REQUEST FOR ADDITIONAL INFORMATION 319-2147 REVISION 1

4/6/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 09.05.06 - Emergency Diesel Engine Starting System
Application Section: Tier 2 Section 9.5.6

QUESTIONS for Balance of Plant Branch 2 (ESBWR/ABWR) (SBPB)

09.05.06-1

FSAR Tier 1, Section 2.6.4, “Emergency Power Sources,” does not contain a design description of the gas turbine starting 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 should provide a design description in Tier 1 for the gas turbine starting system that describes the most safety significant aspects of the system.

09.05.06-2

FSAR Tier 1 Table 2.6.4-1 item 7 requires a test to assure that the as-built piping support systems within the gas turbine generator (GTG) system is qualified as seismic Category I. It is unclear to the NRC staff how a pressure test, as specified under ITAAC item 7 in Table 2.6.4.1, is going to qualify a piping support to seismic Category I. This item should be reconsidered by the applicant.

09.05.06-3

FSAR Tier 1 Table 2.6.4-1 item 10 specifies that a test be performed to demonstrate that the gas turbine generator starting system (GTGSS) can perform a single start of the GTG system. This is insufficient in that FSAR Tier 2 Section 9.5.6 states that the stored air within the GTGSS is capable to perform three starts without recharging. The ITAAC item should be revised to demonstrate that 3 starts can be achieved without recharging the receivers.

09.05.06-4

There is no ITAAC provided to assure that the low-pressure alarm for the air receiver is received in the main control room as specified by the SRP Section 9.5.6. An ITAAC should be added to verify this function.

09.05.06-5

The description of the GTGSS provided in FSAR Tier 2 Section 9.5.6 appears to contain a number of inconsistencies. The description should be revised to clarify the system design. Areas of apparent discrepancy are as follows:

- It is stated in FSAR Tier 2 Section 9.5.6 that each GTG starting system includes four air starting units. According to Figure 9.5.6-1, there are only two starting air units per GTG.

- It is stated in FSAR Tier 2 Section 9.5.6.2.1.1 six compressors are provided for the two starting systems per GTG. According to Section 9.5.6.2.1.2, each starting system is equipped with two receivers. That would imply a total of four receivers. Figure 9.5.6-1 and the rest of the description indicate that only two receivers are provided per GTG.

- It is stated in FSAR Tier 2 Section 9.5.6.2.2 that each compressor keeps one receiver pressurized. However, this is not consistent with Figure 9.5.6-1. According to Figure 9.5.6-1, all six compressors feed both air receivers via a common header with no isolation between air compressors.

- The starting sequence is stated in FSAR Tier 2 Section 9.5.6.1 to require 100 seconds. It is claimed that this time period is less than that assumed in FSAR Chapter 15. According to the description of the accident analysis in Chapter 15, this time period is identical to what is assumed in the accident analysis.

- FSAR Tier 2 Section 9.5.6.1 states that the codes and standards applicable to the GTGSS are listed in Section 3.2. Section 3.2 only lists the air receiver for this system in Table 3.2-2. The FSAR Tier 1 Section 2.6.4.1 requires that all associated GTG equipment that is required to operate be seismic Category I and ASME Code Section III Class 3, including piping and valves.

- In FSAR Tier 2 Section 9.5.6.2 it is stated that each starting system consists of six compressors. In Section 9.5.6.2.1.1 it is stated that six compressors constitutes two starting systems.

09.05.06-6

In addition to the discrepancies noted, the description of the system provided in FSAR Tier 2 Section 9.5.6 does not adequately describe how the system is configured and the level of redundancy. Each GTG system includes two gas turbines (GTs). According to Figure 9.5.6-1 each starting unit (one receiver and two solenoid valves) serves only one GT. Presumably failure of one GT to start will prevent the GTG system from starting. Consequently it appears that both air receivers are required to start the two GTs and there is no redundancy provided by the air receivers. The applicant should clearly describe the relationship between the two starting units and the two GTs as well as with the starting of the overall GTG system.

09.05.06-7

The GTGSS must have the capability to meet independence and redundancy criteria stated in SRP Section 9.5.6. FSAR Tier 2 Section 9.5.6.1 states that the starting system is designed so that a single failure of any component cannot result in complete loss of the power source. Each GTG includes four starter motors. It is unclear from the descriptions in FSAR Section 9.5.6 how many of the four motors are required to start the GTG. The applicant should provide this detail so the level of redundancy can be determined.

09.05.06-8

GDC 17 requires the onsite electric power system to have sufficient independence and redundancy to perform their safety functions, assuming a single failure. Guidance provided in the SRP Section 9.5.6 states that as a minimum, the air starting system should be capable of attempting five starts without recharging the receiver(s). However, Item A of Section 9.5.6.3 in the FSAR Tier 2, states that the system holds sufficient air to start the GTG three times. The applicant should provide information justifying this departure.

09.05.06-9

GDC 17 requires the EDG starting system to meet independence and redundancy criteria. SRP Section 9.5.6 provides guidance for determining if air starting systems meet GDC 17 requirements. One criterion specifies that starting air should be dried to a dew point of not more than 10ºC (50ºF) when installed in a normally-controlled 21ºC (70ºF) environment; otherwise, the starting air dew point should be controlled to at least 5.5ºC (10ºF) less than the lowest expected ambient temperature. Another criterion is that the starting system design precludes fouling of the air start valve or filter with moisture and contaminants like oil and rust carryover. Air dryers should be installed upstream of air receivers to remove entrained moisture as described in SRP Section 9.5.6 and recommended by NUREG-0660. The FSAR does not address these issues. The applicant should provide design information for the GTGSS sufficient to demonstrate how the possible effects from water, oil, rust and other contaminants are prevented or mitigated. Also note that Section C.2.2.3 of “Qualification and Test Plan of Class 1E Gas Turbine Generator System,” December 2007 (MUAP-07024-P(R0)) states that the air starting system includes an air dryer.

09.05.06-10

SRP Section 9.5.6 states that the GTGSS should be reviewed as to its ability to be maintained and repaired in a timely fashion. Sufficient space must be provided to allow these operations. Neither discussion nor detailed design drawings are provided within the FSAR to review the design against this acceptance criterion. The applicant should provide drawings that show the spatial arrangement of the components so this criterion can be reviewed.

09.05.06-11

The NRC Staff needs more details regarding start reliability of gas turbine generator systems in order to evaluate the reliability of the proposed system. The applicant should provide data from actual operational experience of similar gas turbines in similar operational conditions. The details should include:

- The type of systems that are included in the database
  - Size
  - Service (emergency, standby, base load, etc.)
  - Start motor type (electric, air, etc.)
- Time required for start of the systems within the database
- The types of start events that is included in the database (rapid, cold, hot, etc.)
- The documentation level of the start events (confidence level for data)
- Definitions for the database as compared to Regulatory Guide 1.9 definitions for the following:
  - Start attempt
  - Failed start attempt

09.05.06-12

Most gas turbine systems include an instrumentation interlock that prevents restart after turbine trip until the turbine spins down to a low speed. This coast down can take minutes depending on the speed at which a trip occurs. The applicant should address how this coast down requirement impacts the start time and reliability of the US-APWR GTGs. As a minimum, the NRC staff needs the following information:

- Interlocks that are included in the GTG system that will prevent a rapid restart attempt
- Braking system that is included in the GTG system to minimize the coast down period
- The time between start failure and restart initiation
- The fraction of turbine failed start attempts would require a coast down period

09.05.06-13

FSAR Tier 2 Section 9.5.6.2.2 describes a check valve in the receiver charging line. These valves are not shown on Figure 9.5.6-1. Due to the critical function of these valves, they should be including on Figure 9.5.6-1.

09.05.06-14

FSAR Tier 2 Section 9.5.6.2.2 states that “the valves in the compressor discharge header can be aligned manually so that either air receiver can be recharged from either air compressor.” “Either” air compressor implies that there are only two compressors and should be corrected. In addition, the compressors are all headered together

according to Figure 9.5.6-1 and all together supply both receivers. Or any one of the compressors can feed both air receivers. Verify that all of the valves described in Section 9.5.6.2.2 are shown on Figure 9.5.6-1 and that the normal valve positions indicated on the figure are correct and consistent with the description.

09.05.06-15

FSAR Tier 2 Section 9.5.6.3.B states that a failure of a compressor is indicated by an air receiver low-pressure alarm. Since there are five other compressors that will automatically restore and maintain receiver pressure, the applicant should explain how this arrangement will detect a failed compressor?

09.05.06-16

FSAR Tier 2 Section 9.5.6.3.C notes that the GTGSS is seismic Category I and ASME Section III Class 3 except for the air compressors and air coolers. In accordance with SRP Section 9.5.6, the piping interfaces between seismic and non-seismic as well as between ASME Section III and non-Section III should be indicated on the P&ID (Figure 9.5.6-1).

09.05.06-17

FSAR Tier 2 Section 9.5.6.3.C states that systems, equipment and components (SSCs) which are not seismic Category I and, "whose failure could impair the functioning of the lubrication system are upgraded in design to seismic Category I." In this statement, "lubrication" should be changed to "starting". In addition, this statement should be reworded for clarity – SSCs "which are not seismic Category I" should be changed to SSCs "which are not normally required to be seismic Category I based on their safety function, but whose failure could impair…"

09.05.06-18

FSAR Tier 2 Table 9.5.6-1 includes non safety-related piping, fittings and valves designed to ANSI B31.1 (this should be ASME B31.1). Whereas Section 9.5.6.3 states that the starting system, except for the air compressors and air coolers are ASME Code Section III, Class 3. The latter statement implies that there will not be any piping designed to ASME B31.1. The applicant should clarify the design. Note that the check valves that maintain air receiver pressure and all piping, fittings and valves downstream of these check valves must be ASME Section III and seismic Category I.

09.05.06-19

FSAR Tier 2 Table 9.5.6-1 indicates the air volume for one start in units of Nm^3. This volume should be in ft^3 to be consistent with the rest of the table.

09.05.06-20

Section C.2.2.3 of "Qualification and Test Plan of Class 1E Gas Turbine Generator System," December 2007 (MUAP-07024-P(R0)) states that the air starting system air receivers will be in accordance with ASME Section VIII. Verify that the US-APWR starting air system air receivers will be in accordance with ASME Section III, Class 3.

09.05.06-21

Section C.2.2.11.3 of "Qualification and Test Plan of Class 1E Gas Turbine Generator System," December 2007 (MUAP-07024-P(R0)) indicates normal air pressure and air pressure after three starts for the air receiver in psig units. For the same parameters, FSAR Tier 2 Table 9.5.6-1 indicates the same parameters with essentially the same numerical values except that the units are psia. The applicant should correct this discrepancy.

09.05.06-22

Section C.2.2.11.4 of "Qualification and Test Plan of Class 1E Gas Turbine Generator System," December 2007 (MUAP-07024-P(R0)) indicates that pipes from air tanks to the generator set shall be zinc coated to prevent pipes from rusting. FSAR Tier 2 Table 9.5.6-1 indicates that piping will be stainless steel and carbon steel. The applicant should provide more specific information on which piping is carbon steel, which is stainless steel and which is zinc coated. The description should address the potential for loose rust, failed zinc plating, etc., in piping subject to moist air to cause failure of the starting system.

09.05.06-23

The guidance in Regulatory Guide 1.9 includes a monthly "slow start" and a "fast start" every six months. The distinction is intended to minimize stress and wear on the system while ensuring start reliability, based on the assumption that fast starts create more stress and wear on the diesel generator system. Surveillance Requirement 3.8.1.2 of FSAR Tier 2 Chapter 16 requires a monthly start test for the GTG. In the report "Justification for deviations between NUREG-1431 Rev. 3.1 and USAPWR Technical Specifications," dated August 2008 the applicant states that the GTG system does not require a slow start. The applicant should address the potential for increased wear and stress on the GTG system caused by more frequent fast starts and the possible effect on system performance and reliability.