NRR-DMPSPEm Resource

From: Poole, Justin
Sent: Monday, November 26, 2018 3:49 PM
To: Catron, Steve
Cc: Cusumano, Victor; Smith, Stephen; Russell, Andrea; Klein, Paul; Yoder, Matthew; Hoang, Dan; Chawla, Mahesh; Wentzel, Michael; Danna, James
Subject: NextEra Fleet Closure of GL 2004-02 Audit Plan
Attachments: NextEra Fleet Closure GL 04-02 Audit Plan for Jan 2019.pdf

Mr. Catron,

By letters dated December 20, 2017 (Agencywide Document Access and Management System (ADAMS) Accession No. ML17362A108), December 29, 2017 (two letters) (ADAMS Accession Nos. ML17363A265 and ML17363A253), and January 31, 2018 (ADAMS Accession No. ML18031B248), NextEra (the licensee) submitted updated final responses to Generic Letter (GL) 2004-02 "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized- Water Reactors," (ADAMS Accession No. ML042360586) for St. Lucie Units 1 and 2 (St. Lucie); Turkey Point Nuclear Units 3 and 4 (Turkey Point); Point Beach Nuclear Plant, Units 1 and 2 (Point Beach); and Seabrook Station (Seabrook), respectively. These letters are intended to document the licensee's methodology for closing GL 2004-02. The U.S. Nuclear Regulatory Commission (NRC) reviews each licensee's response to GL 2004-02 and has performed a review of the subject letters.

This email is to inform you that the NRC staff has determined that an audit of the licensee's methods will increase efficiency in the review. This audit will focus on the licensee's methodology for performing evaluations in accordance with NRC staff approved guidance. The attached provides an audit plan in accordance with NRC Office of Nuclear Reactor Regulation, Office Instruction LIC-111, "Regulatory Audits," dated December 29, 2008 (ADAMS Accession No. ML082900195). The NRC staff plans to develop an audit summary report to document its observations within 90 days of the conclusion of the audit.

If you have any questions, please call or email me.

Thanks

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<u>Audit Plan for NextEra Methodologies for Closure of Generic Letter 2004-02</u>

Audit Dates and Location: January 15, 2019 to January 17, 2019, at NextEra offices in Juno Beach, Florida

Background

By letters dated December 20, 2017 (Agencywide Document Access and Management System (ADAMS) Accession No. ML17362A108), December 29, 2017 (two letters) (ADAMS Accession Nos. ML17363A265 and ML17363A253), and January 31, 2018 (ADAMS Accession No. ML18031B248), NextEra submitted updated final responses to Generic Letter (GL) 2004-02 "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized- Water Reactors," (ADAMS Accession No. ML042360586) for St. Lucie Units 1 and 2 (St. Lucie); Turkey Point Nuclear Units 3 and 4 (Turkey Point); Point Beach Nuclear Plant, Units 1 and 2 (Point Beach); and Seabrook Station (Seabrook), respectively. These letters are intended to document the licensee's methodology for closing GL 2004-02. The U.S. Nuclear Regulatory Commission (NRC) reviews each licensee's response to GL 2004-02 and has performed a review of the subject letters.

Regulatory Audit Scope

The scope of this audit may include all information provided in the licensee's letters that responded to GL 2004-02. The intent of the audit is to gain an understanding of the licensee's application of the NRC staff guidance applicable to the resolution of GL 2004-02. The audit may also include discussions regarding exemptions that are required by Point. Beach and Seabrook for their plant specific implementation. There are four appendices to this audit plan. Each appendix documents the specific questions that the NRC staff has for each plant because each plant used a different strategy to address the GL because of plant-specific design differences associated with GL 2004-02 topics.

Information Needs

NextEra is requested to have available the documents that provide the bases for information in the GL 2004-02 closure letters. The documentation may be provided electronically or by paper copies. For documentation provided electronically, understand that the audit team may choose to print, if necessary. The following are the planned major areas of focus for detailed discussion and document review. Additional information needs identified during the audit will be communicated to the designated point of contact.

- St. Lucie
    - Application of Nuclear Energy Institute (NEI) 04-07 Guidance (ADAMS Accession No. ML050550138) and Staff Safety Evaluation (SE) (ADAMS Accession No. ML050550156)
        - Break Selection
        - Debris Generation
        - Transport
        - Headloss and Vortexing
        - Net Positive Suction Head (NPSH)
        - Structural
        - Chemical Effects
    - In-Vessel
        - Penetration testing and evaluation of the results
        - Approved method for evaluating debris limits
    - Regulatory
        - Use of R-II evaluation method for flashing
- Turkey Point
    - Application of NEI 04-07 Guidance and Staff SE,
        - Break Selection
        - Debris Generation
        - Debris Characteristics
        - Transport
        - Head Loss and Vortexing
        - NPSH
        - Chemical Effects
        - Structural
        - Screen Modification Package
    - In-Vessel
        - Penetration and transport methodology
        - Need approved method for evaluating debris limits
    - Licensing Basis
        - Unit 4 is using a Region II analysis. If the regulation is not met with a Region I analysis, an exemption or license amendment request (LAR) is likely required
        - Licensing basis for use of containment accident pressure

- Point Beach
  - Application of NEI 04-07 Guidance and Staff SE
    - Break Selection
    - Debris Generation
    - Transport – Show cases with various break locations and pump combinations including the effects of debris interceptors for R-I and II cases
    - Head Loss and Vortexing
    - Coatings
    - Structural
    - Chemical Effects
  - In-Vessel
    - Need approved method for evaluating debris limits
  - Licensing Basis
    - Ensure technical specification (TS) bases and final safety analysis report (FSAR) are revised to be consistent with the change
- Seabrook
  - Application of NEI 04-07 Guidance and Staff SE
    - Break Selection
    - Debris Generation
    - Transport
    - Head Loss and Vortexing
    - NPSH
    - Coatings
    - Upstream Effects
    - Screen Mod Package
    - Structural
    - Chemical Effects
  - In-Vessel
    - Penetration and transport methodology
    - Need approved method for evaluating debris limits
  - Licensing Basis
    - Documentation of updated licensing basis for containment accident pressure credit
    - Documentation of updated licensing basis for single failure assumptions.

- Other – Use of risk values to demonstrate defense-in-depth and safety margins are adequate is not valid.

Team Assignments

The audit team will consist of:

- Steve Smith, Technical Specifications Branch Technical Reviewer, Office on Nuclear Reactor Regulation (NRR)
- Paul Klein, Chemical, Corrosion, and Steam Generator Branch Technical Reviewer, NRR
- Matt Yoder, Chemical, Corrosion, and Steam Generator Branch Technical Reviewer, NRR
- Dan Hoang, Structural Engineering Branch Technical Reviewer, NRR
- Victor Cusumano, Chief, Technical Specifications Branch, NRR
- Andrea Russell, Technical Specifications Branch Technical Reviewer, NRR
- Justin Poole, Project Manager, Plant Licensing Branch I, NRR
- Mahesh Chawla, Project Manager, Plant Licensing Branch III, NRR

The following support personnel are requested:

- Staff familiar with each plant's technical evaluation for GL 2004-02 closure
- Staff familiar with the licensing basis for discussions regarding exemptions and the potential need for a LAR to credit accident pressure for Turkey Point 4 and Seabrook.

Logistics and Agenda

Entrance and exit briefings will be held at the beginning and end of this audit, respectively.

