

NRC Materials Research

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Office of Nuclear Regulatory Research

Overview



- Mandated by Congress
- About 256 staff
- Engineers, scientists, and analysts
- >\$60M funding
- Currently located at
21 Church St.,
Rockville, MD
- Move to 3WFN planned
for January 2013

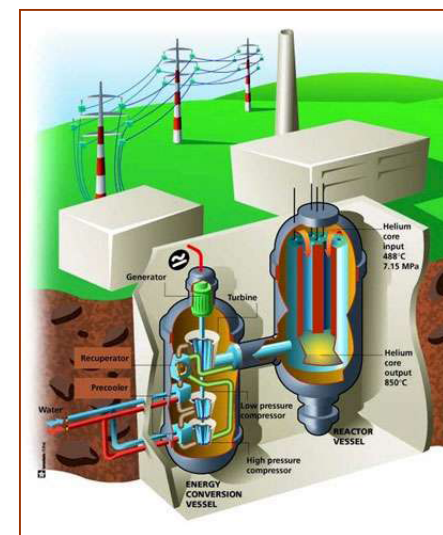


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What Do We Do?



- Develop technical bases to support regulatory decisions
 - Technical tools, data, and analytical models
 - Confirmatory research and analyses
- Provide in-house technical expertise to regulatory offices and the Regions
- Anticipate NRC's future needs
 - Develop technical infrastructure for advanced reactor licensing reviews
 - Support new reactor licensing
 - Develop Long-Term Research Plan



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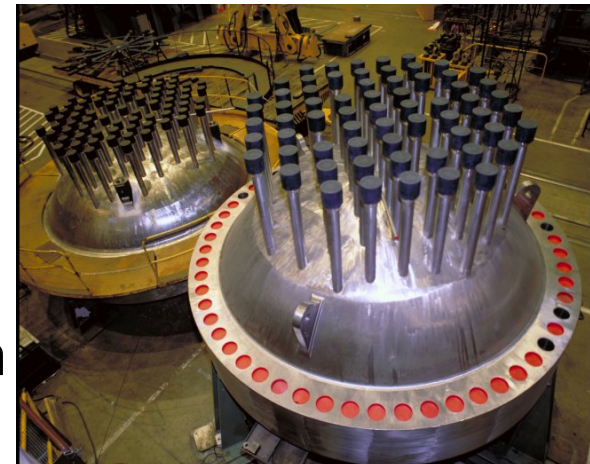


Why Perform Research?

- Support regulatory decisions on nuclear reactors, nuclear materials, and radioactive waste
- Identify and resolve safety issues for current and new designs and technologies
- We accomplish this through:
 - Testing
 - Code and data development
 - Analyses
 - National and international collaboration



Cladding
oxidation



Reactor Pressure Vessel
Head

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Materials Research Activities



- Supporting regulatory offices:
 - Emergent issues
 - User Need Requests
- Topical areas:
 - Component integrity assessments
 - Non-Destructive Evaluation (NDE)
 - Primary water stress corrosion cracking (PWSCC)
 - Steam generator tube integrity
 - Aging of materials used for wet/dry storage of spent fuel
 - Codes and Standards
 - License renewal research (long term operation)
 - Irradiation-assisted stress corrosion cracking (IASCC)
 - New reactor materials

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Cooperative Research Activities

- Over 100 agreements with 24 countries and with OECD
- Active participation in NEA, CSNI, IAEA
- Memoranda of Understanding with EPRI, DOE, and others
- Provide intellectual capital, expert analysis, and experience
- Incorporate international research and analysis results into NRC knowledge base and activities
- Leverage foreign expertise and research programs
- Cooperative research in thermal hydraulics and severe accident codes (CAMP/CSARP)
- Data and models may be developed cooperatively; however, NRC maintains responsibility to independently analyze the results for licensing decisions

RES/EPRI Memorandum of Understanding (MOU)

