

Regulatory

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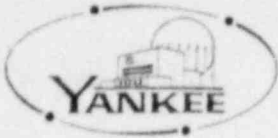
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WYR 76-87

YANKEE ATOMIC ELECTRIC COMPANY



20 Turnpike Road Westborough, Massachusetts 01581

August 31, 1976

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Office of Nuclear Reactor Regulation
Mr. Robert Purple

- Reference: (1) License No. DPR-3 (Docket No. 50-29)
(2) NRC letter dated February 19, 1976
(3) Yankee letter to NRC dated
June 2, 1976, WYR 76-63
(4) NRC letter dated July 2, 1976

Dear Sir:

In your letter to Yankee Atomic Electric Company (Reference 2), you requested that certain information be supplied for the purpose of evaluating the stations compliance with Appendix I to 10 CFR 50. Yankee submitted on June 2, 1976 (Reference 3) that portion of the information you requested which meets the requirements of Section V.B. of Appendix I, and indicated that in addition radiological dose analyses would be performed by Yankee Atomic and submitted to the Commission.

The enclosure to this letter contains Amendment 1 to Yankee's original submittal of information for use in the Appendix I evaluation (Reference 3). Amendment 1 contains both the radiological dose assessment for Yankee's demonstration of compliance with Appendix I, as well as updated meteorological dispersion parameters which were used in the dose calculations. A recent review of the meteorological literature relative to the calculation of deposition rates indicates that the most generally used approach involves the method of plume depletion and deposition velocity. This approach was used to recalculate the X/Q and D/Q values in an attempt to use as realistic modeling as available.

Amendment 1 should be inserted into Yankee's June 2, 1976 submittal (Appendix I Report) in accordance with the attached instruction sheet.

The additional information you requested in your letter of July 2, 1976 (Reference 4) is being prepared, and will be submitted as an amendment to the Appendix I Report by October 11, 1976. Included in this submittal will be a detailed description of the meteorological modeling which has been used.

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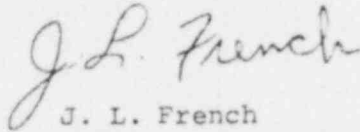
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Any questions regarding this submittal should be directed to Mr. Peter Littlefield, at our Engineering Office in Westborough, Massachusetts.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY



J. L. French
Manager of Operations

Enclosure

Section II
Meteorology

Data collected from the Yankee Rowe on-site meteorological system was analyzed for the period October 1, 1971 through September 1, 1972. 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 96.3 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 Zim¹ 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 and assumptions were used in the calculation of X/Q and D/Q values.

- A. Primary vent stack release:
1. Mixed release mode
 2. Physical height of the release point above ground: 46 meters
 3. Inside diameter of stack: 1.07 meters
 4. Vertical exit velocity of plume: 10.8 meters/second
 5. Maximum adjacent building height: 46 meters
 6. Depth of mixing layer: 1,000 meters
 7. Average ambient air temperature: 281°K
 8. Recirculation correction factors: 1.0

TABLE I.3-1

YANKEE ROWE: PRIMARY VENT 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)	3.8	3.8	>5.0	2.9	0.59
	Terrain Height (feet)	899	899		899	138
	X/Q (undepleted)	2.807 E-07	2.807 E-07		4.175 E-07	2.061 E-06
	X/Q (depleted)	2.075 E-07	2.075 E-07		3.174 E-07	2.050 E-06
	D/Q	3.734 E-10	3.734 E-10		5.727 E-10	5.670 E-09
NNE	Distance (miles)	4.9	3.3	>5.0	2.8	0.59
	Terrain Height (feet)	1056	961		919	538
	X/Q (undepleted)	1.581 E-07	2.832 E-07		3.752 E-07	4.650 E-06
	X/Q (depleted)	1.174 E-07	2.193 E-07		2.955 E-07	4.068 E-06
	D/Q	1.898 E-10	3.563 E-10		4.808 E-10	6.735 E-09
NE	Distance (miles)	>5.0	2.3	>5.0	2.3	0.85
	Terrain Height (feet)		958		958	837
	X/Q (undepleted)		4.084 E-07		4.084 E-07	1.920 E-06
	X/Q (depleted)		3.200 E-07		3.200 E-07	1.611 E-06
	D/Q		4.838 E-10		4.838 E-10	2.435 E-09
NE	Distance (miles)	--	--	--	*1.4	--
	Terrain Height (feet)				919	
	X/Q (undepleted)				8.237 E-07	
	X/Q (depleted)				6.699 E-07	
	D/Q				1.016 E-09	
ENE	Distance (miles)	5.0	5.0	>5.0	3.7	1.1
	Terrain Height (feet)	1191	1191		1191	899
	X/Q (undepleted)	7.898 E-08	7.898 E-08		1.250 E-07	8.487 E-07
	X/Q (depleted)	5.631 E-08	5.631 E-08		9.265 E-08	7.018 E-07
	D/Q	8.742 E-11	8.742 E-11		1.444 E-10	1.100 E-09

* Summer Camp

TABLE Q 11.5-1 (con't)

YANKEE ROWE: PRIMARY VENT 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
ENE	Distance (miles)	--	--	--	*1.8	--
	Terrain Height (feet)				1056	
	X/Q (undepleted)				3.714 E-07	
	X/Q (depleted)				2.956 E-07	
	D/Q				4.641 E-10	
E	Distance (miles)	3.6	3.6	>5.0	1.8	1.1
	Terrain Height (feet)	997	997		978	938
	X/Q (undepleted)	1.832 E-07	1.832 E-07		5.216 E-07	1.208 E-06
	X/Q (depleted)	1.332 E-07	1.332 E-07		4.080 E-07	9.841 E-07
	D/Q	1.655 E-10	1.655 E-10		5.115 E-10	1.232 E-09
ESE	Distance (miles)	4.5	2.1	>5.0	2.1	1.3
	Terrain Height (feet)	919	919		919	918
	X/Q (undepleted)	1.079 E-07	3.454 E-07		3.454 E-07	7.458 E-07
	X/Q (depleted)	7.909 E-08	2.741 E-07		2.741 E-07	6.134 E-07
	D/Q	1.190 E-10	4.188 E-10		4.188 E-10	9.389 E-10
SE	Distance (miles)	>5.0	1.9	>5.0	1.3	0.70
	Terrain Height (feet)		1017		1017	1017
	X/Q (undepleted)		6.364 E-07		1.098 E-06	3.237 E-06
	X/Q (depleted)		5.042 E-07		8.930 E-07	2.732 E-06
	D/Q		8.316 E-10		1.477 E-09	4.490 E-09
SSE	Distance (miles)	5.0	2.9	>5.0	1.2	0.59
	Terrain Height (feet)	958	958		958	838
	X/Q (undepleted)	2.284 E-07	5.191 E-07		2.005 E-06	6.927 E-06
	X/Q (depleted)	1.566 E-07	3.868 E-07		1.617 E-06	5.841 E-06
	D/Q	2.269 E-10	5.592 E-10		2.353 E-09	8.391 E-09