The following logistics are also requested:

- Telephone available to call NRC Headquarters if necessary
- Wireless internet access for NRC staff
- Private space for internal NRC staff discussion separate from NextEra staff
- A white board in the conference room to assist in discussion
- A projector and screen as needed for NextEra to present information

Suggested Agenda:

<u>Tuesday, January 15</u>

8:00 a.m.	Introductions and opening remarks
8:30 a.m.	Discussion of St. Lucie audit Issues
10:00 a.m.	Break
10:15 a.m.	Continue St. Lucie discussions
12:00 p.m.	Lunch
1:00 p.m.	Discussion of Turkey Point audit issues
2:00 p.m.	Break
2:15 p.m.	Continue Turkey Point discussions
4:00 p.m.	Wrap up meeting

Wednesday, January 16

8:00 a.m.	Discussion of Point Beach Issues
10:00 a.m.	Break
10:15 a.m.	Continue Point Beach discussions
12:00 p.m.	Lunch
1:00 p.m.	Discussion of Seabrook Issues
2:00 p.m.	Break
2:15 p.m.	Continue Seabrook discussions
4:00 p.m.	Wrap up meeting

Thursday, January 17

8:00 a.m.	Discussion of open questions, all plants
10:00 a.m.	Break
10:15 a.m.	Continue discussion of open questions
12:00 p.m.	Lunch
1:00 p.m.	Continue discussion of open questions
2:00 p.m.	Break and NRC break out meeting
3:15 p.m.	Exit meeting
4:00 p.m.	Adjourn

Special Requests

It is requested that NextEra keep a list of the material presented during the audit and that list be provided electronically to the audit team which will be included in the audit report.

Deliverables

Within 90 days of the audit, the NRC staff will prepare a detailed audit report documenting the information reviewed during the audit, and any open items identified as a result of the audit. The NRC staff will also document its understanding of the proposed resolution of any identified open items. The audit report will be provided to NextEra in draft form for proprietary markup.

Appendix A – St. Lucie (PSL) Questions for Discussion

Break Selection

1) Provide the break size assumed for longitudinal breaks.

Debris Generation

2) Page E1-29 of the submittal discusses polyvinyl chloride (PVC) jacketing. Is any of this material potentially within a zone of influence (ZOI)? If so, does it need to be accounted for?

Transport

3) Explain how the areas in Figures 3.e.1-7 and 9 that do/do not support transport are determined. Some areas adjacent to the transporting areas seem to support transport, but are not within the cross hatched areas. This may require a clarification of flow direction vectors in the questionable areas.

4) Provide the verification that the Calcium-Silicate (Cal-Sil) installed at St. Lucie is of rigid pressed construction. This will allow the NRC to evaluate the erosion rate assumptions provided in the submittal.

Headloss and Vortexing

5) Provide the assumptions regarding timing associated with correction of the single failure of a low pressure coolant injection (LPCI) pump to trip. This can affect headloss and transport.

6) Regarding strainer testing for Unit 1, provide the basis for adding small pieces to only one side of the strainer. Describe why more particulate was added to one side of the strainer.

7) Provide the basis for the debris addition sequence for Unit 1 full load test 1 that alternated small and fine fiber debris batches. In general, fine debris will transport more readily than smalls. Provide additional justification for the addition sequence and clarification that small pieces were added only to the front of the strainer. (page E1-87)

8) The flashing evaluation uses a methodology described in Section 6 of NEI 04-07 for a Region II analysis. The staff SE on the R-II methodology states that analyses that credit additional pressure should be based on the pressure in the containment, not absolute pressure. The SE also states that the staff expects that licensees will provide detailed information regarding more realistic assumptions when applying them in their GL responses. The justification for the flashing evaluation does not contain the information requested by the SE. The staff did not understand the need to apply additional pressure to suppress flashing if the maximum sump fluid temperature at swapover is 192 °F or less. This temperature should provide a significant amount of subcooling. The accepted method to show margin to flashing is to perform a conservatively high sump temperature calculation and a conservatively low containment pressure calculation, then compare the saturation pressure and temperature from these calculations to show flashing will not

occur. An alternate method is to use design basis and potentially realistic containment calculations to show a large margin to flashing.

9) Discuss whether the NPSH margin calculation accounts for void fraction at the pump suction below the 2 percent limit. NPSH required should be adjusted per Regulatory Guide (RG) 1.82, "Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident" (ADAMS Accession No. ML111330278).

NPSH

10) Explain the meaning of the second bulleted statement on page E1-138 (143). Describe the effect of this assumption on the level calculation. The material is minimal compared to the volume below EL 21'.

11) Explain the meaning of the first bulleted statement under Unit 1 Sump Temperature on page E1-138 (143). The exact sump temperature at recirculation actuation signal (RAS) has minimal effect on the NPSH calculation and was assumed negligible.

12) Describe how the maximum sump temperatures during recirculation were determined. Are these from limiting temperature cases? Single cooling train failure, maximum RWST temperature?

13) For the minimum sump level calculation, discuss whether the holdup on horizontal and vertical surfaces includes water flowing on those surfaces or whether only droplets due to spray and condensation are included. If flowing water is not accounted for, provide justification.

14) Explain why reduced containment pressures (lower than TS minimum) are used for the NPSH calculations? (Item 3.g.14)

Coatings

15) Verify that there are no un-topcoated inorganic zinc (CZ-11) coatings that are treated as qualified coatings in the analysis. If there are un-topcoated qualified inorganic zinc coatings, provide justification for using a 4D ZOI. The use of a 4D ZOI is appropriate for epoxy systems or epoxy on top of inorganic zinc, however staff guidance recommends a 10D ZOI for un-topcoated inorganic zinc.

Structural

16) Provide the differential pressure assumed for the structural analysis for the Unit 2 strainer.

17) Does the discussion on page E1-179 apply to both units or just Unit 2?

In-Vessel

18) Describe how the penetration test results are scaled up to the plant.

19) The photo for fiber preparation for Unit 2 penetration testing is difficult to see and appears to have significant clumps of class 3 and 4 fiber in it (Figure 3.n.1-9 on page E1-214). Verify that the fiber preparation for this test resulted in a majority of the debris, by mass, being class 2 fiber.

20) The staff did not review the in-vessel portion of the submittal other than to review the strainer penetration testing portion. An approved basis and methodology for in-vessel debris limits is needed before the acceptability of in-vessel effects is performed.

Chemical Effects

21) Provide an overall discussion of the chemical effects methodology and assumptions used including how aluminum solubility was credited.

22) The temperature values provided for the post-LOCA sump temperatures appear to be lower than the assumed sump temperature at swap-over to recirculation. The values are about 160 °F at 20 minutes compared to a maximum recirculation temperature of about 190 °F. Explain the sump temperature profile used in the chemical analysis.

Regulatory

23) Use of a Region II analysis implies that the regulations cannot be met using Region I guidance. The flashing evaluation uses R-II methods. Describe how using a R-II analysis shows that the plant can meet the regulations and associated staff R-I guidance. (Related to Headloss comment above.)

Appendix B – Turkey Point (PTN) Questions for Discussion

Break Selection

1) Justify that the use of eight angular orientations to evaluate debris generation produces reasonably limiting debris loads for specific break sizes and locations. For PTN3 this is not an issue since only double-ended guillotine breaks (DEGBs) are evaluated. For PTN4, there is considerable margin between the minimum debris generation break size (DGBS) and the 23 inch size used in the analysis. This may provide adequate conservatism to address this issue. However, all analyses should consider the limiting debris amount from each break location.

2) Figure 3.a.1-1 shows what appears to be the pressurizer surge line with only one break location. The line is at about the 7 o'clock position on the drawing. A similar observation was made for the line shown in Figure 3.a.1-2 at about 1 to 2 o'clock. This line appears to be missing a weld or two. Verify that all welds described to be in the scope of the evaluation were analyzed for debris generation. This may not be necessary for PTN3 since a R-II analysis is not used.

Debris Generation

3) Provide the basis for the ZOI used for ceramic fiber. It is stated that it is assumed to have the same properties as Temp-Mat, but no basis is provided for the assumption. Temp Mat is fiberglass based while ceramic fiber is made of ceramic fibers.

Debris Characteristics

4) Provide the materials of construction for the reflective metal insulation (RMI).

