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November 19, 2012

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-12289

Subject: MHI's 2nd Amended Response to US-APWR DCD RAI No.584-4468 (SRP 09.02.02) Question 9.2.2-72

References:
1) "Request for Additional Information No. 584-4468 Revision 0, SRP Section: 09.02.02 – Reactor Auxiliary Cooling Water Systems Application Section: 9.2.2 Chilled Water System" dated May 10, 2010.
2) "MHI's Response to US-APWR DCD RAI No.584-4468 Revision 0" dated June 10, 2010.
3) "Amended MHI's Response to US-APWR DCD RAI No.584-4468 Revision 0" dated July 15, 2011.
4) "Audit Report from April 18-19, 2012 to Review US-APWR Design Control Document, Revision 3 Issues for Chapter 9 (Including Calculations)" dated May 15, 2012. (ML12137A002)

With this letter, Mitsubishi Heavy Industries, Ltd. ("MHI") transmits to the U.S. Nuclear Regulatory Commission ("NRC") a document entitled "Amended Response to Request for Additional Information No. 584-4468 (SRP 09.02.02) Question 9.2.2-72".

Enclosed is the response to RAI Question 9.2.2-72 contained within Reference 1 and is the amended version of the response previously transmitted in References 2 and 3. This amended response for Question 9.2.2-72 is being submitted to include additional DCD markups for Section 9.2.7 that were discussed during the April 18-19, 2012 audit of Section 9.2 documented in Reference 4.

Please contact Mr. Joseph Tapia, General Manager of Licensing Department, Mitsubishi Nuclear Energy Systems, Inc. if the NRC has questions concerning any aspect of this submittal. His contact information is provided below.

Sincerely,

Y. Ogata

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

D081
NRO

Enclosure:

1. Amended Response to Request for Additional Information No. 584-4468 (SRP 09.02.02) Question 9.2.2-72

CC: J. A. Ciocco
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Enclosure 1

UAP-HF-12289
Docket No.52-021

Amended Response to Request for Additional Information No. 584-4468 (SRP 09.02.02) Question 9.2.2-72

November 2012

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

11/19/2012

US-APWR Design Certification
Mitsubishi Heavy Industries
Docket No. 52-021

RAI NO.:	**NO.584-4468 REVISION 0**
SRP SECTION:	**09.02.02 – Reactor Auxiliary Cooling Water Systems**
APPLICATION SECTION:	**DCD Tier 2 Section 9.2.7**
DATE OF RAI ISSUE:	**05/10/2010**

QUESTION NO. : 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.

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.

ANSWER:

This RAI response is being revised to include additional DCD markups that were discussed during the April 18-19, 2012 audit of Section 9.2. MHI committed to revise Table 9.2.7-2, as documented in the NRC's audit report dated May 15, 2012 (ML12137A002). This revised RAI response completes the MHI commitment. Note that no changes to the responses below have been made; only the DCD markup is revised.

Question 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.

Answer 1:
The ECWS flowrate and heat removal capacity design assumes the worst-case requirements as input to the sizing calculations. The flowrate requirements for the ECWS pumps are determined by the heat removal requirements of the system loads. The flowrate necessary to remove the design heat load for each air handling unit served, while limiting the temperature rise across the cooling coil to 16°F, is summed for all of the heat loads to arrive at the total required ECWS train flowrate. The highest train flowrate requirement, based on the heat loads served under the worst-case conditions, is used as the basis for the design flowrate for all ECWS trains. These flowrate requirements are conservatively determined to ensure available margin for detailed design. A conservative heat removal capability margin is provided in the design of the air handling units as stated in the response to RAI Question No.09.02.02-7. The worst-case condition for heat load requirements, and therefore ECWS flowrate requirements, is the Abnormal Operation case indicated in DCD Table 9.2.7-2. This case is the LOCA case, and results in the operation of safety-related equipment for accident response and the greatest heat removal requirement for the safety-related HVAC systems and the ECWS.