* Summer Camp

TABLE Q I.5-1 (con't)

YANKEE ROWE: PRIMARY VENT 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)	>5.0	1.8	>5.0	1.4	0.59
	Terrain Height (feet)		938		938	778
	X/Q (undepleted)		1.661 E-06		2.379 E-06	1.078 E-05
	X/Q (depleted)		1.269 E-06		1.857 E-06	8.957 E-06
	D/Q		1.380 E-09		2.020 E-09	9.645 E-09
SSW	Distance (miles)	>5.0	>5.0	>5.0	3.8	0.94
	Terrain Height (feet)				919	899
	X/Q (undepleted)				5.488 E-07	4.866 E-06
	X/Q (depleted)				3.853 E-07	3.913 E-06
	D/Q				3.385 E-10	3.434 E-09
SW	Distance (miles)	>5.0	>5.0	>5.0	0.79	0.62
	Terrain Height (feet)				479	478
	X/Q (undepleted)				7.489 E-06	1.166 E-05
	X/Q (depleted)				6.346 E-06	1.003 E-05
	D/Q				4.745 E-09	7.491 E-09
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.79	0.62
	Terrain Height (feet)				459	338
	X/Q (undepleted)				7.660 E-06	1.191 E-05
	X/Q (depleted)				6.699 E-06	1.172 E-05
	D/Q				4.927 E-09	8.741 E-09
W	Distance (miles)	>5.0	>5.0	>5.0	0.76	0.62
	Terrain Height (feet)				758	558
	X/Q (undepleted)				5.525 E-06	7.974 E-06
	X/Q (depleted)				4.560 E-06	6.656 E-06
	D/Q				3.694 E-09	5.425 E-09

TABLE Q 11.3-1 (con't)

YANKEE ROWE: PRIMARY VENT 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
WNW	Distance (miles)	1.2	1.2	4.1	1.2	0.59
	Terrain Height (feet)	997	997	1358	997	718
	X/Q (undepleted)	1.418 E-06	1.418 E-06	2.150 E-07	1.418 E-06	4.888 E-06
	X/Q (depleted)	1.139 E-06	1.139 E-06	1.529 E-07	1.139 E-06	4.108 E-06
	D/Q	1.171 E-09	1.171 E-09	1.564 E-10	1.171 E-09	4.208 E-09
NW	Distance (miles)	>5.0	>5.0	>5.0	1.3	0.59
	Terrain Height (feet)				997	718
	X/Q (undepleted)				1.299 E-06	5.368 E-06
	X/Q (depleted)				1.043 E-06	4.541 E-06
	D/Q				1.285 E-09	5.564 E-09
NNW	Distance (miles)	2.2	2.2	2.8	0.28	0.59
	Terrain Height (feet)	817	817	958	138	618
	X/Q (undepleted)	7.384 E-07	7.384 E-07	5.127 E-07	2.379 E-06	6.395 E-06
	X/Q (depleted)	5.639 E-07	5.639 E-07	3.813 E-07	2.367 E-06	5.372 E-06
	D/Q	8.703 E-10	8.703 E-10	5.876 E-10	8.933 E-09	8.224 E-09
NNW	Distance (miles)	--	--	--	**1.8	--
	Terrain Height (feet)				818	
	X/Q (undepleted)				1.018 E-06	
	X/Q (depleted)				7.935 E-07	
	D/Q				1.226 E-09	

** Nearest off-site residence and vegetable garden

TABLE Q II.3-2

YANKEE ROWE; 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)	3.8	3.8	>5.0	2.9	0.59
	Terrain Height (feet)	899	899		899	138
	X/Q (undepleted)	2.644 E-07	2.644 E-07		3.881 E-07	4.290 E-06
	X/Q (depleted)	2.135 E-07	2.135 E-07		3.216 E-07	3.912 E-06
	D/Q	3.838 E-10	3.838 E-10		5.827 E-10	7.425 E-09
NNE	Distance (miles)	4.9	3.3	>5.0	2.8	0.59
	Terrain Height (feet)	1056	961		919	538
	X/Q (undepleted)	1.522 E-07	2.691 E-07		3.535 E-07	3.659 E-06
	X/Q (depleted)	1.217 E-07	2.237 E-07		2.984 E-07	3.361 E-06
	D/Q	1.966 E-10	3.645 E-10		4.879 E-10	5.709 E-09
NE	Distance (miles)	>5.0	2.3	>5.0	2.3	0.85
	Terrain Height (feet)		958		958	837
	X/Q (undepleted)		3.735 E-07		3.735 E-07	1.564 E-06
	X/Q (depleted)		3.161 E-07		3.161 E-07	1.404 E-06
	D/Q		4.848 E-10		4.848 E-10	2.209 E-09
NE	Distance (miles)	--	--	--	*1.4	--
	Terrain Height (feet)				919	
	X/Q (undepleted)				7.259 E-07	
	X/Q (depleted)				6.346 E-07	
	D/Q				9.860 E-10	
ENE	Distance (miles)	5.0	5.0	>5.0	3.7	1.1
	Terrain Height (feet)	1191	1191		1191	899
	X/Q (undepleted)	7.508 E-08	7.508 E-08		1.174 E-07	7.180 E-07
	X/Q (depleted)	5.847 E-08	5.847 E-08		9.480 E-08	6.377 E-07
	D/Q	9.056 E-11	9.056 E-11		1.483 E-10	1.041 E-09

