REQUEST FOR ADDITIONAL INFORMATION 260-2023 REVISION 1

3/4/2009

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

SRP Section: 03.12 - ASME Code Class 1, 2, and 3 Piping Systems and Piping Components and TheirAssociated Supports
Application Section: 3.12

QUESTIONS for Engineering Mechanics Branch 1 (AP1000/EPR Projects) (EMB1)

03.12-5

DCD 3.12.3.3 describes Independent Support Motion (ISM) Method and stated that “The modal and directional responses are then combined as discussed in Subsection 3.12.3.2.4 and 3.12.3.2.5, respectively”. Subsection 3.12.3.2.4 stated that ‘A 10% grouping method is used for combining the response of closely spaced modes as delineated in Regulatory Position C1.1 of RG 1.92, Rev.1”.

Volume 4, Section 2 of NUREG-1061 presented industry and NRC’s position. NUREG-1061 clearly stated that group responses for each direction should be combined by the absolute sum method, and modal and directional responses should be combined by the SRSS method without considering closely spaced frequencies.

The staff noted that the modal and spatial combination methods described in RG 1.92 apply only when using the uniform support motion (USM) method for response spectrum analysis of multi-supported systems. The staff requests applicant to provide technical justification for its ISM method. Otherwise the applicant has to provide an acceptable ISM method which will address all of the provisions (for groups, modes, spatial and inertial and seismic anchor motions (SAM) combination methods) contained in NUREG-1061.

03.12-6

SRP 3.9.2, subsection II.2(G) identified the method/formula to obtain of the maximum relative support displacements for seismic anchor movement (SAM) effects.
US-APWR DCD Section 3.12.3.2.6 did not provide the method/formula in determining the maximum relative movements for SAM. Describe the method/formula for obtaining the maximum relative support displacements.

03.12-7

In DCD Section 3.12.4.4, MHI states that if the amplified response spectra at the branch connection point can not be developed,"...movements of the connection point from the seismic inertia analysis of the pipe run are analyzed as anchor movements and the solution is added to the seismic analysis of the decoupled branch line by absolute summation." Provide technical justification for this approach.

03.12-8

For fatigue analysis of RCL piping presented in DCD Section 3.9.3.1.4, MHI states that the procedure is repeated to create the next most severe alternating stress range and until the combinations have an allowed number of cycles less than 10^{11}. Clarify if the allowed number of cycles should be greater than 10^{11}.

03.12-9

For design basis pipe break (DBPB) loads in DCD Section 3.12.5.3.7, MHI states that DBPB loads are considered in Level D service load combinations. However, in SRP Section 3.9.3 the staff recommends to include DBPB in the Level C service load combinations. Clarify if DBPB will be included in the service level C load combinations.

03.12-10

In DCD Section 3.12.5.9, MHI claims that for US-APWR there is no problem that would occur due to the thermal stresses caused by thermal stratification or temperature changes in the closed branch piping connected to RCS. The US-APWR piping design provides the following three approaches against thermal oscillations induced by leaking valves in an unisolable piping connected to the RCS: installation of double isolation valves, leakage detection by measuring the downstream temperature for a single valve configuration, or permitting continuous leakage through the valve gland packing in a gate valve configuration (as indicated in DCD Tables 3.12-7 and 3.12-8). It is not clear how each of these three approaches would ensure mitigating the effects of thermal oscillations induced by leaking valves. Explain how the suggested approaches will mitigate the effects of thermal oscillation in an unisolable piping connected to the RCS.

03.12-11

Notes 5 and 6 to DCD Table 3.12-5 indicate that for ASME Code, Section III, Class 1, 2 and 3 piping, when slug-flow water hammer loads are only combined with pressure, weight and other sustained mechanical loads, the Equation 9 stress does not exceed the smaller of 1.8 S_y and 2.25 S_m for Class 1 piping and 1.8 S_y and 2.25 S_h for Class 2/3 piping. These limits correspond to Service Level C stress limits. As indicated in chapter 7 of NUREG-1367, slug flow may produce collapse and thus constitutes a threat to functional capability and therefore, it suggests no increase in Code Equation 9 stress limits. Also, since slug flow is difficult to anticipate in the design stage, the piping design should include drains and vents, and operating procedures should be implemented so that the possibility of slug flow is minimized. Clarify if the safety related piping design incorporates drains and vents to minimize the effects of slug flow loads, and operating procedures are to be implemented so that the possibility of slug flow is minimized.

03.12-12

Typically, supports are designed separately from the piping analysis, with design methods to match the assumed analysis constraints. As such, the supports should be designed to minimize their effects on the piping analysis and not invalidate the piping analysis assumptions. For cases when assumptions made in the piping analysis deviate from those of the support design, either the support is redesigned in accordance with the assumptions made in the piping analysis, or the piping system is reanalyzed using the actual parameters used in the design of the pipe supports. Clarify whether US-APWR standard plant pipe supports are designed to these requirements; otherwise discuss the criteria for reconciling piping analysis assumptions that deviate from the as-built pipe support design.

03.12-13

(a) In DCD Section 3.12.6.1, MHI states that for Service Levels A, B and C, the seismic Category I pipe supports will be designed in accordance with Subsection NF of the ASME Code and for Service Level D, Appendix F of Section III of the ASME Code will be utilized. However, DCD Section 3.12.6.2.2 states that all piping supports designed in accordance with the rules of Subsection NF of the Code up to the building structure interface are defined by the jurisdictional boundaries in Subsection NF-1130 of the ASME Codes.

(i) Since Appendix F of the Section III provides only the Service Level D limits for evaluation of loading [per Code Table NF-3523(b)-1 for stress limit factors] for Class 1, 2, 3 and MC type supports, clarify if the seismic Category I pipe supports will be designed to ASME Subsection NF for all four Service Level A, B, C and D loads, while using the acceptance stress limits by the Appendix F for Service Level D supports.

(ii) Also, clarify if the Subsection NF will be used to manufacture, install and testing of all seismic Category I pipe supports. If not, which other standard will be used.

(iii) In DCD Section 3.9.3.4 MHI states that the building structure component supports (connecting the NF support boundary component to the existing building structure) are designed in accordance with ANSI/AISC N690 (1994 edition), "Nuclear Facilities – Steel Safety-Related Structures for Design, Fabrication and Erection." Clarify if this standard is also applicable to piping support design.

(b) MHI states that non-seismic Category I pipe supports are designed using guidance from the AISC Manual of Steel Construction. This manual is used to design steel constructions in frame type or other structural element of component supports. Based on DCD Section 3.12.1, ASME Code B31.1 is being used for a certain seismic Category II piping. The design of all supports for the non-nuclear piping (that typically uses B31.1 for piping analysis) should satisfy the requirements of ASME/ANSI B31.1 Power Piping Code, Paragraph 120 for loads on pipe supporting elements and Paragraph 121 for design of pipe supporting elements. Clarify if this is applicable to US-APWR pipe support design, otherwise explain how the AISC manual will be used to design component supports (e.g., clamps, springs).

03.12-14

In DCD Section 3.12.6.2.1, MHI states that for piping analyzed to B31.1, the jurisdictional boundary guidance of ND-3611 will be utilized. Clarify if the reference guidance should be ND-1132 instead of ND-3611.

03.12-15

(a) In DCD Section 3.12.6.3.9, MHI provided a minimum design load criteria that will be used for all supports so that uniformity is obtained in the load carrying capability of the supports. All supports will be designed for the largest of the following three loads: 100% (instead of 125% per WRC Bulletin 353) of the Level A condition load, the weight of a standard ASME B31.1 span of water filled, schedule 80 pipe, and minimum value of 150 pounds. Provide the technical basis for these criteria.

(b) DCD Table 3.12-4 provides the specific load combinations that will be used in the design of pipe supports. Clarify how the building settlement loading is addressed for piping supports.

03.12-16

In DCD Appendix 3C.2.2.1, MHI states that the stiffness of the upper and intermediate lateral supports includes the SG shell flexibility. Describe the method/procedure to account for SG shell flexibility in determining the stiffness of the upper and intermediate lateral supports.

In DCD Appendix 3C.2.2.2, MHI states that the value of the support stiffness of the RCP lateral support also includes flexibility of the RCP casing. Describe the method/procedure to account for RCP casing flexibility in determining the stiffness of the lateral supports.

In DCD Appendix 3C.4, MHI states that RCL static analyses are modeled to include the RV supports, and the column supports of SG, and the RCP as active RCL supports. Clarify if the SG lower lateral supports are included in RCL static analyses.

In DCD Figure 3.8.3-2 indicated the RV and hot leg piping thermal growth is directly restrained by the SG lower lateral support. The staff noted that this arrangement may cause significant thermal stresses and loading in the RV and SG nozzles, Clarify this design strategy.