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January 29, 2009

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-09028

Subject: MHI's Responses to US-APWR DCD RAI No. 132-1538 Revision 1

Reference: [1] "Request for Additional Information No. 132-1538 Revision 1, SRP Section: 09.01.02 – New and Spent Fuel Storage – Design Certification and New License Applicants, Application Section: 9.1.2," dated December 18, 2008.

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. 132-1538 Revision 1".

Enclosure 1 and 2 are the responses to the 17 RAIs contained within Reference [1].

The RAI Response is being submitted in two versions. One version (Enclosure 1) includes certain information, designated pursuant to the Commission guidance as sensitive unclassified non-safeguards information, referred to as security-related information ("SRI"), that is to be withheld from public disclosure under 10 CFR 2.390. The information that is SRI is identified by brackets. The second version (Enclosure 2) omits the SRI and is suitable for public disclosure. In the public version, the SRI is replaced by the designation "[Security-Related Information - Withheld Under 10 CFR 2.390]".

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 below.

Sincerely,

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

D081
NRO

Enclosures:

1. Responses to Request for Additional Information No. 132-1538 Revision 1
   (SRI included version)

2. Responses to Request for Additional Information No. 132-1538 Revision 1
   (SRI excluded version)

CC: J. A. Ciocco
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Enclosure 2

UAP-HF-09028
Docket No. 52-021

Responses to Request for Additional Information
No. 132-1538 Revision 1

January 2009

(Security-Related Information Excluded)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

1/29/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 132-1538 REVISION 1

SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-01

[9.1.2-1] The staff requests the applicant to update the DCD in order to clarify these apparent editorial errors.

a) On page 9.1-8 of DCD Tier 2, Figure 9.1.2.2-1 is referenced. This figure does not exist. The NRC staff requests the applicant to provide this figure.

b) On page 2.7-188 of the Tier 1 DCD, the text refers to the new fuel storage and the referenced table discusses the spent fuel storage.

ANSWER:

a) The correct DCD Tier 2 Figure number should be 9.1.2-2 "Spent Fuel Rack Array". Editorial changes will be made to reflect the correct Figure 9.1.2-2 in Section 9.1.2.2.2 Spent fuel storage, Page 9.1-8, instead of Figure 9.1.2.2-1 as referenced in the section.

b) Tier 1 DCD text in Section 2.7.6.2.2, Page 2.7-188, will be corrected to "spent fuel storage" instead of "new fuel storage" to reflect the correct referenced Table 2.7.6.2-1.

Impact on DCD

a) Tier 2 DCD Section 9.1.2.2.2, Page 9.1-8, will be updated with the following:

"Moderate density racks containing neutron absorbing material are provided in the spent fuel pit. Center-to-center spacing of the rack array is 11.1 to* maintain the required degree of subcriticality as shown in Figure 9.1.2-2."

b) Tier 1 DCD Section 2.7.6.2.2, Page 2.7-188, text will be updated with the following:

"The ITAAC for the spent fuel storage are located in Table 2.7.6.2-1"

Impact on COLA
There is no impact on the COLA

Impact on PRA
There is no impact on the PRA

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SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-02

[9.1.2-2] SRP Section 9.1.2, Section III.1 states that "Low-density storage should be used, at a minimum, for the most recently discharged fuel to enhance the capability to cool it." In Section 9.1.2.1 of the DCD it is stated that "The spent fuel rack is designed as a moderate density storage arrangement which provides adequate natural coolant circulation to remove the residual decay heat from spent fuel stored in the spent fuel rack..."
The staff requests the applicant to include in the DCD justification for this deviation from the guidelines presented in the SRP.

ANSWER:

As noted in DCD Section 9.1.2.2.2 - Spent Fuel storage, the US-APWR has a center-to-center spacing of the spent fuel rack array of 11.1 inches to maintain the required degree of subcriticality. By comparison, the Spent Fuel Rack Design in AP1000's DCD contains both Region 1 rack modules with a center-to-center spacing of nominally 10.9 inches and Region 2 rack modules with a center-to-center spacing of nominally 9.03 inches. These Pressurized Water Reactor spent fuel rack spacing's are typical of other U.S. Operating plants which have replaced fuel racks to increase the storage capacity ("Reracked"). The natural coolant circulation of these high density racks has been repeatedly demonstrated for these reracked design. Therefore, the US-APWR moderate density storage arrangement is considered as not deviating from the guidelines presented in the SRP. The actual natural coolant circulation capability of the moderate density US-APWR spent fuel storage racks will be demonstrated by ongoing thermal-hydraulic analysis which will be completed within the month of May 2009.

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.

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SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-03

[9.1.2-3] SRP Section 9.1.2, Section III.2.L states that a dry new fuel storage vault drain should be sized to handle the maximum flow from the rupture of the largest water pipe in the area. The staff requests the applicant to include in the DCD the sizing criteria for the NFP drains and to discuss how the design of these drains meet the design criteria discussed in SRP Section 9.1.2 Section III.2.L.

ANSWER:

The New Fuel Storage Vault or "New Fuel Pit" (NFP) of the US-APWR is surrounded by a dike to prevent unanticipated water from entering the pit. This area enclosed by the dike will include terminal connections and piping sized ¾ inches to 1 inch. for demineralized water.