* Summer Camp

TABLE Q .3-2 (con't)

YANKEE ROWE: 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
ENE	Distance (miles)	--	--	--	*1.8	--
	Terrain Height (feet)				1056	
	X/Q (undepleted)				3.336 E-07	
	X/Q (depleted)				2.870 E-07	
	D/Q				4.602 E-10	
E	Distance (miles)	3.6	3.6	>5.0	1.8	1.1
	Terrain Height (feet)	997	997		978	938
	X/Q (undepleted)	1.703 E-07	1.703 E-07		4.622 E-07	1.011 E-06
	X/Q (depleted)	1.359 E-07	1.359 E-07		3.935 E-07	8.822 E-07
	D/Q	1.696 E-10	1.696 E-10		5.026 E-10	1.147 E-09
ESE	Distance (miles)	4.5	2.1	>5.0	2.1	1.3
	Terrain Height (feet)	919	919		919	918
	X/Q (undepleted)	1.030 E-07	3.168 E-07		3.168 E-07	6.523 E-07
	X/Q (depleted)	8.150 E-08	2.699 E-07		2.699 E-07	5.742 E-07
	D/Q	1.228 E-10	4.174 E-10		4.174 E-10	9.007 E-10
SE	Distance (miles)	>5.0	1.9	>5.0	1.3	0.7
	Terrain Height (feet)		1017		1017	1018
	X/Q (undepleted)		5.748 E-07		9.591 E-07	2.525 E-06
	X/Q (depleted)		4.931 E-07		8.419 E-07	2.286 E-06
	D/Q		8.263 E-10		1.431 E-09	3.983 E-09
SSE	Distance (miles)	5.0	2.9	>5.0	1.2	0.59
	Terrain Height (feet)	958	958		958	838
	X/Q (undepleted)	2.155 E-07	4.760 E-07		1.692 E-06	5.040 E-06
	X/Q (depleted)	1.649 E-07	3.889 E-07		1.481 E-06	4.560 E-06
	D/Q	2.352 E-10	5.670 E-10		2.237 E-09	7.051 E-09

* Summer Camp

TABLE Q .3-2 (con't)

YANKEE ROWE: 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
S	Distance (miles)	>5.0	1.8	>5.0	1.4	0.59
	Terrain Height (feet)		938		938	778
	X/Q (undepleted)		1.445 E-06		2.017 E-06	7.606 E-06
	X/Q (depleted)		1.218 E-06		1.731 E-06	6.830 E-06
	D/Q		1.344 E-09		1.919 E-09	7.699 E-09
SSW	Distance (miles)	>5.0	>5.0	>5.0	3.8	0.94
	Terrain Height (feet)				919	899
	X/Q (undepleted)				5.099 E-07	3.819 E-06
	X/Q (depleted)				3.981 E-07	3.359 E-06
	D/Q				3.499 E-10	3.009 E-09
SW	Distance (miles)	>5.0	>5.0	>5.0	0.79	0.62
	Terrain Height (feet)				479	478
	X/Q (undepleted)				5.795 E-06	8.389 E-06
	X/Q (depleted)				5.153 E-06	7.540 E-06
	D/Q				3.964 E-09	5.814 E-09
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.79	0.62
	Terrain Height (feet)				459	338
	X/Q (undepleted)				5.930 E-06	8.539 E-06
	X/Q (depleted)				5.288 E-06	7.698 E-06
	D/Q				3.991 E-09	5.809 E-09
W	Distance (miles)	>5.0	>5.0	>5.0	0.76	0.62
	Terrain Height (feet)				758	558
	X/Q (undepleted)				4.210 E-06	5.748 E-06
	X/Q (depleted)				3.762 E-06	5.183 E-06
	D/Q				3.080 E-09	4.245 E-09

TABLE Q 3-2 (con't)

 YANKEE ROWE: 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	1.2	4.1	1.2	0.59
	Terrain Height (feet)	997	997	1358	997	718
	X/Q (undepleted)	1.200 E-06	1.200 E-06	2.025 E-07	1.200 E-06	3.491 E-06
	X/Q (depleted)	1.050 E-06	1.050 E-06	1.590 E-07	1.050 E-06	3.159 E-06
	D/Q	1.091 E-09	1.091 E-09	1.624 E-10	1.091 E-09	3.306 E-09
NW	Distance (miles)	>5.0	>5.0	>5.0	1.3	0.59
	Terrain Height (feet)				997	718
	X/Q (undepleted)				1.123 E-06	3.876 E-06
	X/Q (depleted)				9.778 E-07	3.514 E-06
	D/Q				1.219 E-09	4.480 E-09
NNW	Distance (miles)	2.2	2.2	2.8	0.28	0.59
	Terrain Height (feet)	817	817	958	138	618
	X/Q (undepleted)	6.624 E-07	6.624 E-07	4.682 E-07	1.433 E-05	4.649 E-06
	X/Q (depleted)	5.548 E-07	5.548 E-07	3.836 E-07	1.323 E-05	4.203 E-06
	D/Q	8.666 E-10	8.666 E-10	5.946 E-10	2.105 E-08	6.801 E-09
NNW	Distance (miles)	--	--	--	**1.8	--
	Terrain Height (feet)				818	
	X/Q (undepleted)				8.979 E-07	
	X/Q (depleted)				7.652 E-07	
	D/Q				1.203 E-09	