Transport

5) Discuss whether any small debris will be washed down in the annulus. This is not shown in Figures 3.e.1-4 and 5.

6) Explain how it was determined where debris would transport (cross hatched areas) as shown in Figures 3.e.1-7 and 9. Why is no debris in the annulus shown as transporting?

7) Provide the basis for the Cal-Sil erosion value of 17 percent. Confirm that the Cal-Sil is of the rigid pressed type, not molded.

8) For PTN4, describe how the interceptors were assumed to affect flow and debris transport. Include a description for fine and larger debris sizes. Provide details of the interceptor construction (opening size, height, clearances at walls, etc.) to allow the staff to validate the assumptions regarding the effect of the interceptors on transport.

Headloss and Vortexing

9) The PTN3 strainer vortex evaluation depended on comparison to PSL testing. The PSL strainer has the plenum at the bottom of the strainer while the PTN3 strainer has the plenum on the side. The PTN 3 strainer configuration would likely result in higher

strainer approach velocities near the top of the strainer than the PSL strainer. Vortices are more likely to occur with higher velocities near the surface of the pool. Discuss how this design difference was considered in the evaluation. Comparison of average velocities may not be adequate for this comparison. The staff was unable to determine whether the conservative velocities and submergence used in the PSL1 testing was adequate to compensate for the potential higher velocity near the surface for the PTN3 strainer.

10) The PTN3 debris laden vortexing evaluation did not appear to address the submergence associated with a small-break loss-of-coolant accident (SBLOCA). The PSL1 test submergence with debris present was stated to be 6.5 inches. The SBLOCA submergence for PTN3 is about half of that value. For breaks above the pressurizer, the submergence was stated to increase quickly, so these breaks may be adequately covered by testing. The SBLOCA at the hot leg centerline was not addressed. The flow velocity issue discussed above should also be considered since a SBLOCA may not generate enough debris to cover the strainer. In addition, the debris may collect differently on the PTN3 strainer because the plenum is on the side instead of the bottom.

11) For the PTN4 strainer, the debris laden vortex testing does not appear to bound the SBLOCA conditions. Discuss whether the level increases above the minimum SBLOCA condition, and the timing and magnitude of any level increase. It may be demonstrated that significant debris will not be deposited until the level reaches the tested value.

12) For the comparison between the PSL1 strainer test and the PTN3 strainer, how was the design difference regarding the plenum location evaluated? It appears that the PSL1 strainer is more likely to promote a non-uniform bed because gravity and the higher flow rate at the bottom of the strainer would promote the collection of debris at the bottom of the strainer. The higher test velocity used in the PSL1 tests could have also increased the non-uniformity of the bed.

13) The submittal states that the PTN4 R-II chemical head loss is based on the PTN4 headloss test results. The PTN4 results are stated to be 0.39 psi. The PBN conventional debris head loss is used for the PTN R-II conventional head loss. The PBN chemical head loss is 0.55 psi and likely would have been higher had more chemical precipitate been added. Provide a basis for assuming that the PTN4 R-I chemical headloss is valid for the higher R-II debris load considering that the chemical head loss is at least partially dependent upon the conventional debris bed to which the precipitates are added. The staff found that the PBN head loss increased significantly following the final chemical debris addition indicating that it may have increased further had more chemicals been added. The use of PTN4 chemical headloss, which occurred on a debris bed with insufficient conventional debris, and the potential for increased headloss from chemical precipitate that was not added should be addressed.

14) The PBN testing did not bound the debris loads for PTN4 R-II. Plotting the debris loads for the PBN test from (PTN) Table 3.f.7-5 on Figure 3.f.7-1 shows that there are several breaks above and to the right of the test points (they have more fiber and Cal-Sil than was tested). Provide an evaluation of the headloss that would be associated with the breaks not bounded by the testing. The potential for increased headloss from conventional debris and that from chemical debris should be evaluated. The staff notes that the PBN tests had significantly more particulate debris than PTN, but a valid basis

for crediting particulate coating debris to account for a test deficient in Cal-Sil was not provided. The submittal states that there is about 7 times the break amount of coatings particulate in the test. It is likely more relevant to compare the excess coatings amounts to the Cal-Sil that was not included in the test although the staff is not aware of a precedent for determination of an equivalent amount of coatings to account for Cal-Sil. The submittal also states that excess particulate accounts for fiber that was not included in the test amount. This was not justified and substitution of any type of debris for fiber has not been accepted by the staff in previous evaluations. Provide a justification for this assumption.

15) Describe the basis for the assertion that the value in Table 3.f.7-6 maintains a 50 percent margin above the potential plant values considering that the headloss associated with chemical effects may have been underestimated because some breaks were not bounded by the test debris loads.

16) The PTN 3 flashing evaluation uses a methodology described in Section 6 of NEI 04-07 for a Region II analysis. The staff SE on the R-II methodology states that analyses that credit additional pressure should be based on the pressure in the containment, not absolute pressure. The SE also states that the staff expects that licensees will provide detailed information regarding more realistic assumptions when applying them in their GL responses. The justification for the flashing evaluation does not contain the information requested by the SE. The accepted method to show margin to flashing is to perform a conservatively high sump temperature calculation and a conservatively low containment pressure calculation, then compare the saturation pressure and temperature from these calculations to show flashing will not occur. An alternate method is to use design basis and potentially realistic containment calculations to show a large margin to flashing. A R-II analysis of this type is not to be used, even for R-II, unless all other options have been exhausted. Provide a similar justification for the PTN4 R-I flashing analysis.

<u>NPSH</u>

17) Describe how the potential for void fraction at the pump inlet at less than the 2 percent limit was evaluated for effect on NPSH margins? RG 1.82 provides guidance for increasing NPSH required as void fraction at the pump suction increases from 0-2 percent. If the RG 1.82 guidance is not followed, provide assurance that the pumps will operate for the required time period considering the void fractions predicted at the pump suction.

18) Describe the experiments that demonstrated that blockage or reduced flow in the PTN3 and 4 refueling canal drains will not occur. Justify any assumptions and provide the basis for the conclusion.

19) Describe how water flowing on vertical and horizontal surfaces was accounted for when determining the minimum sump water level. The submittal states that water droplets formed by steam condensation and spray are accounted for, but does not discuss holdups due to flowing water.

20) Use of containment pressure above that present prior to the postulated LOCA, for calculation of NPSH margins, may require a LAR. See regulatory comments.

Coatings

21) The response reports a dry film thickness of 12 mils for Carboline 890N epoxy qualified coatings. Was this coating system applied as a single coat or were there multiple coats applied? The manufacturer recommends that a single coat application be 4 to 8 mils and not exceed 10 mils. The intent of the staff question is to determine if the coating thickness used in the analysis is bounding with respect to the debris generated in the ZOI for qualified coatings.

Chemical Effects

22) Provide an overall discussion of the chemical effects methodology and assumptions used including how aluminum solubility was credited.

23) Provide a comparison of the tested debris loads to the potential chemical loads in the plants. It appears for PTN3, that the conventional debris load is small and chemicals might not have a large effect. PTN3 (PSL1) test used 125 kg of aluminum oxyhydroxide (AlOOH) and 212 kg of sodium aluminum silicate (SAS).

24) For PTN4, it appeared that the last batch of chemical precipitates added to test 2 resulted in headloss increases. Evaluate the potential for increases in headloss from precipitate amounts greater than those tested. (The design basis chemical amount was not added.)

25) The reactor cavity volume is assumed to be stagnant except for reactor cavity breaks. There is a significant amount of aluminum RMI predicted to be in the cavity. Explain whether aluminum in solution in the cavity could disperse into the sump pool over time. If the fluid in the cavity may communicate with the pool, provide a chemical effects evaluation that accounts for this.

Structural

26) Provide justification that loads greater than those tested will not cause differential pressure across the strainer to exceed its structural capabilities.

27) Provide a more detailed discussion of the pipe whip analysis.