The expected US-APWR design utilizes a NFP drain consisting of a funnel leading to a 3 inch pipe (not finalized and subject to change if necessary).

Therefore, the NFP vault device will handle the maximum flow from any water piping in the area.

From the criticality safety perspective, the criticality analysis was performed under NFP conditions assuming it is filled by a water/air from mixture that is the most severe with respect to potential new fuel criticality.

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.

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SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-04

[9.1.2-4]SRP Section 9.1.2, Section III.2.L states that "Backflow into the [dry new fuel] vault through the drain system should be prevented." In the DCD Section 9.1.2.2.1 the applicant states that the design of the manually operated drain piping system prevents backflow into the new fuel pit storage area through the drain system. It is unclear to the staff how the manually operated drain piping system will be able to provide flooding and backflow protection at the same time.
The staff requests the applicant to include in the DCD:
a) an explanation as to how the manually operated drain piping system will be able to provide flooding protection and backflow protection at the same time,
b) justify why no automatic backflow protection devise (for example, a check valve) is needed, and c) explain why there is no ITAAC requiring the testing of the proper function of the backflow protection measures.

ANSWER:

a) and b) The description in DCD Section 9.1.2.2.1 is incorrect regarding the manually operated drain piping valves. The drain line from the NFP to the reactor building (R/B) sump has a check valve to prevent backflow.

c) The drain check valve described above is not required for criticality safety. As stated in DCD Subsection 9.1.1.3, flooding in the NFP is prevented or minimized, but subcriticality is maintained for both flooded and optimum moderation conditions. Based on the check valve's role in minimizing flooding potential of the NFP, MHI will revise the Tier 1 Design Description for new fuel storage, to include the backflow prevention function. The check valve will then be subject to ITAAC item 2 in Table 2.7.6.1-1 that requires inspection of the as-built new fuel storage facilities to verify conformance with the Design Description.

Impact on DCD

In Tier 1 Subsection 2.7.6.1.1 Design Description, the third bullet under Key Design Features will be revised as follows:

- "The new fuel pit is provided with a drain system, which is connected to the reactor building sump and designed to prevent backflow into the NFP, to prevent the new fuel pit from being flooded by an unanticipated release of water."

In DCD Subsection 9.1.2.2.1, New Fuel Storage, the third paragraph will be revised as follows:

"The new fuel storage pit is provided with a ~~manually-operated~~ drain system, which is connected to the R/B sump to prevent the new fuel pit from being flooded by an unanticipated release of water. The design of the drain piping system includes a check valve to prevent~~s~~ backflow into the new fuel pit storage area through the drain system."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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SRP SECTION: **9.1.2 – New and Spent Fuel Storage**

APPLICATION SECTION: **9.1.2**

DATE OF RAI ISSUE: **12/18/2008**

QUESTION NO.: 09.01.02-05

[9.1.2-5] SRP Section 9.1.2, Section III.2.J states that the dry new fuel storage racks should be designed with openings at the bottom to facilitate drainage if intended for dry storage or flooding if intended for wet storage. These design considerations were not discussed within the DCD, and the drawings of the new fuel storage rack are not of sufficient detail to determine if these design criteria are met.
The staff requests the applicant to include in the DCD additional design considerations for the sizing of the openings on the bottom of the new fuel rack.

ANSWER:

The NFP is of the dry type and is also designed to maintain criticality safety even if the pit is flooded with pure water or an "optimum density" (for potential criticality) water/air foam mixture. New fuel racks are designed with an opening (called "side holes") at the bottom of each of the 4 sides of each storage cell, which can drain unanticipated water. These openings are sized to be the same as the openings at the bottom of the spent fuel storage rack cells.

The NFP is of the dry type and is also designed to maintain criticality safety even if the pit is flooded with pure water or an "optimum density" (for potential criticality) water/air foam mixture. New fuel racks are designed with various openings at the bottom of the storage which can drain unanticipated water.

Impact on DCD

In DCD Subsection 9.1.2.2.1, New Fuel Storage, the third paragraph will be revised as follows (these revisions are separate from and in addition to the revisions described in the Answer to QUESTION NO.: 09.01.02-04):

"The new fuel storage pit is provided with a manually operated drain system, which is connected to the R/B sump to prevent the new fuel pit from being flooded by an unanticipated release of water. The design of the drain piping system prevents backflow into the new fuel pit storage area through the drain system. The new fuel rack storage cells are each designed with an opening at the bottom of each of the four sides, which can drain such unanticipated release of water.

These openings are sized the same as the openings at the bottom of the spent fuel storage rack cells.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA

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APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-06

[9.1.2-6] SRP Section 9.1.2, Section II, subsection Technical Rationale, paragraph 4 states that "Provisions for inspection and testing are necessary to verify that there is no corrosion of the spent fuel pool liner or new and spent fuel storage racks, no buildup of crud or debris that may obstruct coolant flow in wet storage facilities, and no degradation of any strong fixed neutron absorbers." The applicant has not established an inspection program for the spent fuel storage racks and spent fuel pool liner. The staff requests the applicant to include in the DCD a description of the inspection program (including testing interval) for the spent fuel storage racks and spent fuel pool liner.

