February 20, 2008

MEMORANDUM TO: Michael L. Scott, Chief
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SUBJECT: SUMMARY OF PHONE CALLS WITH PERFORMANCE CONTRACTING, INC. (PCI)/AREVA/ALDEN TO DISCUSS HEAD LOSS TEST PROTOCOL

A series of 10 phone calls was held from May 24, 2007, to September 26, 2007, with industry representatives to discuss 8 topics that resulted from prior discussions in a closed meeting at NRC Headquarters on April 19, 2007. The summary of this meeting may be viewed on the NRC Agencywide Documents Access and Management System (ADAMS), at Accession No. ML071380457. The 8 topics in the April 19, 2007, meeting summary were developed from review of and discussions about the PCI Sure-Flow Strainer Revised Test Protocol (ADAMS Accession No. ML071010089). Participants on the calls are listed in the enclosure and included representatives of PCI, Areva, Alden Research Laboratory (ARL) and client/licensees of the PCI team. Other, supporting documents were also discussed on the calls. These are identified below in the body of this call summary. Also, all action items where noted below are closed. The call summary follows in chronological order:

<u>First Phone Call - May 24, 2007 Topics</u>:
1. Test schedule
2. WCAP-16530
3. PCI's clean strainer head loss correlation
4. Teleconference schedule

1. PCI/ARL are in the process of getting contracts in place with licensees for test facility design and construction. Therefore, the earliest time for them to build the test facility will be in the August time frame. Realistically, head loss testing will continue into the end of December if everything goes well.

2. A representative of the Pressurized Water Reactor Owner's Group (PWROG) and PCI indicated that the staff's position on WCAP-16530, "Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids To Support GSI-191," would significantly alter the schedule, the testing method, and test loop construction.

3. PCI is preparing a white-paper regarding its clean strainer head loss correlation. They will submit it to the staff for further discussions.

4. PCI and licensees suggested having this kind of teleconference every Wednesday morning between 10:00 AM to 12:00 AM to cover the eight issues identified in the April 19, 2007, meeting until resolution is reached. Action items will be identified during these teleconferences.

<u>Second Phone Call - May 30, 2007 Topics</u>:
1. Retesting
2. Average velocity and turbulence
3. PCI white papers
4. Debris introduction

1. The staff informed PCI and PCI customers that head loss with chemical effects retesting is necessary for high fiber and high particulate loading plants.

2. Discussion of prediction of average velocity and turbulence around the strainer.

   PCI will provide a calculation procedure to address the following issues:
   -Predict the average velocity considering nearby wall and structures;
   -Predict the average velocity and design the testing module for strainer arrays in a sump pit;
   -Predict the representative turbulence level based on the computational fluid dynamics (CFD) analysis; and
   -Provide an analysis to demonstrate the correlation between the down-comer water jet and the flow stream turbulence.

3. PCI plans to submit three white papers to the staff on June 8, 2007, for staff to review:
   -Clean strainer head loss correlation;
   -Debris preparation procedure to cover the fine fiber, particulate; and
   -Vortexing evaluation.

4. Staff and PCI initiated discussion about debris introduction.

<u>Third Phone Call - June 1, 2007, Topics</u>:
1. PCI's proposed debris introduction sequence.
2. Mixed homogeneous debris
3. Debris preparation
4. Licensee's proposal
5. Action item

1. Setting up initial large debris concentration inside the flume upstream of the strainer is questionable because the initial uniform distribution of the debris does not have a technical basis to support taking credit for large chunks of debris behaving as a filtering device.

2. Injecting mixed homogeneous debris may cause arbitrary agglomeration at the injection point. For example, reflective metallic insulation (RMI) debris may tangle with fine fiber and cause non-conservative trapping of fine fiber debris.

3. Inside the pre-load tank, the debris is prepared in a high concentration. The staff asked if there is any possibility that the preparation and injection process may cause debris to agglomerate or become trapped in the discharging system.

4. Licensee's Proposal:
   -Divide the debris into different bins according to their categories with each bin only containing one type of debris.

   -Discharge these bins in an order like the following: fine fiber + particulate, large chunks of fiber, RMI, in an order that the most transportable goes first.

