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PCI
PERFORMANCE
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ENGINEERED SYSTEMS

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Solving Flow Problems Since 1894

NRC – Luminant / CPNPP Public Meeting

Comanche Peak Emergency Sump Performance July 9th 2009

AREVA

PCI PERFORMANCE CONTRACTING INC ENGINEERED SYSTEMS

Presenters:

- **Performance Contracting, Inc.**
  - >James M. Bleigh; PCI / ESG Manager
- **AREVA NP, Inc.**
  - >Fariba Gartland, Project Manager
  - >Matt Bost; Test Engineer
- **Alden Research Laboratory, Inc.**
  - >Stuart Cain; PhD, President
  - >Ludwig Haber; PhD

Rockville, MD
July 9, 2009

Comanche Peak RAI No. 8

Issue

Erosion of smalls / large fibers not transporting in large flume testing

CP RAI No. 8

Erosion of smalls / large fibers not transporting in large flume testing

> Erosion of fibers is defined herein as the release of "fines" contained from within small or large clumps of fibers not transporting during recirculation.

> Our expectations regarding the post LOCA for this issue is as follows:

- "Fines" are not created from smalls or large fiber clumps during recirculation; rather, they are created from the blast and are loose and / or trapped within the fiber clumps that form naturally post-LOCA.
- A significant percentage of fines generated are mixed with and trapped within smalls and large fiber clumps by the blast and by the sheeting action of pool fill up
- The erosion of fines (to the extent it can occur) will happen quickly in the event; as has been observed in testing by Alion
- The release of fines from a mixed fibrous / particulate debris bed is expected to be minimal because particulate laden water will diminish the release of fines as particulates become mixed with fibers.

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> The PCI fibrous debris used in the large flume test for Comanche Peak as "smalls" was processed through a wood chipper; then screened dry to pass through 1" x 4" grid openings. There were no "fines" removed from this processed debris prior to testing. This fiber class is called "smalls without fines removed".

> "Smalls without fines removed" has been measured by PCI to contain ~25% of easily removed loose fines and approximately another 16 % of fines that are loose but within the fiber clumps. The first 25% was removed using a shaker table with a ½" x ½" mesh screen for only 90 seconds. The additional 16% was measured from debris classified as "smalls with fines removed" using a shaker table with a ¼" x ¼" mesh screen for 30 minutes. This represents a total of 41% by mass of fines available for erosion when introduced into the large test flume.

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Erosion of smalls / large fibers not transporting in large flume testing

- The quantity of fines tested already includes an overly conservative allowance for fines expected to be separate from or eroded from small and large fiber clumps.
- The quantity of fines which were defined prior to the test by acceptable NEI / US NRC SE methodologies are introduced prior to the introduction of other fibrous debris in a flow stream with a higher concentration of particulates in suspension than the plant; which is both unrealistic and very conservative.
- The erosion of fibers from small and large fiber classes are expected to occur in the first few hours of recirculation; prior to the capture of more and more particulates within the settled fibers.
- Since the "debris form tested" as smalls contain at least as much if not more loose fines as is reasonably expected in the plant condition, there is no need to increase the quantity of fines in large scale testing.

Comanche Peak RAI No. 15

Issue

Introduction of latent fibers
5 minutes prior to start up

CP RAI No. 15

Introduction of latent fibers 5 minutes prior to start up

- Based upon a comment by the NRC staff at the first large flume test in January 2008, PCI introduced either 0.5 lbs or 25% of the latent fiber "fines" throughout the test flow stream 5 minutes prior to pump start up for SFS client tests.
- Comanche Peak introduced 0.5 lbs of the 0.8 lbs total of latent fiber prior to pump start. The remaining 0.3 lb was introduced after pump start and after all of the most transportable particulates were introduced.
- In a test implemented on June 30, 2009 to test the behavior of latent fibers introduced into a test flume 5 minutes prior to pump start, PCI has the following observations to report:
  - The large majority of fibers appear to be separated fibers; meaning, not agglomerated. There were "some" small fiber clumps.
  - Upon introduction, the fibers formed a cloud with some fibers moving around in the water column. At the same time other fibers began to settle.

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Introduction of latent fibers 5 minutes prior to start up

> Continued from previous slide; observations to report:

- Just prior to pump start, some fibers were still suspended in the water column; however, the majority of fibers had settled to form a very loose layer of fibers on the flume floor.
- As soon as the pump started, **ALL** fibers began to immediately transport towards the test strainer. The turbulence of pump start lifted some of the settled debris back into the water column; while other fibers tumbled over each other on the way to the test strainer.
- Within a few minutes of pump start; all but one clump of fibers that had formed during transport had reached the screen. This "clump" failed to transport through a flume transition into a lower flow velocity zone representative of Comanche Peak.

