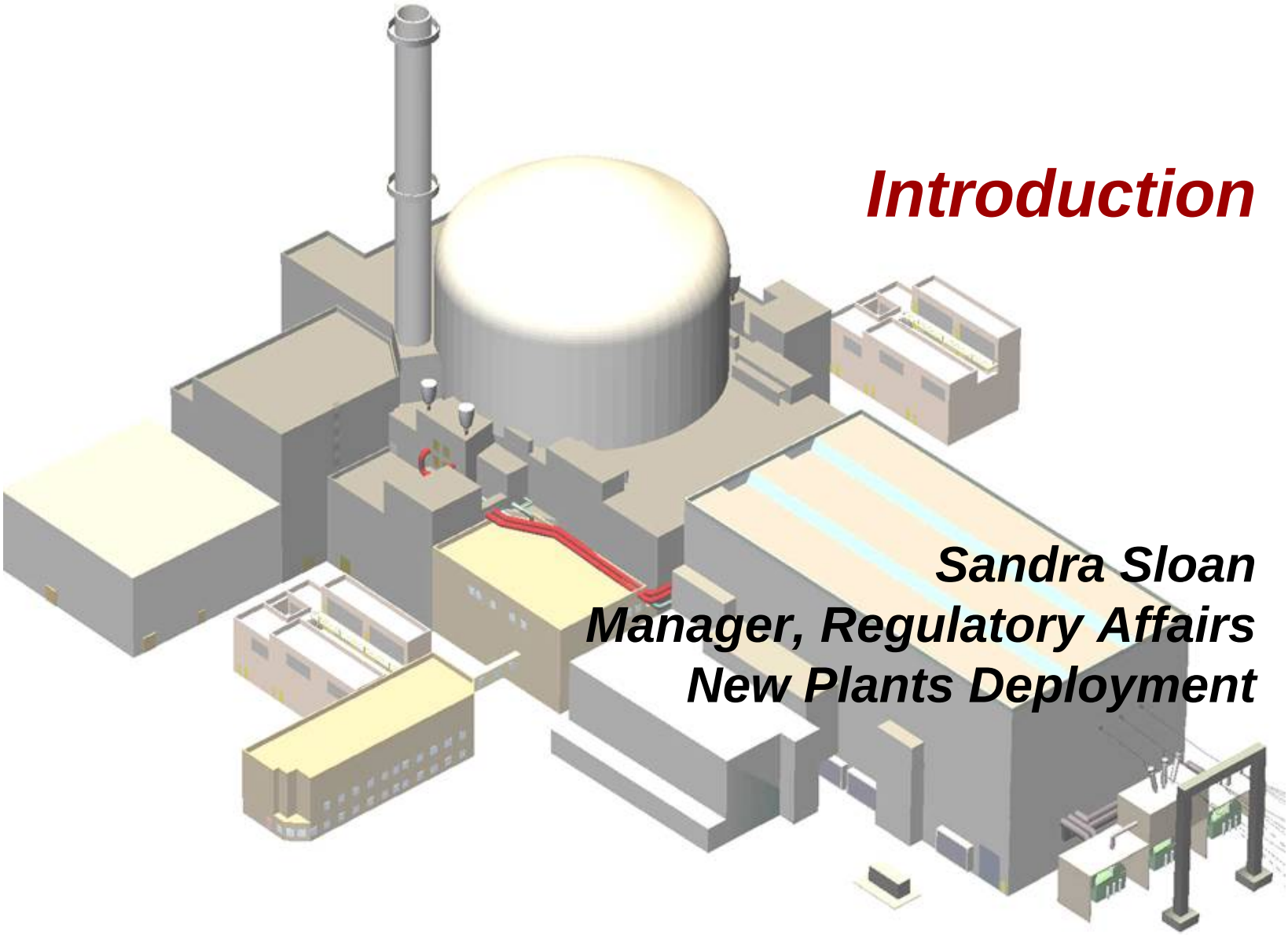
U.S. EPR Pre-Application Review Meeting:

Digital Instrumentation and Control System Topics

AREVA NP Inc. and the NRC
August 31, 2006

Introduction



Sandra Sloan
Manager, Regulatory Affairs
New Plants Deployment

Meeting Objectives

- Provide a technical discussion of key elements of the U.S. EPR Instrumentation & Controls (I&C) design
- Provide an overview of the purpose, content, and schedule for planned U.S. EPR I&C pre-application reports
- Obtain early NRC feedback associated with the U.S. EPR I&C system design and topical report plans

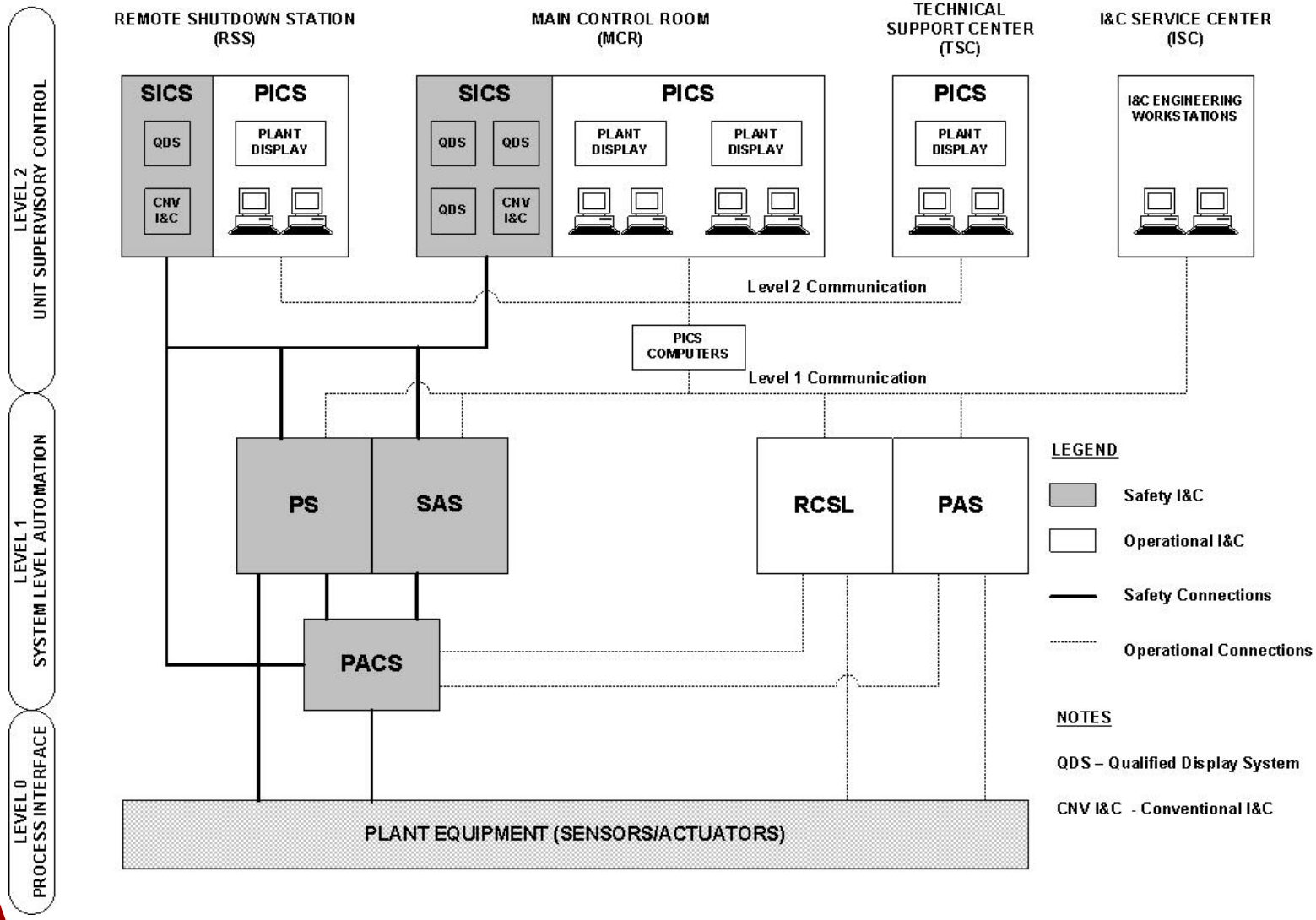
Meeting Outline

- **Technical discussions**
  - **I&C architecture and systems (Vic Fregonese)**
  - **Selected safety system topics (Shelby Small, Jeremy Shook, Phil Liddle)**
  - **Control room and Human Machine Interface (HMI) (Jeff Jones)**
- **Pre-application submittals for I&C and Human Factors Engineering (Vic Fregonese)**

Technical Discussions: I&C Architecture and Systems

Vic Fregonese
Manager, I&C

I&C Systems Architecture



I&C Systems Definition

LEVEL 2
UNIT SUPERVISORY CONTROL

SICS
TXS (QDS), Conventional I&C
• Backup to PICS for limited operation and safe shutdown • Manual actuation of safety functions • Safety grade display of PAM information • Misc. Safety Related I&C

PICS
TXP
• Primary console for operators • Controls and display for all plant systems (safety and non-safety)

