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February 27, 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-09071

Subject: MHI's Response to US-APWR DCD RAI No. 169-1740 Rev. 1, 173-1865 Rev.1 and 174-1873 Rev. 1

References: 1) "Request for Additional Information No. 169-1740 Revision 1, SRP Section: 12.02 – Radiation Sources, Application Section: 12.2," dated February 3, 2009
2) "Request for Additional Information No. 173-1865 Revision 1, SRP Section: 12.03-12.04 – Radiation Protection Design Features, Application Section: 12.3.1," dated February 3, 2009
3) "Request for Additional Information No. 174-1873 Revision 1, SRP Section: 12.03-12.04 – Radiation Protection Design Features, Application Section: 12.3.1," dated February 3, 2009

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

Enclosed are the responses to three RAIs contained within References 1 through 3.

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.

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Enclosures:

1. Response to Request for Additional Information No.169-1740 Revision 1
2. Response to Request for Additional Information No.173-1865 Revision 1
3. Response to Request for Additional Information No.174-1873 Revision 1

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-09071
Docket No. 52-021

Response to Request for Additional Information
No. 169-1740 Revision 1

February, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

2/27/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 169-1740 REVISION 1**
SRP SECTION:	**12.02 – Radiation Sources**
APPLICATION SECTION:	**12.2**
DATE OF RAI ISSUE:	**2/3/2009**

QUESTION NO.: 12.02-15

10 CFR 20.1301 "Dose limits for individual members of the public" requires compliance with the provisions of 40 CFR 190 shall comply with those standards. NUREG-0800 Chapter 11.4 "Solid Waste Management System", notes that 10 CFR 20.1301(e) requires that facilities licensed by the U.S. Nuclear Regulatory Commission comply with the provisions of 40 CFR Part 190. The EPA annual dose limits are 25 mrem to the whole body from all sources on the site, which may have either single or multiple units. This requires the consideration of all potential sources of external radiation and radioactivity, including liquid and gaseous effluents and external radiation exposures from buildings, storage tanks and radioactive waste storage areas.

Question 1:

The APWR DCD Section 12.2.1.1.10 "Miscellaneous Sources" states: If it becomes necessary to temporarily store radioactive wastes/materials outside the plant structures, radiation protection measures are to be taken by the radiation protection staff to ensure compliance with 10 CFR 20 and to be consistent with the recommendations of RG 8.8. The SWMS facilities process and store dry active waste. The DCD notes that if it becomes necessary to install additional radwaste facilities for dry active waste, these facilities are to be provided by the COL Applicant and that radiation shielding is to be provided such that the dose rates comply with the requirements of 10 CFR 20. Section 12 of the DCD is silent with respect to the requirements of 40 CFR 190.

In accordance with 10 CFR 20.1301 and 40 CFR 190, please provide information that demonstrates that the requirements of 40 CFR 190 are to be met for storage of radioactive material outside the plant structures.

ANSWER:

In addition to the commitment made in the sixth and seventh paragraphs of DCD section 12.2.1.1.10 to be in compliance with 10 CFR 20 for the temporary storage of radwaste outside plant structures, the US-APWR will commit to be in compliance with the requirements of 40 CFR 190.

Impact on DCD

DCD Subsection 12.2.1.1.10 will be revised, and a new reference will be added to DCD Subsection 12.2.4, as indicated in the Attachment.

Impact on COLA

FSAR Subsection 12.2.1.1.10, Miscellaneous Sources, needs to be revised to reflect the addition of 40 CFR 190.

Impact on PRA

There is no impact on the PRA.

12.2.1.1.10 Miscellaneous Sources

The principal sources of activity outside the buildings include the following:

- The refueling water storage auxiliary tank
- The primary makeup water tank

The content of the water tanks is processed by the SFP purification system, or the boron recycle system until the activity in the fluids is sufficiently low ~~to allow the shielding afforded by the concrete tank walls~~ to result in ~~surface~~ dose rates less than 0.25 mrem/h at 2 meters from the surface of the tank.

