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

February 6, 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-09048

Subject: MHI's Response to US-APWR DCD RAI No. 147-1850 Revision 1

References: 1) "Request for Additional Information No. 147-1850 Revision 1, SRP Section: 12.03-12.04 – Radiation Protection Design Features, Application Section: 12.03," dated January 9, 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. 147-1850 Revision 1".

Enclosed are the responses to Questions 12.03-12.04-3, 12.03-12.04-4 and 12.03-12.04-5 that are 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 submittal. His contact information is below.

Sincerely,

Y. Ogata

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

Enclosures:

1. Response to Request for Additional Information No.147-1850 Revision 1

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

Contact Information
C. Keith Paulson, Senior Technical Manager
Mitsubishi Nuclear Energy Systems, Inc.
300 Oxford Drive, Suite 301
Monroeville, PA 15146
E-mail: ck_paulson@mnes-us.com
Telephone: (412) 373-6466

D081
NRC

Docket No. 52-021
MHI Ref: UAP-HF-09048

Enclosure 1

UAP-HF-09048
Docket No. 52-021

Response to Request for Additional Information
No. 147-1850 Revision 1

February, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

2/6/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 147-1850 REVISION 1**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.03**
DATE OF RAI ISSUE:	**1/9/2009**

QUESTION NO.: 12.03-12.04-3

10 CFR 20.1101(b), 1201and 1202 require licensees to control internal and external occupational exposure, and to ensure that engineering controls are used to keep occupational doses ALARA. In 10 CFR 20 the definition for ALARA includes guidance to make every reasonable effort to maintain exposures below regulatory limits, taking into account the state of technology. Regulatory Guide 1.206 section C.I.12.3.1 "Facility Design Features" notes that the Applicant should identify features that reduce the potential for exposure by minimizing the time in the area, reducing source build up, providing remote operation, reduce activation product generation. Regulatory Guide 8.8 Position C2e, notes that the applicant should provide design features that reduce the potential for exposure by selection of materials to reduce activation product formation, finishing of the material surfaces to minimize erosion, facilitate decontamination and reduce deposition. EPRI TR-103296 Rev-1 "Cobalt Reduction Guidelines" and EPRI TR-1003390 "Radiation Field Control Manual" note that Co-60 is the primary long term source of radiation fields in power plants.

APWR DCD Section 12.1.2.1 notes that the use of low cobalt material and provision of features to prevent buildup of radioactive material are effective methods of reducing personnel exposure. Industry standard documents, like EPRI report TR-1003390 "Radiation Field Control Manual" note that preconditioning of surfaces by means like electro-polishing can reduce dose rates from some Steam Generator Primary Side components by about 50%. Another example offered by TR-1003390 noted that the use of low cobalt impurity material, such as Alloy 690 tubing in Steam Generators could reduce dose rates associated with Co-60, by 30%, and provides as an example that tubing should have an average cobalt content of less that 150 ppm and a maximum value should be specified for any one heat. Another example of a dose reducing initiative, was that using Stabilized Chromium pre-coating of components reduces long term dose rates from these components by factors of 2 to 6 over just electro-polishing alone. These methods of material specification and pre-conditioning are known, proven, cost effective and documented dose reduction techniques. DCD Section 12.3.1.1.1.1.D "Nuclear Steam Supply System Equipment – SGs", fails to note any of these aspects as part of the design bases for the equipment.

In accordance with 10 CFR 20.1101(b), RG 8.8 and RG 1.206, please revise chapter 12.3 to include the information that describes the design specifications for the material selection and finishing methods employed for the purpose of ALARA, or revise chapter 12.3 to provide your justification for not specifying known and proven exposure reduction methods and materials as part of the design features discussed in section 12.3.1.1.1.1.D.

ANSWER:

MHI will revise chapter 12.3 to include the design specifications for the material selection employed for the purpose of ALARA. However, MHI will not include the finishing methods in this chapter because MHI recognizes that there is no reasonable finishing method to reduce exposure effectively in a new-built plant.

Impact on DCD

The DCD Subsection 12.3.1.1.1.1.D will be revised as described in the Attachment.