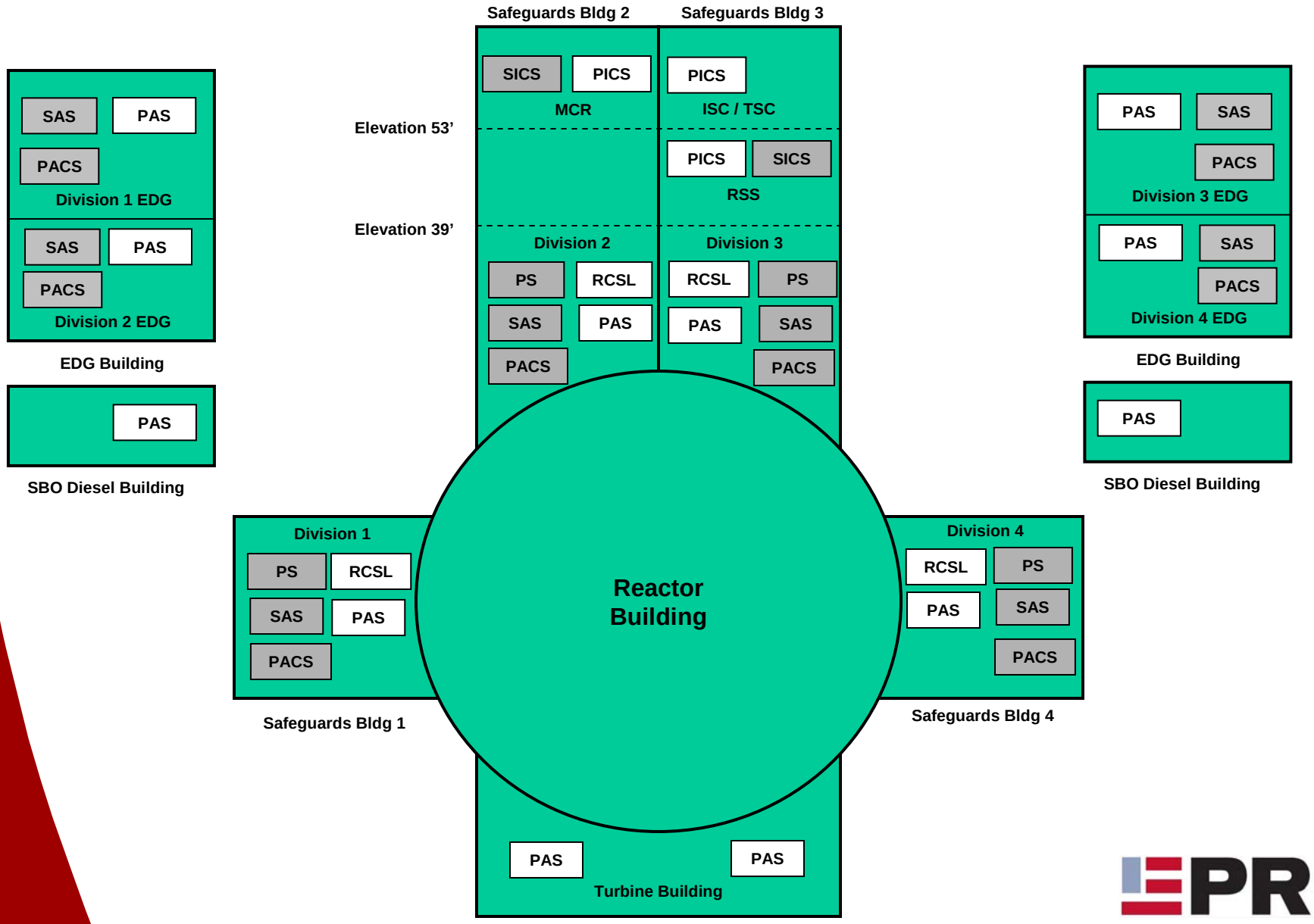
LEVEL 1
SYSTEM LEVEL AUTOMATION

PS	SAS
TXS	TXS
• Reactor Trip • ESFAS • Permissives	• MSRT • EFW • RHR • CCWS • ESWS • HVAC (Safety) • EDG • Post Accident Monitoring

RCSL	PAS
TXS	TXP
• Core Related Limitations • Primary Related Limitations • Core Related Controls • Primary Related Controls	• Misc. Primary Controls • Secondary Loop Controls • Turbine Controls • Waste and Disposal Systems • Cooling Water Systems (Non-safety) • HVAC (Non-safety) • Diverse Protection

PACS
TXS (AV-42)
• Prioritization of Safety and Non-Safety Signals • Component Protection • Drive Actuation • Drive Monitoring • MCR-RSS Selection

I&C Systems Arrangement



Regulatory Differences Drive Design Changes in U.S.

I&C Safety Classifications		
Finland	**France**	**U.S.**
SC-2	**F1A**	**Safety**
SC-3	**F1B / F2**	**Safety / Non-Safety**
SC-4	**F2**	**Non-Safety**

Global EPR Systems Differences

SYSTEM	OL-3	FL-3	U.S.
PS	TXS	TXS	TXS
*SAS	TXP	TXP	TXS
RCSL	TXS	TXS	TXS
*PAS	TXP	TXP	TXP
PACS	TXS (priority modules)	Switchgear cabinets	TXS (priority modules)
SICS	Mostly conventional I&C, limited QDS	Mostly QDS, limited conventional I&C	Mostly QDS, limited conventional I&C
PICS	TXP	TXP	TXP
DIVERSE PROTECTION FUNCTIONS	TXP / HBS	TXP	TXP

* The functional definition of these systems is slightly different for the U.S. EPR than for the European plants

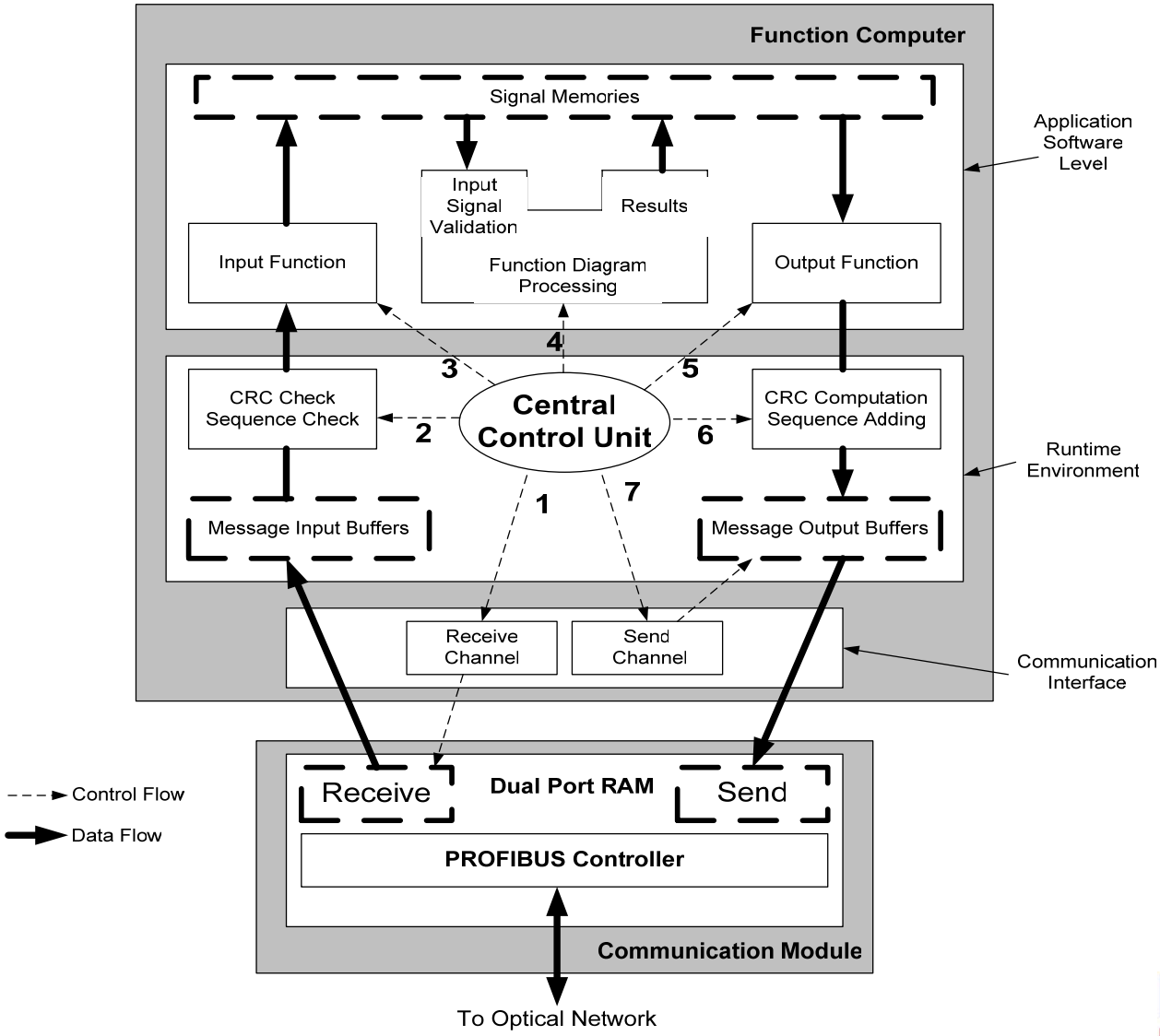
Technical Discussions: Selected Safety System Topics

Shelby Small
Jeremy Shook
Phil Liddle

Safety System Topics

- Protection System
  - Safety Classified Communication Principles
    - TXS communication processing
    - TXS network features
    - PS examples
  - Fault Detection and Accommodation
    - TXS features
    - PS specific features
  - PS Redundancy and Diversity
- PACS
  - System Overview
  - AV-42 Priority Control Module
- Methods for Manual Initiation of Protective Actions from SICS
- Methods for Communication Between Safety and Non-Safety Systems
- Qualified Display System (QDS)
- Diversity and Defense-in-Depth
- Computer Security

TXS Safety Classified Communication: Processing Overview



TXS Safety Classified Communication: Processing Overview

- **Central Control Unit coordinates data flow in a sequential fashion:**

1) **Communication interface transfers messages from "receive RAM" to corresponding message input buffers**
2) **CRC checksum, message identification and sequence increment checks performed and transfer of messages from message input buffers to input function**
3) **Input function identifies individual signals within messages and allocates them to signal memories**

TXS Safety Classified Communication: Processing Overview

4) Function diagram processing (including signal validation) is performed. Results stored in dedicated signal memory locations
5) Output function collects result signals and forms output messages.
6) RTE attaches new CRC checksum, message identification and cycle counter and stores messages in message output buffers
7) Communication Interface transfers messages from message output buffers to “send RAM”

SER Received on TXS communication processing in May, 2000

TXS Safety Classified Communication: Processing Summary

- Runtime environment controls all processing actions and ensures discrete, cyclic processing
- Independent control flow of function computer and communication module
- Token passing protocol used at communication module level to avoid data collisions
- Individual memory locations for each message ensure separation of send and receive flows
- Checks performed on received messages (prior to function diagram processing) ensures valid message transmission
- Checks on input signals ensure valid input data to function diagrams

Ensures interference-free communication

TXS Safety Classified Communication: Network Configurations

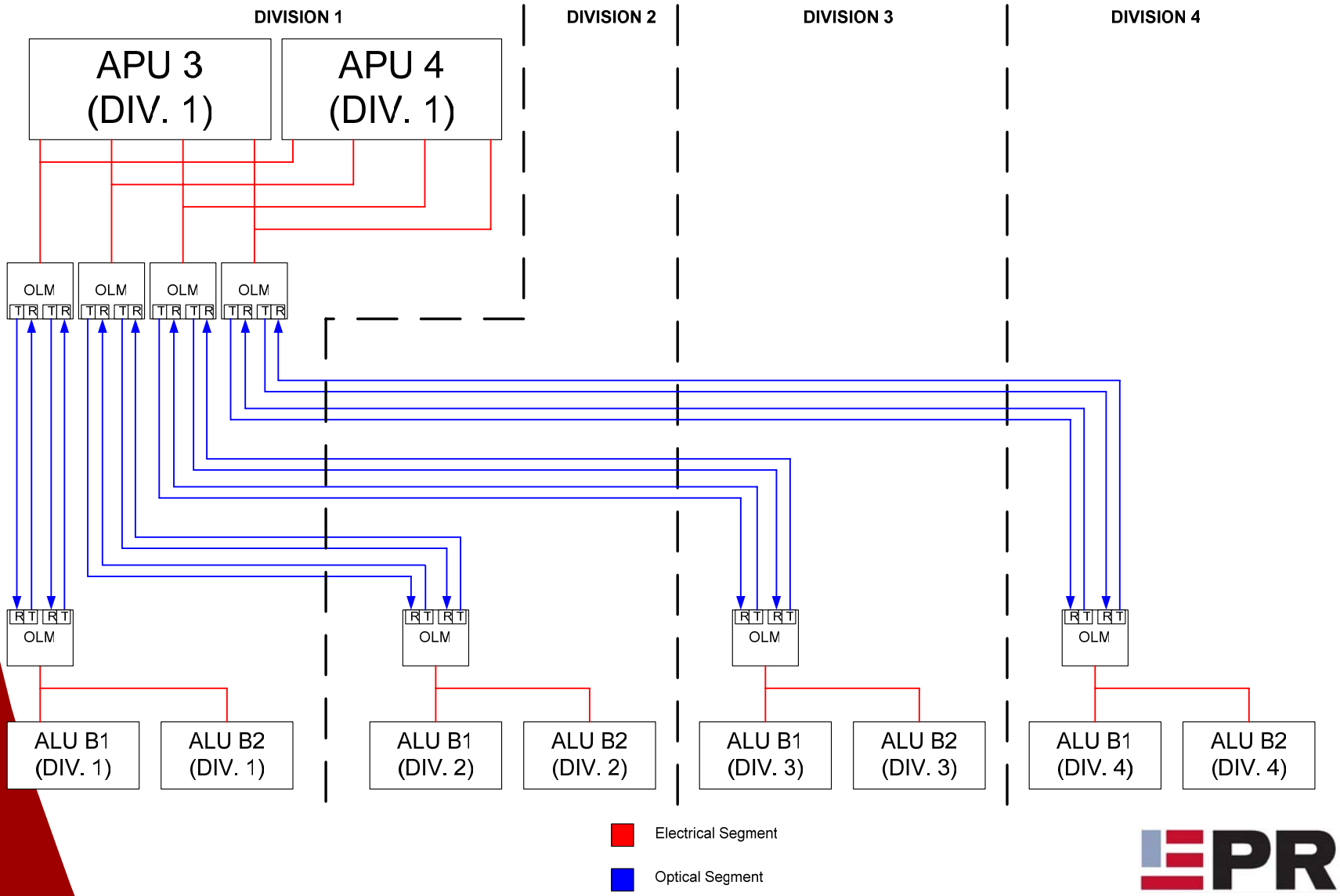
- Communications between divisions or between different cabinets in the same division use fiber optic cabling and optical link modules
- TXS platform provides multiple options for reliable network configurations
- Configurations chosen based on specific applications

