

The Impact of Research at the US NRC

Consejo De Seguridad Nuclear

Conference on Research and
Development

May 23, 2019

Agenda

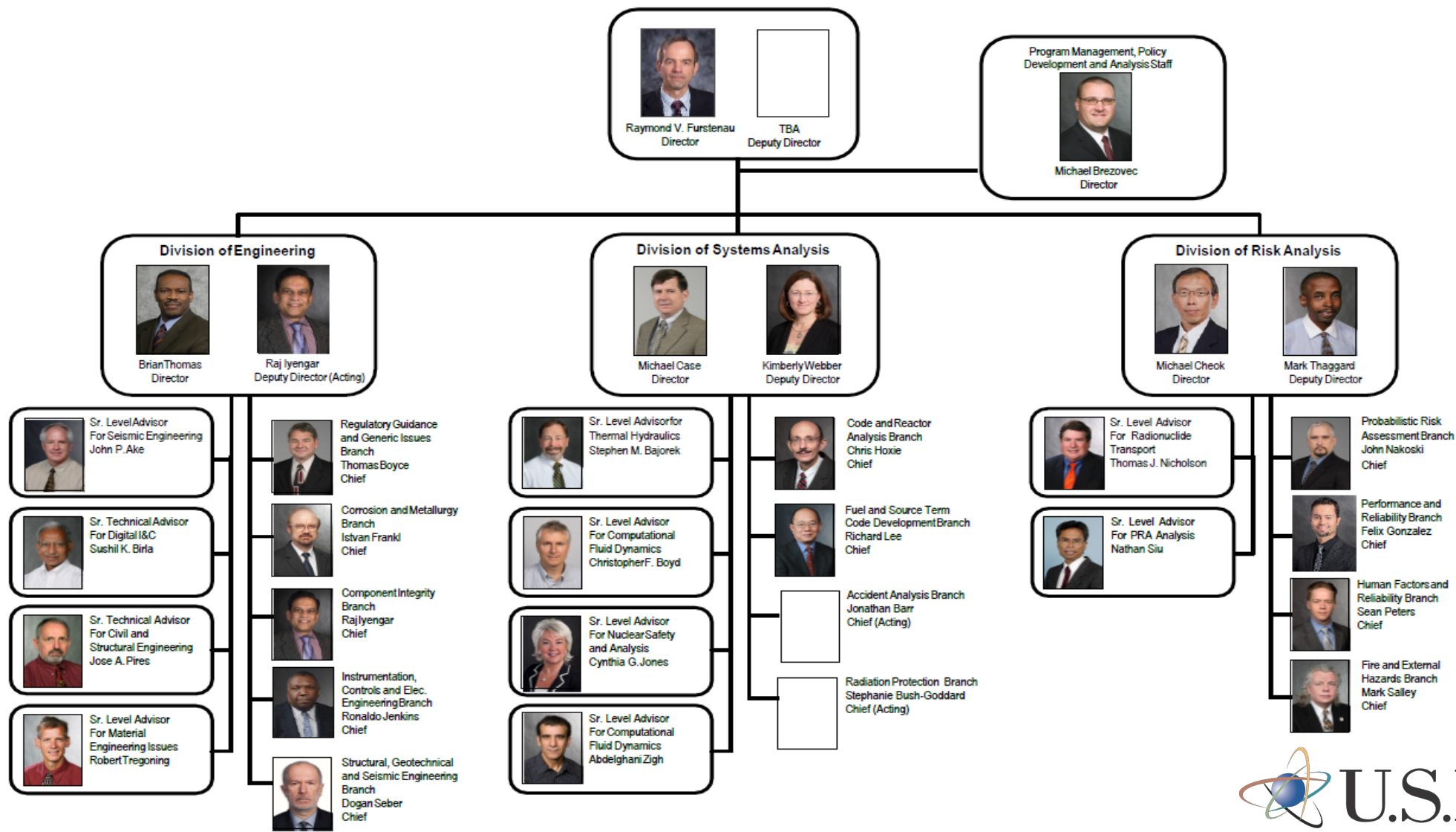
- Overview of NRC and Research Program Responsibilities
- Research Program Organization and Technical Areas
- Research Goals and Planning
- How we Collaborate
- NRC Research Focus Areas
- Impacts of Research Examples



