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Likelihood and Reliability

July 26, 2001

Attachment 3



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Purpose

- Provide general response to RAI likelihood and reliability questions



Background

- 10CFR70 requires applicant to define likelihood categories
- SRP allows applicant to define likelihood categories qualitatively or quantitatively
- 10CFR70 describes likelihood requirements as a function of the consequence to the dose receptor



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Background - 10CFR70.61 Performance Criteria

CONSEQUENCE	High (3)	Meets PC	Does Not Meet PC	Does Not Meet PC
	Intermediate (2)	Meets PC	Meets PC	Does Not Meet PC
	Low (1)	Meets PC	Meets PC	Meets PC
		Highly Unlikely (1)	Unlikely (2)	Not Unlikely (3)
		LIKELIHOOD		



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Background - Summary of CAR Analysis Methodology

- Performed hazard assessment to identify potential events
- Assumed unmitigated likelihood of not unlikely, equivalent to event occurs
- Determined unmitigated consequences
- If potential unmitigated consequences could exceed low consequence criteria, principle SSCS assigned (IROFS) to prevent or mitigate the event



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Background - Summary of CAR Analysis Methodology

- Method requires failure of prevention or mitigation controls to be highly unlikely
- Very conservative in that it does not credit initiator, additional protection features, or IROFS-Defense in Depth Features



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Background - Highly Unlikely Definition in CAR

- Events originally classified as Not Unlikely or Unlikely to which sufficient principle SSCs are applied to further reduce their likelihood to an acceptable level
- Also committed to
 - Application of single failure criteria or double contingency principle (includes redundancy/diversity, independence, failsafe)
 - 10CFR50 Appendix B, NQA-1 QA program
 - Specific codes and standards
 - Management Measures

Summary of RAI Likelihood Comments



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- Explain how the application of the single failure criteria or double contingency principle meets the performance criteria of 10CFR70.61
- Provide quantification of IROFS reliability or provide IROFS reliability targets



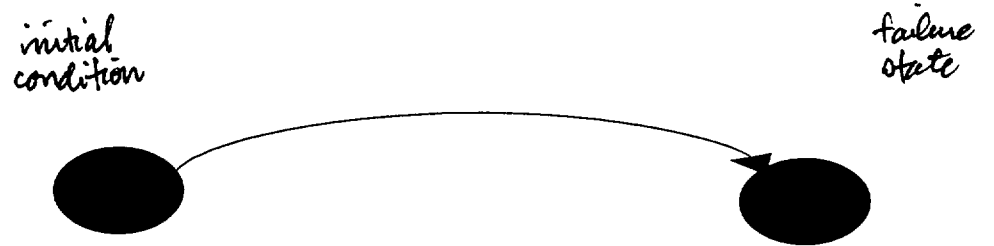
Response to First Comment

- Single Failure Criteria by itself may require rigorous reliability analysis to demonstrate Highly Unlikely Criteria is met
- However, Highly Unlikely Criteria is ~~easily~~ met with the application of the following:
 - Single Failure Criteria or double contingency principle
 - Management measures including IROFS Surveillance (IROFS failure detection and Repair or Process Shutdown)
 - 10CFR50 App B, NQA-1 QA Program *Such items are generally reliable to $< 10^{-2}$ failures per year.*
 - Industry Codes and Standards

