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Creation Date:	7/13/04 1:36PM
From:	<Maggie_McClure@dom.com>
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JXC9 (Jack Cushing)

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From: <Maggie_McClure@dom.com>
To: <jxc9@nrc.gov>
Date: 7/13/04 1:36PM
Subject: Outgoing Dominion Correspondence to NRC - North Anna ESP - RAI RegardingEnvironmental Portion of ESP Application (SN 04-170A)

Mr. Cushing,

Joe Hegner asked that I send this to you electronically since Mr. Kugler is out of the office. Please note that the CD will be coming your way via the postal service (mailed directly to you).

(See attached file: 04-170A_Letter&Attonly.pdf)

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Dominion®

July 12, 2004

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

Serial No. 04-170A
ESP/LTB
Docket No. 52-008

DOMINION NUCLEAR NORTH ANNA, LLC
NORTH ANNA EARLY SITE PERMIT APPLICATION
RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION REGARDING ENVIRONMENTAL PORTION OF ESP APPLICATION

In its March 12, 2004 letter titled "Request for Additional Information (RAI) Regarding the Environmental Portion of the Early Site Permit (ESP) Application for the North Anna Site (TAC No. MC1128)," the NRC requested additional information regarding certain aspects of Dominion Nuclear North Anna, LLC's (Dominion's) Early Site Permit application. Dominion provided responses to 46 of the 51 RAIs in a May 17, 2004 letter. This letter contains responses to the remaining 5 RAIs and 2 revised responses:

E3.8-7 (revised), E3.8-12, E5.4.2-2, E5.4.2-3 (revised), E5.4.3-1, E7.1-1, E7.2-1

In its June 3, 2004 letter titled "Request for Additional Information No. 7," the NRC requested additional information regarding the Site Safety Analysis Report. One of the questions in that letter, RAI 2.3.4-1, impacts the response to RAI E7.1-1. The RAI 2.3.4-1 response contains information related to the atmospheric dispersion factors that were also used in the response to RAI E7.1-1. Therefore, our response to RAI 2.3.4-1 is included in this letter.

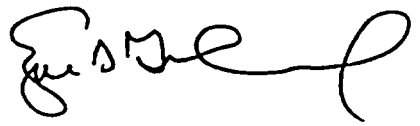
In addition, included in this letter are responses to various follow-up questions posed by the NRC staff during a June 23, 2004 telephone conference relating to 10 of the 46 Dominion responses provided on May 17, 2004. The responses are listed below with the original RAI number in parentheses.

1 (RAI E3.8-1), 2 (RAI E3.8-5), 3 (RAI E3.8-12), 4 (RAI E5.4.2-1),
5 (RAI E5.4.2-2), 6 (RAI E5.4.3-1), 7 (RAI E5.4.4-1), 8 (RAI response E7.2),
9 (RAI response E4.5-3), 10 (RAI response E4.5-4)

It is Dominion's intent to update the North Anna ESP application to incorporate the responses to these and other RAIs to support issuance of the NRC staff's draft safety and environmental evaluations scheduled for later this year. Planned changes to the application are identified following the response to each RAI.

If you have any questions or require additional information, please contact us.

Very truly yours,



Eugene S. Grecheck
Vice President-Nuclear Support Services

Enclosures:
1. Responses to Environmental RAIs
2. Compact Disc (CD) containing the following:
   a. RADTRAN results for the GT-MHR and PBMR in response to RAI E3.8-12.
   b. MAACS2 code outputs for the ABWR and AP1000 and revised AP1000 Table 7-4 in response to follow-up environmental RAI 8 (RAI response 7.2).
   c. PAVAN input files in response to RAI 2.3.4-1.

Commitments made in this letter:

1. Revise North Anna ESP application to reflect Environmental RAI responses.

cc: U.S. Nuclear Regulatory Commission, Region II
Sam Nunn Atlanta Federal Center
61 Forsyth Street, SW
Suite 23T85
Atlanta, Georgia 30303

Mr. Andy Kugler
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. Michael Scott
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Mr. M. T. Widmann (w/o Encl. 2)
NRC Senior Resident Inspector
North Anna Power Station

Ms. Ellie L. Irons, Program Manager
Office of Environmental Impact Review
Virginia Department of Environmental Quality

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 Support Services, of Dominion Nuclear North Anna, LLC. He has affirmed before me that he is duly authorized to execute and file the foregoing document on behalf of Dominion Nuclear North Anna, LLC, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 12th day of July, 2004.

My Commission expires: 3/31/08

Maggie McClure
Notary Public

(SEAL)

Enclosure 1

Final Responses to NRC Requests for Additional Information Regarding Environmental Portion of North Anna ESP Application

RAI E3.8-7 (NRC 3/12/04 Letter)

p. 3-3-79 (Section 3.8.2.3, first paragraph) - The ER provides an annual value of truck shipments for the reference LWR (110 shipments), the PBMR (18 shipments), and GT-MHR (41 shipments). When adding up the individual values for unirradiated fuel shipments, spent fuel shipments, and low level waste shipments within that same section, we obtained different totals – reference LWR (112 shipments); PBMR (22 shipments); and GT-MHR (58 shipments). Explain the differences.

Revised Response

Table 1 provides an estimate of truck shipments based on the following assumptions:

- 40 years of operation
- 1 initial core load
- 40 annual core reloads
- 40 annual spent fuel shipments for the LWR; 34 annual spent fuel shipments for the gas-cooled reactors (to achieve the much higher burnup and to account for a minimum five-year cooling time prior to shipping).
- 40 years of LLW generation

The estimate was normalized to an equivalent electrical generation (i.e., the GTMHR shipments were reduced by 12% and the PBMR shipments were reduced by 30%). The calculated numbers of shipments were then rounded to the next whole number.

Table 1

	Number of Shipments		
	LWR	GT-MHR	PBMR
Initial core load	18	51	44
Annual reload	6	20	20
Annual spent fuel	60	38	16
LLW	46	6	9
40 year total	4498	2383	1748
Yearly average	113	60	44
Adjusted yearly average	113	53	31

These values for the gas-cooled reactors are different from the ER and the RAI. The original worksheet used different assumptions in normalizing power and rounding. One reason these numbers do not match the RAI numbers is that the total number of unnormalized shipments are calculated first and then adjusted for the electrical generation to compute the annual shipments. Doing it this way, there is no annual rounding up of the number of shipments. This is a more representative estimate,

because the plant operator would likely wait until a full shipment was available and not just ship because the year is drawing to a close.

Application Revision

The 8th paragraph of ER Section 3.8.2.3 will be revised to read as follows (see also the response to follow-up RAI 2 in this letter):

> The Table S-4 value, traffic density in trucks per day, for the reference LWR is given as less than one per day. Both the gas-cooled reactor technologies would also have less than one per day. In fact, the new gas-cooled reactor technologies would have far fewer shipments per year. The reference LWR bounding annual value for truck shipments is 113 based on a 40-year period, while the normalized number of truck shipments for the gas-cooled reactor technologies would require as few as 31 for the PBMR and only 53 for the GT-MHR.

RAI E3.8-12 (NRC 3/12/04 Letter)

General comment - Provide a transportation risk assessment for gas-cooled reactor spent fuel shipments using an accepted methodology, such as RADTRAN V. Provide justification that the best available information has been used to generate the RADTRAN input values, and that those values are appropriate for gas-cooled fuel shipments. Provide a comparison of the results of that assessment with the spent fuel shipment risk estimates contained in NUREG-0170, *Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes.*

Response

RADTRAN V highway runs were conducted for a GT-MHR and a PBMR spent fuel shipment from the Maine Yankee Nuclear Plant to Yucca Mountain. (This route was chosen to conservatively bound potential transportation routes.) The TRAGIS Routing Engine Version 1.4.15, which uses the 2000 Census data, provided the routing information and the population densities. This analysis of gas-cooled reactor fuel shipments was based on a conservative assumption that the transportation dose rates are at the 10 CFR 71 regulatory limits of 2 mrem/hr in the cab and 10 mrem/hr at 2 meters from the cask. The input values were taken primarily from the Yucca Mountain Final EIS, in particular, the *Transportation Health and Safety Calculation/Analysis Documentation in Support of the Final EIS for the Yucca Mountain Repository.* Specifically, the values for the high integrity high-temperature gas-cooled reactor spent nuclear fuel referred to as type 8 were used. The inputs and output results of these RADTRAN analyses are provided on the enclosed compact disc. A comparison of the incident free results with NUREG-0170 is provided in Table 1.

Table 1. Comparison of Incident Free Results

	Per shipment person-rem from NUREG-0170 based on 1530 spent fuel truck shipments for the year 1985	RADTRAN V per shipment person-rem results for GTMHR Spent Fuel from Maine Yankee to Yucca Mountain	RADTRAN V per shipment person-rem results for PBMR Spent Fuel from Maine Yankee to Yucca Mountain	Difference between RADTRAN V results and NUREG-0170
Passengers	0	0.000	0.000	0.000
Crew	0.123	0.157	0.157	0.034
Attendants	0.000	0.000	0.000	0.000
Handlers	0.200	0.102	0.102	-0.098
Off-Link	0.015	0.012	0.012	-0.003
On-Link	0.007	0.081	0.081	0.073
Stops	0.019	0.177	0.177	0.158
Storage	0.005	0.000	0.000	-0.005
Totals	**0.369**	**0.529**	**0.529**	

The major difference between these RADTRAN V analyses and NUREG-0170 is the dose during stops. Approximately 25% of the difference is the result of inspections at the beginning and the end of the trip were included in these RADTRAN V simulations but which were not modeled in the NUREG-0170 analysis. The remaining difference can be attributed to greater distance traveled, hence more refueling stops, and the different methodologies used to calculate the stop doses. This evaluation used 1996 truck stop data (*Investigation of Radtran Stop Model Input Parameters for Truck Stops,* SAND96-0714C) and modeled public doses in two concentric rings: 1m to 14m and 30m to 800m. The population in the inner ring used the results of the Stop Model study while the population in the outer ring used route specific 2000 Census population data weighted by a 3% urban, 26% suburban and 71% rural distribution. The NUREG-0170 study modeled just one ring, 10 to 2600 feet, and used three fixed population densities.

Factors contributing to the increased on-link population dose are that NUREG-0170 assumed a 2500 km shipment distance with a 5% urban, 5% suburban and 90% rural population. This evaluation used updated 2000 census information showing a 3% urban, 26% suburban and 71% rural population and a conservative 4,733 km shipment distance.

In addition to the incident free results, the RADTRAN V runs also include accident results. Due to the preliminary nature of the gas-cooled reactor fuel designs, it is premature to provide a meaningful comparison with NUREG-0170. The RADTRAN V runs were made with the gas-cooled fuel values in the Yucca Mountain FEIS. Specifically, the values for the high integrity high-temperature gas-cooled reactor spent nuclear fuel referred to as type 8 were used. As such, these runs give a reasonable estimate of what the GT-MHR and PBMR results might look like. It is important to remember that the gas-cooled reactor spent fuel shipments are no different from other spent fuel shipments in that all shipments are required to meet NRC and DOT regulations. These regulations address design and performance standards for the casks and specify radiological performance criteria for both normal transport and severe accident conditions. Compliance with these regulations ensures that shipments will be conducted in a manner with minimal environmental impacts.

Application Revision

None.