Screen Modification Package

28) A significant area of the PTN3 strainer is stated to be obstructed in the submittal. Is the obstructed area capable of passing flow through the perforations? Explain how the area is obstructed. The smaller strainer area was referenced in the headloss evaluation which is conservative even if flow can pass through the obstructed area. The opposite is true for penetration testing. State whether the penetration evaluation used the original area or unobstructed area.

Downstream Effects – Fuel and Vessel

29) Provide the test conditions for the Diablo Canyon (DCPP) penetration testing. Comparison between the plant conditions may not provide the information necessary to

determine if the DCPP test provides an adequate basis for the PTN3 penetration estimation.

30) Provide the date and location of the performance of the referenced DCPP penetration testing. The NRC has information on testing performed by DCPP in 2008.

31) On page E1-227 (233), the submittal states that the first two batches of fiber in the DCPP penetration testing were 100 percent Kaowool fines. On pages E1-232-233 (238-239) the test description states that the first two batches consisted of Nukon, Kaowool, and Temp-Mat in identical quantities for each batch. However, all of the Kaowool was added in the first two batches. Provide the correct description for the debris addition sequence. This distinction is important because Kaowool is more likely to penetrate than Temp-Mat or Nukon as stated on page E1-227 of the submittal. Nukon and Temp-Mat could deposit on the strainer and prevent some Kaowool from penetrating.

32) Provide a comparison of the potential fiber source terms arriving at the PTN3 strainer and the fiber batches added to the DCPP testing. Justify that the mixture used in the DCPP testing is an acceptable surrogate for PTN3.

33) The configuration of the strainer at PTN3 is different from that of DCPP. DCPP has a front and rear module. The front module has the plenum on the side and the rear module has the plenum on the bottom. The PTN3 strainer has only a plenum on the side. Describe how the difference in strainer configuration was considered when applying the DCPP testing to the PTN3 condition.

34) Provide the batch sizes broken down by material for each of the PTN4 penetration test debris additions. The batch masses are provided, but not the amount of Nukon and Temp-Mat in each.

35) The staff did not review the in-vessel portion of the submittal other than to review the strainer penetration testing portion. An approved basis and methodology for determining in-vessel debris limits is needed before the acceptability of in-vessel effects is performed. The staff noted that the simplified method for the PTN4 hot-leg break appears to be conservative.

Regulatory

36) PTN4 is using a Region II analysis as described beginning on page E1-14 of its submittal. Use of R-II analyses implies that the most challenging breaks cannot be mitigated using accepted R-I guidance. The premise for allowing a R-II analysis is that breaks above the debris generation break size (DGBS) (or transition break size (TBS)) are unlikely and therefore a less rigorous treatment is required. If all breaks can be treated deterministically using approved R-I guidance, the R-II analyses should not be required. Please describe how the use of a R-II analysis allows compliance with regulations without changing the licensing basis or requiring an exemption. If PTN4 is using another plant’s strainer test to show that it can meet the requirement for the largest breaks, this can be done by demonstrating that the other test program conditions are equivalent to, or more challenging than, PTN4 plant conditions. This does not require a R-II analysis. A R-II analysis is required only if the largest breaks cannot be mitigated.

The staff notes it appears that the headloss from the strainer testing (including that from another site) used in the PTN4 analysis is greater than available NPSH margin for PTN4 and did not cover the range of potential debris loads at PTN4. Therefore, a R-I analysis may not adequately address the larger breaks. Application of a R-I analysis requires a valid test that bounds all plant debris loads and results in positive NPSH margin, calculated using the design basis NPSH methodology.

37) PTN4 is crediting an increase in containment pressure to assure adequate NPSH margins. Unless PTN4 already has the use of accident pressure documented in its licensing basis, a LAR is required for this credit. RG 1.82 states, “The predicted performance of the ECCS and the containment heat removal pumps and their associated strainers should be independent of the calculated increases in containment pressure caused by postulated LOCAs to ensure reliable operation under a variety of possible accident conditions.” RG 1.82 states further, “The design of the emergency core cooling and containment heat removal systems should ensure that sufficient available NPSH is provided to the system pumps, assuming the maximum expected temperature of the pumped fluid and no increase in containment pressure from that present before the postulated LOCA. It is conservative to assume that the containment pressure equals the vapor pressure of the pool water. This ensures that credit is not taken for containment pressurization during the transient.”

In SRM-SECY-11-0014 (ADAMS Accession No. ML110740254) the Commission approved Option 1 of the associated SECY on use of containment accident pressure. Enclosure 1 (ADAMS Accession No. ML102110167) of the SECY (ADAMS Accession No. ML102590196) contains the current staff guidance on the use of containment accident pressure.

The following is from a PTN response to a request for additional information (RAI) for its extended power uprate (EPU) documented in ADAMS Accession No. ML11151A204.

> The suction source elevation (RWST or sump) is minimized for the specific system alignment, and the water source surface pressure is assumed to be the saturation pressure of the liquid. By making this assumption, the atmospheric pressure and the vapor pressure terms in the NPSHA equation cancel out, and no credit is taken for elevated pressure at the liquid surface. The pump flow rate is maximized to result in a conservatively high NPSHR from the vendor pump curve, and a high flow rate through the suction piping losses are calculated to minimize the NPSHA.

The PTN4 GL 2004-02 submittal does not appear to be consistent with the assumptions from its EPU RAI response. If the increase in containment pressure is required only for R-II breaks, Section 6 of NEI 04-07 and the staff SE provide a technical justification for using alternate assumptions. However, the NEI guidance and staff SE require that exemptions or license amendments are needed for licensing basis changes. The guidance also states that new containment analyses may be required if accident pressure is credited for NPSH calculations. Provide the required licensing basis changes and containment analyses or justify that they are not required.

Appendix C – Point Beach (PBN) Questions for Discussion

Break Selection

1) Partial breaks were evaluated at 8 orientations. Justify that the use of eight angular orientations to evaluate debris generation produces reasonably limiting debris loads for specific break sizes and locations. Considering that the transition break size (TBS) used for Point Beach is larger than the approved TBS, there may be adequate margin.

2) Figure 3.a.1-1 does not show breaks at the reactor nozzles for Unit 1. Verify that all welds described to be in the scope of the evaluation were analyzed for debris generation.

Debris Generation

3) Verify that the cassettes that contain mineral wool are at least as robust as those tested and found to have the destruction pressure of 114 psi as found during air jet impact testing for BWRs. The staff has accepted that cassettes with welded (including spot welded) seams can be credited with a relatively high destruction pressure, but cassettes with riveted seams have a much lower destruction pressure.

Transport

4) Provide details on the design of the interceptors (flow diverters) that are credited with slowing and lengthening the debris flow path to minimize debris transport. The staff requests this information to validate the assumptions associated with debris behavior as it interacts with the interceptors.

5) Referencing steps 5-7 of the basic transport methodology on page E1-45, discuss how the final debris locations prior to recirculation were determined. Would washdown result in further redistribution of the small debris? (e.g., Figure 3.e.1-4)

6) Confirm that the Cal-Sil installed at Point Beach is not manufactured using a molding process, but is the rigid pressed type. This information is needed to validate the erosion rate assumed for the material.

7) The recirculation transport cases all consider either the A or B pump running. Provide justification for not performing a case with both pumps running. For R-I analysis it is likely that a single pump running is conservative from a transport perspective because debris is split if two pumps are running. For R-I the assumption should be examined to ensure it is valid. For R-II cases that requires both pumps, additional total debris may transport due to higher velocities and turbulence in the pool. For the audit, in order for the staff to attain better understanding, consider demonstrating recirculation cases that include the effects of various break locations, pump combinations, and debris interceptors on transport. R-I and II cases may be demonstrated.

8) Table 3.e.6-3 indicates that 16 to 17 percent of large pieces (fiber and RMI) are washed down the refueling canal (RFC) drains. Discuss how this washdown physically occurs and whether it could cause blockage of the RFC drains or reduced flow through the drains. The 17 percent assumption does not appear to be consistent with the

description of the refueling canal strainer in Section 3.i (upstream effects), which indicates that only small debris can pass through the strainer. Some portion of large fibrous debris could pass through as eroded fines.

Headloss and Vortexing

9) It appears that some R-I breaks could have lower submergence than that present during the test used to demonstrate that no vortex will occur. These breaks would also have lower debris amounts. Discuss how these cases were evaluated for vortex formation, flashing, and degasification. Clarify the rate at which the sump level increases above the minimum level. Is this rate faster than the potential for increase in head loss due to debris deposition on the strainer?

10) The transport evaluation did not list any paint chips as transporting to the strainer. Provide the basis for including paint chips in the testing. Provide the basis for not including paint chips in the transport analysis?

11) Describe the difference between the debris surrogate types paint chips and pressure washed paint chips. Provide a description of what each of these was a surrogate for.

12) For the thin-bed test with the head loss trace depicted in Figure 3.f.4-10, discuss how it was determined that a filtering thin bed formed before adding the chemical debris. The confirmatory test, with less fiber, resulted in higher headloss prior to the addition of chemical debris and there is a discrete point at which it appears that a filtering bed was formed (immediately after the fiber batch 4 addition). No such increase in headloss occurred in the thin-bed test.

13) Clarify statement 3 on page E1-109. It states that all four tests bounded the coating debris loads. It appears that full debris load (FDL) Test 2 had a lower coating amount than predicted for the PBN2 Region I bounding breaks.

14) Figure 3.f.7-3 includes a data point with a fiber value greater than 200 lb. This value is not shown in Table 3.f.7-4 which lists the bounding fiber break as 97 lb. Provide a discussion to clarify what the values in Tables 3.f.7-3 and 4, and Figure 3.f.7-3 represent and discuss the apparent discrepancy. Provide a similar discussion for Figure 3.f.7-4 and Table 3.f.7-5, which also indicate that fine fiber amounts greater than those in the table may be produced and transported.

15) The last chemical addition during head loss testing (FDL Test 1) resulted in significant headloss increase. The staff disagrees with the statement on page E1-115 that the final headloss increases were negligible. Provide a justification as to why additional chemical additions were not made. Reactor cavity breaks are not bounded for chemicals.

16) Explain why it is reasonable to use thin-bed test results to determine the head loss for PBN2 Region II when the test was deficient in both fiber and Cal-Sil. It is also important to note that the test did not indicate that a thin bed formed, when conversely, a thin bed formed during the confirmatory test that had lesser fiber amounts.

17) The comparison of the PBN1 R-II loads to the thin-bed test is questionable because of the thin-bed test results. The thin-bed test did not indicate that a filtering bed had

formed and the confirmatory test, that included lesser fiber amounts, resulted in the apparent formation of a filtering bed.

18) Justify that the R-I breaks demonstrate acceptable performance for flashing and deaeration. The methodology in the submittal is approved for R-II breaks which is to be used only after other evaluations have proven inadequate. The accepted method to evaluate flashing and deaeration for R-I breaks is to show significant margin by maximizing sump temperature and minimizing containment pressure and comparing thermal hydraulic conditions, or showing significant margin using design basis and/or realistic containment analyses.

19) The submittal states that the void fraction at the pumps is less than 2 percent, but does not state whether void fractions are accounted for in the NPSH calculation as discussed in RG 1.82. Describe how deaeration between 0-2 percent is accounted for in the NPSH analysis. If is it is not accounted for, justify that the pumps will operate as required with anticipated void fractions for the duration of the recovery period.

20) The statement on Page E1-135 regarding R-II breaks being bounded by tested debris loads appears to be inconsistent with the headloss section (Cal-Sil not bounded). Provide clarification of the statement.

Coatings

21) Verify that there are no un-topcoated inorganic zinc (Dimetcote 6) coatings that are treated as qualified coatings in the analysis. If there are un-topcoated qualified inorganic zinc coatings, provide justification for using a 4D ZOI. The use of a 4D ZOI is appropriate for epoxy systems or epoxy on top of inorganic zinc, however staff guidance recommends a 10D ZOI for un-topcoated inorganic zinc.

22) Provide a description of the actively delaminating qualified coating system(s) from which paint chips originate. Are these entirely epoxy systems or are some chips from inorganic zinc topcoated with epoxy?

In-Vessel

23) The staff did not review the in-vessel portion of the submittal other than to review the strainer penetration testing portion. An approved basis and methodology for in-vessel debris limits and amounts is needed before the acceptability of in-vessel effects is performed.

Chemical Effects

24) Provide an overall discussion of the chemical effects methodology and assumptions used including how aluminum solubility was credited.

Structural

25) Provide the design crush pressure for the strainer for both units.

Licensing Basis

26) Ensure that Point Beach updates the TS bases and FSAR to clarify the methodology being used for R-II.

Appendix D – Seabrook Questions for Discussion

The NRC staff identified many of the issues documented below as RAIs during reviews of previous submittals. The staff did not find these issues adequately addressed in the current submittal for Seabrook.

- The most significant issues identified in the current submittal were identified in August 2009 RAIs sent to Seabrook (ADAMS Accession No. ML091210519).

- As documented in a public meeting summary for November 17, 2009 (ADAMS Accession No. ML093350036), the staff stated that small fines are not a suitable test surrogate for fine fiber. The staff found that the licensee used small pieces for testing based on licensee information.

- During a December 4, 2009 (ADAMS Accession No. ML100120377), meeting the staff restated its concerns from the August 2009 RAIs. The NRC staff stated that they remained concerned with the amounts and characterization of debris assumed to reach the strainer, and that testing did not adequately model the plant or the assumed debris characteristics. The licensee stated its intent to retest debris interceptors using 100 percent fine fibers. The licensee also stated it would consider the other identified debris generation and transport issues.

- In a public call in March 2010, Seabrook stated their intent to perform updated testing that meets staff guidance. Seabrook stated that 100 percent of the fines generated would be assumed to transport to the strainer in their analysis. (This is true for Region I in the current submittal.) Seabrook also discussed performing erosion testing and stated plans for replacing Nukon within the ZOIs with RMI.

The major sources of guidance that should be used for this evaluation are the NEI guidance, NEI 04-07 (ADAMS Accession No. ML050550138) and the associated staff SE (ADAMS Accession No. ML050550156), the NRC revised content guide (ADAMS Accession No. ML073110278), and the March 2008 staff guidance in the areas of Coatings (ADAMS Accession No. ML080230462), Chemical Effects (ADAMS Accession No. ML080380214), and Strainer Testing (ADAMS Accession No. ML080230038). NEI guidance for fibrous debris preparation can be found at ADAMS Accession No. ML120481057. RG 1.82 also provides more general, yet significant guidance for these evaluations, including references to additional guidance documents.

<u>Break Selection</u>

1) Justify that using eight orientations selected for partial break debris generation analyses adequately identifies the limiting debris amounts. For all breaks it is required that the most limiting break be mitigated. Seabrook uses a 17 inch DGBS for its transition from R-I to R-II.

Debris Generation

2) The submittal states that reactor nozzle break ZOIs were truncated at the primary shield wall and also included a line of sight out the nearest primary shield penetration. Clarify whether there are other lines of sight through other penetrations that were not included.

3) Provide the basis for not including the Microtherm and Temp-Mat insulation on the reactor top and bottom heads in the evaluation.

4) Explain why the proportion of small and fine fibers generated is much lower for the limiting partial break cases than the DEGB cases. (See Tables 3.b.4-1 and 3.b.4-2.)

Transport

5) Provide details on the design of the debris interceptors (annulus and bioshield) installed at Seabrook. Provide the heights, widths, methods of attachment to the floor and wall, clearances between the floors and walls, and details on the plate, screen, grating, wire mesh cloth, etc. used to capture debris.