** Nearest off-site residence and vegetable garden

TABLE Q II.3-3

YANKEE ROWE: PRIMARY VENT 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)	3.8	3.8	>5.0	2.9
	Terrain Height (feet)	899	899		899
	X/Q (undepleted)	3.579 E-07	3.579 E-07		5.309 E-07
	X/Q (depleted)	2.621 E-07	2.621 E-07		4.001 E-07
	D/Q	3.530 E-10	3.530 E-10		5.393 E-10
NNE	Distance (miles)	4.9	3.3	>5.0	2.8
	Terrain Height (feet)	1056	961		919
	X/Q (undepleted)	2.003 E-07	3.574 E-07		4.732 E-07
	X/Q (depleted)	1.506 E-07	2.799 E-07		3.766 E-07
	D/Q	2.072 E-10	3.855 E-10		5.185 E-10
NE	Distance (miles)	>5.0	2.3	>5.0	2.3
	Terrain Height (feet)		958		958
	X/Q (undepleted)		5.234 E-07		5.234 E-07
	X/Q (depleted)		4.112 E-07		4.112 E-07
	D/Q		4.557 E-10		4.557 E-10
NE	Distance (miles)	--	--	--	**1.4
	Terrain Height (feet)				919
	X/Q (undepleted)				1.053 E-06
	X/Q (depleted)				8.593 E-07
	D/Q				9.537 E-10
ENE	Distance (miles)	5.0	5.0	>5.0	3.7
	Terrain Height (feet)	1191	1191		1191
	X/Q (undepleted)	1.026 E-07	1.026 E-07		1.620 E-07
	X/Q (depleted)	7.188 E-08	7.188 E-08		1.183 E-07
	D/Q	7.918 E-11	7.918 E-11		1.302 E-10

*May through October

** Summer Camp

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

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

Radial Sector		Milk Cow	Meat Animal	Milk Goat	Nearest Residence and Vegetable Garden
ENE	Distance (miles)	--	--	--	**1.8
	Terrain Height (feet)				1056
	X/Q (undepleted)				4.783 E-07
	X/Q (depleted)				3.766 E-07
	D/Q				4.159 E-10
E	Distance (miles)	3.6	3.6	>5.0	1.8
	Terrain Height (feet)	997	997		978
	X/Q (undepleted)	2.193 E-07	2.193 E-07		6.177 E-07
	X/Q (depleted)	1.546 E-07	1.546 E-07		4.711 E-07
	D/Q	1.398 E-10	1.398 E-10		4.287 E-10
ESE	Distance (miles)	4.5	2.1	>5.0	2.1
	Terrain Height (feet)	919	919		919
	X/Q (undepleted)	9.997 E-08	3.169 E-07		3.169 E-07
	X/Q (depleted)	7.192 E-08	2.482 E-07		2.482 E-07
	D/Q	8.194 E-11	2.868 E-10		2.868 E-10
SE	Distance (miles)	>5.0	1.9	>5.0	1.3
	Terrain Height (feet)		1017		1017
	X/Q (undepleted)		5.750 E-07		9.899 E-07
	X/Q (depleted)		4.536 E-07		8.022 E-07
	D/Q		6.498 E-10		1.151 E-09
SSE	Distance (miles)	5.0	2.9	>5.0	1.2
	Terrain Height (feet)	958	958		958
	X/Q (undepleted)	2.310 E-07	5.251 E-07		2.012 E-06
	X/Q (depleted)	1.544 E-07	3.797 E-07		1.590 E-06
	D/Q	1.960 E-10	4.831 E-10		2.026 E-09

* May through October

**Summer Camp

TABLE Q 11.3-3 (con't)

YANKEE ROWE: PRIMARY VENT 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)	>5.0	1.8	>5.0	1.4
	Terrain Height (feet)		938		938
	X/Q (undepleted)		1.777 E-06		2.545 E-06
	X/Q (depleted)		1.359 E-06		1.988 E-06
	D/Q		1.294 E-09		1.894 E-09
SSW	Distance (miles)	>5.0	>5.0	>5.0	3.8
	Terrain Height (feet)				919
	X/Q (undepleted)				5.961 E-07
	X/Q (depleted)				4.229 E-07
	D/Q				3.561 E-10
SW	Distance (miles)	>5.0	>5.0	>5.0	0.79
	Terrain Height (feet)				479
	X/Q (undepleted)				8.739 E-06
	X/Q (depleted)				7.451 E-06
	D/Q				5.555 E-09
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.79
	Terrain Height (feet)				459
	X/Q (undepleted)				1.173 E-05
	X/Q (depleted)				1.024 E-05
	D/Q				7.368 E-09
W	Distance (miles)	>5.0	>5.0	>5.0	0.76
	Terrain Height (feet)				758
	X/Q (undepleted)				8.770 E-06
	X/Q (depleted)				7.235 E-06
	D/Q				5.404 E-09

*May through October

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

YANKEE ROWE: PRIMARY VENT 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)	1.2	1.2	4.1	1.2
	Terrain Height (feet)	997	997	1358	997
	X/Q (undepleted)	1.917 E-06	1.917 E-06	2.913 E-07	1.917 E-06
	X/Q (depleted)	1.530 E-06	1.530 E-06	2.050 E-07	1.530 E-06
	D/Q	1.291 E-09	1.291 E-09	1.726 E-10	1.291 E-09
NW	Distance (miles)	>5.0	>5.0	>5.0	1.3
	Terrain Height (feet)				997
	X/Q (undepleted)				1.610 E-06
	X/Q (depleted)				1.297 E-06
	D/Q				1.215 E-09
NNW	Distance (miles)	2.2	2.2	2.8	0.28
	Terrain Height (feet)	817	817	958	138
	X/Q (undepleted)	8.813 E-07	8.813 E-07	6.122 E-07	1.907 E-06
	X/Q (depleted)	6.748 E-07	6.748 E-07	4.567 E-07	1.904 E-06
	D/Q	7.973 E-10	7.973 E-10	5.387 E-10	4.791 E-09
NNW	Distance (miles)	--	--	--	***1.8
	Terrain Height (feet)				818
	X/Q (undepleted)				1.216 E-06
	X/Q (depleted)				9.495 E-07
	D/Q				1.123 E-09