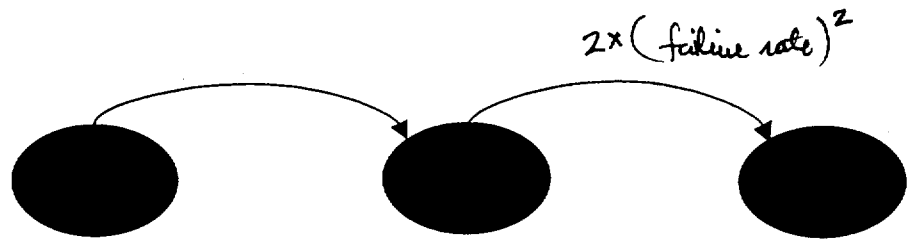


Statistical Models

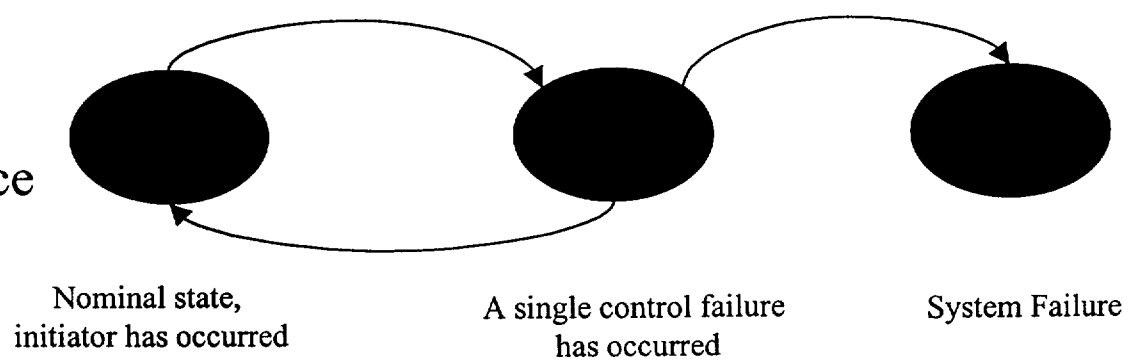
Model 1:
Single Control Model



Model 2:
Single Failure Model
(double contingency model)



Model 3 (MFFF):
Single Failure and Surveillance





Approximate Failure Frequency for Model 3 (per year)

Markov Model

--IROFS Surveillance Time--

IROFS		per	per	per	<i>no surveillance detection & repair</i>
<u>Rel #</u>	<u>continuous</u>	<u>shift</u>	<u>week</u>	<u>month</u>	<u>none</u>
0.1	apprx. 0	2E-5	4E-4	2E-3	2E-2
0.01	<i>apprx. 0</i>	<i>2E-7</i>	<i>4E-6</i>	<i>2E-5</i>	2E-4
0.001	<i>apprx. 0</i>	<i>2E-9</i>	<i>4E-8</i>	<i>2E-7</i>	<i>2E-6</i>

- inherent assumption of "repair rate"
- PCS will shut down if "repair rate" is limiting



Conclusion

Results indicate that DCS commitments produce likelihood values that are equal to or lower than those provided in the SRP, thus satisfy the definition of highly unlikely

- Single Failure Criteria or double contingency principle
- Management measures including IROFS Surveillance (IROFS failure detection and Repair or Process Shutdown)
- 10CFR50 App B, NQA-1 QA Program
- Industry Codes and Standards



Second Question

- Provide quantification of IROFS reliability or provide IROFS reliability targets



Response to Second Question

- The previous slides have shown that the overall system failure rate is a function of more than just reliability
- The previous slides have shown that acceptable system failure rates - or targets - are provided by committing to the following:
 - Single Failure Criteria or double contingency principle
 - Management measures including IROFS Surveillance (IROFS failure detection and Repair or Process Shutdown)
 - 10CFR50 App B, NQA-1 QA Program
 - Industry Codes and Standards

Response to Second Question (con't)



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- The ISA will provide sufficient information to provide reasonable assurance that these targets are met through:
 - detailed IROFS description
 - demonstration of single failure criteria
 - description of surveillance method
- Additionally, this method is consistent with SRP guidance as described on the following pages



Discussion of SRP Guidance

- SRP guidance allows qualitative definition, and semi qualitative methods, and evaluation
- Information provided in CAR and to be provided in ISA is consistent with SRP guidance



Discussion of SRP Guidance

- SRP - Qualitative definition is acceptable if:
 - reasonably clear and based on objective criteria
 - can distinguish between Highly Unlikely and Unlikely Events
- CAR -
 - objective criteria provided
 - did not use unlikely category



Discussion of SRP Guidance

- SRP - Qualitative definition of highly unlikely is acceptable if it incorporates availability and reliability qualities to an appropriate degree
 - commitment to double contingency principle
- CAR -
 - provides commitments including a commitment to the double contingency principle



Discussion of SRP Guidance

- SRP - Qualitative method is acceptable if IROFS characteristics are described:
 - safety margins, type of control, management measures, surveillance measures, failure modes, demand rate, failure rate, defense in depth features, degree of redundancy, degree of independence, diversity, and vulnerability to common cause
- ISA-
 - will provide similar information

Conclusion Related to Second Question



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- Likelihood targets are provided in the CAR through identified commitments
- Qualitative methods are consistent with the SRP
- Thus, additional quantitative likelihood or reliability targets and/or values are not necessary

Summary of MFFF Likelihood Strategy



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- **CAR - provide commitments to:**
 - single failure or double contingency
 - 10CFR50 Part B, NQA-1 QA program
 - codes and standards
 - Management measures including IROFS surveillance
- **ISA - demonstrates commitments are met:**
 - identify IROFS
 - demonstrate double contingency/single failure satisfied
 - describe IROFS surveillance methods