PMSTPCOL PEmails

From: Elton, Loree [leelton@STPEGS.COM]
Sent: Wednesday, January 13, 2010 3:01 PM
To: Muniz, Adrian; Dyer, Linda; Wunder, George; Tonacci, Mark; Eudy, Michael; Plisco, Loren; Anand, Raj; Foster, Rocky; Joseph, Stacy; Govan, Tekia; Tai, Tom
Attachments: U7-C-STP-NRC-100007.pdf

Please find attached a courtesy copy of letter number U7-C-STP-NRC-100007, which contains responses to NRC staff questions included in Request for Additional Information (RAI) letter numbers 236 and 237 related to Combined License Application (COLA) Part 2, Tier 2 Appendix 6C.

The official version of this correspondence will be placed in today's mail. Please call Jim Tomkins at 805-215-6129 if you have any questions concerning this letter.

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Hearing Identifier: SouthTexas34Public_EX
Email Number: 2153

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January 13, 2010
U7-C-STP-NRC-100007

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

South Texas Project
Units 3 and 4
Docket Nos. 52-012 and 52-013
Response to Requests for Additional Information

Attached are responses to NRC staff questions included in Request for Additional Information (RAI) letter numbers 236 and 237 related to Combined License Application (COLA) Part 2, Tier 2 Appendix 6C.

Attachments 1 through 12 address the responses to the RAI questions listed below:

RAI 06.02.02-14	RAI 06.02.02-20
RAI 06.02.02-15	RAI 06.02.02-21
RAI 06.02.02-16	RAI 06.02.02-22
RAI 06.02.02-17	RAI 06.02.02-23
RAI 06.02.02-18	RAI 06.02.02-24
RAI 06.02.02-19	RAI 06.02.02-25

There are no commitments in this letter.

For RAI responses that make COLA revisions, these will be incorporated at the next routine revision of the COLA following NRC acceptance of the RAI response.

If you have any questions regarding these responses, please contact me at (361) 972-7206, or Bill Mookhoek at (361) 972-7274.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 1/13/2010

Mark McBurnett
Vice-President, Oversight and Regulatory Affairs
South Texas Project Units 3 & 4

jet

Attachments:

1. Question 06.02.02-14
2. Question 06.02.02-15
3. Question 06.02.02-16
4. Question 06.02.02-17
5. Question 06.02.02-18
6. Question 06.02.02-19
7. Question 06.02.02-20
8. Question 06.02.02-21
9. Question 06.02.02-22
10. Question 06.02.02-23
11. Question 06.02.02-24
12. Question 06.02.02-25

cc: w/o attachment except*

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CPS Energy

RAI 06.02.02-14:

<u>QUESTION</u>:

This RAI supplements RAI 06.02.02-6.

The staff has reviewed The Evaluation Report for Net Positive Suction Head of Pump in Emergency Core Cooling System (ECCS) (Report 1), The Supplementary Document for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer (Report 2), and The Evaluation example of the Head Loss of the ECCS Suction Strainer and Pipe in the ECCS Pump Run-Out Flow Condition (Report 3) which were submitted to support STP in showing they have a bounding head loss analysis. In accordance with 10 CFR 50.46(a)(1)(i) and Regulatory Guide 1.82 Revision 3, the NRC staff requests that the applicant provide the following information to assist the staff in completing their safety evaluation. According to Report 1 it appears that the Small Scale Test, which is reported on pages 10 and 11, is being used to determine correction coefficient for bed thickness (empirical shape factor) of a cassette shaped strainer. Report 2 also appears to explain that the Small Scale Test was used to determine the correction coefficient for bed thickness (empirical shape factor) and also the specific surface area used for the cassette-shaped strainer:

a.) The staff finds this to be confusing. The applicant should provide clarification for the use of the small scale testing and whether or not this testing is being used to not only determine the various parameters to be used in the theoretical head loss correlation, but also to determine empirical head loss data to be used in comparison of the theoretical calculation of head loss. Also provide information which describes what makes this small scale test conservative or prototypical.

b.) If STP is suggesting that the small scale testing used to show NPSH predicted under debris loading is conservative, the applicant should also provide clarification of why the four pocket vertical small scale test was chosen to be conservative or prototypical.

c.) The applicant provided in page 24 of Report 2 'Test Case' at the top of the page. The applicant did not distinguish if the three test cases are used to determine the theoretical correction parameters for the NUREG/CR-6224 correlation or if they were used to determine empirical head loss data to be used in comparison of the theoretical calculation of head loss. The applicant should distinguish the uses of these test cases and provide a description of what makes them prototypical or conservative with respect to the Reference Japanese ABWR plant scenario Loss of Coolant Accident (LOCA). The applicant should also provide detailed procedures along with a description of what makes the procedures conservative or prototypical with respect the Reference Japanese ABWR plant scenario LOCA. In addition:

i.) The applicant should provide detailed information along with the procedures explaining why the debris selection, (i.e. size and density), debris loading, and debris preparation (I.e. crushing or shredding) was chosen as conservative or prototypical.

ii.). The applicant should also address the conservativeness or prototypicality with respect to settling and approach velocity for the testing used to determine empirical head loss data.

iii.) The applicant should clarify how it determined the thin bed effect cases and discuss what guidance was used in determining the appropriateness of this being acceptable for a thin bed effect.

d.) The staff finds the reports to be difficult to follow. The staff and the members of the public need be able to understand the logic used to determine the methods selected and how the evaluation was performed. The applicant should be sure that the logic is clear throughout the reports.

RESPONSE:

Responses corresponding to each letter item are provided below.

Response to Item a:

There are 2 types of small scale testing used to design and qualify the Emergency Core Cooling System (ECCS) strainers:

1. The first small scale test is to determine the empirical shape factor (fg) for bed thickness of a cassette-shaped strainer. (The analytical correlation of head loss due to debris given in NUREG/CR-6224 is based on a one-dimensional strainer and would therefore under-predict the head loss for a cassette-type strainer that has the same surface area.) This scale testing gives fg factors for a range of debris bed thicknesses, as shown in Figures 4-4 and 4-5 of Report 1. These figures are used to select an appropriate fg for each ECCS strainer. Note that fg is a function of debris bed thickness, which is a function of the size of the strainers.

2. The second small-scale tests are to confirm that the analytical head losses for a final, as-designed strainer (for both Residual Heat Removal (RHR) and High Pressure Core Flooder (HPCF)) are conservative, and that the strainers are adequately sized. This head loss testing uses conditions, including scaled quantities of debris, consistent with all the design conditions. Therefore, it is a “prototypical” test. This testing is conservative because the testing facility has upward opening strainer pockets and all the debris reaching the strainer collects in them.

Response to Item b:

The small-scale testing with the upward opening strainer pockets is the most conservative arrangement. The number of the strainer pockets for testing is limited by the size of the CCI testing facility and the size of each strainer pocket. For the Reference Japanese ABWR (and thus for STP 3&4), four full-size strainer pockets can fit in the CCI vertical flow loop test facility. The debris included in each test is proportional to four divided by the total number pockets in the cylindrical strainer assembly for each ECC system.

In the actual plant, the strainer pocket cassettes are arranged in two cylindrical frames and are supported from piping tees on each ECCS suction line above the suppression pool floor. In the in-plant case, gravity would oppose debris being sucked into the strainer pockets on the underside and sides of the cylindrical strainer frames. The debris collection in the in-plant strainers would not be any greater than the collection of debris in the upward opening cassettes in the small-scale test fixture. Therefore, the small-scale test cannot be less conservative than the actual in-situ strainers.

Response to Item c:

The test cases shown on page 24 of Report 2 are the small-scale tests used to confirm that the analytical head losses for the final-size strainers are conservative based on the following. Test Case A is a full debris case, and Test Case B is the "thin bed" debris case. The thin bed case is necessary to ensure that a different pipe break that generates a smaller amount of debris will not result in a greater head loss than the break location that generates the largest quantity of debris. Test Case C is another smaller debris case to confirm that thin bed cases result in a smaller head loss than the Case A full debris case. (See Response to RAI 06.02.02-19 for additional discussion on "thin bed effects.")

The considerations for selecting the worst case break location for the Reference Japanese ABWR are discussed on pages 13, 14 and 15 of Report 2. The Main Steam (MS) line is the largest pipe size in the ABWR primary containment, and three MS line break locations are considered. The worst case is Location B, due to the largest amount of fiber below the drywell floor grating. (Head loss due to fiber is much higher than for Reflective Metal Insulation (RMI))

The design details of the Reference Japanese ABWR are proprietary to Toshiba and the Japanese utility, but the insulation quantities and testing program were developed in accordance with controlled procedures and processes. The debris that will be applicable to STP 3 & 4 is different than for the Reference Japanese ABWR, which includes fibrous and calcium silicate types of insulation materials. STP 3 & 4 will use RMI on all pipe sizes, so there will be no fibrous or calcium silicate materials, other than the assumed "latent" fiber quantity of 1 ft^3 (0.03 m^3). Since STP 3 & 4 has committed to use the same size strainers as are in the Reference Japanese ABWR, the head loss with the much lower (two orders of magnitude) fiber amount will result in a lower head loss compared with the Reference Japanese ABWR, and this value will be confirmed during final strainer sizing analyses and confirmatory testing for STP 3 & 4.

Response to Item c.i:

Preparation of calcium silicate and mineral (or rock wool) wool insulation is not relevant for STP 3&4. Preparation of sludge, paint chips, rust flakes, dust are discussed in Report 2 and are based on debris destructive testing results, e.g., test reports in the URG back-up volumes. Detailed CCI procedures for debris preparation were available for review by NRC during the June 30 strainer meeting, and these procedures will be made available for NRC review by January 29, 2010.