   -Allow sufficient time between each batch so that the debris can dilute, settle, and transport.

5. Action Item: Licensees and vendors to discuss internally and come up with a proposal based on today's phone call. The proposal will be discussed during the next phone call on June 11, 2007.

<u>Fourth Phone Call - June 11, 2007, Topics</u>:
1. PCI's proposed debris introduction sequence
2. Test termination criteria
3. Small Break LOCA case
4. Thin bed
5. Chemical precipitates
6. Action items

1. Staff reiterated concerns regarding the debris introduction sequence. PCI understood staff's position that the most transportable debris should be introduced first and the least transportable last; PCI would revise the introduction protocol to support further discussion.

2. Termination criteria proposed by PCI with 1%/30 minutes may result in test being too short to capture the peak head loss. 15 tank turn-overs is considered a minimum to establish stable head loss due to particulate and fiber. PCI will revise the termination protocol to support further discussion.

3. Staff reiterated concerns regarding the small break loss-of-coolant (SBLOCA) case selection. Staff indicated that, when considering the SBLOCA case, the debris type, debris mix, flow rate, and local turbulence need to be considered to determine if it is necessary to perform SBLOCA case head loss evaluation. PCI will revise the introduction protocol to support further discussion.

4. Staff indicated that the proposed thin-bed evaluation criteria appeared to be reasonable. In addition, slow introduction of fine fiber and particulate will be helpful in determining the possibility of thin bed formation. However, since chemical precipitate will be introduced, it is unlikely that thin bed head loss testing can be excluded if it is determined that all of the

screen area is fully covered. PCI would revise the introduction protocol to support further discussions.

5. Regarding chemical precipitates and anything related to chemical effects, PCI would submit the revised protocol for review.

6. Action Item: Licensees and vendors to discuss internally and come up with revised protocol based on the phone call.

Fifth Phone Call - June 21, 2007, Topics:
1. Chemical surrogate material preparation
2. Termination criterion considering chemical effect
3. Chemical surrogate material introduction sequence
4. PCI's proposed debris introduction sequence
5. Test termination criteria
6. Small break LOCA case
7. Thin bed
8. Post phone call discussion
9. Summary
10. Action items

1. The staff questioned the chemical surrogate material concentration in the pre-mixing tank and the injection rate. In addition, the staff inquired as to the relevance of a high concentration mixture and chemical precipitates in the plant post-LOCA environment with regard to settlement. PCI indicated that the new settlement data report (Page 9 of 45, “Testing Debris Preparation & Surrogates”) supported its view of debris preparation and introduction. The staff indicated that NRC has not seen this report. In addition, the PCI/AREVA chemical expert was not on the phone to answer questions associated with the chemical precipitation model. Future dialog is needed.

2. The staff indicated some uneasiness with the proposed termination criterion because of chemical effects. The staff asked whether it is possible to run the test far beyond the point determined by the proposed termination criteria. The longer test does not have to be done for each case. However, one longer test for each plant would be helpful to support the use of the proposed termination criteria.

3. As with surrogate material, the introduction of chemical precipitates needs to be discussed further.

4. The revised new introduction procedure does address many of the staff’s comments and issues. However, the staff’s understanding is not clear regarding introduction of small and fine debris at the same time. In addition, the predetermined introduction rate is not clearly defined. The staff is concerned that the “small” fiber debris may also trap the “fine” debris. Further internal discussion is needed. It is the staff’s view that a slow introduction of debris early on during the test will help the tester identify the “thin bed” effect and the relevant head loss. Once the debris bed has accumulated thick enough, slightly larger batches could be introduced.

5. With regard to termination criteria, it is not clear to the staff what kind of mathematical method will be used to perform a curve fit at the end of head loss testing.

6. PCI's new write-up expressed its view regarding the determination of SBLOCA case. Licensees indicated that it was their responsibility to determine whether they need to conduct SBLOCA head loss testing. Therefore, this issue is no longer treated by PCI's testing protocol and test loop design.

7. The proposed determination process to model the thin bed appears to be reasonable to the staff. Further internal discussion will be conducted to finalize the staff position.

