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January 21, 2010

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Attention: Mr. Jeffrey A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-10013

Subject: MHI's Responses to US-APWR DCD RAI No. 422-2823 Revision 0

Reference: [1] "Request for Additional Information No. 422-2823 Revision 0, SRP Section: 06.02.02 - Containment Heat Removal Systems Application Section: 6.2 and 6.3 - Design Certification and New License Applicants, Application Section: 6.2 and 6.3," dated July 7, 2009.

[2] Letter MHI Ref: UAP-HF-09204 from Y. Ogata (MHI) to U.S. NRC, "Additional Information for Sump Strainer Performance" dated April 24, 2009.

[3] Letter MHI Ref: UAP-HF-08306 from Y. Ogata (MHI) to U.S. NRC, "Transmittal of the Technical Report entitled "US-APWR Sump Strainer Performance" (MUAP-08001 Rev.2)", dated December 26, 2008.

[4] Letter MHI Ref: UAP-HF-09233 from Y. Ogata (MHI) to U.S. NRC, "MHI's response to US-APWR DCD RAI No. 349-2586 Revision 0", dated May 12, 2009.

[5] Letter MHI Ref: UAP-HF-10002 from Y. Ogata (MHI) to U.S. NRC, "Submittal of Additional Information for US-APWR Seismic Analysis and Sump Strainer Head Loss Test", dated Jan 12, 2010.

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Response to Request for Additional Information No. 422-2823 Revision 0".

Enclosed is the response to questions that are contained within Reference [1].

With the letter (Reference 2) dated April 24, 2009, MHI submitted the plan for strainer head loss tests to support for licensing review by the NRC. In the letter, MHI committed to do a plant specific head loss test of the US-APWR, and will update our technical report incorporating the results. We also stated that we will still keep our comparative evaluation, referred as a "bounding evaluation", in the technical report MUAP 08001-NP(R2) (Reference 3), and will add further justification for its use based on existing knowledge and the results of the US-APWR head loss tests.

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This letter was also identified as MHI's response to the RAI-349-SPCV2586 (Reference 4) that requested us to provide test data that validates the use of the comparative evaluation.

After the letter (Reference 2) submission, the NRC reviewed the strainer head loss test plan and discussed the results in conference calls with MHI on May 28 and on June 10, 2009. In the calls, the NRC expressed their concerns about the test plan which was similar to the protocols applied to the operating plants in the US. NRC questions have not been adequately addressed in these protocols, and could impact the acceptability of the testing unless they are resolved in advance. Further, the NRC expressed the difficulty of regulatory acceptance if the comparative evaluation is still identified as licensing basis. And then, these NRC concerns were issued in the RAI-422-SPCV2823 questions (Reference 1).

MHI reviewed the NRC's questions raised for the operating plant, and identified those applicable to the US-APWR. MHI provides responses and/or approaches within this letter and enclosures herein, to resolve those questions with the NRC input prior to implementation of the US-APWR head loss tests.

Further, MHI proposes herein to eliminate the bounding evaluation from our technical report, and will apply plant specific testing results to the report as our licensing basis.

The head loss testing for the US-APWR is currently rescheduled in March, 2010. (Reference 5) Before testing, MHI would like to have several interactions with the NRC to consider feedbacks from the staff into our test plan. (Reference 5) Associated technical report will be revised incorporating tests results after the completion of the tests, and will be provided to the NRC in April 2010. (Reference 5) This timeline depends on further interactions with the NRC, and therefore, additional date changes are possible.

Please contact Dr. C. Keith Paulson, Senior Technical Manager, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of the submittals. His contact information is provided below.

