



Global Expertise • One Voice

SHIELD[®] PRA Implementation Questions

Roy Linthicum

Chairman – PWROG Risk Management Committee

P R E S S U R I Z E D W A T E R R E A C T O R O W N E R S G R O U P

Background



- Final Safety Evaluation (SE) on SHIELD® PRA Model (PWROG-14001-P-A) was issued on 8/23/17 (ML17200C876)
- Several Licensees had submittals being reviewed prior to the approval PWROG-14001-P-A

Questions Requiring Generic Resolution

- Does crediting SHIELD® in a PRA Model represent a PRA model maintenance or an upgrade activity per the PRA Standard?
- How should utilities address changes to PWROG-14001-P-A that were made after they made their submittals?

PRA Model Maintenance or Upgrade?

Model Maintenance versus Upgrade

- ASME/ANS PRA Standard Section 1-2.2:
 - PRA Maintenance: The update of the PRA models to reflect plant changes such as modifications, procedural changes, or plant performance (data).
 - However, if there is significant change in risk insights, prudence may call for a peer review for such a case. The recommendation is that such a peer review need not be schedule only on the basis of that change. Instead, an internal review should be performed, thoroughly documented and, when a peer review is schedule for another reason, its scope should include the complex design change at issue.
 - PRA Upgrade: The incorporation into the PRA model of a new methodology or significant changes in scope or capability that impact the significant accident sequences. This could include items, such as, new human error analysis methodology, new data update methods, new approaches to quantification or truncation, or new treatment of common cause failures.

Model Maintenance versus Upgrade

- Section 1-A.2 of the Nonmandatory Appendix 1-A, Item (c) provides further clarification for what constitutes an upgrade:
 - New methodology,
 - Change in scope that impacts the significant accident sequences or the significant accident progression sequences, or
 - Change in capability that impacts the significant accident sequences or the significant accident progression sequences.
- The rationale for requiring peer reviews of PRA upgrades:
 - PRA upgrades represent more extensive changes to the PRA (relative to PRA maintenance) and are likely to involve methodologies or scope that were not covered in previous peer reviews.
 - PRA maintenance generally involves changes within the framework of an existing model structure and PRA configuration control program, and involves methodologies that have been applied in the PRA, and have been previously reviewed.

Model Maintenance versus Upgrade

- Incorporation of SHIELD[®] can be interpreted to meet both definitions
 - It is a plant modification (Maintenance)
 - It changes significant accident sequences (Upgrade)
 - It uses existing modeling practices following an NRC approved topical report (Maintenance)

Model Maintenance versus Upgrade

- PWROG Position
 - Incorporation of SHEILD® is a PRA Maintenance activity
 - It will not impact the ability of the PRA model to meet the applicable sections of the ASME/ANS Level 1/Large Early Release Frequency PRA Standard
 - Modeling will be implemented within the existing framework of a PRA model.
 - Therefore, a focused PRA peer review of any scope assessing this change is not required.

Basis for PRA Model Maintenance

- Define the model change:
 - All PRA models for plants with Westinghouse RCPs currently have a RCP seal leakage model
 - The seal leakage model for the SHIELD® shutdown seal is provided in PWROG-14001-P-A
 - Implementation of this model requires several new events to be considered in loss of RCP seal coolant events:
 - SDS Actuates and Seals – this includes failure of SDS actuation, failure to establish the initial seal, and failure to remain sealed (including shaft O-ring for 93A pumps)
 - RCP Trip to Prevent SDS Damage
 - RCP Trip to Prevent RCP Seal Damage
 - A total loss of RCP seal cooling events typically includes station blackout (SBO), loss of component cooling water, and loss of service water.

