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June 19, 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- 09326

Subject: MHI's Responses to US-APWR DCD RAI No. 326-2279 Revision 0

Reference: [1] "Request for Additional Information No. 326-2279 Revision 0, SRP Section: 09.02.01 – Station Service Water System - Design Certification and New License Applicants, Application Section: 9.2.1," dated April 8, 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. 326-2279 Revision 0".

Enclosure 1 contains the responses to 28 questions in 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.

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NRO

Enclosures:

1. Responses to Request for Additional Information No. 326-2279 Revision 0

CC: J. A. Ciocco
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Docket No. 52-021
MHI Ref: UAP-HF- 09326

Enclosure 1

UAP-HF-09326
Docket No. 52-021

Responses to Request for Additional Information
No. 326-2279 Revision 0

June 2009

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-3

Standard Review Plan Section 9.2.1, "Station Service Water System," and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. During the review of the information in Tier 2 of the design control document (DCD), Section 9.2.1, "Essential Service Water System", the staff found the description of the essential service water system (ESWS) to be generally incomplete and does not adequately explain how design bases considerations are satisfied by the proposed design, the heat transfer requirements and capabilities, what limiting assumptions apply, how much excess margin is available, what operating conditions and experience insights are relevant and how they are addressed, and so forth. Consequently, information in Tier 1 and Tier 2 of the DCD needs to be revised to include information that is sufficient to demonstrate that the ESWS is capable of performing its design-bases functions, that applicable design considerations are satisfied by the proposed design, and that reasonable assurance exists that the availability and design-bases capability will be maintained over the life of the plant.

ANSWER:

Revision 1 of Tier 2 DCD Section 9.2.1 together with the responses to RAIs 9.2.1-4 thru 9.2.1-30, including proposed changes to the DCD, provide detailed information adequately explaining ESW system design bases, heat transfer capabilities, margins available, inspection, testing maintenance and surveillance requirements.

Response to RAI 9.2.1-9 describes margin provided in the ESW pump design. Table 9.2.1-3 provides heat loads and flow requirements for all operating modes of ESWS operation. ESW system requires approximately 12000 gpm per train for all plant operating modes, including accident mitigation. The pump is designed for 13000 gpm. Total Dynamic Head (TDH) required to be developed by the pump depends upon type and location of UHS and is thus site specific. Adequate margin will be added to TDH computation.

Bulk of the heat is transferred to the ESW system in the CCW heat exchangers. Design details of the heat exchanger are provided in Tier 2 DCD Section 9.2.2, "Component Cooling Water System."

Limiting assumptions such as maximum operating temperatures and pressures, UHS water level, and pump suction elevation are site specific and must be provided by the COL applicant.

ESW system layout provides inherent protection to minimize the impact of adverse operational occurrence like water hammer. Adverse environmental conditions like freezing are site specific.

ESW system components required to be included in ISI and IST programs are identified in Tier 2 DCD Table 3.9-13, Table 3.9-14, and Section 6.6.

The information provided in the Tier 2 DCD Section 9.2.1 including proposed revisions does demonstrate that ESWS is capable of performing its design-bases functions. Programs and procedures will be developed by the COL applicant to provide reasonable assurance that the availability and design bases-capability will be maintained over the life of the plant, as stated in COL 9.2(23).

Tier 1 DCD Subsection 2.7.3.1 provides an upper level description of the ESWS. The ESWS ITAAC in Tier 1 DCD Table 2.7.3.1-5 will be revised to include verification of key aspects of the system. The ITAAC include verification of adequate heat removal capability under all plant operating conditions, including normal plant operating, abnormal and accident conditions. Refer to the response to RAI 9.2.1-29, which addresses some other specific aspects of Tier 1 information for ESWS.

Impact on DCD

Tier 1 DCD Table 2.7.3.1-5, item 7 will be revised, as formerly addressed in the response to RAI 192-1847, question 14.03.04-14. The table is as shown below:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The ESWS **components identified in Table 2.7.3.1-2** provide adequate cooling water ~~required for the various components~~ **to the CCW heat exchangers and chiller units of the ECWS** during all plant operating conditions, including normal plant operating, abnormal, and accident conditions.	7.**i** ~~Tests of the as-built ESWS~~ **An inspection of a report that determines the capability of the as-built ESWS** will be performed.	7.i **A report exists that** ~~T~~the as-built ESWS provides adequate cooling water **to the CCW heat exchangers and the essential chiller units of the ECWS** ~~required for the various components~~ during all plant operating conditions, including normal plant operating, abnormal, and accident conditions.
	7.ii Tests will be performed to confirm that the as-built ESWS pumps can provide flow to the CCW heat exchangers and the essential chiller units of the ECWS.	**7.ii The as-built ESWS pumps identified in Table 2.7.3.1-2 are capable of achieving their design flow rate.**

Impact on COLA

No specific impact on the COLA due to response to this RAI.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-4

Standard Review Plan Section 9.2.1, Station Service Water System, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. The staff noted that Tier 2, Design Control Document (DCD) Section 9.2.1.1 states that the essential service water system (ESWS) performs both safety-related as well as non-safety related functions and that the ESWS is designed with the capability to isolate non-safety related portions of the system. The staff was unable to find non-safety related components listed in Tier 2, DCD Table 3.2.2, "Classification of Mechanical and Fluid System, Components, and Equipment," or in either of the two system drawings or diagrams; Tier 1, Figure 2.7.3.1-1, "Essential Service Water System", and Tier 2, Figure 9.2.1-1, "Essential Service Water System Piping and Instrumentation Diagram", for the non-safety components of the ESWS. The DCD should discuss the following items related to GDC 2.

1. Provide clarification in Tier 1 Section 2.7.3 and Tier 2 Section 9.2.1 of the DCD related to the non-safety related function. Provide clarification related to the nonsafety-related function in all appropriate sections of the DCD.

2. Address (a) how ESWS integrity and operability is assured by the safety-related boundary with non-safety components so that common-cause simultaneous failure of all non-safety related ESWS piping will not compromise the ESWS safety functions during seismic events, and (b) a description of any other performance assumptions that pertain to the boundary isolation valves or other parts of the system that are necessary to assure the capability of the ESWS to perform its safety functions during natural phenomena. Describe the boundaries of the safety-related and non-safety related portions of the ESWS and how the system meets the GDC 2, ensuring the capability of the system to perform its safety-related functions during natural phenomena.

ANSWER:

ESWS does not provide cooling water to any nonsafety-related component. However, some portions of the system are nonsafety-related, e.g., sections of pipe in the heat exchanger drains piping after the isolation valves. These isolation valves, which provide separation between safety-related and nonsafety-related portions, are normally closed. Drain piping for maintenance operations will not be shown in the system's P&ID, therefore, the Tier 2 DCD Figure 9.2.1-1 will

be revised to show only the building boundaries between safety-related equipment in different locations (see revised figure in RAI 09.02.01-6 response). No equipment classification will be made concerning the ditto piping.

Capability to automatically isolate nonsafety-related portions of the system is site specific and depends upon the type of ultimate heat sink. Sites using cooling towers will require isolation of the intake basin blowdown system to prevent water inventory loss.

Answer to Part 1

ESWS operates during all modes of plant operation including accident mitigation. System operation during power generation mode is a nonsafety-related function. Clarification related to the nonsafety-related function will be provided in appropriate DCD sections. Clarification related to the nonsafety-related function will be provided in all appropriate sections of the DCD.

Answer to Part 2

(a) Nonsafety-related portions of the ESWS piping are isolated by the safety-related valves (in heat exchanger drain pipes) from safety-related portions of the system. These valves are normally closed. Simultaneous failure of all nonsafety-related ESWS piping will not impact operation of any ESWS train and will not affect ESWS capability to perform its safety function.

(b) Boundaries between safety-related and nonsafety-related portions are described above. All boundary isolation valves are normally closed. Compliance with GDC 2 to ensure that the system will perform its safety function is described in Tier 2 DCD Subsection 9.2.1.1.1.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.1.2 will be revised to change the title of this subsection will be changed to read "**Nonsafety-Related Design Bases** and include the following after the 1st paragraph:

~~"The ESWS is designed to provide cooling water to the plant components and transfer heat to the UHS during all modes of normal operation.~~ **The ESWS does not provide cooling water to any nonsafety-related component. However, some portions of the system are nonsafety-related, e. g., sections of pipe in heat exchanger drains piping after the isolation valves. These boundary isolation valves which provide separation between the safety-related and nonsafety-related portions are normally closed. During a design basis event, postulated simultaneous failure of all nonsafety-related piping would not impact operation of any ESW train and would not affect ESWS capability to perform its safety functions.**"

The following COL items will be revised in DCD Chapter 1 Table 1.8-2 Compilation of All Combined License Applicant Items for Chapters 1-19 and DCD 9.2.10 Combined License Information.

COL 9.2(7) *The COL Applicant is to provide the piping, valves,* ***including those at the boundary between the safety-related and nonsafety-related portions,*** *and other design of the ESWS related to the site specific conditions, including the safety evaluation.*

Impact on COLA

The COL applicant is to address site specific, nonsafety-related system isolation as applicable. This will be addressed as the resolution to COL 9.2(7).

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-5

Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. The review criteria of SRP 9.2.1, Station Service Water System, requires that essential system components are protected from the effects of high and moderate energy line breaks. Although essential service water system (ESWS) design pressure and temperature was provided in Tier 2, Design Control Document (DCD), Section 9.2.1, the staff found that information pertaining to the system's operating pressure and temperature was not provided in Tier 2, DCD Section 9.2.1 to make a final determination of the proper designation as high or moderate energy. Describe the system operating data of pressure and temperatures in metric units to confirm the designation of moderate-energy.

ANSWER:

System operating pressure and temperature are site specific data dependent upon location and selection of ultimate heat sink. Operating temperature depends upon site meteorological data. However, the design pressure and temperature provided in Tier 2 DCD Table 9.2.1-1 bounds the maximum operating pressure and temperature. This data also facilitates designation of the system as moderate-energy since maximum operating pressure and temperature will not exceed the design pressure and temperature.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: **NO. 326-2279 REVISION 0**

SRP SECTION: **9.2.1 – Station Service Water System**

APPLICATION SECTION: **9.2.1**

DATE OF RAI ISSUE: **4/8/2009**

QUESTION NO.: 09.02.01-6

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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, "Cooling Water," requirements. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. Provide a system description as well as piping and instrumentation diagrams (P&IDs) for the essential service water system (ESWS) showing all of the systems equipment used for normal and abnormal operations. The staff found instances of incomplete descriptive information and missing equipment in Tier 1 DCD Figure 2.7.3.1-1, "Essential Service Water System," and in Tier 2 DCD Figure 9.2.1-1, "Essential Service Water System Piping and Instrumentation Diagram." Include in the Design Control Document (DCD); 1) more information related to a complete description of the ESWS system and, 2) all system equipment is to be included on the Tier 1 and Tier 2 drawings, to include the following:

- Tier 2 of the DCD Section 9.2.1 provides a description of components used to prevent water hammer. In addition, describe how the ESWS is filled and vented. These components should be shown on Tier 1 and Tier 2 system diagrams. Discuss the need for system vacuum breakers.
- Tier 2 of the DCD Section 9.2.1; for the two strainers in parallel downstream of the ESWS pumps (ESWSP), provide the piping connections used to back-flush an isolated, clogged strainer. Describe how the strainers are backwashed.
- Tier 1 and Tier 2 system drawing and diagrams of the DCD should indicate the building locations for ESWS components and indicating where the building transition occurs.
- Tier 2 of the DCD Section 9.2.1 does not provide design details such as system operating temperatures, pressures, and flow rates for all operating modes and alignments.
- Tier 2 of the DCD Figure 9.2.1-1 indicates a coolant line downstream of the two parallel strainers which provides coolant to the ESWS pump motor. The system description does not discuss this function or the required flow rates for this function.
- Tier 2 of the DCD Figure 9.2.1-1 does not show a separate strainer to the essential chiller units. This figure does not show any connections that would be used for backwash (cleaning) of the essential chiller units. Provide these on the figures and describe in Section 9.2.1 or provide the basis for why they are not needed.

- The system description does not provide an indication as to whether the ESWS backwash for the strainers utilizes a motor, and if so, how these are classified and powered (i.e. safety-related, Class1E).
- Tier 1of the DCD Figure 2.7.3.2-1 does not show all of the system components, for example the radiation monitors, the strainers and piping for backwashing strainers and heat exchangers. A similar level of detail needs to be provided in the Tier 1 and Tier 2 drawings of the DCD in order to meet inspections, tests, analyses, and acceptance criteria (ITAAC) commitments for verifying system configuration.
- Provide a discussion in Section 9.2.1 of the DCD on the ESWS pump discharge motor operated valve (MOV) logic for opening and closing, during any accident conditions. The Tier 2 Section 9.2.1 description does not provide a complete understanding of the logic of the MOVs. For example, describe any time or a signal delay on the opening of the MOVs after the ESWS pump start or stops. Also address and described in the DCD how long the ESWS pumps are deadheaded as the pump discharge valve opens and state that this time is acceptable for long term pump performance. Describe the results if the MOV does not open with the pump operating and resultant system alarms provided in the main control room.
- Tier 2 of the DCD Section 9.2.1 system description is not clear on how many ESWS trains are normally operating and how many system trains are in standby during various operating conditions.
- Tier 2 of the DCD Figure 9.2.1-1, sheet 2 of 3, describes the piping classification downstream of the ESWS pump motor.
- The system descriptions in Tier 2 of the DCD did not describe the essential service water piping tunnel for trains A, B, C and D. It is not clear that some of the ESWS piping is underground or in a tunnel, or both.
- Tier 2 of the DCD Section 9.2.1.2.1, typo 'doses not' should be 'does not.' There are many other typos in Section 9.2.1.
- Tier 2 of the DCD Section 9.2.1.2.2.5 states that the underground piping is lined; provide clarification of the materials.
- Tier 2 of the DCD Table 9.2.1-1, the CCWS heat exchange should be designed for total system flows for maximum flushing results.
- Tier 2 of the DCD Section 9.2.1, the design bases of the maximum ESW temperature is missing.

ANSWER:

Question:

- Tier 2 of the DCD Section 9.2.1 provides a description of components used to prevent water hammer. In addition, describe how the ESWS is filled and vented. These components should be shown on Tier 1 and Tier 2 system diagrams. Discuss the need for system vacuum breakers.

Answer:

As discussed in Tier 2 DCD Section 9.2.1, the ESWS layout ensures that the fluid pressure in the system is above saturation condition at all locations. The ESWS layout, in combination with the motor-operated valves at the discharge of each ESW pump, minimizes the potential for transient water hammer. The starting logic of the ESW pump interlocks the motor-operated valve with pump operation. The MOV opens gradually to prevent sudden surge of ESW, thus precluding water hammer. Voiding in any train may occur on loss of offsite power and subsequent pump trip. To preclude water hammer on pump re-start, the MOV at each pump discharge is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed.

The CCW heat exchangers and essential chilled water chillers are located at a much lower elevation (-26' 4") than the ESWS pumps and ultimate heat sink. The location of the ESW pumps intake structure, and UHS is site-specific. The system layout assures that all points in the system are above atmospheric pressure. Therefore, a vacuum breaker is not required. Plant procedures will be developed for system filling and venting (see response for RAI 09.02.01-30 on a new COL item, COL 9.2(25).

Question:

- Tier 2 of the DCD Section 9.2.1; for the two strainers in parallel downstream of the ESWS pumps (ESWSP), provide the piping connections used to back-flush an isolated, clogged strainer. Describe how the strainers are backwashed.

Answer:

Tier 2 DCD Subsection 9.2.1.2.2.2 provides discussion on two 100% strainers located in each ESW pump discharge line. The strainers are manually cleaned. When the differential pressure across the clogged strainer reaches a predetermined set pressure, alarms are sent to the MCR and the clogged strainer is isolated manually and the standby strainer is placed in service. These are basket-type strainers that do not need back-flushing; instead the strainer cartridges will be manually replaced when they become clogged.

Question:

- Tier 1 and Tier 2 system drawing and diagrams of the DCD should indicate the building locations for ESWS components and indicating where the building transition occurs.

Answer:

Tier 1 DCD Figure 2.7.3.1-1, and Tier 2 DCD Figure 9.2.1-1 will be revised to indicate the building locations, and where building transition occurs.

Question:

- Tier 2 of the DCD Section 9.2.1 does not provide design details such as system operating temperatures, pressures, and flow rates for all operating modes and alignments.

Answer:

System operating pressure and temperature are site specific. The ESW flow to each user is established by system resistance and does not require automatic control. The flow balance remains unchanged for each user during all modes of operation.

Question:

Tier 2 of the DCD Figure 9.2.1-1 indicates a coolant line downstream of the two parallel strainers which provides coolant to the ESWS pump motor. The system description does not discuss this function or the required flow rates for this function.

Answer:

The ESW pump motor is water cooled by tapping the ESW header downstream of the basket-type strainers towards the pump. Pump motor cooling flow rates depend on vendor specifications; enough margin is included for possible flow rate variations.

Question:

- Tier 2 of the DCD Figure 9.2.1-1 does not show a separate strainer to the essential chiller units. This figure does not show any connections that would be used for backwash (cleaning) of the essential chiller units. Provide these on the figures and describe in Section 9.2.1 or provide the basis for why they are not needed.

Answer:

The strainer provided at the inlet of the CCW heat exchanger precludes suspended impurities build up. This strainer is continuously blown down to prevent clogging. This minimizes heat exchanger backwashing frequencies during plant operation. The strainers located at the pump discharge provide adequate protection for the essential chillers heat exchanger, thus no additional strainer is required.

Question:

- The system description does not provide an indication as to whether the ESWS backwash for the strainers utilizes a motor, and if so, how these are classified and powered (i.e. safety-related Class1E).

Answer:

None of the strainers are backwashed, therefore, no electrical power requirements apply.

Question:

- Tier 1 of the DCD Figure 2.7.3.2-1 does not show all of the system components, for example the radiation monitors, the strainers and piping for backwashing strainers and heat exchangers. A similar level of detail needs to be provided in the Tier 1 and Tier 2 drawings of the DCD in order to meet inspections, tests, analyses, and acceptance criteria (ITAAC) commitments for verifying system configuration.

Answer:

A revised Tier DCD Figure 2.7.3.2-1 will be incorporated in the DCD to contain the same level of details to meet ITAAC commitment verification.

Question:

- Provide a discussion in Section 9.2.1 of the DCD on the ESWS pump discharge motor operated valve (MOV) logic for opening and closing, during any accident conditions. The Tier 2 Section 9.2.1 description does not provide a complete understanding of the logic of the MOVs. For example, describe any time or a signal delay on the opening of the MOVs after the ESWS pump start or stops. Also address and described in the DCD how long the ESWS pumps are deadheaded as the pump discharge valve opens and state that this time is acceptable for long term pump performance. Describe the results if the MOV does not open with the pump operating and resultant system alarms provided in the main control room.

Answer:

The ESWS pump discharge MOV is interlocked with the pump operation. After the predetermined time delay after the pump starts, the valve starts opening. The valve is interlocked to open as gradually as possible to preclude water hammer. This short time duration during which the pumps are deadheaded is not detrimental for long term pump performance. If the valve fails to open, the

pump is stopped and this is alarmed in the control room. When the pump is stopped or tripped the discharge MOV is closed.
Question:

- Tier 2 of the DCD Section 9.2.1 system description is not clear on how many ESWS trains are normally operating and how many system trains are in standby during various operating conditions.

Answer:

The ESWS consists of four independent trains. During normal plant operation, as indicated in Tier 2 DCD Table 9.2.1-2, two trains are operating and the other two trains are in standby. Each train is designed to provide 50% of cooling capacity required for design basis accident and for safe shutdown with LOOP. The ESWS is designed to perform its safety function of accident mitigation assuming that one train is out of service for maintenance coincident with the loss of offsite power and a single failure in another train. The above discussion will be incorporated in Tier 2 DCD.

Question:

- Tier 2 of the DCD Figure 9.2.1-1, sheet 2 of 3, describe the piping classification downstream of the ESWS pump motor.

Answer:

Tier 2 DCD Figure 9.2.1-1, Sheet 2 of 3, shows an Equipment Class 3 piping downstream of the ESW pump motor-discharging into intake basin. Therefore, it is safety-related.

Question:

- The system descriptions in Tier 2 of the DCD did not describe the essential service water piping tunnel for trains A, B, C, and D. It is not clear that some of the ESWS piping is underground or in a tunnel, or both.

Answer:

The ESWS piping is located either underground or in the pump house and in the RB. Tier 2 DCD in Section 9.2.1.2.5 addresses the piping layout. Underground piping is installed in the trenches, and/or tunnels. Manholes are provided at appropriate locations to facilitate periodic inspection.

Question:

- Tier 2 of the DCD Section 9.2.1.2.1, typo 'doses not' should be does not.' There are many other typos in Section 9.2.1.

Answer:

Tier 2 DCD Section 9.2.1 and Subsection 9.2.1.2.1 will be revised to correct typographical errors.

Question:

- Tier 2 of the DCD Subsection 9.2.1.2.2.5 states that the underground piping is lined; provide clarification of the materials.

Answer:

Underground piping is epoxy lined carbon steel. Tier 2 DCD Subsection 9.2.1.2.2.5 will be revised to specify lining material for underground piping during detail design phase.

Question:

- Tier 2 of the DCD Table 9.2.1-1, the CCWS heat exchanger should be designed for total system flows for maximum flushing results.

Answer:

The ESWS water flows to the ESWS pump motor, CCWS heat exchanger, and essential chiller coolers. Most of the heat is transferred in the CCW heat exchanger, and therefore, bulk of the water flows to the CCW heat exchanger. Required backflush water flow will be based on the heat exchanger manufacturer recommendation for maximum flushing.

Question:

- Tier 2 of the DCD Section 9.2.1, the design bases of the maximum ESW temperature is missing.

Answer:

The ESW maximum operating temperature of 95° F is based on the bounding meteorological and water source conditions from representative locations in the United States. This temperature is deemed conservative. The above discussion will be incorporated in Tier 2 DCD Subsection 9.2.1.2.1.

Impact on DCD

The 4th paragraph of Tier 2 DCD Subsection 9.2.1.2.1 will be revised to include the following:

"The ESWS layout ensures that the fluid pressure in the system is above saturation condition at all locations. T~~his~~e **ESWS layout**, in combination with the ~~control of the pump discharge~~ **motor-operated valves at the discharge of each ESW pump**, minimizes the potential for transient water hammer. **The starting logic of the ESW pump interlocks the operation of the motor operated valve with the pump operation. The voiding in any train may occur on loss of offsite power and subsequent pump trip. To preclude water hammer on pump re-start, the MOV at each pump discharge is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed. After a predetermined time delay after the pump starts, the MOV starts to gradually open to preclude water hammer. If the valve fails to open the pump is tripped and alarmed in the MCR. The short time duration during which the pump is dead headed is not detrimental for long term pump performance.**"

In Subsection 9.2.1.2.2.1, the following will be added at the end of this subsection:

"The ESW pump motors are water cooled."

The 1st paragraph of Subsection 9.2.1.2.2.2 will be replaced to read as follows:

"Two 100% capacity strainers are located in each ESW pump discharge line. **The differential pressure across the operating strainer is monitored.** When **the predetermined high**~~the~~ differential **set** pressure **is alarmed in the MCR,** ~~across~~ the **clogged** strainer **is place out of service by first shutting off the ESW pump and then closing the strainer isolation valves.** ~~reaches a predetermined set pressure the clogged strainer is isolated, and t~~**T**he standby strainer

is **then** placed in service **by manually opening the strainer isolation valves**. The ~~isolated~~ **clogged** strainer **cartridge** ~~is~~ **will be** manually ~~backwashed~~ **replaced.**

One 100% capacity self-cleaning type strainer is located upstream of each CCW HX. ~~The continuous backwash water is discharged downstream of the CCW heat exchanger.~~ **The strainer is continuously blown down at a rate of 500 gpm to prevent buildup of impurities and clogging of the CCW heat exchangers. The blowdown water is discharged downstream of the CCW heat exchanger.**"

In Subsection 9.2.1.2.2.5, the 3rd sentence will be revised to read as follows;

"Underground piping is **epoxy** lined **carbon steel** and placed in trenches."

The following paragraph will be added at the beginning of Subsection 9.2.1.2.3.1:

"The ESWS consists of four independent trains. During normal plant operation, two trains are operating and at least one other train is on standby. Each train is designed to provide 50% of cooling capacity required for design basis accident and for safe shutdown with LOOP. The ESWS is designed to perform its safety function of accident mitigation assuming that one train is out of service for maintenance coincident with the loss of offsite power and a single failure in another train. A maximum ESW operating temperature of 95° F, based on the bounding meteorological and water source conditions from representative locations in the United States, has been evaluated to adequately remove CCW HX heat load at all operating conditions. This temperature is deemed conservative."

Revised Tier 1 DCD Figure 2.7.3.1-1 is found within the responses to RAI 09.02.01-28.

Tier 2 DCD Figure 9.2.1-1 will be revised to show the building boundary locations as shown next page.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

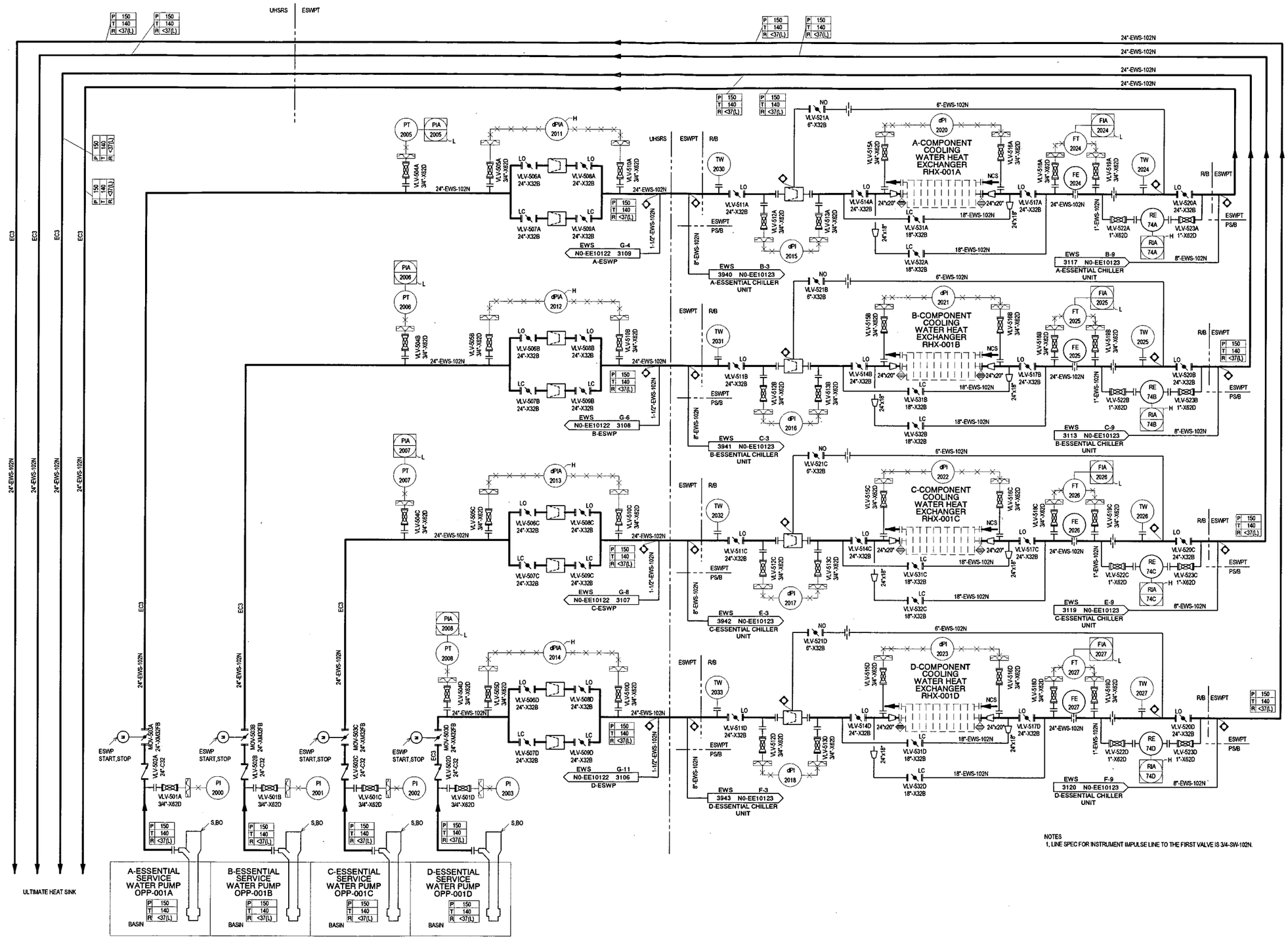

Figure 9.2.1-1 Essential Service Water System Piping and Instrumentation Diagram (sheet 1 of 3)

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-7

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Flooding isolation of the Essential Service Water System (ESWS) pumps is discussed in Tier 2 of the DCD, Section 19.1.5.3.1, "Description of the Internal Flooding Risk Evaluation," however, Tier 2 of Section 9.2.1 makes no mention of this important feature to mitigate a flood. From Tier 2 of the DCD 19.1.5.2.2.5, flooding of the ESWS can to be isolated within 15 minutes and flooding of the fire protection system can be isolated within 30 minutes. The four trains of the ESWS have physical separations and flooding in one train does not propagate to the other trains. Describe in the DCD, Section 9.2.1 the design features that are credited for mitigating the consequences of flooding from the ESWS and provide schematic diagrams showing all inputs (i.e., logic inputs, sensor inputs, all variables, actuation logic, binary limitation signals), with input types (i.e. hardwired, fiber, type of isolation used), ESWS circuit components, and all ESWS control signal outputs of the ESWS control system.

ANSWER:

Plan view of each CCW pump& CCWHX room is shown in Figure 1.2-14 of DCD Rev.1; the east side and west side of the reactor building(R/B) are physically separated by flooding preventive equipment such as watertight doors, as described in assumption k of DCD Rev.1 subsection 19.1.5.3, to prevent the spread of flooding damage. These doors are monitored and controlled during plant operation and maintenance. When maintenance work is on-going and the doors are opened, a watch will be posted to assure that they are closed if needed.

Each CCW pump & CCW HX room has a leak-detecting floor drain box with electrode type level switch to provide alarm in the main control room for the detection of a leaking train from ESWS or CCWS. A common alarm in the main control room provides audible indication of a leak or flooding.

A method of identifying a leaking train by an operator who recognizes leakage of the ESWS in either side of R/B through the above alarm from the CCW pump & CCW HX room will be the indications from the inlet pressure and outlet flow of the CCW HX and essential chiller units. The

leaking ESWS train is then isolated by shutting down the corresponding ESWS pump and CCWS pump, and activating the standby and intact ESWS and CCWS trains.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.3 on Safety Evaluation will be revised to add the following after the 4th paragraph:

"Flooding and flooding effects in the ESWS are mitigated due to the physical separations in the reactor building such as watertight doors. These doors are monitored and controlled during plant operation and maintenance. Each CCW pump & CCW HX room has a leak-detecting floor drain box with electrode type level switch to provide alarm in the main control room for the detection of a leaking train from ESWS or CCWS. A common alarm in the main control room provides audible indication of a leak or flooding. A method of identifying a leaking train by an operator who recognizes leakage of the ESWS in either side of R/B through the above alarm from the CCW pump & CCW HX room will be the indications from the inlet pressure and outlet flow of the CCW HX and essential chiller units. The leaking ESWS train is then isolated by shutting down the corresponding ESWS pump and CCWS pump, and activating the standby and intact ESWS and CCWS trains."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-8

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Describe for the essential service water system (ESWS), the minimum system heat transfer and flow requirements for normal plant operations, shutdown, and accident conditions. All heat loads should be specified for all operational conditions as well as ESWS pump flow and system heat transfer data, to confirm that the ESWS system can meet those heat transfer requirements. Provide in the design control document (DCD) the required data to address heat transfer and flow under all operating, shutdown, and accident conditions. In addition, describe in the DCD the mechanism of how water temperatures are controlled between the ESWS, ultimate heat sink (UHS), and other heat exchangers that the ESWS supplies since temperature control valves or throttled valves are not described for the ESWS.

ANSWER:

Essential service water system minimum heat transfer and flow requirements for normal plant operation, shutdown, and accident conditions will be provided in Tier 2 DCD Table 9.2.1-3 and Table 9.2.1-4.

Each ESW train supplies cooling water to ESW pump motor, CCW heat exchanger, and essential chiller cooler. Most of the heat is transferred by the CCW system and therefore bulk of water flows to CCW heat exchanger. Water supply temperature to any of the users depends on the UHS. The UHS is designed to keep supply water temperature to the users below 95° F at the users' maximum heat load, i.e. during safe shutdown condition as shown in the new Table 9.2.1-3; this is addressed in DCD Tier 2 9.2.5.1. Each of these user components is designed on the bases of ESW supply temperature of 95° F and the design flow shown in the new Table 9.2.1-4. Therefore, water temperature to any of the users is not controlled but shall be kept below 95 ° F, and water flow to all users remains unchanged after initial balancing.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.3.1 will be revised to add the following after the end of the first paragraph of this subsection:

"Table 9.2.1-3 and Table 9.2.1-4, respectively, provide heat loads and water flow balance for various operating modes."

Table 9.2.1-3 and Table 9.2.1-4 are found in the next two pages.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

Table 9.2.1-3 Essential Service Water System Heat Loads (in Btu/hr)

Train	Component	No. of components	Startup		Normal Power Operation		Cooldown by CS/RHRS		Accident (LOCA)		Safe Shutdown	
A & B	CCW Heat Exchanger	2	2	65.4×10^6	1	50.0×10^6	2	220.4×10^6	1	161.7×10^6	1	190.9×10^6
	Essential Chiller Unit	2	2	8.66×10^6	1	4.33×10^6	2	8.66×10^6	1	4.33×10^6	1	4.33×10^6
	ESW pump motor	2	2	0.10×10^6	1	0.05×10^6	2	0.10×10^6	1	0.05×10^6	1	0.05×10^6
	Total		2	74.16×10^6	1	54.38×10^6	2	229.16×10^6	1	166.08×10^6	1	195.28×10^6
C & D	CCW Heat Exchanger	2	2	61.2×10^6	1	41.2×10^6	2	221.2×10^6	1	161.7×10^6	1	190.9×10^6
	Essential Chiller Unit	2	2	8.66×10^6	1	4.33×10^6	2	8.66×10^6	1	4.33×10^6	1	4.33×10^6
	ESW pump motor	2	2	0.10×10^6	1	0.05×10^6	2	0.10×10^6	1	0.05×10^6	1	0.05×10^6
	Total		2	69.96×10^6	1	45.58×10^6	2	229.96×10^6	1	166.08×10^6	1	195.28×10^6

Table 9.2.1-4 Essential Service Water System Flow Balance (in gpm)

Train	Component	No. of components	Startup		Normal Power Operation		Cooldown by CS/RHRS		Accident (LOCA)		Safe Shutdown	
A & B	CCW Heat Exchanger	2	2	22000	1	11000	2	22000	1	11000	1	11000
	Essential Chiller Unit	2	2	1086	1	543	2	1086	1	543	1	543
	ESW pump motor	2	2	50	1	25	2	50	1	25	1	50
	Continuous strainer blowdown	2	2	1000	1	500	2	1000	1	500	1	500
	Total		2	24136	1	12068	2	24136	1	12068	1	12068
C & D	CCW Heat Exchanger	2	2	22000	1	11000	2	22000	1	11000	1	11000
	Essential Chiller Unit	2	2	1086	1	543	2	1086	1	543	1	543
	ESW pump motor	2	2	50	1	25	2	50	1	25	1	25
	Continuous strainer blowdown	2	2	1000	1	500	2	1000	1	500	1	500
	Total		2	24136	1	12068	2	24136	1	12068	1	12068

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-9

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Provide the design and operating information that identifies conditions that could lead to degradation of the essential service water system (ESWS) capability to meet minimum heat transfer requirements, quantify the allowable degradation from these sources, and provide system data to verify the margin available to successfully meet minimum heat transfer requirement during operating, shutdown, and accident conditions. Discuss in the Design Control Document (DCD), the excess flow and heat transfer margins provided by the ESWS pump and system design to accommodate heat transfer degradation by fouling, fluctuations due to supplied electrical frequency, pressure drop through the heat exchangers/chillers, pump leakage, excessive differential pressures due to strainer loading or other means and the bases for these margins.

ANSWER:

ESW pumps are sized to deliver 13000 gpm. Total flow required by the ESW users is 12000 gpm, excluding pump motor cooling flow, in all operating modes providing margin in the pump design flow. This flow includes approximately 500 gpm for strainer blowdown. Sufficient margin is included to account for fouling in the CCW heat exchangers and chillers, pump leakage, and strainer clogging.

The total dynamic head to be developed by the pump is computed by adding the pressure drops through the piping, pressure drops across the pump discharge strainer, CCW heat exchanger inlet strainer and the CCW heat exchanger. The pressure drops across the pump discharge strainer, CCW heat exchanger inlet strainer, and the CCW heat exchanger are maximum expected pressure drops when they reach the maximum allowable pressure loss. Based on the selection of the UHS, pressure drops across the UHS equipment and static lift (if applicable) are

added to compute the total required head. The CCW heat exchanger and the pump discharge strainer are not expected to reach the maximum allowable pressure loss simultaneously providing margin in the head computation. This assures that the ESW pump supplies required water flow during all modes of plant operation including accident mitigation.

The CCW heat exchanger design incorporates adequate margin to account for fouling.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-10

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

For the essential service water system (ESWS), the requirements include specifying for other interfacing systems, such as the ultimate heat sink (UHS), the maximum water temperature, the minimum time (e.g. 30 days) that the UHS must be expected to be available, and so on. Tier 2 of the DCD Section 9.2.1 does not identify any interface requirements for the ESWS. Design Control Document (DCD) Tier 1, Section 2.7.3 and 3.2, specifies an interface requirement that the maximum UHS supply water temperature to the ESWS is 35 °C (95 °F) under peak load conditions to assure sufficient cooling capacity. The UHS is also to keep the water level at a net positive suction head (NPSH) greater than the pump's required NPSH. This interface requirement is not specified in Tier 2 of the DCD description of the ESWS in Section 9.2.1. Describe all ESWS interface requirements in the DCD.

ANSWER:

ESWS interfaces with Ultimate heat sink (UHS) system. Type and location of UHS is site specific and this is addressed as COL items 9.2(3) and 9.2 (18). The COL applicant is to assure that selection and design of the UHS supplies water to the ESWS at a maximum temperature of 95° F under all operating conditions. The UHS design also assures supply of cooling water for a minimum of 30 days (or 36 days for cooling pond in accordance with Regulatory Guide 1.27) without makeup to mitigate the consequences of a design basis event. The COL Applicant is to design ESW intake structure or UHS basin such that minimum water level (after 30 or 36 day operation) will provide adequate NPSH to ESW pumps under the accident conditions, which addresses COL item 9.2(6).. Design and selection of the ESW pumps will assure that the required NPSH is less than the available NPSH under all operating conditions.

Impact on DCD

In Tier 2 DCD Subsection 9.2.1.2.1, a description of the ESW-UHS interface will be added after the 5th paragraph as follows:

"The ESWS interfaces with UHS System which is further described in Section 9.2.5. Type and location of UHS is site specific. The maximum ESW supply temperature should not exceed 95° F under all operating conditions to assure sufficient cooling capacity. The UHS design assures the ESWS cooling water inventory for a minimum of 30 days (or 36 days for cooling pond in accordance with Regulatory Guide 1.27) without makeup to mitigate the consequences of a design basis event."

The last sentence of Subsection 9.2.1.2.2.1 will be replaced with the following:

"The COL Applicant to provide the site specific data for the ESWPs and assure that the selected ESWP will require less NPSH than the minimum available NPSH under all operating conditions."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-11

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. Safety related active components that are required to operate during design basis accidents, with a loss of offsite power, are required to be powered by the Class IE on-site power source. Verify in the design control document, that all active essential service water system (ESWS) components, including the ESWS pumps and discharge motor operated valves are serviced by motor control centers powered from the Class IE gas turbine generators.

ANSWER:

The ESWS safety related-active components that are required to perform their intended function during design basis accident are identified in Tier 1 DCD Table 2.7.3.1-2 which has been revised according to RAI 288-2274.

Tier 2 DCD Subsection 9.2.1.2.3.2 will be revised to include the following:

On loss of offsite power, onsite Class 1E gas turbine generators are automatically started to restore power to the Class 1E 6.9 KV power buses that service safety-related active components such as ESWS pumps and discharge MOVs. This is further described in Tier 2 DCD Section 8.3.1.

Impact on DCD

The first paragraph of Tier 2 DCD Subsection 9.2.1.2.3.2 will be replaced with the paragraph below:

"On loss of offsite power, onsite Class 1E gas turbine generators (GTGs) are automatically started to restore power to the Class 1E 6.9 KV power buses that service safety-related active

components such as ESWS pumps and discharge MOVs. Gas turbine generator operation, including automatic starting and sequencing logic, is further described in Subsection 8.3.1."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-12

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

The system P&ID, Design Control Document (DCD) Figure 9.2.1-1, and description in Section 9.2.1 does not indicate vent lines or other means to provide for venting and filling the system. The system description also does not provide a description of operating procedures to fill and vent the ESWS or indicate this is a COL item. The system description in Tier 2 of the DCD Section 9.2.1 does not address the potential for water hammer, and system design to maintain functions following an inadvertent water hammer event. The Standard Review Plan (SRP) identifies NUREG-0927 "Evaluation of Water Hammer Occurrence in Nuclear Power Plants," that provides guidance for water hammer prevention and mitigation. Describe in the design control document (DCD) design features to maintain design functions after an occurrence of water hammer and address procedures and commitments for venting and filling of systems to address the potential for water hammer, to maintain operating procedures for avoiding a water hammer event, and a system design to maintain functions following an inadvertent water hammer event.

ANSWER:

Tier 2 DCD Subsection 9.2.1.2.1 will be revised to include the following information:

The ESWS layout ensures that the fluid pressure in the system is above the saturation condition at all locations. This in combination with the motor-operated valves at the discharge of each ESW pump minimizes the potential for transient water hammer. The starting logic of the ESW pump interlocks the motor-operated valve with pump operation. Voiding in any train may occur on loss of offsite power and subsequent pump trip. To preclude water hammer on pump re-start, the MOV at each pump discharge is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed.

The CCW heat exchangers and Essential Chilled Water Chillers are located at a much lower elevation (-26' 4") than the ESWS pumps and ultimate heat sink which are located at grade elevation). Location of the ESW pumps intake structure and UHS is site specific. This layout assures that all points in the system remain above atmospheric pressure.

The COL Applicant is to develop operating and maintenance procedures for the ESWS to address water hammer issues in accordance with NUREG-0927. These procedures also include plant procedures for system filling and venting. (See response to RAI 09.02.01-30 regarding water hammer prevention program as a COL item.)

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.1 will be revised to include the following:

[See response to question no. 09.02.01-06 for changes to DCD Tier 2 Subsection 9.2.1.2.1, fourth paragraph.]

(After the 4th paragraph:)

"The CCW heat exchangers and the essential chiller units are located at floor elevation (-26' 4") in the reactor building. The ESW pumps and ultimate heat sink which is site dependent will be located at grade elevation. This arrangement assures that all points in the system remain above atmospheric pressure.

The COL Applicant will develop operating and maintenance procedures for the ESWS to address water hammer issues in accordance with NUREG-0927."

Impact on COLA

The COL Applicant is to develop operating and maintenance procedures for the ESWS to address water hammer issues in accordance with NUREG-0927.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-13

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

The design control document (DCD) states that the essential service water system (ESWS) layout ensures that the fluid pressure is above saturation conditions at all locations. Maintaining pressure above saturation, in combination with the control of the pump discharge valves, minimizes the potential for water hammer. From the staff's review, additional information is required to verify that the system configuration (layout) is adequate to ensure that fluid pressures are above saturation conditions to preclude the potential for a water hammer event. The means to verify this design through operating procedures is also not addressed. Describe in the DCD in detail how the layout of the ESWS ensures that the water pressure is above the saturation pressure at all locations and during all operating conditions for the ESWS. A discussion of operating procedures and a commitment to those procedures that will verify this condition is met is also requested.

ANSWER:

Tier 2 DCD Subsection 9.2.1.2.1 will be revised to include the following:

Location of the ESW pumps intake structure and UHS is site specific. These components will be located at grade elevation. ESW piping from the pump discharge after passing through the discharge strainers drops underground and runs to the plant. The ESW tunnels near the plant are located at (-26' 4") elevation. After serving the CCW heat exchangers and essential chillers the piping runs to the UHS. The ESW pumps are sized to provide positive pressure at the highest point in the system. The ESW system is designed for 140 F. The CCW heat exchangers and essential chillers are located at a much lower elevation (-26' 4") than the ESWS pumps and ultimate heat sink. ESWS layout assures that the fluid pressure in the system is above saturation condition at all locations. This in combination with the control of motor operated valves at the

discharge of each ESW pump minimizes the potential for transient water hammer. The starting logic of the ESW pump interlocks the motor operated valve with pump operation. Voiding in any train may occur upon loss of offsite power and subsequent pump trip. To preclude water hammer on pump re-start, the motor-operated valve at each pump discharge is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed.

Plant operating procedures to avoid water hammer will be developed, such as those described in COL 9.2(25) in response to RAI 09.02.01-30.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.1 will be revised by adding the following after the 3rd paragraph:

"ESW piping from the pump discharge after passing through the discharge strainers drops underground and runs to the Reactor Building. The ESW tunnels near the building are located at -26' 4" elevation. After serving the CCW heat exchangers and the essential chiller units ESW piping runs to the UHS.

The ESW pumps are sized to provide positive pressure at the highest point in the system. The system is designed for 140° F. The system layout and the design assure that the fluid remains above saturation conditions at all locations during all modes of operation."

Impact on COLA

The COL Applicant is to develop operating and maintenance procedures for the ESWS to address water hammer issues in accordance with NUREG-0927.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-14

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Describe the procedures and commitments to address the potential for water hammer, to maintain operating procedures for avoiding a water hammer event, and a system design to maintain functions following an inadvertent water hammer event. The design control document for the essential service water system did not provide adequate information concerning how the operators are alerted to drainage of inventory in an essential service water (ESWS) train, and how "keep fill" requirements for the ESWS are met. The DCD description also lacked information as to how the operator has indication of abnormal pump or system conditions such as a dead-headed ESWS pump if the pump discharge MOV fails to open on restart of an ESWS pump or pump runout if required net positive suction head is not available and the discharge MOV is fully open. Provide in the DCD the information to address the inadequacies as described related to water hammer.

ANSWER:

Procedures and commitments for avoiding water hammer event and maintaining system function following an inadvertent water hammer event are addressed in RAI's 9.2.1-12, and 9.2.1-13.

Tier 2 DCD Subsection 9.2.1.2.3.1 will be revised to include the following:

All valves except the pump discharge valves in each ESW train flow path are locked open. The MOV discharge valve position is monitored in the control room. Failure of the valve to open on restart is alarmed in the control room. The operator will stop the pump and restart the standby pump. The operation of a dead headed pump for short duration should not be detrimental. The pump discharge pressure is monitored and low pressure (e.g. due to excessive leakages) is

alarmed. The pump discharge MOV is normally fully open during pump operation. The system design provides adequate resistance to prevent pump run out.
Draining of ESW in an inactive or tripped ESWS train is prevented by double isolation valves downstream of the ESWP, i.e. check valve and MOV. Potential voids caused by insufficient venting may be formed in the ESWS lines. Inservice testing, as described in Tier 2 DCD Subsection 3.9.6.2, includes periodic testing of the high points in the ESWS and discharge the any voids into the UHS basin. These tests ensure that voids and unacceptable dynamic effects like water hammer are minimized.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.3.1 will be revised to add the following after the 1st paragraph:

"All valves except the pump discharge valves in the flow path are locked open. The MOV discharge valve position is monitored in the control room. Failure of the valve to open on pump restart is alarmed in the control room. The operator will stop the pump and restart the standby pump. The pump discharge pressure is monitored and low pressure is alarmed. The system design and layout provides adequate resistance to prevent pump run out."

The following will be added after the 2nd paragraph of Tier 2 DCD Subsection 9.2.1.2.3.1:

"Draining of ESW in an inactive or tripped ESWS train is prevented by double isolation valves downstream of the ESWP, i.e. check valve and MOV. Potential voids caused by insufficient venting may be formed in the ESWS lines. Inservice testing, as described in Tier 2 DCD Subsection 3.9.6.2, includes periodic testing of the high points in the ESWS and discharge the any voids into the UHS basin. These tests ensure that voids and unacceptable dynamic effects like water hammer are minimized."

Impact on COLA

The COL Applicant is to develop procedures discussed above. See related COL 9.2(25) in response to RAI 09.02.01-30.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-15

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Describe procedures and commitments to address the potential for water hammer, to maintain operating procedures for avoiding a water hammer event, and a system design to maintain functions following an inadvertent water hammer event. The staff determined that the DCD contained inadequate information to describe how drainage of the essential service water system (ESWS) is prevented during a loss of offsite power during the approximately 100 seconds that the ESWS pumps are without power and the discharge motor operated valves (MOV) remain open. Provide in the design control document (DCD), information as to how water hammer effects in the ESWS are addressed given loss of offsite power during the time that the system would drain for 100 seconds until emergency electrical power is available from the gas turbine generators to start the ESWS pumps. Also given a loss of offsite power event, describe if the pump discharge MOV remains full open on an emergency power restart or if the discharge MOV goes full close.

ANSWER:

Procedures and commitments for avoiding water hammer event and maintaining system function following an inadvertent water hammer event are addressed in RAI 9.2.1-12 and 9.2.1-13.

Upon loss of offsite power, ESW pump(s) will stop. The motor operated pump discharge valve, being powered by a DC power source, is unaffected by the loss of offsite power and will close.

Check valve located in the pump discharge pipe will prevent water flowing through the pump to the intake structure. After the emergency electrical power becomes available from gas turbine generators, the ESW pump is restarted in accordance with blackout sequence; the discharge MOV then gradually opens with pump start signal.

Since most of the ESW system remains filled with water, the ESW pump restart will sweep out the trapped air, and any potential water hammer forces should have minimum impact on the ESW system operation.

Impact on DCD

The 2nd paragraph of Tier 2 DCD Subsection 9.2.1.2.3.1 will be revised as follows:

"Voiding in any train may occur on loss of offsite power and subsequent pump trip. **The motor-operated pump discharge valve, being powered by a DC power source, is unaffected by the loss of offsite power and will close when the pump stops. Water downstream of the high point in the CCW heat exchanger discharge pipe will drain to the UHS. The check valve located in the pump discharge pipe will prevent water flowing through the pump into the intake structure.** In order to preclude water hammer on pump restart the MOV at the discharge of each pump is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed. ~~The valve starts to open after the respective pump starts.~~ **After the emergency electrical power becomes available from gas turbine generators, the ESW pump is restarted in accordance with blackout sequence and the discharge MOV opens. Since most of the ESW system remains filled with water, the ESW pump restart will sweep out the trapped air via high point vents. Therefore, any potential water hammer forces, if present, will have minimum impact on the ESW system operation.**"

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-16

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan (SRP) Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. Section III of the SRP addresses acceptable provisions for addressing fouling of the service water system that are contained in generic letters (GL) 89-13, "Service Water System Problems Affecting Safety-Related Equipment," and 89-13 Supplement 1.

In Tier 2, DCD Table 1.8-2 "Compilation of All Combined License Applicant Items for Chapters 1-19," contains COL 9.2(8) for the COL applicant to specify ESW chemistry requirements. Tier 2, Section 9.2.1.4 specifies that periodic performance verification of ESWS components, including the heat exchanger, will be performed to detect performance degradation due to fouling. The staff does not find this to be sufficient to address all issues associated with system fouling. SRP 9.2.1 specifies that the provisions of generic letter (GL) 89-13 and 89-13, Supplement 1 are to be evaluated in the DCD. In Tier 2 of the DCD Table 1.9.2-9, the provisions of GL 89-13 and GL 91-13 "Request for Info Related to the Resolution of GI 130, Essential Service Water System Failures at Multi-Unit Sites," were noted as it relates to SRP Section 9.2.1 which states the information will be considered acceptable if the provisions GL 89-13 and GL 91-13 are appropriately addressed.

The staff has determined that there is no discussion of GL 89-13 and GL 89-13, Supplement 1 in the DCD in terms of biofouling and the design provisions and testing/inspection activities that are specified. The GL specifies ongoing surveillance, control, and testing measures to prevent fouling of piping and heat exchangers from macroscopic biofouling such as could occur from asiatic clams. There is no discussion of the need to consider fouling effects in the design of the heat exchangers in the ESWS system. Discuss how GL 89-13 biofouling aspects are addressed in the design for the ESWS and/or how it is to be addressed by the COL applicant and provide information to consider how fouling considerations will be incorporated in the margin for the safety-related heat removal capacity of the heat exchangers in the ESWS system.

ANSWER:

Bio-fouling and chemistry control of the ESW system is site specific and depends upon the type of UHS. The COL applicant is to develop the inspection program and test procedures as a resolution to COL item 9.2(23).

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-17

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. Measures must be specified to protect the essential service water system (ESWS) from failures due to adverse environmental conditions.

The staff found that design control document description for the ESWS did not specify a design (such as screens or strainers) to prevent debris buildup and blockage of the ESWS pumps and the pumps suction source. The design and procedures to assure that failure of the ESWS pumps due to debris are not described. Describe specify design details and operating procedures/measures to prevent ESWS pumps from failing due to blockage by buildup of debris or identify a COL item that addresses this issue.

ANSWER:

Design of the ESWS intake structure including screens and pump inlet strainers is site specific. The COL Applicant is to design intake screens/strainers to prevent debris build up and clogging of the pump suction as a resolution to COL item 9.2(4). Tier 2 DCD Subsection 9.2.5.2 System Description 8th paragraph states, "The COL Applicant is to determine location and design of the ESW intake structure.". The COL applicant is to develop maintenance and test procedures to monitor debris build up and flush out debris.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.1 will be revised to add the following at the end of this subsection:

"The COL applicant is to develop maintenance and test procedures to monitor debris build up and flush out debris."

The following COL items will be added in DCD Chapter 1 Table 1.8-2 Compilation of All Combined License Applicant Items for Chapters 1-19 and DCD 9.2.10 Combined License Information.

COL 9.2(26) The COL applicant is to develop maintenance and test procedures to monitor debris build up and flush out debris.

Impact on COLA

The COL applicant is to develop maintenance and test procedures to monitor debris build up and flush out debris as a resolution to COL 9.2(26).

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-18

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Measures must be specified to protect the essential service water system (ESWS) from failures due to adverse environmental conditions. The staff found that the ESWS description in Tier 2 of the Design Control Document (DCD) Section 9.2.1, does not adequately describe the means to backwash the two parallel strainers downstream of the ESWS pump discharge and the associated system diagram, Tier 2, DCD Figure 9.2.1-1 does not show the piping connections used to back-flush an isolated, clogged strainer. The staff finds the diagram to be incomplete without this information. Additionally, the description does not clearly describe the process for backwashing these strainers, whether the flow is from system pressure or a separate motor/pump. Provide in the DCD an updated figure showing the required connections, components, safety related to non-safety related piping class breaks, and provide a more detailed description of the procedure and other required components to backwash the strainers. In addition, clarify if the ESWS pump is shutdown during this process since the description implies that all ESWS flow is stopped (the strainer is isolated and the standby strainer is placed into service) during this process.

ANSWER:

Tier 2 DCD Subsection 9.2.1.2.2.2 provides discussion on two 100% capacity basket-type strainers located in each ESW pump discharge line. The differential pressure across the operating strainer is monitored. When predetermined high differential set pressure is alarmed in the main control room, the standby strainer is placed in service by manually opening the strainer inlet and outlet valves. The clogged strainer is isolated manually by closing corresponding inlet and discharge valves.

A clogged strainer is placed out of service by first shutting off the ESW pump. Instead of backflushing operations, manual replacement of the strainer cartridge takes place.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.2.2 will be revised to replace the first paragraph with the following:

"Two 100% capacity strainers are located in each ESW pump discharge line. **The differential pressure across the operating strainer is monitored.** When the **predetermined high** ~~the~~ differential **set** pressure **is alarmed in the MCR,** ~~across~~ the **clogged** strainer **is place out of service by first shutting off the ESW pump and then closing the strainer isolation valves.** ~~reaches a predetermined set pressure the clogged strainer is isolated, and t~~**T**he standby strainer is **then** placed in service **by manually opening the strainer isolation valves**. The ~~isolated~~ **clogged** strainer **cartridge** ~~is~~ **will be** manually ~~backwashed~~ **replaced.**"

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-19

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Measures must be specified to protect the essential service water system (ESWS) from failures due to adverse environmental conditions. Tier 2, Design Control Document (DCD) Figure 9.2.1-1 indicates a strainer downstream of the two parallel strainers at the inlet to each component cooling water (CCW) heat exchanger in each train of the ESWS. The ESWS also provides cooling water flow to the essential chiller units; however, there is no such additional strainer indicated for the piping to the essential chiller units in each train. The staff asks the applicant to address in the DCD, the need for an additional strainer for the essential chiller units served by the ESWS, either adding a necessary strainer or discussing the basis for why a strainer is not needed.

ANSWER:

As addressed in response to RAI 9.2.1-16, the strainer located in the CCW heat exchanger inlet pipe removes fine suspended particles to minimize heat exchanger fouling. However, two 100% strainers located in each ESW pump discharge pipe provide adequate protection to essential chiller unit coolers. Therefore, additional strainers for essential chiller unit coolers are not required.

As shown in Tier 2 DCD figure 9.2.1-1, CCW heat exchangers are plate type heat exchangers. Clogging of plates greatly impacts heat transfer capability. Therefore, a strainer with a self-cleaning effect that is continuously blown down is located in the CCW heat exchanger inlet pipe to remove fine suspended particles to minimize heat exchanger fouling. Two 100% capacity strainers located in each ESW pump discharge pipe filters out most of the debris and thus protect ESW system components. The essential chiller unit coolers are shell and tube type heat exchangers. The pump discharge strainers provide adequate protection for this type of heat exchangers and no additional filtration is deemed necessary.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.2.2 will be revised to include the following statement at the end of the 1st paragraph:

"These strainers filter out most of the debris and thus provide adequate protection for ESW system components."

The following statement will be added at the end of the 2nd paragraph:

"No strainer is provided for essential chiller unit coolers since filtration is provided by the ESW pump discharge pipe strainers and additional filtering is not deemed necessary.

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-20

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Measures must be specified to protect the essential service water system (ESWS) from failures due to adverse environmental conditions. The staff did not find, for the ESWS on Tier 2, Design Control Document (DCD) Figure 9.2.1-1 connections for backwash cleaning of the essential chiller units on the ESWS side. There is also no discussion of the need to backwash or clean the ESWS side of the essential chiller units and how this is accomplished. Describe in the DCD, the need to backwash (clean) the ESWS side of the essential chiller units and provide indication of the connections and components on the Tier 2 Figure 9.2.1-1. In addition, clarify whether or not the associated ESWS train has to be removed from service for this operation.

ANSWER:

See response to RAI No. 9.2.1-19. Flushing/cleaning of the ESWS side of the essential chiller unit is not anticipated while the unit is in operation. The chiller unit's performance is monitored per site specific program which will be provided as a resolution to COL item 9.2(23). The ESWS side of the chiller units will be cleaned during outages or when off-line per established maintenance program.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-21

The essential service water system (ESWS) 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. Also, 10 CFR 52.47(a)(22) requires that information demonstrating how operating experience insights have been incorporated into the plant design be included in the Design Control Document (DCD).

During a recent review of industry operating experience, the staff found that some licensees were experiencing significant wall thinning of pipe downstream of butterfly valves that were being used to throttle service water flow. In order to assure that this will not occur in the ESWS for the US-APWR design, the applicant needs to provide additional information in Tier 2, DCD Section 9.2.1 to describe to what extent butterfly valves will be used to throttle ESWS flow and design provisions that will be implemented to prevent consequential pipe wall thinning from occurring.

ANSWER:

The ESWS supplies cooling water to CCW heat exchangers, essential chiller unit coolers, and ESW pump motors. Pipe lines and associated butterfly valves are adequately sized to provide the required cooling water to all components. Flow control orifices downstream of the CCW heat exchangers are installed to prevent excessive throttling of the butterfly flow control valves. After the initial flow balancing during startup, the valve positions are adjusted to supply required cooling water to all users. The cooling water flow to individual users and the valve positions remain unchanged during all modes of plant operation. Pipe wall thinning due to butterfly valve throttling is not anticipated.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.2.6 will be revised as follows to include the following statement at the end of this subsection:

"To avoid concerns with potential downstream pipe wall thinning, butterfly valves provided in the ESW system piping are not used for excessive throttling of the water flow. Orifices having adequate differential pressures are installed downstream of the heat exchangers to prevent excess throttling of the butterfly flow control valves."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-22

The essential service water system (ESWS) must be capable of removing heat from systems, structures 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. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

The instrumentation and controls (I&C) for the essential service water system (ESWS) must be specified in adequate detail to confirm that monitoring, surveillance, and maintenance of the ESWS can be accomplished for normal operations and safe shutdown. The staff found several inadequacies and insufficient information in the applicant's design control document (DCD) with respect to I&C for the ESWS. The staff requests the applicant provide additional information in the DCD to fully describe the I&C for the ESWS, the functions for I&C, and how the operating staff uses the provided information. The following are examples of inadequacies that must be addressed:

• Describe in the DCD industry standards and requirements that I&C for the ESWS is designed to meet, for example IEEE standards 603, 323, etc.
• DCD, Tier 1, inspections, tests, analyses, and acceptance criteria (ITAAC), item number 12, refers to ESWS displays in the remote shutdown console (RSC). Tier 2 of the DCD Section 9.2.1 does not indicate any I&C for monitoring or control in the RSC. Provide a full description of any ESWS I&C located in the RSC with their functions in Tier 2.
• Discuss all ESWS operator controls and instruments in Tier 2 of the DCD Section 9.2.1 that are available in the MCR and RSC. Tier 1 of the DCD Table 2.7.3.1-4 information should be included in Tier 2, Section 9.2.1.
• Verify that the I&C information that is described in Tier 2 of the DCD Section 9.2.1 is consistent with the I&C listed on ESWS system diagrams, Tier 1of the DCD Figure 2.7.3.1-1 and Tier 2 of the DCD Figure 9.2.1-1.
• Describe in the DCD any system logic connections (such as pump trips and automatic starts) between the ultimate heat sink (if fans are utilized in the conceptual design), component cooling water system and essential chilled water system or indicated these are all manual operations.

ANSWER:

Question:

- Describe in the DCD industry standards and requirements that I&C for the ESWS is designed to meet, for example IEEE standards 603, 323, etc.

Answer:

The standards applicable to the ESWS Instrumentation and Controls are already identified in the DCD or the applicable MHI Topical reports available to the NRC. Plant wide compliance with Regulatory Guides is delineated in Tier 2 DCD Table 1.9.1-1. Table 7.1-2 "Regulatory Requirements Applicability Matrix" describes the compliance of the US-APWR I&C system to regulatory requirements and guidance. The related sections of the DCD are also described. Compliance to the corresponding sections of Appendix C.I.7.1-A in RG 1.206, "Digital Instrumentation and Control Systems Application Guidance", is discussed in Subsection 7.1.3. Additionally, compliance with Appendices C.I.7.1-B, "Conformance with Institute of Electrical and Electronics Engineers (IEEE) Std 603", and C.I.7.1-C, "Conformance with IEEE Std 7-4.3.2", are discussed in Topical Report MUAP- 07004 Appendices A and B, respectively.

Compliance with IEEE-603 1991 is further discussed in a new Tier 2 Table in Section 14.3, added as response to RAI 255-2110 Rev. 1. Compliance with IEEE-323 and other industry standards is described in detail in Section 3 of MHI Topical Reports MUAP-07004, MUAP-07005, MUAP-07006, and MUAP-07007.

The instrumentation and controls that are applicable to the ESWS conform to the listed regulations and standards.

Question:

- DCD, Tier 1, inspections, tests, analyses, and acceptance criteria (ITAAC), item number 12 refers to ESWS displays in the remote shutdown console (RSC). Tier 2 of the DCD Section 9.2.1 does not indicate any I&C for monitoring or control in the RSC. Provide a full description of any ESWS I&C located in the RSC with their functions in Tier 2.

Answer:

The RSC has both safety and nonsafety-related human-system interface system (HSIS). As described in DCD Section 7.4.1.5 "The operator has the same functional control and monitoring capability at the RSR as in the MCR. The RSC provides equivalent functions of the operational VDUs and the safety VDUs in the MCR." Therefore, all of the functionality in the MCR for the ESWS is available at the RSC.

Tier 2 DCD Subsection 9.2.1.5 will be revised to provide description of ESWS I & C located in the RSC and their functions.

Question:

- Discuss all ESWS operator controls and instruments in Tier 2 of the DCD Section 9.2.1 that are available in the MCR and RSC. Tier 1 of the DCD Table 2.7.3.1-4 information should be included in Tier 2, Section 9.2.1.

Answer:

The Operator controls and instrumentation described in Tier 2 DCD Subsection 9.2.1.5 are complete and consistent with the DCD Figure 9.2.1-1.

Question:

- Verify that the I&C information that is described in Tier 2 of the DCD Section 9.2.1 is consistent with the I&C listed on ESWS system diagrams, Tier 1 of the DCD Figure 2.7.3.1-1 and Tier 2 of the DCD Figure 9.2.1-1.

Answer:

Safety-related I&C information is shown in Tier 1 DCD Table 2.7.3.1-4. The instruments listed are used for reactor trip, engineered safety features actuation, safe shutdown, post-accident monitoring, and interlock systems important to safety. These functions are addressed in Tier Chapter 7.

Question:

- Describe in the DCD any system logic connections (such as pump trips and automatic starts) between the ultimate heat sink (if fans are utilized in the conceptual design), component cooling water system and essential chilled water system or indicated these are all manual operations.

Answer:

Tier 2 DCD Section 9.2.1.2.3.1 states that, "A low signal of ESW header pressure due to tripping of the operating ESWP is alarmed in the main control room (MCR). When the alarm is achieved, the standby component cooling water pump (CCWP) of the same subsystem and the corresponding ESWP are placed in service to resume the cooling process. The previously activated CCWP is shut off after the switch in operating pump." Stoppage of the operating ESW pump automatically activates the alternate standby pump via interlocks between the ESWS and CCWS. The ESWS is interlocked with the Component Cooling Water System such that at either a low ESW supply header pressure or at low CCW header pressure, alternate standby pumps are being automatically activated. There are no interlocks between the ESWS and the essential chilled water system.

For the typical UHS designs, e.g. cooling pond, cooling towers, etc. no interlocks with the ESWS are expected to be needed. DCD Section 9.2.5.2 for the UHS states that, "The COL Applicant is to provide a detailed description and drawings of the UHS, including water inventory, temperature limits, heat rejection capabilities under limiting conditions, instrumentation, and alarms."

Impact on DCD

Tier 2 DCD Subsection 9.2.1.5 will be revised as follows to include the following at the beginning of this subsection:

"The operator has functional control and monitoring capability of the ESWS in the MCR and also at the RSR. All functions described below that are available in the MCR are also available at the RSC."

The 2nd paragraph of Subsection 9.2.1.5.7 will be revised as follows:

"In addition, remote**ly** operated **pump discharge** valves are provided with position indication instrumentation. The valve positions are monitored in the MCR. **Valve operation is interlocked with pumps as noted in Subsection 9.2.1.2.3.1. The ESW pump control and status indication are provided in the MCR.**"

The second sentence of Tier 2 DCD Subsection 9.2.1.2.3.1 will be revised for clarification as follows:

"A low signal of ESW header pressure due to tripping of the operating ESWP is alarmed in the main control room (MCR). When the **low ESW header pressure** alarm is ~~achieved~~ **annunciated**, the standby component cooling water pump (CCWP) of the same subsystem and the corresponding ESWP are placed in service to resume the cooling process. ~~The previously activated CCWP is shut off after the switch in operating pump.~~ **Stoppage of the operating ESW**

pump automatically activates the alternate standby pump via interlocks between the ESWS and CCWS."

The following will be added at the end of Subsection 9.2.1.5.7:

"The ESWS is interlocked with the CCWS such that at either a low ESW supply header pressure or at low CCW header pressure, alternate standby pumps are being automatically activated. There are no interlocks between the ESWS and the essential chilled water system."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-23

The essential service water system (ESWS) must be designed so that periodic inspections of piping and components can be performed to assure that the integrity and capability of the system will be maintained over time in accordance with General Design Criteria (GDC) 45, "Inspection of Cooling Water System" requirements. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

The staff finds the design to be acceptable if the DCD describes inspection program requirements that will be implemented and are considered to be adequate for this purpose. While Tier 2 of the DCD Section 9.2.1.4 indicates that periodic inspections will be performed, the accessibility and periodic inspection of ESWS piping in the piping tunnels and buried piping is of particular interest. Describe in the DCD to the extent and nature of inspections that will be performed in non-accessible areas, such as in piping systems that are buried or locations in piping tunnels.

ANSWER:

Extent of the ESW system piping located in the essential service water piping tunnel (ESWPT) is shown in revised Figure 9.2.1-1 sheet 1 of 3 in the response to RAI 9.2.1-6. Piping located in tunnels will be inspected periodically per established ISI program. A similar description is provided in Tier 2 DCD Subsection 9.2.1.2.2.5.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-24

The essential service water system (ESWS) must be designed so that periodic pressure and functional testing of components can be performed in accordance with General Design Criteria (GDC) 46, "Testing of Cooling Water System," requirements to assure the structural and leak tight integrity of system components, the operability and performance of active components, and the operability of the system as a whole and performance of the full operational sequences that are necessary for accomplishing the ESWS safety functions. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

The staff finds the design to be acceptable if the DCD describes pressure and functional test program requirements that will be implemented and are considered to be adequate for this purpose. While Tier 2 of the DCD Section 9.2.1.4 indicates that periodic testing will be performed, the extent and nature of these tests and procedural controls that will be implemented to assure continued ESWS structural and leak tight integrity and system operability over time were not described. Consequently, provide additional information in the DCD to describe the extent and nature of testing that will be performed and procedural controls that will be implemented commensurate with this requirement.

ANSWER:

DCD Tier 2 Subsection 9.2.1.4 describes inspection and testing requirements for the ESW system and components. Two ESW trains are in operation during power operation. System pressure, temperature, and flows are monitored. The periodic performance verification of the ESWS components, including the heat exchanger which is cooled by the ESW, is performed to detect performance degradation due to the fouling as described in Subsection9.2.1.4. System components will be walked down periodically per established program to inspect for leakages. Operation of the trains will be alternated per operating procedures. Active components will be tested per established IST program. Frequency of testing is provided in DCD Tier 2 Subsection 3.9.6.

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.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-25

Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, provide guidance on the specific information that should be included in the application for evaluation by the staff. Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. Section III.3.D of SRP Section 9.2.1 indicates that there should be provisions to detect and control leakage of radioactive contamination. SRP Section 9.2.1, Section III, also indicates that an acceptable design is the ability to isolate leaking components by one automatic and one manual valve in series.

The applicant's design control document (DCD) for the essential service water system (ESWS) shows a radiation monitor at the outlet of the component cooling water system (CCWS) heat exchanger of the ESWS, however, there is no description in the DCD as to how leakage of radioactive contamination will be isolated in conformance with the SRP. The US-APWR application did not discuss valves and/or other means that would be utilized to isolate a train or component in the event of radioactive leakage from the CCWS to the ESWS or the procedure that would be used. The staff review did not identify automatic and manual isolation valves that could serve the purpose described in SRP Section 9.2.1 for isolating a contaminated ESWS train. Provide a detailed discussion of the design and procedure to be used to isolate an ESWS component or train in the event of radioactive contamination leakage from the CCWS to the ESWS.

ANSWER:

The radiation monitors located downstream of the CCW heat exchangers on the ESW piping monitors radioactivity which is signaled in the MCR. When the radiation level exceeds the set point, an alarm is transmitted to the MCR. The operator isolates the contaminated ESWS train and corresponding CCW train by stopping the ESWS and CCW pumps and thus taking the contaminated CCW heat exchanger out of service. Standby CCWS and ESWS trains are placed in service. The manual isolation valves placed on each side of the CCW heat exchanger will also be closed to ensure that the radioactive leakage is not circulated in the ESW and eventually in the UHS. A second valve, which acts as a control valve, downstream of the CCW downstream

isolation valve can also be closed to further isolate the train. However, since the leaking train is taken out of service, there is no need to further isolate the CCW heat exchanger.

Nevertheless, the CCWS, which is intermediate between the ESWS and reactor auxiliaries, has been designed so that no radioactive contamination to the environment occurs through direct leakage into the ESWS. If, however, radioactive leakage does occur in the CCWS, radiation monitors will alarm in the MCR to enable immediate stoppage of the CCW pump and isolation of the leaking train. The ditto train is ultimately placed out of service to treat this problem. Therefore, prior to occurrence of radioactive leakage into the ESWS, isolation of the affected CCWS train should have taken place first.

Impact on DCD

Tier 2 DCD Subsection 9.2.1.2.3.1 will be revised as follows to add the following at the end of this subsection:

"Radioactivity leakages from the CCWS to the ESWS can be detected by the radiation monitors located downstream of the CCW heat exchangers. Predetermined high radiation level is alarmed in the MCR. The operator manually isolates the contaminated ESWS train and corresponding CCW train by stopping the ESWS and CCW pumps, and thus taking the contaminated CCW heat exchanger out of service. Standby CCWS and ESWS trains are placed in service. The manual isolation valves placed on each side of the CCW heat exchanger will also be closed to ensure that the radioactive leakage is not circulated in the ESW and eventually in the UHS. A second valve, which acts as a control valve, downstream of the CCW downstream isolation valve can also be closed to further isolate the train. However, since the leaking train is taken out of service, there is no need to further isolate the CCW heat.

Nevertheless, the CCWS, which is intermediate between the ESWS and reactor auxiliaries, has been designed so that no radioactive contamination to the environment occurs through direct leakage into the ESWS. If, however, radioactive leakage does occur in the CCWS, radiation monitors will alarm in the MCR to enable immediate stoppage of the CCW pump and isolation of the leaking train. The ditto train is ultimately placed out of service to treat this problem. Therefore, prior to occurrence of radioactive leakage into the ESWS, isolation of the affected CCWS train should have taken place first."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

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Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. Chapter 16 of the application is to provide the design technical specifications and bases.

Tier 2, Design Control Document (DCD) Chapter 16 technical specifications (TS) for the essential service water system (ESWS) are inaccurate in their identification of the cooling loads serviced by the ESWS. The basis section B.3.7.8 states that each ESWS train cools one component cooling water system (CCWS) heat exchanger and one gas turbine generator (GTG) cooler. This statement is inconsistent with Tier 2, Section 8.3.1.1.3.10 which states that the GTG does not require cooling water and Tier 2, Section 9.2.1 which does not identify GTG coolers as components cooled by the ESWS. Section 9.2.1 states that in addition to the CCW heat exchangers, essential chiller units are cooled by the ESWS. Section B.3.7.8 does not indicate the essential chiller units as being cooled by the ESWS. Provide an update to the Tier 2, Chapter 16 TS and Bases to clarify the safety-related cooling loads for the ESWS which includes the ESWS motor and specifically address the cooling bases to the essential chiller units and gas turbine generators (GTG) and revise the DCD, Sections 9.2.1, technical specification Bases 3.7.8, and Section 8.3.1.1.3.10 to correctly and consistently state the correct heat loads for the ESWS.

ANSWER:

Tier 2 DCD Chapter 16 Technical Specification Section 3.7.8 in Subsection B.3.7.8 is in error. As stated in DCD Tier 2 DCD Section 9.2.1, each ESW train supplies cooling water to ESWS pump motor, CCW heat exchanger, and essential chiller unit cooler. The GTGs do not require cooling water. Tier 2 Section 8.3.1.1.3.10 is correct in stating that the GTG coolers do not require cooling water. Response to RAI 9.2.1-8 provides the list of safety-related cooling loads for the ESWS which is the same as Tier 2 DCD Table 9.2.1-3.

DCD Tier 2 Chapter 16 Subsection B.3.7.8, second paragraph will be revised as follows:

"The ESWS consists of four separate, safety-related cooling water trains. Each train consists of one 50% capacity pump, one component cooling water (CCW) heat exchanger, one essential chiller unit, piping valves, instrumentation, and two types of strainers."

Impact on DCD

The changes for Tier 2 DCD Chapter 16, Section T-spec 3.7.8 and B.3.7.8 are to be incorporated as follows.

For T-spec 3.7.8:

- NOTE 1 of A1, "Enter applicable and Required Actions of LCO 3.8.1, "AC Sources-Operating," for Class 1E gas turbine generator made inoperable by ESWS" will be deleted.

For B 3.7.8:

- The first sentence of the second paragraph of BACKGROUND in BASES will be revised as follows:

  "The ESWS consists of four separate, safety related, cooling water trains. Each train consists of one 50% capacity pump, one component cooling water (CCW) heat exchanger, ~~one Class 1E gas turbine generator (GTG) cooler~~ **one essential chiller unit**, piping, valv~~inges~~, instrumentation, and two **types of** strainers."

- The first and second sentence of the second paragraph of ACTIONS in BASES will be revised as follows:

  ~~"The first Note indicates that the applicable Conditions and Required Actions of LCO 3.8.1, "AC Sources - Operating," should be entered if an inoperable ESWS train results in an inoperable GTG.~~ The ~~second~~ Note indicates that the applicable Conditions and Required Actions of LCO 3.4.6, "RCS Loops - MODE 4," should be entered if an inoperable ESWS train results in an inoperable decay heat removal train."

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-27

Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff.

Tier 2 of the Design Control Document (DCD), Chapter 16, provides the design Technical Specifications (TS) and Bases. The staff's review of Chapter 16, Section 3.7.8, determined that the TS and the Bases for the water level for the ESWS pumps and system maximum temperature requirements have not been properly addressed relative to ESWS considerations described in Tier 2 of the DCD Section 9.2.1. The staff determined that the surveillance requirement (SR) 3.7.8.2 in the TS does not adequately define the logic to be tested for the essential service water system discharge motor operated valves. Provide clarification in the TS SR 3.7.8.2 that all automatic features, opening and closing, for the pump discharge MOVs must be tested. Also provide the specific basis for this SR in Tier 2, Chapter 16, Section B.3.7.8.

ANSWER:

Water source for the ESW system is site specific and depends on Ultimate Heat Sink. The Water level in the ESW pump intake structure to be maintained (if cooling towers is UHS) or available (if ponds, lake, etc. is UHS) is site dependent and not included in the surveillance requirements parameter. The COL applicant will investigate water level for ESW pumps as a resolution to COL item 9.2(6). The maximum supply temperature of UHS should be maintained below 95° F as shown in DCD 9.2.5.1. The lowest water level and the maximum supply water temperature for the ESWS pumps will be incorporated in the site–specific T-spec and BASES by the COL Applicant. This is specified in COL 16.1_3.7.9 (1).

The surveillance requirement (SR) 3.7.8.2 in the TS (Tier 2 DCD Chapter 16) will be revised so that all components associated with the valve logic and automatic features like opening and closing of the ESW pump discharge MOVs will be tested.

Table 3.9-14, "Valve Inservice Test Requirements" of DCD Rev.1 describes safety–related missions, safety functions, and inservice testing type and frequency for the essential service water system discharge motor operated valves.

Therefore, MHI will revise TS SR 3.7.8.2 and Section B.3.7.8 to incorporate Subsection 3.9.6 of DCD Rev.1.

Impact on DCD

The statement below will be added as a third sentence in SR3.7.8.2 in DCD Chapter 16, item B3.7.8:

"This surveillance is tested to assure the requirements of IST program described in Table 3.9-14."

The statement below is added as fourth sentence of SR3.7.8.2 in DCD Chapter 16, item B3.7.8:

"The motor operated valve is provided at the discharge of each pump. The starting logic of the ESWP interlocks the motor operated valve with the pump operation. This interlock prevents the pump from starting if the valve is not closed. The closed discharge valve opens after starting the ESWP."

COL 16.1_3.7.9(1) will be revised to read:

"*COL 16.1_3.7.9(1)* LCO 3.7.9 and associated Bases for the Ultimate Heat Sink based on plant specific design**, including required UHS water volume, lowest water level for ESW pumps and maximum water temperature of the UHS**, are to be developed.

Impact on COLA

The COL Applicant is to develop a resolution for revised COL item 16.1_3.7.9 (1).

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-28

Standard Review Plan (SRP) Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. SRP Section 14.3, Appendix C, Item 1B.ix states that design control document (DCD), Tier 1 figures for safety-related system 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 ask the applicant to revise the information in DCD, Tier 1 Section 2.7.3.1 and applicable Tier 2 Sections (as appropriate) to address the following considerations in this regard:

• 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 of the DCD Section 9.2.1. Conversely, some of the key information provided in Tier 2 section 9.2.1 is not provided in the Tier 1 system information, Section 2.7.3 (e.g., active safety function, loss of motive power position, harsh environment considerations, MCR alarm and display, control function, and RSC display).
• Tier 1 of the DCD, Figure 2.7.3.1-1 does not include many of the major components of the ESWS, such as strainers, radiation monitors, check valves, and pump motor self-cooling lines, nominal pipe sizes, testing connections, and so forth. This figure should contain all of the system level detail found in the Tier 2, Section 9.2.1, and Figure 9.2.1-1. The Tier 1 Figure 2.7.3.1-1 shows a '3' in a box in four locations which should be clarified. Revise Figure 2.7.3.1-1 to indicate all the major components of the ESWS to be confirmed by ITAAC, Item 1a.
• Tier 1 of the DCD, Table 2.7.3.1-2, "Essential Service Water System Equipment Characteristics," does not show power classification (IEEE class) for each applicable component.
• Tier 1 of the DCD, Table 2.7.3.1-2, "Essential Service Water System Equipment Characteristics," does not show system check valves which must change positions during normal and accident condition operations.

ANSWER:

- The following items address inconsistencies between DCD Tier 2 and Tier 1 Section 2.7.3: -Loss of motive power position: Because this information is not provided in Tier 2, the

information will be added to DCD Tier 2 9.2.1.2.2.6 to make a cross-reference between Tier 1 and Tier 2.
-Harsh environment considerations: Tier 2 DCD Section 3.11, " Environmental Qualification of Mechanical and Electrical Equipment," describes harsh environment considerations and technical report MUAP-08015, "US-APWR Equipment Environmental Qualification Program," also mentions detailed description regarding harsh environment considerations.
-MCR alarm and display: DCD Figure 9.2.1-1 shows which parameters and alarms are being displayed in the MCR and RSC. Instrumentation symbols are explicitly described in Figure 1.7-3 on "Legend for Piping and Instrumentation Diagrams of Primary System" found in Tier 2 DCD Chapter 1.
-Control Function: Tier 2 DCD Subsections 9.2.1.2.3.1 on "Normal Operation" and 9.2.1.3.2 on "Emergency Operation" states the control functions of ESWS.
-Active safety function: This information in contained in both Tier 2 DCD Table 3.9-14 and Tier 1 Table 2.7.3.1.-2.

- Tier 1 DCD Figure includes system components that are directly involved in maintaining the safety functions of the system as discussed in the design description. Below are statements that explain the importance or unimportance to show the following components in the Tier 1 Figure 2.7.3.1-1:

  -Strainers: the strainers have no direct safety function, therefore these will not added to the Tier 1 figure.
  -Radiation monitors: the monitors have no safety-related function as mentioned in DCD Tier 2 Subsection 11.5.2.5.2.
  -Check valves: the check valves with safety-related function addressed in DCD Tier 2 Table 3.9-14 on "Valve Inservice Test Requirements will be added to the Tier 1 figure. These valves are also added to Table 2.7.3.1-2 and Table 2.7.3.1-5 as ITAAC confirmation items.
  -Pump motor self-cooling lines: these lines have safety-related function to maintain the integrity of essential service water pumps. The lines will be added to the Tier 1 figure.
  -Nominal pipe sizes: The nominal piping sizes are determined based on realistic economical considerations. All ESWS piping is conformant to ASME Code Section III, Class 3 and seismic Category I requirements, however, the nominal pipe sizes themselves are not important to safety because their only major influence in design would be the pump head requirements that are not directly related to ESWS safety functions.

  A boxed number 3 in four locations indicates that all the ESWS process piping is Safety Class 3. A legend for the Tier 1 figure codes is given in Tier 1 DCD Section 1.5.

- Tier 1 DCD Table 2.7.3.1-2 does identify power classification (IEEE Class) for each applicable component. Column 6 of the table consists of two parts: (1) equipment classification class 1E; and (2) qualification for harsh environment. "Yes" in each row is for Class 1E equipment and "No" is for harsh environment equipment qualification.

- The check valves with active safety-related function will be added in Table 2.7.3.1-2, as already addressed in RAI 288-2774, question number 03.09.06-34; DCD markups are found in Attachment 2 of the responses.

Impact on DCD

Tier 2 DCD Table 2.7.3.1-1 will be revised as formerly addressed in the responses to RAI 288-2774, question number 03.09.06-34; revised table can be found in Attachment 2 of the responses to this RAI. The table is shown as formerly addressed:

Table 2.7.3.1-1 Essential Service Water System Location of Equipment and Piping

System and Components	Location
Essential service water pumps	Ultimate heat sink related structures
Essential service water supply header piping and valves	Ultimate heat sink related structures and essential service water pipe tunnel
Essential service water return header piping and valves	Ultimate heat sink related structures and essential service water pipe tunnel
Essential service water supply line piping and valves to component cooling water heat exchangers	Reactor Building and essential service water pipe tunnel
Essential service water return line piping and valves from component cooling water heat exchangers	Reactor Building and essential service water pipe tunnel
Essential service water supply line piping and valves to essential chiller units	Power Source Building and essential service water pipe tunnel
Essential service water return line piping and valves from essential chiller units	Power Source Building and essential service water pipe tunnel
Essential service water pump motor cooling water piping and valves	**Ultimate heat sink related structures**

Tier 1 DCD Table 2.7.3.1-2 will also be revised as formerly addressed in the responses to RAI 288-2774, question number 03.09.06-34; revised table can be found in Attachment 2 of the responses to this RAI. However, there were some errors in the added items. A correct version of the table is shown below:

Table 2.7.3.1-2 Essential Service Water System Equipment Characteristics

Equipment Name	Tag No.	ASME Section III Class	Seismic Category I	Remotely Operated Valve	Class 1E/ Qual. For Harsh Envir.	PSMS Control	Active Safety Function	Loss of Motive Power Position
Essential service water pumps	EWS-OPP-001 A, B, C, D	3	Yes	-	Yes/No	**ECCS Actuation** **Loop Sequence**	Start **Start**	-
Essential service water pump discharge valves	EWS-MOV-503 A, B, C, D	3	Yes	Yes	Yes/No	**Pump Start**	Transfer Open	As Is
Essential service water pump discharge check valves	**EWS-VLV-502A, B, C, D**	**3**	**Yes**	**No**	**-**	**-**	**Transfer Open/ Transfer Close**	**-**
Essential service water pump cooling water check valves	**EWS-VLV-602A, B, C, D**	**3**	**Yes**	**No**	**-**	**-**	**Transfer Open/ Transfer Close**	**-**
Component Cooling Water Heat Exchanger Essential Service Water Flow	EWS-FT-2024, 2025, 2026, 2027	-	Yes	-	Yes/ No		-	-
Essential Service Water Header Pressure	EWS-PT-2005, 2006, 2007, 2008	-	Yes	-	Yes/ No		-	-

NOTE:
Dash (-) indicates "not applicable."

Tier 1 DCD Table 2.7.3.1-3 will be revised as formerly addressed in the responses to RAI 288-2774, question number 03.09.06-34; revised table can be found in Attachment 2 of the responses to this RAI. The table is shown as formerly addressed:

Table 2.7.3.1-3 Essential Service Water System Piping Characteristics

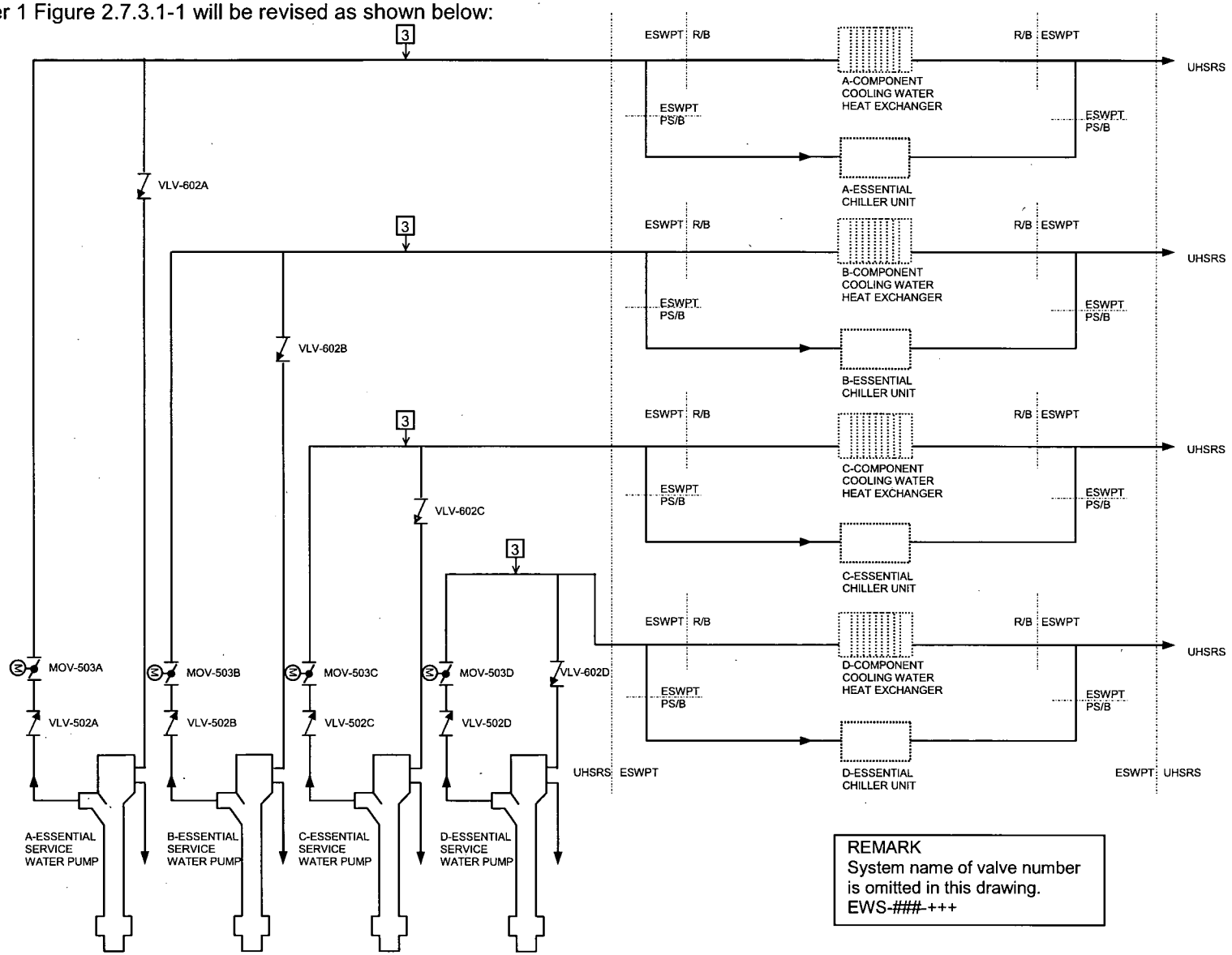
Pipe Line Name	ASME Code Section III Class	Seismic Category I
Essential service water supply header piping and valves	3	Yes
Essential service water return header piping and valves	3	Yes
Essential service water supply line piping and valves to component cooling water heat exchangers	3	Yes
Essential service water return line piping and valves from component cooling water heat exchangers	3	Yes
Essential service water supply line piping and valves to essential chiller units	3	Yes
Essential service water return line piping and valves from essential chiller units	3	Yes
Essential service water pump motor piping and valves	**3**	**Yes**

DCD Tier 1 Table 2.7.3.1-5 will be revised as shown below:

Table 2.7.3.1-5 Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria (Sheet 3 of 3)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
8. Controls exist in the MCR to open and close the remotely operated valves identified in Table 2.7.3.1-2.	8. Tests will be performed on the as-built remotely operated valves listed in Table 2.7.3.1-2 using controls in the MCR.	8. Controls in the MCR operate to open and close the as-built remotely operated valves listed in Table 2.7.3.1-2.
9.a The **motor-**operated **and check** valves, identified in Table 2.7.3.1-2 to perform an active safety-related, function to change position as indicated in the table.	9.a.i Tests or type tests of the valves will be performed that demonstrate the capability of the valve to operate under its design conditions.	9.a.i Each valve changes position as indicated in Table 2.7.3.1-2 under design conditions.
	9.a.ii Tests of the as-built **motor-operated** valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	9.a.ii Each as-built **motor-operated** valve changes position as indicated in Table 2.7.3.1-2 under pre-operational test conditions.
	9.a.iii Tests of the as-built check valves will be performed under pre-operational flow, differential pressure, and temperature conditions.	**9.a.iii Each as-built check valve changes position as indicated in Table 2.7.3.1-2.**
9.b Upon the receipt of an ESWP start signal, the essential service water discharge valve opens automatically.	9.b Tests of the as-built essential service water discharge valve will be performed using a simulated test signal.	9.b Upon the receipt of a simulated test signal, the as-built discharge valve opens automatically.
9.c After loss of motive power, the remotely operated valves, identified in Table 2.7.3.1-2, assume the indicated loss of motive power position.	9.c Tests of the as-built valves will be performed under the conditions of loss of motive power.	9.c Upon loss of motive power, each as-built remotely operated valve identified in Table 2.7.3.1-2 assumes the indicated loss of motive power position.
10.a Controls exist in the MCR to start and stop the pumps identified in Table 2.7.3.1-4.	10.a Tests will be performed on the as-built pumps in Table 2.7.3.1-4 using controls in the MCR.	10.a Controls in the MCR operate to start and stop the as-built pumps listed in Table 2.7.3.1-4.
10.b The pump identified in Table 2.7.3.1-4 starts after receiving a signal.	10.b Tests will be performed using simulated signal.	10.b The as-built pump identified in Table 2.7.3.1-4 starts after receiving simulated signal.
11. Displays of the parameters identified in Table 2.7.3.1-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the ESWS parameters in the as-built MCR.	11. The displays identified in Table 2.7.3.1-4 can be retrieved in the as-built MCR.
12. Remote shutdown console (RSC) displays and/or controls provided for the ESWS are identified in Table 2.7.3.1-4.	12. Inspections will be performed on the as-built RSC displays and/or controls for the ESWS.	12. Displays and/or controls exist on the as-built RSC as identified in Table 2.7.3.1-4.

DCD Tier 1 Figure 2.7.3.1-1 will be revised as shown below:



The sentence below will be at the end of the second paragraph of Tier 2 DCD Subsection 9.2.1.2.2.6 on "Valves":

"**If the motive power of the valve is lost, the valve maintains its open position.**"

Impact on COLA

There is no impact on the COLA.

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-29

Standard Review Plan Section 9.2.1, Station Service Water System, Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. The applicant must address inspections, tests, analyses, and acceptance criteria (ITAAC) in the design control document (DCD). The staff found that the proposed ITAAC in Tier 1 of the DCD, Section 2.7.3, Table 2.7.3.1-5, for the essential service water system is incomplete, inconsistent, inaccurate, or that clarification is needed. Consequently, the Tier 1, Section 2.7.3 and Table 2.7.3.1-5 information needs to be revised to address the following:

• Item 1a only refers to functional arrangement, but it should refer to functional arrangement and design details since nominal pipe size is an important consideration that needs to be verified.
• Item 1b verifies physical separation of the as-built ESWS mechanical divisions. The acceptance criteria are that each division is physically separated from the other divisions by structural and/or fire barriers. The requirements for physical separation of the ESWS pumps, and associated valves and other components, located in the ESWS pump house and piping tunnels are not clear. The requirements for physical separation of ESWS components in the pump house need to be provided.
• Item 7; clarify how the ITAAC will account for the degradation in heat removal capability at the maximum allowable supply water temperature of 35 oC (95 oF). Clarify how the as-built provides adequate cooling water.
• The DCD needs a test item to specify that ESWS pump testing to demonstrate adequate net positive suction head will be completed at the lowest ultimate heat sink level. The acceptance criteria for an acceptable test need to be specified.
• Quantitative acceptance criteria need to be established for all ITAAC as applicable (flow rates, heat transfer rates, completion times, etc.).
• The DCD needs to stipulate that the ESWS design provides for flow testing of the pumps during operation is incomplete in that it does not specify provisions for flow testing the individual component flow paths to verify flow balance requirements are satisfied.
• The DCD does not stipulate that the ESWS is accessible for performing periodic inspections as required by GDC 45.
• The DCD needs a test item to demonstrate that water hammer will not occur in the as built system upon manual or automatic start of a previously idle train, and during loss-of-power scenarios.

• The DCD needs an item for the inspection of Class 1E divisional separation.
• The DCD needs a test item for the testing of the ESW pump discharge strainer differential pressure alarms and monitors.
• The DCD needs a test item for the testing of the CCW heat exchanger inlet strainer differential pressure alarms and monitors.
• The DCD needs a test item for the testing of the CCW discharge radiation monitor alarms and monitors.
• The DCD needs a test item for the testing of essential chiller unit alarms and malfunctions on the ESWS side.
• The DCD needs a test item for the testing of ESWS check valves.
• The DCD needs an inspection item for supports per the requirements of ASME.
• The DCD needs an inspection item for lined underground piping which is placed in trenches.

ANSWER:

Question: Item 1a only refers to functional arrangement, but it should refer to functional arrangement and design details since nominal pipe size is an important consideration that needs to be verified.

Answer: The guidance provided in NUREG-0800 Section 14.3 does not require that nominal piping size is required in the functional arrangement or design description of systems. Piping size is an important design consideration especially on an economic point of view; however, MHI considers nominal piping sizes to be beyond the level of detail for Tier 1.

Question: Item 1b verifies physical separation of the as-built ESWS mechanical divisions. The acceptance criteria are that each division is physically separated from the other divisions by structural and/or fire barriers. The requirements for physical separation of the ESWS pumps, and associated valves and other components, located in the ESWS pump house and piping tunnels are not clear. The requirements for physical separation of ESWS components in the pump house need to be provided.

Answer: Table 2.7.3.1-5 will be revised to clarify the ESWS divisions including exceptions.

Question: Item 7; clarify how the ITAAC will account for the degradation in heat removal capability at the maximum allowable supply water temperature of 35 °C (95 °F). Clarify how the as-built provides adequate cooling water.

Answer: ITAAC Item 7 requires inspections and testing to verify that the ESWS provides adequate flow for heat removal during all plant operating conditions, including normal plant operating, abnormal, and accident conditions. In response to RAI 192, question 14.03.04-15, MHI is increasing the specificity of the ITAAC to demonstrate heat removal capability of the ESWS, component cooling water system (CCWS) and essential chilled water system (ECWS). The IST program includes periodic pump testing to provide assurance that pump performance continues to support system heat removal capability for the life of the plant. The COL applicant program to monitor heat exchanger performance is addressed in response to RAI question 9.2.1-30.

Question: The DCD needs a test item to specify that ESWS pump testing to demonstrate adequate net positive suction head will be completed at the lowest ultimate heat sink level. The acceptance criteria for an acceptable test need to be specified.

Answer: Tier 1 DCD Section 3.0 on Interface Requirements states that a COL applicant referencing the US-APWR DCD "is responsible to assure that the site-specific design meets the interface requirements and verify the conformance with the ITAAC process." The interface requirement also states that, "The UHS keeps the water level at a net positive suction head (NPSH) greater than the pump's required NPSH", therefore, the COL applicant will address the ITAAC item regarding ESW pump NPSH.

Question: Quantitative acceptance criteria need to be established for all ITAAC as applicable (flow rates, heat transfer rates, completion times, etc.).

Answer: As revised in response to RAI 192, question 14.03.04-15, ITAAC Item 7 will require a report to conclude that the as-built ESWS provides adequate flow for heat removal during all plant operating conditions, including normal plant operating, abnormal, and accident conditions. MHI believes this approach provides sufficient assurance that ITAAC adequately demonstrate system performance, without introducing excessive detail to Tier 1.

Question: The DCD needs to stipulate that the ESWS design provides for flow testing of the pumps during operation is incomplete in that it does not specify provisions for flow testing the individual component flow paths to verify flow balance requirements are satisfied.

Answer: The ESWS system flow is established by system resistance and does not require automatic control. The flow balance remains unchanged for each user during all modes of operation. Therefore, no special provisions for online testing are applicable to the ESWS.

Question: The DCD does not stipulate that the ESWS is accessible for performing periodic inspections as required by GDC 45.

Answer: NUREG-0800 Section 14.3 Appendix C, Subsection I.A.xii, states that accessibility does not need to be addressed in Tier 1 but should be addressed in Tier 2. Therefore, accessibility is not addressed in Tier 1 Subsection 2.7.3. As stated in DCD Tier 2 Subsection 9.2.1.2.2.5, ESWS piping is arranged to permit access for inspection.

Question: The DCD needs a test item to demonstrate that water hammer will not occur in the as built system upon manual or automatic start of a previously idle train, and during loss-of-power scenarios.

Answer: MHI will revise the DCD Tier 1 interlock description in Subsection 2.7.3.1.1 to describe the ESW pump discharge valve interlock feature consistent with Tier 2 DCD Subsection 9.2.1.2.3. ITAAC item 9.b in Table 2.7. 3.1-5, which tests the interlock to assure water hammer prevention, will be revised accordingly. Refer to the response to RAI 326, questions 9.2.1-4 and 9.2.1-12, for additional description of measures to preclude water hammer.

Question: The DCD needs an item for the inspection of Class 1E divisional separation.

Answer: ITAAC Item 6.b in Table 2.7. 3.1-5 requires an inspection to verify the separation between each Class 1E division, and separation between each Class 1E division and non-Class 1E cable.

Question: The DCD needs a test item for the testing of the ESW pump discharge strainer differential pressure alarms and monitors.

Answer: Refer to the response to RAI 326 question 9.2.1-22 for changes to the DCD Tier 1 Table 2.7.3.1-4, "Essential Service Water System Equipment Alarms, Displays, and Control Functions." ITAAC item 11 in Table 2.7.3.1-5 will be revised to include verification that alarms can be retrieved in the as-built MCR.

Question: The DCD needs a test item for the testing of the CCW heat exchanger inlet strainer differential pressure alarms and monitors.

Answer: As described in Tier 2 DCD Subsection 9.2.1.5 and in response to RAI 326 question 9.2.1-22, CCW heat exchanger inlet strainer differential pressure is indicated locally. Therefore, no alarms or monitors for this parameter are included in the Tier 1 DCD Table 2.7.3.1-4 which includes MCR alarms, displays and controls that are subject to ITAAC.

Question: The DCD needs a test item for the testing of the CCW discharge radiation monitor alarms and monitors.

Answer: The CCW radiation monitors are included in Tier 1 Table 2.7.6.6-1, Process Effluent Radiation Monitoring and Sampling System Equipment Characteristics. ITAAC testing is not applicable to these non-Class 1E monitors. ITAAC item 1 in Table 2.7.6.6-2, as revised in response to RAI 184, question 14.03.07-21, requires an inspection to verify consistency with the Tier 1 Design Description functional arrangement.

Question: The DCD needs a test item for the testing of essential chiller unit alarms and malfunctions on the ESWS side.

Answer: Refer to the response to RAI 326 question 9.2.1-22 regarding completeness of the DCD description of ESWS instrumentation.

Question: The DCD needs a test item for the testing of ESWS check valves.

Answer: As identified in Tier 2 DCD Table 3.9-14, "Valve Inservice Test Requirements," ESW pump cooling water check valves EWS-VLV-502A, B, C, and D and ESWP motor cooling line check valves EWS-VLV-602A, B, C, and D are in the IST program with active safety functions to transfer open and transfer closed. MHI will add these valves to DCD Tier 1 and include ITAAC testing.

Question: The DCD needs an inspection item for supports per the requirements of ASME.

Answer: In MHI's response to RAI 242 question 14.03.03-6, ITAAC # 2.b was revised to explicitly include supports with the piping ITAAC to verify conformance with ASME Code Section III requirements by inspection and analyses.

Question: The DCD needs an inspection item for lined underground piping which is placed in trenches.

Answer: Refer to response to RAI 326 question 9.2.1-23.

Impact on DCD

ITAAC Item 1.b in Table 2.7.3.1-5 will be revised to reflect the exceptions as follows:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.b Each mechanical division of the ESWS (Divisions A, B, C & D) **except for piping** is physically separated from the other divisions **with the exception of components in the ESWS piping tunnel**.	1.b Inspections of the as-built **ESWS** ~~system~~ will be performed.	1.b Each mechanical division of the as-built ESWS **except for piping** is physically separated from other mechanical divisions of the system by structural ~~and/or fire~~ barriers **with exception of the components in ESWS piping tunnel**.

DCD Tier 1 Subsection 2.7.3.1.1 "Design Description" will be revised as follows:

Interlocks

Upon the receipt of an ESWP start signal, the essential service water discharge valve opens automatically. **The motor operated valve at the discharge of each pump is interlocked to close when the pump is not running or is tripped. This interlock prevents the pump from starting if the valve is not closed. The valve starts to open after the respective pump starts.**

Tier 1 DCD Table 2.7.3.1-2, "Essential Service Water System Equipment Characteristics," will be revised to add the ESW pump cooling water check valves. (Table revision reflects addition of "PSMS Control" column in response to RAI 192, question 14.03.04-18; however, the revised table as given in the response to RAI 09.02.01-28 will be used in the DCD revision.)

Table 2.7.3.1-5, "Essential Service Water System Inspections, Tests, Analyses, and Acceptance Criteria," will be revised as follows (revision reflects changes previously incorporated in response to RAI 192 question 14.03.04-17)::

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.b Upon the receipt of an ESWP start signal, the essential service water discharge valve opens automatically. **Each pump's discharge valve is interlocked to close when the pump is not running or is tripped. The valve starts to open after the respective pump starts.**	9.b. A test of each as-built **interlock for the** essential service water discharge valves will be performed using a simulated test signal.	9.b **The ESW discharge valve closes when its respective pump is not running.** Upon the receipt of a simulated ESWP start signal the as-built discharge valve **for the respective pump starts to open** ~~opens~~ automatically **after the pump starts. The valve closes when the pump is tripped.**

New ITAAC item will be added for check valves:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.d The check valves identified in Table 2.7.3.1-2, perform an active safety function to change position as indicated in this table.	**9.d Tests of the as-built check valves will be performed under pre-operational flow, differential pressure, and temperature conditions.**	**9.d Each as-built check valve changes position as indicated in Table 2.7.3.1-2 under pre-operational test conditions.**

Revise ITAAC Item 11 to include alarms in the MCR:

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. **MCR alarms and displays** ~~Displays~~ of the parameters identified in Table 2.7.3.1-4 can be retrieved in the MCR.	11. Inspections will be performed for retrievability of the ESWS parameters in the as-built MCR.	11. **MCR alarms and** ~~The~~ displays identified in Table 2.7.3.1-4 can be retrieved in the as-built MCR.

Impact on COLA

There is no impact on the COLA

Impact on PRA

There is no impact on the PRA.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

6/19/2009

US-APWR Design Certification

Mitsubishi Heavy Industries, Ltd.

Docket No. 52-021

RAI NO.: NO. 326-2279 REVISION 0

SRP SECTION: 9.2.1 – Station Service Water System

APPLICATION SECTION: 9.2.1

DATE OF RAI ISSUE: 4/8/2009

QUESTION NO.: 09.02.01-30

Standard Review Plan Section 9.2.1, "Station Service Water System," Sections II and III, and Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)", provide guidance on the specific information that should be included in the application for evaluation by the staff. The design control document (DCD) must specify Combined License (COL) items for future license applications against the DCD.

The staff found that an extensive amount of new information will be required by the applicant to address RAIs 9.2.1-1 through 9.2.1-28. The overall presentation of essential service water system information required to address the requirements of Standard Review Plan Section (SRP) 9.2.1, was found to be incomplete and inadequate for the staff's review. Due to the extensive amount of revisions and information that is requested in the RAIs in this section, the staff expects that the applicant will need to reevaluate the set of COL action items, 9.2 (1) through 9.2 (8) in Tier 2 of the DCD Table 1.8-2. The resulting set of COL items for the essential service water system (ESWS) in the revised Tier 2 of the DCD Section 9.2.1, should be written to be more detailed in terms of what the COL applicant is requested to provide. In addition to the request to reevaluate the existing COL items in DCD Revision 1, the following are some of the issues noted in the existing COL items.

- In item 9.2(1), the COL applicant was asked to evaluate the essential service water pump (ESWP) at the lowest probable water level of the UHS. The staff finds that more detail is required as to what the applicant is asking the COL applicant to provide in its evaluation. The staff also requests that the COL item address procedures for the ESWP in the event of low water levels in the UHS.
- In item 9.2(2), the COL applicant was asked to provide the protection against adverse environmental, operating, and accident conditions that can occur such as freezing, and thermal over pressurization. The staff finds that this item does not specifically address what the COL applicant is to provide. The staff finds that procedures for protection against the adverse conditions should also be specified.
- In item 9.2(8) the COL applicant was asked to specify chemistry requirements for the ESWS. This item should be clear in asking for chemistry requirements that specify the corrosion inhibitors and other chemistry requirements necessary to address trains that are in normal operation as well as those that may be in standby for a period of time.
- The staff finds that an additional COL item may be necessary to provide a design configuration and evaluation for prevention of water hammer events in the ESWS.

- It is not clear how the maximum allowable UHS water supply temperature of 35 oC (95 oF) will be addressed. A COL item may be necessary for this item.
- The staff finds that an additional COL item may be necessary to provide drawings indicating the elevation of the ESWS pump impellers.
- Tier 2 of the DCD Section 9.2.1.2.3.1, describes placing the standby component cooling water pump (CCWP) of the same subsystem and the corresponding ESWP placed in service to resume the cooling process. "The previously activated CCWP is shut off after the switch in operating pump". The second sentence need to be clarified and this should be a COL information item to have procedures developed for this sequence in operating equipment.

ANSWER:

Question: In item 9.2(1), the COL applicant was asked to evaluate the essential service water pump (ESWP) at the lowest probable water level of the UHS. The staff finds that more detail is required as to what the applicant is asking the COL applicant to provide in its evaluation. The staff also requests that the COL item address procedures for the ESWP in the event of low water levels in the UHS.

Answer: Revise COL 9.2(1) as follows:

"The COL Applicant is to provide the evaluation of the ESWP net positive suction head at the lowest probable water level of the UHS. **The COL applicant is to develop recovery procedures in the event of approaching low water level of UHS.**"

Question: In item 9.2(2), the COL applicant was asked to provide the protection against adverse environmental, operating, and accident conditions that can occur such as freezing, and thermal over pressurization. The staff finds that this item does not specifically address what the COL applicant is to provide. The staff finds that procedures for protection against the adverse conditions should also be specified.

Answer: Revise COL 9.2(2) as follows:

"The COL Applicant is to provide the protection against adverse environmental, operating, and accident conditions that can occur, such as freezing **and** thermal overpressurization. **The COL Applicant is to provide the preventive measures for protection against the adverse environmental conditions.**"

Question: In item 9.2(8) the COL applicant was asked to specify chemistry requirements for the ESWS. This item should be clear in asking for chemistry requirements that specify the corrosion inhibitors and other chemistry requirements necessary to address trains that are in normal operation as well as those that may be in standby for a period of time.

Answer: Revise COL 9.2(8) as follows:

"The COL Applicant is to specify **the following** ESW chemistry requirements~~.~~**:**

- **A chemical injection system to provide non-corrosive, non-scale forming conditions to limit biological film formation.**
- **Type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant based on the site conditions.**"

Question: The staff finds that an additional COL item may be necessary to provide a design configuration and evaluation for prevention of water hammer events in the ESWS.

Answer: A new item COL 9.2(25) will be added as follows:
The COL applicant will develop operating and maintenance procedures for the ESWS to address water hammer issues in accordance with NURG-0927.

Question: It is not clear how the maximum allowable UHS water supply temperature of 35° C (95° F) will be addressed. A COL item may be necessary for this item.

Answer: COL 9.2(20) requires the applicant to provide the maximum allowable UHS water supply temperature. DCD Tier 2 9.2.5.1 states that the maximum ESW temperature is 95° F.

Question: The staff finds that an additional COL item may be necessary to provide drawings indicating the elevation of the ESWS pump impellers.

Answer: The specific information like pump impeller elevation drawing is not required in SRP 9.2.1 or R.G. 1.206, however this information needs to evaluate net positive suction head.

Question: Tier 2 of the DCD Section 9.2.1.2.3.1, describes placing the standby component cooling water pump (CCWP) of the same subsystem and the corresponding ESWP placed in service to resume the cooling process. "The previously activated CCWP is shut off after the switch in operating pump". The second sentence need to be clarified and this should be a COL information item to have procedures developed for this sequence in operating equipment.

Answer: The answer to this question is addressed in the response to RAI 09.02.01-22.

Impact on DCD

The following COL items will be added or revised in DCD Chapter 1 Table 1.8-2 Compilation of All Combined License Applicant Items for Chapters 1-19 and DCD 9.2.10 Combined License Information.

COL 9.2(1) *The COL Applicant is to provide the evaluation of the ESWP net positive suction head at the lowest probable water level of the UHS.* ***The COL Applicant is to develop recovery procedures in the event of approaching low water level of UHS.***

COL 9.2(2) *The COL Applicant is to provide the protection against adverse environmental, operating, and accident conditions that can occur, such as freezing,* ***and*** *thermal overpressurization.* ***The COL Applicant is to provide the preventive measures for protection against adverse environmental conditions.***

COL 9.2(8) *The COL Applicant is to specify the* ***following*** *ESW chemistry requirements:*

- ***A chemical injection system to provide non-corrosive, non-scale forming conditions to limit biological film formation.***
- ***Type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant based on the site conditions.***

COL 9.2(25) ***The COL applicant will develop operating and maintenance procedures for the ESWS to address water hammer issues in accordance with NURG-0927.***

The sentence below will be added at the end of the 11th paragraph of Tier 2 DCD Subsection 9.2.1.3 Safety Evaluation:

"**The COL applicant is to develop recovery procedures in the event of approaching low water level of UHS.**"

Tier 2 DCD Subsection 9.2.1.3 Safety Evaluation, twelfth paragraph will be revised as shown below:

"The COL Applicant is to provide the protection against adverse environmental, operating, and accident conditions that can occur, such as freezing~~,~~ **and** thermal overpressurization. **The COL Applicant is to provide the preventive measures for protection against adverse environmental conditions.**"

The 6th paragraph of 2 DCD Subsection 9.2.1.2.1 will be further revised to include the following:

"**Bio-fouling and chemistry control of the ESW system is site specific and depends upon the type of UHS.** The COL Applicant is to specify the **following** ESW chemistry requirements:

- **A chemical injection system to provide non-corrosive, non-scale forming conditions to limit biological film formation**
- **The type of biocide, algaecide, pH adjuster, corrosion inhibitor, scale inhibitor and silt dispersant based on the site conditions.**"

Impact on COLA

The resolution to COL 9.2(1) will be revised to include recovery procedures in the event of approaching low water level of UHS.

The resolution to COL 9.2(2) will be revised to include preventive measures for protection against the adverse conditions.

The resolution to COL 9.2(8) will be revised to include specific chemistry requirements.

New description regarding operating and maintenance procedures for the ESWS to address water hammer issues will be added as a resolution of COL 9.2(25).

Impact on PRA

There is no impact on PRA.