Response to Item c.ii:

As discussed in the Response to Items a and b above, the vertical configuration of the small-scale strainer test assembly makes it impossible for the debris to settle out prior to reaching the strainer pockets, and therefore the small-scale testing is both conservative and prototypical. The approach velocities used in the confirmatory small-scale testing are scaled to represent in-plant ECCS flow rates, and are therefore prototypical.

Response to Item c.iii:

As discussed in the Response to RAI 06.02.02-19, the debris thickness for thin bed effects evaluation is calculated from the head loss equation in NUREG CR-6224, which is Equation 1 on page 6 of Report 1. The peak head loss due to a thin debris bed occurs for both the RHR and HPCF strainers in the Reference Japanese ABWR with a debris bed thickness of about 10 mm (0.39 in.). CCI conducted head loss tests for the Reference Japanese ABWR for debris bed thicknesses of 8 to 10 mm (0.31 to 0.39 in.), and confirmed that the measured head losses were much lower than the analytically derived head losses. The guidance used for performing the head loss testing is provided in NUREG CR-6224.

Response to Item d:

Report 1 is a translation of a report provided to the Japanese regulator, and therefore is a historical document. Report 1 will be revised to correct some translation errors. Report 2 was prepared to supplement the information in Report 1. This report will be revised to clarify the approach and methodology, including the following topics:

- Shape factor (fg) and the two types of small-scale testing, including discussion of differences between confirmatory small-scale testing results and analytically predicted head loss. A non-proprietary description of this information will be provided in a supplemental response to this RAI by January 29, 2010.
- Details of strainer pocket dimensions and overall strainer surface area calculations, including design area, area considering dimensional tolerances, and minimum required area.
- Appropriateness of using the orifice methodology to determine clean (i.e., without debris) strainer head loss.
- Quantities of debris and conversion factors (densities) used for small-scale tests.

- Thin bed effects head loss analytical values and test results.
- Clarification that full-scale test results are for information only and were not used for strainer sizing (because they were less conservative than small-scale tests).
- Addition of results from another full-scale test (for information) to allow comparison of results from tests that used different flow rates.

The revised reports will be submitted as proprietary and non-proprietary documents by February 15, 2010.

No COLA change is required as a result of this response.

RAI 06.02.02-15:

QUESTION:

In Report 2 (Supplementary Document for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer) on Page 18, the Test Filter Area is given in units of meters squared while on page 23 of Report 2 the HPCF Test Filter Area and RHR Test Filter Area are given in units of meters cubed. The applicant should address the difference in units. In addition, the applicant should explain why the values for these test filter areas are different since they are for the same test.

RESPONSE:

"Cubic meters" is a typographical error. The units for Test Filter Area is square meters (m^2). The small-scale test described on Page 18 was a general test conducted by CCI to determine the specific surface area of particulate/granular debris (Svp) parameter for calcium-silicate for several utility customers. The small-scale tests described on Page 23 are specifically for the Reference Japanese ABWR.

No COLA change is required as a result of this response.

RAI 06.02.02-16:

QUESTION:

On page 42 of Report 1 (The Evaluation Report for Net Positive Suction Head of Pump in Emergency Core Cooling System) and on Page 10 of Report 2 (The Supplementary Document for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer) there is an evaluation of the debris loading and flow on the ECCS Suction Strainers which sites the use of an orifice to evaluate flows through the fully loaded strainer. The applicant should provide clarification of what makes the orifice prototypical or conservative with respect to plant conditions.

RESPONSE:

The small-scale testing which determines the head loss due to the debris loaded on the strainers is not able to reproduce the clean strainer head loss because the test fixture with the four filter pockets does not replicate the flow constriction (orifice) at the outlet of the cylindrical strainer assembly. Therefore, the analytically determined clean strainer head loss is added to the analytical (confirmed by test) debris-loaded strainer head loss to determine Available NPSH. The appropriateness and validity of using the orifice methodology to determine the analytical head loss for the clean strainer case were confirmed using full-scale testing for a Japanese BWR that also used a CCI cassette-type strainer. Additionally, analyses using computational fluid dynamic (CFD) methodology confirmed the appropriateness and validity of the orifice methodology for both clean and debris-loaded CCI cassette-type strainers.

No COLA change is required as a result of this response.

RAI 06.02.02-17:

QUESTION:

Report 2 (The Supplementary Document for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer), Table 3.5 provides 'Debris volume on each strainer'. The applicant's explanation is confusing as to how these values were determined as compared to Table 3-6 on page 35 of Report 2. The applicant should explain if Table 3-5 was meant to show debris volume on each pump as opposed to each strainer.

RESPONSE:

Debris quantities in Table 3-5 are for each pump, not each strainer. The title for Table 3-5 will be corrected when Report 2 is revised (see Response to RAI 06.02.02-14). The debris values in Table 3-6 are for each High Pressure Core Flooder (HPCF) strainer (so are one-half of the quantities shown in Table 3-5).

No COLA change is required as a result of this response.

RAI 06.02.02-18:

QUESTION:

In Appendix A of Report 2 (The Supplementary Document for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer), the results for head loss test with full scale strainer for BWR plant were provided. The staff was unable to determine the effectiveness of the full scale testing and requests the applicant address the following concerns:

a.) The applicant should provide a description explaining why full scale testing was prototypical or conservative

b.) The applicant provided various test matrices in Table 3-1, Table F-1, Table B-1, Table B-2, and Table B-3, however the staff could not identify how these matrices were determined to be conservative or prototypical with respect to the Reference Japanese ABWR plant scenario LOCA. Please provide a description of how these matrices were determined and what makes them prototypical or conservative with respect to Reference Japanese ABWR plant scenario.

c.) The applicant provided general statements on debris preparation and the procedure for running the full scale test. The applicant should provide a more detailed description of the procedures and debris preparation in order to help the staff in determining what makes the procedures and debris preparation prototypical or conservative in predicting head loss with respect to the Reference Japanese ABWR plant scenario LOCA.

d.) In the applicants assessment to meeting Regulatory Guide 1.82 Rev. 3 2.3.2.4 the applicant states 'debris settling is not postulated'. Since no credit is taken for settling and STP assumes all debris is transported to the Suppression Pool (S/P), the applicant should clarify how they met this assumption in the full scale test considering only a baffle was available to prevent settling.

RESPONSE:

Responses corresponding to each letter item are provided below.

Response to Item a:

The full-scale testing described in Report 2 was originally intended to confirm the conservatism of the small-scale testing. The full-scale testing, however, was done at CCI prior to implementation of measures to ensure all test debris would adhere to the strainers and not settle out. As noted in the response to RAI 06.02.02-14 (item b), the upward opening strainer pockets in the vertical, small-scale strainer testing assembly ensures that all debris is collected in the strainer pockets and is a conservative test for determining strainer head loss. Therefore, the full-scale testing described in Report 2 is provided for information only and is not used for the sizing of the reference Japanese ABWR strainers.

Response to Item b:

The full-scale testing described in Appendix A of Report 2 was performed for debris conditions selected from several Japanese BWR and ABWR plants (including the Reference Japanese ABWR). The purpose was to compare the effect on head loss of different types of debris. As noted in the response above, the full-scale testing is not as conservative as the small-scale testing, and therefore is not used for sizing of the strainers in the Reference Japanese ABWR.

Response to Item c:

As noted above in Item a, the full-scale tests were not used to size the ECCS strainers for the Reference Japanese ABWR. See Response to RAI 06.02.02-14 (item c.i) for a discussion of debris preparation for small-scale strainer testing.

Response to Item d:

The compliance table for RG 1.82, Section 2.3.2.4 will be revised to say that "debris settling is not credited" in the calculations of latent debris or debris transported to the suppression pool. A revision of the RG 1.82 compliance table is being submitted with the Response to RAI 06.02.02-24.

All debris postulated to be in the suppression pool is assumed to adhere to the strainers, and a ratio of this debris was used in the small-scale strainer testing (see Response to RAI 06.02.02-14). As noted above, the full-scale testing is not as conservative as the small-scale testing, and therefore is not used to confirm the acceptability of the strainer designs (sizes) for the Reference Japanese ABWR.

No COLA change is required as a result of this response.

RAI 06.02.02-19:

<u>QUESTION</u>:

Page 24 of Report 2 (The Supplementary Document for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer) provides a test case for high head loss due to thin bed effect. On page 15 of Report 1 the report speaks to having a case dealing with thin bed effect which showed thin bed head loss results. The applicant should clarify how it determined these thin bed effect cases and discuss what guidance was used in determining the appropriateness of this case being acceptable for a thin bed effect.

<u>RESPONSE</u>:

The debris thickness for thin bed effects evaluation is calculated from the head loss equation in NUREG CR-6224, which is Equation 1 on page 6 of Report 1. This equation correlates head loss due to debris bed thickness, including additional losses due to particulate debris. There is a peak in the plot of the analytical head loss with respect to debris bed thickness at a point of low debris bed thickness, which is the "thin bed effect." Analytically, the peak head loss due to a thin debris bed occurs for both the Residual Heat Removal (RHR) and High Pressure Core Flooder (HPCF) strainers in the Reference Japanese ABWR with a debris bed of about 10 mm (0.39 in.) thick. CCI conducted head loss tests for the Reference Japanese ABWR for debris bed thicknesses of 8 mm to 10 mm (0.31 in. to 0.39 in.), and confirmed that the measured head losses were much lower than the analytically derived head losses. The guidance used for performing the head loss testing is NUREG CR-6224.

No COLA change is required as a result of this response.

RAI 06.02.02-20:

QUESTION:

In its RAI 06.02.02-6 Supplemental Response, dated October 29, 2009, the applicant proposed a change to the STP 3&4 FSAR that "The ECCS suction strainer design to be used on STP 3&4 is the same as the design for the Reference Japanese ABWR." (page 4 of 247)
The applicant should provide sufficient information in the FSAR on the strainers rather than referring to a plant for which information is not readily available.

