Amendment 1

to

Supplement Information For
the Purposes of Evaluation of
10 CFR Part 50, Appendix I

for

VERMONT YANKEE NUCLEAR POWER STATION

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Amendment 1
August 31, 1976

VERMONT YANKEE NUCLEAR POWER CORPORATION

License No. DPR-28
Docket No. 50-271

Instructions For Entering Amendment 1 to the report entitled "Supplemental Information For the Purposes of Evaluation of 10 CFR Part 50, Appendix I".

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Response: The primary release point for radioactivity in gaseous effluents at Vermont Yankee is from a 94 meter stack. The stack qualifies as an elevated release point as defined in draft Regulatory Guide 1.DD. Table Q1.2-1 list the distances from the stack to important land use characteristics in the vicinity of the plant. The turbine building roof vents are considered a ground level release point and are located approximately 900 feet south of the stack. Table QI.2-2 list the distances to the important land uses from the turbine building. In addition to these users, there are numerous individual residences through this area. However, the three mile radius surrounding the plant is primarily farm or undeveloped land. The actual distribution of individual residences, as well as farms, follows the main roadways in the area. As a result, the distribution of farms and residences in the land use Tables represents those areas where additional residences are located. Figure Q1.8-1 shows these locations where individual residences can be found within three miles.

Question 3. Based on considerations in Draft Regulatory Guide 1.DD, provide estimates of relative concentration (X/Q) and deposition (D/Q) at locations specified in response to item 2 above for each release point specified in response to item 1 above.

Response: See Section II for meteorological information concerning estimates of X/Q and D/Q values at points of interest.

Question 4. Provide a detailed description of the meteorological data, models and parameters used to determine the X/Q and D/Q values. Include information concerning the validity and accuracy of the models and assumptions for your site and the representativeness of the meteorological data used.

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TABLE QI.2-1
VERMONT YANKEE
Distance To Important Land Use Characteristics From The Plant Stack

Sector	Milk Cows (1) (Miles)	Milk Goats (1) (Miles)	Meat Animals (1) (Miles)	Nearest Resident & (1) Vegetable Garden (2) (Miles)	Nearest Site (1) Boundary (Miles)
N	>5.0	3.6	>5.0	0.95	0.25
NNE	>5.0	>5.0	>5.0	0.93	0.22
NE	>5.0	2.6	>5.0	1.4	0.22
ENE	>5.0	>5.0	>5.0	0.63	0.23
E	1.4	>5.0	1.4	0.65	0.31
ESE	1.8(3)	>5.0	1.8	1.8	0.43
SE	2.3	2.6	1.6 2.3	1.3	0.45
SSE	3.5	>5.0	3.5	1.3	0.54
S	1.6	>5.0	1.6	0.33	0.24
SSW	1.4	>5.0	1.4	0.30	0.18
SW	>5.0	>5.0	>5.0	0.25	0.16
WSW	>5.0	>5.0	>5.0	0.27	0.16
W	0.65 0.64	>5.0	0.35 0.28 0.65 0.64	0.28	0.26
WNW	1.8 2.9	>5.0	0.05 2.9	0.68	0.35
NW	>5.0	>5.0	>5.0	1.4	0.34
NNW	>5.0	>5.0	>5.0	1.3	0.34

(1) First location indicates distance of nearest land use within 5 miles. Additional distances indicate location of all users within 5 miles.
(2) Nearest vegetable garden is assumed to be located at the nearest resident.
(3) Two separate locations at approximately same distance.

TABLE QI.2-2
VERMONT YANKEE
Distance To Important Land Use
Characteristics From The Turbine Building Vent.

Sector	Milk Cows (1) (Miles)	Milk Goats (1) (Miles)	Meat Animals (1) (Miles)	Nearest Resident & (1) Vegetable Garden (2) (Miles)	Nearest Site (1) Boundary (Miles)
N	>5.0	3.7	>5.0	1.1	0.30
NNE	>5.0	>5.0	>5.0	1.0	0.28
NE	>5.0	2.6	>5.0	0.65	0.28
ENE	1.4	>5.0	1.4	0.55	0.30
E	1.6	>5.0	1.6	0.75	0.31
ESE	1.6	>5.0	>5.0	1.6	0.30
SE	2.0	2.4	2.0	1.0	0 33
SSE	3.3	>5.0	1.4 (T3-4) 3.3	1.2	0.37
S	>5.0	>5.0	>5.0	1.2	0.37
SSW	1.2 1.4	>5.0	1.2 1.4	0.25	0.20
SW	>5.0	>5.0	>5.0	0.24	0.17
WSW	>5.0	>5.0	>5.0	0.25	0.17
W	0.75	>5.0	0.75	0.28	0.19
WNW	0.77 2.0	>5.0	0.39 0.48 0.77 1.2	0.39	0.23
NW	3.0	>5.0	3.0	1.6	0.51
NNW	>5.0	>5.0	>5.0	1.4	0.42

(1) First location indicates distance of nearest land use within 5 miles. Additional distances indicate location of all users within 3 miles.
(2) Nearest vegetable garden is assumed to be at the nearest resident.

Section II
Meteorology

Data collected from the Vermont Yankee on-site meteorological system was analyzed for the period April 1, 1975 through March 31, 1976. The annual and monthly joint frequency distributions of wind speed and direction by atmospheric stability class in Table QII.6-1 provide a detailed description of the meteorological data. A 96.6 percent data recoverability was achieved for the period of record.

The Straight-Line Airflow Model, with appropriate source configuration considerations as described in NRC Regulatory Guide 1.111, the Source-Depletion Model as described in Meteorology and Atomic Energy (1968) and deposition velocities as given by Pelletier and Zimbrich (1970) were used to determine the X/Q and D/Q values for specific receptors as provided in Table QII.3-1 through QII.3-4. Site specific recirculation correction factors, for a river valley site, are in the process of being developed with the use of appropriate mesoscale diffusion models.

The following site specific parameters assumptions were used in the calculation of X/Q and D/Q values.

A. Stack release:

1. Elevated release
2. Physical height of the release point above ground: 94 meters
3. Inside diameter of stack: 2.13 meters
4. Vertical exit velocity of plume: 19.4 meters/second
5. Maximum adjacent building height: 0 meters
6. Depth of mixing layer: 1,000 meters
7. Average ambient air temperature: 281°K
8. Recirculation correction factors: 1.0

TABLE Q II.3-1

VERMONT YANKEE: STACK
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
N	Distance (miles)	>5.0	>5.0	3.6	0.95	0.25 to river
	Terrain Height (feet)			810	30	10
	X/Q (undepleted)			3.374 E-07	3.546 E-08	8.618 E-08
	X/Q (depleted)			2.513 E-07	3.537 E-08	8.615 E-08
	D/Q			6.194 E-10	1.695 E-10	4.643 E-10
NNE	Distance (miles)	>5.0	>5.0	>5.0	0.93	0.22
	Terrain Height (feet)				50	10
	X/Q (undepleted)				1.573 E-08	2.823 E-08
	X/Q (depleted)				1.569 E-08	2.823 E-08
	D/Q				6.165 E-11	1.412 E-10
NE	Distance (miles)	>5.0	>5.0	2.6	1.4	0.22
	Terrain Height (feet)			550	200	10
	X/Q (undepleted)			1.495 E-07	3.219 E-08	1.472 E-08
	X/Q (depleted)			1.464 E-07	3.213 E-08	1.472 E-08
	D/Q			2.457 E-10	9.152 E-11	6.236 E-11
ENE	Distance (miles)	>5.0	>5.0	>5.0	0.63	0.24
	Terrain Height (feet)				35	10
	X/Q (undepleted)				7.633 E-09	9.447 E-09
	X/Q (depleted)				7.622 E-09	9.445 E-09
	D/Q				2.562 E-11	4.587 E-11
E	Distance (miles)	1.4	1.4	>5.0	0.65	.39 across river 0.31
	Terrain Height (feet)	50	50		70	10
	X/Q (undepleted)	1.493 E-08	1.482 E-08		1.350 E-08	2.322 E-08
	X/Q (depleted)	1.490 E-08	1.490 E-08		1.348 E-08	2.321 E-08
	D/Q	9.183 E-11	9.183 E-11		7.644 E-11	1.376 E-10

