

REQUEST FOR ADDITIONAL INFORMATION 584-4468 REVISION 0

5/10/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems
Application Section: 9.2.7 Chilled Water System

QUESTIONS for Balance of Plant Branch 2 (SBPB)

09.02.02-70

This is a follow-up to RAI 343-2208, Question 09.02.02-5:

In response to RAI 09.02.02-5, the applicant stated that the ECWS and non-ECWS are both completely independent and separated systems. The RAI response also stated that the piping of the non-ECWS within an area containing safety-related equipment is designed as seismic Category II. Since Table 3.2-2 does not show any seismic Category II piping for the non-ECWS, it is not clear what non-ECWS seismic Category II piping is being referenced. Table 3.2-2 specifically defines non-ECWS "Piping and valves (except portion of the containment penetration)" as Seismic Category "NS".

Due to the apparent inconsistencies referred to above, the staff cannot conclude whether any of the non-ECWS piping should be seismic Category II and that non-ECWS failures will not adversely impact safety-related SSCs. The applicant is requested to:

1. Provide clarification and revise the DCD as necessary to address the above inconsistency with respect to seismic classification of non-ECWS piping and components.
2. Describe to what extent failures of non-ECWS piping and components can adversely impact safety-related SSCs, including the basis for this determination.
3. Parts of the non-ECWS which are non-safety related were designated as Equipment Class 4, Seismic Category NS, and Quality Group D. However, Rev 2 of the DCD changed this to Equipment Class 9, Seismic Category NS, and Quality Group N/A. The reason for this change in non-ECWS classification is unclear. In addition, more confusion is added by the designation of Equipment Class 5 that is assigned to the Auxiliary Building air handling unit (AHU) as shown in Tier 2 Table 9.4.3-1; which appears to be inconsistent with the equipment classification that was assigned for non-ECWS which provides the chilled water that is used for cooling this AHU. Therefore, additional explanation and justification is needed for the changes that were made to the non-ECWS classification designations that were made and the apparent inconsistencies that exist.
4. Tier 2 Table 3.2-2 (page 55 of 57) references "Valves VWS-MOV-425, -426" as Seismic Category I. However, Valve "-426" is not shown on non-ECWS Figure 9.2.7-2.

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Explain this apparent discrepancy and revise the DCD as necessary to resolve this problem.

Reference:

MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-71

This is a follow-up to RAI 343-2208, Question 09.02.02-6:

Standard Review Plan (SRP) 9.2.2 Section III, which is being utilized as guidance for the review of the chilled water system, specifies in Section III confirmation of the overall arrangement of the system. The chilled water system description and flow diagrams in Tier 2, Design Control Document (DCD), Figure 9.2.7-1, were reviewed to assess the design adequacy of the chilled water system for performing its heat removal functions. While the flow diagrams show the essential chilled water system (ECWS) components, some of the information is incomplete, inaccurate, or inconsistent. Consequently, the applicant was asked, in RAI 09.02.02-6 to revise the DCD to address a large number of technical issues identified by the staff. The applicant responded to each of the RAI 09.02.02-6 issues identified by the staff. In reviewing the Rev. 2 of the DCD, submitted in October 2009, the staff found that the majority of the issues were satisfactorily incorporated; however, there were a few that were not satisfactory. These remaining issues are discussed below.

1. The staff asked the applicant to revise the DCD to address Tier 2, DCD Figure 9.2.7-1 not showing where indications are displayed (e.g., local, remote panel, control room), and what instruments provide input to a process computer and/or have alarm and automatic actuation functions. This item was not addressed anywhere in the applicant's RAI response. Therefore, the applicant is asked to address the original staff request to show on Figure 9.2.7-1 where indications are displayed and what instruments provide input to a process computer and/or have alarm and automatic actuation functions. Or, as indicated in RG 1.206 (C.I.9.2.1.5), describe the system alarms, instrumentation, and controls. Include a description of the adequacy of instrumentation to support required testing, as well as the adequacy of alarms to notify operators of degraded conditions.

2. Answer (4) in the applicant's response states that "Instrumentation of ECWS is designed as non-safety related." However, DCD Section 9.2.7.5.1 indicates that instrumentation is safety-related. Confirm whether the instrumentation is safety-related.

3. Answer (11) in the applicant's response states that Sections 9.2.7 will be revised to state that GDC 4 and 44 are met for the ECWS. In addition, revisions to Section 9.2.7.1.1.1 and 9.2.7.3.1 were proposed to correct errors in the system descriptions. The staff reviewed DCD Rev. 2 to determine if the proposed revisions have been acceptably incorporated. The staff found that the proposed revision to Section 9.2.7.1.1.1 to correct system errors has been incorporated; however, the revision to Subsection 9.2.7.3.1 has not been incorporated. Additionally, the staff could not locate the incorporation into DCD Rev. 2 of the applicant's proposed statement that GDC 4 and 44 are met for the ECWS. The applicant should address these possible omissions.

