Mark D. Mitchell
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Dominion®

August 17, 2015

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

Serial No. NA3-15-022
Docket No. 52-017
COL/DBE

DOMINION VIRGINIA POWER
NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION
SRP 12.02: REVISED RESPONSE TO RAI LETTERS 146 AND 147

On November 14, 2014, the NRC transmitted nine letters requesting additional information to support the review of certain portions of the North Anna Unit 3 Combined License Application (COLA), which consisted of nine questions. Dominion submitted responses to the nine questions on January 8, 2015, in letter number NA3-14-049R (ML15009A235).

After discussing the submitted responses with the NRC staff, two of the nine responses are being revised. The revised Request for Additional Information (RAI) responses supersede the responses previously submitted by Dominion. The responses to the RAI questions listed below are provided in Enclosures 1 and 2:

- RAI 7703, Question 12.02-21 Airborne Release Concentrations
- RAI 7704, Question 12.02-22 Annual Liquid Release Concentrations

This information will be incorporated into a future submission of the NA3 COLA, as described in the enclosures. The schedule for making a COLA submission formally incorporating these changes will be discussed with the NRC project manager.

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

Very truly yours,

Mark D. Mitchell

Mark D. Mitchell

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NRO

Enclosures:

1. Revised Response to NRC RAI Letter No. 146, RAI 7703 Question 12.02-21
2. Revised Response to NRC RAI Letter No. 147, RAI 7704 Question 12.02-22

Commitments made by this letter:

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

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 17 day of AUGUST, 2015

My registration number is 253183 and my

Commission expires: SEPT. 30, 2016

Kathryn W. Prokopis
Notary Public

KATHY W. PROKOPIS NOTARY PUBLIC MY COMMISSION NUMBER 253183 COMMONWEALTH OF VIRGINIA

cc: J.J. Shea, Jr. 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

Revised Response to NRC RAI Letter No. 146

RAI No. 7703, Question 12.02-21

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 7703 (RAI Letter 146)

SRP SECTION: 12.02 – RADIATION SOURCES

QUESTIONS for Health Physics Branch (CHPB)

DATE OF RAI ISSUE: 11/14/2014

QUESTION NO.: 12.02-21

Per SRP 11.3, The review or conduct of the independent source term and dose calculations for the purpose of assessing the performance of the GWMS against the NRC requirements of 10 CFR 20.1302; Table 2, of Appendix B to 10 CFR Part 20; and the dose objectives of Appendix I to 10 CFR Part 50, is performed under SRP Section 11.3 and SRP Section 11.5. The calculations in this table concerning the concentrations of radioactive materials in gaseous effluents released to unrestricted areas should not exceed the concentration limits in Table 2, of Appendix B, to 10 CFR Part 20. The current calculations for FSAR Table 12.2-17R require additional information to evaluate the source term quantities.

In Table 12.2-17R Comparison of Airborne Release Concentrations with 10 CFR 20 Limit:

1. Please explain the source term calculations related to assessing the 10 CFR 20 requirement calculation(s) involved for all radionuclide values in the Unit 3 Annual Release column 2, MBq/yr to Unit 3 Concentration column 4, Bq/m^3 and all radionuclide values in Unit 3 Annual Release column 3, Ci/yr to Unit 3 Concentration column 5, uCi/ml in a footnote or note at the end of the table.
2. Please change the title of the table to "Comparison of **Annual** Airborne Release Concentrations with 10 CFR 20 Limit" to make it similar to the liquid calculations and to state that all values are considered over an annual period.

Dominion Response

This response revises and supersedes the response submitted in Dominion letter, NA3-14-049R, dated January 8, 2015 (ML15009A235). The revised response provides further clarification of the information presented in FSAR Table 12.2-17R, as requested by the NRC during an audit of the underlying calculations on July 1, 2015.

1. FSAR Table 12.2-17R will be revised to include footnotes that explain the source term calculations related to 10 CFR 20 requirements for all radionuclide values in columns 2-5 of the table. As an example, the calculations of the values for the nuclide H-3 are summarized below.

   FSAR Table 12.2-17R shows the following information for H-3:

	Unit 3 Annual Release		Unit 3 Concentration		Units 1, 2 & 3 Concen-tration	ECL	Units 1, 2 & 3 Fraction of ECL
Nuclide	MBq/yr	Ci/yr	Bq/m^3	µCi/ml	µCi/ml	µCi/ml	
H-3	9.3E+06	2.5E+02	1.4E+00	3.7E-11	3.7E-11	1.0E-07	3.7E-04

Unit 3 Annual Release

H-3 release rates are calculated as follows:

Table 1. Annual Release of H-3 from Unit 3

Release Point	Release (MBq/yr)	Release (Ci/yr)	Comment
Reactor Building	1.2E+06	3.2E+01	Values in MBq/yr are from DCD [Ref 1] Table 12.2-16. Values in Ci/yr are obtained by dividing by 3.7E+04 MBq/Ci.
Turbine Building	1.2E+06	3.2E+01	
Drywell	2.6E+05	7.0E+00	
Circulating Water Hybrid Cooling Tower	6.7E+06	1.8E+02	The concentration in Lake Anna is 5.6E-06 µCi/ml [FSAR Table 12.2-19bR]. The maximum cooling tower evaporation rate is 3665 m^3/hr or 3.21E+13 ml/yr. The product of the two is 180 Ci/yr or, multiplied by 3.7E+04 MBq/Ci, 6.67E+06 MBq/yr.
Total	9.3E+06	2.5E+02	Sum of the four releases.

