REQUEST FOR ADDITIONAL INFORMATION 585-4464 REVISION 0

5/10/2010

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.02.01 - Station Service Water System
Application Section: 09.02.01

QUESTIONS for Balance of Plant Branch 2 (SBPB)

09.02.01-32

Paragraph 10 CFR 52.47(a)(24) requires "a representative conceptual design for those portions of the plant for which the application does not seek certification, to aid the NRC in its review of the FSAR and to permit assessment of the adequacy of the interface requirements." Nuclear Regulatory Commission (NRC) staff has been reviewing Revision 2 of the Design Control Document (DCD) for the US-Advanced Pressurized Water Reactor (US-APWR). The staff the Tier 1 and Tier 2, DCD ESWS description and related figures and tables. The staff found instances of incomplete or unclear descriptive information as to distinguish conceptual design information (CDI) from standard plant design information (SPDI). The portions that are plant specific still require a conceptual design as required by 10 CFR 52.47(a)(24) and should also be clearly differentiated from the SPDI within the application as follows:

a. SPDI needs to be differentiated from CDI in the text, tables, and figures of the DCD so the staff can properly review the certified design portions against the Standard Review Plan (SRP) and adequately assess to what extent interface requirements need to be established based on the CDI that is provided.

b. Interface requirements should be established for those parts of the description that are CDI as appropriate. Note that interface requirements must be sufficiently detailed to allow completion of the FSAR by COL applicants.

c. The extent that the DCD needs to be revised to satisfy (a) and (b) above could be rather extensive and the DCD should be reviewed in its entirety to ensure that SPDI is properly differentiated from CDI and that the description of this information in the DCD is accurate and consistent throughout.

d. For example, Section 1.2.1.6 indicates that the site-specific details of a US-APWR site plan is to be presented in the combined license application and refers to Figure 1.2-1 for a "typical site plan." This section also states that the area within the perimeter fence of a US-APWR installation includes a site-specific portion of the facility. Contrary to this, Section 1.8 indicates that the standard scope of design for the US-APWR includes the entire nuclear island and all safety-related systems that would be required for constructing the plant at a site. Section 1.8 goes on to state that the standard site plan for US-APWR design certification is shown in Figure 1.2-1. However, it is not clear from Figure 1.2-1 what parts of the site plan are plant-specific (conceptual design) vs. what parts

are within the scope of the certified design. Sections 1.2.1.6 and 1.8, and Figure 1.2-1 need to clearly distinguish what is within the scope of the standard plant design and what is not.

e. For example, Table 1.8-1 indicates that portions of the ESWS outside the US-APWR buildings are outside the scope of the standard plant design. Based on this description, the ESW pumps, piping, pipe tunnel, valves, and instrumentation up to the point where the ESWS enters and exits the reactor and power source buildings are outside the scope of the US-APWR standard plant design. Because there is no way to distinguish CDI from SPDI, the descriptive information provided for the ESWS in Section 9.2.1 and shown on Figure 9.2.1-1 does not distinguish CDI from SPDI. This makes it difficult for the NRC staff and COL applicants to recognize what parts of the description are actually CDI that will need to be replaced by plant-specific information. This lack of clarity also makes it more difficult to properly identify interface requirements and COL information items that should be established. Therefore, the DCD needs to be revised to eliminate this confusion by providing a way to clearly distinguish CDI from SPDI.

f. For example, Table 3.2-2 specifies classification information for all parts of the ESWS. However, for those parts of the ESWS that are not included within scope for the standard plant design, it's not clear to what extent and on what basis this information applies to the COL applicants. Furthermore, additional confusion is added by COL Information Items 3.2(4) and (5) which indicate that the COL applicant is to identify the classifications for site-specific SSCs without identifying specifically which SSCs are site-specific. Therefore, the DCD needs to be revised to eliminate this confusion by providing a way to clearly distinguish CDI from SPDI.

g. For example, Table 3.2-4 specifies the seismic classification for the ESWS pipe tunnel. However, because the ESWS pipe tunnel is not included within the scope of the standard plant design, it's not clear to what extent and on what basis this information applies to the COL applicants. Furthermore, additional confusion is added by COL Information Items 3.2(4) and (5) which indicate that the COL applicant is to identify the classifications for site-specific SSCs without identifying specifically which SSCs are site-specific. Therefore, the DCD needs to be revised to eliminate this confusion by providing a way to clearly distinguish CDI from SPDI.

Understand that in the RAIs that follow, the staff may be asking questions on parts of the DCD description that are not SPDI and are not really relevant. In the absence of clarity, the staff assumed that the descriptive information provided in Revision 2 of the DCD was SPDI unless clearly and consistently distinguished as CDI.

09.02.01-33

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 NRC staff. The staff reviewed Revision 2 of the US-APWR DCD

and found instances of incomplete or unclear descriptive information related to the ESWS as follows:

a. DCD Section 1.2.1.5.4.4 indicates that the ESWS discharges to the discharge pit. However no “discharge pit” is shown on Figure 1.2-1.

b. Section 9.2.1.1.2 is supposed to describe the power generation design basis of the ESWS. However, no discussion of the ESWS power generation design basis is included in this section.

c. Section 9.2.1.1.2 indicates that the COL applicant is to address site-specific non-safety related system isolation (intake basin blow down system, intake basin make up system) as applicable. However, these systems are not part of the ESWS and are not pertinent to the description that is provided in Section 9.2.1. Instead, these systems pertain to the ultimate heat sink (UHS) and should be discussed in Section 9.2.5. Furthermore, to the extent that these systems are not included within the scope of the standard plant, conceptual designs for these systems must be described in accordance with 10 CFR 52.47(a)(24).

d. Section 9.2.1.2.1 indicates that the ESWS is arranged into four independent trains. However, the descriptive information does not adequately explain how the design ensures that failures, events, or conditions that ultimately render one train inoperable won’t adversely affect the other trains. A brief summary discussion is adequate provided complete evaluations of these considerations are provided in other parts of the DCD and referred to for completeness. However, for those parts of the ESWS that are not included within the scope of the standard plant design, it’s not clear to what extent and on what basis this information pertains to COL applicants.

e. Section 9.2.1.2.1 indicates that the COL applicant is to provide the piping, valves, and other design related to the site specific UHS. This does not pertain to the ESWS and should be discussed in Section 9.2.5.

f. Section 9.2.1.2.2.5 indicates that underground piping is epoxy lined carbon steel and placed in trenches. The following considerations need to be addressed:
   - Figure 1.2-1 shows that an ESWS pipe tunnel is used, not trenches.
   - Applicable design specifications and potential failure modes’
   - The buried piping and pipe tunnel are not within scope for the standard plant, and it’s not clear to what extent and on what basis this information applies to the COL applicants.

g. Section 9.2.1.2.2.6 indicates that valves are provided for back-flushing the CCW heat exchangers. It isn’t clear why this design feature is provided since an in-line self cleaning strainer is provided and this needs to be better explained.

h. Section 9.2.1.2.3.1 does not include a description of ESWS operation for satisfying shutdown cooling considerations.

i. Section 9.2.1.3 indicates that the UHS has sufficient water volume to perform required cooling to mitigate the consequences of an accident. The UHS is

described in Section 9.2.5 and this discussion should be relocated to that section accordingly.

j. Section 9.2.1.3 (page 9.2-9) indicates that the COL applicant is to provide the UHS water volume, maximum operating water temperature and the lowest water level for the ESWPs. This item pertains to the UHS and should be discussed in Section 9.2.5.

k. Section 9.2.1.3 indicates that the COL applicant is to provide the safety evaluation for the ESWS design related to the site specific conditions. This item is much too broad and needs to identify what design features and site specific conditions are being referred to for action by the COL applicant.

l. Section 9.2.1.3 indicates that the COL applicant is to provide the protection against adverse environmental, operating, and accident conditions that can occur such as freezing and thermal overpressurization; and that the COL applicant is to provide the preventive measures for protection against adverse environmental conditions. This is much too broad and needs to be more specific. Protection of structures, systems, and components (SSCs) against adverse environmental, operating and accident conditions should not be deferred to a COL applicant unless adequately justified by the plant-specific considerations that are involved. For example, freeze protection of piping systems is dependent on plant-specific temperature considerations and would have to be addressed by the COL applicant. However, protection of piping that is included within the scope of the standard plant from environmental effects due to an accident should be addressed by the standard plant design. The applicant needs to address this.

m. Section 9.2.10, COL 9.2(6) indicates that the COL applicant is to provide ESWP design details – required total dynamic head, NPSH available, etc. NPSH available is a function of the water level in the pump basin and the design detail of interest that needs to be addressed is the minimum NPSH that is required.

n. Section 9.2.10, COL 9.2(7) indicates that the COL applicant is to provide piping and valves, including those at the boundary between safety-related and nonsafety-related portions related to site-specific conditions. It isn't clear what this item is referring to and to what extent it applies to that part of the ESWS that is within scope for the standard plant design, such as vents and drains.

o. Table 9.2.1-4 shows for Trains A & B that 50 gpm are required for cooling the ESW pump motor to support safe shutdown. This appears to be in error since only one ESW pump is needed which requires a flow rate of 25 gpm for motor cooling. Also, because this aspect of the ESWS design is not included within the scope of the standard plant, it's not clear to what extent and on what basis this information applies to COL applicants.

p. Table 9.2.7-1 shows that the cooling water inlet temperature is 100 degrees F. However, the maximum allowed supply temperature for the ESWS is 95 degrees F and this apparent inconsistency needs to be explained.

09.02.01-34

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 NRC staff. The ESWS descriptive information provided in Tier 2 of the DCD, Revision 2, Section 9.2.1.2.2.2 was reviewed to confirm that the ESWS is capable of performing its heat removal function. The staff found that the use of strainers (both ESWS and CCW self-cleaning) was not adequately described and justified in this regard. For example, items that need to be addressed include:

a. Applicable design and quality specifications that apply.
b. Maximum allowed differential pressure and basis; and maximum design differential pressure.
c. Mesh size and basis.
d. Failure modes.
e. Figure 9.2-1 shows that the self-cleaning strainer discharges water through a flow path that includes a flow orifice. This is a potential choke point for debris accumulation that can ultimately cause diminished flow and plugging of this flow path, and no flow indication is provided for monitoring this condition. Furthermore, the debris that is flushed out through this flow path could cause a problem for the UHS if mechanical draft cooling towers are used because the debris could cause the spray nozzles to become obstructed. These aspects of the design need to be addressed and justified.
f. For ESWS strainers: a clear distinction between what actions are automatic vs. what actions require operator action along with justification as appropriate.
g. For ESWS strainers: for worst case scenario with strainers at/near maximum allowable differential pressure, an explanation is needed for how the safety function is assured. Manual operator actions need to be identified and justified.
h. The ESWS strainers are not within the scope of the standard plant, and it's not clear to what extent and on what basis the information in the DCD applies to COL applicants.

09.02.01-35

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) Chapter 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 ESWS descriptive information provided in Tier 2 of the DCD, Revision 2, Section 9.2.1 was reviewed to confirm that the ESWS is capable of performing its heat removal function. The staff found that the minimum system design temperature and low temperature operation were not adequately described and addressed in this regard. Current operating plants have found it necessary to throttle CCWS and ESWS flow rates to accommodate reduced temperature operating conditions and it isn't clear why this will

not be necessary for the US-APWR design during both normal operating and shutdown conditions. The impact of reduced temperature on accident mitigation capability and the need for operator action in this regard also needs to be addressed.

09.02.01-36

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. This guidance includes consideration of water hammer effects. Sections 9.2.1.2.1 and 9.2.1.2.3.1 of the DCD indicate that voiding may occur following a loss of offsite power. In order to minimize the potential for water hammer, the pump discharge valve is interlocked to close when the pump is not running or is tripped. Upon pump restart, after a predetermined time delay, the discharge valve gradually opens to preclude water hammer. The following considerations need to be better addressed:

a) While the description indicates that water downstream of the high point in the CCW discharge pipe will void, this part of the system is apparently CDI and this may not occur for the plant specific design; especially if a cooling tower is on the downstream side.

b) While the pump discharge check valve is supposed to prevent voiding on the upstream side of the ESW pump, no justification in terms of a valve leak rate criterion and recognition of this in the IST program was provided. Likewise for the pump discharge motor operated butterfly valve.

c) The pump is being started in a voided condition with no flow through the pump and no cooling for the motor for a "predetermined" period of time. This mode of operation with no minimum-flow recirculation included in the design needs to be better described and justified.

d) The pump discharge valve is a butterfly valve which may not be capable of providing the flow control that is needed for "precluding" water hammer. Note that the extent of voiding that can occur based on the considerations involved needs to be established during the initial test program and acceptable performance needs to be demonstrated.

e) The description indicates that a pump is tripped if its discharge valve doesn't open and based on the description in Section 9.2.1.2.3.1, this is apparently a manual operator action. Note that manual operator actions are typically not allowed in this regard and must be justified.

f) Upon restart, the ESW pump is supposed to sweep out air in the system through high-point vents. However, there is no discussion about where these high point vents are and how they function to remove air without operator action involved.

g) Due to the uncertainties involved the initial test program needs to include testing to demonstrate that water hammer is not a problem for the design.

Much of the information pertains to parts of the ESWS that are not included within the scope of the standard plant, and it's not clear to what extent and on what basis this information applies to COL applicants.

09.02.01-37

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. This guidance includes consideration of flow rate and net positive suction head considerations' as well as material specifications. Section 9.2.1.2.2.1 of the DCD indicates that each ESW pump is designed to provide 13,000 gpm at the required total dynamic head. The total dynamic head requirement is unknown because much of the system is CDI. This is inconsistent with the information provided in Table 9.2.1-1 which indicates that the pumps are designed for 150 psig. Also, the pump material is listed as stainless steel, which may be inappropriate. The material should be suitable for the UHS and water conditions that exist at the site. All of this needs to be properly addressed in COL information items.

a) For that part of the design that is included within scope, the total dynamic head requirement and basis should be specified. The applicant would have to add this to the total dynamic head required for the plant-specific parts of the design and select a pump that satisfies the total dynamic head requirement for the plant while providing 13,000 gpm flow.

b) Because the ESWS pumps are not included within the scope of the standard plant design, it's not clear to what extent and on what basis this information pertains to COL applicants.

09.02.01-38

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. This guidance includes consideration of net positive suction head (NPSH) requirements for the ESW pumps. Section 9.2.1.3 of the DCD indicates that the COL applicant is to provide the evaluation of ESWP at the lowest probable water level of the UHS. This is inadequate. This evaluation should be performed based on the lowest possible water level that may be reached in the UHS during the 30 day period following an accident, and should address both NPSH and vortex considerations based on the most limiting assumptions that apply (e.g., temperature, flow rate, operation of other pumps). The initial test program in conjunction with appropriate analysis should include confirmation that NPSH and vortex formation considerations are satisfied by the design and operating limitations that have been established.

09.02.01-39

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. This guidance includes consideration of ESWS pump performance considerations. Shutoff head of the ESW pumps is not addressed in the DCD because these pumps are CDI. Consequently, a Tier 1 interface item is needed to specify the maximum allowed ESW pump shutoff head to ensure that ESWS design pressure will not be exceeded. This also needs to be described in Tier 2 Section 9.2.1.

09.02.01-40

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. This guidance includes consideration of ESWS instrumentation that is necessary for operating the ESWS. The instrumentation and controls (I&C) for the ESWS need to be specified in sufficient detail to ensure that plant operators can properly monitor ESWS status and performance. Section 9.2.1.2.3.1 of the DCD indicates that when low ESW header pressure is annunciated, the standby CCW pump of the same subsystem and corresponding ESW pump are placed in service. The following considerations need to be addressed:

a) The description needs to distinguish between manual and automatic actions, and justification needs to be provided as appropriate.

b) The description needs to explain what is meant by the "subsystem" designation, what makes one subsystem different from another, what the consequences are if the CCW or ESW pump of the same subsystem is not available, and how this "subsystem" designation impacts the independence that is credited between trains.

c) Because the ESW pumps and header pressure instrumentation are not included within the scope of the standard plant, it's not clear to what extent and on what basis this information applies to COL applicants.

09.02.01-41

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. This guidance includes consideration of ESWS instrumentation that is necessary for operating the ESWS. The instrumentation and controls (I&C) for the ESWS need to be specified in sufficient detail to ensure that plant operators can properly monitor ESWS status and performance. Section 9.2.1.5 of the DCD provides a description of ESWS instrumentation. The following items require additional consideration and explanation:

a) The ESWP discharge pressure is only provided locally and is not available in the control room. This does not appear to be appropriate since the ESW pumps are started with their respective discharge isolation valves closed and pressure indication is important for confirming proper functioning of the pump/valve interlock when a pump is starting. Therefore, ESWP discharge pressure should be indicated locally and in the control room.
b) The ESWP discharge pressure is reflective of ESW line pressure and a separate indication in the control room for line pressure is not necessary. Low ESWP discharge pressure can be annunciated in the control room to alert operators to a low pressure condition. By taking this approach, the line pressure indicator can be used for local indication but need not be indicated in the control room.
c) The description of those indications that are available in the control room should also state that the indication is available locally for completeness.
d) In order to ensure that ESWS temperature limits are not exceeded during plant cool down and post-accident conditions, the ESWS outlet temperature from the CCW heat exchangers should be indicated and annunciated in the control room.
e) In order for the operators to adequately monitor the status of ESWS cooling for CCW and to ensure that design limitations are not exceeded, the differential pressure for the CCW heat exchanger inlet strainer should be indicated and annunciated in the control room.
f) In order for the operators to adequately monitor ESWS status, alignment of the ESWS strainers, the flow path being used for the essential chiller units (bypass or mainline), and the open/closed position of the blowdown valve for the ESWS/CCW in-line strainer should be indicated in the control room.
g) Some of the ESWS instrumentation is outside the scope of the standard plant, and it's not clear to what extent and on what basis this information applies to COL applicants for those instruments.

09.02.01-42

This is a follow-up to RAI 326-2279, Question 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. SRP 9.2.1, Section III, 2.A requires that ESWS portions to be identified correctly and can be isolated from nonessential portions. Nuclear Regulatory Commission (NRC) staff has been reviewing Revision 2 of the Design Control Document (DCD) for the US-Advanced Pressurized Water Reactor (US-APWR). As previously noted by RAI 09.02.01-4 Item 2, the staff requested the applicant to identify piping and/or components that are identified as non-safety and/or any related isolation design features and class breaks. In addition, the RAI requested the applicant, in Section 9.2.1 of the DCD, to provide a description of (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, (b) how periodic testing will be performed to ensure the specified requirements will be met, and (c) 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.

In its response to RAI 09.02.01-4, the applicant indicated that the ESWS does not provide cooling for any non-safety related systems. However, some piping sections are non-safety related. These piping sections are drains that are connected to the ESWS and are normally isolated by closed valves. The applicant proposed a revision to Tier 2 DCD Subsection 9.2.1.2.2, renaming this subsection to "Nonsafety-Related Design Basis" and to clarify the distinction of safety related and non-safety related piping. The applicant also proposed to alter COL information item 9.2(7) in DCD Chapter 1, Table 1.8-2 and Subsection 9.2.10, "Combined License Information," to specify that the non-safety related design is a COL responsibility and that the COL applicant is to provide the piping and valves that form the boundary between the safety related and non-safety related portions of the ESWS system. The staff reviewed the response and found that it was inadequate. The following items need to be addressed in this regard:

a) In the response to RAI 09.02.01-4 the applicant used the term "ditto piping." The staff is uncertain as to what this means and the DCD needs to be revised to use more conventional terminology.
b) The applicant proposed a revision to Tier 2 DCD Subsection 9.2.1.2.2, renaming this subsection to "Nonsafety-Related Design Basis" and to clarify the distinction of safety related and non-safety related piping. Section 9.2.1.1.2 of the DCD is supposed to describe the power generation design basis of the ESWS. However, no discussion of the ESWS power generation design basis is included in this section. The staff does not agree that the title for Section 9.2.1.2.2 should be changed as proposed in the RAI response. However, a discussion of the ESWS power generation design basis needs to be provided.

The applicant proposed a revision to COL information item 9.2 (7) for the COL applicant to provide piping and valves, including those at the boundary between safety-related and nonsafety-related portions related to site-specific conditions. It isn't clear what this item is referring to and to what extent it applies to that part of the ESWS that is within scope for the standard plant design, such as vents and drains and this needs to be better explained.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-43

This is a follow-up to RAI 326-2279, Question 09.02.01-6:

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. Nuclear Regulatory Commission (NRC) staff has been reviewing Revision 2 of the Design Control Document (DCD) for the US-Advanced Pressurized Water Reactor (US-APWR). The staff reviewed the Tier 2, DCD ESWS description and related drawings; Tier 1, DCD Figure 2.7.3.1-1 and Tier 2, DCD Figure 9.2.1-1. The staff found instances of incomplete descriptive information and missing equipment on the Tier 1 and Tier 2 referenced drawings and diagrams. In RAI 09.02.01-

6, the staff requested the applicant to address numerous instances of incomplete and/or missing information related to those drawings in the DCD.

In its response to RAI 09.02.01-6, the applicant responded to the staff's request to provide the missing or incomplete information on the drawings. The staff found that several of the items in the RAI were not adequately addressed and the following items need to be addressed:

a) The applicant described the operational procedures that help prevent water hammer, and proposed changes to the Tier 2 DCD, subsection 9.2.1.2.1 to highlight system design and operational procedures that prevent water hammer. The applicant also stated that the CCW heat exchanges and essential chilled water chillers are located at a much lower elevation than the ESWS pumps and ultimate heat sink. On this basis the applicant concluded that the ESWS is always at a positive pressure and there is no need for vacuum breakers. However, the staff noted that the ESWS pumps and UHS are currently classified as CDI, and no provisions were established to ensure that COL applicants will place the ESWS pumps and UHS at grade elevation. Consequently, credit cannot be taken for configuration of these items as a basis for addressing water hammer considerations. Therefore, this item will remain open pending satisfactory resolution of this item by the applicant. Note that this issue also applies to RAI 09.02.01-12 and RAI 09.02.01-13.

b) The staff noted that Tier 1 of the DCD Figure 2.7.3.2-1 did not show many of the important system components, such as the radiation monitors, the strainers and piping for flushing the CCW strainers. A level of detail needs to be provided in the Tier 1 drawings of the DCD in order to meet inspections, tests, analyses, and acceptance criteria (ITAAC) commitments for verifying system configuration. The applicant stated that a revised figure will be included containing the same level of detail. However, upon review of revision 2 of the DCD, the level of detail of Tier 1 drawings still appear to be inadequate, and Tier 1 Figure 2.7.3.2-1 appears to be an incorrect figure number. Therefore, this item will remain open pending a satisfactory response to this RAI issue by the applicant.

c) 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. The applicant's response indicated that ESWS piping is described in Tier 2 Section 9.2.1.2.5. The staff was unable to find this section in Revision 2 of the DCD, and evidently the correct reference is Section 9.2.1.2.2.5. However, it is still not clear to the staff what sections of ESWS pipe are buried in trenches. While Section 9.2.1.2.2.5 (page 9.2-5) indicates that underground piping is epoxy lined carbon steel and placed in trenches, Tier 2 Figure 1.2-1 shows that an ESWS pipe tunnel is used. Furthermore, because buried ESWS pipe and pipe tunnel are not within scope for the standard plant, it's not clear to what extent and on what basis this information applies to the COL applicants. Therefore, this item will remain open pending a satisfactory response to the RAI issue by the applicant

d) It was identified in Tier 2 of the DCD Section 9.2.1.2.1, that they typographical error (typo) 'doses not' should be 'does not.' There are many other typos in Section 9.2.1. In its RAI response, the applicant stated that the DCD will be

revised to correct typographical errors, however Tier 2 Section 9.2.1 of DCD Rev 2 still contains typos and additional effort is needed by the applicant to identify and correct editorial errors.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-44

This is a follow-up to RAI 326-2279, Question 09.02.01-7:

Original question
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.

New question
In its response to RAI 09.02.01-7, the applicant provided the following information:

> *"Each CCW pump & CCWHX 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."*

The staff does not agree that use of a common alarm is adequate for operators to be able to diagnose leaks from CCW and ESWS trains. Therefore, additional explanation and justification for this approach needs to be provided, including a description of the

safety classification of the leak detection instrumentation. This item will remain open pending a satisfactory response for the RAI issue by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-45

This is a follow-up to RAI 326-2279, Question 09.02.01-8:

Original question
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.

New question
In its response to RAI 09.02.01-8, the applicant provided information to address the staff’s question. The staff found that proposed Table 9.2.1-4, “Essential Service Water System Flow Balance (in gpm)” appears to contain an error. In the “Safe Shutdown” column for “Trains A&B” the ESW pump motor flow rate is listed as 50, but this flowrate appears to be inconsistent with the rest of the table and appears to be incorrect. This item remains open pending satisfactory resolution of this inconsistency by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-46

This is a follow-up to RAI 326-2279, Question 09.02.01-9:

Original question
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.

New question
In its response to RAI 09.02.01-9, the applicant described how the required pump head is calculated. The applicant states that margin is provided since the maximum allowable pressure loss will not simultaneously occur in the pump strainer and the associated heat exchangers. The staff does not agree with this assumption since is nonconservative and has not been adequately explained and justified. The staff found that the applicant has not defined allowable system degradations nor has the applicant defined the available system margins as requested in RAI 09.02.01-9. Therefore, this item will remain open pending a satisfactory response from the applicant to address this issue.

Also, because the ESWS pumps are CDI, it's not clear to what extent and on what basis this information is applicable to COL applicants.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-47

This is a follow-up to RAI 326-2279, Question 09.02.01-12:

Original question
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. In RAI 09.02.01-12, the applicant was requested to describe in the design control document (DCD) those 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.

New question

In its response to RAI 09.02.01-12, the applicant stated that the UHS is located at grade elevation, and this assures that the ESWS water is always above the saturation pressure. In response to RAI 09.02.01-30 the applicant identified a new COL information item 9.2 (25) requiring the COL applicant to develop operating and maintenance procedures to address water hammer issues in the ESWS in accordance NUREG-0927. However, the staff noted that the ESWS pumps and UHS are currently classified as CDI, and no provisions were established to ensure that COL applicants will place the ESWS pumps and UHS at grade elevation. Consequently, credit cannot be taken for configuration of these items as a basis for addressing water hammer considerations. Therefore, this item will remain open pending satisfactory resolution of this item by the applicant. Note that this issue also applies to RAI 09.02.01-6 and RAI 09.02.01-13.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-48

This is a follow-up to RAI 326-2279, Question 09.02.01-13:

Original question

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. In RAI 09.02.01-13, the staff requested the applicant to 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.

New question

In its response to RAI 09.02.01-13, the applicant stated that the UHS is located at grade elevation, and this assures that the ESWS water is always above the saturation pressure. In response to RAI 09.02.01-30 the applicant also identified a new COL information item 9.2. (25) requiring the COL applicant to develop operating and maintenance procedures to address water hammer issues in the ESWS. However, the staff noted that the ESWS pumps and UHS are currently classified as CDI, and no provisions were established to ensure that COL applicants will place the ESWS pumps and UHS at grade elevation. Consequently, credit cannot be taken for configuration of these items as a basis for addressing water hammer considerations. Therefore, this item will remain open pending satisfactory resolution of this item by the applicant. Note that this issue also applies to RAI 09.02.01-6 and RAI 09.02.01-12.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-49

This is a follow-up to RAI 326-2279, Question 09.02.01-14:

Original question

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.

This includes a description of 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 essential service water (ESWS) trains, 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. In RAI 09.02.01-14 the applicant was requested to provide in the DCD the information to address the inadequacies as described related to water hammer.

New question
In its response to RAI 09.02.01-14, the applicant provided information to address the staff's question. However, the staff found that further clarification/resolution by the applicant is needed for the following items:

a) The applicant referenced the responses to RAI 09.02.01-12 and 09.02.01-13 to explain how an inadvertent water hammer is avoided. The applicant referenced Tier 2 DCD Section 3.9.6.2 where the response stated that periodic inservice testing of the high points in the ESWS results in discharge of any voids into the UHS. The staff's review of DCD Rev 2 Section 3.9.6.2 did not reveal any such procedures. Therefore, this item will remain open pending a satisfactory response by the applicant to describe in the DCD how the potential for voiding an ESWS train is prevented by the design and operating procedures, including a description of periodic inservice tests that are credited.

b) With respect to COL Item 9.2(25), DCD Rev 2 Section 9.2.1.2.1 "General Description," states: "The COL Applicant is to develop procedures for filling and venting the system, analyze inadvertent water hammer events, design the piping system to withstand the potential water hammer forces, and develop procedures to minimize the impact of these forces." However, COL item 9.2(25) in Table 1.8-2 in Rev 2 of the DCD dealing with water hammer does not include this same level of detail. Therefore, this item will remain open pending satisfactory resolution of this discrepancy by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-50

This is a follow-up to RAI 326-2279, Question 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.

In the response to RAI 09.02.01-15, a proposed DCD markup was provided that stated, "Since most of the ESW system remains filled with water, the ESW pump restart will sweep out the trapped air via high point vents…" However, it's not clear how air will be

evacuated from high point vents and this aspect of the system design was not adequately explained. Therefore, this item will remain open pending a satisfactory response explaining how air is vented from these high point vents following a loss of power. Also, because much of the ESWS piping is CDI, the description needs to explain to what extent and on what basis this information pertains to COL applicants.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-51

This is a follow-up to RAI 326-2279, Question 09.02.01-16:

Original question

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. In RAI 09.02.01-16, the staff requested the applicant to 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.

New question
In its response to RAI 09.02.01-16, the applicant stated that biological fouling is a concern of the COL applicant. MHI indicated that this issue is addressed by COL information item 9.2(23) which requires that the COL applicant address this issue. However, COL Information Item 9.2(23) pertains to the UHS and not the ESWS. Furthermore, this COL information item does not adequately address the periodic maintenance, inspection, and testing provisions that are specified by GL 89-13. Consequently, this item will remain open pending satisfactory resolution of this RAI by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-52

This is a follow-up to RAI 326-2279, Question 09.02.01-18:

Original question
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. In RAI 09.02.01-18 the applicant was requested to provide in the DCD an updated figure showing the required connections, components, safety related to non-safety related piping class breaks, and provides a more detailed description of the procedure and other required components to backwash the strainers. In addition, the applicant was requested to 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.

New question
In its response to RAI 09.02.01-18, the applicant stated that the strainers are replaced when they reach the specified differential pressure setpoint, and they are not the backwash type of strainer. The response implies that the replacement is done while the system is in operation as follows: *"… 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." The applicant proposed a revision to Tier 2 DCD Subsection 9.2.1.2.2.2, 1st paragraph. In the revisions it is clearly stated that the ESWS is shut down first, the clogged strainer is isolated, and then the standby strainer is valved into service. The two descriptions provided by the applicant disagree. Consequently, the staff concerns remain unresolved and this item will remain open pending clarification of the information that was provided.

Additionally, relying upon operator actions to identify and address clogged strainer problems is of concern. Depending on what is used as the UHS, strainer clogging could be a common cause failure problem during plant accident conditions. Operator actions are typically not allowed for this condition and need to be justified. Also, the strainers are not included within the scope of the standard plant and it's not clear to what extent and on what basis this information applies to COL applicants. Consequently, staff concerns regarding strainer functionality have not been adequately addressed and this item will remain open pending satisfactory resolution of this RAI.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-53

This is a follow-up to RAI 326-2279, Question 09.02.01-19:

Original question
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 design control document, 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.

New question
In its response to RAI 09.02.01-19, the applicant stated that "additional filtering is not deemed necessary" for the essential chiller units. A more complete explanation in the DCD is needed for why a self-cleaning strainer is necessary for the CCW heat exchangers and not for the chillers.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-54

This is a follow-up to RAI 326-2279, Question 09.02.01-20:

Original question
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. In RAI 09.02.01-20, the applicant was requested to 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.

New question
In its response to RAI 09.02.01-20, the applicant stated that the ESWS side of the essential chiller heat exchangers will be cleaned while the system is offline per an established maintenance program. The applicant further stated that the essential chiller operation will be monitored via a site specific program as prescribed in COL information item 9.2(23). Staff review of COL information item 9.2(23) finds that this item only concerns fouling of the UHS system and does not specifically mention the ESWS. Consequently, this item will remain open pending satisfactory resolution of this RAI by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-55

This is a follow-up to RAI 326-2279, Question 09.02.01-21:

Original question
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.

New question
In its response to RAI 09.02.01-21, the applicant indicated that excessive wall thinning is not anticipated due to throttled butterfly valves following ESWS flow balancing. However, no provisions are established to ensure that excessive throttling of butterfly valves will not occur as a consequence of flow balancing operations. Also, the ESWS pump discharge butterfly valves are throttled every time the ESW pump is started and this needs to be recognized and addressed. It is also likely that butterfly valves will be throttled during low temperature operating conditions and this consideration also needs to be addressed. Finally, because the ESWS pump discharge butterfly valves are not included within the scope of the standard plant, it's not clear to what extent and on what basis this information applies to COL applicants and the applicant needs to address this as well. Consequently, this item will remain open pending satisfactory resolution of this RAI by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-56

This is a follow-up to RAI 326-2279, Question 09.02.01-23:

Original question
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. In RAI 09.02.01-23, the applicant was requested to address in the DCD 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.

New question
In response to RAI 09.02.01-23, the applicant indicated that piping will be inspected periodically per an established in-service inspection program. However, the staff is concerned with the ability to inspect piping systems buried in trenches since these are not generally accessible. The response provided by the applicant does not address this issue. Also, because the ESWS buried piping is not included within the scope of the standard plant, it's not clear to what extent and on what basis this information applies to COL applicants and the applicant needs to address this as well. Consequently, this item will remain open pending satisfactory resolution of this RAI by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-57

This is a follow-up to RAI 326-2279, Question 09.02.01-24:

Original question
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, in RAI 09.02.01-24, the applicant was requested to 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.

New question
In its response to RAI 09.02.01-24, the applicant indicated that two trains are in operation under the normal power generation mode. This allows for monitoring the system temperature, pressure and flows. Periodic in-service inspections will provide

further indication of proper operation. The applicant further stated that the operation of the various trains will be alternated to allow observation of the standby trains. However, a COL information item was not established to ensure proper implementation of this provision by COL applicants. Consequently, this item will remain open pending satisfactory resolution of this RAI by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-58

This is a follow-up to RAI 326-2279, Question 09.02.01-25:

Original question
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 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. The applicant was requested, in RAI 09.02.01-25, to describe 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.

New question
In its response to RAI 09.02.01-25, the applicant indicated that radiation monitors are located downstream of the CCWS heat exchangers and that they alarm in the MCR when the radiation level exceeds the setpoint. Upon receipt of an alarm the operators will isolate the contaminated ESWS train and the corresponding CCWS train. The response goes on and discusses a “ditto” train. The following items remain to be addressed:

a. While radiation monitors are shown on Figure 9.2-1, automatic isolation valves are apparently not provided and this needs to be explained and justified. Furthermore, failure to provide automatic isolation as specified by SRP Section

9.2.1, Paragraph III(3)(D) is an exception to the SRP that needs to be acknowledged and justified in accordance with 10 CFR 52.47(a)(9).

b. Plate-type heat exchangers are much more prone to leakage than shell and tube heat exchangers. Consequently, it is more likely that the use of these heat exchangers for cooling the CCW system will result in the spread of radioactive contamination to the ESWS, UHS, and environment over time unless suitable design and monitoring provisions are established to address 10 CFR 20.1406 considerations and to satisfy the requirements specified by GDC 60 and GDC 64. This is especially true for those situations where the level of contamination in the CCW and ESW systems is below the threshold of detection by the installed radiation monitors. Therefore, additional information is needed to describe design and monitoring provisions that will be implemented to ensure that the spread of contamination over time will be minimized.

c. Section 9.2.1.2.3.1 states, that the “ditto train is ultimately placed out of service…” The use of the term “ditto” in this context is unusual and confusing. The description needs to be rewritten using more conventional terminology.

This item will remain open pending satisfactory resolution of this RAI by the applicant.

Reference: MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.

09.02.01-59

This is a follow-up to RAI 326-2279, Question 09.02.01-29:

Original question
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, RAI 09.02.01-29, requested the applicant to address in the Tier 1, Section 2.7.3 and Table 2.7.3.1-5 revisions to address issues listed below.

(1) 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.
(2) 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.

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

(4) 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.

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

(6) 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.

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

(8) 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.

(9) The DCD needs an item for the inspection of Class 1E divisional separation.

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

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

(12) The DCD needs a test item for the testing of the CCW discharge radiation monitor alarms and monitors.

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

(14) The DCD needs a test item for the testing of ESWS check valves.

(15) The DCD needs an inspection item for supports per the requirements of ASME.

(16) The DCD needs an inspection item for lined underground piping which is placed in trenches.

<u>New question</u>

In its response to RAI 09.02.01-29, the applicant addressed the items referred to above. The staff found that the following items were not adequately addressed and additional clarification is needed by the applicant.

- For part (2), the applicant proposes changes to Tier 1 Table 2.7.3.1-5 that clarifies that piping in the ESWS pipe tunnel is the only exception where separation between divisions is not maintained. This exception needs to be described and justified in Tier 2 of the DCD. Consequently, this item will remain open pending satisfactory resolution of this RAI issue by the applicant.

- For part (3), the applicant stated that this ITAAC item has been expanded in response to RAI 192(-1847) question 14.03.04-15. The applicant further stated that the IST includes periodic pump testing to assure continued operation in the proposed degraded condition. Finally the applicant implies that a new COL applicant program to monitor heat exchange performance is put into place in response to RAI question 09.02.01-30. The staff could not find this new

monitoring program within the RAI response 09.02.01-30. In addition, the program should address all of the provisions contained in Generic Letter 89-13. Consequently, this item will remain open pending satisfactory resolution of this RAI issue by the applicant.

- For part (10), the applicant refers the staff to the response to RAI 09.02.01-22. It is implied that the differential pressure alarm is included in Tier 1 DCD Table 2.7.3.1-4. The NRC staff could not find this alarm listed in this table, nor was a modified table provided in response to RAI 09.02.01-22. Consequently, this item will remain open pending satisfactory resolution of this RAI issue by the applicant.

- For part (11), the applicant refers the staff to the response to RAI 09.02.01-22. It is implied that the CCW heat exchanger inlet strainer is addressed in that response. The NRC staff could not find this component addressed in that response. Consequently, this item will remain open pending satisfactory resolution of this RAI issue by the applicant.

- For part (16), the applicant referred to the response provided to RAI 09.02.01-23. The staff's review of the response to RAI 09.02.01-23 found that piping buried in trenches is not addressed. This item remains open pending satisfactory resolution of this RAI issue by the applicant.

References:

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

MHI's Responses to US-APWR DCD RAI No. 326-2279; MHI Ref: UAP-HF-09326; Dated June 19, 2009; ML091870782.