January 18, 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 DECEMBER 2, 2010, CLOSED MEETING WITH PERFORMANCE CONTRACTING, INC. TO DISCUSS ITS NARROW FLUME TESTING

On December 2, 2010, U.S. Nuclear Regulatory Commission (NRC) staff held a closed meeting with representatives of Performance Contracting, Incorporated (PCI), PCI customers, and PCI's contractors Alden Research Laboratory, Inc. (Alden) and AREVA NP. The meeting was closed to the public due to the proprietary nature of the material presented by PCI. The purpose of the meeting was for PCI to provide additional information concerning narrow flume sensitivity testing performed in support of the protocol to be used by PCI for large-flume sump strainer testing. The large-flume test protocol, which is an integrated test that encompasses debris transport, debris settlement, and head loss based on licensee post-loss-of-coolant accident (post-LOCA) prototypical containment conditions, is being pursued by some pressurized-water reactor licensees in order to demonstrate adequate performance of containment sump strainers in response to Generic Letter 2004-02. PCI presented information to address narrow flume testing-related issues previously identified by NRC staff in a teleconference held on November 19, 2010. A publicly available summary of the November 19, 2010, teleconference is available in the NRC Agencywide Documents Access and Management System (ADAMS) under Accession Number ML103270378.

**DISCUSSION**

To address the NRC staff's concern with the narrowness of the test flume, PCI (Alden) discussed and presented, via a PowerPoint presentation, the applicability of the narrow-flume test data to the Large Test Flume Protocol, concluding that the flume width has negligible effect on the transport of "small fines" fiber and particulate. The presentation also included a qualitative argument as to why particulate entrapment in the settled fibers is not a significant issue with respect to debris transport and, therefore, does not affect head loss testing results. To demonstrate that fiber transport is not sensitive to flume width, PCI (Alden) provided proprietary video of fibrous debris transport testing performed in narrow flumes.

PCI stated that it believes the flume test protocol discussed with staff is appropriate to determine if a given concentration of debris is appropriate for a given plant condition. PCI suggested that for each design basis large flume test going forward, PCI designate a "hold point." PCI requested NRC staff to provide feedback on these items.

NRC staff stated that a final position on the above items could not be reached until staff had an opportunity to review all of the narrow flume test data. The NRC staff had previously noted that important scaling parameters associated with the transport behavior in the narrow flume tests had not been demonstrated to be representative of plant conditions and planned strainer test conditions. Therefore, the staff planned to review the narrow flume sensitivity test data to determine the extent to which the results and other insights from this testing are representative of plant post-accident conditions and planned strainer test conditions. Areas in which the staff's review would focus include the scaling of debris quantities relative to flow channel geometric parameters, the similitude of applicable flow parameters such as velocity and turbulence, and the influence of the flow channel length on the predominate transport mode (i.e., tumbling versus suspension). The staff was particularly interested in understanding the transport behavior in the intermediate range of the flow velocities tested, based on the more complex transport results observed in some of the sensitivity tests and because many plant flow velocities are likely to lie in this range.

NRC staff does agree that higher head loss occurs when particulates are added to the flow prior to fiber introduction; however, the staff expects this is primarily due to an equivalent quantity of transported fiber dispersed on the screen in a more uniform way. Also, as a result of competing effects the vendor has not fully examined, the NRC staff is not convinced that particulates in the flow stream generally tend to increase the transport of fibrous debris, as PCI claims.

PCI provided its positions with regard to chemical precipitate and other particulates that may be trapped by the settled fiber that does not transport. Staff believes that the capture of particulates and chemical precipitates on settled fibrous debris could lead to nonconservative treatment of some plant conditions, largely based on the potential to form significantly deeper piles of settled debris in a narrow flume as compared to plant flow channels. An agreement on this issue could not be reached and it was decided that NRC staff and PCI would examine how to determine if this phenomenon is significant.

The staff also noted that future discussions would need to address how PCI would apply the test results to the revised test protocol. For example, the staff questioned whether the test protocol would specify pauses between the batching of fibrous debris similar to the sensitivity tests, or whether batches of small pieces of fibrous debris would be added in a continuous manner.