Chosen network configurations ensure high network reliability

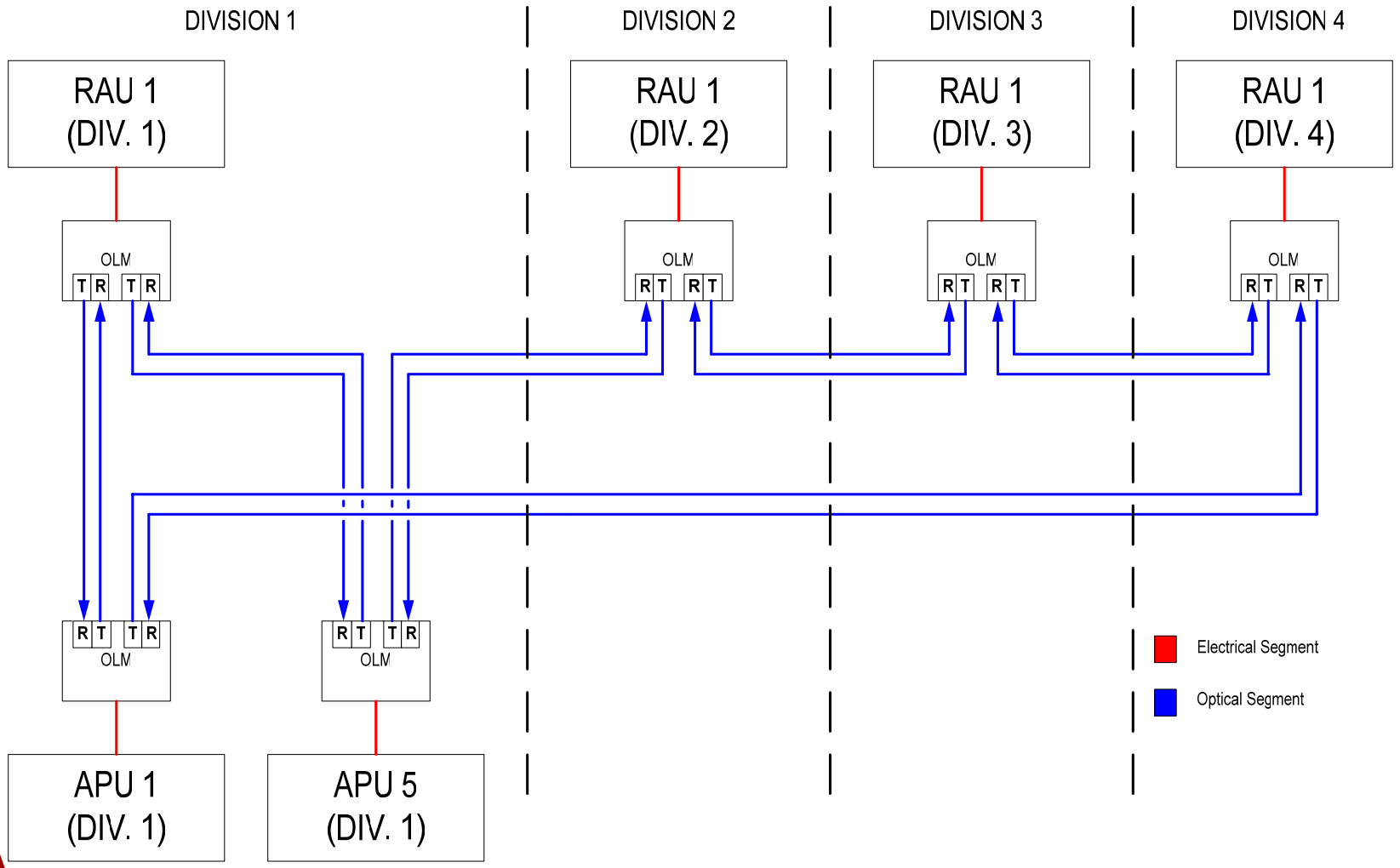
TXS Safety Classified Communication: Optical Link Modules

- Each link module contains electrical and optical channels
  - Only optical channels are used for safety related connections between different cabinets or divisions
- Link modules actively monitor optical paths for interruption
  - Monitoring achieved through “echo” functions
  - Faults in link modules or in optical paths are indicated locally and signaled to cabinet monitoring modules

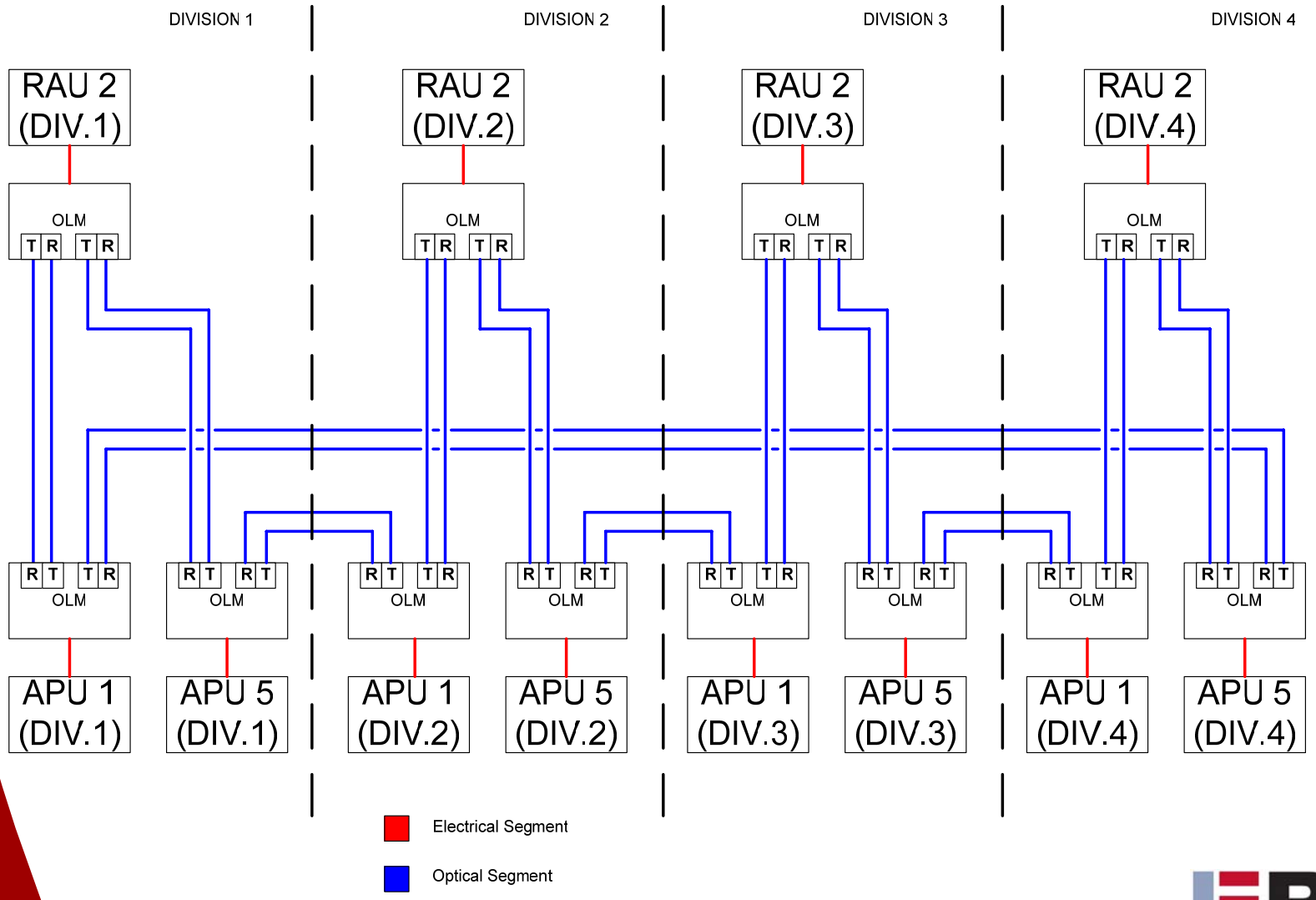
TXS Safety Classified Communication: PS- APU/ALU Network Example



TXS Safety Classified Communication: PS- RAU1 Network Example



TXS Safety Classified Communication: PS- RAU2 Network Example



TXS Safety Classified Communication: Regulatory Analysis

- **IEEE 603 Clause 5.6.1- Independence between redundant portions of a safety system**
  - **Voting logic downstream of communication links ensures that the failure of one division does not prevent another division from performing a safety function**
  - **Each division is physically separated from the other divisions**
  - **Electrical independence between divisions is ensured through Class 1E isolation devices (in accordance with IEEE 384)**

Independence is maintained between redundant divisions

TXS Safety Classified Communication: Regulatory Analysis

- **IEEE 7-4.3.2 Clause 5.6 – Independence**
- **Communications independence ensured by:**
  - **Token passing - no data collisions between divisions**
  - **Independent control flow of function computers and associated communication modules**
  - **Message characteristics (CRC, length, address) checked on all in-coming communications (prior to data being used in a safety function)**
  - **Input signal status monitoring on in-coming data at the function diagram level**
  - **Active monitoring of communication link modules/paths for faults**
  - **Fault handling techniques ensure that data communication errors between divisions do not inhibit the performance of safety functions**

Communications independence is maintained between divisions

TXS Fault Detection: Overview

- **Two types of fault detection**
  - **Detection by mechanisms inherent in the system**
  - **Detection by engineered monitoring functions**
- **Detection by inherent mechanisms:**
  - **“Built-in” monitoring functionality identifies deviations from expected system behavior**
  - **Not application specific**
- **Detection by engineered monitoring functions:**
  - **Used to analyze signal information to detect failures in system equipment and in signal processing**
  - **Application specific**

