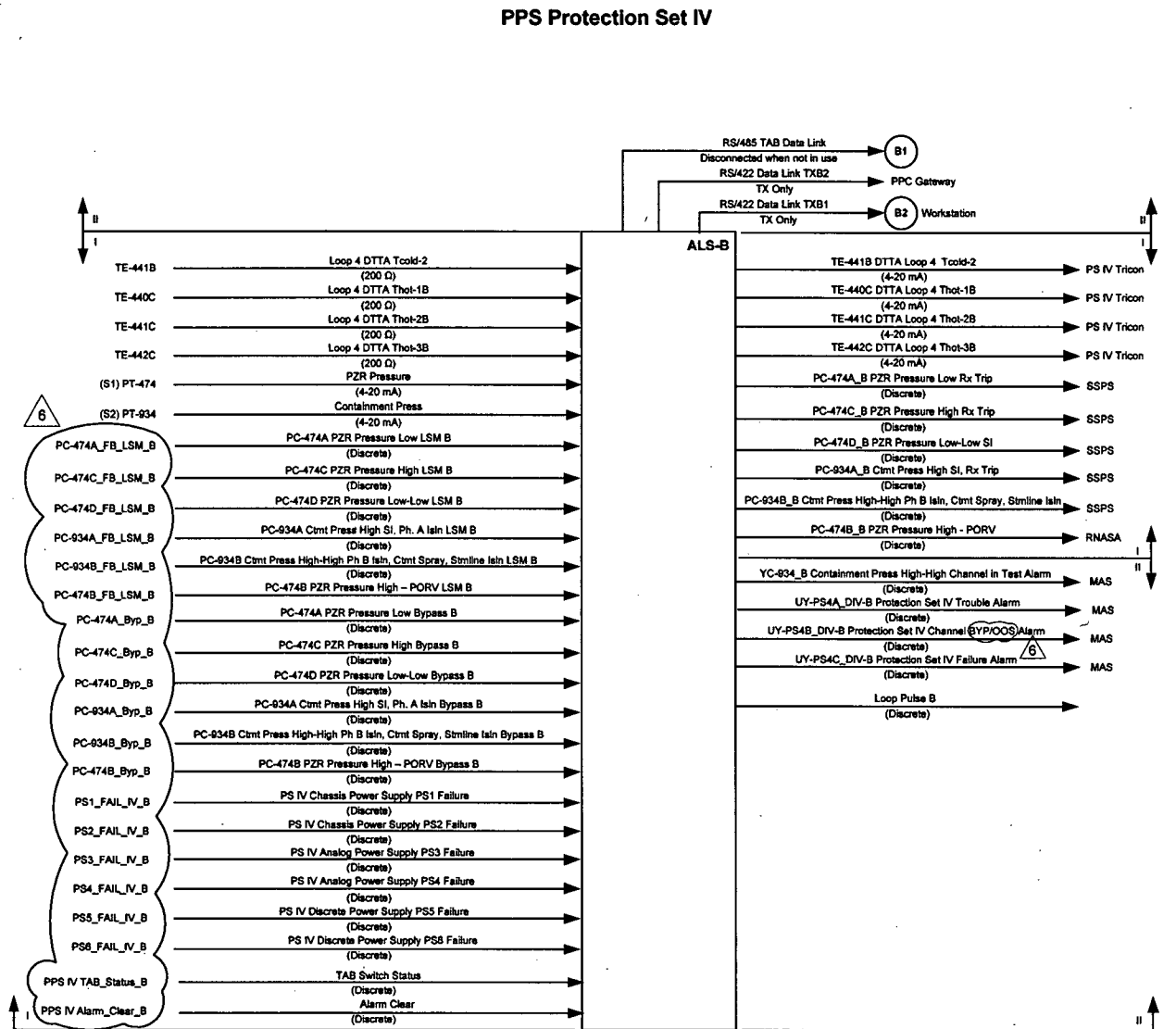


Figure 1-18, continued

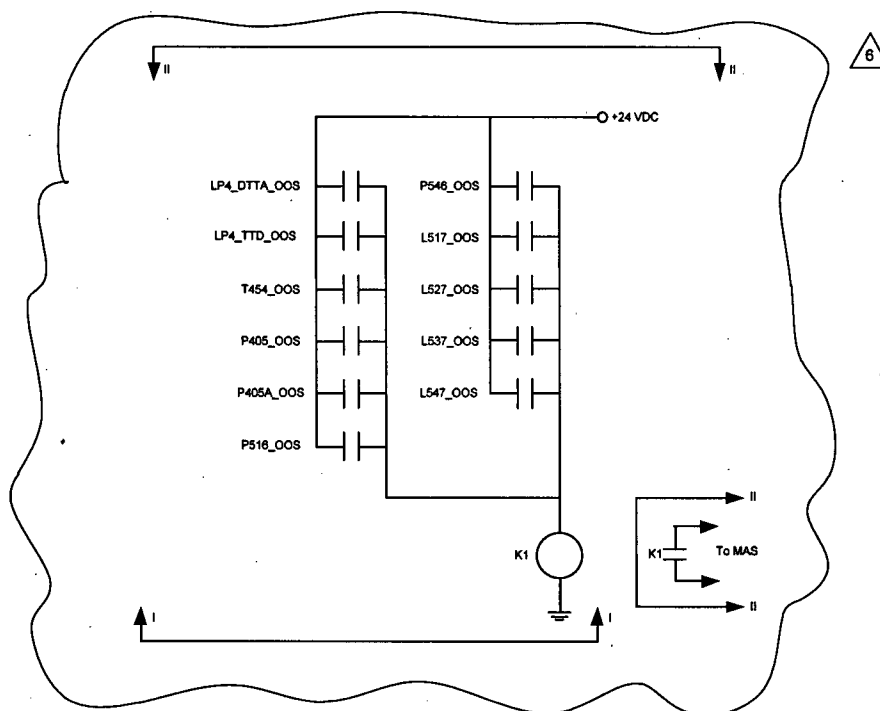
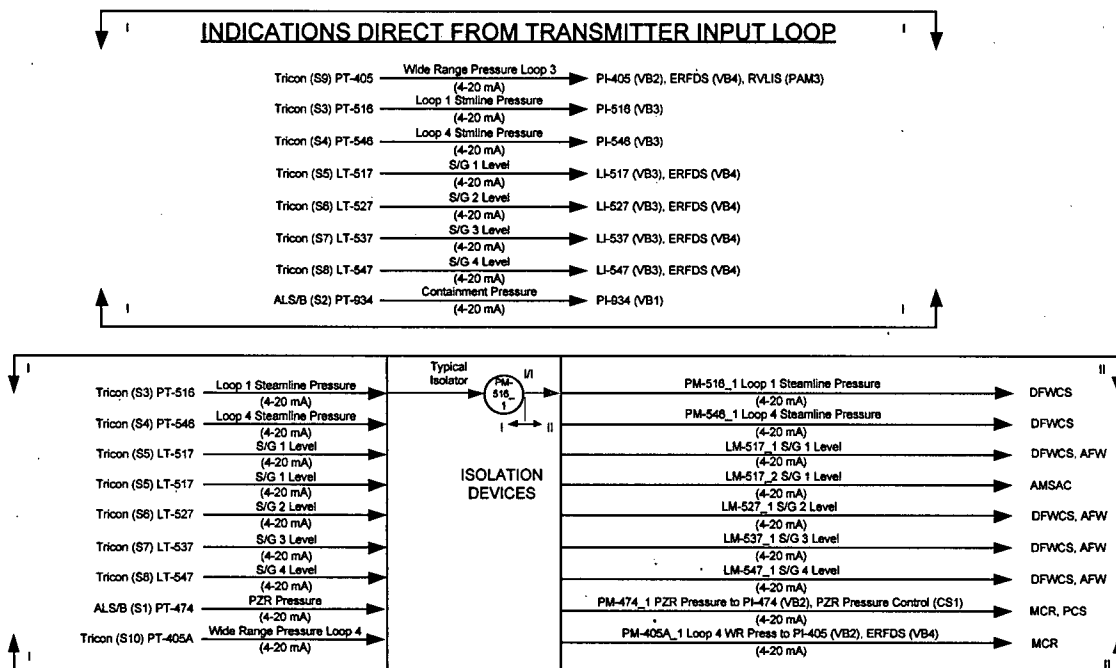


