STP Nuclear Operating Company

STP Units 3 & 4 I & C Systems

October 23, 2008

STP Units 3 & 4

COLA

Introductions

- Current COLA Team for I&C
  - STP 3&4
  - TOSHIBA
  - WESTINGHOUSE

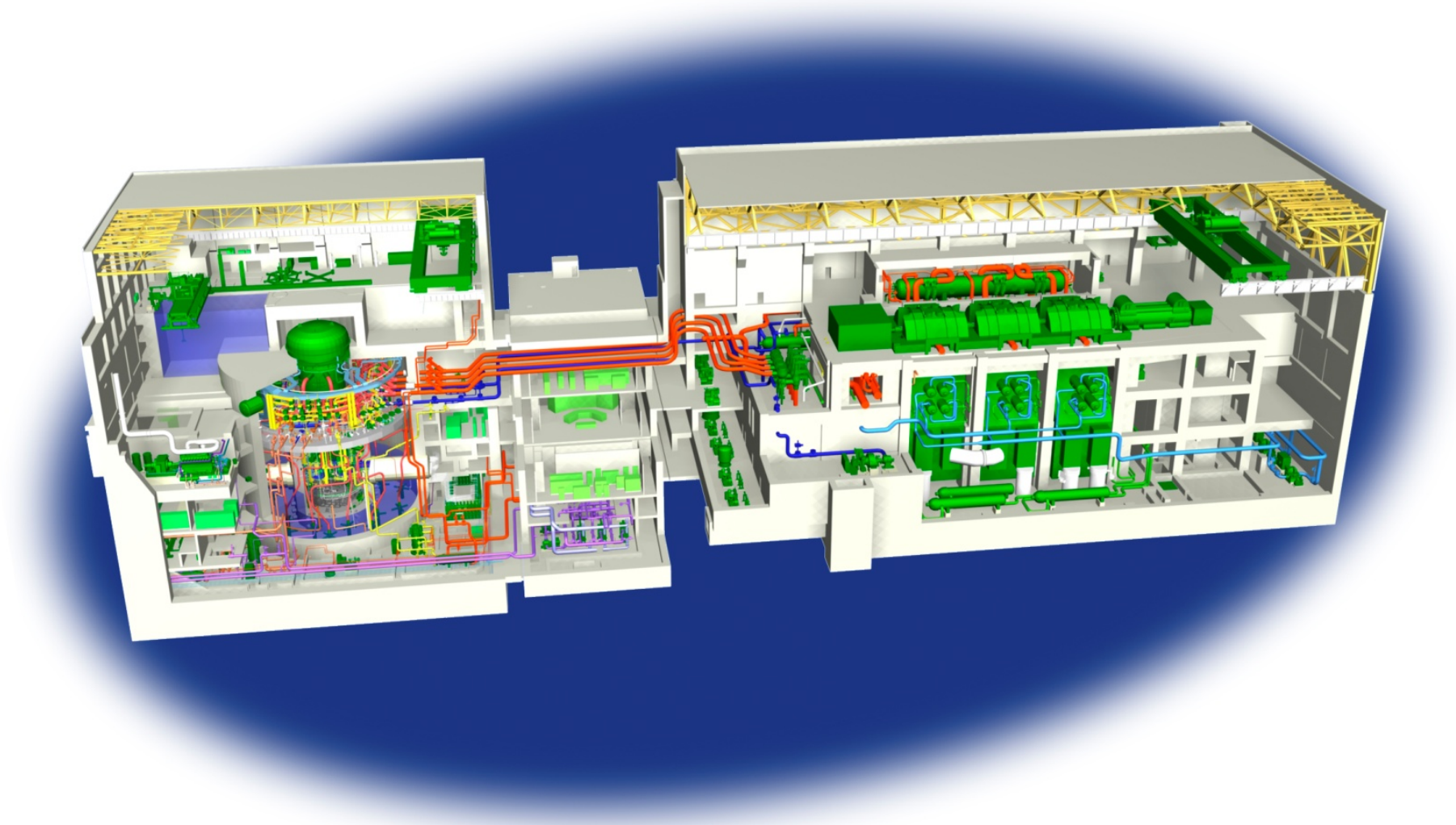
- Key Personnel in Attendance
  - STP
    - Scott Head - Manager of Licensing
    - Tim Hurst - I&C Engineering
    - Kyle Dittman – I&C Principal Engineer
    - Jerry Mauck – I&C Engineering
  - Toshiba
    - Shigeru Suzuki - Asst. VP Nuclear Division
    - Masaaki Matsumoto – I&C Project Manager
    - Jun Ikeda – I&C Manager (HFE)
    - Naotaka Oda – I&C Manager Monitoring Systems (TOSDIA-FPGA)
    - Mamoru Kato – I&C Senior Specialist (RTIS & ELCS)
  - Westinghouse
    - Denise Anderson – I&C Projects Manager
    - Cal Vitalbo – ELCS Engineer

Meeting Agenda

- ABWR Overview
- Summary of DCD I&C Sections
- I&C Departures from the Design Certification
- STP 3&4 - I&C COLA
- I&C DAC ITAAC Schedule
- Key Regulations and Guidance
- Questions and Comments

ABWR Overview

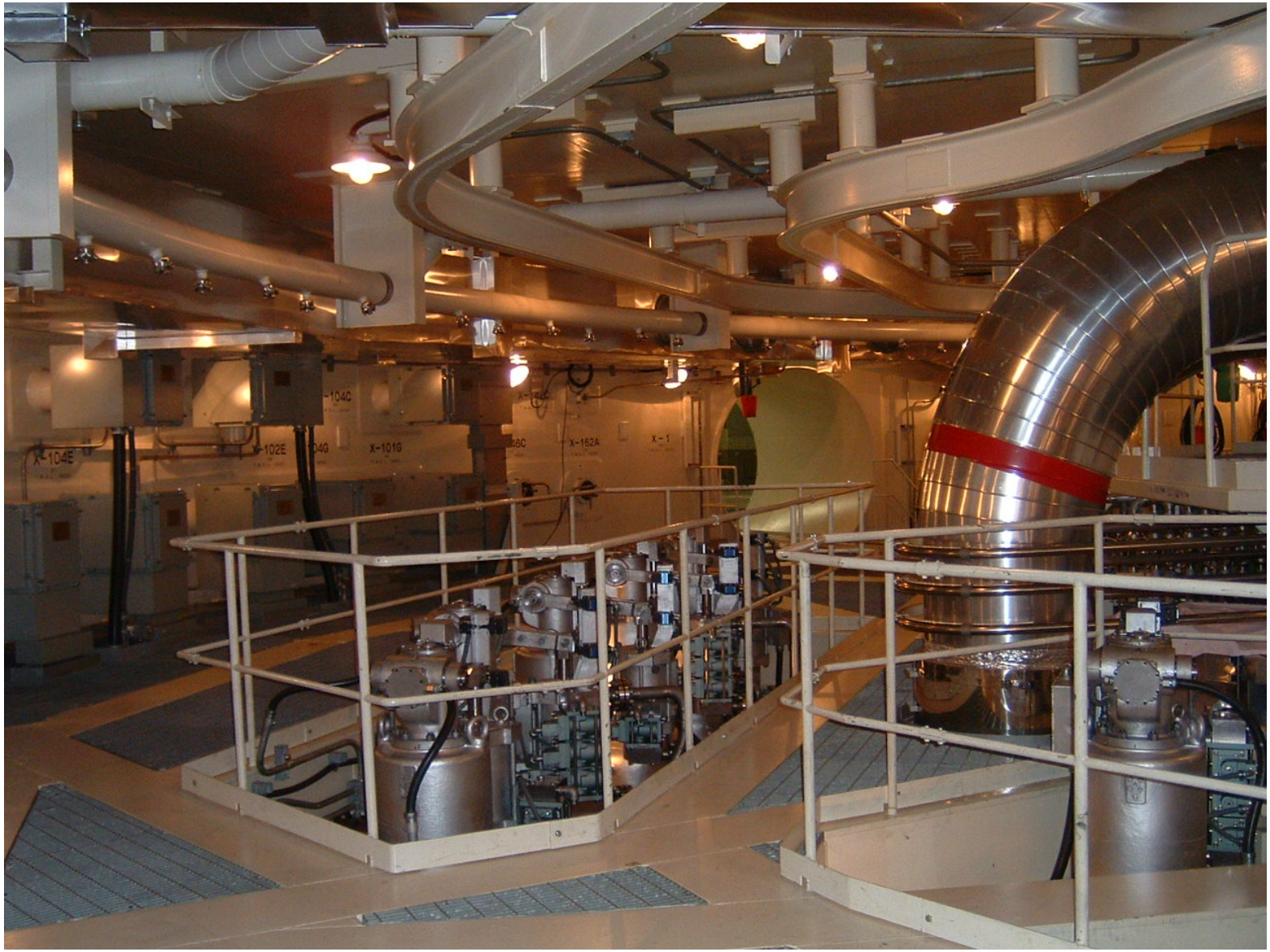
ABWR



Cutaway Rendering of ABWR

Kashiwazaki Kariwa Units 6 & 7

Japanese ABWR Upper Drywell



Japanese ABWR Main Control Room

Summary of DCD I&C Sections

ABWR Design Certification

- Advanced Boiling Water Reactor (ABWR) Design Control Document (Rev. 0)
- NUREG 1503 “Final Safety Evaluation Report to the Certification of the Advanced Boiling Water Reactor Design” including Supplement 1 (April 1997)