NRC's Authorities and Responsibilities as Provided by Statute

- The Energy Reorganization Act of 1974 established an independent regulatory commission to regulate commercial uses of nuclear material
- Recognized the need for continuous improvement in our knowledge of a complex and technically challenging technology
- Established the Office of Nuclear Regulatory Research within the NRC and the following requirements
 - Developing recommendations for research deemed necessary for performance by the Commission of its licensing and related regulatory functions
 - Engaging in or contracting for research which the Commission deems necessary for the performance of its licensing and related regulatory functions
 - Developing a long-term plan for projects for the development of new or improved safety systems for nuclear power plants

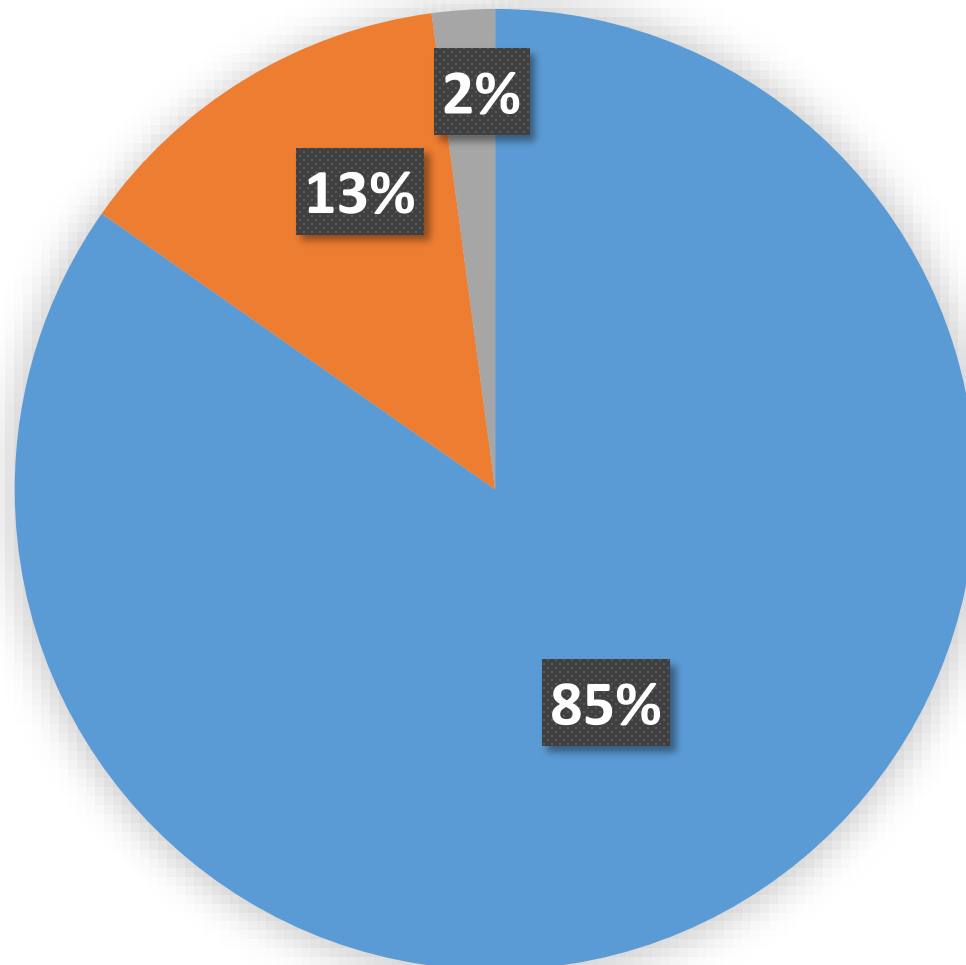
Research Office at a Glance



Our Licensing Office Customers

- Performs research in support of licensing and oversight offices and at direction of Commission

Fiscal Year 2019 Research Budget by Licensing Office



■ Operating Reactors

■ New and Advanced Reactors

■ Nuclear Materials, Fuel Storage, and Decommissioning

Total Budget \$77M (includes 208 Staff and \$39M in contracts)

