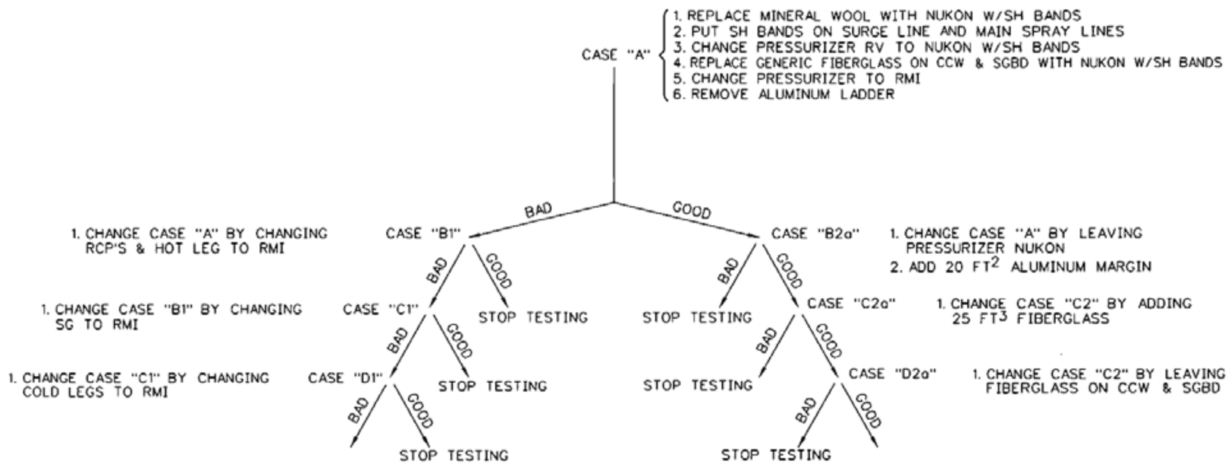
CCNPP performed strainer head loss testing at CCI in Switzerland in the summer of 2010. This was a planned test for success campaign based on multiple insulation replacement schemes. The decision tree below represents the original plan for the testing.



A total of seven (7) tests were completed. Test 1 included both fine and small pieces of fibrous debris and resulted in very low head loss. The conclusion reached based on Test 1 results was to continue testing with only fine fibrous debris and particulate; inclusion of small pieces was considered non conservative.

The prototypical strainer approach velocity at CCNPP is 0.123 inches per second which is very low. This necessitated the use of external agitation to assure the debris introduced in the test flume transported to the strainer. Test 6 was rejected due to non-prototypical agitation. The rejection of Test 6 is not sufficiently justified in the test report or the owners' acceptance review comments.

The Test Specification (0090-0173-SPC-10, Rev 0) dated June 9, 2010 and signed by CCNPP engineers, was provided to CCI prior to any testing and was the basis for the CCI test specifications. It is provided as Appendix A-4 of the CCI report.

The Test Spec was clear about agitation. It was clearly prohibited to use the propeller agitation to direct flow toward the strainer and debris bed. It was also prohibited to use the propeller agitation closer than 50 cm to the debris bed in any case. This should never have been an issue.

In general, the debris in the test tank would settle on the bottom of the testing tank or would settle on or near the strainer face creating a profile in front with the strainer face (Test Bed). Debris that had settled on the bottom of the testing tank, away from the Test Bed, would be squeegeed back away from the strainer face. The motion of pulling the material back with the squeegee was controlled so the motion would not disturb the profile of the Test Bed. Intermittent operation of an impeller driven by a hand held drill would be used to aid in lifting and re-suspending the squeegeed material in the flow so the material could settle within the Test Bed. This process of squeegeeing and agitating the debris was continued the test water was clear and all the material had settled in or on the Test Bed.

The individuals involved in this testing participated in two telephone conference calls during August, 2015. Email archives from the period were also searched. Significant discussion of improper agitation occurring in Test 6 was observed. A Calvert Cliffs employee witnessed the agitation where an electric drill driven propeller disturbed the debris on the face of the strainer. On Test 6, the use of the hand held drill was forcing the debris onto the Test Bed and creating a modified debris bed profile that was considered to be not consistent with previous testing. The CCI test technician admitted to excessive agitation and was not aware of the guidance provided on limiting agitation. After communication with station engineers, the results of Test 6 were rejected. This rejection was performed before proceeding with Test 7.

