MITSUBISHI HEAVY INDUSTRIES, LTD.
16-5, KONAN 2-CHOME, MINATO-KU

April 28, 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-09224

Subject: MHI's Response to US-APWR DCD RAI No. 268-2181 Revision 1

Reference: 1) "Request for Additional Information No. 268-2181 Revision 1, SRP Section: 04.05.01 – Control Rod Drive Structural Materials" dated 3/9/2009

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") documents as listed in Enclosure.

Enclosed is the response to 1 RAI contained within Reference 1.

As indicated in the enclosed materials, this submittal contains information that MHI considers proprietary, and therefore should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential. A non-proprietary version of the document is also being submitted with the information identified as proprietary redacted and replaced by the designation "[ ]".

This letter includes a copy of the proprietary version (Enclosure 2), a copy of the non-proprietary version (Enclosure 3), and the Affidavit of Yoshiki Ogata (Enclosure 1) which identifies the reasons MHI respectfully requests that all materials designated as "Proprietary" in Enclosure 2 be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

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.

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Enclosures:

1. Affidavit of Yoshiki Ogata

2. "Response to Request for Additional Information No. 268-2181, Revision 1" (Proprietary Version)

3. "Response to Request for Additional Information No. 268-2181, Revision 1" (Non-Proprietary Version)

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

Contact Information
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Enclosure 1

Docket No. 52-021
MHI Ref: UAP-HF-09224

MITSUBISHI HEAVY INDUSTRIES, LTD.

AFFIDAVIT

I, Yoshiki Ogata, state as follows:

1. I am General Manager, APWR Promoting Department, of Mitsubishi Heavy Industries, LTD ("MHI"), and have been delegated the function of reviewing MHI's US-APWR documentation to determine whether it contains information that should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4) as trade secrets and commercial or financial information which is privileged or confidential.

2. In accordance with my responsibilities, I have reviewed the enclosed document entitled "Response to Request for Additional Information No. 268-2181, Revision 1", dated April 28, 2009, and have determined that portions of the document contain proprietary information that should be withheld from public disclosure. Those pages contain proprietary information are identified with the label "Proprietary" on the top of the page, and the proprietary information has been bracketed with an open and closed bracket as shown here "[ ]". The first page of the document indicates that all information identified as "Proprietary" should be withheld from public disclosure pursuant to 10 C.F.R. § 2.390 (a)(4).

3. The information identified as proprietary in the enclosed document has in the past been, and will continue to be, held in confidence by MHI and its disclosure outside the company is limited to regulatory bodies, customers and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and is always subject to suitable measures to protect it from unauthorized use or disclosure.

4. The basis for holding the referenced information confidential is that it describes the unique design parameters developed by MHI for the Control Rod Drive Mechanism.

5. The referenced information is being furnished to the Nuclear Regulatory Commission ("NRC") in confidence and solely for the purpose of information to the NRC staff.

6. The referenced information is not available in public sources and could not be gathered readily from other publicly available information. Other than through the provisions in paragraph 3 above, MHI knows of no way the information could be lawfully acquired by organizations or individuals outside of MHI.

7. Public disclosure of the referenced information would assist competitors of MHI in their design of new nuclear power plants without incurring the costs or risks associated with the design of the subject systems. Therefore, disclosure of the

information contained in the referenced document would have the following negative impacts on the competitive position of MHI in the U.S. nuclear plant market:

A. Loss of competitive advantage due to the costs associated with the development of the unique design parameters.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information and belief.

Executed on this 28th day of April 2009.

Y. Ogata

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

Enclosure 3

UAP-HF-08278
Docket No. 52-021

Response to Request for Additional Information No. 268-2181, Revision 1

April 2009
(Non-Proprietary)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

4/28/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 268-2181 REVISION 1**
SRP SECTION:	**04.05.01 - CONTROL ROD DRIVE STRUCTURAL MATERIALS**
APPLICATION SECTION:	**4.5.1**
DATE OF RAI ISSUE:	**3/9/09**

US-APWR Design Certification- 04.05.01 - Control Rod Drive Structural Materials
[Review performed against revision 0 of the US-APWR DCD Tier 2.]

