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Subject: **Reply to Notice of Violation, NRC IR 05200010/2010-201, Clarifications Requested by NRC Staff**

The purpose of this letter is to respond to NRC Staff comments on the GEH response to the subject Notice of Violation (Reference 1), dated November 10, 2010. The violation was identified during the associated NRC inspection conducted July 26-28 and August 30-September 1, 2010 at our facility by R. Prato and his team. Our reply to Reference 1 is provided as Enclosure 1.

If you have any questions about the information provided, please contact me.

Sincerely,

Jerald G. Head
Senior Vice President, Regulatory Affairs

Reference:

1. Letter, RA Rasmussen (NRC) to JG Head (GEH), *GEH Response to US NRC Inspection Report 05200010/2010-201 and Notice of Violation*, Nov 10, 2010.

Enclosure:

1. Reply to Notice of Violation, NRC IR 05200010/2010-201, Clarifications Requested by NRC Staff.

cc: AE Cubbage USNRC (with enclosure)
RA Rasmussen USNRC (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)

IE01
NRO

Enclosure 1
Reply to NRC Notice of Violation
Docket Number 05200010
Inspection Report No. 05200010/2010-201
Response to Clarifications Requested by NRC Staff
November 10, 2010

Clarification 1 Requested by NRC Staff... Determining fire-damage footprints including the overpressure effects in the Reactor Building vertical chase.

Your initial response did not address certain technical issues relative to the staff's initial concern. Please include in your response applicable information to provide a clearer understanding of the use of the fire damage rule sets as it applies to the Reactor Building vertical chases, including related interfacing boundaries; applicable description of any additional impact scenarios (including any new impact analyses, structural damage analyses, and/or fire damage analyses) needed to account for the entire perimeter of the Reactor Building; and descriptions of any updates to fire damage assessment drawings and related systems assessment needed to accurately reflect the final scenarios and assessment. This should include any changes to size, shape, and/or locations of physical damage and fire damage footprints.

GEH Response to Item 1:

GEH is revising the aircraft impact assessment report to clarify assumptions on the effects of overpressure on Reactor Building (RB) vertical chases and their interfacing boundaries. The revision provides more detail on the description of the physical arrangement of the vertical chases; describes the new assumptions; and reflects these changes in the fire damage footprints. DCD Chapter 19D has been revised (ESBWR DCD Revision 9, submitted December 2, 2010, MFN 10-352) to add two design features that are key design features, based on their functional performance as determined by the revised analysis. The DCD is also revised to clarify that physical separation of safety-related divisions of equipment is provided either for the entire quadrant, or for protected compartments within the quadrants to ensure that at least one division of safety-related equipment is unaffected by RB aircraft impact effects. In addition, Chapter 9 of the DCD (Revision 9) is revised such that fire areas are modified for separation of RB vertical chases.

The physical arrangement of the RB vertical chases consists of a Divisional Commodity (DC) chase and a Non-Divisional Commodity (NDC) chase at each corner of the RB. The DC chase is used to route safety-related cables vertically to the safety-related equipment on the associated RB elevations. This chase is rated for a differential pressure of at least 0.034 MPa (5psi) including all penetrations, and is a key design feature that is described in DCD Chapter 19D. The NDC chase is used to route nonsafety-related cables and nonsafety-related HVAC ductwork to its associated RB elevations and it also houses an enclosed High Energy Line Break (HELB) chase that is physically separated from the cables and ductwork with volume reserved for dissipating

HELB scenarios. The NDC chase walls are structurally rated for a differential pressure of at least 0.034 MPa (5psi), and this is also a key design feature discussed in DCD Chapter 19D.

If the DC chase is in the physical impact area, the entire DC chase is assumed to have an overpressure condition; however, propagation of overpressure or fire across the chase boundary to adjacent areas is prevented because of their pressure capability. If the DC chase is not in the physical impact area, but the area external to the chase boundary has overpressure from an aircraft impact, then no overpressure or fire propagates into the chase.