8. During the staff's internal post phone call discussion, the staff concluded that ARL's head loss test conducted in the 1990s was evidently used to support PCI's proposed debris addition sequence. Therefore, staff would like to get a copy of this report which demonstrated that significant fine fiber settled.

9. At the end of the call, the staff went through all seven issues and evaluated the status of their resolution. The following is a summary:

   Near field velocity and turbulence modeling using CFD:
   - -Need PCI's input on CFD analysis procedures

   Debris Preparation:
   - -PCI needs to support another phone call about chemical effects

   Debris Introduction Sequence:
   - -PCI needs to clarify the predetermined rate for fiber and small debris addition
   - -Need further discussion about chemical debris introduction

   Termination Criterion:
   - -PCI needs to provide the mathematical model regarding the curve fit

   Small Break LOCA:
   - -Licensees' responsibility to deal with this issue

   Thin-bed case:
   - -Staff needs to finalize position

   Preparation and introduction of chemical surrogate material:
   - -Needs further interaction

   Clean strainer head loss:
   - -Staff needs to review the package and set up separate phone call

10. Action Items:

    PCI and Licensee Side:
    1. Provide telecon participants name list.
    2. PWROG to provide new settlement test data report and letter report.
    3. PCI to provide input on CFD analysis procedures.
    4. PCI to define upper chemical concentration limit in premix tank and the test tank.
    5. PCI to define the mathematical curve fit form.
    6. PCI to clarify the predetermined debris injection rate during the early phase of the test.
    7. Licensees to determine SBLOCA case based on flow, near field turbulence, debris type and mixes.
    8. Identify the chemical effect person to discuss issues with staff during the next phone call.

    Staff:
    1. Prepare for next phone call in the area of chemical effects.

2. Finalize position regarding thin bed case.
3. Review the clean strainer head loss white paper.

Sixth Phone Call - July 2, 2007, Topics:
1. Chemical precipitates preparation procedure
2. Chemical precipitates introduction rate
3. Test termination criteria
4. Thin-bed case
5. Introduction of small and fine fiber
6. Action items

1. Chemical precipitates preparation procedure. (Reached closure)

2. Chemical precipitates introduction rate. (Reached closure)

3. Test termination criteria. PCI agrees with NRC and will confirm the use of linear extrapolation scheme. (Reached closure)

4. In terms of thin bed case, NRC staff agrees with PCI that if the full load case demonstrates that significant screen surface is not covered, then the thin-bed case is not necessary. PCI agrees with staff's position that even if full load case did not demonstrate thin-bed behavior with the entire screen fully covered, thin-bed chemical head loss testing is necessary. PCI will finalize its introduction of a theoretical 1/8" bed with one pool turn-over between additions.

5. PCI proposed that smalls and fines be introduced together in a given ratio as specific input to head loss testing. Staff stated that if a licensee can provide justification regarding the proposed addition method, the staff would be open to the proposal.

6. Action Items:

   PCI:
   1. Finalize the thin bed case in writing.
   2. Finalize curve fitting - linear extrapolation.
   3. For thin-bed testing, consider 1/8" load with one pool turn-over.

   Staff:
   Finalize position regarding smalls and fines addition.

Seventh Phone Call - July 30, 2007, Topics:
1. Test Protocol Section 2.4, "Methodology for Introduction of Debris into Test Flume"
2. Test Protocol Section 2.5, "Test Termination Criteria"

1.1 The NRC GSI-191 Team Leader emphasized that the discussions regarding the PCI protocol were not an NRC staff approval of the method and did not prevent the staff finding issues with testing in the future. He also stated that the staff has limited resources and has spent a significant amount of time reviewing the PCI protocol and that we should begin to wrap up discussions. The staff will point out where they see issues and PCI can take the input under advisement as desired.

1.2 The staff has no problem if PCI uses hot water to soak fibrous debris in to remove trapped air.

1.3 The staff is concerned that the placement of large debris on the flume floor may not be prototypical or is at least unpredictable and may trap debris that is transporting toward the strainer. The random nature of large debris may not be “averageable” and therefore should not be included in the flume. PCI feels that the staff position is not realistic.