DCD Tier 1 I&C Related Sections

- Summary of Tier 1 Sections
  - Sections 2.1, 2.4, 2.5, 2.6, 2.8 etc.
    - Provide functional I&C requirements for ESF systems (associated with the ESF Logic & Control systems) including the Nuclear Boiler, Reactor Recirculation, High Pressure Core Flooder, etc.
  - 2.2 “Control and Instrumentation Systems”
    - Covers: Rod Control, Reactor Protection, Neutron Monitoring, Feedwater Control, Remote Shutdown, etc.
  - 2.3 “Radiation Monitoring System”
    - Covers: Process and Area Radiation Monitoring and Containment Atmospheric Monitoring
  - 2.7 “Control Panels” (Multiplexer)
    - Covers: Main Control Room as well as other panels and the Multiplexing System

DCD Control System Architecture

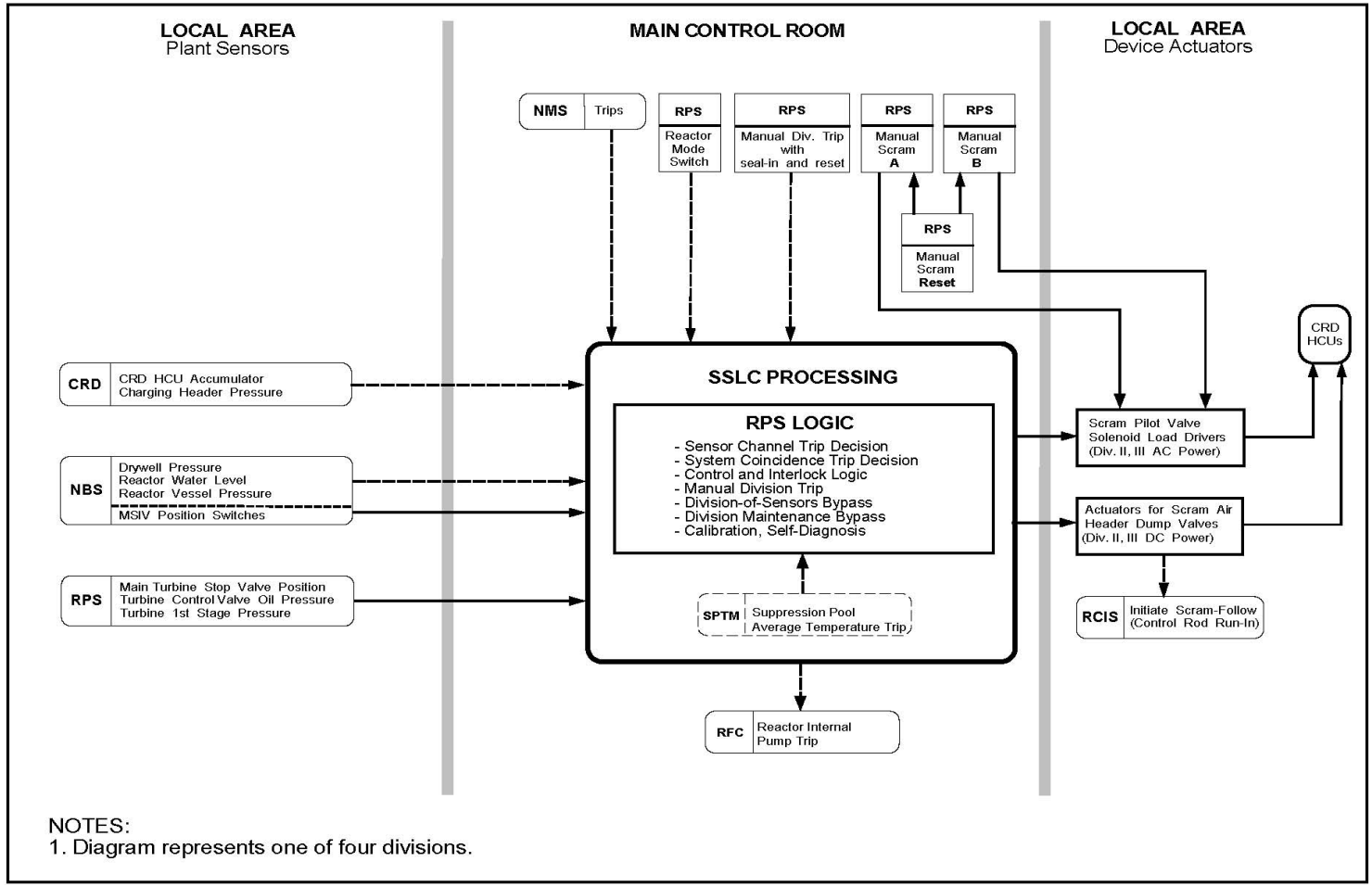


Figure 2.2.7a Reactor Protection System Control Interface Diagram

DCD Control System Architecture

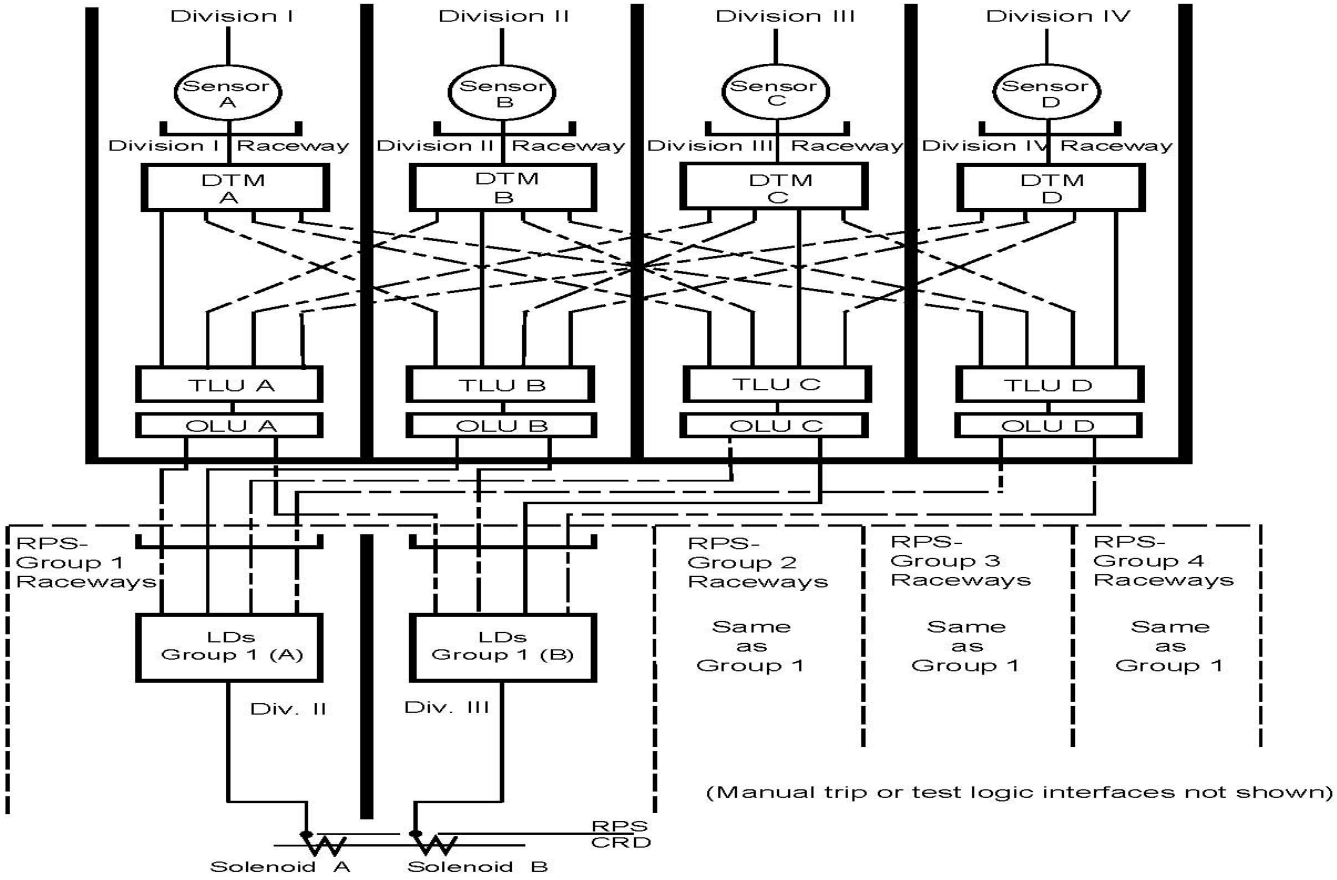


Figure 2.2.7b Reactor Protection System

DCD Primary Design Bases

- Safety System Logic and Control (SSLC) equipment is microprocessor-based software controlled signal processors
- Essential Multiplexing Units
  - Remote Multiplexing Units (RMU)
  - Control Room Multiplexing Units
- Most sensor signals are transmitted through RMUs

DCD Tier 1 I&C DAC Sections

- Summary of Tier 1 DAC I&C Sections
  - 3.1 “Human Factors Engineering”
  - 3.4 “Instrumentation and Control”
    - 3.4.A “Safety System Logic and Control”
    - 3.4.B “I&C Development and Qualification Process”
    - 3.4.C “Diversity and Defense-in-Depth Considerations”

