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TOKYO, JAPAN

February 20, 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-09064

Subject: MHI's Response to US-APWR DCD RAI No. 165-1967 REVISION 1

Reference: 1) "Request for Additional Information No. 165-1967 Revision 1, SRP Section: 05.02.05 - Reactor Coolant Pressure Boundary Leakage Detection, Application Section: DCD Tier 2, Section 5.2.5" dated January 23, 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. 165-1967 Revision 1."

Enclosed is the response to the RAI 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 submittals. His contact information is below.

Sincerely,

Y. Ogata

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

Enclosure:

1. Response to Request for Additional Information No. 165-1967 Revision 1

CC: J. A. Ciocco
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Docket No. 52-021
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Enclosure 1

UAP-HF-09064
Docket Number 52-021

Response to Request for Additional Information
No. 165-1967 Revision 1

February 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

02/20/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 165-1967 REVISION 1**
SRP SECTION:	**05.02.05 - REACTOR COOLANT PRESSURE BOUNDARY LEAKAGE DETECTION**
APPLICATION SECTION:	**DCD TIER 2, SECTION 5.2.5**
DATE OF RAI ISSUE:	**1/23/2009**

QUESTION NO.: 05.02.05-1

The applicant has not provided adequate Tier 1 ITAAC information to verify the compliance with the design criteria required by GDCs 2 and 30. Because the reactor coolant system (RCS) is a safety-related system, the reactor coolant pressure boundary (RCPB) is a safety-related issue. 10 CFR 52.47(b) (1) requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and NRC regulations. The ITAAC should address the sensitivity, response time, and alarm limit for the RCPB leakage detection instrument. The staff requests the applicant to provide ITAAC for this system in the DCD Tier 1.

ANSWER:

MHI will add ITAAC information for the reactor coolant pressure boundary leakage detection system to address its non-safety function. DCD Tier 1 Chapter 2 will be updated to add new subsection for the reactor coolant pressure boundary leakage Detection system. The DCD will be revised to add a description as shown in "Impact on DCD" below.

Impact on DCD

New subsection Tier1 2.x.x Reactor Coolant Pressure Boundary Leakage detection. (Section No. will be determined later)

2.x.x REACTOR COOLANT PRESSURE BOUNDARY LEAKAGE DETECTION

2.x.x.1 Design Description

The reactor coolant pressure boundary (RCPB) leakage monitoring system provides a mean of detecting and monitoring the reactor coolant leakage by measuring the leakage rate or common leakage equivalent. The following leak detection methods quantify the leakage rate and provide information to locate the leakage in order to detect unidentified coolant leakage into containment:

- Containment Sump Level
- Condensate Flow Rate From Air Coolers
- Containment Airborne Particulate Radioactivity

Detecting and monitoring the leakage are performed using instruments and components. Reactor coolant pressure boundary leakage detection methods provide the nonsafety-related function of detecting leaks form Reactor Coolant System.

2.x.x.2 Inspection, Tests, Analyses, and Acceptance Criteria

Table 2.x.x-1 describes the ITAAC for reactor coolant pressure boundary leakage detection.

Table 2.x.x-1 Reactor Coolant Pressure Boundary Leakage detection Inspection, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Reactor coolant pressure boundary leakage detection methods provide the nonsafety-related function of detecting leaks form Reactor Coolant System.	1.i Inspection will be performed for retrievability of the displays of the following channels in the MCR. ・Containment sump level channels LMS-LT-1083A,B ・Stand pipe level channel LMS-LT-1082	1.i Nonsafety-related displays of the following channels can be retrieved in the MCR. ・Containment sump level channels LMS-LT-1083A,B ・Stand pipe level channel LMS-LT-1082
	1.ii Testing will be performed by adding water to the sump and observing display of sump level.	1.ii A report exists and concludes sump level channels LMS-LT-1083A,B can detect level change due to adding water.
	1.iii Testing will be performed by adding water to the stand pipe and observing display of stand pipe level.	1.iii A report exists and concludes stand pipe level channel LMS-LT-1082 can detect level change due to adding water.
	1.iv See Tier1 Material sections: Section 2.7.6.6 for the containment radiation particulate monitor RMS-RE-40	1.iv See Tier1 Material sections: Section 2.7.6.6 for the containment radiation particulate monitor RMS-RE-40

