March 19, 2014

Yoshiki Ogata, Executive Vice President
Mitsubishi Nuclear Energy Systems, Inc.
On behalf of Mitsubishi Heavy Industries, Ltd.[1]
11405 N. Community House Rd, Ste 300
Charlotte, NC 28277

SUBJECT: THE U.S. ADVANCED PRESSURIZED-WATER REACTOR AIRCRAFT IMPACT INSPECTION, NUCLEAR REGULATORY COMMISSION INSPECTION REPORT NO. 05200021/2014-201

Dear Mr. Ogata:

From January 27, 2014, through January 31, 2014, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection of the Mitsubishi Heavy Industries, Ltd. (MHI) Aircraft Impact Assessment (AIA) related to activities conducted in support of your application. The NRC staff performed this inspection at the Mitsubishi Nuclear Energy Systems office located in Arlington, VA. The purpose of the inspection was to assess MHI's compliance with the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.150, "Aircraft Impact Assessment." The enclosed report presents the results of this inspection.

Based on the inspection samples, the NRC inspection team determined that violations of NRC requirements occurred. The violations are cited in the enclosed Notice of Violation (Notice), and the circumstances surrounding them are described in detail in the subject inspection report. The violations cite that MHI did not demonstrate how a credited design feature met assessment requirements and did not fully identify and incorporate into the design those design features and functional capabilities to show the reactor remains cool, or containment remains intact; and spent fuel cooling or spent fuel pool integrity is maintained. With the exception of the violations identified in the Notice, the NRC inspection team concluded that the portions of the MHI U.S. Advanced Pressurized-Water Reactor AIA reviewed comply with the applicable requirements of 10 CFR 50.150, "Aircraft impact assessment."

You are required to respond to this letter and should follow the instructions specified in the enclosed Notice when preparing your response. The NRC will use your response, in part, to determine whether enforcement action is necessary to ensure compliance with regulatory requirements.

It is important to note that the NRC inspection team performed a limited review of the AIA. Many of the deficiencies identified may also affect other portions of the AIA that the NRC inspection team did not review. Therefore, MHI must extend its review, where applicable, beyond the

[1] As described in, "Organizational Change at MHI/MNES," dated April 1, 2013. (Agencywide Document Access and Management System (ADAMS) accession number ML13093A413)

specific examples identified by the inspection team and apply corrective actions as appropriate. In its response to this violation, MHI should document the areas for which it extended its review beyond the specific examples of the deficiencies identified by the inspection team, the extent of its review, the additional findings, and the corrective actions implemented.

In accordance with 10 CFR 2.390 of the NRC's "Public inspections, exemptions, requests for withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Document Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response, if applicable, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

/RA/

Richard A. Rasmussen, Chief
Electrical Vendor Inspection Branch
Division of Construction Inspection
and Operational Programs
Office of New Reactors

Docket No.: 05200021

specific examples identified by the inspection team and apply corrective actions as appropriate. In its response to this violation, MHI should document the areas for which it extended its review beyond the specific examples of the deficiencies identified by the inspection team, the extent of its review, the additional findings, and the corrective actions implemented.

In accordance with 10 CFR 2.390 of the NRC's "Public inspections, exemptions, requests for withholding," of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Document Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response, if applicable, should not include any personal privacy, proprietary, or safeguards information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request that such material is withheld from public disclosure, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Sincerely,

/RA/

Richard A. Rasmussen, Chief
Electrical Vendor Inspection Branch
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and Operational Programs
Office of New Reactors

Docket No.: 05200021

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OFFICE	NSIR/DSO/ISB	OGC	NRO/DCIP/EVIB	AIA FRP Chair	
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DATE	03/12/14	03/19/2014	03/19/2014	03/19/2014	

OFFICIAL RECORD COPY

cc:

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NOTICE OF VIOLATION

Mitsubishi Heavy Industries, Ltd. (MHI)
Arlington, VA 22209 (inspection location)

Docket No.: 05200021
Inspection Report No.: 2014-201

During a U.S. Nuclear Regulatory Commission (NRC) inspection of the Mitsubishi Heavy Industries (MHI) U.S. Advanced Pressurized-Water Reactor (APWR) aircraft impact assessment (AIA) conducted at the Mitsubishi Nuclear Energy Systems, Inc. Headquarters in Arlington, VA, on January 27-31, 2014; two violations of NRC requirements were identified. In accordance with the NRC Enforcement Policy, the violations are listed below:

A. Title 10, of the *Code of Federal Regulations* (10 CFR), Section 50.150, "Aircraft Impact Assessment," Paragraph (b)(2) requires that for applicants identified in paragraph (a)(3) of this section, the preliminary or final safety analysis report, as applicable, must include a description of how the design features and functional capabilities identified in paragraph (a)(1) of this section meet the assessment requirements in paragraph (a)(1) of this section.

   Contrary to the above, as of January 27, 2014, MHI failed to describe in Revision 4 of the U.S. APWR Design Control Document (DCD)[2] how the remote shutdown console (RSC) met the assessment requirements. The DCD credits the RSC as a design feature credited to show that the reactor core remains cooled, or the containment remains intact; and spent fuel cooling or spent fuel pool integrity is maintained; however, the location and orientation reflected in the DCD does not match the location and orientation required in the assessment. Specifically, the RSC required location and orientation changes to move it outside certain shock footprints that were noted in the assessment summary; however, these changes were not reflected in the DCD.

   This issue has been identified as Violation 05200021/2014-201-01.

   This is a Severity Level IV Violation (Section 6.5).

B. Section 50.150 of 10 CFR, "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 January 27, 2014, MHI failed to identify and incorporate into the DCD 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. Specifically, the AIA relied on main control room operator action prior to an aircraft impact to isolate the containment vent and purge lines, and the

[2] As documented in the, "Submittal of US-APWR Design Control Document in Support of Mitsubishi Heavy Industries, Ltd.'s Application for Design Certification of the US-APWR Standard Plant Design," dated December 31, 2007, the DCD constitutes the final safety analysis report for the US-APWR standard plant design as required by 10 C.F.R. § 52.47(a) (ADAMS accession number ML080140503).

chemical volume and control system letdown isolation valves, to prevent fire from entering the containment and prevent a loss of coolant accident outside containment. However, the DCD does not describe the isolation of these two systems as design features needed for an aircraft impact scenario. This is an example of a violation of 10 C.F.R. § 50.150(a)(1).

In addition, MHI failed to credit a concrete heating, ventilation, and air conditioning soffit and fire barriers depicted via cut-away drawings around the 3F and 4F elevations in Chapter 19A, "U.S. APWR Beyond Design Basis Aircraft Impact Assessment," of the DCD that were utilized in the AIA. This is another example of a violation of 10 C.F.R. § 50.150(a)(1).

These examples have been identified as Violation 05200021/2014-201-02.

This is a Severity Level IV Violation (Section 6.5).

Pursuant to the provisions of 10 CFR 2.201, "Notice of Violation," MHI is hereby required to submit a written statement or explanation to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Chief, Electrical Vendor Inspection Branch, Division of Construction Inspection and Operational Programs, Office of New Reactors, within 30 days of the date of the letter transmitting this Notice of Violation. This reply should be clearly marked as a "Reply to a Notice of Violation" and should include: (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. Your response may reference or include previous docketed correspondence, if the correspondence adequately addresses the required response. Where good cause is shown, the NRC will consider extending the response time.

Because your response will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System, accessible at http://www.nrc.gov/reading-rm/adams.html, to the extent possible, it should not include any personal privacy, proprietary, or Safeguards Information so that it can be made available to the public without redaction. If personal privacy or proprietary information is necessary to provide an acceptable response, then please provide a bracketed copy of your response that identifies the information that should be protected and a redacted copy of your response that deletes such information. If you request withholding of such material, you must specifically identify the portions of your response that you seek to have withheld and provide in detail the bases for your claim of withholding (e.g., explain why the disclosure of information will create an unwarranted invasion of personal privacy or provide the information required by 10 CFR 2.390(b) to support a request for withholding confidential commercial or financial information). If Safeguards Information is necessary to provide an acceptable response, please provide the level of protection described in 10 CFR 73.21, "Protection of Safeguards Information: Performance Requirements."

Dated this the 19th day of March 2014

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NEW REACTORS
DIVISION OF CONSTRUCTION INSPECTION AND OPERATIONAL PROGRAMS
VENDOR INSPECTION REPORT

Docket No.:	05200021
Report No.:	05200021/2014201
Inspection Location:	Mitsubishi Nuclear Energy Systems (MNES) Headquarters 1001 19th Street North Arlington, VA 22209
Contact:	Mr. Kevin Lynn Licensing Engineer - DCD kevin_lynn@mnes-us.com
Nuclear Industry Activities:	Mitsubishi Heavy Industries has completed their aircraft impact assessment of the U.S. Advanced Pressurized-Water Reactor design certification to comply with the U.S. Nuclear Regulatory Commission requirements in Title 10 of the *Code of Federal Regulations* Section 50.150, "Aircraft Impact Assessment." MNES was established in 2006 by Mitsubishi Heavy Industries (MHI), as the supplier for Mitsubishi nuclear technologies in the United States.
Inspection Dates:	January 27–31, 2014
Inspectors:	Stacy Smith, Team Leader, NRO/DCIP/EVIB Eugene Huang, NRO/DCIP/EVIB Larry Wheeler, NRO/DSRA/BPTS Dennis Andrukat, NRO/DSRA/BPFP Ryan Nolan, NRO/DSRA/BPFP Pravin Patel, NRO/DE/SEB1 Dr. J. Guadalupe Argüello, Sandia National Laboratory Dr. Alexander L. Brown, Sandia National Laboratory
Approved by:	Richard A. Rasmussen, Chief Electrical Vendor Inspection Branch Division of Construction Inspection and Operational Programs Office of New Reactors

EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) conducted this inspection to verify that Mitsubishi Heavy Industries (MHI) had implemented the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.150, "Aircraft Impact Assessment," and performed a design-specific assessment[3] of the effects on the facility of the impact of a large commercial aircraft.

The NRC conducted the inspection of MHI at Mitsubishi Nuclear Energy Systems, Inc. headquarters in Arlington, VA, January 27–31, 2014.

The following served as the bases for the NRC inspection:

- 10 CFR 50.150

During this inspection, the NRC inspection team implemented Inspection Procedure (IP) 37804, "Aircraft Impact Assessment," dated February 9, 2012.

This inspection was performed to verify that MHI's aircraft impact assessment (AIA) of the U.S. Advanced Pressurized-Water Reactor (APWR) design complies with the requirements of 10 CFR 50.150. Revision 8 of NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," dated April 2011, has been endorsed by the NRC in Regulatory Guide (RG) 1.217, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts," as one means of performing an AIA acceptable to the NRC. MHI utilized NEI 07-13, Revision 8, with no exceptions, to perform their AIA.

The NRC inspection team concluded that, with the exception of violations cited in the Notice, the portions of the MHI U.S. APWR AIA reviewed by the NRC inspection team comply with the applicable requirements of 10 CFR 50.150. The results of the inspection are summarized below.

Systems-Loss Assessment

The NRC inspection team concluded that with the exception of Violation 05200021/2014-201-01, for failure to demonstrate how a credited design feature met assessment requirements, and Violation 05200021/2014-201-02, for failure to identify and incorporate into the design those design features and functional capabilities to show the reactor remains cool, or containment remains intact, and spent fuel cooling or spent fuel pool integrity is maintained, the system-loss assessment performed by MHI for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

Fire Damage Assessment

The NRC inspection team found that with the exception of the two examples of violations identified in Violation 05200021/2014-201-02, for failure to identify and incorporate into the design those design features and functional capabilities to show the reactor remains cool, or

[3] By a ''design-specific'' assessment, the NRC means that the impact assessment must address the specific design of the facility that is either the subject of a construction permit, operating license, standard design certification, standard design approval, combined license, or manufacturing license application (see 74 FR 28129; June 12, 2009).

containment remains intact, and spent fuel cooling or spent fuel pool integrity is maintained, the fire damage assessment performed by MHI for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

Structural Damage Assessment

The NRC inspection team concluded that the structural damage assessment performed by MHI for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

Documentation and Quality Assessment

The NRC inspection team concluded that with the exception of Violation 05200021/2014-201-01 and Violation 05200021/2014-201-02, documented in Sections 1.b.1 and 2.b.1, the documentation and quality assessment performed by MHI for the AIA is acceptable.

REPORT DETAILS

1. Systems-Loss Assessment

   a. Inspection Scope

      The NRC inspection team reviewed the following activities for MHI's U.S. APWR AIA systems-loss assessment:

      - verification of the location of those structures, systems, and components (SSC) that provide core cooling or containment isolation, and spent fuel pool (SFP) integrity to determine the potential for damage by aircraft impact;

      - verification that those SSCs would be capable of performing their intended function given the established structural, shock, and fire damage footprints and the rule sets and assumptions provided in NEI 07-13;

      - verification that MHI addressed accident initiators, such as a breach of the reactor coolant system (RCS) or the failure of the reactor to trip, that could result from damage caused by an aircraft impact; and

      - verification that success paths for core cooling exist.

   b. Observations and Findings

      b.1 Determination of the location of credited SSCs

      The NRC inspection team noted the description of the remote shutdown console (RSC) credited in the AIA and Revision 4 of the U.S. APWR Design Control Document (DCD) was reoriented and relocated to ensure that it was outside certain shock damage footprints; however, the team identified that the location of the RSC in the DCD drawings show the RSC with an orientation and location that would cause the RSC to be within the same shock damage footprint as other credited SSCs on certain strike locations. MHI's failure to reorient and relocate the RSC in the DCD is documented as Violation 05200021/2014-201-01 that cites MHI against 10 CFR 50.150(b)(2). MHI opened corrective action report (CAR) CAR-14-006, dated January 30, 2014, to immediately address this issue.

      The NRC inspection team compared the descriptions of credited SSCs in the AIA to those in the DCD to determine if those SSCs credited in the assessment were included in the DCD. The NRC inspection team noted that the AIA relies on operator action prior to an aircraft impact to isolate the containment vent and purge lines, and the chemical volume and control system (CVCS) letdown isolation valves. These actions prevent fire from entering the containment and prevent a loss of coolant accident (LOCA) outside containment. However, the design document does not identify and incorporate in it the isolation of these two systems. MHI's failure to include these credited design features in the DCD is one example of a violation of 10 CFR 50.150(a)(1) and is documented in Violation 05200021/2014-201-02. MHI opened CAR-14-007, dated January 31, 2014, to immediately address this issue.

b.2 Determination of the state of SSCs in the aircraft impact scenarios

The NRC inspection team verified that a success set existed for the ninety-seven (97) evaluations and the shutdown cooling analysis MHI performed to determine the aircraft impact damage effect on SSCs. Specifically, for an event with the power plant initially at power, the NRC inspection team verified that decay heat removal paths exist using emergency feedwater via the steam generators with atmospheric steam relief or feed and bleed operation of the reactor coolant system, to provide core cooling function. In addition, for an event with the power plant shutdown, the NRC inspection team verified that decay heat removal paths exist using residual heat removal (RHR) or charging pumps to provide core cooling function. The NRC inspection team verified that required support components, such as water storage tanks; instrumentation and controls; and electrical power were available. Before the impact of an aircraft, and to minimize the effect of cross divisional damage, the NRC inspection team noted that the analysis assumes main control room operator action to separate cross connected divisions of the component cooling water system.

b.3 Determination of accident conditions

The NRC inspection team verified that MHI used appropriate assumptions and scenarios to determine accident conditions. These assumptions were consistent with NEI 07-13 and include:

- MHI's success criteria and the scenario analysis that addresses initial plant states of 100 percent power and cold shutdown;
- the assumption that offsite AC power is available unless the damage footprint specifically fails it on-site;
- the assumption, as part of its shutdown cooling scenarios, that the reactor vessel is vented, the water level is at or near the reactor vessel head flange, and the reactor has been shut down for a specified time; and,
- the consideration of the possibility of an anticipated transient without scram (ATWS).

Specifically, the NRC inspection team reviewed MHI's treatment of the following potential accident conditions:

LOCA inside containment

The NRC inspection team determined that the assessment adequately demonstrated that neither shock damage to the containment nor structural damage inside containment would occur. However, the team noted that for some strike locations and scenarios that there is a potential to lose cooling to two of the four or all four reactor coolant pump (RCP) seals, thus, resulting in a seal LOCA. The NRC inspection team verified that for scenarios when RCP seal cooling is lost an adequate number of safety injection pumps remain available to maintain RCS inventory and core cooling function as needed.

LOCA outside containment

The NRC inspection team verified that piping connected to the RCS that penetrates containment includes isolation valves that are not susceptible to damage because of their location. The NRC inspection team noted that prior to aircraft impact, the analysis assumes main control room operator action to isolate CVCS letdown isolation valves, and any vulnerable RHR trains. However, the design document does not describe and incorporate into it containment isolation valves. MHI's failure to include these credited design features in the DCD is an example of a violation, and is cited in Violation 05200021/2014-201-02, as described Section 1.b.1.

ATWS

The NRC inspection team verified that equipment necessary to trip the reactor is outside all damage footprints. Therefore, the ability to trip the reactor is maintained and an ATWS is not a scenario that would result from an aircraft impact.

Flooding

The NRC inspection team reviewed the AIA to determine if MHI adequately assessed the potential for flooding from a large water source as described in NEI 07-13. The NRC inspection team verified that any potential large water source was either not vulnerable or was bounded by the internal flooding analysis.

Loss of Decay Heat Removal

The NRC inspection team verified that MHI adequately assessed the potential for a loss of decay heat removal event during plant shutdown. The NRC inspection team noted that the DCD has administrative controls to ensure that for shutdown-refueling conditions that all four (4) trains of RHR remain in service when the reactor vessel head is removed and the reactor vessel water level is at or near the reactor vessel head flange. In the event of a loss of heat sink resulting in damage to the normal decay heat removal system, the design contains diverse features to cool the reactor core, such as, charging pumps.

b.4 Identification of Success Paths

The inspection team evaluated MHI's core cooling criterion to ensure it was consistent with applicable codes and standards. Specifically, the NRC inspection team noted that MHI considers core cooling to be successful when the core temperatures are maintained stable below 1800 degrees Fahrenheit for a period of 24 hours following a strike. Under this criterion, prolonged oxidation of the fuel and severe fuel damage would not occur. This criterion is therefore consistent with the definition of core cooling applied in the U.S. APWR PRA and with the American Society of Mechanical Engineers (ASME) Standard for level 1/large early release frequency PRA for nuclear power plant applications (i.e., 2009 Addendum to ASME RA-S).

The inspection team compared the success paths identified for strike scenario 39 with information from the PRA to verify that the approach for identifying success paths was being applied correctly. The inspection team reviewed applicable event

trees from the accident sequence analysis in Chapter 3 of the PRA report, success criteria analysis in Chapter 5 of the PRA report and applicable analysis documented in Chapter 6 of the PRA that shows thermal-hydraulic behavior in the core during accident sequences modeled in the PRA. Based on their review of this information, the inspectors concluded that the success paths selected for strike scenario 39 were consistent with the results of the PRA. The inspection team also compared success paths for several other strike scenarios with success criteria documented in Chapter 5 of the PRA report and found them to be consistent with the results of the PRA.

The NRC inspection team also reviewed MHI's target set analysis. The target set analysis is performed in accordance with 10 CFR 73.55 (b)(4) to support the design of physical protection programs that can prevent significant core damage and spent fuel sabotage. The NRC inspection team verified that the target set analysis was properly informed by the success criteria developed as part of the Level 1 PRA. The inspectors compared a sample of target set equipment complements for the various initiating events with success criteria for achieving core cooling in the AIA and found them to be consistent.

c. Conclusions

The NRC inspection team concluded that with the exception of Violation 05200021/2014-201-01, for failure to demonstrate how a credited design feature met assessment requirements, and Violation 05200021/2014-201-02, for failure to identify and incorporate into the design those design features and functional capabilities to show the reactor remains cool, or containment remains intact, and spent fuel cooling or spent fuel pool integrity is maintained, the system-loss assessment performed by MHI for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

2. Fire Damage Assessment

a. Inspection Scope

The NRC inspection team reviewed the following activities for MHI's U.S. APWR AIA fire damage assessment:

- verification that the fire damage assessment identifies and incorporates the necessary design features and functional capabilities;
- verification that the fire damage assessment is realistic and design-specific;
- verification that key design features credited in the AIA are consistent with those documented in the DCD;
- verification that the fire damage assessment includes most limiting scenarios;
- verification that damage footprints include the effects from the spread of fire damage through existing connected compartments and through new compartment connections due to overpressure;

- verification that SSCs credited for safe shutdown following aircraft impact scenarios remain free from physical and fire damages; and,

- verification that each strike location with a physical damage footprint had a corresponding fire damage footprint.

b. Observations and Findings

b.1 Fire-damage assessment

The NRC inspectors reviewed the fire areas, fire barriers, and fire damage footprints credited in MHI's AIA and identified fire barrier details that were not included in DCD Appendix 19A, "US-APWR Beyond Design Basis Aircraft Impact Assessment." Specifically, the inspectors identified two cases where the assessment utilized barriers that are not identified and incorporated in the DCD:

- Case 1: Concrete heating, ventilation, and air conditioning (HVAC) soffit connecting fire area 509 to fire area 504

  The concrete HVAC soffit is not fully or clearly drawn on the fire figures and is not labeled as a fire-rated barrier or 5 psid (pounds-per-square-inch-differential) barrier in the DCD Appendix 9A, "Fire Hazard Analysis"; therefore, this feature was not identified in the DCD fire analysis. The NRC inspectors noted that DCD Appendix 9A figures label the barriers for fire area 504 as 3-hour fire rated only and the barrier between fire areas 507 and 509 as 5 psid (and 3-hour fire rated). No concrete HVAC soffit or any HVAC dampers inside this soffit were identified in the DCD Appendix 9A. The soffit only maintains a 3-hour damper at the fire area 507/509 boundary and no damper at the fire area 504/507 boundary. This does not match the credited features highlighted in DCD Appendix 9A figures.

  MHI took immediate corrective action and initiated CAR-14-004, Revision 1, dated January 31, 2014, to capture this issue.

- Case 2: Cut Away Drawings

  The inspectors noted that DCD Appendix 9A fire drawing figures depict a few areas on the drawing via cut-away drawings. The areas reviewed include fire areas 414, 415, 412, 413, 405, and 406 located around the 3F and 4F elevations. The cut-aways on the fire drawings do not identify all barriers and designations of the barrier segments. Therefore, it cannot be confirmed if or how a barrier is used to meet 10 CFR 50.150 (i.e., is the barrier 3-hour fire rated only or 3-hour fire rated and 5 psid). The process of determining barrier ratings and crediting for AIA, and its references, are not identified in MHI's DCD Appendices 19A or 9A. MHI took corrective action and initiated CAR-14-010, dated February 7, 2014, to capture this issue.

The NRC inspection team identified these cases as additional examples of violations, referenced in Violation 05200021/2014-201-02 that cites MHI's failure 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).

The NRC inspection team evaluated MHI's fire damage footprints to verify that MHI followed the criteria of NEI 07-13 for developing realistic fire damage footprints. The NEI 07-13 guidance states that, "[w]hen applying the one barrier option of the rule set, the fire barrier must also be rated for 5 psid." MHI stated as part of its AIA that it applied NEI 07-13 and took no exceptions to applying the NEI 07-13 guidance for the fire damage assessment; however, the inspection team noted in a few locations, that although the DCD and AIA rated a fire barrier as a 3-hour fire barrier, the fire damage footprints applied the one barrier option of the rule set. Thus the 3-hour fire barriers were credited as 5 psid barriers capable of stopping pressurized fire spread. As a result, the inspectors identified multiple examples of undersized damage footprints.

Some examples the inspectors identified were:

- strike location 74, fire areas FA2-210 and FA2-507,
- strike location 75, fire areas FA2-102 and FA2-202 on the 1 MF level,
- strike location 65, fire areas FA4-101 to FA3-113, 109, and 114,
- strike location 45, fire areas FA4-101 to FA3-109, 113, and FA3-114 to FA3-111 and 109, and
- strike location 19, fire areas FA3-109 to FA4-101.

The inspectors verified that, in all cases identified in the limited sample above, the 3-hour fire barriers were thick concrete walls and found no evidence of penetrations. This gave the inspectors reasonable assurance that these barrier walls are capable of stopping a 5 psid pressurized fire. MHI, in performing its AIA, takes no exceptions to the NEI guidance, including how to apply the one barrier option of the rule set. Since MHI credited the barriers to stop 5 psid fire spread in the fire damage footprints, the barriers must be identified as a 5 psid barrier in the DCD.

Since the NRC inspection team verified that: (1) the above sampled concrete walls would be able to stop a pressurized fire, and (2) MHI's design change process was set up to adequately verify if any design changes could impact the AIA, such as adding a penetration, the NRC inspection team determined this violation to be minor in accordance with the NRC enforcement policy (Section 2.3.1).

The NRC inspectors sampled other strike locations where MHI utilized a single barrier to stop physical damage propagation and fire spread. The NRC inspection team verified that MHI applied NEI 07-13's structural N-wall rule set. This is based on the guidance in NEI 07-13 that assumes the Nth-wall will be intact and functional post-impact to withstand the 5 psid pressure pulse and still prevent fire spread. In similar scenarios, for those structural walls that did not utilize the N-wall rule set, the NRC inspectors verified that an adequate analysis was provided that satisfied the structural inspectors and also provided reasonable assurance to the inspectors to show the wall will be intact and functional post-impact to withstand the 5 psid pressure pulse and still prevent fire spread. The NRC inspectors also verified all of

these barriers were identified as 5 psid and 3-hour fire rated to conclude that the fire propagation would be prevented.

b.2 Fire Damage Effects on SSCs

The NRC inspection team determined that MHI correctly considered the identified SSCs as failing within 5 minutes of the start of the fire consistent with NEI 07-13.

c. Conclusions

The NRC inspection team found that with the exception of the two violations of examples referenced in Violation 05200021/2014-201-02, for failure identify and incorporate into the design those design features and functional capabilities to show the reactor remains cool, or containment remains intact, and spent fuel cooling or spent fuel pool integrity is maintained, the fire damage assessment performed by MHI for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

3. Structural Damage Assessment

a. Inspection Scope

The NRC inspection team reviewed the following activities for MHI's U.S. APWR AIA structural damage assessment:

- verification of information found in plant documentation including plant arrangement drawings that display the locations of major equipment, plant elevation drawings that document the relative heights of various buildings, civil-structural drawings that provide wall thicknesses and reinforcement details, and material specifications;

- verification of general structural analysis considerations such as design inputs, analyses parameters, and assumptions, computer codes, methods used for structural analyses and results to determine whether MHI adequately analyzed the effects of and damage to structures resulting from global and local aircraft impact loads;

- verification of the containment and SFP impact analyses to determine whether MHI has met the criteria in Section 2.5 of NEI 07-13; and,

- verification of the structural damage footprint assessments to determine whether MHI adequately assessed the containment and other reinforced concrete buildings that contain essential SSCs for maintaining reactor core and SFP cooling using the damage rule sets in Section 3.3 of NEI 07-13.

b. Observations and Findings

b.1 Structural Assessment Document Review

The NRC inspection team verified that the civil-structural drawings and AIA design requirements calculations provided correct wall thicknesses, reinforcement details

(sizes, spacing, and distribution) and material specifications consistent with the design requirements.

b.2 General Structural Analysis

The NRC inspection team verified that MHI used the appropriate design inputs including the structural analysis assumptions and limitations, the type of finite elements used in each analysis, material models considered, model mesh refinement, boundary conditions and extent of model, and the time duration of the analysis. In addition, the NRC inspection team verified that MHI adequately documented and justified the structural design input for a sampling of analysis and adequately analyzed the effects on and damage to structures resulting from local and global loading arising from an aircraft impact.

The NRC inspection team reviewed TeraGrande, a software used for final analyses implementing the ANACAP-U concrete material constitutive model. The NRC inspection team verified that MHI had verified, validated, and benchmarked the code for the applicable class of problems assessed, consistent with Appendix C of NEI 07-13, and adequately documented the validation and verification.

The NRC inspection team reviewed a sample of the structural damage impact scenario analyses and verified that MHI properly applied the NRC-supplied forcing function to the appropriate structural damage impact scenarios. In addition, the NRC inspection team reviewed the assumptions used in the structural damage analyses and verified that MHI adequately documented the technical basis in the AIA for the assumptions used in the analyses.

The inspectors reviewed a sample of structural damage analyses and verified that MHI used the correct failure criteria. As part of the review, the NRC inspection team observed that MHI conservatively excluded increase in strength from concrete aging in its analyses related to the pre-stressed concrete containment vessel (PCCV) and SFP.

The inspection team reviewed a sample from the PCCV, Reactor Building, and Power Source Building critical section[4] calculations that were affected by the AIA and verified that the independent AIA design requirements were considered and bounded in the critical section design evaluations.

b.3 PCCV Structure and SFP specific impact assessment

The NRC inspection team observed that MHI used a PCCV and the Reactor Building housing the SFP, to provide SFP protection from a direct impact from an aircraft. Therefore, MHI evaluated several impact scenarios on the PCCV and the Reactor Building structure to address the potential for subsequent damage and to demonstrate integrity of the containment structure and the SFP.

[4] Critical sections are those portions of individual Seismic Category I structures credited in prevention or mitigation of consequences of postulated design basis accidents, or experience the largest structural demands during design basis conditions, or needed for evaluation of an essentially complete design.

The NRC inspection team verified that the structural damage assessments, as it relates to local loading effect on the containment structure, were conducted in accordance with approved guidance. Specifically the NRC verified that MHI documented and cross-checked the aircraft engine parameters used in the analysis against NRC-specified parameters and that MHI properly applied the various local loading formulas to arrive at the degree of local damage. With respect to global loading effects on the containment structure, the NRC verified that MHI effectively used and documented the application of the force time-history analysis method and cross-checked it for its equivalency to the NRC-specified force time-history. In addition, the NRC verified that for the application of the force time-history analysis method, MHI properly used and adequately documented the NRC-specified spatial distribution of the impact force in the analyses.

The NRC inspection team reviewed a sample of documents for material characterization and failure criteria related to the structural damage assessment and verified that the following analysis activities were conducted in accordance with approved guidance:

- MHI used the ANACAP-U concrete constitutive model consisting of material properties and equations used to model the nonlinear behavior of both steel and concrete materials in the analyses. The steel components, including reinforcement, were modeled with appropriate elasto-plasticity models. The model parameters used are adequately documented and consistent with the material properties and equations documented in NEI 07-13, Section 2.3;

- MHI properly applied the dynamic increase factors specified in NEI 07-13, Subsection 2.3.1, for the various materials used in the analyses;

- MHI properly applied the ductile failure strain limits specified in NEI 07-13, Subsection 2.3.2, for the various materials used in the analyses;

- the concrete structural failure criteria used in the analyses are appropriately documented and consistent with the criteria specified in NEI 07-13, Subsection 2.3.3;

- MHI properly applied the material models specified in NEI 07-13, Subsection 2.3.4; and,

- MHI properly applied and adequately documented the structural integrity failure criteria specified in NEI 07-13, Subsection 2.3.5.

The NRC inspection team reviewed NEI 07-13, Section 2.4, regarding the major assumptions applied to the containment and SFP related structural analyses and verified that the following activities were conducted in accordance with approved guidance:

- the force time-history analysis model properly assumed that the aircraft impact strike was perpendicular to the centerline of the PCCV and walls of the Reactor Building and Power Source Building (the SFP is located in the Reactor Building);

- PCCV, SFP, Power Source Building and other nuclear island structures containing critical penetrations received an appropriate level of special consideration; and,

- MHI assessed potential aircraft impact at other locations that could result in critical consequences.

The NRC inspection team reviewed NEI 07-13, Section 2.5, regarding the sufficiency criteria applied to the PCCV structure, the Reactor Building, the Power Source Building, and the SFP analyses and verified that the following activities were conducted in accordance with approved guidance:

- the containment was concluded to remain intact, consistent with the sufficiency criteria in NEI 07-13, Subsection 2.5.1; and,

- the integrity of the SFP was concluded to remain maintained, consistent with the sufficiency criteria in NEI 07-13, Subsection 2.5.2.

b.4 Structural damage footprint assessment

The NRC inspection team reviewed the structural damage footprint analyses and verified that the following criteria related to the damage rule sets identified in NEI 07-13, Section 3, have been met:

- structures of concern that contain SSCs have been identified;

- a systematic evaluation of susceptible damage and vulnerabilities was conducted and adequately documented;

- assumptions used to determine elevations of concern have been addressed and adequately documented; and,

- each external face of each building exposed to a direct hit has been divided into two categories, containment structure (PCCV) and other reinforced concrete buildings; and has been analyzed and adequately documented.

c. Conclusions

The NRC inspection team concluded that the structural damage assessment performed by MHI for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

4. AIA Documentation and Quality Assessment

a. Inspection Scope

The NRC inspection team reviewed the following activities for MHI's U.S. APWR AIA quality assurance assessment:

- verification that MHI adequately documented quality assessment consistent with NEI 07-13, Section 5.1, and

- verification that MHI adequately established standards and measures to establish the validity of the assessment and supporting calculations.

b. Observations and Findings

b.1 Documentation

During its review of the AIA documentation, the NRC inspection team determined that some of the information documented within the AIA was not described in the DCD. The two violations related to the inconsistencies are discussed in the inspection report details of Sections 1.b.1 and 2.b.1.

b.2 Quality Requirements

The NRC inspection team assessed MHI's 4DS-UAP-20120104, "Assessment implementation plan for AIA." The implementation plan references MHI's Quality Assurance (QA) manual and other processes that are used for the assessment to meet the standards and measures identified in NEI 07-13. All design changes are evaluated against the AIA input information package to assess whether a design change impacts the AIA assessment. The inspection team verified that the AIA input information package is maintained to reflect any document revision changes.

The NRC inspection team reviewed a sample of MHI's design changes and verified that the design changes were evaluated and did not impact the AIA. The inspection team verified that design changes related to the AIA followed the design control process and all changes to applicable documents were updated. The NRC inspection team verified that the inputs, assumptions, methodology, assessment results, and conclusions were applied consistent with MHI's quality assurance documents.

b.3 Software

The NRC inspection team reviewed the control of the ANATECH concrete material modeling software, ANA-CAP-U, incorporated into the TeraGrande explicit dynamics finite element software. The NRC inspection team reviewed the TeraGrande qualification report and record of analysis to ensure the suitability of use for the AIA. The NRC inspection team determined that the software and modeling methods used to perform the structural analysis, seismic analysis, and dimensional modeling were adequate to perform the AIA.

c. Conclusions

The NRC inspection team concluded that with the exception of Violation 05200021/2014-201-01 and Violation 05200021/2014-201-02, documented in Sections 1.b.1 and 2.b.1, the documentation and quality assessment performed by MHI for the AIA is acceptable.

5. Entrance and Exit Meetings

On January 27, 2014, the NRC inspection team discussed the scope of the inspection with representatives from MHI. On January 31, 2014, the NRC inspection team presented the inspection results and observations during an exit meeting with representatives from MHI.

ATTACHMENT

1. PERSONS CONTACTED

Name	Title / Inspection Area	Affiliation	Entrance	Exit	Interviewed
Kevin Lynn	Licensing Engineer	MNES	X	X	X
Tomoyuki Kitani	Engineering Manager	MHI	X	X	X
Ikuo Otake	QA Manager	MHI	X	X	X
Vann Mitchell	QA	MNES/MHI	X	X	X
Toshiyuki Moriyama	Structural Engineer	MHI	X	X	X
Ryusuke Haraguchi	Structural Engineer	MHI	X	X	X
Kazunori Inoue	QA Engineering Manager	MHI	X	X	X
Ron Reynolds	Fire Protection / SPA	MNES	X	X	X
Randy James	Structural	ANATECH	X		X
Yasuko Umemoto	System Engineer	MHI	X	X	X
Hiroki Nishio	US-APWR Project Manager	MHI	X	X	X
Mike Tschiltz	Licensing Manager	MNES	X	X	X
Masanori Onozuka	Vice President	MNES	X	X	X
Atsushi Kumaki	Licensing General Manager	MNES	X	X	X
Steve Floyd	Executive Consultant	ERIN	X		X
Gary Hayner	Project Manager	ERIN	X	X	X
Rick Hill	Senior Consultant	ERIN	X	X	X
Koji Shinomiya	Lead Engineer	MHI	X	X	X
Masashi Ito	Engineer	MNES	X	X	X

2. Inspection Procedures Used

Inspection Procedure 37804, “Aircraft Impact Assessment,” dated February 9, 2012.

2. List of Items Opened, Closed, and Discussed

Item Number	Status	Type	Description
05200021/2014-201	Open	NOV	10 CFR 50.150(b)(2)
05200021/2014-202	Open	NOV	10 CFR 50.150(a)(1)

3. Documents Reviewed

Documentation and Quality Assessment and Systems-Loss Assessment

- C0365120004-11489, “Acceptance of AIA Input Package, Revision 3,” dated January 24, 2014
- 4DE-UAP-20120040, “Purchase Specification for Aircraft Impact Assessment,” Revision 2, dated July 3, 2013
- 4DS-UAP-20120104, “US-APWR Standard Design Assessment Implementation Plan for AIA,” Revision 3
- CAR-12-051, Revision 1, dated January 28, 2013
- 2CAS-20130004, “Quality Assurance Manual,” Revision 0
- ANATECH Corp Software Qualification of TeraGrande Version 1.2 for Aircraft Impact Assessments, dated November 2013
- NO-EH10192, “US-APWR Standard design, change list general arrangement of reactor building complex,” Revision 1
- NO-EHC0191, “US-APWR standard design, change list concrete outline drawings for reactor building,” Revision 7
- NO-EHC0291, “US-APWR standard design, change list concrete outline drawings for power source buildings,” Revision 5
- 4CR-UAP-20120043, “General Arrangement Building Complex,” dated August 10, 2012
- 2EB-UAP-20120026, dated August 30, 2012
- 4CR-UAP-20130043,”Fire Area Drawing and Fire Area List,” dated June 19, 2013
- 4CT-UAP-20130071, “Fire Area Drawing and Fire Area List,” Revision 0
- N0-EE10050, “Emergency Feedwater System Piping & Instrument Diagram Change List,” Revision 11
- N0-EE10190, “Refueling Water System Piping & Instrument Diagram Change List,” Revision 9
- 4BR-UAP120053, “Fueling Water Storage System Piping Instrument Diagram,” dated January 28, 2013
- N0-EJ22103, “Basic Layout of Local Panel for 3D-CAD,” Revision 6
- N0-EJ22103, “Basic Layout of Local Panel for 3D-CAD,” Revision 7
- N0-EJ22102, “Electrical Board Layout Drawing (PS/B),” Revision 6, Revision 7
- N0-EJ22102, “Electrical Board Layout Drawing (PS/B),” Revision 7
- N0-EJ22101, “Electrical Board Layout Drawing (A/B),” Revision 7
- N0-EJ22101, “Electrical Board Layout Drawing (A/B),” Revision 8
- N0-EJ22100. “Electrical Board Layout Drawing (R/B),” Revision 7, Revision 8
- N0-EJ22100. “Electrical Board Layout Drawing (R/B),” Revision 8
- 4DS-UAP-20120114, “Input Information Package for Structure Analysis of Aircraft Impact Assessment,” Revision 3
- 4DS-UAP-20120131, “Input Information Package for Heat Removal Evaluation of Aircraft Impact Assessment,” Revision 3
- N0-CG00102, “Fire Area Drawing and Fire Area List,” Revision 6

- ERIN AIA quality plan, PO:0365-12-0004, purchase spec for 4DE-UAP-20120040, Revision 1, dated July 20, 2013
- PO MNP-0431, MHI to ERIN engineering and research for AIA, Revision 3, dated November 26, 2013
- 4DE-UAP-20120040, “Purchase Specification for Aircraft Impact Assessment,” Revision 2, dated July 3, 2013
- N0-EJ13001, “On-site DC Power System Basic Design Plan,” Revision 4
- N0-EJ13001, “On-site DC Power System Basic Design Plan,” Revision 6
- N0-EH46001, “Basic Design Requirements for Personnel Airlock,” Revision 4
- N0-EH46001, “Basic Design Requirements for Personnel Airlock,” Revision 5
- N0-EH46002, “”Basic Design Requirements for Equipment Hatch,” Revision 5
- N0-EH46002, “”Basic Design Requirements for Equipment Hatch,” Revision 6
- N0-EF70102, “Basic Analysis and Design of R/B,” Revision 1
- N0-EF70102, “Basic Analysis and Design of R/B,” Revision 2
- N0-EF70104, “Basic Design of R/B,” Revision 0
- N0-EF70104, “Basic Design of R/B,” Revision 1
- 4DS-UAP-20130145, “Change of pressure boundaries,” Revision 0
- NO-EHC0221, “Concrete outline drawing for power source building (west) EL -26;4”(B1F) & EL -14’-2”(B1MF), Revision 5, March 30, 2012
- NO-EHC0221, “Concrete outline drawing for power source building (west) EL -26;4”(B1F) & EL -14’-2”(B1MF), Revision 6, dated August 31, 2012
- NO-EHC0222, “Concrete outline drawing for power source building (west) EL 3’-7” (1F), Revision 5, dated March 30, 2012
- NO-EHC0222, “Concrete outline drawing for power source building (west) EL 3’-7” (1F), Revision 6, dated August 31, 2012
- NO-EH10156, “General Arrangement Reactor Building Complex EL 35’-2” (2MF), Revision 0, dated Mar. 30, 2012
- NO-EH10156, “General Arrangement Reactor Building Complex EL 35’-2” (2MF), Revision 1, dated Aug. 31, 2012
- NO-EH10155, “General Arrangement Reactor Building Complex EL 25’-3” (2F),” Revision 0, dated March 30, 2012
- NO-EH10155, “General Arrangement Reactor Building Complex EL 25’-3” (2F),” Revision 1, dated August 31, 2012
- NO-EH10153, “General Arrangement Reactor Building Complex EL 3’-7” (1F),” Revision 0, dated March 30, 2012
- NO-EH10153, “General Arrangement Reactor Building Complex EL 3’-7” (1F),” Revision 1, dated August 31, 2012
- N0-EE10051, “Emergency Feedwater System Piping & Instrument Diagram (1),” Revision 10, dated September 2, 2011
- N0-EE10051, “Emergency Feedwater System Piping & Instrument Diagram (1),” Revision 11, dated June 21, 2013
- N0-EE10191, “Refueling Water Storage System Piping & Instrument Diagram (1),” Revision 7, dated October 22, 2012

- N0-EE10191, “Refueling Water Storage System Piping & Instrument Diagram (1),” Revision 8, dated April 9, 2013
- N0-EH10151, “General Arrangement Reactor Building Complex EL – 26’-4” (B1F),” Revision 1 dated August 31, 2012
- N0-EH10151, “General Arrangement Reactor Building Complex EL – 26’-4” (B1F),” Revision 2, dated July 10, 2013
- N0-EE10052, “Emergency Feedwater System Piping & Instrument Diagram (2),” Revision 10, dated 9/1/2011
- N0-EE10052, “Emergency Feedwater System Piping & Instrument Diagram (2),” Revision 11, dated 7/2/2013
- N0-EE10123, “Essential Service Water System Piping & Instrument Diagram (2),” Revision 7, dated September 2, 2011
- N0-EE10123, “Essential Service Water System Piping & Instrument Diagram (2),” Revision 8, dated August 29, 2013
- N0-EE20111, “Main Control Room HVAC System Piping & Instrumentation Diagram (1),” Revision 6, dated May 9, 2013
- N0-EE20111, “Main Control Room HVAC System Piping & Instrumentation Diagram (1),” Revision 7, dated August 9, 2013
- N0-EHC0222, “Concrete Outline Drawing for Power Source Building (West) EL 3’-7” (1F),” Revision 6, dated August 31, 2012
- N0-EHC0223, “Concrete Outline Drawing for Power Source Building (West) EL 39’-6” (Roof),” Revision 6, dated August 31, 2012
- N0-EHC0231, “Concrete Outline Drawing for Power Source Building (West) Section A-A,” Revision 6, August 31, 2012
- N0-EHC0102, “Concrete Outline Drawing for Reactor Building EL 8’7” (B1MF),” Revision 7 August 31, 2012
- N0-EHC0103, “Concrete Outline Drawing for Reactor Building EL 3’-7” (1F),” Revision 7, August 31, 2012
- N0-EHC0104, “Concrete Outline Drawing for Reactor Building EL 13’-6” (1MF),” Revision 7, August 31, 2012
- N0-EH10157, “General Arrangement Reactor Building Complex EL 50’-2”(3F),” Revision 1
- NO-EE20111, “Engineered Safety Features Ventilation System-Main Control Room HVAC System Piping & Instrument Diagram (1),” Revision 7
- N0-EE20112, “Engineered Safety Features Ventilation System-Main Control Room HVAC System Piping & Instrumentation Diagram (2),” Revision 1
- Section 2.3 of Attachment 1 to UAP-SGI-09001, “Functional Criteria,” Revision 2
- UAP-SGI-08002, Target Set Analysis, Revision 3

<u>Fire Damage Assessment</u>

- DCD:
    - Section 9.5.1
    - Appendix 9A

- Figures: 3J-1 (Sheet 10 of 14) and (Sheet 13 of 14)

- 3K-7 (Page 3K-88)
- 3K-8 (Page 3K-89)

- UAP-SGI-09001, "US-APWR Aircraft Impact Assessment," Revision 2, January 2014
- UAP-SGI-09001, Attachment 1, "Final Aircraft Impact Assessment of Heat Removal for the MHI US-APWR Design," January 2014
- UAP-SGI-09001, Attachment 1, Appendix A, "Strike Location Assessment," Revision 2, January 15, 2014
- UAP-SGI-09001, Attachment 1, Appendix B, "Damage Footprint Sketches," Revision 2, January 15, 2014
- UAP-SGI-09001, Attachment 1, Appendix C, "Fire Areas with Door Sketches," Revision 2, January 15, 2014
- UAP-SGI-09001, Attachment 1, Appendix D, "HVAC with Fire Dampers," Revision 2, January 15, 2014

Structural Damage Assessment

- UAP-SGI-9001, Rev 2, Attachment 2, " Aircraft Impact Assessment for MHI-US-APWR Plant Design Consolidation Structural Response Analysis", R/2 (ANA-R-13-923, Jan 2014.
- UAP-SGI-09001, Rev 2 Attachment 1, Appendix B, "Damage Foot Print"
- UAP-SGI-9001, Rev 2 Attachment 1, Appendix A, " Strike Location Assessment AIA for MHI US-APWR", Rev 2
- Concrete Outline drawings for Reactor Building and Power Source Building. Binder Category 3-A(1/14)

4. ACRONYMS USED:

AIA	aircraft impact assessment
ADAMS	Agencywide Documents Access and Management System
CAR	corrective action report
CGD	commercial grade dedication
CFR	Code of Federal Regulations
DCD	design control document
DCIP	Division of Construction Inspection and Operational Programs
EVIB	Electrical Vendor Inspection Branch
FSAR	final safety analysis report
GTG	gas turbine generator
HVAC	heating ventilation air conditioning
IP	inspection procedure
MHI	Mitsubishi Heavy Industries, Ltd.
MNES	Mitsubishi Nuclear Energy Systems, Inc.
NEI	Nuclear Energy Institute
NRC	(U.S.) Nuclear Regulatory Commission

NRO	Office of New Reactors
PCCV	pre-stressed concrete containment vessel
PSID	pounds per square inch differential
QA	quality assurance
RCS	reactor coolant system
RHR	residual heat removal system
RSC	remote shutdown console
SFP	spent fuel pool
SSC	systems, structures, and components
U.S.	United States (of America)