Sincerely,

Y. Ogata

Yoshiki Ogata,
General Manager- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosures:

1. Responses to Request for Additional Information No. 422-2823 Revision 0

2. MHI's response to the RAIs relative to head loss tests originally raised for Comanche Peak 1&2 GL2004-02 responses

CC: J. A. Ciocco
C. K. Paulson

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Enclosure 1

UAP-HF-10013
Docket No. 52-021

Responses to Request for Additional Information
No. 422-2823 Revision 0

January 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

01/21/2010

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 422-2823 REVISION 0**

SRP SECTION: **6.2.2 – Containment Heat Removal Systems**

APPLICATION SECTION: **6.2.2**

DATE OF RAI ISSUE: **07/07/2009**

QUESTION NO.: 06.02.02-52

A test plan was included as Enclosure 2 to MHI letter UAP-HF-09204 dated April 24, 2009. The test plan was reviewed by the NRC and it appears similar to test plans/protocols that the NRC has significant questions on for the operating fleet and could impact the acceptability of this testing. For example: flow modeling debris approach to the strainer, debris suspension in the flume (dependent on turbulence), and how flow entering the containment pool is modeled in the test flume. Therefore the NRC has the following information request:

a) Compare and contrast the Test Plan described in Enclosure 2 with similar plans/protocols implemented by PCI for operating reactor strainer qualification.

b) Provide a detailed description of the technical issues/concerns associated with these PCI test plans/protocols.

c) For those issues that are applicable to the US-APWR strainer design, how have they been resolved or are being addressed to support the MHI USAPWR strainer design qualification testing.

ANSWER:

a) MHI intends to apply the similar test protocol as has been implemented for other U.S. licensee, modified in accord with discussions of those RAIs applied for Comanche Peak unit 1&2 testing.

b) MHI identified the technical issues/concerns to address are as identified by the NRC to Comanche Peak in those 37 RAIs applicable. Of the 37 RAIs, 17 RAIs are identified regarding testing protocol implemented for Comanche Peak and the operating fleet. See Enclosure 2 for detailed description of the technical issues/concerns associated with test plan.

c) Refer Enclosure 2 for answer to each of the RAIs, proposed approaches for resolution.

Impact on DCD

There is no impact on the DCD.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

Enclosure 2

UAP-HF-10013
Docket No. 52-021

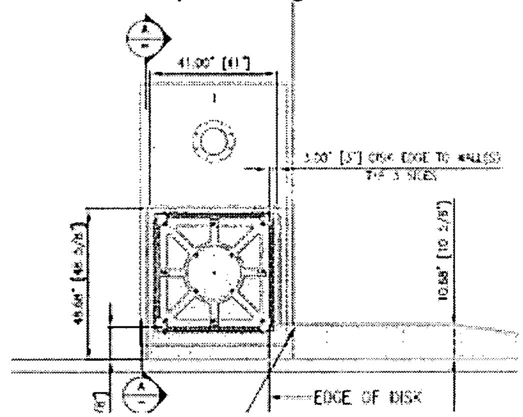
MHI's response to the RAIs relative to head loss tests originally raised for Comanche Peak 1&2 GL2004-02 responses

MHI's response to the RAIs relative to head loss tests originally raised for Comanche Peak 1&2 GL2004-02 responses

