From: HOTTLE Nathan (AREVA) [Nathan.Hottle@areva.com]
Sent: Wednesday, December 18, 2013 5:37 PM
To: Wunder, George
Cc: Clark, Phyllis; RYAN Tom (AREVA); GUCWA Len (EXTERNAL AREVA); UYEDA Graydon (AREVA); RANSOM Jim (AREVA); LEIGHLITER John (AREVA); WILLIFORD Dennis (AREVA); LOSEKE Brian (AREVA); OSWALD Todd (AREVA); DELANO Karen (AREVA); ROMINE Judy (AREVA); WILLS Tiffany (AREVA)
Subject: Response to U.S. EPR Design Certification Application RAI No. 541 (6322), FSAR Ch. 2 - NEW PHASE 4 RAI. Question 02-3, Supplement 2
Attachments: RAI 541 Supplement 2 Response US EPR DC.pdf

George,

AREVA NP Inc. provided a schedule for the response to the one question in RAI 541 on April 18, 2012. Supplement 1 response was sent on September 5, 2013 to provide a final response to Question 02-3.

The attached file, “RAI 541 Supplement 2 Response US EPR DC.pdf,” provides a revised final response to Question RAI 541 - 02-3. 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 Question RAI 541 - 02-3. This Response to RAI 541, Supplement 2 has not changed from the Response to RAI 541 Supplement 1, which was transmitted on September 5, 2013. Some pages in the U.S. EPR FSAR markups were changed to address NRC comments. RAI 541, Supplement 1, in addition to the changed pages in the U.S. EPR FSAR markups in Supplement 2, provide the full and complete Response to Question 02-3.

The following table indicates the pages in the response document, “RAI 541 Supplement 2 Response US EPR DC.pdf” that contain AREVA NP’s final response to the subject question.

Question #	Start Page	End Page
RAI 541 — 02-3	2	4

This concludes the formal AREVA NP response to RAI 541, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Nathan Hottle
AREVA Inc.
3315 Old Forest Road
Lynchburg, VA 24501
Phone 434-832-3864
Mobile 434-485-4239
nathan.hottle@areva.com

From: HOTTLE Nathan (EP/PE)
Sent: Thursday, September 05, 2013 3:30 PM
To: Snyder, Amy (Amy.Snyder@nrc.gov)

Cc: perry.buckberg@nrc.gov; GUCWA Len (External RS/NB); UYEDA Graydon (EP/PE); LEIGHLITER John (RS/NB); RANSOM Jim (RS/NB); RYAN Tom (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 541 (6322), FSAR Ch. 2 - NEW PHASE 4 RAI. Question 02-3, Supplement 1

Amy,

AREVA NP Inc. provided a schedule for the response to the one question in RAI 541 on April 18, 2012.

The attached file, "RAI 541 Supplement 1 Response US EPR DC - PUBLIC.pdf," provides a final response to Question RAI 541 - 02-3. 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 un-redacted security-related version is provided under separate email.

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 Question RAI 541 - 02-3.

The following table indicates the pages in the response document, "RAI 541 Supplement 1 Response US EPR DC - PUBLIC.pdf" that contain AREVA NP's final response to the subject question.

Question #	Start Page	End Page
RAI 541 — 02-3	2	4

This concludes the formal AREVA NP response to RAI 541, and there are no questions from this RAI for which AREVA NP has not provided responses.

Sincerely,

Nathan Hottle
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nathan.hottle@areva.com

From: WILLIFORD Dennis (RS/NB)
Sent: Wednesday, April 18, 2012 8:08 AM
To: Getachew.Tesfaye@nrc.gov
Cc: BENNETT Kathy (RS/NB); DELANO Karen (RS/NB); ROMINE Judy (RS/NB); RYAN Tom (RS/NB)
Subject: Response to U.S. EPR Design Certification Application RAI No. 541 (6322), FSAR Ch. 2 - NEW PHASE 4 RAI

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 541 Response US EPR DC.pdf," provides a schedule since a technically correct and complete response to the one question cannot be provided at this time.

The following table indicates the respective pages in the response document, "RAI 541 Response US EPR DC.pdf," that contain AREVA NP's response to the subject question.

Question #	Start Page	End Page
RAI 541 — 02-3	2	3

The schedule for a technically correct and complete response to this question is provided below.

Question #	Response Date
RAI 541 — 02-3	July 16, 2013

Sincerely,

Dennis Williford, P.E.
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
7207 IBM Drive, Mail Code CLT 2B
Charlotte, NC 28262
Phone: 704-805-2223
Email: Dennis.Williford@areva.com

From: Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
Sent: Wednesday, March 21, 2012 8:36 AM
To: ZZ-DL-A-USEPR-DL
Cc: Harvey, Brad; Hatchett, Gregory; Ford, Tanya; Segala, John; ArevaEPRDCPEm Resource
Subject: U.S. EPR Design Certification Application RAI No. 541 (6322), FSAR Ch. 2 - NEW PHASE 4 RAI

Attached please find the subject request for additional information (RAI). A draft of the RAI was provided to you on March 2, 2012, and on March 16, 2012, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,

Getachew Tesfaye
Sr. Project Manager
NRO/DNRL/LB1
(301) 415-3361

Hearing Identifier: AREVA_EPR_DC_RAIs
Email Number: 4756

Mail Envelope Properties (8D35DF68A379A34E8526B758FDCFC0420B71335B)

Subject: Response to U.S. EPR Design Certification Application RAI No. 541 (6322), FSAR Ch. 2 - NEW PHASE 4 RAI. Question 02-3, Supplement 2
Sent Date: 12/18/2013 5:37:28 PM
Received Date: 12/18/2013 5:38:36 PM
From: HOTTLE Nathan (AREVA)

Created By: Nathan.Hottle@areva.com

Recipients:
"Clark, Phyllis" <Phyllis.Clark@nrc.gov>
Tracking Status: None
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Tracking Status: None
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Tracking Status: None
"ROMINE Judy (AREVA)" <Judy.Romine@areva.com>
Tracking Status: None
"WILLS Tiffany (AREVA)" <Tiffany.Wills@areva.com>
Tracking Status: None
"Wunder, George" <George.Wunder@nrc.gov>
Tracking Status: None

Post Office: FUSLYNCMX01.fdom.ad.corp

Files	**Size**	**Date & Time**
MESSAGE	6103	12/18/2013 5:38:36 PM
RAI 541 Supplement 2 Response US EPR DC.pdf		820884

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

Response to

Request for Additional Information No. 541(6322), Revision 0, Supplement 2

3/17/2012

U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 02 - Site Characteristics and Site Parameters
Application Section: FSAR Tier 1, Section 5.0; FSAR Tier 2, Sections 2.0, 2.3, 3.2.2, 3.5.1.4, 3.5.3, 3.8.1, 3.8.3, 3.8.4, 3.8.5

QUESTIONS for Siting and Accident Conseq Branch (RSAC)

Question 02-3:

OPEN ITEM

New Phase 4 RAI

10 CFR 52.47(a)(1) states that the FSAR for an application for a standard design certification must contain the site parameters postulated for the design and an analysis and evaluation of the design in terms of those site parameters, where site parameters are defined in 10 CFR 52.2(a) as the postulated physical, environmental and demographic features of an assumed site. 10 CFR Part 50, Appendix A, GDC 2 requires that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as tornadoes and hurricanes without loss of capability to perform their safety functions. 10 CFR Part 50, Appendix A, GDC 4 requires that SSCs that are important to safety be appropriately protected against the effects of missiles that may result from events and conditions outside the nuclear power unit.

Nuclear power plants must be designed so that they remain in a safe condition under extreme meteorological events, including those that could result in the most extreme wind events (tornadoes and hurricanes) that could reasonably be predicted to occur at the site. Initially, the U.S. Atomic Energy Commission (predecessor to the NRC) considered tornadoes to be the bounding extreme wind events and issued RG 1.76, ''Design-Basis Tornado for Nuclear Power Plants,'' in April 1974. The design-basis tornado wind speeds were chosen so that the probability that a tornado exceeding the design basis would occur was on the order of 10^{-7} per year per nuclear power plant. In March 2007, the NRC issued Revision 1 of RG 1.76, ''Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants." Revision 1 of RG 1.76 relied on the Enhanced Fujita Scale, which was implemented by the National Weather Service in February 2007. The Enhanced Fujita Scale is a revised assessment relating tornado damage to wind speed, which resulted in a decrease in design-basis tornado wind speed criteria in Revision 1 of RG 1.76. Since design-basis tornado wind speeds were decreased as a result of the analysis performed to update RG 1.76, it was no longer clear that the revised tornado design basis wind speeds would bound design-basis hurricane wind speeds in all areas of the United States. This prompted an investigation into extreme wind gusts during hurricanes and their relation to design basis hurricane wind speeds, which resulted in issuing RG 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants," in October 2011.

RG 1.221 also evaluated missile velocities associated with several types of missiles considered for different hurricane wind speeds. The hurricane missile analyses presented in RG 1.221 are based on missile aerodynamic and initial condition assumptions that are similar to those used for the analyses of tornado-borne missile velocities adopted for Revision 1 to RG 1.76. However, the assumed hurricane wind field differs from the assumed tornado wind field in that the hurricane wind field does not change spatially during the missile's flight time but does vary with height above the ground. Because the size of the hurricane zone with the highest winds is large relative to the size of the missile trajectory, the hurricane missile is subjected to the highest wind speeds throughout its trajectory. In contrast, the tornado wind field is smaller, so the tornado missile is subject to the strongest winds only at the beginning of its flight. This results in the same missile having a higher maximum velocity in a hurricane wind field than in a tornado wind field with the same maximum (3-second gust) wind speed.

Accordingly, the applicant is being requested to add hurricane wind speed and hurricane missile spectra to its list of site parameter values in Tier 1 and Tier 2 of the FSAR and show in Chapter

3 of Tier 2 of the FSAR how SSCs important to safety are protected from the combined effects of hurricane winds and missiles.

Response to Question 02-3:

This Response to RAI 541, Supplement 2 has not changed from the Response to RAI 541 Supplement 1, which was transmitted on September 5, 2013. Some pages in the U.S. EPR FSAR markups were changed to address NRC comments. RAI 541, Supplement 1, in addition to the changed pages in the U.S. EPR FSAR markups in Supplement 2, provide the full and complete Response to Question 02-3.

The highest design basis hurricane speed is shown to be 290 mph in RG 1.221; however, only limited territory along the East Coast and the Mexican Gulf fall into these regions. The highest hurricane wind speed in the main land read from the RG 1.221 is 230 mph. A hurricane design wind speed of 230 mph is therefore selected to match the current tornado design wind speed. The hurricane design wind speed of 230 mph will be added to the site parameters to U.S. EPR FSAR Tier 1, Table 5.0-1. The U.S. EPR FSAR Tier 1, Section 2.0 “System Based Design Description of ITAAC” will also be revised to include hurricane.

RG 1.221 presents a design basis hurricane missile spectrum for nuclear power plants which is the same as the design basis tornado missile spectrum presented in Revision 1 of RG 1.76. This spectrum includes (1) a massive high kinetic-energy missile that deforms on impact (an automobile), (2) a rigid missile that tests penetration resistance (a pipe), and (3) a small rigid missile of a size sufficient to pass through any opening in protective barriers (a solid steel sphere). At a hurricane design wind speed of 230 mph, the respective design basis horizontal hurricane missile velocities (ft/s) are 222, 176, and 155. The design basis vertical missile velocity for hurricane missiles is 85 ft/s. The design basis hurricane wind and hurricane missile spectrum will be added to the site basic parameters in U.S. EPR FSAR Tier 2, Table 2.1-1.

Existing procedures and requirements for protection of structures, systems, and components (SSCs) important to safety subjected to combined effects of tornado winds and missiles are also applicable to combined effects of hurricane winds and missiles.

Tornado effects considered in the design of safety related SSCs include combinations of tornado wind effects, atmospheric pressure change effects, and tornado-generated missile impact effects. The same approach for combining the effects of tornado winds and missiles is used to combine the effects of hurricane winds and missiles, except that the load from the hurricane atmospheric pressure change is negligible. As a result, the maximum enveloping combined extreme wind loading due to tornado or hurricane is used in performing load combination calculations. U.S. EPR FSAR Tier 2, Sections 3.8.1, 3.8.2, 3.8.3, 3.8.4, and 3.8.5 will be revised accordingly.

Hurricane wind velocity is converted into effective pressure that is applied to the surfaces of U.S. EPR Seismic Category I and II SSCs important to safety in the same way in which severe wind pressure loads are determined. The Static Structural Analyses have been updated to incorporate the hurricane wind effects. U.S. EPR FSAR Tier 2 Sections 3.3, 3.3.1, and 3.3.2 will be updated to reflect that hurricane and tornado winds are considered extreme winds. Loads considered for the design of critical sections will be provided in the Response to RAI 155, Question 3.8.4-6.

Since the hurricane missile spectrum is the same as the tornado missile spectrum, U.S. EPR FSAR Tier 2, Section 3.5.1.4 is also applicable to hurricane will be revised accordingly. The same design approach and methodology described in U.S. EPR FSAR Tier 2, Section 3.5.3 “Barrier Design Procedures” are also used in the design evaluation of safety related structures, with the exception that the horizontal hurricane missile velocities are higher than the horizontal tornado missile velocities and the vertical hurricane missile velocities are constant.

ITAAC for hurricane and tornado loading of the Nuclear Auxiliary Building are addressed in the Response to RAI 592.

FSAR Impact:

U. S. EPR FSAR Tier 1, Sections 2.1.1, 2.1.2, 2.1.5, and Tables 2.1.1-8, 2.1.1-10, 2.1.1-11, 2.1.2-3, and 2.1.5-3 were revised as described in the response and were provided in the Response to RAI 541, Supplement 1.

U.S. EPR FSAR Tier 1, Table 5.0-1 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR FSAR Tier 2, Sections 1.2.1, 1.2.3, 3.1.1, 3.3, 3.5.1, 3.5.2, 3.5.3, 3.8.1, 3.8.2, 3.8.3, 3.8.4, 3.8.5, 3.9.3.1, 4.6.1, 6.2.1, 7.1.3, 8.2.2, 8.3.1, 9.2.5, 9.4.11, 9.5.4, 10.3.3, 11.4.1, 16, 19.1.5, and Tables 1.8-1, 1.8-2, 1.9-2, 2.1-1, 3.5-1, 3.5-2, 3.9.3-2, and 3.9.3-4 were revised as described in the response and were provided in the Response to RAI 541, Supplement 1.

U.S. EPR FSAR Tier 2, Sections 2.3, 3.3.1, and 3.3.2, and Figure 2.3-1 will be revised as described in the response and indicated on the enclosed markup.

U.S. EPR Final Safety Analysis Report Markups

Table 5.0-1—Site Parameters for the U.S. EPR Design
Sheet 2 of 3

Tornado	
Parameter	**Value(s)**
Maximum Pressure and Rate of DropTornado (maximum speed, pressure drop, radius of maximum rotational speed, rate of pressure drop, missile spectra)	1.2 psi at 0.5 psi/sMaximum tornado wind speed of 230 mph.
Maximum Rotational Speed	Maximum rotational speed of 184 mph.
Maximum Translational Speed	46 mph
Maximum Wind Speed	Maximum tornado pressure drop of 1.2 pounds per square inch at 0.5 psi per second.230 mph
Radius of Maximum Rotational Speed	Radius of maximum rotational speed is 150 ft.
Missile Spectra	6 in Schedule 40 pipe, 6.625 in diameter x 15 ft long, 287 lb, 34.5 in^2 impact area, impact velocity of 135 fps horizontal and 90 fps vertical.
	Automobile, 16.4 ft x 6.6 ft x 4.3 ft, 4000 lb, 4086.7 in^2 impact area, impact velocity of 135 fps horizontal and 90 fps vertical. (Automobile missile is considered at elevations up to 30.0 ft above grade elevation.)
	Solid steel sphere, 1 in. diameter, 0.147 lb, 0.79 in^2 impact area, impact velocity of 26 fps horizontal and 17 fps vertical.
Hurricane	
Parameter	**Value(s)**
Hurricane (maximum speed)	Maximum hurricane wind speed of 230 mph.
Missile Spectra	6 in Schedule 40 pipe, 6.625 in diameter x 15 ft long, 287 lb, 34.5 in^2 impact area, impact velocity of 176 fps horizontal and 85 fps vertical.
	Automobile, 16.4 ft x 6.6 ft x 4.3 ft 4000 lb, 4086.7 in^2 impact area, impact velocity of 222 fps horizontal and 85 fps vertical. (Automobile missile is considered at elevations up to 30.0 ft above grade elevation).
	Solid steel sphere, 1 in diameter, 0.147 lb 0.79 in^2 impact area, impact velocity of 155 fps horizontal and 85 fps vertical.
Soil	
Parameter	**Value(s)**
Soil properties:	
Minimum angle of internal friction (in situ and backfill)	26.6 degrees(4)

2.3.4 Short-Term Atmospheric Dispersion Estimates for Accident Releases

Atmospheric dispersion factors (χ/Q values) considered to be representative of potential future nuclear plant sites in the U.S. were used to calculate the consequences from postulated accidental releases of radioactive and hazardous materials.

χ/Q values for ground-level releases were calculated at the exclusion area boundary (EAB) and at the low population zone (LPZ) for appropriate time periods up to 30 days after an accident. The accident χ/Q values were either extracted from Reference 1 or were calculated following the methodology in NRC RG 1.145. The ground-level χ/Q values used for short-term atmospheric dispersion dose analyses at the EAB and LPZ receptor locations are provided in Table 2.1-1.

In addition to the offsite accident consequences evaluated at the EAB and LPZ, onsite accident dose consequences at the Main Control Room (MCR) and Technical Support Center (TSC) were evaluated. MCR and TSC χ/Q values, provided in Table 2.1-1 for the main air supply and the unfiltered inleakage, are used for these analyses from potential post-accident release points. These multiple potential release points affecting the MCR and the TSC include:

- The vent stack.
- Main steam relief train (MSRT) releases for steam generator overpressure protection.
- Safeguard Building roofs via the Safeguard Building canopies.
- An open equipment hatch.
- Safeguard Building depressurization shaft.

The information in these tables conforms to the guidance in RG 1.23, RG 1.145, and RG 1.194. Conformance with RG 1.78 is addressed in Sections 2.2, 6.4, 9.4, and 9.5.

The input variables used in calculating the accident χ/Q values are shown in Table 2.3-1—ARCON96 Input Parameters for Control Room Air Intake χ/Q Values and Table 2.3-2—ARCON96 Input Parameters for Unfiltered Inleakage Control Room χ/Q Values.

Figure 2.3-1—U.S. EPR Release Points, Control Room Air Intakes, and Unfiltered Inleakage Locations provides the relative locations of the release points and the control room air intakes. Section 15.0.3 addresses the dose calculation methodology for accident analyses.

A COL applicant that references the U.S. EPR design certification will confirm that site-specific χ/Q values, based on site-specific meteorological data, are bounded by those specified in Table 2.1-1 at the EAB, LPZ, and the control room.

For site-specific χ/Q values that exceed the bounding χ/Q values, a COL applicant that references the U.S. EPR design certification will demonstrate that the radiological consequences associated with the controlling design basis accident continue to meet the dose reference values given in 10 CFR 50.34 and the control room operator dose limits given in GDC 19 using site-specific χ/Q values.

A COL applicant that references the U.S. EPR design certification will provide a description of the atmospheric dispersion modeling used in evaluating potential design basis events to calculate concentrations of hazardous materials (e.g., flammable or toxic clouds) outside building structures resulting from the onsite and/or offsite airborne releases of such materials.

2.3.5 Long-Term Atmospheric Dispersion Estimates for Routine Releases

A COL applicant that references the U.S. EPR design certification will provide the site-specific, long-term diffusion estimates for routine releases. In developing this information, the COL applicant should consider the guidance provided in RG 1.23, RG 1.109, RG 1.111, and RG 1.112. The maximum annual average χ/Q value at the site boundary, provided in Table 2.1-1, is used to calculate radionuclide concentrations associated with routine gaseous effluent releases, addressed in Section 11.3~~ 11.3~~, for comparison with environmental release limits and dose limits given in 10 CFR 20. If a reactor site has an annual average χ/Q value that exceeds the reference value, then a site-specific evaluation will be performed.

A COL applicant that references the U.S EPR design certification will also provide estimates of annual average atmospheric dispersion (χ/Q values) and deposition (D/Q values) for 16 radial sectors to a distance of 50 miles from the plant as part of its environmental assessment.

2.3.6 References

1. EPRI ALWR Utility Requirements Document, "Electric Power Research Institute Advanced Light Water Reactor Utility Requirements Document," Volume II-Revision 8, March 1999.

Table 2.3-1—ARCON96 Input Parameters for Control Room Air Intake χ/Q Values
Sheet 1 of 2

Parameter	Value(s)
Wind instrument heights	Site specific
Wind speed units of measure	Site specific
Release mode	Ground level (used for each pathway)
Building area	Assumed to be zero for each pathway
Vertical velocity	Assumed to be zero for each pathway
Stack flow	Assumed to be zero for each pathway
Stack radius	Assumed to be zero for each pathway
Terrain elevation difference	Assumed to be zero for each pathway
Direction to source	Site specific; EPR FSAR used the direction that produced the highest χ/Q values
Initial diffusion coefficients	Assumed to be zero for each pathway
Minimum wind speed value for ARCON96	0.5 m/sec
Surface roughness for ARCON96	0.2
Sector averaging constant for ARCON96	4.3
Wind direction window for ARCON96	90 degrees
Control Room air intake location employed in analysis	Intake closest to stack
Control Room air intake elevation	32.1 meters (Mid-point of intake)
Control Room air intake horizontal distance to stack base	69.0 meters
Control Room air intake horizontal distance to Main Steam Relief Train, via Silencer:	
SG-4 Silencer to MCR Div. 3 Air Intake (AI)	53.0 meters
SG-3 Silencer to MCR Div. 3 AI	46.0 meters
SG-1 Silencer to MCR Div. 3 AI	78.0 meters
SG-2 Silencer to MCR Div. 3 AI	71.0 meters
Control Room air intake horizontal distances to Canopy exhausts (referred to as the Canopy release point in the present application)	
1) Near depressurization shaft (Safeguard Building Div. 4)	30.1 meters
2) Southeast side of SAB Div. 4	65.3 meters

Table 2.3-1—ARCON96 Input Parameters for Control Room Air Intake χ/Q Values
Sheet 2 of 2

Parameter	Value(s)
Control Room air intake horizontal distance to Material Lock (for the Equipment Hatch release)	97.5 meters
Control Room air intake horizontal distance to the depressurization shaft of Safeguard Building Div. 4	31.4 meters
Release heights	Silencer – 33.9 meters Stack – 32.1 meters[(1)] Canopy Pt. 1 – 15.5 meters Canopy Pt. 2 – 11.5 meters elevation Material Lock (for Equipment Hatch release) – 32.1 meters Depressurization Shaft – 7 meters

Note:

1. Stack release height assumed to be the same as the mid-point of the control room air intake.

Table 2.3-2—ARCON96 Input Parameters for Unfiltered Inleakage Control Room χ/Q Values
Sheet 1 of 2

Parameter	Value(s)
Wind instrument heights	Site specific
Wind speed units of measure	Site specific
Release mode	Ground level (used for each pathway)
Building area	Assumed to be zero for each pathway
Vertical velocity	Assumed to be zero for each pathway
Stack flow	Assumed to be zero for each pathway
Stack radius	Assumed to be zero for each pathway
Terrain elevation difference	Assumed to be zero for each pathway
Direction to source	Site specific; EPR FSAR used the direction that produced the highest χ/Q values
Initial diffusion coefficients	Assumed to be zero for each pathway
Minimum wind speed value for ARCON96	0.5 m/sec
Surface roughness for ARCON96	0.2
Sector averaging constant for ARCON96	4.3
Wind direction window for ARCON96	90 °F
Unfiltered inleakage ~~air intake~~ elevation	32.1 meters
Unfiltered inleakage ~~air intake~~ horizontal distance to stack base	46.0 meters (same distance as SG-3 Silencer to MCR Div. 3 Air Intake)
Unfiltered inleakage ~~air intake~~ horizontal distance to Main Steam Relief Train, via Silencer:	
SG-1 Silencer	70.0 meters
SG-2 Silencer	62.0 meters
SG-3 Silencer	22.0 meters
SG-4 Silencer	32.0 meters
Unfiltered inleakage ~~air intake~~ horizontal distances to Canopy exhausts (referred to as the Canopy release point in the present application)	
1) Near depressurization shaft (Safeguard Building Div. 4)	12.7 meters
2) Southeast side of SAB Div. 4	45.3 meters

Table 2.3-2—ARCON96 Input Parameters for Unfiltered Inleakage Control Room χ/Q Values
Sheet 2 of 2

Parameter	Value(s)
Unfiltered inleakage ~~air intake~~ horizontal distance to Material Lock (for the Equipment Hatch release)	75.2 meters
Unfiltered inleakage ~~air intake~~ horizontal distance to the depressurization shaft of Safeguard Building Div. 4	17.3 meters
Release heights	Silencer – 33.9 meters Stack – 33.9 meters(1) Canopy Pt. 1 – 15.5 meters Canopy Pt. 2 – 11.5 meters elevation Material Lock (for Equipment Hatch release) – 32.1 meters Depressurization Shaft – 7.0 meters

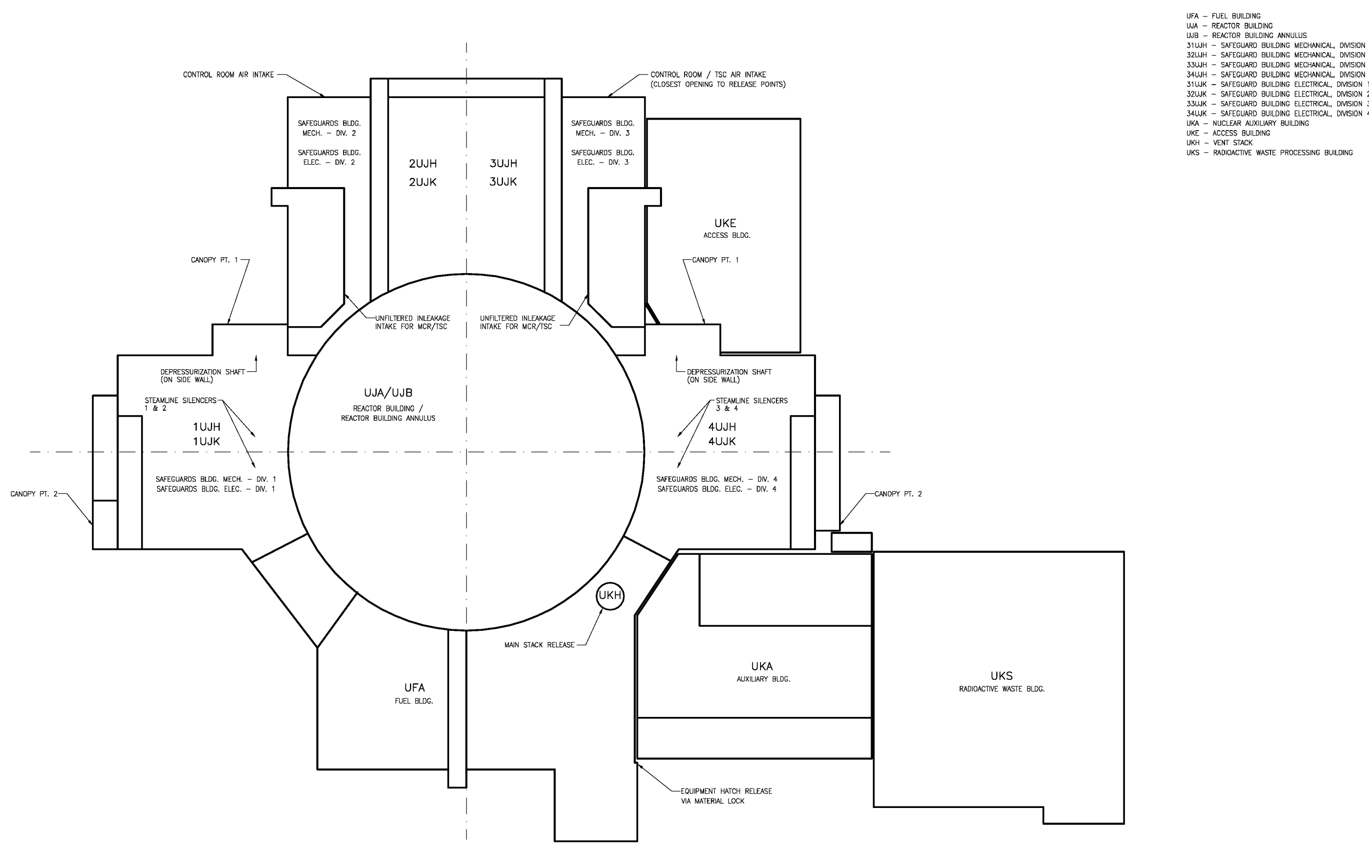
Note:

1. The slant distance from the stack to the ingress point is approximately the same as the slant distance from the SG-3 silencer to the control room air intake; therefore, the SG-3 run, with a release height of 33.9 meters is also used for the stack scenario.

Next File

All indicated changes are in response to RAI 541, Supplement 2, Question 02-3

Figure 2.3-1—U.S. EPR Release Points, ~~and~~ Control Room Air Intakes, and Unfiltered Inleakage Locations



Next File

3.3 Wind, Hurricane and Tornado Loadings

Seismic Category I structures are designed to withstand the effects of wind, hurricane, and tornado loadings. A combined license (COL) applicant that references the U.S. EPR design certification will determine site-specific wind, hurricane, and tornado characteristics and compare these to the standard plant criteria. If the site-specific wind, hurricane, and tornado characteristics are not bounded by the site parameters, postulated for the certified design, then the COL applicant will evaluate the design for site-specific wind, hurricane, and tornado events and demonstrate that these loadings will not adversely affect the ability of safety-related structures to perform their safety functions during or after such events.

3.3.1 Wind Loadings

The U.S. EPR wind pressure loads are determined in conformance with ASCE/SEI Standard 7-05, "Minimum Design Loads for Buildings and Other Structures" (Reference 1). A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for wind loads, will not affect the ability of other structures to perform their intended safety functions.

3.3.1.1 Design Wind Velocity

The design basic wind speed is a 3-second gust speed at 33 feet above ground. The basic wind speed (V) is 145 mph in open terrain, exposure category C associated with a 50-year mean recurrence interval. The velocity pressure ~~basic wind speed~~ is increased by an importance factor of 1.15 to obtain a 100-year mean recurrence interval for the design of safety-related and quality-related structures.

3.3.1.2 Determination of Applied Wind Forces

Wind velocity is converted into an effective pressure to be applied to surfaces of structures in conformance with Reference 1.

Effective wind design velocity pressure (q_z) on structural elements is calculated in conformance with Reference 1, Equation 6-15, as follows:

$$q_z = 0.00256\, K_z\, K_{zt}\, K_d\, V^2\, I\ (\text{lb/ft}^2),$$

Where:

q_z = velocity pressure in pounds per square foot at height "z".

K_z = velocity pressure exposure coefficient at height "z" for Exposure Category C, which is determined in conformance with Reference 1,Table 6-3, but not less than 0.87.

K_{zt} = topographic factor = 1.0 for U.S. EPR standard plant design.

K_d = wind directionality factor = 1.0 for U.S. EPR standard plant design.

V = basic wind speed in miles per hour = 145 mph.

I = importance factor = 1.15 for safety-related and quality-related structures, systems and components (SSC). The importance factor is used to adjust the velocity pressure, q_z, to the appropriate 100-year mean recurrence interval for design of safety-related and quality-related SSC.

Effective pressure loads on structural elements and members are determined in conformance with the applicable requirements of Reference 1, Sections 6.5.12 through 6.5.15. Gust factors are applied in accordance with requirements of this standard.

ASCE paper No. 3269, "Wind Forces on Structures" (Reference 2) is used to determine the external pressure coefficients for distribution of wind pressures around the circumferences of the Reactor Shield Building and the vent stack.

3.3.2 Extreme Wind Loads (Hurricanes and Tornadoes)

Seismic Category I structures are designed to resist hurricane and tornado loadings and remain functional during and following a hurricane or tornado event. In addition, Non-Seismic Category I structures, that have the potential to interact with Seismic Category I structures are evaluated to demonstrate they do not affect Seismic Category I structures under hurricane and tornado load conditions. Hurricane and tornado loads are applied to the roofs and exterior walls of such structures. For Radwaste Seismic Structures, classified as RW-IIa per RG 1.143, additional hurricane and tornado loadings also apply, as specified in RG 1.143.

A COL applicant that references the U.S. EPR design certification will demonstrate that failure of site-specific structures or components not included in the U.S. EPR standard plant design, and not designed for hurricane and tornado loads, will not affect the ability of other structures to perform their intended safety functions.

Tornado wind loads include loads caused by the tornado wind pressure (W_w), tornado atmospheric pressure change effect (W_p), and tornado-generated missile impact (W_m). Hurricane wind loads include loads due to the hurricane wind pressure (W_w) and hurricane generated missiles (W_m). One hundred percent of the design live load is considered with tornado load combinations. Refer to Section 3.8 for loading combinations and acceptance criteria for hurricane and tornado loads considered in combination with other loads. Refer to Section 3.5 for a description of hurricane and tornado wind-generated missile loads and design criteria.

Local damage, such as cracking and spalling of concrete and permanent deformation of structural members and elements, is permissible when structures are designed for hurricane and tornado missile impact loads, provided that Seismic Category I structures remain functional during and subsequent to the missile strike. Structural integrity is demonstrated for all Seismic Category I structures as a result of hurricane and tornado wind-generated missile impact analysis, see Section 3.5.1.4. No adverse effects, such as concrete spalling and cracking, occur as a result of secondary missiles.

3.3.2.1 Applicable Hurricane and Tornado Design Parameters

The following parameters, determined in conformance with RG 1.76, are used for the design basis tornado:

- Radius of maximum rotational speed = 150 ft.
- Maximum wind speed = 230 mph.
- Maximum rotational speed = 184 mph.
- Maximum translational speed = 46 mph.
- Maximum pressure drop = 1.2 psi.
- Rate of pressure drop = 0.5 psi/s.

The following parameter, determined in conformance with RG 1.221, is used for the design basis hurricane:

- Maximum wind speed = 230 mph.

The design basis hurricane and tornado for the U.S. EPR standard plant design are selected for the majority of the contiguous United States (except limited territory along the East Coast and the Gulf of Mexico)~~a worst-case site in the contiguous United States~~, and represents a probability of exceedance of 1 x 10^{-7} per year.

3.3.2.2 Determination of Hurricane and Tornado Forces on Structures

Hurricane and tornado wind velocities are converted into effective pressure loads in accordance with Reference 1 and with guidance provided in NUREG 0800, SRP Section 3.3.2.

Effective hurricane or tornado wind velocity pressure, q_z, is calculated as follows:

$$q_z = 0.00256\ K_z\ K_{zt}\ K_d\ V^2\ I\ (\text{lb/ft}^2),$$

Where:

q_z = velocity pressure in pounds per square foot at height “z.”

K_z = velocity pressure exposure coefficient at height, z, for Exposure Category C, from Table 6-3 (Reference 1), but not less than 0.87 for hurricane; for tornado, the velocity pressure coefficient is constant with height and is equal to 0.870.87, for wind (velocity pressure is considered constant with height).

K_{zt} = 1.0, a topographic factor of unity is used because hurricane and tornado maximum wind speeds are not determined based on site topography.

K_d = 1.0, a wind directionality factor of unity is used.

V = 230 mph, hurricane and tornado maximum wind speed (in miles per hour).

I = 1.15, importance factor.

Effective hurricane and tornado wind pressure loads (W_w) on exterior surfaces of structural elements and members are determined in conformance with the applicable requirements of Reference 1, Sections 6.5.12 and 6.5.13. Gust factors are taken as unity for tornado wind and 0.85 for hurricane wind.

Tornado atmospheric pressure change effect parameters (W_p) and tornado-generated missile impact parameters (W_m) are in conformance with RG 1.76. Hurricane-generated missile impact parameters (W_m) are in conformance with RG 1.221.

The following combinations of the parameters of the total hurricane or tornado load (W_t) are evaluated in the design of Seismic Category I structures and Seismic Category II structures, where W_w is the load from tornado or hurricane wind effect, W_p is the load from tornado atmospheric pressure change effect (the hurricane pressure change can be considered to be negligible), and W_m is the load from tornado or hurricane missile impact effect:

$W_t = W_p$

$W_t = W_w + 0.5W_p + W_m$ (W_p=0 for hurricane)

Exterior walls and roofs of Seismic Category I structures are designed for the maximum differential pressure of 1.2 psi. When the tornado pressure boundary is not established by exterior walls or roofs, the differential pressure is taken as zero.

3.3.2.3 Interaction of Non-Seismic Category I Structures with Seismic Category I Structures

The non-Seismic Category I structures that are adjacent to the Seismic Category I Nuclear Island Common Basemat Structure, Emergency Power Generation Buildings (EPGB), and Essential Service Water Buildings (ESWB) include the Nuclear Auxiliary Building (NAB), Radioactive Waste Building (RWB), Access Building (ACB), and