If the NDC chase is in the physical impact area, the chase is assumed to be damaged at the elevation of the impact and overpressure is propagated to the ductwork at all affected RB elevations. The interfacing boundaries at all elevations (other than the physical damage elevation) propagate fire damage to the areas immediately adjacent to the chase(s) based on the assumption that overpressure in the chase is transmitted through HVAC ductwork because it is not rated for overpressure conditions. If the NDC chase is not in the physical impact area, but the area external to the NDC chase has overpressure, the overpressure is assumed to propagate into the chase through the HVAC ductwork. The interfacing boundaries at all elevations (other than the overpressure damage elevation) are assumed to propagate fire damage to the adjacent areas through the HVAC chase penetrations. If the area external to the NDC chase has fire (but not overpressure), the fire does not propagate across the chase boundary due to the fire protection capability of the NDC chase boundary, penetration seals, and fire dampers within the HVAC ductwork.

A horizontal barrier has been added to each of the B and C NDC chases as a key design feature. These barriers ensure that no propagation of overpressure or fire occurs between the refueling floor and the RB elevations below elevation 27000 within the NDC chases. The analyses account for worst-case impact damage to the entire RB perimeter by assuming that the southwest and southeast NDC chases at elevation 34000 are overpressurized for any impacts at elevation 34000. This design feature maintains adequate protection for safety-related divisions within the RB.

In summary, the aircraft impact assessment is being revised to incorporate assumptions regarding vertical chases and to add resultant key design features, which are described in the DCD. The RB DC and NDC chases have been re-assessed and the fire damage footprint drawings have been revised to reflect these changes. The assumptions on overpressure and fire propagation within and across chase boundaries are intended to demonstrate that worst-case conditions have been applied to aircraft impact scenarios. Due to the bounding nature of these assumptions, no new impact scenarios are required. The updated assessment demonstrates that at least one division of safety-related equipment is unaffected by the aircraft impact effects. The physical damage footprint on the refueling floor scenarios has been changed to assume the B and C NDC chases are overpressurized. Also, in one scenario, two of four quadrants changed from having fire damage to having overpressure and fire damage due to the new assumptions. However, the other two divisions of safety-related equipment remain unaffected in this scenario.

Clarification 2 Requested by NRC Staff... Providing a technical justification for the preliminary impact scenarios selected and those preliminary impact scenarios not selected for the final structural analyses using the NRC specified loading and the material properties given in NEI 07-13, Revision 7.

Your initial response provided a description of the corrective actions, however it did not include sufficient technical-related information to allow the staff to understand the conclusion reached in your response. Please include in your response applicable quantitative and analytical information used to determine the impact scenarios selected for the preliminary and final structural analyses.

GEH Response to Item 2:

The typical wall thicknesses used in NEI 07-13 rule sets are not representative of the ESBWR, which has very thick and heavily reinforced exterior walls for the safety-related structures. In order to perform a more realistic aircraft impact physical damage assessment, finite element analyses of key structures were performed for a number of strike locations. In determining the impact locations to be analyzed using finite element model analyses, GEH sought to identify locations that provided the least resistance to the impacting aircraft. The considerations used to identify these locations included exterior wall thickness, reinforcement ratio, and unsupported span distance both vertically and horizontally. Once the limiting locations were identified, an idealized strike case was run in which the aircraft was assumed to strike in the center of the unsupported span.

In all but one case, credit for structures external (e.g., stair towers and crane bay) to outside walls of the building was not included in the strike scenarios since this would have been non-conservative in most locations. The one case in which a strike on an external structure (crane bay) was performed was in a location that aligned with an opening in the exterior wall of the Reactor Building (RB).

