



Briefing on Nuclear Regulatory Research Program

May 30, 2019



Agenda

- Steven West – Introduction
- Raymond Furstenau – Strategic Overview of the Research Program
- Ho Nieh – Research Benefiting Operating Reactor Business Line Decisions
- Kimberly Webber – Cooperation on Advanced Reactors and Accident Tolerant Fuel
- Raj Iyengar – Technical Basis Development for Supporting Regulatory Decisions
- John Nakoski – Advancing Risk-Informed Decision-Making



Strategic Overview of the Research Program

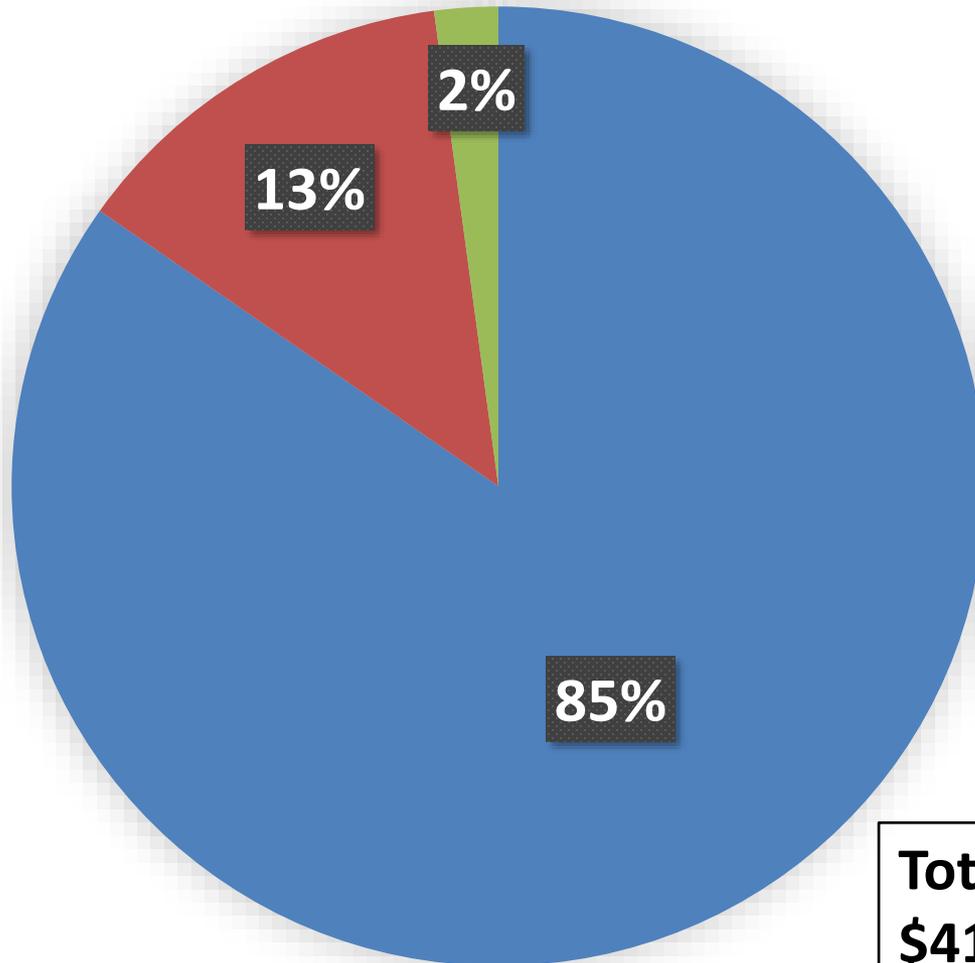
Raymond Furstenau

Director

Office of Nuclear Regulatory Research

Research at a Glance

RES – FY 2019 Budget by Business Line



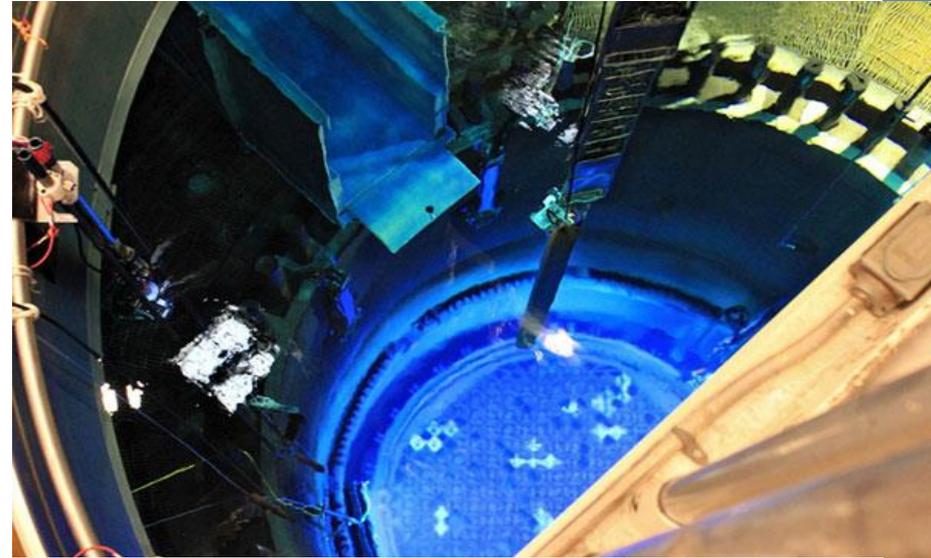
- Operating Reactors
\$33.8M and 183 FTE
- New and Advanced Reactors
\$6.5M and 21 FTE
- Nuclear Materials, Fuel Storage,
and Decommissioning
\$0.9M and 4 FTE

Total Budget \$79.6M (includes \$41.2M in contracts and 208 FTE)

