



Craig Primer

**Plant Modernization Pathway Lead
Light Water Reactor Sustainability**

Light Water Reactor Sustainability

■ Goal

- Enhance the safe, efficient, and economical performance of our nation's nuclear fleet and extend the operating lifetimes of this reliable source of electricity

■ Objectives

- Enable long term operation of the existing nuclear power plants
- Deploy innovative approaches to improve economics and economic competitiveness of LWRs in the near term and in future energy markets.
- Sustain safety, improve reliability, enhance economics

■ Focus Areas

- Materials Research
- Plant Modernization Research and Development
- Risk-Informed Systems Analysis
- Reactor Safety

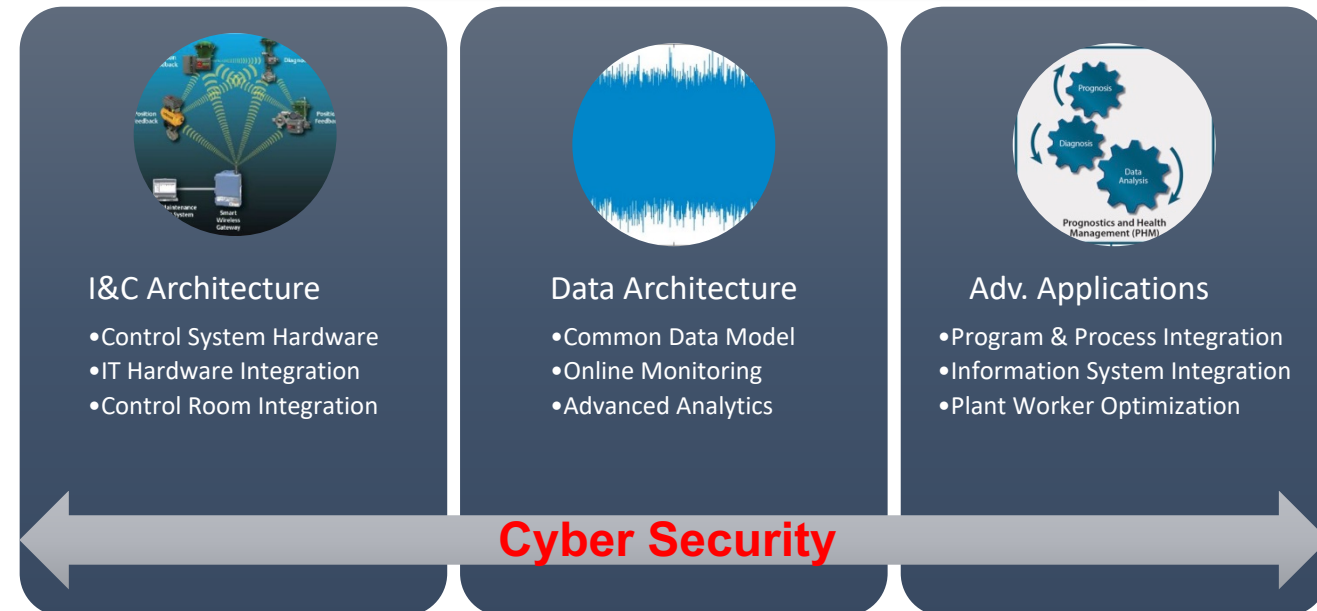


Nine Mile Point ~ Courtesy Exelon

Plant Modernization Pathway Overview

- Plant Modernization Pathway Goal – Extend life and Improve performance
- Pathway Activities –
 - Research that validates new technologies
 - Demonstrations that confirm operational concepts
- Pathway Results – Recommendations that significantly reduce the technical, financial, and regulatory risk of modernization
- Pathway Guidance Includes:
 - End State Requirements Reports
 - Cost Benefit Studies
 - Regulatory Impact Evaluations
 - Implementation Recommendations
- Experience & Capabilities
 - Effective engagement with nuclear power industry
 - Coordinating efforts to achieve greatest impact

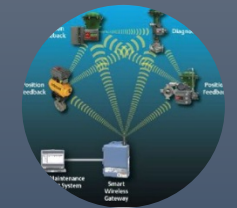
Key Areas of R&D to Achieve Plant Modernization Major Goals