1.4 The staff believes that it should be ensured that debris introduced to the flume had not agglomerated. PCI agreed that a note would be added to the procedure.

1.5 The protocol stated that debris would be introduced as far from the strainer as possible. The staff believes that some debris should probably be introduced closer to the strainer. This is a point of disagreement between PCI and the staff.

1.6 The staff believes that smalls and fines should be added at the same time only if it is shown that the smalls do not inhibit the transport of the fines. PCI stated that this was not prototypical of a plant event. This is a point of disagreement between PCI and the staff.

1.7 The staff believes that paint chips should not be added with other particulate debris, but should be added later, especially if searching for a thin bed, as the addition of chips could disturb the thin bed formation. PCI agreed that the paint chips could be added later.

1.8 The staff felt believes the microporous debris should be added with the particulate debris since the microporous debris could play a role in thin bed formation. PCI agreed that microporous debris would be added with particulate.

1.9 The staff pointed out that the thin bed formation could be very slow if small and fine fibrous debris are added in 1/8 inch increments because only the fine debris may transport. This staff comment was provided for information only.

1.10 The staff considered the note on the detection of a thin bed to be unacceptable. Basically, the note stated that if no spike or sudden increase in head loss occurred, that was an indication that a thin bed may not occur. The note further states that observation of some portions of the disk and gap configuration visible is a further indication of a thin bed not occurring. The staff feels that the only indication of a potential non-thin bed is significant open/clean strainer area. This is particularly important since chemical precipitates are not yet introduced into the test during initial introduction of fiber. PCI stated that they understood the staff position, but it was not clear that they would adopt it.

1.11 It was noted that high fiber plants should probably conduct 2 tests, a full debris load test and a thin bed test.

1.12 The staff questioned the basis for the order in which the large debris is to be added to the flume. PCI explained the basis and it was accepted by the staff.

1.13 PCI stated that they may test various types and sizes of debris for transportability and that they may exclude certain debris from testing based on the results of these tests. The staff agreed that debris that is shown not to transport could be eliminated from the testing.

1.14 The staff agreed that if large debris that is added in a sequence from the most transportable to least transportable begins piling up in the flume and shows no signs of transporting, then the addition of large debris can be stopped.

1.15 The acceptance criteria for chemical surrogate settlement were discussed. The staff indicated that precipitate settlement equal to or slower than the WCAP data for a 2.2 g/l concentration was an acceptable criterion and that this criterion should be applied to all tests. Precipitate settlement should be tested within 24 hours of the use of the surrogate. Further discussions with PWR Owners Group are scheduled for August 1, 2007, and the staff will be providing a position on an acceptable precipitate settlement criteria to the industry, not just PCI. NRC staff indicated they would provide additional information concerning precipitate settling acceptance criteria following the phone call.

2.1 The staff indicated that the use of the term “mission time” in the termination criteria is potentially inappropriate due to it being a licensing term. PCI stated that they understand this, but may leave the terminology the same in the protocol.

2.2 The staff stated that the statement in the protocol that the extrapolation of the head loss curve to the end of the mission is bounding of further bed degradation was not entirely correct. The staff believes that extrapolation is part of an overall conservative approach to Generic Letter 04-02 resolution that will result in bounding head loss numbers from testing.

2.3 The staff asked PCI if any licensees had plans to extend the duration of head loss testing beyond the time when the test termination criteria were satisfied in order to validate the conservative nature of the termination criteria and head loss extrapolation. PCI responded that no licensees have committed to extending a test to evaluate the termination criteria at this point.

Eighth Phone Call - August 1, 2007, Topic: Wolf Creek/Calloway Test Configuration

This was a short phone call involving two NRC staff and 4 individuals of the PCI team. The one page diagram of the Wolf Creek/Calloway Test Configuration (ADAMS Accession No. ML072110238) was discussed. The NRC technical representative stated that he had no issue with the test configuration.