*\$15M for the Integrated University Program is not included

Be Ready for New Technology

- Research is necessary to support licensing and oversight of innovative technologies and designs



Lead test assembly containing accident tolerant fuel (ATF) rods being loaded at Southern Nuclear's Edwin I. Hatch Nuclear Plant (courtesy of Southern Nuclear).

- Activities are a balance of confirmatory and forward-looking research to ensure readiness

Importance of External Engagement

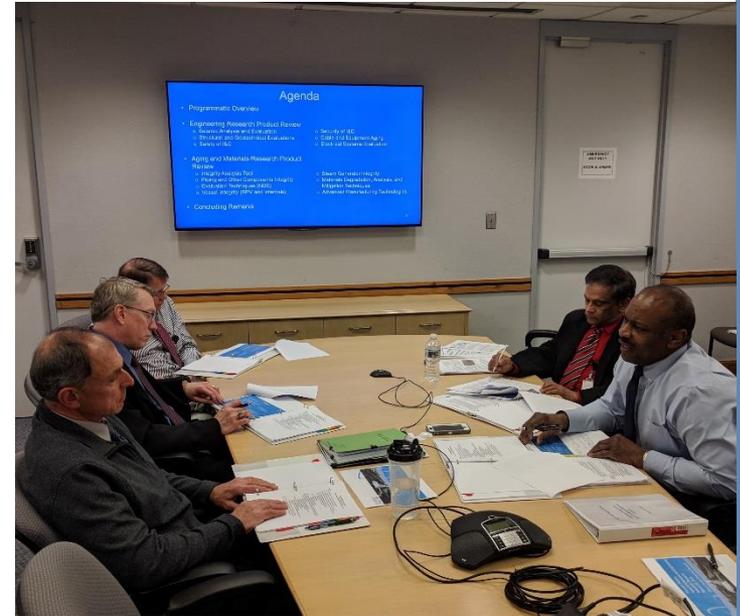
- Providing transparency of research activities internally and externally
- Significant leverage through domestic and international collaborations



RIC Session – Role of Research in Transforming the Regulatory Environment

Performing Research that Matters

- Initiated program reviews of research activities to support strategic alignment with the business lines
- Focus efforts to ensure we are doing the right research at the right time, with the appropriate priority



