August 11, 2010

MEMORANDUM TO: Michael L. Scott, Chief
Safety Issues Resolution Branch
Division of Safety Systems
Office of Nuclear Reactor Regulation

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

SUBJECT: SUMMARY OF JUNE 2, 2010, CLOSED MEETING WITH PERFORMANCE CONTRACTING, INCORPORATED AND LICENSEES TO DISCUSS THE PERFORMANCE CONTRACTING INCORPORATED LARGE FLUME TEST PROTOCOL

On June 2, 2010, Nuclear Regulatory Commission (NRC) staff met with representatives of Performance Contracting, Incorporated (PCI), and client licensees of PCI to discuss technical issues concerning PCI's large flume test protocol for testing pressurized-water reactor containment sump strainer performance. The meeting was a continuation of one held on April 28, 2010. This, and the April 28, 2010, meeting were closed to the public due to the proprietary nature of the discussions. Prior to these meetings the vendor properly submitted a letter and affidavit, according to Title 10 of the *Code of Federal Regulations, Section* 2.390, "Public inspections, exemptions, requests for withholding," requesting that the meeting be closed. A publicly available version of the meeting summary for the April 28, 2010, meeting can be viewed in the NRC Agencywide Documents Access and Management System (ADAMS) at Accession No. ML101600123.

Enclosure 1 to this meeting summary provides a list of those in attendance. Enclosure 2 is the meeting agenda. Two vendor documents were used to facilitate discussion. These documents are proprietary and are retained non-publicly available in ADAMS. One document is titled "SFS UG Large Flume Testing Protocol Elements," dated April 21, 2010. This document is organized in a tabular format, and contains the vendors' (PCI, AREVA NP, Inc./Alden Research Laboratory) large flume test protocol elements. The other document is a slide show presentation entitled, "Responses to NRC Agenda Items Regarding the SFS Team's Large Test Flume Protocol Elements," dated April 28, 2010.

CONTACT: Joseph A. Golla, NRR/DPR
301-415-1002

Mr. Michael Scott, Branch Chief of the NRC Safety Issues Resolution Branch of the Office of Nuclear Reactor Regulation, initiated the meeting by reviewing with the vendor the status of completion of Action Items from the April 28, 2010, meeting. The Action Items indicated below refer to presentation slides that were used at the April 28, 2010, meeting and the PCI "Elements" document referred to above. The April 28 presentation is titled, "Large Flume Test Protocol," by Alden Research Laboratory. The status was determined to be as follows:

Actions for PCI Elements document, Item A, Computational Fluid Dynamics (CFD) Modeling of the Licensee Plant Specific Containment

Slides 14 & 15:
Staff action complete.
Vendor action (develop experiments for water sheets) is not yet complete.
Action: Vendor to provide analysis and test plan regarding pipe break flow and sheet flow by June 25, 2010. Staff to provide feedback by July 2, 2010.

Slides 7 & 16:
Vendor action (calculating flume velocity) not yet complete.

Action: Vendor to provide methodology by July 26, 2010.

Slide 19:
Vendor action (new method to introduce turbulence by pulsing nozzles) not yet complete.

Action: Vendor to provide plan and system description for above after staff feedback on sheet flow. Vendor plan and system description due July 26, 2010. Vendor stated that it would provide contour plots of an example plant and a line plot of simulated turbulent kinetic energy versus that in test flume, both based on CFD.

Action: Staff to provide feedback on turbulence introduction plan and nozzle system description upon receipt from vendor.

Actions for PCI Elements document, Item B, Licensee Plant-Specific Large Test Flume Configuration

Slide 11:
Staff action (provide reference NUREG to vendor) complete.
Vendor action (provide test plan on flume wall effects) not yet complete. Staff stated that vendor should provide test plan intended to show flume narrowness is not an issue. Staff also stated that issue of fine debris holdup on flume walls could be addressed by slowing debris addition rate.

