December 2nd Public Meeting Comments and Responses

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Analysis Comments

During the December 2, 2015 meeting with the NRC, 14 comments on the R-I techniques were identified. The comments and corresponding responses are outlined in the following slides.

The responses in the following slides were developed prior to receiving written NRC comments on the BWROG Phase II Risk Analysis on January 19, 2016. Refer to the BWROG responses provided to the NRC on 2/1/2016 for additional information.

Analysis Comment #1

Comment: Determine how assigning scenarios outside of the bounds of the GE correlation to failure affects the conditional strainer failure probability results

Response: Results in the ECCS SS R-IS Phase II report provide failure attribution w.r.t. the GE correlation for applicable T-H cases. This comment is not applicable to Phase III since the GE correlation is not used for strainer head loss calculation.

Analysis Comment #1

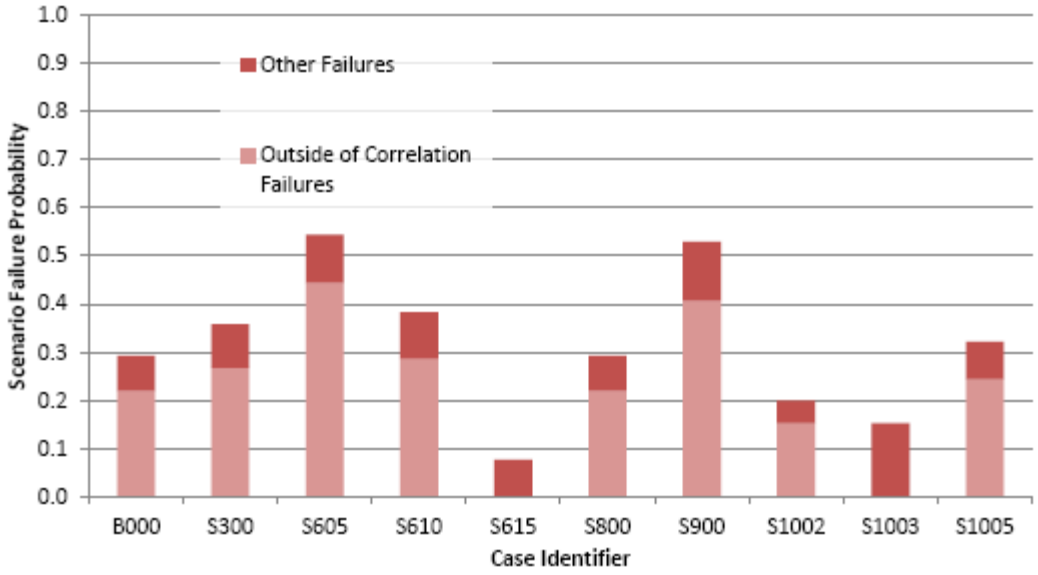

Figure 5-49
STRAINER CONDITIONAL FAILURE PROBABILITY DIVIDED INTO FAILURES CAUSED BY EXCEEDANCE OF THE GE HEAD LOSS CORRELATION RANGE OF APPLICABILITY AND FAILURES CAUSED BY OTHER PHENOMENA FOR THE LBLOCA ABOVE TAF SCENARIO

Analysis Comment #2

Comment: Justify the usage of a 0.125” thick-bed (discuss situations where a 0.125” minimum bed is conservative or potentially non-conservative)

Response: The 0.125” thick bed criterion is used to differentiate between break scenarios that produce sufficient fibrous debris to form a bed capable of filtration of particulates and break scenarios that have head loss similar to clean strainer losses.

Analysis Comment #3

Comment: Consider the impacts and findings of Phase II/III results for ways to qualitatively assess or find implications towards strainers other than the GE design, as well as holistic ECCS variations that accompany these different strainers across the fleet.

Response: The baseline Phase III success/failure technique could be applied to any strainer type using the existing DBA for the ECCS of any specified plant. This will be evaluated in Phase IV.

Analysis Comment #4

Comment: Consider applying a bed limit during the cumulative effects case sensitivity.

Response: This case was not included in Phase II, but may be included in Phase III if the two cases independently lead to increased risk relative to the baseline.

Analysis Comment #5

Comment: Define how the analysis of one pump out of service was integrated into the PRA

Response: The CASA Grande conditional strainer failure probabilities for both 1) all pumps operational and 2) 1 pump out of service were evaluated for only the bounding sensitivity case (i.e., 0.125” thick-bed case) to evaluate the bounding risk impact. The additional risk impact for one pump out of service can be evaluated for other sensitivity cases if judged to provide additional risk insights.