As stated above, heat removal capability margin is accounted for in the design of the air handling units for safety-related HVAC systems. Therefore, the ECWS is not required to be designed with significant additional margin for heat removal. In addition, other than providing margin through the conservative methods used for calculating flow requirements, additional margin for system resistance increases due to changes in pipe roughness and heat transfer surface fouling is not required since the ECWS is a closed-loop system with deaerated, demineralized water treated with corrosion inhibitors. Significant corrosion or fouling is not expected in this system.

Excess margin available in the ECWS design will not be determined until the detailed design phase. At that time, the system flowrate requirements will be finalized, along with system resistances, to confirm that the ECWS pump design provides a 10% design margin for pump head.

DCD Section 9.2.7.2.1 will be revised to provide a description of the design margins for the ECWS.

Question 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.

Answer 2:
As described in Answer 1 above, ECWS pump flow requirements are based on the design heat removal requirements for the safety-related HVAC air handling units while limiting the temperature rise across the cooling coil to 16°F. The ECWS train with the highest flowrate requirement under worst-case heat load conditions defines the flowrate requirement for all trains. The conservatively determined maximum flowrate requirement for the ECWS pumps is 440 gpm.

As described in DCD Section 9.2.7.2.1, the ECWS consists of four independent trains and each train consists of one 50% capacity system. Each 50% capacity ECWS train provides the cooling capacity required for a HVAC equipment train. DCD Section 9.2.7 will be revised to add a FMEA Table that includes ECWS train chiller unit and chilled water pump failure evaluations.

Question 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.

Answer 3:
As described in Answer 1, the Abnormal Operation condition in DCD Table 9.2.7-2 constitutes the worst-case for ECWS heat removal and flowrate requirements. Therefore, the flow rate values in the table are the bounding values for ECWS flowrate requirements for each heat load. DCD Table 9.2.7-1 provides ECWS equipment and component operating data including system operating temperatures, total flowrate, and pump head. The operating data in Table 9.2.7-1 are determined at the system operating point, which is based on the abnormal operation condition, and are considered bounding values. DCD Section 9.2.7.2.1 will be revised to state that Table 9.2.7-1 values are bounding values.

Question 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.

Answer 4:
The Class 1E Electrical Room HVAC air handling unit trains C and D provide cooling to additional non-safety related spaces (refer to DCD Figure 9.4.5-2) that are not heat loads for trains A and B. As such, the heat load for trains C and D is 2,250,000 Btu/hr each whereas the heat load for trains A and B is 1,650,000 Btu/hr each. Conservatively, these non-safety related heat loads are assumed to remain in the Abnormal Operation condition.

Each train of ECWS is designed for a heat removal requirement assuming the Class 1E Electrical Room HVAC heat load is 2,250,000 per train. This is evidenced by the fact that the Class 1E Electrical Room AHU flowrate requirement identified in DCD Table 9.2.7-2 for ECWS train A and B is identical to the corresponding flowrate requirement for trains C and D. Therefore, each of the ECWS trains is capable of removing the maximum heat load. A note will be added to Table 9.2.7-2 for clarification.

Question 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.

Answer 5:
DCD Section 9.2.7.2.1.2 System Operations will be added to the DCD to provide a description of the normal and abnormal operation of the ECWS. DCD Section 9.2.7.2.2.1 System Operations will be added to the DCD to provide a description of the normal and abnormal operation of the non-ECWS.
The automatic level control for the compression tank is shown on Figure 9.2.7-1 for ECWS and Figure 9.2.7-2 for non-ECWS.

DCD Section 9.2.7.2.1 will be revised to indicate the ECWS response to a SBO event.

Question 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.

Answer 6:
For the safety-related HVAC systems served by the ECWS, COL 9.4(4) is only applicable to heating coil capacity. For these HVAC systems, the COL item is worded "The COL Applicant is to determine the capacity of heating coils that are affected by site specific conditions." Therefore, the safety-related cooling coils are not subject to change based on COL 9.4(4) and there is no affect on ECWS heat removal requirements. No similar COL item is needed. DCD Section 9.4.7 will be revised to clarify COL 9.4(4).

Impact on DCD

DC applicant will revise Tier 2, DCD Revision 3, Section 9.2.7 to add the system design margins, clarify the Class 1E Electrical Room HVAC heat load in Table 9.2.7-2, show the heat load and flow rate under only the worst condition, describe the ECWS response to a SBO event, and add the system operations description for the ECWS and non-ECWS.