Key Research Areas

- Reactor Safety Codes and Analysis
- Severe Accident Research and Consequence Analysis
- Radiation Protection, Health Effects, and Environmental Transport
- Probabilistic Risk Analysis
- Human Factors and Human Reliability
- Fire Safety Research
- Seismic and Structural Research
- Materials Performance Research
- Digital Instrumentation and Control and Electrical Research
- Flooding Research



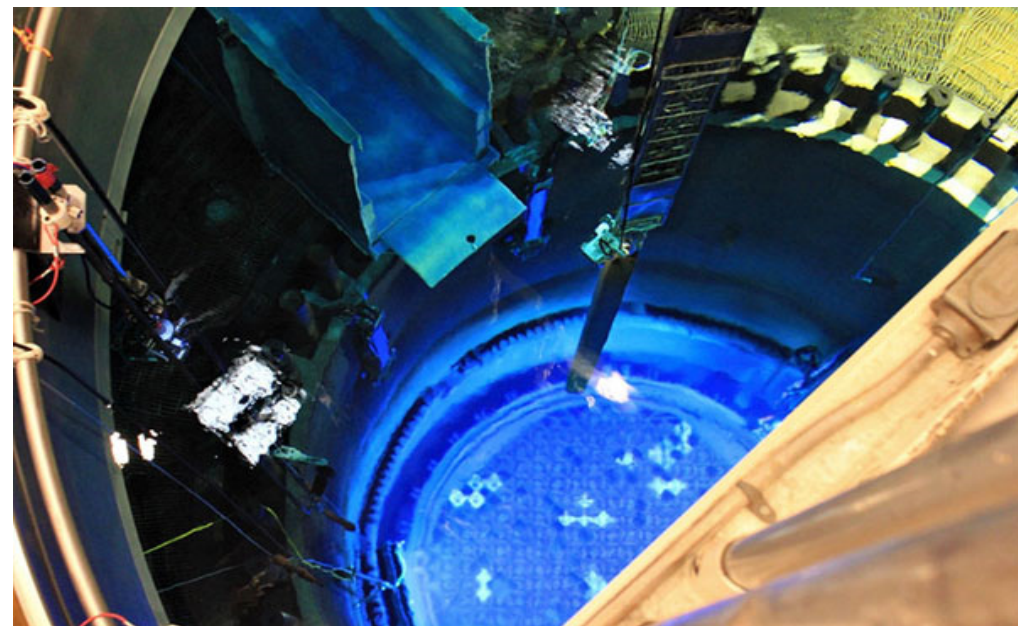
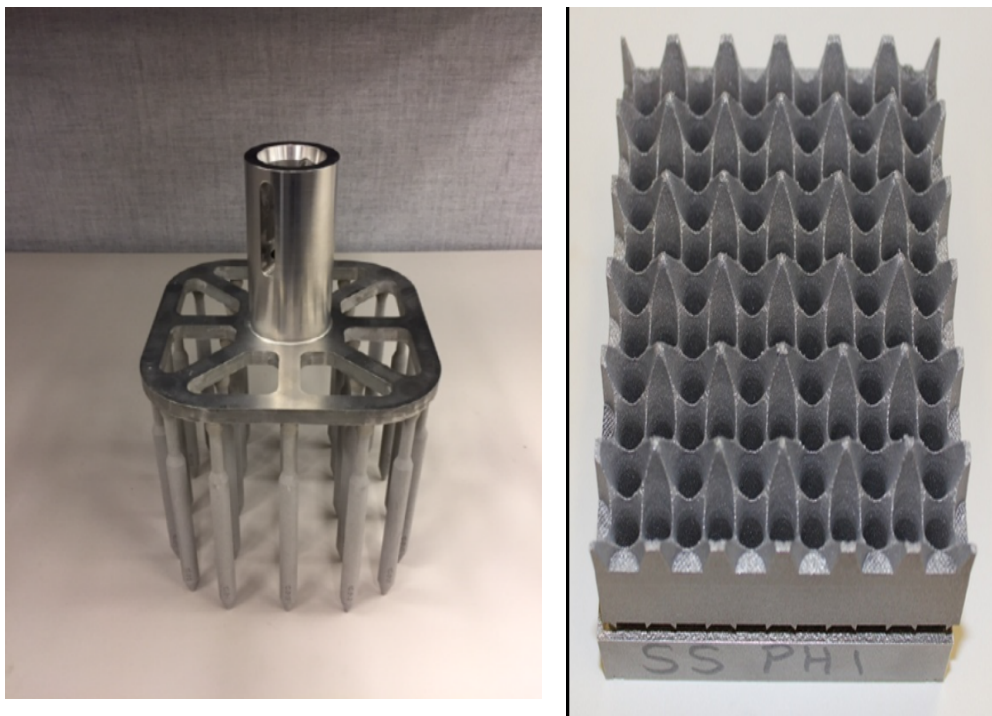
Research Activities
FY 2018-2020