Unit 3 Concentration

For each release point, the concentration at the site boundary is calculated as follows:

$$C = \left(A \frac{Ci}{yr}\right)\left(0.0317 \frac{\mu Ci/sec}{Ci/yr}\right)\left(\frac{\chi}{Q} \frac{sec}{m^3}\right)\left(1.0E\text{-}06 \frac{m^3}{ml}\right) = (3.17E\text{-}08)A\frac{\chi}{Q} \frac{\mu Ci}{ml}$$

(Equation 1)

Where:

- C is the concentration at the site boundary
- A is the activity release rate at the release point
- χ/Q is the maximum (undecayed, undepleted) atmospheric dispersion factor from the release point to the site boundary

For H-3, Unit 3 concentrations due to releases from the reactor building (including drywell), the turbine building, and the cooling tower are calculated as follows:

Table 2. H-3 Concentrations at the Site Boundary from Unit 3

	Reactor Building + Drywell	Turbine Building	Cooling Tower	Comment
Activity Release, A (Ci/yr)	3.9E+01	3.2E+01	1.8E+02	Values are from Table 1.
Atmospheric Dispersion Factor, χ/Q (sec/m^3)	7.1E-08	5.2E-08	6.4E-06	Undecayed, undepleted values are from FSAR Table 2.3-16R.
Concentration, C (μCi/ml)	8.9E-14	5.3E-14	3.7E-11	Calculated by plugging activity release and χ/Q in Equation 1.

The total H-3 concentration for Unit 3 is:

8.9E-14 + 5.3E-14 + 3.7E-11 = 3.7E-11 μCi/ml

This concentration is converted into Bq/m^3 as follows:

$$\left(3.7E\text{-}11 \frac{\mu Ci}{ml}\right)\left(3.7E+04 \frac{Bq}{\mu Ci}\right)\left(1.0E+06 \frac{ml}{m^3}\right) = 1.4E+00 \frac{Bq}{m^3}$$

Units 1, 2 & 3 Concentration

As the UFSAR for Units 1 and 2 [Ref 2, Table 11.3-2] shows no H-3 in gaseous effluent, the total concentration is the same as that for Unit 3: 3.7E-11 µCi/ml.

Effluent Concentration Limit (ECL)

For H-3, 10 CFR 20, Appendix B, Table 2, Column 1 specifies an ECL in air of 1.0E-07 µCi/ml.

Fraction of ECL

For H-3, dividing the total concentration from Units 1, 2, and 3 of 3.7E-11 µCi/ml by the ECL of 1.0E-07 µCi/ml yields an ECL fraction of 3.7E-04.

2. The title of FSAR Table 12.2-17R will be revised for consistency with Table 12.2-19bR and to indicate that all values are considered over an annual period.

References

1. ESBWR Design Control Document, Rev 10.
2. North Anna Units 1 and 2 UFSAR, Rev 45.

Proposed COLA Revision

FSAR Table 12.2-17R and Section 12.2.5 will be revised as indicated in 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.

Table 12.2-20bR. The dose for each liquid radioactive effluent pathway for Unit 3 is less than the corresponding estimate in the ESP-ER. Table 12.2-202 summarizes the annual total body and bone doses to the MEI and shows that the Unit 3 doses are lower than those calculated and presented in ESP-ER Table 5.4-10.

As indicated in Tables 12.2-203 and 12.2-204, the annual total site doses to the MEI and the population within 50 miles of Unit 3 are lower than those calculated and presented in ESP-ER.

12.2.4 COL Information

12.2-2-A Airborne Effluents and Doses

NAPS COL 12.2-2-A This COL item is addressed in Sections 12.2.2.1 and 12.2.2.2.

12.2-3-A Liquid Effluents and Doses

NAPS COL 12.2-3-A This COL item is addressed in Section 12.2.2.4.

12.2-4-A Other Contained Sources

STD COL 12.2-4-A This COL item is addressed in Section 12.2.1.5.

12.2.5 References

12.2-201 [Deleted]

12.2-202 [Deleted]

12.2-203 Virginia Electric and Power Company, North Anna Units 1 & 2 and Independent Spent Fuel Storage Installation (ISFSI) Annual Radiological Environmental Operating Report, April 17, 2006.

12.2-204 NUREG-1437, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, U. S. Nuclear Regulatory Commission, May 1996.

12.2-205 Virginia Electric and Power Company, North Anna Independent Spent Fuel Storage Installation, Final Safety Analysis Report, Revision 6, Docket No. 72-16, License No. 2507, June 2008.

12.2-206 North Anna Power Station Updated Final Safety Analysis Report, Revision 45.

12.2-207 NRC Regulatory Issue Summary (RIS) 2008-03 Return/Re-Use of Previously Discharged Radioactive Effluents

NAPS COL 12.2-2-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-5

Table 12.2-17R Comparison of Annual Airborne Release Concentrations with 10 CFR 20 Limit