*May through October

***Nearest off-site residence and vegetable garden

TABLE Q. 11.3-4

YANKEE ROWE: 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)	3.8	3.8	>5.0	2.9
	Terrain Height (feet)	899	899		899
	X/Q (undepleted)	3.357 E-07	3.357 E-07		4.910 E-07
	X/Q (depleted)	2.696 E-07	2.696 E-07		4.048 E-07
	D/Q	3.632 E-10	3.632 E-10		5.486 E-10
NNE	Distance (miles)	4.9	3.3	>5.0	2.8
	Terrain Height (feet)	1056	961		919
	X/Q (undepleted)	1.938 E-07	3.417 E-07		4.487 E-07
	X/Q (depleted)	1.558 E-07	2,853 E-07		3,802 E-07
	D/Q	2.147 E-10	3.942 E-10		5.258 E-10
NE	Distance (miles)	>5.0	2.3	>5.0	2.3
	Terrain Height (feet)		958		958
	X/Q (undepleted)		4.777 E-07		4.777 E-07
	X/Q (depleted)		4.038 E-07		4.038 E-07
	D/Q		4.545 E-10		4.545 E-10
NE	Distance (miles)	--	--	--	**1.4
	Terrain Height (feet)				919
	X/Q (undepleted)				9.256 E-07
	X/Q (depleted)				8.083 E-07
	D/Q				9.176 E-10
ENE	Distance (miles)	5.0	5.0	>5.0	3.7
	Terrain Height (feet)	1191	1191		1191
	X/Q (undepleted)	9.682 E-08	9.682 E-08		1.507 E-07
	X/Q (depleted)	7.446 E-08	7.446 E-08		1.204 E-07
	D/Q	8.204 E-11	8.204 E-11		1.336 E-10

* May through October

** Summer Camp

TABLE Q 11.3-4 (con't)

YANKEE ROWE: 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
ENE	Distance (miles)	--	--	--	**1.8
	Terrain Height (feet)				1056
	X/Q (undepleted)				4.236 E-07
	X/Q (depleted)				3.618 E-07
	D/Q				4.100 E-10
E	Distance (miles)	3.6	3.6	>5.0	1.8
	Terrain Height (feet)	997	997		978
	X/Q (undepleted)	2.019 E-07	2.019 E-07		5.385 E-07
	X/Q (depleted)	1.586 E-07	1.586 E-07		4.533 E-07
	D/Q	1.435 E-10	1.435 E-10		4.182 E-10
ESE	Distance (miles)	4.5	2.1	>5.0	2.1
	Terrain Height (feet)	919	919		919
	X/Q (undepleted)	9.483 E-08	2.878 E-07		2.878 E-07
	X/Q (depleted)	7.408 E-08	2.431 E-07		2.431 E-07
	D/Q	8.461 E-11	2.851 E-10		2.851 E-10
SE	Distance (miles)	>5.0	1.9	>5.0	1.3
	Terrain Height (feet)		1017		1017
	X/Q (undepleted)		5.181 E-07		8.626 E-07
	X/Q (depleted)		4.438 E-07		7.564 E-07
	D/Q		6.447 E-10		1.110 E-09
SSE	Distance (miles)	>5.0	2.9	>5.0	1.2
	Terrain Height (feet)	958	958		958
	X/Q (undepleted)	2.146 E-07	4.709 E-07	4.709 E-07	1.645 E-06
	X/Q (depleted)	1.604 E-07	3.783 E-07		1.425 E-06
	D/Q	2.033 E-10	4.886 E-10		1.909 E-09

* May through October

** Summer Camp

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

YANKEE ROWE: - 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	1.8	>5.0	1.4
	Terrain Height (feet)		938		938
	X/Q (undepleted)		1.545 E-06		2.157 E-06
	X/Q (depleted)		1.303 E-06		1.851 E-06
	D/Q		1.260 E-09		1.800 E-09
SSW	Distance (miles)	>5.0	>5.0	>5.0	3.8
	Terrain Height (feet)				919
	X/Q (undepleted)				5.558 E-07
	X/Q (depleted)				4.361 E-07
	D/Q				3.677 E-10
SW	Distance (miles)	>5.0	>5.0	>5.0	0.79
	Terrain Height (feet)				479
	X/Q (undepleted)				6.823 E-06
	X/Q (depleted)				6.089 E-06
	D/Q				4.647 E-09
WSW	Distance (miles)	>5.0	>5.0	>5.0	0.79
	Terrain Height (feet)				459
	X/Q (undepleted)				9.081 E-06
	X/Q (depleted)				8.097 E-06
	D/Q				5.983 E-09
W	Distance (miles)	>5.0	>5.0	>5.0	0.76
	Terrain Height (feet)				758
	X/Q (undepleted)				6.664 E-06
	X/Q (depleted)				5.952 E-06
	D/Q				4.460 E-09

* May through October

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

YANKEE ROWE: 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
WNW	Distance (miles)	1.2	1.2	4.1	1.2
	Terrain Height (feet)	997	997	1358	997
	X/Q (undepleted)	1.608 E-06	1.608 E-06	2.737 E-07	1.608 E-06
	X/Q (depleted)	1.401 E-06	1.401 E-06	2.134 E-07	1.401 E-06
	D/Q	1.191 E-09	1.191 E-09	1.796 E-10	1.191 E-09
NW	Distance (miles)	>5.0	>5.0	>5.0	1.3
	Terrain Height (feet)				997
	X/Q (undepleted)				1.394 E-06
	X/Q (depleted)				1.214 E-06
	D/Q				1.152 E-09
NNW	Distance (miles)	2.2	2.2	2.8	0.28
	Terrain Height (feet)	817	817	958	138
	X/Q (undepleted)	7.930 E-07	7.930 E-07	5.608 E-07	1.698 E-05
	X/Q (depleted)	6.645 E-07	6.645 E-07	4.598 E-07	1.569 E-05
	D/Q	7.929 E-10	7.929 E-10	5.453 E-10	1.916 E-08
NNW	Distance (miles)	--	--	--	***1.8
	Terrain Height (feet)				818
	X/Q (undepleted)				1.075 E-06
	X/Q (depleted)				9.162 E-07
	D/Q				1.099 E-09

* May through October

*** Nearest off-site residence and vegetable garden

SECTION IV

RADIOLOGICAL DOSE EVALUATION

Paragraph (c) of 10 CFR Part 20.1 states that a licensee operating a light-water reactor (LWR) should make every reasonable effort to maintain releases of radioactive materials to unrestricted areas as far below the limits specified in Part 20 as is reasonably achievable. Appendix I to 10 CFR Part 50 provides guidance on the acceptable levels of exposure of the general public, resulting from routine radioactive material releases from LWR operations. These exposure guidelines, which if met, establishes that the licensee is in compliance with 10 CFR Part 20.1 providing that none of the other limits established in Part 20 are exceeded.

