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August 26, 2014

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

Serial No. NA3-14-035  
Docket No. 52-017  
COL/BCB

**DOMINION VIRGINIA POWER**  
**NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION**  
**SRP 12.02: RESPONSE TO RAI LETTER 131**

On August 1, 2014, the NRC requested additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA), which consisted of two questions. The responses to the following Request for Additional Information (RAI) Questions are provided in the enclosures:

- RAI 7557, Question 12.02-18                      Basis for GASPAR II Input Values
- RAI 7556, Question 12.02-19                      Basis for LADTAP II Input Values

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

Very truly yours,

Mark D. Mitchell

Enclosures:

1. Response to NRC RAI Letter No. 131, RAI 7557, Question 12.02-18
2. Response to NRC RAI Letter No. 131, RAI 7556, Question 12.02-19

Commitments made by this letter:

None.

DOB9  
NRO

COMMONWEALTH OF VIRGINIA

COUNTY OF HENRICO

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Mark D. Mitchell, who is Vice President-Generation Construction 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 26<sup>TH</sup> day of AUGUST 2014

My registration number is 253183 and my

Commission expires: SEPTEMBER 30, 2016

Kathy W. Prokors  
Notary Public



cc: C. P. Patel, NRC  
U. S. Nuclear Regulatory Commission, Region II  
T. S. Dozier, NRC  
G. J. Kolcum, NRC  
D. Paylor, VDEQ  
W. T. Lough, SCC  
P. W. Smith, DTE  
M. K. Brandon, DTE  
R. J. Bell, NEI

**ENCLOSURE 1**

**Response to NRC RAI Letter No. 131**

**RAI 7557, Question 12.02-18**

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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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**North Anna Unit 3**

**Dominion**

**Docket No. 52-017**

**RAI NO.: 7557 (RAI LETTER NO. 131)**

**SRP SECTION: 12.02 – RADIATION SOURCES**

**DATE OF RAI ISSUE: 8/1/2014**

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**QUESTION NO.: 12.02-18**

FSAR Tier 2 (Rev 7), Section 12.2.2.2, Table 12.2-18aR presents some input design parameters and values used in the GASPARD II computer code and resulting individual and annual population pathway doses (mrem/yr) from gaseous radioactive effluents in Table 12.2-18bR. Staff review indicates insufficient information is provided in the FSAR to independently confirm the calculated individual doses and annual population pathway doses for compliance with 10 CFR 20.1301; 10 CFR 20.1302; 10 CFR 50.34a; 10 CFR 50.36a; 10 CFR 50, Appendix I; and 10 CFR 50, Appendix A, GDC 60 and GDC 61. Regulatory Guide 1.206, Revision 0, and Standard Review Plan 11.3, Revision 3, require the parameters used to determine estimated doses from the gaseous effluent system to be provided.

Please specifically address the following items and provide the following information:

1. Provide the basis for all design parameters and values used in the GASPARD II code calculation. Include value derivations and references (e.g., pointer to FSAR section or table, RG 1.109 table, etc.).
2. If changes are made to the GASPARD II code input/output files, provided in FSAR rev. 7, used to calculate the gaseous effluent doses in Table 12.2-18bR, please resubmit those files.
3. A detailed breakdown of population doses by pathway and organ.

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**Dominion Response**

1. The gaseous effluent doses presented in FSAR Tables 12.2-18bR and 12.2-204 are based on the following GASPARD II input parameters, as specified in the program manual [Reference 1]:

- a. Atmospheric Dispersion and Ground Deposition Factors for Individual Receptors (FSAR Table 2.3-16R) – The cited FSAR table shows the dispersion and deposition factors at the nearest site boundary, vegetable garden, residence, and meat animal. The table also shows the direction and distance to each receptor.
- b. Atmospheric Dispersion and Ground Deposition Factors for 50-Mile Region (FSAR Tables 2.3-209, -211, -213, -215, -217, -219, -221 and -223) – The cited FSAR tables show the 50-mile dispersion and deposition factors by sector for releases from the reactor building, turbine building, radwaste building, and the circulating water cooling tower.
- c. Fraction of the Year that Leafy Vegetables are Grown (0.5) – For Virginia, the geographical value specified in the GASPARD II manual for the length of the pasture season is 8 months per year [Reference 1, Figure 2.2]. The manual further indicates that the growing period for leafy vegetables should be 3 months less than the pasture season [Reference 1, Page 2.8], yielding 5 months per year. This is conservatively rounded up to an annual fraction of 0.5.
- d. Fraction of the Year that Milk Cows are on Pasture (0.67) – For Virginia, the geographical value specified in the GASPARD II manual for the length of the pasture season is 8 months per year [Reference 1, Figure 2.2] or an annual fraction of 0.67.
- e. Fraction of the Maximum Individual's Vegetable Intake that is from His Own Garden (0.76) – This is the default value in GASPARD II [Reference 1, Table 2.3].
- f. Fraction of Milk-Cow Feed Intake that is from Pasture While on Pasture – This is not used, as there are no milk animals near the site.
- g. Average Absolute Humidity over the Growing Season ( $8 \text{ g/m}^3$ ) – This is the default value in GASPARD II [Reference 1, Table 2.3].
- h. Average Temperature over the Growing Season – This is not used if absolute humidity is default value.
- i. Fraction of the Year that Goats are on Pasture – This is not used, as there are no goats near the site.
- j. Fraction of Goat-Feed Intake that is from Pasture While on Pasture – This is not used, as there are no goats near the site.
- k. Fraction of the Year that Beef Cattle are on Pasture (0.67) – For Virginia, the geographical value specified in the GASPARD II manual for the length of the pasture season is 8 months per year [Reference 1, Figure 2.2] or an annual fraction of 0.67.
- l. Fraction of Beef-Cattle Feed Intake that is from Pasture While the Cattle are on Pasture (1.0) – This is the default value in GASPARD II [Reference 1, Table 2.3].
- m. Population Distribution within 50 Miles (Early Site Permit Application (ESPA) Site Safety Analysis Report (SSAR) Figures 2.1-8 and 2.1-13) – FSAR Section 2.1.3

incorporates by reference ESPA SSAR Section 2.1.3, which uses the 2000 census to project population distributions for the years 2010, 2020, 2030, 2040, and 2065. Doses are calculated for 2040, as it is nearest the expected mid-life of North Anna Unit 3. The 50-mile population of  $2.83\text{E}+06$  in 2040 is obtained from the ESPA [Reference 2, Figures 2.1-8 and 2.1-13]. In 2000, the 50-mile population was  $1.56\text{E}+06$  [Reference 2, Figures 2.1-5 and 2.1-9]. Hence, the population is projected to increase from 2000 to 2040 by a factor of 1.81.