Figure 1-19 Replacement PPS Architecture – Set IV Safety-Related Tricon Main Chassis

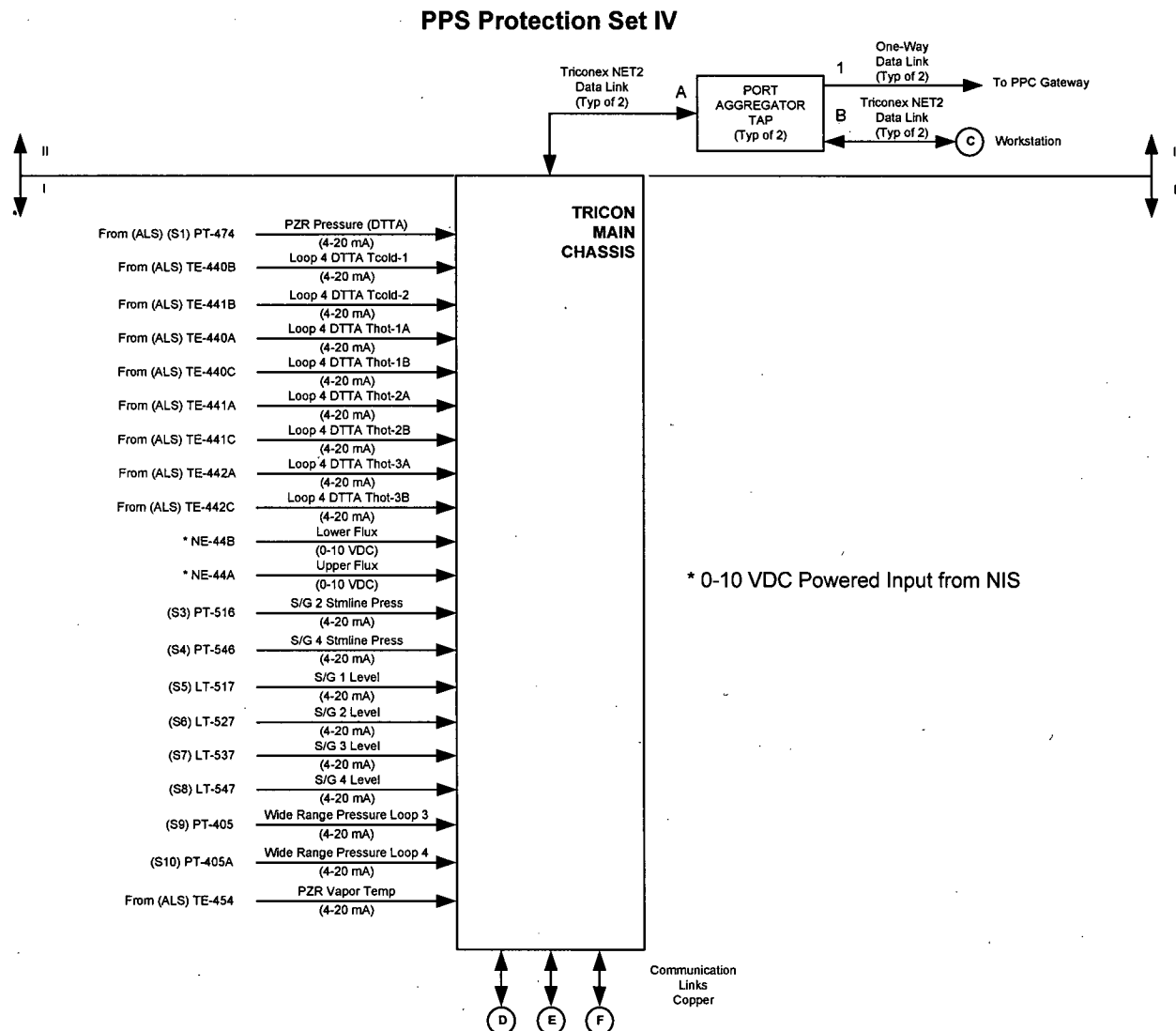


Figure 1-20 Replacement PPS Architecture – Set IV Safety-Related Tricon Primary RXM Chassis

