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Light Water Reactor Sustainability (LWRS)
FY 2017 CINR Webinar: NEUP RC-7

Federal POC: Richard Reister
Technical POC: Mitch Farmer (ANL)

Office of Light Water Reactor Technologies
Office of Nuclear Energy
U.S. Department of Energy

August 2016

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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

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Technical Focus Areas Summary

- **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

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Reactor Safety Technologies (RST)

- **The Reactor Safety Technologies (RST) Pathway provides scientific and technical insights, data, analyses and methods that can support industry efforts to enhance nuclear reactor safety in beyond design basis events**
- **RST activities evolved from a coordinated global effort to assist in the analysis of the Fukushima accident progression and response into the following areas**
  - Fukushima Forensics and Examination Plans: Provides insights into the accident progression at Fukushima through data collection, visual examination of in-situ conditions of the damaged units as well as collection and analysis of samples within the reactor systems and structural components from the damaged reactors
  - Severe Accident Analyses: Analyses using existing computer models and their ability to provide information and insights into severe accident progression that aid in the development of Severe Accident Management Guidance (SAMGs)
  - Accident Tolerant Components: Analysis or experimental efforts for hardware-related issues with the potential to prevent core degradation or mitigate the effects of beyond-design basis events

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RST Research Activities

Fukushima Forensics

Help develop Fukushima Inspection Plan as site is decommissioned

Severe Accident Analysis

In-vessel and ex-vessel severe accident analyses:

- **assist in confirming Severe Accident Guidelines**
- **benchmark Technical Support Guidelines analyses**
- **develop new guidance for water addition strategies ex-vessel**

Accident Tolerant Components

Terry Turbo-pump system dynamic modeling and test planning

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RST RC-7 Workscope

In 2015, a DoE analysis report (ANL/NE-15/4) identified a number of important knowledge gaps that university investigators can assist.

RST researchers have identified two gaps that may be addressed:

Current severe accident computer systems have uncertainties in how degraded core debris can be cooled by steam flow or water flow. There are likely fundamental insights that analysis of past experiments can reveal to improve modeling of fluid flow under such conditions. This work could analyze past tests and proposed improved models.

Cooling of degraded core debris with raw water can have unanticipated consequences especially during boiling heat transfer. Such effects have not been fully considered and the purpose of this work is to seek innovative ideas to better understand these effects as water flow and heat transfer. This work may involve performing bench top experiments or more mechanistic analyses.