Additional items from the November 19, 2010, meeting were discussed as follows:

1. NRC staff has no open issues regarding how to define the flow stream velocity in the test flume to represent a plant condition.

2. NRC staff has no open issues regarding how to define the turbulent kinetic energy (TKE) for the test flume such that it represents the plant condition.

3. The method used to induce the level of TKE is not final. PCI (Alden) outlined a simpler method for generating turbulence during the meeting that may be capable of providing acceptable results. The TKE induced by this method would be confirmed by computational fluid dynamics (CFD) of the test flume by including them in the CFD modeling.

4. PCI (Alden) previously proposed a reduction in the conservatism in the momentum transferred in jet and sheet-flow breakup by applying data from some reduced scale empirical experiments. NRC staff has provided feedback on this proposal and PCI (Alden) is considering whether and how to respond to the staff's comments. Although this issue remains open, the staff agreed that it is acceptable for PCI to define the momentum transfer associated with drainage into the containment pool using the previously accepted conservative methodology; that is, assuming no jet break-up or dissipation of the initial fluid energy. Therefore, the issue is not a restraint to proceeding with large flume testing.

5. NRC staff stated that the outer surface of the strainer should be used, rather than its geometric center, when defining the debris addition distance. The staff considers the physical dimensions of plant strainers as too large to neglect in this determination. PCI (Alden) has agreed to implement the NRC comment and has submitted the debris addition distance paper for the staff's review and comment.

ACTION ITEMS:

PCI will submit the PowerPoint presentation and video formally to the NRC as proprietary information with an affidavit.

PCI will provide a revision to the existing narrow flume test data and conclusions paper by December 17, 2010.

PCI will provide data to support their argument that settled fibers in the test flume will not lead to non-prototypical capture of particulates and chemical precipitates.

PCI and NRC staff both agreed to consider the debris concentrations expected in plant containment pools following a postulated loss-of-coolant accident and discuss to what extent the narrow flume sensitivity tests have addressed expected plant containment pool transport conditions.

NRC staff will provide feedback on the acceptability of the test protocol, the acceptability of the narrow flume sensitivity testing, the applicability of the narrow-flume test results to the large scale flume testing, and the PCI proposal to have NRC staff review the large scale flume test debris loads prior to the execution of the test.

Enclosure: List of Participants

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Enclosure: List of Participants

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**ADAMS ACCESSION NO.:** ML103570129

| OFFICE | LA:DPR:PGCB | PM:DPR:PGCB | BC:DSS:SSIB | PM:DPR:PGCB |
|---|---|---|---|---|
| NAME | CHawes CMH | BPurnell | SBailey | BPurnell |
| DATE | 1/11/11 | 1/11/11 | 1/18/11 | 1/18/11 |

**List of Participants for December 2, 2010,**
**Category 2 Closed Meeting with Performance Contracting, Inc. to Discuss Its Narrow-Flume Testing**

| Name | Affiliation |
|---|---|
| Ron Holloway | Wolf Creek Nuclear Operating Corp. |
| Chuck Feist | Comanche Peak |
| Kara Morgan | Comanche Peak |
| Bill Beckius | Entergy Nuclear Operations, Inc. (Palisades) (call-in) |
| George Goralski | Entergy Nuclear Operations, Inc. (Palisades) |
| Keith Snult | Entergy Nuclear Operations, Inc. (Palisades) |
| Wen Schulz | STP (call-in) |
| Ed Lozito | Turkey Point/St. Lucie (call-in) |
| Ed McLain | Turkey Point/St. Lucie (call-in) |
| Jim Bleigh | Performance Contracting, Inc. |
| Chris Kudla | Performance Contracting, Inc. |
| Fariba Gartland | AREVA |
| Ludwig Haber | Alden Research Laboratory |
| Stu Cain | Alden Research Laboratory (call-in) |
| Steve Smith | NRC |
| John Lehning | NRC |
| Ervin Geiger | NRC |
| Ralph Architzel | NRC |
| Stewart Bailey | NRC |

Enclosure

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