Radionuclide inventories of the refueling water storage auxiliary tank and primary makeup water tank are presented in Tables 12.2-50 and 12.2-51. There are no other significant amounts of radioactive fluids permanently stored outside the buildings.

Spent fuels are stored in the SFP. When the fuel is to be moved away from the SFP, it is placed in a spent fuel shipping cask for transport.

Storage space is allocated in the radwaste processing facility for storage of spent filter cartridges and packaged spent resins.

Radioactive wastes stored inside the plant structures are shielded so that areas outside the structures meet Radiation Zone I criteria. Additional storage space for radwaste is to be provided in the detailed design by the COL Applicant. If it becomes necessary to temporarily store radioactive wastes/materials outside the plant structures, radiation protection measures are to be taken by the radiation protection staff to ensure compliance with 10 CFR 20 (Reference 12.2-1), 40 CFR 190 (Reference 12.2-6) and to be consistent with the recommendations of RG 8.8 (Reference 12.2-2).

The SWMS facilities process and store dry active waste. If it becomes necessary to install additional radwaste facilities for dry active waste, it is to be provided by the COL Applicant. Radiation shielding is to be provided such that the dose rates comply with the requirements of 10 CFR 20 (Reference 12.2-1) and 40 CFR 190 (Reference 12.2-6). Interior concrete shielding is provided to limit exposure to personnel during waste processing. The ALARA methodology of RGs 8.8 (Reference 12.2-2) and 8.10 (Reference 12.2-3) has been used in the design of this facility.

Any additional contained radiation sources that are not identified in ~~subsection~~Subsection 12.2.1, including radiation sources used for instrument calibration or radiography, are to be provided by the COL Applicant.

12.2.1.2 Sources for Shutdown

In the reactor shutdown condition, the only additional significant sources requiring permanent shielding consideration are the spent fuel, the residual heat removal system (RHRS), and the incore instrumentation system (ICIS). Individual components may

12.2-6 "Environmental Radiation Protection Standards for Nuclear Power Operations," Protection of Environment. Title 40, Code of Federal Regulations, Part 190, U.S. Environmental Protection Agency, Washington DC, January 1977.

Enclosure 2

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Docket No. 52-021

Response to Request for Additional Information
No. 173-1865 Revision 1

February, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

2/27/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 173-1865 REVISION 1**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3.1**
DATE OF RAI ISSUE:	**2/3/2009**

QUESTION NO.: 12.03-12.04-11

10 CFR 20.1101(b) and 1406 requires licensees to control external occupational exposure, to ensure that engineering controls are used to keep occupational doses ALARA, and to ensure that facility contamination is minimized. 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. 10 CFR 50 GDC 61 notes that systems containing radioactive material are a potential source of exposure to personnel and are to be designed to ensure adequate safety in the event of leakage during normal operation or an AOO. The guidance contained in Regulatory Guide 1.206 section C.I.12.3.1 notes that the applicant is to provide the information regarding how to keep dose ALARA by reducing time spent in radiation areas, and methods of reducing production of radioactive material. Regulatory Guide 8.8 Position C2.e and C2.f provide methods and techniques that may be used to reduce radiation exposure and leakage associated with operation and maintenance of plant equipment. NRC Bulletin 80-10 "Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment" notes that leakage into some systems may change the status of a non-radiological system. APWR FSAR section 12.3.1.1.1.2.F "Balance of Plant – Heat Exchangers" discusses the use of heat exchangers handling radioactive fluids.

APWR FSAR section 12.3.1.1.1.2.F "Balance of Plant – Heat Exchangers" contains information that appears to be inconsistent with FSAR sections 9.1.3.2.1.3 "Spent Fuel Pit Heat Exchangers" and 9.2.2.2.1.1 "CCW HX", which indicate that Plate Type heat exchangers are the specified design for those heat exchangers.

In accordance with10 CFR 20.1101(b), 10 CFR 50 GDC 61, and Regulatory Guides 8.8 and 1.206, please update chapter 12.3.1.1.1.2.F. to provide design information that is consistent with the design specifications provided in FSAR sections 9.1.3.2.1.3 "Spent Fuel Pit Heat Exchangers" and 9.2.2.2.1.1 "CCW HX". Ensure that 12.3.1.1.1.2.F continues to address the design specifications of the shell and tube type heat exchangers provided for other applications.