RESPONSE:

The basic design of the STP 3 & 4 suction strainer, which is the same as that for the Reference Japanese plant, is a cassette-type strainer that is described in the text and associated references in Appendix 6C to Part 2, Tier 2 of the STP 3 & 4 COLA. That section also provides the criteria to be used for sizing of the suction strainer. As noted in the response to RAI 06.02.02-6 (RAI 2042 Supplement 1), the STP 3 & 4 strainers will be at least as large as the strainers for the Reference Japanese ABWR ECC systems.

As requested by this RAI, this response provides additional suction strainer design details as a revision to the COLA. The FSAR markup previously provided on October 29, 2009 in Letter Number U7-C-STP-NRC-090179 (page 4 of 247) will be revised by replacing the markup of Section 6C.5.1 with the one below. In addition, Section 6C.2 will be revised as shown below to provide additional design details of the strainer. Section 6C.6 is updated to add the three references which are described in the markup to Section 6C.5.1. Changes from COLA Rev. 3 are highlighted with gray shading.

6C.2 ABWR Mitigating Features

The suction strainers design *at* Perry preceded and *did not meet the current regulatory requirements. The ABWR ECCS suction strainers will utilize* ~~*a "T" arrangement with conical strainers on the 2 free legs of the "T"*~~ ~~the state-of-the art~~ a cassette type strainer design. ~~*This design separates the strainers so that it minimizes the potential for a contiguous mass to block the flow to an ECCS pump*~~. The design of the strainers will be based on Regulatory Guide 1.82, NUREG/CR-6224 (Reference 6C-4), NUREG/CR-6808 (Reference 6C-5) and the Utility Resolution Guidance, NEDO-32686-A. The cassette type strainer design is based on a set of cassette modules with U-shaped filter pockets attached to the cylindrical outer jacket. Each strainer consists of filter modules, the outer jacket and flange plates on each end of the cylindrical assembly. The filter module is constructed with cassettes which are arranged axially along the strainer axis. One cassette consists of pocket shaped filters which are arranged radially. A cut-away drawing of the strainer is shown in Figure 6C-1. The material used in the cassette type strainer is stainless steel. The cylindrical strainer assemblies are mounted in pairs on piping tees at each ECCS pump suction line. When the ECCS pump operates, the suction flow in the suppression pool runs into all pockets through the outer jacket windows. Each pocket has five flow paths from the inlet through the five perforated walls to the outlet of the pocket towards the cassette strainer. By using the cassettes with the pocket shaped filters, the strainer has an available filter area which is larger per volume than cylindrical and other shaped strainers. The number of cassettes and pockets is adjusted to produce a specific head loss performance for the strainer. To avoid debris clogging the flow restrictions downstream of the strainers, the size of the holes in the perforated sheets is chosen by considering specific paths of ECCS equipment and piping (for example, the containment spray nozzle and the ECCS pump seal cooling flow orifices). The STP 3 & 4 strainers will have holes no larger than 2.1 mm. ~~As a result, the cassette type strainer has increased available suction surface area without increasing the overall size of the strainer. The holes in each pocket filter are sized to prevent a deleterious quantity of debris from passing through the strainer, but still allow fluid to pass through.~~

A key feature in the design of these strainers is to collect debris where velocity is low, since the pressure drop across the debris bed is known to be proportional to the velocity through the bed. This minimizes head loss across the strainer. ~~Further technical details and methodologies are used to determine the head loss across the strainer for design debris loadings and to determine the structural loads on ECCS penetrations, piping and strainers caused by LOCA induced hydrodynamic forces~~. *The ABWR design also has additional features not utilized in earlier designs that could be used in the highly improbable event that all suppression pool suction strainers were to become plugged. The alternate AC (Alternating Current) independent water addition mode of RHR allows water from the Fire Protection System to be pumped to the vessel and sprayed in the wetwell and drywell from diverse water sources to maintain cooling of the fuel and containment. The wetwell can also be vented at low pressures to assist in cooling the containment.*

6C.5.1 ECCS Suction Strainer Sizing Design Basis

The ECCS suction strainer design to be used on STP 3&4, which is described in the STP 3 & 4 FSAR Appendix 6C.2 and its associated references, is the same as the design for the Reference Japanese ABWR (see References 6C-11, 6C-12 and 6C-13), and the STP 3 & 4 strainers will be at least as large as the Reference Japanese ABWR strainers. Application of the Reference Japanese ABWR ECCS suction strainer design to STP 3&4 is conservative for the following reasons:

- The sizing of the Reference Japanese ABWR strainers is based on the methodology defined in the BWROG's Utility Resolution Guideline (URG) (Reference 6C-3).

- The Reference Japanese ABWR primary containment includes fibrous and calcium silicate thermal insulation, both of which are significant contributors to strainer head loss. For STP 3&4, the only type of thermal insulation allowed inside the primary containment is all stainless steel reflective metal insulation (RMI), which results in a much lower head loss across the ECCS suction strainers.

6C.6 References

6C-9 Application Methodology for the ECCS Strainer, Toshiba Corporation, PDR-2008-100575, Rev 0, June 3, 2008.

6C-11 The Evaluation Report for Net Positive Suction Head of Pump in Emergency Core Cooling System, STP Doc. U7-RHR-M-RPT-DESN-0001, Rev. A, May 27, 2009.

6C-12 The Supplementary Document for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer, STP Doc. U7-RHR-M-RPT-DESN-0002, Rev. B, October 20, 2009.

6C-13 The Evaluation Example of the Head Loss of the ECCS Suction Strainer and Pipe in the ECCS Pump Run-out Flow condition, STP Doc. U7-RHR-M-RPT-DESN-0003, Rev. A, May 27, 2009.

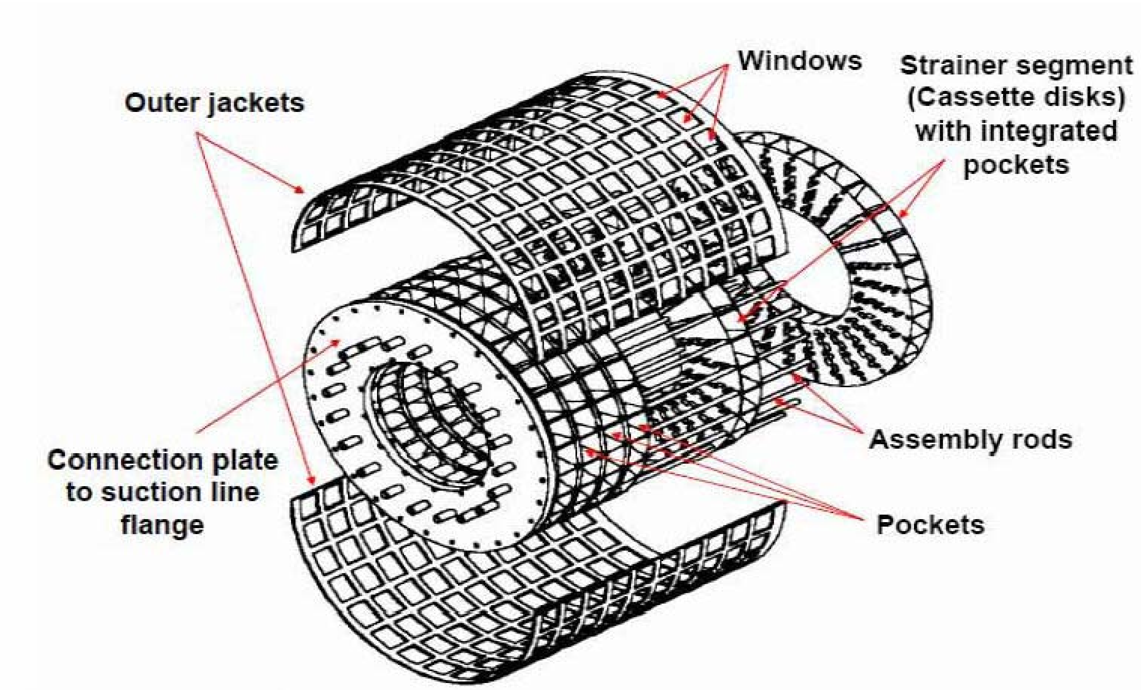

Figure 6C-1 Cassette Strainer Cutaway

RAI 06.02.02-21:

QUESTION:

In its RAI 06.02.02-6 Supplemental Response, dated October 29, 2009, the applicant proposed a change to the STP 3&4 FSAR that "For STP 3&4, the only type of thermal insulation allowed inside the primary containment is all stainless steel reflective metal insulation." (page 4 of 247) The applicant should clarify that fiber is not used in the containment. For example, although fiber is not used as a thermal insulation it may be used as fire barrier material.

RESPONSE:

There is no fiber used in the STP 3 & 4 primary containment.

The STP 3 & 4 COLA will be revised to reflect that no fiber is used in the primary containment as shown in the markup below. This revised markup of newly added Section 6C.3.1.2 replaces the markup of that section previously provided in the response to RAI 06.02.02-2.

6C.3.1.2 LOCA-Generated Debris

Relative to the generation of debris from a postulated pipe break, the ABWR design contains a number of improvements from earlier BWR designs. The elimination of the recirculation piping removed a significant source of insulation debris from the containment and also reduced the likelihood of a large high energy pipe break that could lead to debris generation. For the STP 3&4 design, there is no fibrous insulation or calcium silicate on piping systems, including small bore piping, inside the containment. All thermal insulation material is a Reflective Metallic Insulation (RMI) design. RMI breaks up into shards that are large enough such that they will not pass through the ECCS suction strainers which have a 2.1 mm maximum hole size. Furthermore, the use of fibrous and calcium silicate materials in the STP 3 & 4 Primary Containment is prohibited.

