August 2024

LWRS Status Highlights

Program Mission

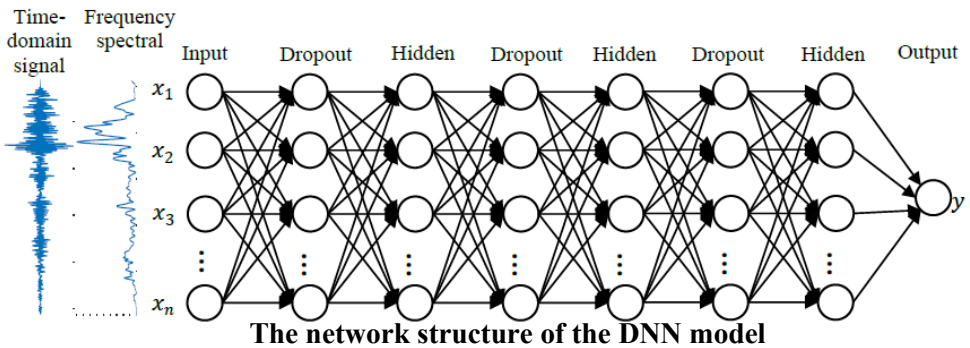
Light Water Reactor Sustainability (LWRS) is a Department of Energy (DOE) program conducting research to develop technologies and other solutions to improve the economics and reliability, sustain the safety, and extend the operation of our nation's fleet of nuclear power plants (NPP). The NRC and the 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.

Material Research Pathway

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

Latest Report:

Performance Comparison of Machine Learning Models for Ultrasonic Nondestructive Evaluation of Alkali-Silica Reaction in Concrete- This report presents a comparative analysis of four machine learning (ML) regression models for predicting concrete material damage induced by ASR expansion using long-term ultrasonic data monitoring. The models investigated include linear regression (LR), support vector regression (SVR), shallow neural networks (NN), and deep neural networks (DNN). LR, SVR, and shallow NN models use features extracted from ultrasonic signals, whereas the DNN model processes time-domain ultrasonic signals and frequency spectra directly. Overall, the results and conclusions of this study could provide insights into the capabilities and effectiveness of ML when applied to ultra-sonic NDE data and help identify best practices for using ML for ultrasonic NDE of concrete material properties.



The network structure of the DNN model

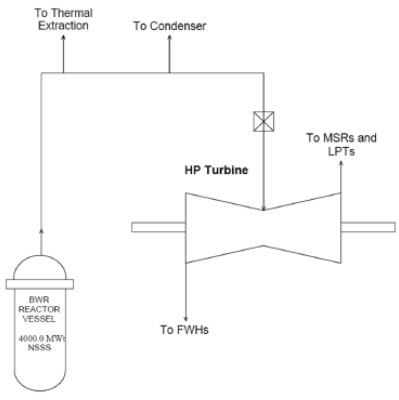
Flexible Plant Operation & Generation (FPOG) Pathway

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

Latest Reports:

***Value of Nuclear Energy to the Reliability of the North American Power System: Results for Western and Eastern Inter-connections*-** This report provides a summary of the significant role nuclear energy plays in the United States' power generation mix, providing around 20% of the nation's electricity generation, spread across 28 U.S. states. Nuclear power is reliable and mostly unaffected by weather and seasonal changes and provides a consistent source of base-load power. In terms of capacity, nuclear power plants have as much as 26% of balancing area power generation capacity. Nuclear power provides a substantial contribution (e.g., 10% of the inertia in the Eastern Interconnection) of the synchronous spinning mass/inertia that buffers the rate at which frequency will change when a load and generation imbalance occurs (e.g., a large plant trips or a load is suddenly shed due to a transmission outage).

Pre-Conceptual Design for Boiling Water Reactor Integration with a 500 MW Hydrogen Production Facility- This report develops a pre-conceptual integration design for a new large-scale high-temperature steam electrolysis (HTSE) hydrogen production facility at an existing boiling water reactor (BWR) nuclear power plant. Previous work has investigated the colocation of an HTSE facility at a pressurized water reactor. While BWR integration is more design-intensive by virtue of the added radiological challenges, this study assesses the feasibility of a modification to extract thermal and electrical power from a BWR for hydrogen production. The reference nuclear plant used in this study is a GE Type 4 design, which is the most common BWR design in the United States. The hydrogen facility is assumed to be a 500 MW_{dc} HTSE hydrogen production facility, similar to the design developed in a previous Sargent & Lundy report.



BWR Thermal Extraction Location

Plant Modernization Pathway

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

***Latest Report* :**

No report for this issue

Physical Security Pathway

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

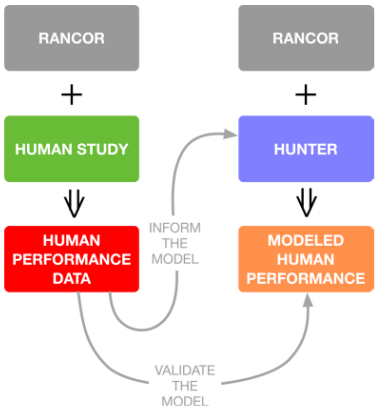
Latest Report: No report for this issue

Risk Informed Safety Analysis (RISA) Pathway

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

Latest Report:

Use of Time Distributions to Predict Operator Procedure Performance in Dynamic Human Reliability Analysis- The Human Uni-model for Nuclear Technology to Enhance Reliability (HUNTER) framework affords software capable of conducting human reliability analysis (HRA) using a dynamic approach built around operating procedures (OPs) from nuclear power plants (NPPs). The present report largely addresses two topics. The first is a new function in HUNTER called the HUNTER-Procedure Performance Predictor (P3). HUNTER-P3 uses HUNTER's built-in Monte Carlo tools featuring human performance variability to identify potential error traps in procedures. The second topic is a time distribution analysis to generate time inputs for dynamic HRA. The current analysis was performed to investigate time distributions for task primitives, which are the minimum task unit of analysis used in dynamic HRA modeling.



Relationship between HUNTER and simulators when performing dynamic HRA modeling

LWRS September Calendar

Monthly Calls ***(link on the dates)***

- FPOG Call-
  September 30, *2024*- ***10:00-11:00 AM***
- ***Data Science and Artificial Intelligence Regulator Applications Workshop*** — ***September 17, 2024***

Past Issues

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