Add the following sentence to the end of the first paragraph in Section 9.2.7.2.1.

> **The operating data in Table 9.2.7-1 are determined at the system operating point, which is based on the abnormal operation condition, and are considered bounding values.**

Revise the last sentence of the second paragraph in Section 9.2.7.2.1.

> The ECWS heat transfer and flow requirements ~~for normal plant operation and abnormal conditions~~ **under the worst condition** are shown in Table 9.2.7-2.

Add the following paragraph after the eighth paragraph in Section 9.2.7.2.1.

> **Essential chilled water system heat removal capacity is determined from the design requirements for the air handling unit cooling coils for safety-related HVAC systems, which include a conservative design margin (Section 9.4). The flowrate requirements for the chilled water pumps are determined by the heat removal requirements of the system loads. The required flowrate limits the temperature rise across individual AHU cooling coils to 16°F. The total pump flowrate is that required for all cooling coils in the train. Flowrate and heat load for each cooling load are provide in Table 9.2.7-2.**

Revise the tenth paragraph in Section 9.2.7.2.1 as follows:

> **The ECWS is a closed-loop system and** water chemistry control of ECWS is performed by adding chemicals to the chemical feed tank to prevent long-term corrosion that may degrade system performance. The chemical feed tank...

Revise the third paragraph in Section 9.2.7.2.1.1 as follows:

> **Essential Chilled Water Pump**
>
> Each essential chilled water pump is designed to supply chilled water to all the cooling coils of safety-related HVAC system for the respective train it serves during all plant condition. The pump is designed in consideration of fluctuation in the supplied electrical frequency, increased pipe roughness, and maximum pressure drop through the system components. The pumps are horizontal centrifugal pumps and driven by an ac induction motor. The pumps are designed quality group C as defined in Regulatory Guide 1.26, seismic category I, and are designed in accordance with the requirements of the ASME Section III, Class 3. **The chilled water pump capacity provides a 10% design margin for required pump head.** The essential chilled water pumps have....

Revise Table 9.2.7-2 to show heat load and flow rate under only worst condition as follows:

Train	Component	Flow rate (gpm)	Heat Load (10^3 Btu/h)
A	Main Control Room AHU	44	341
	Class 1E electrical room AHU	288	1,650
	Safeguard component area AHU	24	180
	Emergency feedwater pump area AHU	11	62
	Penetration area AHU	42	330
	Annulus emergency exhaust filtration unit area AHU	4	10
	CCW pump area AHU	4	30
	Essential chiller unit area AHU	4	30
	Charging pump area AHU	4	10
	Spent fuel pit pump area AHU	15	100
	Essential Chilled Water Pump	-	69
B	Main Control Room AHU	44	341
	Class 1E electrical room AHU	288	1,650
	Safeguard component area AHU	24	180
	Emergency feedwater pump area AHU	15	110
	Penetration area AHU	42	330
	Annulus emergency exhaust filtration unit area AHU	4	10
	CCW pump area AHU	4	30
	Essential chiller unit area AHU	4	30
	Spent fuel pit pump area AHU	15	100
	Essential Chilled Water Pump	-	69
C	Main Control Room AHU	44	341
	Class 1E electrical room AHU	288	2,290
	Safeguard component area AHU	24	180
	Emergency feedwater pump area AHU	15	110
	Penetration area AHU	42	330
	Annulus emergency exhaust filtration unit area AHU	4	10
	CCW pump area AHU	4	30
	Essential chiller unit area AHU	4	30
	Spent fuel pit pump area AHU	15	100
	Essential Chilled Water Pump	-	69
D	Main Control Room AHU	44	341
	Class 1E electrical room AHU	288	2,290
	Safeguard component area AHU	24	180
	Emergency feedwater pump area AHU	11	62
	Penetration area AHU	42	330
	Annulus emergency exhaust filtration unit area AHU	4	10
	CCW pump area AHU	4	30
	Essential chiller unit area AHU	4	30
	Charging pump area AHU	4	10
	Spent fuel pit pump area AHU	15	100
	Essential Chilled Water Pump	-	69

