# MAINE YANKEE ATOMIC POWER COMPANY

# ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

January-December 2002

## 1.0 INTRODUCTION

Tables 1 and 2 summarizes the quantity of radioactive gaseous and liquid effluents, respectively, for each quarter of 2002. Table 3 states that waste was shipped off-site for burial or disposal during the year 2002. Table 4 contains supplementary information.

Appendices A through D, indicate the status of reportable items per the requirements of the Off-site Dose Calculation Manual (ODCM) sections 2.1.5, 2.2.6, 2.3.3, 2.3.4, 2.5 and Appendix C.

Changes to the ODCM made during the year 2002 are summarized in Appendix E. A complete copy of the revised manual is attached as well as the specific pages that changed.

TABLE 1A

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First and Second Quarters, 2002
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* | 2.50E+1 |
| 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/D* | N/D* | 2.50E+1 |
| 2. Average release rate for period | uCi/sec | N/D* | N/D* | |
| 3. Percent of regulatory limit | % | N/D* | N/D* | |
| **C. Particulates** | | | | |
| 1. Particulates with T-1/2 > 8 days | Ci | N/D* | N/D* | 3.50E+1 |
| 2. Average release rate for period | uCi/sec | N/D* | N/D* | |
| 3. Percent of regulatory limit | % | N/D* | N/D* | |
| 4. Gross alpha radioactivity | Ci | N/D* | N/D* | |
| **D. Tritium** | | | | |
| 1. Total release | Ci | 7.69E-2 | 1.0E-1 | 2.50E+1 |
| 2. Average release rate for period | uCi/sec | 9.78E-3 | 1.27E-2 | |
| 3. Percent of regulatory limit | % | 1.71E-4 | 2.22E-4 | |

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, 2002
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* | 2.50E+1 |
| 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/D* | N/D* | 2.50E+1 |
| 2. Average release rate for period | uCi/sec | N/D* | N/D* | |
| 3. Percent of regulatory limit | % | N/D* | N/D* | |
| **C. Particulates** | | | | |
| 1. Particulates with T-1/2 > 8 days | Ci | N/D* | N/D* | 3.50E+1 |
| 2. Average release rate for period | uCi/sec | N/D* | N/D* | |
| 3. Percent of regulatory limit | % | N/D* | N/D* | |
| 4. Gross alpha radioactivity | Ci | N/D* | N/D* | |
| **D. Tritium** | | | | |
| 1. Total release | Ci | 1.52E-1 | 7.90E-2 | 2.50E+1 |
| 2. Average release rate for period | uCi/sec | 1.93E-2 | 1.0E-2 | |
| 3. Percent of regulatory limit | % | 3.34E-4 | 1.7E-4 | |

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, 2002
Gaseous Effluents-Elevated Release

| | | Continuous Mode | | Batch Mode | |
|---|---|---|---|---|---|
| Nuclides Released | Unit | 1st Quarter | 2nd Quarter | 1st Quarter | 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* |
| Cobalt-60 | Ci | N/D | N/D | N/A | N/A |
| Barium-Lanthanum-140 | Ci | N/D | N/D | N/A* | N/A* |
| Others- | | | | | |
| Plutonium-238 | Ci | N/D | N/D | N/A* | N/A* |
| Curium-243,244 | Ci | N/D | N/D | N/A* | N/A* |
| Uranium-234 | Ci | N/D | N/D | N/A* | N/A* |
| Uranium-238 | Ci | N/D | N/D | N/A* | N/A* |
| Thorium-232 | Ci | N/D | N/D | N/A* | N/A* |
| Radium-226 | Ci | N/D | N/D | 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, 2002
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 | N/D | N/D | N/A* | N/A* |
| Cobalt-60 | Ci | N/D | N/D | N/A | N/A |
| Barium-Lanthanum-140 | Ci | N/D | N/D | N/A* | N/A* |
| Others- | | | | | |
| Plutonium-238 | Ci | N/D | N/D | N/A* | N/A* |
| Curium-243,244 | Ci | N/D | N/D | N/A* | N/A* |
| Uranium-234 | Ci | N/D | N/D | N/A* | N/A* |
| Uranium-238 | Ci | N/D | N/D | N/A* | N/A* |
| Thorium-232 | Ci | N/D | N/D | N/A* | N/A* |
| Radium-226 | Ci | N/D | 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 2002
Gaseous Effluents-Ground Level Release

There were no routine measured ground level continuous or batch mode releases during the year 2002.

TABLE 2A

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First and Second Quarters, 2002
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 | 1.36E-04 | 3.97E-4 | 1.50E+1 |
| 2. Average diluted concentration during period | .uCi/ml | 8.33E-10 | 2.48E-9 | |
| 3. Percent of applicable limit | % | 1.96E-2 | 2.41E-2 | |
| **B. Tritium** | | | | |
| 1. Total Release | Ci | 9.26E-02 | 1.08E+00 | 1.50E+1 |
| 2. Average diluted concentration during period | .uCi/ml | 4.99E-7 | 2.24E-6 | |
| 3. Percent of applicable limit | % | 5.32E-2 | 3.14E-1 | |
| **C. Dissolved and Entrained Gases** | | | | |
| 1. Total Release | Ci | N/D* | N/D* | 1.50 E+1 |
| 2. Average diluted concentration during period | .uCi/ml | N/A* | N/A* | |
| 3. Percent of applicable limit | % | N/A* | N/A* | |
| **D. Gross Alpha Radioactivity** | | | | |
| 1. Total release | Ci | N/D | 2.98E-7 | 1.50E+1 |
| 2. Average diluted concentration during period | .uCi/ml | N/A* | 2.25E-11 | |
| **E. Volume of Waste Released (prior to dilution)** | Liters | 8.61E+4 | 1.48E+6 | 1.0E+1 |
| **F. Volume of Dilution Water Used During Period** | Liters | 1.74E+8 | 3.44E+8 | 1.0E+1 |