This section describes the calculational dose models and assumptions which were used in establishing Yankee Rowe's compliance with 10 CFR Part 20.0 and the 10 CFR Part 50 Appendix I dose criteria of "as low as reasonably achievable". The resultant individual radiation doses are based on realistic assessments of radioactive source terms, hydrologic and meteorologic dispersion factors and physically applicable exposure pathways that may or do exist within the site environment. Site specific data is used when available, otherwise, the conservative assumptions of Regulatory Guide 1.109⁽¹⁾ recommended values are used in the dose determinations. The calculated doses resulting from 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

Yankee Rowe is a single reactor unit located on the Deerfield River, 42 river miles above its confluence with the Connecticut River. The reactor site is slightly upstream of Sherman Dam and adjacent to the pond of the Sherman hydroelectric station in the upper northwest corner of the State of Massachusetts. Sherman Pond provides the cooling and service water required for LWR operations. Liquid discharges from the plant are via an overflow weir discharge structure located approximately 125 feet from the Sherman Dam hydroelectric intake structure. Yankee Rowe has a design circulating water flow of 138,200 gallons per minute. The Deerfield River has a 56 year annual average flow of 570 cubic feet per second at Sherman Dam. Table Q B.4-3 of Appendix B of this report is a listing of the liquid effluent isotopic source terms as generated by the GALE⁽²⁾ computer code. Appendix B also describes the plant's liquid effluent controls and operating parameters which were used to determine the potential source terms.

Exposure pathways that could exist as a result of Yankee Rowe liquid effluent releases are fishing, direct exposure from river shoreline sedimentation, and milk and meat via animal ingestion of the Deerfield waters. Hydrologic studies have shown that the Rowe discharge plume is a surface plume that is highly affected by the operation of the Sherman hydroelectric station. When the Sherman hydro-station is operating, the Rowe discharge plume is rapidly entrained and mixed with the hydro-station influx. When the hydroelectric station is inoperative, the plume moves up pond requiring approximately 12 hours before it impacts the closest

observed public fishing access. Boat fishing in or near the Rowe discharge is extremely poor because (1) the pond bottom profile provides little food or cover for the fish species within the pond and (2) the species present show a decided preference for non-thermally impacted waters. Public fishing access also exists about five miles downstream of Sherman Dam, just below the Fife Brook hydroelectric installation. Public fishing has not been observed in the five mile section of the Deerfield as (1) the valley walls form a canal-like channel for the river with extremely steep banks and (2) the river water level fluctuates quite rapidly as a result of hydroelectric plant operations. The fishing location chosen for evaluation is the downstream location as it is possible for Rowe effluent discharges to impact this fishing area in three hours. This location is also used for evaluation of doses from shoreline sedimentation. The aquatic invertebrate pathway is non-existent based on the results of several river biota surveys.

The cow milk-meat animal pathway may exist as a result of animal access to the Deerfield River. Cattle have been observed to have access to the river bank about 16 river miles downstream of Sherman Dam and may have river access, although the river bank is extremely steep and brushy at this point. Another animal herd that has easy access to the river is located 21.5 river miles downstream. The cow milk-meat animal pathway has been evaluated at the 16 mile downstream location.

The meat, milk and vegetable pathways via crop irrigation do not exist and are not likely to exist in the remaining years of plant lifetime because the type of farming practiced in the area is not economically

amendable with irrigation. Surveys have shown that there is no water withdrawn from the Deerfield River for drinking purposes.

The calculational methods used in assessing the radiation dose to individuals have been taken from Regulatory Guide 1.109 for liquid exposures through aquatic food, shoreline deposition, and milk cow-meat animal pathways. The dilution factor to be used for calculational purposes for evaluation of the fishing pathway in either Sherman Pond or the downstream Fife Brook installation is 1.85 which is equivalent to a mixing ratio of 0.54. Further downstream, increased water shed area provides additional water for dilution with a resultant dilution factor of 3.125 (equivalent mixing ratio of 0.32) used for the evaluation of the milk cow-meat animal pathway.

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 discharge.

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 may exist at the downstream 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. Transit or hold-up times of 48 hours and 20 days were used for milk and meat products, respectively.

The maximum external dose from shoreline activities as evaluated at the downstream fishing location is 1.23×10^{-2} millirem per year to the whole body and 1.43×10^{-2} millirem per year to the skin of a teenager spending 67 hours per year at this location. The external exposures from shoreline activities at the nearest downstream fishing access are given in Table Q IV.1-1. The internal exposures from the meat, milk, and fish pathways are also summarized in the same table. The maximum calculated total whole

body dose from internal and external exposures is 2.99 millirem per year to an adult who receives his meat and milk from the downstream cattle, his fish from the nearest downstream fishing location and occupies the nearest downstream fishing location for shoreline activities of 12 hours per year. This calculated dose is within the Appendix I criteria of three millirem per year. The critical organ dose is to the liver of the same adult with a maximum calculated annual dose of 4.03 millirem which is 40.3 percent of the Appendix I criteria of 10 millirem per year to any organ from all pathways.

The freshwater fish pathway is the critical internal exposure pathway for liquid effluents discharged from Yankee Rowe. The fish pathway contributes 2.97 millirem of 2.99 millirem annual whole body dose and similar proportions of the other organ doses. Cesium is the radionuclide of interest as it is the source of 98.9% of the total whole body dose and 99% of the total liver dose via the freshwater fish pathway. Actual radioactive liquid releases at Yankee have been much lower than the GALE computer code predicts and, therefore, the actual dose from the fish pathway is not expected to approach the value calculated above. Fishing in the Deerfield River is largely put and take as fish stocked by the Massachusetts State Division of Fisheries and Game provides 90% of the downstream fish catch. Fish caught in Sherman Pond are usually stocked further upstream by the Vermont Department of Fisheries and Game and have been washed downstream to the pond. Environmental samples⁽³⁾ taken of the fish pathway have shown that there has been no buildup of radio-cesium in excess of background levels in fish samples taken from Sherman Pond and downstream areas of the Deerfield River. Also, no credit has been taken for the depletion of suspended radionuclides by deposition

processes while the water is in transit from the point of discharge to the point of exposure.