Action: Vendor to provide test plan by July 26, 2010.

Slide 24:
Vendor action (provide an example to help illustrate proximity zone definition and methodology) not yet complete. Vendor to provide method and example by June 25, 2010.

Slide 10:
The staff provided feedback on temperature modeling, indicating that the references cited do not support a particular increase in turbulent kinetic energy to determine settlement of fine fiber.

Action: Vendor to consider path forward on this and inform staff by July 26.

Following is a synopsis of the items covered in the Large Flume Testing Protocol Elements document, Sections C through F. The indented information summarizes the discussion at the meeting:

C. Debris Types, Debris Surrogates and Debris Forms (Major Debris Types Only)
1. Fibrous debris is almost always the same insulation product as exists in the plant; except for asbestos fibers which are a combination of ceramic fiber and cal sil used in combination as a surrogate.

The staff agrees this statement is correct.

2. Fibrous debris is produced and tested in the form of latent, fines, small fines, smalls, smalls with fines removed, and larges.

The staff views removal of fines from smalls as potentially changing properties of small pieces. Vendor stated that for future tests, they will screen the smalls but not shake them. Staff stated that it views this approach as acceptable.

3. NUKON® latent and fines are produced by introducing small strips of NUKON base wool to a shredder machine. In dry form, this is easily separated into individual fibers and/or a small group of fibers. This dry debris form was acceptable to the NRC prior to implementing large flume testing on the condition the fibers would be diluted enough to prevent agglomeration. Please evaluate the "dry" form preparation.

The staff stated that dry debris form preparation is acceptable as an intermediate step in the debris preparation process.

4. NUKON® small fines and smalls are produced by introducing small strips of NUKON base wool to a wood chipper machine. In dry form, this is easily separated into individual fibers, small groups of fibers, small clumps of fibers and larger clumps of fibers. Only debris that passes through a 1" x 4" plate opening is accepted by PCI for this debris form. PCI has confirmed this debris form contains about 41 percent of loose "fines" that can be removed by a screen and shaker table in 30 minutes. Please evaluate the "dry" form preparation.

The staff stated the approach described is acceptable with the exception of use of shaking as discussed in element C.2 above.

5. NUKON® smalls with fines removed are produced by introducing "smalls/fines" to a shaker table for 5 minutes to removing loose fines. This debris form lost about 25 percent of its loose fines in this process. Please rate the "dry" form preparation only here.

The staff stated that this item has the same status as element C.2.

6. NUKON® "larges are produced by introducing small strips of NUKON base wool to a wood chipper machine. In dry form, this is easily separated into individual fibers, small groups of fibers, small clumps of fibers and some larger clumps of fibers. Only the debris that does not pass through a 1" x 4" plate opening is accepted by PCI for this debris form. Please rate the "dry" form preparation only here.

The staff stated that debris preparation is reasonable but that large pieces generated may be incompatible with narrow flumes. Vendor stated that future testing will use smalls as surrogate for larges.

7. Calcium Silicate is purchased "pulverized" in powder form from the manufacturer.

The staff finds this acceptable.

8. Inorganic Zinc is a coating material usually used on steel surfaces. The surrogate material for IOZ is tin powder with a particle size range of ~10 to 44 microns.

The staff finds this acceptable.

9. Top Coatings (Paint Chips) are usually an alkyd, acrylic, enamel, or epoxy material. The surrogate material is an acrylic coating formed into different sizes of chips. Chip specific gravity is based on the least dense actual coating material to conservatively bound all other coating materials other than IOZ.

The staff finds this acceptable.

10. Top Coatings (Powder) are usually an alkyd, acrylic, enamel, or epoxy material. The surrogate material is an acrylic coating formed into different sizes of chips. When tested as a powder, the chips are pulverized by air jets into powder with a size distribution averaging ~15 microns. Pulverized chip specific gravity is based on the least dense actual coating material to conservatively bound all other coating materials other than IOZ.

