NRC STAFF EXPERIENCE WITH ADVANCED REACTOR VENDORS APPLYING RIPB PRINCIPLES

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2 OPENING THOUGHTS/DISCLAIMER

- Context is Part 50/52 – lots of good discussion in Part 53 rulemaking process
- Advanced Reactors = Non-LWR
- General discussion - I'll try not to identify any vendors
- My thoughts – not NRC official position

3 CONTENTS OF APPLICATIONS – TECHNICAL INFORMATION

50.34(a)(4) A preliminary analysis and evaluation of the design and performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility and including determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and the adequacy of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents…

4 ADDITIONAL STANDARDS

50.43(e) Applications for a design certification, combined license, manufacturing license, operating license or standard design approval that propose nuclear reactor designs which differ significantly from light-water reactor designs that were licensed before 1997. Or use simplified, inherent, passive, or other innovative means to accomplish their safety functions **will be approved only if**:

- (1)(i) The performance of each safety feature of the design has been demonstrated through either analysis, appropriate test programs, experience, or a combination thereof;
- (ii) Interdependent effects among the safety features of the design are acceptable, as demonstrated by analysis, appropriate test programs, experience, or a combination thereof; and
- (iii) Sufficient data exist on the safety features of the design to assess the analytical tools used for safety analyses over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions; or

5 ADDITIONAL STANDARDS (CONT.)

- (2) There has been acceptable testing of a prototype plant over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions. If a prototype plant is used to comply with the testing requirements, then the NRC may impose additional requirements on siting, safety features, or operational conditions for the prototype plant to protect the public and the plant staff from the possible consequences of accidents during the testing period.

6 GENERAL ISSUES

- Many different types and sizes of designs
- Limited codes and standards
- Limited guidance documents

PERFORMANCE-BASED APPROACH IS REQUIRED

- Given the general issues mentioned previously, a prescriptive approach is not possible
- Advanced reactor designers and NRC staff have embraced a performance-based approach

PERFORMANCE CRITERIA

- Ultimate criteria is dose to the public – QHOs
- Maintain radionuclide barriers
- Control reactivity/heat generation
- Control heat removal

9 FUEL QUALIFICATION

- Many new types
- Some fuel is similar to previous designs but used in different conditions
- Limited data available
  - Ensure it is applicable for design conditions
  - Ensure QA is adequate
  - NRC staff published generic guidance and has endorsed several topical reports (Oct. 2020 stakeholder meeting)

EVENT SELECTION

- Lack of experience with these technologies
  - How do we know that we considered everything (or at least everything important to safety)?
- If you don't use LMP, what is the maximum credible accident?

RISK-INFORMED APPROACH

- How detailed does the PRA need to be?
  - Uncertainties in data
  - What are the applications?
- How do you mix PRA with other systematic approaches?
- Can you just do a bounding, deterministic approach?

12 FINAL THOUGHTS

- https://www.nrc.gov/
- Thanks for your attention!