



U.S. DEPARTMENT OF  
**ENERGY**

**Nuclear Energy**

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## **Light Water Reactor Sustainability (LWRS) FY 2017 CINR Webinar: NEUP RC-6**

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# Light Water Reactor Sustainability (LWRS) Program

## ■ LWRS Program Goal

- Develop fundamental scientific basis to allow continued long-term safe operation of existing LWRs (beyond 60 years) and their long-term economic viability

## ■ LWRS program is developing technologies and other solutions to

- Enable long term operation of the existing nuclear power plants
- Improve reliability
- Sustain safety

## ■ LWRS focus areas

- Materials Aging and Degradation
- Advanced Instrumentation and Controls
- Risk-Informed Safety Margin Characterization
- Reactor Safety Technologies



*Nine Mile Point ~ Courtesy Constellation Energy*



# Technical Focus Areas Summary

## Nuclear Energy

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### ■ Nuclear Materials Aging and Degradation

- Understand and predict long-term environmental degradation behavior of materials in nuclear power plants, including detecting and characterizing aging degradation

### ■ Advanced Instrumentation, Information, and Control Systems Technologies

- Address long-term aging and obsolescence of existing instrumentation and control technologies through a strategy for long-term modernization

### ■ Risk-Informed Safety Margin Characterization

- Develop significantly improved safety analysis tools (computer codes called RELAP-7 and Grizzly) and apply these tools to analyze the safety margin of aging plants

### ■ Systems Analysis and Emerging Issues

- Address high impact emerging issues such as flexible operations and water usage issues (the potential backfit of cooling towers)

### ■ Reactor Safety Technology

- Address emerging safety concerns in response to the Fukushima accident
- Develop technologies to enhance the accident tolerance of current and future reactors



# Advanced Instrumentation, Information, and Control Systems

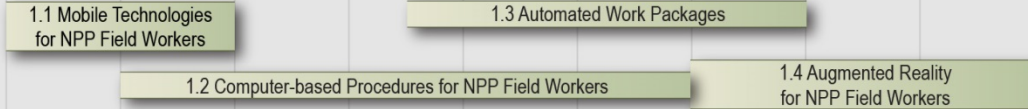
- **Address long-term aging and reliability concerns of existing II&C technologies:**
  - *Establish a strategy to implement long-term modernization of II&C systems.*
  - *Develop, test, and deploy advanced technologies.*
  - *Promulgate technologies, lessons learned, and foster industry standardization.*
  - *Develop advanced condition monitoring technologies to monitor, detect, and characterize aging and degradation*





# LWRS II&C Pilot Projects

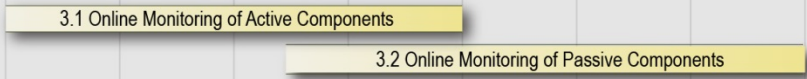
## 1.0 Human Performance Improvement for NPP Field Workers



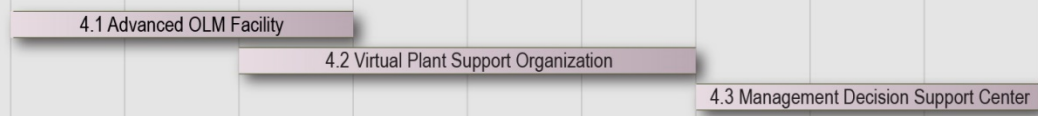
## 2.0 Outage Safety and Efficiency



## 3.0 Online Monitoring



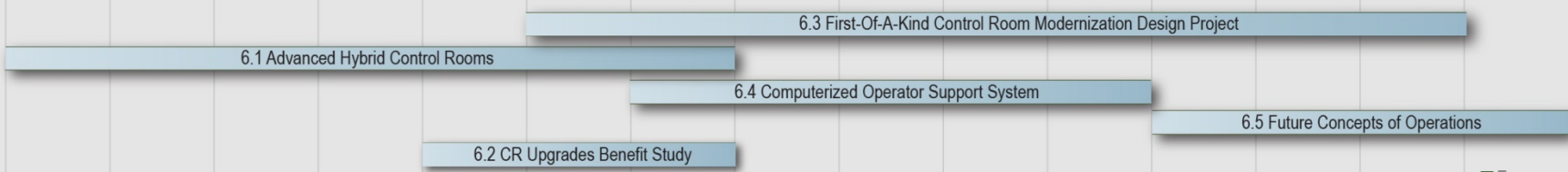
## 4.0 Integrated Operations



## 5.0 Automated Plant



## 6.0 Hybrid Control Room







## CINR Workscope (RC-6): Background

- **A number of recent safety challenges have occurred as a result of outage and shutdown safety requirements management.**
- **Include potentially safety significant events such as those documented in the following Licensee Event Reports (LERs):**
  - Conditions that could prevent fulfillment of a plan safety function (LER 2015-006-00);
  - Loss of shutdown cooling in Mode 5 (Refueling) (LER 2015-002-01);
  - Operations with the potential to drain the reactor pressure vessel with secondary containment inoperable (LER 2015-007-0);
  - Conditions prohibited by Technical Specifications during operations with the potential to drain the reactor pressure vessel (LER 2015-003-00)
  - Conducting fuel movement without satisfying all necessary technical specifications (LER 2015-003-00)
- **All of these involve conditions prohibited by Technical Specifications that, when discovered, result in work stoppage and impede the progress of ongoing or planned outage work.**
- **Some events reduce the layers of safety that are relied upon for defense in depth during refueling outages when plant configurations are changing and are not easily apprehended.**
- **All of these reflect the inherent complexity in managing outage operations and the amount of information that must be correctly integrated to appropriately manage safety requirements.**

- **In Response to these challenges, research is sought to help manage oversight of these many requirements, accounting for:**
  - Technical Specifications;
  - Limiting Conditions of Operation and other requirements important to safety;
  - Ongoing and planned work;
  - Scheduled tasks, durations, effects of uncertainty in schedule delays, task elongation, etc. on overall picture of ongoing work in relation to plant safety requirements.
- **Very interested in the role of big data, business analytics, and other cutting edge solution technologies.**
- **Desire a picture of the current ‘here and now’ during a plant evolution, as well as ability to look ahead – predict conflicts or challenges that may arise.**
- **Interested also in how to present and distribute the information to users within a plant organization.**
  - Engineering, Operations, Maintenance, Radiation Work Control, Schedulers and Planners, Management.
- **Successful applicant will be expected to address how the research will test and demonstrate proposed technology in actual plant setting during project execution – facilitation of this by LWRS program is possible.**