RIC 2011
Risk Insights of Using Containment Accident Pressure for NPSH

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Staff Analysis

- Purpose: Estimate ΔCDF that results from relying upon containment accident pressure to prevent ECCS pump cavitation.
- General approach:
  - Modify SPAR models for Browns Ferry and Monticello, assuming that CAP credit is needed whenever the CS or RHR pumps are taking suction on the suppression pool.
  - Limited to all internal initiating events in the SPAR models (transients and LOCAs). External events were excluded:
    - Lack of detailed cable routing information to assess the impact on fire on containment integrity
    - Lack of containment seismic fragility information for small leaks

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Loss of Containment Integrity

- The event "loss of containment integrity" means that the containment is leaking enough to prevent adequate NPSH.
- The leak size needed to prevent adequate NPSH is plant-specific, and should be determined through containment thermal-hydraulic analyses (e.g., GOTHIC, MELCOR).
- Leak sizes used in previous license-performed risk evaluations:
  - Vermont Yankee EPU:
    - 27 La (calculated using 10 CFR 50 Appendix K requirements)
    - 60 La (using more realistic assumptions)
  - Browns Ferry EPU: 35 La (engineering judgment)
- Assumed 20 La in this analysis

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Three Timeframes Considered

- Pre-initiator: Containment may be leaking before an initiating event occurs.
- Upon-initiator: Containment may failure to isolate when an initiating event occurs.
- Post-initiator: Containment may start to leak after the initiating event occurs.

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Pre-Initiator Leak Probability

- Previous licensee risk evaluations (Vermont Yankee, Browns Ferry) used a pre-initiator (pre-existing leak) probability that only depended on the size of containment leakage.
- However, the probability of a pre-initiator containment leak should also depend on how the containment integrity is tested:
  - How often the test is performed
  - Test efficiency (how good is the test at detecting leaks of the size needed to preclude adequate NPSH)
- The staff developed a semi-Markov model to represent the impact of containment integrity testing on the pre-initiator leak probability.

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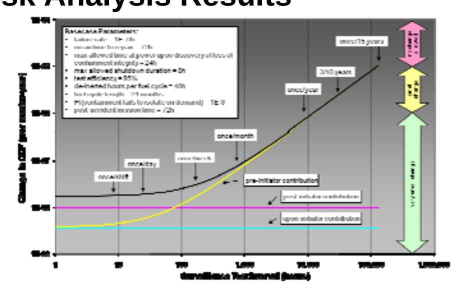
Risk Analysis Results



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Risk Insights

- There is only one minimal cut set where the loss of containment integrity leads directly to core damage (large LOCA).
- The increase in CDF is very small ($<10^{-6}$/y, as defined in RG 1.174) when testing is conducted at least once/year (assuming a leak failure rate of 10^{-7}/h).
- Contributions to containment leakage probability:
  – Pre-initiator (basecase): 55.9%
  – Post-initiator: 32.1%
  – Upon-initiator: 12.0%

Risk Insights (Continued)

- Importance measures for loss of containment integrity:
  – Fussell-Vesely (FV): 0.017
  – Risk achievement worth (RAW): 750
  – The loss of containment integrity is a "significant basic event," as defined in the ASME/ANS PRA Standard, over a wide range of model parameters.
- Sensitivity studies indicate that the pre-initiator contribution to the containment leakage probability mainly depends on:
  – The containment leakage failure rate
  – The surveillance test interval