RAI E5.4.2-2 (NRC 3/12/04 Letter)

Section 5.4.2 of ER (Radiation Doses to Members of Public) – The ER states that the LADTAP II computer code was used to calculate dose estimates to the maximally exposed individual and the population from the liquid effluent pathway. Provide the values of the following parameters that were used as inputs for the LAPTAP II analysis:

- Shore-width factor
- Population supplied by drinking water
- Dilution factor for water intake locations
- Transit time from discharge location to water supply intake (hours)
- Supply rate of drinking water for current water plant (gallons/day)
- Average rate of water usage by individuals (gallons/day)
- Total shoreline usage time (person-hours/year)
- Dilution factor for current shoreline exposure location
- Transit time from release point to current shoreline location
- Total exposure time for swimming for the current usage location (person-hours/year)
- Dilution factor for the current swimming usage location
- Transit time from the release point to current swimming location
- Total exposure time for boating activities (person-hours/year)
- Dilution factor for current boating usage location
- Transit time from release point to current boating location (hours)

Response

The values used as inputs for the LADTAP II computer program are as follows:

- Shore-width factor – 0.3
- Population supplied by drinking water – 22,100
- Dilution factor for water intake locations – 10
- Transit time from discharge location to water supply intake (hours) – 0
- Supply rate of drinking water for current water plant (gallons/day) – this parameter is not used in LADTAP II if the total population supplied by drinking water is specified (see second bullet above)
- Average rate of water usage by individuals (gallons/day) – this parameter is not used in LADTAP II if the total population supplied by drinking water is specified (see second bullet above)
- Total shoreline usage time (person-hours/year) – 1.31E6
- Dilution factor for current shoreline exposure location – 10
- Transit time from release point to current shoreline location – 0
- Total exposure time for swimming for the current usage location (person-hours/year) – 8.76E5
- Dilution factor for the current swimming usage location – 10

- Transit time from the release point to current swimming location – 0
- Total exposure time for boating activities (person-hours/year) – 2.19E6
- Dilution factor for current boating usage location – 10
- Transit time from release point to current boating location (hours) – 0

Application Revision

None.

E5.4.2-3 (NRC 3/12/04 Letter)

Section 5.4.2 of ER (Radiation Doses to Members of Public) – The ER states that the GASPAR II computer code was used to calculate dose estimates to the maximally exposed individual and the population from the gaseous effluent pathway. Provide the values of the following parameters that were used as inputs for the GASPAR II analysis:

- Distance (miles) from site to northeast corner of US
- Fraction of year leafy vegetables are grown
- Fraction of year that milk-cows are on pasture
- Fraction of the maximum individual's vegetable intake that is from his own garden
- Fraction of milk-cow feed intake that is from pasture while on pasture
- Average absolute humidity over the growing season
- Average temperature over the growing season
- Fraction of year that goats are on pasture
- Fraction of year that beef-cattle are on pasture
- Fraction of beef-cattle intake that is from pasture while on pasture
- Milk production (liters/year) by distance and sector
- Meat production (kilograms/year) by distance and sector

Revised Response

The values used as inputs for the GASPAR II computer program are as follows:

- Distance (miles) from site to northeast corner of US – this parameter is only used by GASPAR II if NEPA doses are calculated; NEPA doses, which extends to the population beyond 50 miles of the plant, are not calculated because they are not specified by NUREG-1555
- Fraction of year leafy vegetables are grown – 0.5
- Fraction of year that milk-cows are on pasture – 0.67
- Fraction of the maximum individual's vegetable intake that is from his own garden – 0.76
- Fraction of milk-cow feed intake that is from pasture while on pasture – 1
- Average absolute humidity over the growing season – 8 g/m^3
- Average temperature over the growing season – not used when absolute humidity is specified
- Fraction of year that goats are on pasture – 0.75
- Fraction of year that beef-cattle are on pasture – 0.67
- Fraction of beef-cattle intake that is from pasture while on pasture – 1
- Milk production (liters/year) by distance and sector – uniform production option used with total of 7.17E8 liters/year
- Meat production (kilograms/year) by distance and sector – uniform production option used with total of 1.71E9 kilograms/year

Application Revision

None

RAI E5.4.3-1 (NRC 3/12/04 Letter)

Section 5.4.3 of ER (Impacts to Man) – Table 5.4-12 of the ER provides collective dose data within 50 miles of the proposed units. How were the collective doses calculated? Were the LADTAP II and GASPAR II codes used to calculate collective doses?

Response

Other than the natural background dose, the doses per unit in Table 5.4-12 were calculated using LADTAP II and GASPAR II. The doses from both units were obtained by doubling the doses from a single unit.

Application Revision

None.

RAI E7.1-1 (NRC 3/12/04 Letter)

Table 7.1-2 – Table 7.1-2 summarized the resulting doses at the ESP site for postulated design basis accidents using the AP-1000 and the ABWR as surrogate designs. Update the table for each design basis accident to include (1) AP-1000 and ABWR doses used for the exclusion area boundary and low population zone, and (2) the ratio of site-specific X/Qs to design certification X/Qs used.

Response

ER Table 7.1-1 will be revised to show ratios of site-specific χ/Qs to design certification χ/Qs. ER Table 7.1-2 will be revised to reflect the updated summary of doses. ER Tables 7.1-4, 7.1-6, 7.1-8, 7.1-10, 7.1-11, 7.1-13, 7.1-15, 7.1-17, 7.1-19, 7.1-20, 7.1-22, 7.1-24, 7.1-26, and 7.1-28 will be revised to show design certification doses and the χ/Q ratios used to obtain site-specific doses.

Application Revision

The first paragraph of ER Section 7.1.4 and ER Table 7.1-1 will be revised to read as follows:

7.1.4 Radiological Consequences

For the accidents identified in Section 7.1.1, site-specific doses are calculated by multiplying the design certification doses by the ratio of site χ/Qs to design certification χ/Qs. Using the EAB and LPZ site χ/Qs of 3.34E-5 and 2.17E-6 sec/m^3, respectively, from Section 7.1.2, with the design certification χ/Qs (Reference 12 and Reference 13), the following ratios are obtained:

Table 7.1-1 Design Certification X/Q Values and Ratios to Site χ/Q Values

		χ/Q (sec/m^3)		χ/Q Ratio (Site/DC)	
	Time (hr)	AP1000	ABWR	AP1000	ABWR
EAB	0 - 2	6.00E-04	1.37E-03	5.57E-02	2.44E-02
LPZ	0 - 8	1.35E-04	1.56E-04	1.61E-02	1.39E-02
	8 - 24	1.00E-04	9.61E-05	2.17E-02	2.26E-02
	24 - 96	5.40E-05	3.36E-05	4.02E-02	6.46E-02
	96 - 720	2.20E-05	7.42E-06	9.86E-02	2.92E-01

Note: Ratio (Site/DC) columns show the ratios of site χ/Qs to design certification χ/Qs.

ER Tables 7.1-2, 7.1-4, 7.1-6, 7.1-8, 7.1-10, 7.1-11, 7.1-13, 7.1-15, 7.1-17, 7.1-19, 7.1-20, 7.1-22, 7.1-24, 7.1-26, and 7.1-28 will be revised to read as shown on the following pages.

Table 7.1-2 Summary of Design Basis Accident Doses

SRP Section	Accident	Reactor	TEDE (Rem) EAB	TEDE (Rem) LPZ	TEDE (Rem) Limit
15.1.5	PWR Main Steam Line Break				
	Pre-Existing Iodine Spike	AP1000	3.9E-02	1.1E-02	25
	Accident-Initiated Iodine Spike	AP1000	4.5E-02	4.5E-02	2.5
15.2.8	PWR Feedwater System Pipe Break	AP1000	4.5E-02	4.5E-02	2.5
15.3.3	Reactor Coolant Pump Rotor Seizure (Locked Rotor Accident)	AP1000	1.4E-01	9.6E-03	2.5
		ABWR	Not Postulated		
15.3.4	Reactor Coolant Pump Shaft Break	AP1000	1.4E-01	9.6E-03	2.5
		ABWR	Not Postulated		
15.4.8	PWR Rod Ejection Accident	AP1000	1.7E-01	3.1E-02	6.3
15.4.9	BWR Control Rod Drop Accident	ABWR	Not Postulated		6.3
15.6.2	Failure of Small Lines Carrying Primary Coolant Outside Containment	AP1000	7.2E-02	4.8E-03	2.5
		ABWR	6.4E-03	4.1E-04	2.5
15.6.3	PWR Steam Generator Tube Rupture				
	Pre-Existing Iodine Spike	AP1000	1.7E-01	5.7E-03	25
	Accident-Initiated Iodine Spike	AP1000	8.4E-02	4.5E-03	2.5
15.6.4	BWR Main Steam Line Break				
	Pre-Existing Iodine Spike	ABWR	7.6E-02	4.9E-03	25
	Accident-Initiated Iodine Spike	ABWR	3.7E-03	2.4E-04	2.5
15.6.5	Loss-of-Coolant Accident	AP1000	1.4E+00	2.0E-01	25
		ABWR	2.6E-01	1.7E+00	25
15.7.4	Fuel Handling Accident	AP1000	1.3E-01	9.6E-03	6.3
		ABWR	9.2E-02	6.0E-03	6.3

SRP Section	Accident	Reactor	TEDE (Rem) EAB	LPZ	Limit

Notes:

The AP1000 design certification indicates that the doses associated with the feedwater system pipe break are bounded by the main steam line break (Reference 12, Section 15.2.8.3).

The AP1000 design certification indicates that the doses for the reactor coolant pump shaft break are bounded by the reactor coolant pump rotor seizure (Reference 12, Section 15.3.4.2).

The ABWR design certification indicates that there are no radiological consequences for the reactor coolant pump rotor seizure, the reactor coolant pump shaft break, and the control rod drop accident (Reference 13, Sections 15.3.3.5, 15.3.4.5, and 15.4.10.6).

Table 7.1-4 Doses for AP1000 Main Steam Line Break, Pre-Existing Iodine Spike

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	7.00E-01		5.57E-02	3.90E-02	
0 - 8 hr		2.40E-01	1.61E-02		3.86E-03
8 - 24 hr		8.00E-02	2.17E-02		1.74E-03
24 - 96 hr		1.30E-01	4.02E-02		5.22E-03
96 - 720 hr		0.00E+00	9.86E-02		0.00E+00
Total	7.00E-01	4.50E-01		3.90E-02	1.08E-02
Limit				25	25

Table 7.1-6 Doses for AP1000 Main Steam Line Break, Accident-Initiated Iodine Spike

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	8.00E-01		5.57E-02	4.45E-02	
0 - 8 hr		6.40E-01	1.61E-02		1.03E-02
8 - 24 hr		4.20E-01	2.17E-02		9.11E-03
24 - 96 hr		6.30E-01	4.02E-02		2.53E-02
96 - 720 hr		0.00E+00	9.86E-02		0.00E+00
Total	8.00E-01	1.69E+00		4.45E-02	4.47E-02
Limit				2.5	2.5

Table 7.1-8 Doses for AP1000 Locked Rotor Accident

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	2.50E+00		5.57E-02	1.39E-01	
0 - 8 hr		6.00E-01	1.61E-02		9.64E-03
8 - 24 hr		0.00E+00	2.17E-02		0.00E+00
24 - 96 hr		0.00E+00	4.02E-02		0.00E+00
96 - 720 hr		0.00E+00	9.86E-02		0.00E+00
Total	2.50E+00	6.00E-01		1.39E-01	9.64E-03
Limit				2.5	2.5

Table 7.1-10 Doses for AP1000 Rod Ejection Accident

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	3.00E+00		5.57E-02	1.67E-01	
0 - 8 hr		1.40E+00	1.61E-02		2.25E-02
8 - 24 hr		2.60E-01	2.17E-02		5.64E-03
24 - 96 hr		4.60E-02	4.02E-02		1.85E-03
96 - 720 hr		1.20E-02	9.86E-02		1.18E-03
Total	3.00E+00	1.72E+00		1.67E-01	3.12E-02
Limit				6.3	6.3

Table 7.1-11 Doses for AP1000 Failure of Small Lines Carrying Primary Coolant Outside Containment

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	1.30E+00		5.57E-02	7.24E-02	
0 - 8 hr		3.00E-01	1.61E-02		4.82E-03
8 - 24 hr		0.00E+00	2.17E-02		0.00E+00
24 - 96 hr		0.00E+00	4.02E-02		0.00E+00
96 - 720 hr		0.00E+00	9.86E-02		0.00E+00
Total	1.30E+00	3.00E-01		7.24E-02	4.82E-03
Limit				2.5	2.5

Note: No activity release information is available for this accident.

Table 7.1-13 Doses for ABWR Failure of Small Lines Carrying Primary Coolant Outside Containment

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0 - 2 hr	9.40E-04	4.80E-02	2.38E-03	2.44E-02	6.36E-03	
0 - 8 hr	9.40E-04	4.80E-02	2.38E-03	1.58E-03		4.13E-04
8 - 24 hr						0.00E+00
24 - 96 hr						0.00E+00
96 - 720 hr						0.00E+00
Total	9.40E-04	4.80E-02	2.38E-03		6.36E-03	4.13E-04
Limit					25	25

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.10 for power adjustment.