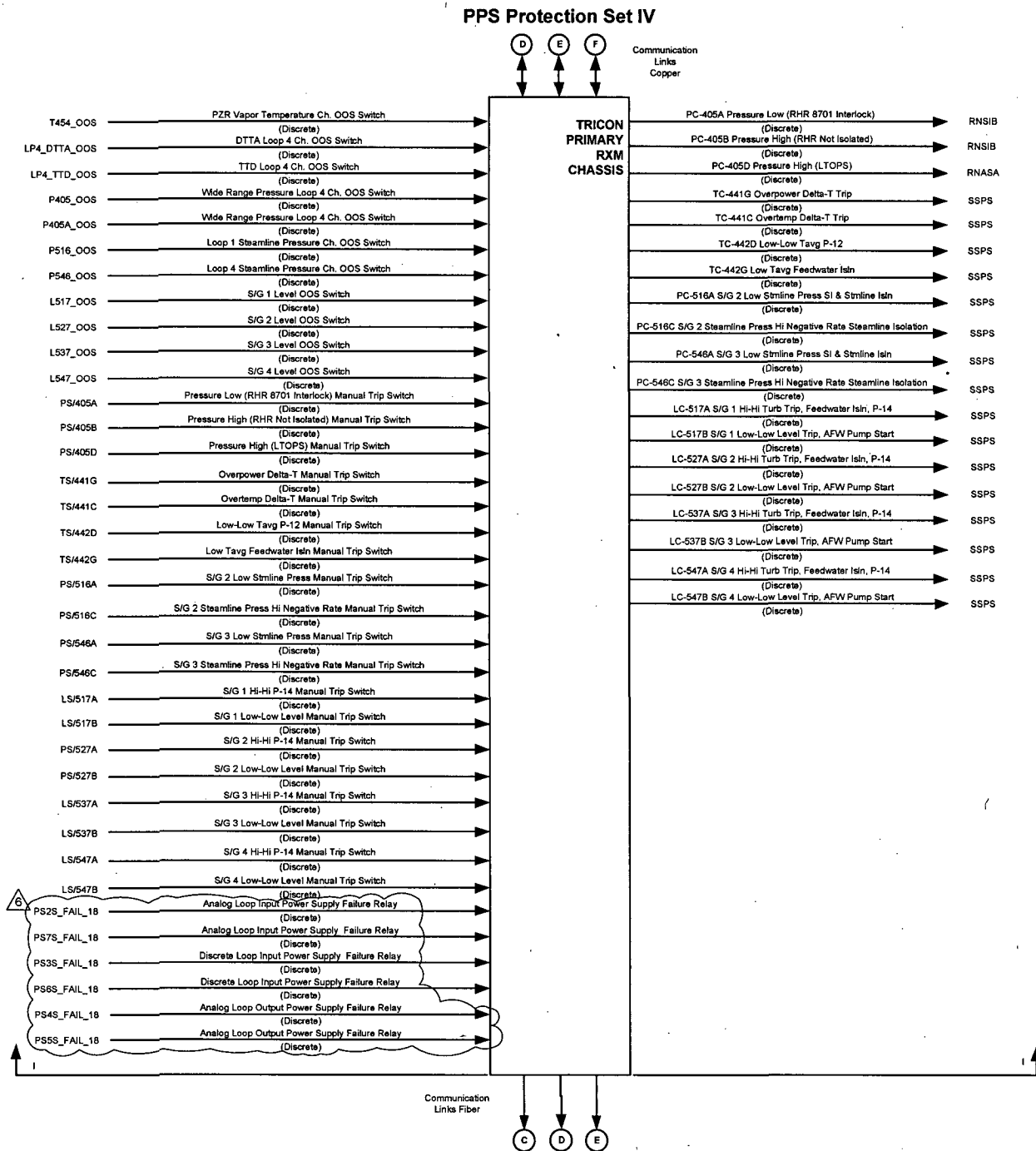


Figure 1-21 Replacement PPS Architecture – Set IV Non-Safety-Related Tricon Chassis

