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Committed to Nuclear Excellence



Regulatory Conference, March 17, 2005

Kewaunee Nuclear Power Plant

**Containment Equipment Hatch
Interference**

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Agenda

Introduction	Craig Lambert
Background	Kevin Davison
Risk Analysis	Tom Breene
Corrective Actions	Kevin Davison
Conclusion	Craig Lambert

Background

- Reactor Pressure Vessel (RPV) head replacement - Fall 2004 outage.
- Temporary transport (rail) system required to move RPV head into/out of containment.
- Two piece system to facilitate hatch closure.
- Interference identified during closure for refueling integrity.
- Although we believe the risk from this issue to be very low, this was a significant event for Kewaunee.

Success Paths

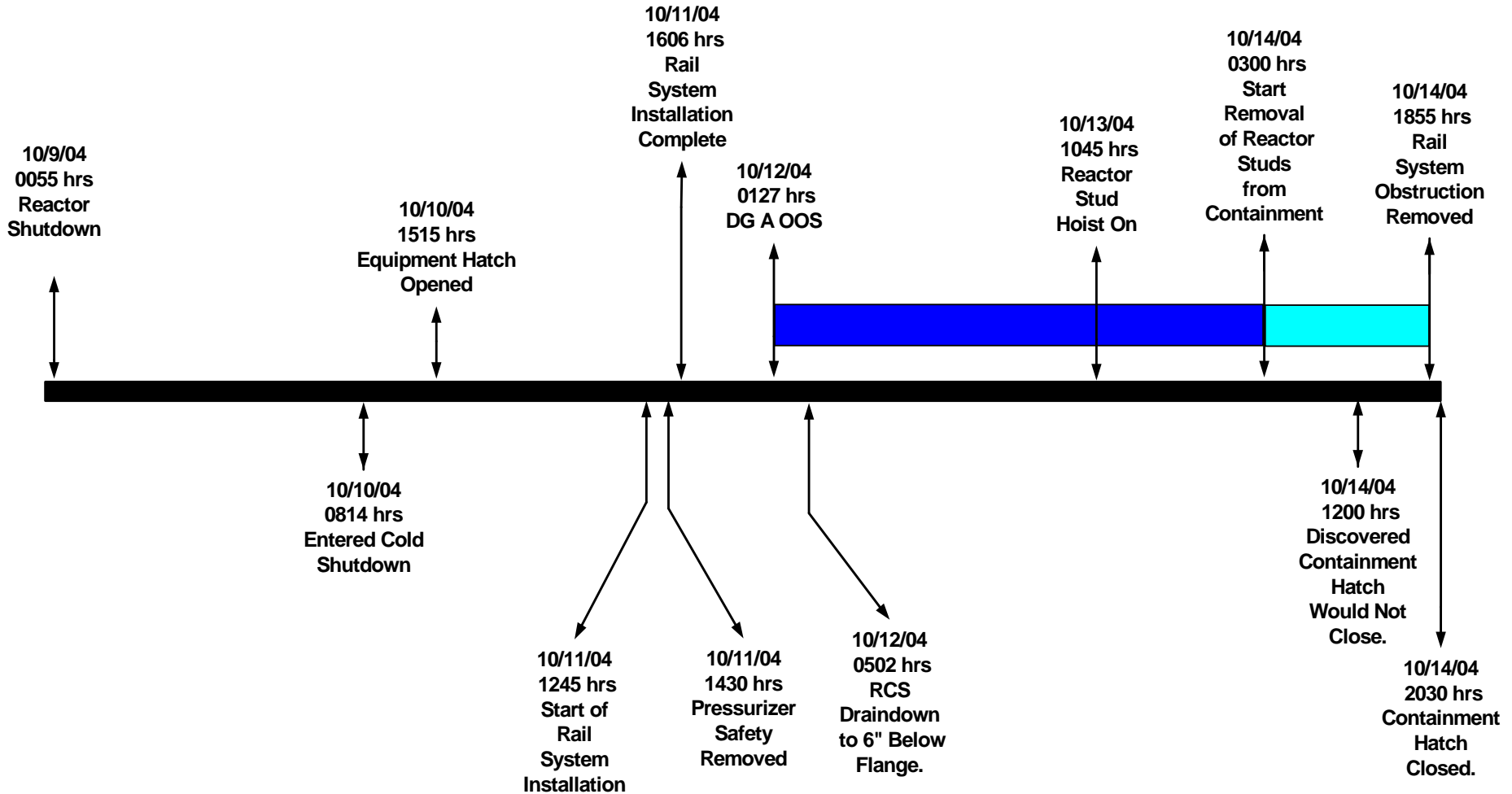
- Successfully completing any of the following would end the exposure time
 - Restore off-site power
 - Restore “B” Emergency Diesel Generator
 - Restore the Station Blackout (SBO) Diesel Generator
 - Close the equipment hatch

