Safety Review of U.S. Research Reactors

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Introduction (1/2)

- This presentation will focus on the following areas of safety evaluation for license renewal of research reactors in the U.S.
  - Reactor characteristics
  - Accident analysis
  - Technical specifications
- There are many other important topics included in a complete safety evaluation

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Introduction (2/2)

- The operating organization is responsible for preparing the safety analysis and operating the reactor according to the safety analysis
- The regulator is responsible for evaluating the safety analysis and licensing the operating organization to operate the reactor

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NRC Application Review (1/5)

- Initial review for completeness and acceptability
- NRC officially files the application on the facility docket
- Inform the public of the application and offer the public an opportunity to request a hearing

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NRC Application Review (2/5)

- Technical review of the Final Safety Analysis Report
  - Verify safety-related conclusions
  - Use technical guidance documents
  - Use inspection reports
  - Use operating experience
  - Use prior NRC approval

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NRC Application Review (3/5)

- Review of the Technical Specifications to verify compliance with the regulations
  - Technical Specifications often require updates to meet the current regulations
- Review of Emergency Plan, Security Plan, Operator Training and Requalification Plan, and Quality Assurance Plan against current guidance

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NRC Application Review (4/5)

- If required, review of startup plan to ensure the licensee can safely bring the reactor into routine operation in accordance with the renewed license
- Review of the environmental report to verify compliance with the National Environmental Policy Act

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NRC Application Review (5/5)

- Request for Additional Information
  - A question asked to provide missing information
  - A question asked to clarify an inconsistency
  - A question asked to resolve a misunderstanding
  - Used for supplementing the application with information that must be part of the official NRC file or “docket” for the facility

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NRC Renewal Documentation (1/2)

- Final Environmental Impact Statement required for a testing facility
- Environmental Assessment required for a research reactor
- Notice informing the public of the Final Environmental Impact Statement or Environmental Assessment

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NRC Renewal Documentation (2/2)

- License renewal package
  - Renewed Facility License
  - Technical Specifications (TS)
  - Final Safety Evaluation Report (SER)
  - Notice informing the public of the license renewal

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Overview of Safety Evaluation (1/2)

- The safety evaluation is an evaluation of the safety analysis report to determine that it is complete, accurate, and technically correct
- The safety evaluation is documented in the SER
- The SER explains the licensing basis to the operating organization and the public

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Overview of Safety Evaluation (2/2)

- The safety evaluation results in conclusions about reactor safety and the ability of the operating organization to safely operate the reactor
  - No fuel damage
  - No radiological consequences that exceed the regulatory requirements
  - The operating organization is technically and financially qualified to operate the reactor

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Standard Review Plan (1/5)

- NUREG-1537 Part 2, "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors, Standard Review Plan and Acceptance Criteria"
- NUREG-1537 covers all licensing of research reactors, including periodic safety reviews (license renewal)

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Standard Review Plan (2/5)

- Areas of review
  - Describes the scope of the safety evaluation for each section of the safety analysis
  - Describes the systems, components, analysis, data, and other information that should be included in each safety analysis

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Standard Review Plan (3/5)

- Acceptance criteria
  - Purpose of the safety evaluation
  - Applicable regulatory requirements
  - Technical basis for the acceptance criteria

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Standard Review Plan (4/5)

- Review procedures
  - Describes how to perform the safety evaluation
  - Describes the information that should be documented in the safety evaluation

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Standard Review Plan (5/5)

- Evaluation findings
  - Describes the type of conclusions that are needed to find the safety analysis acceptable
  - Generally, each section of the SER should have a conclusion to document the results of the safety evaluation

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Safety Evaluation Method (1/12)

- Reactor characteristics
  - Verify that the safety analysis completely describes all reactor characteristics
  - Verify that the safety analysis discusses normal values of all reactor characteristics
  - Verify that the safety analysis provides the limiting values of all reactor characteristics important to safety

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Safety Evaluation Method (2/12)

- Reactor characteristics
  - Verify that the safety analysis uses validated methods for analyzing the reactor characteristics
    - experiments
    - measurements
    - technical papers
    - comparison to similar reactors
    - benchmarked computer codes and models

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Safety Evaluation Method (3/12)

- Reactor characteristics
  - Perform check calculations of the safety analysis to find any mathematical errors
  - Perform independent calculations of the safety analysis to determine that the results are reasonable and correct
  - Review any supporting documentation to verify that it is applicable to the safety analysis

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Safety Evaluation Method (4/12)

- Accident analysis
  - Verify that the safety analysis includes all credible accidents that apply to the reactor design, including a maximum hypothetical accident (MHA)
  - Verify that the consequences of the MHA bound the consequences of all other accidents

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Safety Evaluation Method (5/12)

- Accident analysis
  - Verify that the safety analysis describes the initiator and event sequence for each accident
  - Verify that the safety analysis shows that credible accidents do not cause fuel damage
  - Verify that the safety analysis shows that credible accidents do not result in radiation exposures greater than the regulatory limits

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Safety Evaluation Method (6/12)

- Accident analysis
  - Verify that all assumptions and initial conditions are consistent with the safety analysis of the reactor characteristics
  - Verify that all assumptions and initial conditions are specified in the TS or are fundamental design features of the reactor

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Safety Evaluation Method (7/12)

- Accident analysis
  - Verify that all systems and equipment that reduce the consequences of an accident are specified in the TS
    - safety channels and instruments
    - emergency core cooling
    - ventilation and filtration systems
    - emergency power

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Safety Evaluation Method (8/12)

- Accident analysis
  - Perform check calculations of the safety analysis to find any mathematical errors
  - Perform independent calculations of the safety analysis to determine that the results are reasonable and correct
  - Review any supporting documentation to verify that it is applicable to the safety analysis

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Safety Evaluation Method (9/12)

- Technical specifications
  - Verify that the technical specifications contain safety limits (SL) and a basis for each SL that is supported by the safety analysis report
  - Verify that the SL will protect the reactor fuel from damage

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Safety Evaluation Method (10/12)

- Technical specifications
  - Verify that the technical specifications contain limiting safety system settings (LSSS) and a basis for each LSSS that is supported by the safety analysis report
  - Verify that the accident analysis shows that the LSSS will provide adequate safety margin to the SL

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Safety Evaluation Method (11/12)

- Technical specifications
  - Verify that the technical specifications contain a limiting condition for operation (LCO) or a design feature specification for each system or component that is part of the accident analysis
  - Verify that the TS contain a basis for each LCO that is supported by the safety analysis report

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Safety Evaluation Method (12/12)

- Technical specifications
  - Verify that the technical specifications contain a surveillance requirement for each system or component that has a LCO
  - Verify that the TS contain requirements for any procedures or actions included in the accident analysis

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Safety Evaluation Report (1/2)

Format of the SER

1) Description of the subject of the safety analysis
2) Discussion of the safety analysis and conclusions made by the operating organization
3) Discussion of how the regulator evaluated the safety analysis

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Safety Evaluation Report (2/2)

Format of the SER

4) Discussion of the regulatory requirements and acceptance criteria
5) Explanation of how the safety analysis satisfies the regulatory requirements
6) Conclusions based on the evaluation

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Conclusion (1/1)

- Questions?

- Thank you for your attention.