QUESTION NO. : RAI 2181-4.5.1-1
In order for the staff to conclude that the CRDM materials meet the requirements of GDC 1 and GDC 26, the staff requests that the applicant address the following:

1. Table 4.5-1 lists SA-213 Type 304 material. The staff notes that Type 304 should be listed as Grade TP304 to be consistent with SA-213 and ASME Code, Section II, Part D, Table 2A. The staff requests that the applicant modify the FSAR accordingly.

2. Table 4.5-1 indicates that "an equivalent" may be used for Haynes 25 and Stellite 6. The staff requests that the applicant modify Table 4.5-1 to include the specifications that will be used to procure these materials.

3. Table 4.5-1 lists weld filler material specifications as meeting SFA-5.9 or SFA-5.4.The staff requests that the applicant modify Table 4.5-1 to include weld filler metal classifications. In addition, the staff requests that the applicant provide a sketch of the CRDM indicating the location of all welds with a description of each weld including welding requirements.

4. Table 4.5-1 specifies SA356 Grade 60-40-18 for the coil assembly housing, the staff was unable to locate SA-356 in ASME Code, Section II. The staff requests that the applicant explain this discrepancy.

5. In order to provide clarity, the staff requests that the applicant identify the materials in Table 4.5-1 that are exposed to reactor coolant.

6. The FSAR states that the information in Subsection 4.5.1 addresses relevant requirements of General Design Criteria (GDC) of 10 CFR 50, Appendix A, GDC 1 and GDC 14. The applicant did not however reference GDC 26. Application of GDC 26 to the control rod drive system materials ensures that material selection and fabrication support reliable rod movement for reactivity control; it also preserves fuel and cladding integrity, the primary barriers to the release of fission products. The staff requests that the applicant modify Subsection 4.5.1 to address its compliance with GDC 26.

ANSWER:

1. In the ASME Code, Section II SA-213, 304 type is identified "Grade TP 304" as the RAI has noted. We will make the following change.
DCD Table 4.5.1 Material Specification will be revised from" SA-213 Type 304" to "SA-213 Grade TP 304".

2. The reason for allowing an equivalent material to replace the preferred material in Table 4.5.1 is to allow an alternative material to be used in the event of unforeseen procurement or manufacturing problems with the preferred material. The equivalent material will be required to have the same chemistry and properties as the preferred material. A footnote will be added to Table 4.5.1 to define "equivalent material".