The staff finds this acceptable.

11. WCAP 16530-NP Chemicals are surrogates for Aluminum Oxyhydroxide or Calcium Phosphate or Sodium Aluminum Silicates. Due to its hazardous disposal state, the SFS Team uses ALOOH for Sodium Aluminum Silicates. All tests have been implemented with ALOOH, and/or ALOOH and Calcium Phosphate as appropriate.

The staff finds this acceptable.

D. Non-Chemical Debris Introduction & Sequencing

1. Sequence and introduce debris forms from the most transportable to the least transportable, generally speaking.

The staff finds this acceptable.

2. Do not mix debris types and/or debris forms. Introduce “like” debris forms separately and “incrementally”. For example, do not mix fibrous debris fines with small fines or smalls.

The staff finds this acceptable.

3. Introduce a portion of latent debris along the full length of the flow stream between the test strainer and debris drop zone to represent latent debris that may exist near the plant strainers prior to pump start.

For future tests, vendor will incorporate latent fine fiber into same time sequence as other fine fiber with pump running. Addition location is dependent on drop zone location. The method for this will be discussed after below vendor action.

Action: Vendor to provide method and example by June 25, 2010. (Slide 24, previously discussed.)

4. Start the Pump. All particulates are highly diluted and mixed in water. All particulates are introduced from buckets before latent and fine fibrous debris are introduced (with the exception of paint chips which follow the latent and fine fibrous debris).

The staff finds this acceptable.

5. All fibrous debris is highly diluted and aggressively stirred by paddle mixers. Agglomeration of fibers is “minimized” to the extent possible, and further diminished upon introduction into the flow stream as has been documented by separate post test studies.

The staff stated that it would find 15 grams or less of fiber per liter, acceptable for this item. Vendor agreed to do this.

6. The fibrous debris is added incrementally from buckets to the surface of the Large Test Flume.

The staff finds this acceptable.

7. Latent and fine fibrous debris are introduced before small fines, smalls, smalls with fines removed, larges (if tested).

The staff finds this acceptable.

8. Large debris, if tested, is introduced last so as to not trap smaller more transportable debris.

This item is resolved for future testing since the vendor plans to use smalls as surrogate for larges.

9. Eroded fibrous debris is introduced after other non-chemical debris to represent the ‘delayed’ time-frame associated with the fibrous debris erosion.

The staff recommended adding eroded fine fibers in same addition sequence as other fine fiber. The vendor agreed to do this.

10. The non-chemical debris is allowed to recirculate until head loss is stable; most times over night; before beginning the introduction of chemical debris introduction.

The staff finds this acceptable.

E. Chemical Debris Introduction & Sequencing

1. Scale the chemical precipitates tested to equal the "mass per unit area of screen" for the 30-day event.

The staff finds this acceptable.

2. Use the Westinghouse Commercial Atomic Power (report) (WCAP) surrogate for chemical precipitates ALOOH and Calcium Phosphate.

The staff finds this acceptable.

3. Use the WCAP surrogate ALOOH for the chemical precipitate sodium aluminum silicate. ALOOH has a lower specific gravity and is thus, more easily transported. Plus, ALOOH, when tested at the same mass as calculated for sodium aluminum silicate, will occupy more space than an equivalent mass of sodium aluminum silicate.

The staff finds this acceptable.

4. Only use the WCAP surrogate if it meets the most conservative settling characteristic for the WCAP surrogate; e.g., ALOOH met the settling characteristic for concentrations of 2.2 g/l.

Vendor will reference applicable WCAP-16530, Fig. 7.6-1 acceptance criterion for their chemical precipitate settlement.

5. Do not use the WCAP surrogate if it was mixed more than 24 hours prior to introduction.

The staff finds this acceptable.

6. Reduce the size of batches introduced so as to not over concentrate the Large Test Flume more than once every 5 to 10 pool turnovers. (The purpose of sequencing and limiting the quantity of the incremental batches is to prevent a faster settling of chemical precipitates which can occur with higher concentrations.)

