UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

February 5, 2009

MEMORANDUM TO: ACRS MEMBERS

FROM: David Bessette**/RA/**
Advisory Committee on Reactor Safeguards

SUBJECT: CERTIFICATION OF THE MINUTES OF THE THERMAL HYDRAULIC SUBCOMMITTEE MEETING, UPDATE ON GSI-191, ASSESSMENT OF DEBRIS ACCUMULATION ONPWER SUMP PERFORMANCE, HELD IN ROCVILLE, MARYLAND ON SEPTEMBER 23, 2008

The minutes of the subject meeting have been certified as the official record of the proceedings for that meeting. A copy of the certified minutes is attached.

Attachment: As stated

cc via e-mail: ACRS Staff Engineers
S. Duraiswamy
J. Flack
V. Murphy

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MEMORANDUM TO: David Bessette, Senior Staff Engineer
ACRS

FROM: Sanjoy Banerjee, Chairman
Thermal Hydraulic Phenomena Subcommittee

SUBJECT: CERTIFICATION OF THE MINUTES OF THE THERMAL HYDRAULIC PHENOMENA SUBCOMMITTEE MEETING ON UPDATE ON GSI-191, ASSESSMENT OF DEBRIS ACCUMULATION ON PWR SUMP PERFORMANCE, HELD IN ROCKVILLE, MARYLAND, ON SEPTEMBER 23, 2008

I hereby certify, to the best of my knowledge and belief, that the minutes of the subject meeting on July 7, 2008, are an accurate record of the proceedings for that meeting.

/RA/

Sanjoy Banerjee, Chairman
Thermal Hydraulic Phenomena

2-5-2009
Date

Certified by: Sanjoy Banerjee Issued: 2/5/2009
Certified: 02 /05/2009

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
SUBCOMMITTEE ON THERMAL HYDRAULIC PHENOMENA
SEPTEMBER 23, 2008
ROCKVILLE, MARYLAND

INTRODUCTION

The ACRS Thermal Hydraulic Phenomena Subcommittee met with representatives of the NRC Office on Nuclear Regulatory Research Staff (RES). The purpose was to review progress toward the resolution of Generic Safety Issue 191, Assessment of Debris Accumulation on PWR Sump Performance. During the meeting, the Subcommittee heard presentations by and held discussions with NRR staff and Westinghouse. David Bessette was the Designated Federal Official. The meeting was convened by the Chairman at 8:30 a.m. and adjourned at 5:30 p.m..

ATTENDEES

ACRS
Sanjoy Banerjee, Chairman
Said Abdel-Khalik, Member
Michael Corradini, Member
Otto Maynard, Member
Michael Ryan, Member
William Shack, Member

Thomas Kress, Consultant
Graham Wallis, Consultant
David Bessette, Designated Federal Official

SPEAKERS

Staff
John Burke, RES
Ervin Geiger, NRR
Donnie Harrison, NRR
Paul Klein, NRR
William Krotiuk, RES
John Lehning, NRR
William Ruland, NRR
Steve Smith, NRR
Robert Tregoning, RES
Matt Yoder, NRR

Industry
Tim Andreychek, Westinghouse
Maurice Dingler, Westinghouse
Gil Zigler, Alion Science and Technology

Public
David Lochbaum, Union of Concerned Sc.

AGENDA

1.	Opening Remarks by the Chairman	Sanjoy Banerjee
2.	NRR Opening Remarks	William Ruland, NRR
3.	Update on GSI-191 - Status and Future Activities	Donnie Harrison, NRR
4.	Strainer Head Loss Testing	Steve Smith, NRR
5.	Chemical Effects	Paul Klein, NRR
6.	Chemical Effects PIRT Update	John Burke, RES

7. NRR Activities Related to WCAP-16793
8. Remarks by Union of Concerned Scientists — David Lochbaum, UCS
9. In-Vessel Downstream Effects Fuel Inlet Blockage — Steve Smith, NRR; William Krotiuk, RES
10. Subcommittee Discussion

1. OPENING REMARKS BY THE CHAIRMAN - Sanjoy Banerjee

The Chairman opened the meeting and introduced the subject matter. Dr. Shack noted that he had a conflict with a portion of the material to be discussed.