Program Review on Engineering Research

Improving Decision Making

Proactive Regulatory Research

Forward-looking research lays the foundation to support innovative technologies

Confirmatory Analysis

Our role as an independent regulator is strengthened by tools and analyses that aid timely decision making

Reduce Uncertainties

By increasing our body of knowledge and understanding, we can reduce unnecessary conservatism in our rules and guidance



**Focus on
What
Matters**



Research Benefiting Operating Reactor Business Line Decisions

Ho Nieh

Director

Office of Nuclear Reactor Regulation

Closing GSI-191 because safety has been improved and the low safety significance of in-vessel effects



Better modeling of FLEX using Operating Experience and Human Reliability Analysis



Reactor Oversight Process (ROP) Decision Making Relies on Research

- SPAR models enable independent assessment of safety-significance
 - Significance Determination Process
 - Event response
 - Emergent issues
- ROP Enhancement Project requested research to confirm that, in general, the level of safety has improved over the last 20 years



Research Cooperation on Advanced Reactors And Accident Tolerant Fuel

Kimberly A. Webber
Deputy Director
Division of Safety Analysis

“BE READY” ATTITUDE

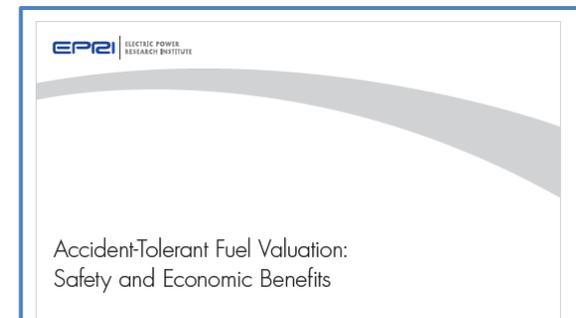


- Improved mission value through cooperation
 - Delivers cost savings
 - Reduces duplication of effort
 - Builds staff expertise
 - Brings regulatory perspectives to new ideas



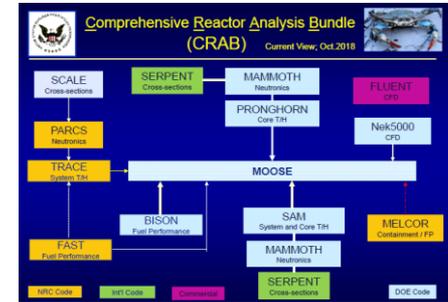
Capitalizing on Partnerships to Support Licensing of Accident Tolerant Fuels (ATF)

- Numerous interactions with fuel vendors
- Obtaining data from DOE research programs
- Gaining insights from EPRI on safety of ATF and operational flexibilities
- Developing insights on fuel safety criteria through international partnerships

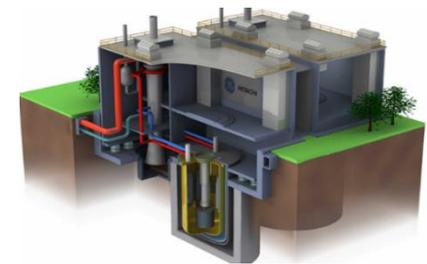


Strategic Research for Advanced Reactor Licensing

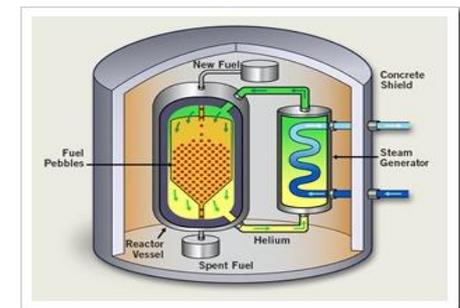
- Use of DOE's codes and expertise fill gaps in NRC computation capabilities
- Building staff expertise in sodium fast reactors through DOE's Versatile Test Reactor Program
- Accelerating NRC knowledge about graphite through cooperation with the United Kingdom