Office of Nuclear Regulatory Research

Ready for Tomorrow's Technology

- Agency research supports our licensing and oversight mission to regulate innovative technology and designs
- Activities are balanced between confirmatory and forward-looking research to ensure readiness

Thimble Plugging Device



Lead test assembly containing ATF rods being loaded at Hatch Nuclear Plant in February 2018

External Engagement

- RES regularly engages with Federal Agencies, and industry stakeholders on topics of mutual interest
 - e.g. Department of Energy (DOE), Electric Power Research Institute (EPRI)
- RES utilizes domestic and international partnerships to leverage its resources
- Significant collaborative research is performed in the areas of computer codes, fuels, materials, emergency preparedness, fire, human factors, and external hazard safety

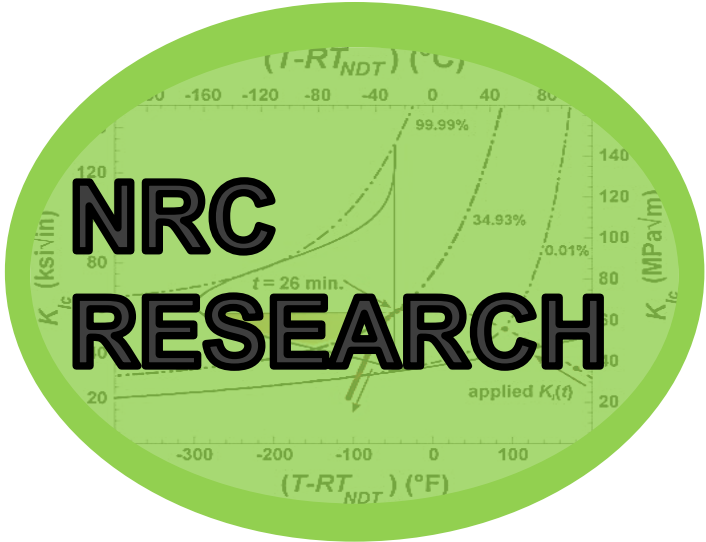


How is Research Conducted?

DOE, National Labs, and Commercial Contractors



Technical Requests



Tech Solutions

Knowledge
Tools
Data
Expertise
Guidance



Codes & Standards Organizations

EPRI, Owners Groups, Industry Partners

International Partners

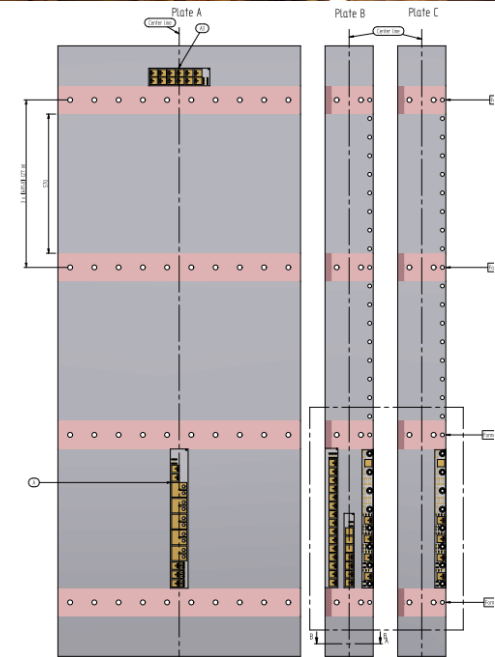
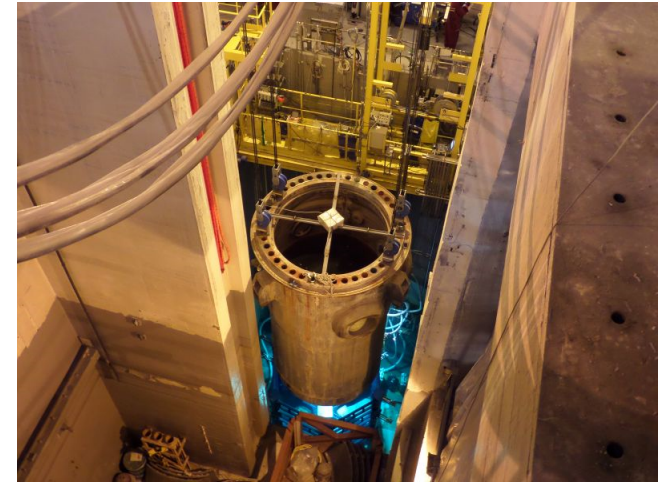
Strong Collaboration with Spain