Analysis Comment #6

Comment: Why is the conditional failure probability for above TAF LOCAs larger than below TAF LOCAs?

Response: The conditional strainer failure probabilities calculated in CASA Grande are based on the predicted plant response from thermal-hydraulics calculations. These calculations predict that certain pumps and strainers may be unnecessary for above TAF LOCAs. Since these pumps and strainers are modeled as being idle in CASA Grande, the remaining pumps and strainers are more likely to fail. Additionally, the Phase II implementation of the GE head loss correlation magnifies the role of the reduced number of active strainers.

Analysis Comment #7

Comment: When considering break frequency, how is NUREG-1829 evaluated in the PRA?

Response: Mean LOCA exceedance frequencies from NUREG-1829 used as basis to calculate total LOCA frequency for specific LOCA ranges modeled in the PRA (i.e., Large, Medium, Small LOCA). Appendix L of NUREG-1829 used to estimate the percent contribution of individual system contributors to LOCA categories to calculate individual system based LOCA frequencies modeled in the PRA (e.g., Large LOCA above TAF in Core Spray injection line).

Analysis Comment #8

Comment: How is the weighting assigned to the frequencies for above and below TAF break locations? Are break locations weighted equally and should there be separate weighting frequencies for above and below TAF?

Response: In CASA Grande, the conditional failure probabilities are provided for above/below TAF separately. Furthermore, the Phase III baseline uses bottom-up weighting by system to provide relative weighting within the above/below TAF conditional strainer failure probabilities.

As discussed in the response to Comment #7, the frequencies for above and below TAF LOCAs are based on the conditional system contributions identified in Appendix L of NUREG-1829. Based on where the system piping penetrates the RPV, the LOCA frequencies for specific system piping can be categorized as above or below TAF.

Analysis Comment #9

Comment: Consideration for back-flush of systems. How is this being accounted for in Phase III?

Response: Unlike the Phase II pilot plant, the Phase III pilot plant does not maintain a procedure for back-flush of the ECCS suction strainers. Therefore, the Phase III risk evaluation does not plan to credit back-flush of the ECCS suction strainers for any sensitivity cases.

Analysis Comment #10

Comment: Provide an explanation of core damage for the plant specific PRA model; concern was raised about the 5.5 minute time to suction strainer failure.

Response: Consistent with industry PRA models, core damage for the plant specific PRA model is defined as peak core temperatures greater than 1800F for more than 10 minutes. The reference to 5.5 minutes is the CASA Grande calculated minimum time to suction strainer failure for the bounding 0.125” thick-bed case. The reference to 5.5. minutes is not the calculated time to core damage.

Analysis Comment #11

Comment: Provide plant response to debris with one pump operating by factoring the result into the ΔCDF plant factor percent for determining the ΔCDF.

Response: As discussed in the response to Comment #6, the predicted plant response may require only one pump to operate to mitigate the event (e.g., Small LOCA above TAF). This is factored into the CASA Grande calculations and the ΔCDF calculations. For the postulated scenario where only one pump is operating because all other pumps were unavailable (e.g., due to random failure or maintenance), the probability for this scenario is extremely low and would not contribute to the ΔCDF.

Analysis Comment #12

Comment: LERF: Qualitative report about debris seemed reasonable, however; NRC would like to see sequences. Prepare a list of core damage that come from debris.

Response: Table G-2a of the Phase II report provides the ΔCDF cutsets of 2.4E-6/yr for PRA Case 8A (0.125” Thick Beds case with RHR pump D unavailable). The top 3 cutsets are Large or Medium LOCA events with loss of RPV makeup with the RPV at low pressure. The top 3 cutsets account for 99% of the ΔCDF of 2.4E-6/yr.

Analysis Comment #13

Comment: Understand pump configurations being out and why. The NRC would like to see a greater evaluation of pump configurations. Add more descriptions for pump selection and logic.

Response: The response to Comment #5 discusses the treatment of one pump unavailable for the bounding sensitivity case. Additional analyses for additional pump configurations (e.g., two or more pumps unavailable) can be discussed.

Analysis Comment #14

Comment: The NRC discussed the current level of rigor for the Level 2 analysis; a quantification of LERF is desired.

Response: An explicit quantification of LERF can be performed, but is judged to result in marginal benefit for providing risk insights. During Dec. 2 NRC public meeting, the impact on LERF for the dominant LOCA scenarios was postulated as not more limiting than CDF based on NRC sponsored reference information (e.g., SDP Inspection Manual, NUREG/CR-6595).