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TOKYO, JAPAN

January 24, 2013

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-13010

Subject: MHI's Response to US-APWR DCD RAI No. 980-6954 (SRP 12.03-12.04)

References: 1) "Request for Additional Information No. 980-6954, SRP Section: 12.03-12.04 – Radiation Protection Design Features," dated December 10, 2012 (ML12345A164)

2) MHI Letter No. UAP-HF-12288 "Response to Request for Additional Information No.963-6828" dated October 29, 2012 (ML12307A243)

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. 980-6954".

Enclosed is the response to 1 RAI question contained within Reference 1, which is a follow-up question to MHI's previous response to Question 12.03-48 contained in Reference 2.

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, 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,
Director- APWR Promoting Department
Mitsubishi Heavy Industries, LTD.

Enclosure:

1. Response to Request for Additional Information No. 980-6954

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NRO

CC: J. A. Ciocco
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Contact Information

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Docket No. 52-021
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Enclosure 1

UAP-HF-13010
Docket No. 52-021

Response to Request for Additional Information No. 980-6954

January 2013

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

01/24/2013

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

RAI No.:	**No. 980-6954**
SRP Section:	**12.03-12.04 – Radiation Protection Design Features Application Section**
APPLICATION SECTION:	**12.03-12.04**
DATE of RAI ISSUE:	**12/10/2012**

QUESTION NO.: 12.03-49

Title 10 of the Code of Federal Regulations (10 CFR), Part 20, "Standards for Protection Against Radiation," Section1101(b) "Radiation protection programs" requires that Occupational Radiation Exposures (ORE) be maintained as low as is reasonably achievable (ALARA) as defined in 10 CFR 20.1003, "Definitions", that is, making every reasonable effort to maintain exposure as low as possible. The guidance contained in Regulatory Guide (RG) 8.8 "Information Relevant for Ensuring that Occupational Radiation Exposures at Nuclear Power Stations is Reasonably Achievable," and RG 1.206 "Combined License Applications for Nuclear Power Plants" Section C.I.12.3.1 "Facility Design Features," state that the design should minimize ORE through the use of maintenance requirements and chemistry controls.

Response to US-APWR RAI 963-6828 Revision 0 Question 12.03-48 dated October 29, 2012 states that the CVCS system demineralizers are provided with resin-retaining screens on the backwash lines that returns to the CVCS holdup tanks. Consistent with staff experience, industry literature, including INPO and EPRI documents describe the potential for the presence of resin fines downstream of resin retention elements. Resin fines contained that are transported to the CVCS Holdup Tanks could result in elevated localized radiation levels around the tanks, Evaporator Feed Pumps (EFP) and the associated flow control valves. Chemical and particulate materials present in the resin fines can increase wear rates of mechanical seals of the EFPs resulting in increased maintenance and the resultant ORE. Documents, such as NRC Generic Letter 97-001, and INPO event reports describe the potential adverse effects that chemical constituents resulting from the decomposition of resin fine can have on RCS pressure boundary components and fuel cladding. Any chemical impurities contained in holdup tank water, that are not removed by the Boric Acid Evaporator feed filter, or the Boric Acid Evaporator Feed demineralizer will be concentrated in the Boric Acid Evaporator and may be returned to the reactor coolant system through the boron recycle system and the Primary Makeup water system.

Please revise and update US-APWR DCD Section 12.3 "Radiation Protection Design Features" and Subsection 9.3.4 "Chemical and Volume Control System," to describe the design features provided to prevent the increase in ORE or a reduction in plant or component reliability due to the introduction of resin fines into the CVCS Holdup Tanks from the backwashing of CVCS demineralizers, or describe the specific alternate approaches and the associated justification.

ANSWER:

Most resin fines are removed by circulating the holdup tank water through the Boric Acid (B.A.) evaporator feed demineralizer and the Boric Acid (B.A.) evaporator feed demineralizer filter and the holdup tank. The B.A evaporator feed demineralizer filter has a 0.8 μ m mesh size to remove remaining fines following each back washing to the holdup tank in the above operation. This operation removes broken resin fine sediments prior to the next backwashing into the holdup tank.

Removing broken resin fines minimizes localized radiation levels around the tanks, B.A evaporator feed pumps and the associated flow control valves, reduces pump maintenance frequency, and minimizes resultant ORE.