Risk Analysis

Topics

- Event Timeline
- Methodology
- Dominant Risk Sequence
- Differences between final NMC analysis and NRC choice letter
- Probability of Hatch Closure
- Summary of the Risk Analysis

Background Timeline



Risk Analysis

Methodology

- Used dominant risk sequences from shutdown PRA
- Examined basis for recovery actions
- Assessed the time available for hatch closure
- Calculated human error probabilities

Risk Analysis

Dominant Risk Sequence

- Loss of off-site power.
- Loss of emergency diesel generator B.
- Loss of charging via the SBO diesel generator.
- Failure to close equipment hatch.
- A/C Power is not recovered.

Risk Analysis

Risk Value Detail

Failure	NMC Revised	NRC SERP
Loss of offsite power during shutdown (per year)	0.189	0.189
Emergency Diesel generator B fails	0.0108	0.0546
Core uncover before flow restoration	0.068	0.131
Charging via SBO diesel fails	0.0661	0.0899
Equipment hatch closure fails	0.37	1.00
Exposure time (years)	0.00748	0.00765
Total large early release frequency (Δ LERF)	2.5×10^{-8}	9.3×10^{-7}

Risk Analysis

Differences Between Preliminary NRC Choice Letter and Final NMC Assessment

- EDG diesel generator failure probability
 - Plant specific failure data updated through January 2005
 - Removed double-counting of diesel air supply and exhaust failure
 - A recovery probability was applied
 - Mission time was updated

Risk Analysis

Differences Between Preliminary NRC Choice Letter and Final NMC Assessment

- SBO diesel generator failure probability
 - Plant specific failure data updated through January 2005
 - Removed double-counting of diesel air supply and exhaust failure
 - Mission time was updated
 - Removed the Test and Maintenance probability term
 - Increased the assumed stress level for charging alignment

Risk Analysis

Differences Between Preliminary NRC Choice Letter and Final NMC Assessments

- Time to core uncovering
 - 5.4 hours – pressurizer safety valve removed case
 - >9.0 hours - pressurizer safety removed and head detensioned case

Risk Analysis

Sensitivity

- Assuming a probability of 1.0 for failure to close the hatch.
 - Δ LERF becomes 6.9×10^{-8}
 - Very low risk significance (Green)