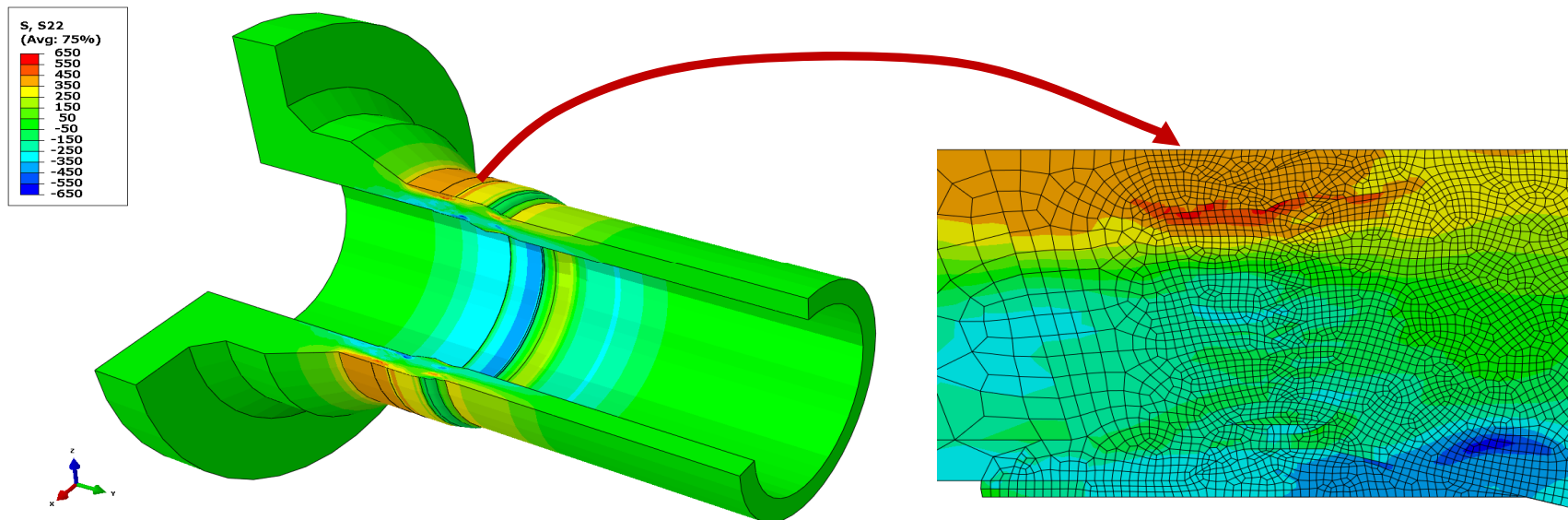


- Structure to conduct appropriate research efforts cooperatively to mutually benefit both parties while maintaining the independence of both parties:
 - avoid unnecessary duplication of effort
 - topics of mutual interest
 - applicability of research results
 - contribution to plant safety
 - impact upon risk reduction
- Improved communication between NRC and EPRI with respect to generated research, technical bases, and assessment tools

RES/EPRI MOU Addenda

Weld Residual Stress Model Development & Validation

- Independently validate WRS model to physical WRS measurements
- Verify and validate the effectiveness of the optimized weld overlay PWSCC mitigation technique (Phase IV)
- Project completed in four phases:
 - Phase I: Plate and cylinder configurations
 - Phase II: Prototypic pressurizer surge nozzles
 - Phase III: Safety/relief nozzles
 - Phase IV: PWR cold leg nozzle with optimized weld overlay



RES/EPRI MOU Addenda

xLPR and EAF



- Extremely Low Probability of Rupture (xLPR)
 - Develop a modular probabilistic computer code for the prediction of the probability of failure of reactor coolant system components
 - Currently focused on primary piping systems approved for leak-before-break susceptible to PWSCC
 - Pilot Study completed in 2011
 - Development of Version 2.0 code ongoing
- Environmentally-Assisted Fatigue (EAF)
 - Collect available data on environmental fatigue effects
 - Evaluate current environmental fatigue methodology for RCS pressure boundary components and reactor internals
 - Revise NUREG/CR-6909 and RG 1.207
 - To be completed by December 2012