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Reference:

MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-72

This is a follow-up to RAI 343-2208, Questions 09.02.02-7 and 09.02.02-9:

General Design Criterion (GDC) 44 requires the essential chilled water system (ECWS) to be capable of removing heat from structures, system and components (SSCs) important to safety during normal operation. RAI 09.02.02-7 and 09.02.02-9 requested additional information regarding the heat transfer and flow requirements. In its response, the applicant proposed the addition of Table 9.2.7-2. Based upon review of this response, the staff does not find this response to provide the information requested by the RAI. The RAI requested a description of the excess head margin for the pumps along with the basis for this determination. The excess margin and basis should include a quantitative statement of the losses and the resulting excess capacity that is provided by the design. Therefore, additional information is needed to provide a more quantitative description of the excess flow and head capacity that are provided by the ECWS pumps, including the basis for these determinations. In particular:

1. Section 9.2.7 should fully describe and explain what the minimum system heat transfer and flow requirements are for normal operating, refueling, and accident conditions, the bases for these requirements including limiting assumptions that apply (such as temperature and heat load considerations), how much excess margin is available and how this was determined, and what limiting system temperatures and pressures are assumed with supporting basis. The RAI response should re-address these items and clearly address excess margin that is available, and explain why the excess margins that are available are considered to be sufficient to ensure adequate performance over the life of the plant.
2. The addition of Table 9.2.7-2 provides the flow rates for Normal and Abnormal operation. Abnormal flow demand is indicated as 440 gpm and the ECWS pump is sized for 440 gpm. This table provides an overall demand for all 4 trains of the ECWS. Describe the basis for the pump flow rating and how many ECWS trains are required to cool the respective rooms during normal and abnormal operation.
3. The system description in DCD, Tier 2 Section 9.2.7, should provide design details for ECWS such as system operating temperatures, pressures, and flow rates for all operating modes and alignments. Alternatively, bounding values could be provided.
4. Table 9.2.7-2 provides the Normal and Abnormal operation flow and heat load and is misleading in regards to the chilled water system demands. In accordance with Table 9.2.7-2 and Table 9.4.5-1, Class 1E Electrical Room air handling unit (AHU) abnormal heat load operation per train (A, B) is 1,650,000 btu/hr and heat load operation per train (C, D) is 2,250,000 btu/hr. The reason for this large difference in heat loads needs to be explained, including to what extent ECWS is capable (during normal and abnormal operation) of providing adequate cooling with only A & B trains operable (i.e. train C in maintenance and failure of train D). This assessment should include operation with and without offsite power available.

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5. For both ECWS and non-ECWS, Section 9.2.7 is missing an “operating section”, which usually includes the system configuration during normal and abnormal operation. It is not clear how many ECWS trains are normally operating and the normal required heat load and flow requirements are not clearly defined. The staff requests the applicant to include a normal and emergency operation section in Section 9.2.7 of the DCD and, as a minimum, clearly define the following for normal and abnormal operation and update the DCD accordingly:

- a. Provide details of valve configuration: normally open or closed during modes of operation
- b. Define whether some trains running and other standby. Provide description of signal and process for starting standby trains.
- c. Provide description of how many ECWS and non-ECWS trains are required to provide cooling during normal and accident conditions to ensure the operating requirements for the various rooms are met.
- d. Include details of the configuration of the ECWS and non-ECWS on safety injection signal or LOOP.
- e. Discuss any adjustments which require automatic or manual configuration.
 - f. Describe what actions are needed for by the operators to align makeup to the compression tank on low level.

6. Section 9.4.7 of the DCD contains a COL 9.4(4) for the air handling units (AHUs) indicating that “The COL Applicant is to determine the capacity of cooling and heating coils provided in the air handling units that are affected by site specific conditions.” It is not clear why the standard plant heat load would not bound the plant-specific situation in most cases. Therefore, address the need, if any, for the ECWS to contain a similar COL item to account for any changes to the ECWS as a result of COL 9.4(4) items that will directly affect the ECWS capacity.

Reference:

MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-73

This is a follow-up to RAI 343-2208, Question 09.02.02-10:

The essential chilled water system (ECWS) must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. In order to satisfy system flow requirements, the ECWS design must assure that the required minimum net positive suction head (NPSH) for the ECWS pumps will be met for all postulated conditions, including consideration of vortex formation.