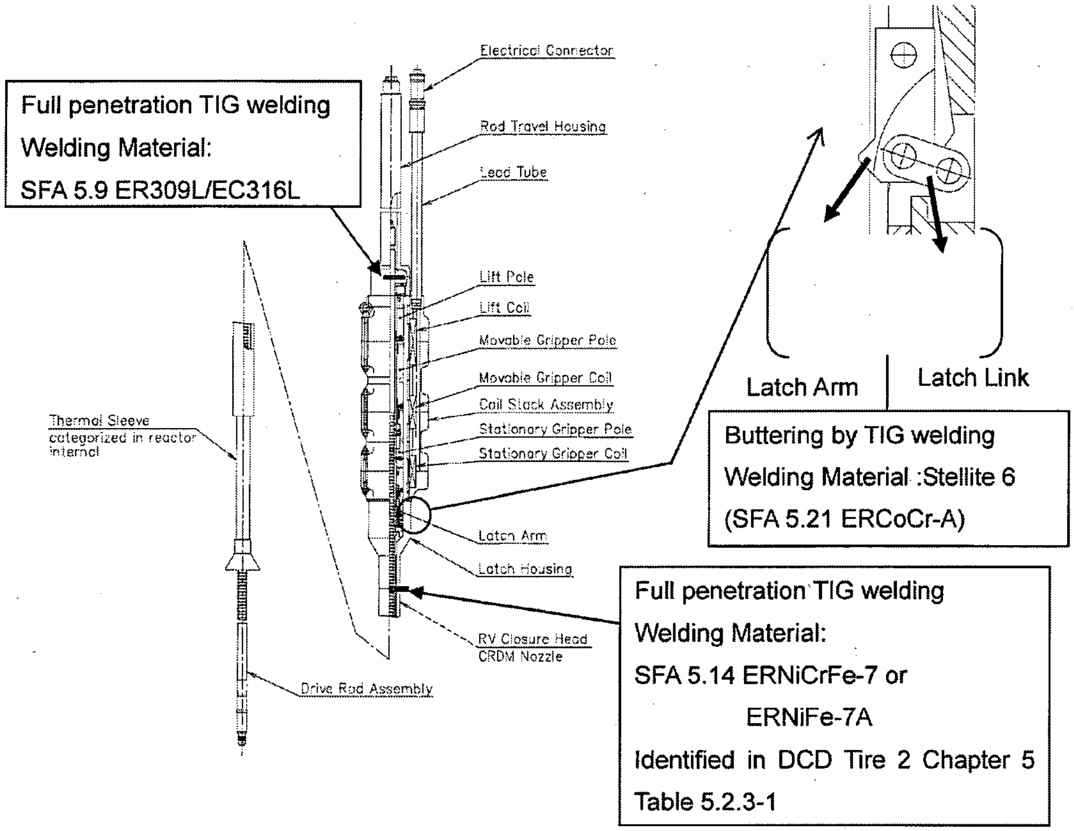
As an example of an equivalent material, a comparison of material chemistry between HAYNES® 25 and MA25 is shown below. Mechanical characteristics of MA25 will be requested to cover HAYNES® 25 in the procurement specification.

	Co	Ni	Cr	W	Fe	Mn	Si	C
HAYNES® 25	As balance	10	20	15	3*	1.5	0.4*	0.1
MA25	As balance	10	20	15	1.5	1.5	1*	0.1

*Maximum

MHI doesn't plan to use an equivalent material for Stellite 6, but if MHI needs to make a change, the procurement requirements will specified in the same manner as the example discussed.

3. Welding locations and welding requirements are shown in sketches below.



4. Specifying SA-356 was mis-worded. Ductile iron castings are used for the coil housings and the standard material specification is ASTM A 536. MHI will change Table 4.5.1 from SA-356 to ASTM A 536.

5. The materials that are exposed to reactor coolant water are identified in Table 4.5.1. Components such as the flux rings and coil assembly that are set on the outside of the pressure housing are identified as not being exposed to reactor coolant.

6. Compliance with GDC26 will be added in the applicable DCD section to identify materials in the reactivity control system. A brief description of the RCCA materials is shown in Subsection 4.2.3.6 of the DCD.

Impact on DCD

DCD Revision 2 will incorporate the following change:

- Table 4.5-1 will be revised as shown in attachment-1 to this RAI.

Impact on COLA

There is no impact on COLA.

Impact on PRA
There is no impact on PRA.

QUESTION NO. : RAI 2181-01-2

Cold working can increase the susceptibility of stress-corrosion cracking in austenitic stainless steels. The applicant states in FSAR Subsection 4.5.1.1 that strain-hardened, austenitic stainless steels are controlled to have a 0.2 percent offset yield strength that is no greater than 90,000 psi, which reduces the probability of stress-corrosion cracking in these materials. However, Subsection 5.2.3 which is referenced in Subsection 4.5.1.2 states that cold-worked, austenitic stainless steel is not used. The staff requests that the applicant clarify whether strain-hardened and/or cold-worked material is used for any CRDM,RCPB or non-pressure boundary components.

ANSWER:

Strain hardened and/or cold working material is not a specified material for the CRDM. The DCD will be revised to delete the sentence of the strain-hardened stainless steel.