6) Provide details of the testing conducted to determine the penetration and bypass, or efficiency characteristics, of the debris interceptors. Information similar to that provided for strainer testing should be included. For example, design of test, test termination criteria bases, debris preparation and addition details, test screen comparison to plant interceptors design, debris amount captured by each test screen, plant velocities and bases, test velocities, and plant submergence range and tested submergence. Other details may be requested as information regarding the testing is better understood by the NRC staff. Unless specifically requested not to, provide the information below for both interceptor test programs.

    a. Describe the analysis used to compare the bioshield interceptor testing 1/8 scale model to the plant condition. Provide the critical parameters considered in the comparison and how it was verified that the critical parameters were adequately modeled.

    b. How was the material that remained within and that which exited the annulus area in the bioshield testing captured and the mass quantified?

    c. The submittal states that the results of the bioshield testing were not used in the transport analysis, but that the bioshield interceptors were assumed to be completely blocked. Describe how it was determined that assuming these interceptors are blocked is a valid or conservative assumption.

    d. Provide characterization of the debris added to the testing for both test programs.

        i. How was each size category of the debris prepared and characterization determined?

        ii. What was the debris size distribution for each category? Please refer to NUREG/CR-6808, (1:2) Cover – Chapter 4, “Knowledge Base for the Effect of Debris on Pressurized Water Reactor Emergency Core Cooling

Sump Performance," (ADAMS Accession No. ML030780733) Table 3-2 for fiber size classes and describe the classes of fiber (1-7) used for each size category (fine, small, large, intact).

iii. How much water and fiber was included in each batch (grams of fiber per liter of water)?

iv. How many batches were added?

v. How long did it take to add each batch?

vi. How much time elapsed between additions?

vii. What container size was used to add the debris?

viii. How was the debris mixed prior to addition?

ix. How much time elapsed between final mixing and the addition?

x. Was the debris continually mixed during addition?

e. Describe the debris addition points and compare them to the transport analysis. Describe how blowdown, washdown, pool fill, and recirculation were considered in the design of the testing and application of the results.

f. Describe the methodology used to determine the amounts of fine and small debris bypassing the annulus debris interceptors (DIs) was determined. (Fine holdup is credited in R-II analysis.)

g. Provide size of the openings in the debris capture screens in the test apparatus. (Ref. Fig. 3.e.4-2) Compare the test screen design to the plant screens. Provide an evaluation of whether debris could pass through the debris capture screens and if so, how it would affect the test results.

h. It is stated that only 75 percent of the retention fraction for fines is credited for R-II.

i. State whether fine and small debris were tested separately. If not tested separately, justify that a combined test can provide accurate quantifiable results.

ii. If separate testing was not performed, state the method for determining the fine and small retention factors.

iii. Provide the masses of fines added to the tests and the bypassed amounts.

iv. Provide the masses of smalls added to the tests and the bypassed amounts.

v. It appears that the debris passed through a pump and control valve after bypassing the interceptor. Discuss whether this could have had an effect on the debris characterization of the bypassed debris.

i. Describe how the turbulence in the DI testing was measured and compared to the plant turbulence. (Testing at a smaller scale has been demonstrated to create lower turbulence than the plant condition.) Consider flow streams and objects in the plant that could affect turbulence.

j. Provide the amounts and characterization of any debris that settled away from the DI(s) during testing.

k. Provide the time periods for the interceptor tests. Include timing of important events like test start, flow changes, debris addition timing, etc.

l. Provide the test termination criteria and the basis for their acceptability. The submittal states that the annulus interceptor test was continued until the rate at which fiber left the bioshield area was less than 0.1 lb/hr. Provide the basis for this value. For the additional acceptance criterion for increases in bed length and height, provide the basis for the choice of 1/8 inch per hour bed length and height increase. Provide extrapolation of the test acceptance criteria to effects in the plant.

m. The results of a single test with particulate debris was provided.

   i. It appears that the addition of particulate to the test reduced the bypass percentage.

      1. Provide observations of fiber transport to the DI compared to similar tests without particulate.

      2. Theoretically, the particulate in the bed would decrease the porosity thus inhibiting flow through the bed and DI resulting in an increase in the fluid velocity over the DI. This could increase the bypass. Provide details on observations made with respect to the reduction in bypass for the particulate case.

      3. Particulate might inhibit small fiber bypass while increasing fine fiber bypass. Provide the bypass fractions separately for small and fine fiber measured for this test.

      4. Provide the debris introduction methodology for the particulate and fiber for the particulate annulus interceptor test. Include any changes in the fiber introduction methods for that specific test.

   ii. Describe the phenomena that resulted in lower bypass amounts for the test that included particulate.

iii. Describe the method used to determine the amount and size classification of each debris type that penetrated, or passed over the strainer and that which remained upstream.

n. Describe how the amount of debris that could transport to the upstream of each interceptor was determined and how this was modeled in the tests or how the application of test results considered the range of amounts that could arrive at each interceptor.

o. Describe how eroded fines were treated with respect to debris interceptor capture for the annulus interceptors. Provide the transport analysis assumptions with respect to erosion of small (and fine for R-II) debris. Discuss whether any eroded fines are assumed to be trapped by the interceptors.

p. Provide a justification for using a test article that is taller than some of the plant interceptors.

7) Figure 3.e.1-4 shows the distribution of small debris in lower containment at the start of recirculation. Discuss whether the figure shows debris blown to upper containment and washed down to lower containment. For example, it appears that some debris would be washed in other areas not shaded in green.

8) In Figure 3.e.1-6, it is not clear why some areas inside the shield wall do not support transport. The cross hatched area border is clearly drawn through an area of red on the east side of the reactor cavity. It also appears that debris on the west side of the cavity would also support transport unless there are obstructions (DIs?) to flow that are adequate to fully prevent transport. Describe any obstructions.

a. If transport of small (and large) debris is prevented, but it remains in a high flow/high turbulence area is it more likely to be eroded beyond the assumed value. This appears to be the case if debris is trapped on the west side of the cavity. Describe how this potential effect was evaluated.

9) In the pool fill transport section, there is a statement that all debris laden break flow has to pass through 2 interceptors prior to reaching the strainers. Discuss whether washdown flow can reach the strainers without passing through interceptors.

10) The discussion of the R-II transport evaluation did not provide adequate justification for changes in fine debris transport fractions. Provide the methodology for determining these values along with one or more examples of how the values were calculated.

11) The NRC staff safety evaluation (Section 6.4) for the NEI 04-07, Section 6 analysis, states that debris generation and transport analyses for the R-II breaks use the same methodology as R-I breaks due to significant uncertainties and the limited amount of experimental and analytical information available to improve the models. The Seabrook transport evaluation does not follow this guidance for fine debris transport. Specifically, all fine debris in the pool is assumed to transport to the strainer. R-II allows timing dependent evaluations, not changes to other aspects of the R-I methodology. Provide an evaluation of fine debris transport that is consistent with guidance in the staff SE.

Headloss and Vortexing

The NRC staff guidance for headloss testing is intended to create test conditions that result in a headloss that will bound the head loss that may occur in the plant. The guidance is based on the regulations and is intended to provide reasonable assurance that the head loss determined by testing will not be exceeded in the plant. There are considerable unknowns involved in the determination of the headloss. For R-II analyses some parts of the guidance may be relaxed if the relaxations are shown to be realistic and in accordance with the NRC staff SE on the NEI guidance. The Seabrook testing described in the submittal does not provide adequate information to show that the test assumptions, inputs, and methods resulted in assurance that the tested headloss will be at least as high as that which may occur in the plant.