ANSWER:

The program for in-service testing and inspection of the spent fuel storage racks and spent fuel liner are the responsibility of the COL applicant. DCD Subsection 3.8.4.7 requires the COL applicant to address monitoring of seismic category I structures in accordance with the requirements of NUMARC 93-01 and 10 CFR 50.65. See also the response to question 11.

Aside from neutron absorber material sample coupon testing already described in DCD Section 9.1.2, no additional testing of the spent fuel storage racks or the spent fuel pit (SFP) liner is needed. Inspections of the integrity of the liner and SFP storage racks, verifying their presence, absence of significant corrosion, etc., will be conducted upon completion of construction/installation, and informally upon every visit of plant personnel to the operating floor in the vicinity of the SFP. Formal inspections will be conducted before every fuel move interfacing with the SFP, and especially for the SFP racks prior to their utilization. Any build-up of crud or debris that may interfere with inspection of the SFP floor areas or, in a worst-case scenario, have the potential to obstruct coolant flow for the spent fuel storage racks, will be cleared as necessary by underwater vacuum systems with underwater viewing capabilities whenever necessary prior to significant build-up. The spent fuel rack design provides significant areas of coolant flow to eliminate any concerns about such crud or debris build-up obstructing coolant flow capabilities. Accordingly, no additional inspection program detailing is deemed necessary.

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

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APPLICATION SECTION: 9.1.2

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QUESTION NO.: 09.01.02-07

[9.1.2-7] SRP Section 9.1.2, Section III.2.H.i states that the bottoms of any transfer gate should be above the top of the fuel assemblies, and that the volume of the adjacent fuel handling areas should be limited so that leakage into these areas would not reduce the coolant inventory to less than 3 meters (10 feet) above the top of the fuel assemblies. The DCD does not provide enough detail to evaluate if the bottoms of the gates are above the top of the fuel assembly. It is also unclear if the volumes of the adjacent fuel handling areas are small enough so that leakage past the gates would not reduce the coolant inventory to less than 10 feet above the top of the fuel assemblies.
The staff requests the applicant to:
a) specify in the DCD that the bottom of the fuel transfer gate is located above the stored fuel assemblies,
b) justify why there is no need for an ITAAC to verify that the bottom of the fuel transfer gate is located above the stored fuel assemblies, and
c) determine the impact of any transfer gate failure on the SFP water level (water level drop), and to include in these results in the DCD.

ANSWER:

The weir elevations of pit gates are higher than the top of spent fuel seated in the spent fuel storage racks. Tier 2 DCD Section 9.1.4, Figure 9.1.4-2 is revised below to illustrate this.

The "Key Design Features" in the Tier 1 Subsection 2.7.6.2.1 Design Description, will also be revised as indicated below to indicate this. ITAAC item 2 in Table 2.7.6.2-1 requires the as-built spent fuel storage facilities to conform to the functional arrangement as described in the Design Description. Therefore no additional ITAAC to verify the relative elevation of the weir gates and stored spent fuel is necessary.

Calculations show that the volume contained in all pits (including refueling canal, cask pit and fuel inspection pit) adjacent to and connected to the SFP such that they would fill in the event all gates between the pits fail (as shown in revised Figure 9.1.4-1 below) is sufficiently small such that the SFP water level would still be approximately 3.8 meters above the top of spent fuel stored in the spent fuel storage racks.

Security-Related Information - Withheld Under 10 CFR 2.390

(SRI)

Impact on DCD

In Tier 1 Subsection 2.7.6.2.1, the seventh (7^{th}) bullet under "Key Design Features" will be revised as follows:

• The refueling canal is connected on one side to the SFP, and on its opposite side, the refueling canal connects to the spent fuel cask loading pit and to the fuel inspection pit. A weir and gate provide physical isolation of the refueling canal from each of the pits. All the gates are located above the top elevation of the fuel seated in the SFP racks: they are normally closed and only opened as required.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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RAI NO.: NO. 132-1538 REVISION 1

SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

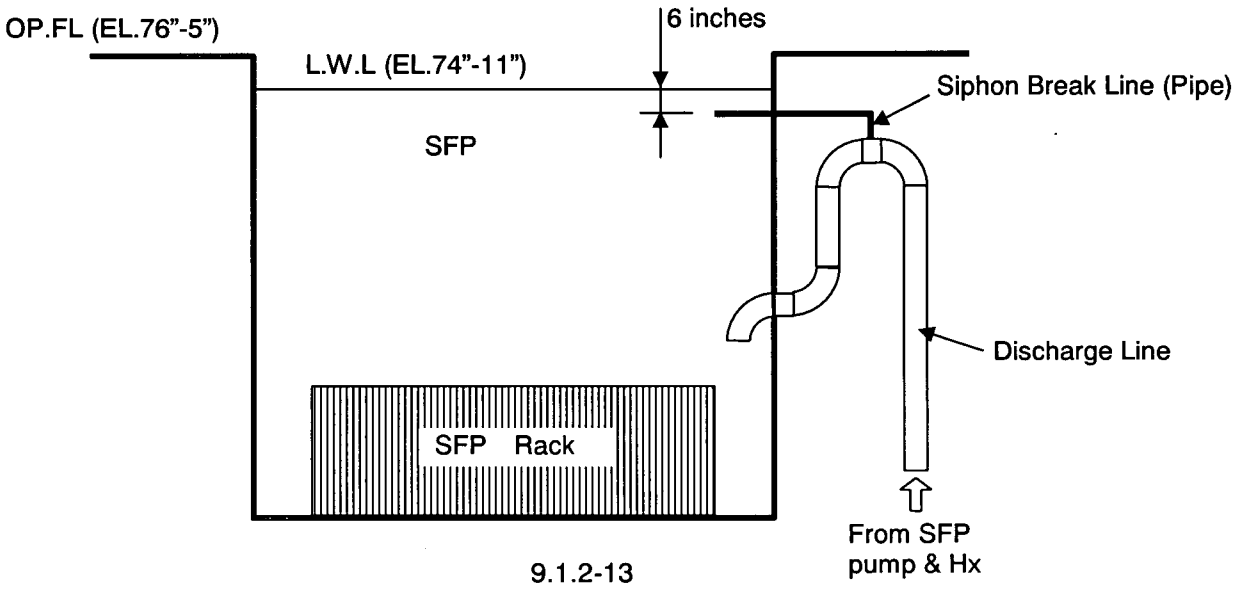
DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-08

[9.1.2-8] The applicant stated that the pipes that discharge into the SFP are designed with anti-siphon devices to prevent the unanticipated draining of the SFP. This design feature is consistent with the recommendations of SRP Section 9.1.2. The staff also determined that the applicant has not proposed an ITAAC to verify the proper construction and operation of the anti-siphon devices.
The staff requests the applicant to create an ITAAC to verify the proper construction and operation of the anti-siphon devices.

ANSWER:

The sketch below illustrates the intended SFP Siphon Breaker Line design. Its operation depends only on water level dropping to the level of the line opening and therefore does not have a specific ITAAC item associated with it. MHI will add the anti-siphon feature to the Tier 1 Figure 2.7.6.3-1 Spent Fuel Pit Cooling and Purification System. Verification of the existence of the siphon breaker line will be performed to satisfy the functional arrangement ITAAC, item #1 in Tier 1 Table 2.7.6.3-5. To remove any confusion, the Note 1 on DCD Figure 9.1.3-1 will be clarified.



Impact on DCD

DCD Revision 1 Tier 1 Figure 2.7.6.3-1 Spent Fuel Pit Cooling and Purification System will be revised to identify the siphon breaker line.

Tier 2 DCD Figure 9.1.3-1, Note 1 will be revised as follows:

"1. ~~RELEASE~~ LOCATE THE SIPHON ~~BLEAKER~~ BREAKER LINE (PIPE) ~~ABOUT~~ 6 INCHES BELOW ~~NORMAL~~ LOW WATER LEVEL."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA

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RAI NO.: NO. 132-1538 REVISION 1

SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-09

[9.1.2-9] SRP Section 9.1.2, Section III.2.I states that the applicant should show that "The thermal-hydraulic analysis of the flow through the spent fuel racks is adequate for decay heat removal from the spent fuel assemblies during all anticipated operating and accident conditions. Furthermore, the analysis should show adequate natural circulation of the coolant during all anticipated operating conditions, including full core-offloads during refueling, to prevent nucleate boiling for all fuel assemblies." The staff requests that the applicant provide information in the DCD that demonstrates the ability to cool spent fuel assemblies. This analysis should be conservative in its assumptions of thermal load and environmental conditions. The applicant should also demonstrate that sufficient openings exist within the racks to allow the coolant to flow freely. The DCD should include a description of the assumptions, inputs, and conclusions of the thermal analysis.

ANSWER:

The thermal-hydraulic analysis demonstrating the flow through the spent fuel racks is adequate for decay heat removal from the spent fuel assemblies during anticipated operating and accident conditions is currently in progress and will be completed within the month of May 2009.

Upon completion of this analysis a summary of the results will be submitted to NRC.

Impact on DCD

DCD will be updated with information from the thermal-hydraulic analysis report.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-10

[9.1.2-10] SRP Section 9.1.2, Section III.2.B states that improper loading of fuel elements should be avoided. It is unclear how the accidental loading of a fuel assembly into an improper location is avoided in the US-APWR design. Improper loading can result in accidental criticality and reduced cooling. The staff requests that the applicant provide information in the DCD on how improper loading of both new and spent fuel assemblies will be prevented.

ANSWER:

As per DCD subsection 9.1.4.2.1.1 "Refueling machine" and 9.1.4.2.1.2 "Fuel handling machine" precise indexing for fuel storage locations is provided, as well as electrical interlocks, limit switches, and mechanical stops. Therefore, improper loading of either new or spent fuel assemblies is prevented. However, any conceivable improper positioning of a new or spent fuel assembly in either the new or spent fuel racks cannot result in accidental criticality and reduce cooling compared to its proper position.

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.

