CPSES Comments on and Input to NRC draft trip report

Comment 1 - Draft statement "CPSES resolved to investigate the issues with chemical effects head loss testing."

We understand the NRC issues with the chemical surrogate material and the test environment may not represent the actual plant conditions; however, CASES does not plan to do separate head loss testing (e.g. to get a bump up factor). Manufactured chemical surrogates were used in lieu of generating them as described in WCAP-16530-NP. CASES is in the process of obtaining settling and filterability testing to determine if the manufactured surrogate is suitable for head loss testing. Depending on the settling and filterability test of manufactured chemical byproducts, additional evaluation may be required. The chemical bypoducts for CPSES are on the order of latent debris (e.g. 200lbm) which is insignificant in comparison to coating debris. Based on the observed behavior of fibers at the strainers under full flow conditions*, I do not believe that additional testing will be required to address the NRC concerns for CPSES concerning temperatures and debris arrival times; however, these are generic issues and we are working with NEI, PWROG, and the vendors to address these concerns.

* On day 1, we ran shakedown tests with clear water and fiber fines only. At full flow (0.0073 fps), individual fibers floated across the face of the strainer and would not adhere. With no particulate, there was no head loss. However, no visible fiber bed formed.

Comment 2 - The Test 5 quantity of added Nukon was supposed to be 20.67 lbm. I have confirmed this value was used versus 21.8 lbm in your draft.

Comment 3 - Draft statement "...a flume flow rate of 26 gpm, representing an emergency core-cooling system flow rate of 4,900 gpm."

The flow rate was 26.7 gpm to simulate 4,900 gpm.

Comment 4 - Draft statement "Note that in its December 6, 2004, safety evaluation on Nuclear Energy Institute's Pressurized Water Reactor Sump Evaluation Methodology, the staff stated that when evaluating downstream effects licensees may not take credit for the filtering effects of the debris bed formed on the sump screen."

We understand this and it was discussed during test planning. The primary purpose of these tests was head loss and the debris was selected to make that conservative. Downstream sampling was added to gather "data" during that testing. We decided not to run a special bypass test in this series. In addition to Test 1 and 5, downstream samples were taken for Test 2 with higher fiber than Test 1 and for Test 3 with paint chips for unqualified epoxy. Test 2 had just enough fiber for a thin bed. However, Test 3 had no fiber. Test 3 tested for unqualified coatings failure in the absence of fiber in accordance with the December 6, 2004, safety evaluation on Nuclear Energy Institute's Pressurized Water Reactor Sump Evaluation Methodology. The data from test 3 is consistent with the staff's view on this.

Comment 5 - Draft statement "After five turnovers of the volume of water in the flume (81 minutes), the screen head loss was 0.356 ft, and ..."

The measured head loss was 0.356 feet. The measured head loss is corrected for clean strainer head loss, suction pipe head loss, and pipe velocity head loss to get the debris load head loss. The preliminary debris load head loss for this case is 0.285 feet at 46.7 degrees F.

Comment 6 - Test 5 Nukon preparation.

The finely shredded fiber included in Test 1 was for latent fibers. The low density fiberglass insulation for Test 1 was shredded and mixed with paddle mixers in a bucket to separate fibers Since Test 5 was to add the Nukon insulation debris from an entire steam generator to our design basis case, it was prepared the same as for Test 1 as described by PCI below. The finely shredded "latent" fibers from Test 1 were still in the flume as well as the Test 1 insulation fibers. I think the Test 5 actually added a great deal of finely shredded fibers. I believe we saw confirmation that a thin bed of fibers is still the worst case. The added distribution of fibers probably created a filtering effect that either kept a bed from forming or created a thick bed that did not compress due to the very very low approach velocity (0.0073 fps). Either way, I think the Test 5 results were valid although it is not a design case for CASES. Since RMI will reduce head loss by capturing fibers, it is reasonably to expect large quantities of fibers to do the same.

I think the debris preparation for Test 5 as an "added" debris to test 1 was valid. The mixing stage in buckets is an important point with me.

There is no standard protocol for preparing fibrous debris for testing; other than the protocol which was accepted for testing during the BWR strainer tests. The standard then was to shred the fibrous insulation through a wood chip shredder. Our approach for PWRs now is consistent with the testing protocol accepted by the NRC at that time. We believe this precedent should remain acceptable to the NRC. The true distribution mix of fine fibers, small fiber clumps and fiber clumps generated in a LOCA is not reasonably predicted; nor would it be the same for any two LOCA. There is no evidence to support a LOCA will generate only fine fibers from insulation, therefore the use of fine fibers as the debris component for fibrous insulation is non-prototypical. Also note that during the shredding process; fines are produced but captured within the other debris. These fines are further separated during the mixing stage with paddle mixers in buckets.

Test 1 is a low fiber plant condition. The percentage of latent fiber to fibrous insulation is high in this condition; warranting a higher fines to shredded fiber ratio. Test 5 includes latent fiber and a large fibrous insulation debris condition. It is not prototypical to assume a significant volume of fines to shredded fiber ratio for this test. Dependent on the flow rate through the screen or debris bed, the change in head loss is not necessarily significant or dependent on the percentage of fiber fines in the debris mix. Lower flow rates have a significant affect on the head loss component; especially when below 0.01 fps. This design is at 0.0073 fps. Therefore, the head loss measured in these tests is not expected to be affected by the percentage of fine fibers versus shredded fibers collected against the screens.

Comment 7 - The test quantities for Aluminum Hydroxide was 0.4 lbm. For Sodium Aluminum Silicate, it was 1.0 lbm.

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Comment 8 - Table 5 No. 3 Near Field

Prior to the CASES test, AREVA revised the test protocol to introduce the debris within 3 feet upstream of the strainer to address the issue of "near-field effect". The overhead spray was used to help keep the debris in suspension and therefore more easily transportable to the strainer. After the CASES test, AREVA performed sensitivity tests where they put everything on top of the strainer in one test and everything up stream in another test (everything else stayed the same in both tests), the resulted head loss were similar. The test where everything was placed on top of the strainer reached maximum head loss faster than that of the second test.

My own observation of the near field versus CFD issue is that our transport CFD and head loss test debris was for our old screens with high channeled approach velocities. The flume testing was for the new strainer design. We are redoing our CFDs for the new plant design. I expect there to be a much closer correlation to what I observed in the flume when the CFD is redone. However, the transport CFDs don't model that last few inches where gravity becomes the overwhelming influence for such low approach velocities. They only show what gets "near" the strainer.

NOTE: Comments transmitted by e-mails from Charles Feist (TXU Power) to Hanry Wagage (NRC) June 6, June 8, and June 13, 2006.