REQUEST FOR ADDITIONAL INFORMATION 428-2910 REVISION 1

7/30/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021
SRP Section: 12.03-12.04 - Radiation Protection Design Features
Application Section: 12.3

QUESTIONS for Health Physics Branch (CHPB)

12.03-12.04-22

The US-APWR FSAR Revision 1 Tier 2 Sections 3 “Radiation Protection Design Features” and Section 12.4 “Dose Assessment”, describes design features for maintaining personnel exposure ALARA and the exposure estimates associated with operation, maintenance and refueling activities.

Supplemental Question (SQ-1) derive from RAI 171-1858, Question 12.03-12.04-9 and RAI 172-1864, Question 12.03-12.04-10

RAI 171-1858 Question 12.03-12.04-9 and RAI 172-1864 Question 12.03-12.04-10 requested additional information about the radiation protection design features associated with some large piping areas identified in the figures presented in section 12.3. Question 171-1858 12.03-12.04-9 requested that the applicant provide information regarding equipment to be located in some large piping areas and, due to the high dose rates in the areas, what design features were to be provided to keep Operational Radiation Exposure ALARA.

Question 172-1864 12.03-12.04-10 requested that the applicant provide information regarding access to the areas and the physical barriers provided to control access.

In the responses to Questions 12.03-12.04-9 and 12.03-12.04-10, the applicant indicated that:

- Although not shown on the original drawings, access openings to allow visual inspection are now anticipated, with actual locations to be determined at a later date. The applicant noted that Figure 12.3-1 will be revised to include access openings in the general locations noted in the figures attached to the response to RAI 171-1858 Question No. 12.03-12.04-9.

- There are no plans to install equipment that may require access for operation, maintenance or periodic surveillance in these areas.

- One of the areas indicated as a piping area, is actually, a valve area.

These responses appear to be inadequate, or inconsistent with information provided by MHI in other documents, for the following reasons:

1. Based upon the supplied drawings and the size and shape of the areas, changes “to allow visual inspection” to all of the areas, will require personnel access through areas that may have dose rates up to 500 R/h. (See figure 12.3-1 Sheet 16). These are large areas, which require personnel access, to areas containing components, which are causing high dose rates. The information presented to the staff is not sufficient to allow the staff to determine the sources of radiation exposure to personnel, and the features provided to reduce exposure to personnel in these areas.

2. Contrary to the statement, “There are no plans to install equipment which may require access for operation, maintenance or periodic surveillance in this area”, in the response to 172-1864 Question 12.03-12.04-10, the applicant noted that at least one of these areas is actually a valve area. Even relatively inactive components, such as valves, require access for periodic packing adjustment or replacement and actuator maintenance. If a valve in this area is in a system that could contain highly radioactive fluids, as noted in NUREG-0737 III.D.1.1, then periodic access will be required to ensure that ESF leakage remains less than the leakage rate value assumed in the FSAR Chapter 15 accident analysis.

Requested Information

1. Describe the sources of personnel radiation exposure in these areas, and the design features provided to reduce Operational Radiation Exposure (ORE) or provide the specific alternative approaches used and the associated justification.

2. Please clarify the statements provided in the responses Questions 12.03-12.04-9 and 12.03-12.04-10, regarding the type of components installed in these areas.

References

1. "Request for Additional Information No. 171-1858 Revision 1, SRP Section: 12.03-12.04 - Radiation Protection Design Features, Application Section: 12.3.1, Question No.: 12.03-12.04-9" dated February 3, 2009 CHPB Branch (ADAMS Accession No. ML0906802330)

2. "Request for Additional Information No. 172-1864 Revision 1, SRP Section: 12.03-12.04 - Radiation Protection Design Features, Application Section: 12.3.3, Question No.: 12.03-12.04-10" dated February 3, 2009 CHPB Branch (ADAMS Accession No. ML0906802350)

12.03-12.04-23

The US-APWR FSAR Revision 1 Tier 2 Sections 3 “Radiation Protection Design Features” and Section 12.4 “Dose Assessment”, describes design features for

maintaining personnel exposure ALARA and the exposure estimates associated with operation, maintenance and refueling activities.

Supplemental Question (SQ-2) derive from RAI 171-1858, Questions 12.03-12.04-7 and 12.03-12.04-8

RAI 171-1858 Questions 12.03-12.04-7 and 12.03-12.04-8 requested additional information about the radiation protection design features associated with the operation and maintenance of the Boric Acid Transfer Pumps (BATP) and the Boric Acid Evaporator (BAE) and the BAE Distillate (BAEDP) and Concentrates (BAECP) Pumps.

In summary, the MHI Response indicated that:

1. Based on other plant experience, actual doses from this equipment will be insignificant.

2. That the filters and Demineralizers would remove all of the activity, so no activity will remain in the boron recycle system.

3. There is no impact on the DCD or COLA.

This response appears to be inadequate and inconsistent with other information provided by MHI:

1. The use of a source term based on operational experience is contrary to the source term stated in the US-APWR FSAR Tier 2 Section 12.2.1.1 “Sources for Full-Power Operation”. In this section, the applicant makes the statement that “The design basis for the shielding source terms for the fission products for full-power operation is cladding defects in the fuel rods producing 1% of the core thermal power”. The use of cladding defects for determining the shielding requirements is consistent with the Acceptance Criteria contained in SRP Section 12.2.