DCD Control System Architecture

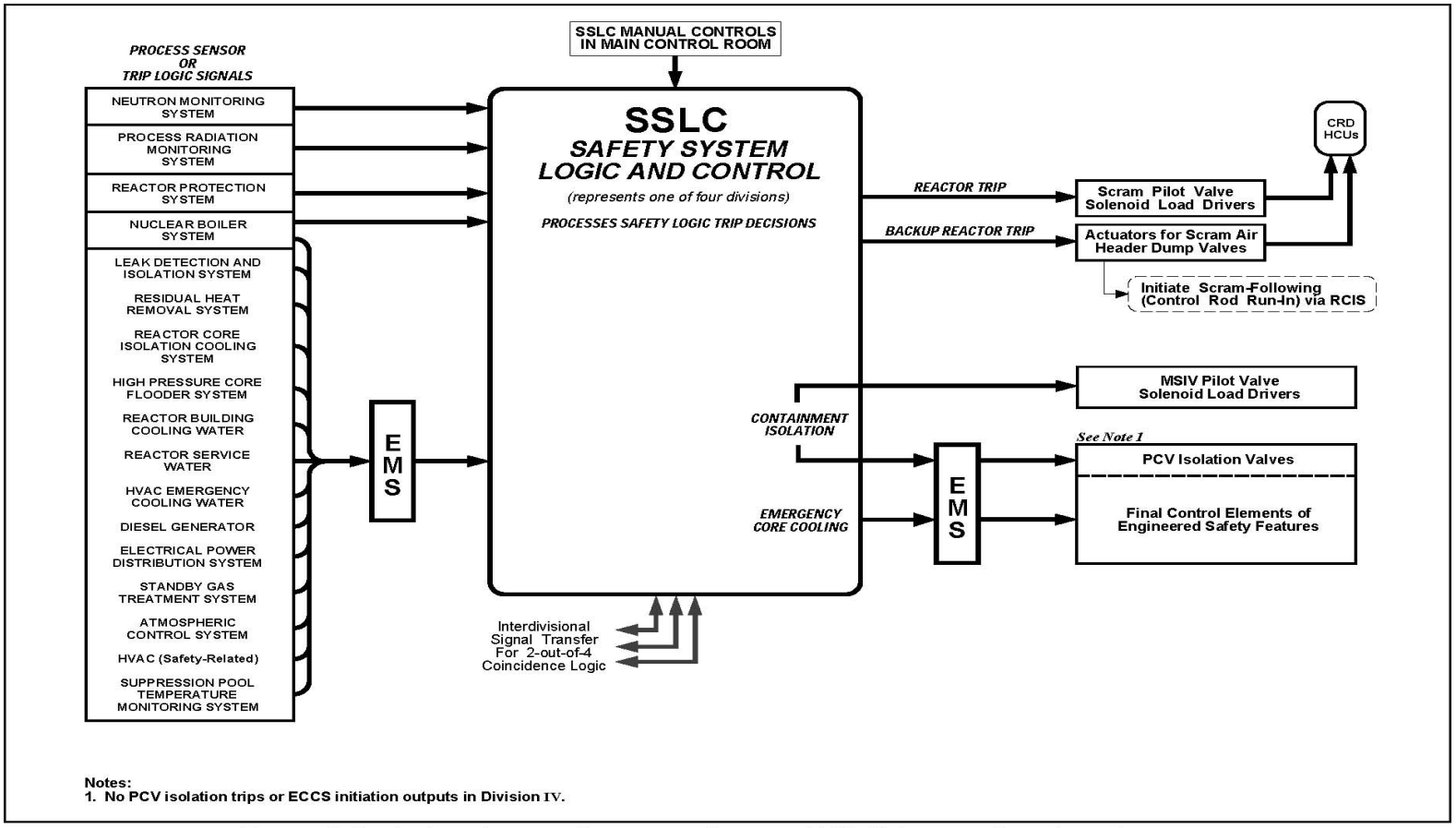


Figure 3.4a Safety System Logic and Control (SSLC) Control Interface Diagram

DCD Control System Architecture

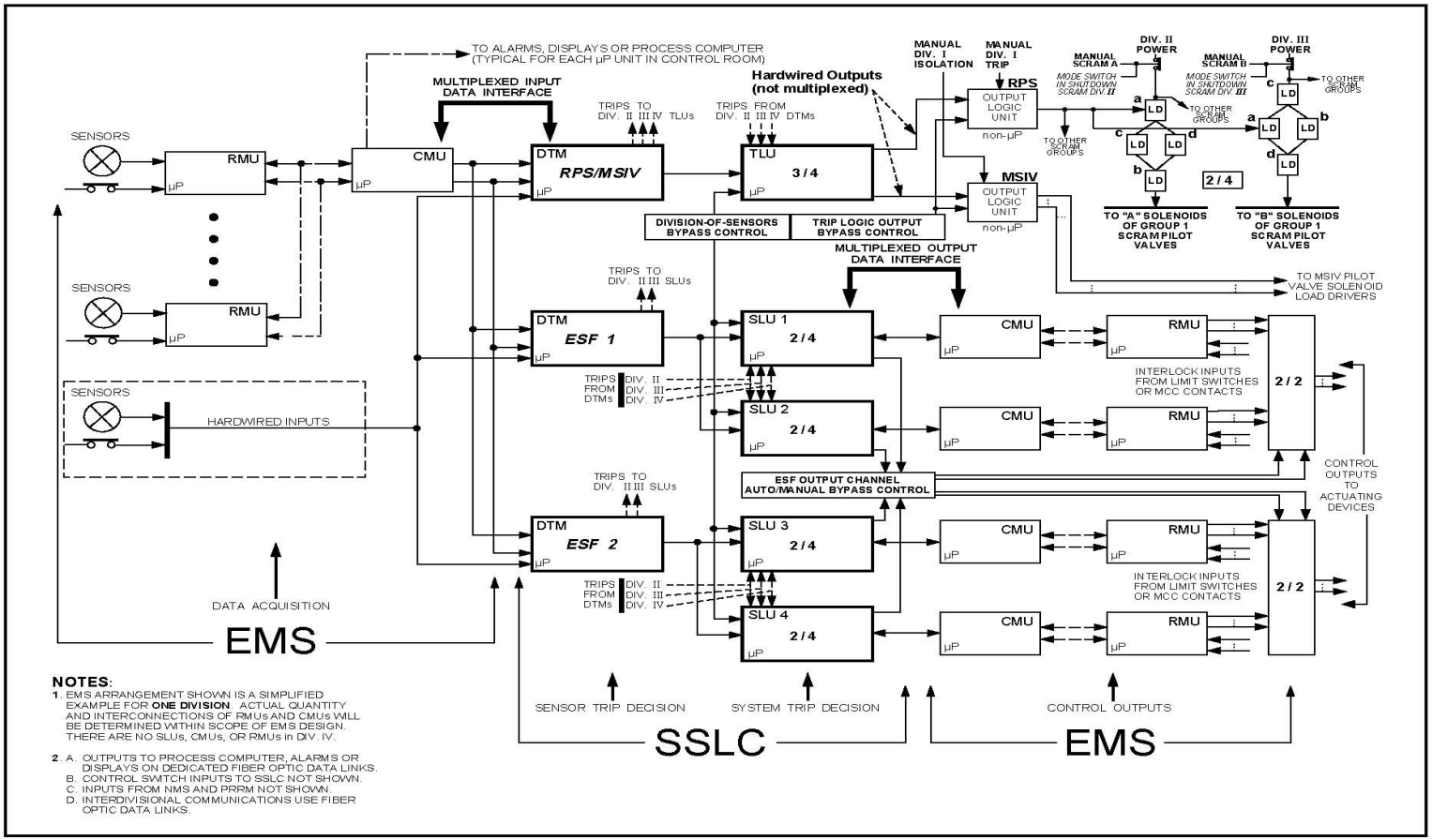


Figure 3.4b Safety System Logic & Control Block Diagram

DCD Tier 2 I&C Sections

- Summary of Tier 2 I&C Systems
  - 7.1 Introduction
  - 7.2 Reactor Protection (Trip) System (RPS)
  - 7.3 Engineered Safety Feature Systems
  - 7.4 Systems Required for Safe Shutdown
  - 7.5 Information Systems Important to Safety
  - 7.6 All Other Instrumentation Systems Required for Safety
  - 7.7 Control Systems Not Required for Safety
- 11.5 Process and Effluent Radiological Monitoring and Sampling Systems

I&C Departures from the Design Certification

I&C Departures from the Design Certification

- Corrections
  - Changes to eliminate inconsistencies
  - ABWR I&C technical design not impacted
- Clarification of Content
  - Addition of information to ensure understanding
- Advancements in Technology
  - Incorporation of generic BWR I&C Improvements
  - Obsolete technology or designs

I&C Departures from the Design Certification

- Clarification of Content
  - Expansion of the discussion of Automatic Depressurization System (ADS) initiation logic to improve understanding of bypass timer operation
  - Expansion of the discussion of the RHR Suppression Pool Cooling logic to enhance understanding of automatic and manual operations

I&C Departures from the Design Certification

- Advancements in Technology
  - Adoption of BWR generically approved Oscillation Power Range Monitor (OPRM)
  - Adoption of BWR generically approved removal of main steam high radiation Trip (SCRAM) & Isolation function.

I&C Departures from the Design Certification

- Advancements in Technology (Cont.)
  - Updated I&C Architecture
    - Replaced obsolete Fiber Distributed Data Interface (FDDI) multiplexer communication technology with current data communication technology
    - Simplification of intra-divisional design
    - I&C platform definitions resulted in extensive nomenclature changes. Examples:
      - Multiplexer to Data Communication
      - Trip Logic Unit (TLU) to Trip Logic Function (TLF)