Table 7.1-15 Doses for AP1000 Steam Generator Tube Rupture, Pre-Existing Iodine Spike

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	3.00E+00		5.57E-02	1.67E-01	
0 - 8 hr		3.20E-01	1.61E-02		5.14E-03
8 - 24 hr		2.60E-02	2.17E-02		5.64E-04
24 - 96 hr		0.00E+00	4.02E-02		0.00E+00
96 - 720 hr		0.00E+00	9.86E-02		0.00E+00
Total	3.00E+00	3.46E-01		1.67E-01	5.71E-03
Limit				25	25

Table 7.1-17 Doses for AP1000 Steam Generator Tube Rupture, Accident-Initiated Iodine Spike

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	1.50E+00		5.57E-02	8.35E-02	
0 - 8 hr		1.80E-01	1.61E-02		2.89E-03
8 - 24 hr		7.20E-02	2.17E-02		1.56E-03
24 - 96 hr		0.00E+00	4.02E-02		0.00E+00
96 - 720 hr		0.00E+00	9.86E-02		0.00E+00
Total	1.50E+00	2.52E-01		8.35E-02	4.46E-03
Limit				2.5	2.5

Table 7.1-19 Doses for ABWR Main Steam Line Break, Pre-Existing Iodine Spike

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0 - 2 hr	1.30E-02	5.10E-01	2.83E-02	2.44E-02	7.56E-02	
0 - 8 hr	1.30E-02	5.10E-01	2.83E-02	1.58E-03		4.91E-03
8 - 24 hr						0.00E+00
24 - 96 hr						0.00E+00
96 - 720 hr						0.00E+00
Total	1.30E-02	5.10E-01	2.83E-02		7.56E-02	4.91E-03
Limit					25	25

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.10 for power adjustment.

Table 7.1-20 Doses for ABWR Main Steam Line Break, Accident-Initiated Iodine Spike

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0 - 2 hr	6.20E-04	2.60E-02	1.40E-03	2.44E-02	3.74E-03	
0 - 8 hr	6.20E-04	2.60E-02	1.40E-03	1.58E-03		2.43E-04
8 - 24 hr						0.00E+00
24 - 96 hr						0.00E+00
96 - 720 hr						0.00E+00
Total	6.20E-04	2.60E-02	1.40E-03		3.74E-03	2.43E-04
Limit					2.5	2.5

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. Since the ABWR design certification document does not include an LPZ dose for this accident, the site LPZ dose is obtained by multiplying the ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.10 for power adjustment.

Table 7.1-22 Doses for AP1000 Loss-of-Coolant Accident

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	2.48E+01		5.57E-02	1.38E+00	
0 - 8 hr		9.20E+00	1.61E-02		1.48E-01
8 - 24 hr		3.30E-01	2.17E-02		7.16E-03
24 - 96 hr		3.10E-01	4.02E-02		1.25E-02
96 - 720 hr		2.90E-01	9.86E-02		2.86E-02
Total	2.48E+01	1.01E+01		1.38E+00	1.96E-01
Limit				25	25

Table 7.1-24 Doses for ABWR Loss-of-Coolant Accident

	ABWR EAB Dose (Sv)			ABWR LPZ Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0 - 2 hr	4.10E-02	1.90E+00	9.80E-02				2.44E-02	2.62E-01	
0 - 8 hr				1.00E-02	3.10E-01	1.93E-02	1.39E-02		2.94E-02
8 - 24 hr				8.00E-03	2.00E-01	1.40E-02	2.26E-02		3.46E-02
24 - 96 hr				1.10E-02	7.90E-01	3.47E-02	6.46E-02		2.45E-01
96 - 720 hr				9.00E-03	1.10E+00	4.20E-02	2.92E-01		1.35E+00
Total	4.10E-02	1.90E+00	9.80E-02	3.80E-02	2.40E+00	1.10E-01		2.62E-01	1.65E+00
Limit								25	25

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. The site doses include a multiplier of 1.10 for power adjustment.

Table 7.1-26 Doses for AP1000 Fuel Handling Accident

	AP1000 TEDE (Rem)		χ/Q Ratio	Site TEDE (Rem)	
Time	EAB	LPZ	(Site/AP1000)	EAB	LPZ
0 - 2 hr	2.40E+00		5.57E-02	1.34E-01	
0 - 8 hr		6.00E-01	1.61E-02		9.64E-03
8 - 24 hr		0.00E+00	2.17E-02		0.00E+00
24 - 96 hr		0.00E+00	4.02E-02		0.00E+00
96 - 720 hr		0.00E+00	9.86E-02		0.00E+00
Total	2.40E+00	6.00E-01		1.34E-01	9.64E-03
Limit				6.3	6.3

Table 7.1-28 Doses for ABWR Fuel Handling Accident

	ABWR EAB Dose (Sv)			χ/Q Ratio	Site TEDE (Rem)	
Time	W. Body	Thyroid	TEDE	(Site/ABWR)	EAB	LPZ
0 - 2 hr	1.20E-02	7.50E-01	3.45E-02	2.44E-02	9.21E-02	
0 - 8 hr	1.20E-02	7.50E-01	3.45E-02	1.58E-03		5.99E-03
8 - 24 hr						0.00E+00
24 - 96 hr						0.00E+00
96 - 720 hr						0.00E+00
Total	1.20E-02	7.50E-01	3.45E-02		9.21E-02	5.99E-03
Limit					6.3	6.3

Note: The ABWR TEDE is whole body dose plus 3% of thyroid dose. The site LPZ dose is obtained by multiplying ABWR EAB dose by ratio of site LPZ χ/Q to ABWR EAB χ/Q. The site doses include a multiplier of 1.10 for power adjustment.

RAI E7.2-1 (NRC 3/12/04 Letter)

Section 7.2.2 – The ER addresses the severe accident impacts by using "exposure indices" (EIs), which are based on the product of population distribution and wind direction frequency. The EIs were assessed for the North Anna ESP site for the year 2040 based on a comparison of the 50-mile population projected for year 2040 to the 50-mile population for year 2030 used in NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* Dominion estimated that the EIs would be 90% greater than reported in NUREG-1437. Please provide the following:

a. an assessment of the 10-mile and 150-mile EIs for the ESP site for the year 2040 based on consideration of the projected populations and their distributions within each of these regions and the best available wind direction frequency information,

b. the rationale for selecting the year 2040 as the basis for the severe accident assessment, and

c. an assessment of the 10-mile and 150-mile EIs for the ESP site for the year 2065 (through which new unit operations could extend, according to Section 2.5.1.5 of the Environmental Report), based on the same considerations specified in a. above.

Response

a. The 10-mile and 150 mile exposure indices (EIs) for the North Anna ESP site for the year 2040 are shown below:

	10 Miles	150 Miles
2040 EI	4.2E3	1.1E6

The EIs are calculated based on the latest U.S. Census Bureau population data (circa 2000) projected to the year 2040. Best available wind direction frequency information was used in the projection. Wind data was taken from hourly wind direction frequency information for the period 1996-1998.

Information on 10-mile and 150-mile EIs for the North Anna site has been published. NUREG 1437, Vol. 1, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, includes two tables that provide 10-mile and 150-mile EIs for each licensed plant in the U.S. (The EIs were calculated for the middle year of license renewal.) The 10-mile EI values in GEIS Table 5.7 range from 96 to 18,959 with a North Anna value of 704. The 150-mile EI values in

GEIS Table 5.8 range from 132,195 to 2,863,844 with a North Anna value of 876,587.

The North Anna EI values at 10 and 150 miles shown above projected to the year 2040 are within the range of values in the GEIS tables.

b. The year 2040 was selected as the basis for the severe accident assessment because it represents a 40-year projection from the point in time of the most recent population data, circa 2000. This is consistent with the approach used in the North Anna license renewal application, which similarly evaluated severe accident impacts over a 40-year period.

c. The 10-mile and 150-mile exposure indices (EIs) for the North Anna ESP site for the year 2065 are provided in the table below:

	10 Miles	150 Miles
2065 EI	5.7E3	1.4E6

The 2065 EIs for both 10 and 150 miles continue to be within the range of values specified in the GEIS.

References

1. NUREG 1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, Vol. 1, April 1996.

Application Revision

Section 7.2.2.1 will be revised as follows:

7.2.2.1 **Evaluation of Potential Releases via Atmospheric Pathway**

The site-specific significant factors of demography and meteorology are considered in the evaluation of the atmospheric exposure pathway for new units at the ESP site. For this evaluation, NUREG-1437 calculates an exposure index (EI) for use in comparing the relative risk for the current fleet of nuclear power plants. NUREG-1437 provides the following discussion of EI:

> Population, which changes over time, defines the number of people within a given distance from the plant. Wind direction, which is assumed not to change from year to year, helps determine what proportion of the population is at risk in a given direction, because radionuclides are carried by the wind. Therefore, an EI relationship was developed by multiplying the wind direction frequency (fraction of the time per year) for each of 16 (22.5 degrees) compass sectors

> times the population in that sector for a given distance from the plant and summing all products... . Population varies with population growth and movement, and with the distance from any given plant. As the population changes for that plant, the EI also changes (the larger the EI, the larger the number of people at risk). Thus, EI is proportional to risk and an EI for a site for a future year can be used to predict the risk to the population around that site in that future year.

Thus, the EI is a function of population surrounding the site, weighted by the site-specific wind direction frequency, and is, therefore, a site-specific parameter. Because meteorological patterns, including wind direction frequency, tend to remain constant over time, the site meteorology would not be significantly different for the ESP site than that considered in NUREG-1437 for the NAPS site and only population can significantly affect the resulting risk in any given year of reactor operation.

Two EI values are evaluated in NUREG-1437. A 10-mile EI is found to best correlate with early fatalities and a 150-mile EI is found to best correlate with latent fatalities and total dose. Using these indices, it is determined that the risk of early and latent fatalities from individual nuclear power plants is small and represents only a small fraction of the risk to which the public is exposed from other sources.

NUREG-1437 indicates a 10-mile EI for the NAPS site of 704 for the year 2030, while the 10-mile EI for the current generation of nuclear power plant sites ranges from 96 to 18,959 (Reference 1, Table 5.7). Using the US Census Bureau population data (circa 2000) projected to years 2040 and 2065 with the best available wind direction frequency information (1996-1998), 10-mile EI values of 4200 and 5700 are calculated for the ESP site for the years 2040 and 2065, respectively. For both years, the ESP site 10-mile EI is within the range of risk calculated for the existing fleet of nuclear power plants.

NUREG-1437 indicates a 150-mile EI for the NAPS site of 876,587 for the year 2030, while the 150-mile EI for the current generation of nuclear power plant sites ranges from 132,195 to 2,863,844 (Reference 1, Table 5.8). Using the US Census Bureau population data (circa 2000) projected to years 2040 and 2065 with the best available wind direction frequency information (1996-1998), 150-mile EI values of 1.1E6 and 1.4E6 are calculated for the ESP site for the years 2040 and 2065, respectively. For both years, the ESP site 150-mile EI is within the range of risk calculated for the existing fleet of nuclear power plants.

Thus, the risks for new units at the ESP site for the atmospheric exposure pathway would be within the range of those considered in NUREG-1437 as "small." NUREG-1437, Section 5.5.2.1, indicates that these predicted effects of a severe accident "are not expected to exceed a small fraction of that risk to which the population is already exposed."

1. RAI E3.8-1 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 3.8.1 of ER) – The radionuclide inventory data for the IRIS and ACR-700 plants is needed.

The applicant indicated that the data were available in the submittal titled "Early Site Permit Environmental Reports Sections and Supporting Documentation" Adams Accession No. ML040580285. The data listed in this report do not appear to include the full radionuclide inventory. For example, for the ACR-700, no actinides are listed. In addition, there are radionuclides that are repeated and have different values, but it is not clear whether these need to be added together for a total of that radionuclide. Discuss whether actinides should be assumed for the ACR-700 and explain how to handle the multiple values for the radionuclides.