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

TABLE 2A

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
Third and Fourth Quarters, 2002
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 | 1.87E-03 | 1.08E-3 | 1.50 E+1 |
| 2. Average diluted concentration during period | .uCi/ml | 1.54E-07 | 1.79E-06 | |
| 3. Percent of applicable limit | % | 2.11E-1 | 9.77E+00 | |
| **B. Tritium** | | | | |
| 1. Total Release | Ci | 3.52E-02 | 3.20E-02 | 1.50 E+1 |
| 2. Average diluted concentration during period | .uCi/ml | 3.87E-6 | 6.6E-5 | |
| 3. Percent of applicable limit | % | 2.21E-2 | 3.95E+00 | |
| **C. Dissolved and Entrained Gases** | | | | |
| 1. Total Release | Ci | N/D* | N/D* | 1.50 E+1 |
| 2. Average diluted concentration during period | .uCi/ml | N/A* | N/A* | |
| 3. Percent of applicable limit | % | N/A* | N/A* | |
| **D. Gross Alpha Radioactivity** | | | | |
| 1. Total release | Ci | 6.37E-7 | N/D | 1.50 E+1 |
| 2. Average diluted concentration during period | .uCi/ml | 1.6E-11 | N/A | |
| **E. Volume of Waste Released (prior to dilution)** | Liters | 1.0E+5 | 9.7E+4 | 1.0E+1 |
| **F. Volume of Dilution Water Used During Period** | Liters | 1.59E+8 | 8.10E+05 | 1.0E+1 |

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

TABLE 2B

Maine Yankee Atomic Power Station
Effluent and Waste Disposal Annual Report
First and Second Quarters, 2002
Liquid Effluents

| Nuclides Released | Unit | Continuous Mode 1st Quarter | Continuous Mode 2nd Quarter | Batch Mode 1st Quarter | Batch Mode 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* | 1.14E-05 | 9.76E-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* | 6.66E-05 | 2.13E-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-Lathanium-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* | 5.77E-5 | 1.56E-04 |
| Antimony-125 | Ci | N/A* | N/A* | N/D* | 1.79E-05 |
| Unidentified | Ci | N/A* | N/A* | N/D* | N/D* |
| Total for period (above) | Ci | N/A* | N/A* | 1.36E-4 | 3.97E-4 |
| 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, 2002
Liquid Effluents

| Nuclides Released | Unit | Continuous Mode 3rd Quarter | Continuous Mode 4th Quarter | Batch Mode 3rd Quarter | Batch Mode 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* | N/D* |
| Cesium-137 | Ci | N/A* | N/A* | 6.32E-05 | 7.98E-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* | 7.80E-04 | 1.86E-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-Lathanium-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* | 8.76E-4 | 8.76E-4 |
| Antimony-125 | Ci | N/A* | N/A* | 1.53E-04 | 1.4E-05 |
| Unidentified | Ci | N/A* | N/A* | N/D* | N/D* |
| Total for period (above) | Ci | N/A* | N/A* | 1.87E-3 | 1.08E-3 |
| 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 Semiannual Report
First Half, 2002
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. | 3.5 | |
| | Ci. | 1.50 E+01 | +/- 25 |
| b. Dry compressible waste, contaminated equipment, DAW, cement. | Cu. M. | 1725 | |
| | Ci. | 2.66 E+01 | +/- 25 |
| c. Irradiated Hardware. | Cu. M. | 3.25 | |
| | Ci. | 5.49 E+02 | +/- 25 |

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

| | | | |
|---|---|---|---|
| a. | Co-60 | 76.58% | 1.15E+01 |
| | Ni-63 | 21.09% | 3.16E+00 |
| | Ce-144 | 2.08% | 3.12E-01 |
| b. | Co-60 | 31.22% | 8.30E+00 |
| | Fe-55 | 12.01% | 3.19E+00 |
| | Ni-63 | 42.95% | 1.14E+01 |
| | Cs-137 | 11.86% | 3.16E+00 |
| | Ce-144 | 1.25% | 3.31E-01 |
| c. | Co-60 | 59.3% | 3.26E+02 |
| | Fe-55 | 30.5% | 1.67E+02 |
| | Ni-63 | 9.9% | 5.44E+01 |

3. Solid Waste Disposition

| Number of Shipments | Mode of Transportation | Destination |
|---|---|---|
| 4 | Trucking over Highway | Chem-Nuclear, Barnwell, S.C. |
| 1 | Trucking over Highway | Diversified Scientific Services Kingston, TN |
| 5 | Trucking over Highway | Envirocare of Utah Clive, Utah |
| 9 | Rail | Envirocare of Utah Clive, Utah |

**Table 3**
**Cont.**

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 | 1.727E+03 | 1.86E+02 | +/- 25% |
| B | 1.63E+00 | 3.93E+02 | +/- 25% |
| C | 3.57E+00 | 1.17E+01 | +/- 25% |

| Container | Type | Package Volume (Cu. M.) |
|---|---|---|
| DT-58 Steel Liner | Steel Liner | 1.6 |
| 40 Foot Sealand | Strong Tight Container | 76.5 |
| 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 | 3.5 |
| 8-120 Steel Liner | Strong Tight Container | 3.6 |
| R14-195 Steel Liner | Strong Tight Container | 5.9 |
| 55 Gallon Drum | Strong Tight Container | 0.2 |

**TABLE 3**
Maine Yankee Atomic Power Station
Effluent and Waste Disposal Semiannual Report
Second Half, 2002
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 | Cu. M. | 7.50 | |
| sludges, etc. | Ci. | 8.47 E+01 | +/- 25 |
| b. Dry compressible waste, | Cu. M. | 6584 | |
| contaminated equipment, DAW, cement. | Ci. | 1.34 E+01 | +/- 25 |