RAI No.	NRC question	US-APWR approach for resolution
8	The November 26, 2008, supplemental response indicates that a significant percentage of small pieces of fiberglass were assumed to transport to the strainers (i.e., 78%). In addition, 16–17% of large fibrous debris pieces were assumed to transport as well. These analytical assumptions minimized the quantity of settled small and large pieces of fiberglass that were analytically assumed to erode in the containment pool. However, for the strainer head loss testing conducted by Performance Contracting Inc. (PCI), the staff considers it likely that a significant fraction of small pieces that were analytically considered transportable actually settled in the test flume rather than transporting to the test strainer. This issue is exacerbated by the fact that the licensee's head loss testing modeled the 1-foot-high debris interceptor in front of the strainer, whereas the debris transport calculation did not credit this interceptor, over which very few fiberglass pieces would be capable of transporting. The head loss testing did not model the erosion of this debris that was analytically assumed to have transported. The licensee's consideration of debris erosion, therefore, appears to be non-conservative, because neither the analysis nor the head loss testing accounted for the erosion of debris that settled during the head loss testing. Please estimate the quantity of eroded fines from small and large pieces of fiberglass debris that would result had erosion of the settled debris in the head loss test flume been accounted for and justify the neglect of this material in the head loss testing program.	To resolve this RAI, the percent of fiber fines to be implemented for testing shall be based on the following: 1. Of the 100% of fibrous debris generated, use the default value that states 60% of the debris that is generated is "smalls / fines" and transports; and the other 40% of fibrous debris does not transport. This is per NEI 04-07 and the NRC SE defaults. 2. Further assume the 40% of fibers generated that did not transport erodes into fines that do transport. Although this debris is likely to be in stagnate areas; we will use the very conservative value of 40% as the erosion factor; 4 times the value supported by Alion's erosion testing for debris that IS in a flow stream. This equals 40% x 40 or 16% of the debris generated is fines from this component. 3. Of the 60% that transports; assume 15% is "fines". This is based on the SE; Appendix II that states it is acceptable to assume 25% of the "smalls / fines" is fines. MHI Note: This is very conservative based on blast test data evaluated by PCI. 4. Of the 60% that was supposed to transport (but may not based on prior large flume debris testing) assume 45% (60% smalls/fines - 15% fines) erodes at a rate of 40% (4 times the erosion factor supported by the Alion testing of fibers in a flow stream); which yields another 18% of fines for testing; eg., 40% x 45 = 18%. 5. Adding up all fines from components 3, 4 & 5 above yields a total percentage of fines to be tested of 16% + 15% + 18%or 49% of fibrous debris generated. Therefore, of the 100% of debris generated; MHI will test 49% as "fines". Since the above uses a very conservative erosion factor for fibers not transporting, there are no "smalls" to include in the test since smalls that "erode" are by definition "smalls" that do not transport.
10	Sufficient information was not provided in the supplemental responses dated February 29, 2008, and November 26, 2008, to provide assurance that the flow conditions simulated in the strainer head loss test flume are prototypical or conservative with respect to	To resolve this RAI, prior to testing the plant and test flume configuration CFDs will be compared to confirm the flow stream velocities and TKE of the test flume is equivalent to and / or bounding compared to the plant configuration. Comparisons shall be similar

RAI No.	NRC question	US-APWR approach for resolution
	the plant conditions. Therefore, please provide plots of velocity and turbulence contours in the containment pool for the bounding computational fluid dynamics cases with respect to these two parameters that include the entire pool and which are based on the computational fluid dynamics model used in the debris transport analysis. Please also provide close-up plots of the velocity and turbulence contours (which include a numerical scale with units) in the region of the strainer and its immediate surroundings from the computational fluid dynamics model that was used to determine the flume velocities and turbulence levels for head loss testing. Please identify the bounding break scenario that was used to derive the flow parameters (e.g., velocity and turbulence) that were simulated in the head loss test and identify which of the strainers is modeled in the test.	to the approach implemented for Comanche Peak.
11	Please discuss any sources of drainage that enter the containment pool near the containment sump strainers (i.e., within the range of distances modeled in the head loss test flume, e.g., 27 ft based on page 62 of the November 26, 2008, supplemental response or 22 ft based on Attachment D to that response, page 7 of 95). Please identify whether the drainage would occur in a dispersed form (e.g., droplets) or a concentrated form (e.g., streams of water running off of surfaces, drain lines, etc.). Please discuss how these sources of drainage are modeled in the test flume to create a prototypical level of turbulence in the test flume. Please discuss how the narrowness of the test flume (roughly four inches at its minimum) affected the level of turbulence generated in the test flume versus the plant condition that typically has much wider flow channels.	The test flume will be configured to conservatively represent the plant flow stream conditions using the standard vendor's double weighted averaging of flow streams leading to the modules and sump array or equivalent as appropriate to model the turbulent energy. Additionally, the turbulence in the plant will be matched or exceeded in the test flume; as confirmed by comparisons of CFD analysis of the plant condition and test flume configuration. The turbulent energy will be introduced via a vertical column of water nozzles pointing downstream from a separate closed loop pipe / pump system to create the equivalent turbulent energy represented by the 18" down comers moving towards the plant strainers. These nozzles will introduce 40% of the total sump / array flow; as is true of the plant conditions. Upstream of this turbulent energy will be a flow stream representing 60% of the flow stream to the sump / array. Debris will be introduced in the same ratio as the flow streams feeding the sump / array; namely, 40% near the strainer and 60% from a less turbulent flow stream upstream of this turbulence. The combination of a conservative flow stream and the modeling of the turbulent energy from the 18" down comers into the test flow stream at a distance equivalent to that of the plant represents a conservative and bounding test condition as compared to the plant