Add Note 2 for the Class 1 Electrical Room AHU – Abnormal Operation heat load in Table 9.2.7-2 as follows:

Note:
(1) Dash (-) indicates no requirement.
<u>(2) The trains C and D Class 1 Electrical Room AHU heat load conservatively includes additional non-safety related heat loads. This higher heat load is used for the heat removal capability design for each of the ECWS trains.</u>

Revise the fourth paragraph in Section 9.2.7.2.1, as follows:

During LOOP, each of the essential chilled water system is powered from the respective safety emergency power source. **<u>The essential chiller units stop for one hour after a SBO occurs until the alternate ac gas turbine generator restores power (Chapter 8, Section 8.4).</u>**

Add the last paragraph in Section 9.2.7.2.2, as follows:

The non-ECWS is capable of performing alternate cooling of the containment fan cooler units through CCWS and the alternate source of component cooling water to the charging pump in a severe accident. The non-ECWS cooling tower and condenser water pump are capable of providing the alternate source of component cooling water to the charging pump in order to maintain RCP seal water injection.

Add Section 9.2.7.2.1.2 and 9.2.7.2.2.1, and associated subsections, as follows:

9.2.7.2.1.2 System Operations
Table 9.2.7-2 provides heat loads and water flow rates for individual ECWS heat loads for normal and abnormal operating modes.

9.2.7.2.1.2.1 Normal Power Operation
During normal operation, two trains of ECWS are placed in service. A total of two essential chilled water pumps and two essential chiller units are in operation. An operating essential chilled water pump supplies chilled water to cooling coils of safety-related HVAC systems through the chiller units. The chiller units and pumps that are not in service are placed in standby. In the event that a required chiller unit malfunctions or trips, a standby chiller unit can be manually placed in service.

The essential chiller units can be controlled manually from the MCR or RSC.

The chiller unit includes a start permissive that ensures that chilled water and condenser water flows are established prior to chiller unit start.

9.2.7.2.1.2.2 Loss of Offsite Power
In the event of a LOOP, four essential chilled water pumps and four essential chiller units are powered from the emergency power source and they are actuated automatically by the LOOP load sequence signal. As a minimum, two trains are required to operate during a LOOP.

9.2.7.2.1.2.3 Loss of Coolant Accident
In the event of a LOCA, four essential chilled water pumps and four essential chiller units are actuated automatically upon receipt of the ECCS actuation signal, and are loaded onto

their respective Class 1E power source. As a minimum, two trains are required to operate during a LOCA."

9.2.7.2.2.1 System Operations
9.2.7.2.2.1.1 Normal Power Operation
During plant startup, shutdown, and power operation, and while in cold shutdown/refueling conditions, three non-essential chilled water pumps and three non-essential chiller units, including dedicated cooling towers and condenser pumps, are operated. The additional train of equipment is placed in standby.

9.2.7.2.2.1.2 Loss of Offsite Power
During the LOOP conditions, two non-essential chilled water pumps and two non-essential chiller units are powered from the permanent non-safety power distribution system and are actuated automatically. In the event of a LOOP, the non-essential chilled water pumps and the non-essential chiller units are actuated to protect property and assets.

9.2.7.2.2.1.3 Loss of Coolant Accident
In the event of a LOCA, the non-ECWS containment isolation valves are automatically closed upon receipt of the containment isolation signal.

9.2.7.2.2.1.4 Severe Accident
The CCWS can be manually aligned to supply the cooling water to the containment fan cooler units via the non-ECWS for mitigating containment failure in a severe accident condition.

The non-ECWS can be manually aligned to provide an alternate source of component cooling water to the charging pumps in order to maintain RCP seal water injection in the event of a loss of component cooling water in a severe accident condition.

DC applicant will revise Tier 2, DCD Revision 3, Section 9.4.7, to clarify COL 9.4(4), as follows:

COL 9.4(4) *The COL Applicant is to determine the capacity of* ***heating coils provided in the safety-related HVAC system and the capacity of*** *cooling and heating coils provided in the* ***non-safety related HVAC system*** *air handling units that are affected by site specific conditions.*

DC applicant will revise Tier 2, DCD Revision 3, Section 9.2.7 to add the ECWS FMEA in Table 9.2.7-3.