Ninth Phone Call - August 9, 2007, Overall Topic: the 6/25/2007 PCI/Areva/Alden "CFD Document," Subtopics:

1. Use of average velocities
2. Uncertainties
3. Use of computational fluid dynamics (CFD) calculations
4. Turbulence and debris transport
5. Best estimate approach on turbulence
6. Equation 3
7. The term “vault”
8. Equation 4

1. NRC staff inquired as to the appropriateness of using average velocities in the test flume instead of a more conservative weighting of higher velocity flow streams. Whether or not near-field obstructions are present, the staff noted that debris transporting to the strainers will more likely come from high velocity flow channels than from lower velocity channels. The physical reasons for this include the following: (1) higher velocity flow streams will generally entrain more debris because they are nearer to debris originating from the break and spray drainage, (2) higher velocity flow channels will tend to create more debris through erosion, and (3) even if the debris concentration in the pool were uniform, more debris will

transport along high velocity channels because the fluence is higher. Using an average flow velocity for strainer testing, as PCI proposed, would neglect these considerations, and could lead to nonconservative results.

2. The staff observed that conducting only one or possibly two tests can lead to uncertainties that the worst case head loss has been bounded, particularly for a testing approach that considers both debris transport and head loss. For instance, if there is significant settling during a maximum debris loading test, it may be unclear that this case will bound other cases for which there is less debris, but higher near-strainer velocities. Incorporating conservatism into the selection of the velocities used in the test flume could help to address these uncertainties. However, it is not clear to what extent individual licensees will address this uncertainty.

3. The staff noted that the use of a robust method to determine the fluid velocities and turbulence, such as CFD, would be preferred. The staff was concerned that analytical hand calculations or nodal network approaches could lead to nonconservative results. PCI stated that all or almost all of its clients would be performing CFD calculations and that, therefore, this item may be resolved.

4. The staff noted that the location at which turbulent energy acts may have a significant effect on debris transport if concentrated high-energy flows enter the pool near the strainer. For example, the staff noted that if a single drain of a given area enters the pool in the near field at the plant, modeling it in the test flume with x nozzles each of 1/x area might not be a conservative approach because the dispersed flow from the smaller nozzles may not penetrate to the flume floor as easily as the single drain in the plant.

5. The staff noted that uncertainties will result from a best estimate approach on turbulence due to the fact that it is very difficult to accurately represent the actual plant turbulence in the test flume. It was not clear if PCI plans to add conservatism to address this concern.

6. ARL noted a mistake in equation 3 and is in the process of correcting this error.

7. NRC staff inquired about the term "vault" in paragraph b) under Design Criteria. ARL explained that was a reference to a plant that had a vault; however, in the general discussion, this term can be generalized to an opening from above the pool.

8. NRC staff inquired about how to select the value for the assumed fraction k in equation (4). ARL said they could get an indication of what value to select based on plant data, CFD modeling, etc.

<u>Tenth Phone Call – September 26, 2007</u>

Topics:
1. Heating the test water.
2. PCI's use of fiber processed through a power shredder.
3. Changes to the generic test protocol based on staff input to sections 2.4 & 2.5.
4. Design Basis Rev. B document (Comments made by PCI intended to document telecon discussions.)
5. Clean strainer head loss calculation.

1. The staff discussed with PCI the possible effects of heating the test water to 120 °F. This would be done optionally depending on the client for the purpose of helping to remove trapped air from fibrous debris and allowing more prototypical settling due to the reduced buoyancy of debris at higher temperatures. The staff inquired as to what the effect of this would be on the WCAP surrogate chemical debris. A PCI representative stated that he was not sure but thought that the surrogate material would not be affected by temperature. The NRC staff recommended that the effect of the 120 °F test temperature be investigated to determine if this temperature will effect the solubility or the stability of the WCAP surrogate precipitate. Precipitate solubility at the test temperature will be a function of the test fluid pH.