RAI 09.02.02-10 requested the applicant to provide additional information in Tier 2, DCD Section 9.2.7 to fully explain how the required minimum NPSH for the ECWS pumps is satisfied by the system design. In its response, the applicant proposed a simple revision to Tier 2 subsection 9.2.7.2.1.1 that states that the ECWS pumps have sufficient NPSH available based on pressurization of the system by the compression tank. The applicant

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provided a more complete description in the response but did not propose to add this description to the Tier 2 DCD. Based upon review of this response, the staff does not find this response to provide the information requested by the RAI. The RAI requested that the DCD provide the minimum required NPSH and how the required minimum NPSH is satisfied by the system design when vortex formation is included, and how much excess margin is available for the limiting case. The proposed revision to the Tier 2 DCD does not address the information requested.

1. The applicant should provide a more complete description in the Tier 2 DCD Section 9.2.7 of the minimum net positive suction head and how this is satisfied by the system design considering the possibility of vortex formation. This will enable the staff to independently confirm that the design is adequate in this regard, including limiting assumptions that were used along with supporting justification
2. The applicant should address how the potential for dissolved gas (i.e. nitrogen) in the liquid does not negatively impact pump performance.
3. In addition, 10CFR52.47 requires that a DCD to contain the ITAAC that are necessary and sufficient to provide reasonable assurance that, if the ITAAC 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. US-APWR has included an ITAAC in Tier 1, Table 2.7.3.5-5 to confirm that the NPSH available exceeds the required NPSH. However, in the absence of the available or required NPSH details, this ITAAC does not include measurable criteria in order to be closed. The applicant should provide the NPSH ITAAC details similar to those provided in Section 10.4.9.3 for the emergency feedwater system.

Reference: MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-74

This is a follow-up to RAI 343-2208, Question 09.02.02-12:

Under seismic or post-accident conditions where the demineralized water system (DWS) or the primary make-up system (PWS) may be unavailable for ECWS makeup, the compression tanks need to provide sufficient water volume to assure reliable operation without makeup. Makeup water to the compression tank is shown in Tier 2, DCD Figure 9.2.7-1; however, the DCD does not discuss compression tank capabilities in the event of a makeup source interruption. Consequently, the staff prepared RAI 09.02.02-12 to request further information on expected or assumed system leakage and the capabilities of the compression tank to operate without a makeup source for an extended period of time. In its response, the applicant addressed the staff questions and proposed a revision to Tier 2 DCD section 9.2.7.2.1.1.1 (actually added to 9.2.7.2.1.1) for clarification. The compression makeup water is provided with deaerated water from the primary makeup water system (PMWS) or with demineralized water from the demineralized water system (DMS). The deaerated water is used for initial filling of this system and demineralized water is used for makeup when the tank water level reaches

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a low-level setpoint during normal plant operation. The blowdown discharge of the compression tank relief valves (non-radioactive drain sump) was described as discharging to the non-radioactive drain sump. The applicant stated that the compression tank capacity is designed with sufficient water for at least 7 days of operation in the event of a loss of makeup water.

However, the applicant did not define the basis for this 7-day tank capacity and what the minimum level and volume of tank water is based on to assure the tank contains sufficient inventory during all conditions (i.e normal and abnormal). The assumptions used to define the tank capacity, including most limiting system leakage was not provided.

1. Describe whether compression tank is sized to ensure adequate NPSH available and prevent vortexing for its associated SCW pump under worst case conditions.
2. Explain what controls and features are provided to monitor and ensure the compression tank quantity is adequate to support the 7-day supply at all times. Discuss whether a technical specification is needed to verify the 7-day supply is available.
3. Define the most limiting leak rate and assumptions used to define compression tank capacity during normal and abnormal operation.

Reference: MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-75

This is a follow-up to RAI 343-2208, Question 09.02.02-18:

Section 10CFR52.47, Content of Application, states that "the description shall be sufficient to permit understanding of the system design and their relationship to the safety evaluation." Since Tier 2, DCD Section 9.2.7 has missing design bases information related to the importance of the ECWS, the staff generated RAI 09.02.02-18. In addition, the RAI requested applicant to provide justification of why the US-APWR DCD does not have a separate section in the technical specification related to essential chilled water system. In its response, the applicant proposed to add a statement on design bases to Tier 2 DCD sections 9.2.7.1 and 9.2.7.3 and provided the definition of "OPERABLE – OPERABILITY" with respect to technical specifications to argue that operability of the ECWS is indirectly included under other primary system LCO which ECWS supports.

