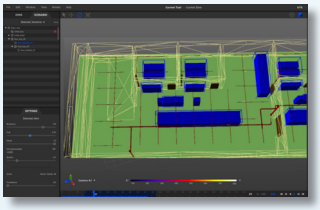
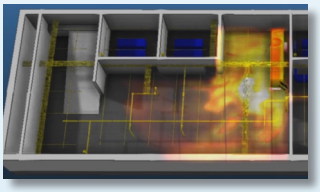
LWRS LIGHT WATER REACTOR SUSTAINABILITY

LWRS Program Research Pathway Fact Sheet

Risk-Informed Systems Analysis Pathway





Dynamic fire PRA scenario modeling (top) simulation (bottom) using risk-informed visualization tool

Project summary and objectives

The Light Water Reactor Sustainability (LWRS) Program has two objectives with respect to long-term operations: (1) to provide science-based solutions to the industry to implement technology to exceed the performance of the current labor-intensive business model; and (2) to manage the aging of plant systems, structures, and components (SSCs) so that nuclear power plant lifetimes can be extended and the plants can continue to operate safely, efficiently, and economically. The LWRS Program does this through three pathways: (1) Materials Research; (2) Plant Modernization; and (3) Risk-Informed Systems Analysis.

The objective of the Risk-Informed Systems Analysis Pathway is to demonstrate and deploy risk-informed tools and methods to optimize safety margins and minimize uncertainties which will support achieving high levels of safety and economic efficiencies of U.S. nuclear power plants.

Accomplishments

- Risk analysis on enhanced resilient plant performance to demonstrate flexible safety margins management with accident tolerant technologies
- Develop Cost Risk Analysis Framework Tool (CRAFT): An integrated cost-risk analysis tool combining probabilistic risk assessment (PRA) and component aging models
- Strategic study on enabling risk-informed methods to improve plant efficiency and economics
- Coupled margins analysis for enhanced external hazard analysis including seismic and flooding phenomena
- Safety margins analysis of commercial reactor for 10 CFR 50.69 industry application
- Demonstration of system reliability analysis capability and surrogate model in Risk Analysis Virtual Environment (RAVEN) open-source software
- Development of deterministic reactor pressure vessel fracture mechanics capability in Grizzly computer code
- Technical basis of safety margin configuration risk management

Current work

- Demonstration of enhanced resilient plant performance with integrated safety enhancements including accident tolerant fuel, diverse and flexible coping strategy (FLEX) and passive cooling

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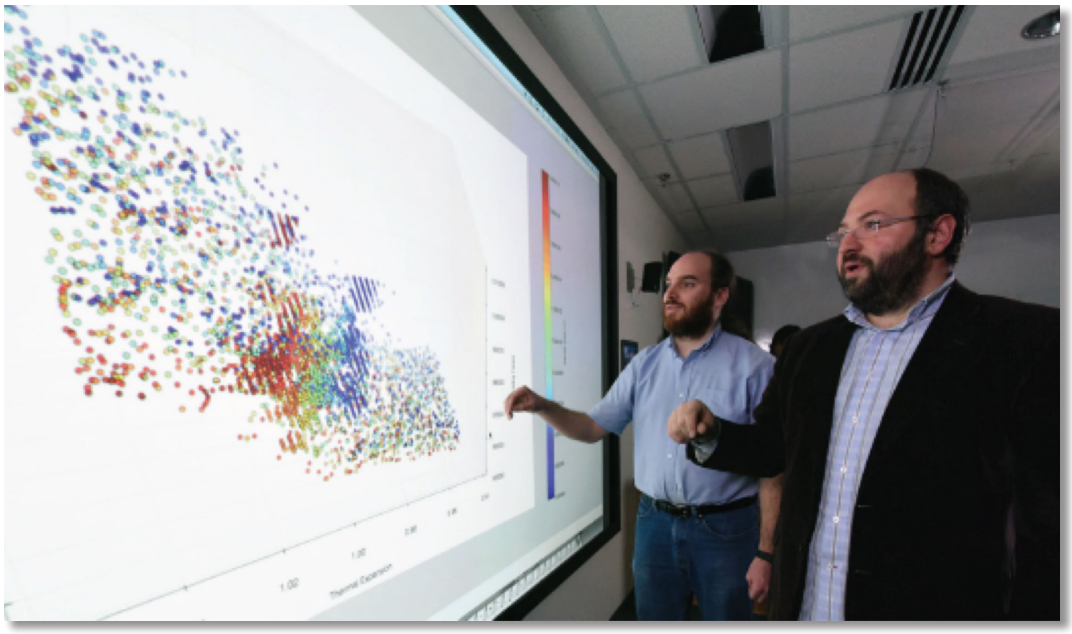

Application of RAVEN for high-dimensional anlaysis.

- Analysis on Terry turbo-pump operation behavior under beyond-design-basis accidents of BWR and PWR to predict integrity and accident prevention and mitigation capability
- Develop risk-informed tools and methods for plant health programs to support optimizing plant equipment performance and reliability management
- Establish structured risk-informed approach to evaluate and prioritize plant capital systems, structures, and components (SSC) maintenance and replacement plans
- Construct and demonstrate advanced visualization tool for dynamic fire PRA scenarios analysis
- Develop risk-informed, high-fidelity and multi-physics analysis framework, and demonstrate fuel extended burnup operation
- Advanced risk assessment methodology development for digital instrumentation and control technologies implementation to existing U.S. nuclear power plants
- Develop and apply methods to enhance the independent optimization of fuel reload licensing process
- Assess validation and verification status of risk-informed tools and methods

Summary

Risk-informed approach provides benefit on margin optimization and minimize over-conservatism of nuclear power plant safety features. Deployment of validated risk-informed systems analysis tools and methods that will support US nuclear industry for effective margin management strategy application which will eventually improve economics, reliability and sustainability for longer-term operation.

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