United States Nuclear Regulatory Commission

Protecting People and the Environment

Risk Assessment Standardization Project (RASP)Handbook for Risk Assessment of Operational Events Volume 1, Revision 2

NRC Public Meeting

May 13, 2013

Presented by

See-Meng Wong
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission

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OVERVIEW

- Background
- Purpose of RASP Handbook
- Handbook Revisions
- Conclusions
- Acknowledgements

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BACKGROUND

- RASP was initiated in 2004 as a collaborative effort between the Office of Nuclear Reactor Regulation (NRR), the Office of Nuclear Regulatory Research (RES), and regional Senior Reactor Analysts (SRAs).

- Purpose of RASP is to provide consistent methods for events and conditions assessments (ECA) in the Significance Determination Process (SDP), Accident Sequence Precursor (ASP) Program, and assessments required per Management Directive (MD) 8.3, “NRC Incident Investigation Program.”

PURPOSE OF HANDBOOK

- The RASP Handbook is a practical, “how to” handbook of methods, best practices, examples, tips, and precautions for using SPAR models to evaluate risk of reactor incidents and inspection findings.

- Best practices based on over 600 ASP analyses (since 1969) and numerous SDP Phase 3 analyses (since 2000).

HANDBOOK REVISIONS

- RASP Handbook, Rev. 1 was made publicly available in January 2008, and was updated on a periodic and as-needed basis.
- Revision 1.02 incorporated suggestions from Nuclear Energy Institute (NEI) letter, dated 11/4/2008 (ADAMS ML083380321).
- New modules included in Revision 2:
  - Common-Cause Failure (CCF) Modeling
  - Initiating Events Analyses
  - Human Reliability Analysis (HRA)
  - Loss of Offsite Power (LOOP) Initiating Events
  - Support Systems Initiating Events (SSIE)

REVISED CCF MODELING GROUND RULES

- Performance deficiency that resulted in a failure of a component in a common-cause component group (CCCG) has the potential for CCF of other components in the applicable CCCG.

- Potential for CCF given an observed performance deficiency (PD) that resulted in a failure of a component in an CCCG is the conditional CCF probability.

- Crediting observed defenses against CCF (e.g., successful operability tests) may be considered qualitatively outside the risk analysis.

Initiating Event Analyses

- Guidance for four initiating event analyses cases is provided in the Handbook:
  - Initiating event only.
  - Initiating event with a mutually exclusive failure of a structure, system, or component (SSC).
  - Initiating event with a mutually inclusive failure of an SSC.
  - An SSC unavailability increases the initiating event frequency.

HRA Guidance

- SPAR-H Method should be used; other HRA methods may be used for sensitivity analyses.
  - Revised SPAR-H guidance taken from "SPAR-H Step by Step Guidance," INL/EXT-10-18533, 2011.
- Minimum human error probability (HEP) for single human failure event (HFE) is 1E-5.
  - Document basis for deviation; must be validated by HRA expert.
- Analysis of Dependencies
  - Guidance on how to determine if dependency exists.
  - Methods to accounting for dependence.
    - Joint HEP for cut sets with more than one HFE ~ 1E-5 for low dependence & 1E-6 for very low dependence.

LOOP INITIATING EVENTS

- Total LOOP event that precedes or results in subsequent reactor trip (manual or automatic).
- Not In-Scope
  - Partial LOOP event (e.g., loss of offsite power to a single vital bus).
  - Total LOOP to all safety buses with no automatic or manual reactor trip.
- LOOP Recovery Models
  - Industry-wide LOOP Non-recovery Curves
  - SPAR-H Method

GUIDANCE FOR SSIEs

- Definition of SSIEs is provided by EPRI Technical Report 1016741.
- Explicit Event Methodology
  - Carry fault tree logic cut sets through event tree in SPAR models.
- SPAR Model Manipulations
  - Activate SSIE logic.
  - ECA of supporting system component(s) failures.

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CONCLUSIONS

- More timely and better quality Phase 3 SDP analyses.
- Results of SDP Phase 3 assessments more consistent with ASP analyses.
- Living document for knowledge management and training initiatives.

ACKNOWLEDGEMENTS

- Big THANK YOU and appreciation of value-added contributions from:
  - RES and Idaho National Laboratory (INL) Subject Matter Experts
  - SRA and NRR Risk Analyst Comments
  - Industry (NEI & PWROG) Feedback

RECEIVED FEEDBACK/COMMENTS

- General comments
  - Uncertainty
  - SDP Initiating Event Analysis
- Common Cause Failures(Section 5) – 11 Comments
- Multi-unit considerations(Section 7) – 2 Comments
- Initiating Event Analyses(Section 8) – 1 Comment
- Human Reliability Analysis(Section 9) – 1 comment