**VERMONT YANKEE
NUCLEAR POWER CORPORATION**

Ferry Road, Brattleboro, VT 05301-7002

REPLY TO
ENGINEERING OFFICE
580 MAIN STREET
BOLTON, MA 01740
(508) 779-6711

February 28, 1992
BVY 92-25

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References: a. License No. DPR-28 (Docket No. 50-271)

Subject: Vermont Yankee Effluent and Waste Disposal Semiannual Report for the Third and Fourth Quarters, 1991

Dear Sir:

Enclosed herewith please find one copy of the Vermont Yankee Nuclear Power Corporation subject report. This report covers the period beginning July 1, 1991 and ending December 31, 1991 and is submitted in accordance with our Technical Specification 6.7.C.1 and 10CFR50.36a(a)(2). The annual dose summary to man for 1991 will be submitted in a supplemental report in accordance with Technical Specification 6.7.C.1.b.

We trust that the enclosed information is satisfactory; however, should you have any questions, please contact this office.

Very truly yours,

VERMONT YANKEE NUCLEAR POWER CORPORATION

Leonard A. Tremblay, Jr.

Leonard A. Tremblay, Jr.
Senior Licensing Engineer

cc: USNRC Region I Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS

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Vermont Yankee Nuclear Power Corporation

Vermont Yankee Nuclear Power Station

Vernon, Vermont

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT FOR THIRD AND FOURTH QUARTERS, 1991

Vermont Yankee Nuclear Power Station

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In the Vermont Yankee Effluent and Waste Disposal Semiannual Report covering the third and fourth quarters of 1991, the following corrections should be made:

None.

TABLE 1A

Vermont Yankee

Effluent and Waste Disposal Semiannual Report

Third and Fourth Quarters, 1991

Gaseous Effluents - Summation of All Releases

	Unit	Quarter 3	Quarter 4	Est. Total Error, %
A. Fission and Activation Gases				
1. Total release	Ci	2.76E+02	1.18E+03	±1.00E+02
2. Average release rate for period	uCi/sec	3.51E+01	1.48E+02	
3. Percent of Tech. Spec. limit	%			
B. Iodines				
1. Total Iodine-131	Ci	1.53E-02	3.09E-02	±5.00E+01
2. Average release rate for period	uCi/sec	1.95E-03	3.93E-03	
3. Percent of Tech. Spec. limit	%			
C. Particulates				
1. Particulates with T-1/2 > 8 days	Ci	3.42E-03	1.09E-02	±5.00E+01
2. Average release rate for period	uCi/sec	4.31E-04	1.37E-03	
3. Percent of Tech. Spec. limit	%			
4. Gross alpha radioactivity	Ci	1.14E-06	3.74E-06	
D. Tritium				
1. Total release	Ci	1.84E+01	1.15E+01	±5.00E+01
2. Average release rate for period	uCi/sec	2.34E+00	1.46E+00	
3. Percent of Tech. Spec. limit	%			

TABLE 1B

Vermont Yankee

Effluent and Waste Disposal Semiannual Report

Third and Fourth Quarters, 1991

Gaseous Effluents - Elevated Release

Nuclides Released	Unit	Continuous Mode Quarter 3	Continuous Mode Quarter 4	Batch Mode (1) Quarter 3	Batch Mode (1) Quarter 4
1. Fission Gases					
Krypton-85	Ci	ND	ND		
Krypton-85m	Ci	1.80E+00	4.99E+00		
Krypton-87	Ci	8.93E+00	2.94E+01		
Krypton-88	Ci	5.90E+00	1.81E+01		
Xenon-133	Ci	1.59E+00	4.04E+00		
Xenon-135	Ci	8.29E+00	2.61E+01		
Xenon-135m	Ci	4.42E+01	1.70E+02		
Xenon-138	Ci	2.05E+02	7.87E+02		
Unidentified	Ci				
Total for period	Ci	2.76E+02	1.04E+03		
2. Iodines					
Iodine-131	Ci	1.53E-02	2.14E-02		
Iodine-133	Ci	5.49E-02	9.02E-02		
Iodine-135	Ci	9.62E-02	1.28E-01		
Total for period	Ci	1.66E-01	2.40E-01		
3. Particulates					
Strontium-89	Ci	9.68E-04	1.74E-03		
Strontium-90	Ci	5.76E-06	2.82E-05		
Cesium-134	Ci	ND	4.06E-06		
Cesium-137	Ci	1.91E-05	4.23E-05		
Barium-Lanthanum-140	Ci	2.42E-03	5.65E-03		
Cerium-141	Ci	1.33E-05	1.98E-04		

(1) There were no batch mode gaseous releases for this reporting period.

ND - Not detected at the plant stack.

TABLE 1C

Vermont Yankee

Effluent and Waste Disposal Semiannual Report

Third and Fourth Quarters 1991

Gaseous Effluents - Ground Level Releases

Nuclides Released	Unit	Continuous Mode Quarter 3	Continuous Mode Quarter 4	Batch Mode (1) Quarter 3	Batch Mode (1) Quarter 4
1. Fission Gases					
Krypton-85	Ci		ND		
Krypton-85m	Ci		6.62E-01		
Krypton-87	Ci		3.92E+00		
Krypton-88	Ci		2.40E+00		
Xenon-133	Ci		5.34E-01		
Xenon-135	Ci		3.48E+00		
Xenon-135m	Ci		2.13E+01		
Xenon-138	Ci		1.03E+02		
Unidentified	Ci				
Total for period	Ci		1.35E+02		
2. Iodines					
Iodine-131	Ci		9.50E-03		
Iodine-133	Ci		4.76E-02		
Iodine-135	Ci		6.39E-02		
Total for period	Ci		1.21E-01		
3. Particulates					
Strontium-89	Ci		1.01E-03		
Strontium-90	Ci		1.42E-05		
Cesium-134	Ci		ND		
Cesium-137	Ci		ND		
Barium-Lanthanum-140	Ci		2.08E-03		
Cerium-141	Ci		8.92E-05		

(1) There were no batch mode gaseous releases for this reporting period.
ND - Not detected at the turbine roof.

TABLE 1D

Vermont Yankee

Effluent and Waste Disposal Semiannual Report

Third and Fourth Quarters 1991

Gaseous Effluents - Nonroutine Releases

There were no nonroutine or accidental gaseous releases during the third or fourth quarters of 1991.

TABLE 2A

Vermont Yankee

Effluent and Waste Disposal Semiannual Report

Third and Fourth Quarters 1991

Liquid Effluents - Summation of All Releases

There were no liquid releases during the third or fourth quarters of 1991.

TABLE 2B

Vermont Yankee

Effluent and Waste Disposal Semiannual Report

Third and Fourth Quarters 1991

Liquid Effluents - Nonroutine Releases

There were no nonroutine or accidental releases during the third or fourth quarters of 1991.

TABLE 3

Vermont Yankee

Effluent and Waste Disposal Semiannual Report

Third and Fourth Quarters, 1991

Solid Waste and Irradiated Fuel Shipments

A. Solid Waste Shipped Off-Site for Burial or Disposal (Not Irradiated Fuel):

1. Type of Waste	Unit	6-Month Period	Est. Total Error, %
a. Spent resins, filter sludges, evaporator bottoms, etc.	m^3	2.90E+01	
	Ci	1.55E+02	
b. Dry compressible waste, contaminated equipment, etc.	m^3	4.89E+01	
	Ci	3.51E+01	
c. Irradiated components, control rods, etc.	m^3	8.13E+00	
	Ci	1.80E+05	

2. Estimate of Major Nuclide Composition (By Type of Waste):

a.	Cobalt-60	%	1.76E+01		Cesium-137	%	4.00E+00
	Zinc-65	%	1.70E+01		Cesium-134	%	2.40E+00
	Cesium-137	%	1.54E+01		Nickel-63	%	8.00E-01
	Iron-[illegible]	%	1.20E+01	c.	Cobalt-60	%	9.32E+01
	Iodine-131	%	1.03E+01		Iron-55	%	6.20E+00
	Xenon-131m	%	8.30E+00		Nickel-63	%	4.00E-01
	Cesium-134	%	6.70E+00			%	
	Bariam-140	%	5.20E+00			%	
	Lanthanum-140	%	5.20E+00			%	
	Nickel-63	%	2.30E+00			%	
b.	Iron-55	%	5.76E+01			%	
	Cobalt-60	%	1.76E+01			%	
	Zinc-65	%	6.40E+00			%	
	Manganese-54	%	4.80E+00			%	

3. Solid Waste Disposition:

Number of Shipments	Mode of Transportation	Destination
13	Truck	Barnwell, SC
1	Truck	Richland, WA

B. Irradiated Fuel Shipments (Disposition): None

C. Supplemental information
1) Class of solid waste containers shipped: 46 A (unstable), 2A, 4B, 5C
2) Types of containers used: 46 Strong-tight Containers, 6 Type A, 5 Type B
3) Solidification agent or absorbent: None

TABLE 5A

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA   STABILITY CLASS A   CLASS FREQUENCY (PERCENT) = .14

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
C-3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
(1)	.00	.00	.00	8.33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	8.33
(2)	.00	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
4-7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
(1)	8.33	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	8.33
(2)	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
8-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	25.00	.00	25.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.04	.00	.04
13-18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	25.00	.00	25.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.04	.00	.04
19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	3
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	8.33	.00	16.67	.00	25.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.02	.00	.04
GT 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	8.33	.00	8.33
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.01
ALL SPEEDS	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	9	0	12
(1)	8.33	.00	.00	8.33	.00	.00	.00	.00	.00	.00	.00	.00	.00	8.33	.00	75.00	.00	100.00
(2)	.01	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.11	.00	.14

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

TABLE 5B

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA STABILITY CLASS B CLASS FREQUENCY (PERCENT) = .70

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
C-3	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	4
(1)	.00	1.69	1.69	.00	.00	1.69	1.69	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	6.78
(2)	.00	.01	.01	.00	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.05
4-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	6.78	.00	6.78
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.05	.00	.05
8-12	2	0	0	0	0	0	2	2	0	0	0	0	1	0	0	18	0	25
(1)	3.39	.00	.00	.00	.00	.00	3.39	3.39	.00	.00	.00	.00	1.69	.00	.00	30.51	.00	42.37
(2)	.02	.00	.00	.00	.00	.00	.02	.02	.00	.00	.00	.00	.01	.00	.00	.21	.00	.30
13-18	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	6	0	8
(1)	.00	.00	.00	.00	.00	.00	.00	1.69	.00	.00	.00	.00	.00	.00	1.69	10.17	.00	13.56
(2)	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.00	.00	.00	.01	.07	.00	.10
19-24	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	14
(1)	6.78	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	16.95	.00	23.73
(2)	.05	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.12	.00	.17
GT 24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	4
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	1.69	.00	5.08	.00	6.78
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.04	.00	.05
ALL SPEEDS	6	1	1	0	0	1	3	3	0	0	0	0	1	1	1	41	0	59
(1)	10.17	1.69	1.69	.00	.00	1.69	5.08	5.08	.00	.00	.00	.00	1.69	1.69	1.69	69.49	.00	100.00
(2)	.07	.01	.01	.00	.00	.01	.04	.04	.00	.00	.00	.00	.01	.01	.01	.49	.00	.70

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

TABLE 5C

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA STABILITY CLASS C CLASS FREQUENCY (PERCENT) = 2.20

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
C-3	0	1	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	5
(1)	.00	.54	.00	1.08	.00	.00	.54	.54	.00	.00	.00	.00	.00	.00	.00	.00	.00	2.70
(2)	.00	.01	.00	.02	.00	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.06
4-7	4	1	1	1	0	1	1	0	1	0	0	0	1	0	3	13	0	27
(1)	2.16	.54	.54	.54	.00	.54	.54	.00	.54	.00	.00	.00	.54	.00	1.62	7.03	.00	14.59
(2)	.05	.01	.01	.01	.00	.01	.01	.00	.01	.00	.00	.00	.01	.00	.04	.15	.00	.32
8-12	8	3	0	1	1	5	2	13	6	0	0	1	1	3	5	20	0	69
(1)	4.32	1.62	.00	.54	.54	2.70	1.08	7.03	3.24	.00	.00	.54	.54	1.62	2.70	10.81	.00	37.30
(2)	.10	.04	.00	.01	.01	.06	.02	.15	.07	.00	.00	.01	.01	.04	.06	.24	.00	.82
13-18	7	1	0	0	0	0	0	2	3	0	0	0	1	3	7	28	0	52
(1)	3.78	.54	.00	.00	.00	.00	.00	1.08	1.62	.00	.00	.00	.54	1.62	3.78	15.14	.00	28.11
(2)	.08	.01	.00	.00	.00	.00	.00	.02	.04	.00	.00	.00	.01	.04	.08	.33	.00	.62
19-24	2	0	0	0	0	0	0	0	0	1	0	0	1	2	0	21	0	27
(1)	1.08	.00	.00	.00	.00	.00	.00	.00	.00	.54	.00	.00	.54	1.08	.00	11.35	.00	14.59
(2)	.02	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.01	.02	.00	.25	.00	.32
GT 24	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	5
(1)	.54	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.54	.00	1.62	.00	2.70
(2)	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.04	.00	.06
ALL SPEEDS	22	6	1	4	1	6	4	16	10	1	0	1	4	9	15	85	0	185
(1)	11.89	3.24	.54	2.16	.54	3.24	2.16	8.65	5.41	.54	.00	.54	2.16	4.86	8.11	45.95	.00	100.00
(2)	.26	.07	.01	.05	.01	.07	.05	.19	.12	.01	.00	.01	.05	.11	.18	1.01	.00	2.20

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

TABLE 5D

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA STABILITY CLASS D CLASS FREQUENCY (PERCENT) = 47.39

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
C-3	50	33	28	19	34	38	59	36	27	12	9	12	12	11	31	44	0	455
(1)	1.26	.83	.70	.48	.85	.95	1.48	.90	.68	.30	.23	.30	.30	.28	.78	1.10	.00	11.42
(2)	.59	.39	.33	.23	.40	.45	.70	.43	.32	.14	.11	.14	.14	.13	.37	.52	.00	5.41
4-7	101	38	24	27	41	73	145	140	77	31	18	11	22	26	45	170	0	989
(1)	2.54	.95	.60	.68	1.03	1.83	3.64	3.51	1.93	.78	.45	.28	.55	.65	1.13	4.27	.00	24.82
(2)	1.20	.45	.29	.32	.49	.87	1.72	1.67	.92	.37	.21	.13	.26	.31	.54	2.02	.00	11.77
8-12	132	30	9	9	20	41	79	129	194	37	38	37	70	113	60	193	0	1191
(1)	3.31	.75	.23	.23	.50	1.03	1.98	3.24	4.87	.93	.95	.93	1.76	2.84	1.51	4.84	.00	29.89
(2)	1.57	.36	.11	.11	.24	.49	.94	1.53	2.31	.44	.45	.44	.83	1.34	.71	2.30	.00	14.17
13-18	[illegible]	39	8	2	5	8	5	10	71	25	12	16	85	156	108	229	0	948
(1)	4.24	.98	.20	.05	.13	.20	.13	.25	1.78	.63	.30	.40	2.13	3.92	2.71	5.75	.00	23.80
(2)	2.01	.46	.10	.02	.06	.10	.06	.12	.84	.30	.14	.19	1.01	1.86	1.28	2.72	.00	11.28
19-24	63	2	1	0	0	0	3	2	12	3	0	0	29	50	46	91	0	302
(1)	1.58	.05	.03	.00	.00	.00	.08	.05	.30	.08	.00	.00	.73	1.26	1.15	2.28	.00	7.58
(2)	.75	.02	.01	.00	.00	.00	.04	.02	.14	.04	.00	.00	.34	.59	.55	1.08	.00	3.59
GT 24	21	0	0	0	0	0	0	0	0	0	0	0	5	12	16	45	0	99
(1)	.53	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.13	.30	.40	1.13	.00	2.48
(2)	.25	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.06	.14	.19	.54	.00	1.18
ALL SPEEDS	536	142	70	57	100	160	291	317	381	108	77	76	223	368	306	772	0	3984
(1)	13.45	3.56	1.76	1.43	2.51	4.02	7.30	7.96	9.56	2.71	1.93	1.91	5.60	9.24	7.68	19.38	.00	100.00
(2)	6.38	1.69	.83	.68	1.19	1.90	3.46	3.77	4.53	1.28	.92	.90	2.65	4.38	3.64	9.18	.00	47.39

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

TABLE 5E

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA STABILITY CLASS E CLASS FREQUENCY (PERCENT) = 33.21

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	2
(1)	.00	.00	.00	.00	.00	.00	.00	.04	.00	.00	.00	.00	.00	.00	.00	.04	.00	.07
(2)	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.01	.00	.02
C-3	87	52	50	43	54	69	74	44	22	15	6	9	16	18	34	72	0	665
(1)	3.12	1.86	1.79	1.54	1.93	2.47	2.65	1.58	.79	.54	.21	.32	.57	.64	1.22	2.58	.00	23.82
(2)	1.03	.62	.59	.51	.64	.82	.88	.52	.26	.18	.07	.11	.19	.21	.40	.86	.00	7.91
4-7	180	19	8	15	19	40	140	143	70	24	16	19	19	21	51	243	0	1027
(1)	6.45	.68	.29	.54	.68	1.43	5.01	5.12	2.51	.86	.57	.68	.68	.75	1.83	8.70	.00	36.78
(2)	2.14	.23	.10	.18	.23	.48	1.67	1.70	.83	.29	.19	.23	.23	.25	.61	2.89	.00	12.22
8-12	70	6	2	1	1	8	36	98	88	36	15	16	40	54	45	209	0	725
(1)	2.51	.21	.07	.04	.04	.29	1.29	3.51	3.15	1.29	.54	.57	1.43	1.93	1.61	7.49	.00	25.97
(2)	.83	.07	.02	.01	.01	.10	.43	1.17	1.05	.43	.18	.19	.48	.64	.54	2.49	.00	8.62
13-18	31	1	0	1	0	0	3	25	37	18	3	4	28	39	[illegible]	111	0	324
(1)	1.11	.04	.00	.04	.00	.00	.11	.90	1.33	.64	.11	.14	1.00	1.40	.82	3.98	.00	11.60
(2)	.37	.01	.00	.01	.00	.00	.04	.30	.44	.21	.04	.05	.33	.46	.27	1.32	.00	3.85
19-24	5	0	0	0	0	0	1	1	8	1	0	2	2	6	5	13	0	44
(1)	.18	.00	.00	.00	.00	.00	.04	.04	.29	.04	.00	.07	.07	.21	.18	.47	.00	1.58
(2)	.06	.00	.00	.00	.00	.00	.01	.01	.10	.01	.00	.02	.02	.07	.06	.15	.00	.52
GT 24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	[illegible]	0	5
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.04	.04	.11	.00	.18
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.01	.04	.00	.06
ALL SPEEDS	373	78	60	60	7[illegible]	117	254	312	225	94	40	50	105	139	159	652	0	2792
(1)	13.36	2.79	2.15	2.15	2.65	4.19	9.10	11.17	8.06	3.37	1.43	1.79	3.76	4.98	5.69	23.35	.00	100.00
(2)	4.44	.93	.71	.71	.8[illegible]	1.39	3.02	3.71	2.68	1.12	.48	.59	1.25	1.65	1.89	7.76	.00	33.21

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

TABLE 5F

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA STABILITY CLASS F CLASS FREQUENCY (PERCENT) = 14.04

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.08	.00	.00	.00	.08
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.01
C-3	42	42	25	25	38	36	47	37	27	19	10	8	12	14	22	37	0	441
(1)	3.56	3.56	2.12	2.12	3.22	3.05	3.98	3.14	2.29	1.61	.85	.68	1.02	1.19	1.86	3.14	.00	37.37
(2)	.50	.50	.30	.30	.45	.43	.56	.44	.32	.23	.12	.10	.14	.17	.26	.44	.00	5.25
4-7	54	11	5	4	12	40	101	94	39	16	11	9	13	14	29	84	0	536
(1)	4.58	.93	.42	.34	1.02	3.39	8.56	7.97	3.31	1.36	.93	.76	1.10	1.19	2.46	7.12	.00	45.42
(2)	.64	.13	.06	.05	.14	.48	1.20	1.12	.46	.19	.13	.11	.15	.17	.34	1.00	.00	6.38
8-12	11	1	0	0	0	1	14	30	23	5	8	3	9	17	14	44	0	180
(1)	.93	.08	.00	.00	.00	.08	1.19	2.54	1.95	.42	.68	.25	.76	1.44	1.19	3.73	.00	15.25
(2)	.13	.01	.00	.00	.00	.01	.17	.36	.27	.06	.10	.04	.11	.20	.17	.52	.00	2.14
13-18	1	0	0	0	0	0	0	0	4	1	1	0	2	3	3	6	0	21
(1)	.08	.00	.00	.00	.00	.00	.00	.00	.34	.08	.08	.00	.17	.25	.25	.51	.00	1.78
(2)	.01	.00	.00	.00	.00	.00	.00	.00	.05	.01	.01	.00	.02	.04	.04	.07	.00	.25
19-24	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.08	.00	.00	.00	.08
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.01
GT 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ALL SPEEDS	108	54	30	29	50	77	162	161	93	41	30	20	36	50	68	171	0	1180
(1)	9.15	4.58	2.54	2.46	4.24	6.53	13.73	13.64	7.88	3.47	2.54	1.69	3.05	4.24	5.76	14.49	.00	100.00
(2)	1.28	.64	.36	.34	.59	.92	1.93	1.92	1.11	.49	.36	.24	.43	.59	.81	2.03	.00	14.04

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

TABLE 5G

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA STABILITY CLASS G CLASS FREQUENCY (PERCENT) = 2.31

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
C-3	4	3	2	4	1	3	1	8	5	8	4	5	2	3	0	1	0	54
(1)	2.06	1.55	1.03	2.06	.52	1.55	.52	4.12	2.58	4.12	2.06	2.58	1.03	1.55	.00	.52	.00	27.84
(2)	.05	.04	.02	.05	.01	.04	.01	.10	.06	.10	.05	.06	.02	.04	.00	.01	.00	.64
4-7	5	2	1	1	1	5	11	16	8	6	6	3	7	10	5	4	0	91
(1)	2.58	1.03	.52	.52	.52	2.58	5.67	8.25	4.12	3.09	3.09	1.55	3.61	5.15	2.58	2.06	.00	46.91
(2)	.06	.02	.01	.01	.01	.06	.13	.19	.10	.07	.07	.04	.08	.12	.06	.05	.00	1.08
8-12	4	0	0	0	0	0	2	12	2	4	1	4	2	6	0	5	0	42
(1)	2.06	.00	.00	.00	.00	.00	1.03	6.19	1.03	2.06	.52	2.06	1.03	3.09	.00	2.58	.00	21.65
(2)	.05	.00	.00	.00	.00	.00	.02	.14	.02	.05	.01	.05	.02	.07	.00	.06	.00	.50
13-18	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	2	0	6
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.52	.00	.00	.00	.52	1.03	1.03	.00	3.09
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.01	.02	.02	.00	.07
19-24	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.52	.00	.00	.00	.00	.00	.00	.00	.00	.52
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.01
GT 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ALL SPEEDS	13	5	3	5	2	8	14	36	16	19	11	12	11	20	7	12	0	194
(1)	6.70	2.58	1.55	2.58	1.03	4.12	7.22	18.56	8.25	9.79	5.67	6.19	5.67	10.31	3.61	6.19	.00	100.00
(2)	.15	.06	.04	.06	.02	.10	.17	.43	.19	.23	.13	.14	.13	.24	.08	.14	.00	2.31

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

TABLE 5H

VERMONT YANKEE JAN91-DEC91 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

297.0 FT WIND DATA   STABILITY CLASS ALL   CLASS FREQUENCY (PERCENT) = 100.00

WIND DIRECTION FROM

SPEED(MPH)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	3
(1)	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.00	.00	.01	.00	.01	.00	.04
(2)	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.00	.00	.01	.00	.01	.00	.04
C-3	183	132	106	94	127	147	183	126	81	54	29	34	42	46	87	154	0	1625
(1)	2.18	1.57	1.26	1.12	1.51	1.75	2.18	1.50	.96	.64	.34	.40	.50	.55	1.03	1.83	.00	19.33
(2)	2.18	1.57	1.26	1.12	1.51	1.75	2.18	1.50	.96	.64	.34	.40	.50	.55	1.03	1.83	.00	19.33
4-7	345	71	39	48	73	159	398	393	195	77	51	42	62	71	133	518	0	2675
(1)	4.10	.84	.46	.57	.87	1.89	4.73	4.68	2.32	.92	.61	.50	.74	.84	1.58	6.16	.00	31.82
(2)	4.10	.84	.46	.57	.87	1.89	4.73	4.68	2.32	.92	.61	.50	.74	.84	1.58	6.16	.00	31.82
8-12	227	40	11	11	22	55	135	284	313	82	62	61	123	193	124	492	0	2235
(1)	2.70	.48	.13	.13	.26	.65	1.61	3.38	3.72	.98	.74	.73	1.46	2.30	1.48	5.85	.00	26.59
(2)	2.70	.48	.13	.13	.26	.65	1.61	3.38	3.72	.98	.74	.73	1.46	2.30	1.48	5.85	.00	26.59
13-18	208	41	8	3	5	8	8	38	115	45	16	20	116	202	144	385	0	1362
(1)	2.47	.49	.10	.04	.06	.10	.10	.45	1.37	.54	.19	.24	1.38	2.40	1.71	4.58	.00	16.20
(2)	2.47	.49	.10	.04	.06	.10	.10	.45	1.37	.54	.19	.24	1.38	2.40	1.71	4.58	.00	16.20
19-24	74	2	1	0	0	0	4	3	21	5	0	2	32	60	51	137	0	392
(1)	.88	.02	.01	.00	.00	.00	.05	.04	.25	.06	.00	.02	.38	.71	.61	1.63	.00	4.66
(2)	.88	.02	.01	.00	.00	.00	.05	.04	.25	.06	.00	.02	.38	.71	.61	1.63	.00	4.66
GT 24	22	0	0	0	0	0	0	0	0	0	0	0	5	15	17	55	0	114
(1)	.26	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.06	.18	.20	.65	.00	1.36
(2)	.26	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.06	.18	.20	.65	.00	1.36
ALL SPEEDS	1059	286	165	156	227	369	728	845	725	263	158	159	380	588	556	1742	0	8406
(1)	12.60	3.40	1.96	1.86	2.70	4.39	8.66	10.05	8.62	3.13	1.88	1.89	4.52	7.00	6.61	20.72	.00	100.00
(2)	12.60	3.40	1.96	1.86	2.70	4.39	8.66	10.05	8.62	3.13	1.88	1.89	4.52	7.00	6.61	20.72	.00	100.00

(1)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PAGE
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD C= CALM (WIND SPEED LESS THAN OR EQUAL TO .95 MPH)

APPENDIX A

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

Supplemental Information
Third and Fourth Quarters, 1991

Facility: Vermont Yankee Nuclear Power Station

Licensee: Vermont Yankee Nuclear Power Corporation

1A. Technical Specification Limits - Dose and Dose Rate

Technical Specification and Category		Limit
a. Noble Gases		
3.8.E.1	Total body dose rate	500 mrem/yr
3.8.E.1	Skin dose rate	3000 mrem/yr
3.8.F.1	Gamma air dose	5 mrad in a quarter
3.8.F.1	Gamma air dose	10 mrad in a year
3.8.F.1	Beta air dose	10 mrad in a quarter
3.8.F.1	Beta air dose	20 mrad in a year
b. Iodine-131, Iodine-133, Tritium and Radionuclides in Particulate Form With Half-Lives Greater Than 8 Days		
3.8.E.1	Organ dose rate	1500 mrem/yr
3.8.G.1	Organ dose	7.5 mrem in a quarter
3.8.G.1	Organ dose	15 mrem in a year
c. Liquids		
3.8.B.1	Total body dose	1.5 mrem in a quarter
3.8.B.1	Total body dose	3 mrem in a year
3.8.B.1	Organ dose	5 mrem in a quarter
3.8.B.1	Organ dose	10 mrem in a year

2A. Technical Specification Limits - Concentration

Technical Specification and Category	Limit
a. Noble Gases	No MPC limits
b. Iodine-131, Iodine-133, Tritium and Radionuclides in Particulate Form With Half-Lives Greater Than 8 Days:	No MPC limits
c. Liquids	
3.8.A.1 Total fraction of MPC excluding noble gases (10CFR20, Appendix B, Table II, Column 2):	≤1.0
3.8.A.1 Total noble gas concentration:	≤2E-04 uCi/cc

3. Average Energy
Provided below are the average energy ($\bar{E}$) of the radionuclide mixture in releases of fission and activation gases, if applicable.

a. Average gamma energy: 3rd Quarter 1.11E+00 MeV/dis
4th Quarter 1.12E+00 MeV/dis

b. Average beta energy: Not Applicable

4. Measurements and Approximations of Total Radioactivity

Provided below are the methods used to measure or approximate the total radioactivity in effluents and the methods used to determine radionuclide composition.

a. Fission and Activation Gases

Continuous stack monitors monitor gross Noble Gas radioactivity released from the plant stack. Total Noble Gas release rates are calculated using this monitor. On days the monitor shows less than detectable release of fission gases, a zero release is considered. To determine the isotopic breakdown of the release, samples are taken of the Steam Jet Air Ejector, which is the source gas for the releases. These samples are analyzed by gamma spectroscopy to determine the isotopic composition. The isotopic composition is then proportioned to the gross releases determined from the stack monitor to quantify the individual isotopic releases. These are indicated in Table 1B and the totals of Table 1A.

Beginning in the fourth quarter of 1991, grab samples were obtained from the Turbine Building roof vents. Only Xe-135 was detected in these samples. The remainder of the gases indicated were calculated by ratioing the indicated Xe-135 to the other gases using the Steam Jet Air Ejector samples as mentioned above. These results are indicated in Table 1C and the totals of Table 1A.

The error involved in these steps may be approximately ±100 percent.

b. Iodines

Continuous isokinetic samples are drawn from the plant stack through a particulate filter and charcoal cartridge. Beginning in the fourth quarter of 1991, continuous particulate and charcoal samples were also taken at the Turbine Building roof vents. The filters and cartridges are normally removed weekly and are analyzed for Iodine-131, 132, 133, 134, and 135. The error involved in these steps may be approximately ±50 percent.

c. Particulates

The particulate filters described in b. above are also counted for particulate radioactivity. The error involved in this sample is also approximately ±50 percent.

d. Liquid Effluents

Radioactive liquid effluents released from the facility are continuously monitored. Measurements are also made on a representative sample of each batch of radioactive liquid effluents released. For each batch, station records are retained of the total activity (mCi) released, concentration (uCi/ml) of gross radioactivity, volume (liters), and approximate total quantity of water (liters) used to dilute the liquid effluent prior to release to the Connecticut River.

Each batch of radioactive liquid effluent released is analyzed for gross gamma and gamma isotopic radioactivity. A monthly proportional composite sample, comprising an aliquot of each batch released during a month, is also analyzed for tritium, SR-89, SR-90, gross beta and gross alpha radioactivity, in addition to gamma spectroscopy.

There were no liquid releases during the reporting period.

5. Batch Releases

a. Liquid

There were no routine liquid batch releases during the reporting period.

b. Gaseous

There were no routine gaseous batch releases during the reporting period.

6. Abnormal Releases

a. Liquid

There were no nonroutine liquid releases during the reporting period.

b. Gaseous

There were no nonroutine gaseous releases during the reporting period.

APPENDIX B

LIQUID HOLDUP TANKS

Requirement: Technical Specification 3.8.D.1 limits the quantity of radioactive material contained in any outside tank. With the quantity of radioactive material in any outside tank exceeding the limits of Technical Specification 3.8.D.1, a description of the events leading to this condition is required in the next Semiannual Effluent Release Report per Technical Specification 6.7.C.1.

Response: The limits of Technical Specification 3.8.D.1 were not exceeded during this reporting period.

APPENDIX C

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

Requirement: Radioactive liquid effluent monitoring instrumentation channels are required to be operable in accordance with Technical Specification Table 3.9.1. If an inoperable radioactive liquid effluent monitoring instrument is not returned to operable status prior to a release pursuant to Note 4 of Table 3.9.1, an explanation in the next Semiannual Effluent Release Report of the reason(s) for delay in correcting the inoperability are required per Technical Specification 6.7.C.1.

Response: Since the requirements of Technical Specification Table 3.9.1 governing the operability of radioactive liquid effluent monitoring instrumentation were met for this reporting period, no response is required.

APPENDIX D

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

Requirement: Radioactive gaseous effluent monitoring instrumentation channels are required to be operable in accordance with Tecnnical Specification Table 3.9.2. If inoperable gaseous effluent monitoring instrumentation is not returned to operable status within 30 days pursuant to Note 5 of Table 3.9.2, an explanation in the next Semiannual Effluent Release Report of the reason(s) for the delay in correcting the inoperability is required per Technical Specification 6.7.C.1.

Response: Since the requirements of Technical Specification Table 3.9.2 governing the operability of radioactive gaseous effluent monitoring instrumentation were met for this reporting period, no response is required.

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Requirement: The radiological environmental monitoring program is conducted in accordance with Technical Specification 3.9.C. With milk samples no longer available from one or more of the sample locations required by Technical Specification Table 3.9.3, Technical Specification 6.7.C.1 requires the following to be included in the next Semiannual Effluent Release Report: (1) identify the cause(s) of the sample(s) no longer being available, (2) identify the new location(s) for obtaining available replacement samples and (3) include revised ODCM figure(s) and table(s) reflecting the new location(s).

Response: The dairy farm at Station TM-16/TC-16 went out of business and was sold at auction in July of 1991. A substitute location was chosen to replace it, and the first samples were collected there in July of 1991. The new milk and cattle feed sampling location is designated TM-15 and TC-15 (for milk and cattle feed, respectively). These changes were made to the ODCM as Revision 11. The changed ODCM pages are attached to Appendix H.

APPENDIX F

LAND USE CENSUS

Requirement: A land use census is conducted in accordance with Technical Specification 3.9.D. With a land use census identifying a location(s) which yields at least a 20 percent greater dose or dose commitment than the values currently being calculated in Technical Specification 4.8.G.1, Technical Specification 6.7.C.1 requires the identification of the new location(s) in the next Semiannual Effluent Release Report.

Response: No locations were identified by the 1991 land use census that would yield at least a 20 percent greater dose or dose commitment than the values currently being calculated pursuant to Technical Specification 4.8.G.1.

APPENDIX G

PROCESS CONTROL PROGRAM

Requirement: Technical Specification 6.12.A.1 requires that licensee initiated changes to the Process Control Program (PCP) be submitted to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the change(s) was made.

Response: The Process Control Program was revised to include the following paragraph at the end of Section 3.0 during this reporting period:

"Vendor supplied or temporary methods of processing resins may be used in lieu of the above process provided that the vendor or temporary process meets the requirements of quality described above and does not conflict with accepted burial criteria or safety requirements. Such methods will be reviewed and approved by the Plant Health Physicist and the Radiation Protection Supervisor prior to implementation."

This change did not reduce the overall conformance of the dewatered spent resins/filter media waste product to existing criteria for solid waste shipments and disposal. It allows the use of qualified vendor supplied or temporary methods of processing resins.

The revised PCP is attached.

VERMONT YANKEE NUCLEAR POWER CORPORATION

PROCESS CONTROL PROGRAM

REV 2

09/18/91

Submitted ____________________
Radiation Protection Supervisor

MTG # 91-64

Approved ____________________
PORC

Approved ____________________
Plant Manager

Approved ____________________ FOR Warren P. Murphy
Sr. Vice President, Operations

VERMONT YANKEE NUCLEAR POWER CORPORATION

PROCESS CONTROL PROGRAM

Introduction:

The Vermont Yankee Nuclear Power Corporation Process Control Program (PCP) describes the administrative and technical controls on the radioactive waste systems which provide assurances that Vermont Yankee meets federal shipping and burial site requirements.

The PCP describes process parameters, controls, and sampling to ensure compliance with 10 CFR Part 71, 10 CFR Part 61, Department of Transportation, state, and burial site regulation requirements.

1.0 Solidification

Vermont Yankee Nuclear Power Corporation does not routinely solidify liquid waste. If the use of solidification to dispose of any liquid waste is required, it will be done by an outside vendor under the vendor's PCP. This PCP will be reviewed and approved by the plant Health Physicist, and the Radiation Protection Supervisor prior to implementation. This review is to identify that there is sufficient supporting documentation of the vendor's PCP to give assurance that the final product will meet all requirements for transport and burial, and that sufficient procedural controls exist to assure safe operations.

2.0 Cartridge Filter Elements

Cartridge filter elements will be air dried and compacted as dry active waste. Filters that are too radioactive to be disposed of in this manner will be placed in spent resin liners for disposal.

3.0 Resins

Vermont Yankee for many years has produced radioactive waste in the form of dewatered resins. The method employed for dewatering is a Bird centrifuge. The resin is then discharged via a hopper into a burial container formed to fit into an approved shipping cask.

Commercial ion exchange resins have a certain moisture content in the form of bound water resulting from the hygroscopic properties of the resin. Beyond this, ion exchange resins can take up free water or surface water which can be removed by centrifuging. The resulting moisture content is expressed in percent of moisture per weight of dry resin.

A number of methods can be used to determine the bound water in ion exchange resins. Oven drying or azeotropic distillation are techniques which are generally used for high polymers. Vermont Yankee used oven drying to determine moisture content in the radioactive spent resins. Graver Water Conditioning Company technical manuals were consulted for the moisture content of unused ion exchange resins.

After centrifuging and discharge to the cask liner, a spent resin sample was obtained. The sample was immediately weighed, then oven dried for 12 hours and re-weighed. The moisture content of the centrifuged spent resin was calculated to be 59.6%. The moisture content of the unused mixtures of resins is between [illegible] and [illegible]. This shows the spent resins are dewatered such that only bound water remains.

A second method was used to determine if vibration would leach water from the unused resin. A lab centrifuge was set up with resin and resin plus filter aid mixtures. The centrifuge was set for 700 RPM for 30 minutes. No free water was observed in any of the mixtures.

The results of these tests showed that the moisture content of centrifuge processed resins was less than or equal to mixtures of unused commercial grade ion exchange resins. At these moisture contents, all the water remains bound even after severe vibration in a centrifuge, therefore it is concluded that Vermont Yankee's centrifuged spent resins do not include any free-standing liquids.

To comply with the statement, "Any liquids present in waste packages shall be non-corrosive with respect to the container", Vermont Yankee tested the pH of various resin mixtures used by the plant in solution with water. The range was found to be 4.2 - 8.4. A solution is not considered corrosive to iron if the pH is greater than 4.0.

A resin sample is taken from each liner prior to shipment. The sample is counted to determine the activity and waste classification. The majority of the resins generated are Class A waste. All Class B or C resins will be disposed of in an approved High Integrity Container (HIC).

Vendor supplied or temporary methods of processing resins may be used in lieu of the above process provided that the vendor or temporary process meets the requirements of quality described above and does not conflict with accepted burial criteria or safety requirements. Such methods will be reviewed and approved by the Plant Health Physicist and the Radiation Protection Supervisor prior to implementation.

4.0 Filter Liners

During refueling outages and normal operation, liquid radwaste processing may require use of a decanting filter on the condensate phase separators. A floating suction is used to decant the water and resin into a filter liner. Filtered water is pumped form the liner. When use of the liner is completed, a vacuum pump is attached to dewater the resin in the liner. The liner is dewatered for a minimum of 48 hours and until no more water is viewed from the pump discharge. A resin sample is taken from the liner and counted to determine the activity and waste classification.

5.0 Dry Active Waste (DAW)

All DAW is examined before being compacted. Any liquids or items found that would compromise the integrity of the package are removed and separated as specified by procedure. All waste is compacted into boxes using a box compactor. Containers used for DAW shipments meet the criteria of 49 CFR 173.425a. or b. "No leakage of radioactive material" as specified in 49 CFR 173.425.b.1 will be met provided that no radioactive materials in quantities equal to or exceeding those specified in 49 CFR 173.443 are detected on the external surfaces of the package at any time during shipment.

6.0 Chelating Agents

In order to comply with 10 CFR [illegible], chelating agents are controlled by the plant chemistry department using procedure AP 0520.

7.0 Explosive Waste

No waste capable of detonation or of explosive decomposition or reaction will be disposed as per 10 CFR 61.56(a)(4).

8.0 Toxic Waste

No waste capable of generating toxic gases, vapors, or fumes will be disposed as per 10 CFR 61.56(a)(5).

9.0 Pyrophoric Waste

No waste that is pyrophoric will be disposed as per 10 CFR 61.56(a)(6).

10.0 High Integrity Containers

Vermont Yankee Nuclear Power Corporation has contracted with various suppliers of approved HICs. South Carolina has approved PCPs for HICs used by Vermont Yankee. Any HIC Vermont Yankee may choose to use at some future time, will meet all applicable requirements.

11.0 Waste Class Determination

Vermont Yankee periodically performs laboratory analysis on all waste streams to determine the activity of radionuclides listed in Tables 1 and 2 of 10 CFR 61. Correlation analysis shows that the relative concentration of each radionuclide, with respect to the overall activity in a given Vermont Yankee waste stream, remains constant over time. A set of scaling factors is determined which allows the activity of 10 CFR 61 radionuclides to be estimated using the results of gamma spectrometric analysis or direct gamma dose rate measurements.

For resin wastes, analysis is performed on samples of each source of resin comprising the contents of a burial container. Scaling factors are applied to the activity of radionuclides identified by gamma spectrometry analysis to determine the activity of those radionuclides which are not detected in the gamma spectrum.

For DAW, dose rate-to-curie conversion calculations are performed to determine the total activity present in a container. Scaling factors are applied to the container's total curie content to determine the activity of individual radionuclides.

Once the activity of each radionuclide in a burial container is estimated, the waste classification is derived using methods required by 10 CFR 61.

Specific procedures for waste class determination are contained in AP 0504, "Shipping and Receiving of Radioactive Material".

PROCEDURES WHICH IMPLEMENT THE PCP

1. AP 0504 Shipment and Receipt of Radioactive Materials
2. OP 2511 Radwaste Cask, Drum and Box Handling
3. AP 0021 Maintenance Requests
4. OP 2151 Liquid Radwaste
5. OP 2153 Solid Radwaste
6. AP 0620 Chemical Material Control

APPENDIX H

OFF-SITE DOSE CALCULATION MANUAL

Requirement: Technical Specification 6.13.A.1 requires that licensee initiated changes to the Off-Site Dose Calculation Manual (ODCM) be submitted to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the change(s) was made effective.

Response: There were two revisions to the Off-Site Dose Calculation Manual during this reporting period:

1. The dairy farm at Station TM-16/TC-16 went out of business and was sold at auction in July of 1991. A substitute location was chosen to replace it, and the first samples were collected there in July of 1991. The new milk and cattle feed sampling location is designated TM-15 and TC-15 (for milk and cattle feed, respectively). These changes were made to the ODCM as Revision 11. They will not reduce the accuracy or reliability of dose calculations or setpoint determination. The changed ODCM pages are attached.

2. The Off-Site Dose Calculation Manual was amended to include Method I off-site dose calculations for a ground level release from the Turbine Building roof vents. Method I dose model assumptions are conservative. They assume a ground level release receptor point at the site boundary with the maximum atmospheric dispersion factors. At this location all possible pathways are assumed to exist (e.g., ground plane, inhalation, garden, milk, and meat). These changes were made to the ODCM as Revision 12. This revision provides a method for integrating the measured releases from the Turbine Building through the roof vents into the total release calculation for the plant. It will not reduce the accuracy or reliability of dose calculations or setpoint determinations. The changed ODCM pages are attached.

VERMONT YANKEE NUCLEAR POWER STATION

OFF-SITE DOSE CALCULATION MANUAL

REVISION # 11

Reviewed ______ 91-53 ______ / 7/24/91
Plant Operations Review Committee — Date

Approved ______ / 7/25/91
Plant Manager — Date

Approved ______ / 7/27/91
Senior Vice President, Operations — Date

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Table 4.1

Radiological Environmental Monitoring Stations(1)

Exposure Pathway and/or Sample	Sample Location and Designated Code(2)		Distance (km)(6)	Direction(6)
1. AIRBORNE (Radioiodine and Particulate)				
	AP/CF-11	River Station No. 3.3	1.9	SSE
	AP/CF-12	N. Hinsdale, NH	3.6	NNW
	AP/CF-13	Hinsdale Substation	3.1	E
	AP/CF-14	Northfield, MA	11.3	SSE
	AP/CF-15	Tyler Hill Road(4)	3.2	WNW
	AP/CF-21	Spofford Lake	16.1	NNE
2. WATERBORNE				
a. Surface	WR-11	River Station No. 3.3	1.9	Downriver
	WR-21	Rt. 9 Bridge	12.8	Upriver
b. Ground	WG-11	Plant Well	--	On Site
	WG-12	Vernon Nursing Well	2.0	SSE
	WG-22	Skibniowsky Well	14.3	N
c. Sediment From Shoreline	SE-11	Shoreline Downriver	0.8	On-Site
	SE-12	North Storm Drain Outfall(3)	0.15	On-Site
3. INGESTION				
a. Milk	TM-11	Miller Farm(4)	0.8	WNW
	TM-12	Dominick(5)	5.2	E
	TM-13	Newton Farm	5.1	SSE
	TM-14	Brown Farm	2.6	S
	TM-15	Gayland Farm	4.7	WNW/NW
	TM-24	County Farm	22.5	N
b. Mixed Grasses	TG-11	River Station No. 3.3	1.9	SSE
	TG-12	N. Hinsdale, NH	3.6	NNE
	TG-13	Hinsdale Substation	3.1	E
	TG-14	Northfield, MA	11.3	SSE
	TG-15	Tyler Hill Rd.(4)	3.2	WNW
	TG-21	Spofford Lake	16.1	NNE

Table 4.1
(continued)

Radiological Environmental Monitoring Stations[1]

Exposure Pathway and/or Sample	Sample Location and Designated Code[2]		Distance (km)[6]	Direction[6]
c. Silage	TC-11	Miller Farm[4]	0.8	WNW
	TC-12	Dominick[5]	5.2	E
	TC-13	Newton Farm	5.1	SSE
	TC-14	Brown Farm	2.6	S
	TC-15	Gayland Farm	4.7	WNW/NW
	TC-24	County Farm	22.5	N
d. Fish	FH-11	Vernon Pond	--	On-Site
	FH-21	Rt. 9 Bridge	12.8	Upriver
4. DIRECT RADIATION				
	DR-1	River Station No. 3.3	1.6	SSE
	DR-2	N. Hinsdale, NH	3.9	NNW
	DR-3	Hinsdale Substation	3.0	E
	DR-4	Northfield, MA	11.0	SSE
	DR-5	Spofford Lake	16.3	NNE
	DR-6	Vernon School	0.46	WSW
	DR-7	Site Boundary	0.27	W
	DR-8	Site Boundary	0.25	SW
	DR-9	Inner Ring	2.1	N
	DR-10	Outer Ring	4.6	N
	DR-11	Inner Ring	2.0	NNE
	DR-12	Outer Ring	3.6	NNE
	DR-13	Inner Ring	1.4	NE
	DR-14	Outer Ring	4.3	NE
	DR-15	Inner Ring	1.4	ENE
	DR-16	Outer Ring	2.9	ENE
	DR-17	Inner Ring	1.2	E
	DR-18	Outer Ring	3.0	E
	DR-19	Inner Ring	3.5	ESE
	DR-20	Outer Ring	5.3	ESE
	DR-21	Inner Ring	1.8	SE
	DR-22	Outer Ring	3.2	SE
	DR-23	Inner Ring	1.8	SSE
	DR-24	Outer Ring	3.9	SSE
	DR-25	Inner Ring	2.0	S

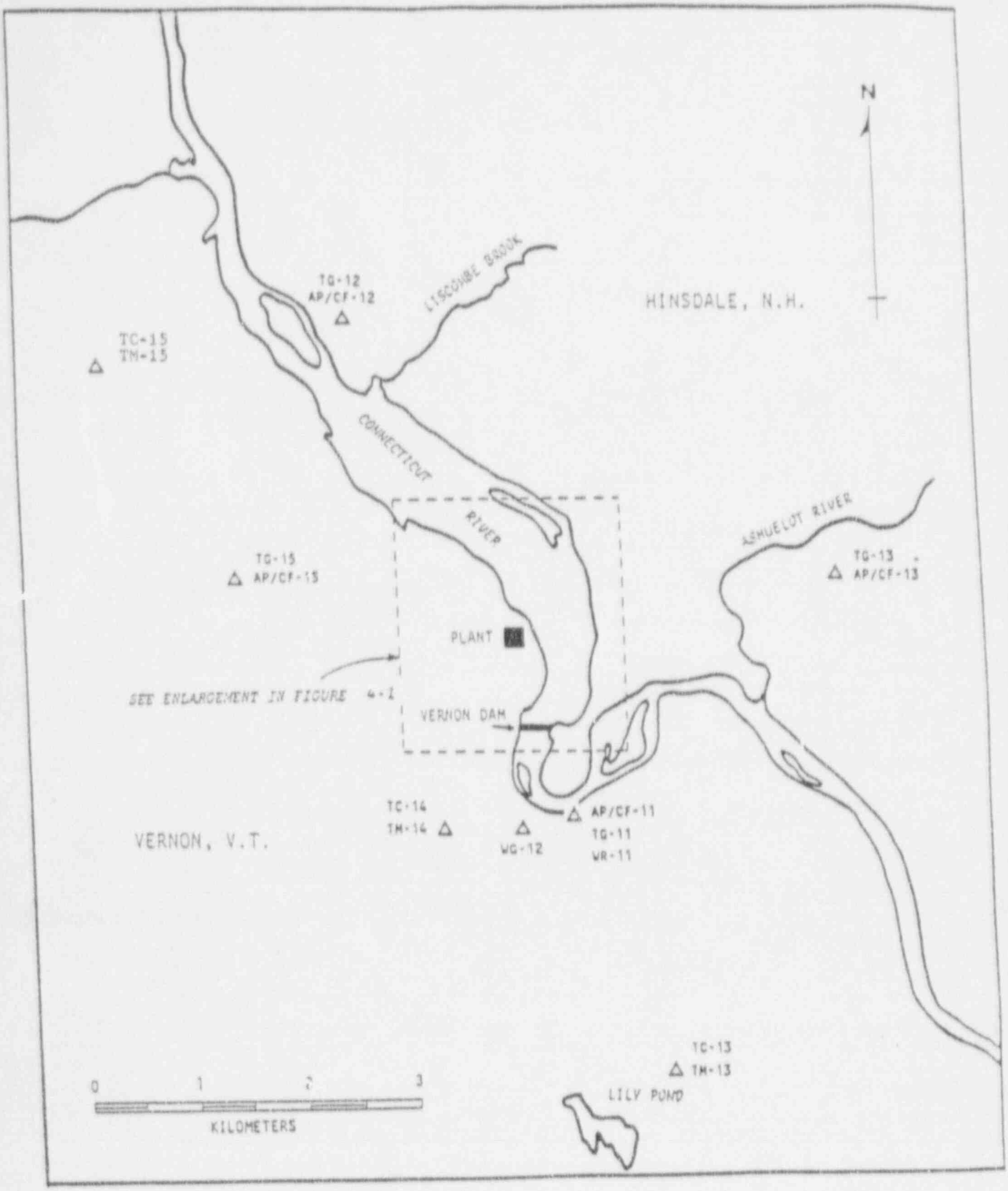

Figure 4-2 Environmental Sampling Locations Within 5 km of Plant

Revision 11 Date 7/27/91

VERMONT YANKEE NUCLEAR POWER STATION

OFF-SITE DOSE CALCULATION MANUAL

REVISION NO. 12

Reviewed ____ 91-65 ____ 9/26/91
Plant Operations Review Committee — Date

Approved ____ for DAR ____ 9/27/91
Plant Manager — Date

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Summary of Methods to Calculate Dose Rates

Equation Number	Category	Equation	Reference Section
3-5	Total Body Dose Rate from Noble Gases Released from Stack	$\dot{R}_{tbs} \left(\frac{mrem}{yr}\right) = 0.70 \sum_i \dot{Q}_i^{ST} DFB_i$	3.4.1
3-39	Total Body Dose Rate from Noble Gases Released from Ground	$\dot{R}_{tbg} \left(\frac{mrem}{yr}\right) = 4.0 \sum_i \dot{Q}_i^{GL} DFB_i$	3.4.1
3-7	Skin Dose Rate from Noble Gases Released from Stack	$\dot{R}_{skins} \left(\frac{mrem}{yr}\right) = \sum_i \dot{Q}_i^{ST} DF'_{is}$	3.5.1
3-38	Skin Dose Rate from Noble Gases Released from Ground	$\dot{R}_{sking} \left(\frac{mrem}{yr}\right) = \sum_i \dot{Q}_i^{GL} DF'_{ig}$	3.5.1
3-16	Critical Organ Dose Rate from Stack Release of Iodines, Tritium, and Particulates with T 1/2 Greater Than Eight Days	$\dot{R}_{cos} \left(\frac{mrem}{yr}\right) = \sum_i \dot{Q}_i^{STP} DFG'_{sico}$	3.6.1
3-40	Critical Organ Dose Rate from Ground Level Release of Iodines, Tritium, and Particulates with T 1/2 Greater Than Eight Days	$\dot{R}_{cog} \left(\frac{mrem}{yr}\right) = \sum_i \dot{Q}_i^{GLP} DFG'_{gico}$	3.6.1

Table 1.1-5

Summary of Methods to Calculate Doses to Air from Noble Gases

Equation Number	Category	Equation	Reference Section
3-21	Gamma Dose to Air from Noble Gases Released From Stack	D^{γ}_{airs} (mrad) = $0.022 \sum_i Q_i^{ST} DF_i^{\gamma}$	3.7.1
3-41	Gamma Dose to Air from Noble Gases Released From Turbine Building (Ground Level Release)	D^{γ}_{airg} (mrad) = $0.13 \sum_i Q_i^{GL} DF_i^{\gamma}$	3.7.1
3-23	Beta Dose to Air from Noble Gases Released From Stack	D^{β}_{airs} (mrad) = $0.019 \sum_i Q_i^{ST} DF_i^{\beta}$	3.8.1
3-43	Beta Dose to Air from Noble Gases Released From Turbine Building (Ground Level Release)	D^{β}_{airg} (mrad) = $0.55 \sum_i Q_i^{GL} DF_i^{\beta}$	3.8.1

Table 1.1-6

Summary of Methods to Calculate
Dose to an Individual from Tritium, Iodine, and Particulates in
Gas Releases and Direct Radiation

Equation Number	Category	Equation	Reference Section
3-25	Dose to Critical Organ from Stack Release of Iodines, Tritium, and Particulates	$D_{cos}\ (mrem) = \sum_i Q_i^{STP}\ DFG_{sico}$	3.9.1
3-44	Dose to Critical Organ from Ground Level Release of Iodines, Tritium, and Particulates	$D_{cog}(mrem) = \sum_i Q_i^{GLP}\ DFG_{gico}$	3.9.1
	Direct Dose		
3-27	Turbine Building	$D_d\ (mrem) = K_{N1}\ (L) * E$	3.11.1
	North Warehouse		
3-29	Shielded End	$D_S = 0.25 \times \dot{R}_S$	3.11.2
3-30	Unshielded End	$D_U = 0.53 \times \dot{R}_U$	3.11.2
	LLW Storage Pad		
3-31	Direct Line (Module Short Side Out)	$D_{dE} = 0.28 \times \dot{R}_d \times f_d$	3.11.3
3-32	Direct Line (Module Long Side Out)	$D_{dS} = 0.39 \times \dot{R}_d \times f_d$	3.11.3
3-33	Skyshine (Resin Liners)	$D_{SKR} = 0.016 \times \dot{R}_{SKR} \times f_{SK}$	3.11.3
3-34	Skyshine (DAW)	$D_{SKD} = 0.015 \times R_{SKD} \times f_{SK}$	3.11.3
3-35	Resin Liner Transfer (Unshielded)	$D_{Tran} = 0.0025 \times \dot{R}_{Tran} \times T_{Tran}$	3.11.3
3-36	Intermodular Gap Dose	$D_{Gap} = 2.44E\text{-}2 \times W_{Gap} \times A_{RL} \times f_{Gap}$	3.11.3

Table 1.1-8

Summary of Variables

Variable	Definition	Units
A_{RL}	= Total gamma activity contained in a resin liner in storage directly in line with a gap between adjacent storage modules	Ci
C_{li}^{NG}	= Concentration at point of discharge of dissolved and entrained noble gas "i" in liquid pathways from all station sources	μCi/ml
C_{l}^{NG}	= Total activity of all dissolved and entrained noble gases in liquid pathways from all station sources	$\frac{\mu Ci}{ml}$
C_{di}	= Concentration of radionuclide "i" at the point of liquid discharge	$\frac{\mu Ci}{ml}$
C_i	= Concentration of radionuclide "i"	$\frac{\mu Ci}{cc}$
C_{pi}	= Concentration, exclusive of noble gases, of radionuclide "i" from tank "p" at point of discharge	$\frac{\mu Ci}{ml}$
C_{mi}	= Concentration of radionuclide "i" in mixture at the monitor	$\frac{\mu Ci}{ml}$
D_{airs}^{β}	= Beta dose to air from stack release	mrad
D_{airg}^{β}	= Beta dose to air from ground level release	mrad
D_{airs}^{γ}	= Gamma dose to air from stack release	mrad
D_{airg}^{γ}	= Gamma dose to air from ground level release	mrad
D_{cos}	= Dose to the critical organ from stack release	mrem
D_{cog}	= Dose to the critical organ from ground level release	mrem
D_d	= Direct dose (Turbine Building)	mrem

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Table 1.1-8
(continued)

Summary of Variables

Variable	Definition	Units
$\dot{R}_d$	= Dose rate at 3' from unobstructed side of storage module facing site boundary	$\frac{mrem}{hr}$
D_{dE}	= Direct dose at site boundary per unobstructed storage module (short end)	$\frac{mrem}{yr\text{-}module}$
D_{dS}	= Direct dose at site boundary per unobstructed storage module (long side)	$\frac{mrem}{yr\text{-}module}$
D^{γ}_{finite}	= Gamma dose to air, corrected for finite cloud	mrad
D_{Gap}	= Intermodular gap dose projected to the maximum site boundary location from resin waste not directly shielded by DAW modules.	$\frac{mrem}{yr}$
D_{mo}	= Dose to the maximum organ	mrem
D^S	= Dose to skin from beta and gamma	mrem
$\dot{R}_S$	= Dose rate at 1 meter from source in shielded end of North Warehouse	$\frac{mrem}{hr}$
D_S	= Annual dose at site boundary from fixed sources in shielded end of North Warehouse	$\frac{mrem}{yr}$
$\dot{R}_{SKD}$	= Maximum dose rate at 3' over top of DAW in a storage module	$\frac{mrem}{hr}$
$\dot{R}_{SKR}$	= Maximum dose rate at 3' over top of each resin liner in a storage module	$\frac{mrem}{hr}$
D_{SKD}	= Skyshine dose at the site boundary from DAW in storage modules (unobstructed top surfaces)	$\frac{mrem}{yr\text{-}module}$
D_{SKR}	= Skyshine dose at the site boundary from resin liners in storage modules (unobstructed top surfaces)	$\frac{mrem}{yr\text{-}liner}$

Table 1.1-8
(continued)

Summary of Variables

Variable	Definition	Units
D_{tb}	= Dose to the total body	mrem
$K_{N/6}(L)$	= The direct dose conversion factor for N-16 scatter from the turbine hall to Location (L)	$\frac{mrem}{MW_e h}$
$\dot{R}_{Tran}$	= Dose rate at contact from the unshielded top surface of resin liner	$\frac{R}{hr}$
D_{Tran}	= Dose at the site boundary from unshielded movement of resin liner between transfer cask and storage module	mrem
$\dot{R}_U$	= Dose rate at 1 meter from source in unshielded end of North Warehouse	$\frac{mrem}{hr}$
D_U	= The annual dose at site boundary from fixed sources in the unshielded end of North Warehouse	$\frac{mrem}{yr}$
DF	= Dilution factor	ratio
DF_{min}	= Minimum allowable dilution factor	ratio
DF'_c	= Composite skin dose factor	$\frac{mrem\text{-}sec}{pCi\text{-}yr}$
DFB_i	= Total body gamma dose factor for nuclide "i"	$\frac{mrem\text{-}m^3}{pCi\text{-}yr}$
DFB_c	= Composite total body dose factor	$\frac{mrem\text{-}m^3}{pCi\text{-}yr}$
DFL_{itb}	= Site-specific, total body dose factor for a liquid release of nuclide "i"	$\frac{mrem}{Ci}$
DFL_{imo}	= Site-specific, maximum organ dose factor for a liquid release of nuclide "i"	$\frac{mrem}{Ci}$
DFG_{sico}	= Site-specific, critical organ dose factor for a stack gaseous release of nuclide "i"	$\frac{mrem}{Ci}$

Table 1.1-8
(continued)

Summary of Variables

Variable	Definition	Units
DFG'_{sico}	= Site-specific, critical organ dose rate factor for a stack gaseous release of nuclide "i"	$\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}$
DFG_{gico}	= Site-specific, critical organ dose factor for a ground level gaseous release of nuclide "i"	$\frac{mrem}{Ci}$
DFG'_{gico}	= Site-specific, critical organ dose rate factor for a ground level gaseous release of nuclide "i"	$\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}$
DFS_i	= Beta skin dose factor for nuclide "i"	$\frac{mrem\text{-}m^3}{pCi\text{-}yr}$
DF'_{is}	= Combined skin dose factor for nuclide "i" from a stack release	$\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}$
DF'_{ig}	= Combined skin dose factor for nuclide "i" from a ground level release	$\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}$
DF^{γ}_i	= Gamma air dose factor for nuclide "i"	$\frac{mrad\text{-}m^3}{pCi\text{-}yr}$
DF_i	= Beta air dose factor for nuclide "i"	$\frac{mrad\text{-}m^3}{pCi\text{-}yr}$
$\dot{R}_{cos}$	= Critical organ dose rate due to iodines and particulates released from stack	$\frac{mrem}{yr}$
$\dot{R}_{cog}$	= Critical organ dose rate due to iodines and particulates released from ground	$\frac{mrem}{yr}$
$\dot{R}_{skins}$	= Skin dose rate due to stack release of noble gases	$\frac{mrem}{yr}$
$\dot{R}_{sking}$	= Skin dose rate due to ground release of noble gases	$\frac{mrem}{yr}$

Table 1.1-8
(continued)

Summary of Variables

Variable	Definition	Units
$\dot{R}_{tbs}$	= Total body dose rate due to noble gases from stack release	$\frac{mrem}{yr}$
$\dot{R}_{tbg}$	= Total body dose rate due to noble gases from ground level release	$\frac{mrem}{yr}$
D/Q	= Deposition factor for dry deposition of elemental radioiodines and other particulates	$\frac{1}{m^2}$
E	= Gross electric output over the period of interest	MW_eh
f_d	= Fraction of a year that a storage module is in use with an unobstructed side oriented toward west site boundary	fraction
f_{Gap}	= Fraction of a year that the intermodular gap is not shielded	fraction
f_{SK}	= Fraction of a year that a storage module is in use with an unobstructed top surface	fraction
F_d	= Flow rate out of discharge canal	gpm
F_m	= Flow rate past liquid radwaste monitor	gpm
F	= Flow rate past gaseous radwaste monitor	$\frac{cc}{sec}$
F_1^{ENG}	= Total fraction of MPC in liquid pathways (excluding noble gases)	fraction
MPC_i	= Maximum permissible concentration for radionuclide "i" (10CFR20, Appendix B, Table 2, Column 2)	$\frac{\mu Ci}{cc}$
Q_i	= Release for radionuclide "i" from the point of interest	curies

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Table 1.1-8
(continued)

Summary of Variables

Variable	Definition	Units
$\dot{Q}_i$	= Release rate for radionuclide "i" at the point of interest	$\frac{\mu curies}{sec}$
$\dot{Q}_i^{ST}$	= The noble gas radionuclide "i" release rate at the plant stack	$\frac{\mu Ci}{sec}$
$\dot{Q}_i^{GL}$	= The noble gas radionuclide "i" release rate from the Turbine Building (ground level release)	$\frac{\mu Ci}{sec}$
$\dot{Q}_i^{SJAE}$	= The noble gas radionuclide "i" release rate at the steam jet air ejector	$\frac{\mu Ci}{sec}$
$\dot{Q}_i^{AOG}$	= The noble gas radionuclide "i" release rate at the exhaust of the augmented Off-Gas System	$\frac{\mu Ci}{sec}$
$\dot{Q}_i^{STP}$	= The iodine, tritium, and particulate radionuclide "i" release rate from the plant stack	$\frac{\mu Ci}{sec}$
$\dot{Q}_i^{GLP}$	= The iodine, tritium, and particulate radionuclide "i" release rate from the Turbine Building (ground level release)	$\frac{\mu Ci}{sec}$
Q_i^{ST}	= The release of noble gas radionuclide "i" from the plant stack	curies
Q_i^{GL}	= The release of noble gas radionuclide "i" from the Turbine Building (ground level release)	curies
Q_i^{STP}	= The release of iodine, tritium, and particulate radionuclide "i" from the plant stack	curies
Q_i^{GLP}	= The release of iodine, tritium, and particulate radionuclide "i" from the Turbine Building (ground level release)	curies
R_{spt}^{L}	= Liquid monitor response for the limiting concentration at the point of discharge	cps

Table 1.1-8
(continued)

Summary of Variables

Variable	Definition	Units
R_{spt}^{skin}	= Response of the noble gas monitor at the limiting skin dose rate	cpm
R_{spt}^{tb}	= Response of the noble gas monitor to limiting total body dose rate	cpm
S_F	= Shielding factor	Ratio
S_g	= Detector counting efficiency from the most recent gas monitor calibration	$\frac{cpm}{\mu Ci/cc}$ or $\frac{mR/hr}{\mu Ci/cc}$
S_{gi}	= Detector counting efficiency for noble gas "i"	$\frac{cpm}{\mu Ci/cc}$ or $\frac{mR/hr}{\mu Ci/cc}$
S_1	= Detector counting efficiency from the most recent liquid monitor calibration	$\frac{cps}{\mu Ci/ml}$
S_{1i}	= Detector counting efficiency for radionuclide "i"	$\frac{cps}{\mu Ci/ml}$
T_{Tran}	= Time that an unshielded resin liner is exposed in the storage pad area	hours
W_{Gap}	= Intermodule gap width between adjacent DAW storage modules which shield resin liner storage modules from the west site boundary	inches
X/Q_s	= Annual or long-term average undepleted atmospheric dispersion factor for stack release	$\frac{sec}{m^3}$
X/Q_g	= Annual or long-term average undepleted atmospheric dispersion factor for ground level release	$\frac{sec}{m^3}$
$[X/Q]_s^{\gamma}$	= Effective annual or long-term average ~amma atmospheric dispersion factor for stack release	$\frac{sec}{m^3}$
$[X/Q]_g^{\gamma}$	= Effective annual or long-term average gamma atmospheric dispersion factor for a ground level release	$\frac{sec}{m^3}$

Table 1.1-10

Dose Factors Specific for Vermont Yankee
for
Noble Gas Releases

Radionuclide	Gamma Total Body Dose Factor DFB_i $(\frac{mrem-m^3}{pCi-yr})$	Beta Skin Dose Factor DFS_i $(\frac{mrem-m^3}{pCi-yr})$	Combined Skin Dose Factor (Stack Release) DF'_{is} $(\frac{mrem-sec}{\mu Ci-yr})$	Beta Air Dose Factor DF_i^β $(\frac{mrad-m^3}{pCi-yr})$	Gamma Air Dose Factor DF_i^γ $(\frac{mrad-m^3}{pCi-yr})$
Ar-41	8.84E-03*	2.69E-03	8.81E-03	3.28E-03	9.30E-03
Kr-83m	7.56E-08	-----	1.49E-05	2.88E-04	1.93E-05
Kr-85m	1.17E-03	1.46E-03	1.83E-03	1.97E-03	1.23E-03
Kr-85	1.61E-05	1.34E-03	8.16E-04	1.95E-03	1.72E-05
Kr-87	5.92E-03	9.73E-03	1.06E-02	1.03E-02	6.17E-03
Kr-88	1.47E-02	2.37E-03	1.32E-02	2.93E-03	1.52E-02
Kr-89	1.66E-02	1.01E-02	1.94E-02	1.06E-02	1.73E-02
Kr-90	1.56E-02	7.29E-03	1.70E-02	7.83E-03	1.63E-02
Xe-131m	9.15E-05	4.76E-04	4.06E-04	1.11E-03	1.56E-04
Xe-133m	2.51E-04	9.94E-04	8.49E-04	1.48E-03	3.27E-04
Xe-133	2.94E-04	3.06E-04	4.57E-04	1.05E-03	3.53E-04
Xe-135m	3.12E-03	7.11E-04	3.03E-03	7.39E-04	3.36E-03
Xe-135	1.81E-03	1.86E-03	2.60E-03	2.46E-03	1.92E-03
Xe-137	1.42E-03	1.22E-02	8.48E-03	1.27E-02	1.51E-03
Xe-138	8.83E-03	4.13E-03	9.60E-03	4.75E-03	9.21E-03

* 8.84E-03 = 8.84×10^{-3}

Table 1.1-10A

Combined Skin Dose Factors Specific for
Vermont Yankee Ground Level Noble Gas Releases

Radionuclide	DF'_{ig} $(\frac{mrem-sec}{\mu Ci-yr})$
AR-41	8.75E-02
KR-83M	8.45E-05
KR-85M	3.08E-02
KR-85	2.34E-02
KR-87	1.96E-01
KR-88	1.08E-01
KR-89	2.52E-01
KR-90	1.98E-01
XE-131M	8.97E-03
XE-133M	1.87E-02
XE-133	6.87E-03
XE-135M	2.71E-02
XE-135	4.08E-02
XE-137	2.19E-01
XE-138	1.12E-01

Table 1.1-11

Dose Factors Specific for Vermont Yankee for Liquid Releases

Radionuclide	Total Body Dose Factor DFL_{itb} ($\frac{mrem}{Ci}$)	Maximum Organ Dose Factor DFL_{imo} ($\frac{mrem}{Ci}$)
H-3	2.06E-04	2.06E-04
Na-24	3.38E-02	3.38E-02
Cr-51	3.10E-04	6.96E-02
Mn-54	2.08E-01	3.00E+00
Mn-56	8.53E-06	5.29E-03
Fe-59	2.49E-01	1.84E+00
Co-58	5.97E-02	4.34E-01
Co-60	2.13E-01	1.28E+00
Zn-65	8.06E+00	1.64E+01
Sr-89	2.55E-01	8.91E+00
Sr-90	4.23E+01	1.67E+02
Zr-95	4.21E-04	1.36E-01
Mo-99	4.79E-03	4.51E-02
Tc-99m	5.04E-06	2.33E-04
Sb-124	8.44E-03	2.22E-01
I-131	2.57E-02	1.47E+01
I-132	3.10E-06	1.29E-04
I-133	3.31E-03	1.63E+00
I-135	3.16E-04	5.90E-02
Cs-134	1.28E+02	1.60E+02
Cs-137	7.58E+01	1.21E+02
Ba-140	4.08E-03	9.72E-02
Ce-141	2.31E-05	4.10E-02
W-187	1.18E-02	8.90E+00

Table 1.1-12

Dose and Dose Rate Factors Specific for Vermont Yankee
for
Iodines, Tritium and Particulate Releases

Radionuclide	Stack Release: Critical Organ Dose Factor DFG_{sico} $(\frac{mrem}{Ci})$	Stack Release: Critical Organ Dose Rate Factor DFG'_{sico} $(\frac{mrem\text{-}sec}{yr\text{-}\mu Ci})$	Ground Level Release: Critical Organ Dose Factor DFG_{gico} $(\frac{mrem}{Ci})$	Ground Level Release: Critical Organ Dose Rate Factor DFG'_{gico} $(\frac{mrem\text{-}sec}{yr\text{-}\mu Ci})$
H-3	1.81E-04	5.70E-03	5.23E-03	1.65E-01
C-14	1.10E-01	3.47E+00	3.17E+00	1.00E+02
Cr-51	3.80E-03	1.32E-01	5.63E-02	2.54E+00
Mn-54	4.36E-01	1.72E+01	1.66E+01	7.47E+02
Fe-59	4.35E-01	1.44E+01	4.89E+00	1.62E+02
Co-58	2.26E-01	8.07E+00	4.55E+00	2.05E+02
Co-60	4.76E+00	2.12E+02	2.59E+02	1.17E+04
Zn-65	2.32E+00	7.51E+01	2.57E+01	8.33E+02
Sr-89	7.08E+00	2.23E+02	7.88E+01	2.49E+03
Sr-90	2.69E+02	8.48E+03	3.01E+03	9.49E+04
Zr-95	4.31E-01	1.42E+01	4.83E+00	1.59E+02
Sb-124	7.86E-01	2.63E+01	8.86E+00	3.19E+02
I-131	4.80E+01	1.51E+03	5.38E+02	1.70E+04
I-133	5.12E-01	1.61E+01	6.81E+00	2.15E+02
Cs-134	9.88E+00	3.28E+02	1.1E+02	3.69E+03
Cs-137	1.01E+01	3.44E+02	1.23E+02	5.55E+03
Ba-140	7.02E-02	3.27E+00	1.11E+00	3.56E+01
Ce-141	1.06E-01	3.37E+00	1.22E+00	3.88E+01
Ce-144	2.40E+00	7.60E+01	2.69E+01	8.52E+02

time duration, this approach of limiting dose rates equivalent to the annual dose limits then assures that 10CFR20.106 limits on an annual average air concentration in unrestricted areas will be met.

Each of the methods to calculate dose or dose rate are presented in separate sections of Chapter 3, and are summarized in Tables 1.1-1 to 1.1-7. Each method has two levels of complexity and conservative margin and are called Method I and Method II. Method I has the greatest margin and is the simplest; generally a linear equation. Method II is a more detailed analysis which allows for use of site-specific factors and variable parameters to be selected to best fit the actual release. Guidance is provided but the appropriate margin and depth of analysis are determined in each instance at the time of analysis under Method II.

The plant has two gaseous release points: the main vent stack (elevated release) and the Turbine Building roof vents (ground level release). Therefore, total dose calculations for skin, whole body, and the critical organ from gaseous releases will be the sum of the elevated and ground level doses.

3.4 Method to Calculate the Total Body Dose Rate From Noble Gases

Technical Specification 3.8.E.1 limits the dose rate at any time to the total body from noble gases at any location at or beyond the site boundary equal to or less than 500 mrem/year. By limiting the maximum R_{tb} to a rate equivalent to no more than 500 mrem/year, assurance is provided that the total body dose accrued in any one year by any member of the general public will be less than 500 mrem in accordance with the annual dose limits of 10CFR Part 20 to unrestricted areas.

Use Method I first to calculate the Total Body Dose Rate from the peak release rate via the plant stack and Turbine Building roof vent. Method I applies at all release rates.

Use Method II if Method I predicts a dose rate greater than the Technical Specification limit (i.e., use of actual meteorology over the period of interest) to determine if, in fact, Technical Specification 3.8.E.1 had actually been exceeded during a short time interval.

Compliance with the dose rate limits for noble gases are continuously demonstrated when effluent release rates are below the plant stack noble gas activity monitor alarm setpoint by virtue of the fact that the alarm setpoint is based on a value which corresponds to the off-site dose rate limit of Technical Specification 3.8.E.1, or a value below it.

Determinations of dose rates for compliance with Technical Specifications (3.8.E.1) are performed when the effluent monitor alarm setpoint is exceeded and the corrective action required by Specification 3.8 E.2 is unsuccessful, or as required by the notations to Technical Specification Table 3.9.2 when the stack noble gas monitor is inoperable.

3.4.1 Method I

The Total Body Dose Rate due to noble gases can be determined by multiplying the individual radionuclide release rates by their respective dose factors, summing all the products together, and then multiplying this total by a conversion constant (0.70), as seen in the following Equation 3-5 (an example calculation is provided in Appendix A):

$$\dot{R}_{tbs} = 0.70 \sum_i \dot{Q}_i^{ST} \quad DFB_i \qquad (3\text{-}5)$$

$$\left(\frac{mrem}{yr}\right) \quad \left(\frac{pCi\text{-}sec}{\mu Ci\text{-}m^3}\right) \quad \left(\frac{\mu Ci}{sec}\right) \left(\frac{mrem\text{-}m^3}{pCi\text{-}yr}\right)$$

where:

$\dot{Q}_i^{ST}$ = In the case of noble gases, the release rate from the plant stack (μCi/sec) for each radionuclide, "i", identified. The release rate at the plant stack is based on the measured radionuclide distribution in the off-gas at the Steam Jet Air Ejector (SJAE) during plant operation when the activity at the stack is below detectable levels, and the recorded total gas effluent count rate from the Stack Gas Monitor I or II. The release rate at the stack can also be stated as follows:

$$\dot{Q}_i^{ST} = \frac{\dot{Q}_i^{SJAE}}{\sum_i \dot{Q}_i^{SJAE}} \quad M \quad \frac{1}{Sg} \quad F \qquad (3\text{-}28)$$

$$\frac{\mu Ci}{sec} = (cpm) \left(\frac{\mu Ci/cc}{cpm}\right) \left(\frac{cc}{sec}\right)$$

M = Plant Stack Gas Monitor I or II count rate (cpm).

S_g = Appropriate or conservative plant stack monitor detector counting efficiency for the given nuclide mix (cpm/(μCi/cc)).

F = Stack flow rate (cc/sec).

$\dot{Q}_i^{SJAE}$ = The last measured release rate at the steam jet air ejector of noble gas i (μCi/sec).

DFB_i = Total body gamma dose factor (see Table 1.1-10).

For ground level noble gas releases, the total body dose rate is calculated as follows:

$$\dot{R}_{tbg} = 4.0 \sum_i \dot{Q}_i^{GL} \quad DFB_i \qquad (3\text{-}39)$$

$$(\frac{\mu Ci}{sec}) \; (\frac{mrem\text{-}m^3}{pCi\text{-}yr})$$

where:

$\dot{Q}_i^{GL}$ = Ground level release rate (μCi/sec) of noble gas from Turbine Building.

During periods (beyond the first five days) when the plant is shutdown and no radioactivity release rates can be measured at the SJAE, Xe-133 may be used in place of the last SJAE measured mix as the referenced radionuclide to determine off-site dose rate and monitor setpoints. In this case, the ratio of each $\dot{Q}_i^{SJAE}$ to the sum of all $\dot{Q}_i^{SJAE}$ in Equation 3-28 above is assumed to reduce to a value of 1, and the total body gamma dose factor DFB_i for Xe-133 (2.94 E-04 mrem-m^3/pCi-yr) is used in Equations 3-5 and 3-39. Alternately, a relative radionuclide "i" mix fraction (f_i) may be taken from Table 5.2-1 as a

function of time after shutdown, and substituted in place of the ratio of $\dot{Q}_i^{SJAE}$ to the sum of all $\dot{Q}_i^{SJAE}$ in Equation (3-28) above to determine the relative fraction of each noble gas potentially available for release to the total (example calculations can be found in Appendix A). Just prior to plant startup before a SJAE sample can be taken and analyzed, the monitor alarm

setpoints should be based on Xe-138 as representing the most prevalent high dose factor noble gas expected to be present shortly after the plant returns to power. Monitor alarm setpoints which have been determined to be conservative under any plant conditions may be utilized at any time in lieu of the above assumptions.

Equations 3-5 and 3-39 can be applied under the following conditions (otherwise, justify Method I or consider Method II):

1. Normal operations (not emergency event), and
2. Noble gas releases via the plant stack and Turbine Building roof vents to the atmosphere.

3.4.2 Basis for Method I

Method I may be used to show that the Technical Specification which limits total body dose rate from noble gases released to the atmosphere (Technical Specification 3.8.E.1) has been met for the peak noble gas release rate.

Method I was derived from Regulatory Guide 1.109 as follows:

$$\dot{R}_{tbs} = 1E{+}06 \; S_F \; [X/Q]^Y \sum_i \dot{Q}_i^{ST} \; DFB_i \qquad (3\text{-}6)$$

$$\left(\frac{mrem}{yr}\right) \quad \left(\frac{pCi}{\mu Ci}\right) \quad (\ ) \quad \left(\frac{sec}{m^3}\right) \quad \left(\frac{\mu Ci}{sec}\right) \quad \left(\frac{mrem\text{-}m^3}{pCi\text{-}yr}\right)$$

where:

S_F = Shielding factor = 1.0 for dose rate determination.

$[X/Q]_S^Y$ = Maximum annual average gamma atmospheric dispersion factor for stack releases

= 6.98E-07 (sec/m^3)

$\dot{Q}_i^{ST}$ = Release rate from the plant stack of noble gas "i" (μCi/sec).

DFB_i = Gamma total body dose factor, $(\frac{mrem-m^3}{pCi-yr})$. See Table 1.1-10.

Equation 3-6 reduces to:

$$\dot{R}_{tbs} = 0.70 \sum_i \dot{Q}_i^{ST} \; DFB_i \qquad (3-5)$$

$$(\frac{mrem}{yr}) \quad (\frac{pCi-sec}{\mu Ci-m^3}) \quad (\frac{\mu Ci}{sec}) \; (\frac{mrem-m^3}{pCi-yr})$$

For ground level releases, the ground level maximum annual average gamma atmospheric dispersion factor = 3.95E-06 sec/m^3, thus leading to:

$$\dot{R}_{tbg} = 1E{+}06 * 3.95E{-}06 \sum_i \dot{Q}_i^{GL} \; DFB_i$$

$$\dot{R}_{tbg} = 4.0 \sum_i \dot{Q}_i^{GL} \; DFB_i \qquad (3-39)$$

The selection of critical receptor, outlined in Section 3.10, is inherent in Method I, as are the maximum expected off-site annual or long-term average atmospheric dispersion factors. Due to the holdup and decay of gases allowed in the AOG, off-gas concentrations at the plant stack during routine plant operations are usually too low for determination of the radionuclide mix at the plant stack. It is then conservatively assumed that most of the noble gas activity at the plant stack is the result of in-plant steam leaks which are removed to the plant stack by building ventilation air flow, and that this air flow has an isotopic distribution consistent with that routinely measured at the SJAE.

Regarding the calculation of ground level release doses from the Turbine Building Roof Vent, the ground level atmospheric dispersion factors are based on the same methodologies as used for the stack dispersion factors

(same noble gas mix, meteorological history [1981-1985], and meteorological models), and are for the site boundary location that will have the highest dose.

In the case of noble gas dose rates, Method II cannot provide much extra realism because $\dot{R}_{tbs}$ and $\dot{R}_{tbg}$ are already based on several factors which make use of current plant parameters. However, should it be needed, the dose rate analysis for critical receptor can be performed making use of current meteorology during the time interval of recorded peak release rate in place of the default atmospheric dispersion factor used in Method I.

3.4.3 Method II

If Method I cannot be applied, or if the Method I dose exceeds the limit, then Method II may be applied. Method II consists of the models, input data and assumptions in Regulatory Guide 1.109, Rev. 1 (Reference A), except where site-specific models, data or assumptions are more applicable. The base case analysis, documented above, is a good example of the use of Method II. It is an acceptable starting point for a Method II analysis. Analyses requiring Method II calculations should be referred to YNSD to be performed and documented.

3.5 Method to Calculate the Skin Dose Rate from Noble Gases

Technical Specification 3.8.E.1 limits the dose rate at any time to the skin from noble gases at any location at or beyond the site boundary to 3,000 mrem/year. By limiting the maximum $\dot{R}_{skin}$ to a rate equivalent to no more than 3,000 mrem/year, assurance is provided that the skin dose accrued in any one year by any member of the general public is much less than 3,000 mrem.

Use Method I first to calculate the Skin Dose Rate from the peak release rate via the plant vent stack and Turbine Building roof vent Method I applies at all release rates.

Use Method II if Method I predicts a dose rate greater than the Technical Specification limits (i.e., use of actual meteorology over the period of interest) to determine if, in fact, Technical Specification 3.8.E.1 had actually been exceeded during a short time interval.

Compliance with the dose rate limits for noble gases are continuously demonstrated when effluent release rates are below the plant stack noble gas activity monitor alarm setpoint by virtue of the fact that the alarm setpoint is based on a value which corresponds to the off-site Technical Specification dose rate limit, or a value below it.

Determinations of dose rate for compliance with Technical Specifications (3.8.E.1) are performed when the effluent monitor alarm setpoint is exceeded and the corrective action required by Specification 3.8.E.2 is unsuccessful, or as required by the notations to Technical Specification Table 3.9.2 when the stack noble gas monitor is inoperable.

3.5.1 Method I

The skin dose rate due to noble gases is determined by multiplying the individual radionuclide release rates by their respective dose factors, and summing all the products together as seen in the following Equation 3-7 (an example calculation is provided in Appendix A):

$$\dot{R}_{skins} = \sum_i \dot{Q}_i^{ST} \quad DF_i' \qquad (3\text{-}7)$$

$$\left(\frac{mrem}{yr}\right) \qquad \left(\frac{\mu Ci}{sec}\right) \left(\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}\right)$$

where:

$\dot{Q}_i^{ST}$ = In the case of noble gases, the noble gas release rate from the plant stack (μCi/sec) for each radionuclide, "i", identified. The release rate at the plant stack is based on the measured radionuclide distribution in the off-gas at the Steam Jet Air Ejector (SJAE) during plant operation when the activity at the stack is below detectable levels, and the recorded total gas effluent count rate from the Stack Gas Monitor I or II. The release rate at the stack can also be stated as follows:

$$\dot{Q}_i^{ST} = \frac{\dot{Q}_i^{SJAE}}{\sum_i \dot{Q}_i^{SJAE}} \quad M \quad \frac{1}{S_g} \quad F \qquad (3\text{-}28)$$

$$\frac{\mu Ci}{sec} = \qquad (cpm) \ \frac{(\mu Ci/cc)}{cpm} \ \left(\frac{cc}{sec}\right)$$

M = Plant stack gas monitor I or II count rate (cpm).

S_g = Appropriate or conservative plant stack monitor detector counting efficiency for the given nuclide mix (cpm/(μCi/cc)).

F = Stack flow rate (cc/sec).

$\dot{Q}_i^{SJAE}$ = The last measured release rate at the steam jet air ejector of noble gas i (μCi/sec).

DF_{is}' = combined skin dose factor (see Table 1.1-10). for stack release.

For Turbine Building roof vent releases, the skin dose rate from noble gases is calculated by Equation 3-38:

$$\dot{R}_{sking} = \sum_i \dot{Q}_i^{GL} \quad DF'_{ig} \qquad (3\text{-}38)$$

where:

$\dot{Q}_i^{GL}$ = The noble gas release rate from the Turbine Building (µCi/sec) for each radionuclide "i" identified.

DF'_{ig} = Combined skin dose factor for a ground level release (Turbine Building) [see Table 1.1-10A].

During periods (beyond the first five days) when the plant is shutdown and no radioactivity release rates can be measured at the SJAE, Xe-133 may be used in place of the last SJAE measured mix as the referenced radionuclide to determine off-site dose rate and monitor setpoints. In this case, the ratio of each $\dot{Q}_i^{SJAE}$ to the sum of all $\dot{Q}_i^{SJAE}$ in Equation 3-28 above is assumed to reduce to a value of 1, and the combined skin dose factor DF'_i for Xe-133 (4.57 E-04 mrem-sec/µCi-year) is used in Equations 3-7 and 3-38. Alternately, a relative radionuclide "i" mix fraction (f_i) may be taken from Table 5.2-1 as a function of time after shutdown, and substituted in place of the ratio of each $\dot{Q}_i^{SJAE}$ to the sum of all $\dot{Q}_i^{SJAE}$ in Equation 3-28 above to determine the relative fraction of each noble gas potentially available for release to the total (example calculations can be found in Appendix A). Just prior to plant startup before a SJAE sample can be taken and analyzed, the monitor alarm setpoints should be based on Xe-138 as representing the most prevalent high dose factor noble gas expected to be present shortly after the plant returns to power. Monitor alarm setpoints which have been determined to be conservative under any plant conditions may be utilized at any time in lieu of the above assumptions.

Equations 3-7 and 3-38 can be applied under the following conditions (otherwise, justify Method I or consider Method II):

1. Normal operations (not emergency event), and
2. Noble gas releases via the plant stack and Turbine Building roof vents to the atmosphere.

3.5.2 Basis For Method I

The methods to calculate skin dose rate parallel the total body dose rate methods in Section 3.4.3. Only the differences are presented here.

Method I may be used to show that the Technical Specification which limits skin dose rate from noble gases released to the atmosphere (Technical Specification 3.8.E.1) has been met for the peak noble gas release rate.

Method I was derived from Regulatory Guide 1.109 as follows:

$$D^{S} = 1.11\ S_F\ D^{\gamma}_{air} + 3.17E{+}04 \sum_i Q_i\ [X/Q]_S\ DFS_i \qquad (3\text{-}8)$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{mrem}{mrad}\right)\ (\ )\ \left(\frac{mrad}{yr}\right)\quad \left(\frac{pCi\text{-}yr}{Ci\text{-}sec}\right)\quad \frac{Ci}{yr}\ \left(\frac{sec}{m^3}\right)\ \left(\frac{mrem\text{-}m^3}{pCi\text{-}yr}\right)$$

where:

1.11 = Average ratio of tissue to air absorption coefficients will convert mrad in air to mrem in tissue.

$$D^{\gamma}_{air} = 3.17E{+}04 \sum_i Q_i\ [X/Q]_s\ DF_i^{\gamma} \qquad (3\text{-}9)$$

$$\left(\frac{mrad}{yr}\right)\quad \left(\frac{pCi\text{-}yr}{Ci\text{-}sec}\right)\quad \left(\frac{Ci}{yr}\right)\ \left(\frac{sec}{m^3}\right)\ \frac{mrad\text{-}m^3}{pCi\text{-}yr}$$

now $$D^{\gamma}_{finite} = D^{\gamma}_{air}\ [X/Q]^{\gamma}_s / [X/Q]_s \qquad (3\text{-}10)$$

$$\left(\frac{mrad}{yr}\right)\quad \left(\frac{mrad}{yr}\right)\ \left(\frac{sec}{m^3}\right)\ \left(\frac{m^3}{sec}\right)$$

and $$Q_i = 31.54\ \dot{Q}_i^{ST} \qquad (3\text{-}11)$$

$$\left(\frac{Ci}{yr}\right)\quad \left(\frac{Ci\text{-}sec}{\mu Ci\text{-}yr}\right)\ \left(\frac{\mu Ci}{sec}\right)$$

so $\dot{R}_{skins} = 1.11\ S_F\ \ 1E{+}06\ [X/Q]^{\gamma}_{s} \sum_i \dot{Q}^{ST}_i\ \ DF^{\gamma}_i$ (3-12)

$(\frac{mrem}{yr})\ (\frac{mrem}{mrad})\ (\ )\ (\frac{pCi}{\mu Ci})\ (\frac{sec}{m^3})\ \ (\frac{\mu Ci}{sec})\ (\frac{mrad\text{-}m^3}{pCi\text{-}yr})$

$+\ 1E{+}06\ X/Q_s \sum_i \dot{Q}^{ST}_i\ \ DFS_i$

$(\frac{pCi}{Ci})\ \frac{sec}{m^3}\ \ \frac{\mu Ci}{sec}\ (\frac{mrem\text{-}m^3}{pCi\text{-}yr})$

substituting

$[X/Q]^{\gamma}$ = 6.98E-07 sec/m^3

X/Q = 5.99E-07 sec/m^3

S_F = Shielding factor = 1.0 for dose rate determinations

gives $\dot{R}_{skins} = 0.77 \sum_i \dot{Q}^{ST}_i\ \ DF^{\gamma}_i + 0.60 \sum_i \dot{Q}^{ST}_i\ DFS_i$ (3-13)

$(\frac{mrem}{yr})\ \ (\frac{pCi\text{-}sec\text{-}mrem}{\mu Ci\text{-}m^3\text{-}mrad})\ (\frac{\mu Ci}{sec})\ (\frac{mrad\text{-}m^3}{pCi\text{-}yr})\ \ (\frac{pCi\text{-}sec}{\mu Ci\text{-}m^3})\ (\frac{\mu Ci}{sec})\ (\frac{mrem\text{-}m^3}{pCi\text{-}yr})$

$= \sum_i \dot{Q}^{ST}_i [0.77\ DF^{\gamma}_i + 0.60\ DFS_i]$ (3-14)

define

$DF'_{is} = 0.77\ DF^{\gamma}_i + 0.60\ DFS_i$ (3-15)

then $\dot{R}_{skins} = \sum_i \dot{Q}^{ST}_i\ \ DF'_{is}$ (3-7)

$(\frac{mrem}{yr})\ \ (\frac{\mu Ci}{sec})\ (\frac{mrem\text{-}sec}{\mu Ci\text{-}yr})$

For determining combined skin doses for ground level releases (Turbine Building), a $^{\gamma}X/Q_g$ = 3.95E-06 sec/m^3 and an undepleted X/Q_g = 1.74E-05 sec/m^3 have been substituted into Equation 3-12 to give:

$$\dot{R}_{sking} = \sum_i \dot{Q}_i^{GL} \left(4.38\ DF_i^{\gamma} + 17.4\ DFS_i\right)$$

then $DF'_{ig} = 4.38\ DF_i^{\gamma} + 17.4\ DFS_i$ (3-37)

and $\dot{R}_{sking} = \sum_i \dot{Q}_i^{GL}\ DF'_{ig}$ (3-38)

where:

$\dot{Q}_i^{GL}$ = The noble gas release rate from the Turbine Building (μCi/sec) for each radionuclide "i" identified.

DF'_{ig} = Combined skin dose factor for a ground level release (Turbine Building) [see Table 1.1-10A].

The selection of critical receptor, as outlined in Section 3.10 is inherent in Method I, as it determined the maximum expected off-site atmospheric dispersion factors based on past long-term site-specific meteorology.

Regarding the calculation of ground level release doses from the Turbine Building roof vent, the ground level atmospheric dispersion factors are based on the same methodologies as used for the stack dispersion factors (same noble gas mix, meteorological history [1981-1985], and meteorological models), and are for the site boundary location that will have the highest dose.

3.5.3 Method II

If Method I cannot be applied, or if the Method I dose exceeds the limit, then Method II may be applied. Method II consists of the models, input data and assumptions in Regulatory Guide 1.109, Rev. 1 (Reference A), except where site-specific models, data or assumptions are more applicable. The base case analysis, documented above, is a good example of the use of Method II. It is an acceptable starting point for a Method II analysis. Analyses requiring Method II calculations should be referred to YNSD to be performed and documented.

3.6 Method to Calculate the Critical Organ Dose Rate from Iodines, Tritium and Particulates with $T_{1/2}$ Greater Than 8 Days

Technical Specification 3.8.E.1.b limits the dose rate to any organ, denoted $\dot{R}_{co}$, from I-131, I-133, 3H, and radionuclides in particulate form with half lives greater than 8 days to 1500 mrem/year to any organ. The peak release rate averaging time in the case of iodines and particulates is commensurate with the time the iodine and particulate samplers are in service between changeouts (typically a week). By limiting the maximum $\dot{R}_{co}$ to a rate equivalent to no more than 1500 mrem/year, assurance is provided that the critical organ dose accrued in any one year by any member of the general public will be less than 1500 mrem.

Use Method I first to calculate the critical organ dose rate from the peak release rate via the plant vent stack and Turbine Building roof vent. Method I applies at all release rates.

Use Method II if Method I predicts a dose rate greater than the Technical Specification limits (i.e., use of actual meteorology over the period of interest) to determine if, in fact, Technical Specification 3.8.E.1.b had actually been exceeded during the sampling period.

3.6.1 Method I

The critical organ dose rate from stack releases can be determined by multiplying the individual radionuclide stack release rates by their respective dose factors and summing all their products together, as seen in the following Equation 3-16 (an example calculation is provided in Appendix A):

$$\dot{R}_{cos} = \sum_i \dot{Q}_i^{STP} \; DFG'_{sico} \qquad (3\text{-}16)$$

$$\left(\frac{mrem}{yr}\right) \qquad \left(\frac{\mu Ci}{sec}\right) \left(\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}\right)$$

where:

$\dot{Q}_i^{STP}$ = Stack activity release rate determination of radionuclide "i" (Iodine-131, Iodine-133, particulates with half-lives greater than 8 days, and tritium), in μCi/sec. For i = Sr89, Sr90 or tritium, use the best estimates (such as most recent measurements).

DFG'_{sico} = Site specific critical organ dose rate factor ($\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}$) for a stack gaseous release. See Table 1.1-12.

For ground releases (Turbine Building) the critical organ dose rate from Iodine, Tritium, and Particulates with T 1/2 greater than 8 days is calculated as follows:

$$\dot{R}_{cog} = \sum_i \dot{Q}_i^{GLP} \; DFG'_{gico} \qquad (3\text{-}40)$$

where:

$\dot{Q}_i^{GLP}$ = Ground activity release rate determination of radionuclide "i" (Iodine-131, Iodine-133, particulates with half-lives greater than 8 days, and tritium), in μCi/sec. For i = Sr89, Sr90 or tritium, use the best estimates (such as most recent measurements).

DFG'_{gico} = Site specific critical organ dose rate factor ($\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}$) for a ground level gaseous release. See Table 1.1-12.

Equations 3-16 and 3-40 can be applied under the following conditions (otherwise, justify Method I or consider Method II):

1. Normal operations (not emergency event), and
2. Tritium, iodine, and particulate releases via the plant stack and Turbine Building vent to the atmosphere.

3.6.2 Basis for Method I

The methods to calculate critical organ dose rate parallel the total body dose rate methods in Section 3.4. Only the differences are presented here.

Method I may be used to show that the Technical Specification which limits organ dose rate from iodines, tritium and radionuclides in particulate form with half lives greater than 8 days (hereafter called Iodines and Particulates or "I+P") released to the atmosphere (Technical Specification 3.8.E.1.b) has been met for the peak I + P release rates.

The equation for $\dot{R}_{cos}$ and $\dot{R}_{cog}$ is derived by modifying Equation 3-25 from Section 3.9 as follows:

$$D_{cos} = \sum_i Q_i \, DFG_{sico} \qquad (3\text{-}17)$$

(mrem) (Ci) $(\frac{mrem}{Ci})$

applying the conversion factor, 31.54 (Ci-sec/µCi-yr) and converting Q to $\dot{Q}$ in µCi/sec as it applies to the plant stack yields:

$$\dot{R}_{cos} = 31.54 \sum_i \dot{Q}_i^{STP} \, DFG_{sico} \qquad (3\text{-}18)$$

$(\frac{mrem}{yr})$ $(\frac{Ci\text{-}sec}{\mu Ci\text{-}yr})$ $(\frac{\mu Ci}{sec})$ $(\frac{mrem}{Ci})$

Eq. 3-18 is rewritten in the form:

$$\dot{R}_{cos} = \sum_i \dot{Q}_i^{STP} \, DFG'_{sico} \qquad (3\text{-}19)$$

$(\frac{mrem}{yr})$ $(\frac{\mu Ci}{sec})$ $(\frac{mrem\text{-}sec}{\mu Ci\text{-}yr})$

DFG'_{sico} and DFG'_{gico} (for Turbine Building vent releases) incorporates the conversion constant of 31.54 and has assumed that the shielding factor

(S_F) applied to the direct exposure pathway from radionuclides deposited on the ground plane is equal to 1.0 in place of the S_F value of 0.7 assumed in the determination of DFG_{sico} and DFG_{gico} for integrated doses over time.

The selection of a critical receptor (based on the combination of exposure pathways which include direct dose from the ground plane, inhalation, and ingestion of vegetables, meat, and milk) which is outlined in Section 3.10 is inherent in Method I, as are the maximum expected off-site atmospheric dispersion factors based on past long-term site-specific meteorology.

Regarding the calculation of ground level release doses from the Turbine Building roof vent, the selection of a critical receptor is based on the site boundary with the highest ground level atmospheric dispersion factor (based on same meteorological history and models as used in the stack) and the assumption that all of the exposure pathways used for the stack release occur at this site boundary.

Should Method II be needed, the analysis for critical receptor critical pathway(s) and atmospheric dispersion factors may be performed with actual meteorologic and latest land use census data to identify the location of those pathways which are most impacted by these type of releases.

3.6.3 Method II

If Method I cannot be applied, or if the Method I dose exceeds the limit, then Method II may be applied. Method II consists of the models, input data and assumptions in Regulatory Guide 1.109, Rev. 1 (Reference A), except where site-specific models, data or assumptions are more applicable. The base case analysis, documented above, is a good example of the use of Method II. It is an acceptable starting point for a Method II analysis. Analyses requiring Method II calculations should be referred to YNSD to be performed and documented.

3.7 Method to Calculate the Gamma Air Dose from Noble Gases

Technical Specification 3.8.F.1 limits the gamma dose to air from noble gases at any location at or beyond the site boundary to 5 mrad in any quarter and 10 mrad in any year. Dose evaluation is required at least once per month.

Use Method I first to calculate the gamma air dose for the plant stack and Turbine Building roof vent releases during the period. Method I applies at all dose levels.

Use Method II if a more accurate calculation is needed.

3.7.1 Method I

The gamma air dose from plant stack releases is:

$$D^{\gamma}_{airs} = 0.022 \sum_i Q_i^{ST} \quad DF_i^{\gamma} \qquad (3\text{-}21)$$

$$(\text{mrad}) \quad \left(\frac{\text{pCi-yr}}{\text{Ci-m}^3}\right) \quad (\text{Ci}) \quad \left(\frac{\text{mrad-m}^3}{\text{pCi-yr}}\right)$$

where:

Q_i^{ST} = total noble gas activity (Curies) released to the atmosphere via the plant stack of each radionuclide "i" during the period of interest.

DF_i^{γ} = gamma dose factor to air for radionuclide "i". See Table 1.1-10

For ground level noble gas releases from the Turbine Building, the gamma air dose is calculated as follows:

$$D^{\gamma}_{airg} = 0.13 \sum_i Q_i^{GL} \quad DF_i^{\gamma} \qquad (3\text{-}41)$$

where:

Q_i^{GL} = Total noble gas activity (curies) released to the atmosphere via the Turbine Building of each radionuclide, "i", during the period of interest

Equations 3-21 and 3-41 can be applied under the following conditions (otherwise justify Method I or consider Method II):

1. Normal operations (not emergency event), and
2. Noble gas releases via the plant stack and Turbine Building vent to the atmosphere.

3.7.2 Basis for Method I

Method I may be used to show that the Technical Specification which limits off-site gamma air dose from gaseous effluents (3.8.F.1) has been met for releases over appropriate periods. This Technical Specification is based on the Objective in 10CFR50, Appendix I, Subsection B.1, which limits the estimated annual gamma air dose at unrestricted area locations.

Exceeding the Objective does not immediately limit plant operation but requires a report to the NRC.

For any noble gas release, in any period, the dose is taken from Equations B-4 and B-5 of Regulatory Guide 1.109 with the added assumption that $D^{\gamma}_{finite} = D^{\gamma}[X/Q]^{\gamma}/[X/Q]$:

$$D^{\gamma}_{airs} = 3.17E{+}04\ [X/Q]^{\gamma}_{S} \sum_i Q_i^{ST}\ DF_i^{\gamma} \qquad (3\text{-}22)$$

$$(\text{mrad}) \quad \left(\frac{\text{pCi-yr}}{\text{Ci-sec}}\right) (\text{sec/m}^3) \quad (\text{Ci}) \left(\frac{\text{mrad-m}^3}{\text{yr-pCi}}\right)$$

where:

$[X/Q]^{\gamma}_{S}$ = maximum annual average gamma atmospheric dispersion factor for a stack release

= 6.98E-07 (sec/m^3)

Q_i^{ST} = number of curies of noble gas "i" released from the plant stack

which leads to:

$$D_{airs}^{\gamma} = 0.022 \sum_i Q_i^{ST} \quad DF_i^{\gamma} \qquad (3\text{-}21)$$

$$(\text{mrad}) \quad \left(\frac{\text{pCi-yr}}{\text{Ci-m}^3}\right) \quad (\text{Ci}) \left(\frac{\text{mrad-m}^3}{\text{pCi-yr}}\right)$$

For the ground level release:

$$D_{airg}^{\gamma} = 3.17E{+}04\ [X/Q]_g^{\gamma} \sum_i Q_i^{GL} \quad DF_i^{\gamma} \qquad (3\text{-}42)$$

where:

$(X/Q)_g^{\gamma}$ = Maximum annual average gamma atmospheric dispersion factor for a ground level release

= 3.95E-06 sec/m^3

leading to:

$$D_{airg}^{\gamma} = 0.13 \sum_i Q_i^{GL} \quad DF_i^{\gamma} \qquad (3\text{-}41)$$

Regarding the calculation of ground level release doses from the Turbine Building roof vent, the ground level atmospheric dispersion factors are based on the same methodologies as used for the stack dispersion factors (same noble gas mix, meteorological history [1981-1985] and meteorological models), and are for the site boundary location that will have the highest dose.

The main difference between Method I and Method II is that Method II would allow the use of actual meteorology to determine $[X/Q]^{\gamma}$ rather than use the maximum long-term average value obtained for the years 1981 to 1985.

3.7.3 Method II

If the Method I dose determination indicates that the Technical Specification limit may be exceeded, or if a more exact calculation is required, then Method II may be applied. Method II consists of the models, input data and assumptions in Regulatory Guide 1.109, Rev. 1 (Reference A), except where site-specific models, data or assumptions are more applicable. Analyses requiring Method II calculations should be referred to YNSD to be performed and documented.

3.8 Method to Calculate the Beta Air Dose from Noble Gases

Technical Specification 3.8.F.1 limits the beta dose to air from noble gases at any location at or beyond the site boundary to 10 mrad in any quarter and 20 mrad in any year. Dose evaluation is required at least once per month.

Use Method I first to calculate the beta air dose for the plant stack and Turbine Building roof vent releases during the period. Method I applies at all dose levels.

Use Method II if a more accurate calculation is needed or if Method I cannot be applied.

3.8.1 Method I

The beta air dose from plant vent stack releases is:

$$D^{\beta}_{airs} = 0.019 \sum_i Q_i^{ST} \quad DF_i^{\beta} \qquad (3\text{-}23)$$

$$(\text{mrad}) \quad \left(\frac{\text{pCi-yr}}{\text{Ci-m}^3}\right) \quad (\text{Ci}) \quad \left(\frac{\text{mrad-m}^3}{\text{pCi-yr}}\right)$$

where:

DF_i^{β} = beta dose factor to air for radionuclide "i". See Table 1.1-10.

Q_i^{ST} = total noble gas activity (Curies) released to the atmosphere via the plant stack of each radionuclide "i" during the period of interest.

For ground level noble gas releases from the Turbine Building, the beta air dose is calculated as follows:

$$D^{\beta}_{air_g} = 0.55 \sum_i Q_i^{GL} \quad DF_i^{\beta} \qquad (3\text{-}43)$$

where:

Q_i^{GL} = Total noble gas activity (curies) released to the atmosphere via the Turbine Building of each radionuclide "i" during the period of interest.

Equations 3-23 and 3-43 can be applied under the following conditions (otherwise justify Method I or consider Method II):

1. Normal operations (not emergency event), and
2. Noble gas releases via the plant stack and Turbine Building vent to the atmosphere.

3.8.2 Basis for Method I

This section serves three purposes: (1) to document that Method I complies with appropriate NRC regulations, (2) to provide background and training information to Method I users, and (3) to provide an introductory user's guide to Method II. The methods to calculate beta air dose parallel the gamma air dose methods in Section 3.7.3. Only the differences are presented here.

Method I may be used to show that the Technical Specification which limits off-site beta air dose from gaseous effluents (3.8.A.1) has been met for releases over appropriate periods. This Technical Specification is based on the Objective in 10CFR50, Appendix I, Subsection B.1, which limits the estimated annual beta air dose at unrestricted area locations.

Exceeding the Objective does not immediately limit plant operation but requires a report to the NRC within 30 days.

For any noble gas release, in any period, the dose is taken from Equations B-4 and B-5 of Regulatory Guide 1.109:

$$D^{\beta}_{airs} = 3.17E{+}04 \ \ X/Q_s \sum_i Q_i^{ST} \ \ DF_i^{\beta} \qquad (3\text{-}24)$$

$$\text{(mrad)} \quad \left(\frac{pCi\text{-}yr}{Ci\text{-}sec}\right) \quad \left(\frac{sec}{m^3}\right) \quad (Ci) \quad \left(\frac{mrad\text{-}m^3}{pCi\text{-}yr}\right)$$

substituting:

X/Q_s = Maximum annual average undepleted atmospheric dispersion factor for a stack release.

= 5.99E-07 sec/m^3

We have

$$D^{\beta}_{airs} = 0.019 \sum_i Q_i^{ST} \quad DF_i^{\beta} \qquad (3\text{-}23)$$

$$\text{(mrad)} \quad \left(\frac{pCi\text{-}yr}{Ci\text{-}m^3}\right) \quad (Ci) \quad \left(\frac{mrad\text{-}m^3}{pCi\text{-}yr}\right)$$

For the ground level release:

$$D^{\beta}_{airg} = 3.17E{+}04 \; (X/Q)_g \sum_i Q_i^{GL} \; DF_i^{\beta} \qquad (3\text{-}44)$$

where:

$(X/Q)_g$ = Maximum annual average undepleted atmospheric dispersion factor for a ground level release (Turbine Building)

= 1.74E-05 sec/m^3

leading to:

$$D^{\beta}_{airg} = 0.55 \sum_i Q_i^{GL} \quad DF_i^{\beta} \qquad (3\text{-}43)$$

Regarding the calculation of ground level release doses from the Turbine Building roof vent, the ground level atmospheric dispersion factors are based on the same methodologies as used for the stack dispersion factors (same noble gas mix, meteorological history [1981-1985], and meteorological models), and are for the site boundary location that will have the highest dose.

3.8.3 Method II

If Method I cannot be applied, or if the Method I dose determination indicates that the Technical Specification limit may be exceeded, or if a more exact calculation is required, then Method II may be applied. Method II consists of the models, input data and assumptions in Regulatory Guide 1.109, Rev. 1 (Peference A), except where site-specific models, data or assumptions are more applicable. Analyses requiring Method II calculations should be referred to YNSD to be performed and documented.

3.9 Method to Calculate the Critical Organ Dose from Iodines, Tritium and Particulates

Technical Specification 3.8.G.1 limits the critical organ dose to a Member of the Public from radioactive Iodines, Tritium, and particulates with half-lives greater than 8 days (hereafter called "I+P") in gaseous effluents to 7.5 mrem per quarter and 15 mrem per year. Technical Specification 3.8.M.1 limits the total body and organ dose to any real member of the public from all station sources (including gaseous effluents) to 25 mrem in a year except for the thyroid, which is limited to 75 mrem in a year.

Use Method I first to calculate the critical organ dose from a vent stack and Turbine Building roof vent release as it is simpler to execute and more conservative than Method II. Method I is conservative for total body, critical organ, and thyroid dose greater than 0.1 mrem.

Use Method II if a more accurate calculation of critical organ dose is needed (i.e., Method I indicates the dose is greater than the limit), or if Method I cannot be applied, or if the majority of the release is Iodine and the 75 mrem limit for Specification 3.8.L.1 needs to be evaluated.

3.9.1 Method I

$$D_{cos} = \sum_i Q_i^{STP} \, DFG_{sico} \qquad (3\text{-}25)$$

(mrem) (Ci) $(\frac{mrem}{Ci})$

Q_i^{STP} = Total iodine, tritium, and particulate activity (Ci) released from the stack to the atmosphere of radionuclide "i" during the period of interest. For strontiums, use the most recent measurement.

DFG_{sico} = Site-specific critical organ dose factor for a stack gaseous release of radionuclide "i" (mrem/Ci). For each radionuclide it is the age group and organ with the largest dose factor. See Table 1.1-12.

The critical organ dose is calculated for ground level releases as follows:

$$D_{cog} = \sum_i Q_i^{GLP} \, DFG_{gico} \qquad (3\text{-}44)$$

(mrem) (Ci) $\left(\frac{mrem}{Ci}\right)$

Q_i^{GLP} = Total iodine, tritium, and particulate activity (Ci) released from the Turbine Building to the atmosphere of radionuclide "i" during the period of interest. For strontiums, use the most recent measurement.

DFG_{gico} = Site-specific critical organ dose factor for a ground level release (Turbine Building) of nuclide "i" (mrem/Ci). For each radionuclide it is the age group and organ with the largest dose factor. See Table 1.1-12.

Equations 3-25 and 3-44 can be applied under the following conditions (otherwise, justify Method I or consider Method II):

1. Normal operations (not emergency event),

2. I+P releases via the plant stack and Turbine Building to the atmosphere, and

3. Any continuous or batch release over any time period.

3.9.2 Basis for Method I

This section serves three purposes: (1) to document that Method I complies with appropriate NRC regulations, (2) to provide background and training information to Method I users, and (3) to provide an introductory user's guide to Method II.

Method I may be used to show that the Technical Specifications which limit off-site organ dose from gases (3.8.G.1 and 3.8.L.1) have been met for releases over the appropriate periods. These Technical Specifications are based on Objectives and Standards in 10CFR and 40CFR. Technical Specification 3.8.G.1 is based on the ALARA Objectives in 10CFR50, Appendix I.

Subsection II C. Technical Specification 3.8.M.1 is based on Environmental Standards for Uranium Fuel Cycle in 40CFR190 (hereafter called the Standard) which applies to direct radiation as well as liquid and gaseous effluents. These methods apply only to I+P in gaseous effluents contribution.

Exceeding the Objective or the Standard does not immediately limit plant operation but requires a report to the NRC within 30 days. In addition, a waiver may be required.

Method I was developed such that "the actual exposure of an individual ... is unlikely to be substantially underestimated" (10CFR50, Appendix I). The use below of a single "critical receptor" provides part of the conservative margin to the calculation of critical organ dose in Method I. Method II allows that actual individuals, with real behaviors, be taken into account for any given release. In fact, Method I was based on a Method II analysis of the critical receptor for the annual average conditions. For purposes of complying with the Technical Specifications 3.8.G.2 maximum long term (five years) average atmospheric dispersion factors are appropriate for batch and continuous releases. That analysis was called the "base case"; it was then reduced to form Method I. The base case, the method of reduction, and the assumptions and data used are presented below.

The steps performed in the Method I derivation follow. First, in the base case, the dose impact to the critical receptor in the form of dose factors (mrem/Ci) of 1 curie release of each I+P radionuclide to gaseous effluents was derived. Then Method I was determined using simplifying and further conservative assumptions. The base case analysis uses the methods, data and assumptions in Regulatory Guide 1.109 (Equations C-2, C-4 and C-13 in Reference A). Tables 3.9-1 and 3.9-2 outline human consumption and environmental parameters used in the analysis. It is conservatively assumed that the critical receptor lives at the "maximum off-site atmospheric dispersion factor location" as defined in Section 3.10. However, he is exposed, conservatively, to all pathways (see Section 3.10). The resulting site-specific dose factors are for the maximum organ and the age group with

the highest dose factor for that organ. These critical organ, critical age dose factors are given in Table 1.1-12.

For any gas release, during any period, the increment in annual average dose from radionuclide "i" is:

$$\Delta D_{ico} = Q_i DFG_{ico} \qquad (3\text{-}26)$$

where DFG_{ico} is the critical dose factor for radionuclide "i" and Q_i is the activity of radionuclide "i" released in curies.

Method I is more conservative than Method II in the region of the Technical Specification limits because it is based on the following reduction of the base case. The dose factors DFG_{ico} used in Method I were chosen from the base case to be the highest of the set for that radionuclide. In effect each radionuclide is conservatively represented by its own critical age group and critical organ.

Because of the assumptions about receptors, environment, and radionuclides and because of the low Objective and Standard, the lack of immediate restriction on plant operation, and the adherence to 10CFR20 concentrations (which limit public health consequences) a failure of Method I (i.e., the exposure of a real individual being underestimated) is improbable and the consequences of a failure are minimal.

3.9.3 METHOD II

If Method I cannot be applied, or if the Method I dose exceeds the limit or if a more exact calculation is required, then Method II should be applied. Method II consists of the models, input data and assumptions in Regulatory Guide 1.109, Rev. 1 (Reference A), except where site-specific models, data or assumptions are more applicable. The base case analysis, documented above, is a good example of the use of Method II. It is an acceptable starting point for a Method II analysis. Analyses requiring Method II calculations should be referred to YNSD to be performed and documented.

Table 3.9-1

Environmental Parameters for Gaseous Effluents at Vermont Yankee
(Derived from Reference A)

Variable		Vegetables Stored	Vegetables Leafy	Cow Milk Pasture	Cow Milk Stored	Goat Milk Pasture	Goat Milk Stored	Meat Pasture	Meat Stored
(V	Agricultural Productivity (Kg/M²)	2.	2.	0.70	2.	0.70	2.	0.70	2.
)	Soil Surface Density (KG/M²)	240.	240.	240.	240.	240.	240.	240.	240.
I	Transport Time to User (HRS)			48.	48.	48.	48.	480.	480.
IB	Soil Exposure Time (HRS)	131400.	131400.	131400.	131400.	131400.	131400.	131400.	131400.
IF	Crop Exposure Time to Plume (HRS)	1440.	1440.	720.	1440.	720.	1440.	720.	1440.
IH	Holdup After Harvest (HRS)	1440.	24.	0.	2160.	0.	2160.	0.	2160.
)F	Animals Daily Feed (KG/DAY)			50.	50.	6.	6.	50.	50.
FP	Fraction of Year on Pasture			0.50		0.50		0.50	
FS	Fraction Pasture when on Pasture			1.		1.		1.	
FG	Fraction of Stored Veg. Grown in Garden	0.76							
FL	Fraction of Leafy Veg. Grown in Garden		0.50						
FI	Fraction Elemental Iodine = 0.5								
H	Absolute Humidity = 5.6 (gm/M³)								

Table 3.9-2

Usage Factors for Various Gaseous Pathways at Vermont Yankee
(from Regulatory Guide 1.109, Table E-5)

Age Group	Vegetables	Leafy Vegetables	Milk	Meat	Inhalation
	(kg/yr)	(kg/yr)	(l/yr)	(kg/yr)	(m^3/yr)
Adult	520.00	64.00	310.00	110.00	8000.00
Teen	630.00	42.00	400.00	65.00	8000.00
Child	520.00	26.00	330.00	41.00	3700.00
Infant	0.00	0.00	330.00	0.00	1400.00

3.10 Receptor Points and Annual Average Atmospheric Dispersion Factors for Important Exposure Pathways

The gaseous effluent dose methods have been simplified by assuming an individual whose behavior and living habits inevitably lead to a higher dose than anyone else. The following exposure pathways to gaseous effluents listed in Regulatory Guide 1.109 (Reference A) have been considered:

1. Direct exposure to contaminated air;

2. Direct exposure to contaminated ground;

3. Inhalation of air;

4. Ingestion of vegetables;

5. Ingestion of cow's milk; and

6. Ingestion of meat.

Section 3.10.1 details the selection of important off-site locations and receptors. Section 3.10.2 describes the atmospheric model used to convert meteorologic data into atmospheric dispersion factors. Section 3.10.3 presents the maximum atmospheric dispersion factors calculated at each of the off-site receptor locations.

3.10.1 Receptor Locations

Three important receptor locations are considered in the dose and dose rate equations for gaseous radioactive effluents. They are:

1. The point of maximum gamma exposure from an overhead noble gas cloud;

2. The point of maximum ground level air concentration and deposition of radionuclides.

The point of maximum gamma exposure (S sector, 400 meters) was determined by finding the maximum five-year average gamma X/Q at any off-site location. The location of the maximum ground level air concentration and deposition of radionuclides (NW sector, 2900 meters) was determined by finding the maximum five-year average depleted X/Q and D/Q at any off-site location. For the purposes of determining the Method I dose factors for iodines, tritium, and particulates, a milk animal was assumed to exist at the location of highest calculated ground level air concentration and deposition as noted above. This location then conservatively bounds the deposition of radionuclides at all real milk animal locations.

Regarding the calculation of ground level release doses from the Turbine Building roof vent, the selection of a critical receptor is based on the site boundary with the highest ground level atmospheric dispersion factor (based on same meteorological history and models as used in the stack) and the assumption that all of the exposure pathways used for the stack release occur at this site boundary.

3.10.2 Vermont Yankee Atmospheric Dispersion Model

The annual average atmospheric dispersion factors are computed for routine (long-term) releases using Yankee Atomic Electric Company's (YAEC) AEOLUS Computer Code (Reference B). AEOLUS is based, in part, on the straight-line airflow model discussed in Regulatory Guide 1.111 (Reference C). The valley in which the plant is located is considered by the model.

AEOLUS produces the following annual average atmospheric dispersion factors for each location:

1. Undepleted X/Q dispersion factors for evaluating ground level concentrations;

2. Depleted X/Q dispersion factors for evaluating ground level concentrations;

3. Gamma X/Q dispersion factors for evaluating gamma dose rates from a sector averaged finite cloud (multiple energy undepleted source); and

4. D/Q deposition factors for evaluating dry deposition of elemental radioiodines and other particulates.

The deposition velocity concept presented in "Meteorology and Atomic Energy - 1968" (Reference E, Section S-3.2) is used to determine the depleted X/Q and D/Q factors, assuming a constant deposition velocity of 1 cm/sec.

Gamma dose rate is calculated throughout this ODCM using the finite cloud model presented in "Meteorology and Atomic Energy - 1968" (Reference E, Section 7-5.2.5). That model is implemented through the definition of an effective gamma atmospheric dispersion factor, $[X/Q^{\gamma}]$ (Reference B, Section 6), and the replacement of X/Q in infinite cloud dose equations by the $[X/Q^{\gamma}]$.

3.10.3 Annual Average Atmospheric Dispersion Factors for Receptors

Actual measured meteorological data for the five-year period, 1981 through 1985, were analyzed to determine all the values and locations of the maximum off-site annual average atmospheric dispersion factors. Each dose and dose rate calculation incorporates the maximum applicable off-site annual average atmospheric dispersion factor. The values used and their locations are summarized in Table 3.10-1. Table 3.10-1 also indicates which atmospheric dispersion factors are used to calculate the various doses or dose rates of interest.

Table 3.10-1

Vermont Yankee Dilution Factors

	Dose Rate to Individual			Dose to Air	
	Total Body	Skin	Critical Organ	Gamma	Beta
X/Q depleted ($\frac{sec}{m^3}$)	-	-	5.85E-07(2) (1.65E-05)(3)	-	-
X/Q undepleted ($\frac{sec}{m^3}$)	-	5.99E-07(2) (1.74E-05)(3)	-	-	5.99E-07(2) (1.74E-05)(3)
D/Q ($\frac{1}{m^2}$)	-	-	5.85E-09(2) (6.50E-08)(3)	-	-
X/Q^{γ} ($\frac{sec}{m^3}$)	6.98E-07(1) (3.95E-06)(3)	6.98E-07(1) (3.95E-06)(3)	-	6.98E-07(1) (3.95E-06)(3)	-

(1) Maximum gamma exposure point: S sector, 400 meters (0.25 miles), for stack release.

(2) Maximum ground level concentration: NW sector, 2900 meters (1.80 miles), for stack release.

(3) Turbine Building (ground level release) maximum dilution factors: S Sector, 366 meters (0.23 miles).

3.11 Method to Calculate Dose From Plant Operation

Technical Specification 3.8.M.1 restricts the dose to the whole body or any organ to any member of the public from all station sources (including direct radiation from fixed sources on-site) to 25 mrem in a calendar year (except the thyroid, which is limited to 75 mrem).

3.11.1 Turbine Building

The maximum contribution of direct dose to the whole body or to any organ due to N-16 decay from the turbine is:

$$D_d = K_{N16}(L) * E \qquad (3\text{-}27)$$

$$(\text{mrem}) \quad \frac{(\text{mrem})}{MW_e h} \quad (MW_e h)$$

where:

D_d = The dose contribution from N-16 decay at either the site boundary off maximum impact (west site boundary) or closest off-site residence - (mrem).

E = Gross electric output over the period of interest ($MW_e h$).

$K_{N16}(L)$ = The N-16 dose conversion factor for (L) equal to either: (1) 3.23E-06 for the maximum west site boundary; or (2) 1.29E-06 for the closest residence (mrem/$MW_e h$).

3.11.2 North Warehouse

Radioactive materials and low level waste can be stored in the north warehouse. The maximum annual dose contributions to off-site receptors (west site boundary line) from sources in the shielded (east) end and the unshielded (west) end of the north warehouse are:

$$D_S = 0.25 \times \dot{R}_S \text{ for the shielded end} \qquad (3\text{-}28)$$

$$(\frac{mrem}{yr}) \quad (\frac{mrem/yr}{mrem/hr}) \quad (\frac{mrem}{hr})$$

and

$$D_U = 0.53 \times \dot{R}_U \text{ for the unshielded end} \qquad (3\text{-}29)$$

$$(\frac{mrem}{yr}) \quad (\frac{mrem/yr}{mrem/hr}) \quad (\frac{mrem}{hr})$$

where:

D_S = The annual dose contribution at the maximum site boundary location from fixed sources of radiation stored in the shielded east end of the North Warehouse $(\frac{mrem}{yr})$.

D_U = The annual dose contribution at the maximum site boundary location from fixed sources of radiation stored in the unshielded west end of the North Warehouse $(\frac{mrem}{yr})$.

$\dot{R}_S$ = Dose rate measured at 1 meter from the source in the shielded end of the north warehouse $(\frac{mrem}{hr})$.

$\dot{R}_U$ = Dose rate measured at 1 meter from the source in the unshielded end of the north warehouse $(\frac{mrem}{hr})$.

0.25 = Dose rate to dose conversion factor which relates mrem/yr at the west site boundary per mrem/yr measured at 1 meter from the source in the shielded end of the warehouse assuming it is full to capacity for one year $(\frac{mrem/yr}{mrem/hr})$.

0.53 = Dose rate to dose conversion factor which relates mrem/yr at the west site boundary per mrem/yr measured at 1 meter from the source in the unshielded end of the warehouse assuming it is full to capacity for one year ($\frac{mrem/yr}{mrem/hr}$).

3.11.3 Low Level Waste Storage Pad

Interim storage of packaged Dry Active Waste (DAW) and spent ion exchange and filter media is permitted in modular concrete storage overpacks on the LLW storage pad facility adjacent to the north warehouse. The arrangement of the storage modules is such that DAW is placed in modules which shield higher activity ion exchange media from the west site boundary. The dose at the maximum site boundary receptor from both direct radiation and skyshine scatter can be calculated as follows:

(a) Direct Dose (line of sight)

$$D_{dE} = 0.28 \times \dot{R}_d \times f_d \quad (3\text{-}30)$$

$$\left(\frac{mrem}{yr\text{-}module}\right) \quad \left(\frac{mrem/yr}{mrem/hr}\right) \quad \left(\frac{mrem}{hr}\right)$$

or

$$D_{dS} = 0.39 \times \dot{R}_d \times f_d \quad (3\text{-}31)$$

$$\left(\frac{mrem}{yr\text{-}module}\right) \quad \left(\frac{mrem/yr}{mrem/hr}\right) \quad \left(\frac{mrem}{hr}\right)$$

where:

D_{dE} = The annual direct dose contribution at the maximum site boundary from a single rectangular storage module which has an unobstructed short end surface (not shielded by other modules) orientated toward the west site boundary ($\frac{mrem}{yr\text{-}module}$).

D_{dS} = The annual direct dose contribution at the maximum site boundary from a single rectangular storage module which has an unobstructed long side surface (not shielded by other modules) orientated toward the west site boundary $(\frac{mrem}{yr\text{-}module})$.

$\dot{R}_d$ = Maximum dose rate measured at 3' from the side of the storage module whose unobstructed face (i.e., a side or end surface which is not shielded by other waste modules) is toward the west site boundary.

f_d = The fraction of a year that a storage module is in use on the storage pad.

0.28 = Dose rate to dose conversion factor which relates mrem/yr at the west site boundary per mrem/hr measured at 3' from the narrow end of the rectangular storage module when that face is orientated toward the west boundary.

0.39 = Dose rate to dose conversion factor which relates mrem/yr at the west site boundary per mrem/hr measured at 3' from the long side of the rectangular storage module when that face is orientated toward the west boundary.

(b) Scatter From Skyshine

$$D_{SKR} = 0.016 \times \dot{R}_{SKR} \times f_{SK} \qquad (3\text{-}32)$$

$$(\frac{mrem}{yr\text{-}liner}) \quad (\frac{mrem/yr}{mrem/hr}) \quad (\frac{mrem}{hr})$$

and

$$D_{SKD} = 0.015 \times \dot{R}_{SKD} \times f_{SK} \qquad (3\text{-}33)$$

$$\left(\frac{mrem}{yr\text{-}module}\right) \quad \left(\frac{mrem/yr}{mrem/hr}\right) \quad \left(\frac{mrem}{hr}\right)$$

where:

R_{SKR} = The annual skyshine scatter contribution to the dose at the maximum site boundary from a single spent ion exchange media liner in a storage module whose top surface is not obstructed due to stacking of modules $\left(\frac{mrem}{yr\text{-}liner}\right)$.

R_{SKD} = The annual skyshine scatter contribution to the dose at the maximum site boundary from a rectangular storage module containing DAW whose top surface is not obstructed due to stacking of modules $\left(\frac{mrem}{yr\text{-}module}\right)$.

$\dot{R}_{SKR}$ = For Resins, the maximum dose rate measured at 3' over the top of each liner in a storage module (mrem/hr).

$\dot{R}_{SKD}$ = For DAW, the maximum dose rate measured at 3' over the top surface of a storage module with DAW (mrem/hr).

f_{SK} = The fraction of a year that a storage module is in use on the storage pad.

0.016 = Dose rate to dose conversion factor for the scatter dose from each resin liner source in storage which relates mrem/yr at the west site boundary per mrem/hour at 3' from the top of the module.

0.015 = Dose rate to dose conversion factor for the scatter dose from DAW boxes in storage which relates mrem/yr at the west site boundary per mrem/hr at 3' from the top of the module.

(c) Dose From Resin Liners During Transfer

During the movement of resin liners from transfer casks to the storage modules, the liners will be unshielded in the storage pad area for a short period of time. The maximum dose contribution at the site boundary during the unshielded movement of resin liners can be calculated from:

$$\underset{(mrem)}{D_{trans}} = \underset{\left(\frac{mrem/hr}{R/hr}\right)}{0.0025} \times \underset{\left(\frac{R}{hr}\right)}{\dot{R}_{tran}} \times \underset{(hr)}{T_{trans}} \qquad (3\text{-}34)$$

where:

D_{trans} = The dose contribution to maximum site boundary resulting from the unshielded movement of resin liners between a a transfer cask and a storage module (mrem).

$\dot{R}_{trans}$ = Dose rate measured at contact (2") from the unshielded top surface of the resin liner in R/hr.

T_{tran} = The time (in hours) that an unshielded resin liner is exposed in the storage pad area.

0.0025 = The dose rate to dose conversion factor for an unshielded resin liner which relates mrem/hour at the west site boundary per R/hr at contact (2") from the unshielded surface of the liner.

(d) Intermodular Gap Dose

In addition to the above methods for determining doses at the west site boundary from the LLW storage pad, another dose assessment model has been included to address the possible condition of spaces or gaps existing between the placement of the DAW storage modules situated along the west facing side of the pad. This could result in a radiation streaming condition existing if ion exchange resin liners were placed in storage directly behind the gap. The direct dose equations (3-30 and 3-31) consider that the storage modules situated on the outside of the pad area provide a uniform shield to storage modules placed behind them. The intermodular gap dose equation (3-35) accounts for any physical spacing between the outside storage modules which have not been covered by additional external shielding.

$$D_{Gap} = 2.44E\text{-}2 \times W_{Gap} \times A_{RL} \times f_{Gap} \qquad (3\text{-}36)$$

$(\frac{mrem}{yr})$ $(\frac{mrem}{yr\text{-}in\text{-}Ci})$ (in) (Ci)

where:

D_{Gap} = The annual dose contribution at the maximum site boundary (west) from radiation streaming through the intermodular gap between DAW storage modules used to shield resin modules from direct radiation (mrem/yr).

W_{Gap} = The intermodular gap width (inches) between adjacent DAW storage modules facing the west site boundary.

A_{RL} = The total gamma activity contained in a condensate resin liner stored directly in line with the intermodular gap adjacent DAW modules (Ci).

f_{Gap} = The fraction of a year that the intermodular gap is not shielded.

2.44E-2 = The activity to site boundary dose conversion factor for a one-inch wide intermodular gap ($\frac{mrem}{yr\text{-}in\text{-}Ci}$).

The site boundary dose from waste materials placed into storage on the Low Level Waste Storage Pad Facility is determined by combining the dose contribution due to direct radiation (line of sight) from Part (a) above with the skyshine scatter dose from Part (b), resin liner transfer dose from Part (c), and any intermodular gap dose from Part (d).

3.11.4 Total Direct Dose Summary

The dose contributions from the N-16 source in the Turbine Building, fixed sources in the north warehouse, and fixed sources on the Low Level Waste Storage Pad Facility, shall be combined to obtain the estimate of total off-site dose to any member of the public from all fixed sources of radiation located on-site.

3.12 Cumulative Doses

Cumulative Doses for a calendar quarter and a calendar year must be maintained to meet Technical Specifications 3.8.B.1, 3.8.F.1 and 3.8.G.1. In addition, if the requirements of Technical Specification 3.8.M.2 dictate, cumulative doses over a calendar year must be determined for Technical Specification 3.8.M.1. To ensure the limits are not exceeded, a running total must be kept for each release.

gas. The nominal plant stack flow is 7.5E+07 cc/sec ((160,000 cfm x 28,300 cc/ft^3)/60 sec/min).

When monitor responses indicate that activity levels are below the LLDs at the stack (or AOG) monitors, the relative contribution of each noble gas radionuclide can conservatively be approximated by analysis of a sample of off-gas obtained during plant operations at the steam jet air ejec r (SJAE). This setpoint example is based on the following data (see Table 1.1-10 for DFB_i and DF_i'):

i	$\dot{Q}_i^{SJAE}$ ($\frac{\mu Ci}{sec}$)	DFB_i ($\frac{mrem\text{-}m^3}{pCi\text{-}yr}$)	DF_i' ($\frac{mrem\text{-}sec}{\mu Ci\text{-}yr}$)
Xe-138	1.03E+04	8.83E-03	9.60E-03
Kr-87	4.73E+02	5.92E-03	1.06E-02
Kr-88	2.57E+02	1.47E-02	1.32E-02
Kr-85m	1.20E+02	1.17E-03	1.83E-03
Xe-135	3.70E+02	1.81E-03	2.60E-03
Xe-133	1.97E+01	2.94E-04	4.57E-04

$$DFB_c = \frac{\sum_i \dot{Q}_i^{SJAE} DFB_i}{\sum_i \dot{Q}_i^{SJAE}} \qquad (5\text{-}11)$$

$$\sum_i \dot{Q}_i^{SJAE} DFB_i = (1.03E+04)(8.83E-03) + (4.73E+02)(5.92E-03)$$

$$+ (2.57E+02)(1.47E-02) + (1.20E+02)(1.17E-03)$$

$$+ (3.70E+02)(1.81E-03) + (1.97E+01)(2.94E-04)$$

$$= 9.83E+01\ (\mu Ci\text{-}mrem\text{-}m^3/sec\text{-}pCi\text{-}yr)$$

$$\sum_i \dot{Q}_i^{SJAE} = 1.03E+04 + 4.73E+02 + 2.57E+02$$

$$+ 1.20E+02 + 3.70E+02 + 1.97E+01$$

$$= 1.15E+04 \ \mu Ci/sec$$

$$DFB_c = \frac{9.83E+01}{1.15E+04}$$

$$= 8.52E-03 \ (mrem\text{-}m^3/pCi\text{-}yr)$$

$$R_{spt}^{tb} = 716 \ S_g \frac{1}{F} \frac{1}{DFB_c} \qquad (5\text{-}9)$$

$$= (716)\ (1E+08)\ \frac{1}{(7.5E+07)}\ \frac{1}{(8.52E-03)}$$

$$= 112{,}050 \text{ cpm}$$

<u>Next</u>:

$$DF'_c = \frac{\sum_i \dot{Q}_i^{SJAE} DF'_i}{\sum_i \dot{Q}_i^{SJAE}} \qquad (5\text{-}12)$$

$$\sum_i \dot{Q}_i^{SJAE} DF'_i = (1.03E+04)(9.60E-03) + (4.73E+02)(1.06E-03)$$

$$+ (2.57E+02)(1.32E-02) + (1.20E+02)(1.83E-03)$$

$$+ (3.70E+02)(2.60E-03) + (1.97E+01)(4.57E-04)$$

$$= 1.04E+02 \ (\mu Ci\text{-}mrem\text{-}sec/sec\text{-}\mu Ci\text{-}yr)$$

$$DF'_c = \frac{1.04E+02}{1.15E+04}$$

$= 9.04E-03$ (mrem-sec/μCi-yr)

$$R^{skin}_{spt} = 3{,}000\ S_g \frac{1}{F} \frac{1}{DF'_c} \quad (5\text{-}10)$$

$$= (3{,}000)\ (1E{+}08)\ \frac{1}{(7.5E{+}07)}\ \frac{1}{(9.04E{-}03)}$$

$$= 442{,}478 \text{ cpm}$$

The setpoint, R_{spt}, is the lesser of R^{tb}_{spt} and R^{skin}_{spt}. For the noble gas mixture in this example R^{tb}_{spt} is less than R^{skin}_{spt}, indicating that the total body dose rate is more restrictive. Therefore, in this example the "Stack Ga. .." and "Stack Gas II" noble gas activity monitors should each be set at 112,050 cpm above background or at some conservative value below this (such as that which might be based on controlling release rates from the plant in order to maintain off-site air concentrations below 2 x MPC when averaged over an hour), or to account for other minor releases from the Turbine Building roof vents. For example, if an administrative limit of 70 percent of the Technical Specification whole body dose limit 500 mrem/yr (112,050 cpm) is chosen, then the noble gas monitor alarms should be set at 78,435 cpm above background (0.7 x 112,050 = 78,435).

5.2.1.3 Basis for the Plant Stack and AOG System Noble Gas Activity Monitor Setpoints

The setpoints of the plant stack and AOG system noble gas activity monitors must ensure that Technical Specification 3.8.E.1.a is not exceeded. Sections 3.4 and 3.5 show that Equations 3-5 and 3-7 are acceptable methods for determining compliance with that Technical Specification. Which equation (i.e., dose to total body or skin) is more limiting depends on the noble gas mixture. Therefore, each equation must be considered separately. The derivations of Equations 5-9 and 5-10 begin with the general equation for the response R of a radiation monitor:

$$R = \sum_i S_{gi} \quad C_{mi} \qquad (5\text{-}13)$$

$$(cpm) \qquad \left(\frac{cpm\text{-}cm^3}{\mu Ci}\right) \left(\frac{\mu Ci}{cm^3}\right)$$

where:

R = Response of the instrument (cpm)

S_{gi} = Detector counting efficiency for noble gas "i" (cpm/(μCi/cm^3))

C_{mi}' = Activity concentration of noble gas "i" in the mixture at the noble gas activity monitor (μCi/cm^3)

The relative release rate of each noble gas, $\dot{Q}_i$ (μCi/sec), in the total release rate is normally determined by analysis of a sample of off-gas obtained at the Steam Jet Air Ejector (SJAE). Noble gas release rates at the plant stack and the AOG discharge are usually so low that the activity concentration is below the Lower Limit of Detection (LLD) for sample analysis. As a result, the release rate mix ratios measured at the SJAE are used to present any radioactivity being discharged from the stack, such as may have resulted from plant steam leaks that have been collected by building ventilation. For the AOG monitor downstream of the charcoal delay beds, this leads to a conservative setpoint since several short-lived (high dose factor) noble gas radionuclides are then assumed to be present at the monitor, which in reality, would not be expected to be present in the system at that point. During periods when the plant is shutdown (after five days), and no radioactivity release rates can be measured at the SJAE, Xe-133 is the dominant long-lived noble gas and may be used as the referenced radionuclide to determine off-site dose rates and monitor setpoints. Alternately, a relative radionuclide, "i", mix fraction, (f_i), may be taken from Table 5.2-1 as a function of time after shutdown (including periods shorter than five days) to determine the relative fraction of each noble gas potentially available for release to the total. However, prior to plant startup before a SJAE sample can be taken and analyzed, the monitor alarm setpoints should be based on Xe-138 as representing the most prevalent high dose factor noble gas

expected to be present shortly after the plant returns to power. Monitor alarm setpoints which have been determined to be conservative under any plant conditions may be utilized at any time in lieu of the above assumptions. C_{mi}, the activity concentration of noble gas "i" at the noble gas activity monitor, may be expressed in terms of $\dot{Q}_i$ by dividing by F, the appropriate flow rate. In the case of the plant stack noble gas activity monitors the appropriate flow rate is the plant stack flow rate and for the AOG noble gas activity monitors the appropriate flow rate is the AOG system flow rate.

$$C_{mi} = \dot{Q}_i \quad \frac{1}{F} \qquad (5\text{-}14)$$

$$\left(\frac{\mu Ci}{cm^3}\right) \quad \left(\frac{\mu Ci}{sec}\right) \left(\frac{sec}{cm^3}\right)$$

where:

$\dot{Q}_i$ = The release rate of noble gas "i" in the mixture for each noble gas identified.

F = Appropriate flow rate (cm^3/sec)

Substituting the right half of Equation 5-14 into Equation 5-13 for C_{mi} yields:

$$R = \sum_i S_{gi} \quad \dot{Q}_i \quad \frac{1}{F} \qquad (5\text{-}15)$$

$$(cpm) \qquad \left(\frac{cpm\text{-}cm^3}{\mu Ci}\right) \left(\frac{\mu Ci}{sec}\right) \left(\frac{sec}{cm^3}\right)$$

The detector calibration procedure establishes a counting efficiency for a given mix of nuclides seen by the detector. Therefore, in Equation 5-15 one may substitute S_g for S_{gi}, where S_g represents the counting efficiency determined for the current mix of nuclides. If the mix of nuclides changes significantly, a new counting efficiency should be determined for calculating the setpoint.

$$R = S_g \frac{1}{F} \sum_i \dot{Q}_i \quad (5\text{-}16)$$

$$(cpm) \quad (\frac{cpm\text{-}cm^3}{\mu Ci}) \; (\frac{sec}{cm^3}) \quad (\frac{\mu Ci}{sec})$$

The total body dose rate due to noble gases is determined with Equation 3-5:

$$\dot{R}_{tbs} = 0.70 \sum_i \dot{Q}_i \quad DFB_i \quad (3\text{-}5)$$

$$(\frac{mrem}{yr}) \quad (\frac{pCi\text{-}sec}{\mu Ci\text{-}m^3}) \quad (\frac{\mu Ci}{sec}) \quad (\frac{mrem\text{-}m^3}{pCi\text{-}yr})$$

where:

$\dot{R}_{tbs}$ = total body dose rate (mrem/yr) due to noble gases from stack release

0.70 = (1.0E+06) x (6.98E-07) ($pCi\text{-}sec/\mu Ci\text{-}m^3$)

1E + 06 = number of pCi per µCi (pCi/µCi)

6.98E - 07 = $[X/Q]^Y$, maximum annual average gamma atmospheric dispersion factor (sec/m^3)

$\dot{Q}_i$ = the release rate of noble gas "i" in the mixture for each noble gas identified (µCi/sec) (Equivalent to $\dot{Q}_i^{ST}$ for noble gases released at the plant stack.)

DFB_i = total body dose factor (see Table 1.1-10) ($mrem\text{-}m^3/pCi\text{-}yr$)

i	$\dot{Q}_i^{SJAE}$ (uCi/sec)	DFB_i (mrem-m^3/pCi-yr)
Xe-138	5.15 E+03	8.83 E-03
Kr-87	2.37 E+02	5.92 E-03
Kr-88	1.29 E+02	1.47 E-02
Xe-135	1.85 E+02	1.81 E-03

Calculation

The dose rate is calculated from Equations (3-5) and (3-28):

$$\dot{R}_{tbs} = 0.70 \sum_i \dot{Q}_i^{ST} \quad DFB_i \qquad (3\text{-}5)$$

$$\left(\frac{mrem}{yr}\right) \left(\frac{pCi\text{-}sec}{uCi\text{-}m^3}\right) \quad \left(\frac{uCi}{sec}\right) \quad \left(\frac{mrem\text{-}m^3}{pCi\text{-}yr}\right)$$

and where the stack release rate is determined from:

$$\dot{Q}_i^{ST} = \frac{\dot{Q}_i^{SJAE}}{\sum_i \dot{Q}_i^{SJAE}} \quad M \quad \frac{1}{Sg} \quad F \qquad (3\text{-}28)$$

$$\left(\frac{uCi}{sec}\right) \qquad (cpm) \quad \left(\frac{uCi/cc}{cpm}\right) \quad \left(\frac{cc}{sec}\right)$$

First, determine the sum ($\sum_i$) of all $\dot{Q}_i^{SJAE}$ and the fraction that each noble gas i represents in the total gas mix.

$$\sum_i \dot{Q}_i^{SJAE} = (5.15\ E{+}03) + (2.37\ E{+}02) + (1.29\ E{+}02) + (1.85\ E{+}02)$$

$$= 5.70\ E{+}03\ uCi/sec$$

and the relative fraction of each noble gas:

i	Q_i^{SJAE} /5.70 E+03		f_i Relative Fraction of Total
Xe-138	5.15 E+03/5.70 E+03	=	0.904
Kr-87	2.37 E+02/5.70 E+03	=	0.042
Kr-88	1.29 E+02/5.70 E+03	=	0.023
Xe-135	1.85 E+02/5.70 E+03	=	0.032

Next, the stack release rate of each noble gas i from Equation (3-28) can be substituted into Equation (3-5) to give the dose rate as:

$$\dot{R}_{tbs} = 0.70 \quad M \quad \frac{1}{Sg} \quad F \sum_i \quad f_i \quad DFB_i$$

$$= 0.70 \quad 80,000 \quad 1/1E+08 \quad 7.55\ E+07 \sum_i \quad f_i \quad DFB_i$$

$$= 4.23\ E+04\ [(0.904)(8.83\ E-03) + (0.042)(5.92\ E-03) +$$

$$(0.023)(1.47\ E-02) + (0.032)(1.81\ E-03)] =$$

Answer

$\dot{R}_{tbs}$ = 365 mrem/year noble gas total body dose rate.

i	f_i (32 day)*	DFB_i**
Kr-85	0.152	1.61 E-05
Xe-131m	0.070	9.15 E-05
Xe-133	0.777	2.94 E-04

*Fraction of nuclide in mix as function of time (see Table 5.2-1).

**Dose factors from Table 1.1-10.

Calculation

The dose rate is calculated from Equations (3-5) and (3-28):

$$\dot{R}_{tbs} = 0.70 \sum_i \dot{Q}_i^{ST} \; DFB_i \qquad (3\text{-}5)$$

$$\left(\frac{mrem}{yr}\right) \; \left(\frac{pCi\text{-}sec}{uCi\text{-}m^3}\right) \; \left(\frac{uCi}{sec}\right) \; \left(\frac{mrem\text{-}m^3}{pCi\text{-}yr}\right)$$

and where the stack release rate is determined from:

$$\dot{Q}_i^{ST} = \frac{\dot{Q}_i^{SJAE}}{\sum_i \dot{Q}_i^{SJAE}} \; M \; \frac{1}{Sg} \; F \qquad (3\text{-}28)$$

$$\left(\frac{uCi}{sec}\right) \qquad (cpm) \; \left(\frac{uCi/cc}{cpm}\right) \; \left(\frac{cc}{sec}\right)$$

However, for a time (t) after shutdown, the ratio of $\dot{Q}_i^{SJAE}$ to the sum release rate of all noble gases can be replaced in Equation (3-28) by the relative fraction $[f_i(t)]$ of each noble gas available in the system; therefore, Equation (3-28) can be written:

$$\dot{Q}_i^{ST} = f_i(t) \quad M \quad \frac{1}{Sg} \quad F$$

Therefore, using the above data for a time period 32 days after shutdown, the dose rate equation can also be written as:

$$\dot{R}_{tbs} = 0.70 \quad M \quad \frac{1}{Sg} \quad F \quad \sum_i \quad f_i(t) \quad DFB_i$$

$$= 0.70 \quad 80{,}000 \quad 1/1E{+}08 \quad 7.55\ E{+}07\ [(0.152)(1.61\ E{-}05) + (0.070)(9.15\ E{-}05) + (0.777)(2.94\ E{-}04)] =$$

Answer

$\dot{R}_{tbs}$ = 10.0 mrem/year noble gas total body dose rates at 32 days after shutdown.

i	$\dot{Q}_i^{SJAE}$ (uCi/sec)	DF'_{is} ($\frac{mrem\text{-}sec}{uCi/year}$)
Xe-138	5.15 E+03	9.60 E-08
Kr-87	2.37 E+02	1.06 E-02
Kr-88	1.29 E+02	1.32 E-02
Xe-135	1.85 E+02	2.60 E-03

Calculation

The skin dose rate is calculated from Equations (3-7) and (3-28):

$$\dot{R}_{skins} = \sum_i \dot{Q}_i^{ST} \quad DF'_{is} \qquad (3\text{-}7)$$

$$(\frac{mrem}{yr}) \qquad (\frac{uCi}{sec}) \quad (\frac{mrem\text{-}sec}{uCi\text{-}yr})$$

and where the stack release rate is determined from:

$$\dot{Q}_i^{ST} = \frac{\dot{Q}_i^{SJAE}}{\sum_i \dot{Q}_i^{SJAE}} \quad M \quad \frac{1}{Sg} \quad F \qquad (3\text{-}28)$$

$$(\frac{uCi}{sec}) \qquad (cpm) \quad (\frac{uCi/cc}{cpm}) \quad (\frac{cc}{sec})$$

First, determine the sum ($\sum_i$) of all $\dot{Q}_i^{SJAE}$ and the fraction that each noble gas i represents in the total gas mix.

$$\sum_i \dot{Q}_i^{SJAE} = (5.15\ E{+}03) + (2.37\ E{+}02) + (1.29\ E{+}02) + (1.85\ E{+}02)$$
$$= 5.70\ E{+}03\ uCi/sec.$$

and the relative fraction of each noble gas:

i	$\dot{Q}_i^{SJAE}$ /5.70 E+03		f_i Relative Fraction of Total
Xe-138	5.15 E+03/5.70 E+03	=	0.904
Kr-87	2.37 E+02/5.70 E+03	=	0.042
Kr-88	1.29 E+02/5.70 E+03	=	0.023
Xe-135	1.85 E+02/5.70 E+03	=	0.032

Next, the stack release rate of each noble gas i from Equation (3-28) can be substituted into Equation (3-5) to give the skin dose rate as:

$$\dot{R}_{skins} = M \quad \frac{1}{5g} \quad F \sum_i \quad f_i \quad DF'_{is}$$

$$= 80{,}000 \quad 1/1E{+}08 \quad 7.55\ E{+}07\ [(0.904)(9.60\ E{-}03) + (0.042)(1.06\ E{-}02) + (0.023)(1.32\ E{-}02) + (0.032)(2.60\ E{-}03)]$$

$$= 6.04\ E{+}04\ (8.68\ E{-}03 + 4.45\ E{-}04 + 3.04\ E{-}04 + 8.32\ E{-}05)$$

$$= 6.04\ E{+}04\ (9.51\ E{-}03)$$

Answer

$\dot{R}_{skins}$ = 574 mrem/year noble gas skin dose rate.

i	f_i (t >5 days)	DF'_{is} ($\frac{mrem-sec}{uCi-year}$)
Xe-133	1.	4.57 E-04

Calculation

The skin dose rate is calculated from Equations (3-7) and (3-28):

$$\dot{R}_{skins} = \sum_i \dot{Q}_i^{ST} \; DF'_{is} \qquad (3\text{-}7)$$

$$(\frac{mrem}{yr}) \qquad (\frac{uCi}{sec}) \quad (\frac{mrem-sec}{uCi-yr})$$

and, the stack release rate is determined from:

$$\dot{Q}_i^{ST} = \frac{\dot{C}_i^{SJAE}}{\sum_i \dot{Q}_i^{SJAE}} \quad M \quad \frac{1}{Sg} \quad F \qquad (3\text{-}28)$$

However, for times greater than five days after shutdown, Xe-133 may be used as the referenced radionuclide alone. Therefore, in Equation (3-28) the ratio of $\dot{Q}_i^{SJAE}$ to the sum of all $\dot{Q}_i^{SJAE}$ can be replaced by a value of 1 which indicates that all the contribution to the release is from Xe-133.

Therefore:

$$\dot{Q}_{Xe-133}^{ST} = 1.0 \times \underset{(cpm)}{120{,}000} \times \underset{(\frac{uCi/cc}{cpm})}{1/1E+08} \times \underset{(cc/sec)}{7.55\ E+07}$$

$$\dot{Q}_{Xe-133}^{ST} = 90{,}600 \text{ uCi/sec.}$$

Therefore, replacing this value of $\dot{Q}_i^{ST}$ into Equation (3-7) we find the skin dose rate as:

$$\dot{R}_{skins} = 90{,}600 \quad \times \quad 4.57\ E\text{-}04$$

$$\left(\frac{mrem}{yr}\right) \quad \left(\frac{uCi}{sec}\right) \qquad \left(\frac{mrem\text{-}sec}{uCi\text{-}yr}\right)$$

Answer

$\dot{R}_{skins}$ = 41.4 mrem/year.

EXAMPLE PROBLEM NO. 6

Type

Critical Organ Dose Rate From Iodine, Tritium, and Particulates

References

a) ODCM Section 3.6 (Method I).

b) Technical Specification 3.8.E.1.b.

Problem

Calculate the critical organ dose rate due to measured effluent data taken from the plant stack for a seven-day sample collection period.

Plant Data

a) Stack particulate analysis for the seven-day period of interest.

i	Activity Q_i^{STP} (uCi/sec)	DFG'_{sico} (1) $\left(\frac{mrem-sec}{yr-uCi}\right)$
Sr-89*	1.42 E-04*	2.23 E+02
Sr-90*	3.50 E-03*	8.48 E+03
Co-60	4.89 E-02	2.12 E+02
Cs-137	3.90 E-03	3.44 E+02
Zn-65	1.01 E-02	7.51 E+01
Na-24**	2.76 E-03**	--
Mn-54+	<2.87 E-06+	1.72 E+01

(1) DFG'_{ico} dose rate factor for each radionuclide is taken from Table 1.1-12.

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Notes

*For Sr-89/90, use the most recent available measurement from quarters composite analysis.

**Na-24 has a half life of less than 8-1/2 days, and therefore is not included in the dose analysis per requirement; of Technical Specification 3.8.E.1.b even though it was detected.

+Mn-54 is not included in the dose analysis since it was not detected as being present above the LLD.

b) Stack iodine (charcoal and particulate activities combined for the seven-day period of interest):

i	Activity Q_i^{STP} (uCi/sec)	DFG'_{sico} ($\frac{mrem-sec}{yr-uCi}$)
I-131	1.16 E-03	1.51 E+03
I-133*	<6.35 E-05*	1.61 E+01
I-135**	7.21 E-03**	5.14 E-01
and		
H-3+	3.17 E-02	5.70 E-03

Notes

*I-133 is not included in the dose analysis for this case since it was not detected is being present in the stack analysis.

**I-135 is not included in the dose analysis because it has a half life less than 8-1/2 for particulates, and is not included as a required iodine in Technical Specification 3.8.E.1.b.

+Tritium value based as latest available stack grab sample.

Calculation

The dose rate is calculated from Equation (3-16):

$$\dot{R}_{cos} = \sum_i \dot{Q}_i^{STP} \; DFG'_{sico} \qquad (3\text{-}16)$$

$$(\frac{mrem}{yr}) \qquad (\frac{uCi}{sec}) \qquad (\frac{mrem\text{-}sec}{uCi\text{-}yr})$$

The dose rate factors (DFG'_{sico}) for each of the radionuclides detected in the plant stack charcoal and particulate filter sample (plus tritium) is taken from Table 1.1-12 of the ODCM.

Therefore:

$$\dot{R}_{cos} = (1.42\ E\text{-}04)(2.23\ E\text{+}02) + (3.50\ E\text{-}03)(8.48\ E\text{+}03) + (4.89\ E\text{-}02)(2.12\ E\text{+}02) + (3.90\ E\text{-}03)(3.44\ E\text{+}02) + (1.01\ E\text{-}02)(7.51\ E\text{+}01) + (1.16\ E\text{-}03)(1.51\ E\text{+}03) + (3.17\ E\text{-}02)(5.70\ E\text{-}03) =$$

Answer

$\dot{R}_{cos}$ = 33.6 mrem/year critical organ dose rate from iodine, tritium, and particulate.

EXAMPLE PROBLEM NO. 7

Type

Gamma Air Dose From Noble Gases released from stack

References

a) ODCM Section 3.7 (Method I).

b) Technical Specification 3.8.F.1.

Problem

Calculate the maximum gamma air dose resulting from noble gases released from the plant stack over a calendar month.

Plant Data

Based on the daily off-gas analysis, the total activity released during the month of interest is:

i	Activity Q_i^{ST} (Ci)	DF_i^{γ} * ($\frac{mrad\text{-}m^3}{pCi\text{-}yr}$)
Kr-88	3.55 E-01	1.52 E-02
Kr-85m	4.71 E+00	1.23 E-03
Xe-138	2.75 E+00	9.21 E-03
Xe-135	3.51 E+01	1.92 E-03
Xe-133	9.42 E+01	3.53 E-04

*Gamma air dose factors taken from Table 1.1-10.

Calculation

The maximum gamma air dose off-site is calculated from Equation (3-21):

$$D^{\gamma}_{airs} = 0.022 \sum_i Q^{ST}_i \; DF^{\gamma}_i \qquad (3\text{-}21)$$

(mrad) $\left(\frac{pCi\text{-}yr}{Ci\text{-}m^3}\right)$ (Ci) $\left(\frac{mrad\text{-}m^3}{pCi\text{-}yr}\right)$

Therefore:

D^{γ}_{airs} = 0.022 [(3.55 E-01)(1.52 E-02) + (4.71 E+00)(1.23 E-03)

+ (2.75 E+00)(9.21 E-03) + (3.51 E+01)(1.92 E-03) +

(9.42 E+01)(3.52 E-04)]

= 0.022 (5.40 E-03 + 5.79 E-03 + 2.53 E-02 + 6.74 E-02 +

3.31 E-02)

Answer

D^{γ}_{airs} = 3.01 E-03 mrad gamma air dose during the month.

EXAMPLE CALCULATION NO. 8

Type

Beta Air Dose From Noble Gases released from stack

References

a) ODCM Section 3.8 (Method I).

b) Technical Specification 3.8.F.1.

Problem

Calculate the maximum beta air dose resulting from the same noble gas releases given in Example Calculation No. 7.

Plant Data

From Example No. 7, the total activity determined to be released during the month is:

i	Activity Q_i^{ST} (Ci)	DF_i^{β} * $(\frac{mrad\text{-}m^3}{pCi\text{-}yr})$
Kr-88	3.55 E-01	2.93 E-03
Kr-85m	4.71 E+00	1.97 E-03
Xe-138	2.75 E+00	4.75 E-03
Xe-135	3.51 E+01	2.46 E-03
Xe-133	9.42 E+01	1.05 E-03

*Beta air dose factors taken from Table 1.1-10.

Calculation

The maximum beta air dose off-site is calculated from Equation (3-23):

$$D^{\beta}_{airs} = 0.019 \sum_i Q^{ST}_i \; DF^{\beta}_i \qquad (3\text{-}23)$$

$$(\text{mrad}) \quad \left(\frac{\text{pCi-yr}}{\text{Ci-m}^3}\right) \quad (\text{Ci}) \quad \left(\frac{\text{mrad-m}^3}{\text{pCi-yr}}\right)$$

Therefore:

$$D^{\beta}_{airs} = 0.019\ [(3.55\text{ E-01})(2.93\text{ E-03}) + (4.71\text{ E+00})(1.97\text{ E-03})$$

$$+ (2.75\text{ E+00})(4.75\text{ E-03}) + (3.51\text{ E+01})(2.46\text{ E-03}) +$$

$$(9.42\text{ E+01})(1.05\text{ E-03})]$$

$$= 0.019\ (1.04\text{ E-03} + 9.28\text{ E-03} + 1.31\text{ E-02} + 8.63\text{ E-02} +$$

$$9.89\text{ E-02})$$

Answer

D^{β}_{airs} = 3.96 E-03 mrad beta air dose during the month.

EXAMPLE PROBLEM NO. 9

Type

Critical Organ Dose From Iodine, Tritium, and Particulates

References

a) ODCM Section 3.9 (Method I).

b) Technical Specification 3.8.G.1.

Problem

Calculate the critical organ dose due to the total activity recorded as being released from the plant stack during a calendar month.

Plant Data

a) From the combined stack analyses during the month, the following activity released is.

i	Q_i^{STP} (Ci)	$DFG_{sico}^{(1)}$ $(\frac{mrem}{Ci})$
Sr-89*	5.42 E-04*	7.08 E+00
Sr-90*	1.10 E-02*	2.69 E+02
Co-60	2.30 E-01	4.76 E+00
Cs-137	1.15 E-02	1.01 E+01
Zn-65	2.60 E-02	2.32 E+00
Na-24**	7.11 E-03**	--
Mn-54	<2.76 E-06+	4.36 E-01

APPENDIX J

ON-SITE DISPOSAL OF SEPTIC WASTE

Requirement: Off-Site Dose Calculational Manual, Appendix B requires that the dose impact due to on-site disposal of septic waste during the reporting year and from previous years be reported to the Commission in the Semiannual Radioactive Effluent Report filed after January 1, if disposals occur during the reporting year.

Response: There were no on-site disposals of septic waste during the reporting year.

Notes for Plant Data a) Above

(1) Critical organ dose factor taken from Table 1.1-12.

*For Sr-89/90, use the most recent available measurement from the quarterly composite analysis.

**Na-24 has a half life of less than 8-1/2 days, and therefore is not included in accordance with Technical Specification 3.8.G.1.

+Mn-54 is not included in the dose analysis since it was not detected as being present above the required LLD.

b) Total iodine release for the month based on the combined charcoal and particulate filter samples taken during the month:

i	Q_i^{STP} (Ci)	DFG_{sico} $(\frac{mrem}{Ci})$
I-131	4.30 E-03	4.80 E+01
I-133	1.12 E-04*	5.12 E-01
I-135**	2.01 E-02**	
and		
H-3+	0.15	1.81 E-04

Calculation

The dose is calculated from Equation (3-25):

$$D_{cos} = \sum_i Q_i^{STP} \; DFG_{sico} \qquad (3\text{-}25)$$

(mrem) (Ci) (mrem/Ci)

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Notes for Plant Data b) Above

*In this case, I-133 was found in one of the weekly stack samples to be present, and therefore based on that value is included in the dose analysis.

**I-135 is not included in the dose analysis because it has a half life less than 8-1/2 days for particulates and is not included as a required iodine in Technical Specification 3.8.B.1.

+Tritium value based on the monthly stack grab sample.

The dose factor (DFG_{sico}) for each radionuclide detected in the plant stack charcoal and particulate filter sample (plus tritium) is taken from Table 1.1-12 of the ODCM.

Therefore:

$$D_{cos} = (5.42\ E{-}04)(7.08\ E{+}00) + (1.10\ E{-}02)(2.69\ E{+}02) + (2.30\ E{-}01)(4.76\ E{+}00) + (1.15\ E{-}02)(1.01\ E{+}01) + (2.60\ E{-}02)(2.32\ E{+}00) + (4.30\ E{-}03)(4.80\ E{+}01) + (1.12\ E{-}04)(5.12\ E{-}01) + (0.15)(1.81\ E{-}04) =$$

Answer

D_{cos} = 4.44 mrem maximum organ dose for the month.

APPENDIX I

RADIOACTIVE LIQUID, GASEOUS, AND SOLID WASTE TREATMENT SYSTEMS

Requirement: Technical Specification 6.14.A requires that licensee initiated major changes to the radioactive waste systems (liquid, gaseous, and solid) be reported to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the Plant Operation Review Committee.

Response: There were no licensee initiated major changes to the radioactive waste systems (liquid, gaseous, and solid) during this reporting period.

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