2. The staff discussed with PCI their use of fiber processed through a power shredder. The staff noted that the as-received "puffs" of fiber did not meet the threshold for being considered fines. However, the staff noted that the PCI procedure also involves mixing this debris with water using a stirrer. Based upon informal experimentation performed by the staff, the staff concluded that, under reasonable debris-to-water concentrations and imparted stirring energies, the as-received pieces could be broken down into fines. The staff further stated that the heat-treated fibrous debris could be broken into finer pieces more readily than those that had not been heat treated, and would therefore be preferable as a surrogate for fine fibrous debris. However, the staff noted that a number of factors could be different between the informal staff experiments and the PCI experimental set up. The staff noted that the debris size distribution actually used at PCI should be evaluated through onsite observations of the vendor's practices, including the shredding and mixing of the debris with water, measures taken to prevent agglomeration in debris holding tanks, and the concentration at which it is added to the test flume.

3. Changes to the generic test protocol were then discussed, as described below in detail.

3.1 Test protocol Section 2.4: Methodology for Introduction of Debris Into Test Flume

In addition to the other effects of running tests at an elevated temperature, the staff noted that the raised temperatures would lessen the range over which any temperature scaling would be performed. This discussion also included the vendor's practices for identification of borehole phenomena. In particular, in addition to performing visual checks of the debris bed, the staff suggested that the vendor consider performing gradual flow variations at the end of a test to provide an indication of whether the variation of head loss with flow is consistent with theoretical predictions. The staff considers the demonstration of expected head loss-versus-flow behavior as providing confirmatory evidence that differential-pressure effects are not unduly disrupting the debris bed morphology and that temperature scaling is justified.

The staff commented on PCI's intention to introduce large pieces of debris on the floor of the flume near the screen prior to the start of the test in order to intercept smaller pieces of debris. The staff reiterated that, if it could be technically justified, this approach would be acceptable. However, the staff stated that the deposition of large pieces of debris is a random process and that technically justifying this process is very challenging because there is no demonstrable basis to show that any credit taken for large debris blocking the transport of smaller debris is conservative or prototypical.

The staff questioned the length of time the debris would sit in the pre-load containers before introducing it into the flume. The staff noted that agglomeration could occur if the debris sits for extended periods. PCI stated that the debris in the pre-load containers would be stirred

immediately prior to adding to the flume. The staff believes that the vendor's procedure should be modified to include this additional information.

The staff commented on PCI's statement that debris should be placed in the flume as far from the strainer as possible (e.g., 35-40 feet away from the strainers). The staff stated that, for example, some debris may wash down into the containment pool very close to the strainers, and that the locations at which debris enters the containment pool are generally plant-specific and should be addressed in each plant's debris transport calculation. The staff did not consider PCI's generic approach of introducing all debris as far away from the test strainer as possible to adequately represent the spectrum of different possible plant conditions.

The staff questioned how the sequencing of the large debris was determined. PCI stated that there is significant information in industry documents regarding the transportability of various debris. The staff responded that there are many types of debris among the types used by PCI customers for which no industry transport testing exists, but agreed with PCI's overall intention to introduce debris from the most transportable to the least transportable.

Discussion on Notes 1 and 3. At the discretion of the client, the vendor stated that they could introduce chemical debris close to the strainer (3 to 5 feet upstream) as an alternative to satisfying the modified precipitate settlement criteria from the WCAP. The staff expressed concern with this approach based on experience from other vendors' testing. In this testing, chemical precipitates were added directly in front of the strainer, but an unexpectedly high amount of settling was seen throughout the length of the flume, either as the result of the precipitate initially passing through the strainer then settling or diffusion against the relatively slow flow in the test flume. Based upon, among other things, the lack of demonstration that the surrogate precipitate had representative settling properties, the staff considered the observed settling of the precipitate to be non-prototypical. Based upon this experience, the staff does not consider PCI's alternate proposal to be an adequate substitution for ensuring that the settling properties of the surrogate chemical precipitate debris are representative of the expected plant condition. The staff commented that Note 3 appears to accept precipitate settlement rates from tests with a distinctly different objective. For tests with an objective of intentionally settling debris, including precipitates, the NRC staff has indicated that an acceptable precipitate settling criterion is on or above the 2.2 g/L settling line (top line) shown in Figure 7.6-1 of WCAP-16530-NP. The 1-hour settled volume greater than 6 mL discussed in Note 3 is for tests with the objective of intentionally keeping the precipitate suspended until it reaches the strainer. In these type tests, the test fluid is typically agitated to promote transport of precipitate and a debris bed is typically well formed on the test strainer before introduction of precipitate. During discussion of Notes 1 and 3 permitting a blend of acceptance criteria, PCI personnel responded that the purpose of this note was to provide test flexibility given the expense of producing the chemical precipitate and that batch to batch variation could result in some precipitate not meeting the WCAP-16530-NP Figure 7.6-1 acceptance criteria.

3.2 Test Protocol Section 2.5: Test Termination Criteria

The staff discussed the test termination criteria and extrapolation with PCI. It was determined that there will not be enough information to make a determination regarding extrapolation of the test results until a test is completed and PCI determines the extrapolation method. The staff expects to follow up on this item during a trip to observe testing at PCI.

4. Discussion on the “Design Basis Rev B” write up:

   The staff discussed the SBLOCA case treatment with PCI. The staff emphasized that testing of large break (LBLOCA) cases will not bound SBLOCA cases in all cases due to differences in debris mixes generated and transported, local flow conditions around the strainer, and potential differences in sump level during the event. The staff also noted that, as the result of issues identified with respect to the previous PCI testing (e.g., in the Watts Bar audit report), the insights that can be gained from comparing previous SBLOCA and LBLOCA test results are limited. The staff also noted that PCI’s discussion of the NUREG/CR-6224 correlation could have been augmented. In particular, there are very limited debris types, velocity ranges, and other conditions for which this correlation has been validated, and plant-specific material properties are not generally known with accuracy. In addition, this correlation is extremely difficult to apply to PCI’s testing, since the quantity of debris actually accumulated on the strainer is unknown. Therefore, the staff believes that SBLOCA cases should be considered on a case by case basis.

Discussion on thin bed Case (“Design Basis Rev B” write up). The staff considered the vendor’s documented procedure concerning the justification for not testing the thin bed case to be inadequate. Specifically, the vendor stated that a “normal” head loss curve and the observation that some sections of the strainer did not form a fiber bed can justify not performing a thin-bed test. The staff position is that justification for not performing thin-bed testing should be based upon the presence of significant clean strainer area during the full load test. The staff further stated that if a significant amount of clean area remained on the test strainer, the head loss across the strainer would essentially not have increased from the clean strainer value. The staff made additional points concerning previous test observations made at PCI’s and other vendors’ facilities that showed that beds significantly thinner than 1/8” inch (e.g., 1/32”, 1/56”) could induce head loss, particularly in the presence of chemical effects and other problematic types of debris such as calcium silicate. The staff also noted the potential for the uniform flow characteristics of PCI’s strainer to encourage an even layer of debris to form.

In addition, the staff has concerns with the performance of the testing in the area of thin bed determination. In order for the “significant clear screen area” criteria to be valid, the test must be run with prototypical quantities of truly fine debris. The staff defined fine debris as single fibers because there is little agreement or documentation on what represents different debris size classifications. If a full load test is run and significant open screen is present after all debris has been transported to the strainer, but the debris was not prototypically fine, the determination of significant clear strainer area may be invalid. For thin bed testing, the staff recommends using fine fibrous debris with the full particulate load. The fine fibrous debris would generally consist of latent fiber, fine fiber created from the break, and eroded fiber. The staff did not expect the total amount of fines expected to be added to a test to exceed the quantity of fines in a licensee’s transport analysis. In addition, the fiber should be added incrementally and slowly to ensure that the thin bed was not bypassed by adding too much fiber too quickly. The proper creation of a thin bed will likely require several turnovers of the flume after each incremental batch of fiber is added. After several turnovers, the head loss should be allowed to plateau prior to adding the next increment of fiber. The staff stated that, for plants with a large amount of fiber, the thin bed test should be continued until the vendor had confidence that the worst-case thin bed head loss had been achieved. Depending upon plant-specific factors affecting the transport of debris in the flume, it may not be possible to specify a generic quantity of fiber to

add to the test flume (e.g., 2 inches) to ensure that the normal range of thin bed thicknesses are examined by the test.