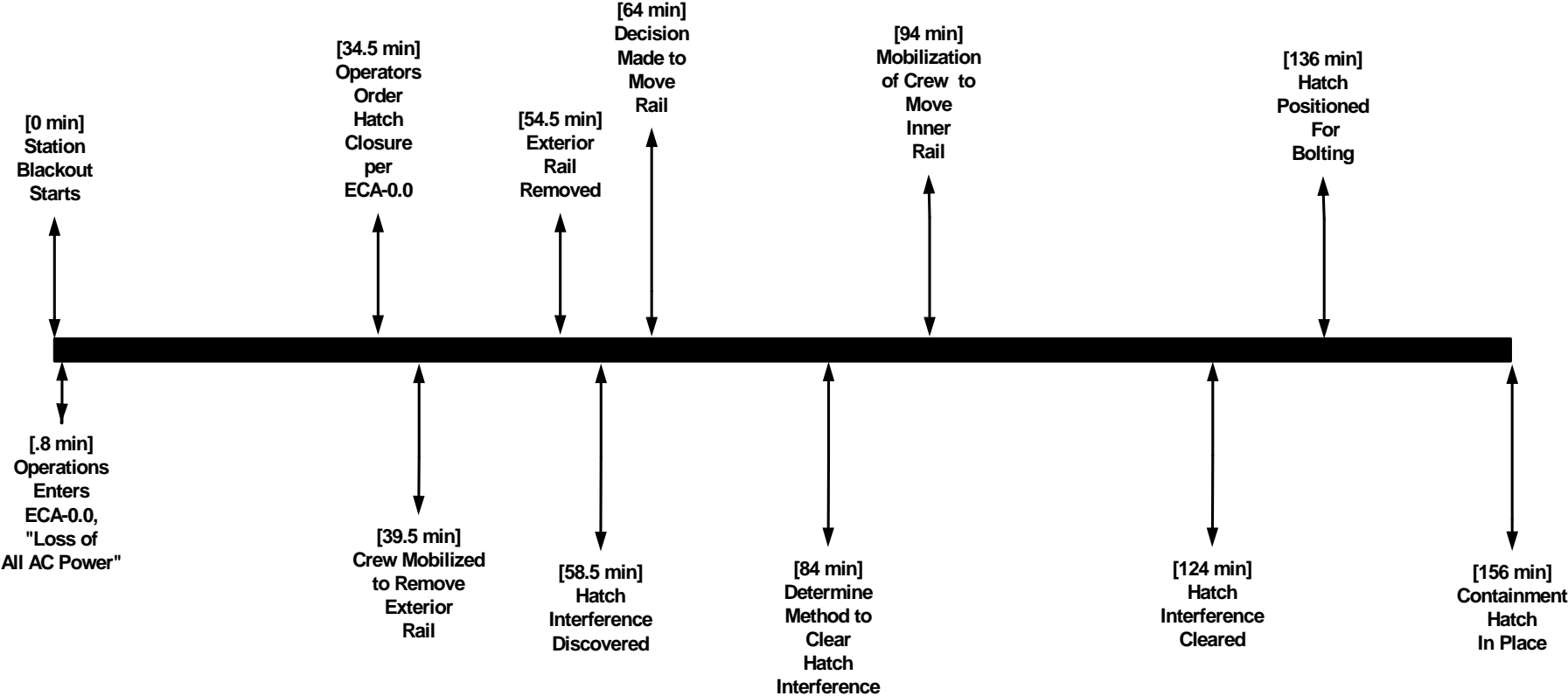
Risk Analysis

Habitability of Containment

- Temperature
 - < 70 degrees at open hatch.
 - Increases at hatch closure.
- Radiation levels
 - Within 10CFR20 limit.
- Noise
 - Hearing protection adequate.
- Lighting
 - Portable generators outside
 - Portable handheld lights inside.

Risk Analysis

Hatch Closure Timeline



Risk Analysis

Human Error Probability

Cognitive Error	0.32
<u>Execution Error</u>	<u>0.05</u>
Total HEP	0.37

- Cognitive error assumes decisions made at Control Room or Outage Control Center
- Execution error assumes containment habitability conditions.

Risk Analysis

Cognitive Error For Moving The Rail

- Type of response is skill based
- Complexity of response is complex
- Environment is habitable
- Stress is extreme

Risk Analysis

Key Analysis Conservatism

- Diesel generator B successfully tested three hours prior to DG A being taken out of service.
- Used conservative decay heat assumptions.
- Kewaunee Steam Generators have 26% more primary side volume than those used in our analysis.
- Kewaunee reactor vessel water level was 9 inches higher than those used in our analysis.

Risk Analysis

Kewaunee analyses validated by industry experts

- PRA results reviewed by NMC PRA peers
- PRA results reviewed by Sciencetech and Erin Engineering
- Habitability conditions analysis reviewed by Enercon Services
- Review results incorporated in final NMC analysis

Risk Analysis

Summary

- The Change in Large Early Release Frequency (Δ LERF of 2.5×10^{-8}) has a very low risk significance (Green).
- Assuming no hatch closure, the Δ LERF is 6.9×10^{-8} , which is also very low risk significance (Green).

Root Cause

Root Cause

- Failure to recognize a potentially risk significant condition outside of the technical specifications or licensing basis.
- Incomplete incorporation of industry guidance.

Cornerstone Affected

- Barrier Integrity

Corrective Actions

- Reviewed this O/E with the NMC Fleet and INPO
- Independent Review Group / Engineering effectiveness
- Reviewed NUMARC 91-06, GL 97-12 and GL 88-17 to identify any additional vulnerabilities.
- Revise procedural controls for containment closure to assure that closure can be accomplished in a time commensurate with plant conditions (time to boil).