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

| | | | |
|---|---|---|---|
| a. | Co-60 | 3.36% | 2.84E+00 |
| | Ni-63 | 75.89% | 6.43E+01 |
| | Cs-137 | 19.47% | 1.65E+01 |
| b. | Ni-63 | 27.99% | 3.75E+00 |
| | Co-60 | 40.97% | 5.49E+00 |
| | Cs-137 | 12.17% | 1.63E+00 |
| | Fe-55 | 17.15% | 2.30E+00 |

3. Solid Waste Disposition

| Number of Shipments | Mode of Transportation | Destination |
|---|---|---|
| 1 | Trucking over Highway | Chem-Nuclear Systems |
| 1 | Trucking over Highway | Permafix Gainsville, FA. |
| 3 | Trucking over Highway | Envirocare of Utah Clive, Utah |
| 26 | Rail | Envirocare of Utah Clive, Utah |
| 2 | Trucking over Highway | Alaron Corporation Wampum, PA. |

**TABLE 3**
(Continued)

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 | 6.58E+03 | 1.34E+01 | +/- 25% |
| B | 7.50E+00 | 8.47E+01 | +/- 25% |
| C | 0.00E+00 | 0.00E+00 | +/- 25% |

| Container | Type | Package Volume (Cu. M.) |
|---|---|---|
| 25 Yard Intermodal | Strong Tight Container | 29.2 |
| 20 Yard Intermodal | Strong Tight Container | 26.2 |
| Gondola Car | Strong Tight Container | 68.0 |
| Sealand Container | Strong Tight Container | 38.2 |
| B-25 Steel Box | Strong Tight Container | 2.9 |
| EL-142 Poly HIC | Strong Tight Container | 3.7 |
| 55 Gallon Drum | Strong Tight Container | 0.2 |
| 8-120 Steel Liner | Steel Liner | 3.6 |
| L14-195 | Steel Liner | 5.9 |

# TABLE 4

## Supplemental Information

1. Regulatory Limits

Effluent Concentrations

| | |
|---|---|
| a. Fission and activation gases | 10 CFR 10; Appendix B, Table 2, Column 1 |
| b Iodines | 10 CFR 10; Appendix B, Table 2, Column 1 |
| c. Particulates, (with half lives greater than 8 days) | 10 CFR 10; Appendix B, Table 2, Column 1 |
| d. Liquid effluents: | 10 CFR 10; Appendix B, Table 2, Column 2 |
| e. Total noble gas concentration: | 2.0 E-4 uCi/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 purge operations are no longer required. Containment ventilation is directed to the Primary Vent Stack, and sampled as described above.

   There are no gaseous effluent release paths associated with ISFSI Operations.

   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, 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 is reported in Tables 1A and 1B.

   There are no gaseous effluent release paths associated with ISFSI Operations

d. Liquid Effluents

There are no continuous 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-89, Strontium-90, and Iron-55.

There are no liquid effluent release paths associated with ISFSI Operations.

4. Batch Releases

a Liquids

1. Number of Batch release: 61
2. Total time period for batch releases: 116.85 hrs or 7011 minutes
3. Maximum time period for a batch release: 9 33 hrs 0r 560 minutes
4. Average time period for batch releases: 1.9 hrs or 115 minutes
5. Minimum time period for a batch release: 15 hrs or 9 minutes
6. Average stream flow during periods of release of effluents into a flowing stream: N/A
7. Maximum gross release concentration (uCi/ml) 3.04E-6

b. Gaseous

1 Number of batch release: 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 (uCi/sec) Not Applicable

5 Unplanned Releases

a. Liquid

No unplanned liquid releases occurred in the year 2002.

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 of 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: No radioactive effluent monitoring instrumentation was out of service for more than 30 consecutive days during the reporting period.

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 Analysis

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 priori lower limits of detection.

## APPENDIX E

Summary of Off-site Dose Calculation Manual Revisions

**Revision number: Change # 18**

Date: 02-02

Summary: Controls and sampling requirements were included in the ODCM to minimize the dose to the public, resulting from on-site building demolition activities

**Revision number: 19**

Date: 05-02

Summary: Table 2.7 of the ODCM was revised to provide clarification as to when alpha smear analysis should be performed to support the release of buildings for demolition.

**Revision number: 20**

Date, 06-02

Summary: Sections 2.1.4, 3.1.1, 3.1.2, Tables 2 3, 2.6, 3 1, 5.1, Figure 5.1 and Appendix A were all revised to eliminate the use of the Forebay from a licensed release path and incorporated the new liquid waste discharge path to the back river. Justification for this change is contained within Calculation MYC-2083 Rev 1.

**Revision number: 21**

Date· 08-02

Summary: Section 2.1.3 was revised to incorporate the reserved technical specification limit of 10 times the concentration levels specified in 10 CFR 20, Appendix B, Table 2, Column 2 and to address the use of dilution to meet concentration limits for liquid waste releases.

**Revision number 22**

Date: 10-02

Summary: Table 2.7 was revised to increase the maximum loose surface contamination limit for surveys performed to turn site buildings over for demolition. The averaged average contamination levels remain the same. The change maintained the same level of control and did not result in an increase of dose to the public.

**Revision number: Change # 18**

MAINE YANKEE

OFF-SITE DOSE CALCULATION MANUAL

APPROVED: ____________________

APPROVAL DATE: 10-21-02

ISSUED
Date: 10-21-02

# ODCM PAGE CHANGE SUMMARY

[ CHANGE NO. 22 DATE: ____________

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| 14 | 08/02 | 44 | 3/00 | 74 | 08/02 | | |
| 15 | 02/02 | 45 | 04/01 | 75 | 08/02 | | |
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| 17 | 02/02 | 47 | 04/01 | 77 | 3/93 | | |
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Date: 10-21-02

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.

