

NRR-DMPSPEm Resource

From: Valentin-Olmeda, Milton
Sent: Monday, March 4, 2019 4:23 PM
To: KIRKLAND, WILLIAM HANK
Cc: STEWART, TRACEY (SCE&G - 8); Sebrosky, Joseph
Subject: VC Summer SPRA Review - Clarification Questions on Peer Review Findings and Plant Modifications

Hank,

As part of the ongoing audit review of the VC Summer Seismic Probabilistic Risk Assessment (SPRA) submittal (ADAMS Accession No. ML18271A109), the NRC staff is working on a technical checklist similar to that in Enclosure 1 of our letter dated July 10, 2018 (ADAMS Accession No. ML18115A138). The checklist is divided in topics and our questions below indicate the topic that will benefit from the clarification responses being requested:

Question on Topic #14 – Seismic PRA Peer Review Finding and Observation (F&O) 19-10 (SPID Section 6.7)

NRC staff position #4 related to NEI 12-13 (ADAMS Accession No. ML18025C024) specifies that the SPRA peer review team is required to review all of the relevant internal event F&Os and determine whether the resolutions were appropriate and in accordance with the probabilistic risk assessment (PRA) standard. This assessment by the SPRA peer review team, provided in Section 4.1.4 of the 2018 peer review report, states that F&O 19-10 was written because of, “the number of open F&Os and the breadth of their impact on the PRA modeling related to technical elements IE, AS, SC, SY, DA, HR, QU, and LE.” The peer review team conclusion states that, “because of the broad nature of the findings against the Internal Events PRA (IEPRA) model and the lack of actual resolutions,” it was not possible for them to assess the collective impact in relations to the SPRA model. The disposition to the F&O provided in Table A-5 of the submittal states that the Independent Assessment Team did not close this finding.

The NRC staff reviewed the licensee’s dispositions for each of the 84 internal event F&Os provided on the portal and in the August 29, 2018 NFPA 805 Revisions submittal (ADAMS Accession No. ML18242A658). The NRC staff’s assessment is that several of the F&Os could potentially impact the SPRA. Section 2.2 of RG 1.200, Revision 2 states that the peer review process determines whether the appropriate methods were applied correctly, but in many cases, it appears that the peer review team did not have the necessary documentation available to make this assessment. Furthermore, high level requirement (HLR) elements HR (human reliability analysis), SC (success criteria), LE (large early release frequency analysis), and SY (system analysis) have multiple F&Os that either were not assessed or are unresolved. In light of these observations:

- a) **Technical Element HR:** Several of the F&Os are associated with the human reliability analysis (HRA) and include dispositions such as the peer review team was not provided the documentation and separate dependency analysis was performed for the seismic PRA. Lack of documentation provided to the peer review team implies that the SR was not peer reviewed. Furthermore, the PRA Standard seismic related SRs (SPR-B2 – adjust performance shaping factors (PSFs) and SPR-B6 – operator access) do not involve an assessment of the model human failure events (HFEs) since it relies on the internal events analysis (SPR-B1). The HR F&Os of specific concern to the NRC staff are:
 - F&O 2-19 (HR-G4: Not Met): Base HFEs indication times on realistic thermal-hydraulic analyses or plant simulation. The disposition states that a separate dependency analysis was performed for the SPRA. However, there is no mention of reviewing, identifying, and correcting HFE timings based on realistic analyses in response to this F&O and inclusion in the SPRA dependency analysis. The

dependency analysis for SPRA is based fundamentally on the HFEs from IEPRA and therefore, can be affected from the issues identified in F&O 2-19.

- F&O 2-20 (HR-G5: CC-I): Base the required time to complete HFE actions in walkthroughs, talkthroughs or simulator observations. The disposition states that the peer review team was not provided the necessary documentation for the basis of HFE execution times. The implication is this aspect of the HRA has not been peer reviewed.
- F&O 5-11 (HR-G7: Not Met): Assess the degree of dependence of HFEs and calculate a joint human error probability (JHEP). The peer review team noted that the details provided were inadequate to assess the method used. The implication is this aspect of the HRA has not been peer reviewed.