Use of DOE Computer Codes



Versatile Test Reactor



High temperature Gas Reactor 1



Technical Bases Development for Supporting Regulatory Decisions

Raj Iyengar
Branch Chief
Division of Engineering

Integrating Knowledge into Engineering Solutions

Readiness for subsequent license renewal

- Identified technical issues proactively
- Coordinated with DOE and EPRI
- Developed joint research roadmaps & separate research programs
- Reduced uncertainties; increased knowledge
- Supported issuance of guidance



Concrete



Cables



Vessel Internals – Baffle Bolt

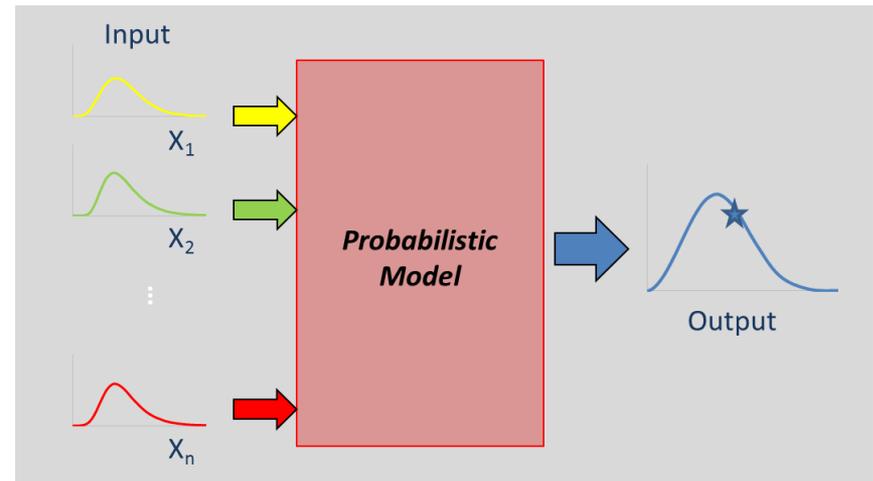
Delivering Efficiency Expertise in Action

Reactor Pressure Vessel Assessment Code (FAVOR)

- Reduction of in-service inspection burden (BWR circumferential welds)
- Evaluation of reactor pressure vessel issues (Doel/Tihange) on US fleet
- Development of Alternate Pressurized Thermal Shock Rule

Probabilistic Fracture Mechanics (PFM)

- Risk-informed efforts throughout metallic component systems



PROBABILISTIC FRACTURE MECHANICS CODE

Extremely Low Probability of Rupture (xLPR)

