MITSUBISHI HEAVY INDUSTRIES, LTD.
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May 19, 2010

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-10140

Subject: MHI's Response to US-APWR DCD RAI No. 570-4428

Reference: 1) "Request for Additional Information No. 570-4428 Revision 0, SRP Section: 03.09.04 – Control Rod Drive Systems, Application Section: 3.9.4," dated 4/13/2010

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") documents entitled "Response to Request for Additional Information No. 570-4428, Revision 0"

Enclosed is the response to 1 RAI 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 the submittals. His contact information is provided below.

Sincerely,

Y. Ogata

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

D081
NRO

Enclosures:

1. "Response to Request for Additional Information No. 570-4428, Revision 0"

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

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Enclosure 1

UAP-HF-10140
Docket No. 52-021

Response to Request for Additional Information No. 570-4428,
Revision 0

May 2010

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

05/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 570-4428 REVISION 0**
SRP SECTION:	**03.09.04 - CONTROL ROD DRIVE SYSTEMS**
APPLICATION SECTION:	**3.9.4**
DATE OF RAI ISSUE:	**04/13/2010**

QUESTION NO.: 03.09.04-3

In the DCD, Revision 2, Tier 1, page 2.4-2, fourth paragraph under 'Seismic and ASME Code Classification', it says "CRDM pressure housings". Later in Tier 1, Table 2.4.1-1, page 2.4-4, it says, "CRDM housing". These entries should be consistent. The applicant is requested to correct one of the entries to be the same as the other.

ANSWER:

MHI's standard wording is "CRDM pressure housing".

Impact on DCD

DCD Revision 3 will incorporate the following changes:

- Table 2.4.1-1 of Tier 1 will be revised as shown in attachment-1 of this RAI.
- Page 3-xviii will be revised as shown in attachment-2 of this RAI.
- 3rd paragraph of Subsection 3.5.1.2.1 will be changed as follows:

  Additionally, postulated missiles in the form of a piece of the CRDM pressure housing or a control rod ejected rapidly from the core is not considered credible. In addition to a low probability of occurrence similar to the RV, the following assurances specific to the CRDMs maintain a low probability of occurrence, P_1, and low probability of impact, P_2, provided by:

- 2nd paragraph of subsection 3.5.1.2.2 will be changed as follows:

  The pressure housings, without canopy seal welds, have been used in several plants in the United States and in Japanese PWR plants. Chrome carbide coating of latch arm surfaces has been applied to Japanese plants.

  1. Pressure housing

  The pressure housing consists of a rod travel housing and a latch housing, both of which are butt welded. The latch housing is butt welded to a CRDM nozzle of the RV head. This butt welded design results in an extremely low probability of primary coolant system leakage, per GDC 14.

The pressure housing is categorized as a Class 1 component in RG 1.26 (Reference 3.9-52) in that it constitutes a pressure boundary of the RCS. It is designed in accordance with ASME Code, Section III (Reference 3.9-1), Subsection NB. The material of the CRDM is described in Subsection 4.5.1.

The rod travel housing is the upper part of the CRDM <u>pressure</u> housing, which enshrouds the drive rod, facilitating its travel during withdrawal and insertion of the RCCA.

An eye bolt is attached on top of the rod travel housing for handling purposes, including handling the CRDM at the plant site, if necessary.

The latch housing is the lower part of the CRDM <u>pressure</u> housing, which contains the latch assembly. The latch assembly is fixed on the inner shelf of the cylindrical housing and is positioned by a threaded fastener. The outside of the latch housing supports the coil stack assembly.

- Title of Table 3.9-9 will be changed as follows:

Table 3.9-9 CRDM <u>Pressure</u> Housing Loading Conditions and Load Combinations

- Title of Table 3.9-10 will be changed as follows:

Table 3.9-10 CRDM <u>Pressure</u> Housing Stress Categories and Stress Intensity Limits