Generic letter 97-001 describes potential adverse effects that chemical constituents resulting from the decomposition of resin fine can have on RCS pressure boundary components. Sulfate is produced by radioactive decomposition of resin fines by passing through the reactor core. The removal of broken resin fines to the extent possible prevents stress corrosion cracking of the Reactor Coolant System (RCS) pressure boundary components due to an increase in reactor coolant sulfate concentration.

DCD Subsection 5.2.3.2.1 "Chemistry with reactor coolant" describes a standard value and limiting value "sulfate concentration" chemistry parameter that assists in identifying demineralizer resin deterioration and ingress of broken fine resins into the RCS (see Table 5.2.3-2 "Recommended Reactor Coolant Water Chemistry Specification"). Sulfate concentration of 0.15 ppm (150 ppb) is set as limiting value in order to comply with the latest EPRI Pressurized Water Reactor Primary Water Chemistry Guidelines Rev.6 that addresses managing ingress of broken resin fines to the RCS and the resultant increase in sulfate concentration. When sulfate concentration reaches the standard value, suitable action is taken to maintain the water chemistry within the limits. Even though most fine resins in the holdup tank water are removed by circulating the holdup tank water though the B.A. evaporator feed demineralizer, the B.A evaporator feed demineralizer filter and the holdup tank, if sulfate concentration reaches the limiting value, ingress of broken resin fines into the RCS is suspected and accordingly the backup letdown demineralizer is placed into service to reduce the sulfate concentration in the RCS.

Impact on DCD

Subsection 5.2.3.2.1 has been revised to add a statement regarding the placement of the backup letdown demineralizer into service to reduce sulfate concentration in the RCS when the RCS water chemistry results are approaching the limits. (See Attachment -1)

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical / Topical Reports

There is no impact on the Technical / Topical Reports.

A soluble zinc (Zn) compound depleted of Zn-64 may be added to the reactor coolant as a means to reduce radiation fields within the primary system. When used, the target system zinc concentration is normally maintained to a concentration no greater than 10 ppb.

Suspended solid (corrosion product particles) and other impurity concentrations are maintained below specified limits by controlling the chemical quality of makeup water and chemical additives and by purification of the reactor coolant through the CVCS.

From the view point of preventing stress corrosion cracking in hot water in austenitic stainless steel, sulfuric acid ion seems to exert no effect in the reduction atmosphere conditions with hydrogen. However, concentration of sulfuric acid ion is known to increase in time of shut down possibility caused by the coolant mix bed demineralizer resin being exposed to solution containing hydrogen peroxide. In order to identify the deterioration of ion exchange resin and provide the index of broken fine resin, 0.05 ppm was set as standard value and 0.15 ppm as limiting value, as the same as chloride ion and fluoride ion.

The backup letdown demineralizer is placed into service to reduce the sulfate concentration in the RCS when RCS water chemistry results indicate that the RCS water chemistry is approaching the sulfate concentration limit in order to prevent an increase in sulfate concentration due to ingress of resin fines and prevent an increase in Occupational Radiation Exposure (ORE) resulting from an increase in sulfate concentration. DCD_12.03-49

5.2.3.2.2 Compatibility of Construction Materials with Reactor Coolant

ASME SA-508 Grade 3 forgings and SA-533 Grade B formed plate are used for the Class 1 ferritic pressure boundary. Field experience has shown that these materials offer the strength and toughness required to meet the pressure boundary safety and design life objectives.

All ferritic low-alloy and carbon steel surfaces that may come into contact with the reactor coolant and are used in RCPB applications are covered with stainless steel or nickel-chromium-iron cladding for corrosion resistance. Stainless steel and nickel-chromium-iron alloy cladding have been proven to be effective at preventing corrosion of RCPB base metals.

Ferritic low-alloy and carbon steel nozzles of RCPB components have stainless steel safe ends that are attached using stainless steel or nickel-chromium-iron alloy weld metal.

Austenitic stainless steel base materials used in RCPB applications are solution heat treated to avoid sensitization, although pressurized-water reactor (PWR) water chemistry is well controlled to prevent SCC of austenitic stainless steels. Nickel-chromium-iron alloy base materials are thermally treated to maximize the resistance to SCC and intergranular corrosion. Heat treatment is required by material specifications.

Components using stainless steel sensitized in the manner expected during component fabrication and installation operate satisfactory under normal plant chemistry conditions in PWR systems because chlorides, fluorides, and oxygen are controlled to very low levels.