      - Plant Computer System to Plant Computer Function (PCF)
      - Creation of ESF Logic & Control System (ELCS)

I&C Departures from the Design Certification

- Eight (8) Departures Require Prior NRC Approval
  - Five (5) Tier 2 changes that impact Technical Specifications
  - **Three (3) Tier 1 changes**
- Forty-one (41) Departures Do Not Require Prior NRC Approval – Tier 2
- All I&C deviations from the Design Certification are identified by Departures

I&C Departures from the Design Certification

- I&C Systems Modified by Tier 1 Departures
  - STD DEP T1 2.2-1, Control Systems Changes to Inputs, Tests, and Hardware
    - Rod Control and Information System (Test Clarification)
  - STD DEP T1 2.3-1, Deletion of MSIV Closure and Scram on High Radiation
    - Reactor Protection
    - Process Radiation Monitoring
  - STD DEP T1 3.4-1, Safety-Related I&C Architecture
    - ESF Logic and Control
    - Multiplexer/Communications
    - Plant Computer (nomenclature)

I&C Departures from the Design Certification

- I&C Systems Modified by Departures
  - Tier 2 Departures
    - I&C Systems Relevant Changes
      - Automatic Depressurization System
      - Post Accident Monitoring
      - Rod Control and Information
      - Neutron Monitoring
      - Residual Heat Removal Control Logic
      - Leak Detection and Isolation
      - Suppression Pool Temperature Monitoring
      - Recirculation Flow Control
      - Automatic Power Regulator

STP 3&4 - I&C COLA Rev 2

COLA Part 2 - I&C Tier 1

Primary DCD Tier 1 Sections Impacted

- Section 2.2 – Control and Instrument Systems
- Section 2.3 – Radiation Monitoring Systems
- Section 2.7 – Control Panels (Multiplexer)
- Section 3.4 – Instrumentation and Control

COLA Part 2 – I&C Tier 1

- 2.2.1 Rod Control & Information System (RCIS)
- 2.2.2 Control Rod Drive System
- 2.2.3 Feedwater Control System
- 2.2.4 Standby Liquid Control System
- **2.2.5 Neutron Monitoring System (NMS)**
- 2.2.6 Remote Shutdown System
- **2.2.7 Reactor Protection System (NMS & RTIS)**
- 2.2.8 Recirculation Flow Control System
- 2.2.9 Automatic Power Regulation System (APRS)
- 2.2.10 Steam Bypass & Pressure Control System
- 2.2.11 Process Computer