Nuclide	Unit 3 ~~Airborne~~ Annual Release[1] MBq/yr	Ci/yr	~~Concentration Bq/m³~~	Unit 3 Concentration[2] Bq/m³	µCi/ml	Units 1, 2 & 3 Concentration µCi/ml[3]	~~10 CFR 20 Bq/m³~~	ECL µCi/ml[4]	Units 1, 2, & 3 Fraction of ECL[5]
Kr-83m	**8.5E+01**	**2.3E-03**	~~4.0E-07~~	1.9E-07	5.2E-18	5.2E-18	~~2.E+06~~	5.0E-05	1.0E-13
Kr-85m	6.6E+05	1.8E+01	~~2.6E-03~~	1.1E-03	3.1E-14	7.0E-11	~~4.E+03~~	1.0E-07	7.0E-04
Kr-85	5.2E+06	1.4E+02	~~2.0E-02~~	8.6E-03	2.3E-13	1.3E-09	~~3.E+04~~	7.0E-07	1.8E-03
Kr-87	1.4E+06	3.9E+01	~~5.4E-03~~	2.4E-03	6.5E-14	4.0E-11	~~7.E+02~~	2.0E-08	2.0E-03
Kr-88	2.1E+06	5.7E+01	~~8.2E-03~~	3.5E-03	9.5E-14	1.3E-10	~~3.E+02~~	9.0E-09	1.4E-02
Kr-89	1.4E+07	3.7E+02	~~1.5E-01~~	9.0E-02	2.4E-12	2.4E-12	~~4.E+01~~	1.0E-09	2.4E-03
Xe-131m	1.5E+05	4.1E+00	~~5.6E-04~~	2.5E-04	6.7E-15	1.8E-12	~~7.E+04~~	2.0E-06	8.9E-07
Xe-133m	1.9E+02	5.2E-03	~~9.2E-07~~	4.3E-07	1.2E-17	1.0E-10	~~2.E+04~~	6.0E-07	1.7E-04
Xe-133	4.1E+07	1.1E+03	~~9.3E-01~~	5.8E-01	1.6E-11	9.2E-09	~~2.E+04~~	5.0E-07	1.8E-02
Xe-135m	2.2E+07	6.1E+02	~~1.9E+00~~	1.3E+00	3.4E-11	4.1E-11	~~1.E+03~~	4.0E-08	1.0E-03
Xe-135	2.8E+07	7.5E+02	~~1.1E+00~~	7.0E-01	1.9E-11	2.3E-10	~~3.E+03~~	7.0E-08	3.3E-03
Xe-137	2.8E+07	7.8E+02	~~4.0E-01~~	2.5E-01	6.6E-12	6.6E-12	~~4.E+01~~	1.0E-09	6.6E-03
Xe-138	2.3E+07	6.3E+02	~~9.4E-02~~	4.3E-02	1.2E-12	2.3E-11	~~7.E+02~~	2.0E-08	1.2E-03
I-131	1.8E+04	5.0E-01	~~1.8E-04~~	1.0E-04	2.8E-15	2.3E-13	~~7.E+00~~	2.0E-10	1.2E-03
I-132	**9.4E+04**	**2.5E+00**	~~1.1E-03~~	6.7E-04	1.8E-14	6.4E-14	~~7.E+02~~	2.0E-08	3.2E-06
I-133	**8.9E+04**	**2.4E+00**	~~1.1E-03~~	6.3E-04	1.7E-14	3.0E-13	~~4.E+01~~	1.0E-09	3.0E-04
I-134	1.5E+05	4.0E+00	~~1.8E-03~~	1.0E-03	2.8E-14	4.5E-14	~~2.E+03~~	6.0E-08	7.5E-07

NAPS COL 12.2-2-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-5

Table 12.2-17R Comparison of Annual Airborne Release Concentrations with 10 CFR 20 Limit

Nuclide	Unit 3 ~~Airborne~~ Annual Release[1] MBq/yr	Unit 3 ~~Airborne~~ Annual Release[1] Ci/yr	~~Concentration Bq/m³~~	Unit 3 Concentration[2] Bq/m³	Unit 3 Concentration[2] µCi/ml	Units 1, 2 & 3 Concentration µCi/ml[3]	~~10 CFR 20 Bq/m³~~	ECL µCi/ml[4]	Units 1, 2, & 3 Fraction of ECL[5]
I-135	**1.2E+05**	**3.2E+00**	~~1.4E-03~~	8.3E-04	2.2E-14	1.4E-13	~~2.E+02~~	6.0E-09	2.3E-05
H-3	~~2.8E+06~~ 9.3E+06	2.5E+02	~~1.2E-02~~	1.4E+00	3.7E-11	3.7E-11	~~4.E+03~~	1.0E-07	3.7E-04
C-14	**5.3E+05**	**1.4E+01**	~~2.0E-03~~	8.7E-04	2.4E-14	2.4E-14	~~1.E+02~~	3.0E-09	7.9E-06
Na-24	5.9E+00	1.6E-04	~~2.8E-08~~	1.3E-08	3.6E-19	3.6E-19	~~3.E+02~~	7.0E-09	5.1E-11
P-32	1.5E+00	4.1E-05	~~7.1E-09~~	3.4E-09	9.1E-20	9.1E-20	~~2.E+01~~	5.0E-10	1.8E-10
Ar-41	1.4E+03	3.8E-02	~~5.4E-06~~	2.3E-06	6.2E-17	6.2E-17	~~4.E+02~~	1.0E-08	6.2E-09
Cr-51	2.7E+02	7.2E-03	~~6.6E-06~~	4.2E-06	1.1E-16	1.1E-16	~~1.E+03~~	3.0E-08	3.7E-09
Mn-54	**3.0E+02**	**8.2E-03**	~~3.2E-05~~	2.1E-05	5.7E-16	5.7E-16	~~4.E+01~~	1.0E-09	5.7E-07
Mn-56	1.2E+01	3.2E-04	~~5.6E-08~~	2.7E-08	7.3E-19	7.3E-19	~~7.E+02~~	2.0E-08	3.7E-11
Fe-55	5.1E+01	1.4E-03	~~2.4E-07~~	1.1E-07	3.1E-18	3.1E-18	~~1.E+02~~	3.0E-09	1.0E-09
Fe-59	**4.1E+01**	**1.1E-03**	~~2.5E-06~~	1.6E-06	4.4E-17	4.4E-17	~~2.E+01~~	5.0E-10	8.8E-08
Co-58	8.0E+01	2.2E-03	~~1.9E-06~~	1.2E-06	3.2E-17	3.2E-17	~~4.E+01~~	1.0E-09	3.2E-08
Co-60	**6.6E+02**	**1.8E-02**	~~5.7E-05~~	3.7E-05	1.0E-15	1.0E-15	~~2.E+00~~	5.0E-11	2.0E-05
Ni-63	5.2E-02	1.4E-06	~~2.5E-10~~	1.2E-10	3.2E-21	3.2E-21	~~4.E+01~~	1.0E-09	3.2E-12
Cu-64	7.5E+00	2.0E-04	~~3.6E-08~~	1.7E-08	4.6E-19	4.6E-19	~~1.E+03~~	3.0E-08	1.5E-11
Zn-65	**6.2E+02**	**1.7E-02**	~~5.0E-06~~	2.7E-06	7.4E-17	7.4E-17	~~1.E+01~~	4.0E-10	1.9E-07
Rb-89	2.0E-01	5.4E-06	~~9.5E-10~~	4.5E-10	1.2E-20	1.2E-20	~~7.E+03~~	2.0E-07	6.1E-14

NAPS COL 12.2-2-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-5

Table 12.2-17R Comparison of Annual Airborne Release Concentrations with 10 CFR 20 Limit