Response

Isotopic listings of the spent fuel inventories were not needed to conduct the comparison with Table S-4 and the reference LWR. With the exception of Kr-85, the comparison required only summary information for fission products, actinides and total activity. See ER Section 3.8.2. In addition to the summary information, the reactor vendors were asked the following: "Note: If available, please provide a complete set of the ORIGEN runs results (or other applicable code for the appropriate reactor type) detailing the spent fuel inventories at 5 years decay." The responses varied. Several of the vendors provided isotopic listing of the inventories; a few provided the computer runs. In all cases, what was provided by the reactor vendors can be found in the "Early Site Permit Environmental Reports Sections and Supporting Documentation," NRC Accession No. ML040580285. In the case of IRIS, only the summary information was provided. For the ACR-700, AECL provided the computer analysis for just the fission product inventory. The multiple fission product outputs occur because the ACR-700 fuel bundle has four rings.

Application Revision

None.

2. RAI E3.8-5 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 3.8.2.3 of ER) – The RAI response states that the initial core fuel loading for the PBMR is 20 MTU (2.5 MTU per reactor module), and the annual average fuel loading is 6.32 MTU/1000 MWe. The fuel design technical basis document states that 260,000 spheres are in the initial fuel loading of 2.5 MTU per reactor module with an annual reload of 18,000 spheres per module. The 18,000 fuel spheres per reload seems low. The average annual fuel reload is 6.32 MTU/1000 MWe (equivalent to 1 MTU per 165 MWe module) per the technical basis document. Provide the calculation to justify the number of spheres required for a reload.

The applicant requested references to the documents that contained the conflicting data. The staff provides the following:

It occurs in two places in the ESP Environmental Report Sections Supporting Documentation ML040580285. First, in the section titled 3.8, Transportation of Radioactive Materials. Table 3.8-2 at the end of Section 3.8.2, Gas-Cooled Reactor Transportation Worksheet, contains information on the unirradiated fuel shipments. Second, in the section titled Vendor Data Submittal for the PBMR, there is an Attachment 1 entitled ESP 8: Reactor Vendor Questionnaire. The first page of that attachment is an unnumbered table entitled "Annual Fuel Requirements." The data on fuel spheres is included in Section 2 Fuel Loading and Section 4 Fuel Form.

Response

An annual reload of 18,000 spheres per PBMR module is incorrect. The correct number is 120,000 spheres per module.

Application Revision

The 3rd paragraph of ER Section 3.8.2.3 will be revised to read as follows:

> The reference LWR assumed an annual reload of 30 MTU. This quantity resulted in 6 truck shipments. For the new gas-cooled reactor technologies, the number of reload shipments was 20 for both the PBMR and GT-MHR. The number of shipments normalized to the electrical generation changes to 14 for the PBMR and 18 for the GT-MHR.

The 8th paragraph of ER Section 3.8.2.3 will be revised to read as follows (see also the revised response to RAI E3.8-7 in this letter):

> The Table S-4 value, traffic density in trucks per day, for the reference LWR is given as less than one per day. Both the gas-cooled reactor technologies would also have less than one per day. In fact, the new gas-cooled reactor technologies would have far fewer shipments per year. The reference LWR bounding annual value for truck shipments is 113 based on a 40-year period, while the normalized number of truck shipments for the gas-cooled reactor technologies would require as few as 31 for the PBMR and only 53 for the GT-MHR.

The 1st paragraph of ER Section 3.8.2.5 will be revised to read as follows:

> Of the close to 30 characteristics/conditions that were examined, there are only 8 that were exceeded by the gas-cooled reactor technologies being considered. Three of these characteristics have no direct transportation impact on the health and the environment: fuel form, U_{235} enrichment, and fuel rod cladding. There are operational issues and fuel cycle impact issues associated with these characteristics that are addressed as part of the operating license and as part of the evaluation of Table S-3 "Uranium fuel cycle data," respectively. Two of these characteristics (number of shipments for initial core loading and number of reload shipments) are really a part of the overall truck transportation picture. When one considers the total number of truck shipments (fresh fuel, spent fuel, and radioactive waste), the new reactor technologies have many fewer total shipments. For example, on an average annual basis, the new reactor technologies require 60 to 82 fewer truck shipments. Comparing the total number of shipments is appropriate since the radiological impacts from fresh fuel are negligible. One characteristic, burnup, manifests its impact through other characteristics, fuel inventory and decay heat at time of shipment, which are addressed separately. In the case of decay heat, both of the gas-cooled reactor technologies would generate fewer watts per MTU at time of shipment, and fewer kW per truck cask at time of shipment. The fuel inventory would be discussed as part of the remaining two characteristics that were exceeded: actinide inventory and krypton-85 inventory.

ER Table 3.8-2, for the number of unirradiated PBMR fuel reload shipments per year, will be revised to read as follows:

Table 3.8-2 Gas-cooled Reactor Transportation Impact Evaluation

Reactor Technology	Reference LWR (Single Unit) (1100 MWe)	GT-MHR (4 Modules) (2400 MWt total) (1140 MWe total)	PBMR (8 Modules) (3200 MWt total) (1320 MWe total)	Comments
Characteristic				
Unirradiated Fuel				
No. of reload shipments/year	6	20 shipments (520 elements per reload per 1.32 years x 4 modules; 80 elements per truck)	20 shipments (120,000 fuel spheres per module x 8 modules, 48,000 spheres per truck)	30 MTU annual reload

3. RAI E3.8-12 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(General comment) - Provide a transportation risk assessment for gas-cooled reactor spent fuel shipments using an acceptable methodology such as RADTRAN V.

Response

See the response to RAI E3.8-12 contained in this letter.

Application Revision

None.

4. RAI E5.4.2-1 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 5.4.2 of ER, Radiation Doses to Member of Public) - The RAI response provided occupational dose estimates for AP1000, ABWR, IRIS, and GT-MHR but did not provide a reference for the estimates. This information conflicts with information found in the Dominion document, dated September 27, 2002, titled "Study of Potential Sites for Deployment of New Nuclear Plants in the United States," which provides an upper bound value for occupational doses of 100 person-rem/y. The RAI response provides an upper value of 150 person-rem/y. Clarify which value is correct.

The applicant stated that there is no conflict between the RAI response and the information in the Dominion document. As stated in the RAI response, the correct value is 150 person-rem/y.

Response

No response is required to this RAI.

Application Revision

None.

5. RAI E5.4.2-2 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 5.4.2 of ER, Radiation Doses to Member of Public) - In Table 5.4-1, what is the basis for the dilution factor for discharge of 10?

Response

As shown in ER Tables 3.1-1 (Section 10.2.1) and 5.4-1, the liquid effluent release rate is 100 gpm with a dilution flow of 10,000 gpm. This yields a dilution factor of 100. Because a lower dilution factor yields higher doses, a dilution factor of 10 was used for conservatism.

Application Revision

None.

6. RAI E5.4.3-1 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 5.4.3 of ER - Impacts to Man) - Provide the information on how the population doses in Table 5.4-12 of the ER were calculated. The footnote to Table 5.4-12 states that 125 mrem/person-yr was used to calculate collective dose to natural background. The value seems low, NCRP Report 94 (Exposure of the Population in the United States and Canada from Natural Background Radiation) estimates dose to natural background radiation as 300 mrem/y.

During the telcon the staff clarified the question. The reworded question is as follows: If the value of 125 mrem/person-yr is a site-specific number, describe the contributors to the dose and specifically identify if radon is considered.

Response

The background dose of 125 mrem/yr is due to cosmic, terrestrial, and internal radiation. The dose due to the inhalation of radon is estimated as 200 mrem/yr (NCRP Report 94, Table 9.7), yielding a total of 325 mrem/yr.

Application Revision

ER Table 5.4-12 will be revised as follows:

Table 5.4-12 Collective Total Body Doses Within 50 Miles

	Dose (person-rem/yr)	
	Each New Unit	Both Units
Liquid	1.4E+01	2.8E+01
Noble Gases	2.9E+00	5.8E+00
Iodines and Particulates	1.4E+00	2.8E+00
H-3 and C-14	1.4E+01	2.7E+01
Total	3.2E+01	6.4E+01
Natural Background	9.2E+05	9.2E+05

Note: Natural background dose is based on a dose rate of 325 mrem/person-yr (Reference 10, Table 11B-8, and Reference 12, Table 9.7) and a population of 2.8E+06 (Table 2.5-8). Occupational workforce doses are not shown.

The following reference will be added to ER Section 5.4 References:

12. NRP Report No. 94, *Exposure of the Population in the United States and Canada from Natural Background Radiation*, National Council on Radiation Protection and Measurements, 1987.

7. RAI E5.4.4-1 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 5.4.4 of ER - Impacts to Biota) - Table 5.4-16 has a value of 27 mrem annually to the biota from the gaseous effluent pathway. How was this value obtained?

Response

The gaseous pathway doses were calculated using GASPAR II. Although GASPAR II does not explicitly calculate biota doses, as indicated in ER Section 5.4.4.2, gaseous immersion and ground deposition doses are independent of organism size.

The doses calculated using GASPAR II for humans were applied to biota with one modification: the ground deposition doses were increased by a factor of two to account for the proximity of biota to the ground.

Application Revision

None.

8. RAI response E7.2 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 7.2 of ER – Severe Accidents) – Table 4, AP-1000 Collapsed Plume Characterization Data, (pg 80) the values for REFTIM for Direct and IC appear to be transposed. Please verify and correct if necessary by sending in a new Table 4.

The staff also requested Dominion to send in two MAACS2 code outputs, one for the ABWR and one for the AP-1000.

Response

Dominion provided the NRC a corrected table for the AP1000 Collapsed Plume Characterization Data and MACCS2 code output files for the AP1000 and ABWR in a June 14, 2004 e-mail. These were acknowledged by the NRC Staff in a June 14, 2004 e-mail. (See docketed e-mail; NRC Accession No. ML041670414.) Copies of the AP1000 table and MACCS2 code output files are included on the enclosed compact disc (CD).

Application Revision

None.

9. RAI response E4.5-3 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 4.5 of ER – Radiation Exposure to Construction Workers) – States that the thermo-luminescent dosimeter (TLD) measurements used to provide the average dose data in Table 4.5-1 were located at the west protected area fence of the existing units.

Was a single TLD located at the west protected area fence or were there several TLDs on this fence (and the data in Table 4.5-1 represented an average reading from these TLDs)?

Response

The measurements at the west protected area fence are from a single TLD.

Application Revision

None.

10. RAI response E4.5-4 (Follow-up RAI from 6/23/04 Conference Call with NRC)

(Section 4.5 of ER – Radiation Exposure to Construction Workers) – States that the west protected area fence TLD readings included dose rate contributions from the independent spent fuel storage installation (ISFSI) at the time of measurement.

a) For each of the years listed in Table 4.5-1 (1996-2002) provide the approximate percentage of full loading of the ISFSI.

b) Provide an explanation for the consecutive increases in the TLD dose measurements (shown in Table 4.5-1) from 55 mrem/yr in 2000 to 69 mrem/yr in 2001 to 74 mrem/yr in 2002. Discuss whether this increase could be due to increased loading of the ISFSI over these years.

c) Provide the total TLD measurement at the west protected area fence for the year 2003.

Response

a) Full load for the existing ISFSI pad is 28 casks. The number of casks placed on the pad each year, total at the end of the year, and percentage of the total are as follows:

Year	Casks Added	Total Casks	Percentage Full
1996	0	0	0
1997	0	0	0
1998	2	2	7
1999	3	5	18
2000	3	8	29
2001	3	11	39
2002	4	15	54
2003	4	19	68

Three more casks have been moved to the pad in 2004 to date, bringing the total to 22, or about 79 percent.

b) Dominion attributes these increases to two activities that were occurring during that time period that involved moving irradiated materials past the west gate. First, Dominion replaced the reactor vessel heads for North Anna Power Station Unit 2 during the fourth quarter of 2002 and for Unit 1 during the first and second quarters of 2003. Second, Dominion was moving spent fuel casks with somewhat higher dose rates to the ISFSI during the third and fourth quarters of 2003 and the first quarter of 2004.

c) The 2003 quarterly dose readings at the TLD on the west protected area fence were 21 mrem, 20 mrem, 18 mrem, and 19 mrem, with a total for the year of 78 mrem.

Application Revision

None.