DCD Control System Architecture

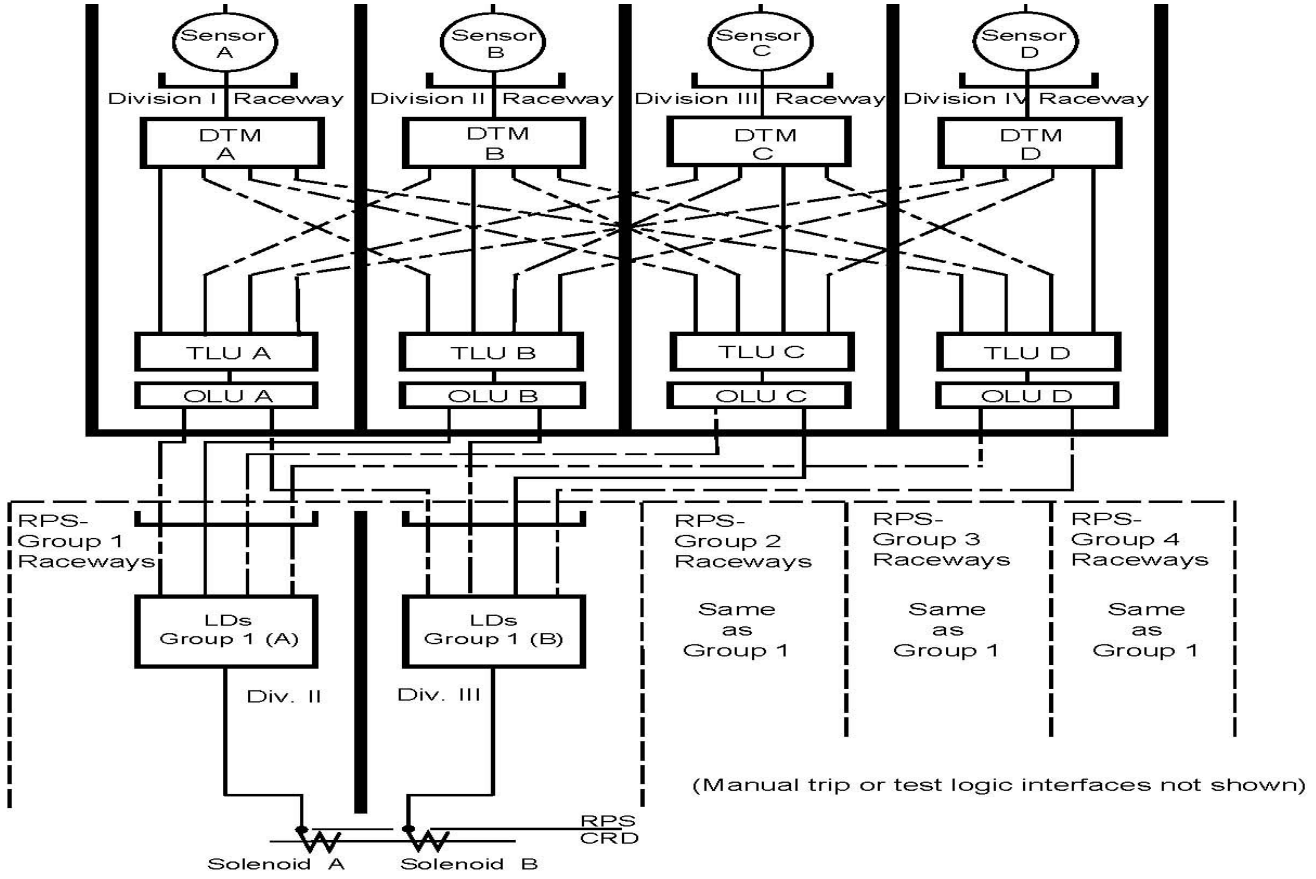
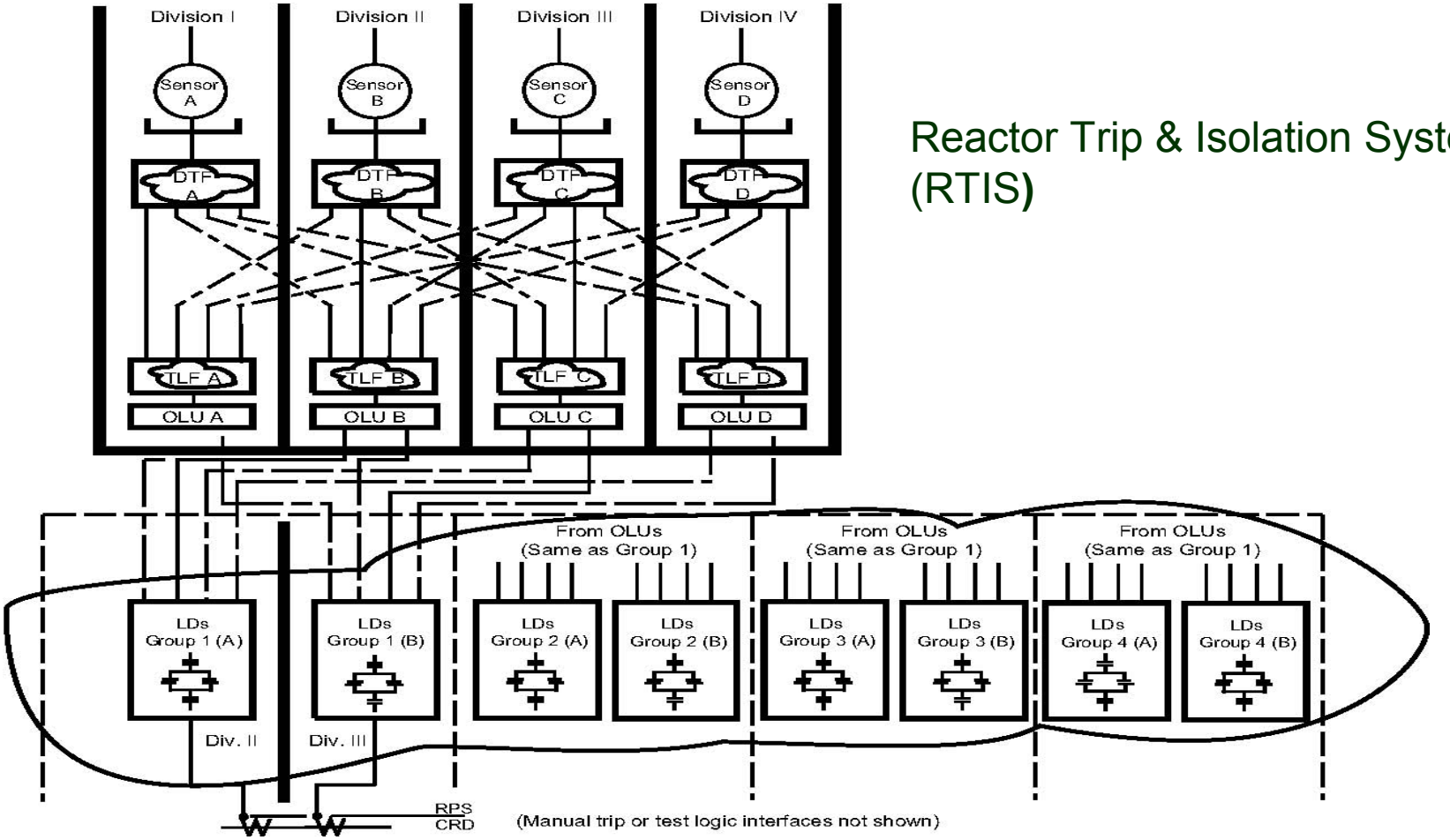


Figure 2.2.7b Reactor Protection System

COLA Part 2 - I&C Tier 1



Reactor Trip & Isolation System (RTIS)

Figure 2.2.7b Reactor Protection System

COLA Part 2 - I&C Tier 1

- Section 3 – Design Acceptance Criteria
  - 3.4 I&C Systems and Programs
    - 3.4.1 (3.4.A) Safety System Logic and Control
      - Technology/Architecture updated
    - 3.4.2 (3.4.B) I&C Development and Qualification Processes
      - Software Management Program was approved by SER
      - STP 3&4 Software Management Plan is in development
    - 3.4.3 (3.4.C) Diversity and Defense-in-Depth Considerations
      - Design approved by SER