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

Table 2.4.1-1 Equipment Key Attributes

Equipment[1]	Tag #	ASME Section III Class	Seismic Category	Class 1E/ Qual. for Harsh Envir	S-VDU
Fuel assemblies (257)	—	None	I	No	No
Rod cluster control assemblies (69)	—	None	I	No	No
Core support structures	—	CS	I	No	No
RCCA guide thimbles	—	None	I	No	No
Reactor vessel, including all nozzles	—	1	I	No	No
Reactor vessel head	—	1	I	No	No
Reactor vessel head stud bolt assemblies	—	1	I	No	No
CRDM pressure housings (69)	—	1	I	No	No
In-core thermocouples	ICT-TE-001 thru ICT-TE-026	—	I	Yes/Yes	Yes
Reactor vessel water level instruments (2)	RCS-LE-181 RCS-LE-182	—	I	Yes/Yes	Yes
Source Range Neutron Flux (2)	NIS-NE-031, 032	—	I	Yes/Yes[2]	Yes
Intermediate Range Neutron Flux (2)	NIS-NE-035, 036	—	I	Yes/Yes[2]	No
Power Range Neutron Flux (4)	NIS-NE-041, 042, 043, 044	—	I	Yes/Yes[2]	No
Wide Range Neutron Flux (2)	NIS-NE-033, 034	—	I	Yes/Yes	Yes

Legend: S-VDU = safety visual display unit (VDU)

Notes:

1. Figures 2.4.1-1, 2.4.1-2, and 2.4.1-3 show many of these components.
2. Qualification for harsh environment is not required for post-accident environmental condition.

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RAI NO.:	**NO. 570-4428 REVISION 0**
SRP SECTION:	**03.09.04 - CONTROL ROD DRIVE SYSTEMS**
APPLICATION SECTION:	**3.9.4**
DATE OF RAI ISSUE:	**04/13/2010**

QUESTION NO.: 03.09.04-4

Revision 2 of the DCD, in response to RAI 107-1293, question 10, inserted the following at the end of section 3.9.4.4.

Post-Refueling Startup Test

- The stepping and the rod drop tests are performed as in-service/post-refueling tests. The criteria of this test are applicable to all CRDMs as described in Subsection 14.2.

This test references the Initial Plant Test Program in section 14.2 which would include the following CRDM tests.

14.2.12.2.1.5 Rod Drop Time Measurement Test
14.2.12.2.1.6 CRDM Operational Test

However, Chapter 16, Technical Specifications, contains surveillance requirements with the criteria for the stepping and rod drop tests as follows.

SR 3.1.4.2
Verified rod freedom of movement (trippability) by moving each rod not fully inserted in the core ≥ 10 steps in either direction.

Frequency: [92 days OR in accordance with the Surveillance Frequency Control Program]

SR 3.1.4.3
Verified rod drop time of each rod, from the fully withdrawn position, is ≤ 3.15 seconds from the beginning of decay of stationary gripper coil voltage to dashpot entry, with:
a. Tavg ≥ 500°F and
b. All reactor coolant pumps operating.

Frequency: Prior to criticality after each removal of the reactor head

As written, the description for the newly inserted test, "The stepping and the drop tests are performed as in-service/post-refueling tests." is not clear as to exactly which tests are being performed and what frequencies are. The applicant is requested to clarify the testing to be performed, their respective frequencies, and the criteria which apply the post-refueling startup test.

Reference: MHI's Response to US-APWR DCD RAI No. 107; MHI Ref: UAP-HF-08278; dated December 19, 2008; ML090130257

ANSWER:

The stepping and the rod drop test are performed as post-refueling startup test. Additionally, the stepping test is also performed in plant operation periodically. Those frequency and criteria are specified in Subsections 14.2 referring to Chapter 16.

Impact on DCD

DCD Revision 3 will incorporate the following changes:

Post-Refueling Startup Test

- The stepping and the rod drop tests are performed as in-service/post-refueling <u>startup</u> tests. The criteria of this test are applicable to all CRDMs as described in Subsection 14.2. <u>In addition, the stepping test is also performed in plant operation periodically, and the frequency is specified in Chapter 16.</u>

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

05/19/2009

US-APWR Design Certification

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Docket No. 52-021

RAI NO.:	**NO. 570-4428 REVISION 0**
SRP SECTION:	**03.09.04 - CONTROL ROD DRIVE SYSTEMS**
APPLICATION SECTION:	**3.9.4**
DATE OF RAI ISSUE:	**04/13/2010**

QUESTION NO.: 03.09.04-5

In the DCD, Revision 2, section 3.9.4.4, the preoperational Test describes a startup test. The test title is inconsistent with the description. The applicant is requested to clarify by either: 1) changing the title to match the test described or 2) changing the description to match the title.

ANSWER:

Both the title and the description will be revised in order to correct the inconsistent between the title and the description.