2. NRR OPENING REMARKS - William Ruland, NRR

Mr. Ruland, Director of Division of Safety Systems began. Much progress has been made by industry and the staff toward resolving GSI-191. All PWRs have installed significantly larger screens. Many have, or will, remove insulation, replaced sump buffers, and made other improvement to address the concern. The staff has found most vendor strainer test protocols to be prototypic or conservative. Strainer testing has been completed in some cases and will be completed in the near future for other plants. Staff review of industry submittals is well underway. Progress has been made toward resolving issues of downstream effects.

3. UPDATE ON GSI-191 - STATUS AND FUTURE ACTIVITIES - Donnie Harrison, NRR

Donnie Harrison continued the NRR presentations. All the licensees responded by March 2008 to Generic Letter 2004-02. The staff has categorized its review into 14 technical areas.

1. Break selection
2. Debris generation and zone of influence
3 Debris characterization
4. Latent debris
5. Debris transport
6. Head loss and possible vortexing
7. Net positive suction head
8. Coatings
9. Debris source term
10. Screen modifications package
11. Structural analysis
12. Upstream effects
13. Downstream effects
14. Chemical effects

For each plant, this review is compiled and reviewed by an integration review team consisting of three senior staff. The review team considers areas of conservatism and uncertainties. Each plant has its own team, although there is considerable overlap amongst all the PWR reviews. Adequacy determinations are made. Requests for addition information (RAIs) are reviewed by the Integration Review Team. When all RAIs are answered in a satisfactory manner, a closure package is prepared for that particular plant. These final packages are public documents. RAIs and the responses are public.

WCAP-16793 is being revised. Testing is still being performed by Westinghouse. When the revised report is submitted and approved by the staff, licensees that reference this report will need to respond. The regions will continue to conduct inspections of implementation activities at the plants including hardware modifications, changes to procedures, etc. For each plant, a closure letter will be issued. In some cases, it is expected that this letter will contain a list of actions still to be completed. These actions will be tracked by NRR and the regions until everything is done.

Generic Letter 2004-02 will be completed in 2009.

In response to the Chairman's question, Mr. Smith indicated that most of the plants have performed testing of their new screens, though many of these will receive RAIs. About ½ of the plants may be considered to have completed testing satisfactorily.

Responding to Professor Corradini, Mr. Klein stated that six to ten plants have changed buffers to sodium tetraborate. ANL tests suggest this may be the best choice for a buffer with respect to chemical effects. With respect to insulation, about ½ of the plants have removed some fibrous insulation.

Mr. Harrison continued by saying low fiber plants generally receive few RAIs. Nearly all plants will reference WCAP-16793 concerning downstream effects. Most plants will probably receive RAIs in 2009 following the staff SER on WCAP-16973. .

4. STRAINER HEAD LOSS TESTING - Steve Smith, NRR

Mr. Smith indicated that the licensees are testing their new strainers to measure pressure drop to ensure net positive suction head. Plant-specific debris load predictions are made. Specific review guidance documents were prepared by the staff in three areas: coatings, chemical effects, and head loss testing.

The staff had as an objective to ensure that the head loss testing was conservative. The staff believes that some of the early tests conducted cannot be shown to be conservative, so these cases have generated RAIs. Later tests have been conducted to more conservative protocols and fewer RAIs have been generated for those. The staff has witnessed a number of tests performed by each of the screen vendors.

In response to a question by Dr. Kress, Mr. Smith indicated that each screen vendor develops its own test protocols. The Chairman indicated that the Subcommittee had stated a concern with respect to tests that allow settling of debris upstream of the screen and whether this could be demonstrated to be prototypic or conservative. Mr. Smith indicated that the staff takes a closer look at those tests that allow settling with respect to that particular issue. Some licensees that used overly conservative test conditions obtained unfavorable test results. They are reexamining their analyses to better determine the test conditions that should be used and are performing further testing. Debris loading is determined following guidance in NEI 04-2004-07, which was subject to a staff Safety Evaluation Report.

Mr. Smith shown some film recorded to CD of several strainer tests. The tests are conducted with fibers introduced first, followed by chemical debris, so that the fibers can collect on the screen and catch the chemical precipitates. For most tests, the fibrous debris is not allowed to settle upstream of the screens. The chemical debris is nearly neutrally buoyant. Debris may

be introduced by bucket or through a pipe. Data are recorded throughout the duration of the test and include temperature, flow rate, and pressure drop across the screen. Mr. Yoder indicated that whether or not chemical precipitates contribute to head loss depends on whether there is a fiber mat on the screen to trap the material.