DCD Control System Architecture

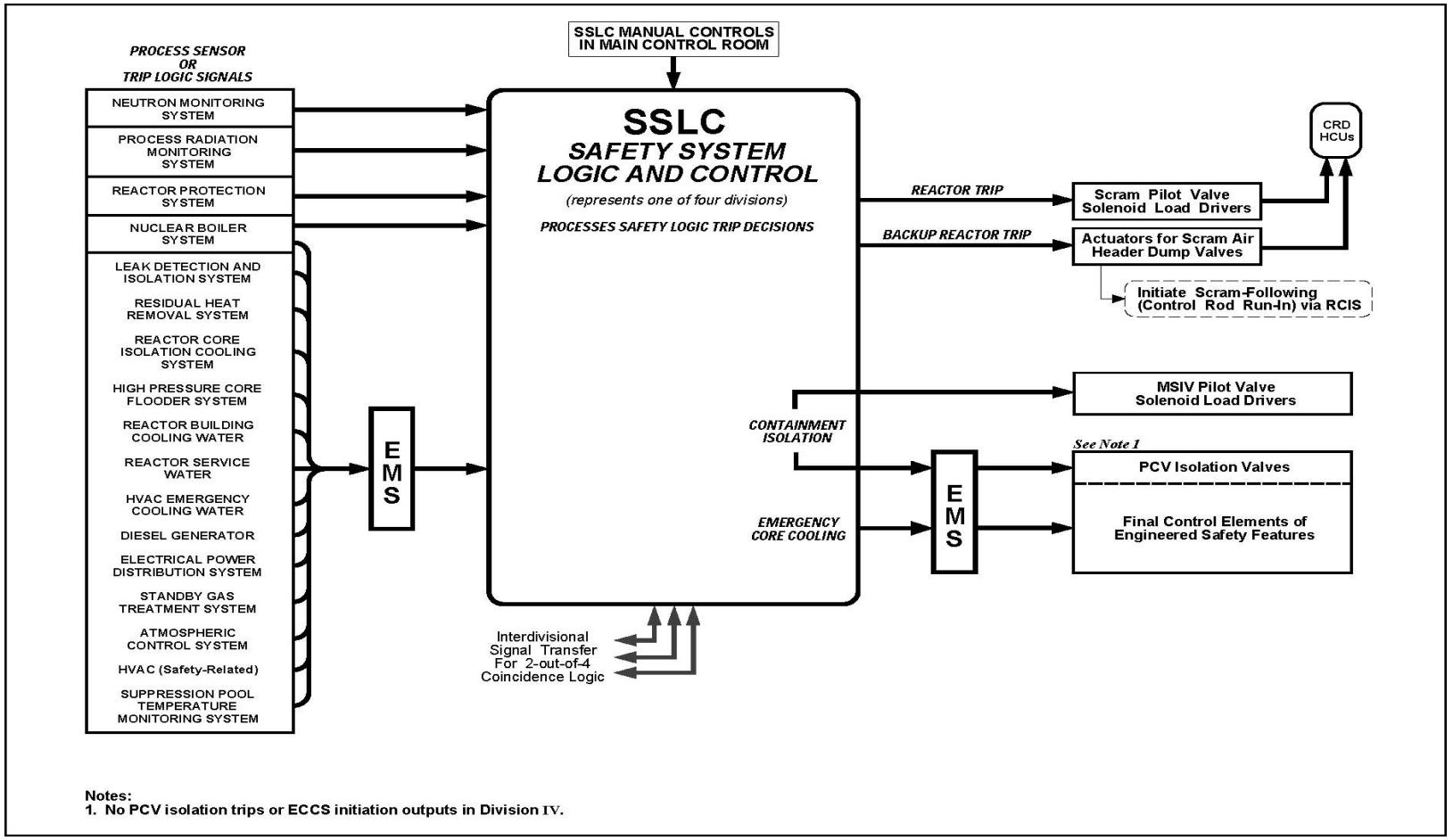


Figure 3.4a Safety System Logic and Control (SSLC) Control Interface Diagram

COLA Part 2 - I&C Tier 1

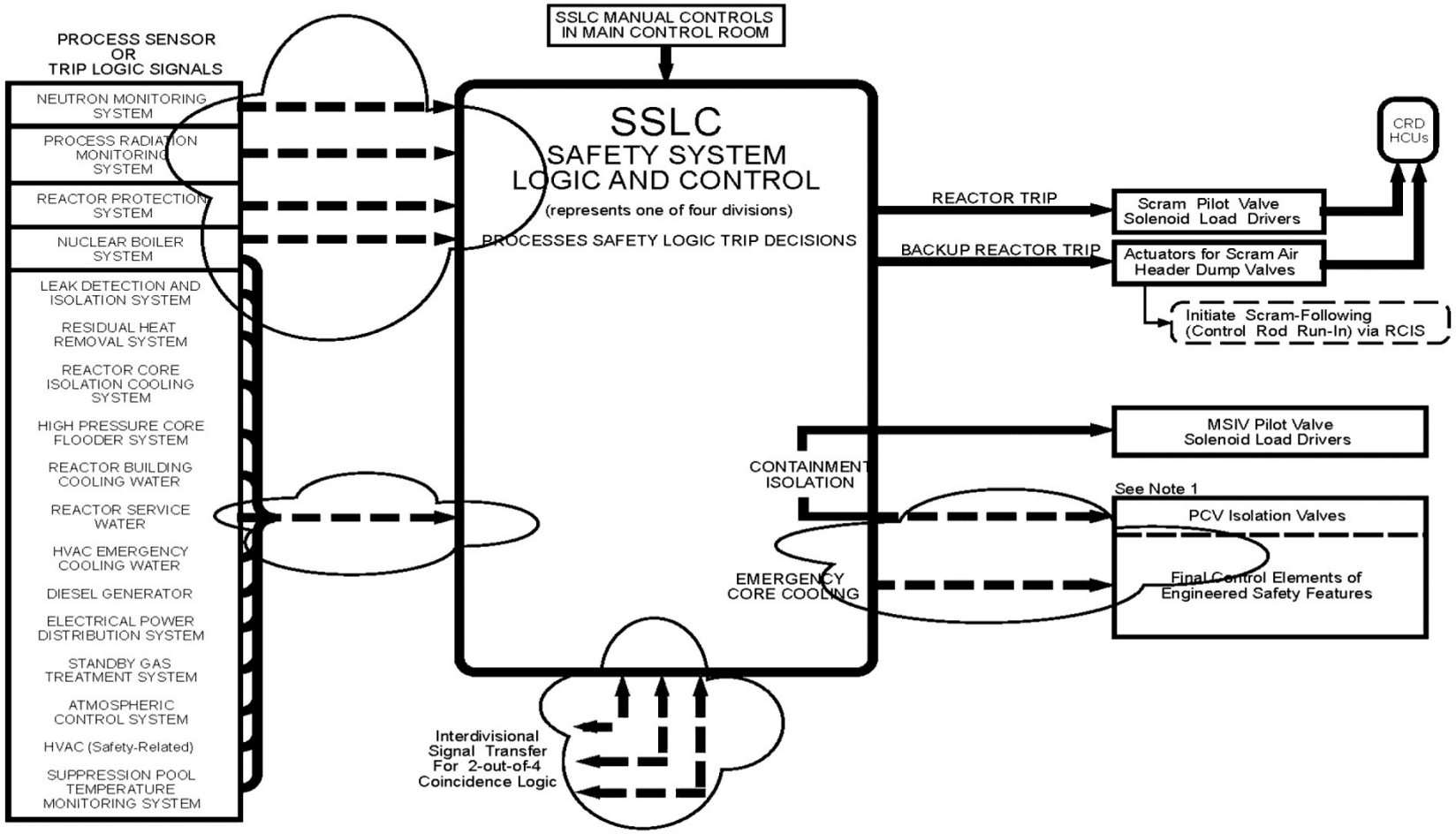


Figure 3.4a Safety System Logic and Control (SSLC) Interface Diagram

DCD Control System Architecture

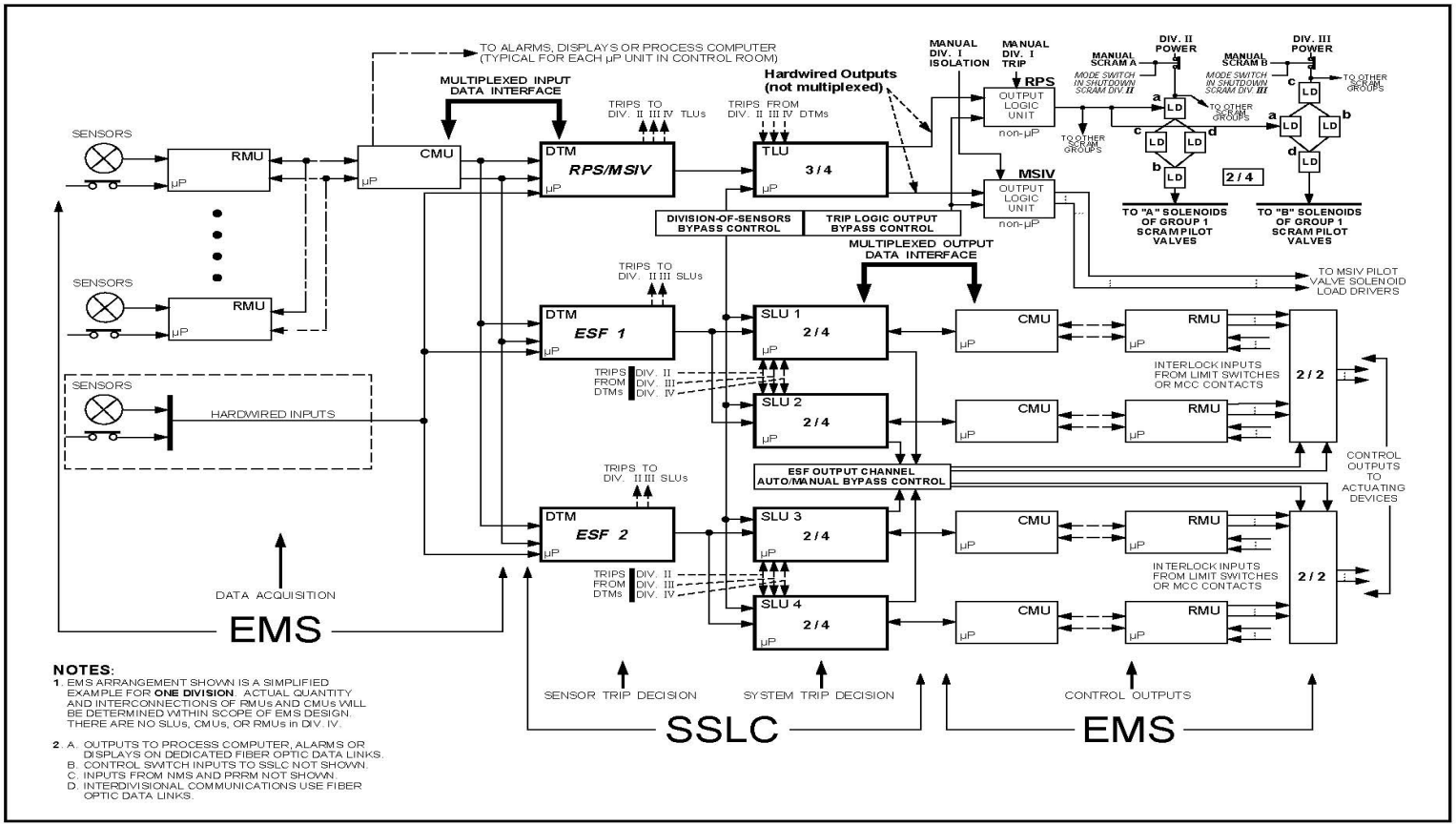


Figure 3.4b Safety System Logic & Control Block Diagram

COLA Part 2 - I&C Tier 1

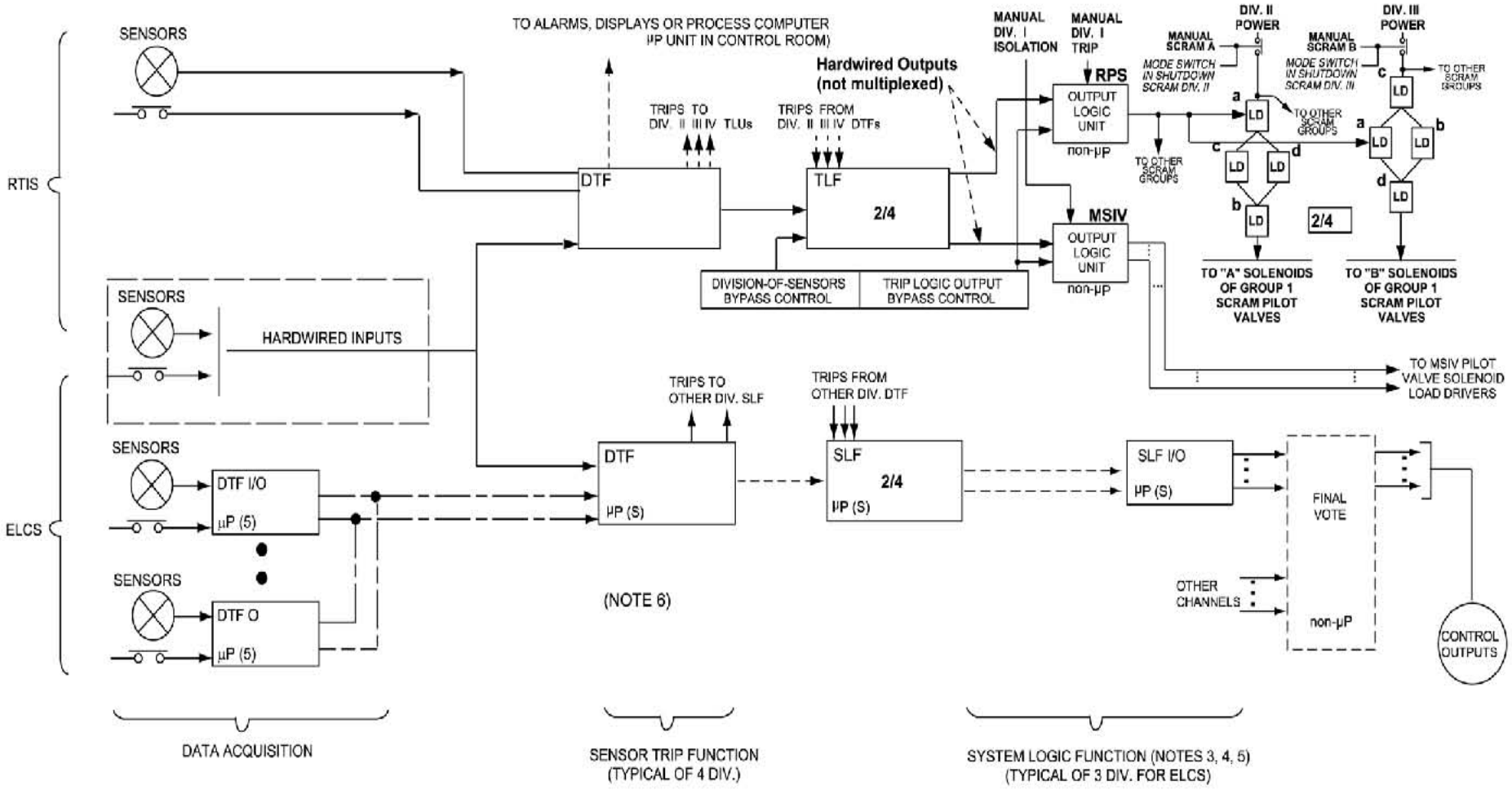


Figure 3.4b Safety System Logic & Control Block Diagram

COLA Part 2 - I&C Tier 2

- Chapter 7 Instrumentation & Control, Sections presented with standard content (Outline follows NUREG-0800, R4)
- Includes new supplemental Sections 7.6S, 7.8S & 7.9S
- Chapter 11.5 addresses Radiation Monitoring Systems (MSL High Radiation Trip)

COLA Part 2 - I&C Tier 2

- Primary DCD Impacts
  - Systems details associated with final system design implementations
  - Changes in data communication technology & capabilities
  - Technology related system and terminology changes (T1 Section 3.4 related changes)
  - Elimination of MSL High Radiation Trip
  - Incorporation of new SAR Sections