Nuclide	Unit 3 ~~Airborne~~ Annual Release[1] MBq/yr	Ci/yr	~~Concentration Bq/m³~~	Unit 3 Concentration[2] Bq/m³	µCi/ml	Units 1, 2 & 3 Concentration µCi/ml[3]	~~10 CFR 20 Bq/m³~~	ECL µCi/ml[4]	Units 1, 2, & 3 Fraction of ECL[5]
Sr-89	**3.1E+02**	**8.3E-03**	~~1.2E-06~~	5.1E-07	1.4E-17	1.4E-17	~~7.E+00~~	2.0E-10	6.9E-08
Sr-90	1.9E+00	5.0E-05	~~7.9E-09~~	3.6E-09	9.7E-20	9.7E-20	~~2.E-01~~	6.0E-12	1.6E-08
Y-90	8.9E-02	2.4E-06	~~4.2E-10~~	2.0E-10	5.4E-21	5.4E-21	~~3.E+01~~	9.0E-10	6.0E-12
Sr-91	7.5E+00	2.0E-04	~~3.6E-08~~	1.7E-08	4.6E-19	4.6E-19	~~2.E+02~~	5.0E-09	9.1E-11
Sr-92	4.9E+00	1.3E-04	~~2.3E-08~~	1.1E-08	3.0E-19	3.0E-19	~~3.E+02~~	9.0E-09	3.3E-11
Y-91	1.9E+00	5.1E-05	~~9.2E-09~~	4.3E-09	1.2E-19	1.2E-19	~~7.E+00~~	2.0E-10	5.8E-10
Y-92	3.8E+00	1.0E-04	~~1.8E-08~~	8.6E-09	2.3E-19	2.3E-19	~~4.E+02~~	1.0E-08	2.3E-11
Y-93	8.1E+00	2.2E-04	~~3.8E-08~~	1.8E-08	4.9E-19	4.9E-19	~~1.E+02~~	3.0E-09	1.6E-10
Zr-95	**9.2E+01**	**2.5E-03**	~~6.6E-06~~	4.3E-06	1.2E-16	1.2E-16	~~1.E+01~~	4.0E-10	2.9E-07
Nb-95	**5.0E+02**	**1.4E-02**	~~2.4E-06~~	1.1E-06	3.1E-17	3.1E-17	~~7.E+01~~	2.0E-09	1.6E-08
Mo-99	**3.4E+03**	**9.3E-02**	~~1.6E-05~~	7.7E-06	2.1E-16	2.1E-16	~~7.E+01~~	2.0E-09	1.0E-07
Tc-99m	2.4E+00	6.5E-05	~~1.2E-08~~	5.4E-09	1.5E-19	1.5E-19	~~7.E+03~~	2.0E-07	7.3E-13
Ru-103	**2.1E+02**	**5.8E-03**	~~1.0E-06~~	4.8E-07	1.3E-17	1.3E-17	~~3.E+01~~	9.0E-10	1.5E-08
Rh-103m	3.8E-03	1.0E-07	~~1.8E-11~~	8.6E-12	2.3E-22	2.3E-22	~~7.E+04~~	2.0E-06	1.2E-16
Ru-106	1.6E-01	4.3E-06	~~7.4E-10~~	3.6E-10	9.7E-21	9.7E-21	~~7.E-01~~	2.0E-11	4.9E-10
Rh-106	5.2E-06	1.4E-10	~~2.5E-14~~	1.2E-14	3.2E-25	3.2E-25	~~4.E+01~~	1.0E-09	3.2E-16
Ag-110m	**1.7E-01**	**4.6E-06**	~~8.1E-10~~	3.8E-10	1.0E-20	1.0E-20	~~4.E+00~~	1.0E-10	1.0E-10
Sb-124	**1.1E+01**	**3.0E-04**	~~5.9E-07~~	3.8E-07	1.0E-17	1.0E-17	~~1.E+01~~	3.0E-10	3.4E-08
Te-129m	1.8E+00	4.9E-05	~~8.6E-09~~	4.1E-09	1.1E-19	1.1E-19	~~1.E+01~~	3.0E-10	3.7E-10

NAPS COL 12.2-2-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-5

Table 12.2-17R Comparison of Annual Airborne Release Concentrations with 10 CFR 20 Limit

Nuclide	Unit 3 ~~Airborne~~ Annual Release[1] MBq/yr	Ci/yr	~~Concentration Bq/m³~~	Unit 3 Concentration[2] Bq/m³	µCi/ml	Units 1, 2 & 3 Concentration µCi/ml[3]	~~10 CFR 20 Bq/m³~~	ECL µCi/ml[4]	Units 1, 2, & 3 Fraction of ECL[5]
Te-131m	6.0E-01	1.6E-05	~~2.9E-09~~	1.4E-09	3.7E-20	3.7E-20	~~4.E+01~~	1.0E-09	3.7E-11
Te-132	1.5E-01	4.1E-06	~~7.3E-10~~	3.4E-10	9.1E-21	9.1E-21	~~3.E+01~~	9.0E-10	1.0E-11
Cs-134	**3.7E+02**	**1.0E-02**	~~2.0E-05~~	1.3E-05	3.5E-16	3.5E-16	~~7.E+00~~	2.0E-10	1.8E-06
Cs-136	**3.1E+01**	**8.3E-04**	~~1.4E-07~~	6.6E-08	1.8E-18	1.8E-18	~~3.E+01~~	9.0E-10	2.0E-09
Cs-137	**5.5E+02**	**1.5E-02**	~~3.3E-05~~	2.2E-05	5.9E-16	5.9E-16	~~7.E+00~~	2.0E-10	2.9E-06
Cs-138	8.5E-01	2.3E-05	~~4.0E-09~~	1.9E-09	5.2E-20	5.2E-20	~~3.E+03~~	8.0E-08	6.5E-13
Ba-140	**1.6E+03**	**4.4E-02**	~~7.2E-06~~	3.4E-06	9.1E-17	9.1E-17	~~7.E+01~~	2.0E-09	4.5E-08
La-140	1.4E+01	3.8E-04	~~6.8E-08~~	3.2E-08	8.5E-19	8.5E-19	~~7.E+01~~	2.0E-09	4.3E-10
Ce-141	**5.5E+02**	**1.5E-02**	~~2.2E-06~~	9.7E-07	2.6E-17	2.6E-17	~~3.E+01~~	8.0E-10	3.3E-08
Ce-144	1.6E-01	4.3E-06	~~7.4E-10~~	3.6E-10	9.7E-21	9.7E-21	~~7.E-01~~	2.0E-11	4.9E-10
Pr-144	1.8E-04	4.9E-09	~~8.6E-13~~	4.1E-13	1.1E-23	1.1E-23	~~7.E+00~~	2.0E-07	5.5E-17
W-187	1.4E+00	3.8E-05	~~6.6E-09~~	3.2E-09	8.5E-20	8.5E-20	~~4.E+02~~	1.0E-08	8.5E-12
Np-239	9.0E+01	2.4E-03	~~4.3E-07~~	2.0E-07	5.5E-18	5.5E-18	~~1.E+02~~	3.0E-09	1.8E-09
Total	1.8E+08	4.8E+03		4.3E+00	1.2E-10	1.1E-08		NA	5.3E-02

