May 24, 2004

TO: David Solorio, Section Chief
Plant Systems Branch
NRR/DSSA

FROM: Angie Lavretta //RA//
Plant Systems Branch
NRR/DSSA

SUBJECT: SUMMARY OF THE MAY 20, 2004, TELEPHONE CONFERENCE WITH THE NUCLEAR ENERGY INSTITUTE (NEI) REGARDING THE BASELINE SECTION OF THE PWR SUMP METHODOLOGY (TAC No.s MA6454 & MC1154)

On May 20, 2004, the U.S. Nuclear Regulatory Commission (NRC) held a telephone conference, supported by their contractor Los Alamos National Laboratory, with NEI to discuss the Baseline Section (that is, Section 3.0) of NEI's PWR Containment Sump Evaluation Methodology. The attached list of initial comments on the Baseline was discussed. NEI agreed to consider these comments. NRC staff review of the Baseline is ongoing.

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Enclosure: As stated

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Initial Comments on Baseline Document

General Concerns

1) Balance Between Over and Under Conservatisms Over-conservatisms would appear to cancel out under-conservatism in baseline, which may be OK when baseline is followed completely. The danger is when a plant deviates from the baseline to reduce over-conservatisms (e.g., supplemental guidance); then the balance could tip towards under-conservatism. Key under-conservatisms include:

   a) The transport of large debris to the sump screens is neglected, i.e., zeroed out in the transport model assumptions. Large debris transport could happen significantly for some plant conditions, i.e., fast flowing sump pools and LOCA generated debris near sump screens.

      All large debris as still canvassed and therefore cannot erode. Debris generation data clearly shows a large portion of large fibrous debris clear of any canvass cover.

   b) The transport of fine debris into inactive pools (i.e., below sump floor, e.g., reactor cavity) may be overpredicted as indicated by the sample problem. The baseline proportions the fine debris between the sump and inactive pools based on water volume but the inactive pools may be filled before the fine debris that was transported into the upper containment is washed back down. The baseline sample problem conservatively keeps 75% of the fibrous fines at the sump but then places 30% of these into inactive pools (23% of total fines). Note that the detailed volunteer plant analysis predicted most of the fines would be transported beyond the reach of the sump pool and most likely would be subsequently washed back to the sump pool. Note that transport analysis capability does not include the time-dependent capability to predict the arrival time of the fines at the sump relative to the filling of the inactive pools. Further, these inactive pools must be truly inactive to prevent suspended debris from escaping over extended long-term recirculation cooling.

   c) When computing the volume of coating debris outside ZOI (Page 3-35, Step 3), the worst case is 3 mils of inorganic zinc primer. For inside ZOI, 3 mils of inorganic zinc primer plus 6 mils of epoxy/epoxy phenolic topcoat is assumed. No explanation is offered but this makes a big difference. The sample problem predicts 2625 lbm of paint debris outside ZOI using 3 mils. If 9 mils were assumed, the mass would be 7875 lbm.

   d) Baseline relies on simple geometric correlations (e.g. 6/diameter for particles) to estimate the specific surface areas. Our experience has found this to be unreliable and non-conservative.

2) Completeness Substantial baseline material deferred to supplemental.

3) Tone of Report Baseline may mislead reader regarding level of conservatism at various points, which may lead to inappropriate relaxations. For example, our recommendations for calcium silicate were described as "excessively conservative" and the concrete dust test result as "too conservative" (Pages 3-111 and 3-112). Note that baseline does not yet include our final recommendations.