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RAI NO.: **NO. 132-1538 REVISION 1**

SRP SECTION: **9.1.2 – New and Spent Fuel Storage**

APPLICATION SECTION: **9.1.2**

DATE OF RAI ISSUE: **12/18/2008**

QUESTION NO.: 09.01.02-11

[9.1.2-11] SRP Section 9.1.2 Section III.3.B states that, if the spent fuel pool liner plate is not designed and constructed to seismic Category I requirements, the spent fuel pool liner plate is reviewed for whether a failure of the liner plate as a result of an SSE will not cause any of the following:

Significant releases of radioactivity due to mechanical damage to the fuel.
Significant loss of water from the pool which could uncover the fuel and lead to release of radioactivity due to heat-up.
Loss of ability to cool the fuel due to flow blockage caused by a complete section or portion of the liner plate falling on the fuel racks.
Damage to safety-related equipment as a result of pool leakage.
Uncontrolled release of significant quantities or radioactive fluids to the environs.

The staff has not been able to determine if the SFP liner was designed as a seismic Category I structure. The staff also noted that the applicant has not proposed an ITAAC to verify the proper construction of the SFP liner. The staff requests the applicant to clarify in the DCD that the SFP liner was designed as a seismic Category I structure or to include in the DCD a justification (that addresses all the elements mention above) that justifies why the SFP liner is not designed as a seismic Category I structure. The staff also requests the applicant to justify why there is no ITAAC to verify the proper construction of the SFP liner (leak tight).

ANSWER:

Since the SFP liner is integrally attached to the SFP structure, which is a portion of the overall reactor building, the liner is classified as seismic Category I. The structural design of the fuel handling area of the reactor building, which includes the SFP, is described in DCD Subsection 3.8.4. As per Subsection 3.8.4, the concrete portions of the reactor building are designed in accordance with ACI 349, and the applicable provisions of RG 1.142 and SRP 3.8.4 using the loads and load combinations documented in DCD Subsection 3.8.4.3 and Table 3.8.4-3. Design of the liner anchorage conforms to the applicable requirements of ACI 349 Appendix B and applicable provisions of RG 1.199. Loads applicable to the SFP include but are not limited to dead, live, hydrostatic, hydrodynamic, seismic, normal operating, accident thermal loads, and spent fuel assembly load drop, and definitions are provided in DCD Subsection 3.8.4.3. The SFP

and its liner are designed to maintain their structural integrity and remain leak tight under all applicable design loads and load combinations.

It should be noted that the liner is conservatively not relied upon as a structural element in the design of the SFP structure. However, the design accounts for strain compatibility of the liner with the SFP structure, and also accounts for loads induced on the SFP structure by the liner such as thermal expansion loads, to assure structural integrity and leak tightness.

Wording in Subsection 9.1.2.2.2 of the DCD will be revised based on the above answer to clarify that the liner is classified as seismic category I and to describe that the SFP liner is designed to withstand all design basis loads. Also, the SFP liner's seismic classification will be clarified in the Design Description of Tier 1 Subsection 2.7.6.2.1, and will therefore be verified as part of ITAAC item 2 in Table 2.7.6.2-1. Additionally, ITAAC of the SFP liner and its anchorage during construction to ensure leak tightness will be achieved through inspection and testing mandated by the applicable codes, standards and specifications as addressed in DCD Subsections 3.8.4.6 and 3.8.4.7, and by construction specifications. Further, COL applicants are required to institute a monitoring/inspection program for seismic Category I structures in accordance with NUMARC 93-01 as described in DCD Subsections 3.8.3.7 and 3.8.4.7, which will serve to identify any degradation of the SFP liner while the plant is in service.

Impact on DCD

Wording in the first paragraph of Subsection 9.1.2.2.2 of the DCD will be revised to clarify as follows:

"The spent fuel storage pit, including its integrally attached liner, is designed as seismic Category I and is located within the seismic Category I reactor building fuel handling area. The spent fuel storage pit and its liner are designed for loads and load combinations addressed in DCD Subsection 3.8.4.3 and Table 3.8.4-3. Applicable loads include but are not limited to dead, live, hydrostatic, hydrodynamic, seismic, normal operating, accident thermal, and spent fuel assembly drop loads. The spent fuel storage pit and its liner are designed to maintain their structural integrity and remain leak tight under all applicable design loads and load combinations. The walls of the spent fuel storage pit are an integral part ..."

DCD Tier 1 Subsection 2.7.6.2.1 Design Description will be revised to explicitly identify the SFP liner's seismic classification.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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Docket No. 52-021

RAI NO.: **NO. 132-1538 REVISION 1**

SRP SECTION: **9.1.2 – New and Spent Fuel Storage**

APPLICATION SECTION: **9.1.2**

DATE OF RAI ISSUE: **12/18/2008**

QUESTION NO.: 09.01.02-12

[9.1.2-12] SRP Section 9.1.2, Section III.2.A states that the spent fuel pool liner should be designed to withstand all design basis loads. The staff determined that the DCD has not addressed this design recommendation. This design goal is also not listed as an ITAAC design feature to be verified in Tier 1 Section 2.7.6.2. The staff requests the applicant to discuss in the DCD the SFP liner capacity to withstand all design basis loads.