CP RAI No. 15

Introduction of latent fibers 5 minutes prior to start up

> Conclusions from the test

- The introduction of a portion of latent fines 5 minutes prior to pump start; either 0.5 lb or 25% of the latent fiber debris quantity, did not prevent the transport and collection of those fibers on the strainer. The single clump that formed during transport to the screen is not significant; and is likely prototypical of fibers that tumble towards the screen in a flow path and reach a "slow" velocity zone.
- The implementation of this test protocol for all SFS client's in the large flume did not affect the measured debris head losses.

Comanche Peak RAI No. 20

Issue

Large Fibrous Debris Tested In a Narrow Flume

CP RAI No. 20

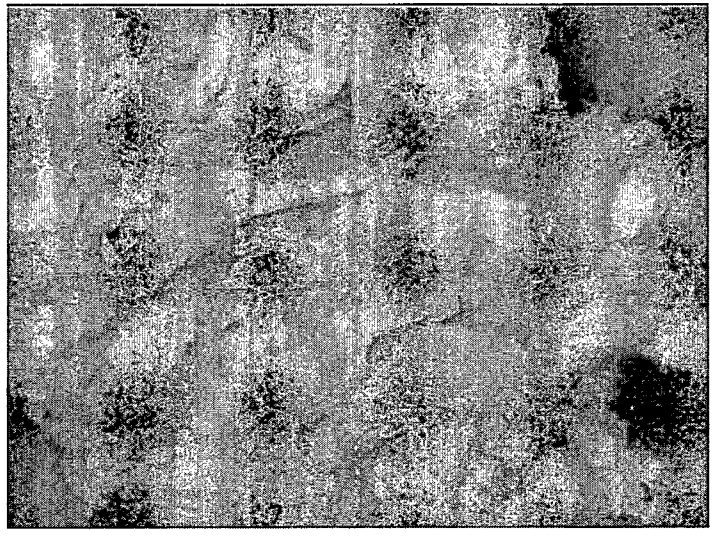
Large Fibrous Debris Tested in a Narrow Flume

- ***The large fibrous debris was prepared dry using a wood chipper. "Large" is defined for PCI debris as fiber clumps that did NOT pass through a 1" x 4" grid***
- ***Prior to introduction into the test flume, the large fibrous debris was submerged in water to remove air. As a result, the volume of the large fibrous debris was reduced to the extent it will not be affected by the narrow flume width (as shown in the following slide).***

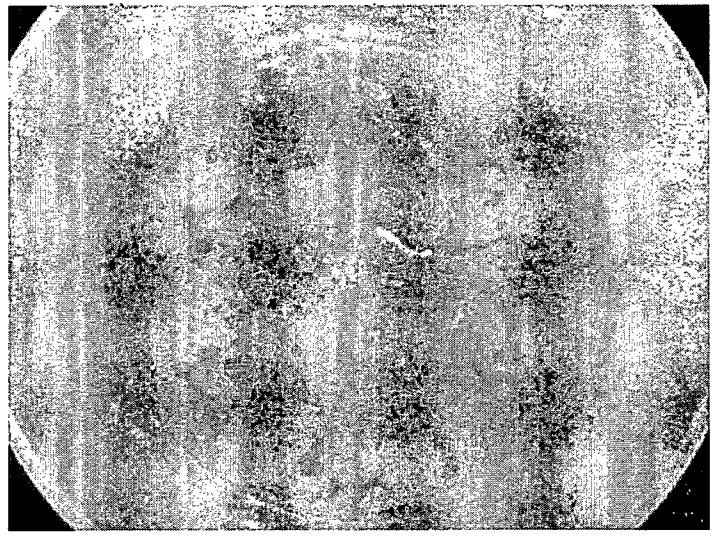
CP RAI No. 20

Large Fibrous Debris Tested in a Narrow Flume

> ***The upper picture illustrates the dry large fibrous debris***



> ***The lower picture illustrates the "soaked" large fibrous debris***



CP RAI No. 20

Large Fibrous Debris Tested in a Narrow Flume

- ***Large fibrous debris was included in the design basis test since the large fibrous debris could tumble along the flume floor to the debris interceptor which could form a ramp for other debris to pass over which is conservative. We wanted to prove the large debris would not form a debris ramp at the interceptor.***

- ***Visibility during the design basis test was limited due to the opaqueness of the water and transport characteristics could not be observed during the test.***

CP RAI No. 20

Large Fibrous Debris Tested in a Narrow Flume

Conclusion

The "large" fibrous debris transport and behavior was prototypical and was included to confirm a debris ramp could not form from large fibrous debris.

CP RAI No. 20

Large Fibrous Debris Tested in a Narrow Flume

Conclusion

The "large" fibrous debris transport and behavior was not affected in the large "narrow" flume test for Comanche Peak because the wet clumps were small enough to behave as expected in the plant conditions; ie., no wedging of debris between the flume walls.

Also, large debris is a small percentage of the tested debris quantity.

Conclusion

> ***The filtering out of chemical precipitants with large fibrous debris during the design basis test, to the extent it occurred, is prototypical of the plant conditions since the chemical precipitants were suspended throughout the water column and the large fibrous debris was unaffected by the test flume width.***