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

2/6/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 147-1850 REVISION 1**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.03**
DATE OF RAI ISSUE:	**1/9/2009**

QUESTION NO.: 12.03-12.04-4

10 CFR 20.1101(b), 1201and 1202 require licensees to control internal and external occupational exposure, and to ensure that engineering controls are used to keep occupational doses ALARA. In 10 CFR 20 the definition for ALARA includes guidance to make every reasonable effort to maintain exposures below regulatory limits, taking into account the state of technology. Regulatory Guide 1.206 section C.I.12.3.1 "Facility Design Features" notes that the Applicant should identify features that reduce the potential for exposure by minimizing the time in the area, reducing source build up, providing remote operation, reduce activation product generation. Regulatory Guide 8.8 Position C2e, notes that the applicant should provide design features that reduce the potential for exposure by selection of materials to reduce activation product formation, finishing of the material surfaces to minimize erosion, facilitate decontamination and reduce deposition. EPRI TR-103296 Rev-1 "Cobalt Reduction Guidelines" and EPRI TR-1003390 "Radiation Field Control Manual" note that Co-60 is the primary long term source of radiation fields in power plants.

APWR DCD Section 12.1.2.1 notes that the use of low cobalt material and provision of features to prevent buildup of radioactive material are effective methods of reducing personnel exposure. Industry standard documents, like EPRI report TR-1003390 "Radiation Field Control Manual" note that Cobalt impurity levels in materials used to construct the Reactor Coolant System should be limited. As an example, this report notes that the use of low cobalt impurity materials in reactor vessel and internals construction, could significantly reduce long term plant dose rates. As examples, the report notes that the Cobalt impurity in stainless steels should be less than 500 ppm, and Inconel alloys should have a Cobalt content of less than 200 ppm. The Cobalt content of nickel plate used to fabricate in-core components should be less than 50 ppm and braze material should be less than 500 ppm. These are known, proven and documented dose reduction techniques. DCD Section 12.3.1.1 "Plant Design Features for As Low As Reasonably Achievable" fails to note any of these material purity aspects as part of the design bases for the equipment.

In accordance with 10 CFR 20.1101(b), RG 8.8 and RG 1.206, please revise chapter 12.3 to include the information that describes the design specifications for the material selection employed for the purpose of ALARA or revise chapter 12.3 to provide justification for not specifying known and proven exposure reduction materials as part of the design features.

ANSWER:

MHI will revise chapter 12.3 to include the design specifications for the material selection employed for the purpose of ALARA.

Impact on DCD

The DCD will be revised to add the Subsection 12.3.1.1.1.1.E and Table 12.3-7 as described in the Attachment.

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

2/6/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 147-1850 REVISION 1**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.03**
DATE OF RAI ISSUE:	**1/9/2009**

QUESTION NO.: 12.03-12.04-5

10 CFR 20.1101(b), 1201and 1202 require licensees to control internal and external occupational exposure, and to ensure that engineering controls are used to keep occupational doses ALARA. In 10 CFR 20 the definition for ALARA includes guidance to make every reasonable effort to maintain exposures below regulatory limits, taking into account the state of technology. Regulatory Guide 1.206 section C.I.12.3.1 "Facility Design Features" notes that the Applicant should identify features that reduce the potential for exposure by minimizing the time in the area, reducing source build up, providing remote operation, reduce activation product generation. Regulatory Guide 8.8 Position C2e, notes that the applicant should provide design features that reduce the potential for exposure by selection of materials to reduce activation product formation, finishing of the material surfaces to minimize erosion, facilitate decontamination and reduce deposition. EPRI TR-103296 Rev-1 "Cobalt Reduction Guidelines" and EPRI TR-1003390 "Radiation Field Control Manual" note that Co-60 is the primary long term source of radiation fields in power plants.