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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 doses to the public resulting from all such releases are within the limits specified 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 not more than ten times the concentrations specified in 10 CFR, Part 20, Appendix B, Table 2, Column 2.

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 limitations apply to the concentration of radioactive materials released in the liquid waste effluents from the site to unrestricted areas at the point of discharge into the Back River. Concentration levels specified in 10 CFR 20, Appendix B, Table 2, Column 2 were established to control the dose to the public to within the limits specified in 10 CFR 20.1301 and 20.1302. Those values assure a continuous discharge at those concentrations (8760 hours per year). Pursuant to the requirements of 10 CFR 50.36a to maintain effluents as low as reasonably achievable (ALARA), Appendix I to 10 CFR 50 specifies dose values that are a small percentage of the dose limits in 10 CFR 20.1301. Consistent with Appendix I to 10 CFR 50, to allow operational flexibility, this specification in conjunction with the dose specification in Section 2.1.4.1 permits an instantaneous concentration release rate up to a factor of ten times greater than specified in 10 CFR 20, Appendix B, Table 2, Column 2 while continuing to limit the total annual discharge to a small fraction of the allowable annual dose as specified in Appendix I.

For determining compliance, it must be demonstrated that the concentrations of radionuclides in liquid effluent prior to discharge to the Back River (Reference Section 6.1) meet the limits specified. The release path for liquid effluent allows direct discharge into the Back River through a submerged discharge line. Additional dilution flow may be added into the discharge line (as shown in Figure 6.1) to ensure concentration limits are met. The volume of dilution water is not included in the 2,000 gallons per tide cycle waste volume limit described in the Section 2.1.4.1 Basis. Liquid effluent must be discharged in a horizontal offshore direction through a 3-inch diameter hose from a position that is at least 1 foot above the riverbed in order to ensure sufficient localized mixing (Reference 11). In addition, the discharge end of the line must be positioned at least 20 feet offshore beyond the low tide line and, during releases of liquid effluent, must be covered by at least 4 feet of water. Those criteria provide assurance that sufficient dilution is available to minimize shoreline doses (Reference 11). Any dilution or mixing that occurs after the effluent has exited the discharge pipe, however, can not be used for determining compliance with effluent concentration limits.

2.1.4 Liquid Effluents: Dose

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.

Remedial Action: 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.

Remedial Action: 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 impact of discharging liquid effluent directly to the Back River has been modeled and assessed (Reference 11), which provide the basis for a dilution factor equal to 110. This factor provides conservative Method I dose estimates for liquid effluent discharged directly to the Back River. The dilution model assumes that liquid effluent discharges are approximately 2,000 gallons and made no more frequently than once per tide cycle. One of the limiting conditions on this model is a restriction on the size of the near field-mixing zone. The model does not allow the edge of the 10:1 dilution isopleth (which is equivalent to the original near field mixing credit) to reach the shoreline where members of the public could have access. The rationale behind this is to limit the shoreline exposure to gamma emitters that might be present in the liquid waste. If liquid effluent contains only low concentrations of tritium (beta emitter only), then the shoreline exposure limitation does not apply and the discharge volume can be larger than 2,000 gallons per tide cycle.

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.

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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, fuel building exhaust, and building demolition activities) 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 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 Gaseous Radwaste 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.

[ Exception: Structures may be isolated from the Gaseous Radwaste Treatment System and
[ released for demolition provided the pre-demolition contamination levels specified in Table
[ 2.7, Radioactive Gaseous Waste Sampling and Analysis Program, are met. Reduction of
[ contamination to those levels by any of various source term reduction and/or
[ decontamination methods shall be deemed as "Treatment" for purposes of this specification.
[ To further minimize the potential for release of radioactive material during demolition,
[ however, engineering controls should be employed as additional treatment options and may
[ include use of a non-soluble fixative or application of a water mist spray to minimize fugitive
[ emissions.

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 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 effluent monitoring instrumentation channels shown in Table 2.2 shall be operable to demonstrate that the limits in Section 2.2.3.1 are not exceeded during release of radioactive material via this pathway.

[ The alarm setpoint of the Fuel Building exhaust ventilation monitor shall be determined in accordance with the methodology in this ODCM.

[ [ Remedial Action: With a radioactive gaseous effluent monitoring instrumentation channel alarm 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 the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous [ effluents. The alarm setpoint for the Fuel Building exhaust ventilation monitor is established [ at a level to ensure that the alarm 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 |
| [ | 2. Flow Rate Measurement Devices [a] | | |
| [ | a. Liquid Radwaste Effluent Line [a] | (1) | 2 |
| [ | b. Dilution Flow or Total Flow [a] | (1) | 2 |

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.

[ ACTION 2 With the number of channels operable less than required by the minimum
[ channels operable requirement, effluent releases may continue provided that
[ flow is estimated by other means at least once per hour during the release. Other
[ means may include but are not limited to insitu generated pump curves, or
[ volume/time measurements.

[ [a] Instrumentation required only if dilution flow is used to ensure discharge limit compliance

## 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. Consider ventilation conditions and work activities when placing sampling equipment.

** 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 I 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.

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.

[ Routine particulate samples are collected in Zone I and II. In addition, sampling is performed in locations in Zone I when a building is no longer tied into existing ventilation systems as described in the ODCM Figure 6.2, Maine Yankee Gaseous Radwaste Treatment System, has large permanent openings to the environment, and is subject to active demolition activities. Demolition occurs after source term has been removed from these buildings and decontamination performed as necessary. No significant effluent release is expected during demolition activities. The number and location of sampling points is dependent on the activities performed. Air samplers are placed in or within close proximity of buildings undergoing demolition activities to provide reasonably assessment of the airborne activity that may be generated. Sampling during demolition activities is performed to validate models and assumptions used to bound demolition effluent releases.