Based on the above F&Os associated with Technical Element HR:

- i. Describe the dependency analysis performed for the development of the licensee's SPRA including the basis for screening JHEPs for further consideration in the SPRA.
 - ii. It is recognized that the composite effect of the issues identified in the above-cited F&Os on the SPRA is essentially bounded by the sensitivity analysis provided in Section 5.7.6 of the submittal in which all seismic HEPs were set to 1.0 (guaranteed failure). However, the staff notes that guaranteed failure of all seismic HEPs (at all accelerations) can lead to unrealistic and skewed results that may not be suitable to support the staff's decision on this submittal. To support the staff's decision, either perform the sensitivity in which all seismic HEPs were set to 1.0 or perform a sensitivity that moves all the 'damage bins' for seismic HEPs to the next lower 'damage bin' (i.e., moves 'damage bin' 2 to 'damage bin' 1 and so on). The sensitivity should be performed in conjunction with others identified as part of this question (see part (e)).
- b) Technical Element SC: Several of the F&Os are associated with the success criteria development and include dispositions that indicate the peer review team was not provided the documentation and that there was not thermal-hydraulic (T-H) analyses to support development of the success criteria. Lack of documentation provided to the peer review team implies that the SR was not peer reviewed. The HR F&Os of specific concern to the NRC staff are:
- F&O 4-01 (SC-A5: Not Met): Specify an appropriate mission time for the accident sequences. The disposition states that if adjustment were determined to be necessary and incorporated that it is not expected to have a significant impact on risk values.
 - F&O 4-04 (SC-B3: Not Met): Use of thermal-hydraulic, structural, or other analyses appropriate to the event being analyzed. The disposition appears to categorize this as a documentation issue. The F&O description provided a few examples which were addressed in the disposition. However, the peer review team stated that this was a systematic issue that required a comprehensive review.
 - F&O 4-05 (SC-B4: Not Met): Use analysis models and computer codes that provide results representative of the plant. The disposition states that it was the peer reviewer's opinion that simulator timing could not be used to support HRA timing. However, in addition to HRA timings, the F&O addressed the use of simulator observations to justify success criteria and assumptions. In relation to the HRA timings, the F&O stated that no supporting documentation related to the simulator observations was provided to the peer review team.
 - F&O 4-06 (SC-B5: Not Met): Check the reasonableness and acceptability of the results used to support the success criteria. The disposition appears to state that the required documentation for this SR was not provided to the peer review team.

- F&O 4-07 (SC-C1: Not Met): Document the success criteria in a manner that facilitates PRA applications and peer review. The disposition states that this is a documentation issue and that the peer reviewer desired the documentation to point out what thermal-hydraulic analysis was used to determine the success criteria. Based on the number of success criteria SRs being not met, it appears that the peer review team could not assess the basis used to determine the models success criteria.
- F&O 4-08 (SC-C2: Not Met): Document the processes used to develop overall PRA success criteria (i.e., definition of core damage, calculations, computer codes, limitations, use of expert judgement, summary of success criteria, basis for time available for human actions, and processes used for grouped initiating events or accident sequences). The disposition for this F&O is similar to F&O 4-07.