Professor Wallis asked about test repeatability, recalling that tests done at Pacific Northwest Labs showed considerable variation depending on how the various debris was introduced. Mr. Smith concurred and noted that repeatability is something the staff monitors. Debris source terms are intended to be plant specific.

Dr. Kress inquired if there were measure a plant could take in the event that, despite all the GSI-191 work, the screen became blocked. Mr. Smith replied that some plants have a back-flush procedure. Also, stopping and restarting the pumps can help.

Several members inquired about the length scale of the screen approach and the Reynolds number, in view of the low velocities and long dimensions. No specific response was available.

Mr. Smith indicated that even with the new screens that are up to 100 times larger than the old, it is possible to get high head losses under worst case conditions. In such cases, it has been necessary for the particular licensee to reduce the potential debris loading by changing insulation within the possible zones of influence.

Professor Wallis and the Chairman questioned whether it is appropriate to introduce debris using a bucket because the jet carries the material introduced downwards. The Chairman inquired whether chemical effects were required in order to achieve high head losses. Mr. Smith replied, “not necessarily.” Chemical effects can behave in a manner similar to severe particulate loadings from CalSil or Microtherm.

5. CHEMICAL EFFECTS - Paul Klein, NRR

Mr. Klein began the presentation by noting that Matt Yoder was the co-reviewer for this subject.

The staff performed tests at Argonne National Laboratory (ANL) in a vertical test section, which tends to produce more uniform deposition and higher head losses than a horizontal test section. Some of the ANL tests resulted in very high head losses. Dr. Shack observed that strainers should be vertical and not horizontal.

AREVA PCI testing was performed at Alden Labs; ACL tests were done at Chalk River; CCI tests were conducted in Switzerland; GEH tests were in New Jersey; Wylie and Fauske also performed tests.

Professor Abdel-Khalik inquired how to determine conservative flow characteristics of a flume. Mr. Lehning responded, “turbulence.”

Mr. Klein indicated that the staff is using Dr. Robert Whitman from ANL as a consultant in chemical effects testing. Professor Wallis referred to tests in France which appeared to show dissolution of fiber glass. Mr. Klein had not seen the French information, but agree there could be some dissolution at higher pHs. Dr. Shack indicated that the presence of aluminum In the system inhibits fiberglass corrosion. Mr. Klein indicated that the WCAP-16530 methodology

provides a very conservative prediction for chemical loads. Higher pH favors dissolution of aluminum.

Mr. Klein noted that the ANL results have been published in three, public letter reports (ML080600180, ML081550043, ML082330153). Tests on aluminum hydroxide solubility as a function of temperature did not indicate any large precipitation events. The industry tests assume, however, that precipitation occurs. Mr. Klein said that the tests show that precipitation is not expected in the RHR system between the heat exchanger and the core entrance.

Mr. Klein summarized that the staff has observed testing at each vendor facility. Vertical test sections are seen as producing the most bounding outcome. Most of the industry tests have been conducted using methods acceptable to the staff. The WCAP-16530 methodology is conservative. The staff plans additional audits of chemical effects.

The Chairman asked about the effects of zinc from galvanized steel, referring to German tests on the matter. Mr. Klein indicated that Germany does not employ a buffer. With a buffer, there is very little corrosion of galvanized steel.

6. CHEMICAL EFFECTS PIRT UPDATE

Mr. Burke began by noting that the last briefing to the Subcommittee on this topic was in 2007. The PIRT was conducted in 2006 and was used to identify knowledge gaps at the time. The PIRT identified 41 highly ranked phenomena. The PIRT NUREG is undergoing final review and will be issued before the end of 2008. The 41 phenomena were not seen as needing immediate attention. Of the 41, 10 were viewed as warranting additional study: 1) radiation effects, 2) carbonation of concrete, 3) alloy corrosion, 4) galvanic corrosion, 5) biological fouling, 6) co-precipitation, 7) inorganic agglomeration, 8) crud release, 9) retrograde solubility, and 10) organic materials. These topics are being evaluated by Pacific Northwest Labs and will be the subject of future reports.