ANSWER:

The response to question 09.01.02-11 indicates the design basis loads for the SFP liner.

Regarding an ITAAC for the SFP liner, NUREG-0800 SRP 14.3 page 14.3-32 item C.iii states "Standard pre-op tests defined in the DCD Tier 2 and Reg Guide 1.68 are not a substitute for ITAAC". However, Reg Guide 1.68 does not mention spent fuel pool (pit) liners testing, and the key feature of the liner, its leak-tightness, will be established by the pit's maintaining of the water used to fill it upon completion of construction and construction inspections, and by the absence of water in the liner leakage collection system which is provided with a leak detection capability, so no liner ITAAC is considered necessary.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

1/29/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 132-1538 REVISION 1

SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-13

[9.1.2-13] SRP Section 9.1.2, Section III.2.K states that "Detection and collection of spent fuel pool liner leaks incorporated into the design with capability to collect pool liner leaks (e.g. drains and sumps) to prevent uncontrolled releases of radioactive material to the environment and to keep radiation exposure as low as reasonably achievable for personnel." In the DCD Section 9.1.2.2.2 the applicant states that a leakage collection system is monitored to determine whether leakage is occurring. The applicant has not defined a monitoring schedule, nor has the applicant defined the capacity of the collection system. The staff also noted that the applicant has not proposed an ITAAC to test the proper operation of the SFP leakage collection system. It is unclear what will happen if the collection system overflows or if overflow generates an alarm.
The staff requests the applicant to include in the DCD a detailed description of the SFP liner leakage collection system monitoring schedule, system capacity, how is the system operability evaluated, and what are the testing intervals. The staff also requests the applicant to justify why there is no need for an ITAAC to test the proper operation of the SFP leakage collection system.

ANSWER:

A leakage collection monitoring schedule is not necessary, as such unexpected leakage would be alarmed upon its occurrence. The capacity of the collection system has not yet been set, but the insignificance of such leakage eliminates concerns about collection system overflows or alarms for such potential overflows – any significant unexpected leakage would be indicated by the SFP level detectors that alarm both locally and in the main control room. During construction, the operability of the leakage collection system will be confirmed to assure no blockages, system leakages, etc. The simplicity of the system eliminates the need for subsequent testing, or for an ITAAC to further confirm the proper operation of the SFP leakage collection system.

As per DCD Subsection 9.1.3.1, possible leakage from the SFP liner plate welds on the pit walls and floor will be directed by the liner leakage collection system to the R/B sump. A separately alarmed pool leak collection point will be established upstream of the R/B sump to ensure essentially immediate detection of any significant liner leakage.

Impact on DCD

The DCD will be revised as appropriate to clarify operation of the spent fuel pool liner leakage collection system.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

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APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-14

[9.1.2-14] SRP Section 9.1.2, Section III.2.O states that "For spent fuel storage, monitoring systems should detect pool water levels, pool temperatures, and pool building radiation levels. Alarms should be both local and in a continuously manned location." In the DCD Section 9.1.2.2.2 the applicant states that SFP water level and temperature gauges, and an area radiation monitor in the fuel handling area are provided with alarms to the main control room (MCR). Additionally, the applicant stated in Tier 1 Section 2.7.6.2, "Spent Fuel Storage," that the SFP liner leakage collection system is provided with a leak detection capability. There are no other alarms, displays, or controls associated with the spent fuel storage facilities.
The staff finds these two statements to be contradictory and neither of these two statements is in accordance with the recommendations given by SRP Section 9.1.2. The staff requests the applicant to clarify in the DCD what are the monitoring requirements for the SFP and to justify in the DCD why the USAPWR design is not in accordance with the recommendations of SRP Section 9.1.2.

ANSWER:

Tier 2 DCD Section 9.1.2.2.2, 8th paragraph states "Spent fuel pit water level and temperature gauges, and an area radiation monitor in the fuel handling area are provided with alarms to the main control room". This statement will be revised to clarify that all of these alarms are also local alarms.

Tier 2 DCD Figure 9.1.3-1, "Schematic of Spent Fuel Pit Purification and Cooling System (Cooling Portion)" will be revised to show both local and main control room monitoring systems (indications and alarms) for the SFP water level and temperature. Regarding the SFP area radiation monitoring, Tier 2 DCD Section 12.3.4.1.2 on Criteria for Location of Area Monitors states, "The ARMS provides a continuous, direct indication or recording of radiation levels in the control room and raises alarms locally and in the control room when radiation levels exceed the set values."

Also, Tier 1 Subsection 2.7.6.2 on Spent Fuel Storage states, "The SFP liner leakage collection system is provided with a leak detection capability. There are no other alarms, displays, or controls associated with the spent fuel storage facilities." These statements will be corrected to refer to instrumentation related to spent fuel storage that is addressed in other Tier 1 subsections. Based on these DCD changes, the US-APWR design is in accordance with the recommendations

of SRP Section 9.1.2 cited in this question.

Impact on DCD

Tier 2 DCD Section 9.1.2.2.2 on Spent fuel storage, 8th paragraph will be revised as follows:

"Spent fuel pit water level and temperature gauges, and an area radiation monitor in the fuel handling area are provided with alarms to the main control room and locally."