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. Routine Particulate | 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. |
| b. Demolition Particulate | Dependent† | Continuous operation+ of sampler with sample collection as required by dust loading but at least once weekly. | Particulate sampler. Analyze for gross beta radioactivity at least 24 hours following filer change. Perform gamma isotopic analysis on any filter indicating activity greater than 5 times the yearly mean of the control samples. Perform gamma isotopic analysis on a composite of the samples collected at least once per quarter. |
| 2. Direct Radiation | 38 | Quarterly. | Gamma dose quarterly. |
| 3. Waterborne | | | |
| a. Surface (Estuary) | 2 | Weekly grab samples for a monthly composite sample*. | 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. |

* For the indicator station, grab samples shall be collected on the tide cycle when the direction of river flow is from the point of discharge toward the collection point.

** 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.

† The number and location of sampling points is dependent on the activities performed. Air samplers are placed in or within close proximity of buildings undergoing demolition activities to provide reasonably assessment of the airborne activity that may be generated.

\+ Continuous operation during periods when a building is no longer tied into existing ventilation systems, has large permanent openings to the environment, and is subject to active demolition activities.

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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/m³) | 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.

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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).

$\lambda$ is the radioactive decay constant for the particular radionuclide.

$\Delta t$ is the elapsed time between sample collection and analysis.

Typical values of E, V, Y, and $\Delta t$ 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/m$^3$) | 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 | |

[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.

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## 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 from buildings serviced by the Gaseous Radwaste Treatment
[ System shall be continuously monitored. The alarm setpoint of the Fuel Building exhaust ventilation
[ monitor shall be 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. Calculations (Reference 14) have been
[ performed that indicate that no significant effluent releases will occur during the demolition of
[ structures during decommissioning. Prior to demolition, source term is removed and the structure is
[ isolated from the Gaseous Radwaste Treatment System. Confirmation of the calculation results and
[ assumptions is provided by REMP Demolition particulate sampling.

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 Each Batch | PR Each Batch | Principal Gamma Emitters[f] | $5 \times 10^{-7}$ |
| | | | I-131 | $1 \times 10^{-6}$ |
| | PR One Batch/M | M | Dissolved and Entrained Gases (Gamma Emitters) | $1 \times 10^{-5}$ |
| [ | PR Each Batch | M Composite[b] | H-3<br>Gross Alpha | $1 \times 10^{-5}$<br>$1 \times 10^{-7}$ |
| | PR Each Batch | Q Composite[b] | Sr-89, Sr-90<br>Fe-55[g] | $5 \times 10^{-8}$<br>$1 \times 10^{-6}$ |

[

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, Co-60, Zn-65, Cs-134, and Cs-137. Ce-144 shall also be measured, but with an LLD of $5 \times 10^{-6}$. 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

[

## 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] | $1 \times 10^{-4}$ |
| | Continuous[b] | W Particulate Sample | Principal Gamma Emitters[c] (I-131, Others) | $1 \times 10^{-11}$ |
| | Continuous[b] | M Composite Particulate Sample | Gross Alpha | $1 \times 10^{-11}$ |
| | Continuous[b] | Q Composite Particulate Sample | Sr-89, Sr-90 | $1 \times 10^{-11}$ |
| | M[e] Grab | M | Tritium | $1 \times 10^{-6}$ |
| B. Fuel Building Exhaust Vent | M Grab | M | Principal Gamma Emitters[c] | $1 \times 10^{-4}$ |
| | Continuous[b] | W Particulate Sample | Principal Gamma Emitters[c] (I-131, Others) | $1 \times 10^{-11}$ |
| | Continuous[b] | M Composite Particulate Sample | Gross Alpha | $1 \times 10^{-11}$ |
| | Continuous[b] | Q Composite Particulate Sample | Sr-89, Sr-90 | $1 \times 10^{-11}$ |
| | Continuous[b] | Noble Gas Monitor | Noble Gases Gross Beta Or Gamma | $1.0 \times 10^{-5}$ |
| | W Grab | W | Tritium | $1 \times 10^{-6}$ |
| [ C. Building Demolition | Notation[f] | Notation[f] | Notation[f] | Notation[f] |

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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.

f. Prior to release of buildings for demolition after isolation from the Gaseous Radwaste Treatment System, contamination levels on all structural surfaces must meet the criteria specified in Reference 14, as follows:

Loose surface contamination
Average: Less than 500 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 5,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 20 dpm/100 $cm^2$ $\alpha$
Fixed contamination
Average: Less than 50,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 500,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 100 dpm/100 $cm^2$ $\alpha$

Loose surface contamination levels shall be counted on an instrument having a minimum detectable activity (MDA) of less than 100 dpm/100 $cm^2$ $\beta$ and 8 dpm/100 $cm^2$ $\alpha$. Alpha measurements are only required in plant areas of known or suspected alpha contamination or when the $\beta / \gamma$ to $\alpha$ ratio is less than 5,000:1. Actual values of all results above MDA will be recorded. The average shall be established by taking the mean of all the samples in a given building, or any subdivision thereof, with the MDA value used for all samples that are less than MDA.



ISSUED
Date. 10-21-02

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:

[ $$D_{tb} = 110 \sum_i Q_i \, DFL_{itb} \qquad (3\text{-}1)$$

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).

[ 110 is the dilution factor generated through effluent discharge modeling and dilution analysis
[ (Reference 11). This factor provides conservative Method I dose estimates for liquid
[ effluent discharge directly to the Back River.

