

# Limerick Generating Station Digital Modernization Project LAR Presubmittal Meeting

NRC Presubmittal Meeting Telecon  
June 12, 2020



## Agenda / Opening Remarks

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- Introductions
- Expected outcome for meeting
- Fee Waiver
- Project description
- Current and Proposed Architecture
- Use of Alternate Review Process (ARP)
- NRC Lessons learned – digital projects
- Closing Remarks



## Introductions – Project Team

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- Susan Korn, VP Project Management
- Steve Hesse, Project Director
- Jerry Segner, Principal Project Manager
- Shannon Rafferty-Czincila, Licensing Director
- Dave Helker, Licensing Manager
- Frank Mascitelli, Licensing Lead
- Bob Dickinson, LGS Regulatory Assurance Manager
- George Budock, LGS Regulatory Assurance
- Pareez Golub, Digital Licensing SME
- Craig Myers, LGS Operations

## Introductions - Engineering

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- Elliott Flick, VP Centralized Design Organization
- Vikram Shah, Director CDO
- John Connelly, I&C Analytical Branch Manager
- Mark Samselski, Lead Responsible Engineer
- George Bonanni, I&C Responsible Engineer
- Scott Schumacher, Systems Engineering
- Farad Zaman, Systems Engineering

## Expected Outcome of Meeting

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- NRC has an overview of project scope
- NRC has understanding of the current project milestones
- Exelon gains insights on NRC lessons learned from previous digital License Amendment Requests (LAR)

## Exelon – DOE Partnership

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- Historically, industry has struggled with modernization of first-echelon safety systems
- NRC issuance of Digital Instrumentation and Controls Interim Staff Guidance #06 (DI&C-ISG-06), Revision 2, *Licensing Process*, addressed perceived regulatory barriers
- In 2019 a public / private partnership was formed through the Light Water Reactor Sustainability Program (LWRS) to research viability of modernization of safety systems

## Exelon – DOE Partnership

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- Research produced two key products - Technical Requirements Specification (TRS) and License Amendment Request framework document
- LAR Framework Document
  - Vendor-independent LAR framework document created in a format consistent with the DI&C-ISG-06 ARP
  - Document is a starting point and will be refined as Limerick's design further matures
  - LAR framework will be made available through LWRS as a starting point for other licensees

## Intent to Request NRC Fee Waiver

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- Request fee waiver under 10 CFR 170.11(b)
- LAR will exercise all portions of the DI&C-ISG-06 Alternate Review Process for a large-scale protection system replacement
- Learnings from LGS execution of ARP will be used to support US operating fleet digital protection system modernization efforts
- First-echelon safety system digitization is critical to US operating fleet sustainability

## Intent to Request NRC Fee Waiver

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- LAR will utilize standardized industry digital design guidance – pilot project for Exelon
  - EPRI Digital Engineering Guide (DEG) and
  - NISP-EN-04, Standard Digital Engineering Process
- NEI 06-04, License Amendment Request Guidance, Appendices F and G
- DOE LWRS research LAR Framework Document subsequent revisions
- LGS LAR will set precedent for US operating fleet protection system modernization