RAI 2.3.4-1 (NRC 6/3/04 Letter)

Please provide the results of executing the PAVAN computer code using the wind speed categories discussed in Section 4.6 of NUREG/CR-2858 (i.e., 0.5, 0.75, 1.0, 1.25, 1.5, 2.0, 3.0, 4.0, 5.0, 6.0, 8.0, and 10.0 m/sec). Also, please provide a copy of the input files to execute PAVAN.

Response

The PAVAN computer code has been rerun using the wind speed categories discussed in Section 4.6 of NUREG/CR-2858. The results are described in the application changes described below. A copy of the input file used to execute PAVAN is provided on the enclosed compact disc (CD).

Application Revision

SSAR Section 2.3.4.2 will be revised to read as follows:

2.3.4.2 **PAVAN Modeling Results**

To calculate the maximum χ/Q values, the shortest distances from the plant parameter envelope boundary to the EAB at each downwind sector were used. These distances are presented in Table 2.3-13. As presented in the table, the maximum 0–2 hours 0.5 percentile direction-dependent χ/Q value (2.26×10^{-4} sec/m^3) is greater than the corresponding 5 percentile overall site χ/Q value (1.56×10^{-4} sec/m^3) at the EAB. Therefore, the direction-dependent 0.5 percentile χ/Q values were used as the proper χ/Q values at EAB.

To be conservative, this shortest distance has been used as the LPZ distance for all downwind sectors in PAVAN modeling. Similarly, Table 2.3-14 shows the maximum 0–2 hours 0.5 percentile direction-dependent χ/Q value (4.65×10^{-5} sec/m^3) is greater than the corresponding 5 percentile overall site χ/Q value (2.72×10^{-5} sec/m^3) at the LPZ. Therefore, the direction-dependent 0.5 percentile χ/Q values were used at the LPZ.

The maximum χ/Q values presented in Table 2.3-13 and Table 2.3-14 for the EAB and LPZ, respectively, are summarized below.

Table 2.3-3 PAVAN Results (0.5% Limiting Case, 1996-98 Meteorological Data)

Source Location	Receptor Location	0–2 hr (Dir, Dist)	0–8 hr (Dir, Dist)	8–24 hr (Dir, Dist)	1–4 days (Dir, Dist)	4–30 days (Dir, Dist)	Annual (Dir, Dist)
Plant Envelope	EAB	2.26E-04 (SE, 1300 m)	1.43E-04 (SE, 1300 m)	1.14E-04 (ESE, 1420 m)	7.05E-05 (ESE, 1420 m)	3.55E-05 (ESE, 1420 m)	1.54E-05 ESE, 1420 m)
Plant Envelope	LPZ	4.65E-05* (ESE, 8843 m)	2.05E-05 (ESE, 8843 m)	1.36E-05 (ESE, 8843 m)	5.58E-06 (ESE, 8843 m)	1.55E-06 (ESE, 8843 m)	3.25 E-07 (ESE, 8843 m)

* The 0–2-hour χ/Q value is reported here for reference only. It is not required based on RG 1.145.

SSAR Tables 2.3-13 and 2.3-14 will be replaced with revised tables as shown on the following pages.

ER Section 2.7.5.2 will be revised to read as follows:

2.7.5.2 PAVAN Modeling Results

Based on the PAVAN-generated ordered χ/Q values (see Table 2.7-11 and Table 2.7-12), the 50 percentile overall site χ/Q values calculated by the model at the EAB and LPZ are 3.34E-05 and 2.17E-06, respectively.

ER Tables 2.7-9 through 2.7-12 will be replaced with revised tables as shown on the following pages.

Table 2.3-13 PAVAN Results for χ/Q Values at the EAB

Plant Name: North Anna ESP
Data Period: 1996-98 JFD
Type of Release: Ground-Level Release
Source of Data: Onsite
Comments: Data period: 1/1/96 - 12/31/98
Meteorological Instrumentation
Wind Sensors Height: 32.8 ft
ΔT Heights: 32.8 ft–158.9 ft
Program: PAVAN, 10/76, 8/79 Revision, Implementation of Regulatory Guide 1.145
0 Relative Concentration (χ/Q) Values (sec/cubic meter) versus Averaging Time

Downwind Sector	Distance (Meters)	0-2 Hours	0-8 Hours	8-24 Hours	1-4 Days	4-30 Days	Annual Average	Hours Per Year Max 0-2 hr χ/Q Is Exceeded In Sector	Downwind Sector
S	954	8.87E-05	6.32E-05	5.33E-05	3.69E-05	2.17E-05	1.14E-05	10.5	S
SSW	877	8.89E-05	6.24E-05	5.23E-05	3.57E-05	2.06E-05	1.05E-05	11.4	SSW
SW	872	9.03E-05	6.24E-05	5.19E-05	3.47E-05	1.95E-05	9.66E-06	11.9	SW
WSW	865	9.30E-05	6.34E-05	5.23E-05	3.45E-05	1.90E-05	9.14E-06	12.9	WSW
W	872	1.16E-04	7.97E-05	6.59E-05	4.37E-05	2.43E-05	1.18E-05	21.7	W
WNW	902	1.02E-04	6.83E-05	5.59E-05	3.61E-05	1.94E-05	9.01E-06	12.5	WNW
NW	988	9.67E-05	6.40E-05	5.21E-05	3.33E-05	1.75E-05	7.98E-06	9.8	NW
NNW	1165	8.20E-05	5.17E-05	4.10E-05	2.49E-05	1.21E-05	5.04E-06	4.6	NNW
N	1378	1.07E-04	7.04E-05	5.70E-05	3.61E-05	1.88E-05	8.42E-06	4.7	N
NNE	1399	1.17E-04	7.79E-05	6.37E-05	4.11E-05	2.20E-05	1.02E-05	4.2	NNE
NE	1432	1.10E-04	7.17E-05	5.78E-05	3.62E-05	1.85E-05	8.15E-06	7.1	NE

ENE	1474	1.13E-04	6.78E-05	5.25E-05	3.01E-05	1.35E-05	5.08E-06	8.5	ENE
E	1435	1.56E-04	9.92E-05	7.91E-05	4.84E-05	2.39E-05	1.01E-05	16.4	E
ESE	1420	2.20E-04	1.42E-04	1.14E-04	7.05E-05	3.55E-05	1.54E-05	40.5	ESE
SE	1300	2.26E-04	1.43E-04	1.13E-04	6.89E-05	3.37E-05	1.40E-05	43.7	SE
SSE	1086	1.30E-04	8.61E-05	7.01E-05	4.49E-05	2.37E-05	1.08E-05	26.0	SSE
Max χ/Q		2.26E-04					Total Hours Around Site:	246.5	
Site Limit		1.56E-04	1.06E-04	8.78E-05	5.80E-05	3.19E-05	1.54E-05		

00.5 Percent χ/Q to an Individual Is Limiting

Table 2.3-14 PAVAN Results for χ/Q Values at the LPZ

USNRC Computer Code-PAVAN, Version 2.0

Plant Name: North Anna ESP
Data Period: 1996-98 JFD
Type of Release: Ground-Level Release
Source of Data: Onsite
Comments: Data period: 1/1/96 - 12/31/98
Program: PAVAN, 10/76, 8/79 Revision, Implementation of Regulatory Guide 1.145

Meteorological Instrumentation
Wind Sensors Height: 32.8 ft
ΔT Heights: 32.8 ft–158.9 ft

0 Relative Concentration (χ/Q) Values (sec/cubic meter) versus Averaging Time

Downwind Sector	Distance (Meters)	0-2 Hours	0-8 Hours	8-24 Hours	1-4 Days	4-30 Days	Annual Average	Hours Per Year Max 0-2 hr χ/Q Is Exceeded In Sector	Downwind Sector
S	8843	6.73E-06	3.29E-06	2.30E-06	1.06E-06	3.49E-07	8.94E-08	5.7	S
SSW	8843	6.03E-06	2.90E-06	2.01E-06	9.08E-07	2.90E-07	7.19E-08	166.2	SSW
SW	8843	6.14E-06	2.90E-06	2.00E-06	8.86E-07	2.76E-07	6.61E-08	4.7	SW
WSW	8843	5.91E-06	2.78E-06	1.91E-06	8.41E-07	2.60E-07	6.18E-08	4.1	WSW
W	8843	8.48E-06	3.95E-06	2.69E-06	1.17E-06	3.56E-07	8.27E-08	8.6	W
WNW	8843	7.81E-06	3.55E-06	2.39E-06	1.02E-06	2.97E-07	6.61E-08	4.7	WNW
NW	8843	8.54E-06	3.86E-06	2.59E-06	1.10E-06	3.18E-07	7.00E-08	3.2	NW
NNW	8843	8.42E-06	3.71E-06	2.46E-06	1.01E-06	2.83E-07	5.94E-08	2.4	NNW
N	8843	1.47E-05	6.88E-06	4.70E-06	2.06E-06	6.30E-07	1.48E-07	2.3	N
NNE	8843	1.77E-05	8.35E-06	5.73E-06	2.53E-06	7.81E-07	1.86E-07	2.5	NNE

NE	8843	1.69E-05	7.83E-06	5.33E-06	2.31E-06	6.93E-07	1.59E-07	5.0	NE
ENE	8843	1.79E-05	7.72E-06	5.07E-06	2.03E-06	5.48E-07	1.10E-07	7.0	ENE
E	8843	2.86E-05	1.27E-05	8.46E-06	3.51E-06	9.90E-07	2.11E-07	15.8	E
ESE	8843	4.65E-05	2.05E-05	1.36E-05	5.58E-06	1.55E-06	3.25E-07	43.7	ESE
SE	8843	4.48E-05	1.88E-05	1.22E-05	4.74E-06	1.22E-06	2.34E-07	39.3	SE
SSE	8843	1.51E-05	6.72E-06	4.49E-06	1.87E-06	5.34E-07	1.15E-07	18.2	SSE
Max χ/Q		4.65E-05					Total Hours Around Site:	333.6	
Site Limit		2.72E-05	1.31E-05	9.07E-06	4.10E-06	1.31E-06	3.25E-07		

00.5 Percent χ/Q to an Individual Is Limiting

Table 2.7-9 1996-98 NAPS Meteorological Data (33-ft Level)

SECTOR	CLASS	Wind Speed (m/s)													
FREQUENCY	CALM	.34-.50	.51-.75	.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	> 10.0	TOTAL
Stability Class A – by ΔT															
N	0	0	2	2	5	3	6	17	19	19	12	5	0	0	90
NNE	0	0	0	0	2	3	5	6	14	4	1	2	0	0	37
NE	0	0	0	2	2	1	4	5	8	3	6	2	0	0	33
ENE	0	0	0	0	2	3	1	10	16	3	0	1	0	0	36
E	0	0	1	2	3	2	22	15	4	5	1	0	0	0	55
ESE	0	0	0	2	4	7	19	26	6	5	0	0	0	0	69
SE	0	0	0	0	1	4	18	26	2	0	0	0	0	0	51
SSE	0	0	0	2	6	2	18	39	1	0	0	0	0	0	68
S	0	0	0	2	3	8	33	113	10	1	0	0	0	0	170
SSW	0	0	0	0	5	5	24	107	73	12	0	1	0	0	227
SW	0	0	0	0	3	3	15	35	50	20	9	1	0	0	136
WSW	0	0	0	0	0	1	11	40	40	12	3	4	0	0	111
W	0	0	0	0	1	4	7	52	55	28	8	3	0	0	158
WNW	0	0	0	1	4	4	19	46	39	36	30	7	0	0	186
NW	0	0	1	2	13	8	41	78	54	26	16	11	3	0	253
NNW	0	0	0	3	12	14	24	20	22	13	18	14	3	0	143
TOTAL	0	0	4	18	66	72	267	635	413	187	104	51	6	0	1823
Stability Class B – by ΔT															
N	0	0	0	0	0	1	3	22	10	3	8	9	0	0	56
NNE	0	0	0	1	0	1	5	8	8	3	1	0	0	0	27
NE	0	0	0	0	0	1	4	9	8	5	1	1	0	0	29
ENE	0	0	0	0	1	4	6	10	4	3	0	0	0	0	28
E	0	0	0	1	2	4	12	12	6	2	0	0	0	0	39
ESE	0	0	0	1	1	3	20	30	2	1	1	0	0	0	59
SE	0	0	0	0	0	1	10	13	4	0	0	0	0	0	28
SSE	0	0	0	0	1	0	7	18	1	0	0	0	0	0	27
S	0	0	0	0	2	3	18	39	6	3	0	0	0	0	71
SSW	0	0	0	1	0	2	16	48	40	15	15	8	0	0	145
SW	0	1	0	0	1	1	4	18	26	11	4	3	0	0	69