Impact on DCD

DCD Revision 2 will incorporate the following change:

4.5.1.1 Material Specifications

Austenitic stainless steel, nickel based alloys, and cobalt based alloys are selected for CRDM components that are in contact with the reactor coolant water because of their corrosion resistance. The material specifications are listed in Table 4.5-1.

The properties of the materials selected for the CRDM are found in Section III, Appendix I, Division 1 of the ASME Boiler and Pressure Vessel Code (ASME Code) (Reference 4.5-3) or Section II, Parts D of the ASME Code. ~~Also, Regulatory Guide (RG) 1.84 (Reference 4.5-4) approved code cases are applied to materials used in the CRDM other than those in Section II. Strain hardened austenitic stainless steels are controlled to have a 0.2 percent offset yield strength that is no greater than 90,000 psi, which reduces the probability of stress corrosion cracking in these materials.~~

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

QUESTION NO. : RAI 2181-01-3

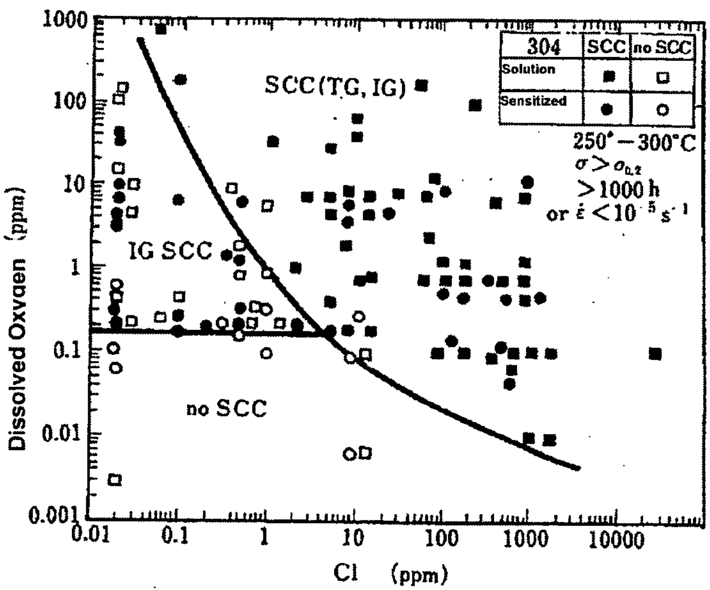
SA-182 Grade F316, SA-479 type 304 and SA-213 Grade TP304 permit a carbon content of up to 0.08%. The applicant states that it will follow RG 1.44, which recommends a carbon content not to exceed 0.03%. However, the applicant's Table 4.5-1 does not contain a supplemental requirement limiting carbon to 0.03%. The staff requests that the applicant modify Table 4.5-1 to include a note that limits carbon to no greater than 0.03% for austenitic stainless steels. In addition, the staff requests that the applicant list FSAR Subsection 4.5.1 in Table 1.9.1-1 under the line item for RG 1.44.

ANSWER:

RG 1.44 allows exceptions to the 0.03% requirement such as material exposed to reactor coolant which has a controlled concentration of less than 0.10 ppm dissolved oxygen at all temperatures above 200°F during normal operation. Furthermore, MHI understands that the NRC position in the RG 1.44 is primarily concerned with BWR environmental conditions.

Dissolved oxygen in PWR primary water is controlled under 0.1 ppm. The standard value of the dissolved oxygen is 0.05 ppm. These are identified in the DCD Tire 2 Chapter 5 Table-5.2.3-2. This dissolved oxygen area is under the limit of SCC environment condition.