Reserve Final Judgment for Confirmatory Analysis

4) i) ZOI radii (ANSI/ANS 58.2-1988 standard), validate Table 3.2.2-1
   ii) Assess potential two-phase effect on destruction pressures (baseline neglects)
   iii) Review treatment of robust barrier and equipment shadowing on ZOI
   iv) Debris size distributions (review available debris data and integrate over PWR sphere). Also baseline assumes destruction pressure indicates fragility and size distribution, i.e., it is conservative to adapt NUKON to material with a higher destruction pressure assuming NUKON 60-40% for others (Transco, Knauf, Temp-Mat, K-wool).
   v) Latent debris estimation method (fines, non-accessible areas, etc) once LANL characteristics study complete.
   vi) Evaluate whether or not the assumed properties for latent debris (i.e. 62.4 and 100 lbm/ft3) are conservative with respect to head loss (using NUREG/CR-6224 correlation). Should add LANL recommendation when available.
   vii) The baseline provides a NUKON™ fiberglass density of 159-lbm/ft^3 in Table 3.2.2-2 (Page 3-41) but uses 175-lbm/ft^3 in the sample problem (Page 3-101). Note that previous NRC work (e.g., BLOCKAGE code, parametric evaluation) used 175-lbm/ft^3. The specific surface area for NUKON™ is interrelated with the fiberglass density, i.e., the parameter set should be consistent. We need to verify that a density of 159-lbm/ft^3 in conjunction with a specific surface area of 171,000/ft is conservative with respect to 175-lbm/ft^3 in conjunction with a specific surface area of 171,000/ft.
   viii) Compare baseline transport methodology to detailed volunteer plant transport analyses to test conservativeness of baseline.
   ix) Deduction of specific surface areas from experimental data using NUREG/CR-6224 correlation.

Example Technical Disagreements

5) The baseline does not recommend a sludge (granular) density for each type of particulate or guidance for determining this density. It does acknowledge that the density of 65 lb/ft^3 applies to BWR corrosion products and that the number is debris type specific (Oct guidance did not). The thin-bed sample problem (Page 3-107) does not mention the sludge density but states that the recommended limiting solidarity is 0.20, which corresponds to BWR corrosion products (i.e., 65-lbm/ft^3/324-lbm/ft^3) even though the particulate consists of paint particles and latent dirt/dust. This will likely lead the general assumption that the limiting porosity is 80% regardless of the type of particulate. Note that the limiting porosity controls thin-bed head loss. In reality, the limiting solidarity (or porosity) depends on the ratio of the sludge density to the particle density, which in turns depends on size distribution. For example, the weight of a bucket of common sand should differ between very course sand and very fine sand, therefore different porosities. An aspect of soil mechanics deals with soil porosity.

6) The calcium silicate destruction pressure(s) in Table 3.2.2-1 (Page 3-21) do not agree with previous comments to the Oct-03 NEI guidance. The table provides three destruction pressures for three jacket seam orientations. We previously pointed out the seam orientation cannot be correlation using the spherical ZOI model that is recommended in the baseline. Hence, only lower number (24 psi) should be recommended but even this number is not a threshold because substantial damage occurred at 24 psi. The knowledge base recommended 20 psi (see footnote 17 on Page 3-18 and the 20D target distance in Table 3-6 of the NUREG/CR-6808).

Further Justification Needed

7) The jet destruction pressure of 1000 psi was based on water jet paint stripping data. But, some justification is needed to apply water jet data to a high-temperature steam jet application. Can a high-temperature steam jet strip paint more efficiently than a water jet?
8) Since paint debris has become an important aspect of sump screen blockage, a better understanding of paint particulate would be prudent even if the baseline guidance appear conservative because (1) supplement guidance may relax conservatisms, and (2) the uncertainty surrounding paint debris (little available data). Suppose paint particulate exposed long-term in chemically treated water becomes soft or spongy rather than particulate. With so little data, is there an unknown?

Missing

9) No discussion regarding whether or not debris can hold up water at upper levels thereby reducing sump water level.

Miscellaneous

10) The sample problem starts with 129 ft^3 of NUKON™ and 8.84 ft3 of latent fibers (Page 3-101) but show an average volume of 2.11 ft^3 (Page 3-103). How can this be?
11) On baseline Page 3-89, the reference for the specific surface area mixing Equation 3.2.5-6 is NUREG/CR-6371. The Oct-03 comments pointed out that this equation did not come from NUREG/CR-6371, noting that the reference recommended a linear averaging rather than a squared averaging in Equation 3.2.5-6. Pete Mast stated in one of the telecom that the ITS corporation had submitted a letter to the NRC on this issue and perhaps should submit it again. The issues are (a) the correct reference should be used in the baseline and (b) that reference should be made available for our review. We need to assess whether or not this difference represents a conservative or non-conservative difference in the predicted head loss.