Maine Yankee

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April 30, 2002
MN-02-021 RA-02-050

UNITED STATES NUCLEAR REGULATORY COMMISSION
Attention: Document Control Desk
Washington, DC 20555

References: (a) License No. DPR-36 (Docket No. 50-309)
(b) Maine Yankee Off-site Dose Calculation Manual (ODCM)

Subject: 2001 Radiological Reports

Gentlemen:

Enclosed as indicated below are radiological reports for 2001 submitted in accordance with the relevant portions of References (a) and (b).

Report Name	Technical Specification Reference (Ref. a)	ODCM (Ref. b)
Annual Radioactive Effluent Release Report	5.7.3	Appendix C, Item 2
Estimated Dose Report For 2001	Not Applicable	Appendix C, Item 3
Annual Radiological Environmental Operating Report	5.7.2	Appendix C, Item 1

We trust we have completed submission requirements for these reports. Should you have questions or comments, please contact me at 207-882-4530.

Sincerely,

Thomas L. Williamson, Director
Nuclear Safety & Regulatory Affairs

Enclosures
c: Mr. R. A. Gramm
Mr. M. K. Webb
Mr. H. J. Miller
Mr. M. C. Roberts
Mr. P. J. Dostie
Mr. W. C. Toppan

IE48
IE25

MAINE YANKEE ATOMIC POWER COMPANY

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

January - December 2001

1.0 INTRODUCTION

Tables 1 and 2 summarize the quantity of radioactive gaseous and liquid effluents, respectively, for each quarter of 2001. Table 3 summarizes waste shipped off-site for burial or disposal during 2001. Table 4 contains supplementary information.

Appendices A through D indicate the status of reportable items per the requirements of ODCM sections 2.1.5, 2.2.6, 2.3.3, 2.3.4, 2.5 and Appendix C.

Changes to the Off-site Dose Calculation Manual (ODCM) made during 2001 are summarized in Appendix E. A complete copy of the revised manual is attached.

TABLE 1A

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First and Second Quarters, 2001
Gaseous Effluents - Summation of All Releases

	Unit	1st Quarter	2nd Quarter	Est. Total Error, %
A. Fission and Activation Gases				
1. Total release	Ci	N/D*	N/D*	2.50 E+01
2. Average release rate for period	uCi/sec	N/D*	N/D*	
3. Percent of regulatory limit	%	N/D*	N/D*	
B. Iodines				
1. Total Iodine-131	Ci	N/A*	N/A*	2.50 E+01
2. Average release rate for period	uCi/sec	N/A*	N/A*	
3. Percent of regulatory limit	%	N/A*	N/A*	
C. Particulates				
1. Particulates with T-1/2 > 8 days	Ci	N/D*	1.75E-06	3.50 E+01
2. Average release rate for period	uCi/sec	N/D*	2.23E-07	
3. Percent of regulatory limit	%	N/D*	4.23E-06	
4. Gross alpha radioactivity	Ci	N/D*	N/D*	
D. Tritium				
1. Total release	Ci	1.57E-01	4.85E-01	2.50 E+01
2. Average release rate for period	uCi/sec	2.00E-02	6.17E-02	
3. Percent of regulatory limit	%	2.06E-04	6.35E-04	

N/D* = Not Detected
N/A* = Not Applicable

TABLE 1A

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
Third and Fourth Quarters, 2001
Gaseous Effluents - Summation of All Releases

	Unit	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission and Activation Gases				
1. Total release	Ci	N/D*	N/D*	2.50 E+01
2. Average release rate for period	uCi/sec	N/D*	N/D*	
3. Percent of regulatory limit	%	N/D*	N/D*	
B. Iodines				
1. Total Iodine-131	Ci	N/A*	N/A*	2.50 E+01
2. Average release rate for period	uCi/sec	N/A*	N/A*	
3. Percent of regulatory limit	%	N/A*	N/A*	
C. Particulates				
1. Particulates with T-1/2 > 8 days	Ci	4.60E-05	N/D*	3.50 E+01
2. Average release rate for period	uCi/sec	5.86E-06	N/D*	
3. Percent of regulatory limit	%	1.02E-04	N/D*	
4. Gross alpha radioactivity	Ci	N/D*	N/D*	
D. Tritium				
1. Total release	Ci	4.26E-01	2.11E-01	2.50 E+01
2. Average release rate for period	uCi/sec	5.42E-02	2.68E-02	
3. Percent of regulatory limit	%	5.58E-04	2.76E-04	

N/D* = Not Detected
N/A* = Not Applicable

TABLE 1B
Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First and Second Quarters, 2001
Gaseous Effluents - Elevated Release

Nuclides Released	Unit	Continuous Mode 1st Quarter	Continuous Mode 2nd Quarter	Batch Mode 1st Quarter	Batch Mode 2nd Quarter
1. Fission Gases					
Krypton-85	Ci	N/D*	N/D*	N/A*	N/A*
Krypton-85m	Ci	N/D*	N/D*	N/A*	N/A*
Krypton-87	Ci	N/D*	N/D*	N/A*	N/A*
Krypton-88	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-133	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-135	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-135m	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-138	Ci	N/D*	N/D*	N/A*	N/A*
Unidentified	Ci	N/D*	N/D*	N/A*	N/A*
Total for period	Ci	N/D*	N/D*	N/A*	N/A*
2. Iodines					
Iodine-131	Ci	N/A*	N/A*	N/A*	N/A*
Iodine-133	Ci	N/A*	N/A*	N/A*	N/A*
Iodine-135	Ci	N/A*	N/A*	N/A*	N/A*
Total for period	Ci	N/A*	N/A*	N/A*	N/A*
3. Particulates					
Strontium-89	Ci	N/D*	N/D*	N/A*	N/A*
Strontium-90	Ci	N/D*	N/D*	N/A*	N/A*
Cesium-134	Ci	N/D*	N/D*	N/A*	N/A*
Cesium-137	Ci	N/D*	N/D*	N/A*	N/A*
Barium-Lanthanum-140	Ci	N/D*	N/D*	N/A*	N/A*
Others- Cobalt-60	Ci	N/D*	1.75E-06	N/A*	N/A*

N/D* = Not Detected
N/A* = Not Applicable

TABLE 1B
Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
Third and Fourth Quarters, 2001
Gaseous Effluents - Elevated Release

		Continuous Mode		**Batch Mode**	
Nuclides Released	**Unit**	**3rd Quarter**	**4th Quarter**	**3rd Quarter**	**4th Quarter**
1. Fission Gases					
Krypton-85	Ci	N/D*	N/D*	N/A*	N/A*
Krypton-85m	Ci	N/D*	N/D*	N/A*	N/A*
Krypton-87	Ci	N/D*	N/D*	N/A*	N/A*
Krypton-88	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-133	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-135	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-135m	Ci	N/D*	N/D*	N/A*	N/A*
Xenon-138	Ci	N/D*	N/D*	N/A*	N/A*
Unidentified	Ci	N/D*	N/D*	N/A*	N/A*
Total for period	Ci	N/D*	N/D*	N/A*	N/A*
2. Iodines					
Iodine-131	Ci	N/A*	N/A*	N/A*	N/A*
Iodine-133	Ci	N/A*	N/A*	N/A*	N/A*
Iodine-135	Ci	N/A*	N/A*	N/A*	N/A*
Total for period	Ci	N/A*	N/A*	N/A*	N/A*
3. Particulates					
Strontium-89	Ci	N/D*	N/D*	N/A*	N/A*
Strontium-90	Ci	N/D*	N/D*	N/A*	N/A*
Cesium-134	Ci	N/D*	N/D*	N/A*	N/A*
Cesium-137	Ci	5.25E-06	N/D*	N/A*	N/A*
Barium-Lanthanum-140	Ci	N/D*	N/D*	N/A*	N/A*
Others- Cobalt-60	Ci	4.08E-05	N/D*	N/A*	N/A*

N/D* = Not Detected
N/A* = Not Applicable

TABLE 1C

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
January - December 2001
Gaseous Effluents - Ground Level Release

There were no routine measured ground level continuous or batch mode releases during 2001.

TABLE 2A

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First and Second Quarters, 2001
Liquid Effluents - Summation of All Releases

	Unit	1st Quarter	2nd Quarter	Est. Total Error, %
A. Fission and Activation Products				
1. Total release (not including tritium, gases, alpha)	Ci	4.25E-04	1.28E-03	1.50 E+01
2. Average diluted concentration during period	uCi/ml	6.94E-10	2.09E-09	
3. Percent of applicable limit	%	1.60E-02	6.30E-02	
B. Tritium				
1. Total Release	Ci	3.40E-02	5.55E-02	1.50 E+01
2 Average diluted concentration during period	uCi/ml	5.55E-08	9.05E-08	
3. Percent of applicable limit	%	5.55E-03	9.05E-03	
C. Dissolved and Entrained Gases				
1 Total Release	Ci	N/D*	N/D*	1.50 E+01
2 Average diluted concentration during period	uCi/ml	N/D*	N/D*	
3. Percent of applicable limit	%	N/D*	N/D*	
D. Gross Alpha Radioactivity				
1. Total release	Ci	N/D*	N/D*	1.50 E+01
2. Average diluted concentration during period	uCi/ml	N/D*	N/D*	
E. Volume of waste released (prior to dilution)	liters	3.28E+04	4.62E+04	1.00 E+01
F. Volume of dilution water used during period	liters	6.13E+08	6.13E+08	1.00 E+01

N/D* = Not Detected

TABLE 2A

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
Third and Fourth Quarters, 2001
Liquid Effluents - Summation of All Releases

	Unit	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission and Activation Products				
1. Total release (not including tritium, gases, alpha)	Ci	6.99E-05	8.50E-04	1.50 E+01
2. Average diluted concentration during period	uCi/ml	1.14E-10	1.39E-09	
3. Percent of applicable limit	%	2.29E-03	7.52E-02	
B. Tritium				
1. Total Release	Ci	4.41E-02	5.99E-02	1.50 E+01
2 Average diluted concentration during period	uCi/ml	7.19E-08	9.77E-08	
3. Percent of applicable limit	%	7.19E-03	9.77E-03	
C. Dissolved and Entrained Gases				
1 Total Release	Ci	N/D*	N/D*	1.50 E+01
2 Average diluted concentration during period	uCi/ml	N/D*	N/D*	
3. Percent of applicable limit	%	N/D*	N/D*	
D. Gross Alpha Radioactivity				
1. Total release	Ci	N/D*	N/D*	1.50 E+01
2. Average diluted concentration during period	uCi/ml	N/D*	N/D*	
E. Volume of waste released (prior to dilution)	liters	4.76E+04	6.21E+04	1.00 E+01
F. Volume of dilution water used during period	liters	6.13E+08	6.13E+08	1.00 E+01

N/D* = Not Detected

TABLE 2B
Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First and Second Quarters, 2001
Liquid Effluents

		Continuous Mode		Batch Mode	
Nuclides Released	**Unit**	**1st Quarter**	**2nd Quarter**	**1st Quarter**	**2nd Quarter**
Strontium-89	Ci	N/A*	N/A*	N/D*	N/D*
Strontium-90	Ci	N/A*	N/A*	N/D*	N/D*
Cesium-134	Ci	N/A*	N/A*	N/D*	N/D*
Cesium-137	Ci	N/A*	N/A*	1.56E-06	8.11E-06
Iodine-131	Ci	N/A*	N/A*	N/D*	N/D*
Cobalt-58	Ci	N/A*	N/A*	N/D*	N/D*
Cobalt-60	Ci	N/A*	N/A*	2.85E-04	1.13E-03
Iron-59	Ci	N/A*	N/A*	N/D*	N/D*
Zinc-65	Ci	N/A*	N/A*	N/D*	N/D*
Manganese-54	Ci	N/A*	N/A*	N/D*	N/D*
Chromium-51	Ci	N/A*	N/A*	N/D*	N/D*
Zirconium-Niobium-95	Ci	N/A*	N/A*	N/D*	N/D*
Molybdenum-99	Ci	N/A*	N/A*	N/D*	N/D*
Technetium-99m	Ci	N/A*	N/A*	N/D*	N/D*
Barium-Lanthanum-140	Ci	N/A*	N/A*	N/D*	N/D*
Cerium-141	Ci	N/A*	N/A*	N/D*	N/D*
Others - Iron-55	Ci	N/A*	N/A*	1.26E-04	1.39E-04
Antimony-125	Ci	N/A*	N/A*	1.23E-05	3.75E-06
Unidentified	Ci	N/A*	N/A*	N/D*	N/D*
Total for period (above)	Ci	N/A*	N/A*	4.25E-04	1.28E-03
Xenon-133	Ci	N/A*	N/A*	N/D*	N/D*
Xenon-135	Ci	N/A*	N/A*	N/D*	N/D*

N/D* = Not Detected
N/A* = Not Applicable

TABLE 2B
Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
Third and Fourth Quarters, 2001
Liquid Effluents

		Continuous Mode		Batch Mode	
Nuclides Released	**Unit**	**3rd Quarter**	**4th Quarter**	**3rd Quarter**	**4th Quarter**
Strontium-89	Ci	N/A*	N/A*	N/D*	N/D*
Strontium-90	Ci	N/A*	N/A*	N/D*	N/D*
Cesium-134	Ci	N/A*	N/A*	N/D*	7.43E-06
Cesium-137	Ci	N/A*	N/A*	5.50E-06	2.72E-04
Iodine-131	Ci	N/A*	N/A*	N/D*	N/D*
Cobalt-58	Ci	N/A*	N/A*	N/D*	N/D*
Cobalt-60	Ci	N/A*	N/A*	2.44E-05	5.41E-04
Iron-59	Ci	N/A*	N/A*	N/D*	N/D*
Zinc-65	Ci	N/A*	N/A*	N/D*	N/D*
Manganese-54	Ci	N/A*	N/A*	N/D*	N/D*
Chromium-51	Ci	N/A*	N/A*	N/D*	N/D*
Zirconium-Niobium-95	Ci	N/A*	N/A*	N/D*	N/D*
Molybdenum-99	Ci	N/A*	N/A*	N/D*	N/D*
Technetium-99m	Ci	N/A*	N/A*	N/D*	N/D*
Barium-Lanthanum-140	Ci	N/A*	N/A*	N/D*	N/D*
Cerium-141	Ci	N/A*	N/A*	N/D*	N/D*
Others - Iron-55	Ci	N/A*	N/A*	4.00E-05	2.98E-05
Unidentified	Ci	N/A*	N/A*	N/D*	N/D*
Total for period (above)	Ci	N/A*	N/A*	6.99E-05	8.50E-04
Xenon-133	Ci	N/A*	N/A*	N/D*	N/D*
Xenon-135	Ci	N/A*	N/A*	N/D*	N/D*

N/D* = Not Detected
N/A* = Not Applicable

TABLE 3
Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First Half, 2001
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, %
b. Dry compressible waste, contaminated equipment, DAW, Cement.	Cu. M. Ci.	1085 5.22 E+02	 +/-25
c. Irradiated hardware	Cu. M. Ci	22.8 1.10 E+05	 +/-25

2. Estimate of major nuclide composition (by type of waste).

b.	Co-60	71.10%	3.71E+02
	Fe-55	7.72%	4.03E+01
	Ni-63	17.08%	8.91E+01
	Cs-137	1.24%	6.46E+00
	Ce-144	2.40%	1.25E+01
c.	Co-60	61.4%	6.75E+04
	Fe-55	30.2%	3.32E+04
	Ni-63	8.5%	9.35E+03

TABLE 3
(Continued)

3. Solid Waste Dispostion

Number of Shipments	Mode of Transportation	Destination
22	Trucking over Highway	Chem-Nuclear Barnwell, SC
28	Trucking over Highway	Duratek, Inc. Oak Ridge, TN
1	Trucking over Highway	Envirocare of Utah Clive, Utah
5	Rail	Envirocare of Utah Clive, Utah
1	Trucking over Highway	F.W. Hake, Memphis, TN
1	Trucking over Highway	Permafix, Gainsville, FA

B. Irradiated Fuel Shipments (Disposition): None Shipped.

Additional ODCM Appendix C requirements.

Solid Waste Class	Volume (Cu. M.)	Est. Activity (Ci)	Est. Total Error
A	1.078E+03	4.70E+02	+/- 25%
B	7.14E+00	5.08E+01	+/- 25%
C	2.28E+01	1.10E+05	+/- 25%

Container	Type	Package Volume (Cu. M.)
3-55 Steel Liner	Steel Liner	1.6
Sealand	Strong Tight Container	38.2
B-25 Steel Box	Strong Tight Container	2.9
25 Yard Intermodal	Strong Tight Container	29.2
20 Yard Intermodal	Strong Tight Container	26.2
8-120 Poly HIC	High Integrity Container	3.4
8-120 Steel Liner	High Integrity Container	3.6
Specialty Container	Strong Tight Container	8.3

TABLE 3
Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
Second Half, 2001
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, etc.	Cu. M.	9.53	
	Ci.	3.02E+02	+/-25
b. Dry compressible waste, contaminated equipment, DAW, Cement.	Cu. M.	1504	
	Ci.	6.78E+01	+/-25
c. Irradiated Hardware	Cu. M.	5.87	
	Ci.	8.85E+00	+/-25

2. Estimate of major nuclide composition (by type of waste).

a.	Co-60	3.75%	1.13E+01
	Ni-63	65.87%	1.99E+02
	Fe-55	20.14%	6.08E+01
	Cs-137	9.35%	2.82E+01
b.	Ni-63	36.05%	2.44E+01
	Co-60	33.61%	2.28E+01
	Cs-137	6.94%	4.71E+00
	Fe-55	20.48%	1.39E+01
	Ce-144	1.70%	1.15E+00
c.	Ni-63	12.85%	1.14E+00
	Co-60	69.51%	6.15E+00
	Cs-137	0.85%	7.51E-02
	Fe-55	14.77%	1.31E+00
	Ce-144	0.83%	7.32E-02
	Pu-241	0.80%	7.10E-02

TABLE 3
(Continued)

3. Solid Waste Dispostion

Number of Shipments	Mode of Transportation	Destination
4	Trucking over Highway	Chem-Nuclear Barnwell, SC
11	Trucking over Highway	Duratek, Inc. Oak Ridge, TN
12	Trucking over Highway	Envirocare of Utah Clive, Utah
9	Rail	Envirocare of Utah Clive, Utah
5	Trucking over Highway	U.S. Ecology Oak Ridge, TN
3	Trucking over Highway	ATG Analytics Oak Ridge, TN

B. Irradiated Fuel Shipments (Disposition): None Shipped.

Additional ODCM Appendix C requirements.

Solid Waste Class	Volume (Cu. M.)	Est. Activity (Ci)	Est. Total Error
A	1.51E+03	6.76E+01	+/- 25%
B	3.41E+00	3.20E+01	+/- 25%
C	7.32E+00	2.79E+02	+/- 25%

Container	Type	Package Volume (Cu. M.)
25 Yard Intermodal	Strong Tight Container	29.2
20 Yard Intermodal	Strong Tight Container	26.2
Twenty Foot Sealand	Strong Tight Container	38.2
Forty Foot Sealand	Strong Tight Container	76.5
B-25 Steel Box	Strong Tight Container	2.9
Specialty Box	Strong Tight Container	29.3
Specialty Box	Strong Tight Container	9.5
8-120 Steel Liner	Steel Liner	3.6
PL14-215	Poly Liner	5.8
L14-195	Steel Liner	5.9

TABLE 4

Supplemental Information

1. Regulatory Limits

   Effluent Concentration

a.	Fission and activation gases:	10CFR20; Appendix B, Table 2, Column 1
b.	Iodines:	10CFR20; Appendix B, Table 2, Column 1
c.	Particulates, (with half lives greater than 8 days)	10CFR20; Appendix B, Table 2, Column 1
d.	Liquid effluents:	10CFR20; Appendix B, Table 2, Column 2
e.	Total noble gas concentration:	2E-04 μCi/ml

2. Average Energy - Not Applicable

3. Measurements and Approximations of Radioactivity

   a. Fission and Activation Gases

   Continuous Discharge - Primary Vent Stack and Fuel Building Exhaust Vent samples are analyzed monthly. Activity levels determined are assumed constant for the surveillance interval. The continuous Fuel Building Exhaust Vent monitor reading is used as a basis for increasing periodic sample frequency.

   Batch Discharges - The waste gas hold-up drums were purged and removed from service in 1997 in preparation for decommissioning. With the permanent cessation of power operations and the removal of the nuclear fuel, containment purging operations are no longer required. Containment ventilation is directed to the Primary Vent Stack, and sampled as described above.

   b. Iodines

   Iodine surveillance no longer applies due to the elapsed time since final plant shutdown from power operations.

   c. Particulates

   Primary Vent Stack and Fuel Building Exhaust Vent particulate totals are taken from a minimum of weekly measurements of continuously collected in-line particulate filters. The estimate total error for the particulate measurement has been increased to 35%. This estimated error is based on a detailed evaluation of sampling uncertainties with the particulate samplers. In the decommissioning configuration, credit is not taken for HEPA filtration. Without verification testing of the filters, it must be assumed that sample line plate-out may increase by up to a factor of three in the Primary Vent Stack and 3.8 in the Fuel Building Exhaust Vent. Detected particulate activity reported in Tables 1A and 1B have been adjusted accordingly.

TABLE 4
(Continued)

d. Liquid Effluents

There are no continuous liquid discharges in the decommissioning mode.

Each batch of potentially radioactive liquid is analyzed for gross alpha, tritium, dissolved gases, and gamma emitting isotopes prior to discharge.

Composite samples are made of liquid effluents for a quarterly analysis of Strontium-90, Strontium-89, and Iron-55.

4. Batch Releases

a. Liquids

1. Number of batch releases: 28
2. Total time period for batch releases: 12 hours, 26 minutes
3. Maximum time period for a batch release: 33 minutes
4. Average time period for batch releases: 27 minutes
5. Minimum time period for a batch release: 19 minutes
6. Average stream flow during periods of release of effluents into a flowing stream: N/A
7. Maximum gross release concentration (μCi/ml): 3.46E-08

b. Gaseous

1. Number of batch releases: 0
2. Total time period for batch releases: Not applicable
3. Maximum time period for a batch release: Not applicable
4. Average time period for batch releases: Not applicable
5. Minimum time period for a batch release: Not applicable
6. Maximum gross release rate (μCi/sec): Not applicable

5. Unplanned Releases

a. Liquid

There were no abnormal liquid releases during the reporting period.

b. Gaseous

There were no abnormal gaseous releases during the reporting period.

APPENDIX A

Radioactive Effluent Monitoring Instrumentation

Requirement: Radioactive effluent monitoring instrumentation channels are required to be operable in accordance with ODCM Sections 2.3.3 and 2.3.4. With less than the minimum number of channels operable and reasonable efforts to return the instrument(s) to operable status within 30 days being unsuccessful, ODCM Sections 2.3.3 and 2.3.4 requires an explanation for the delay in correcting the inoperability in the next Annual Effluent Release Report.

Response: RM-SFP-19 which monitors the Fuel Building Exhaust Ventilation was out of service from April 18, 2001 until May 31, 2001. The unit was declared inoperable due to the failure of an electronic component. Delay was experienced when the unit had to be returned to the vendor for repair.

APPENDIX B

Liquid Radwaste Treatment System

Requirement: With radioactive liquid waste being discharged without treatment with estimated doses in excess of the limits in ODCM Section 2.1.5, a report must be submitted to the Commission in the Annual Effluent Release Report for the period.

Response: The requirements of ODCM Section 2.1.5 were met during this period and, therefore, no report is required.

APPENDIX C

Gaseous Radwaste Treatment System

Requirement: With radioactive gaseous waste being discharged without treatment with doses in excess of the limits in ODCM Section 2.2.6, a report must be submitted to the Commission in the Annual Effluent Release Report for the period.

Response: The requirements of ODCM Section 2.2.6 were met during this period and, therefore, no report is required.

APPENDIX D

Lower Limit of Detection for Radiological Analyses

Requirement: ODCM Section 2.5 requires that when unusual circumstances result in LLD's higher than required, the reasons shall be documented in the Annual Radioactive Effluent Release Report.

Response: All samples were counted in such a manner as to satisfy the specified a priori lower limits of detection.

APPENDIX E

Summary of Off-Site Dose Calculation Manual Revision

Revision 15, approved April 30, 2001

Revised Figure 6.1, Maine Yankee Liquid Radwaste System, to permit use of an equivalent alternative treatment system in lieu of the Duratek system. This change was made to support the reactor cavity drain.

Revised the description of the gaseous radwaste treatment system in Figure 6.2 to reflect the re-routing of the RCA Building vent exhaust from discharge to the Primary Vent Stack (PVS) to discharge to the Fuel Building Exhaust Vent.

Corrected miscellaneous typographical errors.

Added clarification in the discussion and definitions of liquid dilution factors to reflect decommissioning conditions when there is no longer forced dilution flow. This was clarification only and did not impact dose calculations.

Deleted the option to burn radiologically contaminated waste oil in the auxiliary boilers. The boilers have been removed and the building demolished.

Eliminated the requirement to submit an Annual Meteorological Summary Report to the Nuclear Regulatory Commission (NRC). In accordance with ODCM Revision 14, estimated doses are now calculated using historical meteorological data, and current data is no longer collected. In lieu of current data, the historical data summary is required to be submitted to the NRC as part of the Estimated Dose Report.

Revision 16, approved September 26, 2001

Modified the method of calculating the liquid effluent radiation monitor external setpoint to cover situations of low discharge activity.

MAINE YANKEE

OFF-SITE DOSE CALCULATION MANUAL

APPROVED: W.H. Odell
W.H. Odell, Plant Manager

APPROVAL DATE: 9/26/01

ODCM PAGE CHANGE SUMMARY

[CHANGE NO. 16 DATE: ______________

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MAINE YANKEE ATOMIC POWER COMPANY
OFF-SITE DOSE CALCULATION MANUAL

ABSTRACT

The Maine Yankee Nuclear Power Station Off-Site Dose Calculation Manual (MY ODCM) contains the approved methods to estimate the doses and radionuclide concentrations occurring beyond the boundaries of the plant caused by normal plant operation. (The site boundary is shown in Appendix D, SITE BOUNDARY) With initial approval by the U.S. Nuclear Regulatory Commission and the MYNPS Plant Management and approval of subsequent revisions by the Plant Management (as per the Technical Specifications), this ODCM is suitable to show compliance where referred to by the Plant Technical Specifications. Sufficient documentation of each method is provided to allow regeneration of the methods with few references to other material. Most of the methods are presented at two levels. The first, Method I, is a linear equation which provides an upper bound and the second, Method II, is an in-depth analysis which can provide more realistic estimates.

MAINE YANKEE ATOMIC POWER COMPANY
OFF-SITE DOSE CALCULATION MANUAL

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1.0 INTRODUCTION

The purpose of this manual is to provide methods to ensure compliance with the dose requirements of Appendix I to 10 CFR Part 50 (Reference 1). Each method is based on a plant-specific application of the models presented in Regulatory Guide 1.109 (Reference 2).

Methods are included to calculate the doses to individuals from both gaseous and liquid releases from the plant. Under normal operations, experience has shown that the plant will be operated at a small fraction of the dose limits. For this reason, the dose evaluations are presented at different levels of sophistication. The first method being the most conservative, but simplest to use; the second method requiring a full analysis following the guidance presented in Regulatory Guide 1.109 (Reference 2).

The first method, Method I, is based on a critical organ, critical age group, and critical receptor location; as such, it provides a conservative estimate of the doses. If the dose limits are met by application of the first method, no further analysis will be required. If, however, it indicates that the dose limits may be approached or exceeded, a more realistic estimate may be obtained by application of the second method.

The second method, Method II, will calculate the dose to seven organs of four age groups for potentially critical individuals. It is based on measured releases for each nuclide, site-specific [parameters, and measured historical average meteorological parameters. Method II is more accurate, but less conservative than Method I, and will be used to assess doses for the Estimated [Dose Report.

Liquid effluent dose calculation methods are presented in Section 3. Gaseous effluent dose calculation methods in Section 4. In both Sections relevant Technical Specifications are followed by the appropriate Method I dose equations. When necessary, Method II analyses may be performed by applying the site-specific parameters and measured meteorological parameters to the appropriate dose equations specified in Regulatory Guide 1.109 (Reference 2). The basis for each of the dose calculation methods is described in Appendix A.

2.0 RELEASE OF RADIOACTIVE EFFLUENTS

2.1 Release of Liquid Radioactive Effluents

2.1.1 Applicability

The requirements in this section apply at all times to the release of all liquid waste discharged [from the plant which may contain radioactive materials.

2.1.2 Objective

The objective is to establish conditions for the release of liquid waste containing radioactive materials and to assure that all such releases are within the concentration limits specified radioactive in 10 CFR Part 20, and also assure that the releases from the site of radioactive materials in liquid wastes (above background) are kept "as low as is reasonably achievable" in accordance with 10 CFR Part 50, Appendix I.

2.1.3 Liquid Effluents: Concentration

1. The concentration of radioactive material in liquid effluents released from the site to unrestricted areas shall be limited to the concentrations specified in 10 CFR, Part 20, Appendix B, Table 2, Column 2, for radionuclides other than noble gases, and 2×10^{-4} microcuries/ml total activity concentration for all dissolved or entrained noble gases.

Remedial Action: With the concentration of radioactive material released from the site to unrestricted areas exceeding the above limits, without delay take action to restore the concentration to within the above limits.

Basis: These requirements are provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site to unrestricted areas (at the point of discharge into Back River; discharge from the submerged multiport diffuser) will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table 2.

This limitation provides additional assurance that the levels of radioactive materials in bodies of water outside the site will result in exposures within (1) Section II.A design objectives of Appendix I, 10 CFR Part 50, to a member of the public; and (2) the limits of 10 CFR Part 20 to the population.

The concentration limit for noble gases is based upon the assumption that Xe-135 is the controlling radioisotope, and its ECL in air (submersion) was converted to an equivalent concentration in water using the methods described in Internal Commission on Radiological Protection (ICRP), Publication 2 (Reference 3).

For determining compliance under zero Circulating Water/Service Water flow conditions, the concentration of radionuclides in the forebay prior to release must be considered (Reference Section 6.1). Dilution volumes for determining release concentrations are based on a mean low tide volume of 216,000 cubic feet plus the volume of the tide above the mean low tide during the period of the release (based on a forebay surface area of 41,600 square feet) (Reference 11). This conservatively calculates to a minimum dilution volume at neap tide of 3.5 million gallons (Reference 12). If a layer of ice is present on the surface of the forebay, the thickness of the ice must be subtracted from the height of the tide when determining the dilution volume. (The neap tide volume of 3.5 million gallons allows for a thickness of 1.5 feet of ice.) Batch releases discharged into the forebay under flood tide conditions immediately after a low tide will enhance mixing and maximize the benefit of the tidal flushing.

2.1.4 <u>Liquid Effluents: Dose</u>

1. The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released from the site to unrestricted areas shall be limited:

   a. During any calendar quarter to less than or equal to 1.5 mrem to the total body, and to less than or equal to 5 mrem to any organ; and

   b. During any calendar year to less than or equal to 3 mrem to the total body, and less than or equal to 10 mrem to any organ.

<u>Remedial Action</u>: With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission a report within 30 days from the end of the quarter. The report shall identify the cause(s) for exceeding the limit(s) and define the corrective actions to be taken to reduce the releases and the corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

<u>Remedial Action</u>: With the calculated dose from the release of radioactive materials in liquid effluents exceeding twice the above limits, calculations should be made including direct radiation contributions from significant plant sources to determine whether the limits of 40 CFR 190 (Reference 4) have been exceeded.

[If such is the case, prepare and submit a report to the Commission within 30 days. The report shall define the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the limits and include the schedule for achieving conformance with the limits.

If the release condition resulting in violation of 40 CFR Part 190, has not already been [corrected, the report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190.

Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

Basis: These requirements are provided to implement the guidance of Sections II.A, III.A, and IV.A of Appendix I, 10 CFR Part 50. The specification provides the required operating flexibility and, at the same time, assures that the releases of radioactive material in liquid effluents will be kept "as low as is reasonably achievable" as set forth in Section IV.A of Appendix I. In addition, since the facility is located on a saltwater estuary, the release of radioactive waste in liquids will not result in radionuclide concentrations in finished drinking water, which would be in excess of the requirements of 40 CFR Part 190.

The dose calculations performed in accordance with the methods and parameters in this ODCM implement the guidance in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a member of the public through appropriate pathways is unlikely to be substantially underestimated.

The remedial action requiring calculations when releases exceed two times the design objectives is included to assure that appropriate reports and requests for variance are made should effluents exceed the limits set forth in 40 CFR Part 190.

2.1.5 Liquid Radwaste Treatment

1. The Liquid Radwaste Treatment System shall be used in its designed modes of operation to reduce the radioactive materials in the liquid waste prior to its discharge when the estimated doses due to the liquid effluent from the site, when averaged with all other liquid releases over the last 31 days, would exceed 0.06 mrem to the total body, or 0.2 mrem to any organ.

Remedial Action: With radioactive liquid waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission a report with the next Annual Radioactive Effluent Release Report which includes the following information:

a. Explanation of why liquid waste was being discharged without treatment and in excess of the above limits, identification of any inoperable liquid waste equipment which prevented treatment prior to discharge, and the reason for the inoperability;

b. Actions taken to restore the inoperable equipment back to operable status; and

c. Summary description of action(s) taken to prevent a recurrence.

Basis: The requirement that the appropriate portions of the Liquid Radwaste System (as indicated in this ODCM) be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10 CFR Part 50.36a and the design objective guidance given in Section II.D of Appendix I to 10 CFR Part 50.

The specified limits governing the use of appropriate portions of the Liquid Radwaste Treatment System were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

2.2 Release of Gaseous Radioactive Waste

2.2.1 Applicability

The requirements of this section apply at all times to the releases of all gaseous waste discharged from the plant which may contain plant-related radioactive materials.

2.2.2 Objective

The objective is to establish conditions in which gaseous waste containing radioactive materials may be released and to assure that all such releases are within the dose limits specified in 10 CFR Part 20 and also assure that the releases of radioactive materials in gaseous waste (above background) from the site are kept "as low as is reasonably achievable" in accordance with 10 CFR 50, Appendix I.

2.2.3 Gaseous Effluents: Dose Rate

1. The dose rate (when averaged over one hour) due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to the following:

   a. For noble gases to less than or equal to 500 mrem/year to the total body, and less than or equal to 3,000 mrem/year to the skin; and

   b. For Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than eight days to less than or equal to 1,500 mrem/year to any organ.

Remedial Action: With the dose rates averaged over a period of one hour exceeding the above limits, without delay take action to decrease the release rate to comply with the limit.

Basis: These requirements are provided to ensure that the dose rate at any time at the site area boundary and beyond from gaseous effluents from all effluent release points combined (i.e., primary vent stack and fuel building exhaust) will be within the annual dose limits of 10 CFR Part 20 while still providing operational flexibility, compatible with considerations of health and safety, which may temporarily result in releases higher than the absolute value of the concentration values in Appendix B. Reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a member of the public in an unrestricted area to annual doses exceeding the limits specified in 10CFR 20.1001-20.2402 is provided.

For members of the public who may at times be within the site boundary area, the occupancy time will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that at the site boundary.

The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the site area boundary to less than or equal to 500 mrem/year to the total body, or to less than or equal to 3,000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to an infant via the milk-infant pathway to less than or equal to 1,500 mrem/year for the nearest real milk animal to the plant.

2.2.4 Gaseous Effluents: Dose From Noble Gases

1. The air dose due to noble gases released in gaseous effluents from the site to areas at and beyond the site boundary shall be limited to the following:

   a. During any calendar quarter to less than or equal to 5 mrad for gamma radiation, and less than or equal to 10 mrad for beta radiation; and

   b. During any calendar year to less than or equal to 10 mrad for gamma radiation, and less than or equal to 20 mrad for beta radiation.

Remedial Action: With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit a report to the Commission within 30 days from the end of the quarter.

The report shall identify the cause(s) for exceeding limit(s) and define the corrective actions to be taken to reduce the releases of radioactive noble gases in gaseous effluents and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

Basis: These requirements are provided to implement the guidance of Sections II.B, III.A, and IV.A of Appendix I, 10 CFR Part 50. The limiting condition for operation implements the guides set forth in Section II.B of Appendix I.

This section provides the required operating flexibility, and, at the same time, assures that the releases of radioactive material in gaseous effluents from all effluent release points combined will be kept "as low as is reasonably achievable." Sampling and analysis requirements of Section 2.5 implement the guidance in Section III.A of Appendix I, i.e., that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a member of the public through the appropriate pathways is unlikely to be substantially underestimated. The appropriate dose equations are specified in the ODCM equations for determining the air doses at the site area boundary and beyond, and are based upon the historical average atmospheric conditions.

2.2.5 Gaseous Effluents: Dose From Iodine-131, Iodine-133, Tritium, and Radioactive Material in Particulate Form

1. The dose to a member of the public from Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents released to areas at and beyond the site boundary shall be limited to the following:

   a. During any calendar quarter to less than or equal to 7.5 mrem to any organ; and

   b. During any calendar year to less than or equal to 15 mrem to any organ.

[

Remedial Action: With the calculated dose from the release of Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents exceeding any of the above limits, prepare and submit a report to the Commission within 30 days from the end of the quarter.

The report shall identify the cause(s) for exceeding the limit(s) and define the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

Remedial Action: With the calculated dose from the release of radioactive materials in gaseous effluents exceeding twice the limits in Section 2.2.4 or Section 2.2.5, calculations should be made including direct radiation contributions from significant plant sources to determine whether the limits of 40 CFR 190 have been exceeded.

If such is the case, prepare and submit a report to the Commission within 30 days.

The report shall define the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the limits and include the schedule for achieving conformance with the limits.

If the release condition resulting in violation of 40 CFR Part 190, has not already been corrected, the report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190.

Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

Basis: These requirements are provided to implement the guidance of Sections II.C, III.A, and IV.A of Appendix I to 10 CFR Part 50. The limiting conditions for operation are the guides set forth in Section II.C of Appendix I. The specification provides the required operating flexibility and at the same time assures that the releases of radioactive materials in gaseous effluents from all effluent release points combined will be kept "as low as is reasonably achievable." The ODCM calculational methods implement the guidance in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a member of the public through appropriate pathways is unlikely to be substantially underestimated. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions.

The release rate specifications for Iodine-131, Iodine-133, tritium, and radioactive material in particulate form with half-lives greater than eight days are dependent on the existing radionuclide pathways to man in areas at and beyond the site boundary.

The pathways which are examined in the development of these calculations are:

1. Individual inhalation of airborne radionuclides.

2. Deposition of radionuclides onto green leafy vegetation with subsequent consumption by man.

3. Deposition onto grassy areas where milk animals and meat-producing animals graze with consumption of the milk and meat by man; and

4. Deposition on the ground with subsequent exposure to man.

The remedial action requiring calculations if releases exceed two times the design objectives is included to assure that appropriate reports and requests for variance are made should effluents exceed the limits set forth in 40 CFR Part 190.

2.2.6 Gaseous Radwaste Treatment System

1. The Gaseous Radwaste Treatment System and the Ventilation Exhaust Treatment System shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the estimated gaseous effluent air doses due to gaseous effluent releases from the site to areas at and beyond the site boundary would exceed 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation over 31 days.

   The Ventilation Exhaust Treatment System shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the estimated doses due to gaseous effluent releases from the site to areas at and beyond the site boundary would exceed 0.3 mrem to any organ over 31 days.

Remedial Action: With gaseous waste being discharged without processing through appropriate treatment systems, as defined in the ODCM and in excess of the above limits, prepare and submit to the Commission a report with the next Annual Radioactive Effluent Release Report that includes the following information:

a. Explanation of why gaseous radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reasons for the inoperability;

b. Action(s) taken to restore any inoperable equipment to operable status; and

c. Summary description of action(s) taken to prevent a recurrence.

Basis: The requirement that the appropriate portions of the Gaseous Radwaste Treatment System and Ventilation Exhaust Treatment System be used when specified provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This section implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives of Appendix I to 10 CFR Part 50. The action levels governing the use of appropriate portions of the Gaseous Radwaste Treatment System were specified as a suitable fraction of the guides set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

2.3 Radioactive Effluent Monitoring Systems

2.3.1 Applicability

The requirements in this section apply at all times to Radioactive Effluent Monitoring Systems which perform a surveillance, protective, or controlling function on the release of [radioactive effluents from the plant.

2.3.2 Objective

The objective is to assure the operability of the Radioactive Effluent Monitoring Systems to perform their design functions.

2.3.3 Radioactive Liquid Effluent Instrumentation

1. The radioactive liquid effluent monitoring instrumentation channels shown in Table 2.1 shall be operable with their alarm/trip setpoints set to ensure that the limits of Section 2.1.3.1 are not exceeded during periods of release of radioactive material through the pathway monitored.

   The alarm/trip setpoints of these channels shall be determined in accordance with the methodology in this ODCM.

Remedial Action: With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits in Section 2.1.3.1 are met, without delay:

a. Take action to suspend the release of radioactive liquid effluents monitored by the affected channel, or

b. Declare the channel inoperable, or change the setpoint so it is acceptably conservative.

Remedial Action: With less than the minimum number of radioactive effluent monitoring instrumentation channels operable, take action shown in Table 2.1. Exert reasonable efforts to:

a. Return the instrument(s) to operable status within 30 days;and

[b. If unsuccessful, explain in the next Annual Radioactive Effluent Release Report the reason for the delay in correcting the inoperability.

Basis: The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments are to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The operability and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

2.3.4 Radioactive Gaseous Effluent Instrumentation

1. The radioactive gaseous process and effluent monitoring instrumentation channels shown in Table 2.2 shall be operable with their alarm/trip setpoints set to ensure that the limits in Section 2.2.3.1 are not exceeded during release of radioactive material via this pathway.

   The alarm/trip setpoints of these channels shall be determined in accordance with the methodology in this ODCM.

Remedial Action: With a radioactive gaseous process effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits in Section 2.2.3.1 are met, without delay take action to:

a. Suspend the release of radioactive gaseous effluents monitored by the affected channel,

b. Or declare the channel inoperable, or change the setpoint so it is acceptably conservative.

Remedial Action: With less than the minimum number of radioactive effluent monitoring instrumentation channels operable, take action shown in Table 2.2. Exert reasonable efforts to:

a. Return the instrument(s) to operable status within 30 days; and

[b. If unsuccessful, explain in the next Annual Radioactive Effluent Release Report the reason for the delay in correcting the inoperability.

Basis: The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm/trip setpoints for these instruments are to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20.

The operability and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

[2.3.5 Gaseous and Liquid Effluent Instrumentation Surveillance Requirements

[1. Instrument Operation and Source Checks:

[a. Daily* Check: Internal test signals used to check instrument operation. The
[Liquid Waste Effluent Monitor performs a self-diagnostic check without
[operator action.

[b. Quarterly* Functional Test: Expose the detector with either an internal or an
[external radiation source or an electronic signal to verify instrument operation.

[c. 18-Month Calibration: Exposure to known radiation source.

[*When required to be operable

TABLE 2.1
Radioactive Liquid Effluent Monitoring Instrumentation

Instrument	Minimum Channels Operable	Remedial Action
1. Gross Radioactivity Monitors Providing Alarm and Automatic Termination of Release		
a. Liquid Radwaste Effluent Line	(1)	1

Table Notation

ACTION 1 With the number of channels operable less than required by the minimum channels operable requirement, effluent releases may continue provided that prior to initiating or continuing a release:

1. At least two independent samples are analyzed in accordance with Section 2.5, Table 2.6, and
2. At least two technically qualified members of the facility staff independently verify the release rate calculations, and
3. At least two technically qualified members of the facility staff independently verify the discharge valving.

Otherwise, suspend release of radioactive effluents via this pathway.

TABLE 2.2
Radioactive Gaseous Effluent Monitoring Instrumentation

Instrument	Minimum Channels Operable	Remedial Action
1. Primary Vent Stack		
a. Particulate Sampler Filter**	(1)	6
b. Effluent System Flow Rate Measuring Device	(1)	4
c. Sampler Flow Measuring Device	(1)	4
2. Fuel Building Exhaust Vent		
a. Noble Gas Activity Monitor	(1)	5
b. Particulate Sampler Filter**	(1)	6
c. Effluent System Flow Rate Measuring Device	(1)	4
d. Sampler Flow Measuring Device	(1)	4

Table Notation

ACTION 4 With the number of channels operable less than required by the minimum channels operable requirement, effluent releases via this pathway may continue provided the flow rate is estimated at least once per eight hours.

ACTION 5 With the number of channels operable less than required by the minimum channels operable requirement, effluent releases via this pathway may continue provided grab samples are taken at least once per 24 hours and these samples are analyzed for radioactivity within 24 hours.

ACTION 6 With the number of channels operable less than required by the minimum channels operable requirement:

- Take immediate action to suspend activities that may increase the potential for particulate releases via this pathway until such time that the channel is restored or auxiliary sampling equipment is operational, and

- Within 24 hours, commence the collection of samples with auxiliary equipment. For the Fuel Building Exhuast Vent, equipment may include an air sampler at the intake of the exhaust vent.

** Normal shutdown for filter changeout does not constitute inoperability.

2.4 Radiological Environmental Monitoring Program

A program shall be provided to monitor the radiation and radionuclides in the environs of the plant. The program shall provide (1) representative measurements of the radioactivity in the highest potential exposure pathways, and (2) verification of the accuracy of the effluent monitoring program and modeling of environmental exposure pathways. The program shall (1) be contained in the ODCM, (2) conform to the guidance of Appendix 1 to 10 CFR Part 50, and (3) include the following:

1) Monitoring, sampling, analysis, and reporting of radiation and radionuclides in the environment in accordance with the methodology and parameters in the ODCM.

2) A Land Use Census to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of this census, AND

3) Participation in a Inter-laboratory Comparison Program to ensure that independent checks on the precision and accuracy of the measurements of radioactive materials in environmental sample matrices are performed as part of the Quality Assurance Program for environmental monitoring.

2.4.1 Applicability

This section applies at all times to radiological environmental surveillance and land use census.

2.4.2 Objective

The objective of this section is to verify that plant operations have no significant radiological effect on the environment and that continued operation will not result in radiological effects detrimental to the environment. The program also shall verify that any measurable concentrations of radioactive materials related to plant operations are not significantly higher than expected based on effluent measurements and modeling of the environmental exposure pathways.

2.4.3 Radiological Environmental Monitoring

1. The Radiological Environmental Monitoring Program shall be conducted as specified in Table 2.3 with Lower Limits of Detection (LLDs) as specified in Table 2.4.

2. With the Radiological Environmental Monitoring Program not being conducted as specified in Table 2.3, prepare and submit to the Commission, in the Annual Radiological Environmental Operating Report, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

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3. With the level of radioactivity in an environmental sampling medium at a location specified in Table 2.3 exceeding a reporting level of Table 2.5 when averaged over any calendar quarter, prepare and submit to the Commission with the next Annual Radioactive Effluent Release Report, following receipt of the laboratory analyses, a report which includes an evaluation of any release conditions, environmental factors, or other aspects which caused the limits of Table 2.5 to be exceeded. When more than one of the radionuclides in Table 2.5 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \ldots > 1.0$$

Exception: When radionuclides other than those in Table 2.5 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose to an individual is equal to or greater than the calendar year limits in Sections 2.1.4, 2.2.4, and 2.2.5. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

4. With milk samples no longer available from one or more of the sample locations required by Table 2.3, identify the new location(s) if available, for obtaining replacement samples and add to the Radiological Environmental Monitoring Program within 30 days. The specific location(s) from which samples were no longer available may then be deleted from the Monitoring Program. Identify the cause of the samples no longer being available and identify the new location(s) for obtaining available replacement samples in the next Annual Radiological Environmental Operating Report.

Basis: The radiological environmental monitoring required by this specification provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures of individuals resulting from the station operation. This monitoring program thereby supplements the Radiological Effluent Monitoring Program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurement and modeling of the environmental exposure pathways. Program changes may be initiated based on operational experience.

A two-zone sample collection network has been established for environmental surveillance. Samples are collected in Zone I at locations in the vicinity of the plant where concentrations of plant effluents may be detectable.

These samples are compared to samples which have been collected simultaneously at locations in Zone II where the concentration of plant effluents is expected to be negligible. The Zone II samples provide a running background which will make it possible to distinguish significant radioactivity introduced into the environment by the operation of the plant from that introduced by weapons testing or other sources.

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The detection capabilities required by Table 2.4 are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. This does not preclude the calculation of an a posteriori LLD for a particular measurement based upon the actual parameters for the sample in question.

2.4.4 Land Use Census

1. An annual land use census within the distance of five miles shall be conducted to identify the location of the nearest milk animal, the nearest residence, and the nearest garden of 50 m^2.

   In lieu of a garden census, broad leaf vegetation of at least three different kinds may be sampled at or near the site boundary in two different sections.

2. With a land use census identifying a location(s) which yields a calculated dose commitment (via the same exposure pathway) at least twice than at a location from which samples are currently being obtained in accordance with Section 2.4.3.1, identify the new locations in the next Annual Radiological Environmental Operating Report.

   If permission from the owner to collect samples can be obtained and sufficient sample volume is available, then this new location shall be added to the Radiological Environmental Monitoring Program within 30 days. The sampling location having the lowest calculated dose or dose commitment (via the same exposure pathway) may be deleted at this time.