Tier 1 Section 2.7.6.2.1 on Design description for Alarms, Display, and Controls will be revised as follows:

"The SFP liner leakage collection system is provided with a leak detection capability. Instrumentation for SFP level and SFP temperature are addressed in Subsection 2.7.6.3. Radiation monitoring ~~There are no other alarms, displays, or controls~~ associated with the spent fuel storage facilities is addressed in Subsection 2.7.6.13.

Subsequently, a statement at the beginning of Subsection 2.7.6.3.1 under "Alarms, Displays, and Controls" will be added as follows:

"Alarms and displays of the SFP water level and temperature are installed both locally and in the main control room."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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Docket No. 52-021

RAI NO.: **NO. 132-1538 REVISION 1**

SRP SECTION: **9.1.2 – New and Spent Fuel Storage**

APPLICATION SECTION: **9.1.2**

DATE OF RAI ISSUE: **12/18/2008**

QUESTION NO.: 09.01.02-15

[9.1.2-15] The staff evaluation of Tier 1 Section 2.7.6.1 determined that the applicant has not provided sufficient design details in order to develop proper ITAACs to verify the construction and operation of the NFP components that are important to safety. The staff requests the applicant to include in Tier 1 Section 2.7.6.1 a more detailed description of the components and functions that ITAAC Table 2.7.6.1-1 will be verifying.

ANSWER:

The US-APWR new fuel storage facilities are passive, safety-related structures designed to maintain subcriticality of new fuel and structural integrity under design basis conditions. Center-to-center spacing of adjacent fuel assemblies is a Key Design Feature to maintain subcriticality identified in Tier 1 Subsection 2.7.6.1. ITAAC in Table 2.7.6.1-1 address ASME Code Section III criteria applicable to the storage racks, and structural integrity during seismic events and dropped fuel assembly accidents. Tier 1 Subsection 2.7.6.1 and ITAAC in Table 2.7.6.1-1 will be revised to more fully address subcriticality of new fuel assemblies under design basis conditions.

The safety functions for new fuel storage are achieved primarily via structural design and rack geometry. Therefore, aspects such as operating parameters, alarms, displays and controls do not apply to the new fuel storage facilities. Although it is not required to maintain subcriticality, the NFP drain to the reactor building sump is included as a Key Design Feature and subject to the basic configuration ITAAC (Table 2.7.6.1-1, item 2). The backflow prevention design feature of the NFP drain is addressed herein in response to Question No. 09.01.02-04. Light Load Handling System operation, including receipt of new fuel, is addressed in Tier 1 Subsection 2.7.6.4. Other Tier 1 requirements that pertain to fuel handling and storage in general, including reactor building structural design considerations, containment isolation of the fuel transfer tube, and fuel handling area HVAC radiation monitoring, are described herein in response to Question No. 09.01.02-16.

Impact on DCD

Tier 1 Subsection 2.7.6.1.1, Design Description, will be revised to add the following Key Design Feature:

- "The new fuel storage racks maintain subcriticality for all normal and credible abnormal conditions."

Tier 1 Table 2.7.6.1-1, New Fuel Storage Inspections, Tests, Analyses, and Acceptance Criteria, will be revised as follows:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The new fuel storage racks withstand ~~the design basis seismic events~~, and maintain the new fuel assemblies subcritical during: a. design basis seismic events, b. design basis dropped fuel assembly accidents and fuel handling uplift forces. c. conditions of flooding and optimum moderation in the NFP.	1.a An analysis of the new fuel storage racks and fuel assemblies will be performed under design basis seismic conditions.	1.a A report exists and concludes that the new fuel racks withstand seismic design basis dynamic loads and maintain the stored new fuel assemblies subcritical.
	1.b An analysis of the new fuel storage racks and fuel assemblies under design basis dropped fuel assembly loads and fuel handling uplift forces will be performed.	1.b A report exists and concludes that the new fuel racks withstand design basis dropped fuel assembly loads and fuel handling uplift forces and maintain the new fuel assemblies subcritical, .
	1.c An analysis of the new fuel storage racks and fuel assemblies will be performed under conditions of flooding and optimum moderation. ~~An inspection will be performed to verify that the as-built new fuel storage racks are located in the reactor building.~~	1.c A report exists and concludes that the new fuel racks withstand conditions of flooding and optimum moderation and maintain the new fuel assemblies subcritical. ~~The as-built new fuel storage racks are located in the reactor building.~~
2. The functional arrangement of the new fuel storage facilities is as described in Subsection 2.7.6.1.1 Design Description.	2. An inspection of the as-built new fuel storage facilities will be performed.	2. The as-built new fuel storage facilities conform to the functional arrangement as described in the Design Description of this Subsection 2.7.6.1.1.
3. The new fuel storage facilities meet the ASME requirements as described in Subsection 2.7.6.1.1.	3. An inspection of the as-built new fuel storage facilities will be performed.	3. The as-built new fuel storage facilities meet the ASME requirements described in the Design Description of this Subsection 2.7.6.1.1.
4. The new fuel storage racks are located in the reactor building.	4. An inspection will be performed to verify that the as-built new fuel storage racks are located in the reactor building.	4. The as-built new fuel storage racks are located in the reactor building.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 132-1538 REVISION 1**