Impact on DCD

DCD Revision 3 will incorporate the following changes:

- Subsection 3.9.4.4 will be revised as follows:

~~Preoperational Test~~ Initial Startup Test

- The scram time, measured at 85% insertion stroke of the RCCA into the fuel assembly, is confirmed to be within specifications during ~~prior to~~ initial start up tests ~~of the plant and prior to start up after every refueling outage~~. Start up testing is described in Chapter 14.

- Subsection 4.6.3 will be revised as follows:

The CRDS is tested in several phases. These tests may be categorized as follows:

- Prototype test of components
- Production tests of components following manufacture in shop
- ~~Preoperational test on site~~ Initial startup tests

- Periodic in-service tests

These tests, which are performed to verify the proper function of CRDS, are described in Subsection 3.9.4.4 and Section 14.2. They include rod insertion and withdrawal tests, scram test, and hydrostatic tests.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

05/19/2009

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Docket No. 52-021

RAI NO.:	NO. 570-4428 REVISION 0
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DATE OF RAI ISSUE:	04/13/2010

QUESTION NO.: 03.09.04-6

DCD, Revision 2, section 3.9.4.4, lists production tests which are performed on all [CRDM] units before shipment. After the units are installed and prior to fuel loading, CRDM preoperational system testing is performed as required by section 14.2. Section14.2 includes the following CRDM tests.

14.2.12.1.10 CRDM Motor-Generator Set Preoperational Test
14.2.12.1.11 CRDM Initial Timing Preoperational Test

Each of these tests includes the following prerequisites.

1. Required construction testing is completed.
2. Component testing and instrument calibration is completed.

However, there is no information regarding testing of individual CRDM components to ensure their proper installation prior to system testing. The applicant is requested to describe what testing or checks are performed to ensure the proper installation of the individual CRDM components prior to system testing. Also, the applicant is requested to describe what testing or checks are included in the two prerequisites listed above.

ANSWER:

All CRDMs are produced meeting tolerances as specified in the manufacturing specification. Meeting these specifications has assured the expected design performance and validated in the production tests for over 2,000 CRDMs, approximately 450 of which are in operation in the United States. The Latch assemblies are installed at the manufacturing facility in the Latch Housings on the Vessel Head. Shipping integrity is assured through the use of proven supports and a rugged Shipping Container which maintains a nitrogen blanket inside the CRDM pressure housing and the reactor vessel closure head.

On-site checks of the CRDMs prior to initial startup testing include:

1. Visual inspection of the CRDM Pressure Housings, which contain the Latch Assemblies, upon receipt at the site to confirm no physical damage has occurred to the

Shipping Container or to the Pressure Housings.

2. The Coil Stack Assemblies are individually installed on the Latch Housing on site using time-tested written assembly procedures. A proven installation process provides a degree of confidence concerning the expected performance of the components.

3. Each Drive Rod is positioned and engaged with the associated RCCA following fuel loading using certified and proven installation procedures which provide specific step-by-step instructions to the experienced mechanical technician. Once again, an issue-free installation process provides a check on the expected performance. As identified above, these procedures have been used for the installation of over 2,000 CRDMs, many of which are in commercial nuclear reactors operating at U.S. nuclear plant sites.

The tests, inspections and shipping, and storage provisions for each phase of CRDM production, shipping, receipt, assembly and installation prior to initial startup testing provide high confidence in proper performance of the CRDMs. In MHI's experience, CRDMs perform properly upon actuation (with run in exercising, as necessary). Based on the tests, inspections and shipping provisions described above and as demonstrated by actual experience, there is high confidence in proper installation and performance of the CRDMs.

For second request, the two prerequisites in each examination of Subsection 14.2.12.1.10 and Subsection 14.2.12.1.11 are as follows.

14.2.12.1.10 CRDM Motor-Generator Set Preoperational Test

Required construction testing

- Installation inspection
- Generator and motor inspection
- Control panel inspection
- Insulation resistance measurement

Component testing and instrument calibration

- Power incoming circuit inspection
- Excitation relays test
- Protection relays test
- Resistance measurement of relays
- Automatic voltage regulator test
- Timer relays test
- Automatic synchronization device test
- Instruments test

14.2.12.1.11 CRDM Initial Timing Preoperational Test

Required construction testing

- Installation inspection
- Wiring continuity check

Component testing and instrument calibration

- Energization check

(CRDM control system is started up without any error/warning message when applying current.)

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.