GEH began an assessment of the ESBWR vulnerability to aircraft impact before the NRC finalized the rule on aircraft impact. In order to develop a sense of potential vulnerabilities, GEH performed a preliminary set of finite element analyses using an aircraft model similar to that used for the existing plants. For the preliminary analyses, 8 strike location scenarios were assessed. Subsequently, once the rule was finalized, 4 of the 8 original cases were reassessed using the NRC provided loading function and GEH determined that the other 4 cases need not be re-analyzed because the results remained valid or would be bounded by the 4 more limiting cases.

The engineering judgment utilized in re-performing the finite element analyses is described in detail in the following sections.

Case F2

This location was re-assessed to determine if the NRC aircraft load would result in the spent fuel portion of the RB buffer pool not being able to maintain its integrity. The analysis concluded that the integrity of the spent fuel portion of the buffer pool was maintained for this strike location.

Case F3

This scenario was re-performed with the NRC aircraft load and a slight adjustment in the strike location to maximize the expected physical damage. The analysis showed no physical damage beyond the refuel floor. When the post impact conditions were assessed for this strike it was demonstrated that core cooling was maintained.

Case F4

This location was re-assessed to determine if the NRC aircraft load would damage the next wall inside the RB exterior wall. The analysis showed that the wall dividing the inner and outer expansion pools was not severely damaged. When the post impact conditions were assessed for this strike it was demonstrated that core cooling was maintained.

Case F5a and F5b

These cases were re-assessed. The strike location chosen for these analyses offers the least resistance to damage because the unsupported span of the exterior wall was the greatest at this location. The physical damage resulting from the aircraft strike analyzed in this case is used as a "proxy" for credible strike locations on the RB up to elevation 27000. GEH used the damage calculated to occur from this strike scenario and postulated its application in various locations to the RB and then used the NEI rule sets governing damage resulting from fire and overpressure to determine the overall damage footprint. This is conservative since the use of the "proxy" results in greater damage than would otherwise be expected. The locations postulated generally focused on areas where the physical damage could potentially affect more than one division (divisional boundary), or in areas where the spread of fire to other elevations could be exacerbated by vertical chases.

The engineering judgment utilized in determining which preliminary strike scenarios did not need to be re-performed is described in detail in the following sections.

Case F1 and F9

These cases were not re-run because the damage to the structure of interest was dependent upon the residual velocity of the aircraft debris. In this case a maximum residual velocity had been calculated in the preliminary case of F9. Since the velocity was fixed the resulting impact force was dependent upon the mass of the debris. A review of the expected debris mass indicated that the mass expected resulting from the NRC loading function would be bounded by the mass of debris from the preliminary case.

Case F6

This case was not re-run based on engineering judgment that the amount of energy absorbed in impacting the crane chase and the equipment opening in the RB wall would remain the same and that the differences in residual forces impacting the primary containment wall would not challenge the integrity of the primary containment. In addition because of the specific location of this strike, the interior boundaries between the East and West sides of the RB at this elevation would not be affected by postulated secondary missiles.

Case F7

This case involving the FB exterior wall was not re-run since it was very similar to case F3, which was re-assessed. Furthermore, the impact did not result in a structural challenge in demonstrating that the integrity of the spent fuel pool was maintained.

Case F8

This case involving a strike at the roofline of the RB was not re-run based on the margins shown in the preliminary assessment. The roof acts as a structural diaphragm distributing the load to much more of the refueling enclosure walls than in Case F3, which was re-assessed.

In summary, the limited number of cases run using the NRC aircraft loading criteria is sufficient to allow GEH to perform the detailed Aircraft Impact Assessment. Physical damage footprints calculated to result from the most limiting cases are applied at other postulated strike locations as appropriate to conservatively predict a physical damage footprint; the subsequent damage from overpressure and fire is then applied using the rule sets contained in NEI 07-13. A discussion of the basis for which cases were reassessed using the NRC aircraft loading is also being added to NEDE-33512, "ESBWR Aircraft Impact Assessment." Changes have been made in ESBWR DCD Chapters 9 and 19 in Revision 9, submitted to the NRC on December 2, 2010 (MFN 10-352).