TXS Fault Detection: Inherent Mechanism Examples

- **Monitoring by the run time environment**
  - **RTE collects and indicates error messages from I/O drivers, communication monitoring, function diagram modules, etc. during functional task processing**
  - **Information about these errors are stored by the RTE to be used for fault accommodation/annunciation**

- **Cyclic self monitoring**
  - **Time from the end of functional task processing to the beginning of the next cycle is used to test function computer hardware**
  - **Cyclic monitoring is assigned a low priority and cannot interrupt functional task processing (i.e., trip algorithms)**

TXS Fault Detection: Inherent Mechanism Examples

- **Watchdog monitoring**
  - Used to detect a failure of the intended cyclical operation
- **Communication monitoring**
  - Monitors the integrity of the data transmitted between computers
  - The length, correct address and CRC-sum are verified for each data message
- **Startup self-tests**
  - Testing which is impossible during operation is performed during computer start-up or reset

TXS Fault Detection: Engineered Monitoring Examples

- **Function diagram blocks used to:**
  - **Detect faults in hardware components based on binary information from the cabinet monitoring**
  - **Monitor binary input signals**
  - **Perform range monitoring on analog input signals**
  - **Perform consistency checks on redundant signals**
  - **Monitor for processing conditions such as “divide by zero” or “square root of negative number”**

TXS Fault Accommodation: Overview

- Every signal carries a value and a status
- A detected fault will result in a “faulty” status on all affected signals
- Faulty status can be propagated through the function blocks (i.e., if one input is faulty, output is faulty)
- Status of signals is used as input to fault accommodation functions:
  - Safe state output setting
  - Voting logic
- Signal status can be used for fault annunciation

TXS Fault Accommodation: Safe State Outputs

- **Final outputs of the safety systems can be set to the safe state by:**
  - **Ordering the output module to disable its outputs (output signal states remain in memory but do not appear at output terminals)**
  - **Automatically removing power to the output module**
  - **Using functional blocks to force the output value to a pre-defined value**

PS Fault Accommodation: Voting Logic

- 2 out of 4 logic is automatically adjusted according to the number of invalid input signals

Number of Invalid Signals	Logic Leading to Actuation	Logic Leading to No Actuation
0	2/4	2/4
1	2/3	2/3
2	1/2	2/2
3 or 4	Actuation	No Actuation

- For reactor trip functions, logic always degrades to actuation
- Other safety related functions are determined on a case-by-case basis

Fault Detection and Accommodation Summary

- Extensive fault detection mechanisms inherent to TXS platform
- Flexibility in engineered fault detection mechanisms
- Monitoring of processing and data communication functionality
- Fault accommodation through safe state output setting, voting logic, and dedicated function blocks

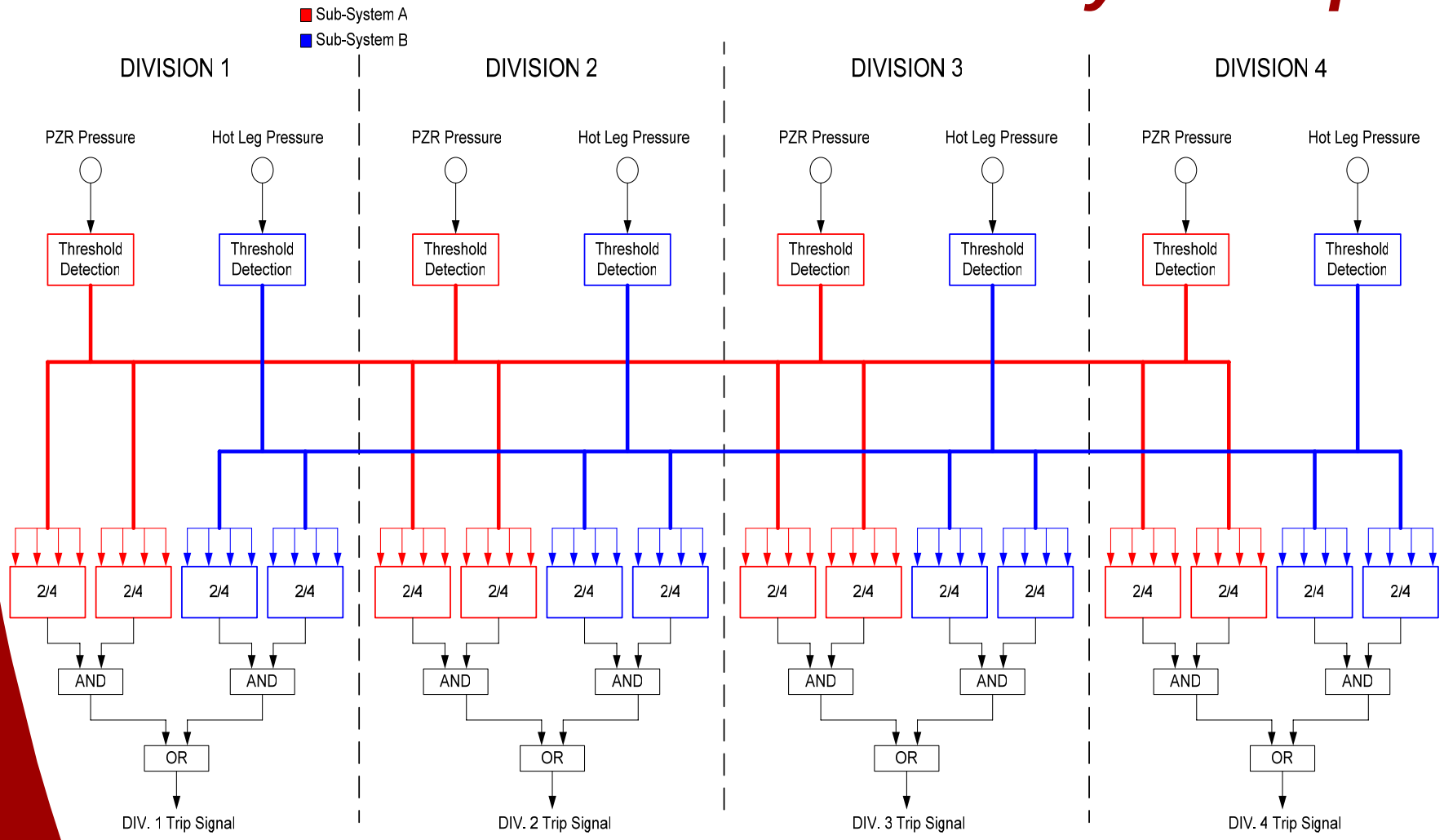
System reliability ensured

PS Redundancy and Diversity: Functional Diversity

- For each event requiring reactor trip, if the primary initiation signal is processed in sub-system A (or B), a diverse initiating signal, if necessary, is provided in sub-system B (or A)
  - A sensor used for a primary initiation signal in one sub-system cannot be used by the secondary initiation signal in the other sub-system
  - Sub-system A must comprise separate function computers from sub-system B
  - The function computers of different sub-systems are not be located in the same cabinets
  - Communications between function computers within a division must be limited to units of the same sub-system
  - Communications between divisions must be limited to units of the same sub-system

The goal is functional independence between sub-systems

PS Redundancy and Diversity: Functional Diversity Example



PS Redundancy and Diversity: Redundant Trip Signal Generation

- Redundant sensors acquired separately in respective divisions
- Each sensor compared to a threshold in its assigned division
- Result of threshold comparison in each division is sent to all 4 divisions for voting
- 2/4 voting performed redundantly in all 4 divisions on threshold information from all 4 divisions
- “AND” logical function performed on results from redundant voters in each division
- Divisional trip signal issued if both voters in a division are in agreement

PS Redundancy and Diversity: Reactor Trip Devices

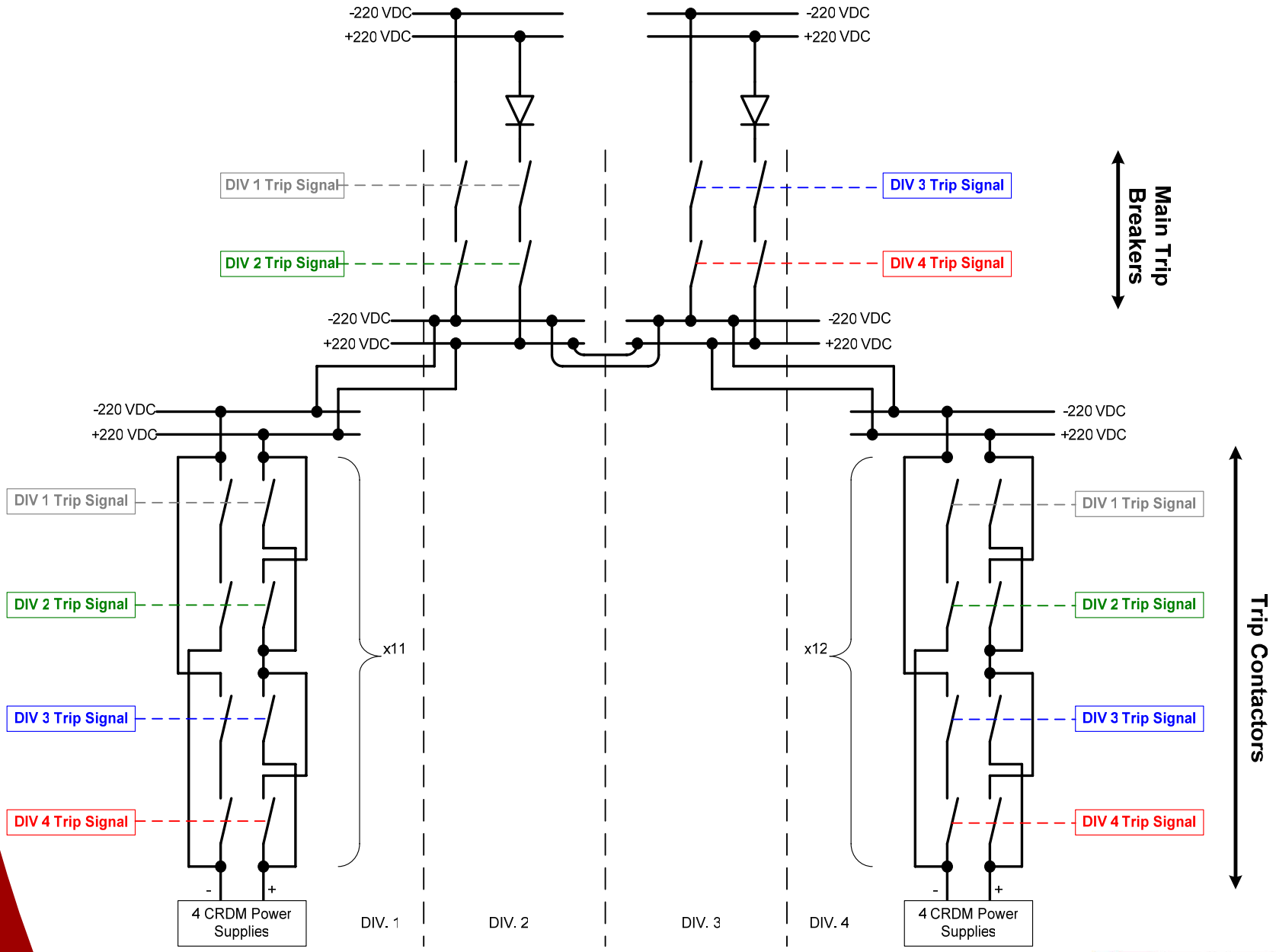
- **The PS acts on 3 diverse levels of the control rod drive power supply system to actuate reactor trip**
  - **Trip breakers**
    - **Safety related devices credited in safety analysis**
  - **Trip contactors**
    - **Safety related devices credited in safety analysis**
  - **Rod control transistors (Part of the rod control system)**
    - **Non-safety related devices – not credited in safety analysis**

PS Redundancy and Diversity: Trip Breakers

- 4 trip breakers (total)
- 2 breakers located in each of physical divisions 2 and 3
- Each breaker is assigned to one division of the PS for actuation

PS Redundancy and Diversity: Trip Contactors

- 23 sets of 4 trip contactors
  - 22 sets provide power to 4 CRDM each
  - 1 set provides power to center CRDM only
  - 11 sets located in physical division 1
  - 12 sets located in physical division 4
- Each divisional trip signal assigned to 1 contactor in each set
- Each set of 4 trip contactors implemented in 2-out-of-4 logic


-220 VDC
+220 VDC
DIV 1 Trip Signal
DIV 2 Trip Signal
DIV 3 Trip Signal
DIV 4 Trip Signal
Main Trip Breakers
x11
x12
Trip Contactors
4 CRDM Power Supplies
DIV. 1
DIV. 2
DIV. 3
DIV. 4

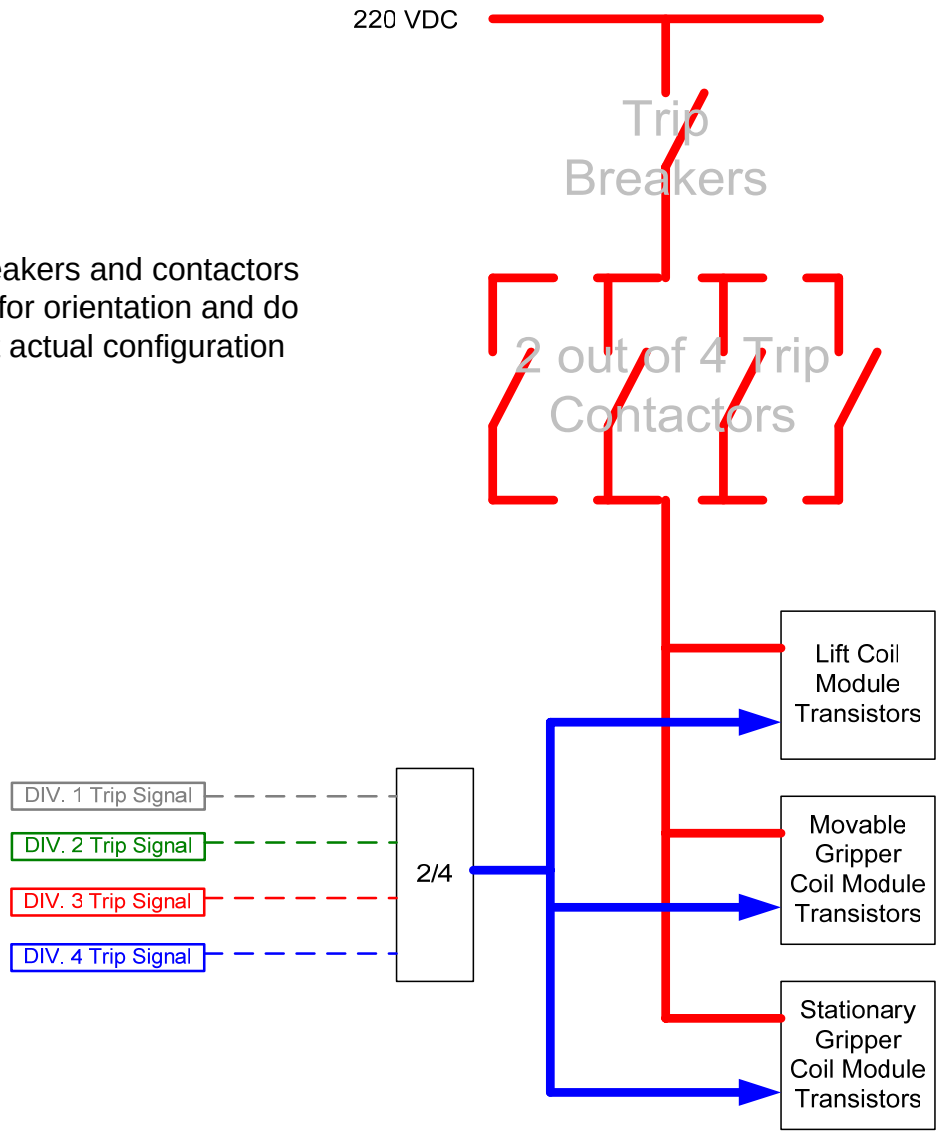
PS Redundancy and Diversity: Rod Control Transistors

- Transistors are used to operate the stationary gripper coil, movable gripper coil, and lift coil for each RCCA
- PS reactor trip signals are used to de-energize the transistors based on 2-out-of-4 logic
- Transistors are the fastest acting of the RT devices and allow the trip breakers and contactors to open under unloaded conditions

Improves performance of safety related trip devices over their lifetime

PS Redundancy and Diversity: Rod Control Transistors

Note: Trip breakers and contactors as shown are for orientation and do not represent actual configuration

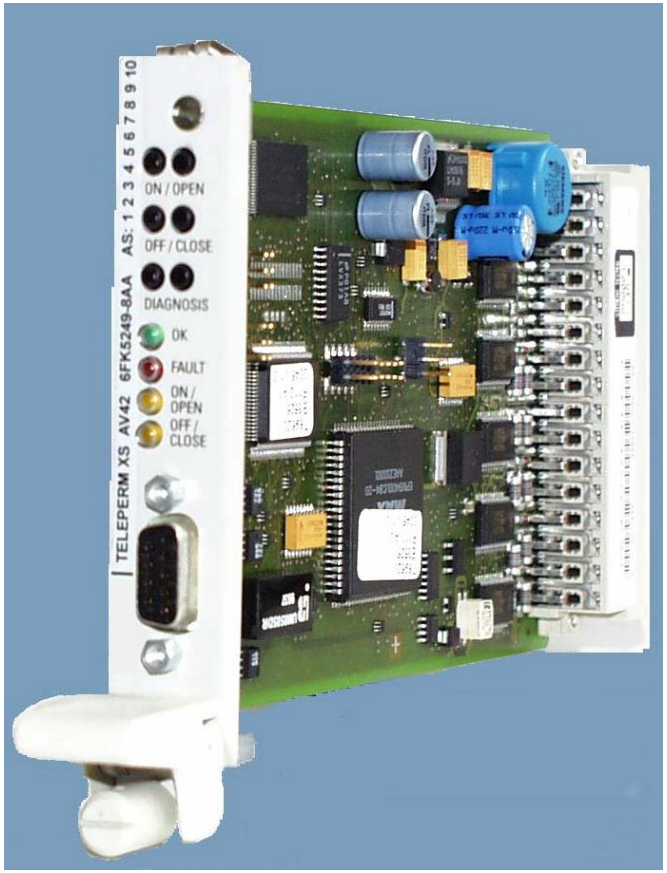


Priority Actuation and Control System: System Overview

- **Functions**
  - **Prioritize actuation requests**
  - **Drive actuation**
  - **Drive monitoring**
  - **Component protection**
  - **MCR/RSS selection**
- **Architecture**
  - **One module for each actuator controlled**
  - **Only for safety related actuators**
  - **Modules located in separate cabinets from other systems**
  - **AV42 TXS module is utilized**

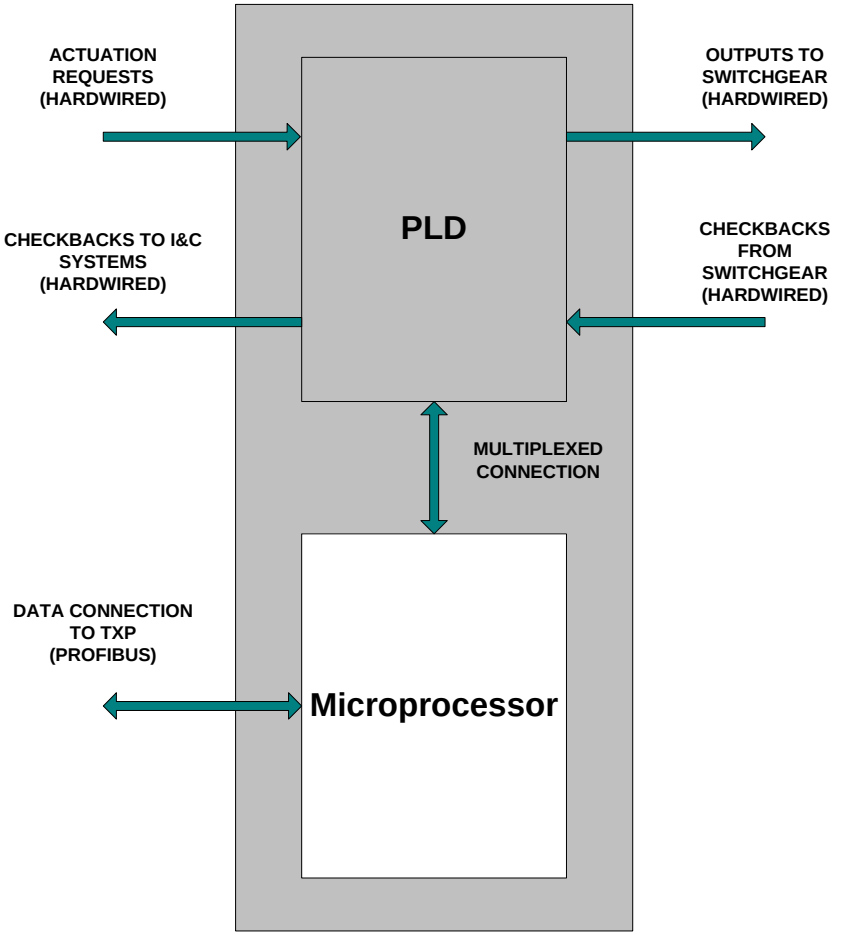
Priority Actuation and Control System: AV42 Priority Control Module

- TXS system component
  - Fully 1E qualified
- PLD for safety functions
  - Simple design
  - 100% testable
  - No operating software
- Microprocessor for non-safety
  - Communication interface to TXP