I&C Hardware Architecture

Instrumentation and Control and Plant Modernization

- Demonstrating a fully digital nuclear plant modernization approach based on modern technology
- In collaboration with nuclear utilities and industry partners, LWRS program researchers are:
 - Developing and demonstrating a **strategy for plant modernization** to replace piecemeal obsolescence management
 - Developing, demonstrating, and deploying **modern digital technologies** to automate work functions, reduce staff requirements, and better use plant information
- Outcomes will....
 - Improve human-system performance
 - Enhance plant safety
 - Enhance economic performance

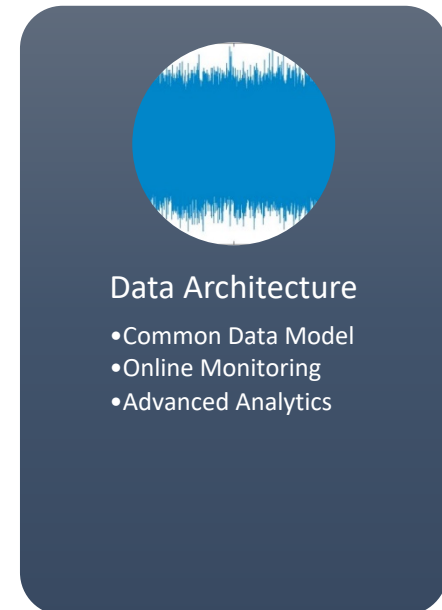


I&C Architecture

- Control System Hardware
- IT Hardware Integration
- Control Room Integration

Online Monitoring and Plant Automation

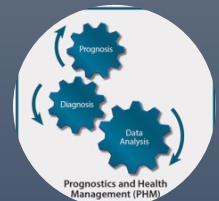
- Replacing the current labor intensive plant monitoring with a centralized online monitoring approach
- Developing a risk-informed predictive maintenance strategy
 - **Data Analytic Capabilities** –
Developing diagnostics and prognostics models using data driven techniques and advancement in sensor technologies
 - **Risk assessment capabilities** – Revisiting probabilistic risk assessment to achieve risk-informed revision of current design basis, margin recovery, and the application of new technologies
- Outcomes will...
 - Reduce LWR Fleet operation and maintenance costs
 - Improve efficiencies gained through automation of plant activities
 - Replace or augment current inspection-based aging management plan with online monitoring capabilities



Advanced Applications

Advanced Applications and Process Automation

- Enabling plant workers to efficiently leverage plant system and process data to improve performance and reduce costs
- In collaboration with nuclear utilities and industry partners, LWRS Program is developing advanced applications. Examples include:
 - Automated Work Packages
 - Image Processing Technology.
- Outcomes will....
 - Provide recommendations the LWR nuclear industry on technologies that provide the highest cost saving on the work process through coupling advanced data mining and machine learning methods with human factors research