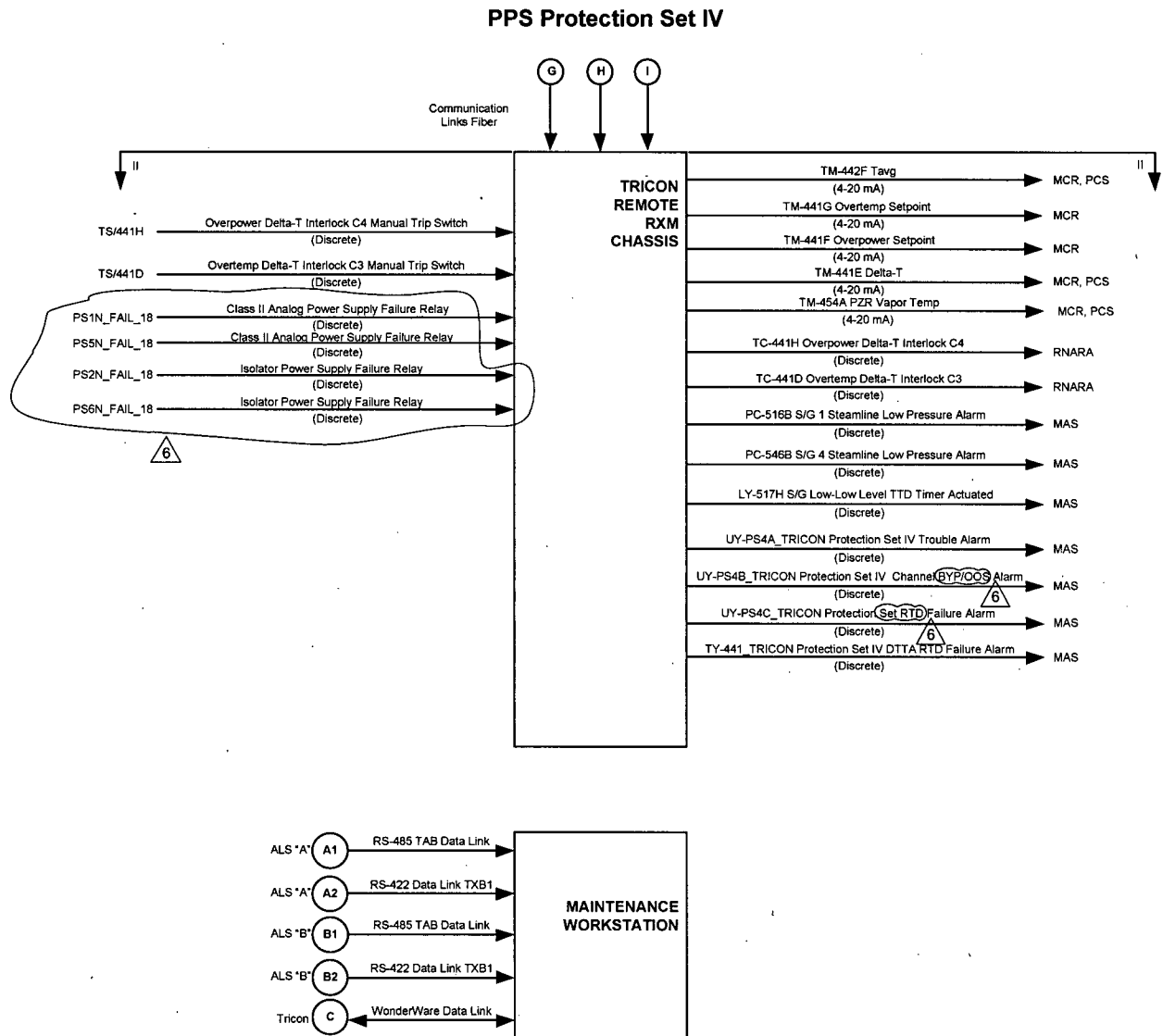
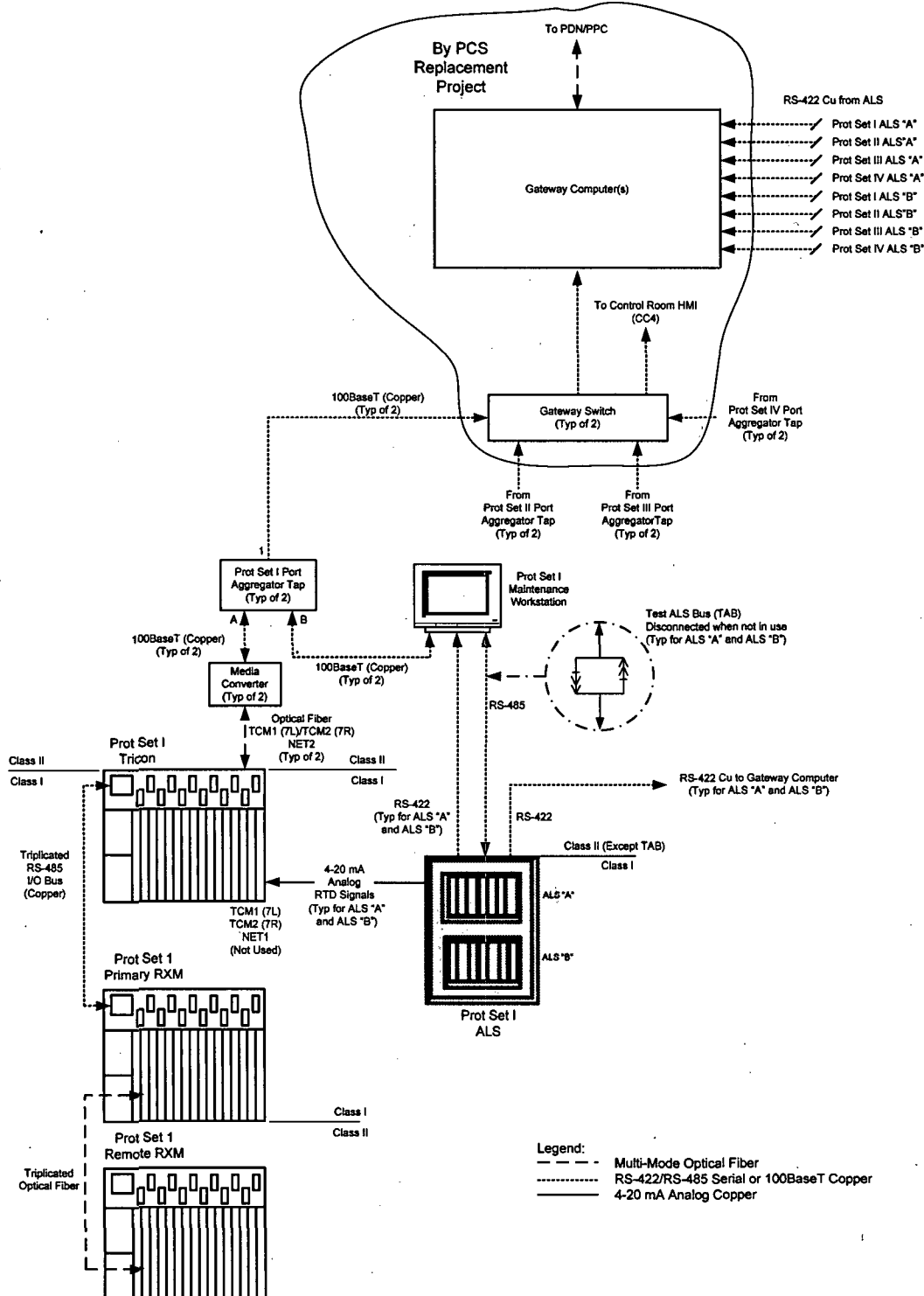


Figure 1-22 Replacement PPS Non-Safety-Related Communications Architecture



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.

2.1 Process Interface Requirements

Appendix 3.1 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.

2.1.1 I/O Power Supplies

The Triconex qualification requires that separate power supplies be used for analog and digital I/O.

1. All Tricon discrete inputs and outputs will be powered in accordance with the requirements provided in the I/O list.
2. The Containment Pressure Bypass switch inputs to the ALS will be dry contacts wetted by 48 Vdc supplied by PG&E.
3. The Pressurizer pressure loops are shared among the ALS, Tricon, and the control system, via Moore Isolator modules, and will be powered by the Tricon ETP as shown in Figure 2-2.
4. Where the analog input signal source is a process transmitter, bounding loop resistances per the I/O list are as follows:
 - a. Max resistance < 750 ohms
 - b. Min resistance > 200 ohms
5. All 4-20 mA analog 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.
6. PG&E will provide adjustable power supplies which will accommodate the above bounding loop resistance values. Analog 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
 - 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 220 ohms [Figure 2-3] when both "A" and "B" 302 boards are in the circuit.
 - i. Triconex 9792-610N Reg. Guide 1.180 FTP Max 48 Vdc (Approx. input resistance: $(250 + 1/(1/250 + 1/3300)) \sim 482$ ohms)
 - j. Input and output loop resistances as shown in Appendix 3.1 based on Triconex resistance above and:
 - Moore CPT isolator input 4-20 mA into 20 ohms
 - Westinghouse VX-252 indicator: 5 ohms (including estimated wire resistance)
 - ERFDS: 50 ohms
 - RVLIS: 250 ohms
 - k. ALS 4-20 mA analog outputs are powered by the ALS. Therefore, temperature inputs to the Tricon will not use the Positive Temperature Coefficient (PTC) thermistor for loop overcurrent protection and the input resistance for Tricon temperature inputs is 250 ohms.
7. Tricon Analog Output Power Supply
- a. Analog outputs in the safety-related Triconex Main Chassis will be powered by redundant power supplies furnished by PG&E. The analog outputs share the same power supplies used for Tricon Main Chassis analog inputs as discussed in the previous section.
 - 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.