# Intent to Request NRC Fee Waiver

|      | A<br>R | Tier |   |   | Plant-Specific Information Submitted with License Amendment Request<br>(Phase 1 for Tier 1, Tier 2, and Tier 3)                                                                                                                 |
|------|--------|------|---|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      |        | 1    | 2 | 3 |                                                                                                                                                                                                                                 |
| 1.1  | X      |      |   |   | (Summary of) Application Software Planning and Processes (see D.4)                                                                                                                                                              |
| 1.2  | X      |      |   |   | (Summary of) Vendor Oversight Plan (see C.2.2)                                                                                                                                                                                  |
| 1.3  | X      | X    | X |   | Approved Topical Report Safety Evaluation (see D.5)                                                                                                                                                                             |
| 1.4  | X      | X    | X | X | System Description (see D.1)                                                                                                                                                                                                    |
| 1.5  | X      | X    | X | X | System Architecture (see D.2)                                                                                                                                                                                                   |
| 1.6  | X      | X    | X | X | (Summary of) Hardware Equipment Qualification (see D.3)                                                                                                                                                                         |
| 1.7  | X      | X    | X | X | (Unified Compliance/Conformance Matrix for) IEEE Std 603-1991 and 7-4.3.2-2003 (see D.6)                                                                                                                                        |
| 1.8  | X      | X    | X | X | (Changes to) Technical Specifications (see D.7)                                                                                                                                                                                 |
| 1.9  | X      | X    | X | X | Setpoint Methodology and Calculations (see D.7)<br>Provided when technical specification setpoint methodology changes or calculations deviate from or are not addressed in an applicable referenced NRC-approved topical report |
| 1.10 | X      | X    | X | X | Secure Development and Operational Environment (see D.8)                                                                                                                                                                        |
| 1.11 |        | X    | X | X | Software Requirements Specification (see D.9.1)                                                                                                                                                                                 |
| 1.12 |        | X    | X | X | Software Design Specification (see D.9.2)                                                                                                                                                                                       |
| 1.13 |        | X    | X | X | Design Analysis Reports for Platform Changes (see D.9.3)                                                                                                                                                                        |
| 1.14 |        | X    | X | X | System Response Time Analysis Report (see D.9.7)                                                                                                                                                                                |
| 1.15 |        |      | X | X | Design Report on Computer Integrity, Test and Calibration, and Fault Detection (see D.9.7)                                                                                                                                      |
| 1.16 |        |      |   | X | Commercial-Grade Dedication Plan (see D.9.9)                                                                                                                                                                                    |
| 1.17 |        |      |   | X | Quality Assurance Plan for Hardware (see D.9.10)                                                                                                                                                                                |
| 1.18 |        |      |   | X | (Summary of) Hardware Development Process (see D.9.10)                                                                                                                                                                          |

DI&C-ISG-06 R2,  
Enclosure B,  
*Information  
Provided in  
Support of a  
License  
Amendment  
Request for a  
Digital  
Instrumentation  
and Control  
Modification*



# *Project Overview*

## Project Scope

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### Replacement of first-echelon Safety-related Systems:

- Reactor Protection System (RPS)
- Nuclear Steam Supply Shutoff System (NSSSS)
- Emergency Core Cooling System (ECCS)

Project scope is draft for NRC discussion and planning purposes. Final scope to be determined by Exelon by August 2020.

## Project Benefits

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- **Increase in plant safety**
  - Reduction in human error potential
  - Increase in operational decision-making accuracy and speed
  - Higher full system availability
  - Enhanced self-diagnostic capabilities
- **Increase in reliability**
  - Elimination of spurious half scrams
  - Elimination of single component vulnerabilities
  - Reduction of obsolete components
  - Elimination of 1800 safety significant components

## Project Benefits

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- **Increase in quality Operations and Maintenance**
  - Improved availability, spectrum and quality of MCR information
  - Improved configuration control
  - Continuous self-testing and diagnostics of all trains of safety functions
  - Reduced administrative overhead
  - Reduced operator burden through automation
- **Supports workforce of the future**

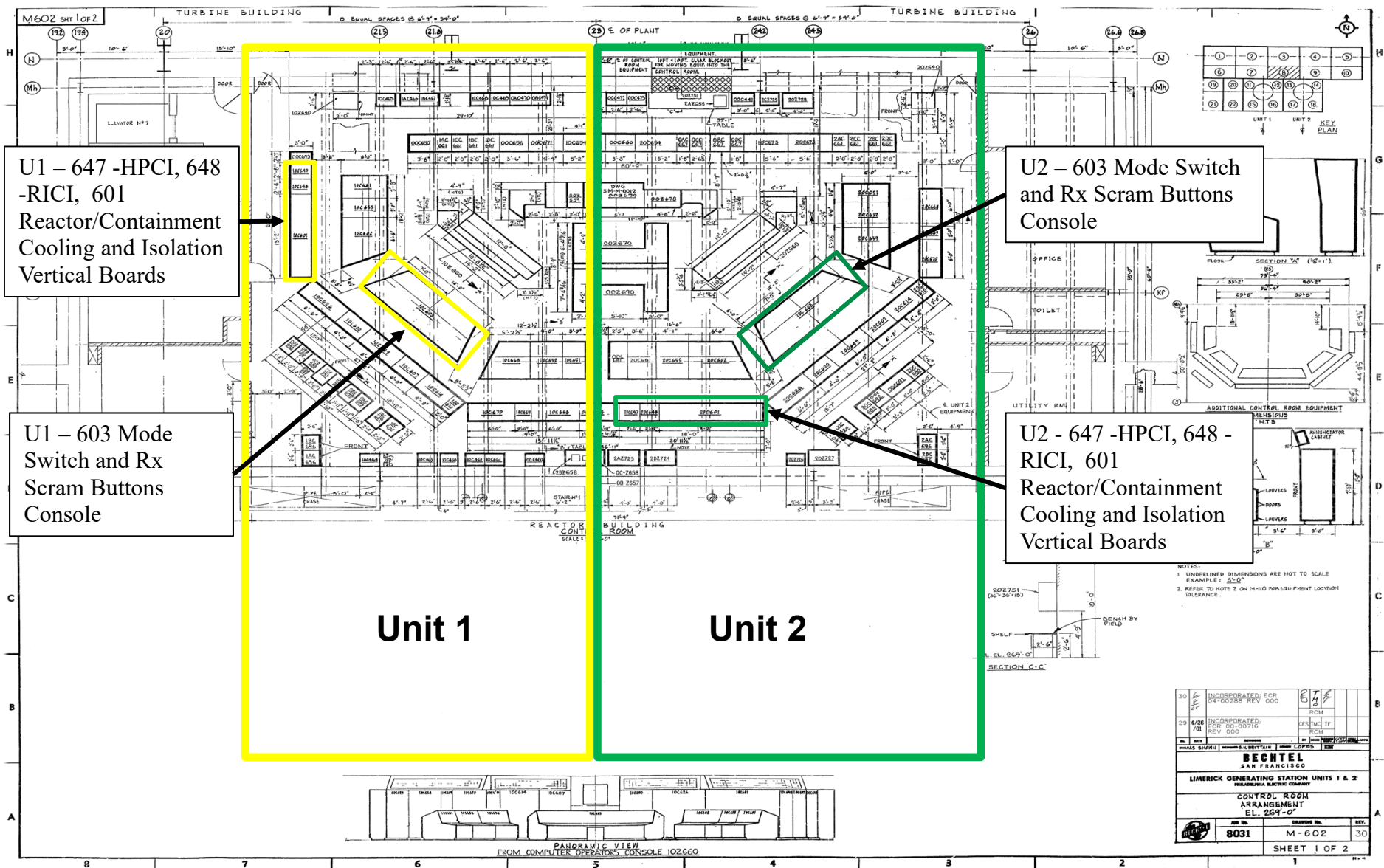
## Project Milestones

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- NRC presubmittal meeting June 2020
- Vendor selection July 2020
- Letter of Intent July 2020
- Fee waiver request letter July 2020
- Next NRC presubmittal mtg Oct 2020
- PPS LAR submittal June 2021