- n. Milk Production within 50 Miles ( $7.17\text{E}+08$  L/yr in 2040) – The total annual milk production in Virginia was  $1.90\text{E}+09$  lb in the year 2001 [Reference 3, Page 67]. Assuming milk to have the same density as water, this converts to  $8.62\text{E}+08$  L/yr. Approximately 46% of the state milk cows are within counties that are within 50 miles of the plant [Reference 3, Page 65]. Multiplying the state production by 0.46 and assuming an increase in production equal to the increase in population within 50 miles (factor of 1.81 from Item 1.m), the projected production in the year 2040 is  $7.17\text{E}+08$  L.
  - o. Meat Production within 50 Miles ( $1.71\text{E}+09$  kg/yr in 2040) – The total annual red meat production in Virginia was  $7.69\text{E}+08$  lb in the year 2001 [Reference 3, Page 63]. Approximately 27% of the state beef cows are within counties that are within 50 miles of the plant [Reference 3, Page 65]. Multiplying the state production by 0.27 yields  $2.08\text{E}+08$  lb within 50 miles. In 2001, poultry production in the state was  $1.33\text{E}+09$  lb broiler,  $5.30\text{E}+08$  lb turkey, and  $2.00\text{E}+07$  lb chicken [Reference 3, Page 69]. Conservatively assuming all the production of poultry within the state to be within 50 miles of the plant, these values are added to the red meat production, yielding a total of  $2.09\text{E}+09$  lb. Assuming an increase in production equal to the increase in population within 50 miles (factor of 1.81 from Item 1.m) and converting units, the projected total meat production in the year 2040 is  $1.71\text{E}+09$  kg.
  - p. Vegetable Production within 50 Miles ( $5.41\text{E}+08$  kg/yr in 2040) – In 2001, the production rates in Virginia were  $3.34\text{E}+08$  lb for vegetables,  $3.10\text{E}+08$  lb for apples,  $8.00\text{E}+06$  lb for peaches, and  $8.24\text{E}+06$  lb for grapes [Reference 3, Pages 50 and 54], yielding a total of  $6.60\text{E}+08$  lb. It is conservatively assumed that all the vegetable produced within the state occurs within 50 miles of the plant. Assuming an increase in production equal to the increase in population within 50 miles (factor of 1.81 from Item 1.m) and converting units, the projected total production in the year 2040 is  $5.41\text{E}+08$  kg.
  - q. Radionuclide Release Rate (FSAR Table 12.2-17R) – The release rates in the units of Ci/yr are shown in the third column of FSAR Table 12.2-17R.
2. No changes have been made to the GASPAR II input and output files provided via Dominion letter number NA3-13-018 dated December 18, 2013 (ML14013A113). The input and output files correspond to the information in FSAR Revision 7 and Revision 8.

3. Gaseous effluent doses by pathway and organ are as follows:

Pathway	Dose (person-rem/yr)	
	Total Body	Thyroid
Plume	4.9E-01	4.9E-01
Ground	7.9E-01	7.9E-01
Inhalation	2.9E-01	7.8E+00
Vegetable	1.4E+00	1.5E+00
Cow Milk	6.7E-01	1.3E+01
Meat	6.3E-01	1.3E+00
Total	4.3E+00	2.5E+01

The total doses in the last row are presented in FSAR Table 12.2-204.

References:

1. NUREG/CR-4653, *GASPAR II – Technical Reference and User Guide*, 1987.
2. *North Anna Early Site Permit Application*, Part 2, Revision 9, September 2006.
3. *Virginia Agricultural Statistics Bulletin and Resource Directory*, Number 77, 2002.

**Proposed COLA Revision**

None.

**ENCLOSURE 2**

**Response to NRC RAI Letter No. 131**

**RAI 7556, Question 12.02-19**



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**RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION**

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**North Anna Unit 3**

**Dominion**

**Docket No. 52-017**

**RAI NO.: 7556 (RAI LETTER NO. 131)**

**SRP SECTION: 12.02 – RADIATION SOURCES**

**DATE OF RAI ISSUE: 8/1/2014**

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**QUESTION NO.: 12.02-19**

FSAR Tier 2 (Rev 7), Section 12.2.2.4, Table 12.2-20aR presents some input design parameters and values used in the LADTAP II computer code and resulting individual and annual population pathway doses (mrem/yr) from liquid radioactive effluents in Table 12.2-20bR. Staff review indicates insufficient information is provided in the FSAR to independently confirm the calculated individual doses and annual population pathway doses for compliance with 10 CFR 20.1301; 10 CFR 20.1302; 10 CFR 50.34a; 10 CFR 50.36a; 10 CFR 50, Appendix I; and 10 CFR 50, Appendix A, GDC 60 and GDC 61. Regulatory Guide 1.206, Revision 0, and Standard Review Plan 11.3, Revision 3, require the parameters used to determine estimated doses from the liquid effluent system to be provided.

Please specifically address the following items and provide the following information:

1. Provide the basis for all design parameters and values used in the LADTAP II code calculation. Include value derivations and references (e.g., pointer to FSAR section or table, RG 1.109 table, etc.).
  2. If changes are made to the LADTAP II code input/output files, provided in FSAR rev. 7., used to calculate the liquid effluent doses in Table 12.2-20bR, please resubmit those files.
  3. A detailed breakdown of population doses by pathway and organ.
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**Dominion Response**

1. The liquid effluent doses presented in FSAR Tables 12.2-19bR and 12.2-204 are based on the following LADTAP II input parameters, as specified in the program manual [Reference 1]:
  - a. Site Water Type (Freshwater) – Lake Anna contains fresh water.
  - b. Liquid Effluent Discharge to Impoundment (0.223 cfs) – This discharge rate is retained from the Early Site Permit Application (ESPA), where Section 10.2.1 of the Plant Parameters Envelope specifies a liquid effluent discharge rate of 100 gpm [Reference 2, ESPA Site Safety Analysis Report (SSAR) Table 1.3-1], which is equivalent to 0.223 cfs.
  - c. Population within 50 Miles ( $2.83\text{E}+06$  in 2040) – FSAR Section 2.1.3 incorporates by reference ESPA SSAR Section 2.1.3, which uses the 2000 census to project population distributions for the years 2010, 2020, 2030, 2040, and 2065. Doses are calculated for 2040, as it is nearest the expected mid-life of North Anna Unit 3. The 50-mile population of  $2.83\text{E}+06$  in 2040 is obtained from the ESPA [Reference 2, Figures 2.1-8 and 2.1-13]. In 2000, the 50-mile population was  $1.56\text{E}+06$  [Reference 2, Figures 2.1-5 and 2.1-9]. Hence, the population is projected to increase from 2000 to 2040 by a factor of 1.81.
  - d. Radionuclide Release Rate (FSAR Table 12.2-19bR) – The release rates in the units of Ci/yr are shown in the third column of FSAR Table 12.2-19bR.
  - e. Impoundment Reconciliation Model (No Model) – This model may be used in LADTAP II to account for dilution that takes place in the impoundment system as well as the buildup of activity due to a recirculation system. The North Anna Units 1 and 2 UFSAR indicates that there is a dilution factor of 0.49 from the discharge canal to the waste heat treatment facility (WHTF) and a buildup factor of approximately 1.5 ( $2.1\text{E}-04$  to  $3.1\text{E}-04$ ) due to recirculation effects [Reference 3, Section 11.2.7]. Since the dilution factor offsets the buildup factor, no adjustment is made for reconciliation. Furthermore, a conservatively low dilution factor is assumed in the discharge canal, as indicated in Item 1.g below.
  - f. Shore-width Factor (0.3) – Shoreline exposure is evaluated at Lake Anna. The LADTAP II manual suggests a shore-width factor of 0.3 for a lake [Reference 1, Table 2.7].
  - g. Dilution Factor (1000 for all receptors) – As indicated in Item 1.b above, the LADTAP II model retains the ESP application liquid effluent discharge rate of 100 gpm (0.223 cfs). The North Anna discharge canal has a flow of 962 cfs [Reference 3, Table 11.2-10] or approximately 430,000 gpm, yielding a dilution factor of 4300. Hence, the dilution factor of 1000 is

conservative as it credits a dilution flow of only 100,000 gpm in the discharge canal.

- h. Transit Time to Exposure Location (0 hr for all receptors) – This is conservative, as no credit is taken for decay during transit.
- i. Fish Consumption for Individual (21 kg/yr for adult, 16 kg/yr for teen, 6.9 kg/yr for child) – Default values for the maximally exposed individual from RG 1.109, Table E-5.
- j. Invertebrate Consumption for Individual (5 kg/yr for adult, 3.8 kg/yr for teen, 1.7 kg/yr for child) – Default values for the maximally exposed individual from RG 1.109, Table E-5.
- k. Drinking Water Consumption for Individual (730 L/yr for adult, 510 L/yr for teen and child, and 330 L/yr for infant) – Default values for the maximally exposed individual from RG 1.109, Table E-5.
- l. Shoreline Usage for Individual (300 hr/yr for all ages) – This is obtained from the North Anna Units 1 and 2 UFSAR [Reference 3, Section 11.2.8].
- m. Swimming Exposure for Individual (200 hr/yr for all ages) – This is obtained from the North Anna Units 1 and 2 UFSAR [Reference 3, Section 11.2.8].
- n. Boating Usage for Individual (500 hr/yr for all ages) – This is obtained from the North Anna Units 1 and 2 UFSAR [Reference 3, Section 11.2.8].
- o. Sport Fishing Harvest (2.66E+05 kg/yr in 2040) – The North Anna Units 1 and 2 UFSAR assumes a fishing harvest in the year 2000 of 3.24E+05 lb [Reference 3, Section 11B.4.2.2] or 1.47E+05 kg. Assuming an increase proportional with population, the projected fishing harvest for 2040 is obtained by multiplying this value by 1.81 [Item 1.c], yielding 2.66E+05 kg.
- p. Commercial Fishing Harvest (None) – Lake Anna is not used for commercial fishing.
- q. Sport Invertebrate Harvest (None) – Lake Anna is not a source of invertebrate harvest.
- r. Commercial Invertebrate Harvest (None) – Lake Anna is not a source of invertebrate harvest.
- s. Population Using Lake Anna for Drinking Water (2.21E+04 in 2040) – Although Lake Anna is not a source of drinking water, it is conservatively assumed that lakeside residents receive all their drinking water from the lake. It is further assumed that each visitor to the lake receives one day's drinking water from the lake. The North Anna Units 1 and 2 UFSAR estimates 4000 permanent and 6000 vacation home residents around the lake [Reference 3, Section 11B.4.2.1]. Adding the two values and

multiplying by 1.81 [Item 1.c] yields a projected total of  $1.81\text{E}+04$  for the year 2040. The number of visitors to the Lake Anna recreational areas is estimated to be  $8.07\text{E}+05$  [Reference 2, Table 2.1-2]. Multiplying by 1.81, the number of visitors is projected to be  $1.46\text{E}+06$  in 2040. Assuming these visitors receive 1/365 of their annual drinking water from the lake is equivalent to an additional 4000 full-time residents. The total effective population receiving drinking water from Lake Anna is thus estimated to be  $2.21\text{E}+04$ .

- t. Shoreline Usage for Population ( $1.31\text{E}+06$  hr/yr in 2040) – It is assumed that  $1.46\text{E}+06$  visitors [Item 1.s] spend 3 hr/visit, with 30% of the time spent on the Lake Anna shoreline [Reference 3, Section 11B.4.2.3].
  - u. Swimming for Population ( $8.76\text{E}+05$  hr/yr in 2040) – It is assumed that  $1.46\text{E}+06$  visitors [Item 1.s] spend 3 hr/visit, with 20% of the time spent swimming [Reference 3, Section 11B.4.2.3].
  - v. Boating for Population ( $2.19\text{E}+06$  hr/yr in 2040) – It is assumed that  $1.46\text{E}+06$  visitors [Item 1.s] spend 3 hr/visit, with 50% of the time spent boating [Reference 3, Section 11B.4.2.3].
  - w. Irrigation Rate (None) – Lake Anna is a negligible source of irrigation water.
2. No changes have been made to the LADTAP II input and output files provided via Dominion letter number NA3-13-018 dated December 18, 2013 (ML14013A113). The input and output files correspond to the information in FSAR Revision 7 and FSAR Revision 8.
3. Liquid effluent doses by pathway and organ are as follows:

Pathway	Dose (person-rem/yr)	
	Total Body	Thyroid
Sport Fishing	$7.8\text{E}-01$	$1.6\text{E}-01$
Drinking Water	$4.4\text{E}-02$	$8.3\text{E}-01$
Shoreline Usage	$1.1\text{E}-02$	0
Swimming	$5.3\text{E}-04$	0
Boating	$6.6\text{E}-04$	0
Total	$8.4\text{E}-01$	$9.9\text{E}-01$

The total doses in the last row are presented in FSAR Table 12.2-204.

References:

1. NUREG/CR-4013, *LADTAP II – Technical Reference and User Guide*, 1986.
2. *North Anna Early Site Permit Application*, Part 2, Revision 9, September 2006.
3. *North Anna Power Station Updated Final Safety Analysis Report*, Revision 45.

**Proposed COLA Revision**

None.