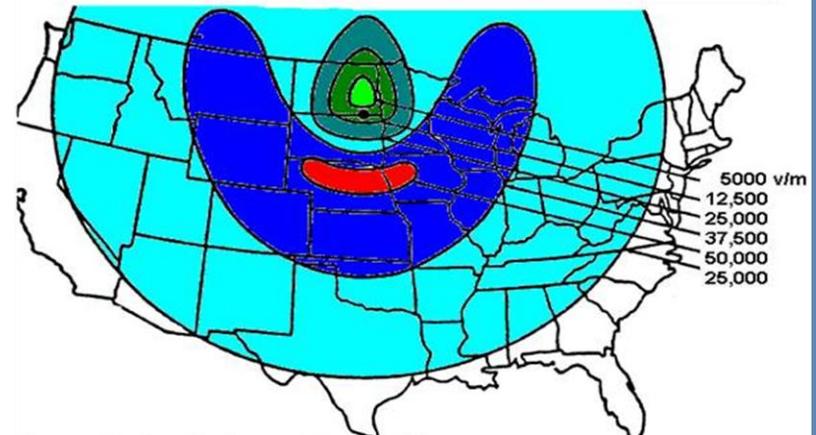
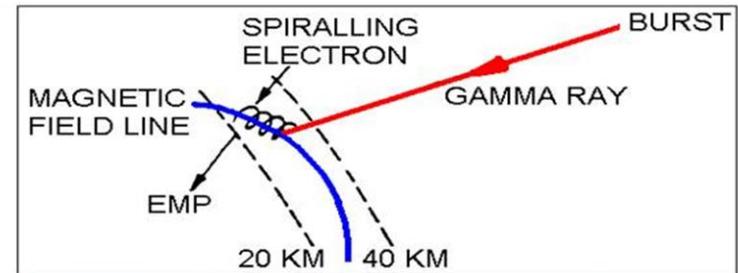
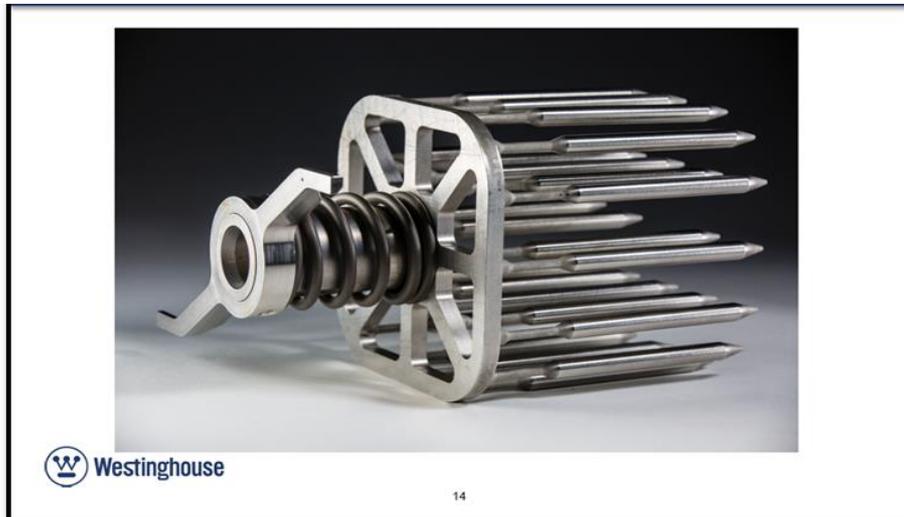
- Leak-Before-Break Applications

Forging the Future

Evaluating New Technologies

- Advanced Reactors: Materials/Components
 - International Operating Experience
 - Technical issues identification and resolution
 - Flexible approaches to material qualification
- Advanced Manufacturing
- Electromagnetic Pulse

Thimble Plugging Device



Source: Nuclear Environment Survivability, U. S. Army, report AD-A278230 (1994)