RAI No.	NRC question	US-APWR approach for resolution
		condition. This is especially true when introducing 40% of the test debris "near the test strainer" in turbulent flow.
13	Based on page 63 of the November 26, 2008, supplemental response, it appears that the recent testing using the revised PCI protocol was performed with a static water depth of 4.17 ft. Please describe any testing performed with the revised PCI test protocol in 2008 or later that includes modeling of the transient containment water level or small-break LOCA water level conditions.	The Test Plan calls for a static water level of 4 feet; which is the minimum water level of all recirculation scenarios of the US-APWR. Therefore, any increase in water level that actually occurs in the plant is bounded by this testing condition.
14	On page 68 of the November 26, 2008, supplemental response, in a number of areas, statements are made to the effect that, because certain types of debris were shown not to transport at fluid velocities of [x] ft/s, they were removed from testing. In all of the cases, the values of x stated are less than or of the same order as the flume velocities listed on page 63 of the same supplemental response. Please justify these statements. For example, given that the flume velocities are in the range of 0.41–0.62 ft/s, it does not logically follow that debris shown not to transport at 0.1 or 0.2 ft/s should be excluded from the testing. The staff expects that transport testing be conducted at velocity and turbulence conditions that are prototypical or conservative with respect to the plant condition.	If miscellaneous debris is tested and found to transport, the debris will be included in the head loss tests. If miscellaneous debris is tested and found to not transport in preliminary transport tests, the debris will not be included in the head loss tests. Since MHI cannot fully predict the miscellaneous debris to eventually be found in a future plant, MHI reserves the right to simply limit miscellaneous debris generated in a pipe break in the US APWR plant to no more than the sacrificial area allowed for by sump design; which is 200 ft^2 / sump; 400 ft^2 total for two operating sumps which equates to 533 ft^2 of miscellaneous tags, labels, etc. per plant; ie. 400 ft^2 / 0.75 transport factor per NEI 04-07.
15	Please provide a basis to add the majority of the latent fiber to Test 4 prior to the starting of the test pump. It appeared that approximately two-thirds of the latent fiber was added in this manner with no flow in the flume. This step was not a part of the version of the revised PCI protocol that had been reviewed by the staff. Such a quiescent condition does not appear consistent with the expected flow conditions in the containment pool during washdown and pool-fill, as evidenced by the volunteer plant study in Appendix III to the SE. The licensee stated that test 4 was the only test for which this practice was done; however, it was the design-basis strainer head loss test, so it is the only test that is significant for the strainer head loss measurement.	The test protocol for US-APWR will be from ones used for CP1/2 testing to introduce ALL debris after the pump start up. A portion of latent fiber, ~25%, shall be distributed and introduced to the surface of the water column after pump start up between the debris drop zone and the test strainer after all latent particulates are introduced into the flume. Therefore, the sequencing of debris introduction is proposed to be from the most transportable to least transportable as follows: For the US APWR design specifically, this means,

RAI No.	NRC question	US-APWR approach for resolution
		1. Latent dirt, dust, etc. all along the flow stream 2. ~25% of latent fiber "fines"; distributed all along the flow stream 3. coating particulates that are not "chips" (if tested) 4. the balance of latent fibers 5. fiber "fines" 6. coating "chips" (if tested) 7. fiber "smalls" 8. RMI foils (if tested) 9. ALOOH chemical precipitates. Note: Introduction of each debris type above shall be allocated on the basis of 40% near the screen; and 60% at the upstream end of the bounding flow stream.
16	Please justify including a sharp turn directly before the strainer in the head loss flume. This sharp turn may have assisted in the removal of debris and in the creation of a non-uniform bed on the test strainer. Please explain how this sharp change in flow direction is prototypical of the plant. Please explain how the debris diverter was modeled in the computational fluid dynamics simulations. The computational fluid dynamics simulations for the plant condition appear to show velocities significantly higher than 0.1 ft/s near a good part of the strainer surface. Furthermore, the computational fluid dynamics simulations also show that flow does approach the strainers directly over a significant part of their surface area, and that such a sharp change in flow direction directly in front of the strainer is not representative of the velocity vectors approaching the plant strainers.	MHI will test in accordance with the test configuration shown in Figure 1; which shall be confirmed by CFDs to match or exceed the turbulence at the screens in the US-APWR strainer array to the upstream corner of the test strainer. Refer Figure 2 for additional information of recirculation pool configuration of the US-APWR.  **<u>Figure-1 90 º arrangement.</u>**
17	From the pictures of the new strainer installation in Appendix A to the November 26, 2008, supplemental response, it is not clear to	There are no debris interceptors at the sumps where the strainer modules exist, as there is for Comanche Peak. Therefore, this RAI