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3.1.1.b Dose to the Total Body (Method II)

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 past 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 and the discharge [ forebay and submerged diffuser are removed from operational status, the mixing ratio may be reduced [ to 0.024 in Method II calculations based on an alternate discharge configuration that includes a [ submerged offshore 3-inch diameter hose situated at least 20 feet offshore from the low water tide line [ with at least 4 feet of water over the release point at low tide (Reference 11, Table 2).

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

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

[ $$D_{co} = 110 \sum_i Q_i \, DFL_{ico} \qquad (3\text{-}2)$$

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).

[ 110 is as defined in Section 3.1.1.a.
[

3.1.2.b Dose to the Critical Organ (Method II)

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 past 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 and the discharge [ forebay and submerged diffuser are removed from operational status, the mixing ratio may be reduced [ to 0.024 in Method II calculations based on an alternate discharge configuration that includes a [ submerged offshore 3-inch diameter hose situated at least 20 feet offshore from the low water tide line [ with at least 4 feet of water over the release point at low tide (Reference 11, Table 2).

## 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 |
| [ | Mn-54 | 4.26E-03 | 2.55E-02 |
| [ | Fe-55 | 1.24E-02 | 7.53E-02 |
| [ | Co-60 | 4.79E-02 | 7.80E-02 |
| | Zn-65 | 2.68E-01 | 5.38E-01 |
| [ | Sr-90 | 3.16E-02 | 1.29E-01 |
| [ | Cs-134 | 2.79E-02 | 3.12E-02 |
| | Cs-137 | 2.92E-02 | 3.41E-02 |
| [ | Ag-110m | 7.92E-03 | 6.26E-01 |
| | Sb-125 | 4.81E-03 | 6.81E-03 |
| [ | Other - β / γ | 7.27E-02 | 4.02E+00 |
| [ | Other - α | 3.49E-01 | 5.03E+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:

[

$$\dot{D}_{tb} = 6.66E-05 * \dot{Q}_{kr-85} \quad (4\text{-}1a)$$

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

[ 6.66E - 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:

[ $$\dot{D}_{skin} = 2.35E - 02 * \dot{Q}_{Kr-85} \quad (4\text{-}2a)$$

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

[ 2.35E - 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 and Bailey Cove, 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:

$$\dot{D}_{co} = \Sigma_i \dot{Q}_i DFG'_{ico} \qquad (4\text{-}3a)$$

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.

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 and Bailey Cove 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, $D^{\gamma}_{air}$, in mrad from Kr-85 released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

[ $$D^{\gamma}_{air} = 2.26E-06 * Q_{Kr-85} \qquad (4\text{-}4a)$$

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

[ 2.26E - 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 and
[ Bailey Cove, 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, $D^{\beta}_{air}$, in mrad from Kr-85 released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

[ $$D^{\beta}_{air} = 1.08E-03 * Q_{Kr-85} \qquad (4\text{-}5a)$$

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

[ 1.08E - 03 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 and Bailey Cove, 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:

$$D_{co} = \sum_i Q_i \, DFG_{ico} \tag{4-6}$$

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 and the Bailey Cove are 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) $DF^{\gamma}_i$ | Beta Air Dose Factor (mrad-m³/pCi-yr) $DF_i^{\beta}$ |
|---|---|---|---|---|
| [ Kr-85 | 1.61E-05 | 2.35E-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

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TABLE 4.3

[ DELETED

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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 | 5.27E - 03 | 1.66E - 01 |
| [ | C-14 | 3.20E + 00 | 1.01E + 02 |
| [ | Mn-54 | 3.98E + 00 | 1.57E + 02 |
| [ | Fe-55 | 1.78E + 00 | 5.61E + 01 |
| [ | Co-60 | 4.31E + 01 | 1.92E + 03 |
| [ | Zn-65 | 2.02E + 01 | 6.53E + 02 |
| [ | Sr-90 | 2.47E + 03 | 7.79E + 04 |
| [ | Ag-110m | 3.72E + 01 | 1.25E + 03 |
| [ | Sb-125 | 7.07E + 00 | 2.76E + 02 |
| [ | Cs-134 | 8.83E + 01 | 2.94E + 03 |
| [ | Cs-137 | 9.06E + 01 | 3.09E + 03 |
| [ | Ce-144 | 2.20E + 01 | 6.97E + 02 |
| | Other - β / γ | 7.03E + 01 | 2.57E + 03 |
| | Other - α | 3.62E + 04 | 1.16E + 06 |

*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 |
| [ (DEMOLITION PARTICULATE)[c] | AP-3X | <.1 | Various |
| 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-14 Boat Dock | 0.5 | NE |
| [ | WE-20 Kennebec River | 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[c] | FH/MU/CA/HA-11 Long Ledge Area | 0.9 | S |
| [ | FH/MU/CA/HA-24 | 11.1 | S |
| [ c. Food Crop[d] 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.