RES/EPRI MOU Addenda

Long-Term Operations



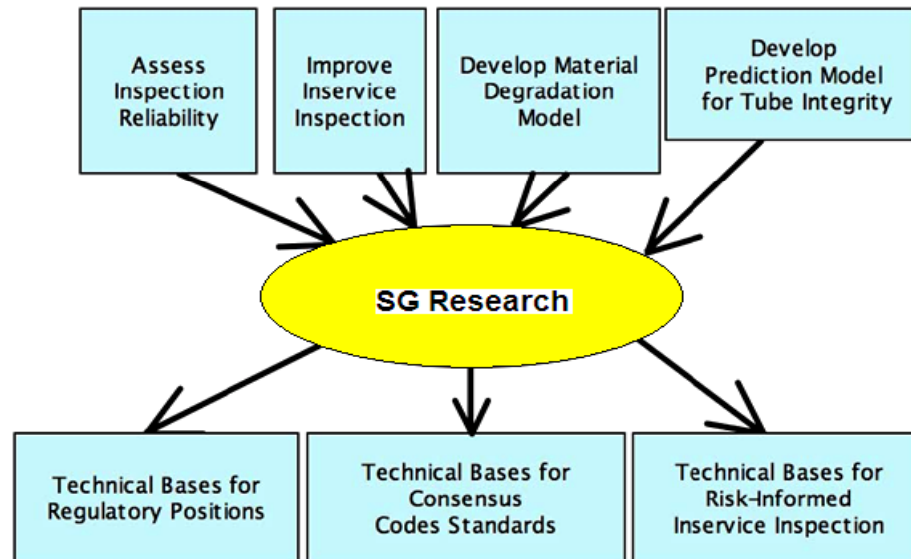
- License Renewal Research
 - Provide technical information to support the development of a regulatory framework for licensing a potential second extended operating period from 60 to 80 years, including:
 - NRC/industry workshops,
 - Expanded materials degradation assessment (EMDA),
 - Assessment of licensees' aging management programs, and
 - Engagement with domestic and international research partners.
 - Interaction has resulted in knowledge sharing through multiple public workshops and conferences, periodic coordination meetings, and EMDA expert elicitation.
 - NRC must ensure that safety and environmental regulatory review guidance is thorough and comprehensive, and be prepared to verify that applications are robust.
 - However, the burden of making a safety case for long term operations is on the applicant.

RES/EPRI MOU Addenda

Steam Generator Tube Integrity Project



- Develop experimental data and predictive correlations and models to evaluate the integrity of steam generator tubes



International Group

France

Canada

Korea

Japan

EPRI

NRC

- Beginning the fifth 5-year term of international cooperation (over 50 NUREGs and publications)
- Ageing materials and new SG designs present challenges

RES/EPRI MOU Addenda

Reliability & Effectiveness of NDE



- Assess the effectiveness and reliability of NDE methods to detect and characterize flaws in RCS components
- Significant progress achieved from MOU:
 - Visual Testing round robin
 - Dissimilar metal weld specimen and data exchange
- Recent NDE operational event:
 - Ultrasonic inspections failed to find five flaws (2 >80% & 3 >40%) recently found in a 5" thick steam generator inlet weld
 - Industry identified this as a "watershed event – requires change"
 - Highlighted need for cross-cutting approach to address NDE issues across ASME Section XI, EPRI NDE Center, and Performance Demonstration Initiative

RES/EPRI Cooperative Agreement

Zorita Internals Research Project

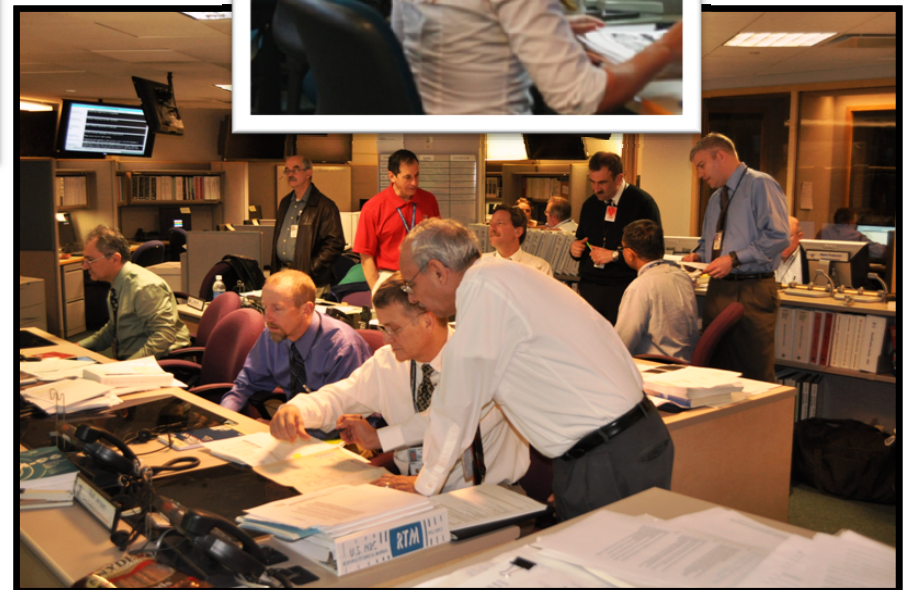
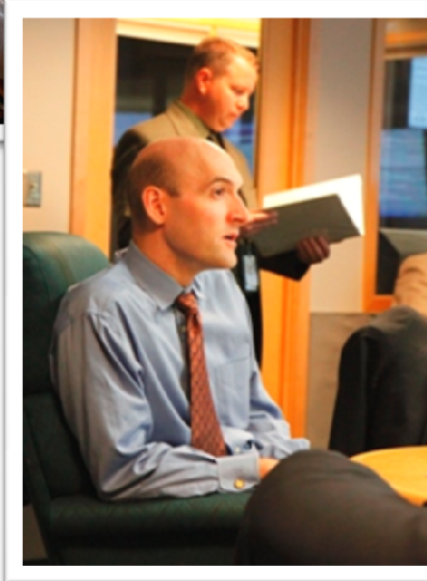