RAI No.	NRC question	US-APWR approach for resolution
	the staff where the debris interceptor credited in the head loss testing is located. Please state where the interceptor is located, identify whether it surrounds the entire strainer for both sumps, and provide photographs showing its location.	does not apply to US APWR.
20	Please address the following items concerning the addition of large pieces of fibrous debris to the head loss tests, particularly the design-basis head loss test (Test 4). a. Considering the presence of a 1-foot high interceptor, it appears to the staff unlikely that large debris pieces would have been capable of climbing over such an obstruction. Examination of the transported debris in sensitivity tests or earlier head loss tests that used large pieces would have allowed this hypothesis to be verified. Please state the basis for considering the transport of large pieces to be credible under the test flume conditions with the 1-foot debris interceptor and identify whether transport of large pieces was observed during head loss tests or transport sensitivity tests that were performed with the interceptor installed. b. In addition, it is unclear to the staff how transport of large pieces could have been prototypically modeled in a flume having a width of the same order as typical large debris pieces. Please identify the distribution of sizes of the large pieces of debris added to the test flume and state whether any of the pieces became stuck in the narrow test flume due to non-prototypical interactions with the flume walls c. In light of the observations above, please identify whether the addition of large debris pieces under such conditions resulted in a non-prototypical means of filtering out chemical precipitate subsequently added to the head loss test	This RAI does not apply to the US-APWR testing since large debris will not be used.
22	The vortexing, air ingestion, and void fraction evaluations were not performed at the minimum containment flood level. The potential for a partially submerged strainer was not fully addressed. Please provide information that shows that the strainer will perform adequately with respect to vortexing, air ingestion, and void fraction at the most limiting submergence value and flow rates for the	The concerns associated with partially submerged strainer due to the water level at SBLOCA are not applicable to the US-APWR. The US-APWR has a different design to operating PWR plants in that it does not need "switch over" to continue long term core cooling after a postulated accident. The US-APWR has an in-containment water

