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Dominion®

February 18, 2011

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Serial No. NA3-10-033RA
Docket No. 52-017
COL/MWH

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
SRP 3.3.1 AND 3.5.1.6: RESPONSE TO RAI LETTER 51

On December 2, 2010, the NRC requested additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA). The responses to the following Request for Additional Information (RAI) Questions are provided in Enclosures 1 and 2:

- RAI 5138 Question 03.03.01-1 UHSRS Wind Loading Design
- RAI 5214 Question 03.05.01.06-1 Aircraft Impact Probability

This information will be incorporated into a future submission of the North Anna Unit 3 COLA, as described in the enclosures.

Please contact Regina Borsh at (804) 273-2247 (regina.borsh@dom.com) if you have questions.

Very truly yours,

Eugene S. Grecheck

D089
NRO

Enclosures:

1. Response to NRC RAI Letter Number 51, RAI 5138 Question 03.03.01-1
2. Response to NRC RAI Letter Number 51, RAI 5214 Question 03.05.01.06-1

Commitments made by this letter:

1. Incorporate proposed changes in a future COLA submission.

COMMONWEALTH OF VIRGINIA

COUNTY OF HENRICO

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Eugene S. Grecheck, who is Vice President-Nuclear Development of Virginia Electric and Power Company (Dominion Virginia Power). He has affirmed before me that he is duly authorized to execute and file the foregoing document on behalf of the Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 18th day of February 2011
My registration number is 7173057 and my
Commission expires: August 31, 2012

Wanda K. Marshall
Notary Public

WANDA K. MARSHALL
Notary Public
Commonwealth of Virginia
7173057
My Commission Expires Aug 31, 2012

cc: U. S. Nuclear Regulatory Commission, Region II
C. P. Patel, NRC
T. S. Dozier, NRC
J. T. Reece, NRC

ENCLOSURE 1

Response to NRC RAI Letter 51

RAI 5138 Question 03.03.01-1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5138 (RAI Letter 51)

SRP SECTION: 03.03.01 – WIND LOADINGS

QUESTIONS for Structural Engineering Branch 1 (AP1000/EPR Projects)(SEB1)

DATE OF RAI ISSUE: 12/02/2010

QUESTION NO.: 03.03.01-1

In order for the NRC staff to demonstrate compliance with GDC-2 in 10 CFR 50, Appendix A, the COL applicant is requested to provide additional information about the response characteristics of the Ultimate Heat Sink Related Structures (UHSRS) to wind effects. Specifically, staff needs additional information to determine whether Method 2 can be used to determine the design wind loads for the UHSRS in accordance with ASCE/SEI 7-05, Section 6.5 requirements.

Design wind loads for buildings and other structures, including the Main Wind-Force Resisting Systems (MWFRS) and components, may be determined using one of three procedures defined in ASCE/SEI 7-05, Section 6.1.2. The COL applicant selected Method 2 – Analytical Procedure described in ASCE/SEI 7-05, Section 6.5 to determine design wind loads for the UHSRS. According to this procedure, Method 2 can only be used to design the MWFRS for buildings that satisfy the two conditions defined in ASCE/SEI 7-05, Section 6.5.1. Condition 2 for Method 2 states that the building does not have response characteristics making it subject to a cross wind loading, vortex shedding, instability due to galloping or flutter; and does not have a site location from which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.

The UHSRS consist of the following Seismic Category I reinforced concrete structures.

- Ultimate Heat Sink (UHS) basins
- UHS cooling tower enclosures
- Essential Service Water System (ESWS) pump houses

The layout and configuration of these site-specific structures exposes certain portions of the UHSRS to wind loads that are determined in accordance with ASCE/SEI 7-05 Method 2 requirements. Because building design details are required to determine the suitability of Method 2 for analysis of wind loadings, the COL applicant is requested to provide an analysis showing that the UHSRS do not have response characteristics making them subject to across wind loading, vortex shedding, instability due to galloping or flutter; and do not have a site location from which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration. The COL applicant is also requested to provide the rationale and technical basis for characterizing these structures as either open or partially vented based on definitions in ASCE/SEI 7-05, Section 6.2.

Dominion Response

Suitability of Method 2 for Design Wind Loading

FSAR Section 3.3.1.2 provides supplemental information for COL Item 3.3(4) and identifies that the UHSRS (seismic category I) are analyzed using Method 2 of ASCE/SEI 7-05.

ASCE/SEI 7-05, Chapter 6, *Wind Loads*, specifies methods and requirements associated with the design and construction of buildings and structures to resist wind loads. ASCE/SEI 7-05, Section 6.5, *Method 2 – Analytical Procedure*, Condition 2 states:

> *The building or structure does not have response characteristics making it subject to across-wind loading, vortex shedding, instability due to galloping or flutter; or does not have a site location for which channeling effects or buffeting in the wake of upwind obstructions warrant special consideration.*

Supplementary material provided by ASCE as Commentary to ASCE/SEI 7-05 provides additional guidance for application of the requirements of the standard. Commentary Section C6.5 provides supplementary material for use in determining whether the conditions for use of Method 2 are satisfied, and Section C6.5.2 discusses limitations on the applicability of the analytical procedure in the form of examples where Method 2 methodology may be inadequate. The following analysis compares the North Anna Unit 3 site details and UHSRS design characteristics to the four items identified in the supplementary material provided in the ASCE/SEI 7-05 Commentary Section C6.5.2.

> *Item 1: Site locations that have channeling effects from up-wind obstructions. Channeling effects can be caused by topographic features (e.g., mountain gorge) or buildings (e.g., a cluster of tall buildings). Wakes can be caused by hills or by buildings or other structures.*
>
> The North Anna Early Site Permit (ESP) Application, Revision 9 (Sept 2006), *Site Safety Analysis Report* (SSAR) Section 2.3.2.4 documents the ESP site as characterized by gently rolling terrain that rises to an average height of 50 to 150 feet above Lake Anna's level, and references SSAR Section 2.3.2.2.1 for discussion of how the topographic features of the site influence wind direction distribution. Section 2.3.2.4 also notes the primary topographic influences on local meteorological conditions at the North Anna site are Lake Anna and the North Anna River Valley.
>
> SSAR Section 2.3.2.2.1 describes the influence of topographical features on average wind direction and speed, wind direction persistence, and atmospheric stability. Section 2.3.2.2.1, part a, discusses the topographic influence on wind direction distribution such as the presence of Lake Anna, where the airflow typically follows the contour lines of the land. Although site topographical features are described as influencing the patterns of wind movement, no up-wind topographic features are described as creating channeling effects in the immediate vicinity of the North Anna site. Further, the North Anna site is classified as exposure category C with respect to basic wind speed as stated in FSAR Section 3.3.1.1. The terrain associated with exposure category C does not contain mountain gorges or hills that promote channeling effects or wakes.

As noted in FSAR Figure 1.2-1R, Site Plan, the UHSRS are aligned along the northwest-southeast direction [note: directions are referenced to true north], with the power block located to the northeast. Parking lots are located southwest and southeast of the UHSRS, in addition to a single administration building several hundred feet to the southeast. SSAR Section 2.3.2.2.1, part a, states that the prevailing wind is from the south-southwest during the summer season and from the northwest and north during the winter season. The UHSRS are not down-wind of a cluster of tall buildings and, therefore, the channeling effect of the prevailing wind through a cluster of tall structures is not possible. COLA Part 11, Section 3.1.1, *Structural Geometry*, defines the dimensions of each UHSRS unit. The tallest portion, which is the UHS cooling tower enclosure, extends 89 feet above the final grade elevation of 290 feet NAVD88. Each cooling tower, as shown on FSAR Figures 3.8-206 through 3.8-211, is 40 feet in width by 98 feet in length such that the cooling towers do not constitute tall slender structures that could result in channeling for downwind UHSRS.

Therefore, the North Anna site topographical features and structures nearby, including the structures comprising the UHSRS, do not create channeling effects on the UHSRS.

Item 2: Buildings with unusual or irregular geometric shape, including barrel vaults, and other buildings whose shape (in plan or profile) differs significantly from a uniform series of superimposed prisms similar to those indicated in Figs. 6-6 through 6-17. Unusual or irregular geometric shapes include buildings with multiple setbacks, curved facades, irregular plan resulting from significant indentations or projections, openings through the building, or multitower buildings connected by bridges.

Figures 6-6 through 6-17 of ASCE/SEI 7-05 reflect external pressure coefficients for common building shapes. The UHSRS plan and sectional views in FSAR Figures 1.2-201 through 1.2-210 reflect the configuration as rectangular structures with no unusual or irregular geometric shapes, multiple setbacks, curved facades, irregular plan resulting from significant indentations or projections, or openings through the UHSRS. In addition, the UHSRS are not multi-tower structures connected by bridges. Therefore, the UHSRS are not buildings with unusual or irregular geometric shapes, including barrel vaults, or other buildings whose shape (in plan or profile) differs significantly from a uniform series of superimposed prisms similar to those indicated in ASCE/SEI 7-05 Figures 6-6 through 6-17.

Item 3: Buildings with unusual response characteristics that result in across-wind loading and/or dynamic torsional loads, loads caused by vortex shedding, or loads resulting from instabilities, such as fluttering or galloping. Examples of buildings and structures that may have unusual response characteristics include flexible buildings with natural frequencies normally below 1 Hz, tall slender buildings (building height-to-width ratio exceeds 4), and cylindrical buildings or structures. Note: Vortex shedding occurs when wind blows across a slender prismatic or cylindrical body. Vortices are alternately shed from one side of the body and then the other side, which results in a fluctuation force acting at right angles to the wind direction (across-wind) along the length of the body.

The UHSRS are relatively low-rise structures. The UHSRS are not cylindrical buildings and are not tall slender structures (i.e., the building height-to-width ratio does not exceed 4) as discussed in the analysis for Item 1 above. Further, COLA Part 11, Table 3.0-4, shows that the first fundamental natural frequency of the UHSRS in any orthogonal direction is 7.28 Hz, occurring in the plant east-west direction. This value exceeds the 1 Hz value cited above, and demonstrates that the UHSRS are not flexible, but rigid, with respect to wind loading. Because the UHSRS are not flexible with respect to wind loading, these structures do not exhibit unusual response characteristics that could result in across-wind loading and/or dynamic torsional loads, loads caused by vortex shedding, or loads resulting from instabilities, such as fluttering or galloping.

Item 4: Bridges, cranes, electrical transmission lines, guyed masts, telecommunication towers, and flagpoles.

The UHSRS are not bridges, cranes, electrical transmission lines, guyed masts, telecommunication towers, or flagpoles.

Based on this analysis, the UHSRS meet the conditions and limitations of ASCE/SEI 7-05 Section 6.5 for applying wind analysis Method 2 to determine design wind loadings.

Characterization of UHSRS

The UHSRS structures are described in FSAR Section 3.8.4.1.3.2. The UHSRS are not open or partially enclosed, but are instead classified as enclosed for purposes of basic wind loading analysis as explained further below.

ASCE/SEI 7-05 Section 6.2 defines an open building as having each wall at least 80 percent open. FSAR Figures 3.8-206 through 3.8-211 show that the UHSRS do not meet this definition.

ASCE/SEI 7-05 Section 6.2 defines a partially enclosed building as complying with the both of the following conditions:

1. The total area of openings in a wall that receives positive external pressure exceeds the sum of the areas of openings in the balance of the building envelope (walls and roof) by more than 10 percent.
2. The total area of openings in a wall that receive positive external pressure exceeds 4 ft^2 (0.37 m^2) or 1 percent of the area of the wall, whichever is smaller, and the percentage of openings in the balance of the building envelope does not exceed 20 percent.

FSAR Figures 3.8-206 through 3.8-211 show that the UHSRS do not meet Condition 1 of the definition of a partially enclosed building. The large circular opening at the top of the structure is of greater area than the combined area of openings on any wall of the UHSRS. Therefore, the UHSRS do not meet the definition for partially enclosed buildings given in ASCE/SEI 7-05 Section 6.2, and are not classified as partially enclosed buildings.

ASCE/SEI 7-05 Section 6.2 defines an enclosed building as a building that does not comply with the requirements for open or partially enclosed buildings. Since the UHSRS do not meet the definitions of open or partially enclosed buildings, the UHSRS are defined as enclosed buildings for the purpose of basic wind loading analysis.

Proposed COLA Revision

None.

ENCLOSURE 2

Response to NRC RAI Letter 51

RAI 5214 Question 03.05.01.06-1

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 5214 (RAI Letter 51)

SRP SECTION: 3.5.1.6 – AIRCRAFT HAZARDS

QUESTIONS for Siting and Accident Conseq Branch (RSAC)

DATE OF RAI ISSUE: 12/02/2010

QUESTION NO.: 03.05.01.06-1

RG 1.206 provides guidance regarding the information that NRC needs to have reasonable assurance that potential hazards in the site vicinity are identified and evaluated, in accordance with the siting criteria in 10 CFR 100.20 and 10 CFR 100.21. In the North Anna Unit 3 COL FSAR, Section 3.5.1.6, the applicant reported aircraft impact probabilities from operations along civil airway V-223 and military routes IR714, IR760/VR1754, and VR1755. However, the applicant did not describe the effective area of the plant used in its calculation. Though the total probability calculated by the staff is on the order of 10^{-6} per year, the applicant concluded that the total probability is approximately 10^{-7} per year. The staff requests that the applicant explain its aircraft impact probability calculation in sufficient detail to allow an independent review, including a description of the effective area information assumed in its calculations.

Dominion Response

Upon review of North Anna Unit 3 COL FSAR, Section 3.5.1.6, a typographical error was found in the probability per year of an aircraft crashing into the plant (P_{FA}) for military routes. The reported value is 1.07 x 10^{-6}, whereas the correct value is 1.07 x 10^{-8}. This value is based on 6,000 military aircraft per year spread equally over the four military airways (1,500 aircraft per year per airway). The methodology used in obtaining the P_{FA} value is shown below.

One civil airway (V223) and four military training routes (IR714, IR760/VR1754, IR720, and VR1755) pass near the site. Therefore, the P_{FA} value was calculated. The calculated probability is dependent on the altitude and frequency of the flights, the width of the corridor, and the corresponding distribution of past accidents. Based on methodology from U.S. Nuclear Regulatory Commission, NUREG-0800, *Standard Review Plan,* Revision 4, March 2010, Section 3.5.1.6, *Aircraft Hazards*, the impact probability per year of an aircraft crashing into the plant can be calculated as:

$$P_{FA} = C \cdot N \cdot \left(\frac{A_{eff}}{w} \right) \qquad (1)$$

Where:

C = in-flight crash rate per mile for aircraft using airway,

N = number of flights per year along the airway,

A_{eff} = effective area of plant in square miles, and

w = width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles.

In-flight Crash Rate Per Mile for Aircraft Using Airway (C)

The in-flight crash rate per mile (C) for the civil airway and military routes are based on the probabilistic commercial aircraft value of 4 x 10^{-10} per aircraft mile as provided in NUREG-0800, Section 3.5.1.6. To determine a value for in-flight crash rates for general aviation and military aircraft that may be using the airway, a weighted airway value for each was obtained. The probabilities of fatal crashes per square mile per aircraft movement provided by NUREG-0800, Section 3.5.1.6 for near airport crash frequency analysis were used to calculate a weight for both general aviation and military classes. The weighted C values were calculated by multiplying the probabilistic commercial aircraft value by the weighted airway values. Table 1, below, shows the weighted airway values used to calculate the weighted C values.

Table 1: Weighted Probability of a Fatal Crash per Square Mile

Distance from end of runway (mi)	U.S. Air Carrier(1)	General Aviation(1)	USAF(1)	Weighted Commercial Airway	Weighted Military Airway
0-1	16.7	84	5.7	5.0299	0.3413
1-2	4.0	15	2.3	3.7500	0.5750
2-3	0.96	6.2	1.1	6.4583	1.1458
3-4	0.68	3.8	0.42	5.5882	0.6176
4-5	0.27	1.2	0.40	4.4444	1.4815
			Average Weight	5.054	0.832
			Weighted C value	2.02E-09	3.33E-10

(1) Values from NUREG-0800, Section 3.5.1.6

The weighted commercial and military airway values were calculated using the following equations:

$$\text{Weighted Commercial Airway} = \left(\frac{\text{General Aviation Probability}}{\text{U.S. Air Carrier Probability}} \right) \qquad (2)$$

$$\text{Weighted Military Airway} = \left(\frac{\text{USAF Probability}}{\text{U.S. Air Carrier Probability}} \right) \quad (3)$$

Width of Airway (w)

The width of the airway, w, is calculated based on NUREG-0800, Section 3.5.1.6 and can be represented by the following equation:

$$w = (\text{Width of Federal Airway}) + 2 \cdot (\text{Distance from the airway edge to the site})$$

The arrangement of each airway and location of Unit 3 are shown in Figure 1 below. Distances from the site to each airway were calculated and applied to this analysis. One commercial airway, V223, passes by the site. The width of a commercial airway is 8 nautical miles or 4 nautical miles on each side of the centerline. One nautical mile is equivalent to 1.15 statute miles; therefore, the corridors are 4.60 statute miles wide on each side of the centerline. Four military routes, IR714, IR 760/VR1754, IR720 and VR1755 pass by the site. The width of a military training route is 10 nautical miles (11.5 statute miles) or 5 nautical miles (5.75 statute miles) on each side of the centerline.

Table 2 below displays each parameter that is used to calculate the width of airway, w, which is included in the last column.

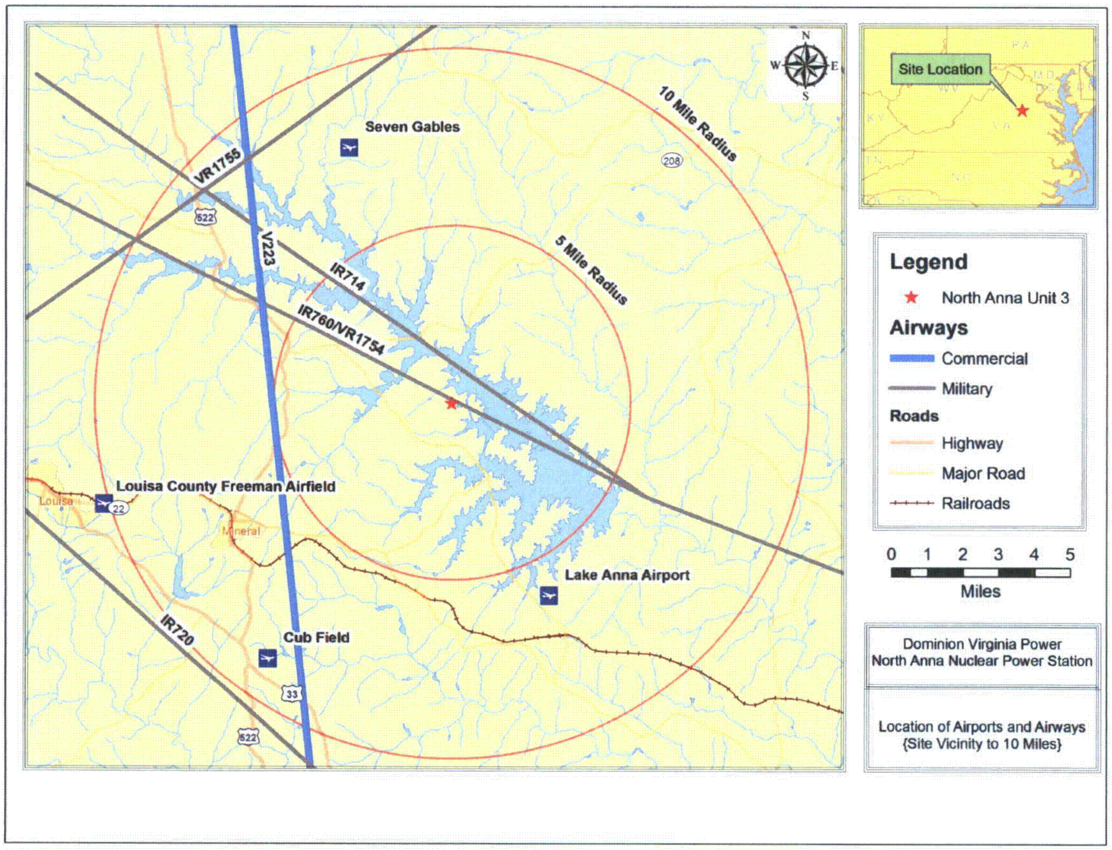
Table 2: Width of Commercial and Military Airways

	Airway	(1) Distance from Airway Centerline to the Site (mi)	(2) Width of Federal Airway each side of centerline (mi)	(3) Remaining Distance to the Site (mi)	(4) Width of Airway (w) (mi)
Commercial	V223	5	4.6	0.4	10
Military	VR1755	8.9	5.75	3.15	17.8
	IR720	10.2	5.75	4.45	20.4
	IR714	0.9	5.75	0	11.5
	IR760 / VR1754	0.1	5.75	0	11.5

The calculation for the commercial airway, V223, is shown below. This methodology also applies to all of the military airways.

(1) Distance from Airway Centerline to the site (mi)
(2) Width of Federal airway per side of centerline (1.00 nm = 1.15 mi) (mi)
(3) Remaining Distance to the site = (1) – (2) = 5 – 4.6 = 0.4 miles
(4) w = (4.6 · 2) + 2 · (0.4) = 10 miles

Figure 1: Location of Airports and Airways



Number of Flights Per Year Along the Airway (N)

The following are assumed numbers of operations along the airways:

- Statistics used to calculate the annual operations on V233 are from Richmond International Airport (RIC), the closest "large" airport. The Terminal Area Forecast (TAF) for December, 2009 projected 146,730 annual operations for the year 2030. There are eight airways inbound and outbound from RIC. It is assumed that the aircraft are spread equally through the eight routes, thus the N value used is 18,341 (rounded up to 18,500 for use in this analysis) aircraft per year per airway.

- Military Training Routes IR714, IR760/VR1754, IR720 and VR1755 all pass near the proposed North Anna Unit 3 site. The number of operations on airways IR714, IR760/VR1754, and VR1755 were provided by the Department of the Navy and are projected to be 9, 274, and 23 operations, respectively. Previous documentation in the ESP application states that approximately 6,000 aircraft per year travelled through all military routes (North Anna Early Site Permit Application, *Part 2 Site Safety Analysis Report, Sections 2.2.2.6.1, 2.2.2.6.2, and 2.2.3.2.2,* Revision 9, September 2006 (ESP, 2006)). It is assumed that the aircraft are spread equally through the four military routes, thus the N value used is 1,500 aircraft per year per airway.

Effective Area of Plant (A_{eff})

Figure 2 below shows the measurement of the bounding rectangle and the diagonal of the building (R) for the skid area. Figure 3 below shows the safety-related structures used to determine the equivalent height of the bounding area. The effective area (A_{eff}) used in Equation (1) is calculated based on the methodology presented in U.S. Department of Energy Standard DOE-STD-3014-2006, *Accident Analysis for Aircraft Crash into Hazardous Facilities,* October 1996, Reaffirmation May 2006. The effective area is the sum of the effective fly-in area (A_f) and effective skid area (A_s):

$$A_{eff} = A_f + A_S \tag{4}$$

The effective fly-in area (A_f) consists of two parts, the footprint area (A_{ft}) and the shadow area (A_{sh}), and is defined by DOE-STD-3014-2006 as:

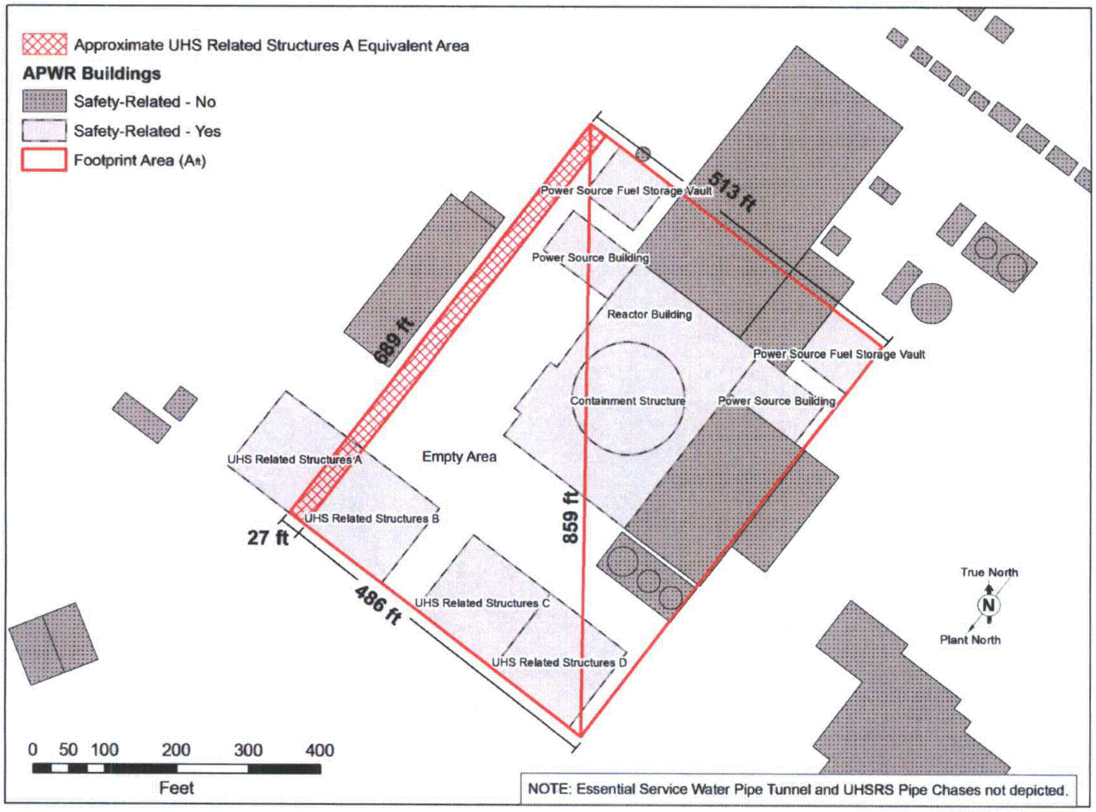
$$A_f = A_{ft} + A_{sh} \tag{5}$$

The footprint area (A_{ft}) is defined as the area an aircraft would hit on its descent if the facility height were zero and is calculated as the product of the length (L_{ft}) and width (W_{ft}) of a rectangle bounding the safety-related structures.

$$A_{ft} = L_{ft} \cdot W_{ft} \tag{6}$$

In order to determine the footprint area, a rectangle with a length of 689 feet and a width of 513 feet was drawn to include the buildings shown in Figure 2. Although the UHS Related Structures (UHSRS) pipe chases are not depicted in Figure 2, the areas occupied by these safety-related structures are included within the 689 feet by 513 feet footprint area. This geometry is conservative because it is plausible, for certain aircraft wingspans and orientation, that an aircraft could crash inside this rectangle and not impact a safety-related structure. The footprint area not including UHSRS 'A' is 689 feet by 486 feet. In order to account for its footprint without encompassing a large amount of space that is irrelevant for this analysis, the area of UHSRS 'A' (133 feet by 135 feet) was included by generating a 689 feet by 27 feet area (See Figure 2). This methodology is acceptable because the analysis does not characterize probability by location but by a general area.

Figure 2: Measurement of the Bound Rectangle and R value for Skid Area



The shadow area (A_{sh}) is the facility area that the aircraft hits on its descent, but would have missed if the height were zero. Thus, it is defined as follows (DOE-STD-3014-2006):

$$A_{sh} = (WS + R) \cdot H_{eff} \cdot \cot(\varphi) + \left(\frac{2 \cdot L_{ft} \cdot W_{ft} \cdot WS}{R} \right) \tag{7}$$

Where:

WS = aircraft wingspan,

R = length of the diagonal cross-section of the bounding rectangle's length and width,

H_{eff} = the effective height of the bounding area,

L_{ft} = length of the bounding rectangle,

W_{ft} = width of the bounding rectangle, and

cotΦ = mean of the cotangent of the aircraft impact angle.

An effective height (H_{eff}) was determined by calculating the ratio of volume to area:

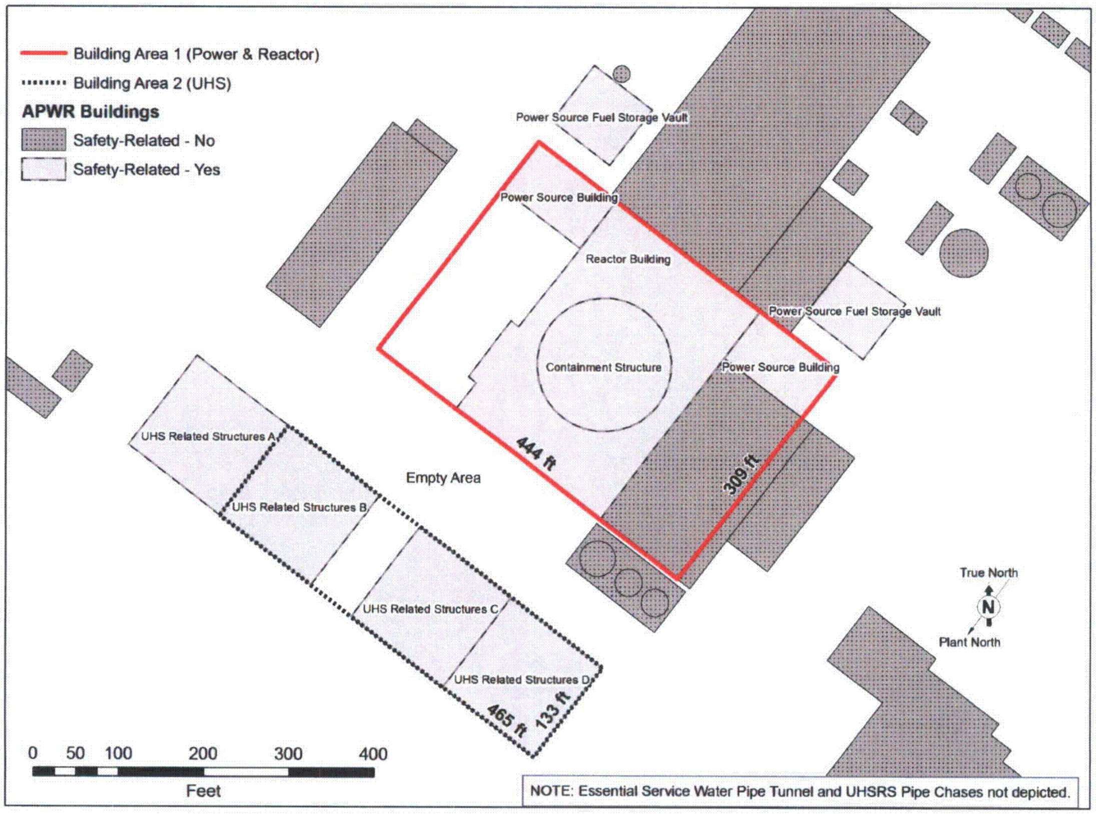
$$H_{eff} = \frac{V_T}{A_T} \tag{8}$$

The total volume (V_T) and total area (A_T) are determined by summing the volumes and areas of the safety-related structures which are outlined in Figure 3. The effective height of the bounding area (H_{eff}) utilizes two building areas within the bounding rectangle. Building Area 1 includes both of the power source buildings, the reactor building and the containment building. Building Area 2 includes three of the four UHSRS (excluding UHSRS pipe chases) as shown in Figure 3. This methodology essentially eliminates the empty space (resulting in a height of zero) within the bounding rectangle so that H_{eff} is not too low. Dimensions of buildings utilized and calculation results are shown in Table 3 below. The power source fuel storage vaults, essential service water pipe tunnel, UHSRS pipe chases, and UHSRS 'A' were not included in the calculation of H_{eff}. Including these heights would result in a less conservative H_{eff}. The H_{eff} of 129 feet is considered applicable to the entire footprint area, even though much of this space contains no structures.

Table 3: Effective Height for Bounding Building Areas

Effective Height, ft (Reactor, Containment, Power Source)					
	Length (ft)	*Width (ft)*	*Height (ft)*	*Area (ft^2)*	*Volume (ft^3)*
V(Reactor Building)	329.50	213.33	157.08	50,727.72	7,968,311
V(Containment)	Diameter >	157.83	234.58	19,564.51	4,589,443
V(Power East)	86.50	123.75	53.67	10,704.38	574,503.8
V(Power West)	69.33	123.75	53.67	8,579.59	460,466.5
V(UHSRS)	133.00	405.00	91.00	53,865.00	4,901,715
Total Area (ft^2), A_T	143,441				
Total Volume (ft^3), V_T	18,494,439				
Effective Height, H_{eff} (ft)	129				

Figure 3: Safety-Related Structures Used for Equivalent Height Calculation



The following assumptions also relate to the configuration of the effective area calculation:

- The diagonal of the building (R) is a function of the plant layout and is therefore determined based on the surrounding buildings and the ability of a skid to impact the safety-related area. The rectangle and diagonal selected bound the scenario of an aircraft approaching the row of four UHSRS which then shield the balance of the safety-related structures.
- From DOE-STD-3014-2006, the largest wingspans for both commercial and small military aircraft were used.
- As seen from Table 4 below, aircraft categories were weighted in order to calculate the effective area for commercial aviation. The TAF for the Commonwealth of Virginia was used to determine the use by each aircraft category which includes all itinerant and local operations. For local flights, half of the civil operations were included under General Aviation because it is assumed to have the most flights while the other half of the total operations were divided evenly amongst the Air Carrier and Air Taxi categories.

Table 4: Percentage of Aircraft Operations

Aircraft Category	Itinerant Flights	Local Flights	Total Operations	Percentage
General Aviation	534,589	325,462	860,051	57.11%
Air Carrier	113,682	162,731	276,413	18.36%
Air Taxi	125,624	162,731	288,355	19.15%
Military	50,549	30,470	81,019	5.38%
		Total	1,505,837	100.00%

Table 5 below is a summary table of all of the variables and values associated with the calculation of the effective area for commercial and military aviation given by Equation (4).

The weighted area (shown in Table 5) for general aviation, air carrier and air taxi were calculated by multiplying the effective area (shown in Table 5) by the percentage of aircraft operations (shown in Table 4). These values were then added to determine the weighted effective area for commercial aircraft. The weighted effective area for military aircraft was determined by calculating the average effective area for large and small military aircraft.

Table 5: Effective Area Spreadsheet Calculation for Commercial and Military Aviation

	WS (aircraft wingspan) ft	**R** (length of diagonal of the facility) ft	**H_{eff}** (effective facility height) ft	**cotφ**	**L** (length of the facility) ft	**W** (width of the facility) ft	**S** (aircraft skid distance) ft	**A_f** (fly-in area) ft^2	**A_s** (skid area) ft^2	**A_{eff}** (effective area) mi^2	**Weighted Area** (mi^2)
General Aviation	50	859	129	8.2	689	513	60	1,356,145	54,540	0.051	0.029
Air Carrier	98	859	129	10.2	689	513	1440	1,693,327	1,378,080	0.110	0.020
Air Taxi	59	859	129	10.2	689	513	1440	1,609,915	1,321,920	0.105	0.020
Large Military											
Takeoff	223	859	129	7.4	689	513	780	1,569,852	843,960	0.087	
Landing	223	859	129	9.7	689	513	368	1,890,881	398,176	0.082	
Small Military											
Takeoff	110	859	129	8.4	689	513	246	1,493,990	238,374	0.062	
Landing	110	859	129	10.4	689	513	447	1,743,992	433,143	0.078	
										Military A_{eff}	0.077
										Commercial A_{eff}	0.069

Airway Operations Impact Probability

Table 6 below summarizes the airway operations impact probability, Equation (1), for each airway that passes through the vicinity of the site as well as the total probability, including both commercial and military airway.

Table 6: Airway Operations Impact Probability

Airway	Airway Operations Impact Probability (per year)
Commercial	
V223	2.59×10^{-7}
Total Commercial	2.59×10^{-7}
Military	
V1755	2.16×10^{-9}
IR720	1.89×10^{-9}
IR714	3.34×10^{-9}
IR760 / VR1754	3.34×10^{-9}
Total Military	1.07×10^{-8}
Total Impact Probability	2.70×10^{-7}

Aircraft Hazards Analysis Summary

A calculation to determine the probability of aircraft accidents which could possibly result in radiological consequences for the proposed North Anna Unit 3 site was conducted. Regulatory Guide 1.206 requires that the aircraft hazard analysis provide an estimate of the total aircraft hazard probability per year. This analysis concludes the total impact probability of aircraft operations into the facility, which consists of the reactor building, both of the power source buildings, both of the power source fuel storage vaults and all of the UHSRS, to be 2.70×10^{-7}.

Proposed COLA Revision

FSAR Section 3.12.5.6 will be revised as indicated on the attached markup.

Markup of North Anna COLA

The attached markup represents Dominion's good faith effort to show how the COLA will be revised in a future COLA submittal in response to the subject RAI. However, the same COLA content may be impacted by revisions to the DCD, responses to other COLA RAIs, other COLA changes, plant design changes, editorial or typographical corrections, etc. As a result, the final COLA content that appears in a future submittal may be somewhat different than as presented herein.

described in Section 2.2, no potential site-proximity missile hazards are identified except aircraft, which are evaluated in Section 3.5.1.6.

NAPS COL 3.5(4)

3.5.1.6 Aircraft Hazards

Replace the paragraph of DCD Subsection 3.5.1.6 with the following.

The second and subsequent paragraphs of SSAR Section 2.2.3.2.2 are supplemented as follows with information on effective plant areas for Unit 3 and the evaluation results.

The R/B, PCCV, UHSRS, PS/B, and the PSFSV were evaluated.

For flights in the civilian airway, a total effective plant area of 0.069 square miles was used in the evaluation.

For flights in the military airways, a total effective plant area of 0.077 square miles was used in the evaluation.

For civil airway V223, the Unit 3 result is:

$$P_{FA} = 2.59 \times 10^{-7}$$

For military routes, IR714, IR760/VR1754, IR720, and VR1755, the Unit 3 result is:

$$P_{FA} = 1.07 \times 10^{\cancel{-6}\,\underline{\underline{-8}}}$$

The total of these two accident probabilities meets the NUREG-0800, Section 3.5.1.6 guideline and is of an order of magnitude of 10^{-7} per year.

3.5.2 Structures, Systems, and Components to be Protected from Externally Generated Missiles

NAPS COL 3.5(5)

Replace the second sentence in the second paragraph of DCD Subsection 3.5.2 with the following.

No site-specific hazards for external events are shown to produce missiles more energetic than tornado missiles identified for Unit 3 site-specific Seismic Category I structure design. The design basis for externally generated missiles is therefore bounded by the design criteria for tornado-generated missiles in Section 3.5.1.4.