REQUEST FOR ADDITIONAL INFORMATION 320-2010 REVISION 1

4/6/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.05.07 - Emergency Diesel Engine Lubrication System
Application Section: 9.5.7

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

09.05.07-1

RAI 9.5.7-01: 10 CFR 52.47(b) (1) requires that a Design Certification (DC) application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the ITAAC are performed and the acceptance criteria met, a plant that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations.

FSAR Tier 1, Section 2.6.4, "Emergency Power Sources," does not contain a design description of the gas turbine lubrication system. The guidelines of Standard Review Plan, Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria," state that Tier 1 provides a design description, describing the most safety significant aspects of the system and be derived from the detailed design information contained in Tier 2. The applicant needs to provide a design description in Tier 1 for the gas turbine lubrication system that describes the most safety significant aspects of the system.

The GTGs provide emergency power that is required by NRC regulations (GDC-17 of Appendix A to 10 CFR 50). Satisfactory installation and testing of the GTG lubricating oil system is necessary for GTG operation to full design requirements. Yet, the FSAR Tier 1, Table 2.6.4-1, does not contain ITAAC that meets the above requirements and the guidelines of Standard Review Plan, Section 14.3, i.e.:

- The existing ITAAC does not verify that the system will operate in accordance with design, i.e. system operating pressure, temperature, pressure differentials, flow rate and heat removal rate are in accordance with the engine manufacturer's recommendations and thus ensure reliable lubricating oil system operation. .
- Item 1 of ITAAC inspects the functional arrangement per subsection 2.6.4.1, yet no functional arrangement in subsection 2.6.4.1 is described for the GTLS.
- Item 3 of ITAAC commits to having a lubrication system for the GTS, yet Item 3 provides no value in determining whether a viable safety related GTLS is installed.

Revise the FSAR to provide ITAAC and design description in FSAR Tier 1 for the GTGs that meets the above requirements.

09.05.07-2

RAI 9.5.7-02: FSAR Tier 1 Table 2.6.4-1 item 7 lists a design commitment that the "support systems for piping that is required to perform safety functions of starting and operating the Class 1E EPS are classified ASME Code Section III." The inspections, tests and analyses to verify this commitment are listed only as pressure tests. Verification that the system meets ASME Section III requirements should be provided and should include the piping and components, not just the piping supports. In addition, pressure tests are only one aspect of the qualification requirements for ASME Section III systems. Verification of the design commitment should include all of the inspections, tests and analyses required by ASME Section III. Revise this ITAAC accordingly. Regulatory Basis – GDC 17.

09.05.07-3

RAI 9.5.7-03: FSAR Tier 2 Section 3.5.1.1.2.1(2) states that missiles generated by gas turbine failure are not postulated because of the over-speed prevention system, deliberate considerations in the inspection of materials, design, production, installation, and operation, and casing material that prevents penetration. Revise the FSAR to provide a description of the analysis performed, including assumptions and acceptance criteria, that demonstrates that the GTG casing material will prevent penetration of an internally generated missile. Regulatory Basis – GDC 4

09.05.07-4

RAI 9.5.7-04: FSAR Tier 2 Figure 9.5.7-1 is inconsistent with the corresponding figure in "Qualification and Test Plan of Class 1E Gas Turbine Generator System," December 2007 (MUAP-07024-P (R0) – Figure B.4.2-1. For example, the oil flow path to the No. 1 bearing is not the same in both drawings. The FSAR figure appears to show the turning motor as the source of oil to this bearing. Compare the figures and revise the FSAR figure to accurately reflect the system flow paths. Regulatory Basis – GDC 17.

09.05.07-5

RAI 9.5.7-05: According to FSAR Figure 9.5.7-1, there is a local temperature indicator for each No. 2 bearing and no temperature measurement for the No. 1 bearings. To provide system monitoring capability that is commensurate with the importance of the safety functions to be performed and to ensure system reliability, provide a high temperature alarm (alarmed in the main control room) for each of the GTG main bearings. Revise the FSAR to include these features. Regulatory Basis – GDC 17.

09.05.07-6

RAI 9.5.7-06: FSAR Tier 2 Section 9.5.7.2 states that the GTG does not need pre-circulation of lube oil during starting of the gas turbine. Automatic pre-lubrication is typical for other types of emergency power sources (diesel generators) yet, no explanation or justification is provided in the FSAR for this assertion. Revise the FSAR to explain the basis for this position. Regulatory Basis - GDC 17.

09.05.07-7

RAI 9.5.7-07: A keep-warm oil lubricating system is typical for other types of emergency power sources (diesel generators), yet FSAR Tier 2 Section 9.5.7.2 does not indicate that the GTG design includes any provisions to heat the lubricating oil during GTG standby. The minimum required lube oil temperature provided in Table 5.4-1 of "Qualification and Test Plan of Class 1E Gas Turbine Generator System," December 2007 (MUAP-07024-P (R0)), is above the design minimum ambient temperature for the US-APWR. Revise the FSAR to describe how the lube oil temperature will be maintained above the allowable minimum ambient temperature. The description should identify any heating equipment and the seismic and quality group classification of the equipment. The information should also include the classification and source of any electrical power supply for the heating equipment. Regulatory Basis – GDC 17.

09.05.07-8

RAI 9.5.7-08: FSAR Tier 2 Section 9.5.7.3, subparagraph B, states that "The components" of the system are designed to ASME Code Section III, Class 3. However Table 9.5.7-1, "Lubrication System Component Data", indicates that of all the system components described in this table, only the reservoir is ASME Section III, Class 3. The other components of the system are identified as being in accordance with "Manufacturer's standard." In addition, Tier 1 Table 2.6.4-1, Item 7, indicates that the piping for EPS support systems is ASME Section III. Additionally, Tier 2, Table 3.2-2, Item 27, "Emergency Gas Turbine Auxiliary System," lists the components of the system as designed to ASME Code Section III, Class 3. Address this apparent discrepancy and make any required changes to the FSAR. Essential portions of the system should be Quality Group C. Revise the FSAR to address these issues. Regulatory Basis – GDC 17.

09.05.07-9

RAI 9.5.7-09: Section 9.5.7.4 of the FSAR Tier 2 states that "The lube oil will have the following tests performed: kinematic viscosity, water content, and wear metal content.

Strainers may be removed and inspected for the buildup of impurities on a periodic basis." Revise the FSAR to provide the acceptance criteria, including bases, and testing frequency for these tests. Regulatory Basis GDC - 17.

09.05.07-10

RAI 9.5.7-10: Section 9.5.7.5 of the FSAR does not identify any instrumentation or alarms for high differential pressure across filters or strainers (a differential pressure indicator is shown on Figure B.4.2-1 of MUAP-07024-P(R0), but none are shown on FSAR Figure 9.5.7-1 and no remote alarms are shown on either figure). In addition, the method for determining lube oil reservoir level is indicated as a dipstick. To provide system monitoring capability that is commensurate with the importance of the safety functions to be performed and to ensure system reliability, each filter and strainer should be provided with differential pressure instrumentation that alarms in the main control room on high level and the lube oil reservoir level should be monitored by level instrumentation and low levels should be alarmed in the main control room. Revise the FSAR to include these features. Regulatory Basis – GDC 17 and the guidance of SRP Section 9.5.7 guidelines which state that P&IDs include the means for indicating and monitoring oil levels, temperatures, and pressures.

09.05.07-11

RAI 9.5.7-11: There are temperature and pressure control devices shown in the lubricating oil flow path on FSAR Figure 9.5.7-1 and Figure B.4.2-1 of MUAP-07024-P (R0). The figures show a temperature regulating valve and pressure regulating valve (appears to be shown as a pressure relief valve on Figure B.4.2-1). Provide a description of the control devices included in the GTLS that can impact system function with a discussion of the potential for their failure to cause GTG failure and a discussion of the design requirements included to minimize that potential. Amend the FSAR to include specific design requirements that are important to the reliability of the system. Regulatory Basis - GDC 17

09.05.07-12

RAI 9.5.7-12: The following appear to be typographical errors in FSAR Tier 2 Section 9.5.7. Revise the FSAR to correct these as appropriate.

1. In FSAR Tier 2 Section 9.5.7.2, the second sentence states that "Receipt of a <u>low</u> <u>high</u> lube oil temperature signal from the trip logic will shut down the GTG during routine operation." Presumably the word "low" should be deleted.

2. In FSAR Tier 2 Section 9.5.7.2, the last sentence states that "The low lube oil pressure shutdown signal is bypassed or defeated during accident conditions." Presumably "pressure" should be "temperature".
3. In FSAR Tier 2 Section 9.5.7.4, the third paragraph refers to "…surveillance testing and inspection of the GTG starting air system is performed to assure operational readiness…" Presumably "starting air" should be "lubricating oil."
4. In FSAR Tier 2 Section 9.5.7.3, Item C states, "…System, equipment, and components which are not seismic category I and whose failure could impair the functioning of the lubricating system are upgraded in design to seismic category I." This statement contradicts itself and needs to be clarified.

09.05.07-13

RAI 9.5.7-13: Presumably the performance of the lubricating oil system coolers depends on the proper functioning of the GTG building ventilation/cooling system. The GTG building ventilation/cooling system is described to a very limited extent in FSAR Section 9.5.8. However it is not clear in Figure 9.5.8-1 whether it is the "Air Supply" or the "Air Intake" that provides cooling air to support the operation of the lube oil coolers. Whichever it is, the components of that system should be in accordance with the requirements for seismic Category I and Quality Group C. In addition, the system should be provided with instrumentation and alarms that are commensurate with the importance of the system's function and will ensure system reliability. In addition, confirm that the cooling air intakes are protected in accordance with GDC 2 from natural phenomena such as earthquakes, tornadoes, hurricanes, floods and tornado missiles; and in accordance with GDC 4 from other missiles. Revise the FSAR to address these issues. Regulatory Basis - GDC 2, GDC 4, and GDC 17.

09.05.07-14

RAI 9.5.7-14: FSAR Tier 2, Section 14.12.1.44 does not include any preoperational tests to verify the operation of the GTG lubricating oil system. Revise the FSAR to include testing for this system that verifies the required operating parameters have been achieved to support operation of the GTGs. Regulatory Basis - GDC 17

09.05.07-15

RAI 9.5.7-15: Surveillance requirement SR 3.8.3.2 states that a minimum of 81 gallons of lube oil inventory must be available for each GTLS. However, the bases for this numerical value are not provided. Revise the FSAR to describe the analysis performed, including assumptions and bases, to arrive at this number based on the expected maximum lube oil consumption rate for seven days of continuous GTG operation,

minimum level required for operation, low-level controls and alarms for the tank, etc. Also address the difference between the allowable minimum level of 74 gallons indicated in Section B.4.2 of "Qualification and Test Plan of Class 1E Gas Turbine Generator System," December 2007 ((MUAP-07024-P(R0)), and this SR.

In addition, presumably the minimum required lubricating oil volume for a GT is specific to the manufacturer and model. The introduction of the referenced report states that MHI "applies" the Kawasaki Heavy Industries GPS 6000. Provide verification that the FSAR commits to this specific make and model. Otherwise, the FSAR should provide the design criteria for the tank volume and include a COL information item to perform the analysis to establish the appropriate level. Regulatory Basis - GDC 17.

09.05.07-16

RAI 9.5.7-16: FSAR Tier 2, Section 9.5.7.5 states that low lube oil pressure during operation of the GTG initiates a GTG trip and GTG oil pressure trip logic initiates a GTG trip. The above stated features is not within the guidelines of Standard Review Plan 9.5.7, "Emergency Diesel Engine Lubrication System," which states that normal protective interlocks do not preclude engine operation during emergency conditions. Also, the above stated features is not within the guidelines of IEEE Std 387, Section 4.5.4, "Protection," which states that protective features such as those listed above shall be blocked from automatically tripping the unit during an accident condition and shall be annunciated in the plant control room, or the unit shall have the coincident logic described in IEEE Std 387, Section 4.5.4.

The staff considers these guidelines applicable to the GTGs. These design features need to be included in the FSAR or the applicant needs to provide an explanation as to why the above described features are not in the FSAR.

09.05.07-17

RAI 9.5.7-17: The staff considers that the guidelines of Standard Review Plan Section 9.5.7, "Emergency Diesel Engine Lubrication System," which specify acceptance criteria are based on meeting the relevant requirements of General Design Criteria (GDC) 2, "Design bases for protection against natural phenomena,"; GDC 4, "Environmental and dynamic effects design bases,"; GDC 5,"Sharing of structures, systems, and components,"; and GDC 17, "Electric power systems," are applicable to the gas turbine lubrication system. The applicant needs to explain how the design of the gas turbine lubrication system meets the requirements of the above mentioned GDCs and revise FSAR Tier 2, Section 9.5.7 to include this information.