RAI No.	NRC question	US-APWR approach for resolution
	strainer. One potential issue is that the licensee assumed that containment sprays will actuate in a maximum of 25 minutes and soon flood the strainer. For a small-break LOCA, spray actuation need not occur immediately or at all, such that the strainer could be operating for a significant period of time at a reduced water level (with only emergency core cooling system flow for small-break LOCA conditions). Analysis has not been presented to demonstrate acceptable strainer performance under this condition. The partially submerged strainer issue is particularly critical because the strainer core tube is only submerged by 2.2 inches at emergency core cooling system switchover for a small-break LOCA. In other words, if the head loss from the outer perforated plate and any accumulated debris on the outer surface of the strainer exceeds 2.2 inches, the core tube would be uncovered, which could adversely and significantly impact the performance of the strainer. The situation is complicated further by the fact that, even if the head loss across the perforated plates is low when a uniform flow calculation is used, if the perforated plate clean strainer head loss plus debris head loss is not small compared to about 2 inches, then reduced flow is going to reach the pump suctions from the plates that are farthest away (i.e., the PCI strainer will have increasingly non-uniform flow as this value is approached and potentially exceeded), since only a 2.2-inch margin in driving head is available to move water through the strainer surface prior to core tube uncovery. Also, since the core tube slots are likely designed for full flow, having less than the design flow will lead to greater flow at the near modules. Thus more flow (and debris) will concentrate on the nearest module to the suction, and the head loss through these nearby disks will increase. Assuming uniform debris distribution in this case may not be conservative. In addition, vortexing could occur inside the strainer disks above the core tube slots. Please explain whether core tube performance testing has been done with only 2.2 inches of submergence to verify no vortexing or flashing at the slots. Furthermore, based on Page 15 of 20 in Attachment E, there appear to be sources of drainage nearby the strainers, which could potentially disturb the water surface near the strainers and	resource (i.e., the RWSP) for the accident. The LBLOCA uses the maximum water volume from the RWSP and minimizes the water level of the RWSP. This is the design basis of the strainer submergence of the US-APWR. Refer responses to the RAI question 06.02.02-26 and 06.02.02-28 for additional information to this response. The configuration of the PCI SFS has the ability to suppress vortexes by its perforated plate surface; the wire reinforcements within the disks and the internal core tube. Observation for the formation of vortexing will be implemented in the test and reported; in addition to a calculation in accord with RG 1.82 Rev 3. Current minimum strainer submergence of the US-APWR (i.e., 3.57in) is to increase to greater than 1ft of water, in order to prevent the occurrence of steam flashing due to debris head loss when the sump fluid temperature exceed 212F. To achieve this, current strainer module disks will be reduced from 27 disks to 21 disks, and total surface area will be reduced from 3,510 ft^2 to 2,730ft^2 per sump. To assure the prevention of steam flashing on the strainer, flashing calculation at two different temperatures will be required; one at sump fluid peak temperature (i.e., 250F), and at lower temperature (i.e., 70F). Since MHI will not apply accidental overpressure for flashing calculation when sump fluid is saturated, the higher temperature applicable for the calculation will be 212F. When sump fluid is at 212F, only the static water head corresponds to the strainer submergence (i.e., 1ft of water) compensates the strainer head loss in order to prevent steam flashing. Since the chemical precipitates do not form in the sump fluid until its temperature is 140F or lower, clean strainer head loss (CSHL) plus non-chemical debris head loss (DHL) will be considered. Once sump water is cooled and its temperature is lower than 212F, water is sub-cooled against containment atmosphere. The sub-cooled pressure at the temperature against containment

RAI No.	NRC question	US-APWR approach for resolution
	core tube slots and result in air entrainment. Please provide the assumptions used in the air ingestion and void fraction calculations, and information that justifies the assumptions. Alternately, for the air ingestion issues, please provide test data, taken under conservative conditions, that show that air ingestion will not occur for the strainer as installed in the plant. Note that, with the strainer only partially submerged, air entering the core tube may not be identified visually so that alternate means of identifying air entrainment may be required. The response to this item should also consider that any debris that is considered to transport to the strainer under partially submerged conditions would accumulate on the reduced strainer area	atmosphere will compensates the strainer head loss, in addition to the static water head due to submergence. When sump fluid is at 140F or lower, chemical precipitates form in the sump fluid. Therefore CSHL plus debris head loss due to both non-chemical and chemical debris will be used for the calculation. In case that, 1ft of water submergence and sub-cooled pressure at the temperature will be considered. The flashing calculation using the mentioned approach will be provided when finalized.
23	Please provide the margin to flashing considering that a more limiting condition may occur at the minimum water level, with the core tube covered only by a small amount of water. The flashing evaluation may have to be performed for several conditions in order to provide assurance that the limiting condition has been identified. With only a small amount of water covering the core tube, it is possible that the clean strainer head loss alone could result in flashing of the fluid within the strainer if some overpressure is not credited in the evaluation.	This RAI does not apply to US APWR testing. Refer MHI response to the above question item 22 for partially submerged strainer as limiting condition.
25	The staff could not determine whether some of the fine fibrous debris was blended into non-prototypical debris. The test photos in attachment D (pages 10 and 29) to the November 26, 2008, supplemental response appear to show clumps of debris that are larger and more agglomerated than would be expected of prototypical fine debris. The debris could have been blended excessively or into a form that is not prototypical of debris created by a steam jet. Please provide information that shows that the fibrous debris had prototypical characteristics when added to the test tank and that the debris was not agglomerated when added. In general the staff considers class 1-3 fibers (reference NUREG/CR-6808, Table 3-2) to be acceptable as fine fibrous debris with the majority being class 2 or 3. In addition, information should be provided that justifies that excessive agglomeration of debris did not occur during the debris addition process.	MHI will apply the protocol to further dilute the fiber "fines" prior to introduction more so than has been implemented for the operating fleet. This is expected to achieve less agglomeration of fines than was witnessed by the NRC for the South Texas Project testing, which was found acceptable. Furthermore, the introduction of fines will be documented with photos and / or a video to confirm the refinement of this effort during the test. This change is not expected to fully eliminate agglomeration; but it will be implemented with the intent to reduce agglomeration more so than has been achieved previously by the protocol implemented with NRC concurrence.
26	One of the test photographs shows 1.66 lb_m of fine fibrous debris.	This RAI does not apply to US APWR testing. The RAI concern is