RAI 06.02.02-22:

QUESTION:

Item 4.c of ABWR DCD Tier 1 Table 2.4.1 states 50% blockage of pump suction strainers in determining NPSH margin as stated in RG 1.82 Rev. 1. However, STP 3&4 are committed to conforming to RG 1.82 Rev. 3 (FSAR Tier 2 Table 1.8-20) which does not refer to a criterion of 50% blockage of pump suction strainers. Instead RG 1.82 Rev. 3 provides guidance for mechanistically determining the debris head loss across pump suction strainers. STP should change the FSAR to reflect conformance with the guidance provided in RG 1.82 Rev. 3.

RESPONSE:

As noted in this RAI, STPNOC has committed to meet RG 1.82, Rev. 3, for the STP 3&4 ECCS strainers, which requires a more mechanistic determination of the debris head loss than just a single percent blockage criterion. Therefore, STPNOC will add details of the strainer blockage analytical approach in the FSAR with a specific reference to the NPSH ITAAC, and the ITAAC "50% blocked strainer" bullet will be replaced with the following criterion: "- analytically derived values for blockage of pump suction strainers based upon the as-built system."

The following changes are made to STP 3 & 4 COLA Part 2 Tier 1 and Tier 2 as well as Part 7. Because these changes require a change to Tier 1 of the COLA, a new departure has been generated to describe and evaluate those Tier 1 changes. These departure markups are reflected in Part 7, Section 2.1 of the COLA which adds STD DEP T1 2.4-4 description and evaluation summary. References to this new departure are also added to the appropriate sections in Tier 1 and Tier 2. Changes from COLA Rev. 3 are highlighted in gray shading.

Part 2 Tier 1 Changes

2.4 Core Cooling Systems

The information in this section of the reference ABWR DCD, including all subsections, tables, and figures, is incorporated by reference with the following departures.

STD DEP T1 2.4-1 (Figure 2.4.1a, Table 2.4.1)

STD DEP T1 2.4-2 (Figure 2.4.3)

STD DEP T1 2.4-3 (Figure 2.4.4a, Table 2.4.4.)

STD DEP T1 2.4-4 (Table 2.4.1, Table 2.4.2, Table 2.4.4)

STD DEP T1 2.14-1 (Figure 2.4.1b, Figure 2.4.1c, Figure 2.4.3)

2.4.1 Residual Heat Removal System

STD DEP T1 2.4-1

STD DEP T1 2.4-4 (Table 2.4.1)

Table 2.4.1 Residual Heat Removal System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
4. continued c. The RHR pumps have sufficient NPSH.	4. continued c. Inspections, tests and analyses will be performed upon the as-built RHR System. NPSH tests of the pumps will be performed in a test facility. The analyses will consider the effects of: — Pressure losses for pump inlet piping and components. — Suction from the suppression pool with water level at the minimum value. — ~~50% blockage of pump suction strainers~~ Analytically derived values for blockage of pump suction strainers based upon the as-built system. — Design basis fluid temperature (100°C) — Containment at atmospheric pressure.	4. continued c. The available NPSH exceeds the NPSH required by the pumps.

2.4.2 High Pressure Core Flooder System

STD DEP T1 2.4-4 (Table 2.4.2)

Table 2.4.2 High Pressure Core Flooder System (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
g. The HPCF pumps have sufficient NPSH available at the pumps.	g. Inspections, tests and analyses will be performed upon the as-built system. NPSH tests of the pumps will be performed in a test facility. The analyses will consider the effects of: — Pressure losses for pump inlet piping and components. — Suction from the suppression pool with water level at the minimum value. — 50% minimum blockage of pump suction strainers Analytically derived values for blockage of pump suction strainers based upon the as-built system. — Design basis fluid temperature (100°C) — Containment at atmospheric pressure.	g. The available NPSH exceeds the NPSH required by the pumps.

2.4.4 Reactor Core Isolation Cooling System

STD DEP T1 2.4-3

STD DEP T1 2.4-4 (Table 2.4.4)

Table 2.4.4 Reactor Core Isolation Cooling (Continued)

Inspections, Tests, Analyses and Acceptance Criteria		
Design Commitment	**Inspections, Tests, Analyses**	**Acceptance Criteria**
j. The RCIC System pump has sufficient NPSH.	j. Inspections, tests and analyses will be performed based upon the as-built system. NPSH tests of the pump will be performed at a test facility. The analyses will consider the effects of: (1) Pressure losses for pump inlet piping and components. (2) Suction from the suppression pool with water level at the minimum value. (3) ~~50% blockage of pump suction strainers~~ Analytically derived values for blockage of pump suction strainers based upon the as-built system. (4) Design basis fluid temperature (77°C) (5) Containment at atmospheric pressure.	j. The available NPSH exceeds the NPSH required by the pump.

Part 2 Tier 2 Text and Table Changes

5.4 Components and Subsystem Design

The information in this section of the reference ABWR DCD, including all subsections, tables and figures, is incorporated by reference with the following departures and supplements.

STD DEP T1 2.4-1 (Figure 5.4-10, Figure 5.4-11)
STD DEP T1 2.4-3 (Table 5.4-2, Figures 5.4-8 and 5.4-9)
STD DEP T1 2.4-4 (Table 5.4-2, Figures 5.4-9 and 5.4-11)
STD DEP T1 2.14-1 (Figure 5.4-10)
STD DEP 5B-1 (Table 5.4-4, Figure 5.4-11)
STD DEP 5.4-1 (Table 5.4-6, Figure 5.4-12, and Figure 5.4-13)
STD DEP 5.4-2 (Figure 5.4-1)
STD DEP 5.4-3 (Table 5.4-3, Table 5.4-5)
STD DEP 5.4-4 (Figure 5.4-4)
STD DEP 5.4-5 (Figure 5.4-12)
STD DEP 6C-1(Table 5.4-1a, Table 5.4-2, Figures 5.4-9 and 5.4-11)
STD DEP 7.3-11
STP DEP 10.1-3
STD DEP Vendor

Table 5.4-2 Design Parameters for RCIC System Components (Continued)

(10) Suction Strainer Sizing The suppression pool suction shall be sized so that: (a) Pump NPSH requirements are satisfied when strainer is ~~50% plugged~~ blocked in accordance with RG 1.82 analysis methods~~; and particles over 2.4 mm diameter are restrained from passage into the pump and feedwater sparger~~.

6.2 Containment Systems

The information in this section of the reference ABWR DCD, including all subsections, tables, and figures, is incorporated by reference with the following departures and supplements.

STD DEP T1 2.3-1 (Table 6.2-7)
STD DEP T1 2.4-2
STD DEP T1 2.4-3 (Tables 6.2-7, 6.2-8 and 6.2-10)
STD DEP T1 2.4-4
STD DEP T1 2.14-1 (Figure 6.2-38, Figure 6.2-40, Figure 6.2-41,Tables 6.2-7, 6.2-8 and 6.2-10)
STD DEP T1 3.4-1
STD DEP 6.2-2 (Tables 6.2-1 and 6.2-2, Figures 6.2-2, 6.2-3, 6.2-4, 6.2-5, 6.2-6a and b, 6.2-7a and b, 6.2-8a, 6.2-8b, 6.2-8c, 6.2-9, 6.2-10, 6.2-11, 6.2-12a and 6.2-12b, 6.2-13a and 6.2-13b, 6.2-14, and 6.2-15, 6.2-22, 6.2-23a, 6.2-23b, 6.2-24, 6.2-25a, and 6.2-25b)
STD DEP 6.2-3 (Tables 6.2-5, 6.2-6, 6.2-7, 6.2-8 and 6.2-10)
STD DEP 6C-1(Table 6.2-2b, 6.2-2c)
STD DEP 9.2-7 (Table 6.2-9)
STD DEP 9.2-9 (Table 6.2-9)
STD DEP 9.3-2 (Tables 6.2-7, 6.2-8, 6.2-9 and 6.2-10)
STD DEP Admin (Tables 6.2-5, 6.2-7, 6.2-8 and 6.2-10)

6.2.2.3.1 System Operation and Sequence of Events

STD DEP T1 2.4-4

(4) ~~Containment cooling is initiated after 10 minutes (see Response to Question 430.26).~~ Containment cooling is initiated after 30 minutes.

Analysis of the net positive suction head (NPSH) available to the RHR and HPCF pumps in accordance with the recommendations of Regulatory ~~Guide~~ Guides *1.1* and 1.82 *is provided in Tables 6.2-2b and 6.2-2c, respectively.*

6.3 Emergency Core Cooling Systems

The information in this section of the reference ABWR DCD, including all subsections,
tables, and figures, is incorporated by reference with the following departures and supplements.

STD DEP Admin
STD DEP T1 2.4-1
STD DEP T1 2.4-3
STD DEP T1 2.4-4 (Figure 6.3-1)
STD DEP 7.3-11 (Figure 6.3-7)
STD DEP 6C-1 (Table 6.3-8, Table 6.3-9, Figure 6.3-1)

6.3.2.2 Equipment and Component Descriptions

STD DEP T1 2.4-4

Regulatory ~~*Guide*~~ Guides *1.1* and 1.82 ~~*prohibits*~~ prohibit *design reliance on pressure and/or temperature transients expected during a LOCA for assuring adequate NPSH. The requirements of* ~~*this*~~ these *Regulatory* ~~*Guide*~~ Guides *are applicable to the HPCF, RCIC and RHR pumps.*

6C.3 RG 1.82 Improvement

(5) The debris in the suppression pool will be assumed to remain suspended until it is captured on the surface of a strainer.