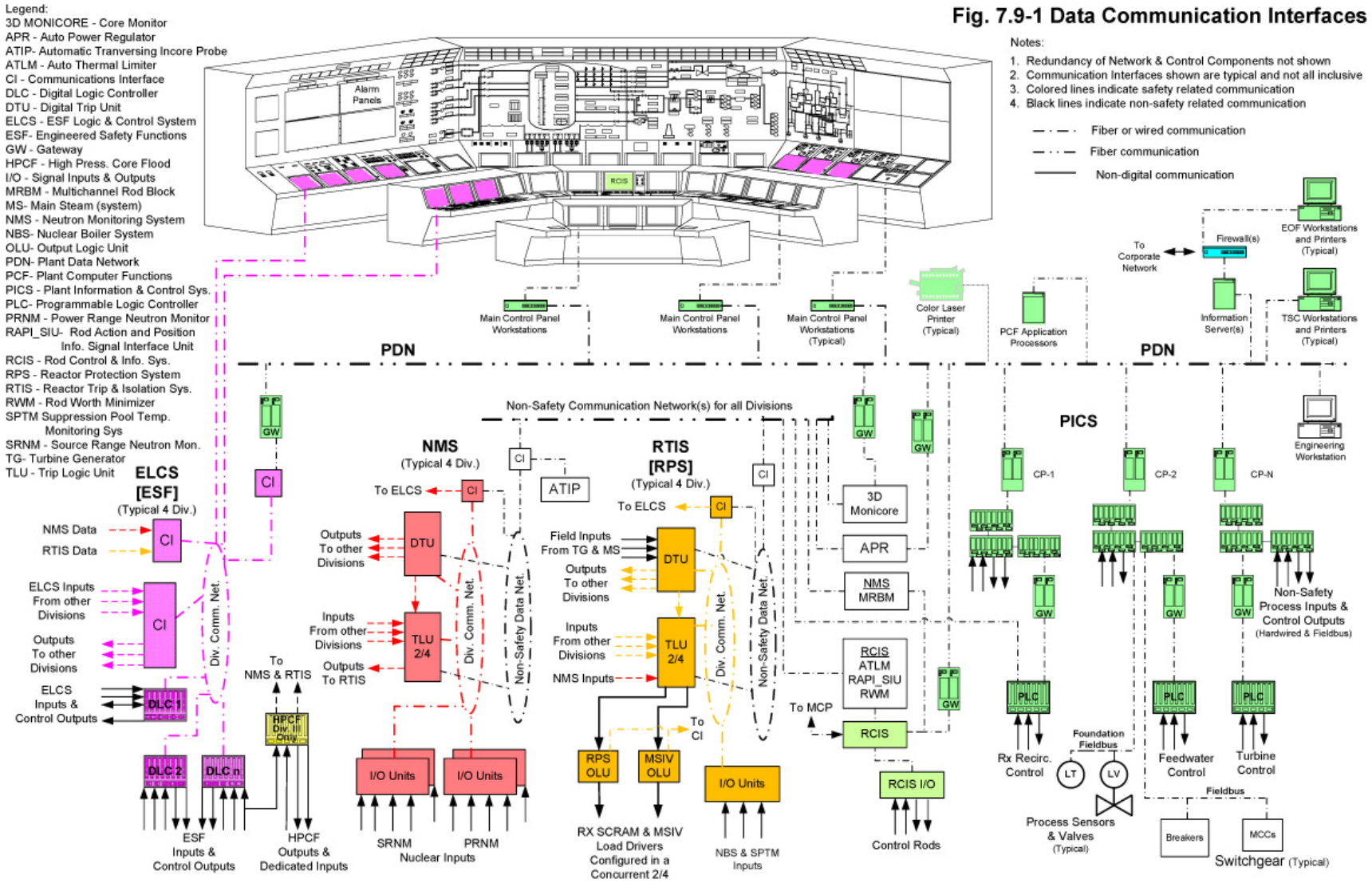
COLA Part 2 - I&C Tier 2

- Chapter 7.9S Data Communication
  - Safety Related Communication
    - RTIS, NMS & ELCS (4 Divisions each)
      - Dedicated Communication per Division
      - Redundant
      - Deterministic
      - Fiber optic based
      - Point to Point
    - ELCS including safety related Main Control Room Video Display Units
    - Dedicated Communication Links
      - Intra-divisional
      - Between Divisions

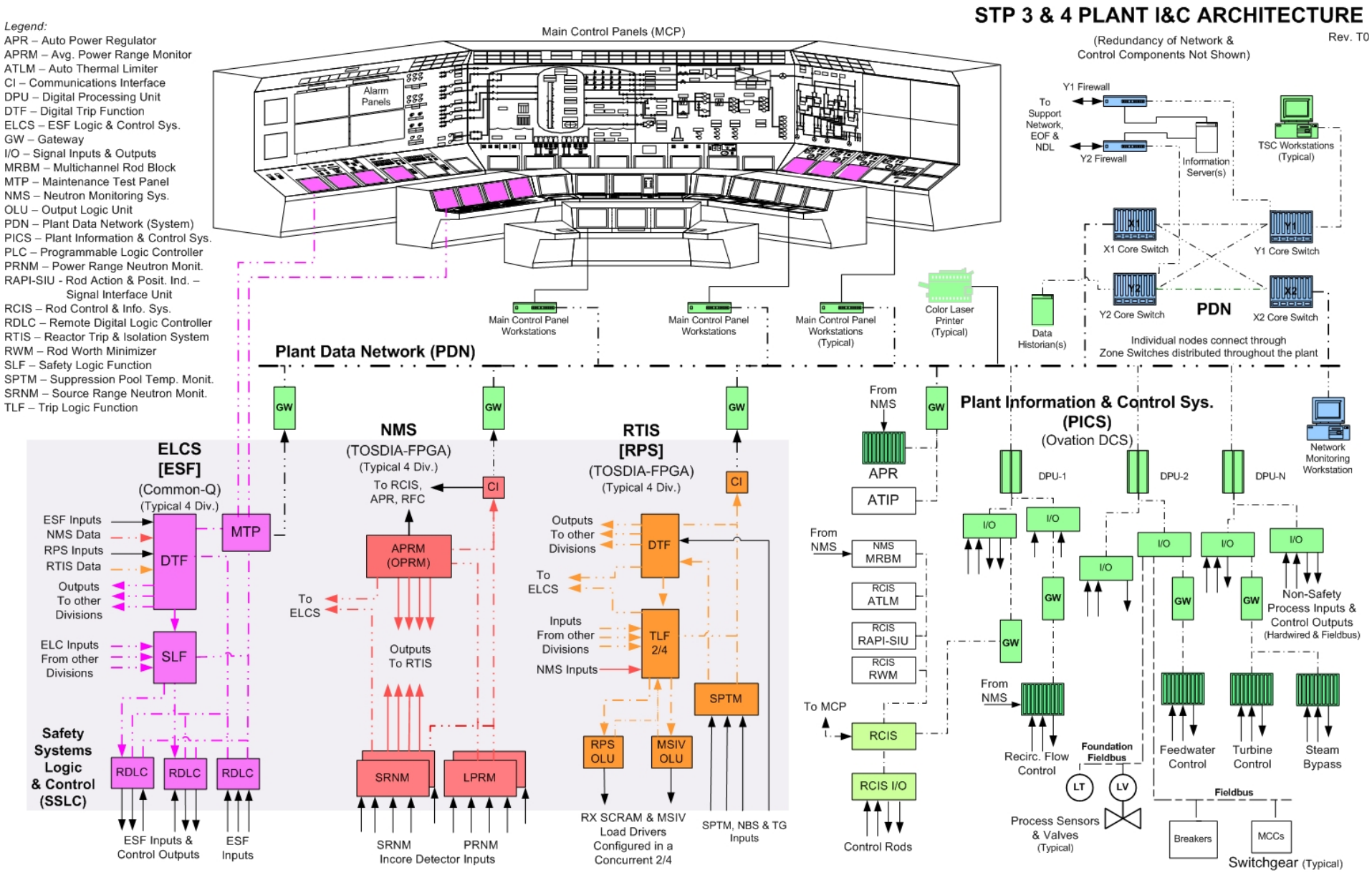
COLA Part 2 - I&C Tier 2

- Chapter 7.9S Data Communication
  - Non-Safety Related Communication
    - Plant Data Network (PDN)
      - Plant wide data network system
      - Fully redundant
      - Fiber Optic Based
      - Layered and segmented
    - Field Bus Communication
      - Field sensors
      - Other electrical devices
    - Dedicated Communication Links

DCD/COLA Rev 1 Architecture



COLA Rev 2 - I&C Architecture



Japanese ABWR Main Control Room

I&C DAC ITAAC SCHEDULE

DAC ITAAC SCHEDULE

- NRC COLA Rev 0, acceptance review question, dated November 16, 2007
- STP commitment letter, dated July 30, 2008
- I&C DAC ITAAC
  - Tier 1 Section 3.4
  - Sixteen (16) specific ITAAC defined
  - DAC will not be closed as part of the COLA

DAC ITAAC Schedule

- SECTION 3.4-ITAAC #1-6 and #16
  - #1-4 Inspection and Tests of SSLC
  - #5 Test of ATWS
  - #6 Inspection of MCR (Alarms, Displays & Controls)
  - #16 Tests to Verify Diversity
- Site Acceptance Testing During Pre-Operational Phase (Fourth Quarter 2014)

DAC ITAAC Schedule

- Section 3.4-ITAAC #7-15
  - #7-10 Digital Systems Software Plans- Third Qtr 2009
  - #11 Digital Systems Software Development Review – Fourth Qtr 2012
  - #12 Digital Platform EMC Qualification Plan – Third Qtr 2009
  - #13 Setpoint Methodology – Second Qtr 2013
  - #14 Environmental Qualification Program Complete – Second Qtr 2013
  - #15 Program Plan for Verifying I&C Installation Correctness Verification – Third Qtr 2009

KEY REGULATIONS AND GUIDANCE

Regulations, Regulatory Guides & Standards

- IEEE 603-1991 – Resolution of I&C issues identified during acceptance review (NRC COLA Acceptance Review letter, dated November 16, 2007)
- Cyber Security - ISG-1, RG 1.152 and BTP 7-14
- ISG-4 Communication Networks
- ATWS meets 50.62
- Diverse Actuation System same as DCD-SECY 93-087
- Digital Platform Qualification & Implementation; SQA-BTP 7-14, IEEE 7-4.3.2 & Appendix B

Conclusions

- Improved Design for I&C Both Safety and Non-Safety
- Maintaining the Key Elements of the Design Certification: DID&D, Communications, HFE
- Incorporation of Attributes from Existing ABWR Design & Operating Experience
- Utilization of the DAC Process to Address Obsolescence
- Addressing the Current Digital I&C Areas of Concern: Cyber Security, D3, Communication, SQA

Questions and Comments