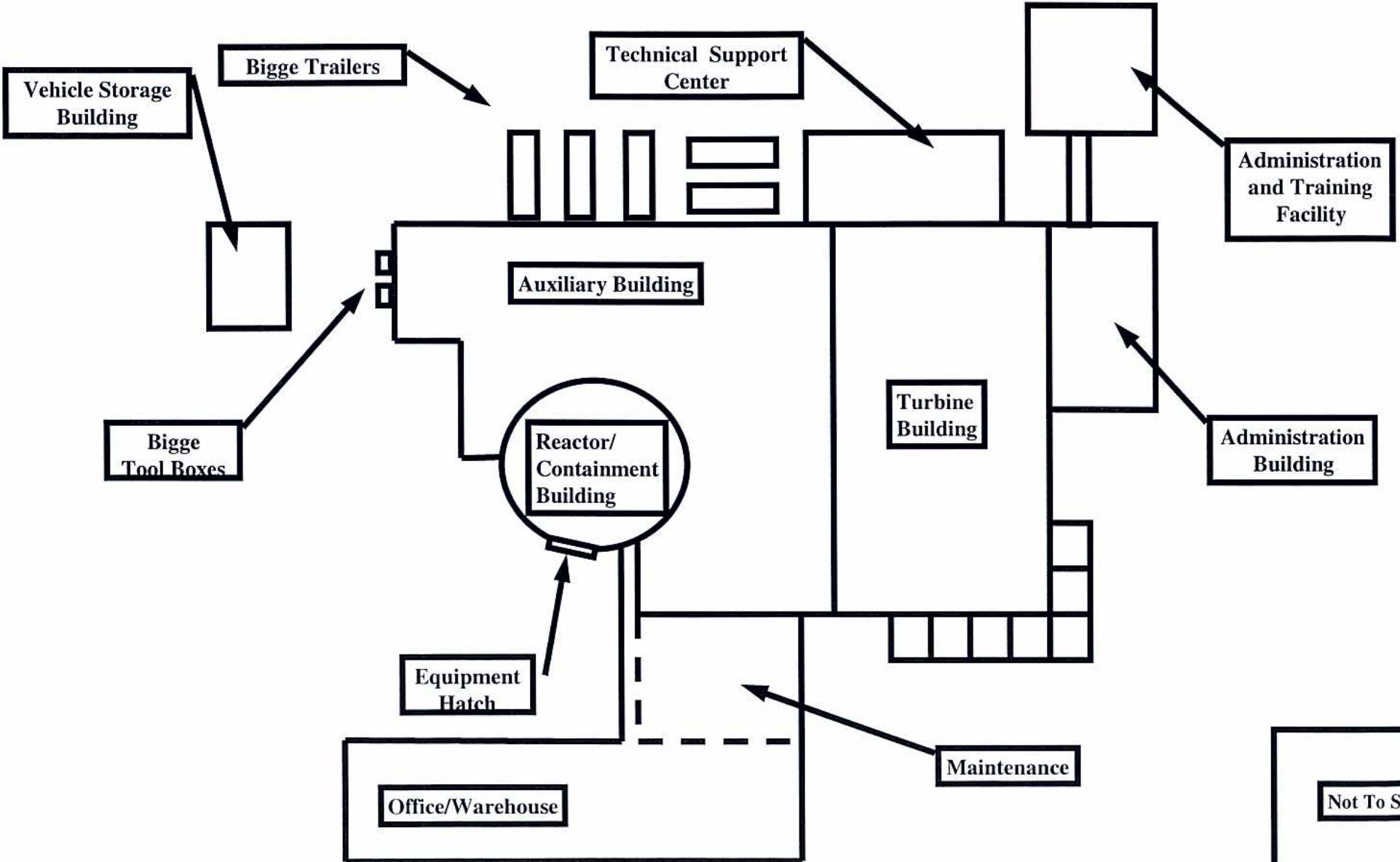
Conclusion

Summary

- Actions have been taken to correct deficiencies.
- Actions are ongoing to find other documents with inadequate reviews.
- Without crediting hatch closure this finding is of very low safety significance (6.9×10^{-8}).
- With credit for hatch closure this finding is of very low safety significance (2.5×10^{-8}).



Kewaunee Nuclear Power Plant Site Map



Not To Scale