Advancing Risk-Informed Decision-Making

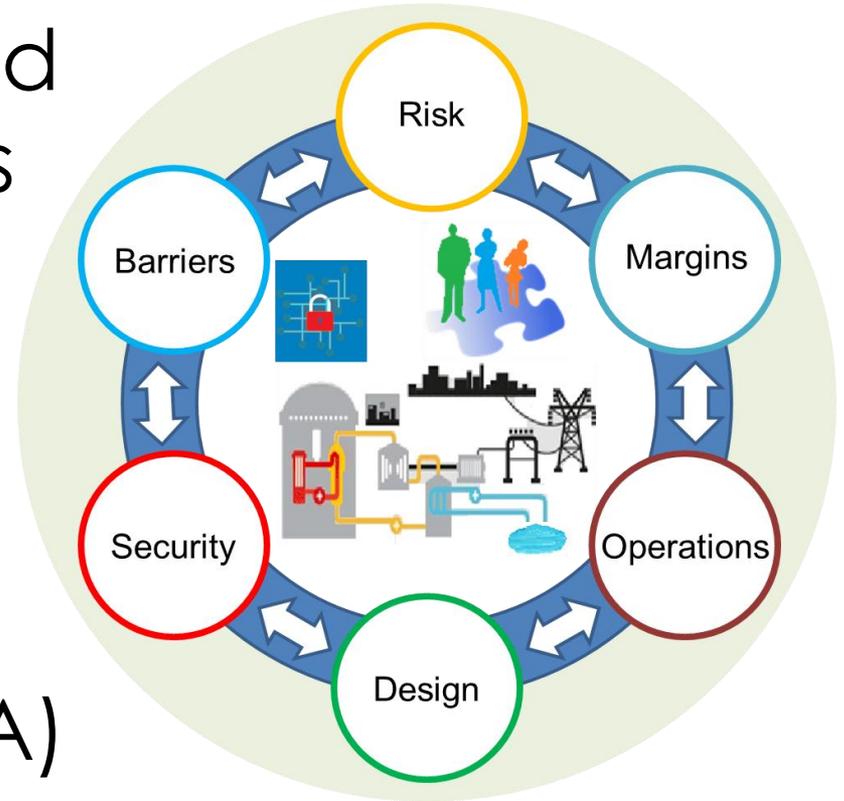
John A. Nakoski

Chief, Probabilistic Risk Assessment Branch

Division of Risk Analysis

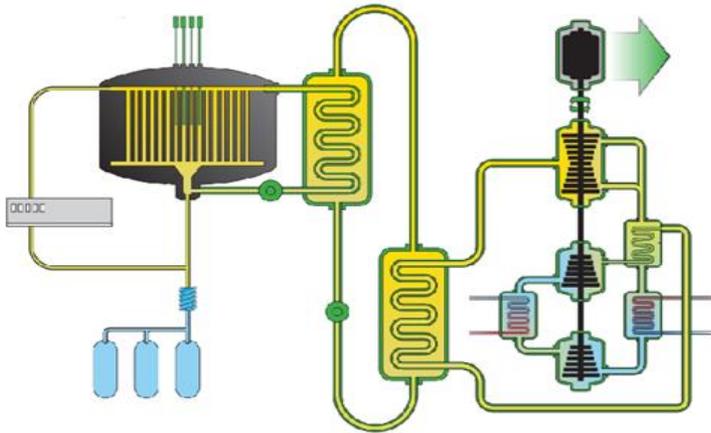
Expanding the Use of Risk Insights in NRC Decision-Making

- Operating, New, and Advanced Reactors
- Cyber and Physical Security, Digital Systems, Materials
- Level 3 Probabilistic Risk Assessment (PRA)
- State-of-the-Art Reactor Consequence Analysis



Focusing Resources on Mission Important Issues

- Advancing Consensus Standards and Methods



- Applying risk tools to Advanced Reactors

- Enabling Knowledge Management and embracing change

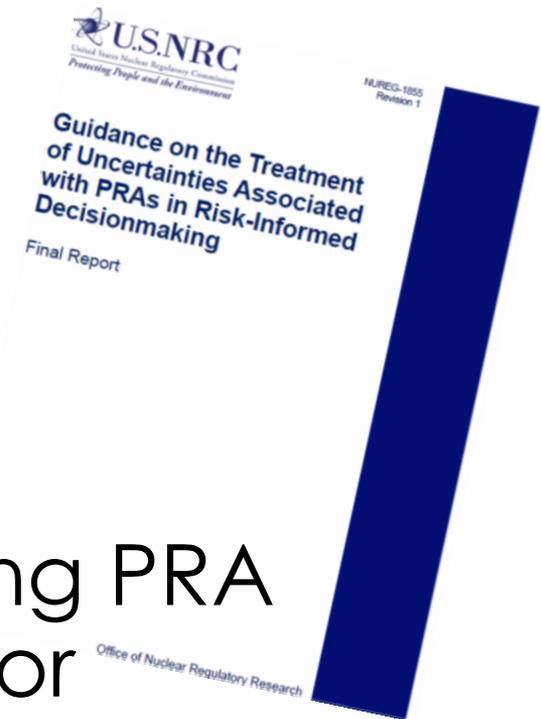


Delivering Tools, Methods, and Data

- Improving realism in risk tools and models to better prioritize activities
- Increasing understanding of uncertainties and safety margins



- Enhancing PRA models for Advanced Reactors



Wrap-up

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

Acronyms

- ATF - Accident Tolerant Fuel
- BWR - Boiling Water Reactor
- FLEX – Diverse and Flexible Coping Strategies
- GSI – Generic Safety Issue
- PRA - Probabilistic Risk Assessment
- ROP – Reactor Oversight Process
- SPAR – Standardized Plant Analysis Risk