

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

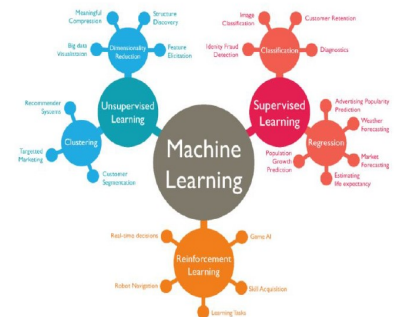
Plant Modernization Pathway

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

Human & Technology Integration

Machine Learning and Economics Models to Enable Risk-Informed Condition Based Maintenance of a Nuclear Plant Asset. This report presents a risk-informed condition-based predictive maintenance on a circulating water system (CWS) and the development of methodologies that can be applied to other nuclear power plant systems.

Regulatory Consideration regarding the Use of Computer Vision Machine Learning in Safety-Related or Risk-Significant Applications in Nuclear Power Plants. This effort aims to evaluate how example artificial intelligence (AI) technologies align with the regulatory framework, and discusses how they could be analyzed, modeled, tested, and validated in a manner similar to typical digital instrumentation and control (DI&C) technologies. **Disclaimer: This report is for NRC internal use only. Please do not distribute outside the agency.**



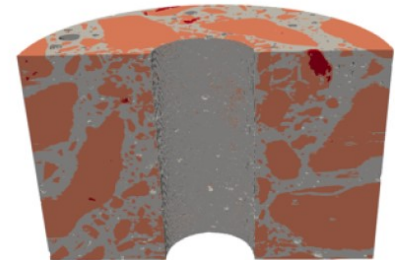
Machine learning taxonomy applications

Materials Research Pathway

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

Updates on Metals and Concrete:

- **Environmental Assisted Fatigue:** this effort will evaluate the microstructure of additive manufacturing (AM) alloys with a focus on porosity and its effect on the fatigue performance of AM alloys.
- **Weld Repair Technology:** on-going collaboration with EPRI to develop advanced welding technology, including laser and friction stir welding, to overcome the repair welding challenges due to helium-induced cracking. (Expected to be done by FY 2025)
- **Irradiation on Concrete :** to understand the effects of irradiation on the bond properties of steel embedded in concrete. This project aims at conducting a scoping experimental study (in cooperation with CVR, Czech Republic) and providing methodological guidelines on the modeling of irradiated reinforced concrete structures.



Concrete specimen

Risk Informed System Analysis (RISA) Pathway

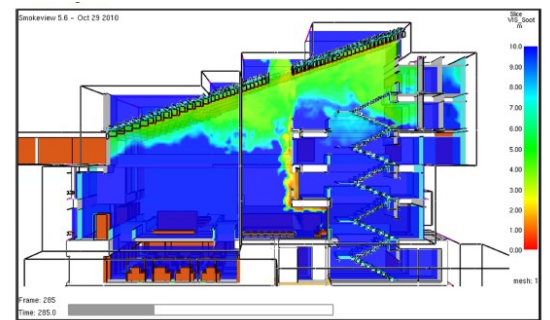
Main Goal: develop safety analysis methods and tools to optimize the safety, reliability, and economics of nuclear power plants

Research Areas:

Enhanced Resilient Systems:

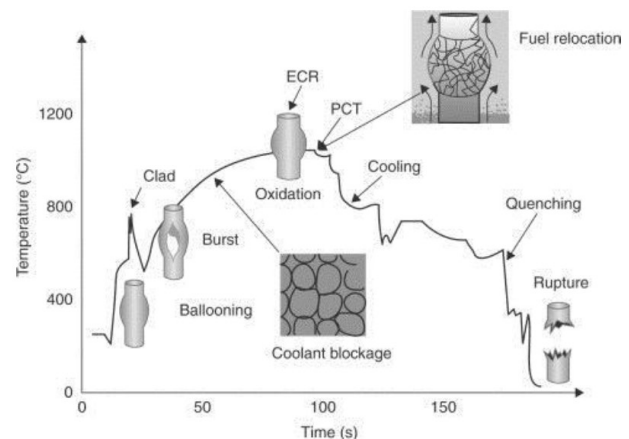
FRI3D Fire Simulation Options and Verification

Tasks- This report presents the software verification against the CFAST (Consolidated Model of Fire and Smoke Transport) fire simulation tool constraints and an evaluation of the Fire Dynamics Simulator (FDS) option tool.



Smoke-view visualization

Assessment of Modeling and Simulation Technical Gaps in Safety Analysis of High-Burnup Accident Tolerant Fuels– In this report, the technical gaps in the modeling and simulation of the high burnup (HBU) accident-tolerant fuels (ATF) were assessed in terms of the fuel cladding behavior during the postulated accident events.



Fuel cladding deformation mechanism during LOCA

Physical Security Pathway

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

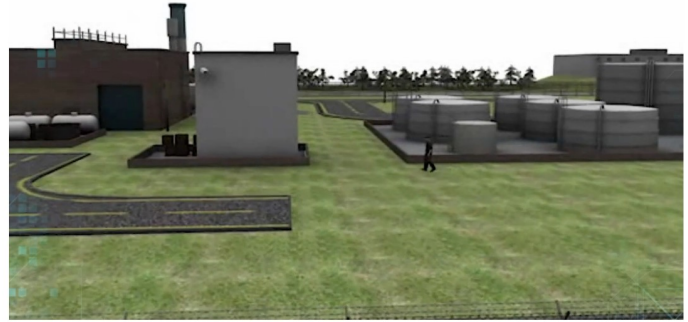
The Physical Security Pathway held two half-day Stakeholder Meetings on January 31, 2023, and February 1, 2023. Presentations provided at those meetings can be found [here](#).

Research Areas

Risk Informed Physical Security –

Economic Analysis of Physical Security at Nuclear Power Plants-

This report describes the development of a framework that integrates results from Force on Force analysis with economic assessment to achieve two closely linked objectives: (1) Estimation of effectiveness of components of the physical security posture, and (2) Evaluation of investments in physical security using an estimated cash flow analysis.



3D model of a nuclear power plant in AVERT software

Flexible Plant Operation & Generation (FPOG) Pathway

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

Preliminary PRA for Steam Electrolysis

Top Hazards Identified

- Internal: Steam line break and loss of offsite power
- External: Electrolysis Plant H₂ leak and H₂ detonation

Hazard Analysis Report (Sandia):

Final Report on Hydrogen Plant Hazards and Risk Analysis Supporting Hydrogen Plant Siting near Nuclear Power Plant- This study investigates the risk of a high temperature steam electrolysis hydrogen production facility (HTEF) in close proximity to a NPP. This analysis evaluate a postulated HTEF located 1 km from a NPP, including the likelihood of an accident and the associated consequence to critical NPP targets

[Past Issues](#)