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TABLE Q II.3-1 (con't)

VERMONT YANKEE: STACK
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
ESE	Distance (miles)	1.75	1.75	>5.0	0.85 Re	0.43
	Terrain Height (feet)	70	70		70	10
	X/Q (undepleted)	2.624 E-08	2.264 E-08		1.529 E-08	1.399 E-08
	X/Q (depleted)	2.616 E-08	2.616 E-08		1.527 E-08	1.398 E-08
	D/Q	1.778 E-10	1.778 E-10		1.109 E-10	7.712 E-11
ESE	Distance (miles)	1.8	---	---	1.8	---
	Terrain Height (feet)	70			70	
	X/Q (undepleted)	2.642 E-08			2.642 E-08	
	X/Q (depleted)	2.634 E-08			2.634 E-08	
	D/Q	1.778 E-10			1.778 E-10	
SE	Distance (miles)	2.2	1.6	2.6	1.2	0.46
	Terrain Height (feet)	90	90	90	30	10
	X/Q (undepleted)	4.411 E-08	3.932 E-08	4.520 E-08	1.679 E-08	2.981 E-08
	X/Q (depleted)	4.395 E-08	3.924 E-08	4.500 E-08	1.676 E-08	2.977 E-08
	D/Q	1.787 E-10	1.795 E-10	1.748 E-10	8.222 E-11	1.281 E-10
SE	Distance (miles)	---	2.2	---	---	Discharge canal 0.344
	Terrain Height (feet)		90			
	X/Q (undepleted)		4.411 E-08			
	X/Q (depleted)		4.395 E-08			
	D/Q		1.787 E-10			
SSE	Distance (miles)	3.5	3.5	>5.0	1.3 1.17	0.54 .374
	Terrain Height (feet)	274	274		80	10
	X/Q (undepleted)	3.265 E-07	3.265 E-07		7.902 E-08	4.990 E-08
	X/Q (depleted)	3.219 E-07	3.219 E-07		7.887 E-08	4.981 E-08
	D/Q	1.019 E-09	1.019 E-09		4.173 E-10	2.793 E-10

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TABLE Q II.3-1 (con't)

VERMONT YANKEE: STACK
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
S	Distance (miles)	1.6	1.6	>5.0	0.33	0.24 (.257, 413)
	Terrain Height (feet)	150	150		30	10
	X/Q (undepleted)	7.811 E-08	7.811 E-08		6.775 E-08	5.274 E-08
	X/Q (depleted)	7.797 E-08	7.797 E-08		6.770 E-08	5.273 E-08
	D/Q	2.646 E-10	2.646 E-10		3.384 E-10	3.115 E-10
S	Distance (miles)	---	---	---	0.37 (.357, 579)	---
	Terrain Height (feet)				30	
	X/Q (undepleted)				6.242 E-08	
	X/Q (depleted)				6.236 E-08	
	D/Q				2.938 E-10	
S	Distance (miles)	---	---	---	1.2	---
	Terrain Height (feet)				50	
	X/Q (undepleted)				2.478 E-08	
	X/Q (depleted)				2.473 E-08	
	D/Q				9.459 E-11	
SSW	Distance (miles)	1.4	1.4	>5.0	0.30 (.202, 325m)	0.18 (school 615m, 0.382 mi.)
	Terrain Height (feet)	150	150		30	10
	X/Q (undepleted)	2.019 E-08	2.019 E-08		2.162 E-08	3.982 E-09
	X/Q (depleted)	2.016 E-08	2.016 E-08		2.161 E-08	3.982 E-09
	D/Q	4.784 E-11	4.784 E-11		8.208 E-11	2.341 E-11
SW	Distance (miles)	>5.0	>5.0	>5.0	0.25	0.16 (.182)
	Terrain Height (feet)				30	10
	X/Q (undepleted)				9.153 E-09	5.557 E-10
	X/Q (depleted)				9.151 E-09	5.557 E-10
	D/Q				3.165 E-11	3.096 E-12

TABLE Q II.3-1 (con't)

VERMONT YANKEE: STACK
X/D, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.27 (450 / 280)	0.16 (182)
	Terrain Height (feet)				30	30
	X/Q (undepleted)				1.254 E-08	1.356 E-09
	X/Q (depleted)				1.254 E-08	1.356 E-09
	D/Q				5.052 E-11	8.308 E-12
W	Distance (miles)	0.64	0.28	>5.0	0.28 (510 / 317)	0.26 (469 / 291)
	Terrain Height (feet)	40	30		30	30
	X/Q (undepleted)	6.283 E-09	9.598 E-09		9.598 E-09	7.638 E-09
	X/Q (depleted)	6.274 E-09	9.596 E-09		9.596 E-09	7.637 E-09
	D/Q	1.188 E-11	2.615 E-11		2.615 E-11	2.247 E-11
W	Distance (miles)	0.65	0.35	---	---	---
	Terrain Height (feet)	50	30			
	X/Q (undepleted)	6.090 E-09	1.367 E-08			
	X/Q (depleted)	6.082 E-09	1.306 E-08			
	D/Q	1.156 E-11	2.980 E-11			
W	Distance (miles)	---	0.64	---	---	---
	Terrain Height (feet)		40			
	X/Q (undepleted)		6.283 E-09			
	X/Q (depleted)		6.274 E-09			
	D/Q		1.188 E-11			
W	Distance (miles)	---	0.65	---	---	---
	Terrain Height (feet)		50			
	X/Q (undepleted)		6.090 E-09			
	X/Q (depleted)		6.082 E-09			
	D/Q		1.156 E-11			

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TABLE Q II.3-1 (con't)

VERMONT YANKEE: STACK
X/D, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
						627-.39
WNW	Distance (miles)	1.8	0.95	>5.0	0.68	0.35
	Terrain Height (feet)	510	100		50	30
	X/Q (undepleted)	6.114 E-07	1.208 E-08		8.991 E-09	2.180 E-08
	X/Q (depleted)	6.081 E-07	1.206 E-08		8.978 E-09	2.179 E-08
	D/Q	7.739 E-10	3.451 E-11		2.291 E-11	7.073 E-11
WNW	Distance (miles)	2.9	2.9	---	---	
	Terrain Height (feet)	530	530			
	X/Q (undepleted)	3.249 E-07	3.249 E-07			
	X/Q (depleted)	3.196 E-07	3.196 E-07			
	D/Q	4.021 E-10	4.021 E-10			
						606-.377
NW	Distance (miles)	>5.0	>5.0	>5.0	1.4	0.34
	Terrain Height (feet)				190	10
	X/Q (undepleted)				7.738 E-08	3.236 E-08
	X/Q (depleted)				7.726 E-08	3.234 E-08
	D/Q				2.410 E-10	9.692 E-11
NNW	Distance (miles)	>5.0	>5.0	>5.0	1.2	0.34
	Terrain Height (feet)				30	10
	X/Q (undepleted)				1.702 E-08	3.525 E-08
	X/Q (depleted)				1.699 E-08	3.523 E-08
	D/Q				6.961 E-11	1.318 E-10

end stack data

TABLE Q 11.3-2

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
N	Distance (miles)	>5.0	>5.0	3.7	1.1	0.30
	Terrain Height (feet)			810	30	10
	X/Q (undepleted)			2.887 E-07	1.633 E-06	1.249 E-05
	X/Q (depleted)			2.184 E-07	1.400 E-06	1.130 E-05
	D/Q			5.730 E-10	3.781 E-09	2.994 E-08
NNE	Distance (miles)	>5.0	>5.0	>5.0	1.0	0.28
	Terrain Height (feet)				30	10
	X/Q (undepleted)				8.287 E-67	6.461 E-06
	X/Q (depleted)				7.210 E-07	5.916 E-06
	D/Q				1.426 E-09	1.184 E-08
NE	Distance (miles)	>5.0	>5.0	2.6	0.65	0.28
	Terrain Height (feet)			530	35	10
	X/Q (undepleted)			1.394 E-07	1.024 E-06	4.013 E-06
	X/Q (depleted)			1.099 E-07	8.966 E-07	3.624 E-09
	D/Q			1.869 E-10	1.539 E-09	6.237 E-09
NE	Distance (miles)	---	---	---	1.4	---
	Terrain Height (feet)				190	
	X/Q (undepleted)				3.034 E-07	
	X/Q (depleted)				2.532 E-07	
	D/Q				4.337 E-10	
ENE	Distance (miles)	1.4	1.4	>5.0	0.55	0.30
	Terrain Height (feet)	70	70		50	10
	X/Q (undepleted)	3.745 E-07	3.745 E-07		1.516 E-06	3.892 E-06
	X/Q (depleted)	3.161 E-07	3.161 E-07		1.345 E-06	3.524 E-06
	D/Q	5.209 E-10	5.209 E-10		2.234 E-09	5.853 E-09