In regards to the technical specification, the applicant needs to justify how Criterion 3 of 10CFR50.36(c)(2)(ii) is not applicable as a basis for the need for a technical specification for the ECWS.

"(C) Criterion 3. A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier."

Operability problems with the ECWS and non-ECWS could result in the failure of systems used to mitigate a design basis accident to be able to perform their safety function. The applicant should also address the need for technical specification

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surveillance requirements to ensure operability of ECWS is maintained (i.e. compression tank 7-day supply inventory and required pressure, chiller discharge temperature, system flow rate requirements, etc.)

Reference: MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-76

This is a follow-up to RAI 343-2208, Question 09.02.02-19:

Standard Review Plan (SRP) 9.2.2, which is being utilized as guidance for the review of the essential chilled water system (ECWS), specifies in Section III confirmation of the overall arrangement of the component cooling system (CCWS). SRP 14.3, Appendix C, Item 1B.ix states that Tier 1 figures for safety-related systems should include most of the valves on the DCD Tier 2 drawings. The staff found that the Tier 1 and Tier 2 information is incomplete, inconsistent, inaccurate, or that clarification is needed and asked the applicant in RAI 09.02.02-19 to revise the information in Design Control Document (DCD), Tier 1 Section 2.7.3.5 and applicable Tier 2 Sections (as appropriate) to address the following considerations in this regard. In the response, a single issue addressed by the applicant was not found to be acceptable to resolve the staff's question. This issue is addressed in the paragraph below.

Although the Introduction Section in Chapter 1 of the Tier 1 DCD states that "information contained in the Tier 1 document was derived from the Tier 2 document," the staff found that much of the information provided in DCD Tier 1 is not described in Tier 2 DCD Section 9.2.7 (e.g., active safety function, loss of motive power position, harsh environment considerations, MCR alarm and display, control function, and RCS display). This information needs to be added to Tier 2. The applicant proposed to revise Tier 2 Section 9.2.7 to add the missing information that is included in Tier 1. However, the applicant did not provide a markup of the proposed Tier 2 DCD changes; therefore, the staff is unable to determine the acceptability of the proposed changes until the next DCD revision.

In addition, the staff has the following related requests:

1. Review DCD to ensure all Tier 1 information is provided in Tier 2, including table and figure content.
2. During a review of DCD Rev. 2, the staff noted that Section 9.2.7.5.1 specifies the compression tanks contain MCR alarms, but Table 2.7.3.5-4 seems to indicate that the tanks do not have any MCR/RSC Alarm. The applicant is asked to resolve this inconsistency.
3. In addition, provide a reason why non-ECWS Tier 1 Section 2.7.3.6.1 does not include valves VLV-421/422 and MOV-424/425 in a table similar to Table 2.7.3.5-2 with the pertinent ITAAC.
4. Table 2.7.3.6-2 should include valves VWS-MOV-424, -425, which are Seismic Category I.

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Reference: MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-77

This is a follow-up to RAI 343-2208, Question 09.02.02-20:

Standard Review Plan (SRP) Section 9.2.2, which is being utilized as guidance for the review of the essential chilled water system (ECWS), specifies in Section III confirmation of the overall arrangement of the component cooling system (CCWS). The staff found that the proposed ITAAC in DCD Tier 1, Section 2.7.3, Table 2.7.3.5-5, are incomplete, inconsistent, inaccurate, or that clarification is needed. Consequently, in RAI 09.02.02-20, the staff identified that the Tier 1 information needed to be revised to address a number of issues. The applicant provided a response to each of the identified issues. Based on the response, the staff has the following questions:

1. The applicant responded that, consistent with the response to RAI 192-1847, question 14.03.04-15, item 7 will require a report to conclude that the ECWS as built provides adequate flow rates for heat removal for all operating conditions. This approach provides sufficient assurance that acceptance criteria are met without adding excessive detail to Tier 1. The staff believes a report should be prepared to confirm the adequacy of the ECWS design (assumptions, sizing, etc.), but testing is needed to confirm that the ECWS will perform in accordance with design specifications, and inspection is needed to confirm functional arrangement. This issue will remain open until the applicant establishes quantitative acceptance criteria for all ITAAC.
2. The applicant added new ITAAC #13 to address ECWS pump and compression tank testing. The staff reviewed the response and found that it was not sufficient. First, the ITAAC should verify the sizing of the compression tank (including the 7-day makeup water supply), not just the ECWS pump performance at minimum tank level. Second, while the nitrogen make-up and relief valve on the compression tank may be non-safety, an ITAAC is needed for where the nitrogen is relieved so that the staff can confirm that it will not pose a hazard for occupancy. Finally, the ITAAC for ECWS pump NPSH only accounts for minimum compression tank level. The ITAAC should also account for minimum tank pressure and temperature limitations.