Provide responses to the questions below for the design basis cases for R-I and R-II unless otherwise noted. It appears that Seabrook is crediting the same test for R-I and R-II, but that test included fiber representing only about half of that predicted to reach the strainer from the limiting R-II breaks. Therefore, the staff did not find a test that suitably represented the R-II condition. Results for tests that included non-chemical debris adequate to represent the R-II cases were provided. The staff did not find justification for neglecting chemical effects in the submittal nor did it find any reason that the non-chemical test results were presented in the submittal. Because of the significant deficiency in debris amounts included in test S3-1S compared to the R-II debris amounts and the inclusion of test results from non-chemical tests, it is unclear which strainer test is intended to be applied to the R-II analysis.

12) Provide a discussion of whether the headloss testing simulated the flow and turbulence parameters as shown in Figure 3.e.1-5 or justify that testing bounded the potential range of plant conditions. Alternately show that the testing was conducted fully in accordance with staff guidance.

    a. Did headloss testing simulate the washdown flows near the strainer modules shown in Figure 3.e.1-2?

    b. If not, provide a justification. Consider potential variations in timing and volume of the flow that may occur.

13) Table 3.f.4-1 states that the test with the largest amount of Nukon included a fiber load scaled from 312 lb. The limiting transport case from Table 3.e.6-10 states that the maximum fine debris load for R-I is 271 lb. with 50 lb. small (for a single train). The transport analysis states that most of the fiber predicted to reach the strainer is fines. Describe the test methods used to ensure that at least 271 lb. of fines was represented in the testing and transported to the strainer. It also appears that the total amount of fiber included in the test (312 lb.) is less than the required amount (321lb). It is also not clear that latent fiber is included in the table values. Table 3.f.7-2 states that the bounding break fine fiber load is 283.45 lb. This information is different than the values from transport analysis and indicates that the test should have represented 333.45 lb. total fiber with at least 283.45 lb. of fines arriving at the strainer. Clarify how the bounding debris load for the R-I analysis was calculated and demonstrate that a valid test bounds the debris amounts for each size and type of debris calculated to arrive at the strainer.

14) The maximum fibrous debris load for R-II is 620 lb. fine and 600 lb. small for two train operation based on Table 3.e.6-12. Table 3.f.4-1 indicates that the maximum fiber load tested for two-train operation was 638 lb. It is unclear whether the transported value includes latent fiber. 638 lb. represents about half of the transported amount. Provide the basis for performing an analysis for the R-II cases considering that there is no test that included the appropriate amounts of debris, including chemical precipitates. Alternately, provide justification for not including chemical effects in the R-II analysis.

15) The response to 3.f.7 states that it is reasonable to conclude that small fiber will not have a significant impact on headloss. The submittal indicates that engineering judgment was used as a justification for this position. This position does not align with staff guidance. Engineering judgment may be used for R-II to estimate realistic behavior, but this statement applies to the R-I evaluation as well as R-II. Explain whether this statement is intended to apply to R-I, and if so, provide a basis for the claim. Also, for the R-II analysis, provide additional insights behind the engineering judgment applied, as the staff has not previously evaluated such a claim for a significant amount of debris.

16) Provide the amounts of each debris surrogate, broken down by size category, added to each test considered for the design basis and state what debris type it was assumed to represent.

17) Table 3.f.7-2 states that 39.55 ft^3 of unqualified (UQ) coatings was generated in the plant, but the test included surrogate that represented 16.11 ft^3. Provide the basis for including less than half of the UQ coating amounts in the test.

18) Provide an evaluation of whether unqualified coatings may fail as chips instead of particulate. If failure as chips is possible, evaluate the potential effects on strainer headloss.

19) The response to 3.f.12 states that near field settling was not credited during the headloss testing and that all debris had an opportunity to suspend in the water column and transport to the test strainer. Provide the following for all tests considered to define the design bases for R-I and R-II.

    a. Debris amounts settled near the test sector (e.g. in the test tank, not the mixing tank, possibly on top of the channel or simulated plenum),

    b. Debris amounts deposited on the strainer,

    c. Debris amounts settled in the mixing tank,

    d. Post-test photos of the strainer, mixing tank, test tank, and areas surrounding the strainer during and after drain down that demonstrate that near field settling did not occur and that only insignificant amounts of debris did not deposit on the strainer.

20) Describe the flow pattern approaching the strainer in the test and compare this to the strainer in the plant. In the test, the flow appeared to approach the strainer from the edge of the disk.

a. Compare the test and plant flow patterns.

b. Describe any mixing or turbulence used in the test tank.

c. If stirring or agitation was used in the test tank, describe how it was determined that the agitation did not disturb the debris bed.

21) Describe results of post-test inspections of the strainer. Describe the bed(s) that formed in terms of strainer coverage, uniformity, thickness, etc. Provide post-test photos of the strainer from the design basis test(s), prior to disturbing the debris bed.

22) Provide justification that the fiber used in the testing was prepared as 100 percent fine fiber. The response to 3.f.7 states that no small pieces of fiber were used in the test. This was not demonstrated in the submittal.

a. Figure 3.f.4-7 does not contain a majority of class 2 (fine) fiber. The wetted fiber is a mixture of small and fine fiber. The majority of the mass of fiber appears to be small, class 3 and 4. (Ref. NUREG/CR-6808.)

b. The submittal states that the fiber used in the testing was shredded 2x. The staff identified that 2x shredded fiber should be classified as small although it contains some fine fiber. The staff conclusion was based on test observations at both CDI and other test facilities that used 2x shredded fiber. Other tests run at CDI close to the time of the Seabrook test used 5x shredded fiber as fines based on operating experience from strainer testing. More recent industry guidance regarding the preparation of fine and small fibrous debris has been developed by NEI and reviewed by the NRC staff.

23) Provide information that shows that agglomeration of debris did not occur during the debris addition process. The submittal states that the fiber was added within a 35 minute span. Provide details on the fiber addition process.

a. Debris addition location(s) for the test,

b. Mass of fiber added in each batch,

c. Volume of liquid added with each batch,

d. Number of batches added,

e. Volume of container used to mix and add the debris,

f. Mass of particulate debris added in each batch,

g. Method of debris mixing prior to and during addition,

h. Time elapsed between final mixing and the addition of each batch,

i. Agitation used during debris additions,

j. Justification that 35 minutes adequately represents an adequate time period to simulate arrival of debris at the plant strainer.

24) Provide information and data that justifies the extrapolation method used (5 percent bump up) to determine the head loss expected at the end of the ECCS mission time. The staff was unable to determine how the method used applies to the data from the Seabrook testing. The extrapolation method includes a term related to turnover time. Explain the effect of turnover time on headloss after the debris has been deposited on the strainer. Staff guidance is that extrapolation of test results should be based on headloss test data.

25) Provide an evaluation of deaeration of the fluid as it passes through the debris bed and strainer.

<u>NPSH</u>

26) Describe how void fraction at the pump suction was accounted for in the calculation of NPSH margin?

27) The submittal states that it is assumed that there is no water trapped in the refueling canal. The submittal also states that to ensure that refueling canal (RFC) drains do not block, that strainers will be added to the RFC drain lines. The submittal further describes the drains as three 4-inch drains that combine into a 2 inch header.

    a. Provide the calculated post-accident flow rate through the drain header and the drains and justify that the relatively small header, and any head loss across the potentially debris laden strainers will not result in holdup.

    b. Provide details that justify the lack of holdup caused by the RFC drain strainers after they have accumulated debris.

    c. Demonstrate that the planned drain line strainer will prevent a 2 inch line from becoming partially or fully blocked with debris.

28) The response to 3.g.8 states that the water available from the RWST during swapover to recirculation is considered as a quantity of water diverted from the sump. Staff notes that it seems that this would be an addition to the sump. Subtracting this volume as a diversion would appear to be conservative. Explain what is meant by the statement.