3. The land use census shall be conducted at least once per 12 months between the dates of June 1 and October 1. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report.

Basis: This specification is provided to ensure that changes in the use of areas at and beyond the site boundary are identified and that modifications to the monitoring program are made if required by the results of this census.

The addition of new sampling locations to Section 2.4.3.1 based on the land use census is limited to those locations which yield a dose commitment at least twice the calculated dose commitment at any location currently being sampled. This eliminates the unnecessary changing of the Environmental Radiation Monitoring Program for new locations which, within the accuracy of the calculation, contribute essentially the same to the dose or dose commitment as the location already sampled. The substitution of a new sampling point for one already sampled when the calculated difference in dose is less than a factor of 2 would not be expected to result in a significant increase in the ability to detect plant effluent-related nuclides. Changes in the location of monitoring locations are not to be done lightly since frequent changes disrupt time series and may make interpretation of data more difficult.

2.4.5 Interlaboratory Comparison Program

Analyses shall be performed on applicable radioactive environmental samples supplied as part of an interlaboratory comparison program which has been approved by NRC, if such a program exists.

If analyses are not performed as required above, a report shall be made in the next Annual Radiological Environmental Operating Report.

Basis: Participation in an NRC-approved interlaboratory comparison program (if one exists) provides quality assurance for the environmental laboratory, similar to programs in place for other environmental monitoring efforts, such as that for water quality.

TABLE 2.3

Radiological Environmental Surveillance Program(1)(2)(3)

Exposure Pathway and/or Sample	Number of Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis(4)
1. Airborne			
a. Particulates	5	Continuous operation of sampler with sample collection as required by dust loading but at least once biweekly.	Particulate sampler. Analyze for gross beta radioactivity at least 24 hours following filter change. Perform gamma isotopic analysis on composite (by location) sample at least once per quarter.
2. Direct Radiation	38	Quarterly.	Gamma dose quarterly.
3. Waterborne			
a. Surface (Estuary)	2	Composite* sample collected over a period of one month.	Gamma isotopic analysis of each monthly sample. Tritium analysis of composite sample at least once per quarter.
b. Ground**	2	At least once per quarter.	Gamma isotopic and tritium analysis of each sample.
c. Sediment from shoreline	2	At least once per six months.	Gamma isotopic analysis of each sample.

* Composite sample shall be collected by collecting an aliquot at intervals not exceeding two hours. Control station samples may be grab samples rather than composite.

** Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where hydraulic gradient or recharge properties are suitable for contamination.

TABLE 2.3 (Continued)

Radiological Environmental Surveillance Program(1)(2)(3)

Exposure Pathway and/or Sample	Number of Sample Locations	Sampling and Collection Frequency	Type and Frequency of Analysis(4)
4. Ingestion			
a. Milk*	2	At least once per month.	Gamma isotopic analysis of each sample.
b. Fish and Invertebrates	2	One sample in season, or semiannually if not seasonal, of each of at least two commercially or recreationally important species.	Gamma isotopic analysis on edible portions.
c. Food Products, consisting of at least three types of broad leaf vegetation. Performed only if milk sampling is not done.	3	Monthly when available.	Gamma isotopic.

(1) Specific sample locations for all media are specified in the Off-Site Dose Calculation Manual and reported in the Annual Radiological Environmental Operating Report.

(2) See Table 2.4 for maximum values for the lower limits of detection.

(3) Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, to seasonal unavailability or to malfunction of sampling equipment. If the latter occurs, every effort shall be made to complete corrective action prior to the end of the next sampling period.

(4) Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to effluents from the plant.

* Food products (4.c) may be substituted for milk samples.

TABLE 2.4

Detection Capabilities for Environmental Sample Analysis(a)(b)(d)
Lower Limits of Detection

Analysis[e]	Water (pCi/1)	Airborne Particulate or Gas (pCi/m^3)	Fish and Invertegrates (pCi/kg/wet)	Milk pCi/1	Sediment (pCi/kg/dry)	Food Products (pCi/kg/wet)
Gross Beta	4	.01				
H-3	2000*					
Mn-54	15		130			
Fe-59	30		260			
Co-58, Co-60	15		130			
Zn-65	30		260			
Zr-Nb-95	15[c]					
I-131	1**	.07		1		60
Cs-134	15	.05	130	15	150	60
Cs-137	18	.06	150	18	180	80
Ba-La-140	15[c,f]			15[c,f]		

* If no drinking water pathway exists, a value of 3,000 pCi/l may be used.

** If no drinking water pathway exists, a value of 15 pCi/l may be used.

TABLE 2.4 (Continued)

Table Notation

a. The LLD is the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability and that only a 5% probability exists of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66 * S_b}{E * V * 2.22 * Y * Exp(-\lambda * \Delta t)}$$

where:

LLD is the "a priori" lower limit of detection as defined above (as picocuries per unit mass or volume).

4.66 is a constant derived from the K_{alpha} and K_{beta} values for the 95% confidence level.

S_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute).

E is the counting efficiency (as counts per disintegration).

V is the sample size (in units of mass or volume).

2.22 is the number of disintegration per minute per picocuries.

Y is the fractional radiochemical yield (when applicable).

λ is the radioactive decay constant for the particular radionuclide.

Δt is the elapsed time between sample collection and analysis.

Typical values of E, V, Y, and Δt can be used in the calculation.

TABLE 2.4 (Continued)

Table Notation

This equation results in an LLD in terms of picocuries. For the purposes of Section 2.5 (Tables 2.6 and 2.7), where the required LLD is set forth in microcuries, the terms 2.22 in the denominator should be replaced by 2.22E6, which is the number of disintegrations per minute per microcurie.

In calculating the LLD for a radionuclide determined by gamma-ray spectrometry, the background shall include the typical contributions of other radionuclides normally present in the samples (e.g., Potassium-40 in milk samples).

The analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally, background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unavailable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

b. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. This does not preclude the calculation of an a posteriori LLD for a particular measurement based upon the actual parameters for the sample in question and appropriate decay correction parameters, such as decay while sampling and during analysis.

c. Parent only.

d. If the measured concentration minus the three standard deviation uncertainty is found to exceed the specified LLD, the sample does not have to be analyzed to meet the specified LLD.

e. This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the listed nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report pursuant to Specification 5.9.1.5.

f. The Ba-140 LLD and concentration can be determined by the analysis of its short-lived daughter product, La-140, subsequent to an eight-day period following collection. The calculation shall be predicated on the normal ingrowth equations for a parent-daughter situation and the assumption that any unsupported La-140 in the sample would have decayed to an insignificant amount (at least 3.6% of its original value). The ingrowth equations will assume that the supported La-140 activity at the time of collection is zero.

TABLE 2.5

Reporting Levels for Radioactivity Concentrations in Environmental Samples

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m³)	Fish and Invertebrates (pCi/kg/wet)	Milk (pCi/l)	Food Products (pCi/l)
H-3	20,000[a]				
Mn-54	1,000		30,000		
Fe-59	400		10,000		
Co-58	1,000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95[b]	400				
I-131	2[c]	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140[b]	200			300	

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[a] If no drinking water pathway exists, a value of 30,000 pCi/l may be used.

[b] Parent only.

[c] If no drinking water pathway exists, a value of 20 pCi/l may be used.

2.5 Radioactive Effluent Monitoring

2.5.1 Applicability

This section applies to monitoring radioactive effluents, both liquid and gaseous.

2.5.2 Objective

The objective of this section is to specify the nature and frequency of radioactive effluent monitoring requirements.

2.5.3 Liquid Effluents: Sampling and Analysis

1. Liquid radioactive waste sampling and activity analysis shall be performed in accordance with Table 2.6.

2. The results of the radioactivity analysis shall be used in accordance with the methodology and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits of Section 2.1.3.1.

3. Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters in this ODCM at least once per 31 days.

2.5.4 Liquid Effluents: Instrumentation

Discharge of liquid radioactive effluents shall be continuously monitored with the alarm/trip setpoints of the monitor set in accordance with the methods outlined in the ODCM such that the requirements of Section 2.1.3 are met.

2.5.5 Gaseous Effluents: Sampling and Analysis

1. Gaseous radioactive waste sampling and activity analysis shall be performed in accordance with Table 2.7.

2. The cumulative doses due to gaseous effluents for the current calendar quarter and calendar year shall be determined to be within the limits of Sections 2.2.3, 2.2.4, and 2.2.5 in accordance with the methodology and parameters of the ODCM at least once per 31 days.

3. Doses due to gaseous releases from the site to areas at or beyond the site boundary shall be compared with the limits of Section 2.2.6 in accordance with the methodology and parameters in the ODCM at least once per 31 days. If all gaseous releases for the period have been processed via a design mode of the Gaseous Radwaste Treatment System, dose estimates for compliance with Section 2.2.6 are not required.

2.5.6 Gaseous Effluents: Instrumentation

[Radioactive gaseous effluents shall be continuously monitored with the alarm/trip setpoints of the monitors set in accordance with the methods outlined in the ODCM such that the requirements of Section 2.2.3 will be met.

2.5.7 Basis

The sampling analysis and instrumentation requirements set forth in this Specification provide reasonable assurance that all significant radioactive releases will be monitored and that the effluents will not result in exceeding the requirements of 10CFR20.

TABLE 2.6

Radioactive Liquid Waste Sampling and Analysis Program

Liquid Release Type	Minimum Sampling Frequency[h]	Analysis Frequency[h]	Type of Activity Analysis	Lower Limit of Detection (LLD) (uCi/ml)[a]
[A. Batch Waste Release Tanks[d]	PR[i] Each Batch	PR Each Batch	Principal Gamma Emitters[f]	5×10^{-7}
			I-131	1×10^{-6}
	PR One Batch/M	M	Dissolved and Entrained Gases (Gamma Emitters)	1×10^{-5}
[[	PR[i] Each Batch	M Composite[b]	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	PR Each Batch	Q Composite[b]	Sr-89, Sr-90 Fe-55[g]	5×10^{-8} 1×10^{-6}
B. Plant Continuous Releases[e] (Turbine Building Sump)	D[c] Grab Sample	W Composite[b]	Principal Gamma Emitters[f]	5×10^{-7}
	W Grab Sample	M Composite[b]	H-3 Gross Alpha	1×10^{-5} 1×10^{-7}
	W Grab Sample	Q Composite[b]	Sr-89, Sr-90 FE-55[g]	5×10^{-8} 1×10^{-6}

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TABLE 2.6 (Continued)

Table Notation

a. The Lower Limit of Detection (LLD) is defined in Table Notation a of Table 2.4 of Section 2.4.

b. A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

c. To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be collected during release and composited in proportion to the rate of flow of the effluent stream. Prior to analyses, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.

d. A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed to assure representative sampling.

e. A continuous release is the discharge of liquid wastes of a non-discrete volume; e.g., from a volume of system that has an input flow during the continuous release.

f. The principal gamma emitters for which the LLD specification will apply are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with an LLD of 5×10^{-6}. This list does not mean that only these nuclides are to be considered. Other gamma peaks which are identifiable, together with the above nuclides, shall also be analyzed and reported in the Annual Radioactive Effluent Release Report. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level.

g. If, after a period of two years, the results indicate that Fe-55 is likely to contribute 1% or less of the total dose attributable to this pathway, the licensee may discontinue the analysis.

h. Frequency notations: PR = Prior to Release
D = Daily
W = Weekly
M = Monthly
Q = Quarterly

[i. Discharges directly to the forebay under zero Circulating Water/Service Water flow conditions
[also require pre-release sampling and analysis of the forebay.

TABLE 2.7

Radioactive Gaseous Waste Sampling and Analysis Program

Gaseous Release Type	Minimum Sampling Frequency[d]	Analysis Frequency[d]	Type of Activity Analysis	Lower Limit of Detection (LLD) (uCi/ml)[a]
A. Primary Vent Stack	M Grab	M	Principal Gamma Emitters[c]	1×10^{-4}
	Continuous[b]	W Particulate Sample	Principal Gamma Emitters[c] (I-131, Others)	1×10^{-11}
	Continuous[b]	M Composite Particulate Sample	Gross Alpha	1×10^{-11}
	Continuous[b]	Q Composite Particulate Sample	Sr-89, Sr-90	1×10^{-11}
	M[e] Grab	M	Tritium	1×10^{-6}
B. Fuel Building Exhaust Vent	M Grab	M	Principal Gamma Emitters[c]	1×10^{-4}
	Continuous[b]	W Particulate Sample	Principal Gamma Emitters[c] (I-131, Others)	1×10^{-11}
	Continuous[b]	M Composite Particulate Sample	Gross Alpha	1×10^{-11}
	Continuous[b]	Q Composite Particulate Sample	Sr-89, Sr-90	1×10^{-11}
	Continuous[b]	Noble Gas Monitor	Noble Gases Gross Beta Or Gamma	1.0×10^{-5}
	W Grab	W	Tritium	1×10^{-6}

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TABLE 2.7 (Continued)

Table Notation

a. The Lower Limit of Detection (LLD) is defined in Table Notation a of Table 2.4 of Section 2.4.

b. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Sections 2.2.3, 2.2.4, and 2.2.5.

c. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported in the Annual Radioactive Effluent Release Report. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported in the Annual Radioactive Effluent Release Report. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level for that nuclide but as "not detected." When unusual circumstances result in LLDs higher than required, the reasons shall be documented in the Annual Radioactive Effluent Release Report.

d. Frequency notations are the same as in Table 2.6.

[e. Tritium grab samples shall be taken weekly whenever the refueling cavity is flooded.

TABLE 2.8

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3.0 LIQUID EFFLUENT DOSE CALCULATIONS

3.1 Liquid Effluent Dose to an Individual

Section 2.1.4.1 limits the dose or dose commitment to a member of the public from radioactive materials in liquid effluents released from the site to Back River:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total body, and to less than or equal to 5 mrem to any organ; and

b. During any calendar year to less than or equal to 3 mrem to the total body, and to less than or equal to 10 mrem to any organ.

3.1.1.a Dose to the Total Body (Method I)

The total body dose, D_{tb}, in mrem for a liquid release is:

$$D_{tb} = K \sum_{i} Q_i \, DFL_{itb} \qquad (3\text{-}1)$$

where:

Q_i is the total activity released for radionuclide i, in Ci (for strontiums use the most recent measurement available).

DFL_{itb} is the site specific Total Body Dose Factor for radionuclide i, in mrem/Ci (see Table 3.1).

K is equal to $935/F_d$; where:

[935 was the design Circulating/Service Water flow in ft^3/sec under normal power
[operating conditions, and

[F_d is the actual average dilution flow rate at the of point of discharge from the multiport
[diffuser (in ft^3/sec) during the period of the discharge. For waste tank discharge periods
[without forced or pumped plant dilution flow greater than 3800 gpm, F_d is set at a
minimum flow of 8.5 ft^3/sec. due to tidal flushing from the plant forebay through the
[diffuser system (Reference 10).

3.1.1.b <u>Dose to the Total Body (Method II)</u>

Method II consists of the models, input data and assumptions (bioaccumulation factors, shore-width factor, dose conversion factors, and transport and buildup times) in Regulatory Guide 1.109, Rev. 1 (Reference 2), except where site-specific data or assumptions have been identified in the ODCM. The general equations (A-3 and A-7) taken from Regulatory Guide 1.109, and used in the derivation of the simplified Method I approach as described in the Bases Section A.1, are also applied to Method II assessments, except that doses calculated to the whole body from radioactive effluents are evaluated for each of the four age groups to determine the maximum whole body dose of an age-dependent individual via all existing exposure pathways. Table A-1 lists the usage factors for Method II calculations. During periods when the Circulating/Service Water System provided dilution flow of effluent releases from the discharge diffuser to the Back River, the mixing ratio for the diffuser's nearfield mixing zone was set at 0.10. Under decommissioning conditions when plant dilution flow is no longer provided by the Circulating/Service Water System, the mixing ratio may be redued to 0.020 in Method II calculations to account for tidal flushing of effluent materials from the plant forebay (Reference 10).

3.1.2.a <u>Dose to the Critical Organ (Method I)</u>

The critical organ dose, D_{co}, in mrem for a liquid release is:

$$D_{co} = K \sum_i Q_i \, DFL_{ico} \qquad (3\text{-}2)$$

where:

Q_i is the total activity released for radionuclide i, in Ci (for strontiums use the most recent measurement available).

DFL_{ico} is the site specific Critical Organ Dose Factor for radionuclide i, in mrem/Ci (see Table 3.1).

K is equal to $935/F_d$; where:

935 was the design Circulating/Service Water flow in ft^3/sec under normal power operating conditions, and

F_d is the actual average dilution flow rate at the point of discharge from the multiport diffuser (in ft^3/sec) during the period of the discharge. For waste tank discharge periods without forced or pumped plant dilution flow greater than 3800 gpm, F_d is set at a minimum flow of 8.5 ft^3/sec. due to tidal flushing from the plant forebay through the diffuser system (Reference 10).

3.1.2.b <u>Dose to the Critical Organ (Method II)</u>

Method II consists of the models, input data and assumptions (bioaccumulation factors, shore-width factor, dose conversion factors, and transport and buildup times) in Regulatory Guide 1.109, Revision 1 (Reference 2), except where site-specific data or assumptions have been identified in the ODCM. The general equations (A-3 and A-7) taken from Regulatory Guide 1.109, and used in the derivation of the simplified Method I approach as described in the Bases Section A.1, are also applied to Method II assessments, except that doses calculated to critical organs from radioactive effluents are evaluated for each of the four age groups to determine the maximum critical organ of an age-dependent individual via all existing exposure pathways. Table A-1 lists the usage factors for Method II calculations. During periods when the Circulating/Service Water System provided dilution flow of effluent releases from the discharge diffuser to the Back River, the mixing ratio for the diffuser's nearfield mixing zone was set at 0.10. Under decommissioning conditions when plant dilution flow is no longer provided by the Circulating/Service Water System, the mixing ratio may be redued to 0.020 in Method II calculations to account for tidal flushing of effluent materials from the plant forebay (Reference 10).

TABLE 3.1

Maine Yankee Dose Factors for Liquid Releases

Nuclide	Total Body Dose Factor mrem/Ci DFL_{itb}	Critical Organ Dose Factor mrem/Ci DFL_{ico}
H-3	2.96E-07	2.96E-07
Na-24	2.46E-05	2.83E-05
Cr-51	1.54E-05	1.45E-03
Mn-54	4.26E-03	2.55E-02
Mn-56	1.89E-06	4.09E-05
Fe-55	1.24E-02	7.53E-02
Fe-59	8.58E-02	6.54E-01
Co-58	2.21E-03	1.35E-02
Co-60	4.79E-02	7.80E-02
Zn-65	2.68E-01	5.38E-01
Sr-89	2.13E-04	7.45E-03
Sr-90	3.16E-02	1.29E-01
Zr-95	5.03E-04	1.73E-02
Mo-99	2.95E-05	2.62E-04
Tc-99m	4.06E-07	1.98E-06
Sb-124	1.34E-03	9.36E-03
I-131	2.07E-04	9.86E-02
I-132	2.54E-06	3.29E-06
I-133	2.46E-05	1.13E-02
I-135	7.12E-06	4.17E-04
Cs-134	2.79E-02	3.12E-02
Cs-137	2.92E-02	3.41E-02
Ba-140	1.54E-04	3.41E-03
Ce-141	2.81E-05	9.13E-03
W-187	6.28E-06	1.32E-03
Ag-110m	7.92E-03	6.26E-01
Sb-125	4.81E-03	6.81E-03
Other	1.51E-01	3.40E+00

4.0 GASEOUS EFFLUENT DOSE CALCULATIONS

4.1 Gaseous Effluent Dose Rate

Section 2.2.3.1 limits the dose rate (when averaged over 1 hour) due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary:

a. for noble gases: less than or equal to 500 mrem/yr to the total body, and less than or equal to 3000 mrem/yr to the skin, and;

b. for Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than 8 days; less than or equal to 1500 mrem/yr to any organ.

4.1.1.a Dose Rate to the Total Body From Noble Gases (Method I)

The total body dose rate, $\dot{D}_{tb}$, in mrem/yr from Kr-85 released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

$$\dot{D}_{tb} = 4.20E - 05 * \dot{Q}_{kr-85} \qquad (4\text{-}1a)$$

Where:

$\dot{Q}_{Kr-85}$ is the release rate of Kr-85 released via the Fuel Building Exhaust Vent and Primary Vent Stack, in units of µCi/sec; and

4.20E - 05 is defined in Section A.2, in units of mrem - sec / µCi - yr.

The total dose rate from the site is the combination of dose rates from the Primary Vent Stack and the Fuel Building Exhaust Vent.

4.1.1.b Dose Rate to the Total Body From Noble Gases (Method II)

Method II consists of the model and input data (whole body dose factors) in Regulatory Guide 1.109, Revision 1 (Reference 2), except where site-specific data or assumptions have been identified in the ODCM. The general equation (B-8) taken from Regulatory Guide 1.109, and used in the derivation of the simplified Method I approach as described in the Bases Section A.2, is also applied to a Method II assessment. No credit for a shielding factor (S_F) associated with residential [structures is assumed. Historical or concurrent meteorology with the release period may be utilized for the gamma atmospheric dispersion factor identified in Appendix B for the release point from which recorded effluents have been discharged. In sectors where the site boundary is adjacent to Back River, the total body dose rate will be evaluated on the nearest opposite shoreline where the potential exists for uncontrolled occupancy. On-site areas or areas with limited and controlled occupancy will be evaluated with those occupancy factors included. The most restrictive location in any of the 16 sectors will be used in determining the dose rate.

4.1.2.a Dose Rate to the Skin From Noble Gases (Method I)

[The skin dose rate, $\dot{D}_{skin}$, in mrem/yr from Kr-85 released via the Fuel Building Exhaust
[Vent or the Primary Vent Stack is:
[

$$\dot{D}_{skin} = 1.39E - 02 * \dot{Q}_{Kr-85}$$

Where:

[$\dot{Q}_{Kr-85}$ is the release rate of Kr-85 released via the Fuel Building Exhaust Vent and Primary
[Vent Stack, in μCi/sec; and

1.39E - 02 is as defined in Section A.3, in units of mrem-sec/μCi - yr.

The total dose rate from the site is the combination of dose rates from Primary Vent Stack and the [Fuel Building Exhaust Vent.

4.1.2.b Dose Rate to the Skin From Noble Gases (Method II)

Method II consists of the model and input data (skin dose factors) in Regulatory Guide 1.109, Revision 1 (Reference 2), except where site-specific data or assumptions have been identified in this ODCM. The general equation (B-9) taken from Regulatory Guide 1.109, and used in the derivation of the simplified Method I approach as described in the Bases Section A.3, is also applied to a Method II assessment. No credit for a shielding factor (S_F) associated with residential structures is assumed. [Historical or concurrent meteorology with the release period may be utilized for the gamma atmospheric dispersion factor and undepleted atmospheric dispersion factor identified in ODCM Appendix B for the release point from which recorded effluents have been discharged. In sectors where the site boundary is adjacent to Back River, the Skin Dose Rate will be evaluated on the nearest opposite shoreline where the potential exist for uncontrolled occupancy. On-site areas or areas with limited and controlled occupancy will be evaluated with those occupancy factors included. The most restrictive location in any of the 16 sectors will be used in determining the dose rate.

4.1.3.a Dose Rate to the Critical Organ From Radioiodines and Particulates (Method I)

The dose rate to the critical organ, $\dot{D}_{co}$, in mrem/yr from Iodine-131, Iodine-133, tritium,
[and radioactive materials in particulate form with half-lives greater than 8 days released via the Fuel
[Building Exhaust Vent or the Primary Vent Stack is:

$$\dot{D}_{co} = \Sigma_i \dot{Q}_i DFG'_{ico}$$

Where:

[$\dot{Q}_i$ is the release rate of radionuclide i released via the Primary Vent Stack and Fuel
[Building Exhaust Vent, µCi/sec; and

DFG'_{ico} is the site specific Critical Organ Dose Rate Factor for radionuclide i,
[in mrem-sec/µCi - yr. (See Table 4.4)

[

The total dose rate from the site is the combination of dose rates from Primary Vent Stack and the
[Fuel Building Exhaust Vent.

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4.1.3.b Dose Rate to the Critical Organ From Radioiodines and Particulates (Method II)

Method II consists of the models, input data and assumptions in Appendix C of Regulatory Guide 1.109, Revision 1 (Reference 2), except where site-specific data or assumptions have been identified in this ODCM (see Tables A-2 and A-3). The critical organ dose rate will be determined based on the location (site boundary, nearest resident, or farm) of receptor pathways as identified in the most recent annual land use census, or by conservatively assuming the existence of all possible pathways (such as ground plane, inhalation, ingestion of stored and leafy vegetables, milk, and meat) at an off-site location of maximum potential dose. Historical or concurrent meteorology with the release period may be utilized for determination of atmospheric dispersion factors in accordance with Appendix B for the release point from which recorded effluents have been discharged. The maximum critical organ dose rates will consider the four age groups independently, and take no credit for a shielding factor (S_F) associated with residential structures. Site boundary locations adjacent to the river will be evaluated on the nearest opposite shoreline. Mud flats exposed at low tide will include an occupancy factor of 0.037 for evaluation of doses at those locations.

4.2 Gaseous Effluent Dose From Noble Gases

Section 2.2.4.1 limits the air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary to the following:

a. During any calendar quarter: less than or equal to 5 mrad for gamma radiation, and less than or equal to 10 mrad for beta radiation; and

b. During any calendar year: less than or equal to 10 mrad for gamma radiation, and less than or equal to 20 mrad for beta radiation.

4.2.1.a Gamma Air Dose (Method I)

The gamma air dose, D^{γ}_{air}, in mrad from Kr-85 released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

$$D^{\gamma}_{air} = 1.42E - 06 * Q_{Kr-85} \quad (4\text{-}4a)$$

Where:

Q_{Kr-85} is the total activity of Kr-85 released via the Fuel Building Exhaust Vent and the Primary Vent Stack during the period of interest, in Ci; and

1.42E - 06 is as defined in Section A.5 of Appendix A, in units of mrad/ci

The total dose rate from the site is the combination of dose rates from Primary Vent Stack and the Fuel Building Exhaust Vent.

4.2.1.b Gamma Air Dose (Method II)

Method II consists of the models, input data (dose factors) and assumptions in Regulatory Guide 1.109, Revision 1 (Reference 2), except where site-specific data or assumptions have been identified in this ODCM. The general equations (B-4 and B-5) taken from Regulatory Guide 1.109, and used in the derivation of the simplified Method I approach as described in the Bases Section A.5 are also applied to Method II assessments. Historical or concurrent meteorology with the release period may be utilized for the gamma atmospheric dispersion factors (see Appendix B) for the release point from which recorded effluents have been discharged. For sectors adjacent to the Back River, the nearest opposite shoreline with an assumed potential occupancy factor of 100% will be used to evaluate doses. On-site areas with limited and controlled occupancy will be evaluated with those occupancy factors included.

4.2.2.a Beta Air Dose (Method I)

The beta air dose, D^{β}_{air}, in mrad from Kr-85 released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

$$D^{\beta}_{air} = 6.37E-04 * Q_{Kr-85} \tag{4-5a}$$

Where:

Q_{Kr-85} is the total activity of Kr-85 released from the Fuel Building Exhaust Vent and Primary Vent Stack during the period of interest, in Ci; and

6.37E - 04 is as defined in Section A.6 of Appendx A, in mrad/ci.

The total dose from the site is the combination of doses from the Primary Vent Stack and the Fuel Building Exhaust Vent.

4.2.2.b Beta Air Dose (Method II)

Method II consists of the models, input data (dose factors) and assumptions in Regulatory Guide 1.109, Revision 1 (Reference 2), except where site-specific data or assumptions have been identified in the ODCM. The general equations (B-4 and B-5) taken from Regulatory Guide 1.109, and used in the derivation of the simplified Method I approach as described in the Bases Section A.6, are also applied to Method II assessments. Historical or concurrent meteorology with the release period may be utilized for the atmospheric dispersion factors (see Appendix B) for the release point from which recorded effluents have been discharged. For sectors adjacent to the Back River, the nearest opposite shoreline with an assumed potential occupancy factor of 100% will be used to evaluate doses. On-site areas or areas with limited and controlled occupancy will be evaluated with those occupancy factors included.

4.3 Gaseous Effluent Dose from Iodine-131, Iodine-133, Tritium, and Radioactive Material in Particulate Form

Sections 2.2.5.1.a and 2.2.5.1.b limit the dose to a member of the public from Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents released to areas at and beyond the site boundary to the following:

a. during any calendar quarter: less than or equal to 7.5 mrem to any organ; and

b. during any calendar year: less than or equal to 15 mrem to any organ.

[

4.3.1.a Dose to the Critical Organ (Method I)

The dose to the critical organ, D_{co}, in mrem from Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than eight days released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

$$D_{co} = \sum_i Q_i \, DFG_{ico} \qquad (4\text{-}6)$$

where:

Q_i is the total activity of radionuclide i released via the Primary Vent Stack and the Fuel Building Exhaust Vent during the period of interest, in Ci; and

DFG_{ico} is the site specific Critical Organ Dose Factor for radionuclide i for a gaseous release in mrem/Ci (see Table 4.4).

The total dose from the site is the combination of doses from the Primary Vent Stack and the Fuel Building Exhaust Vent.

4.3.1.b Dose to Critical Organ (Method II)

Method II consists of the models, input data and assumptions in Appendix C of Regulatory Guide 1.109, Revision 1 (Reference 2), except where site-specific data or assumptions have been identified in this ODCM (see Tables A-2 and A-3). The critical organ dose will be determined based on the location (site boundary, nearest resident, or farm) of receptor pathways, as identified in the most recent annual land use census, or by conservatively assuming the existence of all possible pathways (such as ground plane, inhalation, ingestion of stored and leafy vegetables, milk, and meat) at an off-site location of maximum potential dose. Historical or concurrent meteorology with the release period may be utilized for determination of atmospheric dispersion factors in accordance with Appendix B for the release point from which recorded effluents have been discharged. The maximum critical organ dose will consider the four age groups independently, and use a shielding factor (S_F) of 0.7 associated with residential structures. Mud flats exposed at low tide in areas where the Back River is adjacent to the site boundary will include an occupancy factor of 0.037 for evaluation of doses at those locations. Only the inhalation and ground plane exposure pathways are included in the assessment of doses on the mudflats (for 10 CFR 50, Appendix I, and 40 CFR 190 considerations).

TABLE 4.1

Maine Yankee Dose Factors for Noble Gas Releases*

Nuclide	Total Body Dose Rate Factor (mrem-m³/pCi-yr) DFB_i	Combined Skin Dose Rate Factor (mrem-sec/uCi-yr) DF_i'	Gamma Air Dose Factor (mrad-m³/pCi-yr) DF^{γ}_i	Beta Air Dose Factor (mrad-m³/pCi-yr) DF_i^{β}
Kr-85	1.61E-05	1.39E-02 (Included in dose equation)	1.72E-05	1.95E-03

*For use with Method I dose and dose rate calculations associated with releases from the Primary Vent Stack and Fuel Building Exhaust Vent.

TABLE 4.2

Deleted

TABLE 4.3

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TABLE 4.4

Maine Yankee Dose Factors for Tritium and Particulates

[Released Via the Fuel Building Exhaust Vent or Primary Vent Stack*

Nuclide	Critical Organ Dose Factor (mrem/Ci) DFG_{ico}	Critical Organ Dose Rate Factor (mrem - sec/μCi - yr) DFG'_{ico}
H-3	3.10E-03	9.78E-02
C-14	1.88E + 00	5.93E + 01
Cr-51	2.14E - 02	7.38E - 01
Mn-54	2.40E + 00	9.49E + 01
Fe-55	1.09E + 00	3.44E + 01
Fe-59	2.42E + 00	8.01E + 01
Co-58	1.25E + 00	4.48E + 01
Co-60	2.60E + 01	1.16E + 03
Zn-65	1.27E + 01	4.10E + 02
Sr-89	3.88E + 01	1.22E + 03
Sr-90	1.49E + 03	4.70E + 04
Ag-110m	2.31E + 01	7.76E + 02
Sb-124	4.38E + 00	1.46E + 02
Sb-125	4.28E + 00	1.67E + 02
Cs-134	5.42E + 01	1.80E + 03
Cs-137	5.54E + 01	1.89E + 03
Ba-140	6.34E - 01	2.03E + 01
Ce-141	6.04E - 01	1.92E + 01
Ce-144	1.33E + 01	4.19E + 02
Other	1.06E + 01	3.34E + 02

[*The listed dose factors are derived based on a ground level release model for the Fuel Building
[Exhaust Vent. For Method I dose estimates, these dose factors can also be used as bounding values
[for releases from the Primary Vent Stack.

5.0 ENVIRONMENTAL MONITORING

The Radiological Environmental Monitoring Stations are listed in Table 5.1. The locations of these stations with respect to the Maine Yankee facility are shown on the maps in Figures 5.1 through 5.4.

TABLE 5.1
Radiological Environmental Monitoring Stations[a]

Exposure Pathway and/or Sample	Sample Location and Designated Code[b]	Distance From the Plant (km)	Direction From the Plant
[1. AIRBORNE (PARTICULATE)	AP-11 Montsweag Brook	2.7	NW
[	AP-13 Bailey Farm (ESL)	0.7	NE
[	AP-14 Mason Steam Station	4.8	NNE
[	AP-16 Westport Firehouse	1.8	S
[	AP-29 Dresden Substation	20.1	N
2. DIRECT RADIATION			
	TL-1 Old Ferry Rd.	0.9	N
	TL-2 Old Ferry Rd.	0.8	NNE
	TL-3 Bailey House (ESL)	0.7	NE
	TL-4 Westport Island, Rt. 144	1.3	ENE
	TL-5 MY Information Center	0.2	ENE
	TL-6 Rt. 144 and Greenleaf Rd.	1.0	E
	TL-7 Westport Island, Rt. 144	0.9	ESE
	TL-8 MY Screenhouse	0.2	ESE
	TL-9 Westport Island, Rt. 144	0.8	SE
	TL-10 Bailey Point	0.3	SSE
	TL-11 Mason Station	4.8	NNE
	TL-12 Westport Firehouse	1.7	S
	TL-13 Foxbird Island	0.3	SSW
	TL-14 Eaton Farm	0.7	SW
	TL-15 Eaton Farm	0.8	WSW
	TL-16 Eaton Farm	0.7	W
	TL-17 Eaton Farm Rd.	0.6	WNW
	TL-18 Eaton Farm Rd.	0.8	NW
	TL-19 Eaton Farm Rd.	0.9	NNW
	TL-20 Bradford Rd., Wiscasset	6.4	N
	TL-21 Federal St., Wiscasset	7.1	NNE
	TL-22 Cochran Rd., Edgecomb	8.3	NE
	TL-23 Middle Rd., Edgecomb	6.4	ENE
	TL-24 River Rd., Edgecomb	7.8	E
	TL-25 River Rd. and Rt. 27	7.7	ESE
	TL-26 Rt. 27 and Boothbay RR Museum	7.9	SE
	TL-27 Barters Island	7.2	SSE
	TL-28 Westport Island, Rt. 144 & East Shore Rd.	7.9	S
	TL-29 Harrison's Trailer	6.2	SSW
	TL-30 Leeman Farm, Woolwich	7.8	SW
	TL-31 Barley Neck Rd., Woolwich	6.8	WSW
	TL-32 Baker Farm, Woolwich	7.3	W
	TL-33 Rt. 127, Woolwich	7.4	WNW
	TL-34 Rt. 127, Woolwich	7.9	NW
	TL-35 Rt. 127, Dresden	9.1	NNW
	TL-36 Boothbay Harbor Fire Sta.	12.2	SSE
	TL-37 Bath Fire Station	10.7	WSW
	TL-38 Dresden Substation	20.1	N

TABLE 5.1 (Continued)

Radiological Environmental Monitoring Stations[a]

Exposure Pathway and/or Sample	Sample Location and Designated Code[b]	Distance From the Plant (km)	Direction From the Plant
3. WATERBORNE			
a. Surface (Estuary)	WE-12 Plant Outfall[c] (Composite Sample)	0.3	SSW
	WE-20 Kennebec River (Grab Sample)	9.5	WSW
b. Groundwater	WG-13 Bailey Farm (ESL)	0.7	NE
	WG-24 Morse Well	9.9	W
c. Sediment from Shoreline	SE-18 Foxbird Island	0.6	S
	SE-16 Old Outfall Area	0.6	S
4. INGESTION			
a. Milk	TM-18 Chewonki Foundation	1.9	WSW
	TM-25 Hanson Farm	18.3	W
b. Fish and Invertebrates[d]	FH/MU/CA/HA-11 Long Ledge Area	0.9	S
	FH/MU/CA/HA-24	11.1	S
c. Food Crop[e] Vegetation	TV-1X Indicator (to be determined)	-	-
	TV-1X Indicator (to be determined)	-	-
	TV-2X to be determined	-	-

Footnotes:

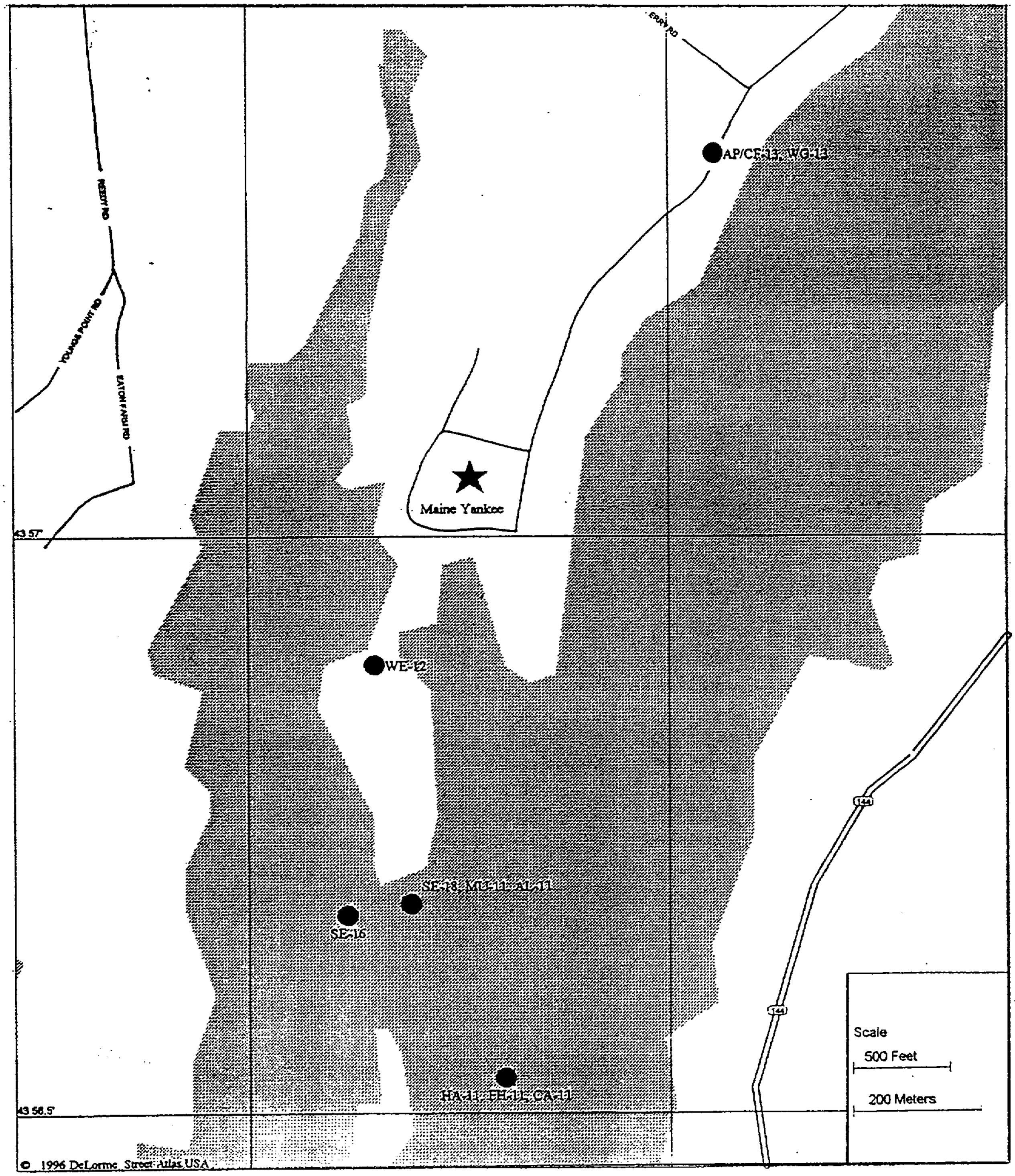
a Sample locations are shown on Figures 5.1 to 5.4.
b With the exception of DIRECT RADIATION locations, Station-1X's are indicator stations and Station-2X's are control stations.
c A dilution factor of 10 shall be applied to any radioactivity detected in a sample at this station.
d The station code letters will vary with the sample media collected. The sampling of all four media types is not required during each sampling period.
e Food crop sampling is not required while milk sampling is being done.

[

MAINE YANKEE ATOMIC POWER COMPANY
OFF-SITE DOSE CALCULATION MANUAL

FIGURE 5.1

Environmental Radiological Sampling Locations
Within 1 Kilometer of Maine Yankee



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MAINE YANKEE ATOMIC POWER COMPANY
OFF-SITE DOSE CALCULATION MANUAL

FIGURE 5.2

Environmental Radiological Sampling Locations
Outside of 1 Kilometer of Maine Yankee

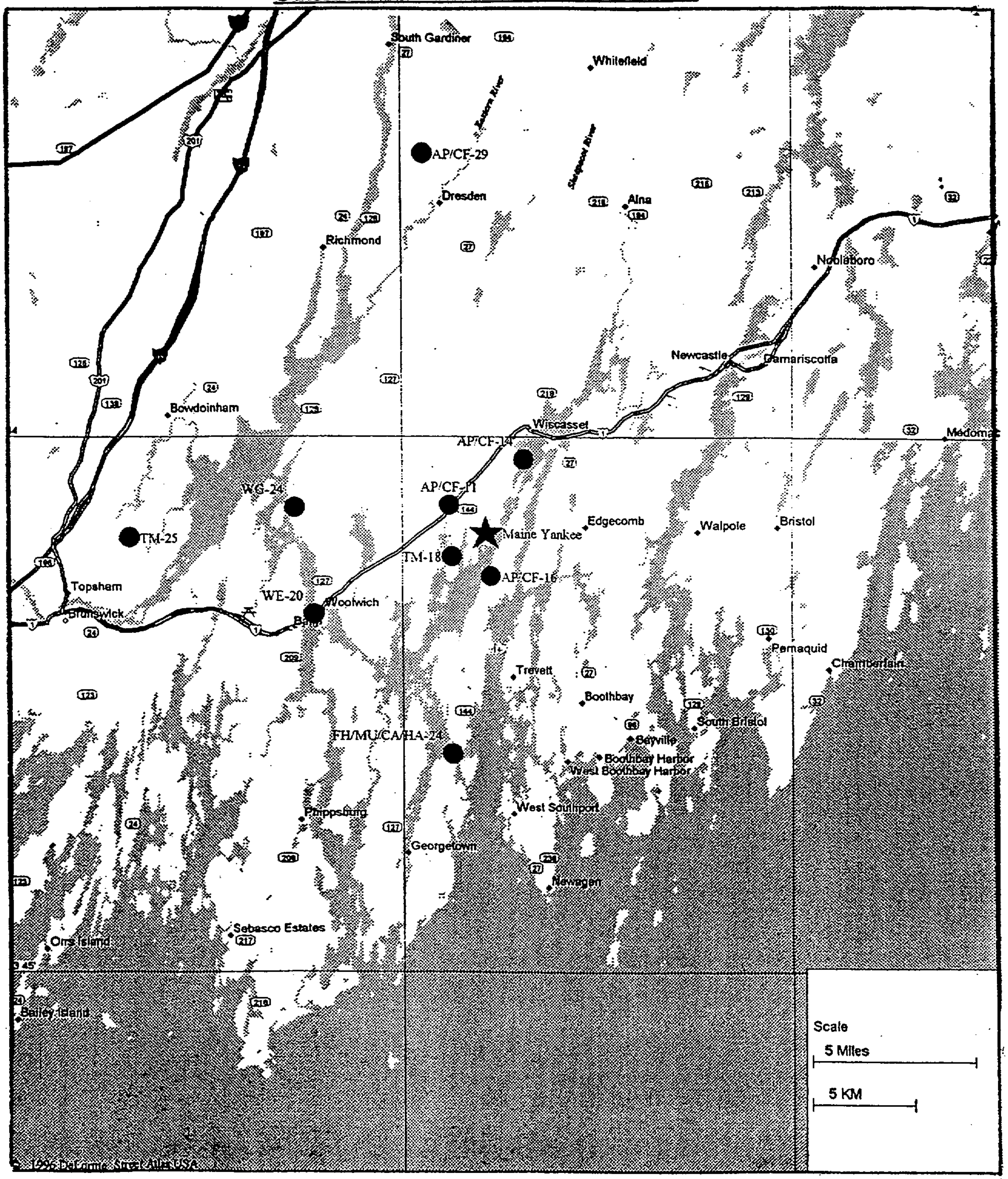

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FIGURE 5.3

Direct Radiation Monitoring Locations Within 1 Kilometer of Maine Yankee

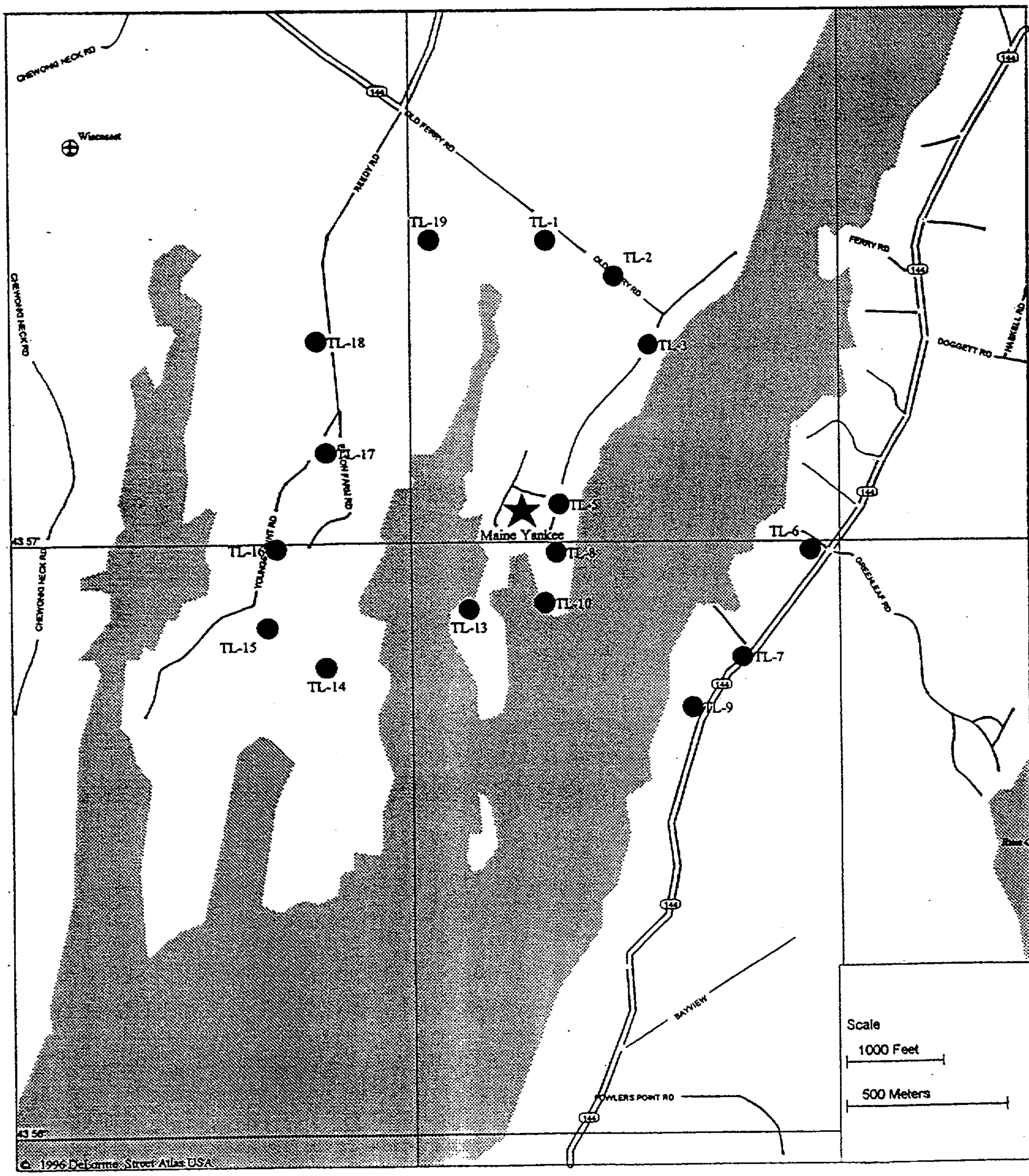

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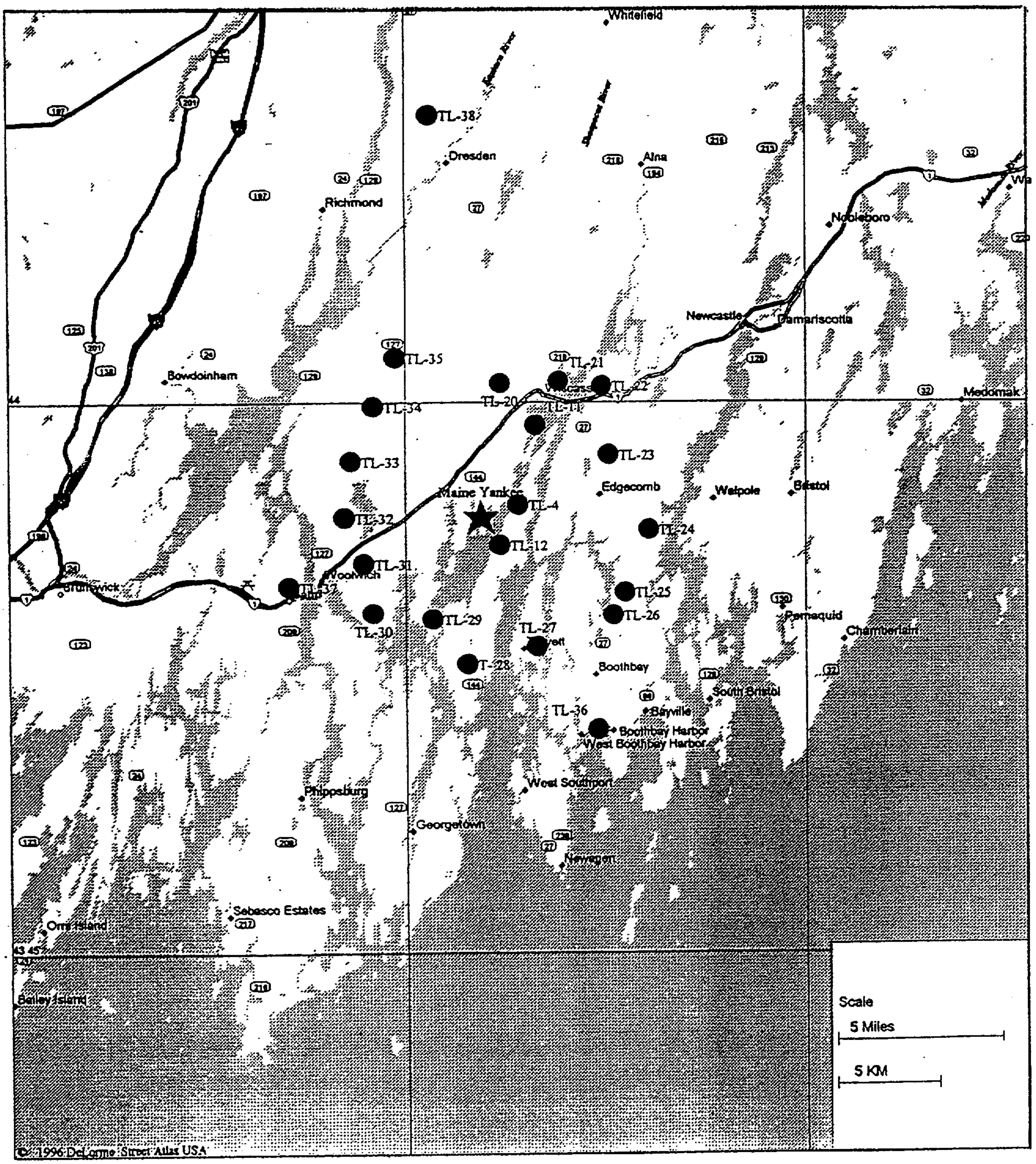
FIGURE 5.4

Direct Radiation Monitoring Locations
Outside of 1 Kilometer of Maine Yankee



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6.0 MONITOR SETPOINTS

6.1 Liquid Effluent Monitor Setpoints

This section describes the methodology to determine alarm/trip setpoints of liquid effluent monitors specified in Table 2.1, Radioactive Liquid Effluent Monitoring Instrumentation.

[[Consistent with Section 2.1.3.1, the total allowable concentration of radioactivity for all releases entering the Back River at any given time shall be limited to a total Effluent Concentration Limit Ratio, ECL Ratio, (R) equal to or less than unity when calculated as follows:

$$R = \sum R_i = \sum \frac{C_i}{ECL_i} \quad \text{shall be equal to or less than 1} \qquad (6.1)$$

Where:

R = Total ECL ratio (dimensionless)

[R_i = ECL ratio (dimensionless) for each individual release "i"

[C_i (under normal dilution flow conditions):

[[[= diluted activity of each radionuclide (i), in µCi/ml, which is the concentration entering the Back River, and is equal to the undiluted concentration $(C_u)_i$ of radionuclide (i) times the flowrate through the monitored pathway (in gpm) (Q_i) divided by the total of the dilution flow (in gpm) (D_i) plus the release flowrate (Q_i). ($(C_u)_i$ includes non-gamma emitting isotopes such as Tritium)

$$= \frac{(C_u)_i * Q_i}{(D_i + Q_i)}$$

[- OR -

[C_i (under zero Circulating/Service Water flow conditions):

[[[[[[[[= the diluted activity concentration of each radionuclide (i), in µCi/ml, entering the Back River, equal to the sum of the undiluted concentration $(C_u)_i$ of radionuclide (i) times the volume (V_i) of radwaste discharged through the monitored pathway (in gallons) plus the pre-release concentration of radionuclide (i) in the forebay $(C_{FB})_i$ times the volume of the forebay (V_{FB} in gallons) divided by the sum of the volume of radwaste discharged plus the volume of the forebay. ($(C_u)_i$ includes non-gamma emitting isotopes such as Tritium)

[[
$$= \frac{((C_u)_i\, V_i) + ((C_{FB})_i\, V_{FB})}{V_i + V_{FB}}$$

ECL_i = Effluent Concentration Limit (ECL) of radionuclide (i) in µCi/ml as specified in Section 2.1.3.1. (Includes non-gamma emitters such as tritium.)

[6.1.1 Internal Setpoints

[Internal monitor setpoints shall be established to monitor compliance with the release concentration limits specified in Section 2.1.3.1. Setpoints shall be calculated so as to alarm the monitor (and, if applicable, terminate the release) if the concentration in the discharge pathway may result in the concentration entering the Back River to exceed the ECL for the most limiting isotope) using the relationship:

[(Under normal dilution flow conditions):

$$Setpoint_i = ECL * [(D + Q_i)/Q_i] * PF_i * RF \quad (6.2)$$

Where:

$Setpoint_i$ = Monitor response (CPM) for the release pathway "i"

ECL = Effluent Concentration Limit (ECL) as specified in Section 2.1.3.1 of the most limiting gamma emitting radionuclide (i) which potentially may be present in the release pathway (μCi/ml).

[D = Minimum expected total Dilution Flow prior to discharge from the forebay.

Q_i = Maximum expected release flowrate through the monitored release pathway, "i" (gpm).

[PF_i = Pathway Factor (a value ≤ 1.0) applied to each monitor setpoint calculation. Application of the pathway factors shall be such that, allowing for instrument uncertainties, the total ECL ratio (R) resulting from releases via multiple pathways (R_i), should they exist, is maintained less than or equal to one, such that:

[$\sum PF_i$ shall be equal to or less than 1.

RF = Radiation monitor response factor (sensitivity factor) (cpm/μCi/ml).

[(Under zero Circulating/Service Water flow conditions):

[$$Setpoint_i = [(ECL (V_{FB} + V_i) - (C_{FB} V_{FB})) / V_i] * PF_i * RF \quad (6.2a)$$

[Where:

[$Setpoint_i$ = Monitor response (CPM) for the release pathway "i"

[ECL = Effluent Concentration Limit (ECL) as specified in Section 2.1.3.1 of the most limiting gamma emitting radionuclide (i) which potentially may be present in the release pathway (μCi/ml).

[C_{FB} = Limiting nuclide concentration in the forebay prior to the release (μCi/ml).

[V_{FB} = Volume of the forebay available for dilution (gallons)

[V_i = Volume of release through the monitored release path (gallons)

[PF_i = Pathway Factor (a value ≤ 1.0) applied to each monitor setpoint calculation. Application of the pathway factors shall be such that, allowing for instrument uncertainties, the total ECL ratio (R) resulting from releases via multiple pathways (R_i), should they exist, is maintained less than or equal to one, such that:

[$\sum PF_i$ shall be equal to or less than 1

[RF = Radiation monitor response factor (sensitivity factor) (cpm/μCi/ml).

6.1.2 External Setpoints

Liquid Radwaste Monitors should also be equipped with an external alarm/trip setpoint. The intent of this setpoint is to provide assurance that the pre-release analysis is representative of the release being made through that monitor, and to alert the operator if a problem does exist. This setpoint shall be determined for each release as follows:

Whenever practical, the ECL ratio (R_i) based on the pre-release analysis for batch releases via the monitored pathway should be less than or equal to 0.5.

Calculate the expected radiation monitor response (ER), as follows:

$$ER = [\sum (C_u)_i - (C_u)_{H-3}] * RF$$

Where:

ER = Expected radiation monitor response (CPM)

$\sum (C_u)_i$ = Sum of the undiluted activity concentration of each of the radionuclides (i) as determined by the pre-release analysis

$(C_u)_{H-3}$ = Undiluted activity concentration of Tritium as determined by the pre-release analysis

RF = Radiation monitor response factor (sensitivity factor) as determined by the most recent monitor calibration (CPM/μCi/ml)

Calculate the external setpoint as follows:

If $R_i \leq 0.5$, then:

[$Setpoint_{External} = 2 * ER + Background$

- BUT -

If $R_i > 0.5$, then:

[$Setpoint_{External}$ shall not exceed $[(1/R_i) * ER] + Background$

The external setpoint shall not be set at a value greater than the internal setpoint.

[If the $Setpoint_{External}$ calculates to a value less than 2000 cpm greater than background, the monitor
[setpoint may be set 2000 cpm above background, provided that setting is less than the internal setpoint.

In the event that the external setpoint alarms and/or trips a release, comply with ACTION 1 of the Table Notations for Table 2.1: Radioactive Liquid Effluent Monitoring Instrumentation.

- If the independent verification is in agreement with the initial analysis, the external setpoint may be established up to the value of the internal setpoint, and the release may proceed.

-but-

- If the independent verification is not in agreement with the initial analysis, the reason for the variation shall be determined, and appropriate corrective action shall be taken prior to recommencing the release. In this event, the external setpoint shall be recalculated and reestablished as described above before proceeding with the release.

Where appropriate, operator monitoring and response action may be an acceptable alternative to an external setpoint considering the following factors:

1. The close physical proximity of the radiation monitor indication from the operator control station (valve control switch).
2. The downstream location of the trip valve with respect to the rad monitor sensing location.
3. The methodology for calculating the expected monitor response is proceduralized.
4. During any release, an operator is stationed to observe the radiation monitor indication.
5. The criteria for taking operator action is proceduralized and available to the operator who is monitoring the release, and the action to be taken by the operator is simple and clearly prescribed in the procedure. (Reference 13)

6.2 Gaseous Effluent Monitor Setpoints

Section 2.5.6 requires that radioactive gaseous effluents be continuously monitored with the alarm/trip setpoints of the monitors set to ensure that the requirements of Section 2.2.3 are met.

Section 2.5.6 ensures that the dose rate at any time at the site area boundary and beyond from gaseous effluents will be within the annual dose rate limits specified in section 2.2.3. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a member of the public in an unrestricted area in excess of limits specified in 10 CFR Part 20, Appendix B, Table 2, Column 1.

This section of the ODCM describes the methodology that may be used to determine the setpoints of the gaseous effluent monitors. Gaseous effluent flow paths and release points, as well as the locations and identification numbers of the gaseous effluent radiation detectors, are shown in Figure 6.2.

The methodology for determining alarm/trip setpoints is divided into two parts. The first consists of calculating an allowable concentration for the radionuclide mixture to be released. The second consists of determining monitor response to this mixture in order to establish the physical settings on the monitors.

6.2.1 Allowable Concentrations of Radioactive Materials in Gaseous Effluents

The ECL-fraction, R_j, for each gaseous effluent release point is calculated by the relationship defined by Note 1 of 10 CFR Part 20, Appendix B:

$$R_j = [X/Q] \, F \sum_i \frac{C_i}{ECL_i} \qquad (6\text{-}5)$$

where:

R_j is the ECL-fraction for the release point j, dimensionless;

[X/Q] is the most conservative sector site boundary or off-site long-term average dilution factor (see Table 7.1) (1.03E-05 sec/m^3);

F is the release flow rate (in m^3/sec);

C_i is the concentration of radionuclide i, in uCi/cc;

ECL_i is the effluent concentration of radionuclide i as specified in 10 CFR Part 20, Appendix B, Table 2, Column 1, in uCi/cc.

The ECL-fractions for the various release points are then summed to yield the total ECL-fraction, R:

$$R = \sum_j R_j \qquad (6\text{-}6)$$

The total ECL-fraction, R, at the most conservative site boundary or off-site location must be less than or equal to one.

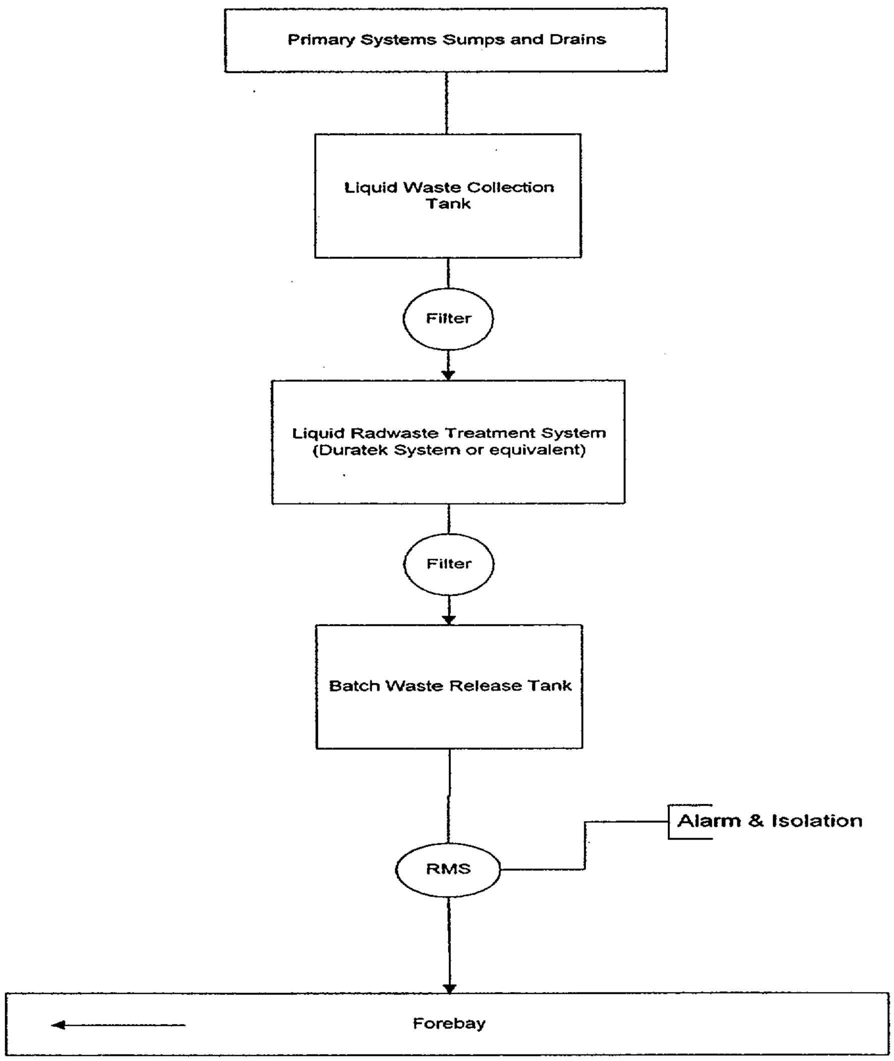
$$R \leq 1. \qquad (6\text{-}7)$$

6.2.2 Monitor Response for Gaseous Effluents

Normal radioactivity releases consist mainly of well-decayed fission gases. Therefore, monitor response calibrations are performed using fission gas with an energy representative of release conditions. The total concentration of radioactive materials in gaseous effluents, in uCi/cc, at the monitor is calculated. The calibration curve or constant, in cpm/(uCi/cc) is applied to determine the expected cpm for the mix of radionuclides. The setting of the monitor is established at some factor, b, greater than one but less than 1/R (see Equation 6-6).

FIGURE 6.1

Maine Yankee
Liquid Radwaste System



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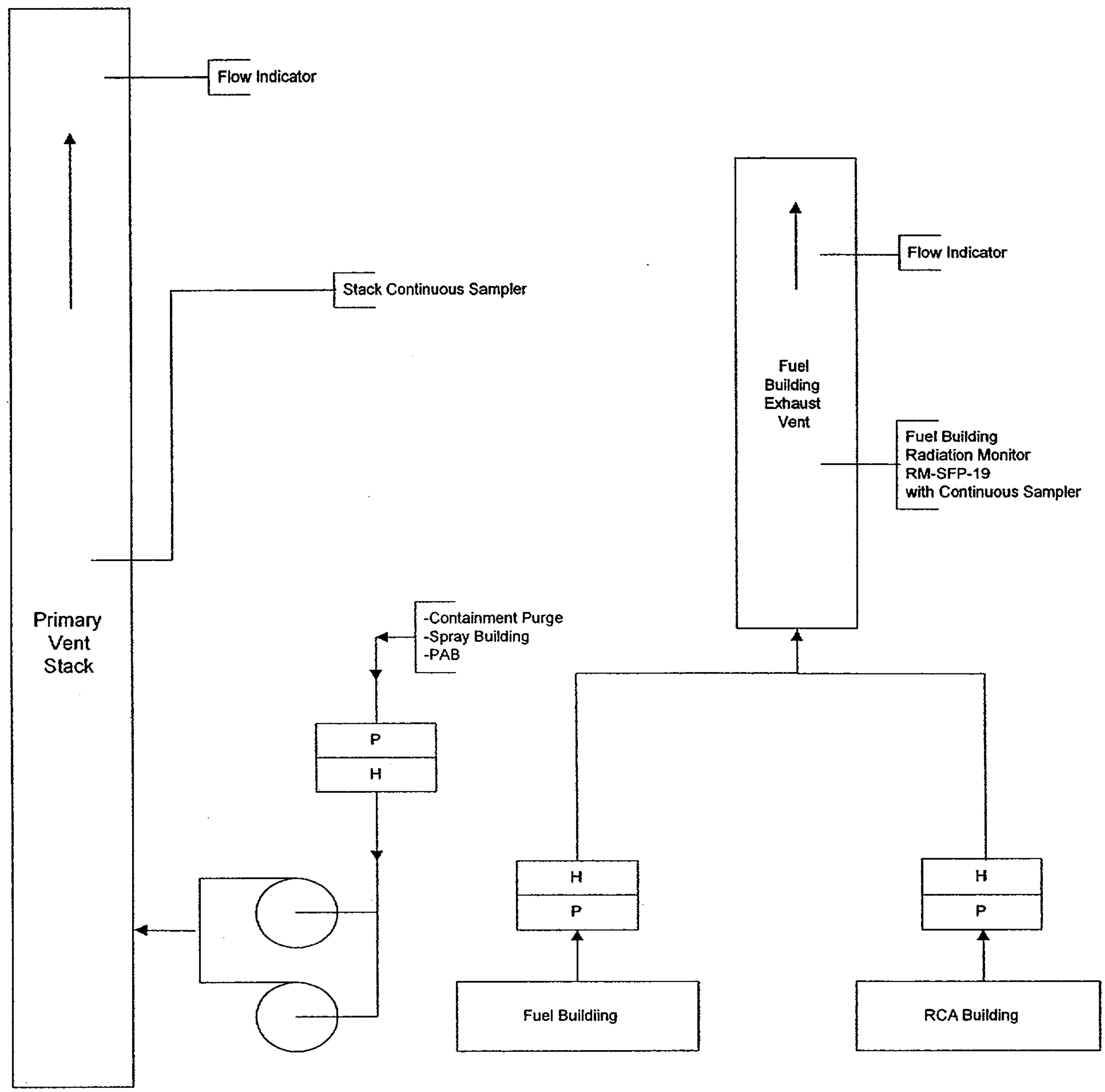
[

FIGURE 6.2

Maine Yankee Gaseous Radwaste System



P = Particulate Prefilter
H = HEPA filter

7.0 METEOROLOGY

The atmospheric dilution factors in the dose calculation methods assume an individual whose behavior leads to a dose higher than expected for anyone else. Since long term (5-year) average meteorology is expected to be representative of the area, the location of the critical receptor can be predicted by scanning all the reasonable off-site locations to find the location with the most limiting dilution factors. Important off-site locations are: site boundaries and nearest residences in each of the sixteen meteorological sectors, as well as all milk farm locations within five miles of the plant.

Exposure pathways assumed to exist at site boundary locations are direct exposure from radioactive materials in the air, direct exposure from radioactive materials deposited on the ground, and exposure from inhalation of radioactive materials. In addition to the pathways present at site boundary locations, exposure pathways present at each residence are assumed to include ingestion of radionuclides in home grown vegetables. Farm locations include all exposure pathways found at residences plus ingestion of radionuclides in meat and milk.

Meteorological data for the year 1986 through 1990 were analyzed for the values of the maximum average dilution factors at the important receptor locations described above. Yankee Atomic Electric Company's (YAEC) AEOLUS-2 computer code (Reference 5) calculated all atmospheric dilution factors. Appendix B briefly describes the YAEC AEOLUS-2 computer code model. Table 7.1 lists the maximum average dilution factors for ground level release points.

The current atmospheric dispersion factors (1986 through 1990) were compared with more recent estimates using meteorological data from 1993 through 1996, and 1998, and were found to be approximately the same; therefore, it was concluded that there has been no climatic changes that would require the update of the current atmospheric dispersion factors. In addition, the atmospheric dispersion factors for ground level releases are more restrictive than those for the plant's Primary Vent Stack. Therefore, doses resulting from releases associated with the Primary Vent Stack can be conservatively calculated using the ground level atmospheric dispersion factors.

With the permanent shutdown of the reactor, plant operations and systems that generated discrete batch releases of radioactive gases have been eliminated. On-going releases associated ventilation exhaust may be modeled as continuous in nature and, therefore, historical average value of atmospheric dispersion factors may be used in lieu of concurrent meteorology to determine doses.

Each dose and dose rate calculation method incorporates the maximum applicable off-site average dilution factors listed in Table 7.1. The maximum potential dose to a member of the public in any year will be conservatively estimated by the dose calculated for a full-time resident living on a hypothetical milk farm 670 to 700 meters from the plant in the southeast sector.

TABLE 7.1

Maximum Off-Site Long Term Average Atmospheric Dispersion Factors

Maximum Long-Term Dispersion Factor	Fuel Building Vent*
Undepleted X/Q (sec/m^3)	1.03E - 05 (670 m SE)
Depleted X/Q (sec/m^3)	9.51E - 06 (670 m SE)
D/Q (1/m^2)	3.20E - 08 (670 m SE)
Gamma X/Q (sec/m^3)	2.61E - 06 (670 m SE)

*Also used for releases from the Primary Vent Stack. Meteorological dispersion of effluents from the Primary Vent Stack (mixed mode release type) are conservatively bounded by dispersion factors associated with the Fuel Building Exhaust Vent (ground level release type).

APPENDIX A

Basis for the Dose Calculation Methods

A.1 Liquid Effluent Doses

Method I is used to demonstrate compliance with Section 2.1.4 which limits the dose commitment to a member of the public from radioactive materials in liquid effluents.

Liquid pathways contributing to individual doses at the Maine Yankee Nuclear Power Station are: ingestion of fish and shellfish, and direct exposure from shoreline deposits. The potable water pathway and the irrigated foods pathway are not considered since the receiving water is not suitable for either drinking or irrigation. Method I is derived from Equations A-3 and A-7 of Regulatory Guide 1.109 (Reference 2). Equation A-3 calculates radiation doses from aquatic foods. Equation A-7 from shoreline deposits.

The use of the methodology of Equations A-3 and A-7 for a 1 curie release of each radionuclide in liquid effluents yielded the dose impact to the critical organ. Table 3.1 lists the resulting site specific total body and critical organ dose conversion factors giving the number of millirem per curie released for each radionuclide. Since the dose factors of Table 3.1 represent a variety of critical organs, Method I conservatively calculates a critical organ dose consisting of the maximum critical organ for each radionuclide of any of the four age groups, and combines them into a composite individual independent of age.

Except for the site specific values noted below, the parameter values recommended in Regulatory Guide 1.109 (Reference 2) were used to derive the liquid dose factors for Method I. Table A-1 lists the usage factors for liquid pathways utilized in the dose analysis.

Liquid effluents discharge from the plant via a submerged multi-port diffuser which extends approximately 1000 feet into the tidal estuary and had a design circulating water flow of 420,000 gpm (935 ft^3/sec). For the aquatic foods pathway, the dilution for the mixing effect of the diffuser based on that design flow was set at a minimum of 10 to 1 in the Method I dose factors (Reference 6). That dilution applied to the edge of the initial mixing zone where the effluent had undergone prompt dilution only. Under current release conditions with no forced circulating water flow, tidal flushing of the plant's forebay increases the dilution factor to 50 to 1 (i.e., mixing ratio = 1/dilution factor, or 0.020) for near-field mixing effects of discharges from the diffuser to the river (Reference 10). For practical purposes, however, the Method I dose factors (Table 3.1) have not been revised to incorporate the lower mixing ratio, but remain conservatively based on the lower 10 to 1 dilution. For shoreline deposits, the nearest point where tidal flats could be occupied on a recurring basis is in Bailey Cove which borders the site on the south and west. The estimated average dilution for Bailey Cove with respect to the discharge is approximately 25 to 1 (Reference 6).

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Shoreline activities in the vicinity of the site include a commercial worm digging industry along the tidal flats of Montsweag Bay. In the area of the plant (Bailey Cove), a commercial worm digger could occupy the mud flats for as long as 325 hours per year. This occupancy time is applied to both adults and teenagers in the dose calculations.

For Method I, the period of time for which sediment is exposed to the contaminated water is fifteen years. This time period represents the approximate mid-point of plant operating lifetime, and thus allows for the calculation of a plant lifetime average concentration of radioactivity in sediment. No credit is taken for the decay of activity in transit from the discharge point to the sediment in Bailey Cove.

APPENDIX A

TABLE A-1

Usage Factors for Various Liquid Pathways at Maine Yankee

(From Reference 1, Table E-5*, except as noted.
Zero where no pathway exists.)

AGE	VEG. (KG/YR)	VEG. (KG/YR)	LEAFY MILK (LITER/YR)	MEAT (KG/YR)	FISH (KG/YR)	INVERT. (KG/YR)	POTABLE WATER (LITER/YR)	SHORELINE (HR/YR)
Adult	0.00	0.00	0.00	0.00	21.00	5.00	0.00	325.00**
Teen	0.00	0.00	0.00	0.00	16.00	3.80	0.00	67.00
Child	0.00	0.00	0.00	0.00	6.90	1.70	0.00	14.00
Infant	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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*Regulatory Guide 1.109.

**Regional shoreline use associated with mudflats - Maine Yankee Atomic Power Station Environmental Report.

A.2 Total Body Dose Rate from Noble Gases

Method I can be used to demonstrate compliance with Section 2.2.3.1.a, which limits total body dose rate from noble gases released to the atmosphere.

Method I applies the methods of Equation B-8 in Regulatory Guide 1.109 (Reference 2) as follows:

$$D_{tb} = S_F \, 3.17E{+}04 \, [X/Q]^{\gamma} \sum_i Q_i \, DFB_i \qquad \text{(A-1)}$$

where:

D_{tb}	is the annual total body dose, in mrem/yr;
S_F	is the attenuation factor that accounts for the dose reduction due to shielding provided by residential structures, but for all dose rate calculations is assumed to be equal to 1 (dimensionless);
3.17E+04	is the number of pCi per Ci divided by the number of seconds per year;
$[X/Q]^{\gamma}$	is the effective long term average gamma dilution factor, in sec/m^3;
Q_i	is the annual release rate of radionuclide i, in Ci/yr; and
DFB_i	is the total body gamma dose factor for radionuclide i, in mrem-m^3/pCi-yr.

For a release from the Fuel Building Exhaust Vent, the analysis of Maine Yankee five-year average meteorology presented in Section 7.0 yielded a maximum effective average gamma dilution factor, $[X/Q]^{\gamma}$, of 2.61E-06 sec/m^3. The maximum gamma dilution factor was identified for an off-site point located 670 meters southeast of the plant. This location is along the opposite shoreline of Back River from the plant in a sector where the site boundary is adjacent to the river. The maximum gamma dilution factor for the site boundary along the river's near shoreline has been determined to be a more restrictive value. However, the definition of site boundary in the Technical Specifications allows for the use of occupancy factors in assessing doses, and the expanded definition of unrestricted area in NUREG-0133 (Reference 7) also does not require dose evaluations over water. For those portions of the adjacent shoreline to the site boundary where mudflats are exposed during low tide, an occupancy factor for worm diggers (0.037) is applied to the average gamma dilution factor at those locations. As a result, the opposite shoreline atmospheric gamma dilution factor becomes limiting due to its assumed full time occupancy since physical constraints (areas over water) do not exist, and there is no control on occupancy available. It should be noted that controlling the maximum dose rate to 500 mrem per year at a location on the opposite shoreline from the plant still ensures that the dose rate on the exposed mudflats during low tide will not exceed a value which would give rise to two mrem in one hour [10 CFR 20] even assuming continuous occupancy during the hour.

Incorporating the above into Equation A-1 and converting from annual release Q (Ci/yr) to maximum instantaneous release rate $\dot{Q}$ (uCi-sec), and multiplying by the conversion constant 31.54 Ci-sec/uCi-yr yields the method to calculate total body dose rate from noble gases:

$$\dot{D}_{tb} = 2.61 \sum_i \dot{Q}_i \, DFB_i \qquad \text{(A-2)}$$

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[Since the only noble gas applicable to Maine Yankee due to the permanent plant shutdown is Kr-85, $DFB_{Kr\text{-}85}$ = 1.61E-05 mrem - m^3/pCi - yr, Table B-1, Ref. 5, the equation can be simplified to:

$$\dot{D}_{tb} = 4.20E\text{-}05 * \dot{Q}_{Kr\text{-}85} \quad (4\text{-}1A)$$

[Since the Primary Vent Stack is modeled as a mixed mode release point, and the Fuel Building Exhaust Vent as a ground level release, the Method I total body dose rate equation for the Fuel Building Exhaust Vent can be used as a conservative (bounding) estimate for any releases from the Primary Vent Stack.

A.3 Skin Dose Rate From Noble Gases

Method I is used to demonstrate compliance with Section 2.2.3.1.a, which limits skin dose rate from noble gases released to the atmosphere, for the peak noble gas release rate.

Method I applies the methods of Equation 11 in Regulatory Guide 1.109 (Reference 2) as follows:

$$\dot{D}_{skin} = 1.11\ S_F\ 3.17E{+}04\ [X/Q]^{\gamma} \sum_i Q_i\ DF_i^{\gamma} + 3.17E{+}04\ X/Q \sum_i Q_i\ DFS_i \quad (A\text{-}3)$$

where:

$\dot{D}_{skin}$	is the annual skin dose rate, in mrem/yr;
1.11	is the average ratio of tissue to air energy absorption coefficient;
S_F	is the attenuation factor that accounts for the dose reduction due to shielding provided by residential structures, but for all dose rate calculations is assumed to be equal to 1 (dimensionless);
3.17E+04	is the number of pCi per Ci divided by the number of seconds per year;
$[X/Q]^{\gamma}$	is the effective long term average gamma dilution factor in sec/m^3;
Q_i	is the annual release rate of radionuclide i, in Ci/yr;
DF_i^{γ}	is the gamma air dose factor for a uniform semi-infinite cloud of radionuclide i, in mrad-m^3/pCi-yr;
X/Q	is the long term average undepleted dilution factor in sec/m^3; and

DFS_i is the beta skin dose factor for a semi-infinite cloud of radionuclide i, which includes the attenuation by the outer "dead" layer of the skin, in mrem-m³/pCi-yr (taken from Reference 2, Table B-1).

[For a release from the Fuel Building Exhaust Vent, the maximum effective five year average gamma dilution factor $[X/Q]^{\gamma}$, is 2.61E-06 sec/m³ (see Table 7.1), and the maximum five year average undepleted dilution factor, X/Q, is 1.03E-05 sec/m³ (see Table 7.1). Incorporating these constants into Equation A-3 and converting from annual release Q (Ci/yr) to maximum instantaneous release rate $\dot{Q}$ (uCi/sec) and multiplying by the conversion factor 31.54 Ci-sec/uCi-yr yields:

$$\dot{D}_{skin} = 2.9 \sum_i \dot{Q}_i DF_i^{\gamma} + 10.3 \sum_i \dot{Q}_i DFS_i$$

[

$$= \sum_i \dot{Q}_i [2.9 DF_i^{\gamma} + 10.3 DFS_i]. \quad (A-4)$$

A combined skin dose factor, DF_i', may be defined:

[$$DF_i' = 2.9 DF_i^{\gamma} + 10.3 DFS_i.$$

Incorporating the combined skin dose factor, DF_i', into Equation A-4 yields the method to calculate skin dose rate from noble gases:

[$$\dot{D}_{skin} = \sum_i \dot{Q}_i DF_i'$$

Since the only noble gas applicable to Maine Yankee is Kr-85, the equation can be simplified with $DF_{KR\text{-}85}^{\gamma}$ equal to 1.72E-05 (mrad-m^3/pCi-yr) and $DFS_{Kr\text{-}85}$ equal to 1.34E-03 (mrad-m^3/pCi-hr) as taken from Regulator Guide 1.109, Table B-1 (Ref. 2). This reduces the equation for Fuel Building Exhaust Vent skin dose rate in mrem/yr from Kr-85 to:

$$\dot{D}_{skin} = \dot{Q}_{Kr-85}\ (2.9(1.72E-05) + 10.3\ (1.34E-03)) = 1.39E-02\ \dot{Q}_{Kr-85}$$

$$\dot{D}_{skin} = 1.39E-02 * \dot{Q}_{Kr-85} \qquad (4\text{ - }2a)$$

As noted above for the total body dose rate, the Primary Vent Stack is modeled as a mixed mode release point, and the Fuel Building Exhaust Vent as a ground level release. Therefore, Method I skin dose rate equation for the Fuel Building Exhaust Vent can also be used as a conservative estimate for any releases from the Primary Vent Stack since the maximum point dispersion estimates for the ground level release model will bound that of the part-time elevated (mixed mode) release case.

A.4 Critical Organ Dose Rate From Iodines and Particulates

Method I is used to demonstrate compliance with Section 2.2.5, which limits the dose rate from Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than 8 days.

The method to calculate the critical organ dose rate from radioactive iodines and particulates is derived from ODCM Equation 4-6 which limits the dose to the critical organ from radioactive iodines and particulates.

$$D_{co} = \sum_i Q_i\ DFG_{ico} \qquad (A\text{-}5)$$

where:

D_{co} is the dose to the critical organ from Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than 8 days, in mrem;

Q_i is the total activity of radionuclide i released via the plant Primary Vent Stack and the Fuel Building Exhaust Vent during the period of interest, in Ci; and

DFG_{ico} is the site specific critical organ dose factor for radionuclide i for a gaseous release, in mrem/Ci (see Table 4.4).

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Applying the conversion factor, 31.54 (Ci-sec/uCi-yr), to convert DFG_{ico} (mrem/Ci) to an organ dose rate factor DFG'_{ico} (mrem-sec/uCi-yr) for use for iodines and particles and changing the shielding factor (S_F) from 0.7 to 1.0 for exposure from a contaminated ground plane yields a new critical organ

[dose rate factor DFG'_{ico} (see Table 4.4), and a dose rate equation in the same form as Equation A-5 above, where the activity release rate $\dot{Q}_i$ is in uCi/sec.

$$\dot{D}_{co} = \sum_i Q_i \, DFG'_{ico} \quad \text{(A-6)}$$

[

A.5 Gamma Air Dose

Method I is used to demonstrate compliance with Section 2.2.4, which limits the gamma air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary.

Method I is derived from the methods of Equations B-4 and B-5 in Regulatory Guide 1.109 (Reference 2) which gives:

$$D^{\gamma}_{finite,\,air} = 3.17E{+}04\ [X/Q]^{\gamma}_{i} \sum_{i} Q_i\, DF^{\gamma}_{i} \qquad \text{(A-7)}$$

where:

$D^{\gamma}_{finite,air}$ is the gamma air dose, in mrad due to a finite cloud release;

3.17E+04 is the number of pCi per Ci divided by the number of seconds per year;

$[X/Q]^{\gamma}$ is the effective long-term average gamma dilution factor in sec/m^3 (see Appendix B for use of effective gamma atmospheric dilution factors);

Q_i is the total activity of noble gas i released during the period of interest, in Ci; and

DF_i^{γ} is the gamma dose factor to air for noble gas i, in mrad-m^3/pCi-yr (taken from Reference 2).

Incorporating the maximum effective long-term average gamma dilution factor of 2.61E-06 sec/m^3 (see Table 7.1) yields:

[$D^{\gamma}_{air} = 0.083\ \Sigma_i\ Q_i\ DF_i^{\gamma}$

DF^{γ} for Kr-85 = 1.72E-05 mrad-m^3/pCi-yr; therefore

[$D^{\gamma}_{air} = 0.083 * Q_{Kr-85} * 1.72E{-}05$

[The gamma air dose, D^{γ}_{air}, in mrad from Kr-85 released to areas at or beyond the site boundary is:

$$D^{\gamma}_{air} = 1.42E{-}06 * Q_{Kr-85} \qquad \text{(4-4a)}$$

Since the Primary Vent Stack is modeled as a mixed mode release point, and the Fuel Building Exhaust Vent as a ground level release, the Method I gamma air dose equation for the Fuel Building Exhaust Vent can also be used as a conservative estimate for any releases from the Primary Vent Stack since the maximum point dispersion estimates for the ground level release model will bound that of the part-time elevated (mixed mode) release case.

A.6 Beta Air Dose

Method I is used to demonstrate compliance with Section 2.2.4, which limits the beta air dose due to noble gases released in gaseous effluents to areas at and beyond the site boundary.

Method I is derived from the methods of Equations B-4 and B-5 in Regulatory Guide 1.109 (Reference 2) which gives:

$$D^{\beta}_{air} = 3.17E{+}04\ X/Q \sum_{i} Q_i\ DF^{\beta}_i \qquad \text{(A-8)}$$

where:

D^{β}_{air} is the beta air dose, in mrad;

3.17E+04 is the number of pCi per Ci divided by the number of seconds per year;

X/Q is the long-term (5-year) average undepleted dilution factor, in sec/m^3;

Q_i is the total activity of noble gas i released during the period of interest, in Ci; and

DF^{β}_i is the beta dose factor to air for noble gas i, in mrad-m^3/pCi-yr.

Incorporating the maximum long-term average undepleted dilution factor of 1.03E-05 sec/m^3 (see Table 7.1) yields:

[$$D^{\beta}_{air} = 0.33 \sum_{i} Q_i\ DF^{\beta}_i$$

[DF^{β} for Kr-85 = 1.95E-03 mrad-m^3/pCi - yr; therefore for a Kr-85 release, the Beta dose in mrad can be expressed as:

$$D^{\beta}_{air} = 6.37E - 04 * Q_{Kr-85} \qquad \text{(4-5a)}$$

Since the Primary Vent Stack is modeled as a mixed mode release point, and the Fuel Building Exhaust Vent as a ground level release, the Method I beta air dose equation for the Fuel Building Exhaust Vent can also be used as a conservative estimate for any releases from the Primary Vent Stack since the maximum point dispersion estimates for the ground level release model will bound that of the part-time elevated (mixed mode) release case.

APPENDIX A

A.7 Dose from Iodines and Particulates

Method I is used to demonstrate compliance with Section 2.2.5, which limits the dose commitment to a member of the public from Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than eight days in gaseous effluents released via the Primary Vent [Stack or the Fuel Building Exhaust Vent to areas at and beyond the site boundary. For site boundaries adjacent to Back River, the off-site atmospheric dispersion parameters were determined (see Table 7.1) for locations on the opposite shore where there is a potential for exposure pathway's to exist on a continuous basis. The maximum of all off-site atmospheric dispersion parameters in any direction was selected in the determination of potential doses from iodines and particulates.

The dose commitments to an individual from Iodine-131, Iodine-133, tritium, and radioactive materials in particulate form with half-lives greater than eight days released to the atmosphere via the plant stack are calculated using the methods of Equations C-2, C-4, and C-13 in Regulatory Guide 1.109 (Reference 2). Gaseous pathways assumed to contribute to individual doses at Maine Yankee are: external irradiation from radionuclides deposited on the ground surface, inhalation of radionuclides in air, and ingestion of atmospherically released radionuclides in food.

The use of the methodology of Equations C-2, C-4, and C-13 for a one curie release of each radionuclide in gaseous effluents yielded the dose impact to the critical organ. Table 4.4 lists the resulting site specific critical organ dose factors for plant stack and Fuel Building Exhaust Vent releases giving the number of millirem per curie released for each radionuclide. Since the dose factors of Table 4.4 represent a variety of critical organs, Method I conservatively calculates a critical organ dose consisting of a [combination of critical organs of different age groups.

Parameter values used to derive the critical organ dose factors for iodines and particulates are listed on Tables A-2 and A-3.

APPENDIX A

Milk and meat animals are assumed to be on pasture 50 percent of the time, consuming 100 percent of their feed from pasture during that period. This assumption is conservative since most dairy operations use supplemental feeding of animals when on pasture or actually restrict animals to full time silage feeding throughout the year.

APPENDIX A

TABLE A-2

Usage Factors for Various Gaseous Pathways at Maine Yankee
(From Reference 1, Table E-5*)

AGE GROUP	VEG. (KG/YR)	LEAFY VEG. (KG/YR)	MILK (1/YR)	MEAT (KG/YR)	INHALATION (M^3/YR)
Adult	520.00	64.00	310.00	110.00	8,000.00
Teen	630.00	42.00	400.00	65.00	8,000.00
Child	520.00	26.00	330.00	41.00	3,700.00
Infant	0.00	0.00	330.00	0.00	1,400.00

*Regulatory Guide 1.109.

APPENDIX A
TABLE A-3

Environmental Parameters for Gaseous Effluents at Maine Yankee
(Derived from Reference 1)*

		Vegetables		Cow Milk		Goat Milk		Meat	
	VARIABLE	Stored	Leafy	Pasture	Stored	Pasture	Stored	Pasture	Stored
YV	Agricultural Productivity (kg/m^2)	2.	2.	0.75	2.	0.75	2.	0.75	2.
P	Soil Surface Density (kg/m^2)	240.	240.	240.	240.	240.	240.	240.	240.
T	Transport Time to User (hrs)			48.	48.	48.	48.	480.	480.
TB	Soil Exposure Time(1) (hrs)	131400.	131400.	131400.	131400.	131400.	131400.	131400.	131400.
TF	Crop Exposure Time T to Plume (hrs)	1440.	1440.	720.	1440.	720.	1440.	720.	1440.
TH	Holdup After Harvest (hrs)	1440.	24.	0.	2160.	0.	2160.	0.	2160.
QF	Animals Daily Feed (kg/day)			50.	50.	6.	6.	50.	50.
FP	Fraction of Year on Pasture(2)			0.50		0.50		0.50	
FS	Fraction Pasture Feed When on Pasture(3)			1.		1.		1.	
FG	Fraction of Stored Veg. Grown in Garden	0.76							
FL	Fraction of Leafy Veg. Grown in Garden		1.0						
FI	Fraction Elemental Iodine = 0.5								
H	Absolute Humidity = 5.6(4) (gm/m^3)								

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* Regulatory Guide 1.09

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Notes:

(1) For Method II dose/dose rate analyses of identified radioactivity releases of less than one year, the soil exposure time for that release may be set at 8760 hours (1 year) for all pathways.

(2) For Method II dose/dose rate analyses performed for releases occurring during the first or fourth calendar quarters, the fraction of time animals are assumed to be on pasture is zero (non-growing season). For the second and third calendar quarters, the fraction of time on pasture (FP) will be set at 1.0. FP may also be adjusted for specific farm locations if this information is so identified and reported as part of the land use census.

(3) For Method II analyses, the fraction of pasture feed while on pasture may be set to less than 1.0 for specific farm locations if this information is so identified and reported as part of the land use census.

(4) For all Method II analyses, an absolute humidity value equal to 5.6 (gm/m^3) shall be used to reflect conditions in the Northeast (Reference: Health Physics Journal, Vol. 39 (August), 1980; Page 318-320, Pergammon Press).

APPENDIX B

Meteorology

Long term (annual and five-year) average dilution factors based on on-site meteorological data were computed for routine primary vent stack and fuel building exhaust vent, releases by the Yankee Atomic Electric Company's (YAEC) AEOLUS-2 (Reference 5) computer code. AEOLUS-2 is based, in part, on the straight-line airflow model as discussed in Regulatory Guide 1.111 (Reference 8). The following AEOLUS-2 features were used in the assessment of dilution factors for the Maine Yankee site:

- hourly meteorological data input (wind direction, wind speed, and vertical temperature difference)
- straight-line air flow model with Gaussian diffusion,
- part-time ground level and part-time elevated releases (split-H model),*
- multi-energy sector-averaged finite cloud dilution factors for gamma dose calculations,
- terrain height correction features,*
- plume rise (momentum),*
- depletion in transit,
- wind speed extrapolated as a function of release height.*
- dry deposition rates (based on Regulatory Guide 1.111).

The following sector-average dilution and deposition factors were produced:

- non-depleted dilution factors for evaluating ground level concentrations of noble gases, tritium, carbon 14 and non-elemental iodines,
- depleted dilution factor for estimating ground level concentrations of elemental radioiodines and other particulates,
- effective gamma dilution factors for evaluating gamma dose rates from a sector-averaged finite cloud (multiple-energy undepleted source), and
- deposition factors for computing dry deposition of elemental radioiodines and other particulates.

*Primary Vent Stack Only

APPENDIX B

Gamma dose rates are calculated throughout the ODCM using the finite cloud model presented in "Meteorology and Atomic Energy - 1968" (Reference 9, Section 7-5.2.5). That model is implemented through the definition of an effective gamma atmospheric dispersion factor, $[X/Q]^{\gamma}$ (Reference 5, Section 6), and the replacement of X/Q in infinite cloud dose equations by the $[X/Q]^{\gamma}$.

APPENDIX C

Routine Reports

1. Annual Radiological Environmental Operating Report

[The Annual Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted by May 15 of each year. The report shall include summaries, interpretations, and an analysis of trends of the results of the Radiological Environmental Monitoring Program for the reporting period, and an assessment of the environmental impact of plant operation, if any. The material provided shall be consistent with the objectives outlined in (1) the ODCM and (2) Sections IV.B.2, IV.B.3, and IV.C of Appendix I to 10 CFR Part 50. The reports shall also include the results of the land use censuses required by Section 2.4.4 of the ODCM.

The Annual Radiological Environmental Operating Reports shall include summarized and tabulated results of radiological environmental samples taken during the report period pursuant to the tables and figures in the ODCM. In the event that some results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The reports shall also include the following: a summary description of the radiological environmental monitoring program including a map of all sampling locations keyed to a table giving distances and directions from the reactor; and a discussion of all analyses in which the LLD required by Table 2.4 of the ODCM was not achievable.

2. Annual Radioactive Effluent Release Report

[The Annual Radioactive Effluent Release Report covering the activities of the unit during the
[previous year shall be submitted prior to May 1 of each year in accordance with 10CFR50.36a.

The report shall include a summary of the quantities of radioactive liquid and gaseous effluents released from the unit summarized on a quarterly basis. The report shall also include a summary of the solid waste released from the unit summarized on a semiannual basis. The material provided shall be (1) consistent with the objectives outlined in the ODCM and PCP and (2) in conformance with 10 CFR 50.36a and Section IV.B.1 of Appendix I to 10 CFR Part 50.

The Radioactive Effluent Release Reports shall include the following information for each class of solid waste (as defined by 10 CFR Part 61) shipped off-site during the report period:

a. Container volume.

b. Total curie quantity (specify whether determined by measurement or estimate).

c. Principal radionuclides (specify whether determined by measurement or estimate).

d. Source waste and processing employed (e.g., dewatered spent resin, compacted dry waste, evaporator bottoms).

e. Type of container (e.g., LSA, Type A, Type B, Large Quantity).

f. Solidification agent or absorbent (e.g., cement, asphalt, "Dow").

The Radioactive Effluent Release Reports shall include a list and description of unplanned releases from the site boundary of radioactive materials in gaseous and liquid effluents made during the reporting period.

The Radioactive Effluent Release Reports shall include a listing of new locations for dose calculations and/or environmental monitoring identified by the land use census pursuant to Section 2.4.4 of the ODCM.

The Radioactive Effluent Release Report shall include changes to the ODCM in the form of a complete, legible copy of the entire ODCM in accordance with Technical Specification 5.6.2.

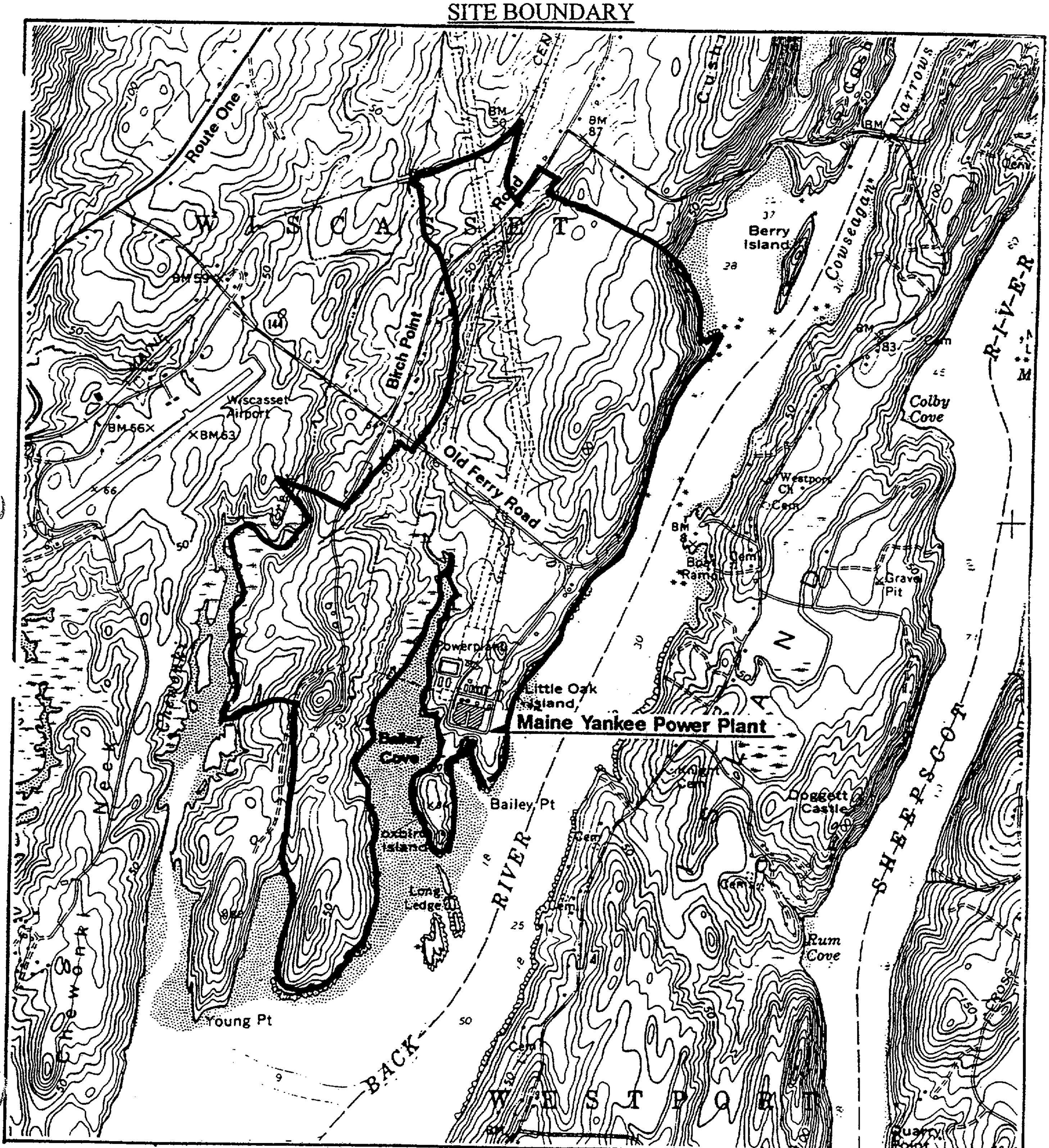
[3. Estimated Dose Report

A report of the estimated maximum potential dose to the members of the public from radioactive effluent releases for the previous calendar year shall be submitted within 120 days after January 1 of each year. The assessment of the radiation doses shall be performed in accordance with the Off-Site
[Dose Calculation Manual (ODCM). Site historical meteorological data used in calculating the
[annual public doses shall be included with the report.

[

APPENDIX D

SITE BOUNDARY



REFERENCES

1. Title 10, Code of Federal Regulations. The Office of the Federal Register, National Archives and Records Administration.

2. Regulatory Guide 1.109, "Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I", U.S. Nuclear Regulatory Commission, Revision 1, October 1977.

3. International Commission on Radiological Protection (ICRP) Publication 2. Oxford: Pergammon.

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5. Hamawi, J.N., "AEOLUS-2 - Technical Description", Entech Engineering, Inc., Document No. P100-R13-A, YAEC - Revised Software Release MOD 05, dated March 1992.

6. "Supplemental Information for the Purposes of Evaluation of 10 CFR 50, Appendix I", Maine Yankee Atomic Power Company, including Amendments 1 and 2, October 1976.

7. NUREG -0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants", U.S. Nuclear Regulatory Commission.

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

9. Slade, D. H., "Meteorology and Atomic Energy - 1968," USAEC, July 1968.

10. MYC-2044, "Proposed ODCM Change for No Service Water Flow Conditions, "Duke Engineering and Services, July 1998.

11. MYC-2035, "Effluent Dilution Factors," Duke Engineering and Services, May 1998.

12. ODCM Evaluation 99-01, "Liquid Radioactive Releases Under Zero Circulating/Service Water Flow Conditions," January 6, 1999.

[13. ODCM Change 99-04, dated November 8, 1999

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ESTIMATED DOSE REPORT FOR 2001

1.0 INTRODUCTION

This report summarizes the radiological dose commitments resulting from all radioactive liquid and gaseous effluent discharges during the 2001 calendar year. The off-site doses presented by calendar quarter in Table 1 were determined from primary effluent data sets, which have been summarized and reported to the NRC in the Annual Radioactive Effluent Release Report for 2001. Cumulative joint frequency distributions for wind speed, wind direction, and atmospheric stability for the 5-year period, January 1986 to December 1990, are provided in Tables A through H. Annual wind roses are also provided in Figures 1 and 2.

For the purposes of demonstrating compliance with 40CFR190, "Environmental Radiation Protection Standards for Nuclear Power Operations," radiation dose estimates must include direct radiation contributions from significant plant sources. Data from thermoluminescent dosimeters (TLDs) in the area of the western security fence indicated a plant-related direct radiation component at Bailey Cove (nearest off-site area to the plant) during 2001. Since members of the public use the mud flats in the cove during periods of low tide, an assessment was performed to determine compliance with the 40CFR190 dose limits. Table 2 lists the results from the combined impact of all plant sources to any member of the public in Bailey's Cove.

Dose commitments from the discharge of radioactive liquid and gaseous effluents were estimated in accordance with the "Maine Yankee Atomic Power Station Off-Site Dose Calculation Manual" (ODCM), and are reported herein as required by ODCM Appendix C.3 (Reference 1). These dose estimates were developed using a "Method II" analysis as described in the ODCM. The Method II analysis incorporates the methodology of Regulatory Guide 1.109 (Reference 2) and 5-year historical measured meteorological data. Table 3 lists important receptor locations as determined by the 2001 Annual Land Use Census.

All calculated liquid and gaseous pathway doses for this reporting period are well below the dose criteria of 10CFR50, Appendix I, and the dose limits for effluent releases stated in the Maine Yankee ODCM. In addition, the total dose to the most limiting member of the public due to the combined exposure to plant-related direct radiation and liquid and gaseous effluents was below the dose standards of 40CFR190.

2.0 METEOROLOGICAL DATA

With the permanent shutdown and decommissioning of Maine Yankee, the generation of gaseous fission and activation products and operation of the batch gas process system has ended. All gaseous effluent releases during the remaining parts of the decommissioning process are anticipated to be continuous and long-term in nature. Guidance provided in Section 3.3 of NUREG-0133 (Reference 6) recommends the use of historical annual average meteorological data for calculating doses under these conditions. Accordingly, the ODCM allows the use of historical annual average data in lieu of concurrent data.

Historical meteorological data collected from the site's 200-foot meteorological tower (located approximately 1800 feet northeast of the Primary Vent Stack) was used in determining offsite doses for gaseous effluent releases during 2001. The tower instrumentation was designed to meet the requirements of Regulatory Guide 1.23 (Reference 3) for meteorological monitoring. Cumulative joint frequency distributions for wind speed, direction, and stability class for the calendar years 1986 -1990 are provided in Tables A through H. Wind rose patterns for all stability classes during the report period are illustrated on Figures 1 and 2.

The first release point for gaseous discharges from the plant is the 176-foot Primary Vent Stack (PVS), located between the Containment Building and the Primary Auxiliary Building. The PVS is treated as a mixed mode release point (part of the time as a ground level source, part of the time as elevated) dependent upon wind speed as described in Regulatory Guide 1.111 (Reference 4) since its height is not at least twice that of nearby structures.

A secondary release point for gaseous discharges from the plant is from the Fuel Building Vent (FBV) exhaust. This vent is located on the roof of the Primary Auxiliary Building adjacent to the Fuel Building. It is treated as a ground level release since it is located below the roof of the adjacent Fuel Building and exits horizontally.

CHI/Q and D/Q atmospheric dispersion values were derived for all receptor points from the site meteorological record using a straight-line airflow model. In the dispersion calculations, lower level wind data collected from the site meteorological tower are used "as is" for the FBV and the ground level portion of PVS releases in keeping with the guidance provided in the NRC meteorological dispersion code "XOQDOQ", NUREG/CR-2919 (Reference 5). For the elevated portion of PVS releases, the lower level wind data are modified in accordance with NUREG/CR-2919 by a power law relationship that extrapolates wind speed from the height of the lower level measurements to the release height of the PVS.

3.0 DOSE ASSESSMENT

3.1 Doses from Liquid Effluents

ODCM Section 2.1.4 limits total body and organ doses from liquid effluents to members of the public in unrestricted areas to those values specified in 10CFR Part 50, Appendix I. The limit for total body dose is 1.5 mrem per calendar quarter, and 3 mrem per calendar year. The limit for organ doses is 5 mrem per calendar quarter and 10 mrem per calendar year. By implementing the requirements of 10CFR Part 50, Appendix I, ODCM Section 2.1.4 assures that the release of radioactive material in liquid effluents will be kept "as low as is reasonably achievable."

Potential exposure pathways associated with liquid effluent from Maine Yankee are ingestion of fish/shellfish and direct exposure from shoreline sedimentation. The drinking water and irrigation pathways do not exist due to the saltwater nature of the receiving water estuary.

The calculated doses from liquid effluent incorporate a mixing ratio (Mp) value equal to 0.02 for exposure due to ingestion of fish and shellfish, and an Mp value of 0.04 for shoreline exposures. Table 4 lists the usage factors by age group and pathway that were applied to liquid effluent.

The whole body and organ doses resulting from liquid effluent discharges are the summations of dose contributions via all active exposure pathways for each release during the reporting period. Table 1 presents the maximum whole body and organ doses from liquid effluent to a member of the public. The estimated quarterly and annual doses resulting from liquid effluent discharges are well below the 10CFR50, Appendix I dose criteria.

3.2 Doses from Noble Gases

ODCM Section 2.2.4 limits the gamma air dose and beta air dose from noble gases released in gaseous effluent from the site to areas at and beyond the site boundary to those values specified in 10CFR50, Appendix I. The limit for gamma air doses is 5 mrad per calendar quarter and 10 mrad per year. The limit for beta air doses is 10 mrad per calendar quarter and 20 mrad per year. By implementing the requirements of 10CFR50, Appendix I, ODCM Section 2.2.4 assures that the releases of radioactive noble gases in gaseous effluents will be kept "as low as is reasonably achievable."

Gamma and beta air doses due to noble gases in gaseous effluent are calculated for several locations when noble gases are recorded in effluent. Those locations are the point of approximate highest off-site ground level air concentration of radioactive material, site boundary (or closest point on opposite shoreline in directions which border the river), nearest resident, nearest vegetable garden, and nearest milk animal within five miles for each of the sixteen principle compass directions.

It is noted that due to the permanent shutdown of the plant (last power operations in December 1996) and decay of the noble gas inventory, no noble gas releases were recorded for 2001.

3.3 Doses From Iodine-131, Iodine-133, Tritium, and Radionuclides in Particulate Form With Half-Lives Greater Than 8 Days

Section 2.2.5 of the ODCM implements limits on organ doses established in 10CFR50 Appendix I, which assures that the releases of iodines, tritium and particulates in gaseous effluent will be kept "as low as is reasonably achievable." Organ doses to individuals located at or beyond the site boundary as a result of iodine-131, iodine-133, tritium and particulate-form radionuclides (with half-lives greater than 8 days) in gaseous effluent are limited to 7.5 mrem per quarter and 15 mrem per year doses. However, short-lived radionuclides such as Iodine-131 and Iodine-133 have decayed away since the permanent shutdown of the plant and no longer present any potential dose to the public.

Potential exposure pathways associated with gaseous effluent are (i) external irradiation from radioactivity deposited on the ground surface, (ii) inhalation, and (iii) ingestion of vegetables, meat, and milk. Dose estimates were determined for site boundary locations (including opposite shoreline for boundaries next to water) and for the locations of the nearest resident, vegetable garden, and milk animal in each of the sixteen principle compass directions. The locations of the nearest resident, vegetable garden, and milk animal in each sector were identified by the 2001 Annual Land Use Census as required by ODCM Section 2.4.4 (see Table 3). Additionally, doses were calculated at the point of approximate maximum ground level air concentration of radioactive materials in gaseous effluent. Doses were calculated for pathways that were determined by the field survey to actually exist. Conservatism in the dose estimates was maintained by assuming that the vegetable garden pathway was active at each milk animal location and that the meat ingestion was an active exposure pathway at each milk cow location. Meat and milk animals were assumed to receive their entire intake from pasture during the second and third quarters. This is a conservative assumption because most dairy operations utilize supplemental feeding when animals are on pasture, or actually restrict animals to full time silage feeding throughout the entire year. Usage factors for gaseous effluent are listed by age group and pathway in Table 5. Table 6 provides dose model parameter assumptions used in the dose assessment.

The organ doses were determined by summing the contributions from all exposure pathways at each location. Doses were calculated for the whole body, GI-tract, bone, liver, kidney, thyroid, lung, and skin for adults, teenagers, children, and infants. The estimated quarterly and annual organ doses due to iodines, tritium and particulates at the location of the maximally exposed individual are reported in Table 1. The estimated organ doses from iodines, tritium and particulates in gaseous effluents are well below the 10CFR50, Appendix I dose criteria.

3.4 Total Dose From Direct External Radiation, Plus Liquid and Gaseous Effluents

The annual (calendar year) total dose or dose commitment to any member of the public due to releases of radioactivity and direct radiation from fixed sources are limited to EPA's radiation protection standards for the uranium fuel cycle (40CFR190). The dose limits are set to less than or equal to 25 mrem per year to the total body or any organ, except the thyroid, which is limited to less than or equal to 75 mrem per year.

Direct external dose from fixed sources of radioactive materials collected within the protected area fence and from within plant structures was estimated from Maine Yankee's 2001 TLD data. The data from TLDs posted in the area from the western security fence to the edge of Bailey Cove indicate above-background radiation in 2001. The annual direct dose from plant-related fixed radiation sources to members of the public on the mud flats (the closest off-site area to the plant), as derived from TLD measurements, was estimated to be 1.9 mrem. That estimated dose incorporated an occupancy time of 325 hours per year for worm diggers, as stated in the Maine Yankee ODCM. The receptor location used in the dose assessment was the center of the nearest portion of mud flats exposed at low tide, approximately 150 meters from the Primary Vent Stack. It is noted that most of the mud flat region in Bailey Cove that is used by the public is situated further away from this selected reference point. As a result, actual exposures from direct radiation would be less than the value applied in the estimate of direct dose (1.9 mrem) to the worm diggers as they move across the flats.

The dose from liquid and gaseous effluents affecting Bailey Cove was added to the direct plant-related dose. Liquid and gaseous effluent doses were calculated as described above in determining compliance with as low as reasonably achievable dose objective of 10CFR50, Appendix I. Those doses were found to be only small fractions of the direct plant-related dose. In 2001, the total dose to a member of the public using the mud flats due to the combined exposure from direct plant-related radiation and discharges of liquid and gaseous effluent was 1.9 mrem (shown in Table 2). The annual total dose complies with the EPA's radiation protection standards in 40CFR190.

Table 2 lists the dose contribution from each component (direct, liquid and gas) to the total body, maximum organ, and thyroid for the limiting member of the public on the mud flats.

4.0 REFERENCES

1. "Off-Site Dose Calculation Manual," Maine Yankee Atomic Power Company, Change No. 17, Approved February 21, 2002.

2. Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance With 10CFR50, Appendix I," U.S. Nuclear Regulatory Commission, Office of Standards Development, Revision 1, October 1977.

3. Regulatory Guide 1.23, "On-Site Meteorological Programs (Safety Guide 23)," U.S. Nuclear Regulatory Commission, Office of Standards Development, February 1972.

4. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light - Water - Cooled Reactors," U.S. Nuclear Regulatory Commission, Office of Standards Development, Revision 1, October 1977.

5. XOQDOQ: "Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations," NUREG/CR-2919, prepared by Pacific Northwest Laboratory for the U.S. Nuclear Regulatory Commission, September 1982.

6. NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, October 1978.

TABLE 1

Maine Yankee Atomic Power Station
Maximum Off-Site Doses/Dose Commitments to Members of the Public from Liquid and Gaseous Effluents for 2001
(10CFR50, Appendix I)

	Dose (mrem)				
Source	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year[b]
Liquid Effluents					
Total Body Dose[a]	2.5E-4	3.8E-4	2.5E-4	5.4E-4	1.4E-3
Footnotes	(1)	(1)	(1)	(1)	
Organ Dose[a]	4.8E-4	7.2E-4	4.6E-4	8.5E-4	2.5E-3
Footnotes	(2)	(2)	(2)	(2)	
Airborne Effluents					
Organ Dose[a] (Tritium + Part.)	2.1E-4	5.1E-4	4.6E-4	3.0E-4	1.5E-3
Footnotes	(3)	(4)	(5)	(3)	
Noble Gases					
Beta Air[a] (mrad)	ND	ND	ND	ND	ND
Footnotes	(6)	(6)	(6)	(6)	
Gamma Air[a] (mrad)	ND	ND	ND	ND	ND
Footnotes	(6)	(6)	(6)	(6)	

(a) The numbered footnotes indicate the age group, organ, and location of the dose receptor, where appropriate.

(1) Adult
(2) Adult/GI-LLI
(3) Child/all organs/SE, 700 meters
(4) Child/lung/SE, 700 meters
(5) Child/liver/SE, 700 meters
(6) ND; no detected activity (noble gases)

(b) "Maximum" dose for the year is the sum of the maximum doses for each quarter. This results in a conservative yearly dose estimate, but still well within the limits of 10CFR 50, Appendix 1.

TABLE 2

Maine Yankee Atomic Power Station
Maximum Annual Dose Commitments from Direct External Radiation, Plus Liquid and Gaseous Effluents for 2001[a]
(40CFR190)

Pathway	Total Body (mrem)	Maximum Organ (mrem)	Thyroid (mrem)
Direct External	1.9E+0	1.9E+0	1.9E+0
Liquids	1.4E-3	2.5E-3	1.2E-3
Gases	5.3E-5	5.4E-5	5.3E-5
Annual Total[b]	1.9E+0	1.9E+0	1.9E+0

(a) The location of maximum individual doses from combined direct radiation plus dose contributions from liquid and gaseous effluent corresponds to exposed mud flats at low tide in Bailey's Cove, west of the plant site.

(b) For any member of the public, EPA radiation protection standards (40CFR190) established annual dose limits of 25 mrem to the total body and any organ (except the thyroid, which has a dose limit of 75 mrem).

TABLE 3

Receptor Locations for Maine Yankee

Sector	Nearest Receptor[a] (Meters)	Nearest Resident[b] (Meters)	Nearest Garden[b] (Meters)	Nearest Milk Animal[b] (Meters)
N	1220	1260	1450	--
NNE	2210	2230	2400	2650 (cows)
NE	1280	1270	1470	--
ENE	910	920	1250	--
E	730	900	900	--
ESE	670	700	2640	--
SE	670	700	900	--
SSE	820	900	900	--
S	1310	1700	1700	5530 (goats)
SSW	2990	3000	5000	--
SW	910	1500	4000	--
WSW	760	960	1940	1880 (cows)
W	670	810	2710	--
WNW	670	1900	1870	--
NW	760	1930	1930	--
NNW	1040	1060	1180	--

(a) The nearest receptor location is taken to be the site boundary for all sectors except the NNE through SSW sectors. The actual site boundary for each of these sectors is located next to Back River (water boundary). The receptor locations noted represent the closest dry land points beyond the site boundary where a 100% occupancy time is assumed. Other site boundaries bordered by water, and mud flats exposed at low tides, which may be worked by worm diggers, have occupancy factors applied equal to 325 hours/year (MY ODCM).

(b) The location(s) given are based on data from the Maine Yankee 2001 Land Use Census.

TABLE 4

Usage Factors for Various Liquid Pathways at Maine Yankee
(From Regulatory Guide 1.109, Table E-5, except as noted.
Zero where no pathway exists.)

Age	Veg. (kg/y)	Leafy Veg. (kg/y)	Milk (l/y)	Meat (kg/y)	Fish (kg/y)	Invert. (kg/y)	Potable Water (l/y)	Shoreline (hr/y)
Adult	0.00	0.00	0.00	0.00	21.00	5.00	0.00	325.00[a]
Teen	0.00	0.00	0.00	0.00	16.00	3.80	0.00	67.00
Child	0.00	0.00	0.00	0.00	6.90	1.70	0.00	14.00
Infant	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

(a) Regional shoreline use associated with mud flats - Maine Yankee Atomic Power Station Environmental Report, Supplement Number One, Volume 1, Section 5.2.2, Maine Yankee Atomic Power Company.

TABLE 5

Usage Factors for Various Gaseous Pathways at Maine Yankee

(From Regulatory Guide 1.109, Table E-5)

Age Group	Veg. (kg/y)	Leafy Veg. (kg/y)	Milk (l/y)	Meat (kg/y)	Inhalation (m^3/y)
Adult	520	64	310	110	8,000
Teen	630	42	400	65	8,000
Child	520	26	330	41	3,700
Infant	0	0	330	0	1,400

TABLE 6

Environmental Parameters for Gaseous Effluents at Maine Yankee

(Derived from Regulatory Guide 1.109)

		Vegetables		Cow Milk		Goat Milk		Meat	
	Variable	Stored	Leafy	Pasture	Stored	Pasture	Stored	Pasture	Stored
YV	Agricultural Productivity (kg/m^2)	2.	2.	0.75	2.	0.75	2.	0.75	2.
P	Soil Surface Density (kg/m^2)	240.	240.	240.	240.	240.	240.	240.	240.
T	Transport Time to User (hrs)			48.	48.	48.	48.	480.	480.
TB	Soil Exposure Time[a] (hrs)	131400.	131400.	131400.	131400.	131400.	131400.	131400.	131400.
TF	Crop Exposure Time to Plume (hrs)	1440.	1440.	720.	1440.	720.	1440.	720.	1440.
TH	Holdup After Harvest (hrs)	1440.	24.	0.	2160.	0.	2160.	0.	2160.
QF	Animals Daily Feed (kg/day)			50.	50.	6.	6.	50.	50.
FP	Fraction of Year on Pasture[b]			0.50		0.50		0.50	
FS	Fraction Pasture Feed When on Pasture[c]			1.		1.		1.	
FG	Fraction of Stored Vegetables Grown in Garden	0.76							
FL	Fraction of Leafy Vegetables Grown in Garden		1.0						
FI	Fraction Elemental Iodine = 0.5								
H	Absolute Humidity = 5.6[d]								

(a) For Method II dose/dose rate analyses of identified radioactivity releases of less than one year, the soil exposure time for that release may be set at 8,760 hours (one year) for all pathways.

(b) For Method II dose/dose rate analyses performed for releases occurring during the first or fourth calendar quarters, the fraction of time animals are assumed to be on pasture is zero (nongrowing season). For the second and third calendar quarters, the fraction of time on pasture (FP) will be set at 1.0. FP may also be adjusted for specific farm locations if this information is so identified and reported as part of the land use census.

(c) For Method II analyses, the fraction of pasture feed while on pasture may be set to less than 1.0 specific farm locations if this information is so identified and reported as part of the land use census.

(d) For all Method II analyses, an absolute humidity value equal to 5.6 (gm/m^3) shall be used to reflect conditions in the Northeast (Reference: Health Physics Journal, Volume 39 (August), 1980; Pages 318-320, Pergammon Press).

TABLE A

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

35.0 FT WIND DATA STABILITY CLASS A CLASS FREQUENCY (PERCENT) = 3.40

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	6	6	16	26	19	8	11	13	10	3	10	1	2	0	2	1	0	134
(1)	.44	.44	1.18	1.92	1.40	.59	.81	.96	.74	.22	.74	.07	.15	.00	.15	.07	.00	9.88
(2)	.02	.02	.04	.07	.05	.02	.03	.03	.03	.01	.03	.00	.01	.00	.01	.00	.00	.34
4-7	31	32	64	36	13	2	11	37	125	70	16	21	20	10	18	17	0	523
(1)	2.29	2.36	4.72	2.65	.96	.15	.81	2.73	9.22	5.16	1.18	1.55	1.47	.74	1.33	1.25	.00	38.57
(2)	.08	.08	.16	.09	.03	.01	.03	.09	.31	.18	.04	.05	.05	.03	.05	.04	.00	1.31
8-12	33	15	23	2	1	0	0	9	41	96	18	12	26	29	56	63	0	424
(1)	2.43	1.11	1.70	.15	.07	.00	.00	.66	3.02	7.08	1.33	.88	1.92	2.14	4.13	4.65	.00	31.27
(2)	.08	.04	.06	.01	.00	.00	.00	.02	.10	.24	.05	.03	.07	.07	.14	.16	.00	1.06
13-18	16	6	3	0	1	0	0	0	3	13	1	6	3	25	98	56	0	231
(1)	1.18	.44	.22	.00	.07	.00	.00	.00	.22	.96	.07	.44	.22	1.84	7.23	4.13	.00	17.04
(2)	.04	.02	.01	.00	.00	.00	.00	.00	.01	.03	.00	.02	.01	.06	.25	.14	.00	.58
19-24	4	0	0	0	0	0	0	0	0	0	0	0	0	2	28	9	0	43
(1)	.29	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.15	2.06	.66	.00	3.17
(2)	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.07	.02	.00	.11
GT 24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.07	.00	.00	.07
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ALL SPEEDS	90	59	106	64	34	10	22	59	179	182	45	40	51	66	203	146	0	1356
(1)	6.64	4.35	7.82	4.72	2.51	.74	1.62	4.35	13.20	13.42	3.32	2.95	3.76	4.87	14.97	10.77	.00	100.00
(2)	.23	.15	.27	.16	.09	.03	.06	.15	.45	.46	.11	.10	.13	.17	.51	.37	.00	3.40

(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 B

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

35.0 FT WIND DATA   STABILITY CLASS B   CLASS FREQUENCY (PERCENT) = 1.44

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	1	2	2	6	5	1	3	5	4	1	1	2	0	2	1	2	0	38
(1)	.17	.35	.35	1.05	.87	.17	.52	.87	.70	.17	.17	.35	.00	.35	.17	.35	.00	6.63
(2)	.00	.01	.01	.02	.01	.00	.01	.01	.01	.00	.00	.01	.00	.01	.00	.01	.00	.10
4-7	6	14	20	15	6	5	5	19	48	27	8	5	7	8	7	10	0	210
(1)	1.05	2.44	3.49	2.62	1.05	.87	.87	3.32	8.38	4.71	1.40	.87	1.22	1.40	1.22	1.75	.00	36.65
(2)	.02	.04	.05	.04	.02	.01	.01	.05	.12	.07	.02	.01	.02	.02	.02	.03	.00	.53
8-12	10	8	10	2	1	0	0	7	18	36	10	5	13	18	25	30	0	193
(1)	1.75	1.40	1.75	.35	.17	.00	.00	1.22	3.14	6.28	1.75	.87	2.27	3.14	4.36	5.24	.00	33.68
(2)	.03	.02	.03	.01	.00	.00	.00	.02	.05	.09	.03	.01	.03	.05	.06	.08	.00	.48
13-18	4	2	5	1	0	0	0	0	4	7	2	4	7	14	36	18	0	104
(1)	.70	.35	.87	.17	.00	.00	.00	.00	.70	1.22	.35	.70	1.22	2.44	6.28	3.14	.00	18.15
(2)	.01	.01	.01	.00	.00	.00	.00	.00	.01	.02	.01	.01	.02	.04	.09	.05	.00	.26
19-24	5	0	0	0	0	0	0	1	0	0	0	0	1	3	10	5	0	25
(1)	.87	.00	.00	.00	.00	.00	.00	.17	.00	.00	.00	.00	.17	.52	1.75	.87	.00	4.36
(2)	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.03	.01	.00	.06
GT 24	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	.52	.00	.52
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.01
ALL SPEEDS	26	26	37	24	12	6	8	32	74	71	21	16	28	45	79	68	0	573
(1)	4.54	4.54	6.46	4.19	2.09	1.05	1.40	5.58	12.91	12.39	3.66	2.79	4.89	7.85	13.79	11.87	.00	100.00
(2)	.07	.07	.09	.06	.03	.02	.02	.08	.19	.18	.05	.04	.07	.11	.20	.17	.00	1.44

(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 C

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

35.0 FT WIND DATA STABILITY CLASS C CLASS FREQUENCY (PERCENT) = 4.24

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	5	9	11	11	11	6	10	11	13	8	5	3	3	2	1	4	0	113
(1)	.30	.53	.65	.65	.65	.35	.59	.65	.77	.47	.30	.18	.18	.12	.06	.24	.00	6.67
(2)	.01	.02	.03	.03	.03	.02	.03	.03	.03	.02	.01	.01	.01	.01	.00	.01	.00	.28
4-7	34	42	54	29	12	8	21	41	128	72	28	20	22	18	27	45	0	601
(1)	2.01	2.48	3.19	1.71	.71	.47	1.24	2.42	7.56	4.25	1.65	1.18	1.30	1.06	1.59	2.66	.00	35.50
(2)	.09	.11	.14	.07	.03	.02	.05	.10	.32	.18	.07	.05	.06	.05	.07	.11	.00	1.51
8-12	47	41	26	6	4	3	4	16	47	85	28	15	28	61	91	75	0	577
(1)	2.78	2.42	1.54	.35	.24	.18	.24	.95	2.78	5.02	1.65	.89	1.65	3.60	5.38	4.43	.00	34.08
(2)	.12	.10	.07	.02	.01	.01	.01	.04	.12	.21	.07	.04	.07	.15	.23	.19	.00	1.45
13-18	25	10	3	0	0	0	0	2	5	12	1	5	16	43	119	56	0	297
(1)	1.48	.59	.18	.00	.00	.00	.00	.12	.30	.71	.06	.30	.95	2.54	7.03	3.31	.00	17.54
(2)	.06	.03	.01	.00	.00	.00	.00	.01	.01	.03	.00	.01	.04	.11	.30	.14	.00	.74
19-24	2	2	0	0	0	0	0	0	0	1	0	0	0	10	60	17	0	92
(1)	.12	.12	.00	.00	.00	.00	.00	.00	.00	.06	.00	.00	.00	.59	3.54	1.00	.00	5.43
(2)	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.03	.15	.04	.00	.23
GT 24	0	0	0	0	0	0	0	0	0	0	0	0	0	4	8	1	0	13
(1)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.24	.47	.06	.00	.77
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01	.02	.00	.00	.03
ALL SPEEDS	113	104	94	46	27	17	35	70	193	178	62	43	69	138	306	198	0	1693
(1)	6.67	6.14	5.55	2.72	1.59	1.00	2.07	4.13	11.40	10.51	3.66	2.54	4.08	8.15	18.07	11.70	.00	100.00
(2)	.28	.26	.24	.12	.07	.04	.09	.18	.48	.45	.16	.11	.17	.35	.77	.50	.00	4.24

(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 D

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

35.0 FT WIND DATA STABILITY CLASS D CLASS FREQUENCY (PERCENT) = 44.72

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	1	1	1	0	0	2	0	0	1	2	2	4	0	0	14
(1)	.00	.00	.00	.01	.01	.01	.00	.00	.01	.00	.00	.01	.01	.01	.02	.00	.00	.08
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.01	.00	.00	.00	.01	.01	.01	.00	.00	.04
C-3	119	97	148	179	218	200	211	266	219	108	113	97	105	92	102	109	0	2383
(1)	.67	.54	.83	1.00	1.22	1.12	1.18	1.49	1.23	.61	.63	.54	.59	.52	.57	.61	.00	13.35
(2)	.30	.24	.37	.45	.55	.50	.53	.67	.55	.27	.28	.24	.26	.23	.26	.27	.00	5.97
4-7	524	497	481	351	234	279	356	739	968	642	469	305	240	228	267	391	0	6971
(1)	2.94	2.79	2.70	1.97	1.31	1.56	2.00	4.14	5.42	3.60	2.63	1.71	1.34	1.28	1.50	2.19	.00	39.07
(2)	1.31	1.25	1.21	.88	.59	.70	.89	1.85	2.43	1.61	1.18	.76	.60	.57	.67	.98	.00	17.47
8-12	542	445	255	110	122	129	163	400	653	618	325	150	164	429	705	530	0	5740
(1)	3.04	2.49	1.43	.62	.68	.72	.91	2.24	3.66	3.46	1.82	.84	.92	2.40	3.95	2.97	.00	32.17
(2)	1.36	1.12	.64	.28	.31	.32	.41	1.00	1.64	1.55	.81	.38	.41	1.08	1.77	1.33	.00	14.38
13-18	179	87	33	19	36	33	25	106	244	104	57	23	33	245	726	318	0	2268
(1)	1.00	.49	.18	.11	.20	.18	.14	.59	1.37	.58	.32	.13	.18	1.37	4.07	1.78	.00	12.71
(2)	.45	.22	.08	.05	.09	.08	.06	.27	.61	.26	.14	.06	.08	.61	1.82	.80	.00	5.68
19-24	18	3	1	1	5	3	2	11	32	6	1	2	2	52	225	64	0	428
(1)	.10	.02	.01	.01	.03	.02	.01	.06	.18	.03	.01	.01	.01	.29	1.26	.36	.00	2.40
(2)	.05	.01	.00	.00	.01	.01	.01	.03	.08	.02	.00	.01	.01	.13	.56	.16	.00	1.07
GT 24	0	0	0	0	2	0	0	1	2	0	0	0	0	3	25	7	0	40
(1)	.00	.00	.00	.00	.01	.00	.00	.01	.01	.00	.00	.00	.00	.02	.14	.04	.00	.22
(2)	.00	.00	.00	.00	.01	.00	.00	.00	.01	.00	.00	.00	.00	.01	.06	.02	.00	.10
ALL SPEEDS	1382	1129	918	661	618	645	757	1523	2120	1478	965	578	546	1051	2054	1419	0	17844
(1)	7.74	6.33	5.14	3.70	3.46	3.61	4.24	8.54	11.88	8.28	5.41	3.24	3.06	5.89	11.51	7.95	.00	100.00
(2)	3.46	2.83	2.30	1.66	1.55	1.62	1.90	3.82	5.31	3.70	2.42	1.45	1.37	2.63	5.15	3.56	.00	44.72

(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 E

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

35.0 FT WIND DATA STABILITY CLASS E CLASS FREQUENCY (PERCENT) = 28.88

WIND DIRECTION FROM

SPEED MPH	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	7	8	1	2	4	3	4	2	2	2	3	5	7	3	5	7	0	65
(1)	.06	.07	.01	.02	.03	.03	.03	.02	.02	.02	.03	.04	.06	.03	.04	.06	.00	.56
(2)	.02	.02	.00	.01	.01	.01	.01	.01	.01	.01	.01	.01	.02	.01	.01	.02	.00	.16
C-3	246	215	204	146	162	153	331	497	402	295	258	273	230	234	264	311	0	4221
(1)	2.13	1.87	1.77	1.27	1.41	1.33	2.87	4.31	3.49	2.56	2.24	2.37	2.00	2.03	2.29	2.70	.00	36.62
(2)	.62	.54	.51	.37	.41	.38	.83	1.25	1.01	.74	.65	.68	.58	.59	.66	.78	.00	10.58
4-7	465	281	152	52	28	66	147	463	648	618	309	283	236	342	453	484	0	5027
(1)	4.03	2.44	1.32	.45	.24	.57	1.28	4.02	5.62	5.36	2.68	2.46	2.05	2.97	3.93	4.20	.00	43.61
(2)	1.17	.70	.38	.13	.07	.17	.37	1.16	1.62	1.55	.77	.71	.59	.86	1.14	1.21	.00	12.60
8-12	110	66	22	7	4	13	30	117	230	271	75	30	42	140	313	167	0	1637
(1)	.95	.57	.19	.06	.03	.11	.26	1.02	2.00	2.35	.65	.26	.36	1.21	2.72	1.45	.00	14.20
(2)	.28	.17	.06	.02	.01	.03	.08	.29	.58	.68	.19	.08	.11	.35	.78	.42	.00	4.10
13-18	26	15	0	0	5	14	19	54	96	41	7	1	6	39	92	19	0	434
(1)	.23	.13	.00	.00	.04	.12	.16	.47	.83	.36	.06	.01	.05	.34	.80	.16	.00	3.77
(2)	.07	.04	.00	.00	.01	.04	.05	.14	.24	.10	.02	.00	.02	.10	.23	.05	.00	1.09
19-24	2	1	0	0	1	6	15	24	28	4	0	0	1	6	26	0	0	114
(1)	.02	.01	.00	.00	.01	.05	.13	.21	.24	.03	.00	.00	.01	.05	.23	.00	.00	.99
(2)	.01	.00	.00	.00	.00	.02	.04	.06	.07	.01	.00	.00	.00	.02	.07	.00	.00	.29
GT 24	0	0	0	0	0	0	7	14	6	0	0	0	0	0	1	0	0	28
(1)	.00	.00	.00	.00	.00	.00	.06	.12	.05	.00	.00	.00	.00	.00	.01	.00	.00	.24
(2)	.00	.00	.00	.00	.00	.00	.02	.04	.02	.00	.00	.00	.00	.00	.00	.00	.00	.07
ALL SPEEDS	856	586	379	207	204	255	553	1171	1412	1231	652	592	522	764	1154	988	0	11526
(1)	7.43	5.08	3.29	1.80	1.77	2.21	4.80	10.16	12.25	10.68	5.66	5.14	4.53	6.63	10.01	8.57	.00	100.00
(2)	2.15	1.47	.95	.52	.51	.64	1.39	2.93	3.54	3.08	1.63	1.48	1.31	1.91	2.89	2.48	.00	28.88

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

TABLE F

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

35.0 FT WIND DATA STABILITY CLASS F CLASS FREQUENCY (PERCENT) = 9.10

WIND DIRECTION FROM

SPEED MPH	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	6	8	9	5	5	3	1	6	3	6	6	7	11	13	8	7	0	104
(1)	.17	.22	.25	.14	.14	.08	.03	.17	.08	.17	.17	.19	.30	.36	.22	.19	.00	2.86
(2)	.02	.02	.02	.01	.01	.01	.00	.02	.01	.02	.02	.02	.03	.03	.02	.02	.00	.26
C-3	188	151	158	135	89	78	127	184	166	161	113	127	182	194	305	289	0	2647
(1)	5.18	4.16	4.35	3.72	2.45	2.15	3.50	5.07	4.57	4.43	3.11	3.50	5.01	5.34	8.40	7.96	.00	72.90
(2)	.47	.38	.40	.34	.22	.20	.32	.46	.42	.40	.28	.32	.46	.49	.76	.72	.00	6.63
4-7	111	45	20	4	0	1	5	22	53	43	22	50	49	72	134	197	0	828
(1)	3.06	1.24	.55	.11	.00	.03	.14	.61	1.46	1.18	.61	1.38	1.35	1.98	3.69	5.43	.00	22.80
(2)	.28	.11	.05	.01	.00	.00	.01	.06	.13	.11	.06	.13	.12	.18	.34	.49	.00	2.07
8-12	3	0	1	0	0	1	1	8	3	4	3	2	3	4	15	3	0	51
(1)	.08	.00	.03	.00	.00	.03	.03	.22	.08	.11	.08	.06	.08	.11	.41	.08	.00	1.40
(2)	.01	.00	.00	.00	.00	.00	.00	.02	.01	.01	.01	.01	.01	.01	.04	.01	.00	.13
13-18	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
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	.03	.00	.00	.00	.03
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
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	308	204	188	144	94	83	134	220	225	214	144	186	245	284	462	496	0	3631
(1)	8.48	5.62	5.18	3.97	2.59	2.29	3.69	6.06	6.20	5.89	3.97	5.12	6.75	7.82	12.72	13.66	.00	100.00
(2)	.77	.51	.47	.36	.24	.21	.34	.55	.56	.54	.36	.47	.61	.71	1.16	1.24	.00	9.10

(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 G

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

35.0 FT WIND DATA STABILITY CLASS G CLASS FREQUENCY (PERCENT) = 8.22

WIND DIRECTION FROM

SPEED MPH	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	17	13	15	12	7	3	6	2	5	8	5	7	11	11	12	9	0	143
(1)	.52	.40	.46	.37	.21	.09	.18	.06	.15	.24	.15	.21	.34	.34	.37	.27	.00	4.36
(2)	.04	.03	.04	.03	.02	.01	.02	.01	.01	.02	.01	.02	.03	.03	.03	.02	.00	.36
C-3	295	257	245	151	65	37	39	45	62	54	60	69	104	158	467	543	0	2651
(1)	8.99	7.83	7.46	4.60	1.98	1.13	1.19	1.37	1.89	1.65	1.83	2.10	3.17	4.81	14.23	16.54	.00	80.77
(2)	.74	.64	.61	.38	.16	.09	.10	.11	.16	.14	.15	.17	.26	.40	1.17	1.36	.00	6.64
4-7	26	13	21	7	2	2	0	2	6	8	5	7	14	30	167	175	0	485
(1)	.79	.40	.64	.21	.06	.06	.00	.06	.18	.24	.15	.21	.43	.91	5.09	5.33	.00	14.78
(2)	.07	.03	.05	.02	.01	.01	.00	.01	.02	.02	.01	.02	.04	.08	.42	.44	.00	1.22
8-12	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	3
(1)	.03	.00	.00	.00	.00	.00	.03	.00	.00	.00	.00	.00	.00	.00	.03	.00	.00	.09
(2)	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.01
13-18	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
19-24	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
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	339	283	281	170	74	42	46	49	73	70	70	83	129	199	647	727	0	3282
(1)	10.33	8.62	8.56	5.18	2.25	1.28	1.40	1.49	2.22	2.13	2.13	2.53	3.93	6.06	19.71	22.15	.00	100.00
(2)	.85	.71	.70	.43	.19	.11	.12	.12	.18	.18	.18	.21	.32	.50	1.62	1.82	.00	8.22

(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 H

MAINE YANKEE JAN86-DEC90 METEOROLOGICAL DATA JOINT FREQUENCY DISTRIBUTION

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

WIND DIRECTION FROM

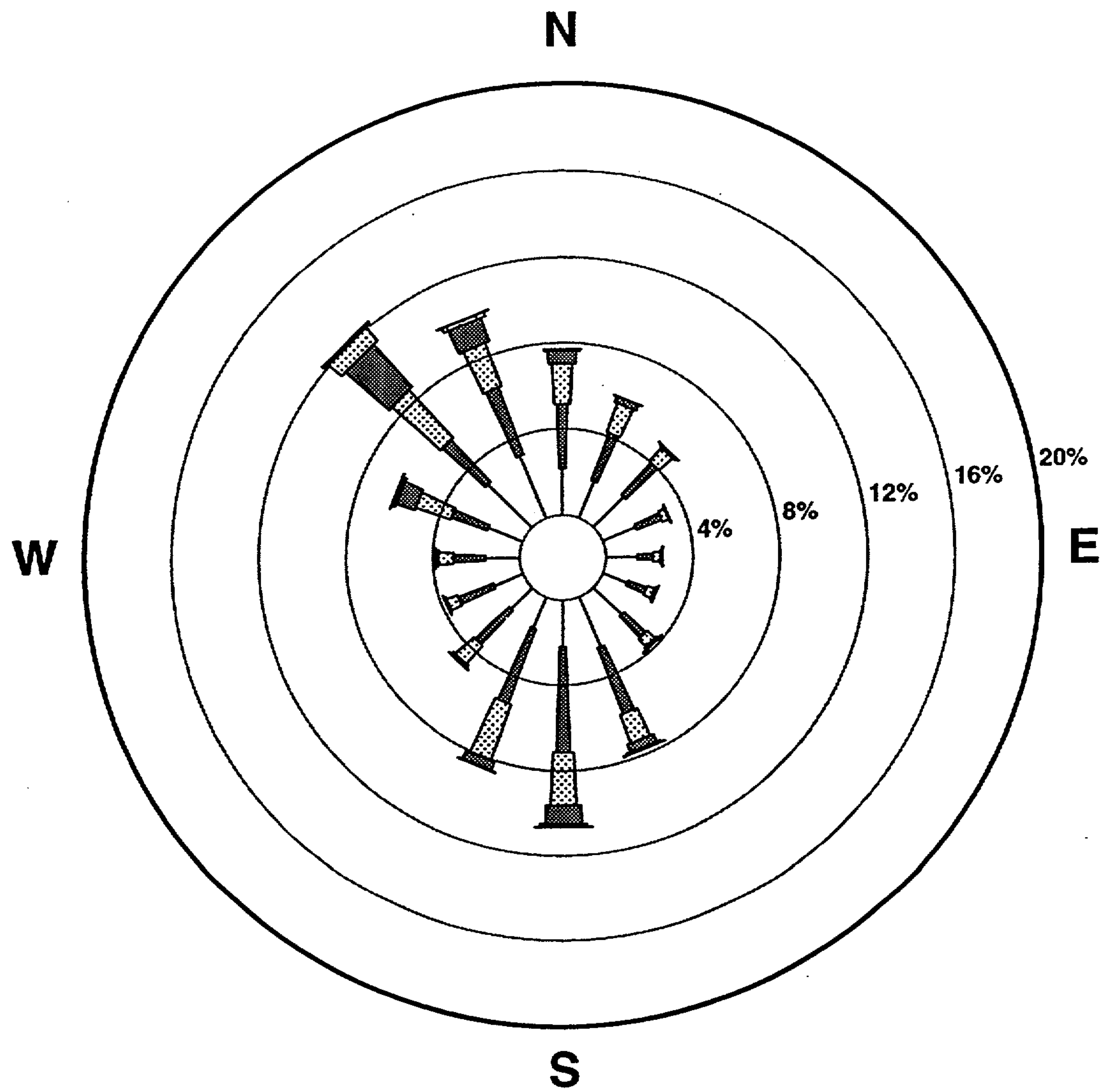
SPEED MPH	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	VRBL	TOTAL
CALM	30	29	25	20	17	10	11	10	12	16	14	20	31	29	29	23	0	326
(1)	.08	.07	.06	.05	.04	.03	.03	.03	.03	.04	.04	.05	.08	.07	.07	.06	.00	.82
(2)	.08	.07	.06	.05	.04	.03	.03	.03	.03	.04	.04	.05	.08	.07	.07	.06	.00	.82
C-3	860	737	784	654	569	483	732	1021	876	630	560	572	626	682	1142	1259	0	12187
(1)	2.16	1.85	1.96	1.64	1.43	1.21	1.83	2.56	2.20	1.58	1.40	1.43	1.57	1.71	2.86	3.15	.00	30.54
(2)	2.16	1.85	1.96	1.64	1.43	1.21	1.83	2.56	2.20	1.58	1.40	1.43	1.57	1.71	2.86	3.15	.00	30.54
4-7	1197	924	812	494	295	363	545	1323	1976	1480	857	691	588	708	1073	1319	0	14645
(1)	3.00	2.32	2.03	1.24	.74	.91	1.37	3.32	4.95	3.71	2.15	1.73	1.47	1.77	2.69	3.31	.00	36.70
(2)	3.00	2.32	2.03	1.24	.74	.91	1.37	3.32	4.95	3.71	2.15	1.73	1.47	1.77	2.69	3.31	.00	36.70
8-12	746	575	337	127	132	146	199	557	992	1110	459	214	276	681	1206	868	0	8625
(1)	1.87	1.44	.84	.32	.33	.37	.50	1.40	2.49	2.78	1.15	.54	.69	1.71	3.02	2.18	.00	21.61
(2)	1.87	1.44	.84	.32	.33	.37	.50	1.40	2.49	2.78	1.15	.54	.69	1.71	3.02	2.18	.00	21.61
13-18	250	120	44	20	42	47	44	162	352	177	68	39	65	366	1071	467	0	3334
(1)	.63	.30	.11	.05	.11	.12	.11	.41	.88	.44	.17	.10	.16	.92	2.68	1.17	.00	8.35
(2)	.63	.30	.11	.05	.11	.12	.11	.41	.88	.44	.17	.10	.16	.92	2.68	1.17	.00	8.35
19-24	31	6	1	1	6	9	17	36	60	11	1	2	4	74	349	95	0	703
(1)	.08	.02	.00	.00	.02	.02	.04	.09	.15	.03	.00	.01	.01	.19	.87	.24	.00	1.76
(2)	.08	.02	.00	.00	.02	.02	.04	.09	.15	.03	.00	.01	.01	.19	.87	.24	.00	1.76
GT 24	0	0	0	0	2	0	7	15	8	0	0	0	0	7	35	11	0	85
(1)	.00	.00	.00	.00	.01	.00	.02	.04	.02	.00	.00	.00	.00	.02	.09	.03	.00	.21
(2)	.00	.00	.00	.00	.01	.00	.02	.04	.02	.00	.00	.00	.00	.02	.09	.03	.00	.21
ALL SPEEDS	3114	2391	2003	1316	1063	1058	1555	3124	4276	3424	1959	1538	1590	2547	4905	4042	0	39905
(1)	7.80	5.99	5.02	3.30	2.66	2.65	3.90	7.83	10.72	8.58	4.91	3.85	3.98	6.38	12.29	10.13	.00	100.00
(2)	7.80	5.99	5.02	3.30	2.66	2.65	3.90	7.83	10.72	8.58	4.91	3.85	3.98	6.38	12.29	10.13	.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)

FIGURE 1

MAINE YANKEE JAN 1986-DEC 1990

35-FOOT WIND DATA



STABILITY CLASS ALL
CALM WINDS 0.82%

NOTE: Frequencies indicate direction from which the wind is blowing.

