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RIC 2025

CHARTING THE NEXT 50 YEARS

MARCH 11-13
**BETHESDA NORTH MARRIOTT
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NRC Research Prospectus

- Latest update planned for summer 2025
- Provides a summary of nuclear safety research activities
- Communicates research activities to support collaboration and feedback on program areas over the next 3 years
- The current FY22-FY24 version can be found at the QR code on right



CHARTING THE
NEXT 50 YEARS

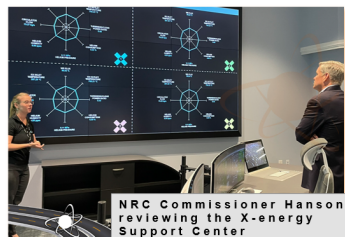
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Looking Ahead



ADVANCED REACTORS AND FUEL CYCLES

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Research on advanced reactors facilitates the NRC's readiness for non-light-water-reactors (non-LWR) licensing reviews.

Research efforts support development of computer codes and knowledge, guidance, and industry codes and standards for regulatory reviews to safely achieve effective and efficient non-LWR mission readiness.

7



SOFTWARE

Analytical Tools

Developing analytical tools and methods, including computer codes and reference plant models from public information.



GUIDANCE

Risk-Informed

Guidance for seismic, materials, chemical process safety, and human factors topics focusing on technology-inclusive, risk-informed, and performance-based approaches.



STANDARDS

Stakeholder Engagement

Engaging standards development organizations, designers, the U.S. Department of Energy, and others to identify and facilitate development of new industry codes and standards.

Looking Ahead

#NuclearResearch

Advanced Reactors and Fuel Cycles

Products and Budget

FY25

- Complete MACCS radionuclide properties on atmospheric transport and dosimetry.
- Develop two demonstration plant models for system analysis and host a SCALE/MELCOR public workshop for a microreactor design.
- Assess guidance needs for updates to chemical process safety for advanced fuel cycles.
- Complete Regulatory Guide (RG) endorsement of 2023 Edition of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Division 5.
- Issue RG 1.247, on Acceptability of PRA results for non-LWRs.

FY26

- Update two demonstration plant models for system analysis.
- Complete review of MACCS capabilities for reviewing tritium releases to the environment.
- Complete scalable reactor operator licensing review guidance.
- Complete computational tool for confirmatory analyses of graphite component integrity.
- Complete trial RGs for risk-informed, performance-based seismic design and seismic isolation.

FY27

- Update two demonstration plant models for system analysis.
- Develop risk-informed decision-making guidance for non-LWRs.
- Create scalable Human Factors Engineering (HFE) and reactor operator licensing guidance.
- Develop evaluation tools for digital twin applications.
- Assess advanced reactor passive component reliability and integrity management for advanced reactors.
- Assess guidance for floating nuclear power plants.
- Assess modeling tools for physical security at advanced reactors.

