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Subject: **Reply to Notice of Violation, NRC Inspection Report 05200010/2010-201**

The purpose of this letter is to respond to the Notice of Violation (Reference 1), dated October 5, 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.

The NRC inspection report comments and suggestions are helpful to us in our constant efforts to improve our programs, to assure quality in our products and processes, and to ensure our compliance with NRC regulations and license conditions.

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

Sincerely,

Jerald G. Head

Jerald G. Head
Senior Vice President, Regulatory Affairs

Reference:

1. Letter, RA Rasmussen (NRC) to JG Head (GEH), *ESBWR AIA Inspection, NRC Inspection Report 05200010/2010-201 and Notice of Violation*, Oct 5, 2010.

Enclosure:

1. Reply to Notice of Violation, NRC Inspection Report 05200010/2010-201.

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

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NRO

Enclosure 1
Reply to NRC Notice of Violation
Docket Number 05200010
Inspection Report No. 05200010/2010-201

The Violation

During a U.S. Nuclear Regulatory Commission (NRC) inspection of GEH aircraft impact assessment (AIA) conducted at the GEH facility in Wilmington, NC, on July 26-28, 2010, and August 30 to September 1, 2010, a violation of NRC requirements was identified. An NRC Inspection Report was issued on 10/5/10. In accordance with the NRC Enforcement Policy, a violation was identified and is listed below: Title 10, of the Code of Federal Regulations (CFR), Section 50.150, "Aircraft impact assessment," Paragraph (a)(1) requires that each applicant listed in 10 CFR 50.150(a)(3) shall perform a design-specific assessment of the effects on the facility of the impact of a large, commercial aircraft. Using realistic analyses, the applicant shall identify and incorporate into the design those design features and functional capabilities to show that, with reduced use of operator actions: (i) the reactor core remains cooled, or the containment remains intact; and (ii) spent fuel cooling or spent fuel pool integrity is maintained. Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed to accurately determine fire-damage footprints; to adequately consider finite element analyses boundary conditions, initial conditions, and the time duration; to include in the AIA, the basis for not performing mesh refinement sensitivity analyses; to provide a technical justification for the preliminary impact scenarios selected and not selected for the final structural analyses using the NRC specified loading and the material properties given in NEI 07-13, Revision 7; to include in the AIA the bases for not performing an analysis for an aircraft impact on the gantry crane and the corresponding potential effects of the crane dropping on the drywell head; and to consider non-local effects from an aircraft impact. Further, GEH failed to identify and incorporate into the design those design features and functional capabilities credited in the AIA to show the reactor remains cool, or containment remains intact; and spent fuel cooling or spent fuel pool integrity is maintained as required by 10 CFR 50.150(a)(1). Specifically, the AIA credited fire barrier design features that were not identified in the design. Further background on this issue can be found in NRC inspection report 05200010/2010-201 and in GEH MFN-10-311.

Resolve issue identified and achieve compliance with noted violation. Per NRC requirements, the resolution should include for each violation (1) the reason for the violation, or, if contested, the basis for disputing the violation or severity level, (2) the corrective steps that have been taken and the results achieved, (3) the corrective steps that will be taken to avoid further violations, and (4) the date when full compliance will be achieved.

GEH Response to the Violation

I. Reason for Violation

Attachment 1 (Response to Deficiencies) addresses each specified deficiency separately to explain the reason for the deficiency, the corrective steps taken and results achieved, and the dates when full compliance will be achieved. The response is organized into the following seven subsections within Attachment 1:

"Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed..."

1. to accurately determine fire-damage footprints;

2. to adequately consider finite element analyses boundary conditions, initial conditions, and the time duration;

3. to include in the AIA, the basis for not performing mesh refinement sensitivity analyses;

4. to provide a technical justification for the preliminary impact scenarios selected and not selected for the final structural analyses using the NRC specified loading and the material properties given in NEI 07-13, Revision 7;

5. to include in the AIA the bases for not performing an analysis for an aircraft impact on the gantry crane and the corresponding potential effects of the crane dropping on the drywell head;

6. and to consider non-local effects from an aircraft impact.

7. Further, GEH failed to identify and incorporate into the design those design features and functional capabilities credited in the AIA to show the reactor remains cool, or containment remains intact; and spent fuel cooling or spent fuel pool integrity is maintained as required by 10 CFR 50.150(a)(1). Specifically, the AIA credited fire barrier design features that were not identified in the design.

II. Corrective Steps Taken and Results Achieved

Refer to the responses in Attachment 1.

III. Corrective Steps to Avoid Further Violations

GEH performed an independent review to determine if the cited deficiencies are symptomatic of broader assessment deficiencies, and assigned additional corrective actions to address any findings. The independent review examined the documentation of the key design features and functional capabilities to identify similar deficiencies. The basis for determining the adequacy of documentation is from NEI 07-13 Section 5:

> Each applicant must provide, in its application to the NRC, a description of the design features and functional capabilities credited for showing that the rule's acceptance criteria are met. In addition, each applicant must provide a description of how these design features and functional capabilities meet the rule's acceptance criteria. Each vendor should retain a file of the complete set of analyses performed consistent with the level of detail described in this methodology document. The documentation should be sufficiently complete and thorough to support an onsite review by the NRC to determine the overall adequacy of the assessments performed.

The independent review asked the following questions for each key design feature and functional capability:

1. Is the GEH documentation (i.e., ESBWR DCD Appendix 19D, NEDE-33512, and ANA-QA-0207) consistent with the level of detail described in NEI 07-13?

2. Is the documentation sufficiently complete and thorough to support an onsite review by the NRC?

3. Is the documentation sufficiently complete and thorough such that future COL applicants can reasonably assess plant changes to ensure they do not invalidate the original assessment as required by 10 CFR 50.150(c), "Control of Changes"?

The review concluded that additional documentation is required to satisfy the NEI 07-13 objectives.

The location and design of Reactor Building structure: GEH needs to revise NEDE-33512 to provide additional basis for the selection of impact scenarios in Section 3.3.1.

The location and design of Turbine Building structure: GEH needs to revise NEDE-33512 Section 3.3.1 to provide additional basis for which walls and elevations provide shielding for the reactor building.

The location and design of Fuel Building structure: GEH needs to revise NEDE-33512 Section 3.3.1 to provide additional basis for which walls and elevations provide shielding for the reactor building.

The locations of the reactor building heating ventilation and cooling ductwork: GEH needs to revise NEDE-33512 Section 3.3.3 to provide clarification for fire spread through ductwork.

The actions of scramming the reactor, closing the Main Steam Isolation Valves, and commencing operation of the Isolation Condenser System: GEH needs to revise NEDE-33512 Section 4.2.2 to clarify how these actions are affected in each damage scenario.

In addition, the review recommended that NEDE-33512 more clearly state, in some cases how the elements of the regulatory criteria are met.

The review concluded that changes to DCD Appendix 19D and ANA-QA-0207, other than those discussed in this response, are not required.

In addition, there is a GEH corrective action is to revise NEDE-33512 per the recommendations of the review.

GEH Quality Assurance and corrective action programs provide the oversight to ensure that the deficiencies cited in this NOV are identified, corrected and reviewed. The GEH Quality Assurance program description is found in NEDO-11209 and in Chapter 17 of the ESBWR DCD. Specifics of the corrective action program are found in GEH procedure CP-16-01. In addition, as noted in the NRC inspection report, NEDO-33181 identifies and defines quality elements intended to meet the standards and measures identified in NEI 07-13.

IV. Date When Full Compliance Will Be Achieved

According to the responses in Attachment 1, full compliance with this NOV will be achieved when NEDE-33512 and ANA-QA-0207 are revised to address the deficiencies discussed in this response, and GEH Corrective Action Report #52962 is closed out, as scheduled, on or before December 10, 2010.

Attachment 1: Response to Deficiencies

Deficiency 1

Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed to accurately determine fire-damage footprints.

I. Reason for Deficiency

GEH did not apply a realistic analysis for the fire and overpressure spread across interfacing walls between the physical damage zones and the respective vertical equipment chases (i.e., the walls separating physical damage footprints from fire damage footprints). In these situations, GEH assumed that these equipment chases only receive fire damage as opposed to fire plus overpressure.

The reason for this deficiency is that the GEH interpretation of the NEI 07-13 guidance was inadequate. Specifically, the NEI guidance for spread of fire damage through connected compartments states that fire damage spreads up, down and laterally through "...significant openings (e.g., hatches, gratings, penetrations, etc., with perimeter lengths of greater than 1 ft.)..." GEH interpreted this guidance to mean that fire and smoke resulting from an aircraft impact would propagate through damaged ductwork or other damaged penetrations that interface through the vertical equipment chases in each quadrant of the Reactor Building. GEH should have assumed the loss of all penetration seals along the interfacing walls from the impact and overpressure damage. Further, GEH should have assumed that the breach from the loss of seal integrity would provide for a direct pathway for the aircraft impact fireball to pass into the equipment chase. A fireball caused from an aircraft impact would consist of fire and pressure that would require a 5-psid rated equipment chase, including all penetration seals, to confine the fire damage within the chase. Otherwise, the overpressure would damage the integrity of the penetrations at other elevations and allow fire to propagate beyond those areas currently identified in the applicant's fire damage footprint drawings.

The consequence of this deficiency is that the Reactor Building fire damage footprints in GEH report NED-33512 did not propagate overpressure and fire damage sufficiently to determine the Reactor Building areas that are postulated to sustain equipment damage following an aircraft impact.

II. Corrective Steps Taken and Results Achieved

A discussion of how the commodity and electrical chases should be treated for propagation of overpressure and fire is being added to the General Notes of the Reactor Building (RB) Aircraft Impact Damage Footprint Section (Appendix A) of NEDE-33512. The discussion will clarify that when a chase is exposed to the overpressure resulting from the initial deflagration, unless the chase has a 5 psid 3-hour fire rating, fire and overpressure will enter the chase and will be propagated throughout height of the chase. At elevations other than the impact location, if the chase walls are 3-hour fire rated they are assumed to be the second barrier and confine the damage to the chase consistent with NEI 07-13.

NEDE-33512 is being revised to include overpressure effects in the Reactor Building vertical chases.

- It will be demonstrated that the revised scenarios do not extend fire damage areas to divisional areas beyond those previously determined and,
- That at least one division remains available for all strike scenarios.

III. Date When Full Compliance Will Be Achieved

NEDE-33512 will be revised by December 10, 2010.

Deficiency 2

Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed to adequately consider finite element analyses boundary conditions, initial conditions, and the time duration.

I. Reason for Deficiency

The GEH assessment did not adequately document GEH conclusions and assumptions regarding finite element analyses boundary conditions, initial conditions, and the time duration in the analyses, as well as the physical extent of each model.

II. Corrective Steps Taken and Results Achieved

The corrective action is to provide better documentation in the analysis report, ANA-QA-0207, "Evaluation of Aircraft Impact on ESBWR Plant Design". A new section, Overview of Finite Element Modeling, is being added to Chapter 2, Analysis Methods and Procedures, to better describe the modeling methods employed (see below), and new model plots illustrating the boundary conditions used for each model are generated and put into the report (see example below).

New Section added in Chapter 2 for added discussion on modeling:

<u>Overview of Finite Element Modeling</u>
The following summary provides an overview description of modeling used in these AIA structural evaluations.

<u>Model Extent and Boundary Conditions</u>
The structural analyses involve a large extent of loading on large structures. For computational reasons, the models are limited to regions of the structure in the general vicinity of the impact location. Some models have boundaries that represent cut sections through walls, floors, girders, and columns of the building. Displacement boundary conditions are enforced on these model boundaries with the intent to generally simulate the effect of that part of the structure that is not included in the model. For example, where a wall or horizontal girder is cut vertically for a model boundary, roller boundary conditions (the displacements normal to the surface of the cut) are applied to simulate that the wall continues beyond the cut, which provides support for the surface of the cut. The displacements transverse to the direction of the wall at the cut are not restrained so that the cut surface is free to move in the transverse direction. For the vertical cuts on walls along the back of the model, these roller supports also provide reactions for the applied loading. Generally the bottom surface of the model is fixed to represent embedment. These displacement boundary conditions are considered conservative because they force the impacted wall to carry more of

the load without the benefit of energy dissipation from overall movement and the inertia of the larger building.

Finite Element Meshes

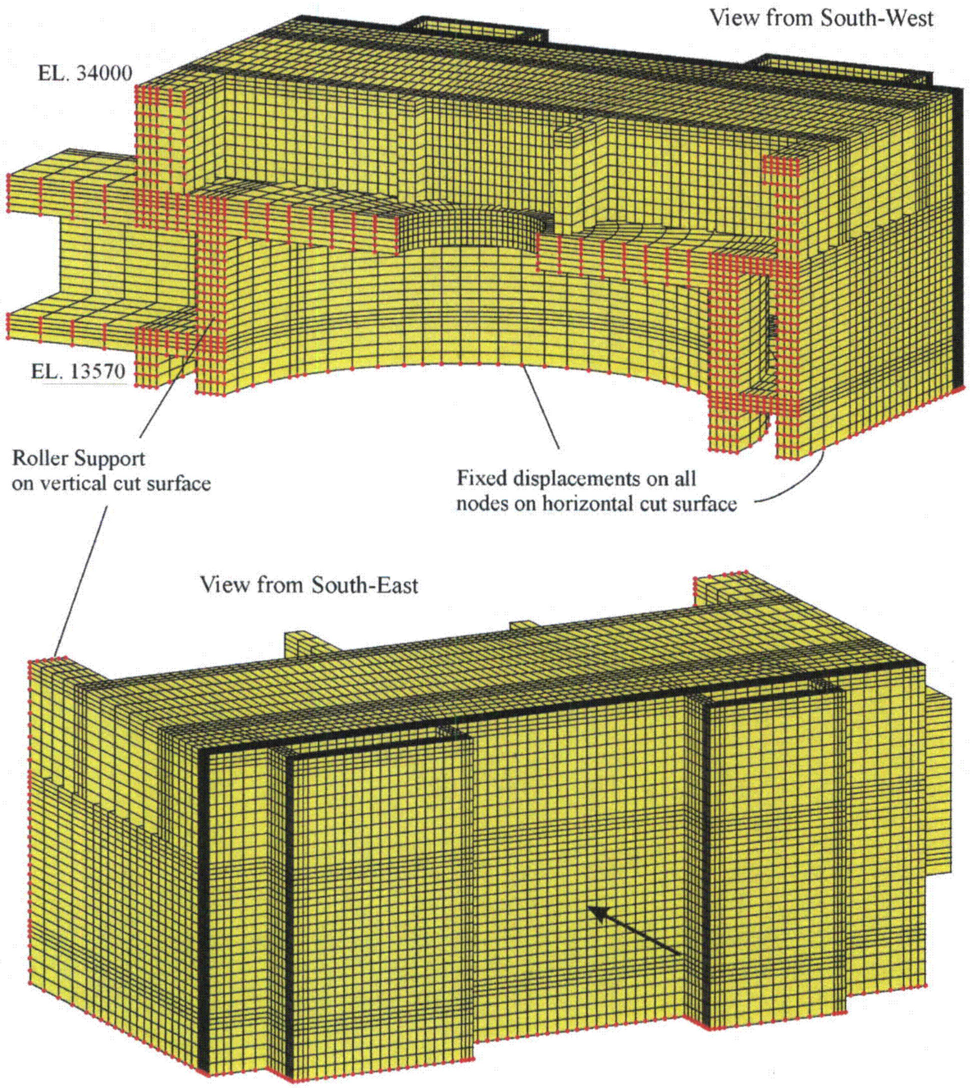
The finite element meshing is generally based on experience with modeling these types of problems over the last several years. The models use element types and formulations considered standard practice for explicit dynamics based analyses. For the concrete elements, 8-node brick elements with 1 integration point and hourglass control are used. For reinforcement, 2-noded "truss type" elements that can be embedded anywhere within the concrete element are used. The strain in the rebar is taken to be the same as the concrete. The concrete stress response is based on the concrete constitutive model and the rebar stress response is based on a steel constitutive model. Liner plate material uses 4-node membrane elements with steel constitutive laws. These membrane elements have stiffness and strength in the plane of the element but no bending stiffness or strength. Generally, for these global response models, the membrane elements use the same 4 nodes as the surface of the concrete element where they are attached so that the liner is "glued" to the concrete surface with strains compatible with the concrete. For embedded or exposed structural steel beams or columns that are deemed important structural components (typically in the load path of the impact), the flanges and webs of these components are modeled with 4-node plate bending elements. Beam element modeling may be used for these type components in areas away from the impacted region. The meshing for the concrete walls is generally more refined in the area of the model that is impacted and less refined in the areas away from the impact where smaller deformations and less damage are expected. For computational reasons, some smearing of reinforcement is used in the models. For example, only every other bar may be explicitly included but with twice the area (modeled as 2:1). As with the concrete, the meshing for the reinforcement is generally more refined in the wall that is impacted and can be approximated in the areas away from impact where less damage develops. Generally, only the impacted wall will have the shear tie reinforcement included. The concrete element sizes are generally about 200-300mm (8"-12") long in the thickness direction in the area under the impact with aspect ratios around 2:1. Gradients through the thickness of the impacted wall with the thinner elements near the surfaces are sometimes used to reduce model size. In addition, a post-calculation assessment for mesh refinement sensitivity was performed for the results obtained to determine if some uncertainty due to meshing sensitivity could affect the overall findings and conclusions. This assessment is discussed in the Summary section of Chapter 5.

Impact Loading and Initial Conditions

The impulsive loading due to the impact is applied to simulate that the impact occurs normal to the surface of the impacted wall. The specified NRC force time histories for fuselage and wings are applied as a pressure load over the specified areas for the fuselage and wings. The pressure is normal to the surface of the wall. For the aircraft models (missile-target interaction), the airplane is oriented to strike normal to the surface. The subsequent loading that develops then depends on the crushing characteristics of the airplane model. This is generally normal to a flat wall, but will depend on the structural response. The initial conditions are that the structure is at rest prior to the impact loading. For the analyses using the airplane model, the airplane is positioned just shy of touching the structure at the point of impact, and all nodes of the airplane are given the appropriate initial velocity.

Analysis Duration

For pressure loading analyses where there is good structural resistance, the analyses are generally performed for the duration of the NRC specified force time history. The displacements for a point or points under the strike location are monitored to establish peak displacement and then the rebound of the displacement. For these cases (good or sufficient structural resistance), the peak displacement generally occurs shortly after the time that the peak force is delivered to the structure or about half way through the applied pressure time history. The reaction forces in the analysis (at the displacement boundary conditions) are summed and this total reaction force history is plotted against the applied force history. The time integral (impulse) of the computed reaction forces is also plotted against the impulse of the applied (specified) force history. These plots (displacements and impulse) are used to establish that the structure can fully resist the applied forces. For the missile-target interaction analyses, the analyses are generally performed for a duration of time over which the momentum of the airplane model is reduced to a level sufficient for the analysis objectives. For a case where sufficient resistance exists in the impacted wall, the time duration will be comparable to that for an applied pressure analysis. For a case where the impacted wall fails, the analysis must be continued in time for subsequent impact of the wreckage and debris on the next interior structure or wall. The velocity histories of points on the airplane model are also monitored to judge the duration of analysis that is needed.



Case 5 as example of new model plots showing boundary conditions

III. Date When Full Compliance Will Be Achieved

ANA-QA-0207 will be revised by December 10, 2010.

Deficiency 3

Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed to include in the AIA, the basis for not performing mesh refinement sensitivity analyses.

I. Reason for Deficiency

The inspection report states that, "...mesh refinement sensitivity analyses, consistent with the guidance provided in NEI 07-13, should have been performed." Although this guidance was not found in the NEI document, GEH did not document its basis for not performing mesh refinement sensitivity analyses.

II. Corrective Steps Taken and Results Achieved

A post-analysis assessment of mesh refinement sensitivity has been performed to evaluate if some uncertainty in the results due to mesh sensitivity might change the findings or overall conclusions reached. The following discussion is being added to the summary section of Chapter 5 of ANA-QA-0207, "Evaluation of Aircraft Impact on ESBWR Plant Design".

This structural assessment is based on best estimate analyses as a beyond design basis event. The complexity of the analyses and the many variables associated with the hypothesized event lead to some uncertainty. The NEI assessment methodology recognizes this and attempts to strike a balance between excessive uncertainty, computational demands, and overly conservative restrictions for the beyond design basis assessment. Mesh refinement is another area contributing to the uncertainty in the analyses. Considerable experience was exercised in developing models for the best estimate analyses to capture failure modes of reinforced concrete walls. The finite element models developed are considered to be consistent with industry standard for the AIA structural analyses based on previous experience and interactions with EPRI expert panel reviews. In addition, a mesh sensitivity assessment of the analysis cases was performed to identify any conditions where a different mesh could lead to significantly different results that might affect the final consequences considered in the overall aircraft impact assessment. For example, a more refined mesh in the exterior wall of the crane chase in Case 6 might provide a somewhat higher residual velocity for the wreckage for secondary impact on the opening of the 1.5m wall. Because the consequence of fuel and wreckage entering the RB at this location is already considered in the assessment, a somewhat higher residual velocity would not cause any change in the final consequences. The wreckage would still be stopped by the 2m thick RCCV without significant damage to the RCCV wall. In all cases, the structural damage determined in the analyses is considered consistent with expectations, and in some cases conservative, and the uncertainty associated with mesh refinement would not affect the final conclusions in the overall assessment for consequences due to aircraft impact. Thus, the meshing used is considered sufficient for the objectives of the analyses.

III. Date When Full Compliance Will Be Achieved

ANA-QA-0207 will be revised by December 10, 2010.

Deficiency 4

Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed to provide a technical justification for the preliminary impact scenarios selected and not selected for the final structural analyses using the NRC specified loading and the material properties given in NEI 07-13, Revision 7.

I. Reason for Deficiency

GEH did not adequately document its technical justification for the preliminary impact scenarios selected and not selected for the final structural analyses.

II. Corrective Steps Taken and Results Achieved

The following is being added to the overview section of Chapter 3 in ANA-QA-0207, "Evaluation of Aircraft Impact on ESBWR Plant Design" for justification on choosing the preliminary analysis cases.

The strike locations for the preliminary analyses are determined based on assessments for worst-case scenarios, both for structural vulnerability and for consequences from structural damage or failure. The strikes are strategically placed at the mid-span of walls at locations where internal structures, systems, and components are at risk, for example, at the mid-span of the longest exposed section of the outer wall of the Expansion Pool, or on the crane chase directly opposite an access opening into the reactor building.

The following justifications are being added to the Overview section of Chapter 4 in ANA-QA-0207.

The preliminary Cases 2, 3, 4, and 5 were taken forward for the final cases using the NRC specified loading. Case 1 considered an airplane model based on the EPRI loading to determine the amount of wreckage that might have secondary impact consequences on the reactor cavity pool and the drywell head. This analysis showed that a significant amount of wreckage would penetrate, including most of the wings that folded alongside the fuselage during the penetration through the outer wall. This entire wreckage was then impacted directly on the drywell head in Case 9, ignoring the effect of the water in the reactor cavity pool covering the drywell head. The total impulse of the NRC specified loading is larger than the EPRI loading used, but based on the apparent and assumed impact velocity associated with the NRC loading, the associated aircraft consisted of a smaller mass but higher velocity (see next section for further discussion of NRC loading and associated impact velocity and mass of equivalent aircraft). It was thus reasoned that repeating Case 1 and Case 9 in the final analyses using the NRC defined loading would not be as limiting as the cases already considered. First, the higher impulse of the NRC specified loading would likely result in wreckage penetrating the outer wall with higher residual velocity, thereby reducing the likelihood that the wreckage would fall directly on the drywell head. Second, the aircraft wreckage would have less mass than that already considered because the NRC compatible aircraft has less mass than the EPRI aircraft considered. Third, for the wreckage to impact on the drywell head, the velocity would have to be the same as that already considered in Case 9 since a different velocity would project the wreckage to a different location away from the drywell head. Therefore, the total impulse of the wreckage for the secondary impact on the drywell head would be less than that already considered.

Preliminary Case 6 considered a strike location directly on the Crane chase opposite the access opening into the RB. This case shows that wreckage would penetrate through the crane chase and into the RB. This case also showed that the 1.5m RB wall, even with the openings and especially the smaller opening, which has been determined to be the appropriate size, is effective in slowing the wreckage. The fire and shock assessment includes the consequences of aircraft wreckage and fuel entering the RB at this location. Using the NRC defined loading would likely have a higher residual velocity of wreckage, but since the 2m thick RCCV wall can easily resist perforation from this wreckage, there would be no further consequences than already included. Thus, there was no need to carry this case forward to the final analyses using the NRC specified loading.

Preliminary Case 7 considered a strike location on the wall above the spent fuel pool, which is below grade, and Case 8 considered a strike on the East wall of RB at the roofline. Case 7 indicated debris would likely fall into the spent fuel pool, but this was considered acceptable because the pool is entirely below grade and constructed with very thick concrete walls. The water in the pool will absorb some of the momentum of the falling debris, and the presence of spent fuel racks in the pool will act as impact limiters for the falling debris. Case 8 indicates that much less damage is expected for a strike at the roofline due to the support of the roof transverse to the wall. It was concluded that it was not necessary to carry either of these preliminary cases forward to the final cases because there would not be any further consequences than already considered.

III. Date When Full Compliance Will Be Achieved

ANA-QA-0207 will be revised by December 10, 2010.

Deficiency 5

Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed to include in the AIA the bases for not performing an analysis for an aircraft impact on the gantry crane and the corresponding potential effects of the crane dropping on the drywell head.

I. Reason for Deficiency

The NEI guidelines discuss the need to evaluate the potential of a polar crane falling inside containment because it can potentially fall directly on safety related equipment. For the ESBWR, there is no crane inside containment, and the reactor building overhead bridge crane will be parked at one end of the building away from the reactor cavity pool during operation. GEH concluded that the reactor building crane would not fall on the reactor cavity pool or other safety related equipment and thus did not perform a detailed analysis in ANA-QA-0207, "Evaluation of Aircraft Impact on ESBWR Plant Design".

II. Corrective Steps Taken and Results Achieved

An assessment was performed considering possible components of the reactor building crane being dislodged by the aircraft impact and falling on the reactor cavity well housing the drywell head. The following discussion is being added to the conclusions in Chapter 5 of the ANA-QA-0207 report.

The reactor building crane is parked away from the reactor cavity pool during plant operation, and thus, secondary impact by crane components falling on the drywell head is considered unlikely. However, based on the concern that crane components could be knocked over to the reactor cavity pool due to impact from the aircraft wreckage, the following qualitative assessment is provided based on the analyses performed for aircraft wreckage impacting the drywell head in Case 9. The bridge girders cannot physically fall directly on the drywell head because they span the entire width of the building. If a bridge girder falls on the reactor cavity pool area, the long girder structure would span across the pool walls, and the force would be absorbed by the pool girders and concrete support structure around the drywell head. Thus, the trolley components are considered the only potential threat for secondary impact with the drywell head. The mass of a typical trolley for a 200 ton overhead bridge crane is estimated at 60 tons. The trolley consists of steel structural support members, but also mechanical equipment, such as drums, ropes, motors, brakes, gear boxes, and the like, that are bolted or welded on the frame. For the trolley to be knocked from the parked location onto the reactor cavity pool, a significant impact from the aircraft wreckage is necessary, and this impact would likely break up the trolley components into separate pieces rather than one larger mass. However, even considering the total mass of 60 tons, the impact momentum on the drywell head is substantially lower than that considered in Case 9 where the complete wreckage of the aircraft was used. The water in the reactor cavity pool covering the drywell head will significantly reduce the incoming momentum of the crane components. Thus, it is concluded that crane components falling into the reactor cavity pool as a result of aircraft impact do not pose any additional consequences over those already identified.

III. Date When Full Compliance Will Be Achieved

ANA-QA-0207 will be revised by December 10, 2010.

Deficiency 6

Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA. Specifically, in its AIA, the applicant failed to consider non-local effects from an aircraft impact.

I. Reason for Deficiency

GEH did not interpret the NEI 07-13 guidelines to require documentation on non-local effects of sliding and overturning of the building. GEH considered the possibility of shear and overturning of the Reactor Building due to aircraft impact to be beyond the scope of a realistic assessment.

II. Corrective Steps Taken and Results Achieved

The non-local effects of AIA are addressed by adding the following assessment in ANA-QA-0207, "Evaluation of Aircraft Impact on ESBWR Plant Design". Note: Portions of the revised assessment containing Safeguards Information are withheld, but are paraphrased in the bracketed, *italicized* text below. This will be a new section, "Overall Global Stability of the Building", included in Chapter 4 of the report.

Overall Global Stability of Building
Here the overall global stability due to aircraft impact on the ESBWR Reactor Building is considered assuming no perforation of the impacted wall occurs. This scenario is bounded by a strike at the roofline as depicted by Case 8 in Figure 1-2, and indeed the results of Case 8 indicate that a perforation failure does not develop for this scenario because of the strengthening effects of the roof. In addition, the other cases for strikes on the 1m thick walls below the roofline show that perforation of the wall does occur. The horizontal force applied by the aircraft impact is calculated as the steady force over the duration of the impact, that is, the impulse of the NRC force time history divided by the duration of the load.

[*The assessment then describes the calculated force and overturning moment of the impact. These values are compared to the enveloping loads for basemat shear and overturning moment and determined to be low enough to discount further consideration. These comparisons have additional conservatism by ignoring that the building is embedded below grade elevation for over 16 m.*]

The safety factors to the actual shear and overturning moment capacities are even higher. Thus, because the shear and overturning due to aircraft impact are well below the enveloping values for seismic design, the building structure is designed for higher demands. Therefore, there will be no critical sections that could fail anywhere in the building due to this impact scenario where wall perforation does not develop because higher demands are part of the design basis. Case 8 also supports this conclusion. The weak section is expected to be where the 1m thick superstructure walls connect to the 1.5m walls at elevation 34000. Case 8 includes this section in the modeling and shows that failure or even any significant damage does not develop at this connection for the loading considered.

III. Date When Full Compliance Will Be Achieved

ANA-QA-0207 will be revised by December 10, 2010.

Deficiency 7

Contrary to the above, as of September 01, 2010, GEH failed to use realistic analyses in certain aspects of its AIA... Further, GEH failed to identify and incorporate into the design those design features and functional capabilities credited in the AIA to show the reactor remains cool, or containment remains intact; and spent fuel cooling or spent fuel pool integrity is maintained as required by 10 CFR 50.150(a)(1). Specifically, the AIA credited fire barrier design features that were not identified in the design.

I. Reason for Deficiency

The GEH interpretation of NEI 07-13 guidance on fire propagation through vertical chases was inadequate. This is also discussed in GEH response to Deficiency 1. Because of the failure to propagate overpressure damage into the four divisional electrical chases in the reactor building and the subsequent spread of fire between elevations, the DCD did not identify these divisional electrical chases, specifically the chase barriers, as key design features or as being 5psid and 3-hour fire-rated barriers. In addition, the DCD credited fire barriers for maintaining separation and preventing the spread of fire between the reactor building East side divisions from the West side divisions. However, the damage footprint assessment in NEDE-33512 contained several reactor building scenarios that resulted in a breach in the East-West separation. The DCD discussion on crediting fire barriers was inadequate because it failed to consider that fire damage may propagate from the East to West side through other pathways, such as through vertical chases due to impacts on other elevations.

Also, GEH improperly assumed that the doors on the elevator chase in the South-East corner of the reactor building were functionally equivalent to 3-hour rated fire doors when determining the damage footprints. Based on this assumption, GEH had determined that the effects of fire and smoke could be confined to one half of the reactor building. This was identified by the NRC in the Inspection Report which stated, "In addition, the ESBWR DCD credits fire barriers for maintaining separation and preventing the spread of fire between the reactor building East side divisions from the West side divisions. However, the AIA contained several reactor building scenarios that resulted in a breach in the East-West separation contrary to the DCD."

II. Corrective Steps Taken and Results Achieved

DCD Appendix 19D has been revised to state that the four divisional electrical chases in the reactor building are credited as a 5psid and 3-hour fire-rated barriers to prevent fire damage spread into the vertical chase and the subsequent spread of fire between elevations.

Based on the assessment of reactor building damage footprints, GEH determined that adding a barrier rated at 5 psi differential pressure will ensure that at least one safety-related division of equipment remains unaffected by fire damage following an aircraft impact. DCD Appendix 19D Table 19D-1 has been revised to increase the rating of the specified fire door for a differential pressure of at least 0.034 MPa (5psi). In addition, Table 19D-1 has been revised to identify the specific 3-hour rated fire barriers that prevent fire damage from propagating to other safety-related divisions of equipment.

DCD Appendix 19D has also been revised to clarify that at least one division of safety-related equipment remains unaffected in the fire damage scenarios.

NEDE-33512 will be revised to be consistent with the key features described in DCD Appendix 19D. The damage footprints will be revised to be consistent with rule sets of NEI 07-13 and as clarified in discussions with the NRC inspection team. As discussed in the response to Deficiency 1, the treatment of the vertical chases in each of the four quadrants of the reactor building will also be applied. The revision of NEDE-33512 will demonstrate and conclude that at least one divisional quadrant of the reactor building is unaffected by the aircraft impact.

III. Date When Full Compliance Will Be Achieved

GEH letter, MFN-10-313, was submitted on October 8, 2010 with the changes required to DCD Appendix 19D to address this deficiency.

NEDE-33512 will be revised by December 10, 2010.