Based on above F&O associated with Technical Element SC:

- Regarding F&O 4-01 against SR SC-A5, clarify if a minimum 24 hour mission time is modeled for each system in the SPRA. If not, justify that not modeling a full 24 hour mission time for each system does not impact the plant response (e.g., success criteria), the SPRA results, and the staff's decisions based on the SPRA results (importance measures). The justification should include discussion on how the PRA model was adjusted to represent the various mission times for systems used in the mitigation of multiple accident scenarios.
 - Regarding F&O 4-01 against SR SC-A5, clarify if sequences exist in the SPRA that require a mission time longer than 24 hours to achieve stable plant conditions as defined by the 2009 ASME/ANS PRA Standard. If such sequences exist, describe the additional evaluation and modeling performed for such sequences as required by SR SC-A5.
 - Describe the systematic review performed to address the concern in F&O 4-04 against SR SC-B3 support the formulation of all PRA modeled success criteria and the outcome of the review. For the concern raised in F&O 4-05 against SR SC-B4 related to success criteria supporting the SPRA that relied on generic analysis and/or simulator observation, provide justification that the generic analysis and/or simulator observation is representative of the plant response or that the staff's decisions based on the SPRA results (importance measures) would not be impacted.
 - Describe the methods used to check the reasonableness and acceptability of the analyses used to support development of the success criteria. Demonstrate that the reasonableness review encompassed all of the success criteria.
 - If any of the responses to the above questions cannot be justified or appropriately demonstrated to not significantly impact the SPRA results, describe sensitivities performed to address those findings. The sensitivities should be performed in conjunction with others identified as part of this question (see part (e)).
- c) Technical Element LE: The LE F&Os of specific concern to the NRC staff are:
- F&O 4-11 (LE-A4: Met): Ensure dependencies between the Level 1 and Level 2 models are properly treated. The F&O is related to the exclusion from LERF quantification of certain Reactor Coolant Pump (RCP) seal loss of coolant accident (LOCA) sequences which can potentially lead to consequential (i.e., induced) steam generator tube rupture (SGTR). The disposition does not provide a resolution to this issue and expects the resolution would not significantly impact large early release frequency (LERF).
 - F&O 4-14 (LE-C1: Not Met): Develop accident sequences to account for the potential contributors to LERF and containment challenges. The disposition states that the LERF analysis was in

accordance with generic industry guidance and that resolution of this F&O is not expected to significantly impact LERF but does not provide sufficient information to support the disposition.

- F&O 4-17 (LE-C5: CC-I): Use appropriate realistic generic or plant-specific analyses for system success criteria for the significant accident progression sequences. The disposition states that the applicability of using generic analysis was expanded in the Level II notebook. However, no description of the realistic generic analyses was provided.

Based on the above F&Os associated with Technical Element LE;

- i. Provide justification that the exclusion of the RCP seal LOCA sequences relevant to F&O 4-11 from LERF quantification does not impact the SPRA submittal conclusions (i.e., SCDF, SLERF, importance values). One possible approach is to include the relevant RCP seal LOCA sequences in the seismic LERF quantification.
- ii. Describe the process used to identify sequences that lead to large early release (LER) based on containment structural capability and provide justification, as noted for CC II of LE-C1, for the categorization of releases as non-LERF from generic sources including consideration of any plant-specific variations from the generic source. Include the basis for the determination that resolution of this F&O would not significantly impact LERF from the SPRA and the NRC staff's decision therefrom (i.e., change in importance measures of dominant contributors).
- iii. Describe the applicability of generic analyses that were used in the development of system success criteria for the significant LERF accident progression sequences to the SPRA or provide justification that the staff's decisions based on the SPRA results (importance measures) would not be impacted by those generic analyses.

d) Technical Element SY: The SY F&Os of specific concern to the NRC staff are:

- F&O 6-17 (SY-A4: Not Met): Perform plant walkdowns and interviews to confirm that the systems analysis correctly reflects the as-built, as-operated plant. The disposition states that walkdowns conducted for the Individual Plant Evaluation (IPE) are in the Plant Walkdown Notebook and notes that recent plant walkdowns have been performed for internal flooding, fire, and seismic. The NRC staff notes that the intent of SR-A4 is to verify that the PRA system models reflect the as-built, as-operated plant, and that the walkdowns performed for the other hazards are for different purposes.
- F&O 6-18 (SY-A11: Not Met): Include in the system model those failures of the equipment and components that would affect system operability. The disposition states that a sensitivity study was performed to assess the impact of the quantitative screening and determined it was a small impact on CDF or LERF (~ 0.3%).
- F&O 6-19 (SY-A13: Not Met): Include those failures that can cause flow diversion pathways that result in failure to meet success criteria. The disposition states that a sensitivity study was performed to assess the impact of the quantitative screening and determined it was a small impact on CDF or LERF (~ 0.3%).
- F&O 6-20 (SY-A14: Not Met): Include consideration of all failure modes. The disposition states that a sensitivity study was performed to assess the impact of the quantitative screening and determined it was a small impact on CDF or LERF (~ 0.3%).
- F&O 6-21 (SY-A15: Not Met): Component screening criteria. The disposition states that a sensitivity study was performed to assess the impact of the quantitative screening and determined it was a small impact on CDF or LERF (~ 0.3%).

- F&O 6-23 (SY-A22: Not Met): Take credit for system or component only if an analysis exists to demonstrate that rated or design capabilities are not exceeded. The disposition states that the appropriate documentation for the heating, ventilation, and air conditioning (HVAC) assessment (room heat-up analysis) was not provided to the peer review team for their review.
- F&O 6-24 (SY-B6: Not Met): Perform engineering analyses to determine the need for support systems that are plant specific. The disposition states that the appropriate documentation for the heating, ventilation, and air conditioning (HVAC) assessment (room heat-up analysis) was not provided to the peer review team for their review.
- F&O 6-25 (SY-B12: Not Met): Do not use proceduralized recovery actions as the sole basis for eliminating a support system. The disposition states that the appropriate documentation was not provided to the peer review team for their assessment.

Based on the above F&Os associated with Technical Element SY:

- Discuss the process used to validate that the PRA revisions capture the plant changes since the IPE to reflect the as-built, as-operated plant. Provide an assessment of the impact on the SPRA results of any identified gaps in the validation process.
 - Describe how the sensitivity analysis described in the dispositions to F&Os 6-18, 6-19, 6-20, and 6-21 was performed and how it addresses each of these peer review findings. Justify the applicability of the sensitivity analysis results to the SPRA submittal (i.e., does not impact the staff's decision by not significantly impacting the SPRA results reported in the submittal).
 - Clarify if the SPRA credits the availability of HVAC and/or operator actions to open doors to prevent SSC failure. If credited, 1) identify the rooms and describe the associated success criteria for each (the dispositions to F&Os 6-23, 6-24, and 6-25 imply that only the electrical room relies on room cooling for the 24 hour mission time) and 2) justify that the credit for room cooling does not impact the decision by not significantly impacting the SPRA results reported in the submittal or provide the results of a sensitivity analysis that removes the credit for room cooling and discuss the impact on the SPRA submittal.
- e) If any of the responses to the questions in Parts a through d result in sensitivity studies, provide the results of an aggregate analysis that incorporates all of changes including updated SPRA Tables 5.4-2, 5.4-3, 5.4-4, 5.5-2, 5.5-3, and 5.6-1. Include discussion of any changes to the F-V importance measures for the SSCs in those tables compared to the submittal. Consider the results in the response to the question on potential plant modifications.

Question on Topic #16 - Review of Plant Modifications and Licensee Actions, If Any

The mean seismic CDF (4.79E-05 per year) and seismic LERF (3.65E-06 per year) provided in Section 5.6 of the seismic PRA submittal indicates a relatively significant level of seismic risk at the plant. Sections 5.4 and 5.5 of the submittal present importance values for the risk-significant SSC seismic fragility failure groups. Additionally, Section C.5, Tables C-3 and C-4 of the Seismic PRA Quantification Report present importance values for the risk-significant operator errors. It appears to NRC staff based on this information that there may be cost-justified safety improvements that could reduce the seismic CDF by 1E-05 per year or the seismic LERF by 1E-06 per year. Elimination of the first failure event or combinations of the remaining failure events identified below appear to have the potential to significantly reduce seismic risk:

- SF-LSP (Seismic-induced loss of offsite power)
- Relay_0.11AC (Relay Fragility Group)
- Relay_0.11BD (Relay Fragility Group)
- SH3-OAEFC (Operator fails to continue EFW after battery depletion (seismic))

- SH4-OAEFC (Operator fails to continue EFW after battery depletion (seismic))
- SF-XVT2662B (RB IA Suction HDR Isolation Valve)
- SF-XBA1 (DC Distribution Bus Battery)
- SHA-OAESF3 (Start A and B Trains of ESFAS Equipment if needed (seismic))
- Relay_0.52 (Relay Fragility Group)
- SF-APN590X (120Volt Vital AC Distribution Panel)

The Seismic PRA Screening Guidance (ADAMS Accession No. ML17146A200) recommends considering single failures and combinations of failures which if eliminated could result in a reduction in seismic CDF of $1E-05$ per year or a reduction in seismic LERF of $1E-06$ per year. Failures with importance values above the risk-reduction worth (RRW) threshold that could achieve these risk reductions provide insights about possible cost-beneficial plant modifications. The NRC staff notes that there appears to several combinations of two failures that if eliminated result in a reduction in seismic CDF of $1E-05$ per year or a reduction in seismic LERF of $1E-06$ per year. The staff also notes that the combinations can be impacted by the results of the sensitivities performed in response to Question 1.

In light of these observations:

- Explain whether cost-justified plant improvement possibilities exist that could reduce the seismic CDF contribution by $1E-05$ per year or reduce the seismic LERF contribution by $1E-06$ per year by eliminating or decreasing the risk associated with combinations of two failure events cited above. Include consideration of changes to the importance measures of SSCs based on the sensitivities performed in response to Question 1.
- With regard to event SF-LSP, which is a contributor to over half of the seismic risk, provide the following:
 - Explain what types of failures are included in event SF-LSP. Discuss if it includes failures that occur at the plant switchyard as well as failures that occur in the electrical grid outside of the jurisdiction of the plant. Note that Table 5.4-3 of the submittal indicates that the event SF-LSP may be entirely “a Yard-Centered” event.
 - If SF-LSP includes failures that occur at the plant switchyard then explain whether cost-justified plant improvements associated with plant switchyard equipment could reduce the seismic CDF contribution by $1E-05$ per year or reduce the seismic LERF contribution by $1E-06$ per year either alone or in combination with other plant modifications. In the response, specifically discuss how the diverse and flexible coping strategies (FLEX) equipment (installed as well as portable) which is not currently modeled in the SPRA can support mitigation of this risk contributor.
- In the responses to parts (a) and (b) above, explain how the cost of plant improvements were considered. In the response, specifically discuss the cost of improvements to plant procedures and operator training (including relay chatter recovery human actions) and to increase the ruggedness of relays, which have been shown to be relatively low cost and potentially cost-beneficial in analyses of severe accident mitigation alternatives.

Your prompt response will be greatly appreciated.
Please contact me if there are any questions related to this email.

Respectfully,

Milton Valentín, PM
US NRC Division of Licensing Projects
Beyond Design Basis Management (Fukushima)

Office of Nuclear Reactor Regulation
Milton.Valentin@nrc.gov
301-415-2864

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From: Valentin-Olmeda, Milton

Created By: Milton.Valentin-Olmeda@nrc.gov

Recipients:
"STEWART, TRACEY (SCE&G - 8)" <TRACEY.STEWART@scana.com>
Tracking Status: None
"Sebrosky, Joseph" <Joseph.Sebrosky@nrc.gov>
Tracking Status: None
"KIRKLAND, WILLIAM HANK " <WILLIAM.KIRKLAND@scana.com>
Tracking Status: None

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