MHI's response to the RAIs relative to head loss tests originally raised for Comanche Peak 1&2 GL2004-02 responses

RAI No.	NRC question	US-APWR approach for resolution
	This would correlate to 56.8 lb_m of debris in the plant. It was unclear what fibrous debris this represented. It appears that the fine debris should have been 30 lb_m of latent fiber (although one place shows 24 lb_m) and 33 lb_m of fine LDFG debris. The total fine fiber would then be 63 lb_m. Please clarify the amount of fibrous fines predicted to reach the strainer and verify that the test amount was scaled correctly.	associated with the scale factor that is specific to Comanche Peak testing. The scaling factor shall be equal to the test strainer's surface area divided by the effective total surface area of the two operating sumps.
27	Staff review of the November 26, 2008, supplemental response identified that the debris addition practices and sequence used during the testing may not have been conservative. Please provide information that justifies that the debris addition sequence and practices did not result in non-conservative debris transport to the strainer during testing. Examples of potential non-conservative practices include adding more easily transportable debris after adding less transportable debris. It appears that the addition of 6 mil paint and lead blanket cover fines in the second batch of debris is contrary to adding the most transportable debris first. From the supplemental response it was difficult to determine how the debris was actually added. For example, was each debris type added separately or were the debris added as one addition? If added separately, please provide the order of addition.	There is no silicon impregnated fiberglass fabric included in the design basis for US APWR.
28	It was unclear that the extrapolation of the test data to the strainer mission time was conservative. Please provide information that justifies that the exponential curve fit results in a conservative estimation of head loss at the end of the mission time. Please include adequate data so that the staff can verify the results of the extrapolation. Please provide information on how the linearly extrapolated value is used in any analyses or provide the reason that it was included in the supplemental response.	During testing and as we near "normal termination criteria", a decision will be made to continue the testing or not dependent on the increase in head loss over time. If flat, or decreasing, no extrapolation is required. If increasing slightly, an exponential curve fit will be applied to the data to predict the final head loss. This head loss curve, inclusive of the extrapolation of data will be provided in the test report to show the final head loss will not exceed the allowable during operation.
29	It appeared that the extrapolation of test results to different temperatures assumed that the flow through the debris bed was fully laminar. However, the supplemental response stated that there was clean strainer area at the end of the test. With clean strainer area, the flow through the strainer may not have been fully laminar. If this is the case, a straight viscosity correction should	This RAI will be resolved by implementing a flow sweep after completing the test termination criteria as has been acceptable to the NRC on the operating fleet. This is already included in the Test Plan.

RAI No.	NRC question	US-APWR approach for resolution
	not be applied for temperature correction. Please provide the methodology and initial conditions used to calculate the debris head loss at higher temperature conditions. Also provide information that justifies the use of a straight viscosity correction for the debris head loss if one was used.	
35	The flume tests were performed with chemical precipitates added after other non-chemical debris. Credit was taken for settling of debris, both non-chemical debris and chemical precipitates in the flume approaching the strainer test section. These tests were performed at a maximum flume fluid temperature of 120 °F. The total head loss in the integrated chemical effect head loss flume tests was acceptable. The licensee makes a statement on page 150 of 351, "Because chemical precipitates were first observed at and below 140 °F, the head loss was calculated in accordance with RG 1.1 and RG 1.82." Please address what this means and how this statement factors into the chemical effects evaluation.	MHI intends to implement chemical precipitate introduction of the ALOOH as has been witnessed and accepted by the NRC in prior tests.