(6) In addition to the above, 1 cu. ft. of latent fiber is assumed to be suspended in the suppression pool and deposited on the surfaces of the operating strainers.

6C.5 Strainer Sizing Analysis Summary

By making realistic assumptions, the following additional conservatisms are likely to occur, but they were not applied in the analysis. No credit in water inventory was taken for water additions from feedwater flow or flow from the condensate storage tank as injected by RCIC or HPCF. Also, for the long term cooling condition, when suppression pool cooling is used instead of the low pressure flooder mode (LPFL), *the RHR flow rate decreases from runout (1130 m^3/h) to rated flow (954 m^3/h), which reduces the pressure drop across the debris.*

In summary, the analytical process for sizing of the strainers is based on debris generation, debris transport and a head loss evaluation in accordance with the Utility Resolution Guidance, NEDO-32686-A supplemented by an assumption of latent fiber. This analytical method will be used to implement the ITAAC as shown in Tier 1, ITAAC 2.4.1.4.c, 2.4.2.3.g, and 2.4.4.3.j.

14.2 Specific Information to be Included in Final Safety Analysis Reports

The information in this section of the reference ABWR DCD, including all subsections, tables, and figures, is incorporated by reference with the following departures and
supplements.

STD DEP T1 2.4-3
STD DEP T1 2.4-4
STD DEP T1 2.14-1
STD DEP T1 3.4-1 (Table 14.2-1)
STD DEP 4.6-1
STD DEP 8.3-1
STD DEP 9.1-1
STD DEP 9.5-1
STD DEP 11.2-1
STD DEP 11.4-1
STD DEP 14.2-1 (Table 14.2-1)
STD DEP Admin
STD DEP Vendor, Vendor Replacement

14.2.12.1.8 Residual Heat Removal System Preoperational Test

STD DEP T1 2.4-4

(2) Prerequisites

Reactor Building Cooling Water System, Instrument Air System, Fuel Pool Cooling and Cleanup System, Leak Detection System, RCIC System, Suppression Pool Water System, Nuclear Boiler System, ~~Process Computer System~~, Electric Power Distribution System, ~~Process Computer~~ Plant Information and Control *System and other required interfacing systems shall* *be available, as needed, to support the specified testing and the appropriate system configurations. Additionally, RHR pump suctionline shall be installed with a ~~50% plugged~~ temporary strainer throughout the test.*

14.2.12.1.10 High Pressure Core Flooder System Preoperational Test

STD DEP T1 2.4-4

(2) Prerequisites

The construction tests have been successfully completed, and the SCG has reviewed the test procedure and approved the initiation of testing. A temporary strainer shall be installed ~~with 50% plugged~~ in the pump suction throughout this test.

Part 2, Tier 2 Figure changes

For the following Figures, the reference to "strainer 50% plugged" will be changed to "strainer blockage based on RG 1.82 analysis":

- Figure 5.4-9, Sheet 1, Note 10
- Figure 5.4-11, Sheet 2 (multiple places)
- Figure 6.3-1, Sheet 1, Note 4

Part 7 Section 2.1 Changes

STD DEP T1 2.4-4 RHR, HPCF and RCIC Turbine/Pump NPSH

Description

The original DCD provided a value of 50% for debris blockage of the suction strainers for purposes of assuring adequate net positive suction head (NPSH) margin for the residual heat removal (RHR) system, the high pressure core flooder (HPCF) system, and the reactor core isolation cooling (RCIC) system. This value was based on Regulatory Guide 1.82 Revision 0. The design basis for the suction strainers for STP 3&4 has been updated to RG 1.82 Rev. 3, which does not use the 50% blockage criterion, but rather provides guidance for mechanistically determining debris head loss across pump suction strainers. The associated ITAAC for the debris blockage of the suction strainers for determination of NPSH margin for the RHR system (T1 Table 2.4.1), HPCF system (T1 Table 2.4.2), and RCIC system (T1 Table 2.4.4) are revised by this departure to be consistent with this updated design basis for the STP 3 & 4 suction strainers.

This change makes the ITAAC consistent with the STP 3&4 suction strainer design and the applicable regulatory guidance. This approach is an improvement in that it uses a mechanistic evaluation for debris blockage and not an assumed value, thus providing a better representation of the debris blockage for purposes of the required NPSH margin determination.

This departure also revises various Tier 2 text and figure references to the 50% blockage criterion and replaces them with reference to an analytically derived blockage based on RG 1.82 Rev. 3.

Evaluation Summary

This departure was evaluated per Section VIII.A.4 of Appendix A to 10 CFR Part 52, which requires 1) the design change will not result in a significant decrease in the level of safety otherwise provided by the design; 2) the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security; 3) special circumstances are present as specified in 10 CFR 50.12(a)(2); and 4) the special circumstances outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption. As shown below, each of these four criteria are satisfied.

(1) As discussed above, the design change represents an improvement and therefore will not result in a significant decrease in the level of safety otherwise provided by the design.

(2) The exemption is not inconsistent with the Atomic Energy Act or any other statute and therefore is authorized by law. As discussed above, the design change represents an improvement and therefore will not present an undue risk to the public health and safety and the design change does not relate to security and does not otherwise pertain to the common defense and security.

(3) Special circumstances are present as specified in 10 CFR 50.12(a)(2). Specifically, special circumstance (iv) is present, since the design change represents an improvement and therefore will result in a benefit to the public health and safety.

(4) This is “standard” departure that is intended to be applicable to COL applicants that reference the ABWR DCD. Therefore this departure will not result in any loss of standardization. Additionally, the design change represents an improvement in safety, and does not adversely affect the configuration of the plant or the manner in which the plant is operated.

As demonstrated above, this exemption complies with the requirements in Section VIII.A.4 of Appendix A to 10 CFR Part 52. Therefore, STPNOC requests that the NRC approve this exemption.

RAI 06.02.02-23:

QUESTION:

In addressing RG 1.82 regulatory position 2.1.2.5, in its RAI 06.02.02-6 Supplemental Response, dated October 29, 2009, the applicant states that "The CCI cassette-type suction strainers are designed to withstand the structural loadings associated with debris accumulation and hydrodynamic loadings, including pool swell, condensation oscillation/chugging, and SRV discharge." (page 10 of 247) The applicant should provide a reference for this statement.

RESPONSE:

Tier 2, Section 3B.5 of the ABWR DCD, which is incorporated by reference in the STP 3 & 4 FSAR, describes the loading and methodology for developing loads on submerged structures in the suppression pool. These hydrodynamic loads due to LOCA and SRV actuations include pool swell and condensation/oscillation/chugging. This section lists some of the key submerged structures that will be subjected to these hydrodynamic loads, including the ECCS suction lines and strainers.

The STP 3 & 4 suction strainer hydrodynamic loads as well as loads due to debris accumulation are still being developed as part of the plant detailed design, and as such the analysis for the strainers has not yet been completed.

In order to provide reasonable assurance that the STP 3 & 4 suction strainers can be designed to withstand these loads, an analysis for these loads for the CCI cassette-type strainer (which will be used on STP 3 & 4) for a Japanese Reference ABWR is available for review. This stress report is proprietary to the Japanese utility. STPNOC will make this report available for NRC review by February 15, 2010.

There are no COLA changes required as a result of this response.

RAI 06.02.02-24:

QUESTION:

In its RAI 06.02.02-6 Supplemental Response, dated October 29, 2009, the applicant provided information on how STP 3&4 conform to regulatory positions stated in RG 1.82 Rev. 3. However, the conformance to regulatory position 2.1.6 Inservice Inspection is missing in the response. The applicant should provide the missing information.

RESPONSE:

RG 1.82 regulatory position 2.1.6 Inservice Inspection was inadvertently omitted from the Compliance Table. A revised Compliance Table is attached, which includes the missing item. This revised table also incorporates the change for RG 1.82, Section 2.3.2.4 as noted in the response to Item d of RAI 06.02.02-18. This revised Compliance Table replaces the previously provided table in its entirety.

There are no COLA changes required as a result of this response.

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1	**Features Needed To Minimize the Potential for Loss of NPSH** The suppression pool is the source of water for such functions as ECC and containment heat removal following a LOCA, in conjunction with the vents and downcomers between the drywell and the wetwell. It should combine the following features and capabilities to ensure the availability of the suppression pool for long-term cooling. The adequacy of the combinations of the features and capabilities should be evaluated using the criteria and assumptions in Regulatory Position 2.2.	STP 3&4 will have CCI cassette type strainers on the ECCS system suctions from the suppression pool. The strainer sizing analyses for the Reference Japanese ABWR and supplemental reports to address differences in the Reference Japanese ABWR and STP 3&4 provide the bases for demonstrating that STP 3&4 ECCS strainers will comply with the requirements of this RG.	See RAI 06.02.02-6 Item A response
2.1.1	**Net Positive Suction Head of ECCS and Containment Heat Removal Pumps**	n/a—subsection heading	n/a
2.1.1.1	ECC and containment heat removal systems should be designed so that adequate 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 prior to the postulated LOCAs. (See Regulatory Position 2.1.1.2.)	The supplemental NPSH evaluation documented in Reference 3 uses 100°C and containment at atmospheric pressure, as required by ABWR DCD Tier 1 Table 2.4.1, Item 4c.	See Reference 3, Page 8