Radiation Doses from Gaseous Effluent Pathways

Gaseous effluent source terms have been calculated using the NRC GALE computer code for pressurized water reactors. Table Q B.6-2 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 a failed fuel fraction of 0.12 percent, and the primary coolant isotopic distribution as reported by the ANS 18.1 Source Term Specification Working Subcommittee. In addition to those nuclides listed in Table Q B.6-2, eight curies per year of Carbon-14 and 25 curies per year of Argon-41 have been added to the gaseous effluents for radiation dose assessments based on the information in the Nuclear Regulatory Commission's NUREG-0017.

The main release point for gases discharged from the plant is via the 150 foot tall primary vent stack, which is located between the vapor container and the primary auxiliary building. In addition to the primary vent, the turbine hall exhausts ventilation air directly to vents located on the turbine hall roof. The turbine hall exhaust is assumed to be a ground level source. The primary vent stack is treated as a mixed mode elevated release point dependent upon windspeed as described in Regulatory Guide 1.111⁽⁴⁾.

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 cow, goat, and meat animal out

to a distance of 5 miles from the reactor. A vegetable garden is assumed to exist at each location listed in Table Q I.2-1 of Section I of this report except at site boundaries. Each garden is assumed to be large enough to produce enough food to meet 76% of the annual usage factor for fruits, vegetables, and grains for the age groups given in Regulatory Guide 1.109, Table A-2. This garden is also assumed to produce 50% of the annual usage factor for fresh leafy vegetables for each age group listed. Table A-2 shows that the gross annual intake of fruits, vegetables, and grains is 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. X/Q and D/Q values were calculated from on-site 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.

The following assumptions are used with those already given:

1. All locations delineated in Table Q I.2-1 have gardens except the site boundary locations.
2. The meat pathway exists at all milk locations.
3. All fresh leafy vegetables consumed during the growing season are grown locally.
4. The animal grazing season is six months per year.
5. Milk cows receive 50% of their food input from stored feeds during the grazing season.
6. Milk goats receive 20% of their food input from stored feeds during the grazing season.

7. Meat animals do not receive stored feeds during the grazing season.

Both gamma and beta air doses were calculated for the receptor point of highest offsite exposure using the methodology and dose conversion factors of Regulatory Guide 1.109. No credit was assumed for decay of gaseous activity in transit to point of exposure. Terrain elevations of the surrounding area were factored into the calculation of X/Q values at each receptor location. The point of highest offsite exposure was determined to be at the west-southwest site boundary. The gamma and beta air dose calculated at this location are 0.061 millirad per year and 0.37 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. Therefore, it can be assumed that any point beyond the site boundary which could at some time in the future be occupied, will also be below these guideline values.

In addition to the air doses, the whole body and skin doses to the most restrictive existing offsite individual, as well as the worst site boundary location which could be occupied in the future were calculated. These doses assumed an occupancy factor of 100% at all sites except summer camps and an attenuation factor of 0.7 to account for the dose reduction due to shielding provided by residential structures. The summer camps are assumed to have an occupancy factor of 25% and doses were calculated using growing season meteorological data. The calculational results indicate the the maximum whole body dose is 0.037 millirem per year for an individual located at the site boundary 0.62 miles west-southwest of the plant. The maximum skin dose is 0.21 millirem per year

for an individual located at the site boundary 0.62 miles west-southwest of the plant. These doses are below the guideline values of five millirem per year for whole body dose and 15 millirem per year skin dose. Table Q IV.1-2 indicates the annual gamma and beta doses calculated at the point of interest.

Radiation doses from both radioiodine and particulates 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. Table Q I.2-1 of Section I indicates the location of the nearest resident, cow, goat, and meat animal in each of the sixteen compass sectors from the plant. 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 were assumed to receive 50% of their intake from pasture during this period. This is a realistic assumption since most dairy operations are utilizing supplemental feeding of animal when on pasture 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 primary vent stack. The turbine building was treated as a ground-level source while the primary vent stack was analyzed as a mixed mode release point dependent upon windspeed conditions. The highest offsite dose was determined to be for a child living 0.79 miles to the west-southwest of the plant. The critical organ was determined to be the thyroid and was primarily the result of fresh and leafy vegetable ingestion. This dose of 2.54 millirem per year is 17% of the 15 millirem per year criteria of Appendix I. Table Q IV.1-3 indicates the total organ doses from all gaseous pathways for the maximum dose locations.

Conclusion

The radiological evaluation of the principal exposure pathways in the Yankee Rowe environment indicates that none of the criteria of 10 CFR 50 Appendix I would be likely to be exceeded during normal operation of the plant. Yankee Rowe as analyzed does meet the "as low as reasonably achievable" criteria for radioactive effluents and is in compliance with Title 10 of the Code of Federal Regulations.

SECTION IV

REFERENCES

1. "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.
2. "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWR-GALE code)", NUREG-0017, U.S. Nuclear Regulatory Commission.
3. "Radiological Surveillance Studies at a Pressurized Water Nuclear Power Reactor", Bernd Kahn, et al, PB-205640, National Environmental Research Center, Cincinnati, Ohio, August 1971.
4. "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

YANKEE ROWE
LIQUID PATHWAY DOSE SUMMARY
FOR LIQUID EFFLUENTS

Millirem per year

Age Group	Total ⁽¹⁾ Whole Body	External Dose from Shoreline Activities		Internal Doses ⁽²⁾						
		Whole Body	Skin	Bone	Liver	Whole Body	Thyroid	Kidney	Lung	GI-LLI
Adult	2.99E+00*	2.20E-03	2.57E-03	2.26E+00	4.03E+00	2.99E+00	2.25E+00	1.40E+00	4.45E-01	2.18E-01
Teen	1.71E+00	1.23E-02	1.43E-02	2.24E+00	4.01E+00	1.70E+00	2.22E+00	1.08E+00	5.09E-01	1.63E-01
Child	6.73E-01	2.56E-03	2.99E-03	2.72E+00	3.47E+00	6.71E-01	2.82E+00	4.71E-01	4.02E-01	7.58E-02
Infant	2.44E-02	-	-	6.44E-02	1.01E-01	2.44E-02	2.55E+00	1.29E-02	2.32E-02	1.50E-02

(1) Consists of whole body external exposure from shoreline activities plus whole body dose from ingestion pathways of fish, milk and meat.

(2) Total dose to organ from ingestion pathways of fish, milk and meat.