[

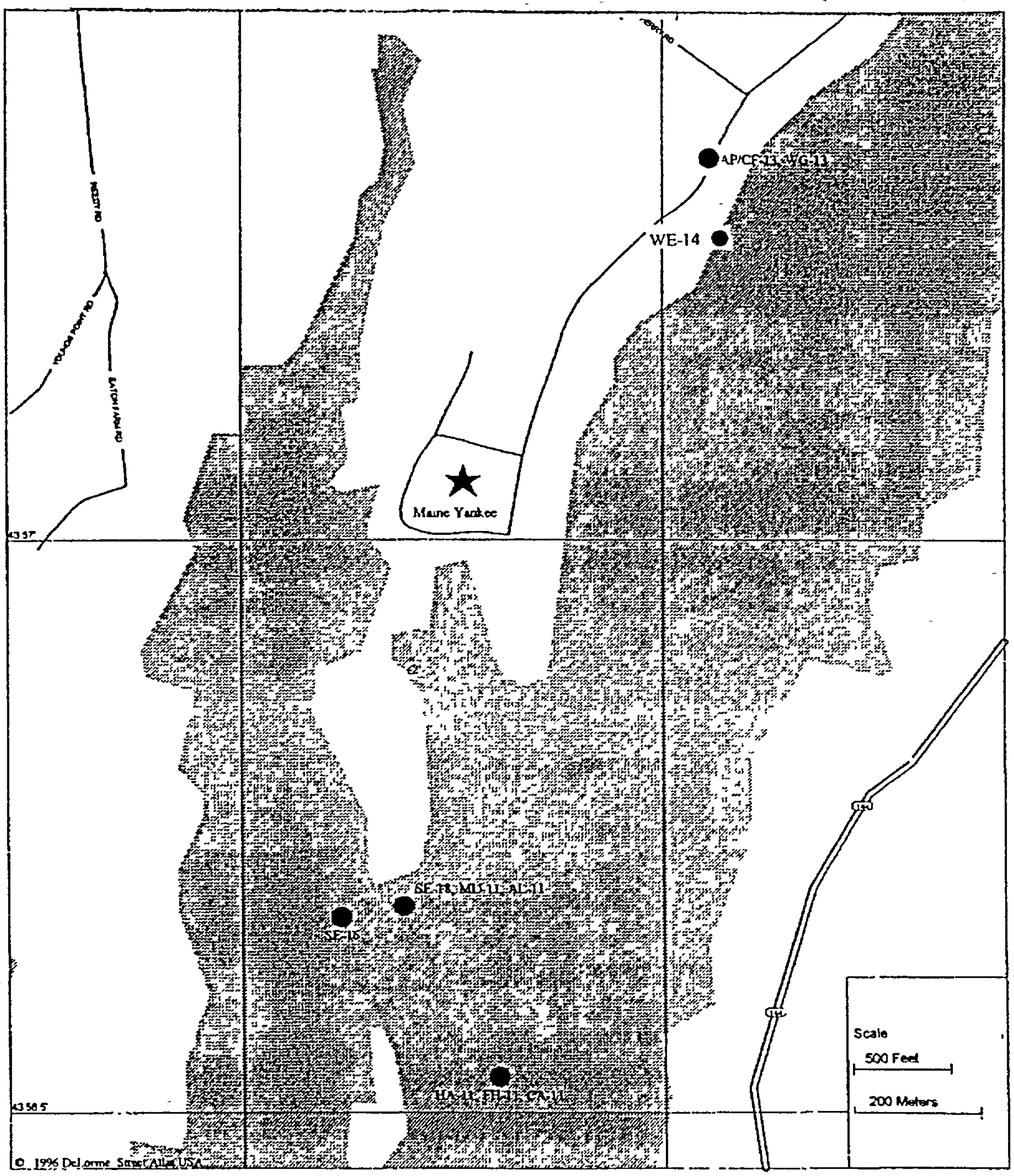
c The station code letters will vary with the sample media collected. The sampling of all four media types is not required during each sampling period.

d Food crop sampling is not required while milk sampling is being done.

e The number and location of Demolition sampling points is dependent on the activities performed. Air samplers are placed in or within close proximity of buildings undergoing demolition activities to provide reasonable assessment of the airborne activity that may be generated.

## FIGURE 5.1

## Environmental Radiological Sampling Locations Within 1 Kilometer of Maine Yankee

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OFF-SITE DOSE CALCULATION MANUAL

FIGURE 5.2

Environmental Radiological Sampling Locations
Outside of 1 Kilometer of Maine Yankee