Table 2.7-9 1996-98 NAPS Meteorological Data (33-ft Level)

SECTOR	CLASS	Wind Speed (m/s)														
FREQUENCY	CALM	.34-.50	.51-.75	.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	> 10.0	TOTAL
WSW	0	0	0	0	0	0	4	16	16	9	3	4	0	0	52
W	0	0	0	0	0	1	2	14	11	7	6	1	0	0	42
WNW	0	0	0	0	1	1	5	20	21	13	9	4	2	0	76
NW	0	0	0	2	3	6	18	14	19	25	21	8	8	8	132
NNW	0	0	0	1	4	3	8	23	16	20	19	14	5	0	113
TOTAL	0	1	0	7	16	32	142	314	198	120	88	52	15	8	993
Stability Class C – by ΔT															
N	0	0	0	5	5	1	14	17	28	28	28	11	1	0	138
NNE	0	0	0	0	3	1	7	9	9	10	8	0	0	0	47
N	0	0	0	2	5	3	3	8	5	3	4	0	0	0	33
ENE	0	0	0	1	3	1	10	17	12	6	0	0	0	0	50
E	0	0	0	0	6	7	13	18	8	3	1	0	0	0	56
ESE	0	0	0	3	3	12	31	48	13	3	5	1	0	0	119
SE	0	0	0	0	2	9	20	22	4	0	0	0	0	0	57
SSE	0	0	0	1	0	3	10	10	1	0	0	0	0	0	25
S	0	0	0	0	4	5	34	30	7	1	0	0	0	0	81
SSW	0	0	0	0	0	5	18	72	28	17	11	4	0	0	155
SW	0	0	0	1	1	4	8	35	28	18	14	10	0	0	119
WSW	0	0	0	0	0	0	7	17	8	6	6	4	0	0	48
W	0	0	0	1	4	3	5	14	17	7	4	3	0	0	58
WNW	0	0	0	4	6	2	10	21	17	15	11	1	2	0	89
NW	0	0	1	1	7	2	14	28	26	29	9	19	5	12	153
NNW	0	0	1	0	7	10	22	32	32	39	15	18	2	3	181
TOTAL	0	0	2	19	56	68	226	398	243	185	116	71	10	15	1409
Stability Class D – by ΔT															
N	2	0	10	33	51	57	176	460	406	263	86	56	6	2	1608
NNE	0	0	6	23	55	53	173	358	233	122	42	16	5	0	1086
NE	0	0	5	14	52	56	139	290	179	87	23	5	7	1	858
ENE	0	1	7	28	45	54	119	227	138	66	21	7	4	0	717
E	0	2	11	31	60	41	138	230	171	63	20	9	11	0	787

Table 2.7-9 1996-98 NAPS Meteorological Data (33-ft Level)

SECTOR	CLASS	Wind Speed (m/s)													
FREQUENCY	CALM	.34-.50	.51-.75	.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	> 10.0	TOTAL
ESE	0	0	6	12	34	32	98	185	115	43	21	2	1	0	549
SE	0	2	7	9	22	21	79	224	59	14	4	0	0	0	441
SSE	0	2	6	13	25	25	56	89	15	2	1	0	0	0	234
S	0	1	5	32	55	75	167	199	38	14	2	0	0	0	588
SSW	1	2	9	39	64	63	176	352	175	91	48	12	0	0	1032
SW	1	2	17	36	51	47	140	266	176	64	41	32	2	0	875
WSW	0	1	13	20	16	21	44	100	102	63	18	4	0	0	402
W	0	4	7	28	31	16	40	67	55	36	17	3	0	0	304
WNW	1	0	3	22	31	32	70	107	74	69	34	25	8	2	478
NW	0	2	2	25	48	59	96	158	119	92	43	27	15	3	689
NNW	0	0	8	25	46	49	147	264	221	141	76	58	7	3	1045
TOTAL	5	19	122	390	686	701	1858	3576	2276	1230	497	256	66	11	11693
							Stability Class E – by ΔT								
N	2	3	14	27	16	16	31	62	28	24	6	9	3	0	241
NNE	1	7	10	21	23	11	29	54	29	9	3	4	3	0	204
NE	1	6	17	20	23	18	31	41	16	9	2	4	3	4	195
ENE	0	9	11	20	19	20	23	43	7	2	0	0	0	1	155
E	2	8	11	13	26	21	53	38	13	1	1	3	0	1	191
ESE	1	6	13	22	35	24	53	72	21	6	6	0	0	0	259
SE	0	4	17	36	28	31	96	131	21	1	1	1	1	0	368
SSE	0	5	17	39	38	50	96	58	10	5	5	0	0	0	323
S	1	14	54	94	115	117	244	185	58	22	1	0	0	0	905
SSW	4	11	67	132	125	85	157	280	145	33	8	1	0	0	1048
SW	1	9	45	102	101	72	133	229	120	50	12	5	0	0	879
WSW	1	11	39	69	56	40	46	97	69	10	1	2	0	0	441
W	1	13	45	81	111	80	105	141	38	18	5	0	0	0	638
WNW	0	11	30	85	99	93	143	107	45	24	10	10	1	0	658
NW	1	9	26	50	80	49	69	51	18	15	6	1	1	0	376
NNW	0	3	22	30	34	25	42	44	21	7	2	7	1	0	238
TOTAL	16	129	438	841	929	752	1351	1633	659	236	69	47	13	6	7119

Table 2.7-9 1996-98 NAPS Meteorological Data (33-ft Level)

SECTOR	CLASS	Wind Speed (m/s)													
FREQUENCY	CALM	.34-.50	.51-.75	.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	> 10.0	TOTAL
Stability Class F – by ΔT															
N	1	3	5	4	1	5	1	0	0	0	0	0	0	0	20
NNE	0	1	7	3	6	0	3	2	1	0	0	0	0	0	23
NE	1	4	7	3	4	3	2	0	0	1	0	0	0	0	25
ENE	2	2	7	9	4	2	4	0	0	0	0	0	0	0	30
E	1	6	15	15	4	3	10	2	0	0	0	0	0	2	58
ESE	1	4	5	7	10	5	9	5	1	0	1	0	0	3	51
SE	0	6	8	8	6	5	8	3	0	0	1	0	0	0	45
SSE	0	1	10	12	6	10	4	1	0	0	2	0	0	0	46
S	0	7	10	36	31	20	12	1	0	0	0	0	0	0	117
SSW	1	4	17	55	55	30	28	10	0	0	0	0	0	0	200
SW	0	8	23	37	26	21	27	20	5	0	0	0	0	0	167
WSW	1	8	20	49	36	8	9	10	2	2	0	0	0	0	145
W	2	12	38	75	85	74	109	26	0	0	0	0	0	0	421
WNW	2	12	37	99	101	66	62	36	1	0	3	0	0	0	419
NW	0	6	24	37	44	20	16	10	1	0	0	0	0	0	158
NNW	2	7	14	7	5	4	5	5	0	0	0	0	0	0	49
TOTAL	14	91	247	456	424	276	309	131	11	3	7	0	0	5	1974
Stability Class G – by ΔT															
N	3	7	5	5	3	2	0	0	0	0	0	0	0	0	25
NNE	1	6	5	3	1	0	0	0	0	0	0	0	0	0	16
NE	2	5	4	4	1	0	0	0	0	0	0	0	0	0	16
ENE	0	4	5	3	3	0	0	0	0	0	0	0	0	0	15
E	1	6	11	9	2	0	0	0	0	0	0	0	0	0	29
ESE	0	1	7	7	4	0	0	0	0	0	0	0	0	0	19
SE	0	1	2	5	6	4	1	0	0	0	0	0	0	0	19
SSE	0	2	1	2	1	2	0	1	0	0	0	0	0	0	9
S	0	0	1	2	1	3	0	0	0	0	0	0	0	0	7
SSW	0	1	1	1	4	2	5	0	0	0	0	0	0	0	14
SW	1	1	6	6	4	4	5	1	0	0	0	0	0	0	28

Table 2.7-9 1996-98 NAPS Meteorological Data (33-ft Level)

SECTOR	CLASS	Wind Speed (m/s)													
FREQUENCY	CALM	.34-.50	.51-.75	.76-1.0	1.01-1.25	1.26-1.5	1.51-2.0	2.01-3.0	3.01-4.0	4.01-5.0	5.01-6.0	6.01-8.0	8.01-10	> 10.0	TOTAL
WSW	1	2	10	7	6	1	0	0	0	0	0	0	0	0	27
W	0	6	16	31	27	8	9	2	0	0	0	0	0	0	99
WNW	0	5	39	120	117	57	40	5	0	0	0	0	0	0	383
NW	3	15	45	89	86	38	17	3	1	0	0	0	0	0	297
NNW	4	14	25	19	10	3	0	0	0	0	0	0	0	0	75
TOTAL	16	76	183	313	276	124	77	12	1	0	0	0	0	0	1078
All Stabilities – by ΔT															
N	8	13	36	76	81	85	231	578	491	337	140	90	10	2	2178
NNE	2	14	28	51	90	69	222	437	294	148	55	22	8	0	1440
NE	4	15	33	45	87	82	183	353	216	108	36	12	10	5	1189
ENE	2	16	30	61	77	84	163	307	177	80	21	8	4	1	1031
E	4	22	49	71	103	78	248	315	202	74	23	12	11	3	1215
ESE	2	11	31	54	91	83	230	366	158	58	34	3	1	3	1125
SE	0	13	34	58	65	75	232	419	90	15	6	1	1	0	1009
SSE	0	10	34	69	77	92	191	216	28	7	8	0	0	0	732
S	1	22	70	166	211	231	508	567	119	41	3	0	0	0	1939
SSW	6	18	94	228	253	192	424	869	461	168	82	26	0	0	2821
SW	3	21	91	182	187	152	332	604	405	163	80	51	2	0	2273
WSW	3	22	82	145	114	71	121	280	237	102	31	18	0	0	1226
W	3	35	106	216	259	186	277	316	176	96	40	10	0	0	1720
WNW	3	28	109	331	359	255	349	342	197	157	97	47	13	2	2289
NW	4	32	99	206	281	182	271	342	238	187	95	66	32	23	2058
NNW	6	24	70	85	118	108	248	388	312	220	130	111	18	6	1844
TOTAL	51	316	996	2044	2453	2025	4230	6699	3801	1961	881	477	110	45	26089

Table 2.7-10 Shortest Distances from the ESP Plant Envelope Boundary to the EAB

Downwind Direction	Distance (ft)	Distance (m)
S	3131	954
SSW	2877	877
SW	2860	872
WSW	2838	865
W	2860	872
WNW	2959	902
NW	3242	988
NNW	3822	1165
N	4521	1378
NNE	4589	1399
NE	4697	1432
ENE	4835	1474
E	4707	1435
ESE	4660	1420
SE	4266	1300
SSE	3562	1086

Table 2.7-11 PAVAN Results for χ/Q Values at the EAB

Plant Name: North Anna ESP
Data Period: 1996-98 JFD
Type of Release: Ground-Level Release
Source of Data: Onsite
Comments: Data period: 1/1/96 - 12/31/98
Program: PAVAN, 10/76, 8/79 Revision, Implementation of RG 1.145
Site Exclusion Boundary Calculations:
Five Percent Overall Site Limit.
Building wake credit is not included.
Correction factors used in the annual average calculations.

Meteorological Instrumentation
Wind Sensors Height: 32.8 ft
ΔT Heights: 32.8 ft–158.9 ft

Below are printed the ordered values of χ/Q and the frequency with which that value is reached or exceeded.
The top number is the χ/Q. The middle number is the frequency normalized to this sector.
The third number is the frequency with respect to all time.