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.1.2	For certain operating BWRs for which the design cannot be practicably altered, conformance with Regulatory Position 2.1.1.1 may not be possible. In these cases, no additional containment pressure should be included in the determination of available NPSH than is necessary to preclude pump cavitation. Calculation of available containment pressure should underestimate the expected containment pressure when determining available NPSH for this situation. Calculation of suppression pool water temperature should overestimate the expected temperature when determining available NPSH.	n/a—STP 3&4 is not an operating plant.	n/a
2.1.1.3	For certain operating BWRs for which the design cannot be practicably altered, if credit is taken for operation of an ECCS or containment heat removal pump in cavitation, prototypical pump tests should be performed along with post-test examination of the pump to demonstrate that pump performance will not be degraded and that the pump continues to meet all the performance criteria assumed in the safety analyses. The time period in the safety analyses during which the pump may be assumed to operate while cavitating should not be longer than the time for which the performance tests demonstrate the pump meets performance criteria.	n/a—STP 3&4 is not an operating plant.	n/a

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.1.4	The decay and residual heat produced following accident initiation should be included in the determination of the water temperature. The uncertainty in the determination of the decay heat should be included in this calculation. The residual heat should be calculated with margin.	The supplemental NPSH evaluation documented in Reference 3 uses 100°C and containment at atmospheric pressure, as required by ABWR DCD Tier 1 Table 2.4.1, Item 4c.	See Reference 3, Page 8
2.1.1.5	The hot channel correction factor specified in ANSI/HI 1.1-1.5-1994 should not be used in determining the margin between the available and required NPSH for ECCS and containment heat removal system pumps.	Hot channel correction factor not used—see References 1, 2 and 3.	none
2.1.1.6	The level of water in suppression pools should be the minimum value given in the technical specifications reduced by the drawdown due to suppression pool water in the drywell and the sprays.	Static head is based on the Reference Japanese ABWR suppression pool minimum water level reduced by suppression pool water in the drywell and the sprays.	See Reference 1, Page 46 (drawdown is not mentioned in Reference 1, but is addressed in system analyses)
2.1.1.7	Pipe and fitting resistance and the nominal screen resistance without blockage by debris should be calculated in a recognized, defensible method or determined from applicable experimental data.	Head loss due to clean strainer, piping and fitting resistances is calculated based on standard literature, as documented in References 1 and 2.	See Reference 1, Pages 16-26.
2.1.1.8	Suction strainer screen flow resistance caused by blockage by LOCA-generated debris or foreign material in the containment that is transported to the suction intake screens should be determined using the methods in Regulatory Position 2.3.3.	Debris generation and transport are in accordance with BWROG Utility Resolution Guidance (URG) NEDO-32686 (cited in 2.3.2.1 below). It is noted that strainer head loss for the Reference Japanese ABWR (References 1 and 2) and the supplemental NPSH evaluation for STP 3&4 (Reference 3) assume fibrous debris will adhere to the ECCS suction strainers, but STP 3&4 is prohibiting the use of non-RMI thermal insulation, so these head loss predictions are conservative for STP 3&4.	none

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.1.9	Calculation of available NPSH should be performed as a function of time until it is clear that the available NPSH will not decrease further.	Available NPSH is conservatively calculated In References 1, 2 and 3 for the worst case condition, i.e., all material transported from the drywell and all material assumed to pre-exist in the suppression pool is assumed to adhere to the ECCS suction strainers for the head loss calculation.	none
2.1.2	**Passive Strainer** The inlet of pumps performing the above functions should be protected by a suction strainer placed upstream of the pumps; this is to prevent the ingestion of debris that may damage components or block restrictions in the systems served by the ECC pumps. The following items should be considered in the design and implementation of a passive strainer.	STP 3&4 will have CCI cassette type strainers on the ECCS system suctions from the suppression pool. The strainer sizing analyses for the Reference Japanese ABWR (References 1 and 2), along with supplemental information in Reference 3, provides the bases for concluding that the STP 3&4 ECCS strainers will comply with the requirements of this RG. More details are provided below.	none
2.1.2.1	The suction strainer design (i.e., size and shape) should be chosen to avoid the loss of NPSH from debris blockage during the period that the ECCS is required to operate in order to maintain long-term cooling or maximize the time before loss of NPSH caused by debris blockage when used with an active mitigation system (see Regulatory Position 2.1.5).	n/a—STP 3&4 will not use active strainers in addition to the passive strainers.	n/a

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.2.2	The possibility of debris clogging flow restrictions downstream of the strainers should be assessed to ensure adequate long-term ECCS performance. The size of openings in the suppression pool suction strainers should be based on the minimum restrictions found in systems served by the suppression pool. The potential for long thin slivers passing axially through the strainer and then reorienting and clogging at any flow restriction downstream should be considered. Consideration should be given to the buildup of debris at the following downstream locations: spray nozzle openings, throttle valves, coolant channel openings in the core fuel assemblies, fuel assembly inlet debris screens, ECCS pump seals, bearings, and impeller running clearances. If it is determined that a strainer with openings small enough to filter out particles of debris that are fine enough to cause damage to ECCS pump seals or bearings would be impractical, it is expected that modifications would be made to ECCS pumps or ECCS pumps would be procured that can operate long term under the probable conditions.	STP 3&4 will use state-of-the-art CCI cassette type strainers with a maximum hole size in this strainer of 1/12 inch (2.1mm). Regarding acceptance criteria for blockage of small clearances, it is noted that there will be no fiber downstream of the STP 3&4 suction strainers because the only fiber potentially inside primary containment (latent loose debris) will not be degraded during the pipe break and will not be small enough to pass through the 1/12-inch diameter holes in the CCI cassette-type suction strainers. Preliminary data from testing conducted by Westinghouse (WEC) to resolve GSI-191 has not identified any coagulation of particulate debris until after fiber is introduced to the flow stream. Therefore, blockage of small clearances in downstream components is not likely for the STP 3&4 downstream components. The analysis of the effects of debris on downstream components such as pumps, valves and heat exchangers in PWR's was documented in WCAP-16406, which was approved by the NRC. It is expected that the analysis results which showed acceptable performance of these components will apply to BWR's due to similarity in materials and clearances to the PWR components. STP 3&4 design strainer bypass testing will be performed to confirm that downstream effects will not impair the functioning of critical components in the ECCS flow loop, such as pumps, valves and instrument lines, as well as ensure that adequate flow exists to cool the core.	See Response to RAI 06.02.02-2
2.1.2.3	ECC pump suction inlets should be designed to prevent degradation of pump performance through air ingestion and other adverse hydraulic effects (e.g., circulatory flow patterns, high intake head losses).	The CCI cassette-type strainers used in the Reference Japanese ABWR, and planned for use in STP 3&4 have been approved for use by several US PWRs during resolution of GSI-191, based on extensive testing.	none

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.2.4	All drains from the upper regions of the containment should terminate in such a manner that direct streams of water, which may contain entrained debris, will not impinge on the suppression pool suction strainers.	The ABWR design is such that flow from the upper regions of the containment (upper drywell) passes through a circuitous route involving any one of the ten drywell connecting vents (DCVs) and then through any one of the thirty horizontal vents before reaching the suppression pool.	See Response to RAI 06.02.02-2
2.1.2.5	The strength of the suction strainers should be adequate to protect the debris screen from missiles and other large debris. The strainers and the associated structural supports should be adequate to withstand loads imposed by missiles, debris accumulation, and hydrodynamic loads induced by suppression pool dynamics. To the extent practical, the strainers should be located outside the zone of influence of the vents, downcomers, or spargers to minimize hydrodynamic loads. The strainer design, vis-a-vis the hydrodynamic loads, should be validated analytically or experimentally.	As noted in 2.1.2.4, any large debris generated by the LOCA will have a circuitous path to reach the suppression pool, so a LOCA-generated missile from the drywell is unlikely. Additionally, the wetwell, which is the chamber in direct contact with the suppression pool, is largely empty with the only significant components/structures being an access tunnel, a grated catwalk and the SRV discharge piping, which are designed to withstand seismic and hydrodynamic loadings (if applicable). Therefore, missile loadings are unlikely. The CCI cassette-type suction strainers are designed to withstand the structural loadings associated with debris accumulation and hydrodynamic loadings, including pool swell, condensation oscillation/chugging, and SRV discharge.	See Response to RAI 06.02.02-2
2.1.2.6	The suction strainers should be designed to withstand the inertial and hydrodynamic effects that are due to vibratory motion of a safe shutdown earthquake (SSE) without loss of structural integrity.	The CCI cassette-type suction strainers are designed to withstand the structural loadings associated with the design basis (safe shutdown) earthquake.	none
2.1.2.7	Material for suction strainers should be selected to avoid degradation during periods of inactivity and operation and should have a low sensitivity to such adverse effects as stress-assisted corrosion that may be induced by coolant during LOCA conditions.	The CCI cassette-type suction strainers are stainless steel, as is the suppression pool liner. Periods of high stress, e.g., during hydrodynamic loads due to pool swell and condensation oscillation are relatively short duration and unlikely to produce stress-assisted corrosion cracking during the 30 day mission time for the strainers.	none