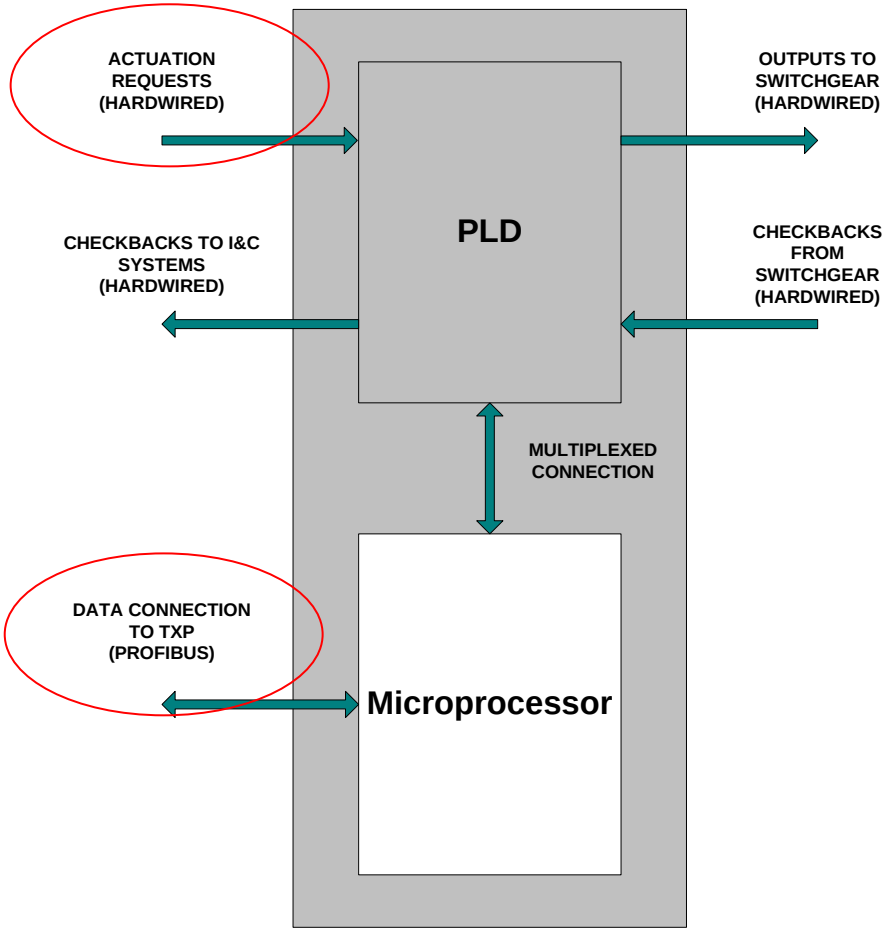
Priority Actuation and Control System: Independence of AV42

- **Principles of isolation**
  - **Physical separation**
  - **Electrical isolation**
  - **Data flow separation**
  - **Functional isolation**



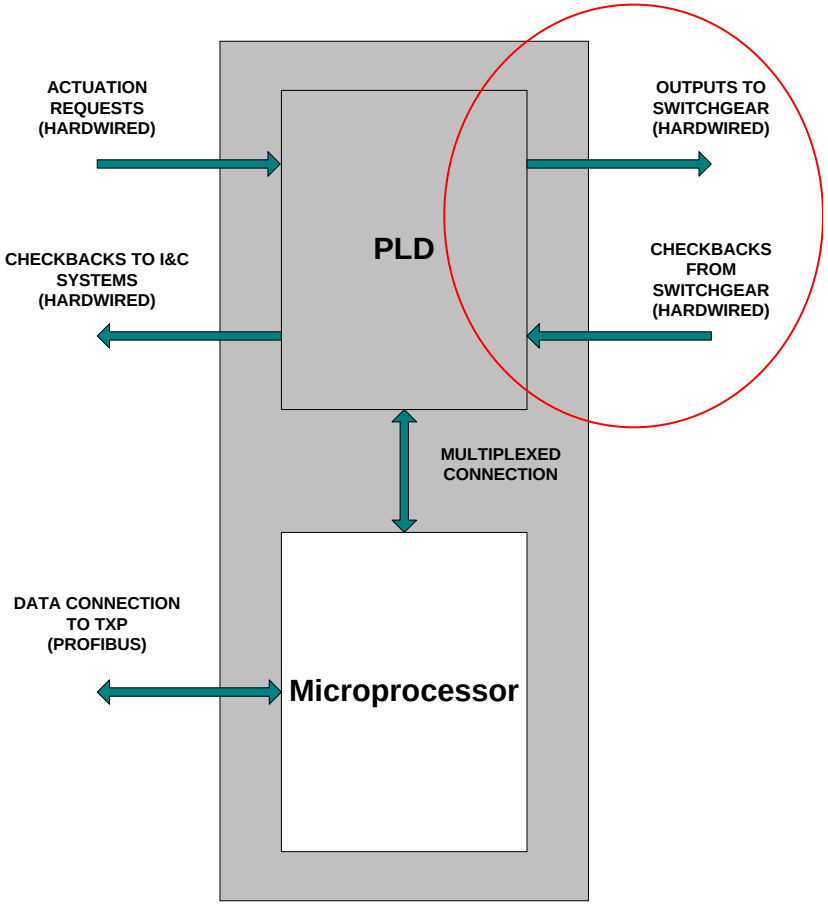
Priority Actuation and Control System: Prioritization of Actuation Signals

- Board front test signals
- Automatic safety system actuation signals
  - PS
  - SAS
- Manual safety system actuation signals
  - SICS (MCR and RSS)
- Operational system actuation signals
  - RCSL
  - PAS
- Other inputs that help to determine priority
  - MCR-RSS SICS selection
  - Operational I&C disable
    - Can be set either from automatic safety system (PS, SAS) or manual safety system (SICS)



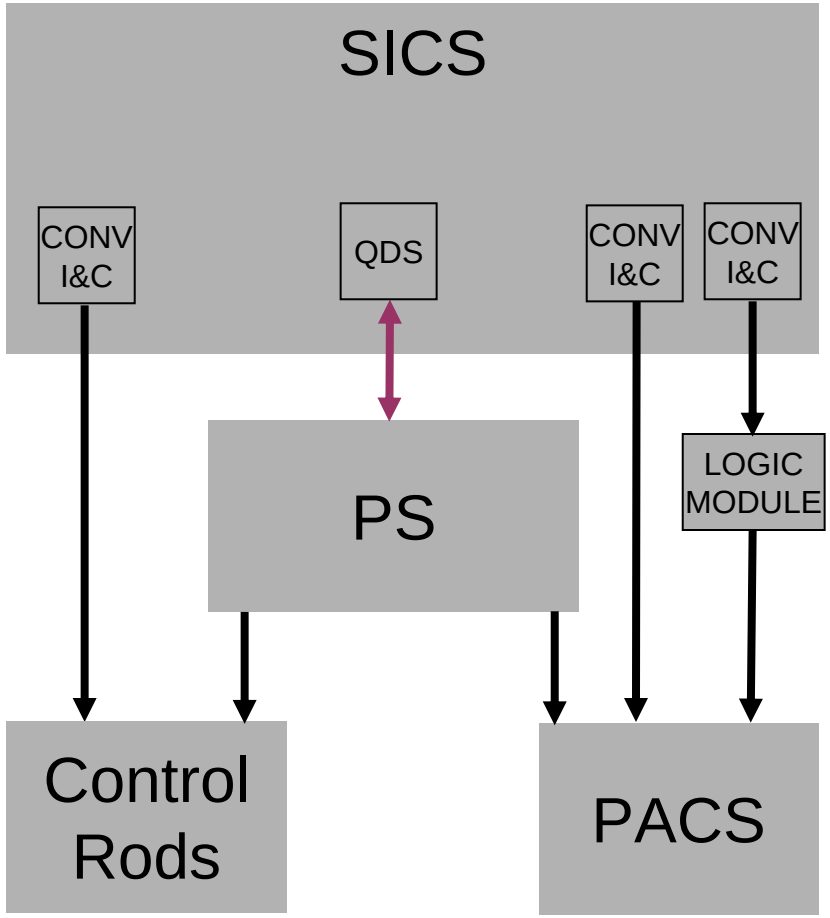
Priority Actuation and Control System: Module Drive Actuation and Monitoring

- **Outputs to switchgear**
  - Close/off command
  - Open/on command
  - Contact power supply
- **Checkbacks from switchgear**
  - Torque switches
  - Limit switches
  - Power supply circuit breaker open
  - Switchgear in test position
  - Motor temperature violation



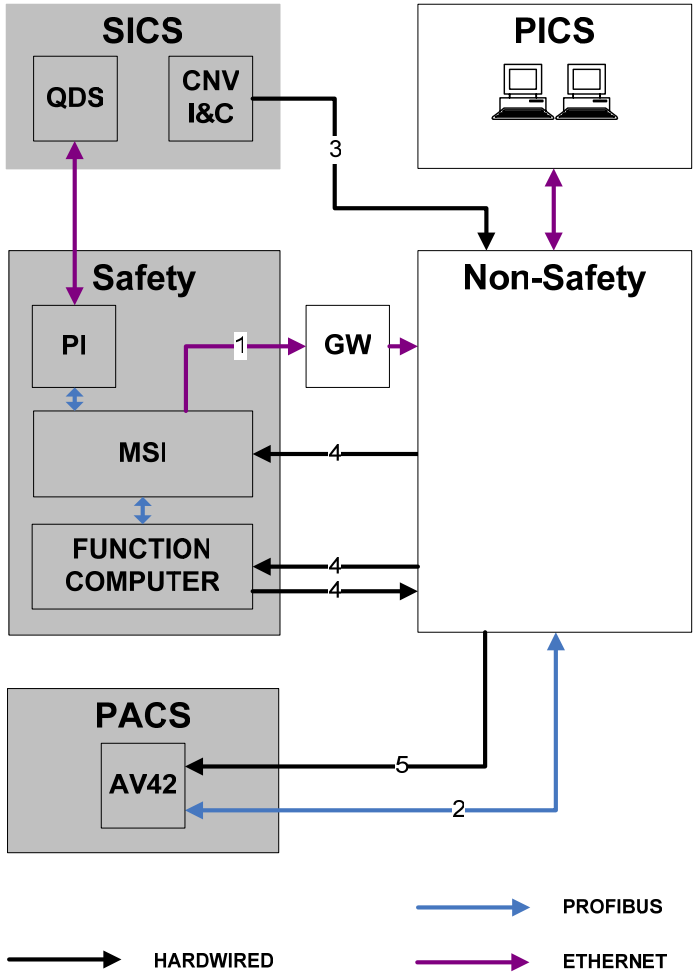
Methods for Manual Initiation of Protective Actions from SICS

- 1 - Conventional controls from SICS to plant equipment
- 2 – Conventional controls from SICS to plant equipment via a non-computerized logic module
- 3 – Computer based controls from SICS to plant equipment via the PS



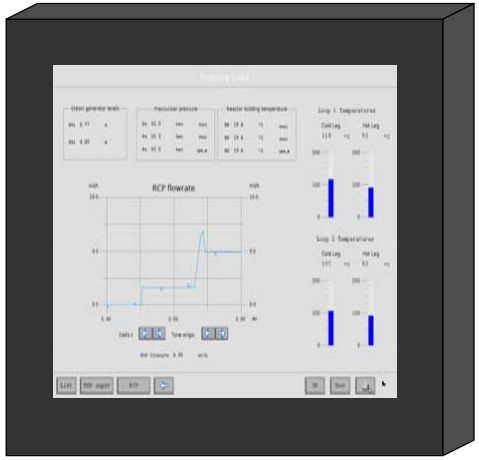
Methods for Communication Between Safety and Non-Safety Systems