2.1.2 Analog Inputs

Figure 2-1, Figure 2-2, and Figure 2-3 illustrate typical PPS analog input signal wiring [1.4.5.6, 1.4.5.7]:

- 1. PT-455 signal shared among Tricon (DTTA functions), ALS-A, ALS-B and an isolation device
- 2. LT-459 signal shared among Tricon, Control Board indicators and an isolation device
- 3. PT-505 signal shared among the Tricon, and an isolation device
- 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 2-2.
- 5. Tricon AI cards 3721 (where used) and 3721N shall be configured for 14-bit resolution, unipolar. These cards are used for all 4-20 mA analog inputs to the PPS

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.
7. Signals from redundant field devices shall be processed on separate input boards.

2.1.3 Discrete Inputs

Signals from redundant field devices shall be processed on separate input boards.

2.1.4 Discrete Outputs

Figure 2-4 and Figure 2-5 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 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.

Refer to the ALS Design Specification [1.4.5.6] for additional information regarding the LSM and field wiring interface.

Figure 2-1 Typical ALS Analog Input Wiring

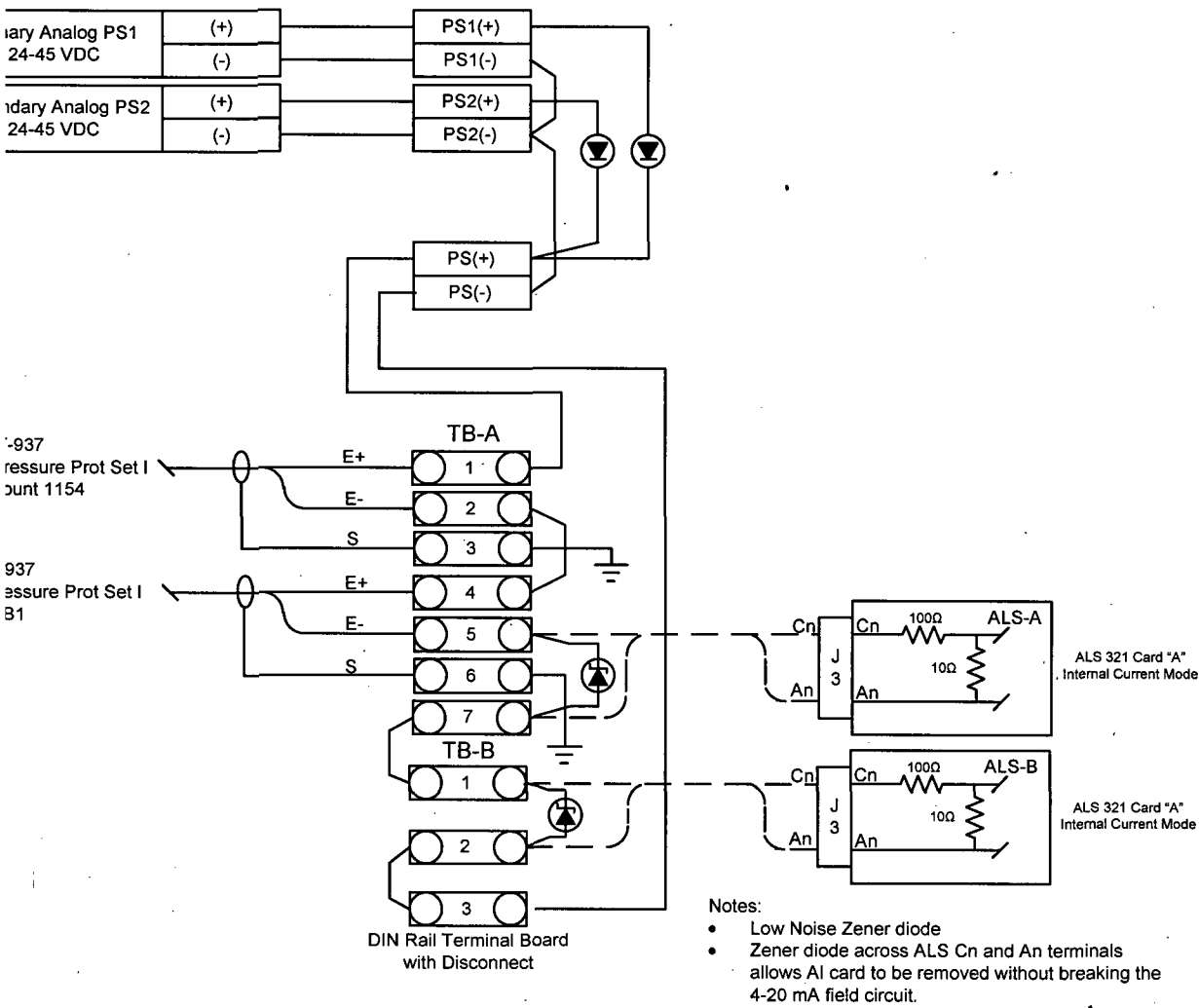


Figure 2-2

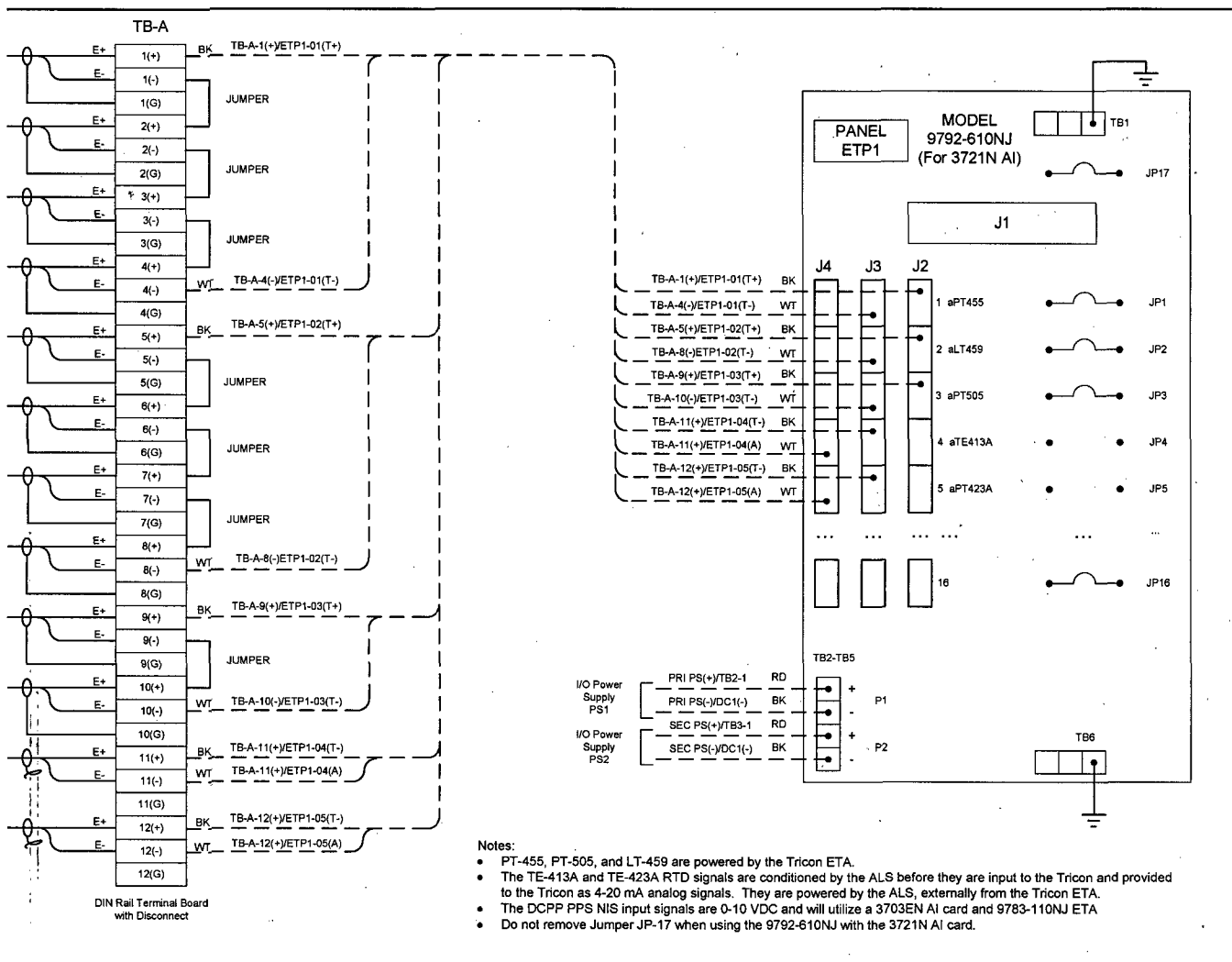


Figure 2-3 Tricon/ALS PT-455 Interface Wiring

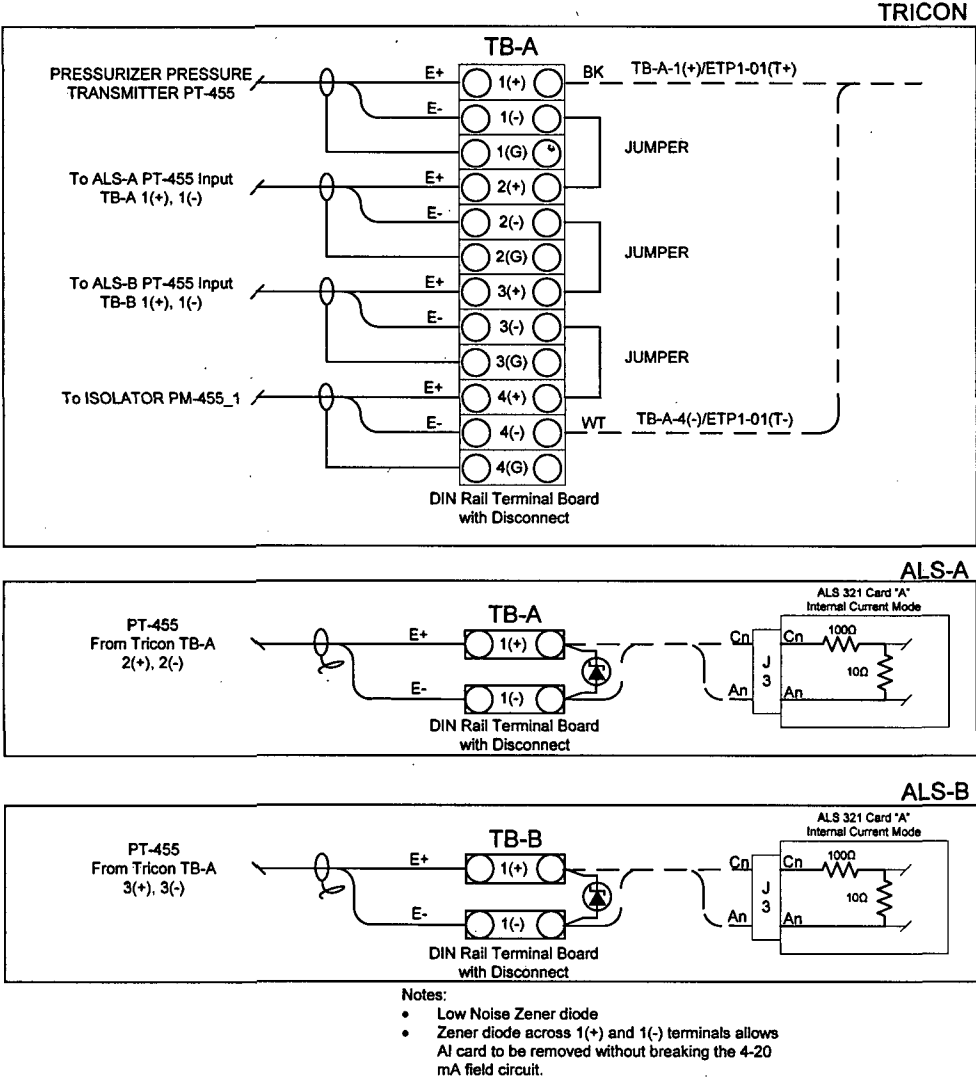
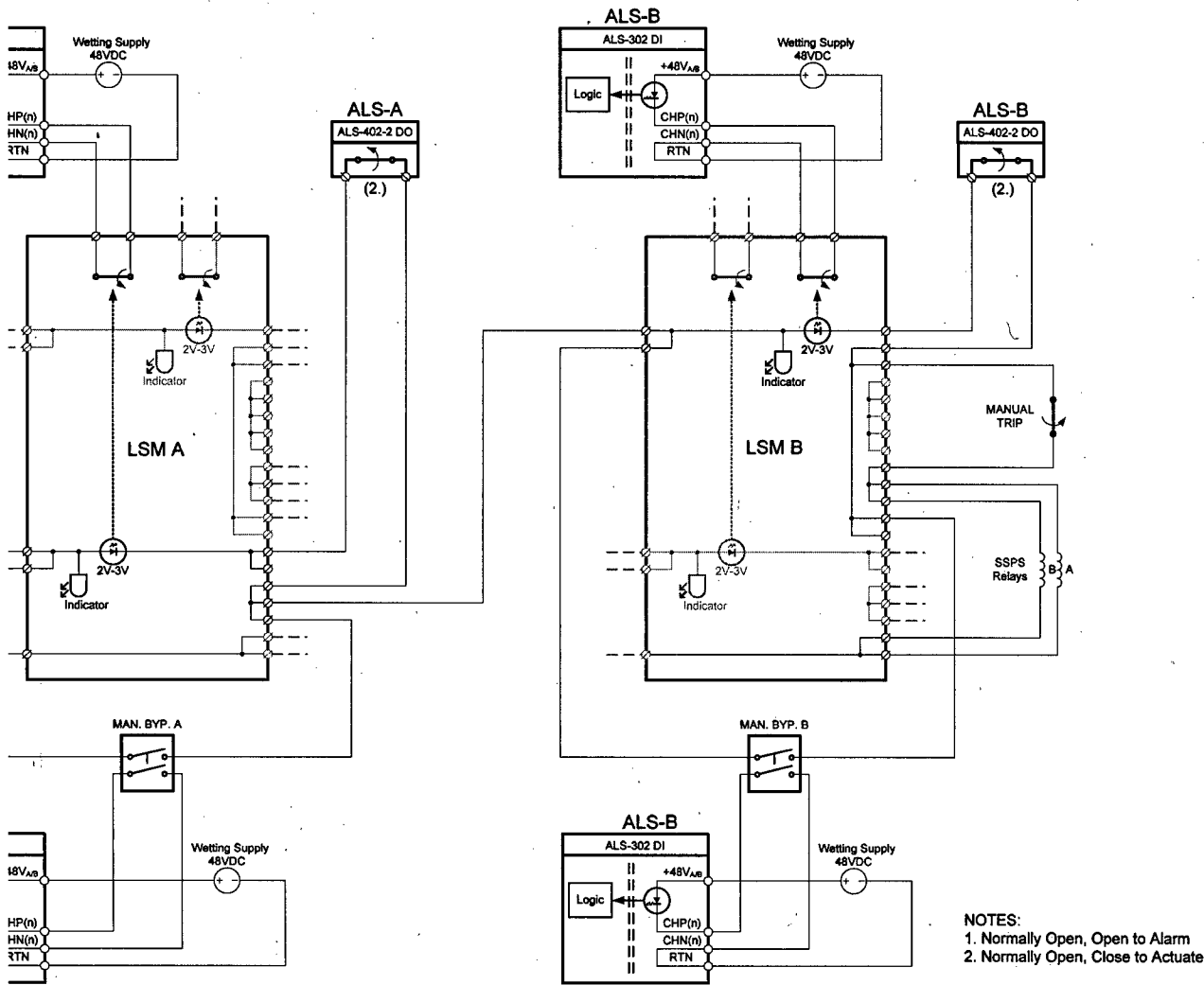
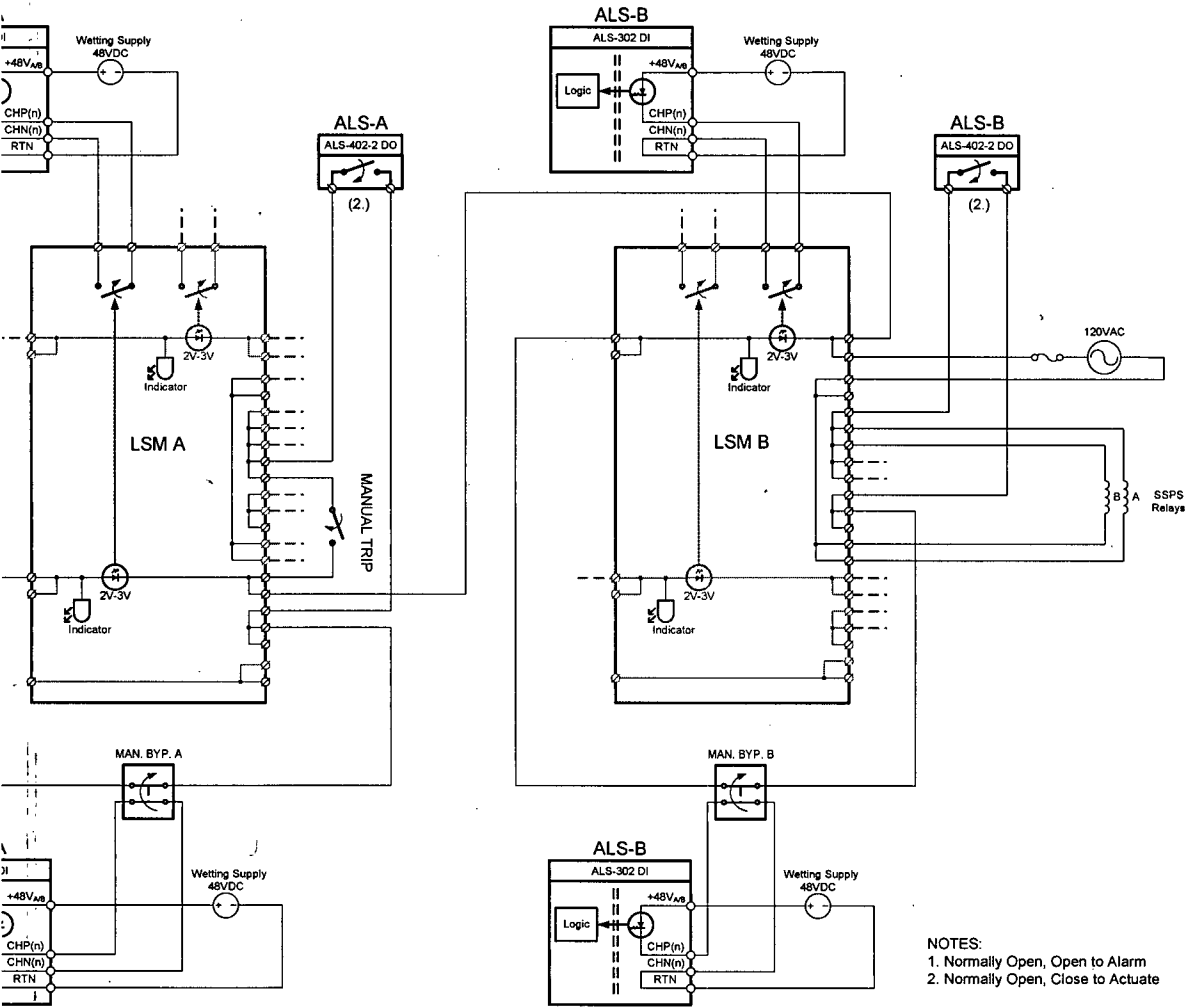