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA

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QUESTION NO.: 05.02.05-2

In Section 5.2.5 of Revision 1 to the DCD Tier 2, the applicant indicates its gaseous radiation monitor can detect one gpm leakage within one hour and the applicant includes the use of a gaseous radiation monitor in the Technical Specifications. However, operating experience (NRC Information Notice 2005-24) indicates that this response time of one gpm within one hour may be a non-conservative estimate for the gaseous radiation monitor based on the assumption of non-realistic radioactive concentration in the RCS. The RCS source terms used in DCD Tier 2, Section 5.2.5 for evaluating the response time may not be sufficiently conservative because of improved fuel performance and RCS chemistry control. The actual RCS source term may be orders of magnitude smaller than that assumed by the applicant to arrive at the sensitivity and response time capability of the radiation monitor. The staff requests the applicant to reevaluate the sensitivity and response time of the radiation monitors (gaseous and particulate) using a realistic radioactive concentration in the RCS. If the response time is much longer than one hour for one gpm leakage, the applicant should reevaluate the appropriateness of keeping theses monitors in the Technical Specifications (TS) and determine that the remaining leakage detection monitors in the TS are still acceptable in terms of "diversity". In Revision 1 of RG 1.45, as opposed to Revision 0 of RG 1.45, the gaseous radiation monitor is no longer required in the TS for RCS leakage detection. The applicant needs to provide the changes, if any, in the DCD and provide a markup in the response.

ANSWER:

The Containment airborne gaseous radioactivity monitor will be deleted from TS leakage detection method. The Containment airborne particulate radioactivity monitor will remain as a diverse method. The DCD Chapter16 Technical Specification will be revised to delete this monitor's description as shown in "Impact on DCD" below.

Impact on DCD

This revision impacts Chapter16, Sections 3.4.15 and Section B3.4.15.
Revise section 3.4.15 as follows:

LCO 3.4.15 The following RCS leakage detection instrumentation shall be

OPERABLE:

a. One containment sump (level) monitor,
b. One containment atmosphere radioactivity monitor (~~gaseous or~~ particulate), and
c. One containment air cooler condensate flow rate monitor.

Revise section B3.4.15, BACKGROUND, forth paragraph as follows:

The reactor coolant contains radioactivity that, when released to the containment, can be detected by radiation monitoring instrumentation. Reactor coolant radioactivity levels will be low during initial reactor startup and for a few weeks thereafter, until activated corrosion products have been formed and fission products appear from fuel element cladding contamination or cladding defects.Instrument sensitivity~~ies~~ of $10^{-9}\mu$Ci/cc radioactivity for particulate monitoring ~~and of $10^{-6}\mu$Ci/cc radioactivity for gaseous monitoring are~~ is practical for these leakage detection system~~s~~.
Radioactivity detection system~~s~~ ~~are~~ is included for monitoring ~~both~~ particulate ~~and gaseous activities~~ activity because of their sensitivity~~ies~~ and rapid response to RCS LEAKAGE.

Revise section B3.4.15, ACTIONS, first paragraph of B.1.1, B.1.2, B.2.1, and B.2.2 as follows:

With both ~~gaseous and~~ particulate containment atmosphere radioactivity monitoring instrumentation channels inoperable, alternative action is required. Either grab samples of the containment atmosphere must be taken and analyzed or water inventory balances, in accordance with SR 3.4.13.1, must be performed to provide alternate periodic information.

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA

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QUESTION NO.: 05.02.05-3

Section 5.2.5.6 of the DCD Tier 2 states that "procedures for converting various indications to a common leakage equivalent will be available to operating personnel." However, the staff could not find the procedures anywhere in the DCD that are promised for the operator to convert the instrument indications of various leakage detection (e.g., containment radioactivity monitors, containment sump level monitor, containment air cooler condensate flow rate monitor) into common leakage rate (gpm). Therefore, the staff requests the applicant to provide the following information.

- Identify a combined license (COL) information item in the DCD to require the COL applicant provide operators the procedures that permit rapid conversion of instrument indications of various leakage detection instruments into common leak rate (gpm).
- Define the alarm setpoints and demonstrate the setpoints are sufficiently low to provide an early warning for operator actions prior to Technical Specification (TS) limits.

ANSWER:

The procedure that provides conversion of instrument indications of various leakage detection instruments into common leak rate (gpm) will be prepared as Operating and Emergency Operating Procedures described in DCD Section 13.5.2.1. The DCD will be revised to add a description as shown in "Impact on DCD" below. The alarm setpoints are determined in consideration of factors such as sensor's capability, back ground counts for radiation monitors, to provide an early warning for operator actions prior to TS limits sensitivity.

Impact on DCD

The following changes will be made to the Tier 2 DCD, Section 5.2.5.6, first paragraph:

Chapter 5 (Section 5.2.5.6, 1st paragraph)

The following leak detection systems instruments will provide the indications of reactor pressure boundary leakage in the MCR with alarms. The alarms will alert the operating personnel to monitor for leakage. Procedures for converting various indications to a common leakage equivalent will be

available to operating personnel. Monitors for items A through D below are provided in gallon per minute leakage equivalent.
Leakage conversion procedure is to be developed as Operating and Emergency Operating Procedures described in DCD Section 13.5.2.1 to convert various indications to an identified and unidentified common leakage equivalent and leakage rate of change.