NAPS COL 12.2-2-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-5

Table 12.2-17R Comparison of Annual Airborne Release Concentrations with 10 CFR 20 Limit

Notes:

1. Unit 3 Annual Release – Values in MBq/yr are from DCD Table 12.2-17 except for H-3, which is adjusted as described below. Values in Ci/yr are obtained by summing the releases (MBq/yr) by building in DCD Table 12.2-16 and dividing by 3.7E+04 MBq/Ci. In accordance with RIS 2008-03 (Reference 12.2-207), tritium from Lake Anna that enters the circulating water hybrid cooling tower and subsequently evaporates into the atmosphere is evaluated as a new release pathway. The H-3 release includes a contribution from the cooling tower of 180 Ci/yr (6.7E+06 MBq/yr), obtained by multiplying the total concentration from Units 1, 2, and 3 in Lake Anna of 5.6E-06 µCi/ml (Table 12.2-19bR) by the maximum cooling tower evaporation rate of 3665 m^3/hr and converting units. Values in bold indicate the nuclide activity is greater than that in ESP-ER Table 5.4-7.
2. Unit 3 Concentration – Concentrations are based on releases from the reactor building, turbine building (including mechanical vacuum pump, turbine seal, and offgas system), and radwaste building releases (MBq/yr) in DCD Table 12.2-16 as well as cooling tower evaporation. For each release location, the nuclide activities are multiplied by the undecayed/undepleted atmospheric dispersion factor to the EAB (Table 2.3-16R) and units are adjusted to obtain the concentrations in Bq/m^3 and µCi/ml. Further information about dispersion factors is provided in Table 12.2-15R.
3. Units 1, 2 & 3 Concentration – Concentrations for Units 1 and 2 are based on the activity releases in the Units 1 and 2 UFSAR, Table 11.3-2 (Reference 12.2-206) and the site boundary atmospheric dispersion factor of 3.3E-06 sec/m^3 (Units 1 and 2 UFSAR, Section 2.3.5.1). These concentrations are added to those from Unit 3 to obtain the totals for the site.
4. ECL – Effluent concentration limits (ECLs) are from 10 CFR 20, Appendix B, Table 2, Column 1.
5. Units 1, 2 & 3 Fraction of ECL – For each nuclide, Units 1, 2 & 3 Concentration is divided by ECL. Total is obtained by summing the nuclide fractions of ECL.

ENCLOSURE 2

Revised Response to NRC RAI Letter No. 147

RAI No. 7704, Question 12.02-22

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

North Anna Unit 3

Dominion

Docket No. 52-017

RAI NO.: 7704 (RAI Letter 147)

SRP SECTION: 12.02 – RADIATION SOURCES

QUESTIONS for Health Physics Branch (CHPB)

DATE OF RAI ISSUE: 11/14/2014

QUESTION NO.: 12.02-22

Per SRP 11.2, the review or conduct of independent source term and dose calculations for the purpose of assessing the performance of the LWMS against the NRC requirements of 10 CFR 20.1302; Table 2, of Appendix B to 10 CFR Part 20; and the dose objectives of Appendix I to 10 CFR Part 50, is performed under SRP Section 11.2 and SRP Section 11.5. The calculations in this table concerning the concentrations of radioactive materials in liquid effluents released to unrestricted areas should not exceed the concentration limits in Table 2, of Appendix B, to 10 CFR Part 20. The current calculations for FSAR Table 12.2-19bR require additional information to evaluate the source term quantities.

In Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limits:

Please explain the source term calculations related to assessing the 10 CFR 20 requirement calculation(s) involved for all radionuclide values in the Unit 3 Annual Release column 2, MBq/yr to Unit 3 Concentration column 4, Bq/m^3 and all radionuclide values in Unit 3 Annual Release column 3, Ci/yr to Unit 3 Concentration column 5, uCi/ml in a footnote or note at the end of the table.

Dominion Response

This response revises and supersedes the response submitted in Dominion letter, NA3-14-049R, dated January 8, 2015 (ML15009A235). The revised response provides further clarification of the information presented in FSAR Table 12.2-19bR, as requested by the NRC during an audit of the underlying calculations on July 1, 2015.

FSAR Table 12.2-19bR will be revised to include footnotes that explain the source term calculations related to 10 CFR 20 requirements for all radionuclide values in columns 2-5 of the table. As an example, the calculations of the values for the nuclide I-131 are summarized below.