The following figure shows the relationship between SCC potential and the chemical condition of dissolved oxygen and chloride ion by M. O. Speidel which was presented at the 1st U.S. – Japan Joint Symposium on Light Water Reactors, Fuji, Japan (1978). From the figure below, it can be seen that the US-APWR chemical condition is not in the SCC area. Furthermore, materials in operating PWR plants constructed from Type 304 stainless steel with higher carbon content, have not experienced the SCC problems reported for BWRs, which further supports the conclusion that the higher carbon content is acceptable.
Therefore MHI considers low carbon stainless steel is not necessary in the primary water of the PWR.



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.

QUESTION NO. : RAI 2181-01-4

FSER Subsection 4.5.1.2 indicates that the delta ferrite content of the CRDM pressure boundary welds may be as low as 3FN for design temperatures above 800oF. The staff's position, as indicated in RG 1.31, is that the delta ferrite content of austenitic stainless steel welds should be 5FN minimum. The staff requests that the applicant modify its minimum ferrite content to 5FN or provide a technical basis for using 3FN.

ANSWER:

Environmental conditions in the CRDM do not exceed 800°F. The sentence regarding high temperature condition which exceeds 800°F will be deleted from the DCD.

Impact on DCD

DCD Revision 2 will incorporate the following change:

4.1.1.1 Austenitic Stainless Steel Components

Discussions of fabrication and processing of austenitic stainless steel are provided in Subsection 5.2.3. The processes for control of welding described in Subsection 5.2.3 are applicable to the pressure housing of the CRDM. For design temperatures up to and including 800 °F, the minimum acceptance delta ferrite is 5FN (Ferrite Number). ~~For design temperatures exceeding 800 °F, the delta ferrite is limited to a range FN3-FN10.~~

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

QUESTION NO. : RAI 2181-01-5

The control rod drive assembly coupling is fabricated from Type 403 martensitic stainless steel. The applicant did not provide any information related to the final condition of Type 403 used in the CRDM. The staff requests that the applicant provide its heat treatment requirements, including a basis for its requirements, for Type 403 martensitic stainless steel and modify the FSAR accordingly.

ANSWER:

The following heat treatment information is MHI Proprietary and is provided only to respond to the RAI.

The coupling material is [ ]. The final condition after heat treatment results in the material characteristics that achieve the desired coupling stiffness and toughness.

A general statement on the coupling heat treatment, which is MHI proprietary, will be provided in the DCD Subsection 4.5.1.

Impact on DCD

DCD Revision 2 will incorporate the following change:

Add the sentence after 5 paragraph of Subsection 4.5.1 as below.

Type 403 martensitic stainless steel used for the coupling of the drive rod assembly undergoes a proprietary heat treatment process that achieves the desired coupling stiffness and toughness.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

QUESTION NO. : RAI 2181-01-6

Alloy X-750 (SA-637 N07750) is used for latch assembly and drive rod assembly springs. Table 4.5-1 indicates that additional requirements of MIL-N-24114 Class A No.1 are applied. Alloy X-750 is a commonly used material in CRDM components, as referenced in SRP 4.5.1. The staff notes that the resistance of Alloy X-750 to stress corrosion cracking is dependent on adequate processing and heat treatment requirements. The staff requests that the applicant discuss its processing and heat treatment requirements for X-750 and provide a basis for why they are optimal to prevent stress-corrosion cracking. In addition, the staff requests that the applicant discuss any service-related industry failures of X-750 spring components that were fabricated and heat treated to the applicant's requirements.

ANSWER:

The number of the standard is miss-worded. MHI changes from MIL-N-24114 Class A No.1 to MIL-S-23192 Class A and D. Class A is used for the coil springs in the latch assembly. Class D is used for the coil springs in the drive rod.

MIL-S-23192 is the standard that will be used for spring material made from X-750. This standard requires solution heat treatment and aging heat treatment to preclude SCC. Springs fabricated from this material have no failure experience in Japan.

Impact on DCD

DCD Revision 2 will incorporate the following change:

MIL-S-23192 is the standard that will be used for spring material made from X-750. This standard requires solution heat treatment and aging heat treatment to preclude SCC.