8

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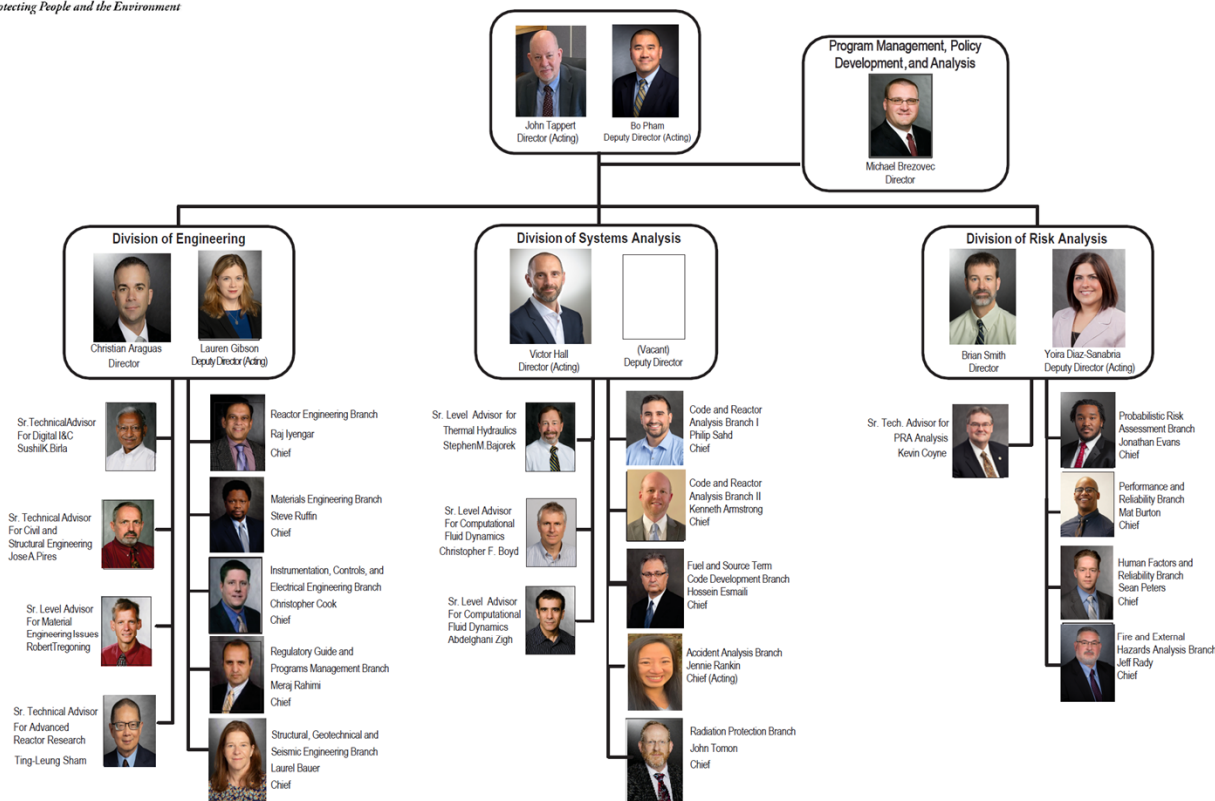
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Office of Nuclear Regulatory Research



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Risk Analysis Research



RISK TOOLS AND STUDIES

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Timely, realistic, and repeatable risk assessments to support NRC licensing reviews, rulemaking, oversight, and OpE evaluation activities.

Risk tools support projects such as sitewide, full-scope Level 3 PRA that includes all major radiological sources for a two-unit pressurized-water reactor reference plant. This project is advancing the state-of-the-art in areas such as human reliability; multi-unit Level 1,2, and 3 risk assessment; and severe accidents.

37



RISK MODELS

SPAR

Maintain the NRC's SPAR models for all operating nuclear power plants with the goal of reflecting current designs and operations.



SOFTWARE

SAPHIRE

Develop, maintain, and use the SAPHIRE computer code to support the development of the agency's SPAR models.



RISK ASSESSMENT

Level 3 PRA Project

Provide living Level 1, 2, and 3 PRA models to support enhanced risk-informed decision-making and analyses of emerging technologies.

Risk Analysis Research

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Risk Tools and Studies

Products and Budget

FY25

- Update SAPHIRE to incorporate user requests.
- Adjust SPAR models to enhance event and condition assessments.
- Modify SPAR dashboard for expanded access to risk insights from SPAR models for nonrisk expert.
- Issue Level 3 PRA project internal reports for reactor low-power and shutdown, spent fuel pool, and integrated site risk.
- Issue Level 3 PRA project draft NUREGs for comment on reactor low-power and shutdown, spent fuel pool, integrated site risk, and project summary.

FY26

- Release SAPHIRE version 9.0 with cloud-based capabilities.
- Make hundreds of requested SPAR model changes to support event and condition assessments for evaluation of inspection finding.
- Expand SPAR model capabilities in internal fires and external hazards, diverse and flexible coping strategies, and HRA.
- Submit all Level 3 PRA project NUREGs for final publication.

FY27

- Integrate IDHEAS-ECA into SAPHIRE.
- Make hundreds of requested SPAR model changes to support event and condition assessments.
- Enhance SAPHIRE and SPAR models to assess time-sensitive and quickly changing conditions.

38

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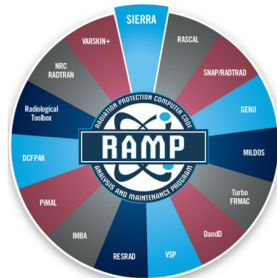
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Systems Analysis Research



RADIATION PROTECTION RESEARCH

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Research for radiation protection, dose assessment, emergency response, and monitoring of radiation exposures for occupational safety.

This research relates to computer code development under RAMP. It supports regulatory decisions affecting radiation protection through development of the Abnormal Occurrence Report to Congress, the Radiation Exposure Information and Reporting System (REIRS), and occupational health RGs.

21

SOFTWARE



Development

Develop and maintain RAMP computer codes in the areas of nuclear power plant licensing and siting, decommissioning, atmospheric transport and dispersion, and emergency response.



CONSOLIDATION

Efficiency and Effectiveness

Gain RAMP computer code flexibility, efficiencies, and increased user-friendliness by consolidating similar dose assessment codes.



INTERNATIONAL

Cooperation

Improve RAMP codes by leveraging global expertise and research results.

Systems Analysis Research

#NuclearResearch

Radiation Protection Research

Products and Budget

FY25

- Issue annual Abnormal Occurrence Report.
- Issue annual REIRS Report.
- Release the Software Integration for Environmental Radiological Release Assessments (SIERRA) code with the atmospheric transport and dispersion and the reactor coolant source module.
- Issue RG 8.39, Revision 2, on release of patients administered radioactive material.

FY26

- Issue annual Abnormal Occurrence Report to Congress.
- Issue annual REIRS Report.
- Release the VARSKIN+ code version 2.0 with the extravasation dosimetry model in support of the medical extravasation rulemaking.
- Issue the RG related to the release of radioactive material administered to veterinary patients.

FY27

- Issue annual Abnormal Occurrence Report to Congress.
- Issue annual REIRS Report.
- Release the SIERRA computer code with the environmental pathways, human and biota exposure, and dose coefficient modules.
- Release the updated and modern Radiological Assessment System for Consequence Analysis (RASCAL) computer code version 5.0.

22

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Engineering Research



MATERIALS AND MECHANICAL SYSTEMS PERFORMANCE

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Assuring component integrity and function by assessing materials and mechanical system performance.

Preparing for review of advanced manufacturing technology use through ASME code cases and applications that rely on nondestructive examination (NDE) inspections. Facilitates risk-informed decision-making for component integrity assessments and addresses the impacts of material degradation for long-term operation.

29



ADVANCED MANUFACTURING
Emerging Applications
Assess advanced technologies for potential use in replacement components and new or advanced reactors.



NONDESTRUCTIVE EXAMINATION
Defense in Depth
Evaluate effectiveness of NDE techniques for detecting and characterizing flaws in components.



STEAM GENERATOR
Tube Integrity
Assess effectiveness of techniques for detecting and characterizing flaws in steam generator tubes to assure structural integrity or leaktightness.



MATERIALS DEGRADATION
Testing and Evaluation
Evaluate materials degradation phenomena like irradiation and thermal embrittlement to ensure component integrity.

Engineering Research

#NuclearResearch

Materials and Mechanical Systems Performance Products and Budget

FY25

- Assess of electron beam welding, direct energy deposition, and laser powder bed fusion.
- Assess of NDE of carbon fiber reinforced polymer
- Assess of irradiated materials test results.
- Reexamine NUREG-1829, "Estimating Loss-of-Coolant Accident (LOCA) Frequencies through Elicitation Process."

FY26

- Assess automated data analysis and ML for NDE.
- Release new Fracture Analysis of Vessels—Probabilistic and Extremely Low Probability of Rupture code.
- Assess primary water stress corrosion cracking initiation testing of Alloy 690/52/152 materials.
- Release flaw evaluation software.

FY27

- Assess effectiveness of virtual and synthetic flaws for NDE training and qualification testing.
- Assess condition monitoring of mechanical systems and components.
- Provide support for ASME Boiler and Pressure Vessel Code, Section III and Section XI, and Operation and Maintenance of Nuclear Power Plants code rulemaking.
- Assess of primary water stress corrosion cracking initiation testing of Alloy 690/52/152 weld dilution zones, heat-affected zones, and weld defects.

30

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