FSAR Table 12.2-19bR shows the following information for I-131:

	Unit 3 Annual Release		Unit 3 Concentration		Units 1, 2 & 3 Concen-tration	ECL	Units 1, 2 & 3 Fraction of ECL
Nuclide	MBq/yr	Ci/yr	Bq/m^3	µCi/ml	µCi/ml	µCi/ml	
I-131	2.29E+02	6.2E-03	1.2E-06	3.1E-11	5.6E-08	1.0E-06	5.6E-02

Unit 3 Annual Release

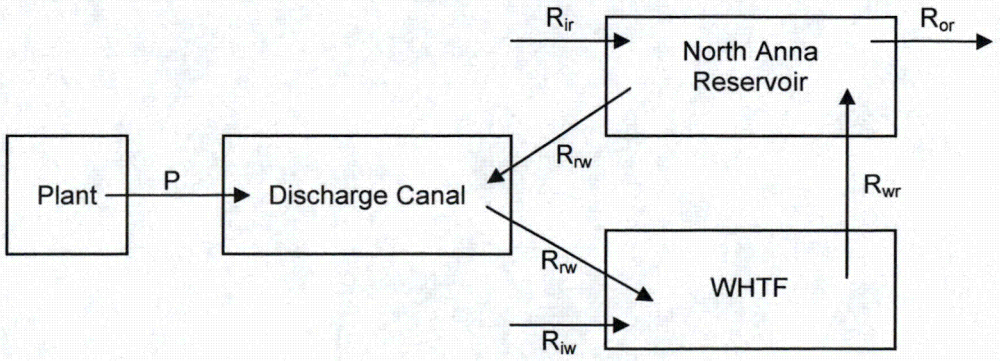
I-131 release rate of 2.29E+02 MBq/yr is from DCD [Ref 1] Table 12.2-19b.

The release rate in Ci/yr is calculated as follows:

$$\left(229\ \frac{\text{MBq}}{\text{yr}}\right)\left(\frac{\text{Ci}}{3.7\text{E+04 MBq}}\right) = 6.2\text{E-03}\ \frac{\text{Ci}}{\text{yr}}$$

Unit 3 Concentration

The concentration in the discharge canal is calculated using the following model from the UFSAR of Units 1 and 2 [Ref 2, Sec 11.2.5.1]:



The Units 1 and 2 UFSAR model also considers evaporation from the North Anna Reservoir and the Waste Heat Treatment Facility (WHTF), but these removal terms are conservatively neglected for Unit 3 to maximize the concentration in the discharge canal.

For a given nuclide, the concentration in the discharge canal is calculated using the following equation [Ref 2, Eq 11.2-8]:

$$C_c = \frac{(0.0317)P}{R_{rw}}\left(\frac{\lambda_w \lambda_r V_w V_r}{\lambda_w \lambda_r V_w V_r - R_{rw} R_{wr}}\right) \qquad \text{(Equation 1)}$$

The parameters are described below, with values taken from the Units 1 and 2 UFSAR [Ref 2, Table 11.2-20] except as noted.

- C_c = Concentration in canal ($\mu Ci/cm^3$)
- P = Activity discharge rate from plant to canal = 6.2E-03 Ci/yr for I-131 from Unit 3 as determined above
- 0.0317 = Conversion from Ci/yr to µCi/sec
- V_w = Volume of WHTF = 2.66E+09 ft^3 = 7.53E+13 cm^3
- V_r = Volume of reservoir = 1.06E+10 ft^3 = 3.00E+14 cm^3
- R_{rw} = Flow from reservoir to discharge canal to WHTF = 100,000 gpm [Ref 3, Table 5.4-1; representing dilution factor of 1000] = 223 ft^3/sec = 6.31E+06 cm^3/sec
- R_{iw} = Inlet flow from environment to WHTF = 30 ft^3/sec = 8.50E+05 cm^3/sec
- R_{ir} = Inlet flow from environment to reservoir = 270 ft^3/sec = 7.65E+06 cm^3/sec
- R_{wr} = Flow from WHTF to reservoir = $R_{rw} + R_{iw}$ = 253 ft^3/sec = 7.16E+06 cm^3/sec
- R_{or} = Overflow from reservoir (cm^3/sec) = $R_{ir} + R_{wr} - R_{rw} = R_{ir} + R_{iw}$ = 300 ft^3/sec = 8.50E+06 cm^3/sec
- λ = Decay constant for I-131

$$= \frac{\ln(2)}{(8.1 \text{ day})(24 \text{ hr/day})(3600 \text{ sec/hr})} = 9.9\text{E-}07 \text{ sec}^{-1}$$

The removal rate from the reservoir, λ_r, is calculated as follows [Ref 2, Eq 11.2-3]:

$$\lambda_r = \frac{R_{or} + R_{rw}}{V_r} + \lambda = \frac{8.50\text{E+}06 + 6.31\text{E+}06}{3.00\text{E+}14} + 9.9\text{E-}07 = 1.0\text{E-}06 \text{ sec}^{-1}$$

The removal rate from the WHTF, λ_w, is calculated as follows [Ref 2, Eq 11.2-4]:

$$\lambda_w = \frac{R_{wr}}{V_w} + \lambda = \frac{7.16E+06}{7.53E+13} + 9.9E-07 = 1.1E-06 \text{ sec}^{-1}$$

Plugging the above values into Equation 1 yields an I-131 concentration in the discharge canal of 3.1E-11 µCi/ml.

This concentration is converted into Bq/m^3 as follows:

$$\left(3.1E-11 \frac{\mu Ci}{ml}\right)\left(3.7E+04 \frac{Bq}{\mu Ci}\right)\left(1.0E+06 \frac{ml}{m^3}\right) = 1.2E-06 \frac{Bq}{m^3}$$

Units 1, 2 & 3 Concentration

The UFSAR for Units 1 and 2 [Ref 2, Table 11.2-14] shows an I-131 concentration in the discharge canal of 5.6E-08 µCi/ml. The total concentration of I-131 in the discharge canal is obtained by adding this concentration to that from Unit 3:

3.1E-11 + 5.6E-08 = 5.6E-08 µCi/ml

Effluent Concentration Limit (ECL)

For I-131, 10 CFR 20, Appendix B, Table 2, Column 2 specifies an ECL in water of 1.0E-06 µCi/ml.

Fraction of ECL

For I-131, dividing the total concentration from Units 1, 2, and 3 of 5.6E-08 µCi/ml by the ECL of 1.0E-06 µCi/ml yields an ECL fraction of 5.6E-02.

References

1. ESBWR Design Control Document, Rev 10.
2. North Anna Units 1 and 2 UFSAR, Rev 45.
3. North Anna Early Site Permit Application, Part 3 – Environmental Report, Rev 9.

Proposed COLA Revision

FSAR Table 12.2-19bR will be revised as indicated in 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.