- CAMP - Thermal-Hydraulic Code Applications and Maintenance Program
 - Significant CSN in-kind technical contributions, 37 publications over the past decade, 9 publications last year, significant use of TRACE to analyze the Spanish operating fleet, support of TRACE Validation & Verification, and TRACE code debugging.
- RAMP – Radiation Protection Code Analysis and Maintenance Program
- CSARP – Cooperative Severe Accident Research Program
- Zorita Material Harvesting
- CNS assignee to work on seismic hazard analyses at NRC



Zorita Internals Research Project

- International cooperative program initiated by CSN to harvest high fluence reactor internals
 - Significant volume of highly-irradiated LWR internals materials made available for research
 - Broad collaboration made program very cost efficient for funding members
- Data has been valuable to increase confidence in internals behavior at high fluence
- Enabled other research that has increased the knowledge on highly irradiated stainless steel behavior



Baffle Former Plates

Quality Assurance of Research Work

- External Evaluations
 - Advisory Committee for Reactor Safeguards (ACRS)
 - Industry peer reviews of Level 3 PRA
- Internal Evaluations
 - Coordinates work with licensing offices (NRR, NRO, NMSS)
 - Internal peer reviews
 - Quality surveys products
 - Office of Inspector General Reviews
 - Audit of NRC's Computer Code Sharing
 - Audit of NRC's Process for Developing and Coordinating Research Activities
 - Non-concurrences and differing professional opinions

Performing Research that Matters

- The office is working to enhance the planning and reporting of research activities
- Program reviews with licensing offices to support strategic alignment
- Project prioritization assesses the relative importance of research activities in supporting the NRC mission

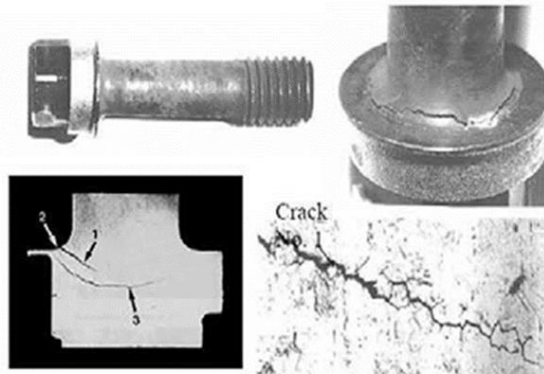


Research Program Focus Areas

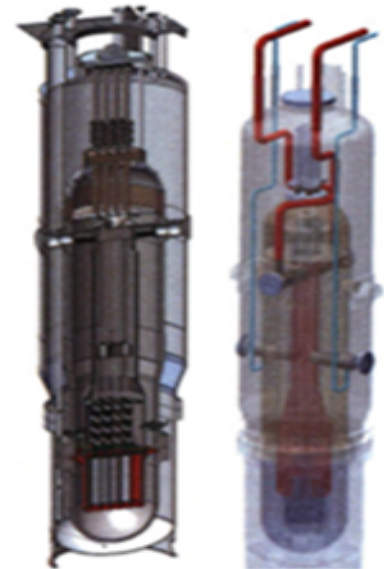
- Providing confirmatory analysis to licensing offices for near-term licensing and oversight functions
- Improve realism in analytical models and the use of risk-insights to better inform regulatory decision-making
- Prepare for licensing and oversight of emerging technologies
 - Accident Tolerant Fuel (ATF)
 - Advanced reactors
 - Advanced Manufacturing



