

REQUEST FOR ADDITIONAL INFORMATION 286- 2145 REVISION 0

3/25/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.02.05 - Ultimate Heat Sink

Application Section: 9.2.5

QUESTIONS for Balance of Plant Branch 1 (AP1000/EPR Projects) (SBPA)

09.02.05-1

Based on a review of the information provided in Tier 2 of the Design Control Document (DCD), Section 9.2.5, "Ultimate Heat Sink," the staff found that the description of the ultimate heat sink (UHS) is incomplete as it does not adequately explain how the applicable regulatory requirements are satisfied by the proposed design, what limiting assumptions apply, how much excess margin is available, what operating experience insights are relevant and how they were addressed. Consequently, Tier 1 and Tier 2 of the DCD needs to be revised to include information that is sufficient to demonstrate that the UHS is capable of performing its design-bases functions, that applicable regulatory requirements 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. In addition, the DCD needs to be revised to include a conceptual design for the UHS in accordance with 10 CFR 52.47(a)(24). The conceptual design should be described in sufficient detail to establish interface requirements that must be satisfied by combined license (COL) applicants.

Inspection, test, analysis and acceptance criteria (ITAAC) for the UHS have not been provided in the DCD Tier 1. DCD Tier 1, section 3.2 provides only a temperature requirement for the UHS. 10 CFR 52.47(b) requires the DCD to contain ITAAC that are necessary and sufficient to provide reasonable assurance that the plant will be built and will operate according to the DCD. The DCD should provide ITAAC for the UHS design. Technical specifications (TS) have not been identified for the UHS in Chapter 16 (TS 3.7.9). 10 CFR 52.47(a) requires the DCD to contain technical specifications. Regulatory Guide 1.206, "Combined License Applications (COL) for Nuclear Power Plants (LWR Edition)," provides guidance on the specific information that should be included in the application for evaluation by the staff.

Specifically, the applicant is requested to demonstrate in the DCD how the UHS design complies with the following General Design Criteria (GDC) or Regulatory Guide (RG). In addition, existing COL information items in the DCD related to the UHS should be evaluated once the conceptual design for the UHS has been provided.

- GDC 2, "Design Bases for Protection Against Natural Phenomena" and RG 1.27, "Ultimate Heat Sink."
- GDC 44, "Cooling Water," and RG 1.72, "Spray Pond Piping Made from Fiberglass."
- GDC 44, "Cooling Water," and RG 1.27, "Ultimate Heat Sink."

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- GDC 44, "Cooling Water," and single failure evaluation.
- GDC 44, "Cooling Water," and essential service water system (ESWS) pump net positive suction head (NPSH).
- GDC 44, "Cooling Water," and instrumentation and controls and electrical features.
- TS Section 3.7.9 and its bases.
- Preoperational testing for the UHS.
- Tier 1, DCD and ITAAC for the UHS.

09.02.05-2

The Design Control Document (DCD), needs to be revised to include a conceptual design for the ultimate heat sink in accordance with 10 CFR 52.47(a)(24). The conceptual design should be described in sufficient detail to establish interface requirements that must be satisfied by combined license (COL) applicants.

Based on a review of the information provided in Tier 2 of the DCD, Section 9.2.5, "Ultimate Heat Sink," and Table 3.2-2, "Classification of Mechanical and Fluid Systems, Components, and Equipment," the staff found that the description of the ultimate heat sink as it relates to equipment classification incomplete. Specifically, the applicant is requested to add equipment classification to Table 3.2-2 for the UHS.

09.02.05-3

The Design Control Document (DCD), needs to be revised to include a conceptual design for the ultimate heat sink in accordance with 10 CFR 52.47(a)(24). The conceptual design should be described in sufficient detail to establish interface requirements that must be satisfied by combined license (COL) applicants.

Standard Review Plan (SRP) 9.2.5 Section III, paragraph 1 instructs the reviewer to confirm the overall arrangement of the ultimate heat sink (UHS). The description and piping and instrumentation diagram (P&IDs) or flow diagrams are incomplete or inaccurate and the DCD needs to be revised to address the following considerations:

- P&ID, flow diagrams, or drawings were not provided for the conceptual design of the UHS. The DCD should explain the criteria that were used in establishing the appropriate pipe sizes (such as limiting flow velocities).
- The UHS system description does not provide design details such as system operating temperatures, pressures, fan speeds (if used), and flow rates for all operating modes and alignments.
- The UHS flow diagram/drawings should show where indications are displayed (e.g., local, remote panel, control room), and what instruments provide input to a process computer and/or have alarm and automatic actuation functions.
- The UHS flow diagram/drawings should show what the normal valve positions are, what valves are locked in position, and what valves have automatic functions; and these design features are not described.
- The UHS flow diagram/drawings should show any UHS bypass flow rates for low load/low ambient temperature conditions to maintain ESW cold water temperature within established limits.

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- If using a UHS with mechanical fans, the UHS fan alarms discussions should be included in the DCD.
- If using a cooling tower, the UHS flow diagram should show the cooling tower basin instruments (level and temperature).

09.02.05-4

The Design Control Document (DCD), needs to be revised to include a conceptual design for the ultimate heat sink in accordance with 10 CFR 52.47(a)(24). The conceptual design should be described in sufficient detail to establish interface requirements that must be satisfied by combined license (COL) applicants.

Tier 2, DCD Section 9.2.5.1 states that the ultimate heat sink along with ESWS is designed to remove the peak heat loads rejected from the ESWS under all conditions in order to mitigate the consequences of a design basis event and for a safe shutdown with or without offsite power. The staff has determined that insufficient information is provided to confirm this capability. Standard Review Plan (SRP) 9.2.5 Section III, paragraph 2.B of "Evaluation Procedures" instructs the reviewer to verify whether "the UHS can dissipate the maximum possible total heat load including that of a loss of coolant accident (LOCA) under the worst combination of adverse environmental conditions." Provide key assumptions and inputs for the design calculations that demonstrate sufficient capability and margin. Additional information that is needed in the DCD includes (for example):

1. Key assumptions and inputs (including justification) for calculations that demonstrate sufficient heat rejection capability to meet maximum predicted heat loads and define the available margin with limited system temperatures and pressures. These assumptions should include sufficient margin to account for uncertainties in the analysis, anticipated degradation in performance over time, and fluctuations in the frequency of electric current. These calculations should be made available for staff audit.
2. For cooling tower performance (if used), explanation of how the wet bulb correction was determined to be sufficient for potential tower interferences.
3. For cooling tower performance or other heat sink designs such as cooling ponds, curves that show the minimum required tower heat rejection capability verses time (including spent fuel pool cooling) for post LOCA cooldown, and cooldown to cold shutdown conditions following a reactor trip with and without offsite power available.
4. Explanation of how UHS heat rejection capability will be monitored to ensure adequate performance over time.

09.02.05-5

General Design Criteria (GDC) 44 requires that "A system to transfer heat from structures, systems, and components important to safety, to an ultimate heat sink shall be provided." The staff noted the protection of the essential service water system (ESWS) pump suction supports compliance with GDC 44 since these components are

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essential for the overall system function. Describe in the Design Control Document (DCD) how the ESWS pump suction is protected from potential debris intrusion (e.g. tower fill degradation, etc.). The staff noted that some plants have found this type of protection to be necessary (e.g. screens) due to damage to the fill from failed cooling tower spray nozzles. Also, provide in the DCD a description of the cooling tower (if used) spray and fill design arrangements related to failure modes.

09.02.05-6

General Design Criteria (GDC) 45 requires the ultimate heat sink (UHS) to 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. The staff finds the design to be acceptable if the Design Control Document (DCD) describes inspection program requirements that will be implemented and are considered to be adequate for this purpose. While Tier 2, DCD Section 9.2.5.4 indicates that the combined license (COL) applicant will provide test and inspection details based on the type of UHS to be provided, the staff cannot determine if the criteria of GDC 45 is met in the DCD. Consequently, additional information needs to be provided in the DCD to describe the extent and nature of inspections that will be performed and procedural controls that will be implemented commensurate with this requirement. For example, the accessibility and periodic inspection of safety related buried piping and the cooling tower spray header system, tower fill, cooling pond systems are of particular interest. The DCD needs to be revised to state that the requirements of GDC 45 have been met.

09.02.05-7

General Design Criteria (GDC) 46 requires the ultimate heat sink (UHS) to be designed so that periodic pressure and functional testing of components can be performed 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 UHS safety functions. 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, DCD Section 9.2.5.4 indicates that the combined license (COL) applicant will provide test and inspection details based on the type of UHS to be provided, the staff cannot determine if the criteria of GDC 46 is met in the DCD. This should include the extent and nature of these tests and procedural controls that will be implemented to assure continued UHS structural and leak tight integrity and system operability over time were not described.

Consequently, additional information needs to be provided 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. The DCD needs to be revised to state that the requirements of GDC 46 have been met.

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09.02.05-8

The Design Control Document (DCD) needs to be revised to include a conceptual design for the ultimate heat sink (UHS) in accordance with 10 CFR 52.47(a)(24). The conceptual design should be described in sufficient detail to establish interface requirements that must be satisfied by COL applicants.

Means must be provided for monitoring effluent discharge paths and the plant environs for radioactivity that may be released in accordance with General Design Criteria (GDC) 64 requirements. Also, 10 CFR 52.79(a)(45) and 10 CFR 20.1406 require combined license (COL) applicants to describe how facility design and procedures for operation will minimize contamination of the facility and the environment. The staff's review criteria (Standard Review Plan (SRP) Section 9.2.1, Paragraph III.3.D) specify that provisions should be provided to detect and control leakage of radioactive contamination into and out of the essential service water system (ESWS) which is part of the UHS. The design is considered to be acceptable by the staff if the UHS/ ESWS flow diagrams, or piping and instrumentation diagrams (P&IDs), show that radiation monitors at components that are susceptible to leakage, and if the components that are susceptible to leakage can be isolated. However, the staff noted that Tier 2, DCD, Section 9.2.5 and the UHS/ESWS flow diagrams, or P&ID, do not include radiation monitors in the system design and the NRC regulations in this regard have not been addressed. Therefore, additional information needs to be included in Tier 2, DCD Section 9.2.5 to address the NRC requirements referred to above.

09.02.05-9

10 CFR 52.47(a)(25) relates to requirements for site specific items to be identified by the design certification applicant that must be addressed by the combined license (COL) applicant.

1. As a result of this review the staff recommends the addition of a new item to address the final selection of ultimate heat sink (UHS) system piping materials. The staff notes that for some site locations the selection of service water system materials in combination with chemical treatment and ongoing inspection programs have proven to be essential for continued assurance of system integrity. Accordingly, the staff recommends that a new COL information item be added to Design Control Document (DCD), Tier 2 Table 1.8-2, "Compilation of All Combined License Applicant Items for Chapters 1-19," that states a COL applicant that references the US-APWR will identify the site specific materials selected for UHS piping and components, including the bases for the selections.

2. The staff notes in Tier 2, DCD that COL 9.2 (21) address UHS makeup water blowdown, but did not specifically address chemical treatment for the control of biofouling. In accordance with 10 CFR 52.47(a)(24) a conceptual design of makeup water and blowdown is needed in order to aid the staff's review and to determine the adequacy of the interface requirements. In addition, due to the importance of the UHS makeup, the UHS makeup should be a separate DCD section and not addressed under Tier 2, DCD Section 9.2.5. RG 1.206 states Section 9 of the application should discuss each of the plant's water systems and because these auxiliary water systems vary in number, type, and nomenclature for various plant designs, the standard format does not assign specific subsection numbers to these system discussions. The applicant should

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provide separate subsections (numbered 9.2.1 through 9.2.x) for each of the systems. This separate section of the DCD would be consistent with other new plant applications (raw water system) including the AP1000 and Evolutionary Power Reactor (EPR).

3. The staff has identified that a specific COL information item did not specifically address the means for providing UHS makeup sufficient to meet the maximum evaporative and drift water loss after 72 hours through the remainder of the 30 day period consistent with RG 1.27. This item may need clarification due to Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plant", Rev 2, Jan 1976, Section C3, which states in part the UHS should consist of at least two highly reliable water sources. In general a specific COL information item did not address all of the regulatory positions in RG 1.27 that have to be met for the specific site COL (reference Tier 2, DCD Table 1.9.1-1, "US-APWR Conformance with Division 1 Regulatory Guides").