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Advancing the Science of Safety

PROBABILISTIC RISK ASSESSMENT USAGE IN SUPPORT OF PLANT OPERATIONS AND MANAGEMENT

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INTRODUCTION

- This paper describes ways in which Risk Information can be used in non-regulatory applications to achieve safety and operational enhancements
- Two areas of focus:
 - Using Risk Insights for Normal Plant Operations
 - Identification of Hazard Sensitivity Areas
 - Training Prioritization and Support
 - Prioritization and Optimization of Preventive Maintenance
 - Development of Diverse Mitigation Strategies
 - Using Risk Insights for Emergent Conditions
 - Evaluation of Extent of Condition
 - Scheduling of Emergent Maintenance



RISK INSIGHTS FOR PLANT OPERATIONS: IDENTIFYING AREAS OF INCREASED HAZARD SENSITIVITY

- Use risk information to identify areas for heightened awareness by Plant staff
 - Areas where workers need to be more sensitive to hazards during their daily work activities
 - Increased sensitivity to radiation or contamination areas.
- Example: Identification of High Risk Fire Areas (HRFA)
 - HRFA: FPRA area with $> 5\%$ CDF/LERF or CCDF > 0.1
 - HRFA characterized by initiator type, affected mitigation capability.
 - Risk Management Actions (RMAs) defined for HRFA might include briefings and signage to increase awareness.
- Can be similarly applied to other hazards, e.g. internal flood, external flood, tornado and high winds, etc.
- Communication of such PRA insights to plant personnel is a key aspect of introducing a PRA model or model update



RISK INSIGHTS FOR PLANT OPERATIONS: TRAINING PRIORITIZATION AND SUPPORT

- Insights from Operator Interviews and HFE Importance Measures to Identify potential procedure improvements and operator training enhancements.
- Example: FLEX
 - Helped validate timeline, support training and increase awareness of impact of access paths.
- Example: Review of External Hazards protection equipment installations and manpower requirements
 - Helped prioritize tasks and assign appropriately sized working groups.
- Example: Review of risk significant actions
 - Supports development of focused training and set frequency
 - Improve quantitative shaping factors and success likelihood



RISK INSIGHTS FOR PLANT OPERATIONS: PRIORITIZING AND OPTIMIZING PREVENTIVE MAINTENANCE

- Risk information provides an effective means for prioritizing component monitoring and testing.
 - Use of risk information and performance data in existing regulatory programs:
 - Generic Letter 89-10 MOV program
 - Risk-Informed Inspection (RI-ISI) Program
- Criteria can also be established for testing/replacement strategies for other types of components.

Consequence Category	CCDP Range	CLERP Range
High	>1E-4	>1E-5
Medium	1E-6<CCDP<1E-4	1E-7<CLERP<1E-5
Low	<1E-6	<1E-7

- Method applied to Raw Water Piping and Heat Exchanger Programs
- Information should be supplemented with operational/financial risk information.



RISK INSIGHTS FOR PLANT OPERATIONS: DEVELOPMENT OF DIVERSE MITIGATION STRATEGIES

- Risk models provide qualitative as well as quantitative insights
 - Examining PRA models can highlight key contributors to safety function impacts and point to needs for specific improvements.
- BWR Outage Example: Torus Re-Coating Evolution
 - Evolution removed an important injection source
 - This caused elevated risk color in shutdown risk model
 - Elevated risk prompted Outage Management to find alternate inventory supplies and develop Ops procedures for implementation.
 - Important dependencies identified and added to risk model to allow tracking of availability during changing outage execution.
 - Approach allowed maintaining safety while controlling outage duration and complications with use of temporary equipment.
 - Low Cost, primarily engineering and procedure revision.



RISK INSIGHTS FOR EMERGENT CONDITIONS: EVALUATION OF EXTENT OF CONDITION

- Risk Information can be used to prioritize emergent equipment inspections. Example:
- 480 V breaker failed in an “unexpected manner”
 - Root Cause evaluation included understanding potential extent of condition, established no OPERABILITY concerns
 - Because there was a very large population of breakers, there were work scheduling limitations; accessibility also a factor.
 - Needed a diverse and staggered inspection of the population
 - Internal Events PRA Risk Achievement Worth used, in conjunction with qualitative factors such as environment and duty cycle, to prioritize the work into 3 groups:
 - Prior to next refueling outage (i.e., high risk importance)
 - During next refueling outage.
 - After next Refueling outage.
 - Inspections were completed as planned without experiencing any similar failures.



RISK INSIGHTS FOR EMERGENT CONDITIONS: SCHEDULING OF EMERGENT MAINTENANCE

- Troubleshooting equipment inside containment can be difficult and might require plant shutdown. Risk information can support decision making; e.g.:
 - BWR Safety Relief Valve (SRV) spuriously lifted and reclosed.
 - OPERABILITY was verified and SRV monitoring established.
 - Site management desired a better understanding of the risk associated with continued operation.
 - Changes in CDF and LERF for both Internal Events and Fire PRA were investigated assuming degraded SRV performance.
 - Results showed relatively large CDF/LERF increases (compared to other SRVs) and led to determined that this SRV was important to dominant fire scenarios.
 - Decision was then made to down-power at the next opportunity (OPERABILITY still being confirmed) and correct the issue.
- Risk information key to conservative decision making.



CONCLUSION

SUMMARY OF PRESENTATION

- Risk Information can be used for non-regulatory applications.
 - **Does not require formal peer review or regulatory approval**
- Risk Information can highlight areas for enhanced safety or operational focus.
 - **Enhances Safety Culture**
- Risk Information can be used to assist strategies to improve safety and performance.
 - **Enhances Efficiency**
- Qualitative and Quantitative results both provide useful Risk Insights.
 - **Detailed Modeling not always required for PRA to be an effective tool, supplemented with operational expertise**



QUESTIONS?

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