- Harvest high-fluence materials from the reactor pressure vessel internals from a decommissioning Spanish PWR
- Generate information related to the effects of radiation on these materials
 - Irradiation assisted stress corrosion crack initiation and growth
 - Mechanical properties
 - Microstructural characterization
- Harvesting is anticipated to take place in early 2013
- Testing to be performed at Studsvik in Sweden and at Mitsubishi Heavy Industries in Japan

NRC Response to Fukushima Accident



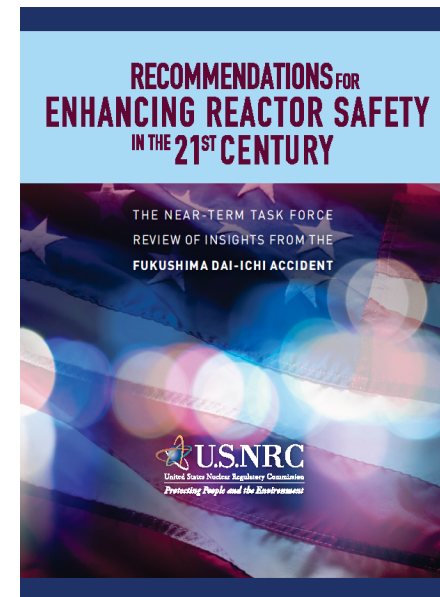
Executive, Reactor Safety, Protective Measures, Safeguards, Public Affairs, and Liaison Teams



NRC Response to Fukushima Accident



- Commission directed a methodical and systematic review of the safety of U.S. facilities in light of events in Japan
- Near-Term Task Force report issued July 12, 2011
 - SECY-11-0093 (www.nrc.gov)
- Similar sequence in US unlikely
- No imminent risk from continued operation
- Existing mitigation measures could reduce the likelihood of core damage and radiological releases



NRC Response to Fukushima Accident

Initial Regulatory Actions



- Subsequent to the NTTF Report, the Commission created a Fukushima Steering Committee to provide guidance to the staff on implementation
- Steering Committee led prioritization of recommendations into three tiers:
 - Tier 1 - To be implemented without unnecessary delay
 - Tier 2 - Could not be initiated in the near term due to resource or critical skill set limitations
 - Tier 3 - Require further staff study to support a regulatory action
 - Considered other issues raised by stakeholders

NRC Response to Fukushima Accident

Tier 1 Activities



- Agency issued three Orders in March, 2012
 - Develop strategies and procure additional equipment to address beyond-design-basis natural phenomena and multiunit events
 - Include a reliable, hardened containment vent system in Mark I and Mark II containments
 - Enhance spent fuel pool instrumentation for beyond design basis accidents
- Tier 1 Rulemaking Activities
 - Station Blackout (SBO) Rulemaking
 - Emergency Procedures Integration Rulemaking

NRC Response to Fukushima Accident

Tier 1 Activities



- Agency issued several requests for information
 - Provide information on the adequacy of facility design bases with respect to seismic and flooding hazards
 - Provide information on whether facility configurations, as confirmed by seismic and flooding walkdowns, are in compliance with current facility design bases
 - Provide information on current communications system power supplies and their availability during a prolonged SBO event
 - Provide information on the required staffing necessary to respond to a multiunit, prolonged SBO event

Thank you!

Questions?