High Energy Arching Fault Testing



Baffle Former Bolts



NuScale

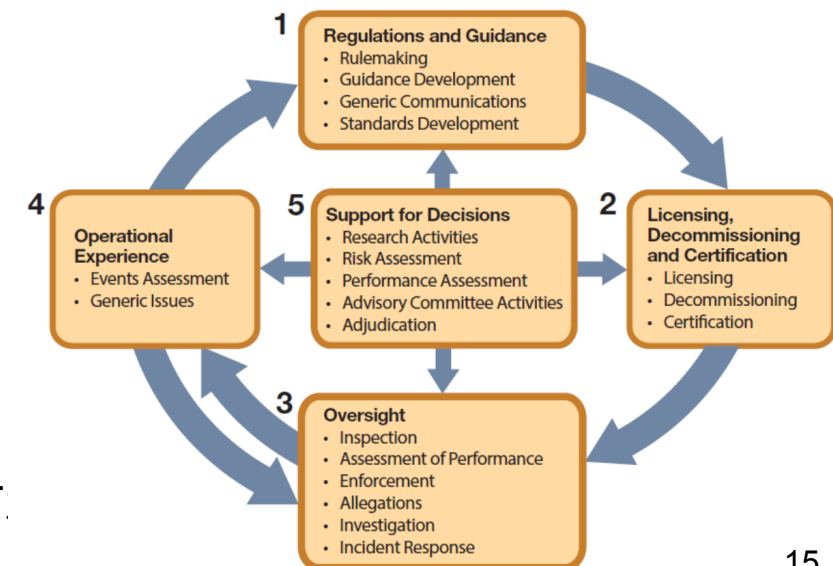
Standardized Plant Analysis Risk (SPAR) Models

Past: NRC developed independent probabilistic risk assessment models for the US reactor fleet to understand plant specific risk insights (Known as SPAR models)

Present: SPAR is used within our regulatory framework, including inspection, oversight, and licensing

- Assessment of safety significance of inspection findings
- Screening of generic safety issues
- Capabilities to assess external hazards

Future Benefits: NRC is looking to use insights from licenses and the SPAR models to determine the safety significance of license amendment request to scope resource review effort

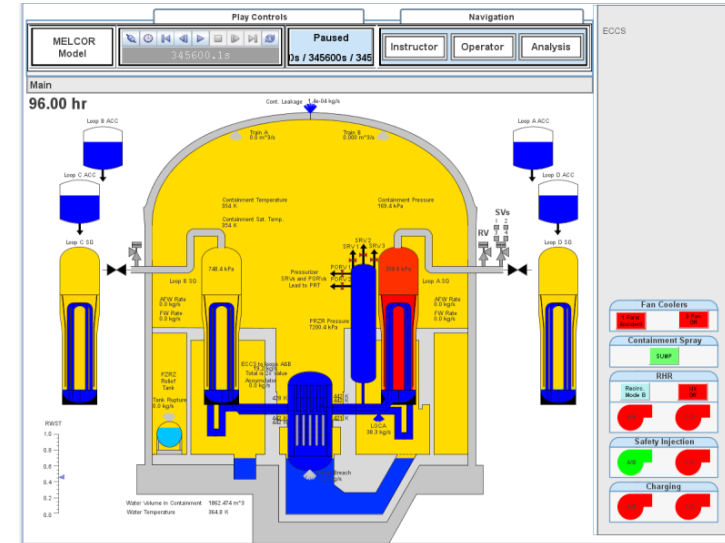


Containment Protection and Release Reduction Technical Basis Insights

Past: NRC used MELCOR and MACCS codes to analyze containment protection and release reduction strategies following an extended loss of AC power accident. The study's results (NUREG-2206) informed NRC's decision to not require filtered containment venting systems.

Present: NRC's severe accident and consequence codes continue to support diverse applications and are shared and used worldwide through the CSARP program.