ANSWER:

As the NRC mentioned, the spent fuel pit heat exchangers and the component cooling water (CCW) heat exchangers (HXs) are not conventional shell and tube type, but rather are plate type. For clarity, MHI will revise DCD Subsection 12.3.1.1.1.2.F "Heat Exchangers" as is indicated in the "Impact on DCD" section of this response.

Impact on DCD

DCD Subsection 12.3.1.1.1.2.F will be revised as indicated in the Attachment.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

drainage system is equipped with a liquid detection instrument which can provide early warning for leakage and/or overflow condition to initiate operator actions. The floors of these cubicles containing radioactive fluid are sloped to facilitate faster drainage and to minimize liquid accumulation, and provided with coating with non-porous material to prevent cross contamination.

F. Heat Exchangers

Most of the heat exchangers are shell and tube type heat exchangers. These~~Heat exchangers~~ are provided with corrosion-resistant tubes of stainless steel or other suitable materials to minimize leakage. Impact baffles are provided and the tube side and shell side velocities are limited to minimize erosion effects. Wherever possible, the radioactive fluid passes through the tube side of the heat exchanger.

Some heat exchangers, specifically the SFP heat exchangers and the component cooling water heat exchangers, are plate-type heat exchangers constructed of austenitic stainless steel. For the SFP heat exchangers, the SFP water circulates through one side of the heat exchanger while the component cooling water circulates through the other side. For the component cooling water heat exchangers, the component cooling water circulates through one side of the heat exchanger while the essential service water circulates through the other side.

G. Instruments

Instruments are located in low radiation zones and away from radiation sources, whenever practical.

Instruments, which are located in high radiation zones, are designed for easy removal to a lower radiation zone for calibration.

Transmitters and readout devices are located in low radiation zones, such as corridors and the control room.

Some instruments in high radiation zones, such as thermocouples, are provided in duplicate to reduce required access and service time. In the containment, instruments are located outside the secondary shield (the area of lowest radiation at power and during shutdown), whenever practical.

Check sources for response verification for airborne radiation monitors and safety-related area radiation monitors are provided.

Chemical seals are provided on the instrument sensing lines of process piping, which may contain highly radioactive solids, to reduce the servicing time required to keep the lines free of solids. Instruments and sensing line connections are located slightly above the pipe mid-plane wherever practical to minimize radioactive crud or gas buildup.

Enclosure 3

UAP-HF-09071
Docket No. 52-021

Response to Request for Additional Information
No. 174-1873 Revision 1

February, 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

2/27/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 174-1873 REVISION 1**
SRP SECTION:	**12.03-12.04 – Radiation Protection Design Features**
APPLICATION SECTION:	**12.3.1**
DATE OF RAI ISSUE:	**2/3/2009**

QUESTION NO.: 12.03-12.04-12

10 CFR 20.1101(b), 1201 and 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 (RG) 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 C2.e, 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.

APWR FSAR section 12.3.1.1.2.E "Common Facility and Layout Designs for ALARA – Equipment Layout" discusses some design features intended to reduce radiation exposure. RG-8.8 C2.i notes that adequate lighting is required for safe and efficient operation of the plant and that for lighting in radiation areas, lighting design should include provisions for access to the light fixtures, such as platforms, installed ladders, quick disconnects or movable fixtures. Based on industry experience, some plants have implemented a number of dose reduction methods on normal and emergency lighting. Relocation of components that require frequent access for maintenance, such as batteries and chargers for emergency lights, to low dose rate areas or to areas eliminates the need to enter high dose rate area. Where ladders or scaffolds are required for personnel access, specifying the use of long life lighting elements is an effective method of reducing exposure associated with maintaining lighting. The use of retractable or quick change fixtures has been demonstrate to save time and effort in both nuclear and non-nuclear industries. FSAR Section 12.3.1.1.2.E "Common Facility and Layout Designs for ALARA – Equipment Layout" fails to note any of these aspects as part of the design bases for the equipment.