0	9.211E-04	9.140E-04	9.090E-04	8.847E-04	8.381E-04	8.101E-04	7.256E-04	6.790E-04	6.263E-04	6.215E-04
	.001	.004	.005	.006	.007	.008	.013	.013	.029	.071
	.00095	.00360	.00454	.00574	.00713	.00827	.01275	.01325	.02858	.07075
0	6.181E-04	6.142E-04	6.099E-04	6.050E-04	6.016E-04	6.016E-04	5.848E-04	5.832E-04	5.755E-04	5.699E-04
	.094	.111	.112	.114	.118	.119	.120	.120	.121	.148
	.09374	.11097	.11183	.11413	.11796	.11857	.11969	.12013	.12070	.14753
0	5.680E-04	5.639E-04	5.628E-04	5.527E-04	5.508E-04	5.499E-04	5.334E-04	4.934E-04	4.808E-04	4.617E-04
	.169	.170	.176	.176	.180	.182	.183	.237	.238	.246
	.16885	.17018	.17573	.17638	.18021	.18185	.18304	.23670	.23803	.24569
0	4.471E-04	4.177E-04	4.175E-04	4.147E-04	4.143E-04	4.121E-04	4.114E-04	4.091E-04	4.011E-04	4.002E-04
	.247	.305	.324	.331	.389	.408	.446	.450	.477	.482
	.24709	.30459	.32376	.33142	.38892	.40808	.44641	.45025	.47708	.48178

0	3.977E-04	3.913E-04	3.863E-04	3.834E-04	3.827E-04	3.799E-04	3.776E-04	3.758E-04	3.739E-04	3.720E-04
	.497	.501	.520	.524	.547	.566	.570	.581	.589	.595
	.49711	.50095	.52011	.52395	.54694	.56611	.56984	.58134	.58901	.59479
0	3.672E-04	3.665E-04	3.635E-04	3.627E-04	3.627E-04	3.590E-04	3.560E-04	3.539E-04	3.533E-04	3.437E-04
	.602	.614	.618	.628	.651	.653	.656	.657	.662	.664
	.60246	.61377	.61790	.62810	.65110	.65267	.65591	.65734	.66168	.66367
0	3.290E-04	3.269E-04	3.240E-04	3.132E-04	3.123E-04	3.107E-04	3.090E-04	3.078E-04	3.041E-04	3.008E-04
	.759	.786	.788	.799	.802	.851	.863	.867	.871	.897
	.75949	.78633	.78783	.79933	.80164	.85147	.86296	.86680	.87063	.89746
0	2.850E-04	2.833E-04	2.785E-04	2.765E-04	2.754E-04	2.743E-04	2.727E-04	2.721E-04	2.651E-04	2.644E-04
	.917	.919	1.091	1.118	1.137	1.222	1.249	1.272	1.291	1.295
	.91663	.91889	1.09138	1.11821	1.13737	1.22170	1.24853	1.27153	1.29070	1.29453
0	2.620E-04	2.609E-04	2.601E-04	2.575E-04	2.575E-04	2.568E-04	2.557E-04	2.556E-04	2.552E-04	2.529E-04
	1.297	1.301	1.303	1.452	1.455	1.482	1.483	1.506	1.567	1.583
	1.29749	1.30132	1.30267	1.45216	1.45487	1.48171	1.48307	1.50607	1.56740	1.58273
0	2.506E-04	2.505E-04	2.493E-04	2.492E-04	2.486E-04	2.472E-04	2.472E-04	2.469E-04	2.467E-04	2.467E-04
	1.602	1.613	1.652	1.698	1.709	1.713	1.744	1.745	1.817	1.863
	1.60190	1.61340	1.65173	1.69772	1.70922	1.71306	1.74372	1.74456	1.81739	1.86338
0	2.441E-04	2.421E-04	2.418E-04	2.407E-04	2.406E-04	2.402E-04	2.337E-04	2.321E-04	2.309E-04	2.302E-04
	1.898	1.952	1.982	1.998	2.024	2.055	2.078	2.082	2.090	2.091
	1.89788	1.95154	1.98221	1.99754	2.02437	2.05504	2.07803	2.08228	2.08995	2.09146
0	2.280E-04	2.203E-04	2.203E-04	2.203E-04	2.180E-04	2.177E-04	2.142E-04	2.123E-04	2.107E-04	2.088E-04

	2.103	2.114	2.137	2.138	2.192	2.200	2.208	2.223	2.230	2.571
	2.10296	2.11446	2.13745	2.13806	2.19173	2.19955	2.20789	2.22322	2.22953	2.57067
0	2.088E-04	2.083E-04	2.074E-04	2.057E-04	2.045E-04	2.027E-04	2.023E-04	1.988E-04	1.983E-04	1.974E-04
	2.577	2.584	2.618	2.687	2.699	2.737	2.741	2.768	2.776	2.814
	2.57721	2.58376	2.61825	2.68725	2.69875	2.73708	2.74135	2.76818	2.77584	2.81417
0	1.962E-04	1.957E-04	1.931E-04	1.927E-04	1.917E-04	1.914E-04	1.900E-04	1.879E-04	1.870E-04	1.847E-04
	2.815	2.819	3.279	3.291	3.314	3.433	3.440	3.456	3.482	3.486
	2.81545	2.81929	3.27925	3.29075	3.31375	3.43257	3.44024	3.45557	3.48240	3.48623
0	1.836E-04	1.814E-04	1.813E-04	1.799E-04	1.782E-04	1.768E-04	1.751E-04	1.712E-04	1.686E-04	1.671E-04
	3.502	3.594	3.624	3.625	3.644	3.648	3.656	3.694	3.759	4.089
	3.50157	3.59356	3.62422	3.62493	3.64410	3.64793	3.65560	3.69393	3.75909	4.08873
0	1.662E-04	1.659E-04	1.648E-04	1.646E-04	1.645E-04	1.644E-04	1.636E-04	1.635E-04	1.627E-04	1.614E-04
	4.231	4.246	4.334	4.365	4.376	4.522	4.545	4.572	4.614	4.721
	4.23055	4.24589	4.33404	4.36471	4.37621	4.52186	4.54486	4.57169	4.61386	4.72118
0	1.604E-04	1.602E-04	1.591E-04	1.586E-04	1.578E-04	1.571E-04	1.565E-04	1.558E-04	1.545E-04	1.539E-04
	4.760	4.836	4.875	4.878	4.913	4.914	4.930	4.979	5.428	5.435
	4.75951	4.83617	4.87450	4.87834	4.91283	4.91419	4.92952	4.97935	5.42782	5.43548
0	1.534E-04	1.531E-04	1.520E-04	1.503E-04	1.498E-04	1.496E-04	1.481E-04	1.469E-04	1.461E-04	1.456E-04
	5.451	5.554	5.600	5.604	5.612	5.635	5.688	5.742	5.744	5.786
	5.45082	5.55431	5.60031	5.60414	5.61180	5.63480	5.68846	5.74213	5.74381	5.78597
0	1.451E-04	1.434E-04	1.433E-04	1.420E-04	1.416E-04	1.416E-04	1.408E-04	1.407E-04	1.393E-04	1.392E-04
	5.809	5.811	5.853	5.887	5.937	6.002	6.006	6.007	6.009	6.154

	5.80897	5.81074	5.85290	5.88740	5.93723	6.00239	6.00622	6.00710	6.00863	6.15428
0	1.389E-04	1.382E-04	1.377E-04	1.376E-04	1.375E-04	1.371E-04	1.361E-04	1.343E-04	1.326E-04	1.322E-04
	6.155	6.163	6.167	6.209	6.213	6.236	6.377	6.378	6.397	6.409
	6.15514	6.16281	6.16664	6.20881	6.21264	6.23564	6.37746	6.37817	6.39733	6.40883
0	1.308E-04	1.304E-04	1.288E-04	1.284E-04	1.284E-04	1.278E-04	1.276E-04	1.265E-04	1.253E-04	1.253E-04
	6.428	6.436	6.654	6.738	6.876	6.892	6.922	7.133	7.137	7.156
	6.42800	6.43566	6.65415	6.73847	6.87646	6.89179	6.92246	7.13328	7.13711	7.15627
0	1.250E-04	1.246E-04	1.246E-04	1.236E-04	1.233E-04	1.224E-04	1.223E-04	1.221E-04	1.216E-04	1.210E-04
	7.168	7.172	7.551	7.693	7.980	7.984	7.992	8.069	8.092	8.218
	7.16777	7.17161	7.55108	7.69290	7.98038	7.98421	7.99187	8.06853	8.09153	8.21802
0	1.209E-04	1.203E-04	1.201E-04	1.191E-04	1.188E-04	1.179E-04	1.168E-04	1.167E-04	1.159E-04	1.147E-04
	8.237	8.318	8.506	8.509	8.574	8.601	8.686	8.747	8.770	8.774
	8.23719	8.31768	8.50550	8.50933	8.57450	8.60133	8.68565	8.74698	8.76998	8.77381
0	1.139E-04	1.129E-04	1.129E-04	1.126E-04	1.121E-04	1.119E-04	1.102E-04	1.090E-04	1.088E-04	1.085E-04
	8.793	8.801	8.804	8.812	8.820	8.843	8.946	8.962	9.130	9.149
	8.79298	8.80064	8.80448	8.81214	8.81981	8.84280	8.94630	8.96163	9.13028	9.14945
0	1.068E-04	1.062E-04	1.052E-04	1.052E-04	1.044E-04	1.044E-04	1.037E-04	1.029E-04	1.027E-04	1.023E-04
	9.157	9.295	9.395	9.399	9.464	9.502	9.517	9.563	9.682	9.694
	9.15711	9.29510	9.39476	9.39859	9.46376	9.50209	9.51742	9.56341	9.68224	9.69374
0	1.014E-04	1.012E-04	9.988E-05	9.969E-05	9.942E-05	9.935E-05	9.887E-05	9.871E-05	9.866E-05	9.784E-05
	9.732	9.943	9.970	10.357	10.391	10.395	10.495	10.702	11.028	11.047
	9.73207	9.94288	9.96972	10.35685	10.39135	10.39518	10.49484	10.70182	11.02763	11.04680

0	9.765E-05	9.758E-05	9.750E-05	9.709E-05	9.683E-05	9.657E-05	9.633E-05	9.626E-05	9.609E-05	9.586E-05
	11.120	11.131	11.139	11.396	11.583	11.737	11.852	11.940	12.078	12.097
	11.11962	11.13112	11.13879	11.39560	11.58342	11.73674	11.85173	11.93989	12.07788	12.09705
0	9.568E-05	9.552E-05	9.470E-05	9.465E-05	9.445E-05	9.443E-05	9.396E-05	9.348E-05	9.171E-05	9.134E-05
	12.132	12.247	12.254	12.427	12.442	12.615	12.618	12.752	12.902	12.906
	12.13155	12.24654	12.25420	12.42669	12.44202	12.61451	12.61834	12.75250	12.90198	12.90582
0	9.070E-05	9.067E-05	8.908E-05	8.894E-05	8.842E-05	8.814E-05	8.755E-05	8.693E-05	8.663E-05	8.558E-05
	12.982	13.013	13.163	13.193	13.301	13.362	13.534	13.623	13.642	13.718
	12.98248	13.01314	13.16263	13.19330	13.30062	13.36195	13.53444	13.62259	13.64176	13.71842
0	8.493E-05	8.431E-05	8.395E-05	8.308E-05	8.239E-05	8.222E-05	8.173E-05	8.157E-05	8.137E-05	8.069E-05
	13.826	13.941	13.987	14.240	14.320	14.604	14.623	14.646	14.723	14.872
	13.82575	13.94074	13.98673	14.23971	14.32021	14.60385	14.62302	14.64602	14.72268	14.87216
0	8.022E-05	8.008E-05	7.965E-05	7.947E-05	7.892E-05	7.828E-05	7.790E-05	7.706E-05	7.602E-05	7.491E-05
	14.914	14.945	14.949	14.956	15.148	15.275	15.367	15.497	15.512	15.547
	14.91433	14.94499	14.94882	14.95649	15.14814	15.27463	15.36662	15.49695	15.51228	15.54678
0	7.403E-05	7.345E-05	7.282E-05	7.164E-05	7.126E-05	7.121E-05	7.098E-05	7.082E-05	7.078E-05	7.074E-05
	15.907	15.968	16.474	16.800	16.946	16.953	17.344	17.655	17.774	17.946
	15.90708	15.96841	16.47437	16.80018	16.94583	16.95350	17.34447	17.65494	17.77377	17.94625
0	7.060E-05	7.004E-05	6.999E-05	6.977E-05	6.954E-05	6.878E-05	6.803E-05	6.716E-05	6.674E-05	6.670E-05
	17.954	18.383	18.422	18.425	18.636	18.901	18.962	19.092	19.104	19.200
	17.95392	18.38322	18.42155	18.42538	18.63620	18.90068	18.96201	19.09233	19.10383	19.19966
0	6.623E-05	6.540E-05	6.500E-05	6.426E-05	6.422E-05	6.419E-05	6.380E-05	6.336E-05	6.323E-05	6.316E-05