The vendor clarified this item as follows: current practice is to introduce chemicals in batches not greater than 20 percent by mass of precipitate mass needed in the flume to match the plant concentration. Introduce each batch not faster than one flume turnover between batches. Different precipitates to be introduced separately.

The staff finds this acceptable.

The staff asked whether vendor procedure monitors flume pH to ensure it does not get too high. The vendor affirmed it has a procedure to monitor pH. The staff stated that the procedure should keep pH below 9.0. The vendor agreed to incorporate this.

The staff asked whether significant amounts of precipitates are collected in the overflow system. The vendor responded that they have not observed such precipitates and that the bag contents are reintroduced to the flume.

F. Termination Criteria

1. Terminate, not before 15 pool turnovers, when the rate of increase of the head loss is flat or decreasing.

The staff finds this acceptable.

2. If the head loss is increasing after 15 pool turnovers; use an exponential curve fit to bound the test data and extrapolate for 30 days. The extrapolated head loss curve is then 'raised' to equal the statistical accuracy of the curve/data.

The staff finds this item acceptable. Staff stated it might question use of exponential curve fit if data trend near end of test appears to be linear.

Discussion of Slide Show Presentation

The staff stated that applying an erosion factor to the quantity of smalls determined analytically to transport could be used to determine the quantity of fines added to the test to account for erosion of debris settled in the test flume. The quantity of fines to be added could reduce the quantity of smalls. This subject was discussed for element C.5.

The vendor asked whether the video shown during the meeting alleviated staff concerns about past practices. Staff replied that it has observed past practices to be inconsistent so staff would need plant-specific visual evidence to accept past testing. For future testing, the staff would consider the video shown today in conjunction with a statement that addition was made gradually and consistent with the 15 gram per liter criterion to conclude that the addition practice is acceptable. This conclusion could change based on staff observations of plant-specific testing. The staff stated that the vendor-proposed concept of a debris injection trough should be helpful.

The vendor stated that they view the debris preparation and introduction protocol as conservative, given factors such as fibrous preparation, introduction at the surface of a moving flow stream, and debris sequencing. The staff responded that, for future testing, actions agreed to at this meeting, if properly implemented, would result in an overall conservative debris preparation and introduction methodology. The staff stated that key uncertainties/potential non-conservatisms in debris addition mean that adequacy of past introduction practices could best be resolved on a plant-specific basis.

The vendor asked whether uniform debris addition in the water column would be acceptable. The staff replied that this is acceptable in principle but that it could occasion additional questions. For example, questions might include flotation and how to handle multiple addition points.

Enclosures:
List of Attendees
Meeting agenda

The staff asked whether significant amounts of precipitates are collected in the overflow system. The vendor responded that they have not observed such precipitates and that the bag contents are reintroduced to the flume.

F. Termination Criteria

1. Terminate when the head loss not before 15 pool turnovers and the rate of increase is flat or decreasing.

The staff finds this acceptable.

2. If the head loss is increasing after 15 pool turnovers; use an exponential curve fit to bound the test data and extrapolate for 30 days. The extrapolated head loss curve is then 'raised' to equal the statistical accuracy of the curve/data.

The staff finds this item acceptable. Staff stated it might question use of exponential curve fit if data trend near end of test appears to be linear.

Discussion of Slide Show Presentation

The staff stated that applying an erosion factor to the quantity of smalls determined analytically to transport could be used to determine the quantity of fines added to the test to account for erosion of debris settled in the test flume. The quantity of fines to be added could reduce the quantity of smalls. This subject was discussed for element C.5.

The vendor asked whether the video shown during the meeting alleviated staff concerns about past practices. Staff replied that it has observed past practices to be inconsistent so staff would need plant-specific visual evidence to accept past testing. For future testing, the staff would consider the video shown today in conjunction with a statement that addition was made gradually and consistent with the 15 gram per liter criterion to conclude that the addition practice is acceptable. This conclusion could change based on staff observations of plant-specific testing. The staff stated that the vendor-proposed concept of a debris injection trough should be helpful.