- **Data-Based**
  - 1 – Safety to Non-Safety
    - Ethernet
    - Unidirectional
    - Class 1E isolation – MSI
  - 2 – PACS to/from Non-Safety
    - Profibus
    - Bidirectional
    - Class 1E isolation – AV42
- **Hardwired**
  - 3 – SICS to Non-Safety
    - Unidirectional
    - Class 1E isolation – Isolation devices in conventional I&C
  - 4 – Safety to/from Non-Safety
    - Unidirectional for each connection, can wire signals in either direction
    - Class 1E isolation –MSI or function computer
  - 5 – Non-Safety to PACS
    - Unidirectional
    - Class 1E isolation – AV42



Qualified Display System (QDS): Overview

- QDS is part of the SICS and will be located in the MCR and the RSS
- Screen based real time interface to TXS
- Fully 1E qualified
- User Interface
  - Touch screen
  - Mouse and/or trackball input



Qualified Display System (QDS): Capabilities

- Control interface (Open/Close/Manual/Auto/Setpoint)
- Monitoring
- Data logging
- Data trend
- Built in testing capabilities

Diversity and Defense-in-Depth: Regulatory Status

- No "official" NRC position (i.e., Regulatory Guide)
- BTP-19 is the *defacto* standard
- Industry is moving toward risk informed or risk insights
- Details of revision to BTP-19 are not known
- Therefore, considered two approaches:
  - "No Common Mode Software Failure" Approach
  - BTP-19 – "Traditional Approach"

Diversity and Defense-in-Depth: "No Common-Mode Failure" Approach

- Functional diversity
- Deterministic operating system
- Asynchronous operation
- Built in monitoring and testing
- Mature operating history
- High reliability, availability and maintainability
- PRA complements
  - Benefit of A and B subsystems for functional diversity is significant
  - Benefit of additional trips in non-safety systems is reduced by spurious trip potential and operating complexity

Diversity and Defense-in-Depth: BTP-19 – Present Approach

- Demonstrate vulnerabilities to common-mode failures have been adequately addressed
- Analyze each event in the accident analysis section of the SAR using best estimate methods
- If a safety function can be disabled, then a diverse means should be required to perform the same function
  - Non-safety systems or manual actions may be used
- Set of displays/controls in the MCR for manual system level actuation, independent and diverse from the safety computer systems

I&C Security

- **Physical**
  - Inside protected area
  - Separated into four areas
  - Key access to cabinets
  - Cabinet door alarms

- **Safety System**
  - Engineering/service tools
    - Password protected by Level (i.e., view, change, etc.)
    - Access allowed to one safety division at a time
  - Communications
    - Static channels (i.e., no network-TCP/IP services in install additional communication channels)
    - Ignores unexpected messages
    - MSI/Gateway has no effect on safety functions
    - Software changeable only by both access via password and key switch
    - No connection outside of the plant control

Technical Discussions: Control Room and Human-Machine Interface (HMI)

Jeff Jones

Control Room Layout

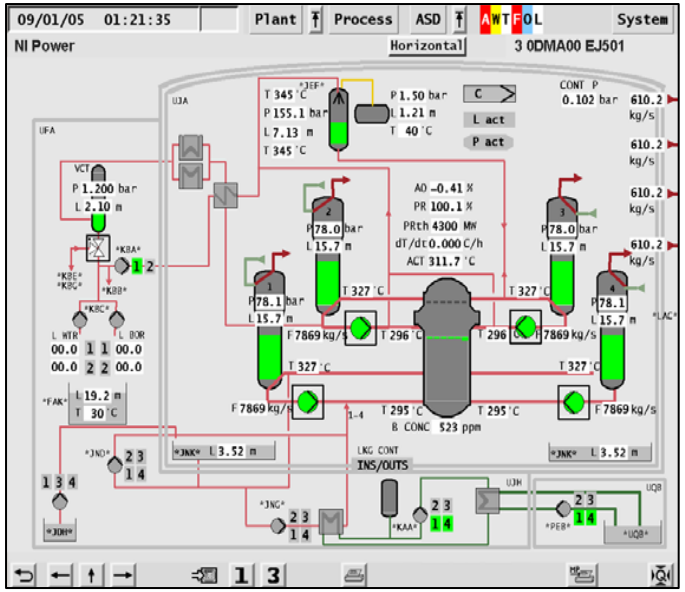
- U.S. control room layout will be different than OL3
- Conceptual layout is finalized

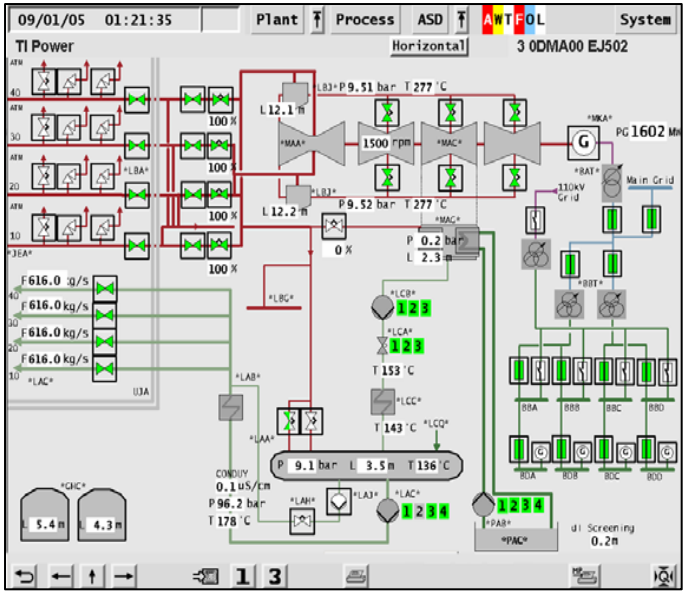
Slide removed to delete Sensitive Unclassified Non-Safeguards Information

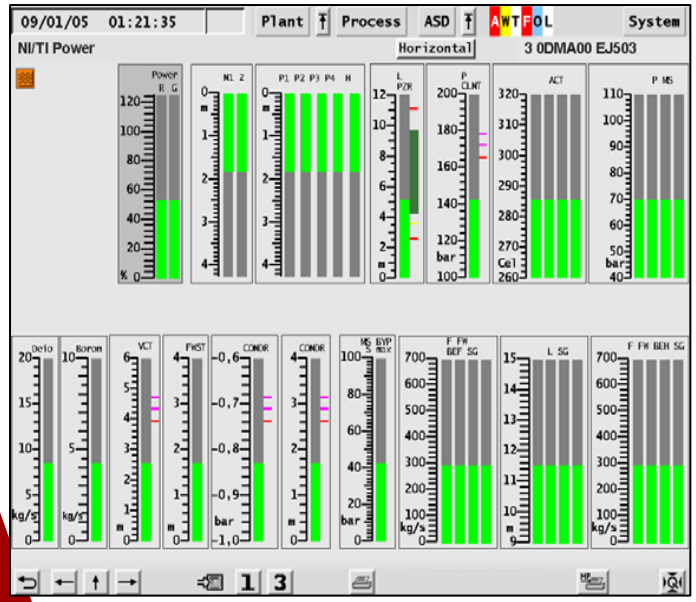
Staffing Assumptions

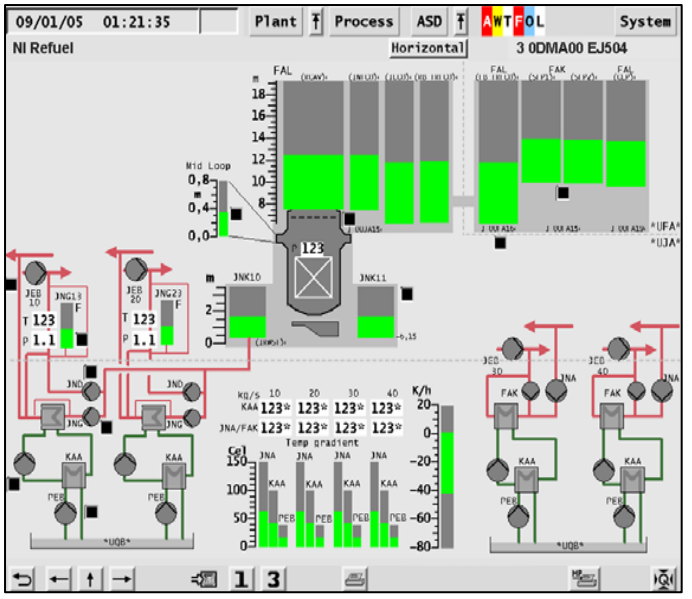
- **Human-Machine Interface is designed to meet the requirements of 10CFR50.54(m):**
  - **Shift supervisor has SRO license**
  - **1 senior reactor operator (control room supervisor)**
  - **1 reactor operator (at the controls at all times)**
  - **1 additional licensed operator (may be out of the control room when operational situation permits)**
- **Shift supervisor fulfills the shift technical advisor function if requirements are met**

