RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

3/24/2014

US-APWR Design Certification

Mitsubishi Heavy Industries

Docket No. 52-021

RAI NO.:	**NO. 1060-7285 REVISION 4**
SRP SECTION:	**03.07.02 – Seismic System Analysis**
APPLICATION SECTION:	**3.7.2**
DATE OF RAI ISSUE:	**11/15/2013**

QUESTION NO. 03.07.02-234:

Each nonlinear sliding analysis described in MUAP-12002, "Sliding Evaluation and Results," Revision 1, is based on the simultaneous input of three perpendicular input acceleration time histories in the X, Y and Z directions. The analysis is for only 1 of 8 possible combinations of the X, Y, and Z input motions (i.e., +x+y+z; +x+y-z; +x-y+z; +x-y-z; -x+y+z; -x+y-z; -x-y+z; -x-y-z). Because nonlinear sliding analyses may be affected by the phasing between the three input motions, particularly between the vertical and horizontal directions, the effect of phasing between the three input motions should be considered. Therefore, the applicant is requested to evaluate all 8 combinations, for the time history case that produced the largest sliding response, in order to ensure that the worst case sliding displacement has been determined.

ANSWER:

Below is MHI's response to the subject RAI as discussed with the Nuclear Regulatory Commission (NRC) staff during the Design Certification Document (DCD) Tier 2, Section 3.7 Audit conducted in September 23-27, 2013.

The nonlinear sliding analysis that produced the largest sliding response corresponds to the Reactor Building (R/B) complex with cracked concrete section properties placed on subgrade profile 900-200 and acted on by the Nahanni seismic acceleration. Two sliding analyses were performed for this case, one with the Finite Element (FE) model and the other with the Lump Mass Stick Model (LMSM). As shown in Table 5.2.5-4 of the Technical Report (TeR) MUAP 12002, Rev. 1 these analyses produced the largest sliding: 0.637 inches - for the FE model, and 0.628 inches - for the LMSM. The combination for the three components of the input motion used in the TeR was +x+y+z.

Seven additional sliding analyses have been performed for this case, using the LMSM with cracked concrete section properties, placed on subgrade profile 900-200. In each of these analyses, the three components of the Nahanni input acceleration have been permutated as requested in this RAI question. The results for all eight cases (including the analysis performed with the LMSM and discussed in the TeR) are compared in Table 1 in terms of maximum total sliding (total sliding is defined in equation 4.5.5-1 of the TeR).

The results listed in Table 1 show that the case analyzed in the TeR (namely +x+y+z) provides the largest sliding response from all possible combinations of the X, Y, and Z components of the input motion. The results supporting this response were developed in a computation during the Section 3.7 Audit. The computation will be formalized in a documented calculation at a future date.

Table 1. Maximum total sliding calculated using the LMSM with cracked section, placed on subgrade 900-200 and acted by the Nahanni seismic acceleration.

CASE	Maximum Total Sliding (inches)	Percent Difference
+x+y+z	0.628	0
+x-y+z	0.598	-5%
-x+y+z	0.576	-8%
-x-y+z	0.548	-13%
+x+y-z	0.445	-29%
+x-y-z	0.435	-31%
-x+y-z	0.423	-33%
-x-y-z	0.420	-33%

Impact on DCD

There is no impact on the DCD.

Impact on R-COLA

There is no impact on the R-COLA.

Impact on PRA

There is no impact on the PRA.

Impact on Technical/Topical Report

There is no impact on the Technical/Topical Report.

This completes MHI's response to the NRC's question.