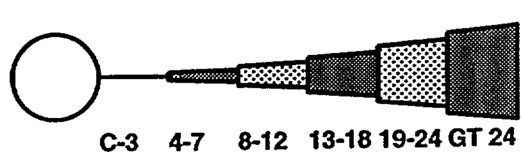
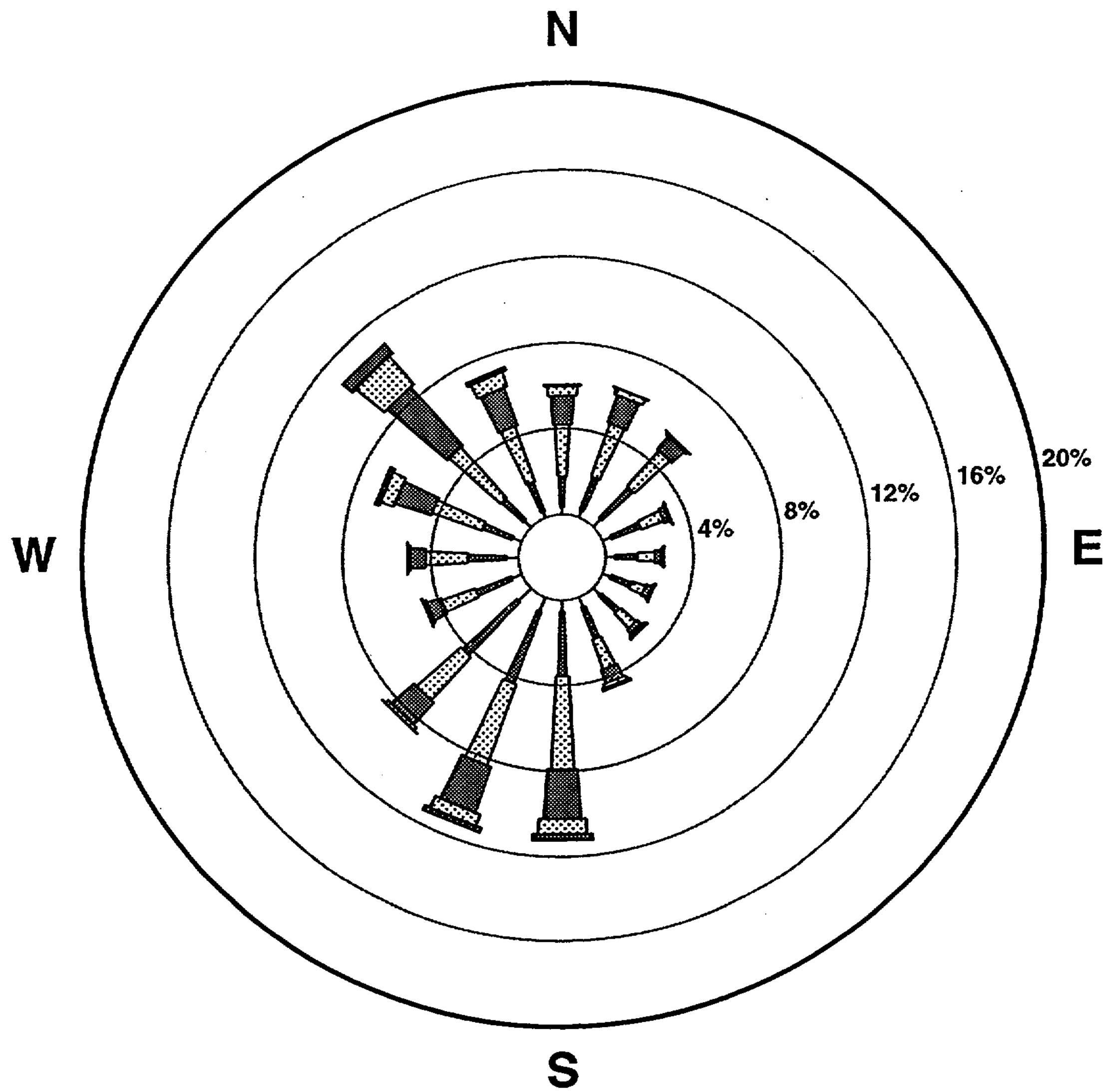


FIGURE 2

MAINE YANKEE JAN 1986-DEC 1990

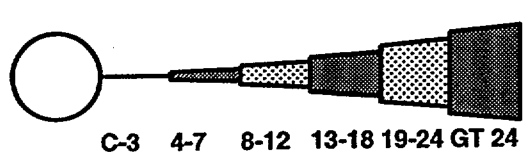
197-FOOT WIND DATA



STABILITY CLASS ALL
CALM WINDS 0.13%

WIND SPEED (MPH)

NOTE: Frequencies indicate direction from which the wind is blowing.



Maine Yankee

RELIABLE ELECTRICITY FOR MAINE SINCE 1972

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

2001

Maine Yankee Atomic Power Station
Maine Yankee Atomic Power Company
Wiscasset, Maine

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MAINE YANKEE NUCLEAR POWER STATION

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

January - December 2001

April 2002

Prepared by:
Duke Engineering and Services
Environmental Health and Safety
400 Donald Lynch Boulevard
Marlborough, Massachusetts 01752

EXECUTIVE SUMMARY

During 2001, as in all previous years of plant operation, a program was conducted to assess the levels of radiation or radioactivity in the Maine Yankee environment. More than 400 samples were collected (including TLDs) over the course of the year, with more than 1200 radionuclide or exposure rate analyses being performed on them. The samples collected as part of this program include air particulate, ground water, estuary water, sediment, marine algae, fish, mussels, clams, crabs, lobsters, mixed vegetation and milk. In addition to these samples, the air surrounding the plant was sampled continuously and the radiation levels were measured continuously with environmental TLDs.

Low levels of radioactivity from naturally occurring, fallout and plant emission sources were detected. Most samples had measurable concentrations of K-40, Be-7, Th-232 or Radon daughter products. These are the most common of the naturally occurring radionuclides. Some milk and sediment samples contained fallout radioactivity from atmospheric nuclear weapons tests conducted primarily from the late 1950's through 1980. A few samples had low levels of radioactivity resulting from emissions from Maine Yankee. These were all collected in the immediate vicinity of the plant or from on-site locations. In all cases, the possible radiological impact was negligible with respect to exposure from natural background radiation. In no case did the detected levels approach or exceed the most restrictive federal regulatory or plant license limits for radionuclides in the environment. Consequently, there was judged to be no environmental or health impact.

Maine Yankee shutdown in December of 1996. In August 1997 the decision was made to permanently cease power operation. The plant has since been in the process of decommissioning which involves the disassembly and removal of the plant components and demolition of structures. This process is taking place in strict conformance with USNRC regulations. Oversight will also continue from the State of Maine.

During 2001, there were no changes made to the radiological environmental monitoring program.

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(continued)

1.0 INTRODUCTION

This report summarizes the findings of the Radiological Environmental Monitoring Program (REMP) conducted by Maine Yankee Atomic Power Company in the vicinity of the Maine Yankee Nuclear Power Station in Wiscasset, Maine during the calendar year 2001. It is submitted annually in compliance with Appendix C, item 1 of the Offsite Dose Calculation Manual (ODCM) and Technical Specification 5.7.2. The remainder of this report is organized as follows:

Section 2: Provides an introduction to the background radioactivity and radiation that is detected in the Maine Yankee environs.

Section 3: Provides a brief description of the Maine Yankee site and its environs.

Section 4: Provides a description of the overall REMP design. Included is a summary of the ODCM requirements for REMP sampling, tables listing routine sampling and TLD monitoring locations with compass sectors and distances from the plant, and maps showing the location of each of the sampling and TLD monitoring locations. Tables listing Lower Limit of Detection requirements and Reporting Levels are also included.

Section 5: Consists of the summarized data as required by the ODCM, in the format specified by the NRC Branch Technical Position on Environmental Monitoring (Reference 1). Also included are complete environmental TLD data. Included in this data are the exposure-rate monitoring results for the proposed Independent Spent Fuel Storage Installation (ISFSI).

Section 6: Provides the results of the 2001 monitoring program. The performance of the program in meeting ODCM requirements is discussed, and the data acquired during the year is analyzed.

Section 7: Provides an overview of the Quality Assurance programs used at the Duke Engineering and Services Environmental Laboratory. The results of the Laboratory participation in an Interlaboratory Comparison Program required by ODCM section 2.4 are also given.

Section 8: Summarizes the requirements and the results of the 2001 Land Use Census.

Section 9: References

2.0 NATURALLY OCCURRING AND MAN-MADE BACKGROUND RADIOACTIVITY

Radiation or radioactivity potentially detected in the Maine Yankee environment can be grouped into three categories. The first is "naturally-occurring" radiation and radioactivity. The second is "man-made" radioactivity from sources other than the Maine Yankee plant. The third potential source of radioactivity is due to emissions from the Maine Yankee plant. For the purposes of the Maine Yankee REMP, the first two categories are classified as "background" radiation, and are the subject of discussion in this section of the report. The third category is the one that the REMP is designed to detect and evaluate.

2.1 Naturally Occurring Background Radioactivity

Natural radiation and radioactivity in the environment, which provide the major source of human radiation exposure, may be subdivided into three separate categories: "primordial radioactivity," "cosmogenic radioactivity" and "cosmic radiation." "Primordial radioactivity" is made up of those radionuclides that were created with the universe and that have a sufficiently long half-life to be still present on the earth. Included in this category are the radionuclides that these elements have decayed into. A few of the more important radionuclides in this category are Uranium-238 (U-238), Thorium-232 (Th-232), Rubidium-87 (Rb-87), Potassium-40 (K-40), Radium-226 (Ra-226), and Radon-222 (Rn-222). Uranium-238 and Thorium-232 are readily detected in soil and rock, whether through direct field measurements or through laboratory analysis of samples. Radium-226 in the earth can find its way from the soil into ground water, and is often detectable there. Radon-222 is one of the components of natural background in air, and its daughter products are detectable on air sampling filters. Potassium-40 comprises about 0.01 percent of all natural potassium in the earth, and is consequently detectable in most biological substances, including the human body. There are many more primordial radionuclides found in the environment in addition to the major ones discussed above (Reference 2).

The second category of naturally-occurring radiation and radioactivity is "cosmogenic radioactivity." This is produced through the nuclear interaction of high-energy cosmic radiation with elements in the earth's atmosphere, and to a much lesser degree in the earth's crust. These radioactive elements are then incorporated into the entire geosphere and atmosphere, including the earth's soil, surface rock, biosphere, sediments, ocean floors, polar ice and atmosphere. The major radionuclides in this category are Carbon-14 (C-14), Hydrogen-3 (H-3 or Tritium), Sodium-22 (Na-22), and Beryllium-7 (Be-7). Beryllium-7 is the one most readily detected, and is found on air sampling filters and occasionally in biological media (Reference 2).

The third category of naturally occurring radiation and radioactivity is "cosmic radiation." This consists of high-energy atomic or sub-atomic particles of extra-terrestrial origin and the secondary particles and radiation that are produced through their interaction in the earth's atmosphere. The primary radiation comes mostly from outside of our solar system, and to a lesser degree from the sun. We are protected from most of this radiation by the earth's atmosphere, which absorbs the radiation. Consequently, one can see that with increasing elevation one would be exposed to more cosmic radiation as a direct result of a thinner layer of air for protection. This "direct radiation" is detected in the field with gamma spectroscopy equipment, high-pressure ion chambers and thermoluminescent dosimeters (TLDs).

2.2 Man-Made Background Radioactivity

The second source of "background" radioactivity in the Maine Yankee environment is from "man-made" sources not related to the power plant. The most recent contributor to this category was the fallout from the Chernobyl accident in April of 1986, which was detected in the Maine Yankee environment and other parts of the world. A much greater contributor to this category, however, has been fallout from atmospheric nuclear weapons tests. Tests were conducted from 1945 through 1980 by the United States, the Soviet Union, the United Kingdom, China and France, with the large majority of testing occurring during the periods 1954-1958 and 1961-1962. (A test ban treaty was signed in 1963 by the United States, Soviet Union and United Kingdom, but not by France and China.) Atmospheric testing was conducted by the People's Republic of China as recently as October 1980. Much of the fallout detected today is due to this explosion and the last large scale one, done in November of 1976 (Reference 3).

The radioactivity produced by these detonations was deposited worldwide. The amount of fallout deposited in any given area is dependent on many factors, such as the explosive yield of the device, the latitude and altitude of the detonation, the season in which it occurred, and the timing of subsequent rainfall which washes fallout from the troposphere (Reference 4). Most of this fallout has decayed into stable elements, but the residual radioactivity is still detectable at low levels in environmental samples worldwide. The two predominant radionuclides are Cesium-137 (Cs-137) and Strontium-90 (Sr-90). They are found in soil and in vegetation, and since cows and goats graze large areas of vegetation, these radionuclides can also be detected in the milk.

Other potential "man-made" sources of environmental "background" radioactivity include other nuclear power plants, coal-fired power plants, national defense installations, hospitals, research laboratories and industry. These collectively are insignificant on a global scale when compared to the sources discussed above (natural and fallout).

3.0 GENERAL PLANT AND SITE INFORMATION

The Maine Yankee Nuclear Power Station is located in the town of Wiscasset, Lincoln County, Maine, approximately six miles northeast of Bath, Maine. The site vicinity is rural and lightly populated.

The plant site is located on Bailey Point, a peninsula bounded to the east by the Back River and to the west by a shallow inlet known as Bailey Cove, both of which are part of the Montsweag Bay-Sheepscot River Estuary. (See the maps in Figures 4.1 to 4.4) Bailey point is an elongated bedrock ridge with flat or gently rolling topography rising to an average elevation of about 25 feet above sea level (Reference 5).

The single 900 megawatt PWR (Pressurized Water Reactor) unit at Maine Yankee began commercial operation in 1972. The Radiological Environmental Monitoring Program (REMP) began pre-operational measurements in 1970, two years prior to commercial operation. The REMP has been in continuous operation since that date.

Maine Yankee shut down in December 1996. In August 1997 the decision was made to permanently cease power operation after 24 years of operation. The plant has since been in the process of decommissioning, which involves the disassembly and removal of the plant components and structures. This process is taking place in strict conformance with USNRC regulations. Oversight also continues from the State of Maine.

The radiological environmental monitoring program for Maine Yankee continued to operate during 2001.

4.0 PROGRAM DESIGN

The Radiological Environmental Monitoring Program (REMP) for the Maine Yankee Nuclear Power Station was designed with the following specific objectives in mind. These objectives will continue to be in force, to varying degrees, throughout decommissioning activities at the Maine Yankee site.

- To provide an early indication of the appearance or accumulation of any radioactive material in the environment caused by the operation of the station.
- To provide assurance to regulatory agencies and the public that the station's environmental impact is known and within anticipated limits.
- To verify the adequacy and proper functioning of station effluent controls and monitoring systems.
- To provide standby monitoring capability for rapid assessment of risk to the general public in the event of unanticipated or accidental releases of radioactive material.

The program was initiated in 1970, approximately two years before the plant began commercial operation in 1972. It has been in operation continuously since that time, with improvements made periodically over those years.

Prior to January 1992, the requirements for the Radiological Environmental Monitoring Program (REMP) were stated in the Radiological Effluent Technical Specifications (RETS). In January 1992, the REMP specifications were removed from the RETS and placed in the Offsite Dose Calculation Manual (ODCM) pursuant to NRC Generic Letter 89-01 (Reference 6).

The REMP is a requirement of the ODCM. The detailed sampling requirements of the REMP are given in Table 2.3 of ODCM Section 2.4. This table is summarized in this report as Table 4.1.

The required sampling locations are identified in Section 5 of the ODCM. The locations actually monitored in 2001 are shown on Tables 4.2 and 4.3, as well as Figures 4.1 through 4.4 of this report. The locations in these tables and figures consist of the required locations specified in the ODCM, as well as any regularly sampled locations. Sampling sites that were used on only one occasion during 2001 are not shown in the tables or maps, but are discussed in the text. The environmental sampling and TLD locations were determined using a differential Global Positioning System (GPS), with a typical accuracy of less than 5 meters. The reference point chosen for direction and distance was the plant Primary Vent Stack (PVS).

4.1 Monitoring Zones

The REMP is designed to allow comparison of levels of radioactivity in samples from the area possibly influenced by the plant to levels found in areas not influenced by the plant. The first area is called Zone 1, and its monitoring locations are called "indicators." The second area is called Zone 2, and its monitoring locations are called "controls." The distinction between the two zones, depending on the type of sample or sample pathway, is based on one or more of several factors, such as site meteorological history, meteorological dispersion calculations, relative direction from the plant, river flow, and distance. Analysis of survey data from the two zones aids in determining if there is a significant difference between the two areas. It can also help in differentiating between radioactivity or radiation due to plant releases and that due to other fluctuations in the environment, such as atmospheric nuclear weapons test fallout or seasonal variations in the natural background.

4.2 Pathways Monitored

Four pathway categories are monitored by the REMP. They are the direct radiation, airborne, waterborne, and ingestion pathways. Each of these four categories is monitored by the collection of one or more sample media, which are listed below, and are described in more detail in this section:

Airborne Pathway:

- Air Particulate Sampling
- Mixed Vegetation Sampling (for airborne deposition)

Waterborne Pathways:

- Estuary Water Sampling
- Ground Water Sampling
- Shoreline Sediment Sampling
- Marine Algae Sampling

Ingestion Pathways:

- Milk Sampling
- Fish and Invertebrate Sampling

Direct Radiation Pathway:

- TLD Monitoring

4.3 Descriptions of Monitoring Programs

4.3.1 Air Sampling

Continuous air samplers are operated at five locations. The sampling pumps at these locations operate continuously at a flow rate of approximately one to two cubic feet per minute. Airborne particulates are collected by passing air through a 47 mm glass-fiber filter. A dry-gas meter is incorporated in the sampling stream to measure the total amount of air sampled in a given interval. The entire air sampling system is housed in a weatherproof structure. The filters, which are collected on a biweekly basis, are initially screened at the Maine Yankee Environmental Services Laboratory with a Geiger Mueller-based "beta counter." To allow for the decay of radon daughter products, they are then held for at least 100 hours at the Duke Engineering and Services Environmental Laboratory (DESEL) before being analyzed for gross-beta radioactivity. The filters are composited by location at the DESEL for a quarterly gamma spectroscopy analysis.

4.3.2 Mixed Vegetation Sampling

Although there is no ODCM requirement for mixed vegetation sampling, a sample is collected from an on-site location twice during the growing season. To collect this sample, all grass is cut to a height of one inch above ground level from a 4 square-meter plot. The grass is shipped to the DESEL, where it is analyzed for gamma-emitting radionuclides.

4.3.3 Estuary Water Sampling

An automatic composite sampler is located at the discharge forebay to monitor water discharged to the Back River. (In-plant systems monitor water prior to release to the discharge forebay.) The sampler is controlled by a timer that collects an aliquot of this water at least every two hours. Every week a one-liter sample is gathered from this composited sample. These one-liter samples are again composited at the Environmental Services laboratory before shipping to the DESEL at the end of the month. A weekly grab sample is collected at the control location in the Kennebec River. These are composited for a monthly sample at the Environmental Services Laboratory. All estuary water samples are preserved with HCl and $NaHSO_3$ to prevent the plate out of radionuclides on the container walls. Each monthly composite or grab sample is analyzed for gamma-emitting radionuclides. These are composited again by location at the DESEL for a quarterly H-3 analysis.

4.3.4 Ground Water Sampling

Due to the hydraulic gradient at the Maine Yankee site, whereby the ground water flow is southward down the peninsula and toward the water on the east and west sides, ground water sampling is not required at the Maine Yankee site, pursuant to ODCM Table 2.3. Nevertheless, grab samples are collected quarterly from one on-site location and one control location. All ground water samples are preserved with HCl and $NaHSO_3$ to prevent the plate out of radionuclides on the container walls. Each sample is analyzed for gamma-emitting radionuclides and tritium.

4.3.5 Sediment Sampling

Shoreline sediment cores are collected semiannually from two locations on Bailey Point. At each location, six 5-cm I.D. plastic coring tubes are driven into the sediment to a depth of at least fifteen centimeters. The cores are then kept in an upright position and frozen prior to delivery to DESEL. At the laboratory, the frozen cores are cut into 5-cm segments. For each location, the 0-5 cm segments are blended into a single sample, as are the 5-10 cm and 10-15 cm segments. These composite samples are then analyzed for gamma-emitting radionuclides.

4.3.6 Marine Algae Sampling

Mixed samples of *Fucus* and *Ascophyllum* marine algae are collected at least semiannually from a location near the plant diffuser discharge. Each sample is frozen for shipment to DESEL. At the laboratory, they are analyzed for gamma-emitting radionuclides. Sampling of this media is not required by ODCM Table 2.3.

4.3.7 Milk Sampling

Milk samples are collected on a monthly schedule from two locations – one indicator and one control. The indicator location is chosen as a result of the annual Land Use Census, based on a hypothetical potential dose commitment. The second location is a control, which is located sufficiently far away from the plant to be outside any potential influence from it.

Samples of milk are chilled after collection and shipped to the DESEL on ice. Methimazole and formaldehyde are added to the milk upon receipt at the Laboratory. Each sample is analyzed for gamma-emitting radionuclides. Although not required by the ODCM, Sr-89 and Sr-90 analyses are also performed on quarterly composited samples.

4.3.8 Fish and Invertebrate Sampling

Samples of commercially important fish and invertebrates are collected two times seasonally at two locations (near the plant discharge and at a control location on the Sheepscot River). Maine Yankee Environmental Services staff collect samples of fish, crabs, lobsters and Molluscs (blue mussels). All samples are separated by species and are then frozen and delivered to the DESEL, where the edible portions are analyzed for gamma-emitting radionuclides.

In 1995, the Town of Wiscasset re-opened several clam flats, including Bailey Cove that had been closed to clam digging for many years. During 2001, two seasonal samples of soft-shell clam (*Mya arenaria*) were collected from two locations within Bailey Cove. The clam samples were frozen and analyzed for gamma emitting radionuclides at the DESEL. These samples are not required by Maine Yankee ODCM.

4.3.9 TLD Monitoring

Direct gamma radiation exposure was continuously monitored with the use of thermoluminescent dosimeters (TLDs). Specifically, Panasonic UD-801AS1 and UD-814AS1 calcium sulfate dosimeters were used, with a total of five elements in place at each monitoring location. Each pair of dosimeters is sealed in a plastic bag, which is in turn housed in a plastic-screened container. This container is attached to an object such as a tree, fence or utility pole. The plant staff posts and retrieves all TLDs quarterly. All TLDs are processed at the DESEL.

In addition to these environmental TLDs, additional TLDs have been placed in a ring around the Independent Spent Fuel Storage Installation (ISFSI), located approximately 450 meters NE of the containment. TLDs have been located in each of the 16 sectors out to a distance of approximately 300 meters from the facility. Originally designated DC-#, these were redesignated as TL-I-# in the fourth quarter of 2001. Two of the environmental TLDs, TL-3 (Bailey House) and TL-5 (Information Center) also serve as ISFSI environmental TLDs, TL-I-05 and TL-I-10, respectively.

4.3.10 Special Monitoring

On occasion, special interest samples are taken that are not required as a part of the Radiological Environmental Monitoring Program (REMP). The sample locations vary from year to year and do not appear in Table 2.3 of the Offsite Dose Calculation Manual, nor do they appear in Table 4.1 or 4.2 of this report. The analysis results may be discussed in Section 5 of this report, as appropriate.

TABLE 4.1

Radiological Environmental Surveillance Program
(as required during 2001 by ODCM Table 2.3)

Exposure Pathway and/or Sample Media	Collection			Analysis	
	Number of Sample Locations	Routine Sampling Mode	Collection Frequency	Analysis Type	Analysis Frequency
1. Direct Radiation (TLDs)	Total Locations: 38	Continuous	Quarterly	Gamma dose	Each TLD
2. Airborne (Particulates)	Total Locations: 5	Continuous	Biweekly	Particulate Sample: Gross Beta Gamma Isotopic	 Each Sample Quarterly Composite (by location)
3. Waterborne					
a. Estuary Water	Total Locations: 2	Composite (aliquot every 2 hrs)	Monthly	Gamma Isotopic Tritium (H-3)	Each Sample Quarterly Composite
b. Ground Water*	Total Locations: 2	Grab	Quarterly	Gamma Isotopic Tritium (H-3)	Each Sample Each Sample
c. Shoreline Sediment	Total Locations: 2	Grab	Semiannually	Gamma Isotopic	Each Sample

* Groundwater samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where hydraulic gradient or recharge properties are suitable for contamination.

TABLE 4.1
(continued)

Radiological Environmental Surveillance Program
(as required during 2001 by ODCM Table 2.3)

Exposure Pathway and/or Sample Media	Collection			Analysis	
	Nominal Number of Sample Locations	Routine Sampling Mode	Nominal Collection Frequency	Analysis Type	Analysis Frequency
4. Ingestion					
a. Milk*	Total Locations: 2	Grab	Monthly	Gamma Isotopic	Each sample
b. Fish and Invertebrates (commercially or recreationally important species)	Total Locations: 2	Grab	Semiannually (or seasonal if appropriate)	Gamma Isotopic on edible portions	Each sample
c. Food Products/Vegetation**	Total Locations: 3	Grab	Monthly when available	Gamma Isotopic	Each sample

* Vegetation may be substituted for milk samples.
** Not required when milk sampling is being performed.

TABLE 4.2

Radiological Environmental Monitoring Locations (non-TLD) in 2001
Maine Yankee Nuclear Power Station

Exposure Pathway	Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
1. Airborne					
a. Air Particulate	AP-11	Montsweag Brook	1	2.7	NW
	AP-13	Bailey Farm (ESL)	1	0.7	NE
	AP-14	Mason Steam Station	1	4.8	NNE
	AP-16	Westport Firehouse	1	1.8	S
	AP-29	Dresden Substation	2	20.1	N
2. Waterborne					
a. Surface Water	WE-12	Plant Outfall (Composite Sample)	1	0.3	SSW
	WE-20	Kennebec River (Grab Sample)	2	9.5	WSW
b. Ground Water	WG-13	Bailey Farm (ESL)	1	0.7	NE
	WG-24	Morse Well	2	9.9	W
c. Sediment	SE-16	Old Outfall Area	1	0.6	S
	SE-18	Foxbird Island	1	0.6	S
d. Clam **	MA-16	Old Outfall Area	1	0.65	S
	MA-18	Foxbird Island	1	0.65	S
e. Marine Algae	AL-11	Long Ledge Area	1	0.9	S
3. Ingestion					
a. Milk	TM-18	Chewonki Foundation	1	1.9	WSW
	TM-25	Hanson Farm	2	18.3	W

TABLE 4.2
(continued)

Radiological Environmental Monitoring Locations (non-TLD) in 2001
Maine Yankee Nuclear Power Station

Exposure Pathway	Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
3. Ingestion, continued b. Fish & Invertebrates	FH-11*** MU-11 CA-11 HA-11	Long Ledge Area	1	0.9	S
	FH-24 MU-24 CA-24 HA-24	Sheepscot River	2	11.1	S

* 1 = Indicator Stations; 2 = Control Stations

** MA = Soft-Shell Clams (*Mya arenaria*).

*** FH = Fish, MU = Mussels, CA = Crabs, HA = Lobsters

ESL = Environmental Services Laboratory

TABLE 4.3

Radiological Environmental Monitoring Locations (TLD) in 2001
Maine Yankee Nuclear Power Station

Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
TL-1	Old Ferry Rd.	I	0.9	N
TL-2	Old Ferry Rd.	I	0.8	NNE
TL-3	Bailey House (ESL)	I	0.7	NE
TL-4	Westport Island, Rt. 144	I	1.3	ENE
TL-5	MY Information Center	I	0.2	ENE
TL-6	Rt. 144 & Greenleaf Rd.	I	1.0	E
TL-7	Westport Island, Rt. 144	I	0.9	ESE
TL-8	MY Screenhouse	I	0.2	ESE
TL-9	Westport Island, Rt. 144	I	0.8	SE
TL-10	Bailey Point	I	0.3	SSE
TL-11	Mason Station	O	4.8	NNE
TL-12	Westport Firehouse	I	1.7	S
TL-13	Foxbird Island	I	0.3	SSW
TL-14	Eaton Farm	I	0.7	SW
TL-15	Eaton Farm	I	0.8	WSW
TL-16	Eaton Farm	I	0.7	W
TL-17	Eaton Farm Rd.	I	0.6	WNW
TL-18	Eaton Farm Rd.	I	0.8	NW
TL-19	Eaton Farm Rd.	I	0.9	NNW
TL-20	Bradford Rd., Wiscasset	O	6.4	N
TL-21	Federal St., Wiscasset	O	7.1	NNE
TL-22	Cochran Rd., Edgecomb	O	8.3	NE
TL-23	Middle Rd., Edgecomb	O	6.4	ENE
TL-24	River Rd., Edgecomb	O	7.8	E
TL-25	River Rd. & Rt. 27	O	7.7	ESE
TL-26	Rt. 27 & Boothbay RR Museum	O	7.9	SE
TL-27	Barters Island	O	7.2	SSE
TL-28	Westport Island, Rt. 144 & E.Shore Rd.	O	7.9	S
TL-29	Harrison's Trailer	O	6.2	SSW
TL-30	Leeman Farm, Woolwich	O	7.8	SW

TABLE 4.3
(continued)

Radiological Environmental Monitoring Locations (TLD) in 2001
Maine Yankee Nuclear Power Station

Station Code	Station Description	Zone*	Distance From Plant (km)	Direction From Plant
TL-31	Barley Neck Rd., Woolwich	O	6.8	WSW
TL-32	Baker Farm, Woolwich	O	7.3	W
TL-33	Rt. 127, Woolwich	O	7.4	WNW
TL-34	Rt. 127, Woolwich	O	7.9	NW
TL-35	Rt. 127, Dresden	O	9.1	NNW
TL-36	Boothbay Harbor Fire Station	2	12.2	SSE
TL-37	Bath Fire Station	2	10.7	WSW
TL-38	Dresden Substation	2	20.1	N

* I = Inner Ring TLD; O = Outer Ring TLD; 2 = Control TLD.

Independent Spent Fuel Storage Installation (ISFSI) Environmental TLDs:

TLD		Direction from ISFSI
TL-I-01	(formerly DC-12)Note 1	N
TL-I-02	(formerly DC-13)	NNE
TL-I-03	(formerly DC-15)	NE
TL-I-04	(formerly DC-01)	ENE
TL-I-05	(also TL-3)Note 2	E
TL-I-06	(formerly DC-02)	ESE
TL-I-07	(formerly DC-03)	SE
TL-I-08	(formerly DC-04)	SSE
TL-I-09	(formerly DC-05)	S
TL-I-10	(also TL-5)Note 2	SSW
TL-I-11	(formerly DC-06)	SW
TL-I-12	(formerly DC-07)	WSW
TL-I-13	(formerly DC-08)	W
TL-I-14	(formerly DC-09)	WNW
TL-I-15	(formerly DC-10)	NW
TL-I-16	(formerly DC-11)	NNW

Note 1: Stations were previously designated as DC-#. In the fourth quarter of 2001, stations were re-designated as TL-I-#, as indicated.

Note 2: Station serves as both a REMP inner circle monitoring location and an ISFSI environmental monitoring location.

TABLE 4.4

Environmental Lower Limit of Detection (LLD) Sensitivity Requirements

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish & Invertebrates (pCi/kg wet)	Milk (pCi/l)	Food Products (pCi/kg/wet)	Sediment (pCi/kg dry)
Gross-Beta	4	0.01				
H-3	2000 *					
Mn-54	15		130			
Fe-59	30		260			
Co-58,60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1 **					
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

* If no drinking water pathway exists, a value of 3000 pCi/l may be used.
** If no drinking water pathway exists, a value of 15 pCi/l may be used.

TABLE 4.5

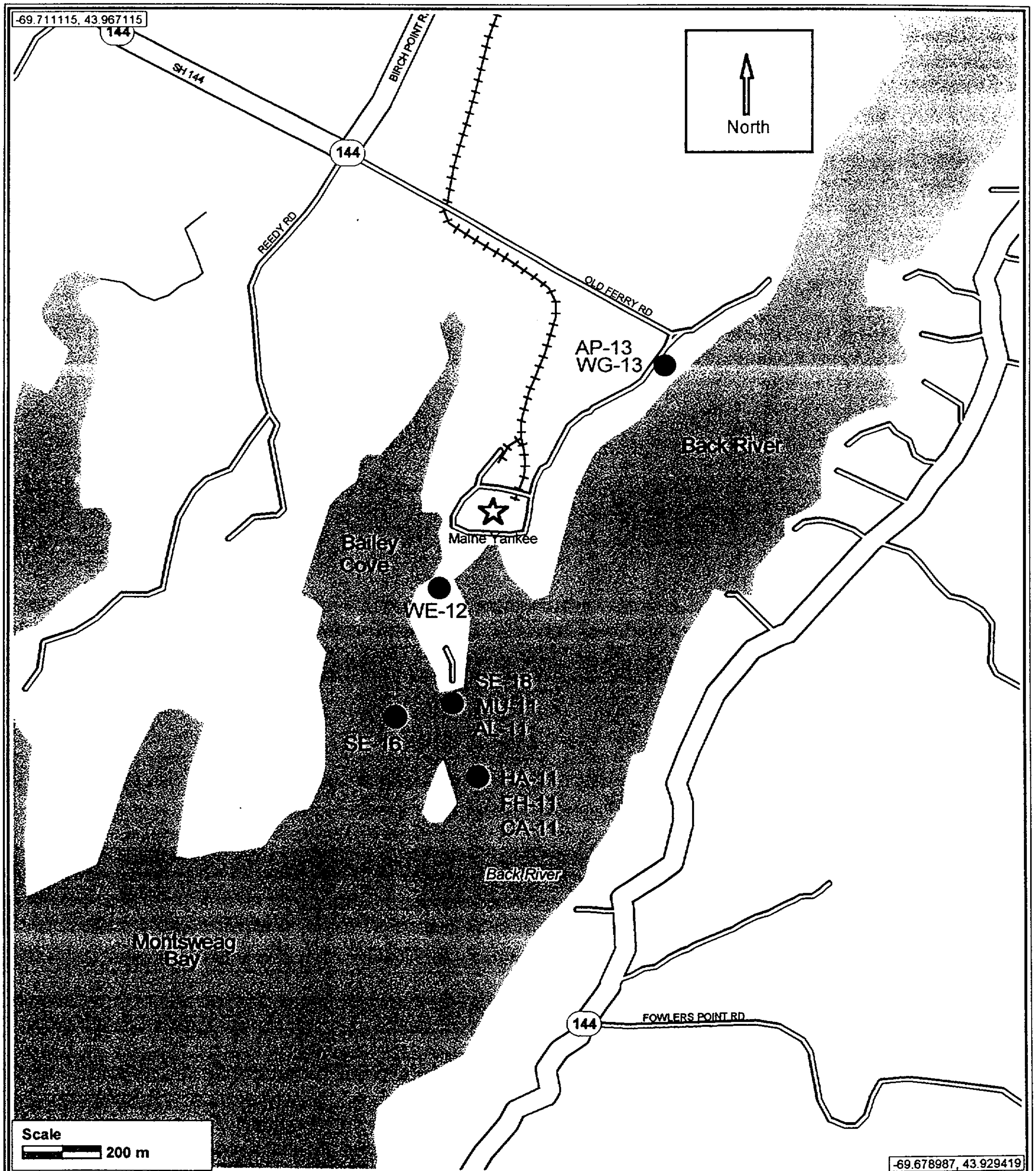
Reporting Levels for Radioactivity Concentrations In Environmental Samples

Analysis	Water (pCi/l)	Airborne Particulates or Gases (pCi/m^3)	Fish & Invertebrates (pCi/kg wet)	Milk (pCi/l)	Food Products (pCi/l)
H-3	20,000 *				
Mn-54	1000		30,000		
Fe-59	400		10,000		
Co-58	1000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400 **				
I-131	2 ***				
Cs-134	30	10	1000	60	1000
Cs-137	50	20	2000	70	2000
Ba-La-140	200 **			300	

* If no drinking water pathway exists, a value of 30,000 pCi/l may be used.
** Parent only.
*** If no drinking water pathway exists, a value of 20 pCi/l may be used.

Figure 4.1

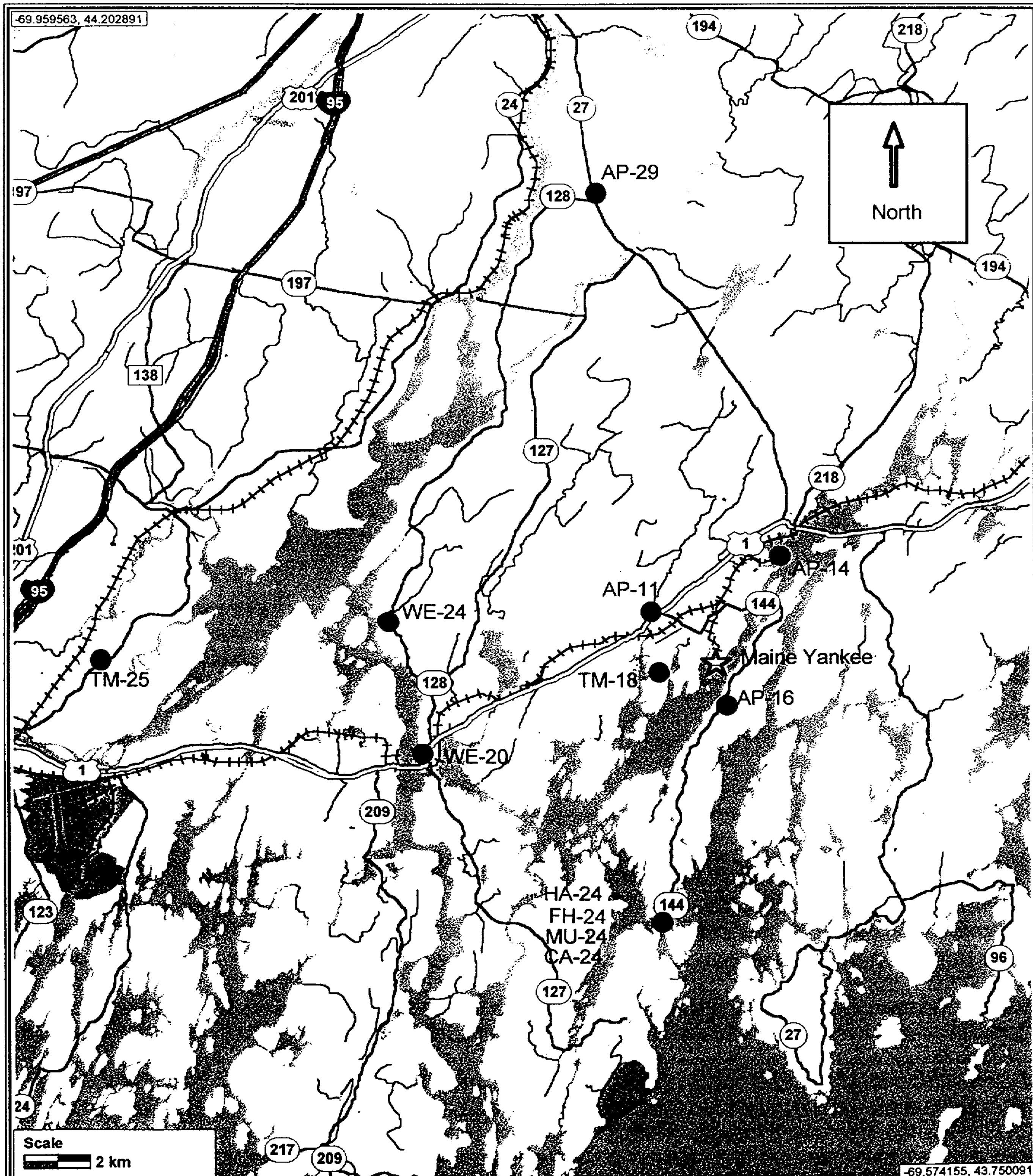
Environmental Radiological Sampling Locations (within 1 KM)



Map created using Precision Mapping 3.0

Figure 4.2

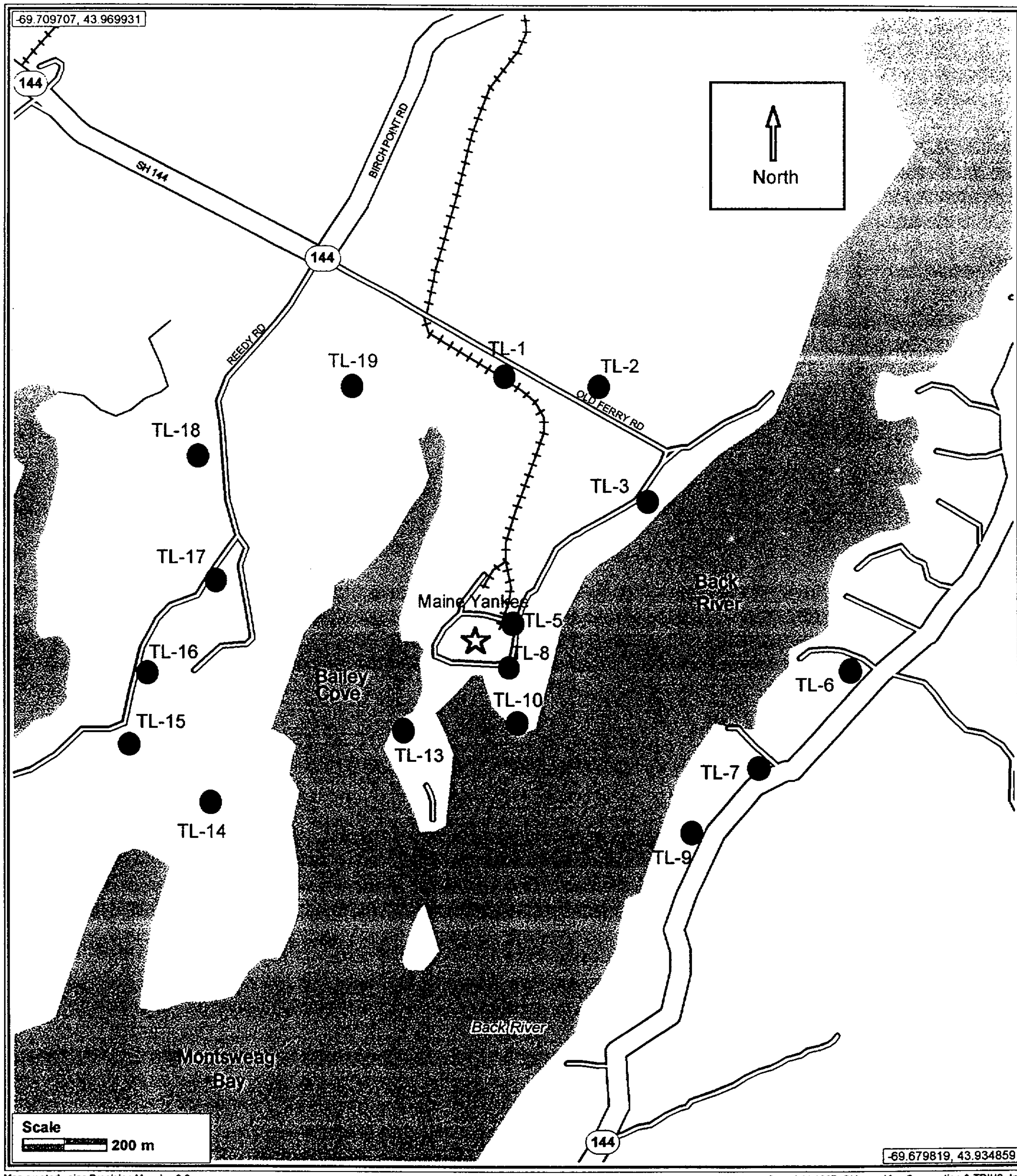
Environmental Radiological Sampling Locations (outside 1 KM)



Map created using Precision Mapping 3.0

Figure 4.3

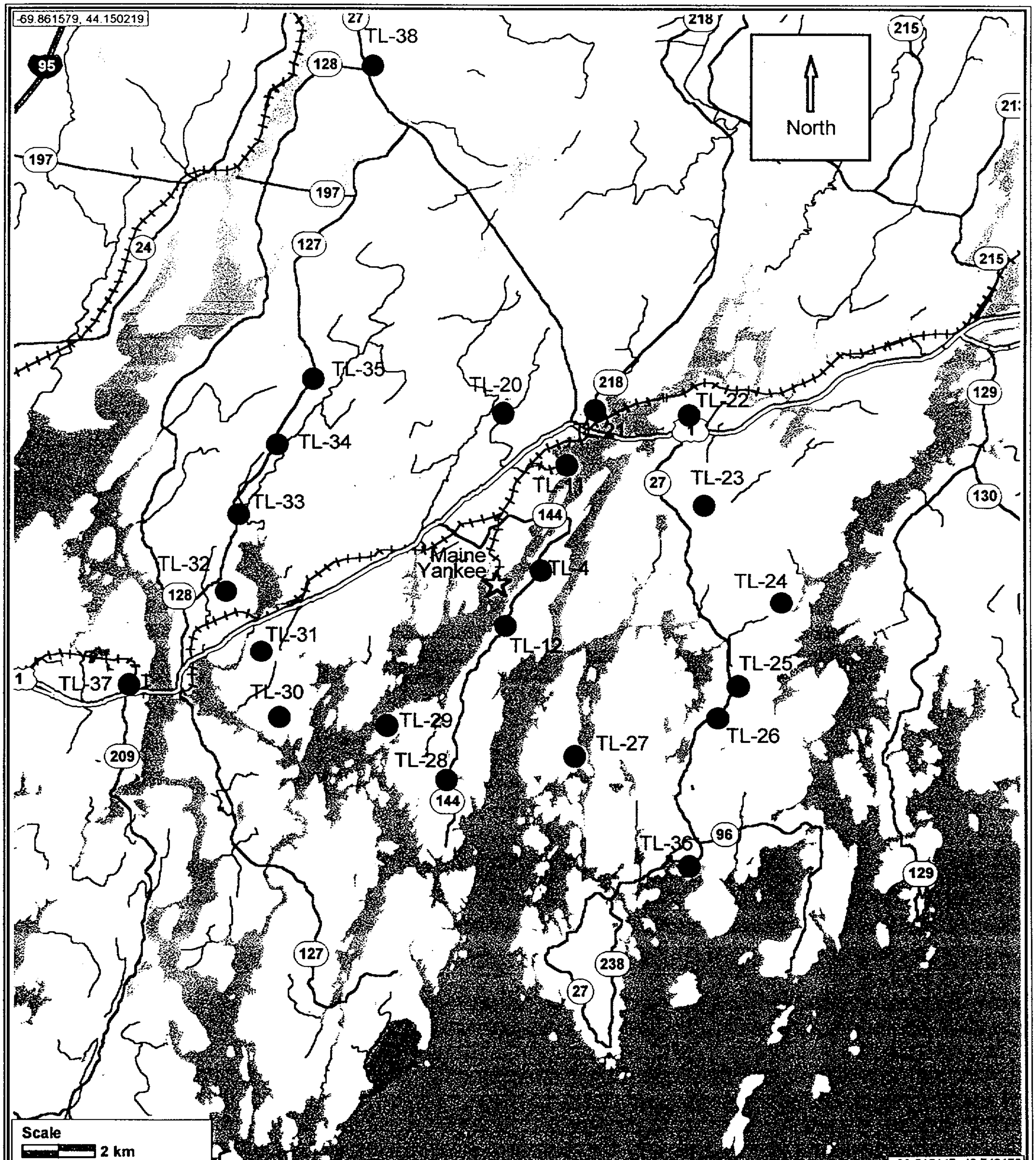
Direct Radiation Monitoring Locations (within 1 KM)



Map created using Precision Mapping 3.0

Figure 4.4

Direct Radiation Monitoring Locations (outside 1 KM)



Map created using Precision Mapping 3.0

5.0 RADIOLOGICAL DATA SUMMARY TABLES

This section summarizes the analytical results of the environmental samples, which were collected during 2001. These results, shown in Table 5.1, are presented in a format similar to that prescribed in the NRC's Radiological Assessment Branch Technical Position on Environmental Monitoring (Reference 1). The results are ordered by sample media type and then by radionuclide. The units for each media type are also given.

The left-most column contains the radionuclide of interest, the total number of analyses for that radionuclide in 2001, and the number of measurements which exceeded the Reporting Levels found in Table 2.5 of the ODCM. Measurements exceeding the Reporting Levels are classified as "Non-Routine" measurements. The second column lists the required Lower Limit of Detection (LLD) for those radionuclides that have detection capability requirements as specified in the ODCM Table 2.4. The absence of a value in this column indicates that no LLD is specified in the ODCM for that radionuclide in that media. The target LLD for any analysis is typically 30-40 percent of the most restrictive required LLD. Occasionally, the required LLD is not met. This is usually due to malfunctions in sampling equipment, which results in low sample volume. Such cases, if any, are addressed in Section 6.2.

For each radionuclide and media type, the remaining three columns summarize the data for the following categories of monitoring locations: (1) the indicator or Zone 1 stations, which are within the range of influence of the plant and which could conceivably be affected by its operation; (2) the station within Zone 1 or Zone 2 which had the highest mean concentration during 2001 for that radionuclide; and (3) the control or Zone 2 stations, which are beyond the influence of the plant. TLD or direct radiation monitoring stations are grouped into either an Inner Ring, an Outer Ring (for emergency response), or a Control category.

In each of these columns, for each radionuclide, the following statistical values are given:

- The mean value of all concentrations, including negative values and values considered "not detectable".
- The lowest and highest concentration.
- The number of detectable measurements divided by the total number of measurements. For example, (4/20) would indicate that 4 of the 20 samples collected in 2001, for that sample type and that radionuclide, contained detectable radioactivity.

A sample is considered to yield a "detectable measurement" when the concentration exceeds three times its associated standard deviation. The standard deviation on each measurement represents only the random uncertainty associated with the radioactive decay process (counting statistics), and not the propagation of all possible uncertainties in the analytical procedure.

The radionuclides reported in this section represent those that: 1) had an LLD requirement in Table 2.4 of the ODCM, or a Reporting Level listed in Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally-occurring or man-made; or 3) were of specific interest for any other reason. The radionuclides routinely analyzed and reported by the DESEL for a gamma spectroscopy analysis are: Ac-Th-228, Ag-110m, Ba-140, Be-7, Ce-141, Ce-144, Co-57, Co-58, Co-60, Cr-51, Cs-134, Cs-137, Fe-59, I-131, I-133, K-40, Mn-54, Mo-99, Np-239, Ru-103, Ru-106, Sb-124, Se-75, Te-I-132, Zn-65 and Zr-95. In no case did a radionuclide other than those in Table 5.1 appear as a "detectable measurement" during 2001.

Data from direct radiation measurements made by TLDs are provided in Table 5.2 in a format essentially the same as above. The complete listing of quarterly TLD data is provided in Table 5.3.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Air Particulates (AP) UNITS: pCi/cubic meter

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean, Range, (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean, Range, (No. Detected***)	Control Stations: Mean, Range, (No. Detected***)
GR-B	(133) (0)	0.01	2.4E -2 (4.7 - 76.1)E -3 (106/ 106)	16	2.4E -2 (1.2 - 5.7)E -2 (27/ 27)	2.4E -2 (1.1 - 6.6)E -2 (27/ 27)
Be-7	(20) (0)		7.5E -2 (4.3 - 11.7)E -2 (16/ 16)	16	8.6E -2 (4.3 - 11.7)E -2 (4/ 4)	8.2E -2 (5.6 - 11.0)E -2 (4/ 4)
Mn-54	(20) (0)		7.9E -5 (-7.0 - 7.1)E -4 (0/ 16)	13	2.8E -4 (-3.2 - 60.3)E -5 (0/ 4)	4.8E -5 (-7.9 - 5.7)E -4 (0/ 4)
Co-58	(20) (0)		2.5E -4 (-1.3 - 1.4)E -3 (0/ 16)	13	4.4E -4 (-1.5 - 11.0)E -4 (0/ 4)	-3.6E -4 (-9.2 - 3.6)E -4 (0/ 4)
Fe-59	(20) (0)		1.4E -3 (-5.1 - 10.7)E -3 (0/ 16)	16	3.6E -3 (-5.1 - 10.7)E -3 (0/ 4)	-2.1E -4 (-1.8 - 1.4)E -3 (0/ 4)
Co-60	(20) (0)		-7.8E -5 (-1.3 - 0.9)E -3 (0/ 16)	11	2.4E -4 (-8.1 - 61.9)E -5 (0/ 4)	-3.2E -4 (-6.5 - 1.1)E -4 (0/ 4)
Cs-134	(20) (0)	0.05	-2.6E -5 (-1.1 - 0.7)E -3 (0/ 16)	29	2.8E -4 (1.1 - 5.8)E -4 (0/ 4)	2.8E -4 (1.1 - 5.8)E -4 (0/ 4)
Cs-137	(20) (0)	0.06	-2.6E -5 (-8.7 - 5.7)E -4 (0/ 16)	14	1.8E -4 (-1.6 - 5.7)E -4 (0/ 4)	-3.4E -4 (-6.5 - 1.0)E -4 (0/ 4)

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Mixed Grass (TG) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean Range (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range (No. Detected***)	Control Stations: Mean Range (No. Detected***)
Be-7	(3) (0)		9.1E 2 (-2.1 - 182.1)E 1 (2/ 3)	11	1.4E 3 (9.4 - 18.2)E 2 (2/ 2)	NO DATA
K-40	(3) (0)		7.0E 3 (5.4 - 8.2)E 3 (3/ 3)	18	7.4E 3 (1/ 1)	NO DATA
I-131	(3) (0)		-2.6E 0 (-2.6 - 1.5)E 1 (0/ 3)	11	-2.6E 0 (-2.6 - 1.5)E 1 (0/ 3)	NO DATA
Cs-134	(3) (0)		5.6E 0 (4.9 - 6.5)E 0 (0/ 3)	11	5.7E 0 (4.9 - 6.5)E 0 (0/ 2)	NO DATA
Cs-137	(3) (0)		4.2E 0 (-1.8 - 11.9)E 0 (0/ 3)	11	7.3E 0 (2.6 - 11.9)E 0 (0/ 2)	NO DATA

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Estuary Water (WE) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean Range (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range (No. Detected***)	Control Stations: Mean Range (No. Detected***)
H-3	(8) (0)	3000	2.4E 2 (-8.2 - 68.1)E 1 (0/ 4)	12	2.4E 2 (-8.2 - 68.1)E 1 (0/ 4)	2.2E 2 (-2.5 - 7.3)E 2 (0/ 4)
K-40	(24) (0)		2.2E 2 (4.4 - 29.0)E 1 (11/ 12)	12	2.2E 2 (4.4 - 29.0)E 1 (11/ 12)	6.8E 1 (1.4 - 22.2)E 1 (6/ 12)
Mn-54	(24) (0)	15	-7.8E -2 (-1.4 - 1.7)E 0 (0/ 12)	12	-7.8E -2 (-1.4 - 1.7)E 0 (0/ 12)	-1.2E -1 (-2.6 - 3.1)E 0 (0/ 12)
Co-58	(24) (0)	15	-3.9E -1 (-1.6 - 1.1)E 0 (0/ 12)	12	-3.9E -1 (-1.6 - 1.1)E 0 (0/ 12)	-6.6E -1 (-1.7 - 2.4)E 0 (0/ 12)
Fe-59	(24) (0)	30	8.3E -1 (-4.9 - 7.2)E 0 (0/ 12)	12	8.3E -1 (-4.9 - 7.2)E 0 (0/ 12)	5.3E -1 (-3.9 - 5.4)E 0 (0/ 12)
Co-60	(24) (0)	15	2.1E -1 (-1.5 - 2.3)E 0 (0/ 12)	12	2.1E -1 (-1.5 - 2.3)E 0 (0/ 12)	1.2E -1 (-1.3 - 1.9)E 0 (0/ 12)
Zn-65	(24) (0)	30	1.5E -1 (-3.2 - 4.8)E 0 (0/ 12)	12	1.5E -1 (-3.2 - 4.8)E 0 (0/ 12)	-7.9E -1 (-7.7 - 9.3)E 0 (0/ 12)
Zr-95	(24) (0)	15	3.6E -1 (-2.4 - 2.4)E 0 (0/ 12)	12	3.6E -1 (-2.4 - 2.4)E 0 (0/ 12)	-7.8E -1 (-4.3 - 3.5)E 0 (0/ 12)
I-131	(24) (0)	15	-7.9E -2 (-5.2 - 3.4)E 0 (0/ 12)	12	-7.9E -2 (-5.2 - 3.4)E 0 (0/ 12)	-7.1E -1 (-1.2 - 0.5)E 1 (0/ 12)
Cs-134	(24) (0)	15	2.9E -1 (-2.0 - 2.4)E 0 (0/ 12)	12	2.9E -1 (-2.0 - 2.4)E 0 (0/ 12)	-2.1E -1 (-1.8 - 1.4)E 0 (0/ 12)
Cs-137	(24) (0)	18	-3.8E -1 (-4.8 - 3.1)E 0 (0/ 12)	12	-3.8E -1 (-4.8 - 3.1)E 0 (0/ 12)	-4.0E -1 (-2.7 - 0.9)E 0 (0/ 12)
Ba-140	(24) (0)	15	-4.0E -1 (-4.7 - 3.6)E 0 (0/ 12)	20	1.5E -1 (-5.1 - 4.4)E 0 (0/ 12)	1.5E -1 (-5.1 - 4.4)E 0 (0/ 12)

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Ground Water (WG) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean Range (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range (No. Detected***)	Control Stations: Mean Range (No. Detected***)
H-3	(7) (0)		1.3E 2 (-4.9 - 24.7)E 1 (0/ 4)	24	3.3E 2 (-1.1 - 7.7)E 2 (0/ 2)	7.1E 1 (-4.4 - 7.7)E 2 (0/ 3)
Mn-54	(8) (0)		-7.2E -1 (-2.1 - 0.8)E 0 (0/ 4)	25	3.9E -1 (0/ 1)	-1.2E 0 (-3.6 - 0.4)E 0 (0/ 4)
Co-58	(8) (0)		-8.4E -1 (-1.7 - 0.1)E 0 (0/ 4)	25	-4.9E -1 (0/ 1)	-1.7E 0 (-3.5 - -0.5)E 0 (0/ 4)
Fe-59	(8) (0)		-1.6E 0 (-4.3 - 2.9)E 0 (0/ 4)	25	1.5E 0 (0/ 1)	6.1E -1 (-2.6 - 2.0)E 0 (0/ 4)
Co-60	(8) (0)		-2.1E -1 (-3.0 - 1.6)E 0 (0/ 4)	25	3.5E -2 (0/ 1)	-5.1E -1 (-1.7 - 0.0)E 0 (0/ 4)
Zn-65	(8) (0)		-4.1E 0 (-7.9 - 3.2)E 0 (0/ 4)	25	3.8E 0 (0/ 1)	6.5E -1 (-4.8 - 3.8)E 0 (0/ 4)
Zr-95	(8) (0)		-3.7E -1 (-1.9 - 1.3)E 0 (0/ 4)	13	-3.7E -1 (-1.9 - 1.3)E 0 (0/ 4)	-6.0E -1 (-2.4 - 0.9)E 0 (0/ 4)
I-131	(8) (0)		1.5E 0 (-1.3 - 7.2)E 0 (0/ 4)	24	2.3E 0 (-4.7 - 47.6)E -1 (0/ 3)	1.3E 0 (-1.6 - 4.8)E 0 (0/ 4)
Cs-134	(8) (0)		-1.0E 0 (-3.3 - 1.2)E 0 (0/ 4)	25	1.2E 0 (0/ 1)	-1.0E 0 (-3.4 - 1.2)E 0 (0/ 4)
Cs-137	(8) (0)		-9.2E -2 (-3.5 - 3.9)E -1 (0/ 4)	25	3.1E -1 (0/ 1)	-1.9E 0 (-5.8 - 0.3)E 0 (0/ 4)
Ba-140	(8) (0)		2.4E 0 (-1.1 - 4.9)E 0 (0/ 4)	13	2.4E 0 (-1.1 - 4.9)E 0 (0/ 4)	8.6E -1 (-7.9 - 48.2)E -1 (0/ 4)

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Sediment (SE) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean Range (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range (No. Detected***)	Control Stations: Mean Range (No. Detected***)
Be-7	(12) (0)		1.3E 2 (-1.9 - 3.9)E 2 (0/ 12)	18	1.4E 2 (-1.9 - 3.9)E 2 (0/ 6)	NO DATA
K-40	(12) (0)		2.0E 4 (1.6 - 2.2)E 4 (12/ 12)	18	2.1E 4 (2.0 - 2.2)E 4 (6/ 6)	NO DATA
Co-58	(12) (0)		-1.0E 1 (-4.9 - 3.1)E 1 (0/ 12)	16	-6.6E 0 (-4.5 - 2.4)E 1 (0/ 6)	NO DATA
Co-60	(12) (0)		1.3E 1 (-5.3 - 5.1)E 1 (0/ 12)	18	1.9E 1 (-6.0 - 51.4)E 0 (0/ 6)	NO DATA
Cs-134	(12) (0)	150	-1.0E -1 (-3.9 - 2.9)E 1 (0/ 12)	18	8.3E 0 (-2.0 - 2.9)E 1 (0/ 6)	NO DATA
Cs-137	(12) (0)	180	2.0E 2 (1.0 - 6.2)E 2 (11/ 12)	16	2.4E 2 (1.0 - 6.2)E 2 (5/ 6)	NO DATA
Th-232	(12) (0)		8.7E 2 (6.0 - 10.3)E 2 (12/ 12)	18	9.2E 2 (7.5 - 10.3)E 2 (6/ 6)	NO DATA

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Marine Algae (AL) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean, Range, (No. Detected***)	Station With Highest Mean: Sta.	Mean, Range, (No. Detected***)	Control Stations: Mean, Range, (No. Detected***)
Be-7	(12) (0)		1.0E 2 (-5.3 - 30.9)E 1 (1/ 12)	11	1.0E 2 (-5.3 - 30.9)E 1 (1/ 12)	NO DATA
K-40	(12) (0)		4.6E 3 (3.6 - 5.8)E 3 (12/ 12)	11	4.6E 3 (3.6 - 5.8)E 3 (12/ 12)	NO DATA
Mn-54	(12) (0)		7.4E -1 (-1.0 - 1.1)E 1 (0/ 12)	11	7.4E -1 (-1.0 - 1.1)E 1 (0/ 12)	NO DATA
Co-58	(12) (0)		7.2E -1 (-8.2 - 13.4)E 0 (0/ 12)	11	7.2E -1 (-8.2 - 13.4)E 0 (0/ 12)	NO DATA
Fe-59	(12) (0)		4.3E 0 (-7.8 - 13.4)E 1 (0/ 12)	11	4.3E 0 (-7.8 - 13.4)E 1 (0/ 12)	NO DATA
Co-60	(12) (0)		3.4E 0 (-3.9 - 9.2)E 0 (0/ 12)	11	3.4E 0 (-3.9 - 9.2)E 0 (0/ 12)	NO DATA
Zn-65	(12) (0)		-1.5E 1 (-4.3 - 1.5)E 1 (0/ 12)	11	-1.5E 1 (-4.3 - 1.5)E 1 (0/ 12)	NO DATA
Ag-110	(12) (0)		-1.9E 0 (-1.7 - 1.6)E 1 (0/ 12)	11	-1.9E 0 (-1.7 - 1.6)E 1 (0/ 12)	NO DATA
Sb-124	(12) (0)		-1.2E 0 (-2.3 - 2.7)E 1 (0/ 12)	11	-1.2E 0 (-2.3 - 2.7)E 1 (0/ 12)	NO DATA
Cs-134	(12) (0)		5.3E 0 (-2.7 - 14.9)E 0 (0/ 12)	11	5.3E 0 (-2.7 - 14.9)E 0 (0/ 12)	NO DATA
Cs-137	(12) (0)		1.4E 0 (-1.3 - 1.5)E 1 (0/ 12)	11	1.4E 0 (-1.3 - 1.5)E 1 (0/ 12)	NO DATA

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Milk (TM) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean / Range / (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean / Range / (No. Detected***)	Control Stations: Mean / Range / (No. Detected***)
K-40	(23) (0)		1.3E 3 (1.3 - 1.6)E 3 (11/ 11)	18	1.3E 3 (1.3 - 1.6)E 3 (11/ 11)	1.2E 3 (7.7 - 14.5)E 2 (12/ 12)
Sr-89	(8) (0)		-1.9E -1 (-7.0 - 2.2)E -1 (0/ 4)	25	2.5E 0 (-1.0 - 5.3)E 0 (0/ 4)	2.5E 0 (-1.0 - 5.3)E 0 (0/ 4)
Sr-90	(8) (0)		3.2E 0 (1.3 - 6.2)E 0 (2/ 4)	25	3.4E 0 (-1.7 - 6.6)E 0 (3/ 4)	3.4E 0 (-1.7 - 6.6)E 0 (3/ 4)
Cs-134	(23) (0)	15	-2.3E -2 (-2.1 - 1.9)E 0 (0/ 11)	25	5.7E -1 (-2.9 - 3.4)E 0 (0/ 12)	5.7E -1 (-2.9 - 3.4)E 0 (0/ 12)
Cs-137	(23) (0)	18	2.3E 0 (-1.3 - 5.7)E 0 (1/ 11)	25	4.2E 0 (1.1 - 7.7)E 0 (3/ 12)	4.2E 0 (1.1 - 7.7)E 0 (3/ 12)
Ba-140	(23) (0)	15	1.2E 0 (-4.1 - 5.6)E 0 (0/ 11)	18	1.2E 0 (-4.1 - 5.6)E 0 (0/ 11)	-1.6E 0 (-3.9 - 2.1)E 0 (0/ 12)

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Fish (FH) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean, Range, (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean, Range, (No. Detected***)	Control Stations: Mean, Range, (No. Detected***)
Be-7	(5) (0)		-7.0E 1 (-2.0 - 0.0)E 2 (0/ 3)	24	6.4E 1 (-4.1 - 17.0)E 1 (0/ 2)	6.4E 1 (-4.1 - 17.0)E 1 (0/ 2)
K-40	(5) (0)		2.4E 3 (1.6 - 3.2)E 3 (3/ 3)	11	2.7E 3 (2.2 - 3.2)E 3 (2/ 2)	2.2E 3 (2.2 - 2.2)E 3 (2/ 2)
Mn-54	(5) (0)	130	1.9E 0 (-1.0 - 1.3)E 1 (0/ 3)	11A	3.2E 0 (0/ 1)	-5.2E -1 (-2.5 - 1.5)E 0 (0/ 2)
Co-58	(5) (0)	130	1.2E 0 (-5.0 - 4.9)E 0 (0/ 3)	11A	4.9E 0 (0/ 1)	-2.2E 0 (-2.7 - -1.7)E 0 (0/ 2)
Fe-59	(5) (0)	260	2.0E 1 (-2.6 - 5.9)E 1 (0/ 3)	11A	5.9E 1 (0/ 1)	-2.4E 1 (-6.5 - 1.7)E 1 (0/ 2)
Co-60	(5) (0)	130	-1.6E 0 (-9.6 - 6.0)E 0 (0/ 3)	24	7.0E 0 (1.7 - 12.2)E 0 (0/ 2)	7.0E 0 (1.7 - 12.2)E 0 (0/ 2)
Zn-65	(5) (0)	260	-2.5E 1 (-5.9 - 1.3)E 1 (0/ 3)	24	-2.0E 1 (-4.2 - 0.3)E 1 (0/ 2)	-2.0E 1 (-4.2 - 0.3)E 1 (0/ 2)
Ag-110	(5) (0)		7.6E -1 (-1.4 - 3.6)E 0 (0/ 3)	11A	3.6E 0 (0/ 1)	5.6E -1 (-4.4 - 5.5)E 0 (0/ 2)
Sb-124	(5) (0)		-8.5E 0 (-2.1 - 0.8)E 1 (0/ 3)	11	-2.5E 0 (-1.3 - 0.8)E 1 (0/ 2)	-3.4E 1 (-3.6 - -3.2)E 1 (0/ 2)
Cs-134	(5) (0)	130	1.3E 0 (-3.7 - 9.7)E 0 (0/ 3)	11A	9.7E 0 (0/ 1)	-1.3E 0 (-5.3 - 2.8)E 0 (0/ 2)
Cs-137	(5) (0)	150	9.7E -1 (-2.3 - 5.2)E 0 (0/ 3)	11	1.5E 0 (-2.3 - 5.2)E 0 (0/ 2)	-1.7E 0 (-3.9 - 0.5)E 0 (0/ 2)

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Lobster and Rock Crab (CR) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean Range (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range (No. Detected***)	Control Stations: Mean Range (No. Detected***)
Be-7	(8) (0)		2.7E 1 (-6.8 - 17.6)E 1 (0/ 4)	11	2.7E 1 (-6.8 - 17.6)E 1 (0/ 4)	-2.9E 1 (-1.2 - 1.3)E 2 (0/ 4)
K-40	(8) (0)		2.1E 3 (1.4 - 2.8)E 3 (4/ 4)	11	2.1E 3 (1.4 - 2.8)E 3 (4/ 4)	1.9E 3 (1.6 - 2.3)E 3 (4/ 4)
Mn-54	(8) (0)	130	-7.4E 0 (-1.5 - 0.1)E 1 (0/ 4)	24	-3.1E -1 (-1.1 - 0.8)E 1 (0/ 4)	-3.1E -1 (-1.1 - 0.8)E 1 (0/ 4)
Co-58	(8) (0)	130	-2.2E 0 (-1.8 - 1.6)E 1 (0/ 4)	11	-2.2E 0 (-1.8 - 1.6)E 1 (0/ 4)	-2.5E 0 (-1.2 - 1.4)E 1 (0/ 4)
Fe-59	(8) (0)	260	-7.0E 0 (-3.7 - 3.7)E 1 (0/ 4)	24	-3.9E 0 (-3.2 - 0.9)E 1 (0/ 4)	-3.9E 0 (-3.2 - 0.9)E 1 (0/ 4)
Co-60	(8) (0)	130	-1.1E 1 (-1.8 - -0.3)E 1 (0/ 4)	24	-3.5E 0 (-1.8 - 1.0)E 1 (0/ 4)	-3.5E 0 (-1.8 - 1.0)E 1 (0/ 4)
Zn-65	(8) (0)	260	-2.4E 1 (-5.8 - 3.2)E 1 (0/ 4)	24	-1.6E 1 (-6.4 - 2.2)E 1 (0/ 4)	-1.6E 1 (-6.4 - 2.2)E 1 (0/ 4)
Ag-110	(8) (0)		1.3E 1 (-5.6 - 37.1)E 0 (0/ 4)	11	1.3E 1 (-5.6 - 37.1)E 0 (0/ 4)	-1.0E 1 (-2.4 - 0.5)E 1 (0/ 4)
Sb-124	(8) (0)		2.5E 0 (-2.5 - 3.8)E 1 (0/ 4)	11	2.5E 0 (-2.5 - 3.8)E 1 (0/ 4)	-3.6E 0 (-5.9 - 4.8)E 1 (0/ 4)
Cs-134	(8) (0)	130	7.6E 0 (0.0 - 1.4)E 1 (0/ 4)	11	7.6E 0 (0.0 - 1.4)E 1 (0/ 4)	3.3E 0 (-8.8 - 15.2)E 0 (0/ 4)
Cs-137	(8) (0)	150	1.8E 0 (-9.3 - 13.0)E 0 (0/ 4)	11	1.8E 0 (-9.3 - 13.0)E 0 (0/ 4)	-6.7E 0 (-3.1 - 1.5)E 1 (0/ 4)

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Mussel (MU) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)	Required LLD	Indicator Stations Mean Range (No. Detected***)	Station With Highest Mean Sta.	Station With Highest Mean Mean Range (No. Detected***)	Control Stations Mean Range (No. Detected***)
Be-7 (4) (0)		-1.7E 0 (-2.8 - 2.4)E 1 (0/ 2)	24	8.5E 1 (0.0 - 1.7)E 2 (0/ 2)	8.5E 1 (0.0 - 1.7)E 2 (0/ 2)
K-40 (4) (0)		8.6E 2 (8.3 - 9.0)E 2 (2/ 2)	11	8.6E 2 (8.3 - 9.0)E 2 (2/ 2)	7.9E 2 (4.1 - 11.6)E 2 (1/ 2)
Mn-54 (4) (0)	130	-1.3E 0 (-2.7 - 0.0)E 0 (0/ 2)	24	1.3E 1 (9.9 - 16.8)E 0 (0/ 2)	1.3E 1 (9.9 - 16.8)E 0 (0/ 2)
Co-58 (4) (0)	130	-8.9E 0 (-1.4 - -0.4)E 1 (0/ 2)	24	-6.8E 0 (-2.2 - 0.8)E 1 (0/ 2)	-6.8E 0 (-2.2 - 0.8)E 1 (0/ 2)
Fe-59 (4) (0)	260	-3.7E 1 (-6.8 - -0.6)E 1 (0/ 2)	24	4.7E 0 (-3.9 - 4.8)E 1 (0/ 2)	4.7E 0 (-3.9 - 4.8)E 1 (0/ 2)
Co-60 (4) (0)	130	-1.5E 0 (-1.3 - 1.0)E 1 (0/ 2)	11	-1.5E 0 (-1.3 - 1.0)E 1 (0/ 2)	-1.9E 0 (-9.8 - 5.9)E 0 (0/ 2)
Zn-65 (4) (0)	260	-2.1E 0 (-7.1 - 2.9)E 0 (0/ 2)	24	3.7E 1 (-2.0 - 9.4)E 1 (0/ 2)	3.7E 1 (-2.0 - 9.4)E 1 (0/ 2)
Ag-110 (4) (0)		-4.4E 0 (-1.1 - 0.3)E 1 (0/ 2)	24	1.6E 0 (-8.1 - 11.3)E 0 (0/ 2)	1.6E 0 (-8.1 - 11.3)E 0 (0/ 2)
Sb-124 (4) (0)		-6.2E 0 (-2.7 - 1.5)E 1 (0/ 2)	24	2.3E 1 (1.4 - 3.2)E 1 (0/ 2)	2.3E 1 (1.4 - 3.2)E 1 (0/ 2)
Cs-134 (4) (0)	130	8.5E 0 (3.8 - 13.2)E 0 (0/ 2)	11	8.5E 0 (3.8 - 13.2)E 0 (0/ 2)	-2.1E 0 (-6.5 - 2.4)E 0 (0/ 2)
Cs-137 (4) (0)	150	-1.3E 0 (-1.4 - 1.2)E 1 (0/ 2)	11	-1.3E 0 (-1.4 - 1.2)E 1 (0/ 2)	-3.5E 0 (-7.8 - 0.9)E 0 (0/ 2)

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

Table 5.1
Radiological Environmental Program Summary
Maine Yankee Nuclear Power Station, Wiscasset, ME
(January - December 2001)

MEDIUM: Soft Shell Clams (MA) UNITS: pCi/kg

Radionuclides* (No. Analyses) (Non-Routine**)		Required LLD	Indicator Stations: Mean Range (No. Detected***)	Station With Highest Mean: Sta.	Station With Highest Mean: Mean Range (No. Detected***)	Control Stations: Mean Range (No. Detected***)
Be-7	(4) (0)		5.4E 0 (-6.5 - 4.0)E 1 (0/ 4)	16	3.6E 1 (3.2 - 4.0)E 1 (0/ 2)	NO DATA
K-40	(4) (0)		1.5E 3 (1.4 - 1.6)E 3 (4/ 4)	18	1.5E 3 (1.4 - 1.6)E 3 (2/ 2)	NO DATA
Mn-54	(4) (0)		3.5E -1 (-2.5 - 4.1)E 0 (0/ 4)	18	2.0E 0 (-2.1 - 41.5)E -1 (0/ 2)	NO DATA
Co-58	(4) (0)		-1.4E 0 (-7.5 - 3.2)E 0 (0/ 4)	18	3.0E 0 (2.9 - 3.2)E 0 (0/ 2)	NO DATA
Fe-59	(4) (0)		-1.1E 1 (-6.2 - 2.3)E 1 (0/ 4)	18	7.2E -1 (-2.2 - 2.3)E 1 (0/ 2)	NO DATA
Co-60	(4) (0)		-3.7E 0 (-8.3 - 2.6)E 0 (0/ 4)	18	-2.9E 0 (-8.3 - 2.6)E 0 (0/ 2)	NO DATA
Zn-65	(4) (0)		-2.9E 1 (-5.0 - -0.4)E 1 (0/ 4)	18	-1.7E 1 (-2.9 - -0.4)E 1 (0/ 2)	NO DATA
Ag-110	(4) (0)		-7.6E 0 (-1.9 - -0.2)E 1 (0/ 4)	16	-4.5E 0 (-5.3 - -3.7)E 0 (0/ 2)	NO DATA
Sb-124	(4) (0)		1.0E 0 (-7.8 - 14.8)E 0 (0/ 4)	18	3.5E 0 (-7.8 - 14.8)E 0 (0/ 2)	NO DATA
Cs-134	(4) (0)		4.5E 0 (-4.0 - 14.2)E 0 (0/ 4)	18	1.0E 1 (6.4 - 14.2)E 0 (0/ 2)	NO DATA
Cs-137	(4) (0)		6.2E 0 (-6.7 - 20.9)E 0 (0/ 4)	18	7.1E 0 (-6.7 - 20.9)E 0 (0/ 2)	NO DATA

* The radionuclides reported in this table are those that: 1) had an LLD requirement in ODCM Table 2.4, or a Reporting Level in ODCM Table 2.5, or 2) had a positive measurement of radioactivity, whether it was naturally occurring or man-made; or 3) were of specific interest for any other reason.

** Non-Routine refers to those radionuclides that exceeded the Reporting Levels in ODCM Table 2.5.

*** The fraction of sample analyses yielding detectable measurements (i.e. >3 standard deviations) is shown in parentheses.

TABLE 5.2

ENVIRONMENTAL TLD DATA SUMMARY
MAINE YANKEE NUCLEAR POWER STATION, WISCASSET, ME
(JANUARY - DECEMBER 2001)

INNER RING TLDs MEAN ± S.D.* RANGE* (NO. MEASUREMENTS)**			OUTER RING TLDs MEAN ± S.D.* RANGE* (NO. MEASUREMENTS)**			STATION WITH HIGHEST MEAN STA. NO.	MEAN ± S.D.* RANGE* (NO. MEASUREMENTS)**			CONTROL TLDs MEAN ± S.D.* RANGE* (NO. MEASUREMENTS)**		
6.9	±	1.0	7.3	±	1.2	37	9.6	±	0.9	7.9	±	1.5
4.0	-	9.0	4.7	-	9.9		8.4	-	10.6	5.4	-	10.6
	(68)			(67)				(4)			(12)	

* Units are micro-R per hour.

** Each "measurement" is based on quarterly readings from five TLD elements.

NOTE: S.D. = standard deviation.

TABLE 5.3

2001 Environmental TLD Measurements
(Micro-R per hour)

Sta. No.	Description	1st Quarter Exp.		1st Quarter S.D.	2nd Quarter Exp.		2nd Quarter S.D.	3rd Quarter Exp.		3rd Quarter S.D.	4th Quarter Exp.		4th Quarter S.D.	Annual Ave. Exp.
TL-1	Old Ferry Rd.	6.5	±	0.3	8.9	±	0.4	8.6	±	0.4	8.6	±	0.4	8.1
TL-2	Old Ferry Rd.	5.5	±	0.2	6.8	±	0.3	7.4	±	0.3	7.1	±	0.3	6.7
TL-3	Bailey House (ESL)	5.4	±	0.2	6.9	±	0.3	7.4	±	0.4	7.3	±	0.4	6.6
TL-4	Westport Isl./Rt. 144	4.0	±	0.2	5.9	±	0.2	6.9	±	0.2	6.8	±	0.3	5.9
TL-5	MY Information Center	6.0	±	0.3	7.3	±	0.3	7.9	±	0.3	7.0	±	0.4	7.1
TL-6	Rt. 144/Greenleaf Rd.	7.6	±	0.5	7.7	±	0.5	7.7	±	0.4	8.0	±	0.4	7.7
TL-7	Westport Isl./Rt. 144	5.4	±	0.2	7.0	±	0.3	7.4	±	0.3	7.4	±	0.4	6.8
TL-8	MY Screenhouse	5.6	±	0.3	6.6	±	0.3	7.5	±	0.3	6.4	±	0.3	6.5
TL-9	Westport Isl./Rt. 144	5.0	±	0.2	7.2	±	0.3	7.5	±	0.3	7.5	±	0.3	6.8
TL-10	Bailey Point	5.6	±	0.2	6.6	±	0.2	7.1	±	0.3	6.4	±	0.4	6.4
TL-11	Mason Station	5.7	±	0.3	7.8	±	0.4	8.4	±	0.3	8.1	±	0.3	7.5
TL-12	Westport Firehouse	5.3	±	0.2	6.9	±	0.3	7.4	±	0.3	7.6	±	0.3	6.8
TL-13	Foxbird Island	6.5	±	0.2	8.1	±	0.2	8.1	±	0.4	7.9	±	0.3	7.6
TL-14	Eaton Farm	4.7	±	0.1	6.6	±	0.2	7.3	±	0.4	7.1	±	0.3	6.4
TL-15	Eaton Farm	5.1	±	0.3	7.2	±	0.2	7.8	±	0.3	7.4	±	0.4	6.9
TL-16	Eaton Farm	5.2	±	0.1	7.1	±	0.2	7.5	±	0.4	6.8	±	0.3	6.7
TL-17	Eaton Farm Rd.	5.7	±	0.2	8.2	±	0.2	9.0	±	0.5		(1)		7.6
TL-18	Eaton Farm Rd.	5.4	±	0.3	7.1	±	0.3	7.5	±	0.3		(1)		6.7
TL-19	Eaton Farm Rd.	6.2	±	0.2	7.2	±	0.3	7.8	±	0.3	7.3	±	0.3	7.1
TL-20	Bradford Rd.	5.0	±	0.2	6.8	±	0.3	7.1	±	0.4	7.1	±	0.3	6.5
TL-21	Federal St.	5.5	±	0.3	6.7	±	0.3	7.9	±	1.0	7.0	±	0.3	6.8
TL-22	Cochran Rd.	5.2	±	0.2	7.3	±	0.3	7.8	±	0.4	7.5	±	0.3	6.9
TL-23	Middle Rd.	6.7	±	0.3	9.4	±	0.5	9.9	±	0.5	9.7	±	0.3	8.9
TL-24	River Rd.	6.5	±	0.3	7.5	±	0.4	8.0	±	0.4	7.9	±	0.3	7.5
TL-25	River Rd./Rt. 27	5.7	±	0.3	7.6	±	0.3	7.8	±	0.3	7.9	±	0.4	7.2
TL-26	Boothbay RR Museum	6.6	±	0.2	7.2	±	0.2	7.8	±	0.4	8.0	±	0.4	7.4
TL-27	Barters Island	5.7	±	0.2	6.7	±	0.2	7.8	±	0.3	7.7	±	0.3	6.9
TL-28	Rt. 144/E. Shore Rd.	4.9	±	0.2	7.0	±	0.2	7.4	±	0.5	7.5	±	0.3	6.7
TL-29	Harrison's Trailer	5.7	±	0.3	6.8	±	0.2	7.4	±	0.4	7.4	±	0.4	6.8
TL-30	Leeman Farm	6.8	±	0.3	8.3	±	0.2	8.4	±	0.4	8.8	±	0.3	8.1
TL-31	Barley Neck Rd.	6.8	±	0.3	8.9	±	0.2	8.9	±	0.5	8.7	±	0.4	8.3
TL-32	Baker Farm	5.1	±	0.3	8.2	±	0.4	8.2	±	0.3	8.1	±	0.3	7.4
TL-33	Rt. 127	5.1	±	0.3	7.5	±	0.3	7.5	±	0.3	7.8	±	0.3	7.0
TL-34	Rt. 127	5.0	±	0.1	7.1	±	0.3	8.1	±	0.4		(1)		6.7
TL-35	Rt. 127	4.7	±	0.3	6.7	±	0.3	7.7	±	0.3	7.1	±	0.3	6.5
TL-36	Boothbay Hbr.Fire Sta.	6.5	±	0.2	6.8	±	0.2	7.0	±	0.4	7.3	±	0.3	6.9
TL-37	Bath Fire Sta.	8.4	±	0.3	9.7	±	0.4	9.8	±	0.6	10.6	±	0.4	9.6
TL-38	Dresden Station	5.4	±	0.2	7.7	±	0.2	7.9	±	0.5	7.9	±	0.3	7.2

Note:
Exp. = Exposure Rate in MicroR/hr
S.D. = Standard Deviation

(1) TLD Missing

TABLE 5.3
(continued)

2001 Environmental TLD Measurements
(Micro-R per hour)

		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Annual
Sta. No.	Description	Exp.	S.D.	Exp.	S.D.	Exp.	S.D.	Exp.	S.D.	Ave. Exp.
TL-I-01	N	5.1	0.2	7.4	0.2	7.9	0.4	7.1	0.3	6.9
TL-I-02	NNE	5.6	0.2	7.2	0.2	7.5	0.3	7.0	0.3	6.8
TL-I-03	NE	6.3	0.3	9	1.1	8.5	0.3	7.5	0.3	7.8
TL-I-04	ENE	5.4	0.2	6.8	0.2	7.6	0.4	7.3	0.5	6.8
TL-I-05	E	5.4	0.2	6.9	0.3	7.4	0.4	7.3	0.4	6.8
TL-I-06	ESE	6.1	0.2	7.9	0.3	8.6	0.3	7.7	0.3	7.6
TL-I-07	SE	5.4	0.2	7	0.3	7.1	0.3	6.8	0.3	6.6
TL-I-08	SSE	4.9	0.3	6.7	0.3	7.1	0.4	6.5	0.2	6.3
TL-I-09	S	5.6	0.2	7.7	0.2	8.2	0.5	7.5	0.3	7.3
TL-I-10	SSW	6.0	0.3	7.3	0.3	7.9	0.3	7.0	0.4	7.1
TL-I-11	SW	6.3	0.3	8.5	0.3	8.8	0.5	8.0	0.3	7.9
TL-I-12	WSW	7.1	0.2	8.6	0.3	8.5	0.4	8.2	0.3	8.1
TL-I-13	WSW	6.9	0.4	8.3	0.4	8.6	0.5	7.7	0.4	7.9
TL-I-14	WNW	5.8	0.2	8.2	0.4	8.4	0.3	7.9	0.3	7.6
TL-I-15	NW	6.6	0.3	8.5	0.3	8.9	0.3	8.4	0.4	8.1
TL-I-16	NNW	6.4	0.3	9.3	0.3	9.8	0.4	9	0.6	8.6

6.0 ANALYSIS OF ENVIRONMENTAL RESULTS

6.1 Sampling Program Deviations

Table 2.3 of the Offsite Dose Calculation Manual (ODCM) allows for deviations in the REMP sampling schedule "if specimens are unobtainable due to hazardous conditions, to seasonal unavailability or to malfunction of sampling equipment." Such deviations do not compromise the program's effectiveness and in fact are considered insignificant with respect to what is normally anticipated for any radiological environmental monitoring program. The deviations for 2001 were as follows:

- On July 5, 2001, the air sampler at Montsweag Dam (AP-11) was found damaged due to apparent lightning strike. The motor had reversed polarity and had blown the filter outward. The unit was replaced with a new pump and no further interruptions occurred.

- On August 29, 2001, the air sampler at Montsweag Dam (AP-11) was discovered not working, with the circuit breaker tripped. It was determined that the sampler had been out of service for approximately 228 hours. The breaker was reset, and the unit returned to service without further problems.

- For the fourth quarter, TL-17, TL-18 and TL-34 were discovered missing. As a result, there are no monitoring results for this quarter for these stations.

6.2 Comparison of Achieved LLDs with Requirements

Table 2.4 of the ODCM gives the required Lower Limits of Detection (LLDs) for environmental sample analyses. (This table is duplicated in Table 4.4 of this report.) Occasionally an LLD is not achievable due to a situation such as a low sample volume caused by sampling equipment malfunction. In such a case, ODCM Appendix C, Section 1 requires a discussion of the situation. At the DESEL, the target LLD for any analysis is typically 30-40 percent of the most restrictive required LLD. Expressed differently, the typical sensitivities achieved for each analysis are at least 2.5 to 3 times greater than that required by the Maine Yankee ODCM.

For each analysis having an LLD requirement in ODCM Table 2.4, the *a posteriori* (after the fact) LLD calculated for that analysis was compared with the required LLD. During 2001, more than 700 analyses had an LLD requirement listed in Table 2.4. All analyzed samples met the required LLD.

6.3 Comparison of Results against Reporting Levels

Section 2.4.3.3 of the ODCM requires the notification of the NRC (via the Annual Radioactive Effluent Release Report) whenever a Reporting Level in ODCM Table 2.5 is exceeded. Reporting Levels are the environmental concentrations that relate to the ALARA design dose objectives of 10 CFR 50, Appendix I. It should be noted that environmental concentrations are averaged over calendar quarters for the purposes of this comparison, and that Reporting Levels apply only to measured levels of radioactivity due to plant effluents. During 2001, no Reporting Levels were exceeded.

6.4 Data Analysis by Media Type

The 2001 REMP data for each media type is discussed below. Whenever a specific measurement result is presented, it is given as the concentration plus or minus one standard deviation. This standard deviation represents only the random uncertainty associated with the radioactive decay process (counting statistics), and not the propagation of all possible uncertainties in the analytical procedure. A sample is considered to yield a "detectable measurement" when the concentration exceeds three times its associated standard deviation. With respect to data plots, it should be noted that all values for a given graph are plotted, whether or not they are considered statistically significant (detectable).

6.4.1 Airborne Pathways

6.4.1.1 Air Particulates

The air particulate filters from each of the five sampling sites were analyzed bi-weekly for gross-beta radioactivity and are designated GR-B in Table 5.1. At the end of each quarter, the filters from each sampling site were composited for a gamma analysis. The results of the air particulate sampling program provided in Table 5.1 and are plotted in Figure 6.1 through Figure 6.5. As shown in Figure 6.1, there has been no significant difference between the quarterly average concentration at the indicator (near-plant) stations and the control (distant from plant) stations.

Figures 6.2 through 6.5 show the gross beta concentration at each air particulate sampling location alongside the control sampling location at AP-29 (Dresden Substation) for the same period. It can be readily seen that the gross-beta measurements on air particulate filters fluctuate significantly over the course of a year. The measurements from control station AP-29 vary similarly, indicating that these fluctuations are due to regional changes in naturally-occurring airborne radioactive materials, and not due to Maine Yankee activities. An increase in the average gross-beta concentration was observed for the month of October. However, since the increase was observed at all stations, including the control, the cause is not likely due to plant operations. Table 5.1 shows that the mean gross beta concentrations from indicator stations are equal to those from control locations, further supporting this conclusion. The only gamma emitting radionuclide detected on air particulate filters was Be-7, a naturally occurring cosmogenic radionuclide.

6.4.1.2 Mixed Grasses

Although not required by the Maine Yankee ODCM, mixed grass samples were collected twice at the Bailey Farm during 2001. In addition, a grass sample was also collected during January from Chewonki Farm (TM-18) as a replacement for the milk sample. As expected, naturally occurring K-40 and Be-7 were detected in the samples.

6.4.2 Waterborne Pathways

6.4.2.1 Estuary Water

Aliquots of estuary water were automatically collected in the discharge canal outfall every two hours during 2001. These composited samples were collected monthly and sent to the DESEL for analysis. Monthly grab samples were also collected at the control location. Table 5.1 shows that naturally-occurring K-40 was detected in samples collected at the WE-12 (plant outfall), as is typical with estuary water. The monthly samples were composited each quarter, by station, for Tritium (H-3) analyses. None of the samples taken showed any detectable level of H-3. Figure 6.6 provides a trend plot for quarterly composite H-3 concentrations at WE-12. All concentrations are plotted regardless of whether they are considered "detectable" or "not detectable". Those concentrations determined to be positive as defined in Section 5 are indicated with a black symbol.

6.4.2.2 Ground Water

Although not a requirement of the Maine Yankee REMP, quarterly ground water samples were collected from the well at the Environmental Services building and at a control location. The results of the gamma isotopic analyses are shown in Table 5.1. None of these off-site samples contained detectable radioactivity.

6.4.2.3 Shoreline Sediment

Semiannual sediment core samples were collected from two on-site locations during 2001. Each set of samples was segmented by depth (0-5, 5-10, 10-15 cm) and analyzed for gamma-emitting radionuclides. The results presented in Table 5.1 show that, as expected, naturally occurring K-40 and Th-232 was detected in all samples. In addition, Cs-137 was detected in 11 out of the 12 segments. Although some Cs-137 is expected to be present from worldwide weapons testing fallout, much of the Cs-137 is due to early plant operations. In the early years of plant operation, routine liquid effluents were discharged in the sediment collection area. Due to poor diffusion with this method, an underwater diffuser was installed, and now the liquid effluents are discharged into the Back River. The Cs-137 levels in each sediment core section are plotted in Figures 6.7 and 6.8. These graphs show a range of Cs-137 concentrations across core sections.

Although there is no Reporting Level for Cs-137 in sediment samples, one might appreciate the negligible dosimetric consequence when the measured concentrations are conservatively compared against the reporting levels for the fish ingestion pathway. The mean and maximum Cs-137 measurements were 200 and 620 pCi/kg (dry), respectively, both well under the Cs-137 Reporting Level in fish of 2000 pCi/kg.

6.4.2.4 Marine Algae

Although not required by the Maine Yankee ODCM, mixed samples of *Fucus* and *Ascophyllum* marine algae (seaweed) were collected at Long Ledge every month during 2001. All samples were analyzed for gamma-emitting radionuclides. As expected, naturally occurring K-40 and Be-7 were detected in the samples.

6.4.3 Ingestion Pathways

6.4.3.1 Milk

Milk samples were collected monthly when available during 2001 at one indicator and one control location. No milk was available from station TM-18 during the month of January due to the cow awaiting birth. Instead, a grass sample was collected from this station and is included in Table 5.1 under Mixed Grass (TG). Each sample collected was analyzed for gamma-emitting radionuclides. Although not an ODCM requirement, the samples were composited quarterly by location and analyzed for Sr-90.

Cs-137 was detected in one of the indicator and three of the control samples. Figures 6.9 and 6.10

show the Cs-137 concentration in cow milk for 2001. The annual average Cs-137 concentrations in cow milk are similar to previous years. All Cs-137 concentrations, whether considered "detectable" or "non-detectable", are plotted in Figure 6.9.

Figure 6.11 shows the Sr-90 concentrations in quarterly composited cow milk for 2001. The amount of strontium in milk is a function of many dietary factors, primarily calcium concentration and the degree of mineral exchange in the bones, and may be observed in the milk once an uptake has occurred. Neither the cesium nor strontium in the milk is attributable to plant activities but rather is due to residual weapons fallout concentrations of Cs-137 and Sr-90.

6.4.3.2 Fish & Invertebrates

Semiannual samples of fish (FH) and invertebrates (lobster (HA), rock crab (CA) and blue mussel (MU)) were collected from locations -11 and -24 during 2001. The media code for the combined category of lobster and rock crab has been designated as CR in Table 5.1. Soft-shell clams (*Mya arenaria* - MA) were collected from two locations within Bailey Cove. The edible portions of each of these biota were analyzed for gamma-emitting radionuclides. As expected in biological matter, naturally occurring K-40 was detected in all 21 fish and invertebrate samples. No other radionuclides were detected.

6.4.4 Direct Radiation Pathway

Direct radiation is continuously measured at 38 locations surrounding the Maine Yankee plant with the use of thermoluminescent dosimeters (TLDs). These are collected every calendar quarter for readout at the DESEL.

As can be seen in Figures 6.13 to 6.23, there is a distinct annual cycle at both indicator and control locations. The lowest point of the cycle occurs during the winter months. This is due primarily to the attenuating effect of the snow cover on radon emissions and on direct irradiation by naturally-occurring radionuclides in the soil. Differing amounts of these naturally-occurring radionuclides in the underlying soil, rock or nearby building materials result in different radiation levels between one field site and another. It can be seen from Figure 6.20 that the TLD at Middle Road in Edgecomb (TL-23) has historically given slightly elevated readings. This is apparently due to its close proximity to a ledge outcrop.

From Tables 5.2 and 5.3, as well as from Figure 6.13, it can be seen that the Inner and Outer Ring TLD mean exposure rates were not substantially different in 2001, and that the Control TLD mean exposure rate was slightly greater than that at the Inner and Outer Rings.

FIGURE 6.1

GROSS-BETA MEASUREMENTS
ON AIR PARTICULATE FILTERS
QUARTERLY AVERAGE CONCENTRATIONS

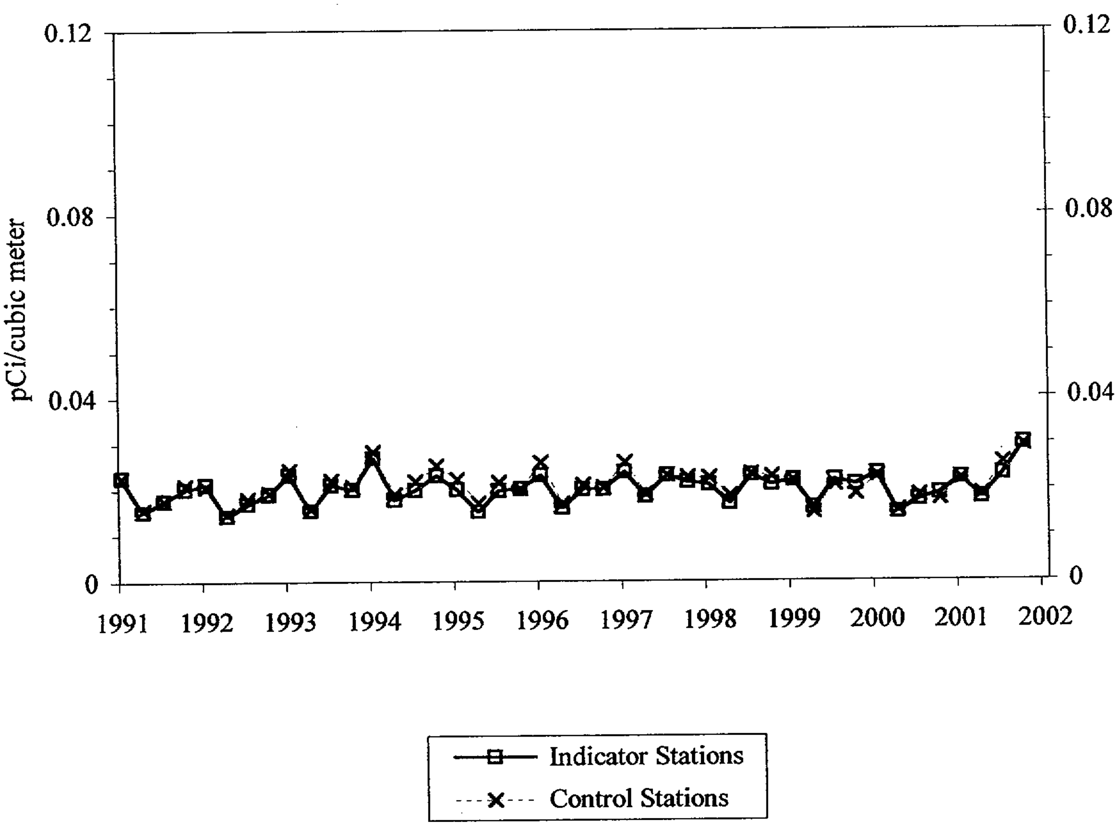
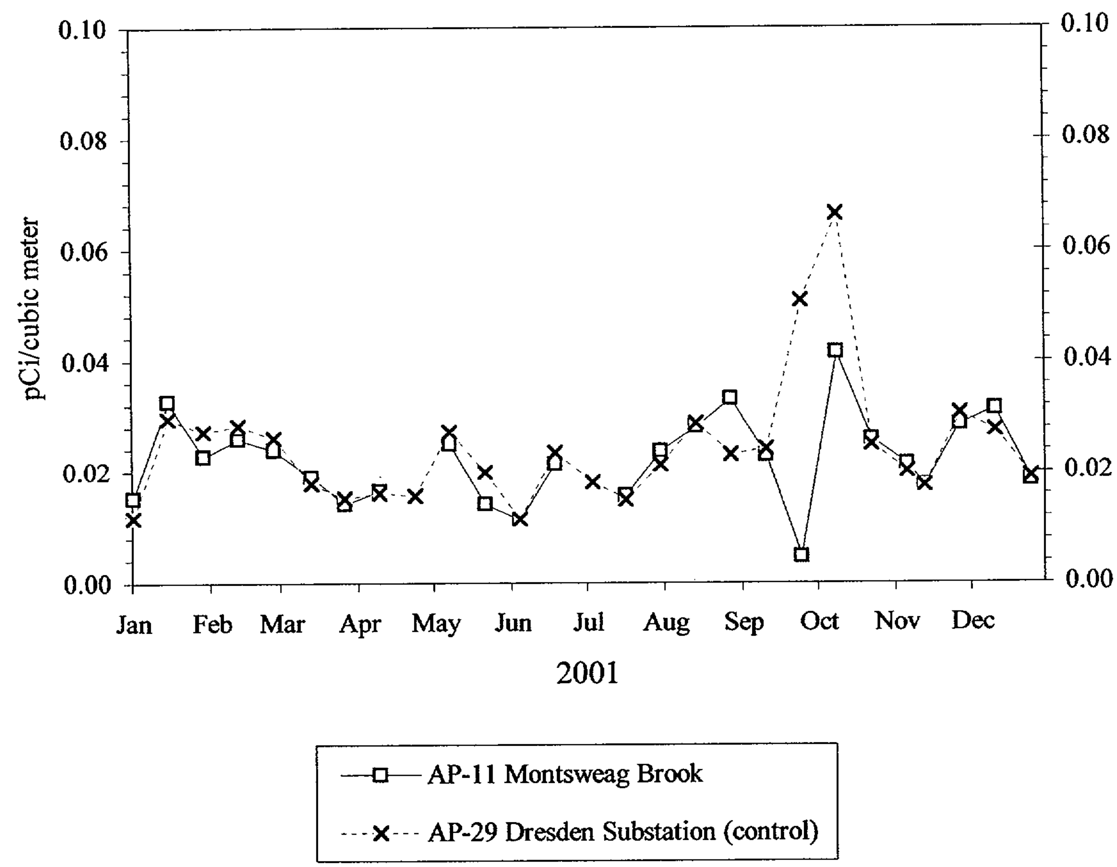


FIGURE 6.2

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS



Note: Low concentration for station AP-11 during September due to light sample loading on air particulate filter.

FIGURE 6.3

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

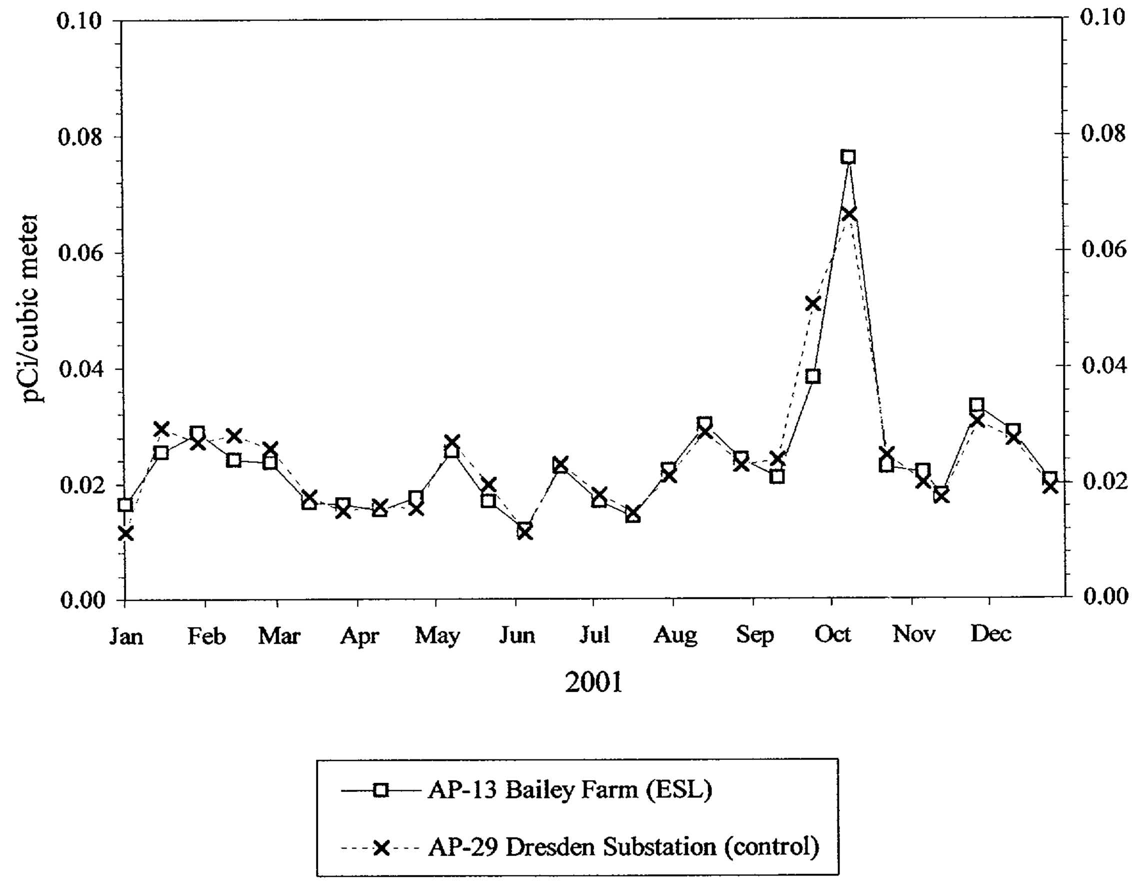


FIGURE 6.4

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

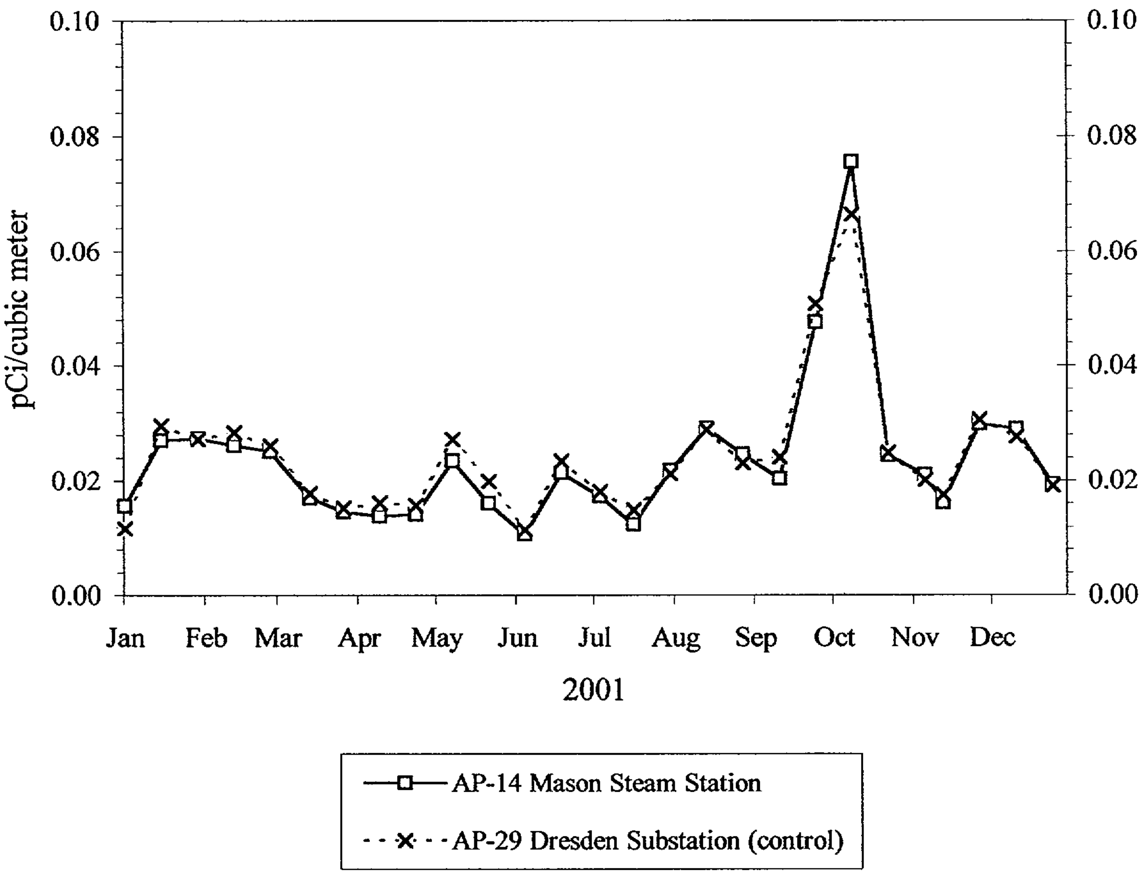


FIGURE 6.5

GROSS-BETA MEASUREMENTS ON AIR PARTICULATE FILTERS

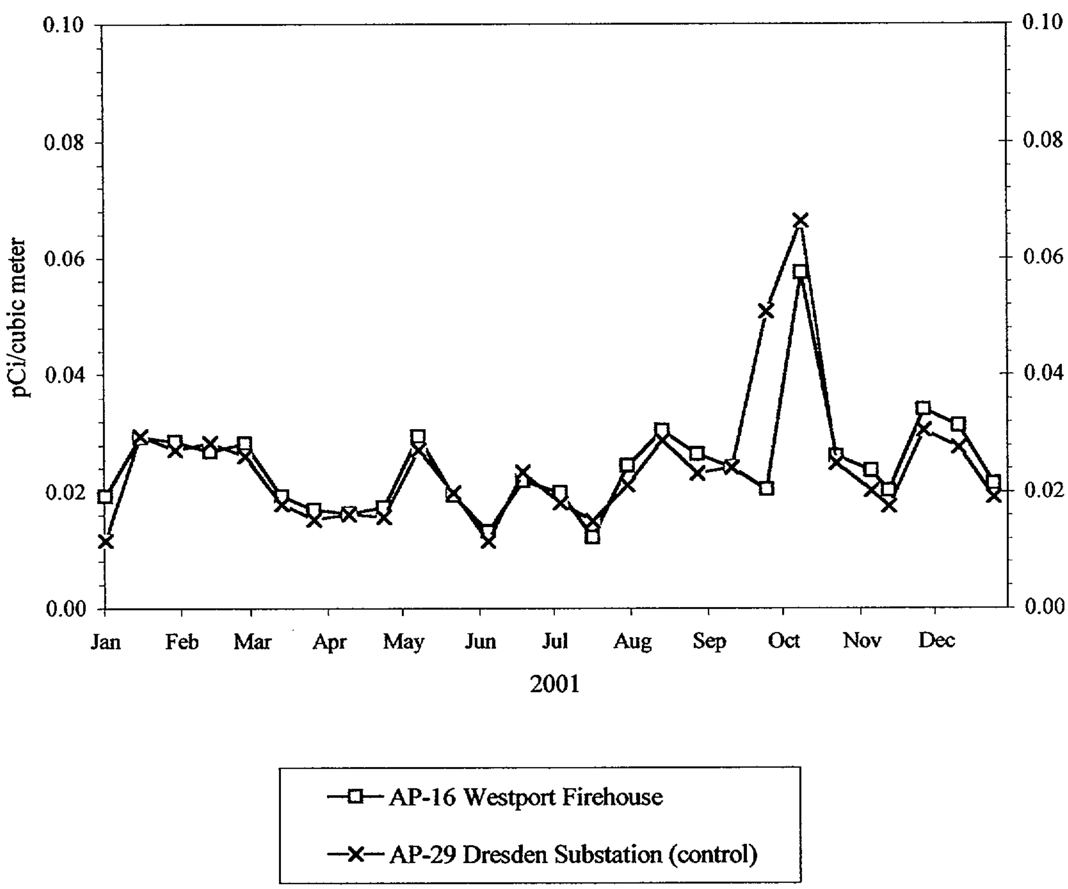


FIGURE 6.6

H-3 IN ESTUARY WATER
WE-12, PLANT OUTFALL

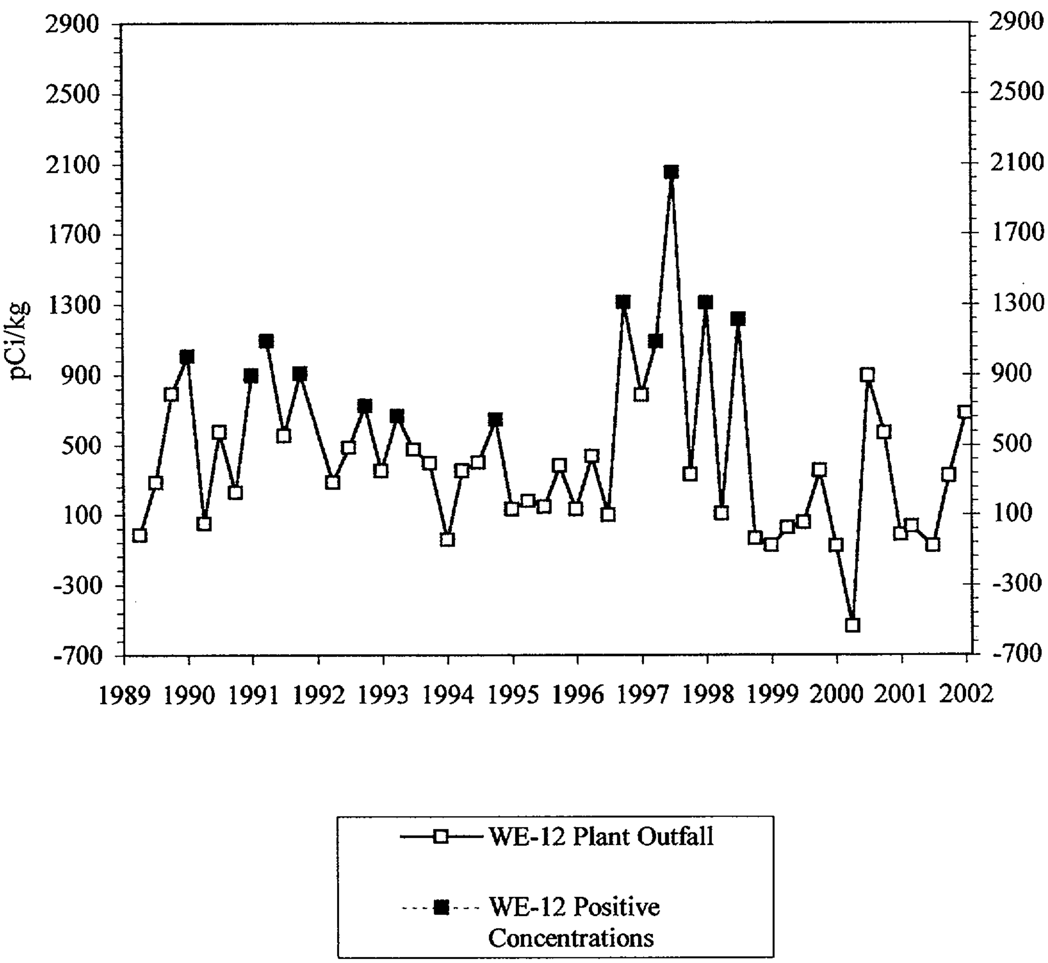


FIGURE 6.7

CESIUM-137 IN SHORELINE SEDIMENT
STATION SE-16, OLD OUTFALL AREA

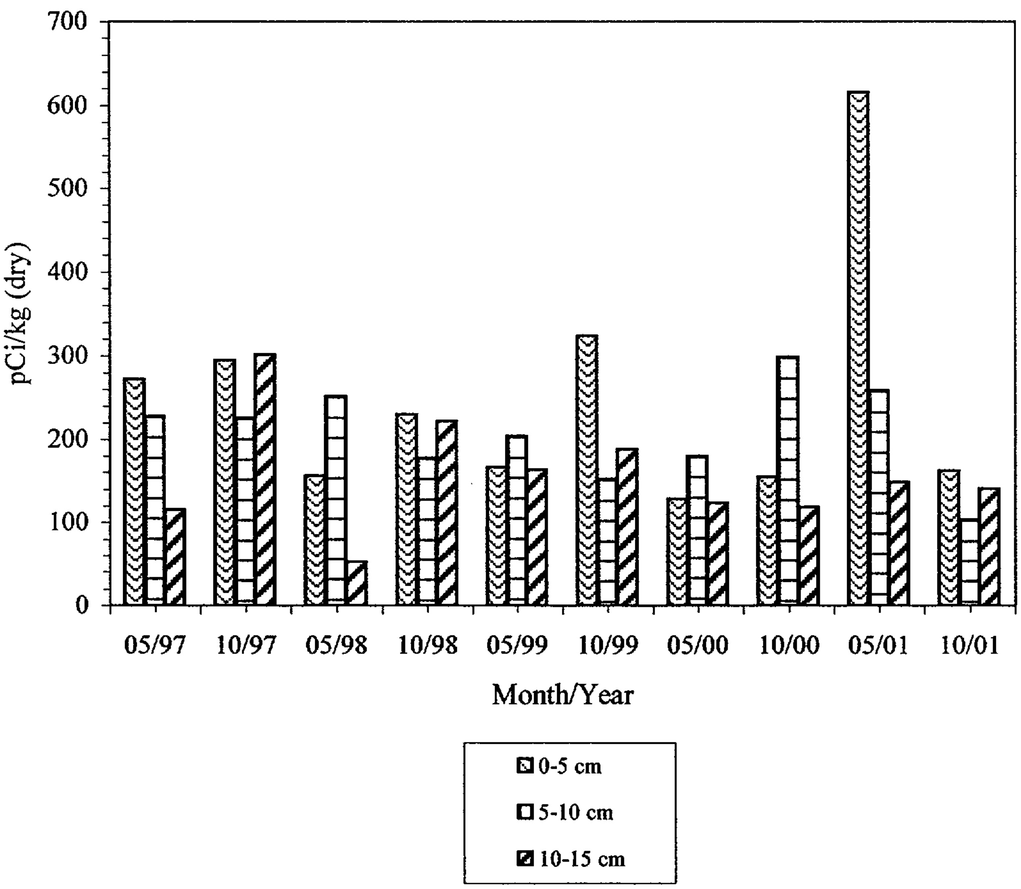


FIGURE 6.8

**CESIUM-137 IN SHORELINE SEDIMENT
STATION SE-18, OLD OUTFALL AREA**

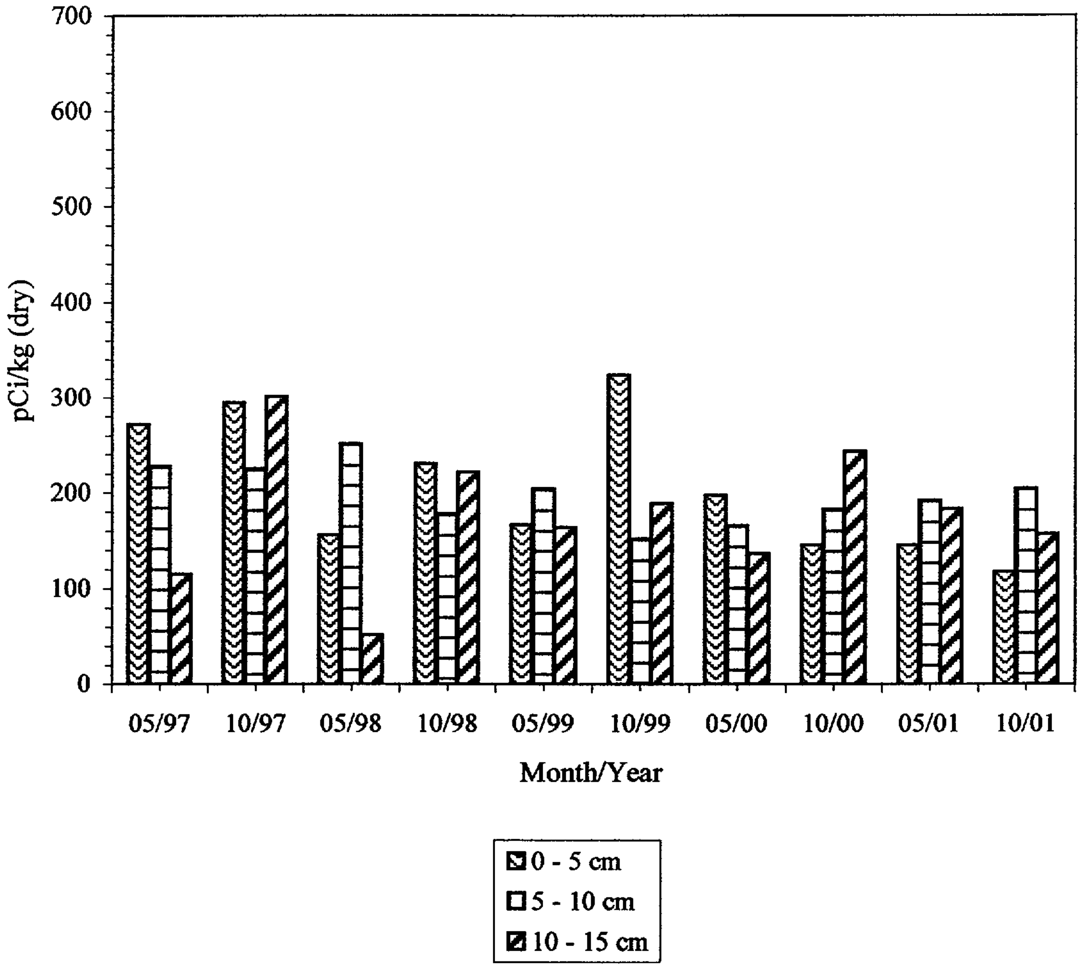


FIGURE 6.9

CESIUM-137 IN MILK

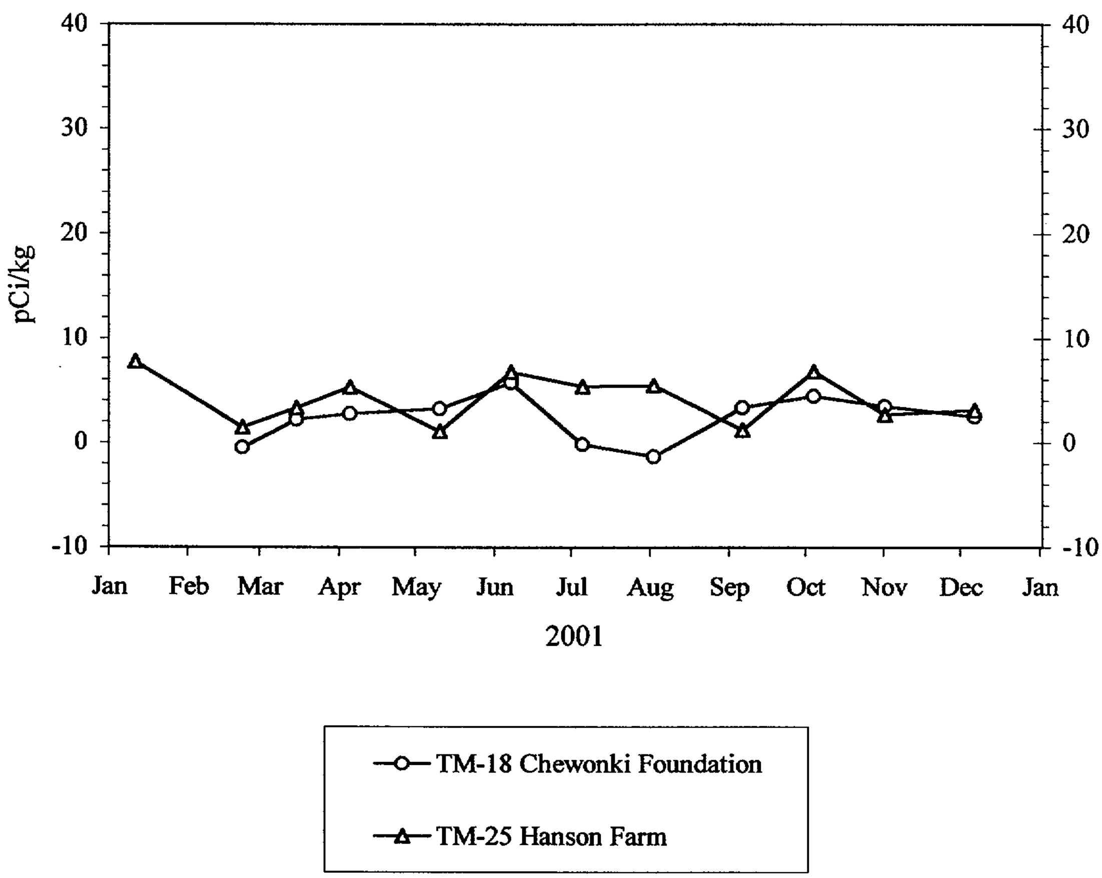


FIGURE 6.10

CESIUM-137 IN MILK
ANNUAL AVERAGE CONCENTRATIONS

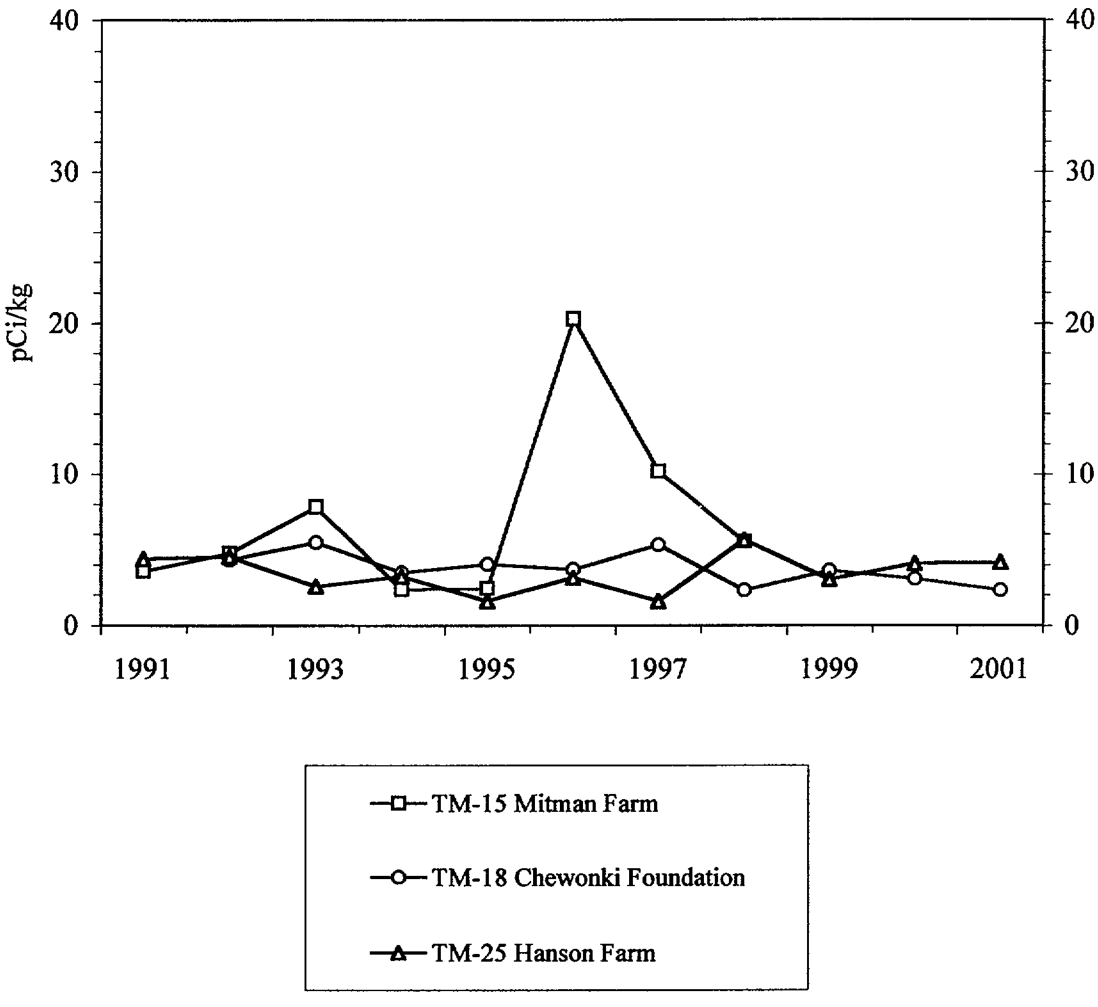


FIGURE 6.11

STRONTIUM - 90 IN MILK

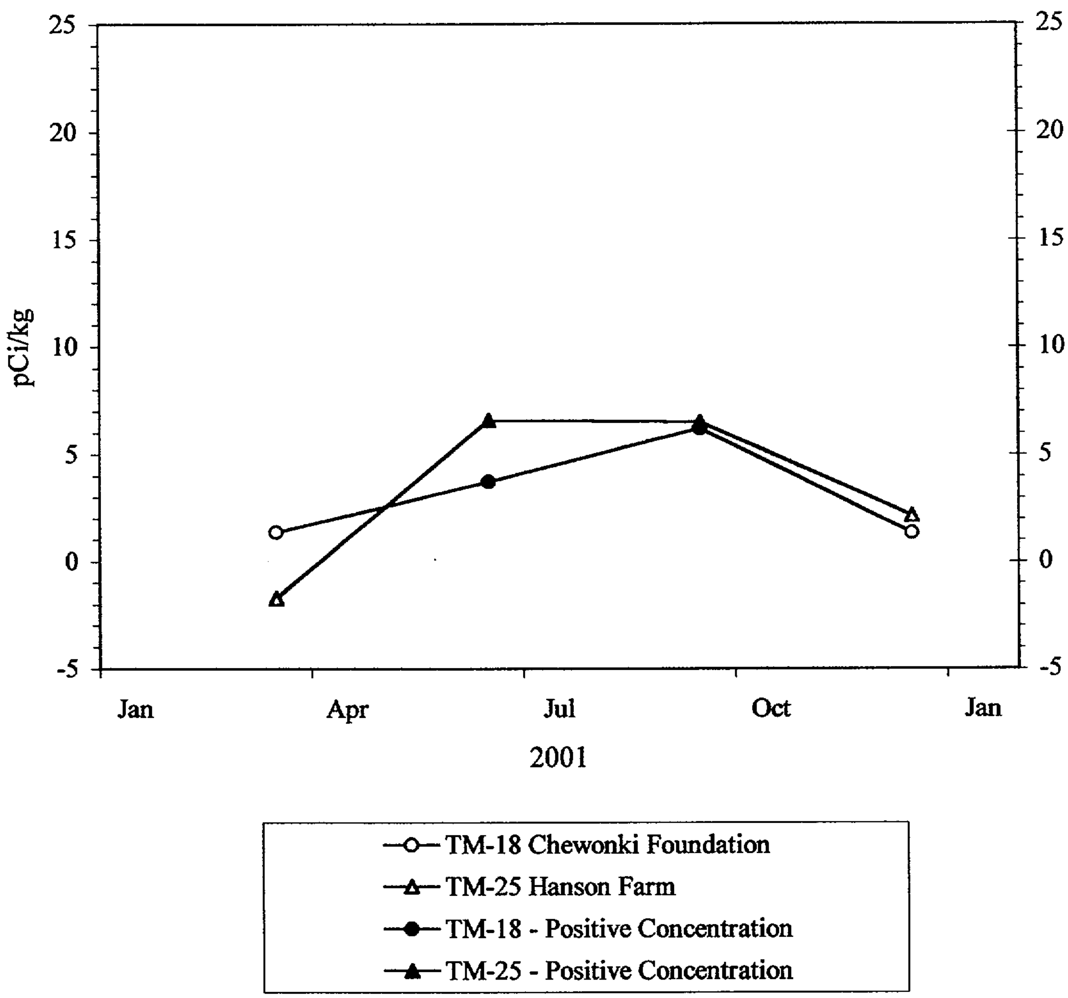


FIGURE 6.12

STRONTIUM-90 IN MILK
ANNUAL AVERAGE CONCENTRATIONS

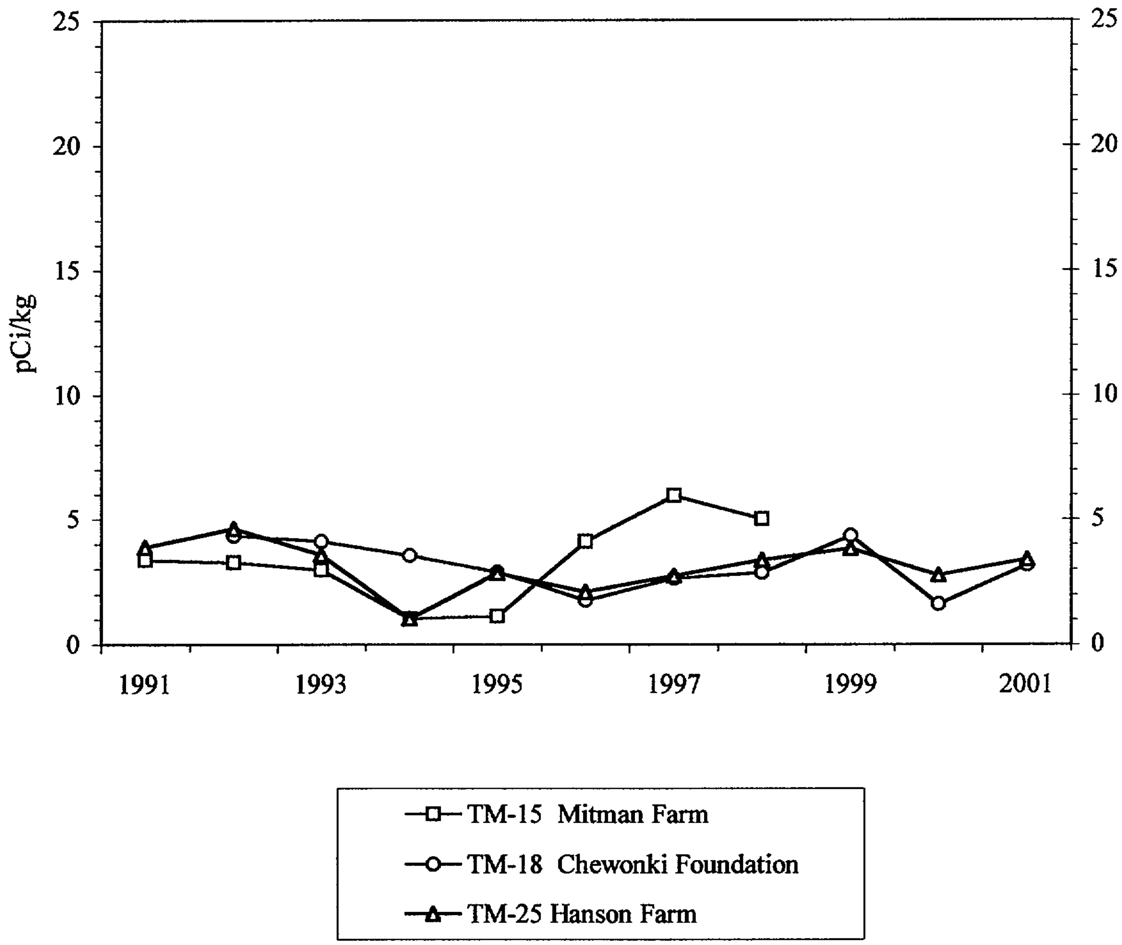


FIGURE 6.13

EXPOSURE RATE AT INNER RING, OUTER RING AND CONTROL TLDS

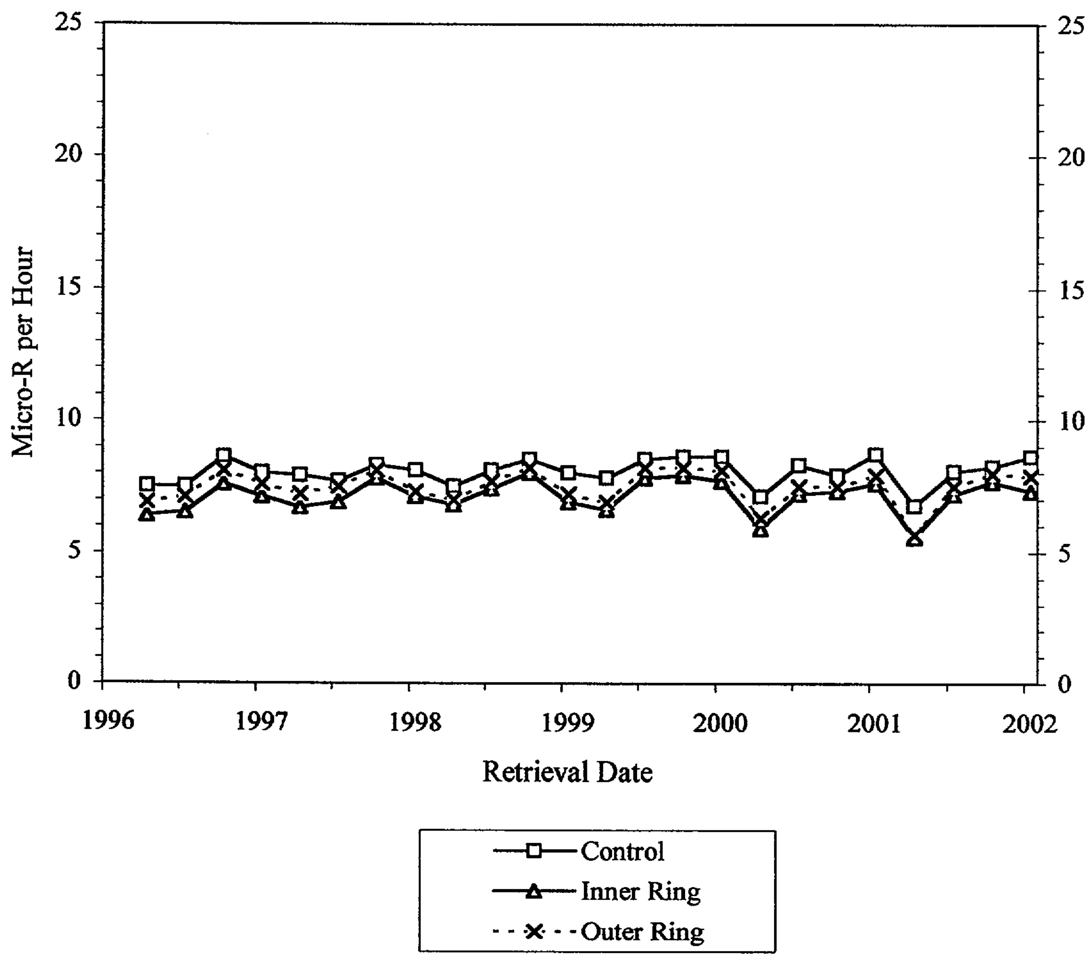


FIGURE 6.14

EXPOSURE RATE AT INNER RING TLDS, TL 01-04

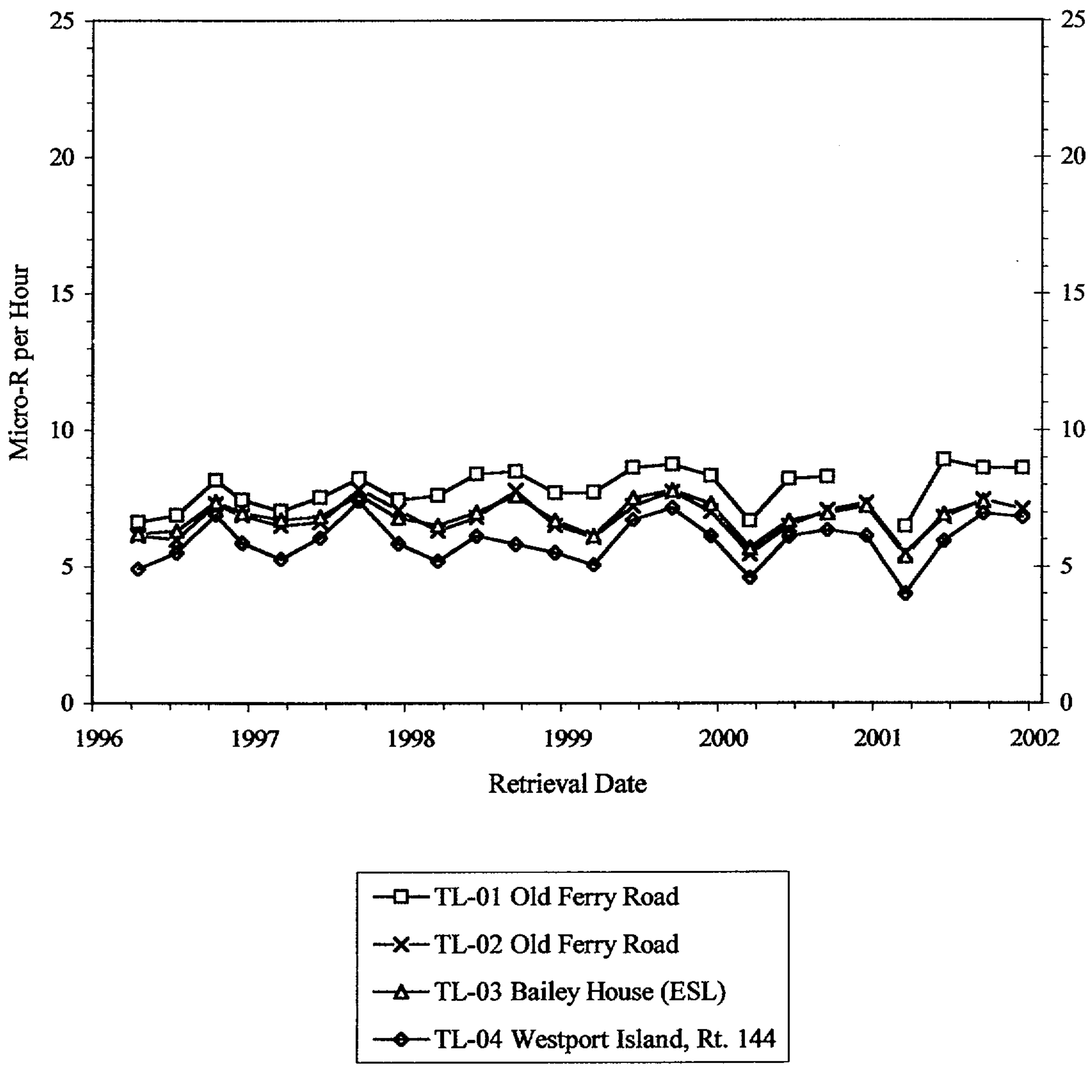


FIGURE 6.15

EXPOSURE RATE AT INNER RING TLDS, TL 05-08

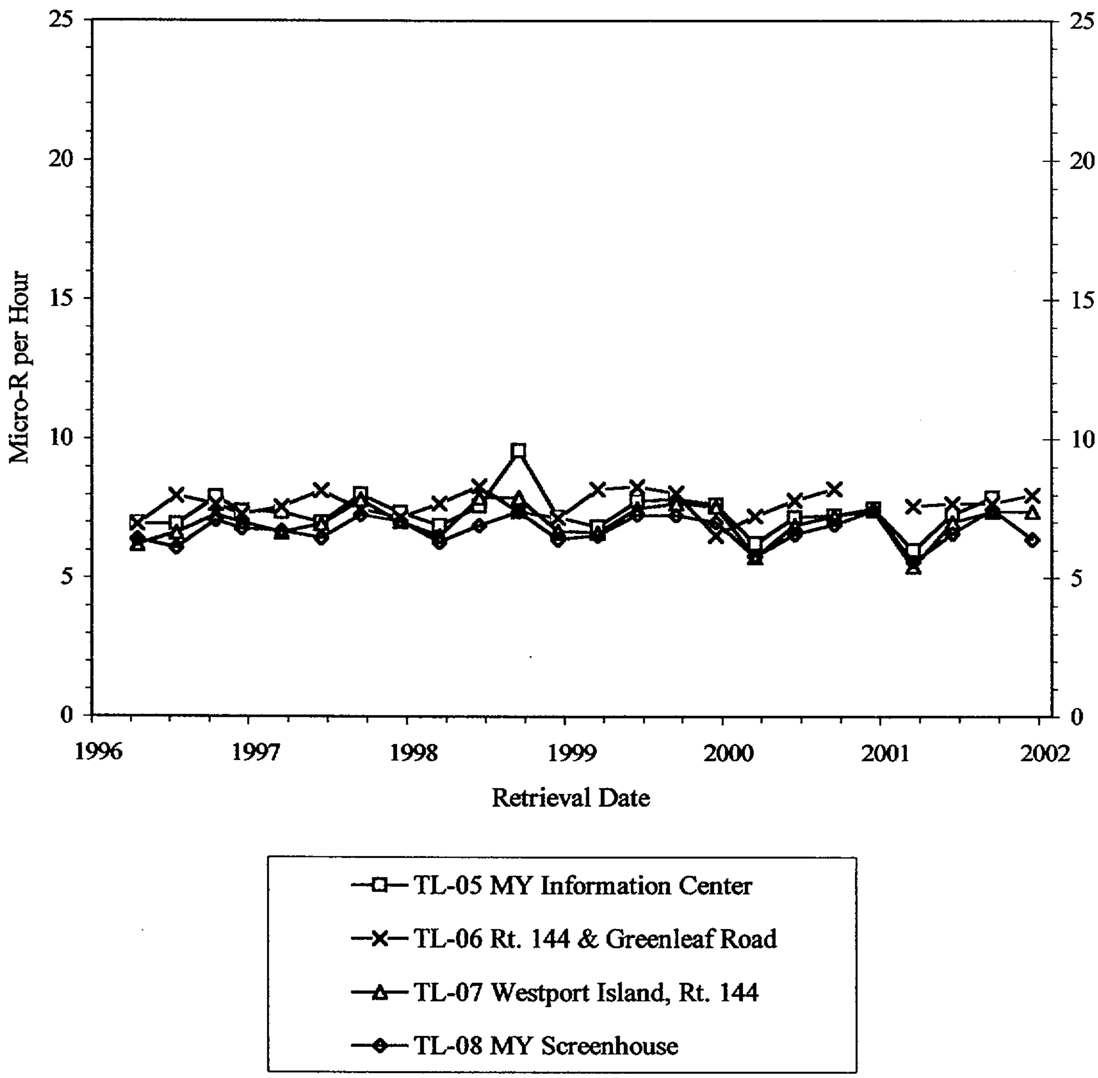
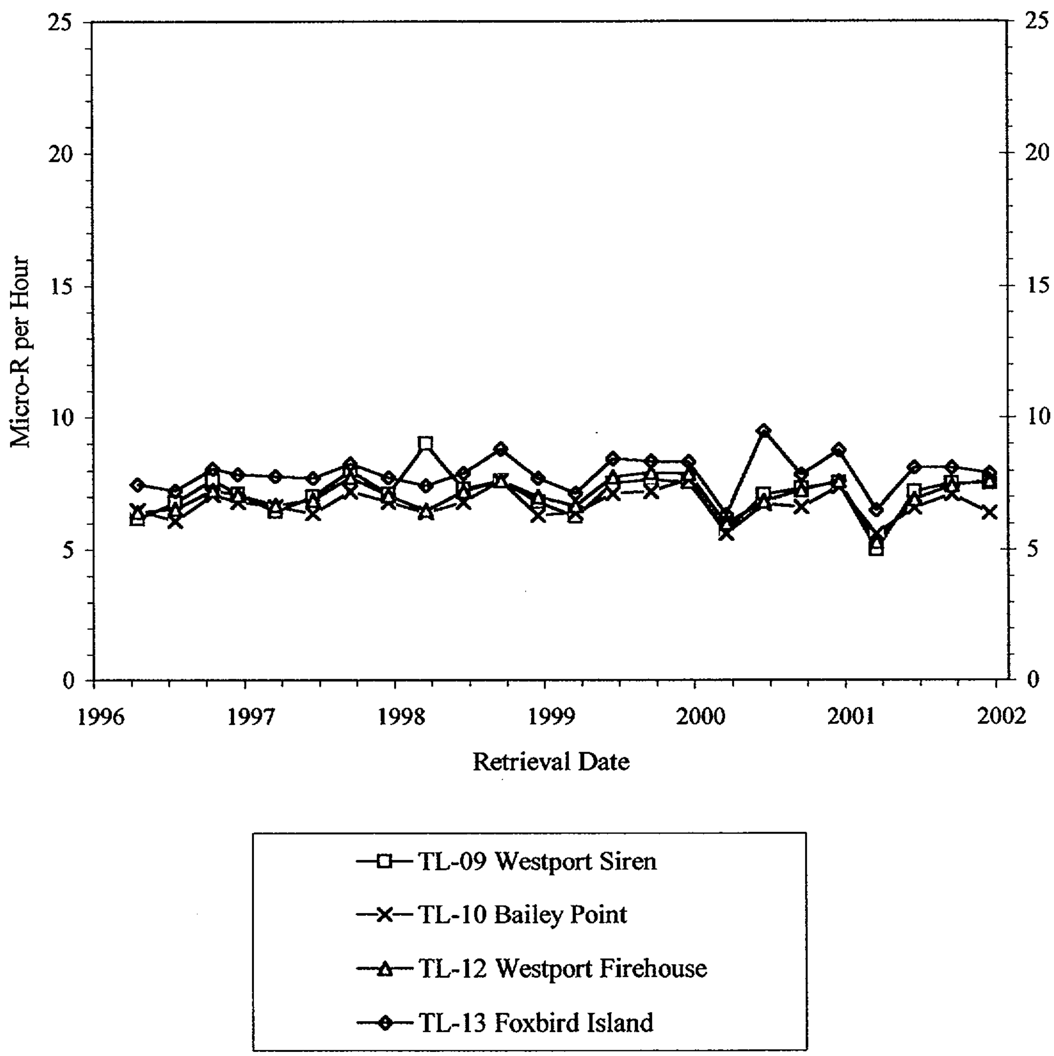


FIGURE 6.16

EXPOSURE RATE AT INNER RING TLDS, TL 09-10, 12-13



<u>**FIGURE 6.17**</u>

EXPOSURE RATE AT INNER RING TLDS, TL 14-16

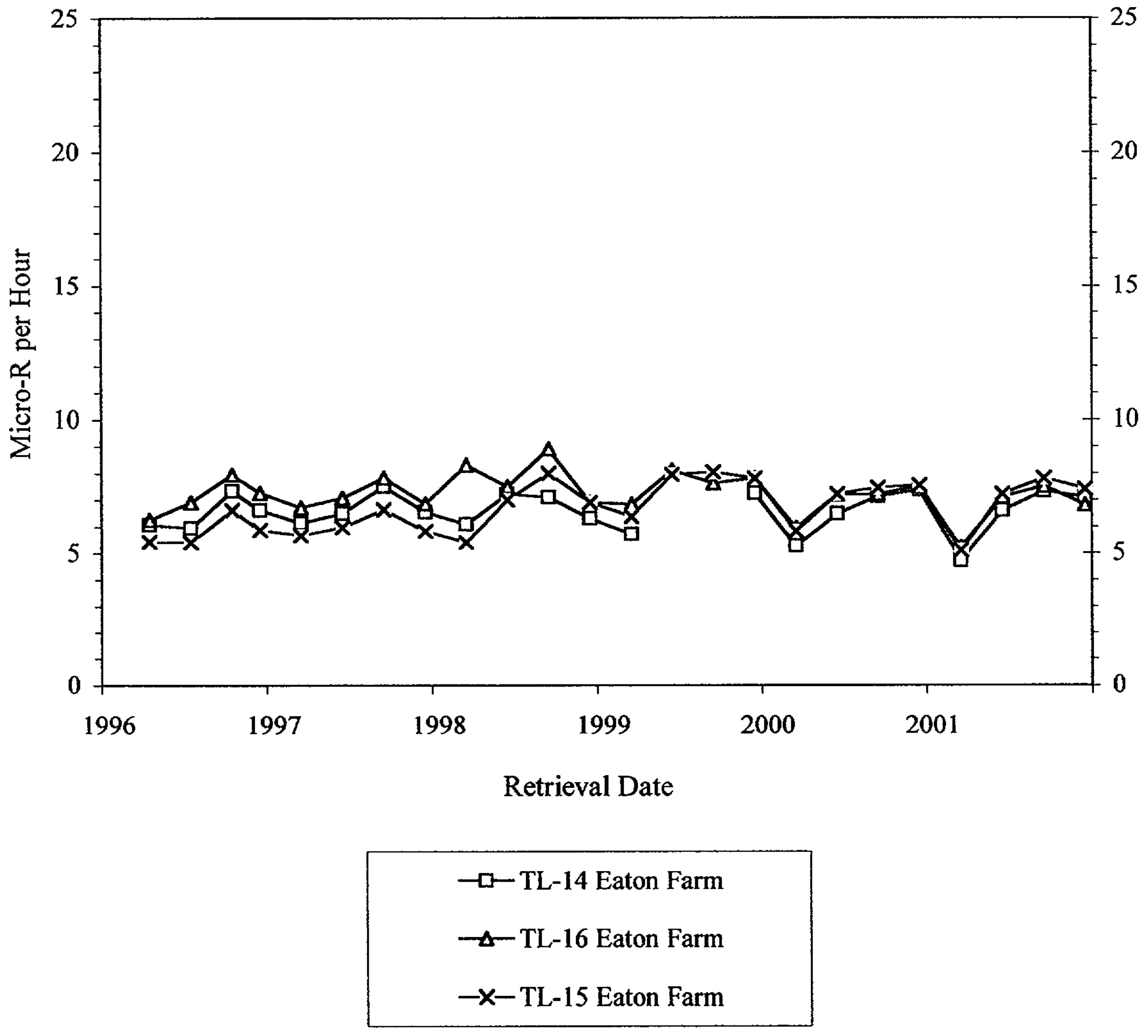


FIGURE 6.18

EXPOSURE RATE AT INNER RING TLDS, TL 17-19

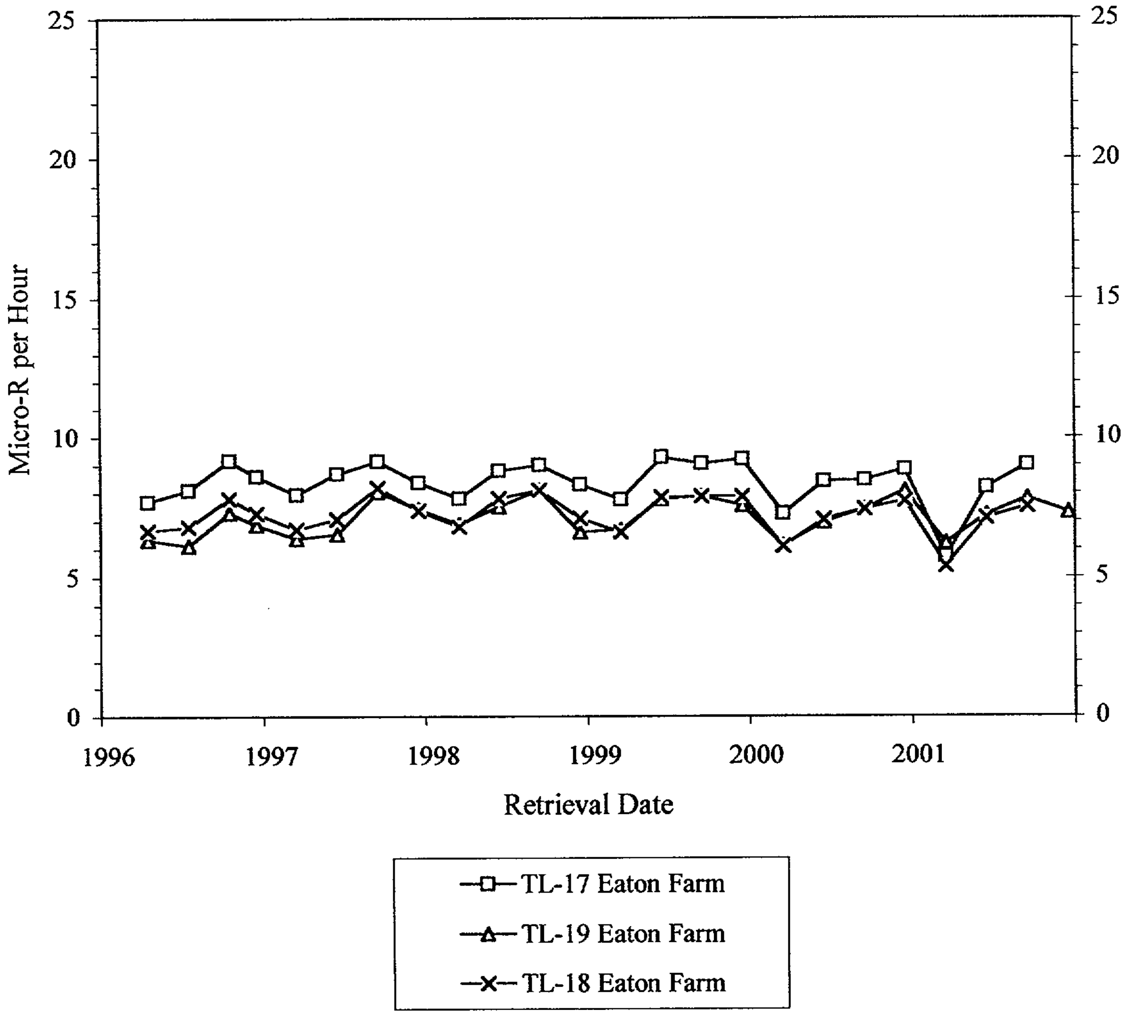


FIGURE 6.19

EXPOSURE RATE AT OUTER RING TLDS, TL 11, 20-22

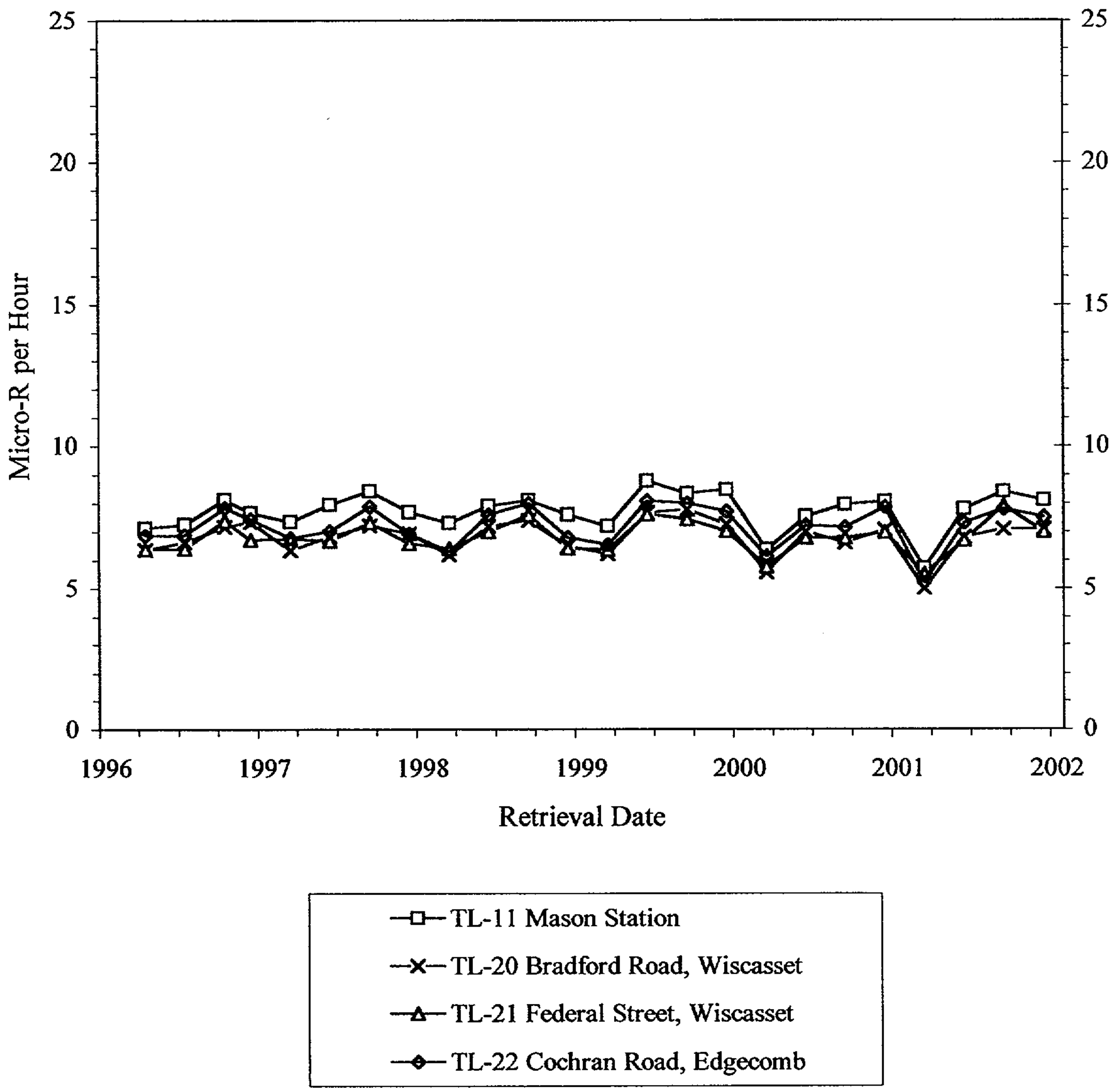


FIGURE 6.20

EXPOSURE RATE AT OUTER RING TLDS, TL 23-26

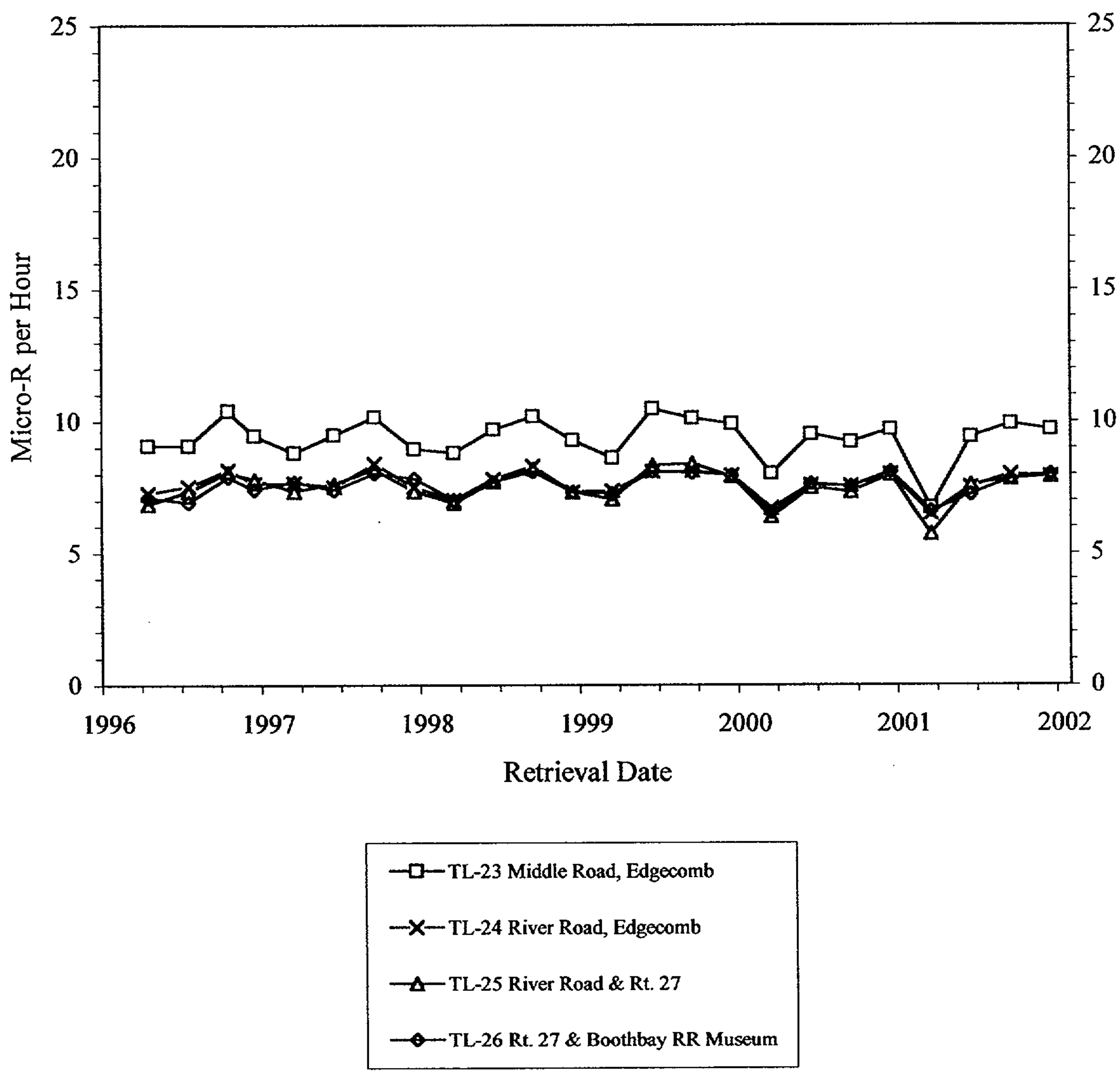


FIGURE 6.21

EXPOSURE RATE AT OUTER RING TLDS, TL 27-30

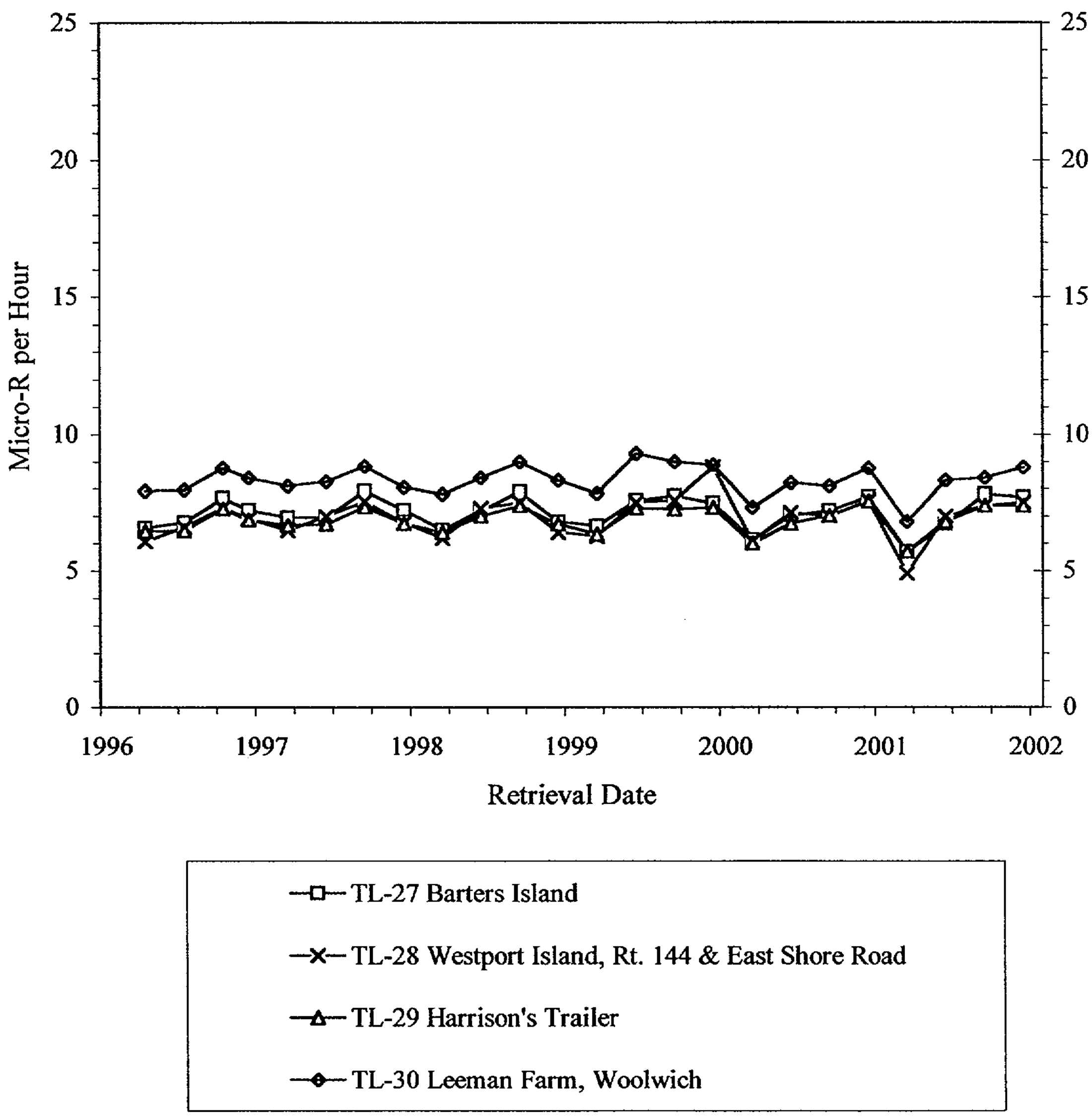


FIGURE 6.22

EXPOSURE RATE AT OUTER RING TLDS, TL 31-35

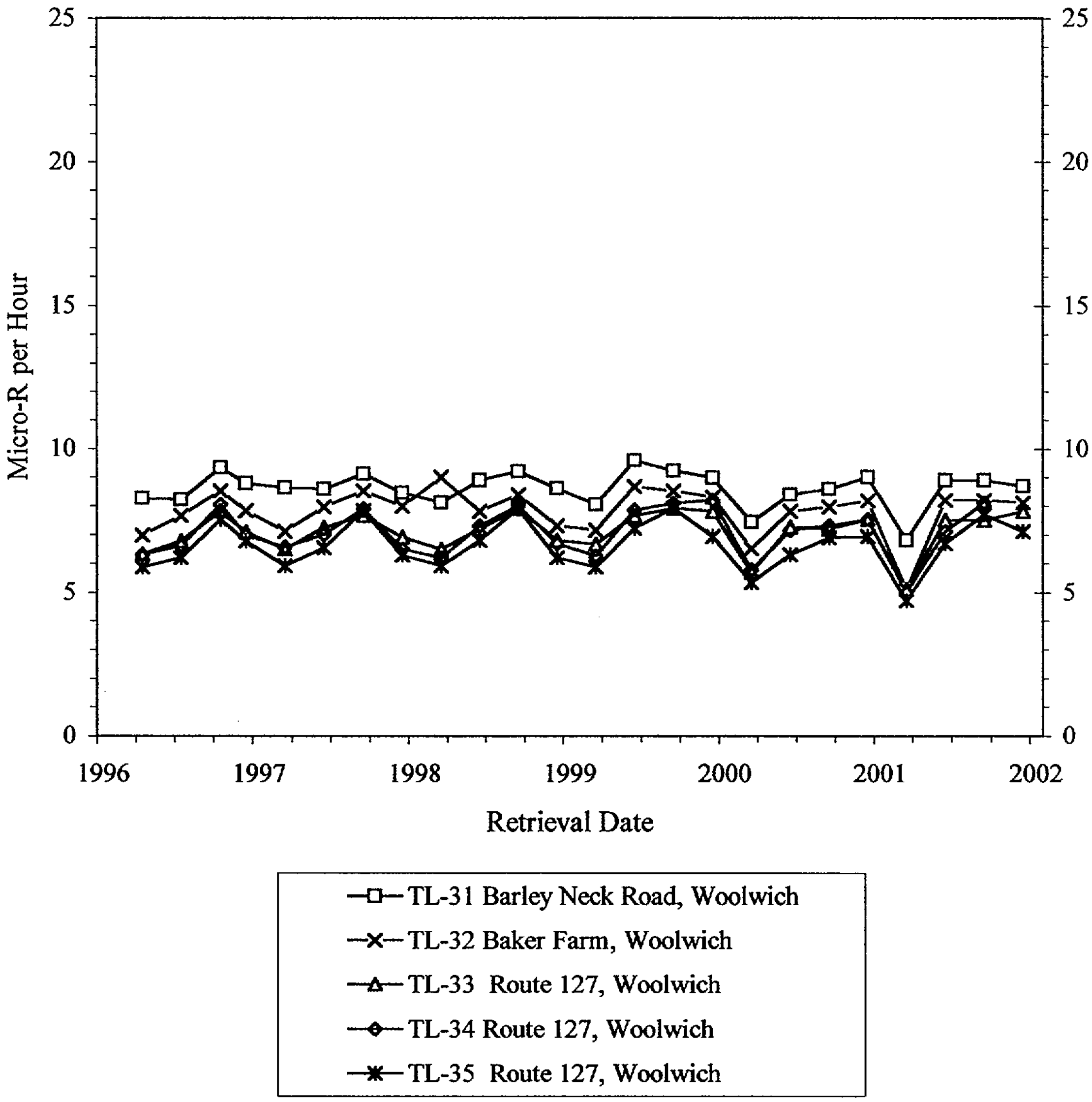
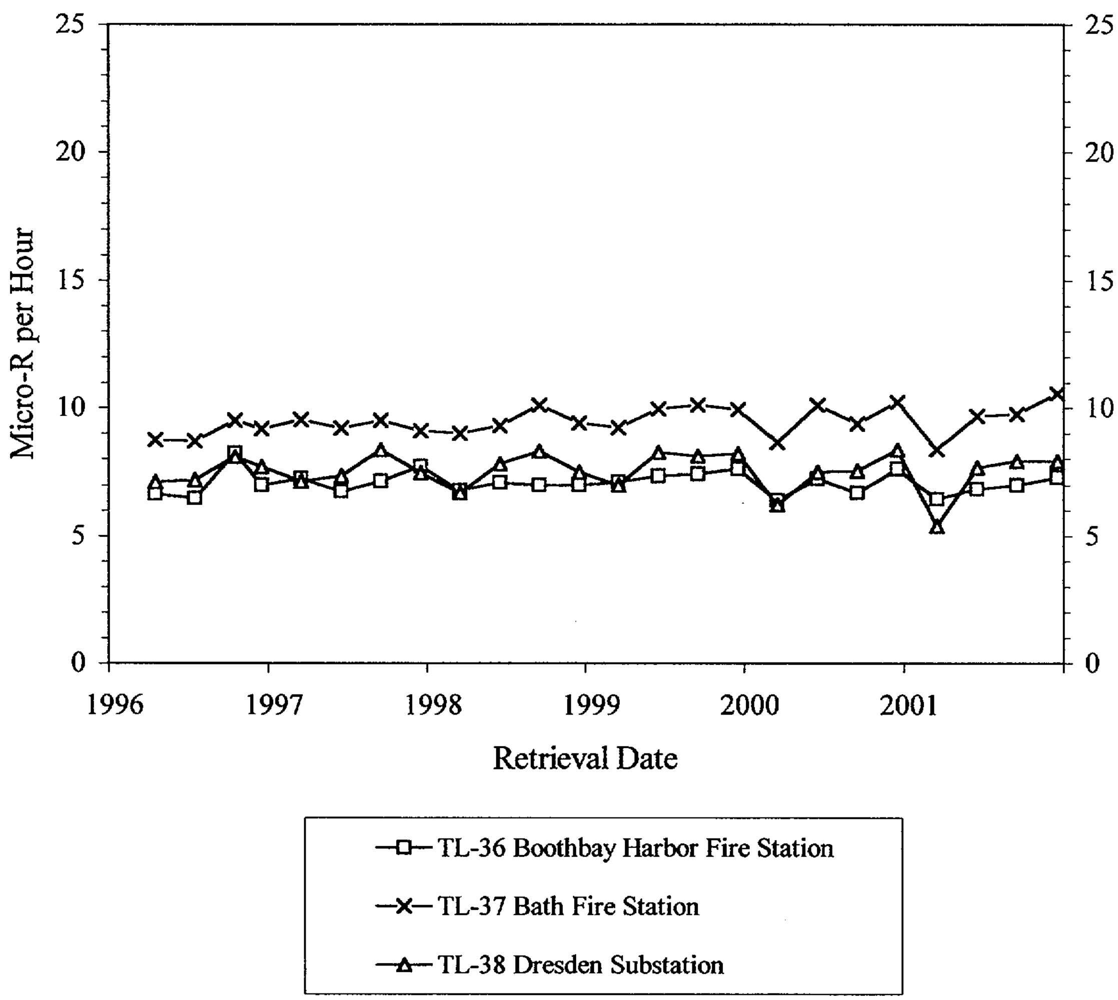


FIGURE 6.23

EXPOSURE RATE AT CONTROL RING TLDS, TL 36-38



7.0 QUALITY ASSURANCE PROGRAM

The quality assurance program at the Duke Engineering & Services Environmental Laboratory (DESEL) is designed to serve two overall purposes: 1) Establish a measure of confidence in the measurement process to assure the licensee, regulatory agencies and the public that analytical results are accurate and precise; and 2) Identify deficiencies in the sampling and/or measurement process to those responsible for these operations so that corrective action can be taken. Quality assurance is applied to all steps of the measurement process, including the collection, measurement and reporting of data, as well as the record keeping of the final results. Quality control, as part of the quality assurance program, provides a means to control and measure the characteristics of the measurement equipment and processes, relative to established requirements.

The DESEL employs a comprehensive quality assurance program designed to monitor the quality of analytical processing to ensure reliable environmental monitoring data. The program includes the use of controlled procedures for all work activities, a nonconformance and corrective action tracking system, systematic internal audits, audits by external groups, a laboratory quality control program, and a staff training program. Monitoring programs include the Intralaboratory Quality Control Program administered by the Laboratory QA Officer (used in conjunction with the National Institute of Standards and Technology Measurement Assurance Program, NIST MAP) and a third party cross check program administered by Analytics, Inc. Together these programs are targeted to supply QC/QA sources at 5% of the client sample analysis load. In addition the Laboratory Quality Control Audit Committee administers a blind duplicate program conducted through client environmental monitoring programs.

This summary reports all intralaboratory and third party results received by DESEL on or before December 31, 2001.

7.1 Intralaboratory Quality Control Program

The DESEL QA Officer administers an extensive intralaboratory quality control program in which process check samples are submitted for analysis. These samples are submitted either in duplicate to evaluate the precision of a measurement process or are "spiked" with a known amount of radioactive material to assess the bias in the measurement. Table 7.1 provides the summary of the process check results for January to December 2001. Of the 290 analyses, 97.9% passed the bias criteria and 100% of the results evaluated for precision were acceptable.

7.2 Third Party Cross Check Program

The DESEL participates in a third party cross check program managed by Analytics Inc. to satisfy the requirement of the Environmental Technical Specification/ODCM. The DESEL Analytics program was originally used to augment the EPA Intercomparison Program that it now replaces. The current program is designed to be comparable to the pre-1996 EPA PE Program in terms of the number of samples, matrices and nuclides. The results for the 4th quarter 2000 through the 3rd quarter 2001 are summarized in Table 7.2. Each sample is analyzed in triplicate and the results are evaluated against the internal acceptance criteria described in the DESEL Manual 100-Laboratory Quality Assurance Plan. This acceptance protocol is used for all interlaboratory programs with no pre-set acceptance criteria. When results fall outside of the acceptance criteria, an investigation is initiated to determine the cause of the problem and, if appropriate, corrective measures are taken. The DESEL internal acceptance criteria are summarized at the end of Table 7.2.

7.3 Blind Duplicate Program

The Laboratory Quality Control Audit Committee (LQCAC) is comprised of representatives from several New England DESEL clients. Two of the primary functions of the LQCAC have been to conduct an annual audit of Laboratory operations and to coordinate the Blind Duplicate Quality Assurance Program. Under the Blind Duplicate Quality Assurance Program, samples are split from homogeneous environmental media by the client and sent to the DESEL for analysis. They are "blind" in that the identification of the matching sample is not identified to the Laboratory.

Participating clients submitted a total of 31 paired samples in 2001. The measurements evaluated include twenty-five gamma emitting radionuclides, H-3, Sr-89, Sr-90, I-131 and gross-beta. All measurements are evaluated, whether the results are statistically positive or not, and whether the net concentration is positive or negative.

The samples submitted as part of this program are listed in Table7.3. For the 2001 program, 99.4% of the measurements met the DESEL internal acceptance criteria.

7.4 Environmental TLD Quality Assurance Program

Performance documentation of the routine processing of the Panasonic environmental TLDs (thermoluminescent dosimeter) program at the DESEL is provided by the dosimetry quality assurance testing program. This program includes the National Voluntary Laboratory

Accreditation Program, independent third party performance testing by Battelle Pacific Northwest Labs and internal performance testing conducted by the Laboratory QA Officer. Under these programs, dosimeters are irradiated to ANSI specified testing criteria and submitted for processing to the Dosimetry Services Group as "unknowns". The bias and precision of TLD processing is measured against this standard and is used to indicate trends and changes in performance. Instrumentation checks, although routinely performed by the Dosimetry Services Group and representing between 5-10% of the TLDs processed, are not presented in this report because they do not represent a true process check sample since the doses are known to the processor.

Eighty-four performance tests were conducted in 2001 by DESEL and the third party tester. Of these, 100% of the dosimeter evaluations met the DESEL Internal Acceptance Criteria for bias (± 20.1%) and precision (±12.8%). In addition 14 TLD test sets passed the control limits set by the LQCAC in 1998 to evaluate the sum of the bias and precision values. A tolerance limit of ± 30% applies to environmental dosimeters. Third Party QC results are summarized below.

Percentage of Individual Analyses which passed DESEL Internal Criteria

Dosimeter Type	Number Tested	Shallow ($7 mg/cm^2$)	
		% passed bias criteria	% passed precision criteria
Panasonic Environmental	84	100	100

Summary of Third Party Testing

Dosimeter Type	Exposure Period	NVLAP Category	Shallow ($7 mg/cm^2$)	
			% (Bias ± SD)	|B| + S*
Panasonic Environmental	Q4/2000	IV, high energy	-1.7 ± 0.8	0.025
"	Q1/2001	IV, high energy	8.8 ± 1.2	0.100
"	Q2/2001	IV, high energy	-2.9 ± 1.3	0.042
"	Q3/2001	IV, high energy	6.4 ± 1.3	0.079

* American National Standards Institute (ANSI) Performance Statistic as referenced in the Dosimetry Services Semi-Annual QA Status Report.

Note: Results are expressed as the delivered exposure for environmental TLD. NVLAP Category IV, High energy photons (Cs-137 or Co-60).

TABLE 7.1

DESEL RESULTS IN THE INTRALABORATORY PROCESS CONTROL PROGRAM
January - December 2001

Media Analysis	Bias Criteria (1) 1	2	3	4	Precision Criteria (2) 1	2	3	4
I. Air Charcoal								
Gamma	36	5	0	0	0	0	0	0
II. Air Filter								
Alpha								
Beta	100	2	0	0	0	0	0	0
Gamma								
III. Milk								
Gamma								
Iodine-LL	7	3	0	0	15	0	0	0
Strontium-89	0	1	9	0	8	2	0	0
Strontium-90	6	3	1	0	7	3	0	0
IV. Water								
Gross Alpha	7	12	21	3	4	1	0	0
Gross Beta	25	5	10	3	5	0	0	0
Gamma	0	0	0	0	6	4	6	0
Iodine-LL								
Radium 226	11	7	2	0	15	4	1	0
Radium-228	3	1	2	0	3	0	2	0
Tritium	4	1	0	0	0	0	0	0
V. Sediment/Soil								
Gamma								
Radium-226								
VI. Vegetation								
Gamma								
Total Number in Range	199	40	45	6	63	14	9	0
Sum of Analyses	290				86			

(1) Percent Bias Criteria by Bias Category
Bias Category = 1 > 0% and < = 5%
Bias Category = 2 > 5% and < = 10%
Bias Category = 3 > 10% and < = 15%, or within 2 sigma of known
Gross alpha and beta, Sr 89/90 > 10% and < = 25%
Transuranics > 10% and < = 20%
Bias Category = 4 Outside Criteria

(2) Percent Precision Criteria by Precision Category
Precision Category = 1 > 0% and < = 5%
Precision Category = 2 > 5% and < = 10%
Precision Category = 3 > 10% and < = 15%, or within 2 sigma of mean
Precision Category = 4 Outside Criteria

TABLE 7.2

DESEL RESULTS IN THE ANALYTICS INC. CROSS CHECK PROGRAM
Quarter 4, 2000 - Quarter 3, 2001

Sample	Quarter Year	Sample Media	Nuclide	Reported Value *	Known Value *	Ratio DESEL/ Analytics	Evaluation
E2477-162	4thoo	Filter	Sr-89	60	85	0.70	Non-agreement
			Sr-90	42	41	1.03	Agreement
E2478-162	4th/00	Filter	Gross Alpha	20	21	0.97	Agreement
			Gross Beta	136	114	1.19	Agreement
E2479-162	4th/00	Water	H-3	9657	10082	0.96	Agreement
E2480-162	4th/00	Milk	I-131LL	89	85	1.05	Agreement
			I-131	86	85	1.01	Agreement
			Ce-141	362	356	1.02	Agreement
			Cr-51	521	503	1.04	Agreement
			Cs-134	84	85	0.99	Agreement
			Cs-137	204	199	1.02	Agreement
			Co-58	79	76	1.04	Agreement
			Mn-54	162	152	1.06	Agreement
			Fe-59	93	82	1.13	Agreement
			Zn-65	148	148	1.00	Agreement
			Co-60	185	184	1.00	Agreement
E2592-162	1st/01	Water	I-131	88	90	0.98	Agreement
			I-131LL	89	90	0.99	Agreement
			Ce-141	100	94	1.06	Agreement
			Cr-51	236	242	0.98	Agreement
			Cs-134	120	129	0.93	Agreement
			Cs-137	97	102	0.95	Agreement
			Co-58	48	48	1.00	Agreement
			Mn-54	103	101	1.02	Agreement
			Fe-59	88	84	1.05	Agreement
			Zn-65	187	186	1.01	Agreement
			Co-60	144	147	0.98	Agreement
E2593-162	1st/01	Water	Gross Alpha	40	39	1.03	Agreement
			Gross Beta	300	268	1.12	Agreement
E2598A-162	1st/01	Filter	Gross Alpha	30	30	1.00	Agreement
			Gross Beta	229	211	1.18	Agreement
E2594-162	1st/01	Water	Ra-226	51	50	1.02	Agreement
			Ra-228	63	63	1.00	Agreement

* pCi/Liter (Filters in pCi)

TABLE 7.2

DESEL RESULTS IN THE ANALYTICS INC. CROSS CHECK PROGRAM
Quarter 4, 2000 - Quarter 3, 2001

Sample	Quarter Year	Sample Media	Nuclide	Reported Value *	Known Value *	Ratio DESEL/ Analytics	Evaluation
E2595-162	1st/01	Milk	I-131	78	77	1.01	Agreement
			I-131LL	74	77	0.96	Agreement
			Ce-141	166	162	1.02	Agreement
			Cr-51	455	418	1.09	Agreement
			Cs-134	217	223	0.97	Agreement
			Cs-137	173	176	0.98	Agreement
			Co-58	86	82	1.05	Agreement
			Mn-54	185	175	1.06	Agreement
			Fe-59	151	146	1.03	Agreement
			Zn-65	328	322	1.02	Agreement
			Co-60	252	254	0.99	Agreement
E2597-162	1st/01	Water	Am-241	5.6	6.0	0.93	Agreement
			Pu-238	7.2	7.5	0.96	Agreement
			Pu-239	5.5	5.5	1.00	Agreement
			Np-237	9.6	7.9	1.22	Non-Agreement
			Cm-244	5.6	6.3	0.89	Agreement
E2670-162	2nd/01	Milk	I-131	63	69	0.91	Agreement
			I-131LL	66	69	0.96	Agreement
			Ce-141	165	163	1.01	Agreement
			Cr-51	228	224	1.02	Agreement
			Cs-134	131	134	0.98	Agreement
			Cs-137	128	121	1.06	Agreement
			Co-58	97	96	1.01	Agreement
			Mn-54	154	150	1.03	Agreement
			Fe-59	91	88	1.03	Agreement
			Zn-65	180	182	0.99	Agreement
			Co-60	138	135	1.03	Agreement
E2666-162	2nd/01	Filter	Ce-141	91	96	0.95	Agreement
			Cr-51	130	132	0.98	Agreement
			Cs-134	74	79	0.94	Agreement
			Cs-137	77	71	1.08	Agreement
			Co-58	57	57	1.00	Agreement
			Mn-54	99	88	1.13	Agreement
			Fe-59	58	51	1.14	Agreement
			Zn-65	118	107	1.10	Agreement
			Co-60	77	79	0.97	Agreement

*Units in pCi/Liter (filter in pCi)

TABLE 7.2

DESEL RESULTS IN THE ANALYTICS INC. CROSS CHECK PROGRAM
Quarter 4, 2000 - Quarter 3, 2001

Sample	Quarter Year	Sample Media	Nuclide	Reported Value *	Known Value *	Ratio DESEL/ Analytics	Evaluation
E2669-162	2nd/01	Water	H-3	7007	7494	0.94	Agreement
E2667-162	2nd/01	Filter	Sr-89	89	84	1.06	Agreement
			Sr-90	75	64	1.17	Agreement
E2806-162	3rd/01	Water	I-131	63	60	1.05	Agreement
			I-131LL	62	60	1.04	Agreement
			Ce-141	96	88	1.09	Agreement
			Cr-51	275	265	1.04	Agreement
			Cs-134	113	116	0.97	Agreement
			Cs-137	234	232	1.01	Agreement
			Co-58	132	128	1.03	Agreement
			Mn-54	153	149	1.03	Agreement
			Fe-59	66	62	1.06	Agreement
			Zn-65	184	184	1.00	Agreement
			Co-60	195	193	1.01	Agreement
E2805-162	3rd/01	Water	Gross Alpha	84	78	1.08	Agreement
			Gross Beta	175	205	0.85	Agreement
E2808-162	3rd/01	Filter	Gross Alpha	51	50	1.02	Agreement
			Gross Beta	136	133	1.02	Agreement
E2809-162	3rd/01	Milk	I-131	90	91	0.99	Agreement
			I-131LL	91	91	1.00	Agreement
			Ce-141	131	121	1.08	Agreement
			Cr-51	374	366	1.02	Agreement
			Cs-134	157	160	0.98	Agreement
			Cs-137	323	319	1.01	Agreement
			Co-58	182	177	1.03	Agreement
			Mn-54	211	205	1.03	Agreement
			Fe-59	87	86	1.01	Agreement
			Zn-65	261	254	1.03	Agreement
			Co-60	274	266	1.03	Agreement
E2807-162	3rd/01	Water	Sr-89	87	85	1.02	Agreement
			Sr-90	61	59	1.03	Agreement
E2810-162	3rd/01	Milk	Sr-89	121	75	1.61	Non-Agreement
			Sr-90	49	50	0.98	Agreement

*Units in pCi/Liter (filters in pCi)

Bias Acceptance Criteria: ± 15%, or as noted below:
Gross alpha and beta, Sr 89/90 ± 25%
Transuranics and Radium ± 20% or,

Precision Acceptance Criteria ± 15%, or as noted below:
Gross alpha and beta, Sr 89/90 ± 25%
Transuranics and Radium ± 20%

If known value falls within 2 sigma range, acceptance criteria is met.

TABLE 7.3

SUMMARY OF BLIND DUPLICATE SAMPLES
January - December 2001

TYPE OF SAMPLE	NUMBER OF PAIRED SAMPLES SUBMITTED
Milk	8
Ground Water	2
Surface Water	14
Algae	2
Mussels	4
Food Product	1
TOTAL	31

8.0 LAND USE CENSUS

Maine Yankee ODCM section 2.4.4 requires that a Land Use Census be conducted annually. The Census identifies the locations of the nearest milk animal, the nearest residence and the nearest garden of greater than 500 square feet producing fresh leafy vegetables in each of the 16 meteorological sectors within a distance of five miles of the plant. The 2001 Land Use Census was conducted during September 2001.

Pursuant to Section 2.4.4 of the ODCM, a dosimetric analysis is performed, using site specific meteorological data, to determine which milk animal locations would provide the optimal sampling locations. If any location has twice the potential dose commitment of a currently-sampled location, the new location is added to the routine environmental sampling program in replacement of the location with the lowest calculated dose (which is eliminated from the program). For the 2001 Census, no such new milk animal location was identified. Consequently, no changes were made in the milk sampling program.

The results of the 2001 Land Use Census are included in this report in compliance with ODCM Section 2.4.4.3 and ODCM Appendix C, item 1. The locations identified during the Census may be found in Table 8.1.

TABLE 8.1

2001 LAND USE CENSUS LOCATIONS

SECTOR	NEAREST RESIDENCE km (miles)	NEAREST GARDEN km (miles)	NEAREST MILK ANIMAL km (miles)
N	1.26 (0.78)	1.45 (0.90)	*
NNE	2.23 (1.38)	2.40 (1.49)	2.7(1.7) (Cows)
NE	1.27 (0.79)	1.47 (0.91)	*
ENE	0.92 (0.57)	1.25 (0.78)	*
E	0.90 (0.56)	0.90 (0.56)	*
ESE	0.70 (0.43)	2.64 (1.64)	*
SE	0.70 (0.43)	0.90 (0.56)	*
SSE	0.90 (0.56)	0.90 (0.56)	*
S	1.70 (1.06)	1.70 (1.06)	5.5 (3.5) (Goats)
SSW	3.00 (1.86)	5.00 (3.11)	*
SW	1.50 (0.93)	4.00 (2.48)	*
WSW	0.96 (0.60)	1.94 (1.20)	1.9 (1.2) (Cows)
W	0.81 (0.50)	2.71 (1.68)	*
WNW	1.90 (1.18)	1.87 (1.16)	*
NW	1.93 (1.20)	1.93 (1.20)	*
NNW	1.06 (0.66)	1.18 (0.73)	*

* No location was identified within 5 miles of the plant.

9.0 REFERENCES

1. USNRC Radiological Assessment Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program," Revision 1, November 1979.

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

3. *Ionizing Radiation: Sources and Biological Effects*, United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), 1982 Report to the General Assembly.

4. Kathren, Ronald L., *Radioactivity and the Environment - Sources, Distribution, and Surveillance*, Harwood Academic Publishers, New York, 1984.

5. *Maine Yankee Final Safety Analysis Report.*

6. NRC Generic Letter 89-01, Subject: Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program. Dated January 31, 1989.

7. USNRC Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.