# *Current Architecture*

# Current Architecture - Main Control Room

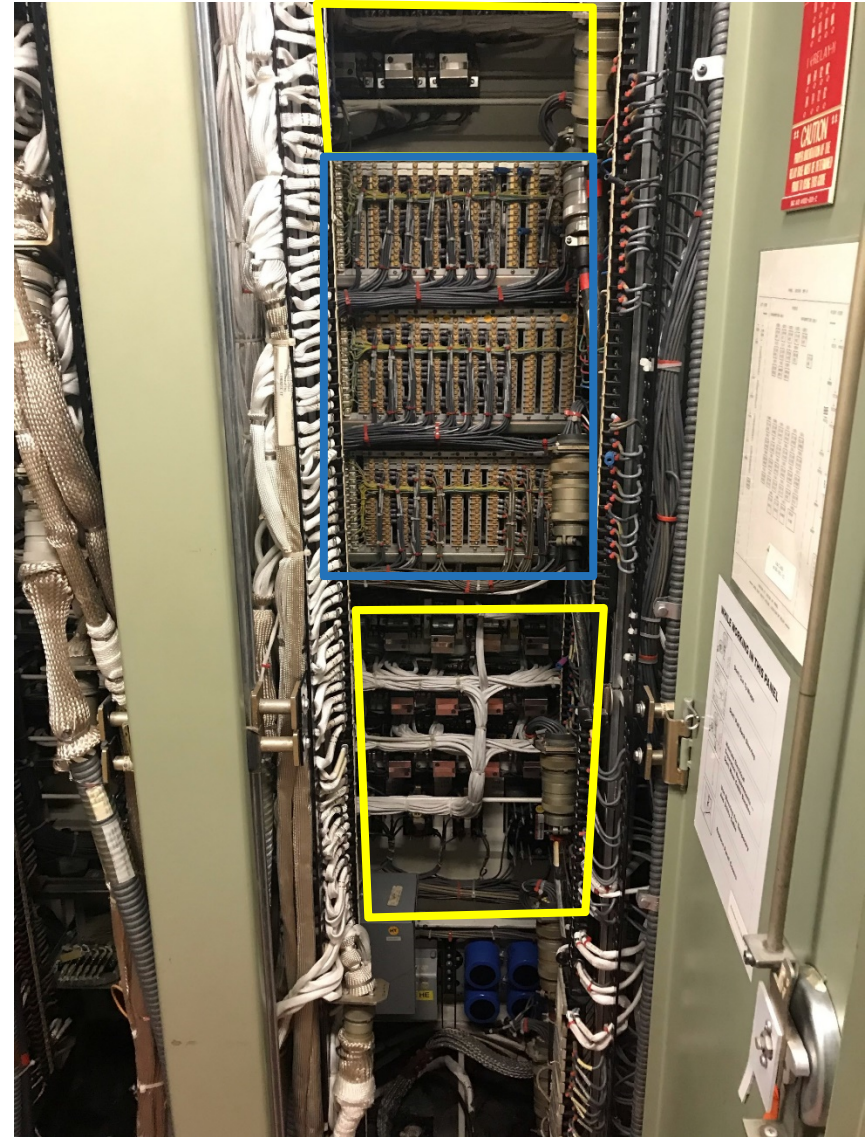






## Current Architecture – RPS, NSSSS, ECCS

- Commonalities between systems
  - Detector → trip unit → relay
  - Operator interface in Main Control Room
  - Logic resides in Aux Equipment Room
  - Up to 8 instrument channels to support 4 divisions of logic
  - Each system installed separately
  - Cohabitation of some logic and detector signals



## Current Architecture - RPS

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- RPS

- Purpose: cause rapid plant shutdown
- Logic
  - Each division has two channels
  - Two divisions
  - One out of two taken twice
  - Fail safe
- Two safeguard power supplies

- NSSSS

- Purpose: Isolate primary containment
- Logic
  - One or two channels per division
  - Up to four divisions
  - Variable, purpose specific logic
  - Fail safe
  - Interposing relays
- Two safeguard power supplies

