DRAFT REQUEST FOR ADDITIONAL INFORMATION EEB 453 REVISION 4

June 17, 2008

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 08.03.01 - AC Power Systems (Onsite)

Application Section: SRP 8.3.1

EEB Branch

QUESTIONS

08.03.01-***

1. Section 8.3.1.1.1 of the US-APWR Design Control Document (DCD) states the station service transformers (SSTs) are protected with differential relays for internal faults. An examination of the Figure 8.3.1-1, "Onsite Ac electrical distribution system (sheet 1of 7)," does not show the differential protection for station service transformers (SSTs) as stated in Section 8.3.1.1.1. The applicant is requested to address this discrepancy between the narrative in the DCD and the accompanying drawings.

08.03.01-***

1. The Drawing 8.3.1.1.1 (sheet 1 of 7) shows (also as described in Section 8.3.1.1.1) that non-safety buses N3, N4 and P1 and N5, N6 and P2 are connected to UAT3 or RAT3 and UAT4 or RAT4 respectively. As described in Section 8.3.1.1.2, safety buses A and B are supplied from UAT3 or RAT3, and safety buses C and D from UAT4 or RAT4. The normal feed for the buses N3 and N4 is from UAT3 and Buses N5 and N6 is from UAT4 respectively. The Normal feed for bus P1 is from RAT3 and bus P2 is from RAT4. Because of the normal and alternate offsite power configurations possibilities, it is plausible that RAT3 would supply the non-safety buses N3, N4, P1 and safety buses A and B. Similarly, RAT4 would supply non safety buses N5, N6, P2 and safety buses C and D at any given time. Discuss and answer the following:

   a. Since the non safety buses N3, N4, N5 and N6 supply reactor coolant pumps (RCP), discuss the impact on the safety bus voltage due to (1) starting of one large RCP pump motor (7431 KVA) and (2) with one RCP pump motor running and second RCP pump motor starting. If a voltage drop and load flow analysis were performed for this limiting condition, then provide and discuss the results and assumptions of such an analysis and the impact on the safety bus voltage regulation.

b. Discuss the impact on the safety buses by assuming a stuck breaker in the non-safety system that fails to clear a fault in the non-safety system.

c. Discuss and provide rationale how the proposed design meets the guidance given in SECY-91-078 which states that offsite source can power the safety buses upon a failure of any non-safety bus.

08.03.01-***

1. The automatic fast class 1E bus transfer scheme is described in Section 8.3.1.1.2.4.A and it states that the fast bus transfer scheme is initiated by RAT protective relays. However the RAT protective relays are not described. Describe the RAT protective relays and what is the approximate time to accomplish the fast transfer from RAT to UAT.

08.03.01-***

1. In the case where the automatic fast transfer of class 1E bus scheme is not successful, the DCD states that slow transfer is initiated by bus undervoltage relays. The DCD further states that the breaker from the UAT is closed after 1 second and loads on the affected buses are started by the LOOP load sequencer. Answer the following questions:

a. Since RAT and UAT are both offsite power sources, a transfer of feed via the slow transfer from RAT to UAT implies that there is no LOOP. (1) Discuss why the LOOP load sequencer is used in loading the affected buses when there is no LOOP. (2) What happens to the loads that were already running before the transfer took place.

b. Describe the slow transfer scheme with respect to voltage decay (residual voltage) of the large motor loads that were tripped and their reconnection to the restored bus. Describe any safety features (permissive) installed in the motor load breakers that will prevent the motor load being connected out-of-phase with the bus voltage?

c. In describing the transfer scheme, it is stated that the slow transfer is initiated by the bus undervoltage signal. Describe whether it is the loss of voltage or degraded voltage signal that initiates the trip of the incoming circuit breaker from the RAT. What is the impact of the low or degraded voltage on the motor loads for the duration until the motor loads are tripped?

08.03.01-***

1. The automatic transfer of class 1E buses initiated by loss of offsite power from the reserve auxiliary transformer (RAT) with the class 1E gas turbine generator (GTG) operating in parallel with the offsite power source during the testing of the GTG is described in Section 8.3.1.1.2.4.B. The DCD states that power is restored either from the unit auxiliary transformer (UAT) or the GTG by slow transfer after tripping of the GTG breaker, load breakers and incoming circuit breaker from the RAT. Further it states that loads required during LOOP are started in sequence by the LOOP load sequencer. If power is restored from the UAT to the Class 1E bus then it is no longer a LOOP condition. Discuss your rationale for loading LOOP loads when offsite power is available to the bus from the UAT during this scenario.

08.03.01-***

1. The automatic transfer of class 1E buses from RAT to UAT due to loss of offsite power from RAT and LOCA occurring simultaneously is described in Section 8.3.1.1.2.4.D. The DCD states that incoming circuit breaker from UAT is closed after one second which implies a slow transfer from the RAT to UAT. One of the conditions described under this scenario is that the main transformer circuit breaker is closed or generator load break switch (GLBS) is closed in order to have power available from the UAT. Answer the following questions:

   a. Under this scenario, is it correct to assume that offsite power is lost only from the RAT but not from the switchyard? Describe the conditions and automatic transfer schemes for the scenario when offsite power is not available in the switchyard.
   b. Under this scenario, the motor loads on the affected bus are tripped and after one second the incoming breaker from the UAT is closed, and the accident loads are started by the ECCS load sequencer. Discuss whether the residual voltage of the motors that were tripped at the beginning of this sequence has decayed sufficiently so as to not cause out-of-phase closing of the motor loads to the bus. Discuss what protection features are installed in the motor load circuits to prevent these motors from loading on to the bus under out-of-phase conditions.
   c. In a letter dated February 8, 2008 from MHI to the NRC, MHI provided a response to question 3 on grid stability analysis that justifies the assumed 3-second time delay for loss of offsite power. It is also stated in the letter that if a turbine trip occurs, the generator load break switch (GLBS) opens after a time delay of 15 seconds. Therefore it can be assumed that with a turbine trip, the unit generator will be running in parallel with the offsite power (via the MT) feeding the UAT, i.e., the MT breaker and the GLBS are both closed. This condition is contrary to the condition described in Section 8.3.1.1.2.4.D of the DCD, therefore clarify and revise the assumed condition in this section of the DCD.
   d. In the scenario assuming when all offsite power is lost, i.e., the UAT cannot be supplied via the MT and the GLBS remains closed for at least 15 seconds to supply power to the UATs. However in this mode it cannot

supply ECCS loads beyond 15 seconds for mitigating LOCA. Revise this section to clarify the transfer of class 1E buses from RAT to UAT when offsite power is available from the MT breaker and the GLBS.

08.03.01-***

1. Section 8.3.1.1.2.4.E, item 3 states that the power to one of the class 1E 6.9 kV buses A or B can be restored from the A alternate AC (A-AAC) GTG. The SBO loads required on the class 1E buses A (or B) are manually started and loads that are not required to be running on the bus P1 are tripped and blocked from starting. The SBO loads are shown in Table 8.3.1-6 as 3283 kW. The AAC-GTG loading (LOOP condition) on Bus P1 are shown in Table 8.3.1.5 as 3836 kW. Since the AAC GTG is sized at 4000 kW, it is not clear what loads are not required to be running during an SBO on the permanent bus P1. Discuss and clarify what are the required and not required loads on the P1 bus during an SBO. Also, discuss what administrative controls and procedures are planned to be put in place to minimize the probability of overloading the AAC-GTG during an SBO event.

08.03.01-***

1. The description in Section 8.3.1.1.2.5 on the degraded voltage protection does not address the guidance in BTP 8-6 with regard to GDC 17 as it relates to the onsite ac power system's capacity and capability to permit functioning of systems important to safety. The DCD states that the voltage levels at the class 1E buses are optimized for maximum and minimum load conditions and for the voltage variations of the offsite power system. However, MHI has not provided any analyses or data to support its conclusions. Therefore to support the above conclusion, provide the following:

   a. Actual minimum and maximum voltages (or a nominal voltage with ± tolerance) for each level of onsite distribution system in accordance with BTP 8-6 position B.3. At the interface of the offsite and onsite power distribution system, specify the minimum and maximum required offsite system voltage that the COLA applicant has to meet for satisfying the requirements of the onsite distribution system. This offsite voltage requirement should be made the responsibility of the COLA applicant since it is site specific.
   b. In accordance with BTP 8-6 (B4), the analytical techniques and assumptions used in the analyses must be verified by actual measurement before initial full-power reactor operation. The COL applicant should be responsible for meeting the BTP 8-6 position B4, since it is site specific. Therefore it should be identified as a COLA action item.
   c. Provide a description of the analytical techniques, methodology, and assumptions used in performing the analyses per BTP 8-6 position B.3.

Provide the results of these analyses for each level of onsite electrical power distribution system.

08.03.01-***

1. The description in Section 8.3.1.1.2.6 on the testing of the onsite ac power system is incomplete. To satisfy GDC-18, address specifically how you meet the guidance of RG 1.32, RG 1.47, 1.118 and 1.153 on testing of the onsite electrical power system and equipment.

08.03.01-***

1. In Section 8.3.1.1.3.3 you provided a description of class 1E GTG starting system. You did not provide a discussion on whether the class 1E GTG can also be started from the Remote Shutdown Panel (as required by Appendix R) in case of evacuation of the main control room (MCR) due to a fire. Provide your rationale for not including the capability of starting the class 1E GTGs from the Remote Shutdown Panel.

08.03.01-***

1. In describing class 1E GTG testing in Section 8.3.1.1.3.8, item 2b states that the class 1E GTG will be loaded to maximum expected load-carrying capability for not less than 1 hour. Explain the term 'maximum expected load-carrying capability in view of the criteria given in RG 1.9 and IEEE 387 for loading it to 90–100 percent of the continuous rating until temperature equilibrium is attained. Also, discuss the power factor (PF) of the load when conducting this test. Provide your rationale if the PF of the load for this test is different than the rated PF of the machine, or the LOOP and ECCS load PF.

08.03.01-***

1. In Section 8.3.1.1.9, "Design Criteria for Class 1E Equipment," you refer to Table 8.3.1-2 for acceptable bus and motor voltages. In Table 8.3.1-2, under column acceptable variations for voltage and frequency, you list voltage variation of ±10% and frequency variation ±5%. It is not clear from the listing whether these limits are applied independently or as combined voltage and frequency limits. Refer to the guidance given in NEMA MG-1-20.45.A3, "Variations from rated voltage and rated frequency" which states that a combined variation in voltage and frequency of ±10% of rated values provided the frequency does not exceed ±5% of rated frequency. Correct the criteria for voltage and frequency as listed in Table 8.3.1-2 to reflect the

industry guidance given in MG-1, or provide justification for departure from industry recommended practice for voltage and frequency variations.

08.03.01-***

1. Section 8.3.1.1.9, "Design Criteria for Class 1E Equipment," under "interrupting capacities," states that switchgear, load centers, MCCs and distribution panels are selected to be greater than the maximum calculated short circuit current at the point of application. It is not clear whether you have already performed the short circuit current calculations including the selection of transformer impedances. If such analyses have been conducted, then provide the result of the analyses, and assumptions used in the analysis to evaluate acceptable ratings for equipment, such as circuit breakers, switchgear short circuit ratings, the containment penetration assemblies and other electrical equipment requiring such analyses. If these analyses have not been performed, then elaborate who is going to conduct it, and if it is the responsibility of the COLA applicant then it needs to be identified as COLA Action Item.

08.03.01-***

1. Section 8.3.1.1.9, "Design Criteria for Class 1E Equipment," under "electric circuit protection," refers to Subsection 8.3.1.1.2.5 for a description of electric circuit protection. Neither of these sections provide sufficient information on the analyses and studies required for the electric circuit protection to prevent damage to the equipment, maintain operational continuity, and reduce the safety hazard to the plant personnel. Elaborate on the electrical distribution system protection and coordination studies that are required for the electric circuit protection of the onsite electrical power distribution system equipment and circuits including the containment penetration assemblies. The required studies should be performed in accordance with the guidance given in pertinent industry standards, such as IEEE Std. 242-2001 and IEEE std 741-2007 to develop a selectively coordinated system or alternatives that are adequately justified. Provide the results from those studies, and acceptance criteria and assumptions used such analyses.

08.03.01-***

1. Section 8.3.1.1.9, "Design Criteria for Class 1E Equipment," under "class 1E cables," describes cables of different voltage levels. Medium voltage (6.9 kV) cables that are installed in duct banks, or underground conduits, or direct buried, and therefore are inaccessible are known to be susceptible to degradation from moisture. Generic Letter 2007-01 addresses this issue for the current fleet of nuclear plants and for new reactors. You

need to include in your discussion on medium voltage cables how US-APWR design incorporates a program to monitor and mitigate the degradation of inaccessible cables in accordance with the guidance of Generic Letter 2007-01. Since degradation of the inaccessible medium voltage cables is an ongoing problem, it will be necessary to address this issue over the life of the plant in accordance with the guidance of Generic Letter 2007-01. It will be the responsibility of the COLA applicant after the plant is licensed therefore it needs to be identified as COLA Action Item.

08.03.01-***

1. Regulatory Guide 1.206, Section C.I.8.3.1.3, "Electrical Power System Calculations and Distribution system studies for AC System," states that the FSAR (DCD) should include electrical power calculations and distribution system studies. The US-APWR FSAR does not include information on the specific studies required for the AC power system in accordance with Section C.I.8.3.1.3 of RG 1.206. Answer the following questions.
   a. Describe and provide assumptions and summary results of the studies listed in Section C.I.8.3.1.3 of RG 1.206 for each voltage level distribution system. If the studies listed in the Section C.I.8.3.1.3 of RG 1.206 for AC power system have not been performed, then indicate when these studies will be performed. Also, indicate when the results of these studies will be submitted to the staff.
   b. Identify the analytical software (and its version) used for performing these studies.
   c. Submit to the staff an electronic copy of the electrical distribution system model that formed the basis of the analytical studies 1 through 6 listed in Section C.I.8.3.1.3 of RG 1.206.