

EVALUATION OF THE CUMULATIVE IMPACT OF PENDING MODEL CHANGES TO ADDRESS MSPI FAQ 14-01

American Nuclear Society PSA-2017 Conference

Joe Lavelline – Enercon Services



Topics of Discussion

- Regulatory Requirements
- Methodology for Addressing FAQ
- Application of Methodology
- Category Based Screening
- Qualitative Screening
- Quantitative Screening
- Integrated Quantitative Evaluation
- Addressing HRA Dependency
- Integrated Quantitative Results
- Summary



Promotional Message



Address Items in PRA Model Database



Regulatory Requirements

- NEI 99-02 Appendix G
 - ◆ Pending model changes that cannot be incorporated into a revision to the site PRA of record prior to the next reporting quarter should be assessed consistent with the PRA Configuration Control program.
 - ◆ If an evaluation of the cumulative impact of proposed resolutions for the pending model changes results in greater than or equal to a predicted factor of three change in the corrected Birnbaum value of an MSPI monitored train or component, the MSPI basis document should be updated...

Regulatory Requirements

- NEI 99-02 Appendix G
 - ◆ If the an evaluation of pending changes indicate that the Birnbaum value for a component previously excluded from monitoring will be greater than $1.0E-06$, the MSPI basis document should be updated to reflect the new Birnbaum values the quarter following identification of the increased impact. The use of supplemental analysis to estimate the revised MSPI inputs is allowed until the site PRA of record is revised. This may be the analysis used to determine the need for the change or a more refined model.

Methodology

- Cataloguing of all open modeling issues in the plant PRA configuration control database.
- Screening all open issues associated with elements not applicable to MSPI (e.g. fire, flooding, Level 2, documentation, etc.).
- Applying qualitative analysis to screen applicable issues.
- Applying quantitative screening analysis to screen applicable issues.

Methodology

- Addressing remaining open issues with a quantification combining the integrated impact of the remaining modeling issues.
- Comparing of resultant Birnbaum values from the combined quantification in the previous step.
- Direct comparison of MSPI values for systems where any constituent Birnbaum value increased.

Cataloguing of Open Modeling Issues

- Modeling issues are assembled and categorized for initial screening.
- A key element to success is to have a PRA model configuration control database with robust data structure and reporting capabilities.
- At Reference Plant
 - ◆ The modeling issues identified in the database that were deemed to be non-applicable to the FAQ were assigned a code corresponding to the exclusion rationale.
 - ◆ Queries and reports were pre-generated so that they are repeatable for future quarterly analysis.

Category Based Screening Rationale

- Administrative item
- EOOS/(a)(4) impact
- Fire model impact
- Seismic model impact
- Internal flooding impact
- Level 2 model impact
- Other external event model impact
- Model enhancement
- No modeling impact

Category Based Screening Rationale

- Documentation impact
- Shutdown model impact
- Open item does not pertain to the ASME Standard (Reference 3) supporting requirement capability category that is required per Reference 2 (Table G-5) for maintaining the MSPI application.

Qualitative Screening - Criteria

- Instances where implementing the resolution to the issue would increase the reliability of a non-MSPI system.
- Modeling issues for which the resolution would result in improved operation for a non-MSPI system
- Modeling issues for which new mitigating systems and/or strategies are implemented (e.g. most FLEX modifications and procedure changes).

Qualitative Screening - Criteria

- Decreases in initiating event frequencies.
- Modeling issues that are judged to only increase risk for sequences where MSPI systems cannot mitigate the event (e.g. short term reactivity control in BWR ATWS).

Qualitative Screening - Examples

- Increasing credit for containment venting without AC power (decreases the reliance on the Residual Heat Removal system).
- Decrease in phenomenological failure probability for combustion turbine generator (decreases the reliance on emergency diesel generators in core damage calculation).
- Implementation of FLEX procedures for alternative injection post-station blackout.

Quantitative Screening

- Model changes which result in a decrease in internal events CDF and no increase in monitored basic event Birnbaum values.
- Model changes for which the increase in risk is minimal (e.g. CDF increase less than $1.0\text{E-}07/\text{yr}$ and no increase or a minimal increase, per analyst's judgment, in monitored basic event Birnbaum values).

Quantitative Screening

- HRA modifications where there is a decrease in human error probability (HEP) or where the increase in HEP is deemed to be negligible based upon analyst's judgment (e.g. less than 1% increase).
- Data or phenomenological probability decreases or increases that are deemed to be negligible based upon analyst's judgment (e.g. less than 1% increase).

Quantitative Screening - Pitfalls

- Screened items can have minimal impact as a single model modification but can have a significant effect in combination with other model modifications.
- There can be a positive impact on Birnbaum values for one system and an adverse impact for another.
- Any impact on single human error probabilities must take into account dependency analysis).

Integrated Quantitative Evaluation

- Issues which cannot be screened by one of the aforementioned mechanisms (category-based, qualitative, or quantitative), must be carried forward into the integrated quantitative evaluation.
- It is also recommended that issues that are deemed to be easily resolved should also be analyzed in the integrated assessment.
- The process for resolving each modeling issue is similar to what is used for preparing a modeling modification for implementation in the PRA model of record.

Addressing HRA Dependencies

- The process for performing a complete re-analysis of the HRA dependency analysis is not practical for an assessment of pending model changes on MSPI.
- A more simplified process is used to approximate the impact of pending model changes on the HRA dependency analysis.
- Open the HRA Calculator Dependency (“DAF”) file with the input the revised single HEP values from the latest version of the HRA Calculator.
- Reanalyze the dependent combinations with single HEPs whose timing has changed.

Addressing HRA Dependencies

- Aspects of HRA dependency NOT performed:
 - ◆ Performance of a “ones run” to ascertain new combinations.
 - ◆ Reassessment of the revised and newly identified combined HEPs (CHEPs).
 - ◆ Recalculation of single HEP “seed” values.
 - ◆ Application of overrides to dependencies with CHEPs where applicable.

Reference Plant Results

Table-1 -- Model-of-Record-MSPI-Results

System	URI	UAI	MSPI
EDGs	-7.74E-08	1.17E-08	-6.6E-08
HPCI	-3.71E-08	-2.15E-08	-5.9E-08
RCIC	-1.54E-09	-6.68E-10	-2.2E-09
RHR	-1.08E-08	9.64E-09	-1.1E-09
RHRSW	-5.89E-10	2.33E-09	1.7E-09

Table-2 -- FAQ-14-01-Sensitivity-MSPI-Results

System	URI	UAI	MSPI
EDGs	-1.11E-07	1.64E-08	-9.4E-08
HPCI	-3.66E-08	-2.13E-08	-5.8E-08
RCIC	-1.38E-09	-6.88E-10	-2.1E-09
RHR	-1.62E-08	1.79E-08	1.7E-09
RHRSW	-1.03E-09	2.89E-09	1.9E-09

Lessons Learned

- Initial Performance Criteria Selection
 - ◆ Robustness of the PRA model configuration control database with respect to item coding and reporting is very important.
 - ◆ The successive screening process effectively minimized the number of open issues that need to be addressed.
 - ◆ The detailed integrated assessment of non-screened items adequately addresses FAQ.
 - ◆ **Utilities should endeavor to keep their PRA model configuration control open items which are applicable to MSPI (full power, internal events) as low as practical.**

Questions ???