

March 22, 2011

MEMORANDUM TO: Stewart N. Bailey, Chief  
Safety Issues Resolution Branch  
Division of Safety Systems  
Office of Nuclear Reactor Regulation

FROM: Blake A. Purnell, Project Manager */RA/*  
Generic Communications and Power Uprate Branch  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

SUBJECT: PUBLIC SUMMARY OF FEBRUARY 2, 2011, PHONE CALL WITH  
PERFORMANCE CONTRACTING, INC. TO DISCUSS ITS NARROW  
FLUME TESTING

On February 2, 2011, U.S. Nuclear Regulatory Commission (NRC) staff held a teleconference with representatives of Performance Contracting, Incorporated (PCI) and its partners (the vendor) to discuss technical issues concerning PCI's narrow flume testing as it relates to pressurized-water reactor containment sump strainer performance. Client licensees of PCI also participated in the call. This teleconference was closed to the public due to the proprietary nature of the discussions.

The following proprietary PCI documents were discussed during the call:

- PCI-2010.12.17 Rev 0, "Debris Piles and Conclusions," dated December 17, 2010
- PDT-2010.11.12 Rev 3, "Narrow Flume Testing Data & Conclusions," prepared by Alden Research Laboratory, Inc., dated January 2011

## **DISCUSSION**

### Debris Piles and Conclusions Document

The "Debris Piles and Conclusions" document was provided by PCI in response to a question raised by the NRC staff during a meeting held on December 2, 2010. A publicly available summary of the December 2, 2010, meeting is available in the NRC Agencywide Documents Access and Management System (ADAMS) at Accession Number ML103570129.

The staff stated that there is some uncertainty regarding the potential for differences in particulate debris capture under test and plant conditions. However, the staff noted that any difference is likely not significant and effects would be minimal when compared to

conservatism inherent in the test procedures used for testing of pressurized-water reactor sump strainers.

The staff had several comments regarding the citation of previous research in the document. In general, the staff noted that the referenced testing was conducted under conditions that were not fully representative of plant conditions. Conditions that should be considered include debris size and potential pool velocities and turbulence. Additionally, some statements in the paper were applicable under only some circumstances with opposite conditions possible under plant and break specific scenarios.

The staff could not find bases in the referenced test documents for the conclusions that were drawn in the paper. In addition, some of the conclusions were made regarding materials not tested in the referenced reports. Specifically, the referenced testing did not include particulate debris which is the debris type of interest for this paper. PCI stated that the conclusions were based on the test results and on its judgment. The staff also considered the conclusion that any material with a specific gravity greater than one would sink in a pool after a loss-of-coolant accident (LOCA) to be oversimplified and not reflective of what could actually occur in the pool. For these reasons the staff concluded that the referenced tests should not be considered a basis for the conclusions drawn in the paper. PCI agreed the context was not clear as to why they had referenced the subject research documents. PCI stated it will revise the document to provide better context for the references.

The paper also discussed miscellaneous debris. The staff had not been concerned with miscellaneous debris entrapping particulate since it is not generally included in strainer head-loss tests. The reason for the discussion of miscellaneous debris was not clear to the staff. PCI explained that miscellaneous and other debris types (e.g., RMI, glass from panels and bulbs) would be present in the post-LOCA containment fluid and could trap both fibrous and particulate debris. PCI agreed that these debris types are not normally used for head loss tests, but they are present in the post-LOCA containment fluid and could significantly trap debris.

The paper discussed the potential for chemical precipitates in a general way and stated that the formation of precipitates usually occurs relatively late in the LOCA recovery. The formation of chemical precipitates is a plant-specific issue. Although, the most problematic precipitates occur relatively late for most plants, some calcium based precipitates may form relatively early in the LOCA recovery.

The staff noted that the paper did not discuss the potential for resuspension of settled debris in the plant after recirculation is initiated.

The paper noted several reasons that some of the referenced test results were of limited use for evaluation of debris settling in the plant and during strainer testing. The staff agreed that there are limitations to the application of the test data. The staff is interested in reviewing tests that provided more relevant information regarding debris settlement. In the absence of relevant data, the staff will conservatively evaluate how available data can be applied. Current staff guidance for baseline evaluations is that all fine debris transports to the strainer. The staff considers the vendor proposals as refinements to the baseline guidance.

PCI discussed a strainer head-loss test that simulated the potential for debris settlement by placing all debris in the test flume prior to starting the recirculation pump. The staff noted that this test was not accepted as valid for several reasons including potential nonconservatism.

The staff agreed that some of the information presented in the paper was relevant with respect to this aspect of testing. PCI agreed to revise the paper so that the material supported the purpose of the paper.

#### Narrow Flume Testing Data and Conclusions Document

The staff had several observations and questions regarding the narrow flume test data and conclusions that were provided for review. The staff noted that it is difficult to determine whether transport is affected more by injection velocity or by debris concentration.

The staff noted that the paper stated that the PCI debris preparation is more conservative than the guidance in Nuclear Energy Institute (NEI) 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," and the associated NRC Safety Evaluation (SE). The staff stated that both NEI 04-07 and the SE prescribe that all small fines (less than 4-inch grating size) are considered to be individual fibers and that these statements in NEI 04-07 and the SE are only applicable to a baseline evaluation, not to evaluations that provide refinements. Therefore, the staff does not consider PCI's debris preparation to be more conservative.

The staff noted that Section 2.3 of the document states that batch sizes are realistic, but the basis for this was not clear. The staff's interest is in realism when compared to the plant and test conditions. The vendor stated that batch sizes were realistic when compared to the test condition and bounded the plant condition because all debris transported during the tests when the concentration was controlled. The staff indicated that they understood the statement within this context.

The staff noted that Section 5 of the document concludes that the effect of settled debris in the flume is conservative. The staff questioned what behavior would occur at very low debris concentrations. For example, what happens to transport and debris pile formation as debris concentration goes to lower values as would be more typical of the plant? The staff agreed with the vendor for cases in which the transport test conditions bound those in the strainer tests.

The staff questioned how plant versus narrow flume turbulence levels might influence transport. The vendor stated that the flume turbulence will provide prototypical conditions in future strainer head loss tests. However, the staff was not sure that the turbulence level in the transport test flume was lower than that in the strainer test flume. The vendor should validate this or explain why it does not impact the application of the test results to the strainer testing. The vendor stated that since future strainer head-loss test flume designs will likely require turbulence generation, the test flumes will bound the plant turbulence conditions.

The staff asked if the conditions in the transport tests bound those expected in the plant and the strainer tests or if the potential differences had been evaluated to ensure that the transport test conditions are realistic or conservative. Conditions of concern include debris concentration, velocity, turbulence, flume lengths, flume widths, and debris pile heights that may occur in the plant and in testing. The vendor stated that the purpose of the transport tests was not to

determine how much fiber will transport under various conditions, but was intended to determine whether flume width or wall effects have an effect on transport.

The staff requested that the vendor provide the basis for limiting confirmatory testing to a particular range of velocities. The vendor stated that these values were based on engineering judgment and provided its reasoning. The staff was not convinced that these values are appropriate limits for requiring confirmatory testing. The staff and vendor agreed that before certain tests are performed the test parameters should be reviewed by the staff and vendor.

The staff requested an evaluation of the effect of a longer flume length on the transport and on the potential effects of flume length at lower velocities. The vendor stated what it observed and the staff stated that it will review the test films to validate this behavior.

The staff and vendor also discussed ongoing testing to determine the effects of jet and sheet flow breakup on the momentum added to the sump pool. The vendor stated that preliminary small scale tests had been conducted and that the results were promising. The results of the test program may be used to refine the pool turbulence calculations. The vendor also stated that they had a solution for adding turbulence to the strainer test flume.

#### Other Statements

PCI inquired and the staff noted during the meeting that PCI has essentially addressed all of the open issues to the extent possible such that PCI could implement the refined Large Flume Test Protocol (LFTP); with the understanding of the staff's need to review several plant specific issues or Hold Points prior to implementation.

The staff noted that PCI has not submitted a topical report for its LFTP that could be referenced by licensees. The possibility that PCI could provide a summary document of the LFTP that could reference other submittals by PCI was discussed. The staff could document its review of the summary which would embody the refinements to the LFTP and include the Hold Points needed on a plant specific basis. This approach would provide licensees with a reference to use for plant-specific testing done in accordance with the LFTP. PCI agreed there are Hold Points that will need review by the NRC prior to proceeding with a test for a licensee and PCI intends to identify those in a generic protocol document.

PCI stated it would review both documents discussed at the meeting and potentially provide draft updates.

A meeting is planned for March 2011 to discuss progress regarding sheet and jet breakup testing and turbulence testing.

Enclosure: List of Participants

cc: James Bleigh/PCI

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**ADAMS ACCESSION NUMBER: ML110600719**

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DATE	3/13/11	3/13/11	3/18/11	3/22/11

**List of Participants for February 2, 2011,  
Phone Call with PCI and Licensees**

<b>Name</b>	<b>Affiliation</b>
Ron Holloway	Wolf Creek Nuclear Operating Corp.
Chuck Feist	Comanche Peak
Bill Beckius	Entergy Nuclear Operations, Inc. (Palisades)
Jeff Weyhmilller	Palasades
Jim Bleigh	PCI
Chris Kudla	PCI
Fariba Gartland	AREVA
Ludwig Haber	Alden Research Laboratory
Stu Cain	Alden Research Laboratory
Wes Schultz	South Texas Project
Keith Smith	Palisades
Bill Beckius	Palisades
Paul Leonard	Florida Power & Light (St. Lucie 2, Turkey Point 4)
Brian Dannaker	AREVA
Patrick Reyes	PCI
Steve Smith	NRC
Blake Purnell	NRC
Stewart Bailey	NRC

Enclosure

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Blake Purnell  
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