References:

MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

MHI's Responses to US-APWR DCD RAI No. 192-1847; MHI Ref: UAP-HF-09167; Dated April 10, 2009; ML091040326.

09.02.02-78

This is a follow-up to RAI 343-2208, Question 09.02.02-13:

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The essential chilled water system (ECWS) must be capable of removing heat from structures, systems and components (SSCs) important to safety during normal operating and accident conditions over the life of the plant in accordance with General Design Criteria (GDC) 44 requirements. The Design Control Document (DCD) does not adequately describe the various operating modes and operator actions that are required and how the ECWS control system functions. RAI 09.02.02-13 was initiated, requesting the applicant to address several technical deficiencies. These considerations need to be fully described in Tier 2, DCD Tier 2 Section 9.2.7. In its response, the applicant addressed the five identified RAI issues. During the staff review of DCD Rev. 2, most of these issues were satisfactorily resolved; however, the staff noted that several will require additional revisions to the DCD by the applicant. The applicant is requested to address the remaining issues as described below.

- For question 4, instrumentation and controls (I&C) related to ECWS automatic operation such as pump and chiller starts signals, trip signals, lock-outs, and permissives should be described in the DCD. This should include loss of offsite power (LOOP) signals and emergency core cooling system (ECCS) actuation signals. The applicant proposed adding the initiation signals to the flow diagram. During a review of DCD Rev. 2, the staff did not find that the I&C automatic initiation signals were added to the flow diagrams nor were they described in the DCD. The applicant needs to address this deficiency.
- For question 5, explain why all instrumentation described in Section 9.2.7.5 are not found on Figure 9.2.7-1 and 9.2.7-2. In addition, indicate whether expansion tank level alarm should be included in Section 9.2.7.5.

Reference: MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.

09.02.02-79

This is a follow-up to RAI 343-2208, Question 09.02.02-17

Means must be provided for monitoring effluent discharge paths and the plant environs for radioactivity that may be released in accordance with General Design Criteria GDC 64 requirements. Also, 10 CFR 52.47(a)(6) and 10 CFR 20.1406 require applicants for standard plant design certifications to describe how facility design and procedures for operation will minimize contamination of the facility and the environment. The staffs review criteria (Standard Review Plan Section 9.2.1, Paragraph III.3.D) specify that provisions should be provided to detect and control leakage of radioactive contamination into and out of the essential service water system (ESWS) which is the heat sink for the essential chilled water system (ECWS). The staff generated RAI 09.02.02-17 to address this concern for the ECWS. In its response, the applicant stated that radiation monitors in the ECWS were not necessary because the compression tanks maintained the system at a higher pressure than potentially contaminated systems. In addition, the applicant stated that the makeup water sources to ECWS contained no contamination. The staff disagrees with the applicant that the ECWS will not contain radioactive material because one of the makeup water paths is the Primary Water System (PWS). As discussed below, the PWS is a contaminated system:

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Figure 9.2.7-1 "Essential Chilled Water System Flow Diagram" shows an interface to PWS VLV-265(A-D)-N. FSAR Section 9.2.7.2.1.1 "Component Descriptions", states, "Makeup water is supplied to the respective surge line. The makeup water is supplied from the following systems.

- Demineralized water system (DWS) which supplies the demineralized water
- Primary makeup water system (PMWS) which supplies the deaerated water"

Section 9.2.6.2.6 "Primary Makeup Water Tanks", states that the tanks also receive distilled water discharged from the boric acid evaporator (subsection 9.3.4). This is shown on Figure 9.2.6-2 "Primary Makeup Water System Flow Diagram".

Section 9.3.4.2.5 "Boron Recycle Subsystem" states "that the boric acid evaporator feed pump transfers water from the holdup tank to the boric acid evaporator by first passing the waste through the boric acid evaporator feed demineralizer, where lithium and radioactive ions are removed. The coolant is then separated into boric acid water of approximately 7,000 ppm Boron and distilled water. The distilled water coming from the boric acid evaporator is transferred to the primary makeup water tank or released to the liquid waste management system (LWMS).

Table 12.2-51 "Miscellaneous Sources - Primary Makeup Water Tank" indicates that the PWS storage tanks contain Cobalt-60.

The applicant should address the staff concerns about this potential for contaminating the ECWS and the possible measures to be used to control and minimize it.

Reference: MHI's Response to US-APWR DCD RAI No. 343-2208; MHI Ref: UAP-HF-09350; Dated July 17, 2009; ML092080395.