## Current Architecture - ECCS

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- From left to right
  - Automatic Depressurization System (ADS)
  - Core Spray (CS) Div. 1 and 3
  - Residual Heat Removal System (RHR) Divisions 1 and 3
  - NSSSS interface
  - Core Spray Divisions 2 and 4
  - RHR Divisions 2 and 4
  - Reactor Core Isolation Cooling (RCIC) System
  - High Pressure Core Injection (HPCI) System



## Current Architecture - ECCS

- Two instrument channels per division
- All use 1 out of 2 logic
- HPCI and RCIC are single division to initiate, two divisions for isolation
- ADS is two divisions
- Four divisions of Low Pressure Injection
- Divisional Diesel backed safeguard power
- Divisional AC and safeguard battery control power

Divisions 1 & 3 ECCS in AER



# *Proposed Architecture*



## Proposed Architecture – Plant Protection System (PPS)

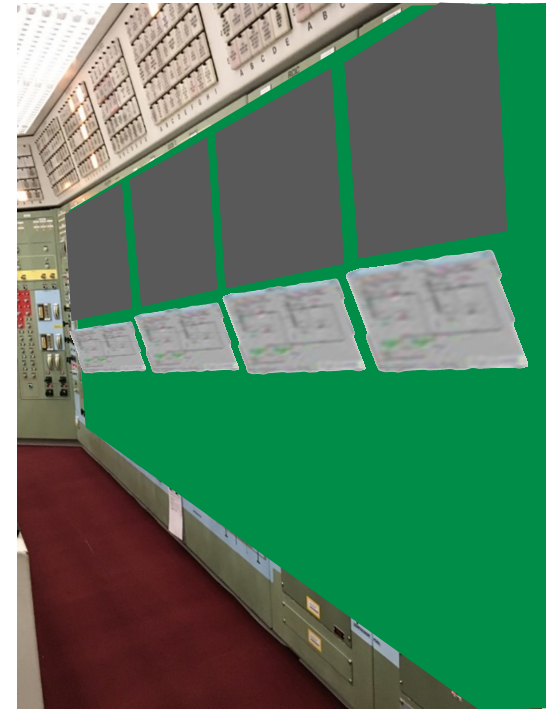
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- New system comprised of vendor's standard platform
  - Vendor platform will have prior NRC approval
  - New system retains similar architecture
  - Replaces the existing four divisions of bi-stable analog trip units in RPS, NSSSS, and ECCS with separate, independent, channel functions in application software
- RPS, NSSSS, and ECCS are designed as segmented functions, running on a common platform
  - Functions retain their existing logic separation
  - Clear differentiation between channels, electrical divisions, and mechanical trains