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TABLE Q II.3-2 (con't)

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
E	Distance (miles)	1.6	1.6	>5.0	0.75	0.31
	Terrain Height (feet)	70	70		70	10
	X/Q (undepleted)	4.508 E-07	4.508 E-07		1.428 E-06	5.777 E-06
	X/Q (depleted)	3.736 E-07	3.736 E-07		1.248 E-06	5.217 E-06
	D/Q	9.810 E-10	9.810 E-10		3.305 E-09	1.354 E-08
ESE	Distance (miles)	1.6	>5.0	>5.0	1.6	0.30
	Terrain Height (feet)	70			70	10
	X/Q (undepleted)	5.116 E-07			5.116 E-07	6.735 E-06
	X/Q (depleted)	4.263 E-07			4.263 E-07	6.105 E-06
	D/Q	1.363 E-09			1.363 E-09	1.886 E-08
SE	Distance (miles)	2.0	2.0	2.4	1.0	0.33
	Terrain Height (feet)	90	90	90	30	10
	X/Q (undepleted)	6.111 E-07	6.111 E-07	4.758 E-07	1.575 E-06	9.542 E-06
	X/Q (depleted)	5.024 E-07	5.024 E-07	3.842 E-07	1.364 E-06	8.664 E-06
	D/Q	1.069 E-09	1.069 E-09	8.153 E-10	2.929 E-09	1.833 E-08
SSE	Distance (miles)	3.3	1.4	>5.0	1.2	0.37
	Terrain Height (feet)	274	90		80	10
	X/Q (undepleted)	6.301 E-07	2.068 E-06		2.798 E-06	1.631 E-05
	X/Q (depleted)	4.877 E-07	1.746 E-06		2.399 E-06	1.470 E-05
	D/Q	1.257 E-09	4.560 E-09		6.290 E-09	3.809 E-08
SSE	Distance (miles)	---	3.3	---	---	---
	Terrain Height (feet)		274			
	X/Q (undepleted)		6.301 E-07			
	X/Q (depleted)		4.877 E-07			
	D/Q		1.257 E-09			

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TABLE Q II.3-2 (con't)

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUALLY)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
S	Distance (miles)	>5.0	>5.0	>5.0	1.2	0.37
	Terrain Height (feet)				50	10
	X/Q (undepleted)				2.253 E-06	1.335 E-05
	X/Q (depleted)				1.886 E-06	1.182 E-05
	D/Q				3.121 E-09	1.941 E-08
SSW	Distance (miles)	1.2	1.2	>5.0	0.25	0.20
	Terrain Height (feet)	150	150		30	10
	X/Q (undepleted)	9.424 E-07	9.424 E-07		1.222 E-05	1.803 E-05
	X/Q (depleted)	7.783 E-07	7.783 E-07		1.091 E-05	1.624 E-05
	D/Q	8.774 E-10	8.774 E-10		1.220 E-08	1.810 E-08
SSW	Distance (miles)	1.4	1.4	---	---	---
	Terrain Height (feet)	150	150			
	X/Q (undepleted)	7.592 E-07	7.592 E-07			
	X/Q (depleted)	6.186 E-07	6.186 E-07			
	D/Q	6.961 E-10	6.961 E-10			
SW	Distance (miles)	>5.0	>5.0	>5.0	0.24	0.17
	Terrain Height (feet)				30	10
	X/Q (undepleted)				1.453 E-05	2.635 E-05
	X/Q (depleted)				1.297 E-05	2.381 E-05
	D/Q				1.173 E-08	2.142 E-08
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.25	0.17
	Terrain Height (feet)				30	30
	X/Q (undepleted)				9.820 E-06	1.908 E-05
	X/Q (depleted)				8.752 E-06	1.724 E-05
	D/Q				8.429 E-09	1.654 E-08

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TABLE Q II.3-2 (con't)

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
W	Distance (miles)	0.75	0.75	>5.0	0.28	0.19
	Terrain Height (feet)	50	50		30	30
	X/Q (undepleted)	1.601 E-06	1.601 E-06		8.138 E-06	1.663 E-05
	X/Q (depleted)	1.358 E-06	1.358 E-06		7.211 E-06	1.497 E-05
	D/Q	1.379 E-09	1.379 E-09		7.316 E-09	1.510 E-08
W	Distance (miles)	---	---	---	0.37	---
	Terrain Height (feet)				30	
	X/Q (undepleted)				5.044 E-06	
	X/Q (depleted)				4.421 E-06	
	D/Q				4.505 E-09	
WNW	Distance (miles)	0.77	0.39	>5.0	0.39	0.24
	Terrain Height (feet)	50	30		30	30
	X/Q (undepleted)	1.780 E-06	5.389 E-06		5.389 E-06	1.282 E-05
	X/Q (depleted)	1.514 E-06	4.728 E-06		4.728 E-06	1.146 E-05
	D/Q	2.013 E-09	6.205 E-09		6.205 E-09	1.478 E-08
WNW	Distance (miles)	2.0	0.48	---	0.85	---
	Terrain Height (feet)	490	30		50	
	X/Q (undepleted)	4.638 E-07	3.850 E-06		1.520 E-06	
	X/Q (depleted)	3.648 E-07	2.348 E-06		1.287 E-06	
	D/Q	4.790 E-10	4.413 E-09		1.713 E-09	
WNW	Distance (miles)	---	0.77	---	---	---
	Terrain Height (feet)		50			
	X/Q (undepleted)		1.780 E-06			
	X/Q (depleted)		1.514 E-06			
	D/Q		2.013 E-09			

TABLE Q II.3-2 (con't)

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (ANNUAL)

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden	Site Boundary
WNW	Distance (miles)	---	1.2	---	---	---
	Terrain Height (feet)		90			
	X/Q (undepleted)		9.779 E-07			
	X/Q (depleted)		8.109 E-07			
	D/Q		1.077 E-09			
NW	Distance (miles)	3.0	3.0	>5.0	1.6	0.51
	Terrain Height (feet)	590	590		210	10
	X/Q (undepleted)	3.041 E-07	3.041 E-07		7.567 E-07	4.076 E-06
	X/Q (depleted)	2.335 E-07	2.335 E-07		6.247 E-07	3.595 E-06
	D/Q	4.216 E-10	4.216 E-10		1.137 E-09	6.630 E-09
NNW	Distance (miles)	>5.0	>5.0	>5.0	1.4	0.42
	Terrain Height (feet)				40	10
	X/Q (undepleted)				8.625 E-07	5.525 E-06
	X/Q (depleted)				7.196 E-07	4.919 E-06
	D/Q				1.633 E-09	1.117 E-08

TABLE Q 11.3-3

VERMONT YANKEE: ~~STACK~~

X/Q, D/Q VALUES FOR SELECTED RECEPTORS ~~(GROWING SEASON)~~*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
N	Distance (miles)	>5.0	>5.0	3.6	0.95
	Terrain Height (feet)			810	30
	X/Q (undepleted)			4.175 E-07	5.656 E-08
	X/Q (depleted)			3.148 E-07	5.642 E-08
	D/Q			7.736 E-10	2.465 E-10
NNE	Distance (miles)	>5.0	>5.0	>5.0	0.93
	Terrain Height (feet)				50
	X/Q (undepleted)				2.663 E-08
	X/Q (depleted)				2.657 E-08
	D/Q				1.048 E-10
NE	Distance (miles)	>5.0	>5.0	2.6	1.4
	Terrain Height (feet)			550	200
	X/Q (undepleted)			1.667 E-07	4.010 E-08
	X/Q (depleted)			1.631 E-07	4.002 E-08
	D/Q			2.892 E-10	1.116 E-10
ENE	Distance (miles)	>5.0	>5.0	>5.0	0.63
	Terrain Height (feet)				35
	X/Q (undepleted)				1.310 E-08
	X/Q (depleted)				1.308 E-08
	D/Q				4.165 E-11
E	Distance (miles)	1.4	1.4	>5.0	0.65
	Terrain Height (feet)	50	50		70
	X/Q (undepleted)	1.106 E-08	1.106 E-08		1.495 E-08
	X/Q (depleted)	1.103 E-08	1.103 E-08		1.492 E-08
	D/Q	5.012 E-11	5.012 E-11		7.309 E-11

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TABLE Q II.3-3 (con't)

VERMONT YANKEE: STACK
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
ESE	Distance (miles)	1.75	1.75	>5.0	0.85
	Terrain Height (feet)	70	70		70
	X/Q (undepleted)	1.620 E-08	1.620 E-08		1.322 E-08
	X/Q (depleted)	1.615 E-08	1.615 E-08		1.319 E-08
	D/Q	8.059 E-11	8.059 E-11		7.196 E-11
ESE	Distance (miles)	1.8	---	---	1.8
	Terrain Height (feet)	70			70
	X/Q (undepleted)	1.632 E-08			1.632 E-08
	X/Q (depleted)	1.627 E-08			1.627 E-08
	D/Q	8.040 E-11			8.040 E-11
SE	Distance (miles)	2.2	1.6	2.6	1.2
	Terrain Height (feet)	90	90	90	30
	X/Q (undepleted)	3.975 E-08	3.374 E-08	4.154 E-08	1.533 E-08
	X/Q (depleted)	3.964 E-08	3.368 E-08	4.139 E-08	1.530 E-08
	D/Q	1.073 E-10	1.029 E-10	1.071 E-10	5.073 E-11
SE	Distance (miles)	---	2.2	---	---
	Terrain Height (feet)		90		
	X/Q (undepleted)		3.975 E-08		
	X/Q (depleted)		3.964 E-08		
	D/Q		1.073 E-10		
SSE	Distance (miles)	3.5	3.5	>5.0	1.3
	Terrain Height (feet)	274	274		70
	X/Q (undepleted)	2.665 E-07	2.665 E-07		7.093 E-08
	X/Q (depleted)	2.630 E-07	2.630 E-07		7.078 E-08
	D/Q	7.216 E-10	7.216 E-10		3.308 E-10

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Q II.3-3 (con't)

VERMONT YANKEE: STACK
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
S	Distance (miles)	1.6	1.6	>5.0	0.33
	Terrain Height (feet)	150	150		30
	X/Q (undepleted)	8.236 E-08	8.236 E-08		1.069 E-07
	X/Q (depleted)	8.219 E-08	8.219 E-08		1.068 E-07
	D/Q	2.719 E-10	2.719 E-10		5.145 E-10
S	Distance (miles)	---	---	---	0.37
	Terrain Height (feet)				30
	X/Q (undepleted)				9.908 E-08
	X/Q (depleted)				9.898 E-08
	D/Q				4.486 E-10
S	Distance (miles)	---	---	---	1.2
	Terrain Height (feet)				50
	X/Q (undepleted)				3.216 E-08
	X/Q (depleted)				3.209 E-08
	D/Q				1.195 E-10
SSW	Distance (miles)	1.4	1.4	>5.0	0.30
	Terrain Height (feet)	150	150		30
	X/Q (undepleted)	2.925 E-08	2.925 E-08		3.553 E-08
	X/Q (depleted)	2.921 E-08	2.921 E-08		3.552 E-08
	D/Q	6.330 E-11	6.330 E-11		1.225 E-10
SW	Distance (miles)	>5.0	>5.0	>5.0	0.25
	Terrain Height (feet)				30
	X/Q (undepleted)				1.015 E-08
	X/Q (depleted)				1.015 E-08
	D/Q				2.031 E-11

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TABLE Q II.3-3 (con't)

VERMONT YANKEE: STACK
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.27
	Terrain Height (feet)				30
	X/Q (undepleted)				2.337 E-08
	X/Q (depleted)				2 336 E-08
	D/Q				9.875 E-11
W	Distance (miles)	0.64	0.28	>5.0	0.28
	Terrain Height (feet)	40	30		30
	X/Q (undepleted)	9.467 E-09	1.664 E-08		1.664 E-08
	X/Q (depleted)	9.454 E-09	1.664 E-08		1.664 E-08
	D/Q	1.628 E-11	4.472 E-11		4.472 E-11
W	Distance (miles)	0.65	0.35	---	---
	Terrain Height (feet)	50	30		
	X/Q (undepleted)	9.146 E-09	2.225 E-08		
	X/Q (depleted)	9.133 E-09	2.224 E-08		
	D/Q	1.575 E-11	4.948 E-11		
W	Distance (miles)	---	0.64	---	---
	Terrain Height (feet)		40		
	X/Q (undepleted)		9.467 E-09		
	X/Q (depleted)		9.454 E-09		
	D/Q		1.628 E-11		
W	Distance (miles)	---	0.65	---	---
	Terrain Height (feet)		50		
	X/Q (undepleted)		9.146 E-09		
	X/Q (depleted)		9.133 E-09		
	D/Q		1.575 E-11		

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TABLE Q II.3-3 (con't)

VERMONT YANKEE: STACK
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
WNW	Distance (miles)	1.8	0.95	>5.0	0.68
	Terrain Height (feet)	510	110		50
	X/Q (undepleted)	4.947 E-07	7.798 E-09		7.678 E-09
	X/Q (depleted)	4.920 E-07	7.783 E-09		7.664 E-09
	D/Q	5.315 E-10	2.068 E-11		2.069 E-11
WNW	Distance (miles)	2.9	2.9	---	---
	Terrain Height (feet)	530	530		
	X/Q (undepleted)	2.623 E-07	2.623 E-07		
	X/Q (depleted)	2.579 E-07	2.579 E-07		
	D/Q	2.764 E-10	2.764 E-10		
NW	Distance (miles)	>5.0	>5.0	>5.0	1.4
	Terrain Height (feet)				190
	X/Q (undepleted)				7.518 E-08
	X/Q (depleted)				7.507 E-08
	D/Q				2.167 E-10
NNW	Distance (miles)	>5.0	>5.0	>5.0	1.2
	Terrain Height (feet)				30
	X/Q (undepleted)				2.197 E-08
	X/Q (depleted)				2.192 E-08
	D/Q				8.699 E-11

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TABLE II.3-4

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
N	Distance (miles)	>5.0	>5.0	3.7	1.1
	Terrain Height (feet)			810	30
	X/Q (undepleted)			3.615 E-07	2.071 E-06
	X/Q (depleted)			2.767 E-07	1.787 E-06
	D/Q			7.182 E-10	4.737 E-09
NNE	Distance (miles)	>5.0	>5.0	>5.0	1.0
	Terrain Height (feet)				30
	X/Q (undepleted)				1.051 E-06
	X/Q (depleted)				9.283 E-07
	D/Q				1.920 E-09
NE	Distance (miles)	>5.0	>5.0	2.6	0.65
	Terrain Height (feet)			530	35
	X/Q (undepleted)			1.612 E-07	1.214 E-06
	X/Q (depleted)			1.292 E-07	1.074 E-06
	D/Q			2.248 E-10	1.877 E-09
NE	Distance (miles)	---	---	---	1.4
	Terrain Height (feet)				190
	X/Q (undepleted)				3.556 E-07
	X/Q (depleted)				3.006 E-07
	D/Q				5.240 E-10
ENE	Distance (miles)	1.4	1.4	>5.0	0.55
	Terrain Height (feet)	70	70		50
	X/Q (undepleted)	4.213 E-07	4.213 E-07		1.695 E-06
	X/Q (depleted)	3.561 E-07	3.561 E-07		1.507 E-06
	D/Q	5.293 E-10	5.293 E-10		2.285 E-09

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TABLE Q II.3-4 (con't)

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
E	Distance (miles)	1.6	1.6	>5.0	0.75
	Terrain Height (feet)	70	70		70
	X/Q (undepleted)	4.647 E-07	4.647 E-07		1.469 E-06
	X/Q (depleted)	3.826 E-07	3.826 E-07		1.277 E-06
	D/Q	6.813 E-10	6.813 E-10		2.290 E-09
ESE	Distance (miles)	1.6	>5.0	>5.0	1.6
	Terrain Height (feet)	70			70
	X/Q (undepleted)	4.969 E-07			4.969 E-07
	X/Q (depleted)	4.079 E-07			4.079 E-07
	D/Q	8.551 E-10			8.551 E-10
SE	Distance (miles)	2.0	2.0	2.4	1.0
	Terrain Height (feet)	90	90	90	30
	X/Q (undepleted)	6.088 E-07	6.088 E-07	4.720 E-07	1.594 E-06
	X/Q (depleted)	5.079 E-07	5.079 E-07	3.873 E-07	1.395 E-06
	D/Q	7.939 E-10	7.939 E-10	6.048 E-10	2.192 E-09
SSE	Distance (miles)	3.3	1.4 → for real 1.6 bc. for stack	>5.0	1.2
	Terrain Height (feet)	274	90		80
	X/Q (undepleted)	5.324 E-07	1.767 E-06		2.398 E-06
	X/Q (depleted)	4.161 E-07	1.501 E-06		2.067 E-06
	D/Q	9.166 E-10	3.348 E-09		4.629 E-09
SSE	Distance (miles)	---	3.3	---	---
	Terrain Height (feet)		274		
	X/Q (undepleted)		5.324 E-07		
	X/Q (depleted)		4.161 E-07		
	D/Q		9.166 E-10		

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TABLE Q II.3-4 (con't)

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
S	Distance (miles)	>5.0	>5.0	>5.0	1.2
	Terrain Height (feet)				50
	X/Q (undepleted)				2.038 E-06
	X/Q (depleted)				1.942 E-06
	D/Q				3.080 E-09
SSW	Distance (miles)	1.2	1.2	>5.0	0.25
	Terrain Height (feet)	150	150		30
	X/Q (undepleted)	1.310 E-06	1.310 E-06		1.716 E-05
	X/Q (depleted)	1.080 E-06	1.080 E-06		1.532 E-05
	D/Q	1.170 E-09	1.170 E-09		1.641 E-08
SSW	Distance (miles)	1.4	1.4	---	---
	Terrain Height (feet)	150	150		
	X/Q (undepleted)	1.056 E-06	1.056 E-06		
	X/Q (depleted)	8.590 E-07	8.590 E-07		
	D/Q	9.289 E-10	9.289 E-10		
SW	Distance (miles)	>5.0	>5.0	>5.0	0.24
	Terrain Height (feet)				30
	X/Q (undepleted)				1.618 E-05
	X/Q (depleted)				1.457 E-05
	D/Q				1.351 E-08
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.25
	Terrain Height (feet)				30
	X/Q (undepleted)				8.758 E-06
	X/Q (depleted)				7.907 E-06
	D/Q				7.806 E-09

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TABLE Q II.[illegible]4 (con't)

VERMONT YANKEE: TURBINE BUILDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
W	Distance (miles)	0.75	0.75	>5.0	0.28
	Terrain Height (feet)	50	50		30
	X/Q (undepleted)	1.458 E-06	1.458 E-06		7.180 E-06
	X/Q (depleted)	1.256 E-06	1.256 E-06		6.446 E-06
	D/Q	1.312 E-09	1.312 E-09		6.735 E-09
W	Distance (miles)	---	---	---	0.37
	Terrain Height (feet)				30
	X/Q (undepleted)				4.469 E-06
	X/Q (depleted)				3.973 E-06
	D/Q				4.190 E-09
WNW	Distance (miles)	0.77	0.39	>5.0	0.39
	Terrain Height (feet)	50	30		30
	X/Q (undepleted)	1.486 E-06	4.396 E-06		4.396 E-06
	X/Q (depleted)	1.276 E-06	3.889 E-06		3.889 E-06
	D/Q	1.442 E-09	4.364 E-09		4.364 E-09
WNW	Distance (miles)	2.0	0.48	---	0.85
	Terrain Height (feet)	490	30		50
	X/Q (undepleted)	3.843 E-07	3.155 E-06		1.274 E-06
	X/Q (depleted)	3.063 E-07	2.769 E-06		1.088 E-06
	D/Q	3.427 E-10	3.114 E-09		1.232 E-09
WNW	Distance (miles)	---	0.77	---	---
	Terrain Height (feet)		50		
	X/Q (undepleted)		1.486 E-06		
	X/Q (depleted)		1.276 E-06		
	D/Q		1.442 E-09		

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TABLE Q II.3-4 (con't)

VERMONT YANKEE: TURBINE BULDING VENT
X/Q, D/Q VALUES FOR SELECTED RECEPTORS (GROWING SEASON)*

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
WNW	Distance (miles)	---	1.2	---	---
	Terrain Height (feet)		90		
	X/Q (undepleted)		8.194 E-07		
	X/Q (depleted)		6.865 E-07		
	D/Q		7.753 E-10		
NW	Distance (miles)	3.0	3.0	>5.0	1.6
	Terrain Height (feet)	590	590		210
	X/Q (undepleted)	2.711 E-07	2.711 E-07		6.857 E-07
	X/Q (depleted)	2.125 E-07	2.125 E-07		5.745 E-07
	D/Q	3.512 E-10	3.512 E-10		9.585 E-10
NNW	Distance (miles)	>5.0	>5.0	>5.0	1.4
	Terrain Height (feet)				40
	X/Q (undepleted)				8.042 E-07
	X/Q (depleted)				6.794 E-07
	D/Q				1.617 E-09

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SECTION IV

Radiological Dose Assessment

SECTION IV

RADIOLOGICAL DOSE ASSESSMENT

Paragraph (c) of 10 CFR Part 20.1, states that a licensee to operate a light-water reactor, should in addition to complying with the limits set forth in that Part of the regulation on the amount of radioactivity that can be discharged in effluents to unrestricted areas, make every reasonable effort to maintain releases of radioactive materials to unrestricted areas as far below the limits specified as is reasonably achievable. Appendix I to 10 CFR Part 50 provides guidance on the levels of exposure of the general public resulting from effluents releases that may be considered to be as low as is reasonably achievable.

This section indicates the calculational dose models and assumptions which were used in determining Vermont Yankee's compliance with the Appendix I dose guideline criteria on "as low as reasonably achievable." The resultant individual radiation doses are based where possible on realistic assessments of radioactive source terms, hydrologic and meteorologic dispersion parameters, and physically applicable dose pathways in the site environment. Where site specific data is uncertain, conservative assumptions were made. The calculated doses due to normal plant operation, including anticipated operational occurrences, are presented in this section and summarized in Tables Q IV.1-1 through Q IV.1-3.

Radiation Doses From Liquid Effluent Pathways

Vermont Yankee is a single reactor unit located on the Connecticut River approximately one-half mile above the Vernon Dam in Vernon, Vermont.