* 2.99E+00=2.99x10⁰

TABLE Q IV.1-2

YANKEE ROWE
GASEOUS PATHWAY DOSE SUMMARY FOR NOBLE GAS EFFLUENTS

LOCATION	GAMMA AIR DOSE (MRAD/YR)	BETA AIR DOSE (MRAD/YR)	WHOLE BODY DOSE (MREM/YR)	SKIN DOSE (MREM/YR)
Maximum site boundary 0.62 miles WSW	6.1×10^{-2}	3.7×10^{-1}	3.7×10^{-2}	2.1×10^{-1}
Maximum offsite resident 0.79 miles WSW	4.3×10^{-2}	2.4×10^{-1}	2.6×10^{-2}	1.4×10^{-1}
Onsite resident 0.28 miles NNW	4.3×10^{-2}	7.4×10^{-2}	2.6×10^{-2}	6.6×10^{-2}
Maximum summer camp 1.4 miles NE	1.9×10^{-3}	8.3×10^{-3}	1.2×10^{-3}	5.3×10^{-3}

TABLE Q IV.5
YANKEE ROWE
GASEOUS PATHWAY DOSE SUMMARY
FOR RADIOIODINE AND PARTICULATES

Location	Age Group	TOTAL ORGAN DOSE (MILLIRUM PER YEAR)									
		Bone	Liver	Kidney	Lung	GI-LLI	Thyroid	Whole Body	Skin		
Maximum Site Boundary 0.62 Miles WSW (1)	Adult	5.95 E-02*	6.48 E-04	5.45 E-02	6.36 E-02	6.21 E-02	6.09 E-01	6.26 E-02	9.01 E-03		
	Teen	1.77 E-02	4.38 E-02	4.74 E-02	4.31 E-02	4.13 E-02	4.94 E-01	4.19 E-02	9.01 E-03		
	Child	1.18 E-02	1.83 E-02	1.31 E-02	1.82 E-02	1.78 E-02	1.70 E-01	1.80 E-02	9.01 E-03		
	Infant	3.14 E-02	5.88 E-02	2.25 E-02	5.76 E-02	5.50 E-02	1.06 E+00	5.65 E-02	9.01 E-03		
Site Boundary 0.59 Miles S (1)	Adult	5.52 E-02	5.98 E-02	5.96 E-02	5.94 E-02	5.75 E-02	4.86 E-01	5.80 E-02	9.95 E-03		
	Teen	1.74 E-02	4.08 E-02	4.42 E-02	4.02 E-02	3.88 E-02	3.94 E-01	3.93 E-02	9.95 E-03		
	Child	1.21 E-02	1.80 E-02	1.34 E-02	1.80 E-02	1.76 E-02	1.37 E-01	1.78 E-02	9.95 E-03		
	Infant	2.95 E-02	5.42 E-02	2.18 E-02	5.33 E-02	5.12 E-02	8.58 E-01	5.24 E-02	9.95 E-03		
Maximum Nearest Resident 0.79 Miles WSW (2)	Adult	2.55 E+00	6.67 E-01	6.66 E-01	6.63 E-01	6.63 E-01	1.27 E+00	6.64 E-01	5.08 E-03		
	Teen	7.94 E-01	9.22 E-01	7.58 E-01	9.18 E-01	9.18 E-01	1.42 E+00	9.19 E-01	5.08 E-03		
	Child	1.92 E+00	2.10 E+00	6.04 E-01	2.09 E+00	2.09 E+00	2.54 E+00	2.09 E+00	5.08 E-03		
	Infant	1.92 E-02	5.70 E-02	1.38 E-02	3.62 E-02	3.48 E-02	6.27 E-01	3.56 E-02	5.08 E-03		

* 5.95 E-02 = 5.95 x 10⁻²

(1) dose evaluation includes contributions from ground plane exposure and inhalation.

(2) dose evaluation includes contributions from ground plane exposure, inhalation and ingestion of home grown vegetables.

TABLE Q IV.1-3 (CONTINUED)
YANKET BOMB
GASEOUS PATHWAY DOSE SUMMARY
FOR RADIOISOTOPES AND PARTICULATES

Location	Age Group	TOTAL ORGAN DOSE (MILLIRUM PER YEAR)									
		Bone	Liver	Kidney	Lung	GI-LLI	Thyroid	Whole Body	Skin		
Maximum Cow, Meat and Resident 1.2 Miles NNW (3) Location of Infant Maximum Organ Doses Except Skin and Thyroid	Adult	7.59 E-01*	1.89 E-01	1.89 E-01	1.88 E-01	1.88 E-01	3.86 E-01	1.89 E-01	1.21 E-03		
	Teen	2.17 E-01	2.48 E-01	2.02 E-01	2.46 E-01	2.46 E-01	4.64 E-01	2.47 E-01	1.21 E-03		
	Child	5.14 E-01	5.57 E-01	1.59 E-01	5.55 E-01	5.55 E-01	8.88 E-01	5.56 E-01	1.21 E-03		
	Infant	3.28 E-01	3.49 E-01	4.90 E-02	3.48 E-01	3.48 E-01	1.05 E+00	3.47 E-01	1.21 E-03		
Onsite Resident 0.28 Miles NNW (4)	Adult	4.28 E-01	1.23 E-01	1.24 E-01	1.20 E-01	1.21 E-01	6.95 E-01	1.25 E-01	9.36 E-03		
	Teen	1.39 E-01	1.64 E-01	1.36 E-01	1.60 E-01	1.60 E-01	6.29 E-01	1.61 E-01	9.36 E-03		
	Child	3.25 E-01	3.54 E-01	1.07 E-01	3.49 E-01	3.49 E-01	8.28 E-01	3.51 E-01	9.36 E-03		
	Infant	1.34 E-02	1.90 E-02	1.11 E-02	1.80 E-02	1.74 E-02	4.68 E-01	1.82 E-02	9.36 E-03		

*7.59 E-01 = 7.59×10^{-1}

(3) Dose evaluation includes contributions from ground plane exposure, inhalation, and ingestion of cow milk, meat and home grown vegetables.
(4) Dose evaluation includes contributions from ground plane exposure, inhalation, and ingestion of home grown vegetables.

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