In accordance with RG 8.8 and RG 1.206, please revise chapter 12.3.1.1.2.E to include the information that describes the specifications for the design features associated with servicing and maintenance of normal and emergency lighting, provided 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 12.3.1.1.2.E.

ANSWER:

The specific Regulatory Guide (RG) 8.8 design features regarding lighting are (13), (14) and (15) of RG 8.8.C.2.i, "Other Features". RG 8.8.C.2.i (13), (14), and (15) read as follows:

> *(13) Station features that provide a favorable working environment such as adequate lighting, ventilation, working space, and accessibility (via such means as working platforms, cat walks, and fixed ladders) can promote work efficiency.*
>
> *(14) The exposure of station personnel who must replace lamps in high radiation areas can be reduced by using extended service lamps and bv providing design features that permit the servicing of the lamps from lower radiation areas.*
>
> *(15) An adequate emergency lighting system can reduce potential exposures of station personnel by permitting prompt egress from high radiation areas if the station lighting system fails.*

Normal and Emergency Lighting is addressed in DCD Subsection 9.5.3. Specifically,

> Subsection 9.5.3.1 bullet number 2 reads:
>
> "Emergency lighting is provided in areas required for safe shutdown of the plant, restoring the plant to normal operation, firefighting, and safe movement of people to the access and egress routes during plant emergencies and loss of normal power supply."
>
> and Subsection 9.5.3.1 bullet number 10 reads:
>
> "The lighting system design provides adequate illumination levels in various plant areas for performing actions required during normal, shutdown, maintenance, and emergency conditions, in accordance with the recommendations of the Illuminating Engineering Society of North America (Ref. 9.5.3-1)."

RG 8.8.C.2.i (13) is considered as addressed by bullet number 10 of Subsection 9.5.3.1. Bullet number 2 of Subsection 9.5.3.1 only addresses emergency lighting in areas required for safe shutdown, and thus does not adequately address RG 8.8.C.2.i (15). Subsection 9.5.3 does not contain any lighting information specific to radiation areas and thus does not address RG 8.8.C.2.i (14).

DCD Subsection 12.3.1.1.2 will be revised to address RG 8.8.C.2.i (13), (14), and (15), as indicated in the "Impact on DCD" section of this response.

Impact on DCD

The DCD will be revised to add Subsection 12.3.1.1.2.G as indicated in the Attachment.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

Exposure from routine in-plant inspection is controlled by locating, whenever possible, inspection points in properly shielded, low-background radiation areas.

Radioactive and non-radioactive systems are separated as far as practicable to limit radiation exposure from routine inspection of non-radioactive systems. For radioactive systems, emphasis is placed on adequate space and the ease of motion in a properly shielded inspection area. Where longer times for routine inspection are required and permanent shielding is not feasible, sufficient space for portable shielding is provided. For example, a remotely operated device is provided for ISI of the reactor vessel. When this is not practicable, written procedures are used which reduce the total occupancy time in the radiation field. In addition, access to high radiation areas is under the direct supervision of the unit health physics personnel.

F. Field Run Piping

Field run piping will be minimized wherever possible.

Fabrication isometrics of radioactive process piping are reviewed by the plant architect/engineer to ensure that adequate shielding is provided.

G. Lighting

Adequate illumination levels shall be provided in radiation areas for performing actions required during normal, shutdown, maintenance, and emergency conditions as described in Subsection 9.5.3.

Extended service lamps shall be utilized in high radiation areas to reduce the exposure of station personnel who service the lamps. Wherever possible, design features that permit servicing of the lamps from lower radiation areas shall be implemented.

In order to reduce the potential of station personnel exposure, an adequate emergency lighting system will be provided in high radiation areas to permit prompt egress if the station lighting system fails.

12.3.1.2 Radiation Zoning and Access Control

12.3.1.2.1 Normal Conditions

12.3.1.2.1.1 Radiation Zoning

Access to areas inside the plant structures and plant yard areas is regulated and controlled by radiation zoning and access control (Section 12.5). Each radiation zone defines the radiation level range to which the aggregate of all contributing sources must be attenuated by shielding.