SRP SECTION: **9.1.2 – New and Spent Fuel Storage**

APPLICATION SECTION: **9.1.2**

DATE OF RAI ISSUE: **12/18/2008**

QUESTION NO.: 09.01.02-16

[9.1.2-16] The staff evaluation of Tier 1 Section 2.7.6.2 determined that the applicant has not provided sufficient design details in order to develop proper ITAACs to verify the construction and operation of the SFP components that are important to safety. The staff requests the applicant to include in Tier 1 Section 2.7.6.2 a more detailed description of the components and functions that ITAAC Table 2.7.6.2-1 will be verifying.

ANSWER:

MHI will revise the SFP Tier 1 information, including ITAAC, to more clearly address the requirement to maintain spent fuel assemblies subcritical during design basis conditions. It should be noted that NUREG-0800 Subsection 14.3.3 Revision 0 (pp. 14.3.3-7 and 14.3.3-8) includes SFP liner welds as an example of non-ASME Code welds that are inappropriate for Tier 1 scope.

Additional design details and ITAAC involving spent fuel storage are found in DCD Tier 1 as follows:

Subsection 2.2, Structural and Systems Engineering, addresses building structure and system structural design, and includes protection against hazards.
Subsection 2.2.1.1, Reactor Building (R/B), includes the fuel storage and handling area that includes new fuel and spent fuel storage (verified to be in the R/B via ITAAC in Table 2.7.6.1-1 and Table 2.7.6.2-1, respectively).
Table 2.2-2 specifies thickness, location and radiation shielding applicability of concrete walls in the R/B, including the fuel storage and handling area. Figures 2.2-6, 2.2-7 and 2.2-10 include architectural layout details of the fuel storage and handling area.
Table 2.2-4 Structural and Systems Engineering Inspections, Tests, Analyses, and Acceptance Criteria: ITAAC item 1 requires verification of the as-built R/B structural configuration, including Table 2.2-2 and Figures 2.2-6, 2.2-7 and 2.2-10. ITAAC item 6 requires verification that the as-built R/B is reconciled with design basis loading conditions.

Subsection 2.7.6.4, Light Load Handling System (LLHS), includes the functional arrangement and design characteristics of the equipment used for refueling operations. The fuel transfer tube blind flange, which provides a containment isolation function, is part of the LLHS and is addressed in this subsection.

Subsection 2.7.6.5, Overhead Heavy Load Handling System, includes design features and limitations on spent fuel cask crane operation that prevent a spent fuel cask drop accident.

Table 2.7.6.13-1, Area Radiation Monitoring System Equipment Characteristics, includes SFP Area Radiation Monitor RMS-RE-5, which is verified to exist per ITAAC item 1 in Table 2.7.6.13-3.

Table 2.7.6.13-2, Airborne Radioactivity Monitoring System Equipment Characteristics, includes Fuel Handling Area HVAC Radiation Gas monitor RMS-RE-49, which is verified to exist per ITAAC item 1 in Table 2.7.6.13-3.

Impact on DCD

Tier 1 Subsection 2.7.6.2.1, Design Description, will be revised to add the following Key Design Feature:

"The spent fuel storage racks maintain subcriticality for all normal and credible abnormal conditions."

Table 2.7.6.2-1, Spent Fuel Storage Inspections, Tests, Analyses, and Acceptance Criteria, will be expanded to verify demonstration of subcriticality under design conditions. Refer the answer of QUESTION NO.: 09.01.02-15.

Impact on COLA

There is no impact to the COLA.

Impact on PRA

There is no impact to the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 132-1538 REVISION 1

SRP SECTION: 9.1.2 – New and Spent Fuel Storage

APPLICATION SECTION: 9.1.2

DATE OF RAI ISSUE: 12/18/2008

QUESTION NO.: 09.01.02-17

[9.1.2-17] DCD Tier 2 Chapter 16 provides the technical specifications for the plant. Technical Specification 3.7.12 involves maintaining an adequate water depth in the spent fuel pool to allow safe movement of spent fuel elements. The frequency of Surveillance Requirement 3.7.12.1 is stated to be 7 days. This is adequate for normal conditions, but is not sufficient for all times. SRP Section 9.1.2 items I.7 and I.9 discuss the need for adequate SFP depth and the monitoring of the SFP depth. The most critical time to assure that the water depth is sufficient is while fuel is being moved. The staff requests the applicant to justify in the DCD why the frequency of surveillance should not be modified to "every 7 days and at the start of any spent fuel movement campaign."

ANSWER:

The frequency of surveillance in DCD Tier 2 Chapter 16, Section 3.7.12 Technical Specification on Fuel Storage Pit Water Level, Surveillance Requirements SR 3.7.12.1 will be revised per NRC comment.

Impact on DCD

DCD Tier 2 Chapter 16, Section 3.7.12, Frequency column of Surveillance Requirements SR 3.7.12.1 will be revised with the following:

"Every 7 days and at the start of any spent fuel movement campaign."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA