

ACRS Subcommittee Review of Kemmerer Construction Permit Application

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TerraPower Sodium Design

- The Sodium design is an 840 MWth sodium fast reactor.
- While it leverages U.S. experience in sodium fast reactors, such as EBR-II, Fast Flux Test Facility (FFTF) and the PRISM design, most of that experience is more than 30 years old.
- This reactor is also the first non-LWR power reactor to submit a CPA, the first to use the Licensing Modernization Project as the basis for its safety case, and the first to use the 10 CFR 50.160 emergency planning rule.
- Hence many aspects of this application are novel and/or noteworthy.

ACRS Focus Areas

- We selected four focus areas, three of which are defined as the “fundamental safety functions”, or FSFs:
 - Control of Heat Generation FSF (e.g., reactivity control)
 - Control of Heat Removal FSF (e.g., decay heat removal)
 - Retention of Radionuclides FSF (e.g., functional containment)
 - Sufficiency of the Overall safety case (e.g., PRA-centered LMP approach)
- Other areas may arise as a result of SC meeting discussions

Subcommittee Meetings

- The applicant and staff provided a comprehensive overview of the plant design and safety analyses as documented in the CPA.
 - October 8-9: Overall Plant Design and implementation of LMP
 - October 21-23: Structures, Systems, and Components
- These meetings satisfactorily addressed each of the focus areas, as discussed in the following slides.

Control of Heat Generation FSF

- Specific review areas include:
 - Sensitivity to reactivity events – Potential for significant reactivity excursions caused by boiling of sodium and core geometry changes
 - Two means of rod insertion – Reliance on the same reactor protection system to control presumably diverse means of rod insertion
 - Limitations on rate of rod-based reactivity insertion – Reliance on non-safety interlocks to limit reactivity insertion rate

Control of Heat Removal FSF

- Specific focus areas include:
 - Reliability of passive cooling – Margin in natural circulation heat transfer relative to decay heat removal needs
 - Transition from forced circulation to natural circulation – Scenarios that lead to a rapid reduction in pump speed and may therefore not transition to natural circulation

Retention of Radionuclides FSF

- Specific focus areas include:
 - First application of a functional containment for an SFR – The rationale for differences from prior SFR containments
 - Sodium Fires – The plan to either limit the energy from chemical reactions involving sodium or design the functional containment for them.

Sufficiency of the Overall Safety Case

- Specific focus areas include:
 - Cliff-edge effects – How the process for hazard evaluation, LBE selection, and cliff-edge screening adequately assess for cliff-edge effects and defense in depth.
 - Role of “Other Quantified Events” (OQEs) – The role of extremely unlikely Sodium scenarios evaluated by the applicant to ensure analyses are bounding when considering uncertainties.
 - Seismic design – The adequacy of the seismic design, since resilience to earthquakes will be particularly important to safety.

Conclusion

- The subcommittee has enough information to proceed to a draft letter report for deliberation by the Full Committee.
- We are prepared to read the draft letter into the record.

List of Acronyms

- ACRS – Advisory Committee on Reactor Safeguards
- CPA – Construction Permit Application
- EBR-II – Experimental Breeder Reactor - II
- FFTF – Fast Flux Test Facility
- FSF – Fundamental Safety Function
- LBE – Licensing Basis Event
- LMP – Licensing Modernization Project
- LWR – Light Water Reactor
- MWth – Megawatts, thermal
- OQE – Other Quantified Event
- PRA – Probabilistic Risk Assessment
- PRISM - Power Reactor Innovative Small Module
- SC - Subcommittee
- SFR – Sodium Fast Reactor