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

QUESTION NO. : RAI 1293-07

Cleaning and cleanliness controls for the CRDM during manufacture and assembly are discussed in Subsection 5.2.3.4.1 as referenced in Subsection 4.5.1.4. Subsection

4.5.1.4 states, "Cleaning and cleanliness tests of the outer surface and the accessible area of the inner surface of subassemblies are performed after the functional test. Cleaning and cleanliness control should comply with description in Subsection5.2.3.4.1." The staff requests that the applicant modify the FSAR to change "should" to "will" or "shall" to provide clarity.

ANSWER:

MHI will change the sentence as below.
Cleaning and cleanliness control shall comply with description in Subsection 5.2.3.4.1.

Impact on DCD

DCD Revision 2 will incorporate the following change:

4.1.1.2 Cleaning and Cleanliness Control

Cleaning and cleanliness tests are performed on all parts of the CRDM before assembling. Cleaning and cleanliness tests of the outer surface and the accessible area of the inner surface of subassemblies are performed after the functional test. Cleaning and cleanliness control ~~should~~ shall comply with description in Subsection 5.2.3.4.1. Onsite cleaning and cleanliness control will be carried out in accordance with ASME NQA-1 and provisions of RG-1.37 (Reference 4.5-6).

Impact on COLA

There is no impact on COLA.

Impact on PRA

There is no impact on PRA.

Table 4.5-1 Summary of Control Rod Drive System Structural Materials

Component	Material Specification[1]	Environment
CRDM pressure housing material in contact with reactor coolant on the inside surface	SA-182 Grade F316	Inside surface exposed to reactor coolant water
Flux Ring	ASTM A519 Gr.1015	Not exposed to reactor coolant water
Latch assembly - magnetic poles, plungers, and keys	SA-479 Type 410	Exposed to reactor coolant water
Latch assembly - springs	Alloy X-750 (ASME SB637 N07750)[2]	Exposed to reactor coolant water
Latch assembly - link pins	Cobalt alloy (HAYNES No. 25 or equivalent material[3])	Exposed to reactor coolant water
Latch assembly - other parts	SA479 Type 304 SA-213 ~~Type~~ Grade TP 304	Exposed to reactor coolant water
Latch assembly - cladding on latch arm tips and pin holes	Cobalt alloy (Stellite No.6 or equivalent material[3])	Exposed to reactor coolant water
Latch assembly - plating on sliding surfaces	Chrome plate	Exposed to reactor coolant water
Latch assembly - coating on tips of latch arms	Chrome carbide	Exposed to reactor coolant water
Drive rod assembly - drive rod,	SA-268 TP410	Exposed to reactor coolant water
Drive rod assembly - unlatch button, protection sleeve	SA-479 Type 410	Exposed to reactor coolant water
Drive rod assembly - coupling	SA-479 Type 403	Exposed to reactor coolant water
Drive rod assembly - springs	Alloy X-750 (ASME SB637 N07750)[2]	Exposed to reactor coolant water
Locking button in the drive rod assembly and pins in the latch assembly	Cobalt alloy (HAYNES No. 25 or equivalent material[3])	Exposed to reactor coolant water
Drive rod assembly other parts	SA-479 Type 304	Exposed to reactor coolant water
Coil assembly - housing	~~SA356~~ ASTM A536 Grade 60-40-18	Not exposed to reactor coolant water
Coil assembly - coil bobbins	Glass silicone resin	Not exposed to reactor coolant water
Coil assembly - wire	Double glass insulated copper	Not exposed to reactor coolant water
Weld material used in CRDMs	SFA 5.9 ER309L EC316L	Not exposed to reactor coolant water

Notes: (1) Additional information appears in the text of Section 4.5 and Subsection 5.2.3.
(2) Additional stringent specification, ~~MIL-N-24114 Class A No.1~~ MIL-S-239192, is applied.
(3) Equivalent material is a substitute material having the same chemistry and properties as the preferred material. The same requirements would be specified in the procurement requirements.