NAPS COL 12.2-3-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-3

Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limit

Nuclide	Unit 3 Annual Release[1] MBq/yr	Unit 3 Annual Release[1] Ci/yr	~~Concentration~~ ~~Bq/m³~~	Unit 3 Concentration[2] Bq/m³	Unit 3 Concentration[2] µCi/ml	Units 1, 2 & 3 Concentration[3] µCi/ml	~~10 CFR 20 MPC~~ ~~Bq/m³~~	ECL[4] µCi/ml	Units 1, 2, & 3 Fraction of ECL[5]
I-131	2.29E+02	6.2E-03	~~2.18E-05~~	1.2E-06	3.1E-11	5.6E-08	~~3.70E-02~~	1.0E-06	5.6E-02
I-132	3.44E+01	9.3E-04	~~3.27E-06~~	1.7E-07	4.7E-12	8.5E-09	~~3.70E+00~~	1.0E-04	8.5E-05
I-133	**1.11E+03**	**3.0E-02**	~~1.06E-04~~	5.6E-06	1.5E-10	6.2E-08	~~2.59E-01~~	7.0E-06	8.9E-03
I-134	1.48E+00	4.0E-05	~~1.41E-07~~	7.4E-09	2.0E-13	1.2E-09	~~1.48E+01~~	4.0E-04	3.0E-06
I-135	2.63E+02	7.1E-03	~~2.50E-05~~	1.3E-06	3.6E-11	3.6E-09	~~1.11E+00~~	3.0E-05	1.2E-04
H-3	5.18E+05	1.4E+01	~~4.92E-02~~	4.4E-03	1.2E-07	5.6E-06	~~3.70E+01~~	1.0E-03	5.6E-03
Na-24	**1.55E+02**	**4.2E-03**	~~1.48E-05~~	7.8E-07	2.1E-11	2.1E-11	~~1.85E+00~~	5.0E-05	4.2E-07
P-32	1.30E+01	3.5E-04	~~1.23E-06~~	6.6E-08	1.8E-12	1.8E-12	~~3.33E-01~~	9.0E-06	2.0E-07
Cr-51	4.07E+02	1.1E-02	~~3.87E-05~~	2.1E-06	5.6E-11	7.9E-11	~~1.85E+01~~	5.0E-04	1.6E-07
Mn-54	4.81E+00	1.3E-04	~~4.57E-07~~	3.1E-08	8.3E-13	4.0E-11	~~1.11E+00~~	3.0E-05	1.3E-06
Mn-56	3.70E+01	1.0E-03	~~3.52E-06~~	1.9E-07	5.0E-12	5.0E-12	~~2.59E+00~~	7.0E-05	7.2E-08
Fe-55	7.03E+01	1.9E-03	~~6.68E-06~~	5.3E-07	1.4E-11	1.4E-11	~~3.70E+00~~	1.0E-04	1.4E-07
Fe-59	2.22E+00	6.0E-05	~~2.11E-07~~	1.2E-08	3.1E-13	2.6E-11	~~3.70E-01~~	1.0E-05	2.6E-06
Co-58	1.37E+01	3.7E-04	~~1.30E-06~~	7.3E-08	2.0E-12	7.4E-10	~~7.40E-01~~	2.0E-05	3.7E-05
Co-60	2.78E+01	7.5E-04	~~2.64E-06~~	2.2E-07	6.1E-12	6.6E-11	~~1.11E-01~~	3.0E-06	2.2E-05
Cu-64	**3.70E+02**	**1.0E-02**	~~3.52E-05~~	1.9E-06	5.0E-11	5.0E-11	~~7.40E+00~~	2.0E-04	2.5E-07
Zn-65	1.37E+01	3.7E-04	~~1.30E-06~~	8.5E-08	2.3E-12	2.3E-12	~~1.85E-01~~	5.0E-06	4.6E-07
Zn-69m	**2.78E+01**	**7.5E-04**	~~2.64E-06~~	1.4E-07	3.8E-12	3.8E-12	~~2.22E+00~~	6.0E-05	6.3E-08

NAPS COL 12.2-3-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-3

Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limit

Nuclide	Unit 3 Annual Release[1] MBq/yr	Ci/yr	~~Concentration~~ ~~Bq/m³~~	Unit 3 Concentration[2] Bq/m³	µCi/ml	Units 1, 2 & 3 Concentration[3] µCi/ml	~~10 CFR 20 MPC~~ ~~Bq/m³~~	ECL[4] µCi/ml	Units 1, 2, & 3 Fraction of ECL[5]
Br-83	**3.70E+00**	**1.0E-04**	~~3.52E-07~~	1.9E-08	5.0E-13	5.0E-13	~~3.33E+01~~	9.0E-04	5.6E-10
Sr-89	7.03E+00	1.9E-04	~~6.68E-07~~	3.7E-08	9.9E-13	1.1E-10	~~2.96E-01~~	8.0E-06	1.4E-05
Sr-90	3.70E-01	1.0E-05	~~3.52E-08~~	3.2E-09	8.6E-14	1.2E-11	~~1.85E-02~~	5.0E-07	2.4E-05
Sr-91	3.52E+01	9.5E-04	~~3.34E-06~~	1.8E-07	4.8E-12	2.4E-11	~~7.40E-01~~	2.0E-05	1.2E-06
Y-91	4.44E+00	1.2E-04	~~4.22E-07~~	2.3E-08	6.3E-13	1.3E-10	~~2.96E-01~~	8.0E-06	1.6E-05
Sr-92	8.51E+00	2.3E-04	~~8.09E-07~~	4.3E-08	1.2E-12	1.2E-12	~~1.48E+00~~	4.0E-05	2.9E-08
Y-92	**3.22E+01**	**8.7E-04**	~~3.06E-06~~	1.6E-07	4.4E-12	4.4E-12	~~1.48E+00~~	4.0E-05	1.1E-07
Y-93	**3.70E+01**	**1.0E-03**	~~3.52E-06~~	1.9E-07	5.0E-12	5.0E-12	~~7.40E-01~~	2.0E-05	2.5E-07
Zr-95	3.70E-01	1.0E-05	~~3.52E-08~~	2.0E-09	5.3E-14	2.1E-11	~~7.40E-01~~	2.0E-05	1.1E-06
Nb-95	3.70E-01	1.0E-05	~~3.52E-08~~	1.9E-09	5.1E-14	2.2E-11	~~1.11E+00~~	3.0E-05	7.4E-07
Mo-99	9.25E+01	2.5E-03	~~8.79E-06~~	4.6E-07	1.3E-11	9.9E-08	~~7.40E-01~~	2.0E-05	5.0E-03
Tc-99m	1.70E+02	4.6E-03	~~1.62E-05~~	8.5E-07	2.3E-11	8.5E-08	~~3.70E+01~~	1.0E-03	8.5E-05
Ru-103	1.48E+00	4.0E-05	~~1.41E-07~~	7.6E-09	2.1E-13	2.1E-13	~~1.11E+00~~	3.0E-05	6.9E-09
Ru-105	**4.81E+00**	**1.3E-04**	~~4.57E-07~~	2.4E-08	6.5E-13	6.5E-13	~~2.59E+00~~	7.0E-05	9.3E-09
Te-129m	2.59E+00	7.0E-05	~~2.46E-07~~	1.3E-08	3.6E-13	3.6E-13	~~2.59E-01~~	7.0E-06	5.1E-08
Te-131m	2.96E+00	8.0E-05	~~2.81E-07~~	1.5E-08	4.0E-13	4.0E-13	~~2.96E-01~~	8.0E-06	5.0E-08
Te-132	3.70E-01	1.0E-05	~~3.52E-08~~	1.9E-09	5.0E-14	4.8E-09	~~3.33E-01~~	9.0E-06	5.3E-04
Cs-134	2.11E+01	5.7E-04	~~2.00E-06~~	1.5E-07	4.2E-12	1.8E-08	~~3.33E-02~~	9.0E-07	2.0E-02

