March 2023

LWRS Status Highlights

Program Mission

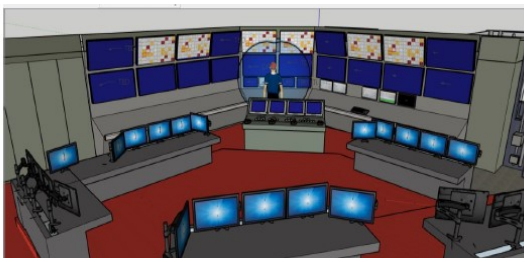
The Light Water Reactor Sustainability (LWRS) is a Department of Energy (DOE) program conducting research to develop technologies and other solutions to improve the economics and reliability, sustain the safety, and extend the operation of our nation's fleet of nuclear power plants (NPP). The NRC and the DOE has a Memorandum of Understanding (MOU) on Nuclear Innovation that allow the entities to share expertise and knowledge on advanced nuclear reactor technologies and nuclear energy innovation which extend to the area of light water reactor long-term operation and proposed modification for light water reactor sustainability

Plant Modernization Pathway

Main Goal: enable plant efficiency improvements through a strategy for long-term modernization

Development of a Cloud-Based Application to Enable a Scalable Risk-Informed Predictive Maintenance Strategy at Nuclear Power Plants – This report presents a techno-economic assessment of a provisional cloud deployment architecture for a nuclear power plant predictive monitoring (PdM) system. The cloud-based monitoring system would enable maintenance and diagnostics (M&D) analysts and other authorized plant users to remotely monitor equipment functionality so as to enable PdM practices and early detection of faults.

Demonstration of the Human and Technology Integration Guidance for the Design of Plant-Specific Advanced Automation and Data Visualization Techniques- This report presents interim findings of two key collaborations with United States utilities currently planning and executing large-scale digital instrumentation and control modifications to their main control rooms. While these collaborations are ongoing, this report presents lessons learned in the demonstration of the human and technology integration methodology.



Example use of 3D modeling to present a concept of a new state vision

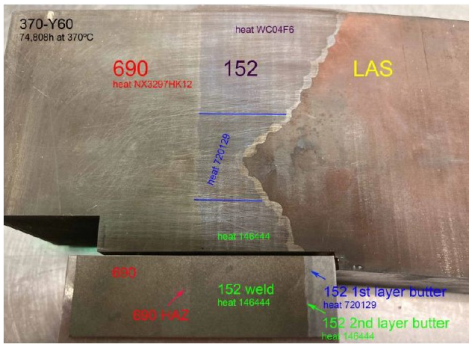
Materials Research Pathway

Main Goal: understand and predict long-term behavior of materials in nuclear power plants

Reactor Core and Primary Systems

Electrochemical Probing of Microstructural Heterogeneities in Irradiated and Deformed Stainless Steel- This work identifies the role of irradiation induced microstructural evolution on corrosion behavior of austenitic stainless steel (SS) and its potential implications on Irradiation assisted stress corrosion cracking (IASCC).

Effect of Thermal Aging on Microstructure and Crack Growth Response of Alloy 152 Weld- The objective of this research is to understand the microstructural changes occurring in high-Cr, Ni-based Alloy 152 weldments during long time exposure to the reactor operating temperatures, and the effect of these changes on the service performance.



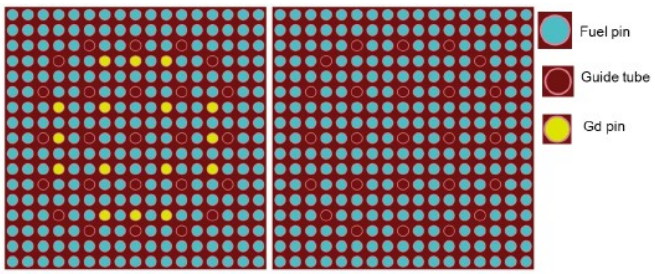
Alloy 152 weld joining Alloy 690 and Alloy 533 aged to a 60-year service equivalent

Risk Informed System Analysis (RISA) Pathway

Main Goal: develop safety analysis methods and tools to optimize the safety, reliability, and economics of nuclear power plants

Development of Genetic Algorithm Based Multi-Objective Plant Reload Optimization Platform- This report summarizes genetic-algorithm-based multi-objective fuel reload optimization activities. Including the development of the non-dominated sorting genetic algorithm II optimizer in the Risk Analysis and Virtual ENviroment (RAVEN) and demonstration and validation of the developed non-dominated sorting genetic algorithm II optimizer using benchmark optimization problems.

Development of Plant Reload Optimization Platform Capabilities for Core Design and Fuel Performance Analysis-This report summarizes activities in platform capability developments in RAVEN. This platform performs simulations using industry codes for core design (i.e., PARCS) and fuel performance (i.e., TRANSURANUS) which will allow expansion of the capabilities to include advanced fuel designs such as accident-tolerant fuel (ATF)s with high burnup.



Pin map of a fuel assembly with (left) and without Gd burnable poison (right)

Physical Security Pathway

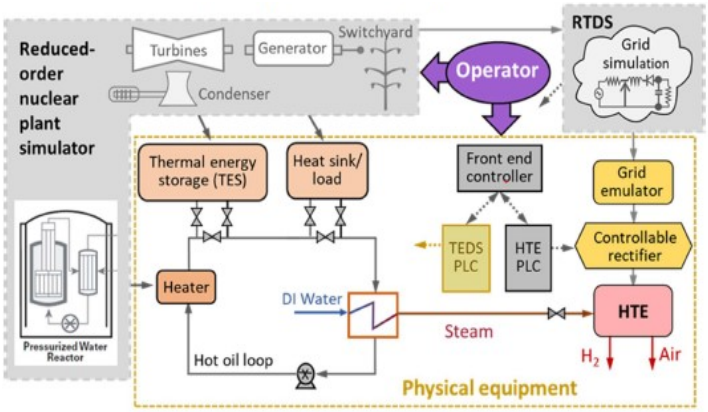
Main Goal: develop technologies and technical bases to optimize physical security

No updates or reports from the Physical Security pathway for this issue.

Flexible Plant Operation & Generation (FPOG) Pathway

Main Goal: enable diversification and increase revenue of light water reactors to produce non-electrical products

Co-simulation of Hydrogen Production with Nuclear Power Plants-
This report documents the implementation of a data link between the Idaho National Laboratory (INL) Human Systems Simulation Laboratory (HSSL) and the INL Energy Systems Laboratory (ESL) connecting a small-scale high temperature electrolysis (HTE) pilot plant and an electricity grid simulation capability. This connection enables virtual/physical co-simulation of an NPP to help develop operating concepts and control systems that will enable nuclear plant operators to dispatch thermal energy and electrical power between a close coupled hydrogen plant, the electricity grid, or energy storage buffers that can be used for power arbitrage.



Schematic of simulated and physical equipment for HTE hardware in the loop (HWIL) test

LWRS April Calendar*

LWRS Program Spring Meeting

- Wednesday, April 26, 2023. 9:00 am-1:00 pm
- Thursday, April 27, 2023. 9:00 am– 2:00 pm

RISA Monthly Call

- "Human Reliability Analysis (HRA) Dependency– data collection study", April 18, 2023 1:00-2:00 pm

Past Issues

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*MS Teams Links on each date