Figure 2-4 ALS-A and ALS-B SSPS Connections (Deenergize to Trip Configuration)



1 A and LSM B are parts of a single LSM.

Figure 2-5 ALS-A and ALS-B SSPS Connections (Energize to Trip Configuration)



1 A and LSM B are parts of a single LSM.

2.2 Safety-Related ALS/Tricon Interface Requirements

1. ALS shall provide 4-20 mA analog Temperature channel inputs to Tricon
2. ALS output signals shall be powered by ALS

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.

2.3.1 Non-Safety-Related Communications from Tricon to Port Aggregator Tap (2-way)

- 2.3.1.1 Hardware: Net Optics PA-CU 10/100BaseT Port Aggregator Tap supplied by PG&E
- 2.3.1.2 Media: Optical Fiber from TCM 100baseT Ethernet Media Converter to port aggregator. Supplied by Triconex.
- 2.3.1.3 Data Interface Protocol: Triconex Standard Ethernet NET2

2.3.2 Non-Safety-Related Communications from Port Aggregator Tap to Maintenance Workstation (2-way)

- 2.3.2.1 Hardware: See Section 2.3.1.1
- 2.3.2.2 Media: 100baseT Ethernet
- 2.3.2.3 Data Interface Protocol: Triconex Standard Ethernet NET2

2.3.3 Non-Safety-Related Data Communications from ALS to Maintenance Workstation (1-way)

- 2.3.3.1 Description: Core Logic Board communication channel TXB1
- 2.3.3.2 Media: RS-422 twisted pair copper to maintenance workstation
- 2.3.3.3 Data Interface Protocol: RS-422

2.3.4 Non-Safety-Related Communications from ALS Test ALS Bus (TAB) to Maintenance Workstation (disabled or enabled by switch position)

- 2.3.4.1 Description: TAB interface with ALS chassis
- 2.3.4.2 Media: RS-485 twisted pair copper to TAB enable switch and MWS
- 2.3.4.3 Data Interface Protocol: RS-485

2.3.5 Non-Safety-Related Communications from ALS to Gateway computer (One-way)

- 2.3.5.1 Description: Core Logic Board communication channel TXB2
- 2.3.5.2 Media: RS-422 twisted pair copper to Gateway computer
- 2.3.5.3 Data Interface Protocol: RS-422

2.3.6 Non-Safety-Related Communications from Port Aggregator Tap to Gateway computer (One-way)

2.3.6.1 Hardware: See Section 2.3.1.1.

2.3.6.2 Media: 100baseT Ethernet + network hub supplied by PG&E

2.3.6.3 Data Interface Protocol: Ethernet-based.

2.4 System Power Requirements

2.4.1 I/O Power

Refer to Section 2.1.1

2.4.2 Tricon System Power Requirements

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 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.

2.4.3 ALS System Power Requirements

The ALS "A" and ALS "B" chassis in each Protection Set requires two redundant safety related sources of 48 VDC power, which are necessary to power the ALS chassis and the individual boards within the chassis. The power supplies are provided by PG&E. As with the Tricon, the single vital 120 VAC power source provided by PG&E for each protection set will be connected in parallel to the two ALS chassis power supplies.

2.5 Instrument Power Supply Locations

To be determined by detailed design.

2.6 System Power Sources Provided by PG&E

2.6.1 The following power sources are available for the Process Protection System:

2.6.1.1 120 Vac vital instrument power [1.4.4.7]:

Voltage: 120V \pm 10% [DC 6010908-397]

Frequency: 60 HZ \pm 5% [DC 6010908-397]

2.6.1.2 Non-safety-related 120 Vac utility power

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].

2.7 Workstations

2.7.1 Maintenance Workstation

The Maintenance Workstation shall allow processing and display of information from both Triconex and ALS portions of the PPS. WonderWare InTouch application shall interface (2-way) with the Tricon and display information from both Tricon and ALS (1-way).

2.7.2 Auxiliary Service Unit Application Software

Software application shall be provided by Vendor CS Innovations to run on Maintenance Workstation.

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 DCP Main Control Room (MCR). Separate input signals shall be provided for these alarms from each Protection Set per Section 3.2.1.5 of the FRS [1.4.4.2].

2.8.1 PPS Failure (Deenergize to Alarm with Reflash capability)

The conditions listed in FRS Section 3.2.1.5.1 shall provide signals to initiate the PPS Failure alarm in the Main Control Room.

2.8.2 PPS Trouble (Deenergize to Alarm with Reflash capability)

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.

2.8.2.1 Controller keyswitch not in RUN (Tricon only)

2.8.2.2 TAB communication enabled (ALS Only)

2.8.3 PPS Channel in Bypass [Energize to Alarm with Reflash capability]

2.8.3.1 External comparator Bypass switches, *where used*, are provided with two (2) separate and independent output contacts.

- 1) One contact physically bypasses the comparator trip/actuation output per FRS Section 3.2.1.3.6.
- 2) One contact satisfies Bypassed Indication requirements per Section 3.2.1.5.3.a) of the FRS

2.8.3.2 External 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 and alarm requirements per FRS Section 3.2.1.3.7.
- 2) One contact for use by the MAS, independent of the PPS.

3 Appendices

3.1 Process Protection System I/O List