NAPS COL 12.2-3-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-3

Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limit

Nuclide	Unit 3 Annual Release[1] MBq/yr	Ci/yr	~~Concentration~~ ~~Bq/m³~~	Unit 3 Concentration[2] Bq/m³	µCi/ml	Units 1, 2 & 3 Concentration[3] µCi/ml	~~10 CFR 20 MPC~~ ~~Bq/m³~~	ECL[4] µCi/ml	Units 1, 2, & 3 Fraction of ECL[5]
Cs-136	1.30E+01	3.5E-04	~~1.23E-06~~	6.6E-08	1.8E-12	2.6E-09	~~2.22E-01~~	6.0E-06	4.3E-04
Cs-137	5.55E+01	1.5E-03	~~5.28E-06~~	4.8E-07	1.3E-11	1.2E-07	~~3.70E-02~~	1.0E-06	1.2E-01
Ba-139	**1.11E+00**	**3.0E-05**	~~1.06E-07~~	5.6E-09	1.5E-13	1.5E-13	~~7.40E+00~~	2.0E-04	7.5E-10
Ba-140	2.55E+01	6.9E-04	~~2.43E-06~~	1.3E-07	3.5E-12	9.5E-11	~~2.96E-01~~	8.0E-06	1.2E-05
Ce-141	2.22E+00	6.0E-05	~~2.11E-07~~	1.1E-08	3.1E-13	3.1E-13	~~1.11E+00~~	3.0E-05	1.0E-08
La-142	7.40E-01	2.0E-05	~~7.03E-08~~	3.7E-09	1.0E-13	1.0E-13	~~3.70E+00~~	1.0E-04	1.0E-09
Ce-143	1.11E+00	3.0E-05	~~1.06E-07~~	5.6E-09	1.5E-13	1.5E-13	~~7.40E-01~~	2.0E-05	7.5E-09
Pr-143	2.59E+00	7.0E-05	~~2.46E-07~~	1.3E-08	3.5E-13	3.5E-13	~~7.40E-01~~	2.0E-05	1.8E-08
W-187	7.40E+00	2.0E-04	~~7.03E-07~~	3.7E-08	1.0E-12	1.0E-12	~~1.11E+00~~	3.0E-05	3.4E-08
Np-239	3.44E+02	9.3E-03	~~3.27E-05~~	1.7E-06	4.7E-11	4.7E-11	~~7.40E-01~~	2.0E-05	2.3E-06
Total w/o H-3	3.66E+03	9.9E-02		1.9E-05	5.1E-10	4.6E-07		NA	2.1E-01
Total w/ H-3	5.22E+05	1.4E+01		4.4E-03	1.2E-07	6.1E-06		NA	2.2E-01

NAPS COL 12.2-3-A
NAPS ESP COL 11.1-1
NAPS ESP VAR 12.2-3

Table 12.2-19bR Comparison of Annual Liquid Release Concentrations with 10 CFR 20 Limit

Notes:

1. Unit 3 Annual Release – Values in MBq/yr are from DCD Table 12.2-19b. These are divided by 3.7E+04 MBq/Ci to obtain the releases in Ci/yr. Values in bold indicate the nuclide activity is greater than that in ESP-ER Table 5.4-6.
2. Unit 3 Concentration – Concentrations in the discharge canal are calculated based on the activity releases and the volumes and flow rates of the bodies of water through which the nuclides traverse. The Units 1 and 2 UFSAR, Section 11.2.5.1 (Reference 12.2-206) shows the flow model for the canal, the WHTF, and the North Anna Reservoir, as well as Equation 11.2-8, which is used to calculate the concentrations.
3. Units 1, 2 & 3 Concentration – Concentrations in the discharge canal due to activity releases from Units 1 and 2 are obtained from the Units 1 and 2 UFSAR, Table 11.2-14 (Reference 12.2-206). These concentrations are added to those from Unit 3 to obtain the totals for the site.
4. ECL – Effluent concentration limits (ECLs) are from 10 CFR 20, Appendix B, Table 2, Column 2.
5. Units 1, 2 & 3 Fraction of ECL – For each nuclide, Units 1, 2 & 3 Concentration is divided by ECL. Total is obtained by summing the nuclide fractions of ECL.