After Test 6 was completed, Calvert Cliffs prepared the attached evaluation and plan for Test 7. The plan for the next tests included additional guidance on limiting agitation.

This evidence provides sufficient proof that Test 6 was legitimately rejected due to improper agitation.

Discussion of Test 5/6 Results and Test 7 Proposals.

Test 5 and Test 6 considered the same debris loads (fines, particulate, precipitants, coating chips) with the only difference being that Test 6 also considered simulated debris from the cloth covers of the lead blanket. The results of the test were as follows:

	Test 5	Test 6
ΔH_L wo/precipitates	1.6 mBar	1.9 mBar
ΔH_L w/precipitates	35.8 mBar	97.7 mBar

The measured debris bed thickness was found to be roughly the same between the two tests. This appears to correlate with the head loss test results prior to the addition of chemical precipitates which differ by only 0.3 mBar (0.010 feet).

The dramatic difference (275%) between the Test 5 and Test 6 head losses after chemical precipitates were added is not readily understood. Possible reasons for the differences are:

1. The lead blanket cover material strengthened the debris bed thus resulting in a higher differential pressure required for a debris bed break through.
2. Normal variations in debris bed construction resulted in a stronger bed in Test 6 and thus a higher differential pressure required for a debris bed breakthrough.

Effect of Lead Blanket Cover Material.

Its not immediately clear how the lead blanket cover material could have had such a dramatic effect on head loss. Much of this material sank to the bottom of the test tank on top of the debris bed tongue in front of the strainer. It is not believed that material located here could have affected the test loop head loss.

However, some of the lead blanket cover fibers (approximately 10%) non-prototypically landed on the debris bed "roof" at the top of the strainer. These longer and thicker fibers could have strengthened the debris bed at the top pockets which is a typical location for debris bed break-throughs. Therefore, a possibility exists that the difference is due to the lead blanket fibers although it would be a non-prototypical effect.

The only other possibility would be that the lead blanket "dust" that was created during debris preparation and which was added to the test tank caused the head loss increase. This kind of debris has significant impacts on strainer head loss; however, the quantity used in the test loop (less than 0.1% of the debris bed total) makes this possibility non-credible.

Effect of Debris Bed Variations.

Variations in debris bed construction are to be expected. For cases where strainer head loss is governed by the differential pressure at which a debris bed break-through occurs these variations in debris bed construction will impact strainer head loss. However, a 275% variation in strainer head loss due to acceptable variations in debris bed construction is not plausible.

If it is postulated that one of Test 5 or Test 6 is not valid it remains to be determined which test is not valid. Based on head loss results from Test 3 and Test 4 a data plot would have predicted a Test 5 head loss of approximately 42 mBar. Given uncertainties in this graphical method as well as acceptable variations in debris bed construction a measured 35.8 mBar head loss correlates acceptably with this prediction. A head loss of 97.7 mBar does not.

Furthermore, Test 3, which had a fiber bed approximately twice as thick as Test 6, had a slightly lower head loss than Test 6. It is not conceivable that such a situation is due to normal variations of debris bed construction.

Therefore, unless it can be shown that the lead blanket cover material caused the dramatic difference in head loss from Test 5 to Test 6 it must be concluded that Test 6 was an invalid test.

<u>Actions Going Forward for Test 7.</u>

A. <u>Lead Blanket Cover Material Changes.</u>
1. Add lead blanket debris so that none of it lands on top of the strainer debris bed. Required test procedure changes would have to be drafted.
2. Prepare lead blanket debris in a more prototypical manner. Review WCAP-16727 to determine what that might be.
3. Don't add lead blanket material to test loop. This material is no more transportable than small insulation pieces. If we aren't adding small insulation pieces we are committing double jeopardy by adding the lead blanket cloth material.

B. <u>Debris Bed Construction Changes.</u>
1. Ensure all agitation is done further than 50 cm from the fiber bed. Follow procedure by not pointing propeller gun towards the debris bed.
2. Agitate only as necessary to get debris to debris bed tongue.
3. Take adequate time during debris addition sequence. Allow test tank to clear prior to agitating near the debris bed.