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TOKYO, JAPAN

August 7, 2009

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

Attention: Mr. Jeffery A. Ciocco

Docket No. 52-021
MHI Ref: UAP-HF-09421

Subject: MHI's Response to US-APWR DCD RAI No. 414-3102

Reference: 1) "Request for Additional Information No. 414-3102 Revision 1, SRP Section: 04.05.02 – Reactor Internal and Core Support Structure Materials, dated 6/24/2009.

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. 414-3102, Revision 1."

Enclosed are the responses to RAIs contained within Reference 1.

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

Sincerely,

Y. Ogata

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

Enclosure:

1. Response to Request for Additional Information No. 414-3102, Revision 1

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

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NRO

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Docket No. 52-021
MHI Ref: UAP-HF-09421

Enclosure 1

UAP-HF-09421
Docket No. 52-021

Response to Request for Additional Information No. 414-3102,
Revision 1

August, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

8/7/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 414 3102 REVISION 1**
SRP SECTION:	**04.05.02 - REACTOR INTERNAL AND CORE SUPPORT STRUCTURE MATERIALS**
APPLICATION SECTION:	**4.5.2**
DATE OF RAI ISSUE:	**6/24/09**

04.05.02-6

Question 1
In response to RAI 269-2155 Question 4.5.2-2a, MHI provided a sketch of the neutron reflector and its components but did not provide the material specifications for the neutron reflector components.
Provide the material specifications for the neutron reflector components and modify Table 4.5-2 of the US-APWR DCD as appropriate (see Question 11).

ANSWER:

The material specifications for the neutron reflectors are as follows.

- The material specification for the neutron reflector ring blocks is SA-336 Grade F304 as listed in Table 4.5.2 in DCD.
- The tie rod material specification is SA-479 Type 316 as listed in Table 4.5.2 in DCD.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-7

Question 2
In response to RAI 269-2155 Question 4.5.2-2d, MHI stated that the maximum fluence at the corner of the neutron reflector will exceed the IASCC (irradiation assisted stress corrosion cracking) threshold of $5x10^{20}$ n/cm2 by the end of design life. MHI also stated that the inner surface of the neutron reflector can be inspected.

Discuss your inspection plan (type of inspection, inspection area, frequency, acceptance criteria, etc.) for the neutron reflector to ensure that IASCC will not affect the integrity of the neutron reflector.

ANSWER:

The potential for IASCC of the neutron reflector is smaller than that of the core baffle structures in the existing PWR because the parts with high stress such as threaded fasteners are eliminated on the effective core region. Therefore in-service inspections based on Section XI requirements of the ASME Code are sufficient to assure the integrity of the neutron reflector as follows.

- Frequency :10 years interval
- Method :visual inspection
- Area : inside surface of the neutron reflector
- Acceptance criteria: No structural damage or change is observed.

Impact on DCD
There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-8

Question 3
In response to RAI 269-2155 Question 4.5.2-3b, MHI did not state if the lower core support plate was considered "Reactor vessel internals primary material" as described in Table 4.5-2 of the US-APWR DCD. The reason for this question was to verify the material specification applicable to the lower core support plate.

Provide the material specification for the lower core support plate and modify Table 4.5-2 of the US-APWR DCD as appropriate (see Question 11).

ANSWER:

The lower core support plate material specification is SA-336 Grade F304 which is included in the category of "Reactor vessel internals- primary material" listed in Table 4.5-2.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-9

Question 4
In response to RAI 269-2155 Question 4.5.2-3b, MHI did not state if the radial support keys are considered "Reactor vessel internals. primary material" as described in Table 4.5-2 of the US-APWR DCD. The reason for this question was to verify the material specification applicable to the radial support keys.

Provide the material specification for the radial support keys and modify Table 4.5-2 of the US-APWR DCD as appropriate (see Question 11).

ANSWER:

The material specification for the radial support keys is SA-182 Grade F304. The keys are clad with cobalt alloy, Stellite No.6 or equivalent material and shown in the category of "Alignment pins and clevis inserts "listed in Table 4.5-2 of DCD.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05-02-10

Question 5
In RAI 269-2155 Question 4.5.2-3b, the staff requested that MHI describe how the radial support keys are attached to the lower support plate. The reason for this question was to determine if the radial support keys that are shown in Figures 3.9-4 and 3.9-6 of the US-APWR DCD are manufactured as an integral part of the lower core support plate or if they are attached to the lower core support plate by welding.

Discuss how the radial support keys are attached to the lower core support plate. If welding processes are used, discuss the welding process and welding materials used to make the attachment.

ANSWER:

The radial support keys are shrink-fit in the lower core support plate and attached with threaded fasteners. No welding process is specified for the attachment of the radial support keys to the lower core support plate.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-11

Question 6
In response to RAI 269-2155 Question 4.5.2-3b, MHI discussed radial supports that are reactor vessel parts as identified in Table 5.2.3-1 of the US-APWR DCD.

a) Confirm that the radial supports are Thermally Treated Alloy 690 in accordance with material specification SB-166 as specified in Table 5.2.3-1 of the US-APWR DCD.

b) Discuss the welding processes and welding materials used to connect the radial supports to the reactor vessel.

c) Discuss whether the radial supports are welded directly to the reactor vessel base material (SA-508 alloy steel) or are welded to the reactor vessel cladding.
Confirm that these welds are qualified as structural welds.

d) Discuss whether stainless steel cladding is used for the entirety of the reactor vessel or whether nickel based cladding is used in the vicinity of the radial supports.

e) If both stainless steel and nickel based cladding is used in the reactor vessel, discuss the cladding sequence.

