



Safety Review of U.S. Research Reactors

**William B. Kennedy, Project Manager
Research and Test Reactor Licensing Branch
U.S. Nuclear Regulatory Commission**

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

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

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

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

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

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

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

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

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

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

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

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)

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

Standard Review Plan (3/5)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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**

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

Conclusion (1/1)

- Questions?
- Thank you for your attention.