Revise the first paragraph in Section 9.2.7.3.1, as follows:

The essential chilled water system is designed to perform its safety function with only two out of four trains operating. **As shown in Table 9.2.7-3, the**~~The~~ essential chilled water system is completely separate and a single failure does not compromise the system's safety function even if one train is out of service for maintenance.

Add Table 9.2.7-3, as follows:

Table 9.2.7-3 Essential Chilled Water System Failure Modes and Effects Analysis

Item	Component	Safety Function	Failure Mode	Effect on System Safety Function	Failure Detection Method
1	Essential Chiller Unit	Provides chilled water to safety-related HVAC AHU cooling coils	Fails to provide chilled water	None Three 50% capacity Essential Chiller Units remain available. Only two are required.	Essential Chiller Unit operating information in the MCR includes RUN indication, high temperature alarm, temperature indication and flow indication.
2	Essential Chilled Water Pump	Provides chilled water flow to safety-related HVAC AHU cooling coils	Fails to provide chilled water flow	None Three 50% capacity Essential Chilled Water Pumps remain available. Only two are required.	Essential Chilled Water Pump operating information in the MCR includes RUN indication and flow indication.

See Attachment 1 mark-up DCD Revision 3 Tier 2, pages 9.2-62, 9.2-121, and 9.2-122 for new DCD changes associated with this response revision. See UAP-HF-11217 Attachment 2 mark-up DCD Revision 3 Tier 2 pages 9-45, 9-46, 9.2-48, 9.2-91, and 9.4-49 for changes associated with the previous response (July 15, 2011).

Impact on R-COLA

There is no impact on the R-COLA.

Impact on S-COLA

There is no impact on the S-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on a Technical/Topical Report.

This completes MHI's response to the NRC's question.

- The non-essential chilled water system supplies 40^{o} F chilled water to the HVAC systems cooling coils during plant normal operation and LOOP.
- The non-essential chilled water system pressure boundary and pressure boundary components are designed to meet ASME Section VIII, and ASME/ANSI B31.1.
- The non-essential chilled water system does not serve any safety function. Therefore, the single failure criterion does not apply.
- The non-essential chilled water system provides accessibility for adjustment, periodic inspection, and maintenance activities to assure continuous functional reliability.

9.2.7.2 System Description

9.2.7.2.1 Essential Chilled Water System

The essential chilled water system flow diagram is shown in Figure 9.2.7-1, equipment and component data is presented in Table 9.2.7-1. The operating data in Table 9.2.7-1 are determined at the system operating point, which is based on the abnormal operation condition, and are considered bounding values. DCD_09.02.02-72

The essential chilled water system consists of four independent trains and each train consists of one 50% capacity system. Each system includes, a water-cooled chiller, a chilled water pump, a compression tank with a make-up water line, a chilled water distribution loop, and instrumentation and control system. The condenser (heat rejection) section of each chiller is supplied with cooling water from the respective essential service water system during both normal and emergency operating conditions. The ECWS heat transfer and flow requirements ~~for normal plant operation and abnormal conditions~~under the worst condition are shown in Table 9.2.7-2. DCD_09.02.02-72 S01

The motor operated three-way control valves are located on the retune lines from each safety-related air handling unit cooling coils. These valves control the heat removal capacity by modulating the flow rate of chilled water through the AHU cooling coils in response to a temperature control signal. The motor operated three-way control valves fail “as is” upon a loss of control signal or electrical power.

During LOOP, each of the essential chilled water system is powered from the respective safety emergency power source. The essential chiller units stop for one hour after a SBO occurs until alternate ac gas turbine generator restores power (Chapter 8, Section 8.4). DCD_09.02.02-72

The chiller of each essential chilled water system is equipped with an integral chilled water temperature control system.

The chillers are protected by ~~a~~ pressure-relief devices to safely relieve overpressure, which ~~and~~ are vented~~piped~~ to the outside of the building in accordance with ANSI/ASHRAE Standard 15 to prevent the discharge from entering any building. The essential chiller units are located within the essential chiller mechanical equipment rooms. ~~And t~~The chiller mechanical equipment rooms meet ANSI/ASHRAE Standard 15 requirements DCD_06.04-14 DCD_06.04-17

Table 9.2.7-2 Essential Chilled Water Heat Load and Flow Rate (Sheet 1 of 2)

Train	Component	Flow rate (gpm)		Heat Load (10^3 Btu/h)		
		~~Normal Operation~~	~~Abnormal Operation~~	~~Normal Operation~~	~~Abnormal Operation~~	DCD_09.02.02-72 S01
A	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341	
	Class 1E electrical room AHU	~~285~~	~~285~~288	~~1,650~~	1,650	DCD_09.02.02-78
	Safeguard component area AHU	-	~~26~~24	-	180	
	Emergency feedwater pump area AHU	~~11~~	11	~~60~~	~~60~~62	DCD_09.02.02-78
	Penetration area AHU	-	42	-	330	
	Annulus emergency exhaust filtration unit area AHU	-	4	-	10	
	CCW pump area AHU	-	4	-	30	
	Essential chiller unit area AHU	-	4	-	30	
	Charging pump area AHU	-	4	-	10	
	Spent fuel pit pump area AHU	-	15	-	100	
	Essential Chilled Water Pump		-		69	
B	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341	
	Class 1E electrical room AHU	~~285~~	~~285~~288	~~1,650~~	1,650	DCD_09.02.02-78
	Safeguard component area AHU	-	~~26~~24	-	180	
	Emergency feedwater pump area AHU	-	15	-	110	
	Penetration area AHU	-	42	-	330	
	Annulus emergency exhaust filtration unit area AHU	-	4	-	10	
	CCW pump area AHU	-	4	-	30	
	Essential chiller unit area AHU	-	4	-	30	
	Spent fuel pit pump area AHU	-	15	-	100	
	Essential Chilled Water Pump		-		69	

Note:
(1) Dash (-) indicates no requirement:
(2) The trains C and D Class 1E Electrical Room AHU heat load conservatively includes additional non-safety related heat loads. This higher heat load is used for the heat removal capability design for each of the ECWS trains. DCD_09.02.02-78

Table 9.2.7-2 Essential Chilled Water Heat Load and Flow Rate (Sheet 2 of 2)

Train	Component	Flow rate (gpm)		Heat Load (10^3 Btu/h)	
		~~Normal Operation~~	~~Abnormal Operation~~	~~Normal Operation~~	~~Abnormal Operation~~
C	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341
	Class 1E electrical room AHU	~~285~~	~~285~~288	~~2,250,~~	~~2,250~~2,290
	Safeguard component area AHU	-	~~26~~24	-	180
	Emergency feedwater pump area AHU	-	15	-	110
	Penetration area AHU	-	42	-	330
	Annulus emergency exhaust filtration unit area AHU	-	4	-	10
	CCW pump area AHU	-	4	-	30
	Essential chiller unit area AHU	-	4	-	30
	Spent fuel pit pump area AHU	-	15	-	100
	Essential Chilled Water Pump		-		69
D	Main Control Room AHU	~~45~~	~~45~~44	~~341~~	341
	Class 1E electrical room AHU	~~285~~	~~285~~288	~~2,250~~	~~2,250~~2,290
	Safeguard component area AHU	-	~~26~~24	-	180
	Emergency feedwater pump area AHU	~~11~~	11	~~60~~	~~60~~62
	Penetration area AHU	-	42	-	330
	Annulus emergency exhaust filtration unit area AHU	-	4	-	10
	CCW pump area AHU	-	4	-	30
	Essential chiller unit area AHU	-	4	-	30
	Charging pump area AHU	-	4	-	10
	Spent fuel pit pump area AHU	-	15	-	100
	Essential Chilled Water Pump		-		69

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Note:
(1) Dash (-) indicates no requirement:
(2) The trains C and D Class 1E Electrical Room AHU heat load conservatively includes additional non-safety related heat loads. This higher heat load is used for the heat removal capability design for each of the ECWS trains.

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