



EPRI Perspectives on NRC's Yucca Mountain ISG-1

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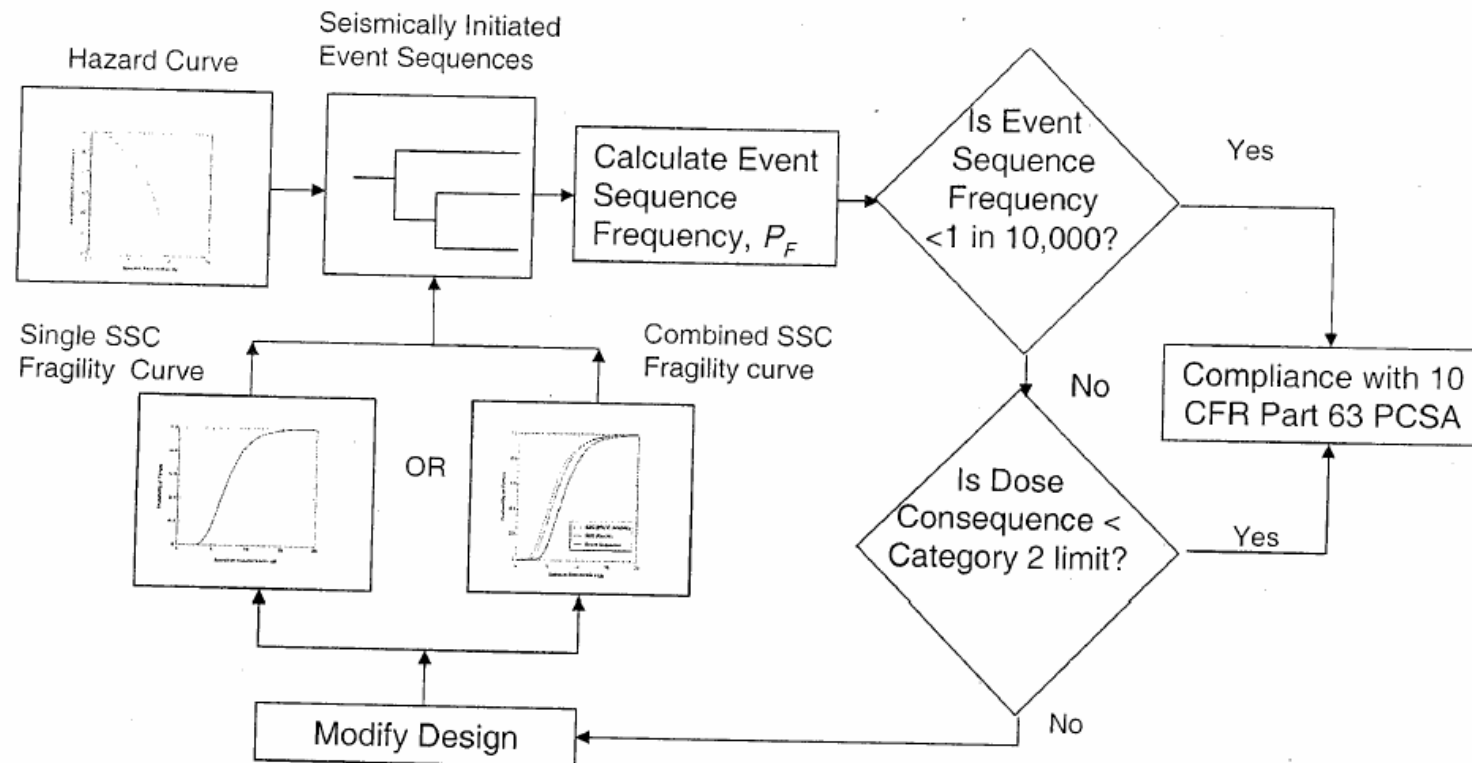
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ISG-1: REVIEW METHODOLOGY FOR SEISMICALLY INITIATED EVENT SEQUENCES



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ISG-1: REVIEW METHODOLOGY FOR SEISMICALLY INITIATED EVENT SEQUENCES

- ISG-1 Methodology Overview
 - First step is to “assess seismic performance of individual SSC”
 - If the failure probability of individual SSCs is less than 1 in 10,000 during the preclosure period the SSC 10 CFR 63.111
 - Otherwise demonstrate seismic sequence is less than 1 in 10,000 over the preclosure period
 - Alternatively, demonstrate consequences are acceptable

Traditional Seismic Probabilistic Risk Assessment (SPRA)

- SPRA Methodology Overview
 - Screen out high capacity components
 - Identify seismically controlling components by function (i.e., “weak link” approach)
 - Incorporate seismic failures into sequence model
 - Evaluate model
 - Review Results
 - Consider
 - Refinements to seismic model
 - Mitigative / recovery actions (e.g., hardware and procedural improvements)
 - Repeat above steps
 - Physical Plant Modification

Relative Merits of a Traditional “weak link” approach vs. ISG-01 methodology

- Weak Link approach

- Identify seismically controlling failure(s) at functional level
- Perform fragility analysis for selected components
- Convolve fragility with hazard only for selected components
- Top-down approach to manage risk of facility

- ISG-01 methodology

- Examine fragility for all components regardless of importance
- Convolve fragility with hazard for all components
- Bottoms up approach risk management – motivation to design all components to withstand hazard

Technical Issues With ISG-1

- Forces a method that is:
 - Not consistent with the majority of seismic probabilistic analyses
 - Methodology not widely demonstrated
- Imposes alternative design requirement
 - First step does not differentiate risk significance of equipment
 - Very resource intensive (if performed as first step)
 - In a typical SPRA 25 – 75 fragilities performed for a site with in excess of 50,000 components (As opposed to 50,000 fragilities)

Technical Issues With ISG-1

- ISG-1 sequenced based as opposed to facility based
 - Does not allow for mitigative / recovery actions
 - Imposes hardware changes before consideration of uncertainty, cost-benefit, other factors
- Criteria that is not consistent with threat posed by hazard
 - 1 in 10,000 over pre-closure period (e.g., significantly lower (more than a factor of 100) than safety goal for operating reactors)
 - Tails of distribution will drive design in the face of extreme uncertainty

Technical Issues With ISG-1

- Single SSC sequences are possible
 - Result being over-designed structures and equipment
 - High costs of construction
 - Some situations posed by the design may not have been encountered in modern construction
 - Back of the envelope analysis indicates a preclosure facility structure with greater than 3.5 feet of steel reinforced concrete (stronger than BWR secondary containments)
 - The above is an artifact of analysis technique as opposed to a physical reality (e.g., expert judgment and uncertainty)
- Provides no guidance on performance of consequence analysis

Conclusions

- Risk management is the process of making decisions in the light of uncertainty
 - ISG-1 appears more risk-based than risk-informed
- Current state-of-the-art in seismic probabilistic analysis may not support the extremely low criteria proposed
 - Uncertainties are extremely large at higher end of seismic hazard curve
 - Design modification to accommodate these higher acceleration levels may not be prudent
- More flexible methodologies may be required to remain risk informed