ANSWER:
a) Yes, the radial supports are Thermally Treated Alloy 690 in accordance with material specification SB-166 as specified in Table 5.2.3-1 of the US-APWR DCD.

b) The radial supports are welded to the reactor vessel by the shielded metal arc welding (SMAW) and gas tungsten arc welding (GTAW) processes, using SFA-5.11 and SFA-5.14 welding materials.

c) The radial supports are welded to the nickel based alloy buttering on the reactor vessel base material (SA-508 alloy steel). The nickel based alloy buttering is qualified as structural welds.

d) The stainless steel cladding is used for the entirety of the reactor vessel except the vicinity of the radial supports where the nickel based alloy buttering is applied.

e) The stainless steel cladding is welded on the reactor vessel first, followed by the nickel based alloy buttering.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-12

Question 7
Discuss in detail how the lower core support plate attaches to the reactor vessel. (Note: Figure 3.9-4 of the US-APWR DCD shows this attachment but not in detail and without identifying certain components such as the reactor vessel radial supports, radial support clevis inserts, and any welds. A detailed sketch of this attachment would be helpful to the staff's understanding but is not required.)

Include the following in your detailed discussion or sketch.

- .Lower core support plate
- . Radial support key
- . Weld between lower core support plate and radial support key (if applicable)
- . Radial support clevis insert
- . Radial support clevis insert bolt and spring
- . Reactor vessel radial support
- . Reactor vessel. Any weld or weld cladding between the reactor vessel radial support and the reactor vessel base material
- . Any component critical to the attachment that was omitted from the list above (if applicable)

ANSWER:

- The radial support keys are stainless steel and are shrink-fit into the lower core support plate and attached with the threaded fasteners. The mating surface of the keys to the clevis inserts is clad with cobalt alloy. There is no welding between the key and the lower core support plate.
- The radial supports made from Alloy 690 material are welded to the nickel based alloy buttering on the reactor vessel inner surface.
- The clevis inserts are Alloy 690 material clad with cobalt alloy and are attached to the radial supports by threaded fasteners. This method of attachment facilitates customization of the tangential clearance with the radial keys. No spring is used there.

• The core barrel bottom is aligned to the vessel by the mechanical contact between the radial keys on the lower core support plate and the clevis inserts on the reactor vessel radial supports.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-13

Question 8
In response to RAI 269-2155 Question 4.5.2-4a, MHI provided a list of core barrel welds that were not listed in Section 3.9.5.1.2 of the US-APWR DCD.

Confirm that these welds will be made using weld materials listed in Table 4.5-2 of the US-APWR DCD, or provide the material specification for these welds in Table 4.5-2 of the US-APWR DCD.

ANSWER:

The electron beam welding process will be applied for the core barrel welding. In this process, no weld materials are used because the base materials at each joint are directly re-melted and fused together.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-14

Question 9
In response to RAI 269-2155 Question 4.5.2-4b, MHI stated that the maximum fluence on the core barrel will exceed the threshold of $5x10^{20}$ n/cm2 by the end of design life.
MHI also stated that the core barrel can be inspected.

Discuss your inspection plan (type of inspection, inspection area, frequency, acceptance criteria, etc.) for the core barrel to ensure that IASCC will not affect the integrity of the core barrel.

ANSWER:

The potential for IASCC of the US-APWR core barrel is smaller than that of the existing PWR because the fluence level on the US-APWR core barrel inside surface is reduced by the radial reflector. Therefore the in-service inspections for the reactor internals based on Section XI requirements of the ASME Code as below are sufficient to assure the integrity of the core barrel. As for the core region, inspections on the barrel inside surface can be represented by those of the neutron reflector as described in the response to Question 2 of this RAI.

- Frequency :10 years interval
- Method : visual inspection
- Inspection area: whole surface of the core barrel except the inside surface of the core region which represented by the inspection of the neutron reflector
- Acceptance criteria: No structural damage or change is observed.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-15

Question 10
In response to RAI 269-2155 Question 4.5.2-5, MHI stated that the DCD will incorporate changes to "4.1.1.1 Controls on Welding".

Confirm that these changes will be made to Section 4.5.2.2 in lieu of Section 4.1.1.1 of the US-APWR DCD.

ANSWER:

The changes with the response to RAI 269-2155 Question 4.5.2-5 will be made to Section 4.5.2.2 in lieu of section 4.1.1.1 of US-APWR DCD.

Impact on DCD
There is no impact on DCD.

Impact on COLA
There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

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04.05.02-16

Question 11
The first Component listed in Table 4.5-2 is "Reactor vessel internals-primary material".

a) Clarify what components are included under "Reactor vessel internals-primary material".
b) Does this category include both internal structures and core support structures that are not specifically listed in Table 4.5-2?
c) Does this category include the neutron reflector components, lower core support plate and radial key inserts?

ANSWER:

a) "Reactor vessel internals-primary material" applies to a component of major importance to the structural and functional operation of the reactor internals. The components classified in the primary material category are summarized below, except for threaded fasteners which are in a different category of importance as defined by Subsection NG of the ASME Code.

- Core barrel with the lower core support plate
- Neutron reflector except the tie rods
- Secondary core support assemblies
- Upper core support
- Upper core plate
- Upper core support columns
- Top slotted columns
- Mixing devices
- RCCA guide tubes except the support pins

b) Yes, "Reactor vessel internals-primary material" includes both internal structures and core support structures that are not specifically listed in Table 4.5-2.

c) "Reactor vessel internals-primary material" includes the neutron reflector components (except tie rods), lower core support plate and the core barrel radial key bodies. The clevis inserts for the radial support are included in the category of "Alignment pins and clevis inserts" in Table 4.5-2.

Impact on DCD

There is no impact on DCD.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.