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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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03/29/2013

**US-APWR Design Certification**

**Mitsubishi Heavy Industries**

**Docket No. 52-021**

**RAI NO.:** NO. 931-6467 REVISION 3

**SRP SECTION:** 03.08.03 – Concrete and Steel Internal Structures of Steel or Concrete Containments

**APPLICATION SECTION:** 3.8.3

**DATE OF RAI ISSUE:** 05/15/2012

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**QUESTION NO. 03.08.03-84:**

Section 3 and other sections of MHI Technical Report (TR) MUAP-11020-P (R0) discuss the design approach for connection regions, connections, and connected parts. In order to understand the distinction between each of these terms, and the specific criteria that apply to each, the applicant is requested to address the items listed below.

1. Clearly define the terms connection regions, connections, and connected parts. Explain what structural elements are included in each of these regions. For example, when referring to connections (in the case of SC to basemat connections), does the connection only include the baseplate, studs, rebar coupler, rebar, and concrete region anchoring the rebar, or does it also include the SC wall section up to the 2T dimension. Also, confirm whether the design approach described in the TR applies only to the connection or also to the connection region.
2. More specifically, Items (i) and (ii) of Section 3.1 discuss required axial tension and in-plane shear strengths of the connection, while Items (iii) and (iv) discuss required flexural and out-of-plane shear strengths of the connection region. It appears that Item (iii) would not apply to the connection region but to the connection. Furthermore, Item (iv) appears to apply to the connection region. Confirm whether this is the case or explain why not.
3. Items (ii) and (iv) of Section 3.1 discuss full strength connection requirements for in-plane and out-of-plane shears, respectively. However, as discussed below, they do not appear to reflect the full strength connection design philosophy, which is, connections are designed to be stronger than the weaker of the two connected parts.

Item (ii) indicates that the required in-plane shear strength of the connection is based on the upper bound in-plane shear strength of SC walls, i.e.,  $10 A_{cv} (f_c')^{0.5}$ . Although, placing this value as an upper bound limit for design of SC walls is conservative, the actual in-plane shear strength of SC walls based on tests may be higher than this upper bound limit. Since the design approach for the connection is to use the strength of the weaker of the two connected parts, the use of the value  $10 A_{cv} (f_c')^{0.5}$  (which is expected to be lower than the actual SC wall in-plane shear strength) for the design of in-plane shear strength of the connection does not meet the stated criterion in item (ii).

In addition, Item (iv) of Section 3.1 specifies required out-of-plane shear strength of the connection region. This provides the design criteria for the connection region; however, where are the design criteria for the connection (i.e., baseplate, studs, rebar coupler, rebar, and concrete surrounding the rebar)? With the consideration of the above discussions, explain how Items (ii) and (iv) of Section 3.1 ensure that the connection design will follow the full strength connection design philosophy.

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**ANSWER:**

This answer revises and replaces the previous MHI answer that was transmitted by letter UAP-HF-12197 (ML12235A511).

1. Section 1.0 of Technical Report MUAP-11020, Rev. 1, provides detailed definitions of connection, connected parts, and connection region.
2. Section 3.1 of Technical Report MUAP-11020, Rev. 1 specifies that the required strength for individual demands (i) - (iv) are also applicable to the connections. Furthermore, Section 3.1 specifies that the out-of-plane individual demands (iii) and (iv) are applicable to the connection regions. Section 3.2 provides additional discussion regarding the applicability of the individual out-of-plane demands to the connection region.
3. Technical Report MUAP-11020, Rev. 1, Section 3.1 (ii), specifies the required in-plane shear strength in terms of the nominal in-plane shear strength, rather than the upper bound in-plane shear strength (i.e.,  $10 A_{cv} (f_c')^{0.5}$ ).

As described in item 2 above, Section 3.1 (iv) Technical Report MUAP-11020, Rev 1, specifies the required out-of-plane shear strength for the connection.

Technical Report MUAP-11020, Rev. 1, Section 3.2, explains how the design of the connection region flexural and out-of-plane shear strengths ensure that the connection design follows the full strength connection design philosophy.

**Impact on DCD**

There is no impact on the DCD.

**Impact on R-COLA**

There is no impact on the R-COLA.

**Impact on S-COLA**

There is no impact on the S-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.

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