The vendor stated that they view the debris preparation and introduction protocol as conservative, given factors such as fibrous preparation, introduction at the surface of a moving flow stream, and debris sequencing. The staff responded that, for future testing, actions agreed to at this meeting, if properly implemented, would result in an overall conservative debris preparation and introduction methodology. The staff stated that key uncertainties/potential non-conservatisms in debris addition mean that adequacy of past introduction practices could best be resolved on a plant-specific basis.

The vendor asked whether uniform debris addition in the water column would be acceptable. The staff replied that this is acceptable in principle but that it could occasion additional questions. For example, questions might include flotation and how to handle multiple addition points.

Enclosures:
List of Attendees
Meeting agenda

DISTRIBUTION: See next page
ADAMS ACCESSION NUMBER: ML102080213

OFFICE	LA:DPR:PLPB	PM:DPR:PLPB	BC:DCI:CSGB	BC:DSS:SSIB
NAME	EHylton	JGolla	RTaylor	MScott
DATE	7/27/10	7/27/10	7/29/10	8/11/10

List of Attendees for June 2 2010,
Meeting With PCI and Licensees

Chuck Feist	Luminant Power
Stu Cain	Alden
Fariba Gartland	AREVA
Jim Bleigh	PCI
Tom Bilger	AREVA
Tom Kendall	FPL (Point Beach)
George Goralski	Entergy (Palisades)
Ron Holloway	WCNOC
Matt Brandes	Ameren
Joe Golla	NRC
Steve Smith	NRC
John Lehning	NRC
Mike Scott	NRC
Paul Klein*	NRC
Wes Schulz*	STP
Lori Christensen*	Kewaunee
Brian Dannaker*	AREVA
Matt Plante*	AREVA
Ludwig Haber*	Alden

* Indicates participated via telecom

Enclosure 1

MEETING AGENDA
U.S. NUCLEAR REGULATORY COMMISSION (NRC)
MEETING WITH PERFORMANCE CONTRACTING, INC.(PCI) AND PRESSURIZED-WATER REACTOR LICENSEES
(MEETING CLOSED TO THE PUBLIC)

June 2, 2010

8:30-8:40	Introductions and meeting purpose	NRC
8:40-10:45	Review of test protocol elements	PCI/NRC
10:45-11:00	Break	
11:00-11:45	Test debris size distribution (e.g., mechanical removal of fines from small pieces and erosion)	NRC/PCI
11:45-12:45	Lunch	
12:45-1:30	Consistency of debris preparation and addition practices	NRC/PCI
1:30-2:15	Addition of debris with pump stopped	NRC/PCI
2:15-3:00	Modeling almost all debris as transporting to the strainers from one flume length away	NRC/PCI
3:00-3:15	Break	
3:15-4:15	Flow modeling	NRC/PCI
4:15-5:00	Flume width	NRC/PCI

Enclosure 2

Memorandum to Michael Scott from Joe Golla, dated August 11, 2010

SUBJECT: SUMMARY OF CLOSED MEETING ON JUNE 2, 2010, WITH PCI AND LICENSEES TO DISCUSS PCI's LARGE FLUME TEST PROTOCOL

DISTRIBUTION:

E-Mail:
RidsNrrOd
RidsNrrAdro
RidsNrrAdes
RidsNrrDss
RidsNrrDci
RidsNrrDpr
RidsNrrDprPgcb
RidsEdoMailCenter
RidsAcrsAcnwMailCenter
RidsOgcMailCenter

Joe Golla
John Jolicoeur
Paul Klein
John Lehning
Michael Scott
Stephen Smith
Robert Taylor
Jim Bleigh (Jim.Bleigh@pcg.com)