Future Benefit: Using accident progression and consequence analysis insights to support the risk-informing of NRC's programs

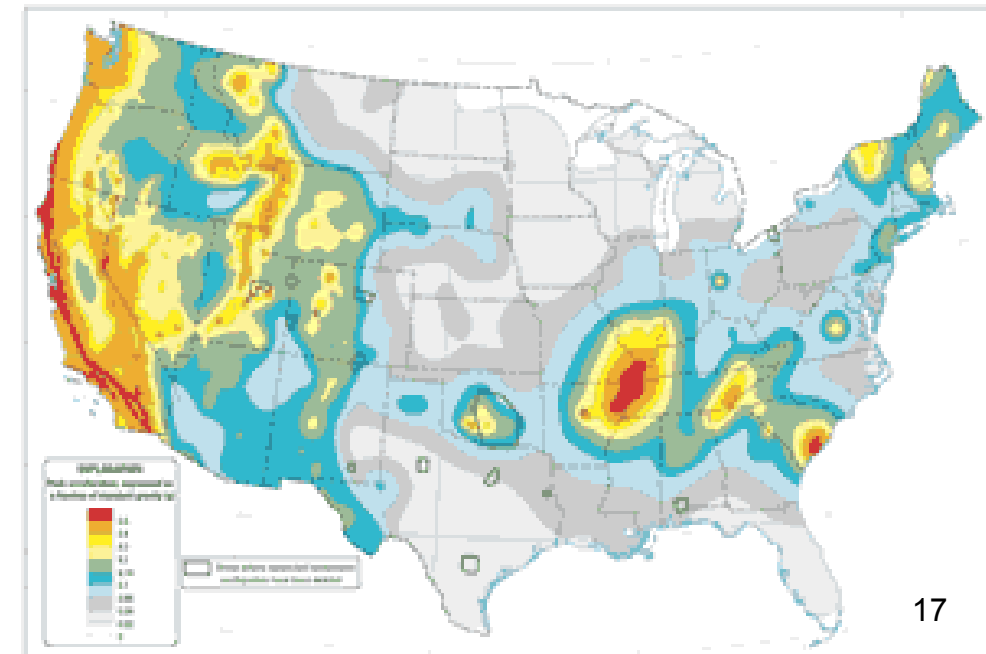
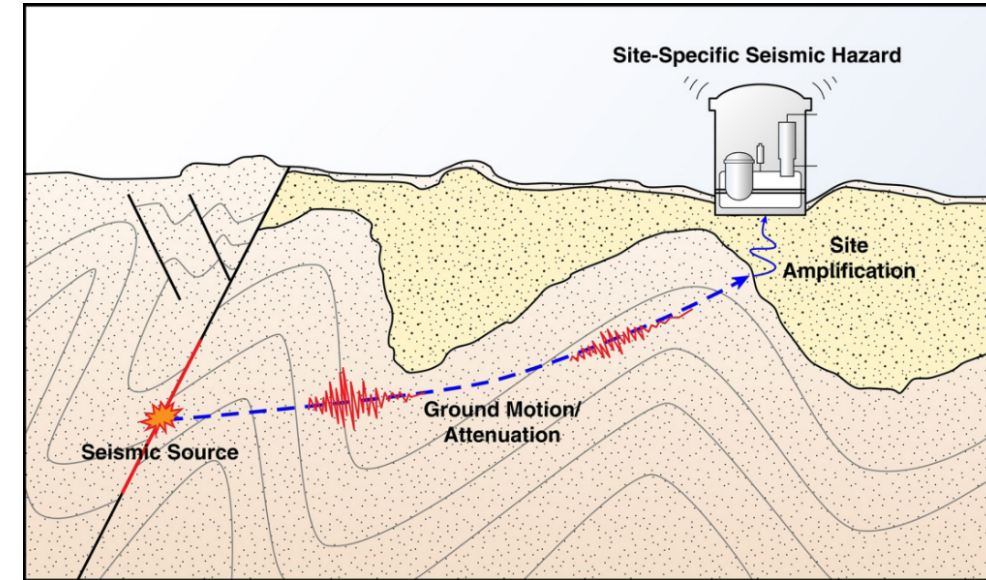


Seismic Safety Readiness

Past: Probabilistic Seismic Hazard Analysis and knowledge of seismic sources in the central and eastern US allowed for a rapid review of risk to the US fleet

Present: Current research focuses on reducing the uncertainties in seismic hazard calculations and plant response

Future Benefit: Seismic PRAs provide licensees flexibility to reclassify safety components that are not risk significant (10 CFR 50.69)



Final Thoughts on Research

- Collaboration is more important than ever before
- Research regulatory activities need to keep pace with innovation and stakeholder needs
- Thoughtful investment is necessary to maintain tools, methods, knowledge, and to solve technical issues