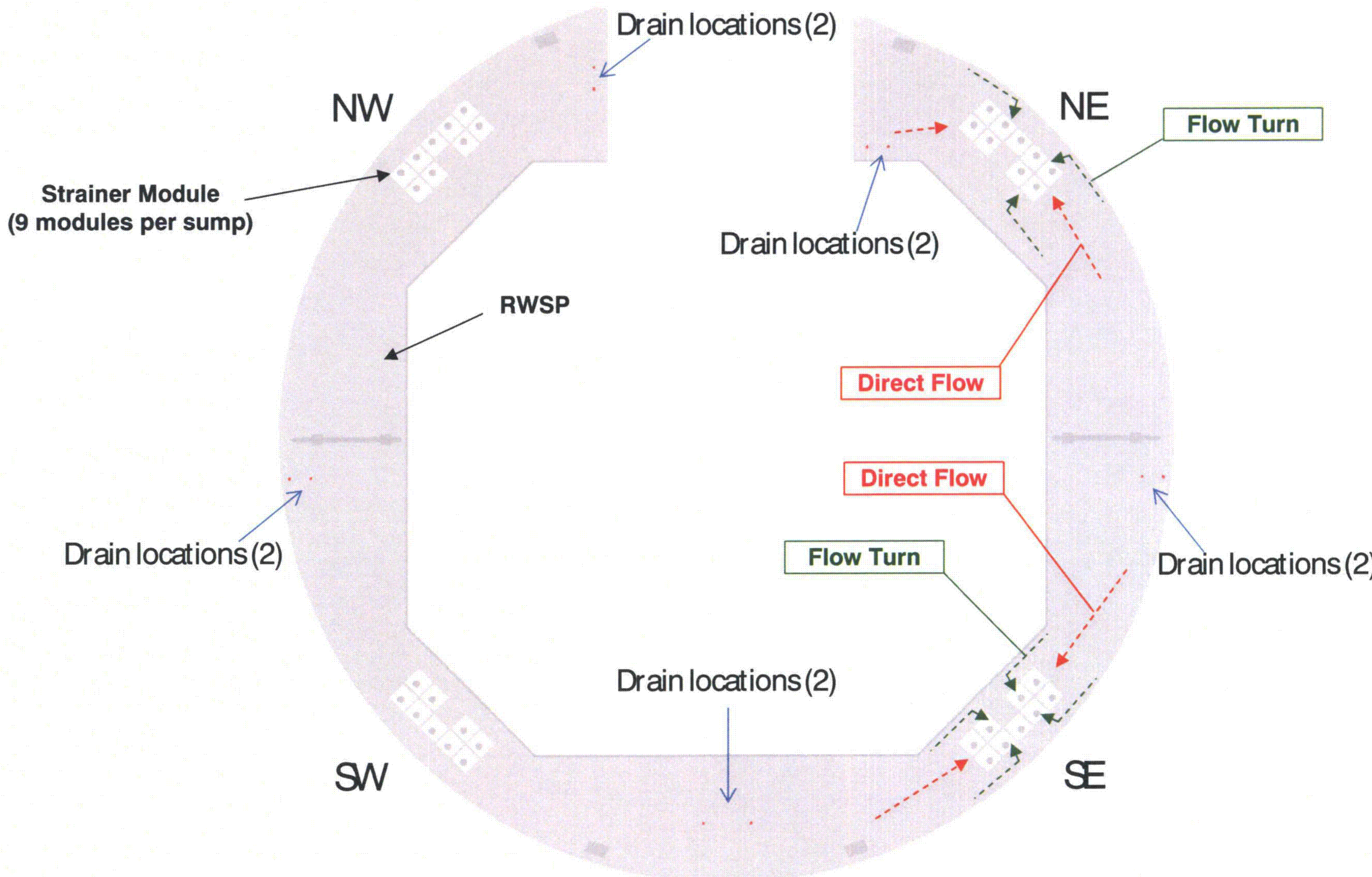


Figure-2 Flow Direction to the Strainer in the RWSP