LWRS Program – Program Overview

LWRS LIGHT WATER REACTOR SUSTAINABILITY

Plant Modernization Pathway

Pathway Lead – Craig Primer

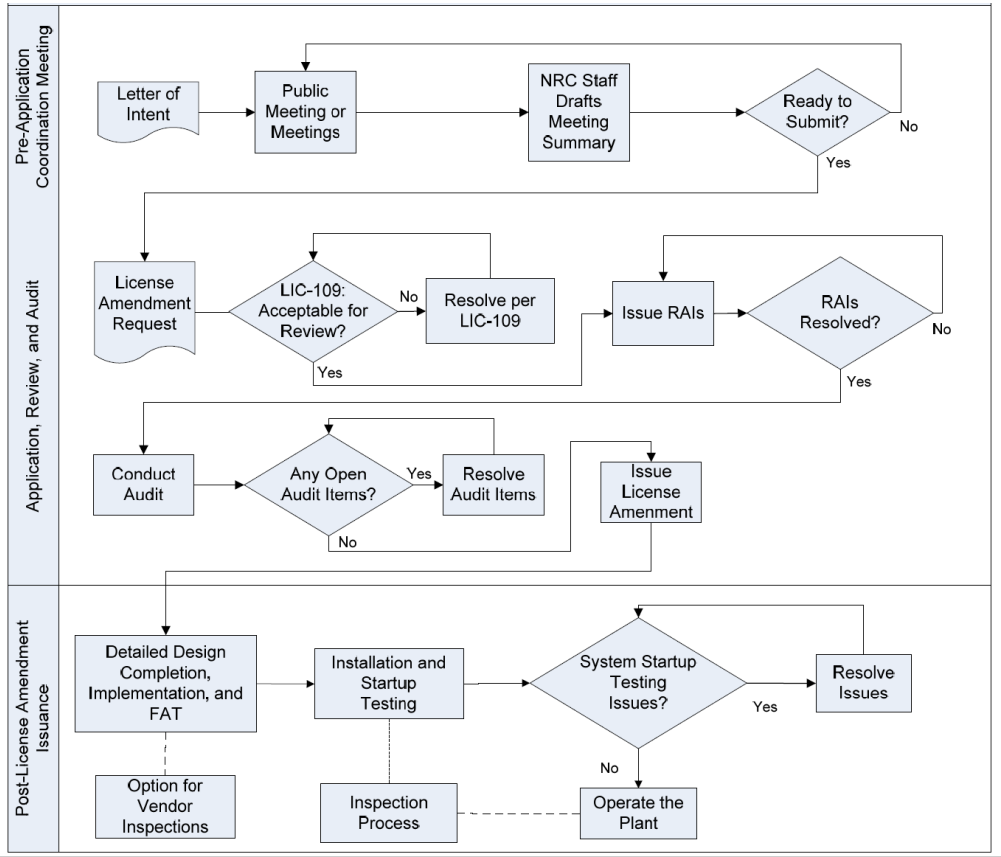
Overview of Plant Modernization Pathway

Plant Modernization Research Objectives and Goals

Objectives	Develop technology modernization solutions that address aging and obsolescence challenges			Deliver a sustainable business model that enables the US nuclear industry to remain cost competitive
Research Areas	I&C Architecture	Digital Architecture	Human & Technology Integration	Integrated Operation for Nuclear
Goals	Develop a sustainable I&C architecture design that enables transition of legacy analog I&C to new advanced digital design, effectively addressing human factors, cost, and regulatory considerations	Develop advanced sensor, monitoring, and data processing technologies, displacing a substantial number of labor-intensive plant support tasks using process automation	Integrate plant personnel and innovative technologies to maximize plant operation efficiency while eliminating human error	Achieve LWR fleet electric market competitiveness by transforming the nuclear business model through business-driven technology and innovation, to achieve long-term technical and economic viability

I&C Pilot Upgrade Establishing Pathway for Safety-Related Digital Modernization

- U.S. nuclear utilities have been reticent to pursue needed safety-related I&C upgrades due to perceived licensing risk.
- The NRC issued updated Interim Staff Guidance (ISG-06, Rev. 2) to include an alternate review process for License Amendment requests to address this concern.
- Exelon and the LWRS Program Plant Modernization Pathway are collaborating on a Pilot Safety-Related Digital I&C Upgrade to demonstrate the viability the alternate review process.
- Upgrade efforts must also be economically viable to promote continued plant operation.