The Chairman inquired about retrograde solubility. Mr. Tregoning stated that the concern was with calcium, aluminum, and silicon compounds. Thermodynamic analysis indicated an approximate balance between retrograde and normal solubility behavior. The most significant potential source of deposits is from boric acid. Professor Wallis noted that the particular area of concern was the core. Mr. Klein replied that the industry is addressing that concern.

7. EVALUATION OF LONG-TERM COOLING CONSIDERING PARTICULATE, FIBROUS AND CHEMICAL DEBRIS IN RECIRCULATING FLUID - Tim Andreychek, Westinghouse

Mr. Andreychek noted that today's presentation was an update of the one given in March 2008. Hole sizes in replacement sump screens are 1/16 to 1/8 inch. With the debris catcher lower nozzles, the entrance hole size to the core is about 1/16 inch. Some debris is expected to pass through the screens. Bypassed debris has the potential to deposit in the core. The shortest time to the start of recirculation is for a large break LOCA and this time is 20 to 30 minutes.

The minimum amount of water that must be supplied to the core to replenish boiloff is about 20 kg/s (350 gpm) for a Westinghouse 4-loop plant. Injection flow in excess of this will mostly spill out the broken cold leg.

For a hot leg break, all the injected flow passes through the core and hot the broken hot leg.

For debris that may deposit in the core region, the three issues being considered are deposition at the core inlet, on fuel rods, or on spacer grids. With respect to deposits on fuel rods, evidence indicates such deposition would not be adherent (NUKON OFC-1).

A bottom nozzle was circulated. Mr. Andreychek indicated that it contains a debris catching device to catch material during normal operation from entering the fuel assembly.

Professor Wallis recalled that the core flow area is approximately 50 ft^2, which is about 1% of the sump screen flow area. The Chairman noted that, given a height of 16 ft from the bottom of the core to the bottom of the cold leg and a void fraction of perhaps 0.25 in the core, the driving head for flow is about 4 ft, or a little over 1 psi. It was previously indicated that the amount of debris that is expected to bypass the screens is 1 ft^3 per 1000 ft^2 screen area. The core inlet represents a horizontal screen with flow vertically upwards.

Mr. Andreychek indicated that the ANL tests showed that for a NUKON fiber bed and an approach velocity of 0.1 ft/s, aluminum compounds produced a greater pressure drop than silicon.

Mr. Andreychek reminded the Subcommittee that LOCADM is a spreadsheet program that treats deposition cladding surfaces. It assumes that all debris that has passed through the screen is deposited on the cladding. The deposition is based on the boiling rate, so a high power region experiences more deposition than a low power region.

Mr. Andreychek described the core inlet debris capture tests. The fibrous debris has a length distribution of 77% < 500 μm, 18% between 500 μm and 1000 μm, and 5% > 1000 μm. SiC particles were used as surrogates with diameters of 10 μm. Aluminum Oxyhydroxide (AlOOH) was used as the chemical surrogate. Three tests were performed thus far. Fourteen more are planned. The test section represents the lower 4 ft of a full length fuel assembly. A variety of lower nozzle designs will be tested to cover the Westinghouse, Combustion Engineering, and AREVA designs. Fiber loading information was obtained from a large number of plants instead of using the benchmark estimate of 1 ft^3 per 1000 ft^2 of screen area (fiber density ~ 2.5 lb/ft^3, 1/60 density of glass).

Mr. Andreychek noted that with respect to screen bypass, the higher the approach velocity, the greater the bypass. Larger screens have a lower approach velocity, which tends to offset the larger screen area available for bypass.

The Subcommittee had a number of questions concerning the plant characteristics of the seven plants being used to formulate the test matrix for the debris capture testing (slide 36).
Mr. Andreychek indicated that the two tests to be discussed were low fibre-low particulate, and low fiber-high particulate. The particulate was introduced first, then the fiber. While particulates alone are circulating, debris accumulation does not begin. It is only after the fibers are introduced that mats begin to form with the fibers trapping the particles. When the chemical precipitate material is added after the fibers, there was little additional increase in pressure drop. There was general discussion of the reasons for this behavior and how it compared with the sump screen blockage test results.

Professor Abdel-Khalik asked about self-consistency of the test conditions, noting that for the scaled flow rate of 3 kg/s (45 gpm) there will be no boiling. Mr. Andreychek indicated that this was for a hot leg break scenario. There followed considerable discussion of the thermal hydraulics of the reactor coolant system, under this scenario, that was inconclusive.