   Describe the source term used as the basis for determining the dose rates, shielding requirements, airborne activity concentration and ventilation system design parameters, and the resultant ORE dose reduction design features for normal operation and AOO, and provide the associated revisions to the FSAR, or provide the specific alternative approaches used and the associated justification

2. The assumption that no activity would be present in the process fluid streams after the demineralizers and filters is inconsistent with the NRC Staff Operating Experience (OE) and the applicant response to RAI 168-1739 Question 12.02-14. In that response MHI provided DF and concentration factors that are consistent with staff OE. The use of these removal and concentration factors indicate that appreciable amounts of radioactive material may be present down stream of the BAE package, under normal conditions, but particularly under design basis cladding defect operating conditions.

Describe the removal factors, and their bases, assumed for the responses to questions 12.03-12.04-7 and 12.03-12.04-8, and provide justification for the use removal factors other than those noted in the response to 168-1739 Question 12.02-14.

3. The response indicates that no changes to the DCD or COLA are required. The lack of dose reducing design features for BATP, BAEDP and BAECP is contrary to FSAR Tier 2 Section 12.1.2.3.2 “Minimizing Radiation Levels in Plant Access Areas and Vicinity of Equipment” which notes that general design criteria used to reduce radiation levels near equipment requiring personnel attention included providing adequate shielding between radiation sources and access and service areas. This statement in the FSAR is consistent with 10 CFR 20.1101(b) and the Regulatory Position noted in RG 8.8 Position C2.b, regarding recommended design features to reduce maintenance and operation related exposure from high dose rate equipment. Based on US-APWR FSAR Figures provided in section 12.3-1 "Radiation Zones for Normal Operation/Shutdown" the Boric Acid Transfer Pumps (BATP) are located where the maximum dose rate could be 10 R/h in the area and the Boric Acid Evaporator Pumps are located where the maximum dose rate could be 100 R/h in the area.

   Consistent with 10 CFR 20.1101(b) and RG 8.8 Position C2.b, describe the design feature provided to reduce ORE associated with the Boron Recycle System components.

References

1. "Request for Additional Information No. 171-1858 Revision 1, SRP Section: 12.03-12.04 - Radiation Protection Design Features, Application Section: 12.3.1, Question No.: 12.03-12.04-7" dated February 3, 2009 CHPB Branch (ADAMS Accession No. ML0906802330)
2. "Request for Additional Information No. 171-1858 Revision 1, SRP Section: 12.03-12.04 - Radiation Protection Design Features, Application Section: 12.3.1, Question No.: 12.03-12.04-8" dated February 3, 2009 CHPB Branch (ADAMS Accession No. ML0906802330)
3. "Request for Additional Information No. 168-1739 Revision 1, SRP Section: 12.02 - Radiation Sources, Application Section: 12.2,", Question No.: 12.02-14" dated February 3, 2009 CHPB Branch (ADAMS Accession No. ML090650632)

12.03-12.04-24

The US-APWR FSAR Revision 1 Tier 2 Sections 3 “Radiation Protection Design Features” and Section 12.4 “Dose Assessment”, describes design features for maintaining personnel exposure ALARA and the exposure estimates associated with operation, maintenance and refueling activities.

Supplemental Question (SQ-3) derive from RAI 147-1850, Question 12.03-12.04-4

RAI 147-1850 Question 12.03-12.04-4 asked the applicant to provide the allowable cobalt content of components in contact with the RCS.

In summary, the MHI Response indicated that:

MHI would provide table 12.3-2 for equipment cobalt specifications. This response included the following cobalt content specifications:

- Fuel assemblies – 0.05 = 500 ppm
- High Neutron flux – 0.05 = 500 ppm
- Upper/Lower core plates 0.10 = 1000 ppm
- RCS Piping, RCP Reactor Internals 0.20 = 2000 ppm

Based on this response, the allowable cobalt content for some components located in high neutron flux areas, are above recommended cobalt impurity levels provided in some industry guidance documents. Due to the significance of irradiated cobalt to Occupational Radiation Exposure (ORE), RG 8.8 C.2(e)(1) provided guidance regarding establishing specifications, to the extent practicable, for the use of low-cobalt bearing materials for primary coolant pipe, vessel internal surfaces. This guidance is consistent with the observations and recommendations noted in industry documents, including:

- EPRI TR-107991 1997 “Radiation Field Control Manual”, which notes that because radiation from Co-60 accounts for >90% of ORE, the cobalt content of materials exposed to high neutron flux should be limited to 50 ppm,
- EUR 8655 “The Control of Cobalt Content In Reactor Grade Steels”, which notes that residual cobalt contamination is the main source of radiation from activated structural components. This reported noted that the core barrel and shroud were the major sources of activation, due to the proximity to the neutron flux, and that the expense associated with feed material selection, may be offset by reductions in decommissioning expenses.

In light of the increased Occupational Radiation Exposure and Decommissioning costs associated with the use of higher cobalt materials located in high neutron flux areas, justify the stated allowable cobalt content in materials located in high neutron flux areas.

References

1. Response to "Request for Additional Information No. 147-1850 Revision 1, SRP Section: 12.03-12.04 - Radiation Protection Design Features, Application Section: 12.03, Question No.: 12.03-12.04-4" dated January 9, 2009 CHPB Branch (ADAMS Accession No. ML0090410552)