Basis for PRA Model Maintenance

- Assess the potentially impacted PRA Standard requirements
 - Failure probabilities for SHIELD® actuation and sealing are provided in PWROG-14001-P-A
 - Tripping the RCPs occur either as a consequence of the event (loss of offsite power) or require an operator action (loss of component cooling water and loss of service water).
- The primary Technical Elements of the PRA Standard that are applicable to these changes are:
 - Accident Sequence Analysis
 - Data Analysis
 - Human Reliability Analysis.
 - Implementation of this revised RCP seal leakage model needs to be done consistent with the PRA methods included in these Technical Elements (already addressed in plant-specific PRA model peer reviews)
 - Given that the new seal leakage model is implemented consistent with the methods and within the existing framework already peer reviewed, the Supporting Requirements for these Technical Elements will continue to be Met or Not Met regardless of implementation of this model change
 - At most, a Fact & Observation (F&O) could be written against a Supporting Requirement, if implementation is incorrect, but the Supporting Requirement will remain Met or Not Met at the appropriate Capability Category.

Basis for PRA Model Maintenance

- Quantification may be impacted:
 - Implementing the RCP seal leakage model change can have a significant impact on core damage frequency (CDF) and large early release frequency (LERF)
 - Cutsets that were previously important may not be with the new seal installed, but new cutsets will be raised in importance
 - Five HLRs of interest associated with Quantification:
 - HLR-QU-A – The level 1 quantification shall quantify core damage frequency and shall support the quantification of LERF.
 - HLR-QU-B – The quantification shall use appropriate models and codes, and shall account for method-specific limitations and features.
 - HLR-QU-C – Model quantification shall determine that all identified dependencies are addressed appropriately.
 - HLR-QU-D – The quantification results shall be reviewed, and significant contributions to CDF (and LERF), such as initiating events, accident sequences, and basic events (equipment unavailabilities and human failure events) shall be identified. The results shall be traceable to the inputs and assumptions made in the PRA.
 - HLR-QU-E – Uncertainties in the PRA results shall be characterized. Sources of model uncertainty and related assumptions shall be identified, and their potential impact on the results understood.
 - All of these requirements will continue to be met with the possible exception of HLR-QU-D.
 - Supporting Requirements under HLR-QU-D require a review of a sample of the significant accident sequences/cutsets to determine that the logic is correct and a sampling of non-significant accident sequences/cutsets to determine they are reasonable
 - These Supporting Requirements have already been addressed by the peer review and were judged to be Met or Not Met at the appropriate Capability Category.
 - Implementation of this model change will not impact this determination.
 - At most, an F&O could be written against a Supporting Requirement, specific to several new cutsets that should now be included in the review of significant accident sequences/cutsets.

Maintenance or Upgrade Conclusion

- The change in the seal leakage model is not a new methodology since the new seal leakage model is considered either a one-for-one replacement with the current seal leakage model or an expansion or addition to the current model.
- It is not a significant change of scope:
 - The scope of the PRA model has not been impacted
- It is not a change in PRA model capability
 - The capability of the PRA remains the same; it now reflects a component design change.
 - The PRA model can still evaluate the risk associated with SBO and total loss of cooling events related to RCP seal failures
- PRA maintenance is defined as changes within the framework of an existing model structure
 - Implementation of the new seal leakage model is a change implemented within the framework of the existing PRA model structure
 - The seal leakage model change is only a change in the seal leakages expected associated with the new SHIELD® failure modes
 - The framework of the model remains essentially the same.
- The PRA Standard Technical Elements, High Level Requirements, and Supporting Requirements are still expected to be Met or Not Met as determined by the peer review of the PRA model
 - The change in the seal leakage model is not expected to impact the peer review assessment in the noted areas.
- Utilities should review the model results following implementation of SHIELD® to verify there are no unexpected changes to the accident sequences.
- As it is expected that incorporation of SHIELD® into the PRA model will result in a significant change to accident sequences, the modeling of SHIELD® should be included in the scope of the next peer review that is scheduled for other purposes

Treatment of Submittals made before the Topical Report was Approved

Issue

- Some Plants made License Amendment Requests (LARs) before the SHIELD® PRA model was approved
- The Topical Report was revised during the review process

Recommendation



- RAs shouldn't be needed
- NRC approval of these LARS should consider using a License Condition to ensure that incorporation of the approved version of PWROG-14001-P does not impact the basis for NRC approval
 - Use wording similar to existing NFPA-805 approvals



Global Expertise • One Voice
www.pwrog.com