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.3	**Minimizing Debris** The amount of potential debris (see Regulatory Position 2.3.1) that could clog the ECC suction strainers should be minimized.	Relative to the generation of debris from a postulated pipe break, the ABWR design contains a number of improvements from earlier BWR designs. The elimination of the recirculation piping removed a significant source of insulation debris from the containment and also reduced the likelihood of a large high energy pipe break which could lead to debris generation. For the STP 3&4 design, there will be no fibrous insulation or calcium silicate on piping systems, including small bore piping, inside the containment. All thermal insulation material will be a Reflective Metallic Insulation (RMI) design. There are also no other sources of fiber in the STP 3&4 containment design.	See Response to RAI 06.02.02-2
2.1.3.1	Containment cleanliness programs should be instituted to clean the suppression pool on a regular basis, and plant procedures should be established for control and removal of foreign materials from the containment.	STPNOC intends to eliminate all fiber in the primary containment and will minimize other debris through an aggressive suppression pool cleanliness program. The Suppression Pool Cleanliness Program is provided in Subsection 6.2.1.7.1 and is included as an operational program in 13.4S. This program is based on industry guidance from INPO and EPRI and will be of comparable quality to the program for ECCS Sump Cleanliness used by STP Units 1 and 2.	See Response to RAI 06.02.02-5
2.1.3.2	Debris interceptors in the drywell in the vicinity of the downcomers or vents may serve effectively in reducing debris transport to the suppression pool. In addition to meeting Regulatory Position 2.1.2, debris interceptors between the drywell and wetwell should not reduce the suppression capability of the containment.	The drywell connecting vents (DCVs) between the upper drywell and lower drywell have horizontal steel plates located above the openings that will prevent any material falling in the drywell from directly entering the vertical leg of the DCVs. Vertically oriented trash rack construction will be installed around the periphery of the horizontal steel plate to intercept debris. In order for debris to enter the DCV it would have to travel horizontally through the trash rack prior to falling into the vertical leg of the connecting vents. Thus the ABWR is resistant to the transport of debris from the drywell to the wetwell.	See Response to RAI 06.02.02-2

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.3.3	Insulation types (e.g., fibrous and calcium silicate) that can be sources of debris that is known to more readily transport to the strainer and cause higher head losses should be avoided. Insulations (e.g., reflective metallic insulation) that transport less readily and cause less severe head losses once deposited onto the strainers should be used. If insulation is replaced or otherwise removed during maintenance, abatement procedures should be established to avoid generating latent debris in the containment.	As noted above, all thermal insulation in the STP 3&4 primary containment will be stainless steel RMI, and this design restriction (no fibrous, calcium silicate or other non-RMI insulation) will continue throughout the life of the plant.	none
2.1.3.4	To minimize potential debris caused by chemical reaction of coolant with metals in the containment, exposure of bare metal surfaces (e.g., scaffolding) to spray impingement or immersion should be minimized either by removal or by using chemical-resistant protection (e.g., coatings or jackets).	The ABWR primary containment is inerted and entered only when the plant is shutdown, so scaffold use is temporary and controlled. Permanent metal features are either stainless steel of carbon steel protected by qualified coatings. No aluminum is allowed in the STP 3&4 primary containment.	See Response to RAI 06.02.02-6 and -8
2.1.4	**Instrumentation** If relying on operator actions to mitigate the consequences of the accumulation of debris on the suction strainers, safety-related instrumentation that provides operators with an indication and audible warning of impending loss of NPSH for ECCS pumps should be available in the control room.	n/a—Operator actions are not required for the STP 3&4 passive strainers.	n/a
2.1.5	**Active Strainers**	n/a—STP 3&4 strainers are passive design.	n/a

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.1.6	**Inservice Inspection** Inservice inspection requirements should be established that include (1) inspection of the cleanliness of the suppression pool, (2) a visual examination for evidence of structural degradation or corrosion of the suction strainers and strainer system, and (3) an inspection of the wetwell and the drywell, including the vents, downcomers, and deflectors, for the identification and removal of debris or trash that could contribute to the blockage of suppression pool suction strainers. These inservice inspections should be performed on a regular basis at every refueling period downtime.	A suppression pool cleanliness program is being implemented, as discussed in the Response to RAI 06.02.02-5. Some specifics of the program as provided in that response are as follows. Following each refueling outage, a detailed visual inspection will be performed of the primary containment to identify and remove any loose debris. This detailed inspection will be controlled by plant procedures in accordance with the Procedure Development Program. All debris identified will be documented and entered into the corrective action program for trending. This inspection will include the vents, downcomers, and deflectors, for the identification and removal of debris or trash that could contribute to the blockage of suppression pool suction strainers. Also following each refueling outage, a remote visual inspection will be performed of the Residual Heat Removal (RHR), Reactor Core Isolation Cooling (RCIC), and High Pressure Core Flooder (HPCF) suction strainers and the suppression pool floor to ensure there is no debris present and that there is no evidence of structural degradation or corrosion of the suction strainers. This inspection will be focused on the presence of debris in the suction strainers but will also look for any structural gaps that would allow debris to bypass the strainer flow holes. Results of these inspections will be documented in the procedure and in the corrective action program. Debris that is identified will be removed and any strainer structure gaps will be assessed and repaired if necessary. Floating debris and sediment in the suppression pool that was not removed by the Suppression Pool Cleanup System will be removed.	See Response to RAI 06.02.02-5

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.2	**Evaluation of Alternative Water Sources** To demonstrate that a combination of the features and actions listed above are adequate to ensure long-term cooling and that the five criteria of 10 CFR 50.46(b) will be met following a LOCA, an evaluation using the guidance and assumptions in Regulatory Position 2.3 should be conducted. If a licensee is relying on operator actions to prevent the accumulation of debris on suction strainers or to mitigate the consequences of the accumulation of debris on the suction strainers, an evaluation should be performed to ensure that the operator has adequate indications, training, time, and system capabilities to perform the necessary actions. If not covered by plant specific emergency operating procedure, procedures should be established to use alternative water sources. The valves needed to align the ECCS with an alternative water source should be periodically inspected and maintained.	See below for discussion of how the STP 3&4 ECCS strainers comply with the requirements of Regulatory Position 2.3. Additionally, should all of the ECCS suction strainers become plugged, the alternate AC (Alternating Current) independent water addition mode of RHR allows water from the Fire Protection System to be pumped to the vessel to maintain cooling of the fuel.	See Response to RAI 06.02.02-2

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3	**Evaluation of Long-Term Recirculation Capability** During any evaluation of the susceptibility of a BWR to debris blockage, the considerations and events shown in Figures 4 and 5 should be addressed. The following techniques, assumptions, and guidance should be used in a deterministic evaluation to ensure that any implementation of a combination of the features and capabilities listed in Regulatory Position 2.1 are adequate to ensure the availability of a reliable water source for long-term recirculation after a LOCA. An assessment should be made of the susceptibility to debris blockage of the containment drainage flowpaths to the suppression pool, flow restrictions in the ECCS, and containment spray recirculation flowpaths downstream of the suction strainer to protect against degradation of long-term recirculation pumping capacity. Unless otherwise noted, the techniques, assumptions, and guidance listed below are applicable to an evaluation of passive and active strainers. The assumptions and guidance listed below can also be used to develop test conditions for suction strainers or strainer systems.	See sections below for STP 3&4 compliance with specific requirements.	n/a
2.3.1	**Debris Sources and Generation**	n/a—subsection heading	n/a

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.1.1	Consistent with the requirements of 10 CFR 50.46, debris generation should be calculated for a number of postulated LOCAs of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated LOCAs are calculated.	Multiple break locations were evaluated for the Reference Japanese ABWR, and the worst-case combination of debris types and quantities was selected. Final strainer sizing evaluations for STP 3&4 will confirm that the Reference Japanese ABWR debris generation assumptions bound the actual piping configurations and potential debris types. Note that the Reference Japanese ABWR uses some fibrous and calcium silicate thermal insulation types, but STP 3&4 only allows the use of stainless steel RMI.	See Reference 2

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.1.2	An acceptable method for determining the shape of the zone of influence (ZOI) of a break is described in NUREG/CR-6224 and NEDO-32686. The volume contained within the ZOI should be used to estimate the amount of debris generated by a postulated break. The distance of the ZOI from the break should be supported by analysis or experiments for the break and potential debris. The shock wave generated during postulated pipe break and the subsequent jet should be the basis for estimating the amount of debris generated and the size or size distribution of the debris generated within the ZOI. Certain types of material used in a small quantity inside the containment can, with adequate justification, be demonstrated to make a marginal contribution to the debris loading for the ECC sump. If debris generation and debris transport data have not been determined experimentally for such material, it may be grouped with another like material existing in large quantities. For example, a small quantity of fibrous filtering material may be grouped with a substantially larger quantity of fibrous insulation debris, and the debris generation and transport data for the filter material need not be determined experimentally. However, such analyses are valid only if the small quantity of material treated in this manner does not have a significant effect when combined with other materials (e.g., a small quantity of calcium silicate combined with fibrous debris).	The ZOI methodology described in the URG (NEDO-32686) was used for the Reference Japanese ABWR, and will be used for the final design calculations for STP 3&4.	See References 1 and 2

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.1.3	All sources of fibrous materials in the containment such as fire protection materials, thermal insulation, or filters that are present during operation should be identified.	References 1 and 2 for the Reference Japanese ABWR include fibrous material, but STP 3&4 will prohibit fibrous materials from being used or carried into the primary containment.	See Response to RAI 06.02.02-6
2.3.1.4	All insulation, painted surfaces, and fibrous, cloth, plastic, or particulate materials within the ZOI should be considered debris sources. Analytical models or experiments should be used to predict the size of the postulated debris.	For the Reference Japanese ABWR, URG (NEDO-32686) guidance was used to conservatively quantify the coatings/paint chips estimated to be within the ZOI for the ABWR. Insulation within the ZOI was explicitly quantified.	See References 1 and 2, and Response to RAI 06.02.02-8

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.1.5	A sufficient number of breaks in each high-pressure system that relies on recirculation should be considered to reasonably bound variations in debris generation by the size, quantity, and type of debris. As a minimum, the following postulated break locations should be considered. • Breaks in the main steam, feedwater, and recirculation lines with the largest amount of potential debris within the postulated ZOI, • Large breaks with two or more different types of debris, including the breaks with the most variety of debris, within the expected ZOI, • Breaks in areas with the most direct path between the drywell and wetwell, • Medium and large breaks with the largest potential particulate debris to insulation ratio by weight, and • Breaks that generate an amount of fibrous debris that, after its transport to the suction strainer, could form a uniform thin bed that could subsequently filter sufficient particulate debris to create a relatively high head loss referred to as the 'thin-bed effect.' The minimum thickness of fibrous debris needed to form a thin bed has typically been estimated at 1/8 inch thick based on the nominal insulation density (NUREG/CR-6224).	See References 1 and 2 for break locations considered before selection of the worst-case break location. Note that the ABWR does not have Reactor Recirculation piping external to the reactor vessel, so postulated breaks in the main steam and feedwater lines result in the largest quantities of debris. Also, note that although References 1, 2 and 3 evaluate strainer head loss due to fibrous insulation, the STP 3&4 primary containment uses only stainless steel RMI for thermal insulation.	See References 1 and 2