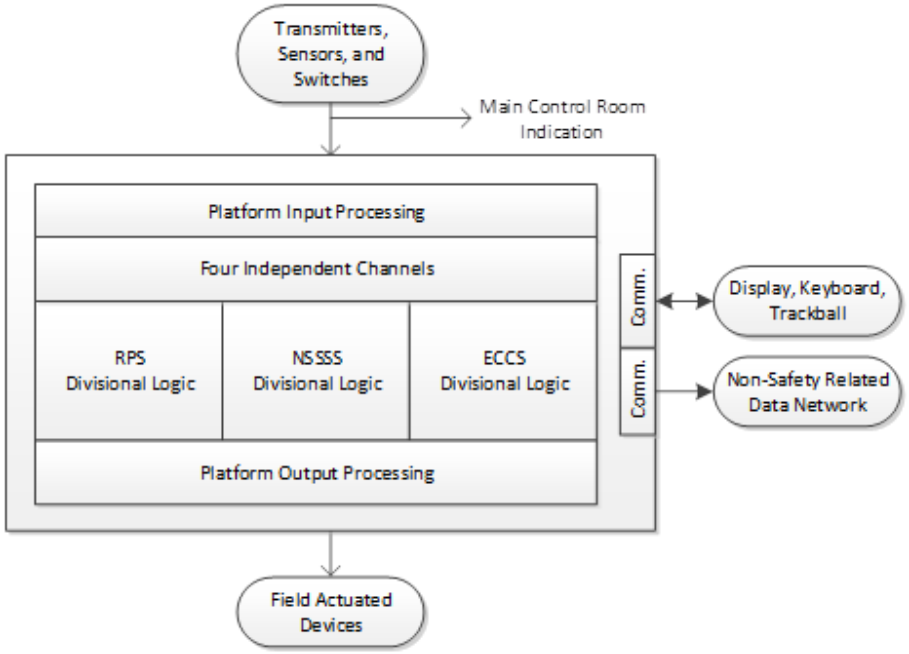


Digital Instrumentation & Control
Interim Staff Guidance
(DI&C-ISG-06)
Alternate Review Process

Vendor-Independent Design Requirements for a Boiling Water Reactor Safety System Upgrade

- LWRS Program researchers in collaboration with industry, developed a design concept and requirements to support the upgrade of Safety-Related I&C Systems.
  - License Amendment Request framework document describes a modern design concept and conforms to the NRC's ISG-06 alternate review process.
  - Safety system and non-safety distributed control system functional requirements that enable improved safety, reliability, and reduced cost.
- Report has been made publicly available to promote similar upgrades:
  - INL/EXT-20-61079: Vendor-Independent Design Requirements for a Boiling Water Reactor Safety System Upgrade)
  - Available on OSTI: https://www.osti.gov/biblio/1755891

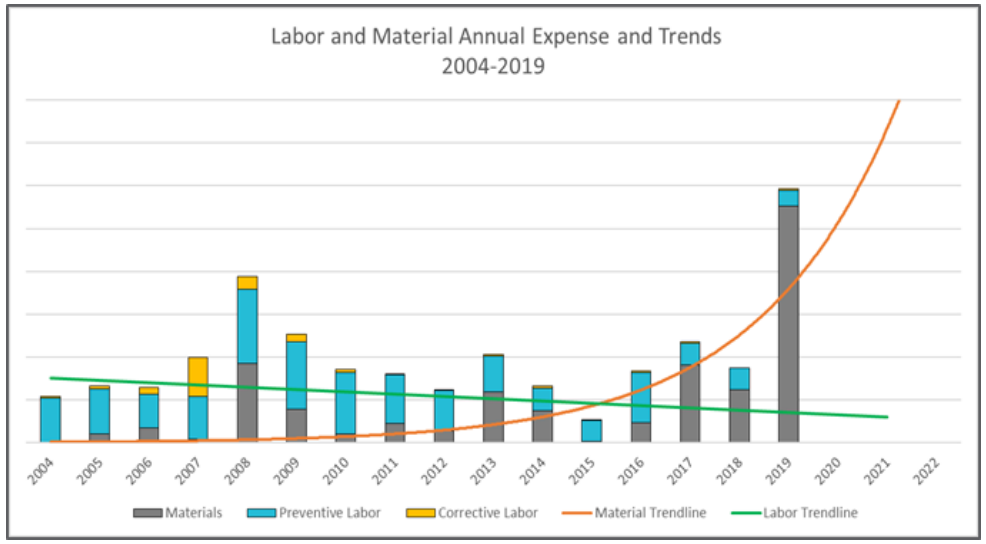
Simplified Digital Plant Protection System Architecture



LWRS researchers working with industry have developed a simplified digital architecture that reduces part counts by almost 75% and significantly reduces safety system costs

Business Case Analysis Methodology

- Business Case Analysis (BCA) developed in conjunction with Pilot I&C Upgrade design concepts.
- A comprehensive analysis of legacy system lifecycle cost drivers was performed.
- Expected benefits of the digital upgrade were quantified.
- Combined with utility estimated project costs, the BCA provides compelling data to support continued Pilot Upgrade efforts.
- Report has been made publicly available to promote similar upgrades:
  - INL/EXT-20-59371: Business Case Analysis for Digital Safety-Related Instrumentation & Control System Modernizations
  - Available on OSTI: https://www.osti.gov/biblio/1660976



BCA Identifies that Costs to Maintain Current I&C Systems are Increasing

Business Case Analysis Research directly supported Exelon's economic justification for pursuing safety-related upgrades

Pilot Upgrade Initiation Phase Implementation Report

- Describes industry processes followed and Initiation Phase products produced for the proposed safety-related I&C upgrade at Exelon's Limerick Generating Station
- Captures lessons learned for industry benefit. This includes leveraging new industry and licensing processes for this work.
- Multi-organization research effort capturing results from work performed by Exelon, MPR Associates, ScottMadden, and LWRS Program personnel.
- Report has been made publicly available to promote similar upgrades:
  - INL-EXT-20-59809: Safety-Related Instrumentation & Control Pilot Upgrade Initiation Phase Implementation Report
  - Available on OSTI: https://www.osti.gov/biblio/1662013

Limerick Generating Station

LWRS Research directly supported Exelon's decision to approve Conceptual Design Phase efforts. License Amendment Request submittal is ongoing.

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LIGHT WATER
REACTOR
SUSTAINABILITY

Sustaining National Nuclear Assets

http://lwrs.inl.gov