Digital platform vendor selection in progress

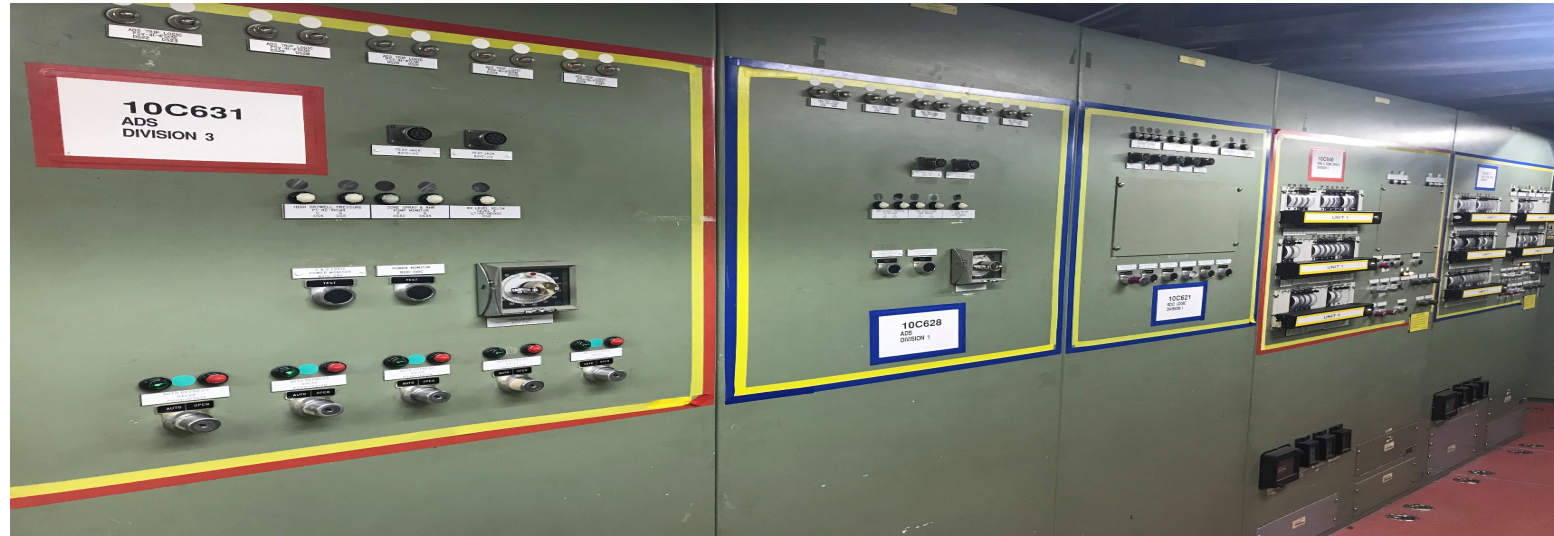
## Current vs. Proposed Architecture – Main Control Room

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- MCR Human Machine Interface (HMI) will be video display units (VDUs)
- Eliminate the separate lamp-based trip, status, and bypass indicators (BISI) and provide the information on the VDUs.
- Select manual controls are retained (e.g., Reactor SCRAM) with soft controls added for division-level systems initiation and component control

# Current vs. Proposed Architecture - Auxiliary Equipment Room





## Proposed Architecture – Plant Protection System (PPS)

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- One-way redundant fiber optic cabling from each safety channel and safety division to the non-safety related DCS data backbone, which allows diverse display of all RPS, NSSSS, ECCS data and status by DCS/Plant Process Computer displays and annunciation.
- Ability to bypass one of the four channels for maintenance, while still retaining 2 out of 3 twice voting in the divisions
- Eliminate or reduction of Technical Specification (TS) Surveillance Requirements (SR) through crediting platform and application self-diagnostics

## Proposed Architecture – Plant Protection System (PPS)

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- Use the existing, retained field input wiring terminals, hardwired connections to the new PPS (RPS, NSSSS, and ECCS) inputs and outputs
- To the extent practicable, eliminate redundant transmitters and bi-stables
- Ensure that the platform design does not preclude future migration of other safety systems and safety functions to the platform

# *LAR Use of Alternate Review Process (ARP)*

## Use of DI&C-ISG-06 Alternate Review Process

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- Several presubmittal meetings to be planned to discuss full list of topics provided by NRC and included in DI&C-ISG-06
- Comprehensive Vendor Oversight Plan (VOP) will be developed for project – VOP Summary will be included in LAR
- NRC-approved platform used / applicability of application software development process (if NRC approved) to proposed software design, implementation, and test
- Regulatory commitments provided for:
  - For uncompleted Plant Specific Action Items (PSAIs) included in LAR
  - For later lifecycle design activities not governed by other regulatory processes

## Next Presubmittal Meeting Topics

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- Key design concepts, including the four fundamental design principles
  - Replacement modification scope
  - Comparison of the existing architecture and the proposed architecture
  - D3 assessment strategy
- Identified significant deviations from a referenced NRC-approved topical report (if applicable)
- Strategy for changing TS SRs based on self-diagnostics
- Impact on Accident Analyses (e.g. response time testing)
- Human Factors considerations

# *NRC Lessons Learned Digital Projects*