5. Clean Strainer Head Loss Calculation.

   The staff discussed the determination of clean strainer head loss for the core tube with PCI. The staff asked several questions on the theory behind the head loss determination. PCI seemed to have a lot of experience with the core tube and has confidence in their correlation for determination of the hydraulic losses associated with it. However, the staff did not fully comprehend or agree with all aspects of the vendor's explanation of the physical processes that drive the core tube head loss. Based upon the licensee's argument that the core tube head loss does not follow normally accepted hydraulic principles and the fact that testing of core tubes has only been completed on articles that appear to the staff to have significant geometrical differences, the staff could not accept the clean strainer head loss determination methodology without additional analysis or test data from PCI. It was agreed that during testing of a sump pit installation, which will have a core tube installed that is geometrically similar to the new PWR strainers, the losses associated with the core tube will be determined. In addition, PCI agreed to measure the head loss with the core tube in a normal configuration (with the distant end of the tube covered with perforated plate) and with the distant end of the core tube capped off. Based on the results of the core tube testing, the staff will revisit this issue.

The staff also requested that PCI provide a schedule of upcoming tests to support the staff's planned observation of testing with the new PCI methodology. PCI stated that a schedule had not been developed as yet, but that one would be provided once it is developed.

Enclosure:
As Stated

List of Telecon Participants

(Note: not all individuals listed participated in each call.)

Ron Holloway	Wolf Creek
Mo Dingler	Wolf Creek
Matt Brandies	Callaway
Wes Schulz	South Texas
Wayne Harrison	South Texas
Chuck Feist	Comanche Peak
Drew Rohrer	Comanche Peak
Tom Kendall	Point Beach
Jeremy Fisher	Point Beach
Brian Smith	Point Beach
George Goralski	Palisades
Bill Beckius	Palisades
Jim Kuemin	Palisades
Scott Putnam	Kewaunee
Lori Sutton	Kewaunee
Brian Dunn	FP&L (St. Lucie 2/Turkey Pt. 4)
Bruce Beisler	FP&L (St. Lucie 2/Turkey Pt. 4)
Mike Moran	FP&L (St. Lucie 2/Turkey Pt. 4)
Larry Hardin	FP&L (St. Lucie 2/Turkey Pt. 4)
Harold Hopkins	FP&L (St. Lucie 2/Turkey Pt. 4)
Tom Doering	Areva
Faribe Gartland	Areva
Matt Bost	Areva
Ray Phan	Areva
Heidi Dergel	Areva
Stu Cain	ARL
Martin Woznik	ARL
Jim Bleigh	PCI
Chris Kudla	PCI
Amy Hazelhoff	NMC
Gabe Salamon	NMC
Steve Smith	USNRC
Mike Scott	USNRC
Joe Golla	USNRC
Paul Klein	USNRC
Allan Hiser	USNRC
John Lehniing	USNRC
Shanlai Lu	USNRC

Enclosure

Memorandum to Michael L. Scott from Joseph A. Golla

SUBJECT: PHONE CALL SUMMARY OF CALLS MADE MAY TO SEPTEMBER 2007, WITH PCI, ALDEN, AREVA AND LICENSEES TO DISCUSS PCI SURE-FLOW STRAINER TEST PROTOCOL

DISTRIBUTION:
AHiser (ALH1)
PKlein (PAK)
JLehning (JXL4)
JGolla (JAG2)
MScott (MLS3)
MMurphy (MCM2)
RArchitzel (REA)
MYoder (MGY)
LWhitney (LEW1)
EGeiger (EXG)
SSmith (SJS2)
JBurke (JPB3)
JBleigh (Jim.Bleigh@pcg.com)
RidsNrrDss
RidsNrrDci
RidsNrrDpr
RidsNrrDprPgcb

ADAMS Accession Number : ML080310263 NRR-106

OFFICE	LA:PGCB:DPR	PM:DPR:PGCB	BC:DCI:CSGB	BC:DPR:PGCB	BC:DSS:SSIB
NAME	CHawes CMH	JGolla JAG	AHiser MY for	MMurphy MCM	MScott
DATE	02/01/08	2/01/08	2/05/08	2/01/08	2/20/08

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