Liquid effluents are discharged from the plant via a shoreline surface discharge structure. The plant cooling water system is designed with both mechanical draft cooling towers and a spray pond which allows the plant flexibility in the way cooling water can be supplied to the main condensers and auxiliary equipment. The cooling system can operate on a total open-cycle or once-through basis, with all of the cooling water from the condensers by-passing the cooling towers and flowing directly to the discharge structure in Vernon Pond. The plant can also be operated on a hybrid-cycle basis, with an adjustable portion of cooling water from the condensers diverted to the cooling towers and subsequently mixed with the remainder of the water before discharge to Vernon Pond. A third mode of operation is completely closed-cycle with all of the water from the condensers diverted to the cooling towers and subsequently returned to the intake structure for recirculation to the condensers. The choice among the three operating modes vary with the season of the year, the cooling towers being used as necessary to assure that biological impact of the heated discharge to the Connecticut River is minimized. The annual allowable frequency of use of each mode of operation is still being studied as part of a test program to evaluate potential thermal impacts on river biota. Therefore, the annual discharge volume of cooling water which can be expected to be discharged from the plant is uncertain at this time. Based on operating data from 1975 and 1976, the cooling system experienced an annual average discharge rate of about 117,000 gpm. During this year period, approximately one-half of the time the plant was on full open cycle, and one-half on hybrid or closed cycle. The liquid radwaste system is designed with dilution pumps which will supply 20,000 gpm of dilution water during periods of radioactive liquid waste discharge, irregardless of the mode of operation of the cooling water system. Table Q B.5-3 of

Appendix B of this report lists the isotopic breakdown of the liquid source term, as generated by the GALE computer code, which might be expected to be discharged annually to the plant's discharge system. Appendix B describes the plant's effluent control systems and operating parameters which were used to analyze this potential liquid source term. The description of the GALE computer code and its assumptions can be found in the Nuclear Regulatory Commission Report NUREG-0016[1]. As discussed in Appendix B, the liquid waste discharge volume is assumed to be 1% of the total volume of water prccessed each year. From actual operating experience, the plant has been able to holdup, process, and reuse waste water to a degree which has not necessitated the routine release of any radioactive liquid waste. Because of this flexibility of operation, it is expected that any plant radioactive waste liquid discharge would be held until suitable conditions of river flow or circulation water discharge flow are present to insure that potential doses through liquid pathways are kept to a minimum.

The liquid pathways which have been evaluated are those which now exist or could be expected to exist at some time during the plant life, and which could contribute a significant fraction of the total individual dose from water related exposures. The liquid pathways determined to be significant at this time include the ingestion of fish, and direct exposure due to sedimentation of radioactivity along the shore where individuals engaged in shoreline activities can be exposed. Included in the dose analysis is the potential exposure to individuals through the irrigation pathway. At the present, there is no known use of the Connecticut River for irrigation in the area near the plant. However,

cultivated fields do exist which border on the banks of the River just below Vernon Dam. It has therefore been assumed that at sometime in the future irrigation water maybe taken from the River for these cultivated fields.

Studies of the Connecticut River indicate that there are no existing municipal water systems which make use of the River for drinking water below Vermont Yankee. At this time, there are no known plans to make use of the River as a source of drinking water in the future, with the exception of a proposal to divert water from the Connecticut River to recharge the Quabbin Reservoir. In comparison to potential doses to individuals from fish caught along the shoreline near the plant, the potential drinking water dose from water drawn from the Quabbin Reservoir are considered insignificant because of the added dilution volume of the Reservoir, and long transit and holdup times which allow for decay and sedimentation of radioactivity. How about increased pop. exposed?

The point at which the dose analysis was performed was just below Vernon Dam, 0.5 miles down stream from Vermont Yankee. At this location, it was assumed that fishing from the shoreline took place, and that water was also withdrawn for the irrigation of nearby fields. Crops grown on irrigated fields were assumed to be used both directly in the farmers home and as feed for milk and meat animals. No direct use of river water for drinking by either individual or cattle is assumed since farming practices in this area make use of ground water from private wells to supply the drinking water requirements. The aquatic invertebrate pathway has also not been assumed since this source of food is not significant in these reaches of the Connecticut River.

The fishing location was chosen at a point below the Dam since fishing in Vernon Pond is considered poor. This is due in part to bottom profile of the pond which provides little food or cover for fish. In addition, the adjacent shoreline between Vermont Yankee and Vernon Dam is either part of the plant's site boundary or is owned by the New England Power Company who operates the hydroelectric station at the Dam. As a result, there is no direct access to the river shoreline between the plant and the Dam. Little boating has been observed in the Vernon Pond which could significantly contribute to any dose pathway.

Based on a 28 year period of record, the average flow rate of the River at Vernon Dam is 10,170 cfs. The monthly average flow varies greatly from a high of about 32,000 cfs in April, to a low of 3400 cfs in August. In addition, the weekly and daily flow rates are greatly influenced by the operation of Vernon hydroelectric station. However, when Vermont Yankee became operational, a minimum flow rate of 1200 cfs was guaranteed to be maintained by the Dam. As a result, the dose assessment conservatively assumed that the minimum flow of 1200 cfs of river dilution was available during periods of liquid discharge, and that the only flow from the plant was due to the 20,000 gpm liquid radwaste dilution pumps. Hydrologic analysis indicates the turbulent action of flow through the Vernon Dam results in complete mixing of plant effluents with river flow below the Dam. Therefore, the dilution factor assumed between plant discharge and point of exposure is approximately 26 to 1. Actual dilution is expected to be much greater than this since the plant has the flexibility to hold waste for long time periods, and since the minimum guaranteed river flow would be expected to occur on an infrequent bases.

The calculational methods used in assessing the radiation dose to individuals have been taken from Regulatory Guide 1.109[2] for liquid exposures through aquatic food, shoreline deposition, and milk - meat animal pathways. The human consumption or usage factors which were used in the dose calculations for ingestion of fish were taken from Regulatory Guide 1.109. For fish ingestion, the consumption rates are 21 Kg per year, 16 Kg per year, and 6.9 Kg per year for adults, teenagers, and children, respectively. For internal doses due to ingestion of fish, an average transit time of 24 hours has been used to allow for radionuclide decay during movement through the food chain, as well as during food preparation. It has also been assumed that the fish which are eaten had reached equilibrium with the water concentration of radioactivity. This assumption leads to conservatism in the calculation since fish tend to be very mobile and are not expected to remain for long periods near the outfall of the Dam.

Shoreline activities have been evaluated using the model listed in Regulatory Guide 1.109 with the shore-width factor of 0.2 used as this pathway is assumed to exist at the fisherman's location. Usage factors of 12 hours per year, 67 hours per year, and 14 hours per year for adults, teenagers, and children, respectively, were used in the dose evaluations. In addition, a fifteen year time period was assumed for the sediment to be exposed to activity in the water. This time period represents the approximate mid-point of plant operating lifetime, and thus allows for the buildup of radioactivity such that a plant lifetime average sediment concentration can be estimated. No credit was taken for plume depletion during the transit of activity between the discharge point and the exposure location.

Usage or consumption factors for milk and meat ingestion are those of

Regulatory Guide 1.109, that is; 310 liters per year, 400 liters per year, and 330 liters for adult's, teenager's, and children's milk ingestion and 110 kilogram per year, 65 kilograms per year, and 41 kilograms per year for adult's, teenager's, and children's meat ingestion, respectively. For the milk ingestion pathway, infants have also been assumed to drink 330 liters per year for the effected sources. Transit or holdup times of 48 hours and 20 days were used for milk and meat products, respectively. The irrigation rate which was assumed to be applied to crops grown for both human consumption and cattle feed was 0.153 liters per meter squared per hour. The animal human consumption of leafy and stored vegetables are respectively 64 and 520 kilograms per year for adults, 42 and 630 kilograms per year for teenagers, and 26 and 520 kilograms per year for children.

The maximum external dose from shoreline activites as evaluated at the fishing location is 9.8×10^{-5} millirem per year to the whole body and 1.2×10^{-4} millirem per year to the skin of a teenager spending 67 hours per year at this location. The external exposures from shoreline activities for all age groups are given in Table Q IV.1-1. The total internal exposures to organs of individuals from the meat, milk, fish, and vegetable pathways are also summarized in this table. The maximum calculated total whole body dose from internal and external exposures is 2.2×10^{-2} millirem per year to an adult who had consumed food products produced with irrigated water from below the Dam and has eaten fish taken from the same river location. This whole body dose is about 0.7 percent of the Appendix I design objective of 3 mrem per year per unit for whole body doses fro liquid effluents. The critical organ dose due to plant liquid effluents represents 3 percent of the Appendix I design criteria dose of 10 mrem per year per unit to any organ. The

critical organ (bone of an adult) is calculated to receive 3.0×10^{-1} mrem per year and is due primarily to the ingestion of fish. Table Q IV.1-1 summarizes all liquid doses due to plant discharges.

Radiation Doses From Gaseous Effluent Pathways

Gaseous effluent source terms have been calculated using the NRC GALE computer code for boiling water reactors (BWR's). Table Q B.7-2 of Appendix B lists the quantities of noble gases, iodines, and particulates which might be generated as annual gaseous releases based on the system description and operating parameters presented in Appendix B. These source terms are based on measurements made at operating BWR's, and the primary coolant isotopic distribution as recommended by the ANS 18.1 Source Term Specification Working Subcommittee. In addition to those nuclides listed in Table Q B.7-2, 9.5 curies per year of Carbon-14 and 25 curies per year of Argon-41 have been added to the gaseous effluents for radiaton dose assessments based on the information in the Nuclear Regulatory Commission's NUREG-0016.

The main release point for gases discharged from the plant is via the 94 meter tall stack which is located in the northern part of the site, about 250 meters from the closest edge of the reactor building. In addition to the plant stack, the turbine hall roof ventilators have been considered in this analysis as a potential release point. Under normal conditions, the turbine hall ventilation system is designed to exhaust air taken from lower levels of the building to the plant stack. However, plant surveys have shown that when the turbine hall roof ventilators are in operation to exhaust excess heat from the operating floor of the turbine building, a portion of the ventilation air from the lower elevations may be drawn to the operating floor and exhausted to the roof fans. Plant measurements indicate that under these conditions

about 20 percent of the exhaust air from the lower floors could be exhausted to the operating floor. Since the primary sources of potential leakages are pumps and equipment which are in the lower elevations of the turbine building, the gaseous source terms generated by the GALE code for the turbine building ventilation system have been assumed released to the environment partly (20 percent) through the turbine roof ventilators and partly (80 percent) through the plant stack. In evaluating both release points, the turbine hall exhaust has been assumed to be a ground level source. The plant stack has been treated as an elevated release point as defined in Regulatory Guide 1.111[3].

Meteorological dispersion of effluents was estimated by a straight-line airflow model applied to an inland valley site. X/Q and D/Q values were determined in each sector for the nearest site boundary, nearest resident and vegetable garden, and nearest cow, goat, and meat animal out to a distance of 5 miles from the reactor plus all cow, goat, and meat animal inventoried within 3 miles. All resident are considered to have a vegetable garden large enough to produce enough food to meet a significant fraction of the assumed usage factors for the age groups given in Regulatory Guide 1.109, Table A-2. This includes the annual intake of fruits and vegetables of 520 Kg per year, 630 Kg per year, and 520 Kg per year for children, teenagers, and adults, respectively, and of leafy vegetables of 26 Kg per year, 42 Kg per year, and 64 Kg per year for the same respective age groups. For leafy vegetables, a factor of 0.5 is applied to the annual consumption which assumes that the garden of interest is able to produce during the six month growing seasons half of the annual

total consumed. For fruits and vegetables, a factor of 0.76 is assumed. X/Q and D/Q values were calculated from onsite meteorological data for both an annual period and six-month growing season. Tables Q II.3-1 through Q II.3-4 of Section II list the X/Q and D/Q values which have been calculated for each receptor point with respect to both the plant stack and turbine building. The stack and turbine building are located on the site approximately 250 meters apart from each other.

Production for pop doses?

Gamma and Beta Doses

Both gamma and beta air doses were calculated for the receptor point of highest offsite exposure. The methodology applied to the dose calculations was consistent with that of Regulatory Guide 1.109 for an elevated release point. Dose conversion factors for noble gases and daughters were taken from Table B-1 of this Regulatory Guide. For the beta air doses, a semi-infinite cloud model was used. The gamma air doses were calculated by considering the passage of the infinite radioactive cloud by the point of interest. No credit was assumed for decay of gaseous activity in transit to point of exposure. Terrain elevations of the surrounding area were factored into calculation of X/Q values at all receptor locations. As a result, the point of highest offsite exposure was determined to be at the southwestern site boundary from the turbine building (south site boundary with respect to the plant stack). The gamma and beta air dose calculated at this location are 1.7 millirad per year and 1.9 millirad per year, respectively, and are thus below the Appendix I guideline gamma and beta air dose values of 10 millirad and 20 millirad per year, respectively. The gamma and beta air doses consider both the contribution from the plant stack and turbine building. The

gamma air dose is primarily due to radiation from the overhead plume from the plant stack. The beta air dose is mainly from the turbine building contribution where the passing plume is essentially at ground level. All points beyond the site boundary experienced lower air doses than the site boundary because of the dispersion of the stack plume by the time it reached ground level, and because of the lessening contribution from the turbine building effluents with increased distance.

In addition to the air doses, the whole body and skin doses to the most restrictive existing offsite individual were calculated. These doses assumed an occupancy factor of 100 percent and an attenuation factor of 0.7 for gamma rays to account for the dose reduction due to shielding provided by residential structures. The dose analyses indicates that the maximum whole body dose to the worst real resident is 0.81 millirem per year for the resident's located 0.33 miles south of the stack (0.24 miles southwest of turbine buildings). The skin dose at this point is calculated to be 1.9 millirem per year. These doses are also below the guideline values of the "as low as reasonably achievable" criteria of Appendix I which are set at 5 mrem per year per unit for whole body dose, and 15 mrem per year unit for skin dose.

The maximum calculated gamma and beta air doses occur at the site boundary which abuts the property of the worst existing residence with respect to whole body and skin doses. Therefore, it can be assumed that any point beyond this existing residence which could at some time in the future be occupied, will also be below the guideline values of Appendix I for beta and gamma air doses as well as whole body and skin doses. Table Q IV.1-2 summarizes the annual air, whole body and skin doses.

Doses From Radioiodine and Particulates

Radiation doses from both radioiodine and particulates (including tritium and carbon-14) which were calculated to be part of the annual gaseous effluents from the plant were determined for the following pathways: 1) external irradiation from activity deposited onto the ground surface, 2) inhalation, and 3) ingestion of vegetable, meat, and milk. The dose models and standard input parameters for crop yield, exposure and holdup times that were utilized in the dose assessment are those found in Regulatory Guide 1.109. Doses were calculated for receptor pathways which were determined by field surveys to actually exist. The resultant organ doses were determined after adding the contribution from all pathways at each location. Tables Q I.2-1 and Q I.2-2 of Section I indicates the location of the nearest resident, cow, goat, and meat animal, plus all milk and meat animals within three miles for each of the sixteen compass sectors centered about both the plant stack and turbine building. Dose pathways which involve grazing of milk or meat animals, or the growing season for vegetables, were analyzed using the six-month meteorological data taken during the growing season. Ground surface exposure, as well as inhalation doses were analyzed using annual meteorological data.