Screen Design: PICS

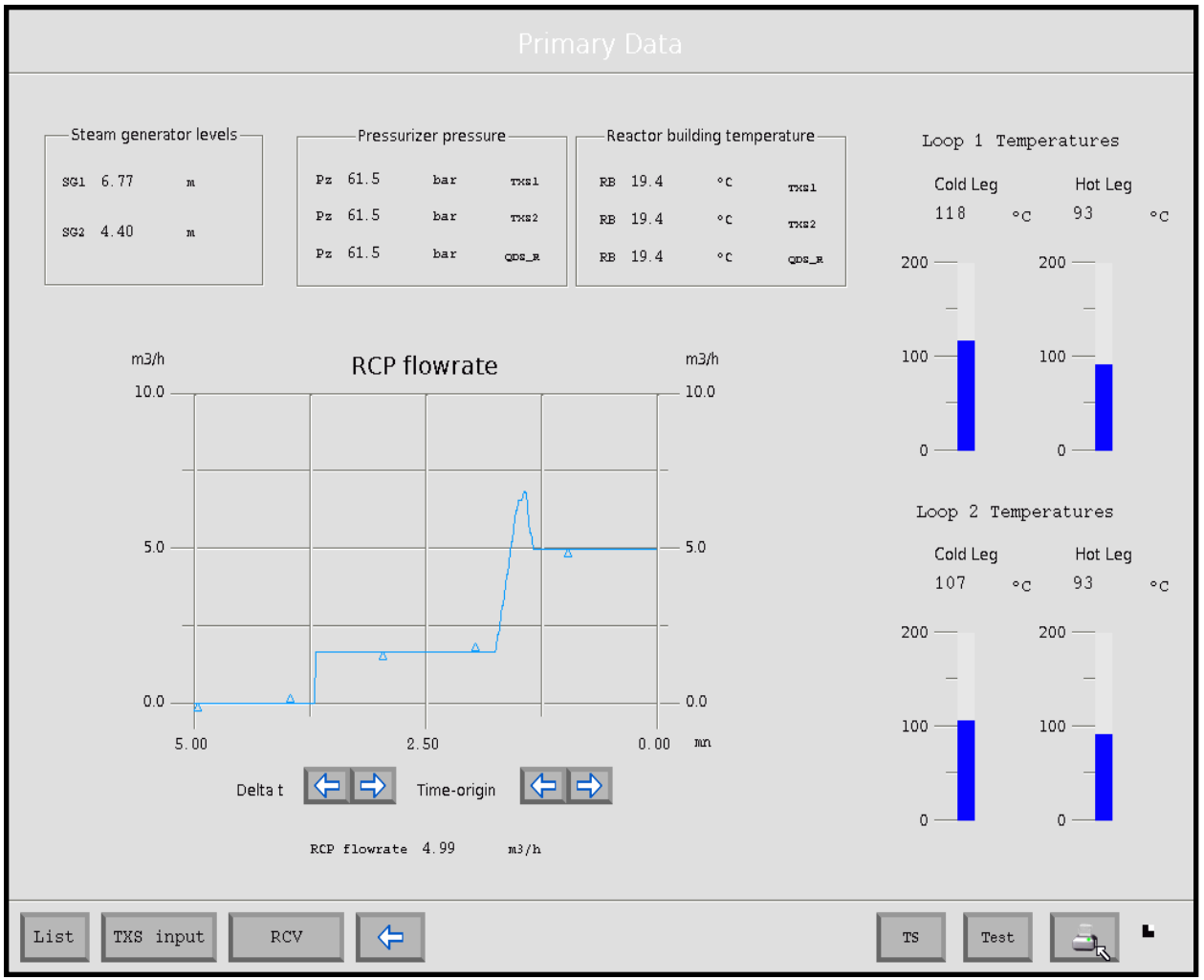








Screen Design: SICS/QDS



Pre-Application Submittals for I&C and Human Factors Engineering

Vic Fregonese

I&C/HFE Report Submittal Schedule

Report	Planned Submittal Date
AV42 Priority Control Module (PAC System) Topical Report	December 2006
Software Program Topical Report	December 2006
Incore and Nuclear Instrumentation Design Report	December 2006
Human Factors Program Topical Report	January 2007
Instrument Setpoint Methodology Topical Report	March 2007
Digital Protection System Design Topical Report	March 2007
I&C Diversity and Defense-in-Depth Topical Report	June 2007

AV42 Priority Control Module (PAC System) Topical Report

- **Purpose**
  - Present design used for priority actuation module (AV42)
- **Content**
  - Licensing Bases
  - AV42 Priority Control Module Description
  - AV42 Priority Control Module Quality
  - Hardware Qualification
  - Independence
  - Configuration Management Plan
  - Reliability

Software Program Topical Report

- **Purpose**
  - **Describe the AREVA NP Software Program**
- **Content**
  - **Software Quality Assurance**
  - **Software Safety Hazard Analysis**
  - **Software Configuration Management**
  - **Software Verification and Validation**
  - **Software Operations and Maintenance**
  - **Software Development, Integration and Documentation**
  - **Problem Reporting and Corrective Actions**

Incore and Nuclear Instrumentation Design Report

- **Purpose**
  - **Describe the incore instrumentation system for U.S. EPR**
- **Content**
  - **Identify the need for instrumentation to be located within the core for the U.S. EPR**
  - **Discuss location, operation and specific design features of Self Powered Neutron Detectors (SPNDs)**
  - **Discuss location, operation and specific design features of the Aeroball Measurement System (AMS)**
  - **Discuss the relationship between SPNDs and AMS with POWERTRAX software as a comprehensive system for 3-D power distribution monitoring and indication**
  - **Discuss incore instrumentation interface to Protection System**

Human Factors Program Topical Report

- **Purpose**
  - **Describe the Human Factors Engineering program for U.S. EPR**
- **Content**
  - **Programmatic overview of the following implementation plans:**
    - Functional Requirements Analysis
    - Functional Allocation
    - Task Analysis
    - Human-System Interface Design
    - Verification and Validation

Instrument Setpoint Methodology Topical Report

- **Purpose**
  - **Documentation of Setpoint Methodology**
- **Scope**
  - **Reactor trip**
  - **Engineered Safety Features Actuation System**
  - **Safety permissives (interlocks)**
- **General Content**
  - **Identify general algorithms**
  - **Provide acronyms and definitions**
  - **Discuss compliance with RG 1.105 and ISA Standards**
  - **Establish methodology to determine instrument loop uncertainty values to be applied to the U.S. EPR conceptual design (values for each parameter will be established after determination of specific equipment)**
  - **Discuss As-Left and As-Found tolerances for compliance with Surveillance Requirements**
  - **Summarize relationships between Safety Analysis Limits, Limiting Trip Setpoints, Allowable Values, Nominal Trip Setpoints, and Margins**

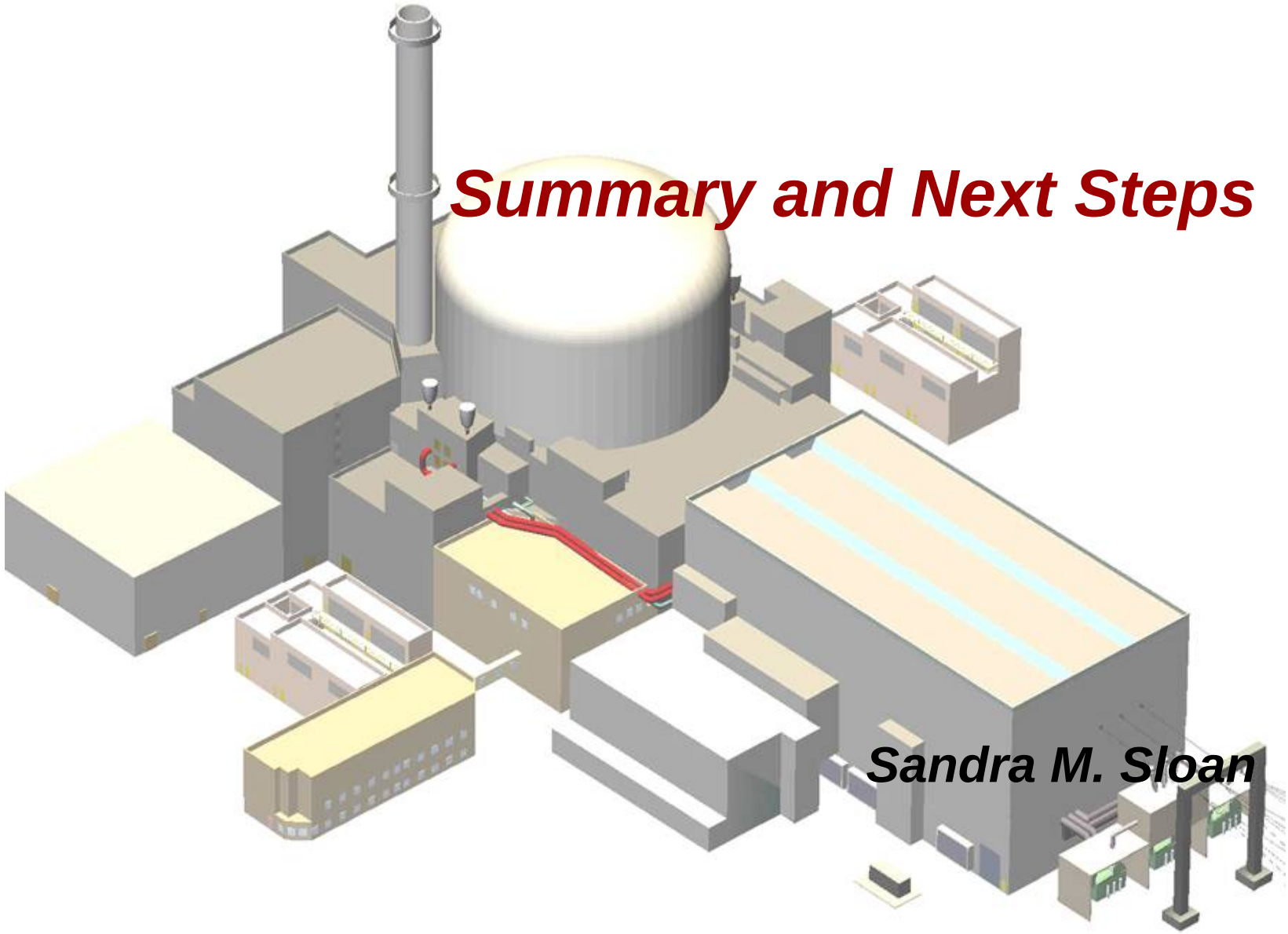
Digital Protection System Design Topical Report

- Purpose
  - Provide a description of the U.S. EPR protection system design
- Scope
  - U.S. EPR protection system design
  - TXS SER updates
  - Qualified display system
  - References to other submittals:
    - Software Program Manual
    - Instrument Setpoint Methodology
    - Human Factors Program
    - Diversity and Defense-in-Depth Report

Diversity and Defense-In-Depth Topical Report

- **Purpose**
  - Describe the type of diversity among the control systems, reactor trip, engineered safety features actuation system, monitoring and indicator system and how they meet the requirement of BTP-19
- **Content**
  - Regulatory position
  - U.S. EPR I&C architecture
  - Defense-in-depth features of the U.S. EPR I&C architecture
  - Assessment methodology
  - Evaluation of diversity within the U.S. EPR I&C architecture

Summary and Next Steps



Sandra M. Sloan

Summary

- **U.S. EPR I&C design is well under way**
  - **High level architecture for U.S. EPR I&C systems has been defined**
  - **Modifications from OL3 design driven by differences in regulatory framework between Finland and U.S.**
  - **Function allocation procedure will force the design to be as close as possible to OL3 while meeting U.S. requirements**
  - **Safety system design utilizes proven principles, equipment**
- **Pre-Application reports**
  - **Will facilitate an efficient review of the Design Certification application**
  - **Will complement and support information in Design Certification application**
- **Takeaway**
  - **Leveraging years of AREVA experience in design, operation and maintenance of digital systems**

Next Steps

> Next meetings

- **September 2006:**
  - **Flow Induced Vibration**
- **October 2006:**
  - **Unique Design Features, Containment Analysis**
  - **PRA Analysis Tools (PRA methods and results) Pre-Submittal**
  - **Quality Assurance (Sections 17.1, 17.2, 17.3) Post-Submittal**
  - **Code Applicability Topical Report Post-Submittal**
  - **AV42 Priority Control Module Pre-Submittal**
  - **Planning for Design Certification Application**

Acronyms

AMS:	Aeroball Monitoring System
ALU:	Actuation Logic Unit
APU:	Acquisition & Processing Unit
CRC:	Cyclic Redundancy Check
CRDM:	Control Rod Drive Mechanism
GW:	Gateway
HBS:	Hardwired Backup System
HMI:	Human Machine Interface
ISC:	I&C Service Center
MCR:	Main Control Room
MSI:	Monitoring & Service Interface
OLM:	Optical Link Module
PACS:	Priority Actuation & Control System
PAS:	Process Automation System
PI:	Panel Interface
PICS:	Process Information & Control System
PLD:	Programmable Logic Device
PS:	Protection System
PZR:	Pressurizer
QDS:	Qualified Display System
RAM:	Random Access Memory
RAU:	Remote Acquisition Unit
RCCA:	Rod Control Cluster Assembly
RCSL:	Reactor Control, Surveillance, & Limitation System
RSS:	Remote Shutdown Station
RTE:	Runtime Environment
SAR:	Safety Analysis Report
SAS:	Safety Automation System
SER:	Safety Evaluation Report
SICS:	Safety Information & Control System
SPND:	Self Powered Neutron Detectors
TSC:	Technical Support Center
TXP:	Teleperm XP
TXS:	Teleperm XS