A Perspective on Risk and Suggestions for Risk Informing the EQ Process

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Presentation Summary

• Discuss different categories of risk, how the categories relate to previous events in the nuclear industry, and what we can do to minimize risk as we move forward in the EQ area

• Discuss some potential issues with the 10 CFR 50.69 risk screening process as applied to EQ components

• Present some ideas about what might be a reasonable alternate treatment approach for EQ components that have been downgraded to RISC 3 under 10 CFR 50.69, both for new qualifications and for replacement parts
What really is risk-informed?

The overall risk of operating a nuclear plant (or really any high hazard industrial endeavor) can be broken up into four categories

- **Known Knowns** – known risk that is quantified by PRAs via accident sequences – this risk has generally now been minimized by effective implementation of PRAs and associated programs

- **Known Unknowns** – specific issues that are explicitly stated as not be addressed by PRAs such as design errors, sabotage, errors of commission - can be minimized by strong programs for design control (including **EQ**), management oversight, operator training, etc.

- **Unknown Knowns** – risks known about but not effectively communicated to decision makers - can be minimized by strong corrective action and operating experience programs

- **Unknown Unknowns** - bad assumptions, unfinished research (generic issues), operation outside limits, new phenomena (previously unidentified issues) - protection provided by defense in depth concepts
Look Back at Some Previous Events

- TMI – Known knowns (weaknesses in initial design, operator errors, no real PRA at the time)
- Chernobyl – Known unknowns (design flaw - positive reactivity coefficient), Unknown knowns (deliberate operation outside limits)
- Fukushima – Unknown knowns (degree of tsunami threat not communicated to decision makers)
- Davis Besse Vessel Head Erosion – Unknown knowns (inadequate corrective action to boric acid corrosion)
- Crystal River Operational Experiment – Unknown knowns (deliberate operation outside limits)
- Sharon Harris minimum recirculation line – known unknowns (design error on minimum flow valve sizing), Unknown knowns (inadequate corrective action)
- Forsmark diesel fail to start – Known unknown (design error in start circuitry)
Observations

• None of these accidents/events likely involved an accident sequence that was modeled at the time by a PRA

• The risk today associated with an accident sequence captured by a PRA has been significantly diminished due to effective implementation of risk-informed strategies and corrective actions

• We need to minimize the risk not captured by current PRAs by maintaining effective programs (including EQ) and defense in depth concepts
10 CFR 50.69 is an attempt to better incorporate risk into the regulatory process by eliminating “special treatment requirements” from low risk safety-related systems and components, thus allowing resources and attention to be better applied to more risk significant items.

10 CFR 50.49 is one of the special treatment requirements that can be eliminated for safety-related but low risk (RISC 3) components.
Issues With 50.69 Screening Process – As Applied to EQ Components

- Failure on demand rates assigned to EQ components (based on generic failure data)
- Cumulative risk impact of multiple component downgrades
- How to model increase in failure rates resulting from removal of special treatment requirements
For Low Risk Items Requiring First Time Qualification

- Possible elimination of accelerated thermal aging requirements for materials known to be age insensitive
- Possible elimination of radiation aging requirements – only required for known radiation sensitive materials
- Elimination of IEEE 323 test envelop margins
- Use of laboratories certified to commercial standards in lieu of Appendix B
- Credit for commercial test data
10 CFR 50.69 - Considerations for an Alternate Approach to EQ for Low Risk Items (RISC 3)

For Low Risk Replacement Parts/Components Previously Qualified

Use CGD-Lite Approach

• Certificates of compliance could be accepted from trusted commercial suppliers as a way of verifying selected critical characteristics
  • For specific performance tests
  • For material verification
• Sample approach to verification of critical characteristics
• M&TE traceability to National Labs not required as long as commercial standards are met
Considerations for the Future

Graduated EQ Approach Based Upon Risk Category

• Beyond Design Basis
• Design Basis LOCA
• High Energy Line Break
• Post Accident Monitoring
Possible Enhancements for Qualification of High Risk Items

- Determination of critical performance margins
  - May require testing to failure to establish critical performance margins
- Increased sample size
  - Design margin + sufficient test samples = reasonable assurance
- Grouping families – increased rigor in determining similarity
Overall Conclusions

• Maintaining effective programs (including EQ) for validating the design of nuclear power plant components is critical to minimizing risk.

• Some additional consideration should be given to how the 10CFR50.69 risk screening process treats EQ components.

• Modifications to the current EQ approach could be taken for those replacement items classified as low risk by 10 CFR 50.69 to make the process more risk-informed and economically viable.