Meat animals were assumed to receive their entire daily dietary intake from open pasture grass during the six-month grazing season. Milk cows and goats were assumed to receive 80% of their intake from pasture during this season. This is a conservative assumption since most dairy operations use supplemental feeding of animal when on pasture which would normally make up about 50% of their daily intake, or actually restrict animals to full-time silage feeding throughout the year. All calculated doses considered both the contribution from the turbine building releases as

well as the plant stack. The turbine building was treated as a ground-level source while the plant stack is considered as an elevated release point.

The highest offsite dose was determined to be for an infant living 3.6 miles north of the plant stack. The critical organ dose (3.8 mrem per year) was to the thyroid and was primarily due to exposure through the ingestion of goats milk. The principle nuclide contributing to this thyroid dose is iodine-131. The maximum calculated organ dose represents about 25 percent of the 15 mrem per year dose criteria of Appendix I for gaseous iodine and particulates, including tritium and carbon-14. Table Q IV.1-3 indicates the total organ doses from all gaseous pathways for locations of maximum dose.

Conclusion

The radiological assessment of the principal exposure pathways in the Vermont Yankee environment indicate that the dose criteria of Appendix I to 10 CFR 50 is not likely to be exceeded during normal operation of the plant. Vermont Yankee as analyzed, does meet the "as low as reasonably achievable" criteria for the radioactive effluents and is in compliance with Federal Radiation Regulations.

REFERENCES

SECTION IV

1. "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (BWR-GALE Code)", NUREG-0016 U. S. Nuclear Regulatory Commission.

2. "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I", Regulatory Guide 1.109, U.S. Nuclear Regulatory Commission, March, 1976.

3. "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled-Reactors", Regulatory Guide 1.111, U.S. Nuclear Regulatory Commission, March 1976.

TABLE Q IV.1-1

VERMONT YANKEE
LIQUID PATHWAY DOSE SUMMARY
(MREM PER YEAR)

AGE GROUP	EXTERNAL DOSE DUE TO SHORELINE EXPOSURE (1)		TOTAL INTERNAL ORGAN DOSE* (2)						
	Whole Body	Skin	Bone	Liver	Kidney	Lung	GI-LLI	Thyroid	Whole Body
Adult	1.8×10^{-5}	2.1×10^{-5}	3.0×10^{-1}	3.4×10^{-2}	5.7×10^{-3}	3.3×10^{-3}	3.7×10^{-2}	3.9×10^{-2}	2.2×10^{-2}
Teen	9.8×10^{-5}	1.2×10^{-4}	2.3×10^{-1}	3.0×10^{-2}	4.9×10^{-3}	3.5×10^{-3}	2.8×10^{-2}	4.2×10^{-2}	1.6×10^{-2}
Child	2.0×10^{-5}	2.4×10^{-5}	1.1×10^{-1}	2.3×10^{-2}	2.7×10^{-3}	3.2×10^{-3}	1.3×10^{-2}	7.0×10^{-2}	8.4×10^{-3}
Infant	0.	0.	6.5×10^{-3}	7.6×10^{-3}	5.7×10^{-4}	1.0×10^{-3}	3.1×10^{-4}	1.0×10^{-1}	9.4×10^{-4}

(1) External dose for shoreline deposits assumed to occur on river banks just below Vernon Dam, 0.5 miles downstream from Vermont Yankee.

(2) Dose to internal organs include contribution for ingestion of fish, vegetable grown or irrigated land, and the ingestion of milk and meat products from animals who have been given feed grown on irrigated land.

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TABLE Q IV.1-2

VERMONT YANKEE

GASEOUS PATHWAY DOSE SUMMARY FOR NOBLE GAS EFFLUENTS

LOCATION from stack	GAMMA AIR DOSE (MRAD/YR)	BETA AIR DOSE (MRAD/YR)	WHOLE BODY DOSE* (MREM/YR)	SKIN DOSE (MREM/YR)
Maximum exposure point, south site boundary, 0.24 miles from plant stack	1.7	1.9	1.2	3.0
Maximum existing residence, 0.33 miles south of plant stack	1.2	1.1	0.81	1.9

*Includes a dose reduction factor of 0.7 for residential structures.

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August 31, 1976

TABLE Q IV.1-3

VERMONT YANKEE
GASEOUS PATHWAY DOSE SUMMARY
FOR RADIOIODINE AND PARTICULATES

Location	Age Group	TOTAL ORGAN DOSE (MREM PER YEAR)							
		Bone	Liver	Kidney	Lung	GI-LLI	Thyroid	Whole Body	Skin
Maximum Organ Dose Farm Located 3.6 Miles North of Plant Stack (1) goat milk Veg	Adult	1.8×10^{-1}	6.2×10^{-2}	5.5×10^{-2}	4.9×10^{-2}	5.0×10^{-2}	8.0×10^{-1}	5.8×10^{-2}	1.6×10^{-2}
	Teen	$8.[illegible] \times 10^{-2}$	8.9×10^{-2}	6.3×10^{-2}	6.8×10^{-2}	6.78×10^{-2}	$1.0 \times 10^{+0}$	7.5×10^{-2}	1.6×10^{-2}
	Child	8.4×10^{-2}	8.8×10^{-2}	3.2×10^{-2}	6.2×10^{-2}	5.6×10^{-2}	$1.7 \times 10^{+0}$	6.8×10^{-2}	1.6×10^{-2}
	Infant	1.5×10^{-1}	1.6×10^{-1}	3.0×10^{-2}	1.1×10^{-1}	1.0×10^{-1}	$3.8 \times 10^{+0}$	1.1×10^{-1}	1.6×10^{-2}
Maximum Nearest Resident 0.33 Miles South of Plant Stack (2) Veg	Adult	5.3×10^{-1}	1.3×10^{-1}	1.3×10^{-1}	1.2×10^{-1}	1.3×10^{-1}	7.5×10^{-1}	1.3×10^{-1}	1.4×10^{-2}
	Teen	1.8×10^{-1}	1.8×10^{-1}	1.4×10^{-1}	1.8×10^{-1}	1.8×10^{-1}	7.1×10^{-1}	1.8×10^{-1}	1.4×10^{-2}
	Child	4.3×10^{-2}	4.2×10^{-2}	2.0×10^{-2}	4.0×10^{-2}	4.0×10^{-2}	4.4×10^{-1}	4.1×10^{-2}	1.4×10^{-2}
	Infant	1.7×10^{-2}	2.0×10^{-2}	1.3×10^{-2}	2.2×10^{-2}	1.7×10^{-2}	7.6×10^{-1}	1.8×10^{-2}	1.4×10^{-2}
Point of Maximum Offsite Ground Level Concentration from the stack, 2000 Meters NNW of Plant Stack (3) w veg	Adult	3.8×10^{-2}	3.7×10^{-2}	5.4×10^{-3}	7.9×10^{-3}	3.4×10^{-2}	4.8×10^{-1}	3.4×10^{-2}	3.6×10^{-2}
	Teen	3.3×10^{-2}	3.6×10^{-2}	3.5×10^{-2}	3.8×10^{-2}	3.3×10^{-2}	4.2×10^{-1}	3.3×10^{-2}	3.6×10^{-2}
	Child	3.2×10^{-2}	3.2×10^{-2}	3.2×10^{-2}	3.3×10^{-2}	3.2×10^{-2}	1.7×10^{-1}	3.2×10^{-2}	3.6×10^{-2}
	Infant	3.6×10^{-2}	3.8×10^{-2}	3.2×10^{-2}	4.2×10^{-2}	3.4×10^{-2}	9.5×10^{-1}	3.5×10^{-2}	3.6×10^{-2}

(1) Dose assessment includes contribution for the following pathways: groundplane exposure, inhalation, and ingestion of goat's milk and home grown vegetables.
(2) Dose assessment includes contribution for the following pathways: ground plane exposure, inhalation and ingestion of home grown vegetables.
(3) Dose assessment includes contribution for the following pathways: ground plane exposure and inhalation, no vegetable pathway is assumed since the maximum ground level air concentration location as a result of effluents from the 94 meter stack is not presently occupied by a residence. Turbine building effluent contribution at this point has been added.

* Includes Tritium and Carbon-14

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