

September 8, 2014

Ms. Lesa P. Hill, Chairman
Boiling Water Reactor Owner's Group
Southern Nuclear c/o GE Hitachi
BWROG
3901 Castle Hayne Road
M/C F-12
Wilmington, NC 28402

SUBJECT: FEEDBACK ON BOILING WATER REACTOR OWNER'S GROUP REPORT
BWROG-ECCS-TP-3-2 R0, BWROG ECCS SUCTION STRAINER THIN BED
HEAD LOSS TEST PLAN

Dear Ms. Hill:

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the Boiling Water Reactor (BWR) Owner's Group (BWROG) report BWROG-ECCS-TP-3-2 R0, "BWROG ECCS Suction Strainer Thin Bed Head Loss Test Plan" (Agencywide Documents Access and Management System Accession No. ML14178B281) and offers the following feedback:

- 1) The test plan goes into some detail in describing how the NRC staff previously agreed with the BWROG position that the thin-bed effect would not occur on complex strainers. The plan states that the BWROG conclusion that thin beds will not form on complex strainers is based on testing, not the results of correlation calculations. The plan further states that details on the BWR testing can be found in NUREG/CR-6808. The staff concern is that the BWROG test methods may not have been designed to allow a thin bed to form. The staff reviewed the NUREG and did not find information that addresses the staff concerns. Test conditions that could affect bed formation are debris addition sequence and amounts, homogeneous vs. heterogeneous debris additions, debris characteristics, debris preparation and addition methods, flow rates/velocities, etc. For example, if the particulate is added prior to the fiber a stratified debris bed may occur so that the addition of fiber beyond a specific amount may not result in significantly increased head loss. The concern originated because test methods have been improved since BWROG testing was completed.
- 2) The test plan states that only fiber and sludge were used for testing and that the conclusions regarding thin-bed formation does not extend to problematic debris like microporous insulations. The test plan does not address how other types of particulate like coatings or latent debris that were not included in the original testing could affect thin-bed formation.
- 3) Figure 1-2 in the test plan graphs the results of head loss tests that appear to be generally higher than those that would be acceptable for ECCS strainers. Why is the figure relevant to plant conditions?

- 4) One purpose of the test, and the test objective, is stated to be to determine if thin beds cause higher head loss than thicker beds. Should the purpose be to determine if a thin bed can cause high enough head loss to be of concern for plant NPSH margin? A demonstration that full loads are bounding over thin-bed loads may be adequate if all plants determined their design basis head loss based on their maximum debris load, and plants did not assume that a fiber/particulate debris bed would not contribute to strainer head loss because their fiber loading is less than a specified value.
- 5) Should the test strainer flow rate be based on the average for the PCI strainer plants instead of all plants? This may not be a large difference.
- 6) What is the basis for the size distribution for Nukon debris listed in section 5.2.1? Reference NUREG/CR-6224, pages B-15, B-25, and E-27 for a discussion of expected fiber size distribution and the mechanisms resulting in fiber fragmentation. The fiber used in testing should be similar in characteristics to that expected to arrive at the strainer.
- 7) How was it determined that using only sludge as particulate debris would be conservative compared to the plant condition? Should coatings and latent debris surrogates be included? Was it determined that sludge is the dominant particulate debris based on mass or volume?
- 8) The test matrix and evaluation of results should consider the potential that particulate debris may concentrate in a relatively small layer (stratified) within a debris bed. This may occur for both homogeneous tests and tests where the particulate is added first followed by fiber.
- 9) The staff expects fine fiber to be mostly class 2 fiber with a small amount class 1 and 3 fiber produced as a matter of preparation methodology.
- 10) The test procedure should reflect the staff guidance for performing head loss tests (March 2008). For example, the guidance states that finer fiber should be added before coarser fiber because finer fiber is expected to transport more easily.
- 11) For the homogeneous debris bed test, should the initial batches be smaller, similar to the test that adds the entire particulate amount first?
- 12) Has the BWROG considered what outcomes would support the supposition that thin beds will not occur on complex geometry strainers? What outcomes would result in additional tests being performed?
- 13) What is the basis for assigning the particulate amount used in the test based on the average sludge amount for the BWR fleet? Are tests with varying particulate amounts required to demonstrate that thin-bed head loss is not a concern? For example, the p/f ratio of 30 at a 3/16 inch theoretical bed thickness may not be an adequate demonstration. The NRC staff has noted that beds below a threshold thickness may not result in thin-bed effect head losses due to inadequate structural strength. The conclusion regarding the p/f ratio of 30 was based on testing that may not have been adequate as discussed above.

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Items 1-3 above regarding head loss theory do not need to be addressed to assure that the test program fulfills its objectives. However, a more thorough evaluation of these factors might provide a better basis for the planned testing.

If you have any questions regarding the above staff feedback, please contact Joseph Golla at 301-415-1002 or via e-mail at Joe.Golla@nrc.gov.

Sincerely,

/RA/

Anthony J. Mendiola, Chief
Licensing Processes Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 691

cc: See next page

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