29) Based on the response to 3.g.10 it appears that the sump level was recalculated and that the additions and holdups associated with sump level were also determined. A majority of these holdups were stated to have negligible effect on sump level. The staff does not understand why these holdups were not included in the updated calculation for sump level, pool height, and strainer submergence. It appears that the holdups that are not explicitly accounted for are small, but may not be negligible considering the low NPSH margins calculated for the containment building spray (CBS) pumps. Provide a value for each of the holdups and calculate the resulting sump level. The design values for strainer submergence and NPSH should be clearly developed and stated.

30) The response to 3.g.16 for the R-II analysis states that the partial pressure of air, prior to the accident (equal to 29.76 ft.), may be credited for the NPSH calculation as allowed by guidance for R-II. The staff SE on the R-II methodology states that analyses that credit additional pressure should be described in terms of pressure in the containment, not absolute pressure. The SE also states that the staff expects that licensees will provide detailed information regarding more realistic assumptions when applying them in their GL responses. The justification for the NPSH evaluation does not contain the information requested by the SE. A R-II analysis of this type is not to be used, even for R-II, unless all other options have been exhausted. The NEI 04-07 guidance states that elevated containment pressure is to be credited in the alternate evaluation methodology only after full consideration has been given to other possible use of more realistic models and assumptions in the analysis. The staff SE also states that a new containment analysis may be required when containment pressure is credited for the NPSH calculation. In addition, licensing basis changes may be required to credit containment pressure that has not previously been credited for NPSH calculations.

    a. Describe the realistic assumptions and models that were considered prior to crediting additional containment pressure.

    b. Provide the results of the realistic analyses.

    c. The NPSH analysis does not provide a valid debris head loss, including an evaluation of chemical effects, for the R-II analysis. It is unlikely that NPSH margin would be lost if a large containment pressure is credited. It is more likely that the structural margin of the strainer would be exceeded before NPSH margin would be lost. Provide a valid R-II head loss that is used in the evaluation and show that structural and NPSH margins will not be exceeded, or provide an alternate evaluation.

    d. Provide an evaluation of whether a new containment analysis is required as suggested in the NRC staff SE for NEI 04-07.

Coatings

31) The coatings analysis assumed that all unqualified coatings fail as particulate. Based on test results, it appears likely that a filtering bed did not form on the strainer. Guidance states that the evaluation should consider the addition of coatings as chips under these conditions. Justify adding all coatings as particulate.

32) Coating quantities added to the tests were less than those calculated to reach the strainer by the transport evaluation. Provide a basis for the acceptability of using less than the calculated coatings source terms for testing.

33) Provide the methodology used to scale from plant coating amounts to tested amounts. Discuss whether scaling is based on volume or mass.

Upstream Effects

34) A question regarding the potential for holdup in the refueling canal is asked in the NPSH section. No additional information is required for this section.

Screen Modification Package

35) Provide information on the design of the debris interceptors that will allow the NRC staff to evaluate their potential effect on debris transport. For example, what are the DIs constructed of? What are the opening sizes and shapes? How tall and wide are they? How are the openings between the DIs and adjacent structures or components closed off to prevent bypass?

Structural

36) Provide the maximum differential (crush) pressure for the strainer. If there are different values for the R-I and R-II analyses, please provide both values. If the value used in the structural evaluation is different from the design maximum differential pressure based on strainer testing, provide the structural design maximum differential pressure.

37) Provide a more detailed discussion of the pipe whip analysis. Include discussions of whether the accumulator skirt or scupper interceptors are in the path of a postulated pipe whip or jet spray.

38) Explain why the IR value of 1.0 is acceptable for the connector plate bolting.

Chemical Effects

39) Provide an overall discussion of the chemical effects methodology and assumptions used including how aluminum solubility was credited.

40) Provide a chemical effects analysis for the Region II breaks.

41) Clarify that "test strainer" and "test article" as described in 3.o.2.12 refer to the same test component. That is, confirm that all of the chemical precipitate deposited on the strainer/debris bed.

In-Vessel

42) The staff did not review the in-vessel portion of the submittal other than to review the strainer penetration testing portion. An approved basis and methodology for in-vessel debris limits is needed before the acceptability of any in-vessel effects evaluation is performed.

43) The submittal states that St. Lucie penetration testing was used to estimate the Seabrook strainer penetration. The NRC staff was unable to conclude that use of the PSL testing provides an adequate estimate of bypass for Seabrook.

   a. Provide the average and maximum approach velocities for the Seabrook strainer and the average and maximum approach velocities used in the PSL penetration testing. Explain why the values used in the testing are valid for the application to Seabrook considering that the Seabrook strainer had a significant area with no debris on it after the headloss test based on the results.

b. The staff noted that the Seabrook strainer is taller than the PSL1 strainer and that the PSL1 strainer had a significantly skewed debris deposition during penetration testing. It appeared that there was some open strainer area following the test. In addition, the Seabrook strainer has a larger debris load than the PSL strainer. Provide a basis for the conclusion that the PSL strainer test can be extrapolated to the Seabrook condition considering these parameters. Include an evaluation of the total strainer areas.

c. Provide the basis for the maximum fiber bed thickness calculated for Seabrook. Clarify whether the value was calculated assuming one or two strainers in service.

d. Provide the methodology used to scale from the test penetration amounts to the plant penetration amounts.

e. Based on PWROG testing, Temp-Mat fiber is significantly longer than Nukon after fiber preparation, and therefore less likely to penetrate the strainer. Provide a basis for the acceptability of applying the results of testing that included Temp-Mat to Seabrook. Provide the amount of each fiber type added in each batch during the PSL testing. Justify that including Temp-Mat in the bypass test would not result in a reduction of Nukon penetration.

f. Provide the basis for the equipment operational states assumed for the R-I and R-II in-vessel evaluations. Verify that the operators are instructed to secure a running CBS pump for R-I breaks. Clarify how the operators determine whether the break is a R-I or R-II break in order to determine how many CBS pumps should be operated.

<u>Licensing Basis</u>

44) The Seabrook submittal credits an increase in containment pressure to assure adequate NPSH margins. RG 1.82 states, “The predicted performance of the ECCS and the containment heat removal pumps and their associated strainers should be independent of the calculated increases in containment pressure caused by postulated LOCAs to ensure reliable operation under a variety of possible accident conditions.” RG 1.82 states further, “The design of the emergency core cooling and containment heat removal systems should ensure that sufficient available NPSH is provided to the system pumps, assuming the maximum expected temperature of the pumped fluid and no increase in containment pressure from that present before the postulated LOCA. It is conservative to assume that the containment pressure equals the vapor pressure of the pool water. This ensures that credit is not taken for containment pressurization during the transient.”

Credit for pressure in the containment, greater than atmospheric (or greater that the vapor pressure of the fluid for higher temperatures) for R-I or R-II require a LAR unless Seabrook’s current licensing basis currently includes such a credit. In SRM-SECY-11-0014 (ADAMS Accession No. ML110740254) the Commission approved Option 1 of the associated SECY. Enclosure 1 (ADAMS Accession No. ML102110167) of the SECY (ADAMS Accession No. ML102590196) contains the current staff guidance on the use of containment accident pressure. The NEI guidance and staff SE state that exemptions or license amendments are needed for licensing basis changes. The guidance also states that new containment analyses may be required if accident pressure is credited for NPSH calculations. Please provide the required licensing basis changes and containment analyses or justify that they are not required. (See the NPSH section above.)

45) Describe how changes to the FSAR and TS Bases will be implemented to describe the changes in single failure criterion for R-II breaks.

46) If approved prior to the installation of the strainers, the NRC staff SE on the exemption will need to include a license condition that the refueling cavity strainers are installed prior to the SE being valid. (Planned installation is May 2020.)

General

47) There is a statement on page E1-15 that "the defense in depth and safety margin considerations in RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," (ADAMS Accession No. ML17317A256) can be implicitly assured by the low probabilities of the events." The staff disagrees with this statement. Defense-in-depth and safety margins are separate from risk calculations and must be demonstrated in addition to the risk values.