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA

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QUESTION NO.: 05.02.05-4

The operating experience at Davis Besse indicated that prolonged low-level unidentified leakage inside containment could cause material degradation such that it could potentially compromise the integrity of a system leading to the gross rupture of the reactor coolant pressure boundary. The DC applicant does not indicate that sufficient procedures for identifying, monitoring, and trending prolonged low-level leakage are to be developed and provided to the operators. Reliance only on leak rate alarms set at the TS limits is not acceptable without proper compensatory measures. Guidance and Regulatory Positions about developing procedures for ensuring effective management of leakage, including low-level leakage, is available in RG 1.45, Revision 1. The staff requests the applicant to provide a COL information item that requires a COL applicant to establish procedures that specify operator actions in response to prolonged low leakage conditions that exist above normal leakage rates and below the TS limit to provide the operator sufficient time to take actions before the TS limit is reached. Please include this information in the DCD and provide a markup in your response.

ANSWER:

MHI agrees the need to establish procedures that specify operator actions in response to leakage rates less than the limits set forth in the plant technical specifications. The procedures to specify operator actions for conditions departing from normal will be prepared as Operating and Emergency Operating Procedures described in DCD Section 13.5.2.1. The DCD will be revised to add a description as shown in "Impact on DCD" below.

Impact on DCD

The following changes will be made to the Tier 2 DCD, Section 5.2.5.8:

Chapter 5 (Section 5.2.5.8)

In accordance with the position 9 of regulatory guide 1.45 the limiting condition for identified and unidentified reactor coolant leakages are identified in the Chapter 16. Subsections 3.4.13 addresses RCS leak limits. Subsection 3.4.15 addresses RCS leak detection instrument requirements.

The leakage management procedure is to be developed as Operating and Emergency Operating Procedures described in DCD Section 13.5.2.1 to identify leak source, monitor and trend leak rate, evaluate various corrective action plans in response to prolonged low leakage conditions that exceeds normal leakage rates and not exceed the Technical Specification (TS) limit in order to provide the operator sufficient time to take corrective actions before the leakage exceeds TS limit value.

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA

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QUESTION NO.: 05.02.05-5

Applicants for standard plant design approval must provide plans for preoperational testing and initial operations in accordance with 10 CFR 50.34(b) (6) (iii) requirements.
SRP Section 14.2, Subsection II, "Acceptance Criteria", states that the DC applicant can meet the above requirements by conforming to the criteria stated in Regulatory Guide (RG) 1.68.
The staff reviewed Chapter 14 of Tier 2 of the US-APWR DCD to ensure the applicant conformed to Initial Plant Test requirements. Chapter 14, "Verification Programs", of the US-APWR DCD lists Section 14.2.12.1.71, "RCS Leak Rate Preoperational Test," and Section 14.2.12.2.1.10, "RCS Final Leak Test." However, the staff was not able to find the sensitivity, response time, alarm limit of the leak detection systems being included in the above tests. The applicant is request to identify the tests to demonstrate the sensitivity, response time, and alarm limit of the leak detection systems.

ANSWER:

DCD Subsection 14.2.12.1 will be revised to add RCPB leakage detection systems test as a new preoperational test. The preoperational tests for RCPB leakage detection systems and RCS leak rate measurement will require construction testing and instrument calibration as test pre-requisites that ensure their required ability. The changes were described to the NRC in response to RAI No. 33, Revision 0, Question No 14.02-69 and No. 102-1391 Revision 0, Question No 14.02-101.

Impact on DCD

There is no impact on the DCD

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA

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QUESTION NO.: 05.02.05-6

In Section 5.2.5.4.1.2 of the DCD Tier 2, Revision 1, fourth paragraph, there is a list: (Na-24,Cr-51,Zr-65,Mn-54,56, Co-58,60, Fe-55,59). There is no Zr-65. The staff compared it with DCD Section 11.1 and found that it might be an error to type Zn-65 into Zr-65. The applicant is request to verify the above error and revise the DCD accordingly.

ANSWER:

MHI concurs with the NRC on the typographical error of "Zr-65" as described in DCD Section 5.2.5.4.1.2. The word "Zr-65" will be changed into "Zn-65".

Impact on DCD

The following changes will be made to the Tier 2 DCD, Section 5.2.5.4.1.2, fourth paragraph:

Chapter 5 (Section 5.2.5.4.1.2, 4th paragraph)

Assuming that corrosion and activation product concentration in the reactor coolant is 2x10-1μCi/g (Na-24,Cr-51,~~Zr~~Zn-65,Mn-54,56, Co-58,60, Fe-55,59) and the distribution coefficient is 0.3, after leak occurrence, a leak rate of 1gpm can be detected within one hour.

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA