ArevaEPRDCPEm Resource

From: WILLIFORD Dennis (AREVA) [Dennis.Williford@areva.com]
Sent: Friday, April 26, 2013 5:16 PM
To: Snyder, Amy
Cc: Ford, Tanya; ANDERSON Katherine (EXTERNAL AREVA); DELANO Karen (AREVA); LEIGHLITER John (AREVA); ROMINE Judy (AREVA); RYAN Tom (AREVA); PEDERSON Ronda (AREVA); LEWIS Ray (EXTERNAL AREVA)
Subject: Response to U.S. EPR Design Certification Application FINAL RAI No. 565 (6933), FSAR Ch. 19 - NEW PHASE 4 RAI - AIA Methodology, Supplement 1
Attachments: RAI 565 Supplement 1 US EPR DC - PUBLIC.pdf

Amy,

AREVA NP Inc. provided a schedule for a technically correct and complete response to the seven questions in RAI No. 565 on January 23, 2013.

The attached file, "RAI 565 Supplement 1 US EPR DC –PUBLIC.pdf," provides a technically correct and complete final response to the seven questions in RAI No. 565. Because the response file contains security-related sensitive information that should be withheld from public disclosure in accordance with 10 CFR 2.390, a public version is provided with the security-related sensitive information redacted. This email and attached file do not contain any security-related information. An unredacted security-related version is provided under separate email.

NRC staff comments, received on April 24, 2013 on the Advanced Response to these RAI questions, requested that AREVA consider adding the Radioactive Waste Processing Building (RWPB) sliding concrete barrier door to Table 3.2.2-1 of the U.S. EPR FSAR. U.S. EPR FSAR Tier 2, Section 3.2.2 states that Table 3.2.2-1 – Classification Summary lists the quality group classification of the U.S. EPR pressure-retaining components, such as pressure vessels, heat exchangers, tanks, pumps, piping, and valves. Therefore, AREVA believes that the RWPB sliding concrete door should not be included in FSAR Tier 2, Table 3.2.2-1 since it is not a pressure-retaining component.

Appended to this file are affected pages of the U.S. EPR Final Safety Analysis Report in redline-strikeout format which support the response to RAI 565 Questions 19-357, 19-358, 19-359, 19-360, 19-361 and 19-363.

AREVA Technical Report ANP-10295 contains Safeguards Information (SGI), and is being sent under separate letter transmittal. In addition, AREVA Technical Reports ANP-10296 and ANP-10317 contain SUNSI information. A public version with the Security Sensitive Information redacted will be sent separately.

The following table indicates the respective pages in the response document, "RAI 565 Supplement 1 US EPR DC – PUBLIC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 565 — 19-357	2	2
RAI 565 — 19-358	3	5
RAI 565 — 19-359	6	7
RAI 565 — 19-360	8	9
RAI 565 — 19-361	10	10
RAI 565 — 19-362	11	11
RAI 565 — 19-363	12	13

This concludes the formal AREVA NP response to RAI 565, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
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Phone: 704-805-2223
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From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, January 23, 2013 3:43 PM
To: 'Snyder, Amy'
Cc: WELLS Russell (RS/NB); tanya.ford@nrc.gov; DELANO Karen (RS/NB); LEIGHLITER John (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB); WILLS Tiffany (CORP/QP); Michael.Miernicki@nrc.gov
Subject: Response to U.S. EPR Design Certification Application FINAL RAI No. 565 (6933), FSAR Ch. 19 - NEW PHASE 4 RAI - AIA Methodology

Amy,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 565 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the 7 questions cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 565 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

Question #	Start Page	End Page
RAI 565 — 19-357	2	2
RAI 565 — 19-358	3	3
RAI 565 — 19-359	4	4
RAI 565 — 19-360	5	5
RAI 565 — 19-361	6	6
RAI 565 — 19-362	7	7
RAI 565 — 19-363	8	8

The schedule for a technically correct and complete response to these 7 questions is provided below.

Question #	Response Date
RAI 565 — 19-357	**April 26, 2013**
RAI 565 — 19-358	**April 26, 2013**
RAI 565 — 19-359	**April 26, 2013**
RAI 565 — 19-360	**April 26, 2013**
RAI 565 — 19-361	**April 26, 2013**
RAI 565 — 19-362	**April 26, 2013**
RAI 565 — 19-363	**April 26, 2013**

Sincerely,

Dennis Williford, P.E.
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From: Snyder, Amy [mailto:Amy.Snyder@nrc.gov]
Sent: Friday, December 14, 2012 3:19 PM
To: ZZ-DL-A-USEPR-DL
Cc: Ford, Tanya; Vettori, Robert; Lee, Samuel; ArevaEPRDCPEm Resource; Segala, John; McKenna, Eileen; Miernicki, Michael
Subject: U.S. EPR Design Certification Application FINAL RAI No. 565 (6933), FSAR Ch. 19 - NEW PHASE 4 RAI - AIA Methodology

Attached please find the subject request for additional information (RAI). A draft of the RAI was provided to you on November 23, 2012, and discussed with your staff on December 3, 2012. Draft RAI Question 19-363 was modified as a result of those discussions. On December 11, 2012, you informed us that the RAI does not contain AREVA Proprietary information or SGI information and that the draft RAI with the modifications is clear and no further clarification is needed. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs, excluding the time period of **December 24, 2011 thru January 2, 2012, to account for the holiday season** as discussed with AREVA NP Inc on November 28, 2012. For any RAIs that cannot be answered **within 40 days or January 23, 2012**, it is expected that a date for receipt of this information will be provided to the staff within the 40-day period so that the staff can assess how this information will impact the published schedule."

Thank You,

Amy

Amy Snyder, U.S. EPR Design Certification Lead Project Manager
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Email Number: 4348

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Subject: Response to U.S. EPR Design Certification Application FINAL RAI No. 565 (6933), FSAR Ch. 19 - NEW PHASE 4 RAI - AIA Methodology, Supplement 1
Sent Date: 4/26/2013 5:15:51 PM
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From: WILLIFORD Dennis (AREVA)

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Files	**Size**	**Date & Time**
MESSAGE	6491	4/26/2013 5:15:59 PM
RAI 565 Supplement 1 US EPR DC - PUBLIC.pdf		234178

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Response to

Request for Additional Information No.565, Supplement 1

12/14/2012
U.S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 19 - Probabilistic Risk Assessment and Severe Accident Evaluation
Application Section: Beyond Design Basis Large Commercial Aircraft Impact Assessment
BPFP Branch

Question 19-357:

US EPR FSAR Tier 2 Revision 3, Section 19.2.7.3, “Methodology,” states that the methodology used for assessing effects of aircraft impact is described in NEI 07-13, “Methodology for Performing Aircraft Impact Assessments for New Plant Designs,” Revision 7. The methodology of NEI 07-13, Revision 7 was followed with no exceptions.

Since the original FSAR submittal, Regulatory Guide 1.217, August 2011, “Guidance for the Assessment of Beyond-Design-Basis Aircraft Impact,” references Revision 8 of NEI 07-13. The applicant should consider changing their FSAR to the latest NEI 07-13 revision (Revision 8) and provide applicable changes to Section 19.2.7.3 of the FSAR.

Response to Question 19-357:

U.S. EPR FSAR Tier 2, Sections 19.2.7.3 and 19.2.8, and AREVA NP Technical Report ANP-10317 will be revised to reference NEI 07-13 Revision 8.

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 19.2.7.3 and Section 19.2.8, will be revised as described in the response and indicated on the enclosed markup.

Technical Report Impact:

ANP-10317, “Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures,” Revision 0, will be revised as described in the response. The revision to ANP-10317 is provided separately in AREVA letter to NRC, NRC 13:022, dated April 26, 2013.

Question 19-358:

US EPR FSAR Tier 2 Revision 3, Section 19.2.7.4, “Design Features Credited for Conformance with 10 CFR 50.150,” states that the location and design of the concrete sliding door in the Radioactive Waste Processing Building at Elevation 0 feet described in FSAR Section 1.2.3 and Reference 24 provides protection to portions of the Fuel Building.

Contrary to the requirements of paragraph (b)(1) of 10 CFR 50.150, Section 19.2.7.4 does not contain a description of design features nor functional capabilities relied upon for the concrete sliding door to ensure that the assessment requirements in paragraph (a)(1) of 10 CFR 50.150 are met.

The applicant should include in the FSAR how this protection is provided by describing, at a minimum, the following:

1. the normal position of this concrete sliding door during power operations and at shutdown conditions
2. controls in place that allow the door to be open/closed
3. the time it would take to close this concrete door
4. key design features that would potentially be affected or lost in the fuel building by a large commercial aircraft impact with the concrete door open, and the effects on the fuel pool, fuel pool cooling, or spent fuel pool liner.

Response to Question 19-358:

The criteria for the design feature located at the interface of the Radioactive Waste Processing Building (RWPB) and Nuclear Auxiliary Building (NAB) are shown in Figure 2-9 of AREVA NP Technical Report ANP-10317.

U.S. EPR FSAR Tier 2, Section 19.2.7.4, Item 3, Bullet 5 will be revised as follows:

> “The location and design of the Radioactive Water Processing Building (RWPB) is described in Section 1.2.3. The design features for the RWPB concrete sliding door located between the RWPB and NAB at Elevation 0 feet that are relied upon to meet the requirements of paragraph (a) (1) of 10 CFR 50.150 are described in Reference 24.”

Figure 19-358-1 illustrates the purpose of the RWPB concrete sliding door.

Item 1 Response:

The concrete sliding door is maintained closed during operations and shutdown conditions. The door is periodically opened to the size of a typical personnel door for personnel access. Per NEI 07-13 Revision 8, Section 3.2.2, Damage Rule Sets for Reinforced Concrete Buildings, “the assessment should extend the physical damage through any opening greater than the area of a typical single personnel access door.” Doors not greater than a typical single personnel door “are not considered to provide a substantial debris pathway and need not be considered in the assessment.” Therefore, the COL applicant may maintain the normal position of the concrete sliding door as partially open (not to exceed the size of a typical personnel door) without invalidating the assessment conducted in support of U.S. EPR FSAR Tier 2, Section 19.2.7.

Further, since the concrete sliding door is only infrequently opened in excess of the size of a typical personnel door for equipment transit, this concrete sliding door requires no further analysis be performed. While the concrete sliding door may be temporarily opened for the transit of equipment, the concrete sliding door may not be maintained open in excess of the size of a typical personnel door.

Technical Report ANP-10317 (U.S. EPR FSAR Tier 2, Chapter 19, Reference 24) will be revised to clarify that:

- The normal position of this concrete sliding door is closed during power operations.
- The normal position of this concrete sliding door is closed during shutdown conditions.
- “Due to the weight of the concrete sliding door, electrical power, hydraulic controls, or other controls or devices are required to open and close the concrete sliding door located in the hallway between the RWPB and the NAB.”

U.S. EPR FSAR Tier 2, Section 1.2.3.1.2, will be revised to add the following sentence to the end of the RWPB section - “The design of the concrete sliding door located in the hallway between the RWPB and the NAB is described in Section 19.2.7.4.3.”

Item 2 Response:

ANP-10317 will be revised to include a requirement that opening and closing of the RWPB concrete sliding door will be controlled by site administrative procedures, which are the responsibility of the COL applicant.

Item 3 Response:

There is not a time constraint for closing this concrete sliding door with the exception of meeting the “infrequently opened beyond the size of a single personnel door.” This time constraint will be controlled by site administrative procedures, which are the responsibility of the COL applicant.

Item 4 Response:

Since this concrete sliding door is only infrequently opened in excess of the size of a typical personnel door for equipment transit, the opening is not considered to provide a substantial debris pathway and need not be considered in the assessment.

Figure 19-358-1

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 19.2.7.4, will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Section 1.2.3.1.2, will be revised as described in the response and indicated on the enclosed markup.

Technical Report Impact:

ANP-10317, "Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures," Revision 0, will be revised as described in the response. The revision to ANP-10317 is provided separately in AREVA letter to NRC, NRC 13:022, dated April 26, 2013.

Question 19-359:

The US EPR FSAR Tier 2 Revision 3, Section 19.2.7 submittal reviewed by the NRC should accurately reflect the results of the Aircraft Impact Assessment (AIA) performed by the applicant as required by 10 CFR 50.150. The submittal should include all key design features and functional capabilities credited in the AIA to meet the acceptance criteria. As such, the applicant is requested to verify that the submittal fully identified and described all key design features and functional capabilities credited in the AIA.

FSAR 19.2.7.5.2, “RCS Heat Removal Capability,” states that the analyses performed demonstrated the ability of the U.S. EPR design, after the impact by a large commercial aircraft, to maintain functionality of one or more divisions of systems credited in U.S. EPR FSAR Tier 2, Chapter 15 with providing reactor core cooling under accident conditions. The U.S. EPR design has features such as hardened and isolated shield structures, a strategic site arrangement and plant structural design, fire barriers, and the physically separate and redundant trains. These features contribute to the success of one or more divisions of systems credited in Chapter 15 to maintain functionality to provide reactor core cooling after the impact of a large commercial aircraft.

The submittal should include all key design features for RCS heat removal capability (Tier 2 FSAR Section 19.2.7.5.2) and functional capabilities credited in the AIA to meet the acceptance criteria and not just reference SSCs credited in Chapter 15 of the FSAR. Support systems such as the ultimate heat sink (UHS), component cooling water (CCWS), and essential service water systems (ESWS) are not described in Chapter 15 of the FSAR.

As such, the applicant is requested to verify that the submittal fully identifies and describes all key design features and functional capabilities credited in the AIA for RCS heat removal capability.

The applicant should revise the submittal if it is found that there are key design features and functional capabilities credited in the AIA that are not clearly identified or described in the US EPR FSAR Section 19.2.7.

Response to Question 19-359:

The front line systems, used in the analysis for determining if adequate core cooling could be provided after an aircraft impact, are those systems credited in the U.S. EPR FSAR Tier 2, Chapter 15, accident analyses and also those systems credited in the PRA-based success sets.

The analysis also considered the impact on the front-line systems from damage to supporting systems and dependencies. The front-line systems, support systems, and dependencies are included in the list of protected systems listed in U.S. EPR FSAR Tier 2, Section 19.2.7.4.

U.S. EPR FSAR Tier 2, Section 19.2.7.5, will be revised to indicate that supporting systems necessary for the front-line systems to be able to perform their intended functions are protected from damage (e.g., UHS, CCWS, ESWS, HVAC).

The following items will be added to the list of protected equipment in U.S. EPR FSAR Tier 2, Section 19.2.7.4:

- Add to list of systems under sub item (1): “CCWS Common Headers (Section 9.2.2)”
- Add to list of systems under sub item (1): “SFP Makeup Capability (9.1.3.2.4)”
- Add to list of systems under sub item (1): “Electrical Power Supply System (EPSS) (Section 8.3.1 - Portions of Trains 2 and 3 in Safeguards Buildings)”
- Add to list of systems under sub item (2): “Electrical Power Supply System (EPSS) (Section 8.3.1 - Portions of Trains 1 and 4 in Safeguards Buildings)”

The following clarification will be added to U.S. EPR FSAR Tier 2, Section 19.2.7.4, sub part (1):

> “The use of hardened and isolated shield structures provides protection for the Containment, Fuel Building, and Safeguard Building 2/3 structures and the credited portions of following SSCs that are housed in these structures:”

The following clarification will be added to U.S. EPR FSAR Tier 2, Section 19.2.7.4, sub part (1):

> “The structural isolation of the shield structures provides protection against shock induced vibration from the impact of a large commercial aircraft so that the credited portions of the SSCs housed in these structures are not damaged.”

The following clarification will be added to U.S. EPR FSAR Tier 2, Section 19.2.7.4, sub part (2):

> “The hardened building exterior provides protection for the credited portions of the following SSCs housed in Safeguard Buildings 1 and 4 from physical damage resulting from the impact of a large commercial aircraft:”

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 19.2.7, will be revised as described in the response and indicated on the enclosed markup.

Question 19-360:

U S EPR FSAR Tier 2 Revision 3, Section 19.2.7.3, “Methodology,” states that the methodology used to demonstrate compliance with 10 CFR 50.150 is NEI 07-13, “Methodology for Performing Aircraft Impact Assessments for New Plant Designs,” Revision 7.

FSAR Section 19.2.7.4, “Design Features Credited for Conformance with 10 CFR 50.150,” states that because the systems necessary to scram the reactor are housed in the hardened and isolated Shield Building structures, there is no potential for impact damage that would prevent a scram. Following shutdown, one or more trains of the safety related and support systems in this section are available to maintain core cooling and SFP cooling.

Tables 3-4 “Approach to Key Issues in Scenario Development,” and 3-5 “Key Assumptions to be Used in Damage Footprint Assessment,” of NEI 07-13 provides the guidance for treating reactor scram in the assessment. Item 3 in Table 3-4 states in part “However, in reviewing damage footprints in areas with equipment essential to reactor scram an assessment will be made of the potential for damage to prevent a scram should it have not occurred.” In this regard, describe those design features that assure the reactor will be shutdown following an aircraft impact, including any features that protect equipment in the Reactor Trip System (Section 7.2.). Include in your discussion the necessary key design features needed for any core boration (reference FSAR Section 6.8, “Extra Borating System”) to maintain the core subcritical during cooldown of the reactor coolant in FSAR Section 19.2.7.5.2, “RCS Heat Removal Capability.”

The applicant should provide the staff with a marked-up copy of FSAR Section 19.2.7 that shows the required descriptions and include the descriptions in the next Revision of the FSAR. If detailed descriptions of the subject design features are described in sections of the FSAR other than FSAR 19.2.7, then in FSAR Section 19.2.7, identify the features and the sections of the FSAR containing the descriptions. Include descriptions of any success criteria in the US EPR design PRA that are associated with the key design features.

Response to Question 19-360:

The assessment evaluated the location of equipment essential to reactor scram to determine if a potential exists for damage to prevent a scram should it have not occurred. The reactor trip components will be added to the list of protected equipment in U.S. EPR FSAR Tier 2, Section 19.2.7.4. The assessment evaluated the location of equipment essential to core boration to determine if a potential exists for returning to criticality during cooldown after an impact by a commercial airliner. The Extra Borating System (U.S. EPR FSAR Tier 2, Section 6.8) is listed as protected equipment in U.S. EPR FSAR Tier 2, Section 19.2.7.4.

U.S. EPR FSAR Tier 2, Section 19.2.7 and AREVA Technical Reports ANP-10295, ANP-10296, and ANP-10317 provide a description of the design features and success criteria credited in the assessment. The success sets are consistent with the PRA success criteria. FSAR Section 19.2.7.4 will be revised to reflect that supplemental details on credited features are found in AREVA Technical Reports ANP-10295, ANP-10296, and ANP-10317. U.S. EPR Tier 2, Section 19.2.8 and U.S. EPR FSAR Tier 2, Table 1.6-1 will be revised to reflect the addition (and revisions) of AREVA Technical Reports ANP-10295, ANP-10296, and ANP-10317 that are being submitted in a separate transmittal.

The following item will be added to the list of protected equipment under U.S. EPR FSAR Tier 2, Section 19.2.7.4:

- Add to list of systems under sub item (1): “Reactor Trip Breakers (Section 7.2.1.1)”

FSAR Impact:

U.S. EPR FSAR Tier 2, Table 1.6-1, Section 19.2.7.4, and Section 19.2.8 will be revised as described in the response and indicated on the enclosed markup.

Question 19-361:

US EPR FSAR Tier 2 Revision 3, Section 19.2.7.4, "Design Features Credited for Conformance with 10 CFR 50.150," states that the use of hardened and isolated shield structures provides protection for the Containment, Fuel Building, and Safeguard Building 2/3 structures and the following credited SSCs that are housed in these structures. Component cooling water system (CCWS), trains 2/3 is one of these systems which protection is provided.

US EPR FSAR Section 19.2.7.5, "Evaluation of U.S. EPR Performance," states that the physically separate and redundant train design of the U.S. EPR provides for survival of supporting functions such as emergency power and ultimate heat sink capability.

US EPR FSAR Section 9.2.2, "Component Cooling Water System," state that the CCWS divisions are cross connected between various headers, for example; 1A, 1B, 2A, 2B and the thermal barrier. Cross connected trains also exists for the safety chilled water system (FSAR 9.2.8).

Describe in FSAR Section 19.2.7 the key design features that are credited and have cross connections between division/trains for aircraft impact in accordance with paragraph (b)(1) of 10 CFR 50.150. Specifically describe in the FSAR that the key design features which may physically be located in multiple structures, which are able to be cross connected with motor operated, automatic, hydraulic, or manual valves will be able to perform their intended function for core cooling or spent fuel pool cooling after the impact of a large commercial airplane.

The applicant should provide the staff with a marked-up copy of FSAR Section 19.2.7 that shows the required descriptions and include the descriptions in the next revision of the FSAR.

Response to Question 19-361:

The assessment evaluated multi-divisional effects for normally cross-tied divisional systems (e.g., CCWS, SCWS). The assessment evaluated the system response of the cross-tied system to determine if damage in one division will affect the functionality of the second division. A summary of the evaluation is included in AREVA Technical Report ANP-10296.

The following sentence will be added to U.S. EPR FSAR Tier 2, Section 19.2.7.5.2:

> "The assessment evaluated multi-divisional effects for normally cross-tied divisional systems (e.g., Component Cooling Water System and Safety Chilled Water System). The assessment evaluated the system response of the cross-tied system to determine if damage in one division will affect the functionality of the second division. "

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 19.2.7 will be revised as described in the response and indicated on the enclosed markup.

Question 19-362:

US EPR FSAR Tier 2 Revision 3, Section 9.1.4, "Fuel Handling System," describes a spent fuel cask transfer system which is connected to the underside of the spent fuel loading pit. One of the structures of concern in NEI-07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," is the fuel handling building.

Describe in FSAR 19.2.7 the key design features for an aircraft impact assessment (AIA) postulating an impact of a large commercial airplane during spent fuel assemblies off loading from the spent fuel pool into a spent fuel cask. Describe if during an aircraft impact and during spent fuel assemblies off loading from the spent fuel pool if there is a leakage path below the minimum water level due to related vibrations/shock damage.

The applicant should provide the staff with a marked-up copy of FSAR Section 19.2.7 that shows the required descriptions and include the descriptions in the next revision of the FSAR.

Response to Question 19-362:

No additional key design features beyond those already listed in U.S. EPR FSAR Tier 2, Section 19.2.7.4 are required for the protection of the cask loading system. The location of the connection between the cask and the cask loading pit/transfer compartment and the location of the transport vehicle supporting the cask were evaluated for vibration effects in the assessment. No damage resulting in a leakage path below the minimum water level due to related vibrations/shock damage was predicted.

FSAR Impact:

The U.S. EPR FSAR will not be changed as a result of this question.

Question 19-363:

It is stated in US EPR FSAR Tier 2 Revision 3, Section 19.2.7, "Beyond Design Basis Large Commercial Aircraft Impact Assessment," that the methodology used for assessing effects of aircraft impact is described in NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," Revision 7 (NEI 07-13).

Detailed description for support systems related to key design features appear to be missing from FSAR 19.2.7 aircraft impact assessment including:

Essential Service Water Pump Building Ventilation (9.4.11)

Nuclear Auxiliary Building Ventilation (9.4.3)

Safeguard Building Controlled-Area Ventilation System (9.4.5)

Containment Building Ventilation System (9.4.7)

Emergency Power Generating Building Ventilation System (9.4.9)

Containment Isolation System (6.2.4)

Cask loading pit/transfer compartment (9.1.3.2.4)

Alternating Current Power (8.3)

The US EPR FSAR Tier 2 Revision 3, Section 19.2.7 submittal reviewed by the NRC should accurately reflect the results of the Aircraft Impact Assessment (AIA) performed by the applicant as required by 10 CFR 50.150. The submittal should include all key design features and functional capabilities credited in the AIA to meet the acceptance criteria. As such, the applicant is requested to verify that the submittal fully identified and described all key design features and functional capabilities credited in the AIA.

The applicant should provide an assessment of the above noted systems and provide the staff with a marked-up copy of FSAR Section 19.2.7 that shows the required descriptions and include the descriptions in the next revision of the FSAR.

Response to Question 19-363:

The analysis considered the impact on the front line systems from damage to supporting systems and dependencies. The front lines systems, support systems, and dependencies were evaluated against the list of protected systems listed in U.S. EPR FSAR Tier 2, Section 19.2.7.4.

As noted in the response to Question 19-359, U.S. EPR FSAR Tier 2, Section 19.2.7.5 will be revised to indicate that supporting systems necessary for the front line systems to be able to perform their intended functions are protected from damage (e.g., UHS, CCWS, ESWS, HVAC).

However, not all the systems included in Question 19-363 were identified in the AIA as having a direct support role for the emergency equipment including:

- Nuclear Auxiliary Building Ventilation (U.S. EPR FSAR Tier 2, Section 9.4.3) – No dependencies on this system were identified.

- Containment Building Ventilation System (U.S. EPR FSAR Tier 2, Section 9.4.7) – No dependencies on this system were identified.
- Alternating Current Power (U.S. EPR FSAR Tier 2, Section 8.3) – (Analysis credits the EPSS instead).
- Safeguard Building Controlled-Area Ventilation System (U.S. EPR FSAR Tier 2, Section 9.4.5) – (Analysis credits SBVSE instead).

The following sentence will be added to U.S. EPR FSAR Tier 2, Sections 19.2.7.5.2 and 19.2.7.5.4:

> "Maintaining front-line system functionality includes availability of sufficient supporting systems (e.g.; cooling, makeup water supply, power, heat sink systems as identified in Section 19.2.7.4) to allow the front-line system to perform its intended function."

The following items will be added to the list of protected equipment for U.S. EPR FSAR Tier 2, Section 19.2.7.4:

- Add to list of systems under sub item (1): "Containment Isolation System (Section 6.2.4)."
- Add to list of systems under sub item (1): "Cask loading pit/transfer compartment (9.1.4.3.1)."
- Add to list of systems under sub item (4): "Essential Service Water Pump Building Ventilation (9.4.11)."
- Add to list of systems under sub item (4): "Emergency Power Generating Building Ventilation System (9.4.9)."

FSAR Impact:

U.S. EPR FSAR Tier 2, Section 19.2.7, will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

19-358

radiological release limits in the event of an SSE or other hazard. Isolation of the building is provided if radioactivity is released inside the building. The interaction of the Radioactive Waste Processing Building with Seismic Category I structures is described in Section 3.7.2. The design of the concrete sliding door located in the hallway between the RWPB and the NAB is described in Section 19.2.7.4.3.

Ultimate Heat Sink Structure

Four division-related and independent mechanical draft cooling towers serve as the UHS for the U.S. EPR. Each division has an ESWS Pump Building located with the respective cooling tower structure. The UHS is arranged with two of the four divisions located on opposite sides of the Reactor Building. The UHS is described in Section 9.2.5. The design of the ESWS Pump Buildings is described in Section 3.8.4.

1.2.3.2 Reactor Coolant System

The RCS configuration is a conventional four-loop design. The RPV is located at the center of the Reactor Building and contains the fuel assemblies. The reactor coolant flows from the RPV through the hot leg pipes to the SGs and returns to the RPV via the cold leg pipes, which contain the RCPs. The PZR is connected to one hot leg via a surge line and to two cold legs by spray lines. The RCS is described in further detail in Chapter 5.

1.2.3.2.1 Reactor Pressure Vessel

The RPV is the main component of the RCS. The vessel is cylindrical, with a welded hemispherical bottom and a removable flanged hemispherical upper head with gasket. The RPV is made of low-alloy steel, with the internal surface covered by stainless steel or NiCrFe alloy cladding for corrosion resistance. This unit is designed to provide the volume required to contain the reactor core, the control rods, the heavy reflector, and the supporting and flow-directing internals. The RPV nozzles are the fixed point of the RCS.

The RPV has four inlet nozzles and four outlet nozzles located in a horizontal plane just below the reactor vessel flange but above the top of the core. Coolant from the cold legs enters the vessel through the inlet nozzles and flows down through the annulus formed by the space between the core barrel and the reactor vessel inner wall. At the bottom of the vessel, the coolant is deflected to pass up through the core to the outlet nozzles. Heated reactor coolant leaves the RPV through four outlet nozzles, flowing into the hot legs and toward the SGs.

The cylindrical shell of the RPV consists of two sections, an upper and a lower part. To minimize the number of large welds, which require frequent in-service inspections, the upper part of the RPV is machined from a single forging and fabricated with eight nozzles. Because the nozzles are welded to an axis-symmetric ledge machined out

Table 1.6-1—Reports Referenced
Sheet 2 of 5

Report No. (See Notes 1, 2, and 3)	Title	Date Submitted to NRC	FSAR Section Number(s)
[*ANP-10287P ANP-10287NP*	*Incore Trip Setpoint and Transient Methodology for U.S. EPR Topical Report*]*	11/27/07	4.3, 4.4, 7.1, 7.2, 15.0, 15.1, 15.2,15.3,15.4,15.6, 16
ANP-10288P ANP-10288NP Revision 1	U.S. EPR Post-LOCA Boron Precipitation and Boron Dilution Technical Report	1/10	15
ANP-10290 Revision 1	AREVA NP Environmental Report Standard Design Certification	9/11/09	19.2
ANP-10291P ANP-10291NP	Small Break LOCA and Non-LOCA Sensitivity Studies and Methodology Technical Report	5/09	15
ANP-10292 Revision 1	U.S. EPR Conformance with Standard Review Plan (NUREG-0800) Technical Report	5/09	1.9
ANP-10293P, Revision 4	U.S. EPR Design Features to Address GSI-191 Technical Report	11/11	6.3 and 15.6.5.4.3
ANP-10294 Revision 1	U.S. EPR Reactor Coolant Pump Motor Flywheel Structural Analysis Technical Report	3/09	5.4.1.6.6
ANP-10295P ANP-10295NP Revision 4~~3~~	U.S. EPR Security Design Features Technical Report	4/13~~2/12~~	13.6 and 19.2.7
ANP-10296 Revision 1	U.S. EPR Design Features that Enhance Security	4/13~~12/08~~	13.6 and 19.2.7
ANP-10299P Revision 2	Applicability of AREVA NP Containment Response Evaluation Methodology to the U.S. EPR for Large Break LOCA Analysis, including Supplement 1, August 2011.	12/09	6.2.1 and 6.2.5
[*ANP-10304 Revision 5*	*U.S. EPR Diversity and Defense in Depth Assessment Technical Report*]*	5/12	1.9, 7.1, 7.2, 7.3, 7.8, 18.7, 19.1
ANP-10306P, Revision 1	Comprehensive Vibration Assessment Program for U.S. EPR Reactor Internals Technical Report	1/13 ~~12/09~~	3.9.2.1.1, 3.9.2.3, 3.9.2.4, and 3.9.2.7

19-360

Table 1.6-1—Reports Referenced
Sheet 3 of 5

Report No. (See Notes 1, 2, and 3)	Title	Date Submitted to NRC	FSAR Section Number(s)
[*ANP-10309P ANP-10309NP Revision 4*	*U.S. EPR Protection System Technical Report*]*	5/12	4.6, 7.1, 7.2, and 7.3
[*ANP-10310P Revision 1*	*Methodology for 100% Combinatorial Testing of the U.S. EPR Priority Module Technical Report*]*	3/11	7.1
ANP-10314	The Operating Strategies for Severe Accidents Methodology for the U.S. EPR Technical Report	7/10	19.2
[*ANP-10315P Revision 1*	*U.S. EPR Protection System Surveillance Testing and Teleperm XS Self-Monitoring Technical Report*]*	6/11	7.1,7.3
ANP-10317 Revision 1	Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures	4/13~~5/11~~	19.2.7.4
ANP-10318P	Pipe Rupture External Loading Effects on U.S. EPR Essential Structures, Systems, and Components Technical Report	3/11	3.6.2
ANP-10322P	Qualification and Testing of the U.S. EPR Passive Autocatalytic Recombiner	6/12	6.2.5
[ANP-10324P	*U.S. EPR Implementation Plan for the Integration of Human Reliability Analysis (HRA) with the Human Factors Engineering (HFE) Program]**	1/13	18.6
[ANP-10327P	*U.S. EPR HFE Program Management Plan]**	4/13	18
[ANP-10328P	*U.S. EPR Human System Interface Design Implementation Plan]**	4/13	18
BAW-10132-A	Analytical Methods Description – Reactor Coolant System Hydrodynamic Loadings During a Loss-of-Coolant Accident	7/20/79	App. 3C
BAW-10133P-A BAW-10133-A Revision 1, Addendum 1 and 2	Mark-C Fuel Assembly LOCA-Seismic Analysis	10/30/00	4.2

19-357 and 19-358

19.2.7.3 Methodology

The methodology used to demonstrate compliance with 10 CFR 50.150 is NEI 07-13, Revision 8~~7~~, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," dated April 2011~~May 2009~~ (Reference 18), applying the aircraft impact loading function provided by the NRC (Reference 19). The methodology of NEI 07-13, Revision 8~~7~~ was followed with no exceptions.

19-357

The methodology is subdivided into two major evaluations:

- Containment and Spent Fuel Pool Evaluation.

  Two distinct types of structural failure modes were evaluated for the containment structure and spent fuel pool: local failure (i.e., scabbing and perforation) caused by aircraft fuselage or engine impact and global structural failure (i.e., plastic collapse) caused by impact of the complete aircraft.

- Heat Removal Evaluation.

  The evaluation considered physical, shock, and fire effects of a large commercial aircraft impact that can cause damage to systems needed to maintain cooling of fuel in the vessel and the spent fuel pool.

19.2.7.4 Design Features Credited for Conformance with 10 CFR 50.150

The U.S. EPR design incorporates system redundancy, diversity, and independence. The key features incorporated to mitigate the effects of potential impact of aircrafts that are credited for compliance with 10 CFR 50.150 are as follows:

1. The use of individual hardened and isolated shield structures specific to the Containment, Fuel Building, and Safeguard Building 2/3.

   The hardened and isolated shield structures, as described in ANP-10317, "Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures¨ (Reference 24) and Sections 1.2.3.1.2, 3.8.4, Appendix 3B, and Appendix 3E.1.7, are a key design feature credited for compliance with 10 CFR 50.150. The use of hardened and isolated shield structures provides protection for the Containment, Fuel Building, and Safeguard Building 2/3 structures and credited portions of the following credited SSCs that are housed in these structures:

   19-359

   – Containment vessel (Section 3.8.2).

   – Containment Isolation System (Section 6.2.4). 19-363

   – RCS (Section 5.0).

   – Reactor Trip Breakers (Section 7.2.1.1). 19-360

   – Emergency core cooling water source, IRWST (Section 6.3).

- Main steam system (MSS) from the SGs to the Safeguard Building annulus penetration (Trains 1, 2, 3, and 4) (Section 10.3).
- Main feedwater system (MFWS) from the SGs to the Safeguard Building annulus penetration (Trains 1, 2, 3, and 4) (Section 10.4.7).
- SFP (Section 9.1).
- SFP Makeup Capability (Section 9.1.3.2.4).
- Fuel pool cooling and purification system (Section 9.1.3).
- Cask Loading Pit/Transfer Compartment (Section 9.1.4.3.1).
- MCR (Section 6.4).

19-363

- MCR HVAC (Section 9.4.1).
- Safety injection/RHRS (Trains 2 and 3) (Section 6.3).
- EFW system (Trains 2 and 3) (Section 10.4.9).
- CCWS (Trains 2 and 3) (Section 9.2.2).

19-359

- CCWS Common Headers (Section 9.2.2).
- ESWS (interior portions) (Trains 2 and 3) (Section 9.2.1).
- Uninterruptible electrical power supply systems (Trains 2 and 3) (Section 8.3.2).
- Electrical Power Supply System (EPSS) (Section 8.3.1 - portions of Trains 2 and 3 in Safeguard Buildings).
- Safety chilled water system (SCWS) (Trains 2 and 3) (Section 9.2.8).
- Electrical division of Safeguard Building ventilation system (Trains 2 and 3) (Section 9.4.6).
- Fuel Building ventilation system (Section 9.4.2).
- Annulus Ventilation System (Section 6.2.3.2.2).
- EBS (Section 6.8).
- I&C for the systems and components in this list (Section 7.0).

The structural isolation of the shield structures provides protection against shock-induced vibration from the impact of a large commercial aircraft so that the credited portions of SSCs housed in these structures are not damaged.

2. The use of a hardened building exterior for Safeguard Buildings 1 and 4.

   The hardened building exterior, as described in Reference 24 and Sections 1.2.3.1.2, 3.8.4, and Appendix 3B, is a key design feature credited for compliance with 10 CFR 50.150. The hardened building exterior provides protection for credited portions of the following SSCs housed in Safeguard Buildings 1 and 4 from physical damage resulting from the impact of a large commercial aircraft:

   – Safety Injection/RHRS (Trains 1 and 4) (Section 6.3).
   – EFW system (Trains 1 and 4) (Section 10.4.9).
   – CCWS (Trains 1 and 4) (Section 9.2.2).
   – ESWS (interior portions) (Trains 1 and 4) (Section 9.2.1).
   – SCWS (Trains 1 and 4) (Section 9.2.8).
   – Uninterruptible electrical power supply systems (Trains 1 and 4) (Section 8.3.2).
   – MSS from the Safeguard Building annulus penetration to the MSIV (Trains 1, 2, 3, and 4) (Section 10.3).
   – MFWS from the Safeguard Building annulus penetration to the MFW isolation valve (MFWIV) (Trains 1, 2, 3, and 4) (Section 10.4.7).
   – Electrical Power Supply System (EPSS) (Section 8.3.1 - portions of Trains 1 and 4 in Safeguard Buildings).
   – Electrical division of Safeguard Building ventilation system (Trains 1 and 4) (Section 9.4.6).
   – I&C located in Safeguard Buildings 1 and 4 for the systems and components in this list (Section 7.0).

19-359

3. Screening by the site arrangement and plant structural design.

   The site arrangement and structural design of major structures are key design features credited for compliance with 10 CFR 50.150. The arrangement and design of the major structures limits the location and effects of potential aircraft strikes on these structures. The characteristics of the structures credited for compliance with 10 CFR 50.150 are described in Reference 24 and supplemented by information in the U.S. EPR FSAR. The assessment credits the arrangement and design of the following building features to limit the location and effects of potential aircraft strikes on the U.S. EPR structures:

   – The location and design of concrete barriers at selected locations along the exterior of the U.S. EPR structures described in Reference 24 or in Appendix 3B provides protection of the interior of these structures.

- The location and design of the Emergency Power Generating Building structures and layout described in Section 3.8 and Reference 24 provides protection of portions of Safeguard Building 2/3 and Safeguard Building 4.

- The location and design of the Essential Service Water Building structures and layout described in Section 3.8 and Reference 24 provides protection of portions of Safeguard Building 1, Safeguard Building 2/3, and Safeguard Building 4.

- The location and design of the Nuclear Auxiliary Building structure and layout described in Section 1.2.3 and Reference 24 provides protection of portions of Safeguard Building 4 and the Fuel Building.

19-358

- The location and design of the Radioactive Waste Processing Building (RWPB) is described in Section 1.2.3. The design features for the RWPB concrete sliding door ~~in the Radioactive Waste Processing Building~~ (located between the RWPB and NAB at Elevation 0 feet) that are relied upon to meet the requirements of paragraph (a)(1) of 10 CFR 50.150 are described in ~~Section 1.2.3 and~~ Reference 24. ~~provides protection of portions of the Fuel Building.~~

4. Physically separate and redundant trains.

   Physically separate and redundant trains, as described in Section 1.2.3.1 are a key design feature credited for compliance with 10 CFR 50.150. This design feature results in one or more divisions of systems credited in Chapter 15 analyses remaining functional after the impact from a large commercial aircraft to maintain core and SFP cooling capability. The following U.S. EPR safety-related and support systems credited in Chapter 15 are physically separated and redundant:

   - Safety Injection/RHRS (Section 6.3).
   - EFW System (Section 10.4.9).
   - CCWS (Section 9.2.2).
   - ESWS (Exterior and buried portions) (Section 9.2.1).
   - ESW Pump Building Ventilation System (Section 9.4.11).
   - Ultimate heat sink (Section 9.2.5).
   - Uninterruptible electrical power supply systems (Section 8.3.2).
   - Emergency power supply system (EPSS) and EDG (Section 8.3.1).
   - EPGB Ventilation System (Section 9.4.9).

19-363

   In the event of an aircraft impact threat while the reactor is at power operation, NEI 07-13 (Reference 18) allows the assumption that the operators will have advance warning to take manual action to shutdown the reactor prior to impact.

Because the systems necessary to scram the reactor are housed in the hardened and isolated Shield Building structures, there is no potential for impact damage that would prevent a scram. Following shutdown, one or more trains of the safety-related and support systems in this section are available to maintain core cooling and SFP cooling.

For an aircraft impact that occurs during shutdown with the reactor head removed and the reactor pit not flooded, the same safety-related and support systems in this section are used and one or more trains of these systems remain available to maintain core cooling.

5. Fire barriers and fire protection features.

   Selected fire barriers, fire dampers, fire doors, and penetration seals are three-hour rated to prevent fire damage in one division from spreading to an adjacent division. Selected structural elements and blast dampers are 5 psid rated to prevent explosion effects from spreading to adjacent areas. The credited fire barriers, fire dampers, fire doors, penetration seals, structural elements, and blast dampers are identified on the fire zone layout figures in Appendix 9A.

19-360

6. AREVA NP Technical Reports ANP-10295 (Reference 25), ANP-10296 (Reference 26), and ANP-10317 (Reference 24) provide additional description of the design features and success criteria credited in the assessment.

19.2.7.5 Evaluation of U.S. EPR Performance

The U.S. EPR design was evaluated to establish a damage footprint for physical, fire, and vibration damage.

- Physical Damage.

  Finite element analyses indicate that interior areas of the four Safeguard Buildings, Fuel Building, and the Containment Building are not susceptible to damage due to physical perforation of aircraft components into the structures. The containment vessel, emergency core cooling water, spent fuel pool, fuel pool makeup systems, main control room, safety injection/residual heat removal systems, emergency feedwater systems, component cooling water systems, essential service water systems (interior portions), and uninterruptible electrical power supply systems are housed in the Safeguard, Fuel, or Containment Buildings and are not susceptible to damage resulting from physical perforation of aircraft components into the structures. The physically separate and redundant train design of the U.S. EPR provides for survival of supporting functions such as emergency power and ultimate heat sink capability.

- Fire Damage.

  The analyses indicate that perforation and entry of aircraft fuel are prevented or controlled, and areas within the protected perimeter are not susceptible to damage because of accelerant-fed fires. The fire damage footprint includes effects from

exterior fires that may damage areas within the air intake and exhaust ducts up to the first three hour and 5 psid fire-rated barrier.

- Vibration Damage.

  An analysis was performed of the linear distance from the impact point to each elevation of each structure. This resulted in specific zones at each elevation to account for the damage footprint for the most sensitive equipment. Analyses were performed based on shock induced vibration from an exterior wall strike and a strike on the adjacent Containment Shield Structure.

The damage footprint was used to assess containment integrity, RCS heat removal capability, SFP integrity, and SFP heat removal capability.

19.2.7.5.1 Containment Integrity

The Containment Structure is considered to be acceptable if the containment is maintained intact after both the local and global impact analyses. The assessment concluded that the hardened and isolated containment shield structure was not perforated, and no significant structural damage occurred because of either local or global impacts. The Containment Building, inside the Containment Shield Structure, was not impacted by the aircraft or any associated debris. Therefore, the containment performance, including ultimate pressure capacity, is unaffected. Under these conditions, no physical damage or fire damage inside containment needs to be considered.

19.2.7.5.2 RCS Heat Removal Capability

The reactor coolant system heat removal is considered sufficient if the heat removal capability analyses performed conclude that sufficient heat removal equipment is
19-359
available consistent with the PRA success criteria. The analyses performed demonstrated the ability of the U.S. EPR design, after the impact by a large commercial aircraft, to maintain functionality of one or more divisions of front-line and support systems (e.g., UHS, CCWS, ESWS, HVAC) credited in U.S. EPR FSAR Tier 2, Chapter 15 with providing reactor core cooling under accident conditions. The U.S. EPR design has features such as hardened and isolated shield structures, a strategic site arrangement and plant structural design, fire barriers, and the physically separate and
19-361
redundant trains. These features contribute to the success of one or more divisions of systems credited in Chapter 15 to maintain functionality to provide reactor core cooling after the impact of a large commercial aircraft. The assessment evaluated multi-divisional effects for normally cross-tied divisional systems (e.g., CCWS, SCWS). The assessment evaluated the system response of the cross-tied systems to determine if damage in one division affected functionality of the second division.

19-363

Maintaining front-line system functionality includes availability of sufficient supporting systems (e.g., cooling, makeup water supply, power , heat sink systems as

19-363

identified in Section 19.2.7.4) to allow the front-line system to perform its intended function. In addition, an aircraft impact does not create any new events that have not been analyzed in Chapter 15. NEI 07-13 does not require postulating a Chapter 15 event concurrent with an aircraft impact that does not perforate the structures containing RCS piping. Therefore, the RCS heat removal capability evaluation demonstrates additional margin in the U.S. EPR design.

19.2.7.5.3 SFP Integrity

The SFP integrity is considered to be maintained if the fuel pool liner does not have a leakage path below the minimum water level, the fuel is protected and there would be no unacceptable releases of radionuclides to the environment. Analyses demonstrate that no physical damage to the interior of the Fuel Building results from the aircraft crash. The prevention of aircraft perforation of the hardened and isolated shield structure surrounding the Fuel Building ensures that the SFP is not perforated and that SFP integrity is maintained.

19.2.7.5.4 SFP Heat Removal Capability

19-363

With the SFP integrity maintained, SFP cooling is provided consistent with the PRA. The availability of the make-up systems is assured due to the integrity of the hardened and isolated shield structure surrounding the Fuel Building. The shield structure provides physical and fire damage protection against an aircraft impact. The isolation of this structure provides continued functionality of the SFP makeup and protection against shock induced vibrations. Maintaining front-line system functionality includes availability of sufficient supporting systems (e.g., cooling, makeup water supply, power, heat sink systems as identified in Section 19.2.7.4) to allow the front-line system to perform its intended function. The fire protection system provides the capability to fill the Spent Fuel Pool.

19.2.7.6 Conclusions

The U.S. EPR has inherent protection to avoid or mitigate, with reduced reliance on operator actions, the effects of an aircraft impact. Although the regulations require meeting only two of the acceptance criteria, the assessment summarized above confirms the U.S. EPR design meets the four acceptance criteria in 10 CFR 50.150(a)(1) by following the methodology described in NEI-07-13 (Reference 18). The reactor remains cooled, the containment remains intact, and spent fuel cooling and spent fuel pool integrity are maintained. Accordingly, the U.S. EPR design features and functional capabilities provide for adequate protection of public health and safety in the event of an impact of a large commercial aircraft as required by 10 CFR 50.150.

14. Meyer, L., et al, “Melt Dispersion and Direct Containment Heating (DCH) Experiments in the DISCO-H Test Facility,” FZK Report FZKA 6988, ISSN 0947-8620, May 2004.

15. ANP-10290, Revision 1, “Environmental Report Standard Design Certification,” AREVA NP Inc, September 2009.

16. NEI 05-01 (Rev A), “Severe Accident Mitigation Alternatives (SAMA) Analysis, Guidance Document,” Nuclear Energy Institute, November 2005.

17. NUREG/BR-0184, “Regulatory Analysis Technical Evaluation Handbook,” U.S, Nuclear Regulatory Commission, January 1997.

19-357

18. NEI 07-13, “Methodology for Performing Aircraft Impact Assessments for New Plant Designs,” Revision 8~~7~~, April 2011~~May 2009~~.

19. Letter from D. Matthews, NRC to R. Ford, AREVA NP, “Approval of AREVA NP Inc. Safeguards Protection Program and Reviewing Official, and Transmittal of Beyond Design Basis, Large Commercial Aircraft Characteristics Specified by the Commission”, December 21, 2007.

20. Deleted.

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22. NUREG/CR-5334, “Severe Accident Testing of Electrical Penetration Assemblies,” SAND89-0327, November 1989.

23. ANP-10314, Revision 0, “The Operating Strategies for Severe Accidents Methodology for the U.S. EPR Technical Report,” AREVA NP Inc., July 2010.

19-360

24. ANP-10317, Revision 1~~0~~, “Design Requirements for the U.S. EPR Aircraft Hazard Protection Structures,” AREVA NP Inc., April 2013~~May 2011~~.

25. ANP-10295P, Revision 4, “U.S. EPR Security Design Features Technical Report,” AREVA NP Inc., April 2013.

26. ANP-10296, Revision 1, “U.S. EPR Design Features that Enhance Security,” AREVA NP Inc., April 2013.