	19.219	19.223	19.257	19.295	19.391	19.437	19.449	19.453	19.560	19.698
	19.21882	19.22266	19.25715	19.29548	19.39131	19.43731	19.44880	19.45264	19.55996	19.69795
0	6.314E-05	6.313E-05	6.297E-05	6.262E-05	6.255E-05	6.244E-05	6.240E-05	6.231E-05	6.211E-05	6.179E-05
	20.005	20.070	20.097	20.292	20.369	20.376	20.476	20.714	20.718	20.821
	20.00459	20.06976	20.09659	20.29207	20.36873	20.37640	20.47606	20.71370	20.71754	20.82103
0	6.166E-05	6.143E-05	6.117E-05	6.103E-05	6.089E-05	6.052E-05	6.050E-05	6.031E-05	6.016E-05	6.006E-05
	21.239	21.258	21.308	21.396	21.446	21.768	21.806	21.971	22.082	22.117
	21.23883	21.25800	21.30783	21.39598	21.44581	21.76779	21.80612	21.97094	22.08210	22.11659
0	5.993E-05	5.973E-05	5.961E-05	5.938E-05	5.933E-05	5.923E-05	5.915E-05	5.897E-05	5.895E-05	5.893E-05
	22.201	22.504	22.531	22.722	22.929	23.370	23.378	23.489	23.696	23.703
	22.20092	22.50373	22.53056	22.72221	22.92920	23.37000	23.37766	23.48882	23.69580	23.70347
0	5.872E-05	5.852E-05	5.842E-05	5.836E-05	5.825E-05	5.822E-05	5.795E-05	5.788E-05	5.773E-05	5.750E-05
	23.715	23.826	24.029	24.401	24.880	24.919	25.122	25.133	25.168	25.179
	23.71497	23.82613	24.02928	24.40108	24.88021	24.91854	25.12169	25.13319	25.16769	25.17919
0	5.737E-05	5.731E-05	5.703E-05	5.697E-05	5.679E-05	5.666E-05	5.635E-05	5.597E-05	5.591E-05	5.537E-05
	25.455	25.835	25.842	25.854	26.241	26.666	26.747	26.870	26.873	26.896
	25.45517	25.83464	25.84231	25.85381	26.24094	26.66641	26.74690	26.86956	26.87339	26.89639
0	5.509E-05	5.502E-05	5.442E-05	5.363E-05	5.341E-05	5.336E-05	5.308E-05	5.304E-05	5.261E-05	5.225E-05
	27.015	27.230	27.253	27.491	27.586	27.763	28.131	28.150	28.338	28.445
	27.01522	27.22987	27.25286	27.49051	27.58634	27.76266	28.13063	28.14979	28.33761	28.44494
0	5.218E-05	5.140E-05	5.093E-05	5.069E-05	4.995E-05	4.994E-05	4.982E-05	4.969E-05	4.968E-05	4.943E-05
	28.663	29.166	29.258	29.269	29.311	29.392	29.472	29.495	29.618	29.629

	28.66342	29.16555	29.25754	29.26904	29.31120	29.39170	29.47219	29.49519	29.61785	29.62935
0	4.936E-05	4.894E-05	4.875E-05	4.855E-05	4.834E-05	4.816E-05	4.785E-05	4.776E-05	4.735E-05	4.732E-05
	30.078	30.174	30.323	30.649	30.653	30.814	30.898	31.255	31.393	31.669
	30.07781	30.17364	30.32313	30.64893	30.65277	30.81376	30.89808	31.25455	31.39254	31.66852
0	4.723E-05	4.722E-05	4.698E-05	4.694E-05	4.596E-05	4.585E-05	4.567E-05	4.454E-05	4.447E-05	4.421E-05
	31.776	32.082	32.094	32.098	32.266	32.420	32.496	32.864	33.052	33.508
	31.77584	32.08249	32.09398	32.09782	32.26647	32.41979	32.49645	32.86442	33.05224	33.50837
0	4.395E-05	4.378E-05	4.347E-05	4.313E-05	4.273E-05	4.273E-05	4.243E-05	4.224E-05	4.211E-05	4.204E-05
	33.589	34.651	35.314	35.341	35.525	35.540	35.559	35.563	35.590	35.812
	33.58886	34.65061	35.31373	35.34056	35.52454	35.53988	35.55904	35.56287	35.58971	35.81202
0	4.198E-05	4.162E-05	4.120E-05	4.078E-05	4.042E-05	4.034E-05	3.982E-05	3.981E-05	3.974E-05	3.946E-05
	36.188	36.226	36.230	36.326	36.333	36.337	36.345	36.383	36.594	36.858
	36.18766	36.22599	36.22982	36.32565	36.33332	36.33715	36.34482	36.38315	36.59396	36.85844
0	3.915E-05	3.914E-05	3.900E-05	3.828E-05	3.788E-05	3.780E-05	3.778E-05	3.768E-05	3.746E-05	3.727E-05
	36.904	37.579	37.824	37.943	38.139	38.158	38.277	39.147	39.450	41.443
	36.90444	37.57906	37.82437	37.94320	38.13868	38.15784	38.27667	39.14677	39.44958	41.44276
0	3.727E-05	3.702E-05	3.698E-05	3.692E-05	3.662E-05	3.654E-05	3.641E-05	3.599E-05	3.582E-05	3.561E-05
	41.477	42.413	43.785	43.789	43.984	44.045	44.647	44.666	45.214	45.441
	41.47725	42.41251	43.78474	43.78857	43.98406	44.04539	44.64717	44.66634	45.21446	45.44061
0	3.558E-05	3.549E-05	3.541E-05	3.536E-05	3.521E-05	3.450E-05	3.439E-05	3.418E-05	3.416E-05	3.405E-05
	46.150	46.660	47.062	47.066	47.070	47.081	47.257	47.269	47.338	48.047
	46.14972	46.65952	47.06199	47.06582	47.06965	47.08115	47.25747	47.26897	47.33796	48.04708

0	3.358E-05	3.354E-05	3.341E-05	3.335E-05	3.319E-05	3.319E-05	3.312E-05	3.294E-05	3.291E-05	3.279E-05
	48.576	48.603	49.676	50.240	50.274	51.616	51.903	53.666	54.559	54.970
	48.57603	48.60287	49.67612	50.23957	50.27407	51.61563	51.90311	53.66631	54.55940	54.96954
0	3.250E-05	3.245E-05	3.237E-05	3.201E-05	3.190E-05	3.178E-05	3.168E-05	3.157E-05	3.156E-05	3.152E-05
	55.211	56.089	56.629	56.687	56.809	56.813	56.852	57.032	57.473	57.695
	55.21102	56.08878	56.62924	56.68674	56.80939	56.81323	56.85156	57.03171	57.47251	57.69483
0	3.148E-05	3.138E-05	3.136E-05	3.130E-05	3.122E-05	3.090E-05	3.087E-05	3.068E-05	3.059E-05	3.045E-05
	57.756	58.615	58.634	59.006	59.067	59.094	59.650	59.903	60.117	60.198
	57.75616	58.61476	58.63392	59.00573	59.06705	59.09388	59.64967	59.90265	60.11730	60.19780
0	3.031E-05	3.029E-05	3.026E-05	3.024E-05	3.012E-05	3.002E-05	2.989E-05	2.981E-05	2.980E-05	2.936E-05
	60.225	60.800	60.803	60.976	60.999	61.467	61.926	61.938	62.084	62.202
	60.22463	60.79958	60.80342	60.97590	60.99890	61.46653	61.92649	61.93799	62.08365	62.20247
0	2.934E-05	2.904E-05	2.873E-05	2.871E-05	2.868E-05	2.847E-05	2.817E-05	2.809E-05	2.805E-05	2.795E-05
	62.287	63.843	64.107	64.272	64.399	64.479	64.483	64.648	64.740	64.778
	62.28680	63.84301	64.10749	64.27231	64.39880	64.47929	64.48312	64.64793	64.73993	64.77826

Table 2.7-12 PAVAN Results for χ/Q Values at the LPZ

Plant Name: North Anna ESP
Data Period: 1996-98 JFD
Type of Release: Ground-Level Release
Source of Data: Onsite
Comments: Data period: 1/1/96 - 12/31/98
Program: PAVAN, 10/76, 8/79 Revision, Implementation of RG 1.145
Low Population Zone Calculations:
Five Percent Overall Site Limit.
Building wake credit is not included.
Correction factors used in the annual average calculations.

Meteorological Instrumentation
Wind Sensors Height: 32.8 ft
ΔT Heights: 32.8 ft–158.9 ft

Below are printed the ordered values of χ/Q and the frequency with which that value is reached or exceeded.
The top number is the χ/Q. The middle number is the frequency normalized to this sector.
The third number is the frequency with respect to all time.

0	1.237E-04	8.410E-05	5.981E-05	5.607E-05	4.205E-05	4.067E-05	3.364E-05	2.803E-05	2.711E-05	2.701E-05
	.061	.353	.406	1.108	2.307	2.656	3.714	4.190	5.136	5.198
	.06133	.35264	.40630	1.10775	2.30749	2.65629	3.71421	4.18951	5.13627	5.19759
0	2.102E-05	2.033E-05	1.837E-05	1.776E-05	1.627E-05	1.492E-05	1.356E-05	1.256E-05	1.225E-05	1.017E-05
	5.493	7.241	7.735	7.781	9.406	9.410	10.468	10.487	12.166	13.350
	5.49274	7.24060	7.73506	7.78106	9.40626	9.41009	10.46801	10.48718	12.16604	13.35045
0	9.185E-06	8.543E-06	7.847E-06	7.348E-06	6.341E-06	6.123E-06	5.695E-06	5.303E-06	4.592E-06	4.550E-06
	16.574	16.647	17.149	20.710	20.752	23.634	24.102	24.114	29.292	29.319
	16.57403	16.64686	17.14898	20.70987	20.75204	23.63448	24.10211	24.11361	29.29204	29.31887
0	4.271E-06	3.417E-06	3.375E-06	2.848E-06	2.668E-06	2.482E-06	2.206E-06	2.136E-06	1.880E-06	1.493E-06
	30.814	33.443	39.703	42.390	44.915	44.935	45.839	52.961	53.226	66.932
	30.81375	33.44321	39.70255	42.38952	44.91549	44.93466	45.83926	52.96103	53.22552	66.93244

0	1.410E-06	1.245E-06	1.151E-06	1.128E-06	1.026E-06	9.388E-07	9.339E-07	7.932E-07	7.471E-07	6.366E-07
	67.113	67.120	75.844	75.894	75.917	80.632	80.705	82.610	82.824	82.828
	67.11259	67.12025	75.84424	75.89405	75.91705	80.63168	80.70450	82.60951	82.82416	82.82799
0	6.226E-07	5.949E-07	4.759E-07	4.670E-07	4.327E-07	4.244E-07	3.183E-07	3.113E-07	2.546E-07	2.335E-07
	83.089	84.070	84.323	85.189	85.231	85.247	85.342	86.868	87.182	88.114
	83.08863	84.06989	84.32287	85.18914	85.23130	85.24663	85.34245	86.86799	87.18228	88.11370
0	2.122E-07	1.868E-07	1.592E-07	1.557E-07	1.167E-07	1.061E-07	9.339E-08	8.490E-08	7.958E-08	6.366E-08
	88.512	89.221	90.789	91.234	91.506	95.143	95.182	95.239	97.581	98.758
	88.51231	89.22141	90.78912	91.23375	91.50589	95.14342	95.18176	95.23925	97.58121	98.75794
0	5.305E-08	3.979E-08	3.183E-08	2.894E-08						
	99.494	99.889	99.969	100.000						
	99.49386	99.88866	99.96915	99.99981						