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.1.6	The cleanliness of the suppression pool and containment during plant operation should be considered when estimating the amount and type of debris available to block the suction strainers. The potential for such material (e.g., thermal insulation other than piping insulation, ropes, fire hoses, wire ties, tape, ventilation system filters, permanent tags or stickers on plant equipment, rust flakes from unpainted steel surfaces, corrosion products, dust and dirt, latent individual fibers) to impact head loss across the suction strainer should also be considered.	URG quantities of coatings, rust, sludge and dust are all included in References 1, 2 and 3. Additionally, STP 3&4 has committed to assuming that 1 ft^3 of latent fiber and blockage of 2 strainer cassettes by miscellaneous latent debris (e.g., tags) in the final strainer sizing analysis.	See Responses to RAIs 06.02.02-4 and -6
2.3.1.7	The amount of particulates estimated to be in the pool prior to a LOCA should be considered to be the maximum amount of corrosion products (i.e., sludge) expected to be generated since the last time the pool was cleaned. The size distribution and amount of particulates should be based on plant samples.	The URG values of 50 lbs (23 kg) rust and 195 lbs (89 kg) sludge were used in References 1, 2 and 3. The appropriateness of the sludge quantity will be confirmed by comparison with TEPCO data from the Japanese ABWRs K6 & 7.	See Responses to RAIs 06.02.02-5 and -6
2.3.1.8	In addition to debris generated by jet forces from the pipe rupture, debris created by the resulting containment environment (thermal and chemical) should be considered in the analyses. Examples of this type of debris would be disbondment of coatings in the form of chips and particulates or formation of chemical debris (precipitants) caused by chemical reactions in the pool.	STP 3&4 design specifications allow only qualified coatings inside primary containment. The URG assumption that over 600 ft^2 of qualified coatings are within the ZOI and are removed from the base metal and all end up in the suppression pool (85 lbs of inorganic zinc and epoxy topcoat) is included in the head loss evaluations in References 1, 2 and 3. Chemical debris is not included in the head loss evaluations because potentially reactive materials (e.g., aluminum) are prohibited from the STP 3&4 containment.	See Responses to RAIs 06.02.02-8 and -9
2.3.2	**Debris Transport**	n/a—subsection heading	n/a

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.2.1	It should be assumed that all debris fragments smaller than the clearances in the gratings will be transported to the suppression pool during blowdown. Credit may be taken for filtration of larger pieces of debris by floor gratings and other interdicting structures present in a drywell (NEDO-32686 and NUREG/CR-6369). However, it should be assumed that a fraction of large fragments captured by the gratings would be eroded by the combined effects of cascading break overflow and the drywell spray flow. The fraction of the smaller debris generated and thus transported to the suppression pool during the blowdown, as well as the fraction of the larger debris that may be eroded during the washdown phase, should be determined analytically or experimentally.	As noted in 2.1.3.2 above, the ABWR contains design features which minimize the transport of accident-generated debris to the suction strainers. For the Reference Japanese ABWR, the URG factors for Mark III containments were used to predict the quantities of debris types transported to the suppression pool. The URG transport factors were based on BWROG testing and were previously accepted by NRC.	See References 1 and 2
2.3.2.2	It should be assumed that LOCA-induced phenomena (i.e., pool swell, chugging, condensation oscillations) will suspend all the debris assumed to be in the suppression pool at the onset of the LOCA.	All debris predicted to be transported to the suppression pool was assumed to adhere to the suction strainers for the Reference Japanese ABWR.	See References 1 and 2
2.3.2.3	The concentration of debris in the suppression pool should be calculated based on the amount of debris estimated to reach the suppression pool from the drywell and the amount of debris and foreign materials estimated to be in the suppression pool prior to a postulated break.	As stated above, all debris predicted to be transported to the suppression pool was assumed to adhere to the suction strainers for the Reference Japanese ABWR, and all materials assumed to be in the suppression pool prior to the LOCA (e.g., sludge) was assumed to adhere to the suction strainers. Additionally, the final strainer sizing analyses for STP 3&4 will assume an additional quantity of latent fiber, and that 2 cassettes in each CCI strainer are blocked due to miscellaneous latent debris like equipment tags.	See Response to RAI 06.02.02-6

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.2.4	Credit should not be taken for debris settling until LOCA-induced turbulence in the suppression pool has ceased. The debris settling rate for the postulated debris should be validated analytically or experimentally.	Debris settling is not credited.	none
2.3.2.5	Bulk suppression pool velocity from recirculation operations, LOCA-related hydrodynamic phenomena, and other hydrodynamic forces (e.g., local turbulence effects or pool mixing) should be considered for both debris transport and suction strainer velocity computations.	Strainer head loss analyses are conservatively performed using pump runout flow rates.	See Reference 3
2.3.3	**Strainer Blockage and Head Loss**	n/a—subsection heading	n/a
2.3.3.1	Strainer blockage should be based on the amount of debris estimated using the assumptions and guidance described in Regulatory Position 2.3.1 and on the debris transported to the wetwell per Regulatory Position 2.3.2. This volume of debris, as well as other materials that could be present in the suppression pool prior to a LOCA, should be used to estimate the rate of accumulation of debris on the strainer surface.	See above discussions about compliance with Regulatory Positions 2.3.1 (Debris Generation) and2.3.2 (Debris Transport).	none
2.3.3.2	The flow rate through the strainer should be used to estimate the rate of accumulation of debris on the strainer surface.	Strainer head loss is calculated for the point in time in which all debris transported to the suppression pool, along with material already in the suppression pool, has adhered to the strainers.	See References 1, 2 and 3

RG 1.82 Subsection No.	RG Requirement	STP 3&4 Compliance (Note 1)	Comment
2.3.3.3	The suppression pool suction strainer area used in determining the approach velocity should conservatively account for blockage that may result. Unless otherwise shown analytically or experimentally, debris should be assumed to be uniformly distributed over the available suction strainer surface. Debris mass should be calculated based on the amount of debris estimated to reach or to be in the suppression pool. (See Revision 1 of NUREG-0897, NUREG/CR-3616, and NUREG/CR-6224.)	Uniform adhesion of all material in the suppression pool to the suction strainers is assumed in the strainer head loss analyses. Debris mass is calculated consistent with URG guidance.	See References 1, 2 and 3
2.3.3.4	The NPSH available to the ECC pumps should be determined using the conditions specified in the plant's licensing basis.	Reference 3 was prepared to adjust the analyses in References 1 and 2 to use pump runout flow (instead of pump design flow), in accordance with the U.S. ABWR DCD statement that the NPSH evaluation is performed under pump runout conditions.	See Reference 3
2.3.3.5	Estimates of head loss caused by debris blockage should be developed from empirical data based on the strainer design (e.g., surface area and geometry), postulated debris (i.e., amount, size distribution, type), and velocity. Any head loss correlation should conservatively account for filtration of particulates by the debris bed.	Head loss correlations from NUREG/CR-6224 were confirmed to conservatively predict strainer head loss based on testing of the CCI cassette-type strainers. Filtration by the debris bed was considered.	See References 1 and 2
2.3.3.6	The performance characteristics of a passive or an active strainer should be supported by appropriate test data that addresses, at a minimum, (1) suppression pool hydrodynamic loads and (2) head loss performance.	Testing was performed for the Reference Japanese ABWR as documented in References 1 and 2. Confirmatory testing will be performed for STP 3&4 after final strainer sizing calculations are completed.	See References 1 and 2

Note 1: References used in this table include:

- Reference 1—"The Evaluation Report for Net Positive Suction Head of Pump in Emergency Core Cooling System," Proprietary, STP Doc. U7-RHR-M-RPT-DESN-0001, Rev. A, May 27, 2009.
- Reference 2—"The Supplementary Documentation for the Head Loss Evaluation Report of Japanese ABWR ECCS Suction Strainer," Proprietary, STP Doc. U7-RHR-M-RPT-DESN-0002, Rev. B, October 20, 2009.
- Reference 3—"The Evaluation Example of the Head Loss of the ECCS Suction Strainer and Pipe in the ECCS Pump Run-out Flow Condition," Proprietary, STP Doc. U7-RHR-M-RPT-DESN-0003, Rev. A, May 27, 2009.

RAI 06.02.02-25:

QUESTION:

In addressing RG 1.82 regulatory position 2.3.1.7, in its RAI 06.02.02-6 Supplemental Response, dated October 29, 2009, the applicant states that "The appropriateness of the sludge quantity will be confirmed by comparison with TEPCO data from the Japanese ABWRs K6 & 7." (page 20 of 247) The applicant should state how it would confirm the sludge quantity.

RESPONSE:

STPNOC has received a proprietary report that summarizes the results of the Japanese ABWR Kashiwazaki-Kariwa Unit 6 and Unit 7 suppression pool inspections following the initial 5 years of operation for each unit. This report, STPTEP-2-023 Rev. 0, is available for NRC review at NRC convenience. The report shows that the assumption for sludge generation in the Reference Japanese ABWR (and therefore for STP 3 & 4) is bounded by the actual quantities of sludge recovered from each of the Kashiwazaki-Kariwa units.

There are no COLA changes required as a result of this response.