Mr. Andreychek resumed. The tests showed that the fibers provide trapping sites for particulates. The chemical precipitates behaved like a second source of particulates. The fiber material was deposited at each grid location in the test section as well as the entrance to the lower end nozzle. The distribution appeared to be rather uniform. The material tends to resemble clumps of felt. The deposits of silicon carbide are uniform across the fiber bed. The pressure drop from the high particulate case was similar to the low particulate case. From this, as well as the fact that the addition of the chemical surrogate did not increase the pressure drop, it is concluded that the fibers are the controlling factor rather than the particles.

Professor Wallis inquired about whether the debris will deposit uniformly across all the holes at the entrance or might some holes remain open. Mr. Dingler replied that thus far the deposits appear uniform. There have been no measurements of the material that continues to circulate around the loop. Members of the Subcommittee indicated it would be advisable to obtain these to obtain filtration efficiencies.

Mr. Ziger (Alion) indicated that the results being obtained from the Westinghouse tests are consistent with other similar testing. The behavior of fiberglass shards is different than strands since the bridging potential is different. The results are similar to data obtained in Finland in the late 1990s time frame as part of an OECD NEA program. The Chairman indicated that more information should be provided on how the size distribution used in the experiments was obtained.

Mr. Andreychek indicated that should unacceptable test results be obtained based on the debris loadings used as inputs to the tests, there are two options for the utility; 1) remove material, and/or 2) determine whether analyses of the possible zones of influence were too conservative.

The Chairman requested better information on the test matrix, such as quantities of fiber, particulates, chemical, flow rates, etc, and how these values were determined

This concluded the discussion of core head loss testing and began the discussion on the cladding and spacer grids. Mr. Andreychek indicated that LOCADM had been used to perform parametric studies varying conductivity of deposits and thickness of deposits. Peak calculated clad temperatures were low throughout the parametric ranges examined.

8. REMARKS BY UNION OF CONCERNED SCIENTISTS - David Lochbaum, UCS

Mr. Lochbaum presented information from a May 1996 event where a hydrogen burn occurred when a worker attempted to weld the lid on a dry cask at Point Beach. The hydrogen evolved from chemical reaction of epoxy coating on the inside of the dry cask. A considerable amount of white precipitate matter floated off into the spent fuel pool. This raises concerns that the testing of coatings covers a sufficient range of temperatures and other possible effects.

Dr. Kress asked whether there was information on the composition of the debris. Mr. Lochbaum replied that no information could be found in the Public Document Room. Mr. Geiger added that

in this case the coating was zinc-based and was more reactive than epoxy, though in common use. The environment was borated water which was acidic.

The Chairman thanked Mr. Lochbaum for making the time and effort to present this information.

9. IN-VESSEL DOWNSTREAM EFFECTS FUEL INLET BLOCKAGE - Steve Smith, NRR and William Krotiuk, RES

Mr. Smith began the presentation indicating that the Westinghouse fuel inlet designs are similar to each other. The AREVA designs have some differences. About 2/3 of the PWRs have Westinghouse fuel and 1/3 AREVA.

Diablo Canyon performed testing of the Westinghouse P-grid which the staff observed (trip report available). The test section was limited to the bottom nozzle and grid. Tests were run with flow rates representative of cold leg and hot leg breaks.

Professor Wallis indicated that the term “thin bed” is used in an ill-defined and ambiguous manner. The apparent meaning is a saturated layer or mat in which the intermesh volume catches and becomes filled with particulates until the pressure drop increases considerable over a more open bed.

The Chairman inquired as to how much material is bypassed as a function of passes through the screen since the tests are run with numerous passes and only the net deposition appears to be measured. Professor Wallis asked why fiber only testing is conservative. Mr. Ruland committed to provide the information.

Mr. Smith indicated that Diablo Canyon performed testing with CDI of the core inlet. The tests were run using debris that passed through the strainer. The deposits were uniform across the lower nozzle and first grid. Professor Wallis stated that the results should be compared to the ANL tests.

Mr. Klein noted that the amount of fiber seems to be the controlling factor in the CDI tests. Dr. Shack added that the WCAP surrogate is conservative.