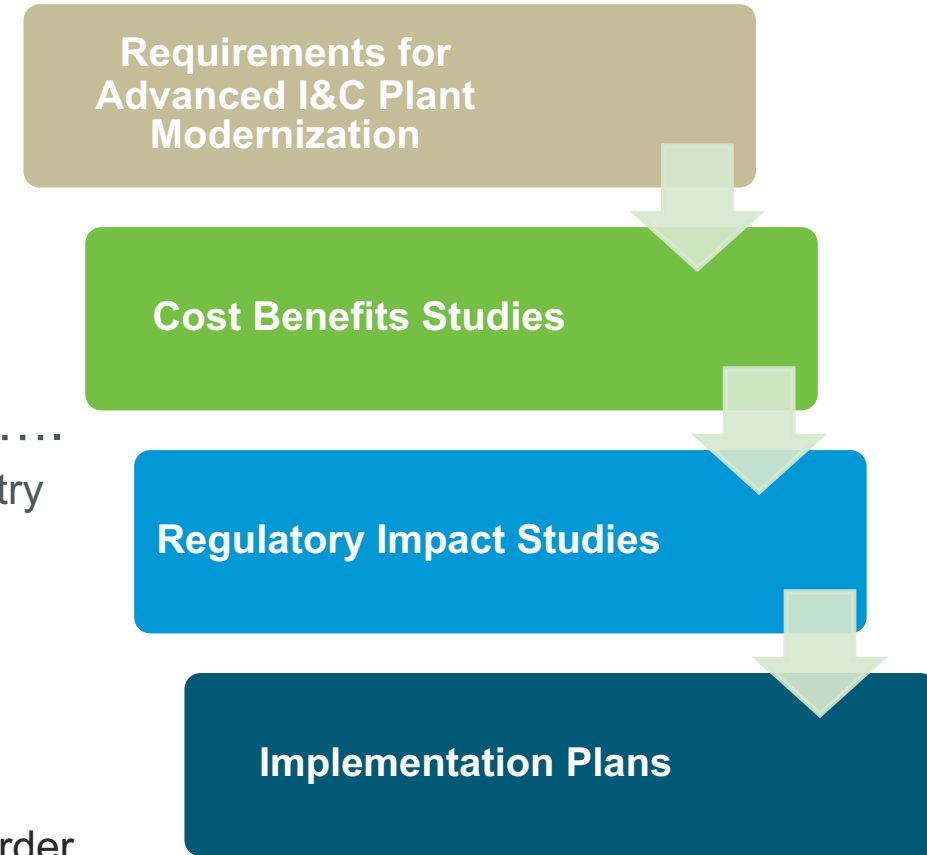


Adv. Applications

- Program & Process Integration
- Information System Integration
- Plant Worker Optimization

Key R&D Deliverables Provided to Assist US Nuclear Industry Achieve Optimum Modernization Results

- Requirements for Advanced I&C Modernization – Provide US Nuclear Industry with....
 - R&D of technologies that result in end-state architecture requirements to support full plant modernization which enables significant O&M cost reduction
- Cost Benefit Study – Provide US Nuclear Industry with....
 - Specific business cases will be developed for monitoring and plant automation technology implementation, both incrementally for new technologies and comprehensively in determining the cost savings for the entire nuclear plant O&M costs
- Regulatory Impact Studies – Provide US Nuclear Industry with....
 - Demonstrate, assess and provide results that will assist the nuclear industry evaluate modernization of I&C end state architecture, data integration and work automation
- Implementation Plans – Provide US Nuclear Industry with....
 - A logical sequence of implementation of technologies will be developed, considering the underlying architecture and the optimum implementation order to gain the highest leveraged benefits through individual technologies.

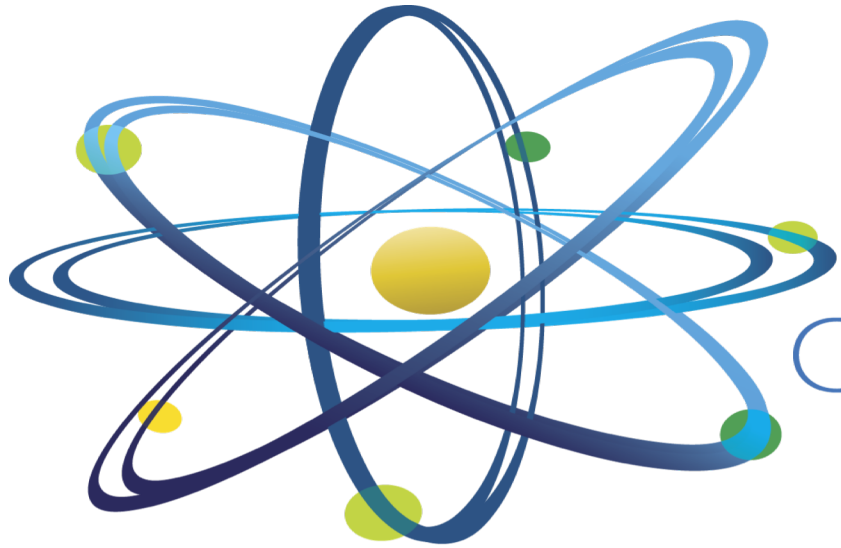


CINR Workscope: RC-8

- Digital Instrumentation and Control Qualification
 - Elimination of Common Cause Failures
 - Testability – Determine and approach to perform 100% exhaustive testing to ensure no digital defects
 - Elimination of CCF Triggers - Develop an approach that would ensure latent digital defects are not concurrently triggered
- Analytics to Support Equipment Condition Monitoring
 - Automate data collection & analytic based decision making using novel:
 - Sensors
 - Automation technologies
 - Data analysis methodologies
 - Results should help to drive down costs of maintenance and enable risk informed maintenance programs



Questions?



Clean. **Reliable. Nuclear.**