APWR DCD Section 12.1.2.1 notes that the use of low cobalt material and provision of features to prevent buildup of radioactive material are effective methods of reducing personnel exposure. Industry standard documents, like EPRI report TR-1003390 "Radiation Field Control Manual" note that identifying the type of component, the cobalt content, the duty cycle and resultant Cobalt introduction rate helps to identify valves that require Cobalt Hard Facing (HF) material based on service conditions. The report notes that limiting the use of Cobalt HF materials to only those applications where service conditions warrant the use of these materials results in lower cobalt introduction rates and lower long-term plant dose rates. Documented industry Operating Experience demonstrates that application of these techniques during the design phase is more effective than retroactively implementing these criteria. These are known, proven and documented dose reduction techniques. DCD Section 12.3.1.1 "Plant Design Features for As Low As Reasonably Achievable" fails to note any of these material purity aspects as part of the design bases for the equipment.

In accordance with 10 CFR 20.1101(b), RG 8.8 and RG 1.206, please revise chapter 12.3.1.1 to include the information that describes the design specifications and the models describing the bases for determining the material selection of valves connected to the Reactor Coolant System, employed for the purpose of ALARA or revise chapter 12.3 to provide justification for not specifying known and proven exposure reduction methods and materials as part of the design features.

ANSWER:

MHI will revise chapter 12.3 to include the design specifications for the material selection employed for the purpose of ALARA.

Impact on DCD

The DCD will be changed as mentioned in the response to the question No.12.03-12.04-4.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

C. Reactor Vessel Insulation

Insulation, in the area of the reactor vessel nozzle welds, is fabricated in sections with a thin reflective metallic sheet covering and quick disconnect clasps to facilitate the removal of the insulation for the inspection of the welds.

D. SGs

The SGs incorporate several design features to facilitate maintenance and inspection in reduced radiation fields. The SGs have the following design aspects:

1. Manways of the channel head are sized to facilitate access for tube bundle inspections and maintenance.
2. The channel head has a cylindrical region just below the tube sheet primary side to enhance the access of tooling to all tubes, including those on the periphery of the tube bundle.
3. Rapid entry/exit nozzle dam systems are provided in both primary nozzles to minimize occupational radiation exposure and to enhance personnel safety.

The specification of low cobalt tubing material for the US-APWR steam generator design is an important feature of the design; not only in terms of reduced exposure relative to the steam generator, but to the total plant radiation source term. The cobalt content is controlled to be not more than 0.016 mass percent for the US-APWR steam generator tubing.

E. Materials

Equipment specifications for components exposed to high temperature reactor coolant contain limitations on the cobalt content of the base metal as given in Table 12.3-7. The use of hard facing material with cobalt content such as stellite is limited to applications where its use is necessary for reliability considerations.

Nickel-based alloys in the reactor coolant system (Co-58 is produced from activation of Ni-58) are similarly used only where component reliability may be compromised by the use of other materials. The major use of nickel-based alloys in the reactor coolant system is the inconel steam generator tubes.

12.3.1.1.1.2 Balance of Plant Equipment

A. Filters

Filters that accumulate radioactivity are supplied with the means either to back-flush the filter remotely or to perform cartridge replacement with semi-remote tools.

For cartridge filters, adequate space is provided to allow removal, cask loading, and transportation of the cartridge to the solid radwaste area.

Table 12.3-7 Equipment Specification Limits for Cobalt Impurity Levels

Application	Maximum Mass Percent of Cobalt
Inconel and stainless steel components in fuel assembly	0.05
Inconel Tubing in Steam Generator	0.016
Components in region of high neutron flux such as Neutron Reflector and Lower Core Barrel	0.05
Divider Plate of Steam Generator and weld clad surfaces of Reactor Vessel, Pressurizer and Channel Head of Steam Generator	0.05
Upper Core Plate, Upper/Lower Core Support Plate and Upper Core Barrel	0.10
Main Coolant Piping, casings and internals of Rector Coolant Pumps and Reactor Internals other than listed above	0.20
Bearing and hard-facing materials	Not limited (However, precipitation hardening stainless steel will be used for some valves exposed to severe depressurization conditions, and non-cobalt hard-facing material will be used for Reactor Coolant Pump.)
Auxiliary components such as valves except for listed above, piping instrumentation, tanks, and so on, including bolting materials in primary and auxiliary components	Not limited
Welding material, except where used as weld cladding	Not limited