Mr. Krotiuk discussed his analyses of the effect of blockage on core flow. The analyses were performed using TRACE and were checked using hand (Excel) calculations. The calculations were done for a cold leg break scenario. The core blockage was conservatively assumed to occur instantaneously at 120s. In the plant, recirculation and bed formation would not begin until sometime after approximately 1800s, at which time decay heat would be lower. The Martinelli-Nelson correlation was used to calculate two-phase pressure drop.

The core inlet pressure drops used were for bed thicknesses of 1.2, 2.4, and 4 inches of Nukon and CalSil, as determined from PNL testing. Those tests were done with long, un-chopped fibers. Chemical effects were not included.

The pressure drop is a linear function of velocity (u) as opposed to u^2. Loss coefficients were used in the TRACE calculation to represent the bed resistances. Prof. Wallis inquired into how the debris amount in these calculations compared to the 53 g per assembly being used by Westinghouse. An answer was not available.

In the TRACE calculations, the void fraction for the worst case, 4-inch bed, reached 1 at 2000s. The hand calculation agreed within 10-20%. The thinner beds did not reach dryout. Prof. Abdel-Khalik asked how the core flow rate changed with bed thickness. The reply was

unblocked	115 kg/s
1.2-inch	78 kg/s
2.4-inch	61 kg/s
4.8-inch	25 kg/s

Prof. Wallis noted the advantage of the approach Mr. Krotiuk took in developing a straightforward theory over the industry approach of defining some limiting case and arguing that this case is indeed limiting. The Chairman noted that the main difficulty is in defining, or characterizing the bed. Responding to a question by the Chairman, Mr. Krotiuk said that the pressure drop across the 4-inch bed was about 4 psi. Discussion of the available driving head followed. If the core were completely voided, Prof Wallis noted that the value would be about 7.8 psi. It was again noted that the bed resistance dominates the uncertainty. The bed resistance is converted using the Ergun equation to a form loss used in the TRACE model.

Discussion followed as to how these analyses of a uniformly blocked core related to earlier TRACE analyses where 95% of the core entrance was fully blocked and 5% was not blocked at all.

Mr. Smith concluded by noting that testing by the Owner's Group is continuing and will examine the difference designs of Westinghouse, Combustion Engineering, and AREVA fuel.

10. SUBCOMMITTEE DISCUSSION

The Subcommittee discussed the agenda for the full Committee.

Dr. Kress indicated that the testing strategy is important including how many and what types of tests will be sufficient. For those tests that allow settling, the amount of settling needs to be justified. Mr. Krotiuk's analyses were valuable.

Prof. Wallis noted that many more tests are forthcoming and WCAP-16793 will be revised. While the Owner's Group has a test plan, it is likely that this plan will evolve as test results are examined. It was not clear how all the testing from the different utilities will be reviewed by the staff in a coherent manner. The staff should state their views on what progress has been made since the time of the last ACRS GSI-191 letter, and what remains to be done. Site specific issues are not as important as the ability to extrapolate the results of screen testing to the plant.

Mr. Maynard was encouraged by the testing plans. There needs to be as much justification as possible as to the adequacy, including prototypicality, of the testing, Limitations of the testing should also be described. Dr. Kress' comment on settling was seconded. To what extent CFD calculations were reliable was uncertain. It is not possible to address every issue completely, so conservatisms must be used. The final objective is reasonable assurance. The issue will continue to be present as new plants come along. The staff's review process is important, including the guidance documents the staff has developed. The Owner's Group test plans are also important. Mr. Krotiuk's analyses were very helpful.

Dr. Ryan supported the comments above, and added that justification of why key factors are conservative must be provided, including reasons, if any, as to why important assumption might not be conservative.

Prof. Abdel-Khalik noted the importance of extrapolating from tests to the plant. Mr. Krotiuk's analyses were helpful. Any discrepancies between those and the Westinghouse analyses should be resolved. There needs to be a rationale of how to combine the effects of the three types of loadings: insulation, particles, and chemicals.

The Chairman indicated that the full Committee presentations should include a status summary. The tests that are done, in progress, or planned are very important. Prototypicality or conservatism needs justification for both the screen testing and bed formation at the core entrance. Extrapolation of results to the plants is necessary. The adequacy of testing in both areas will need to be justified in the end.

Members were encouraged that progress has been made and that the plans indicated a satisfactory path forward.

Prof. Wallis stated that, for the next meeting, it is vital that any documentation that supports the agenda must be available before the meeting to allow sufficient time for review.

The meeting was adjourned at 5:30 p.m.