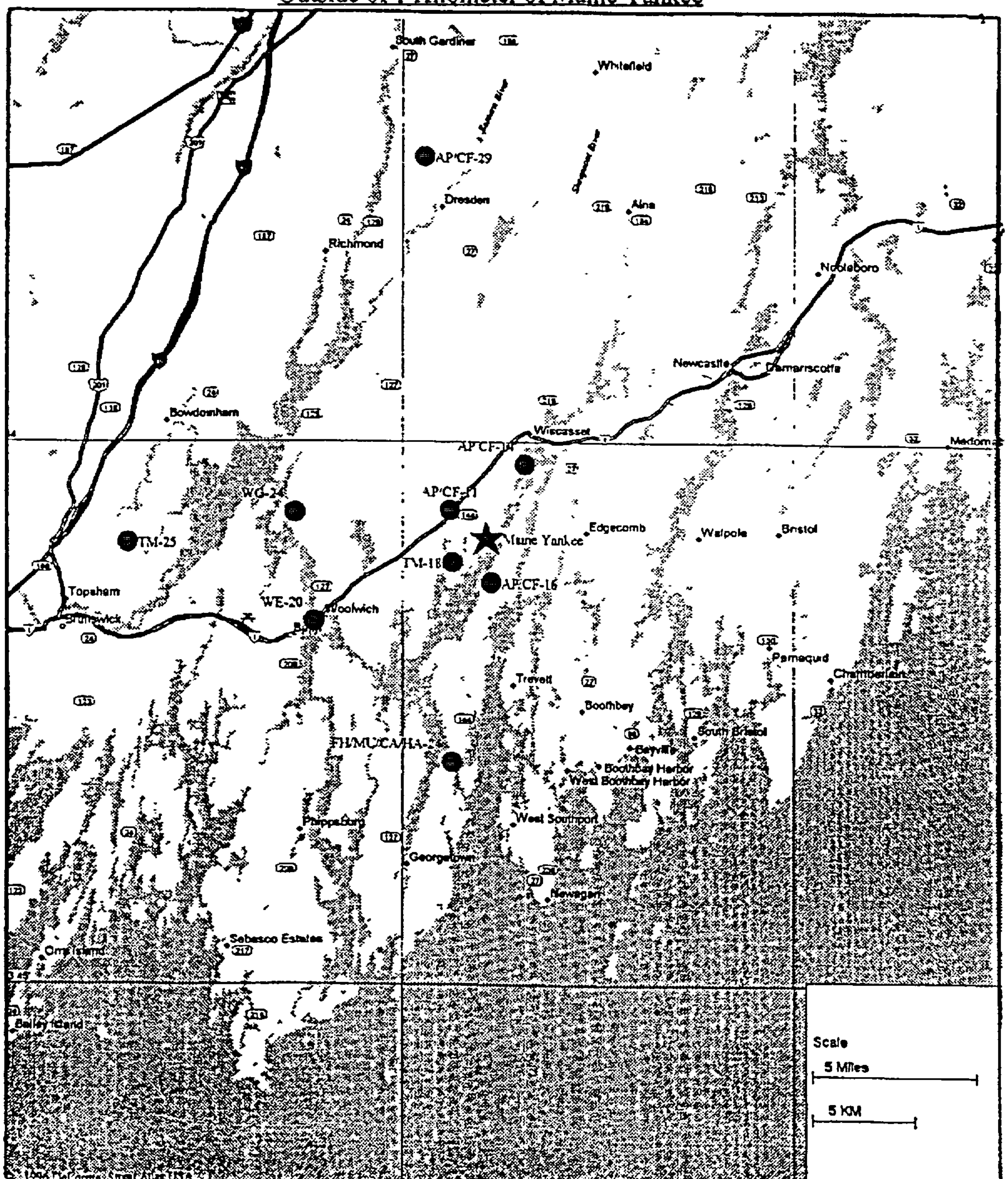


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FIGURE 5 3

Direct Radiation Monitoring Locations
Within 1 Kilometer of Maine Yankee

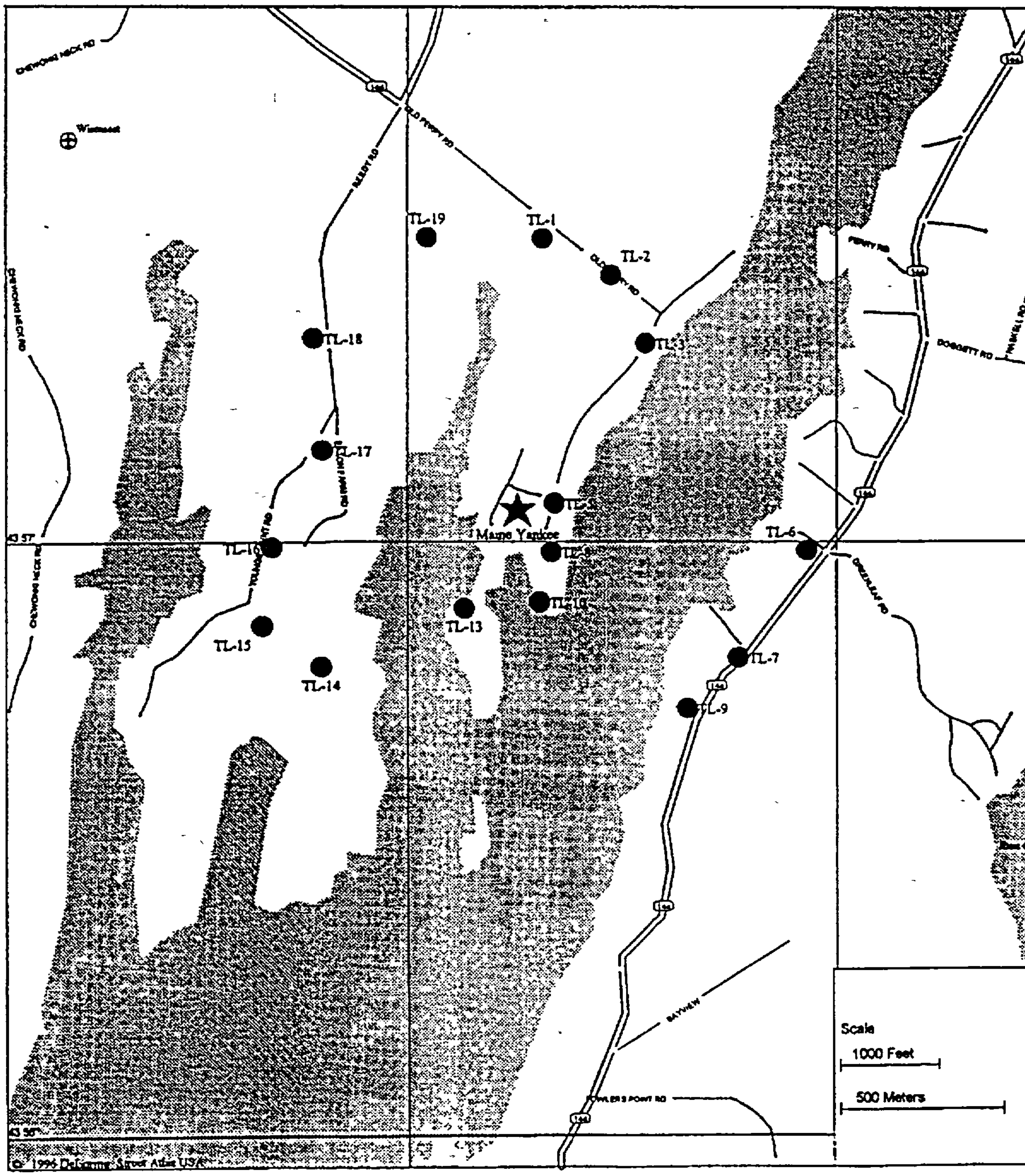


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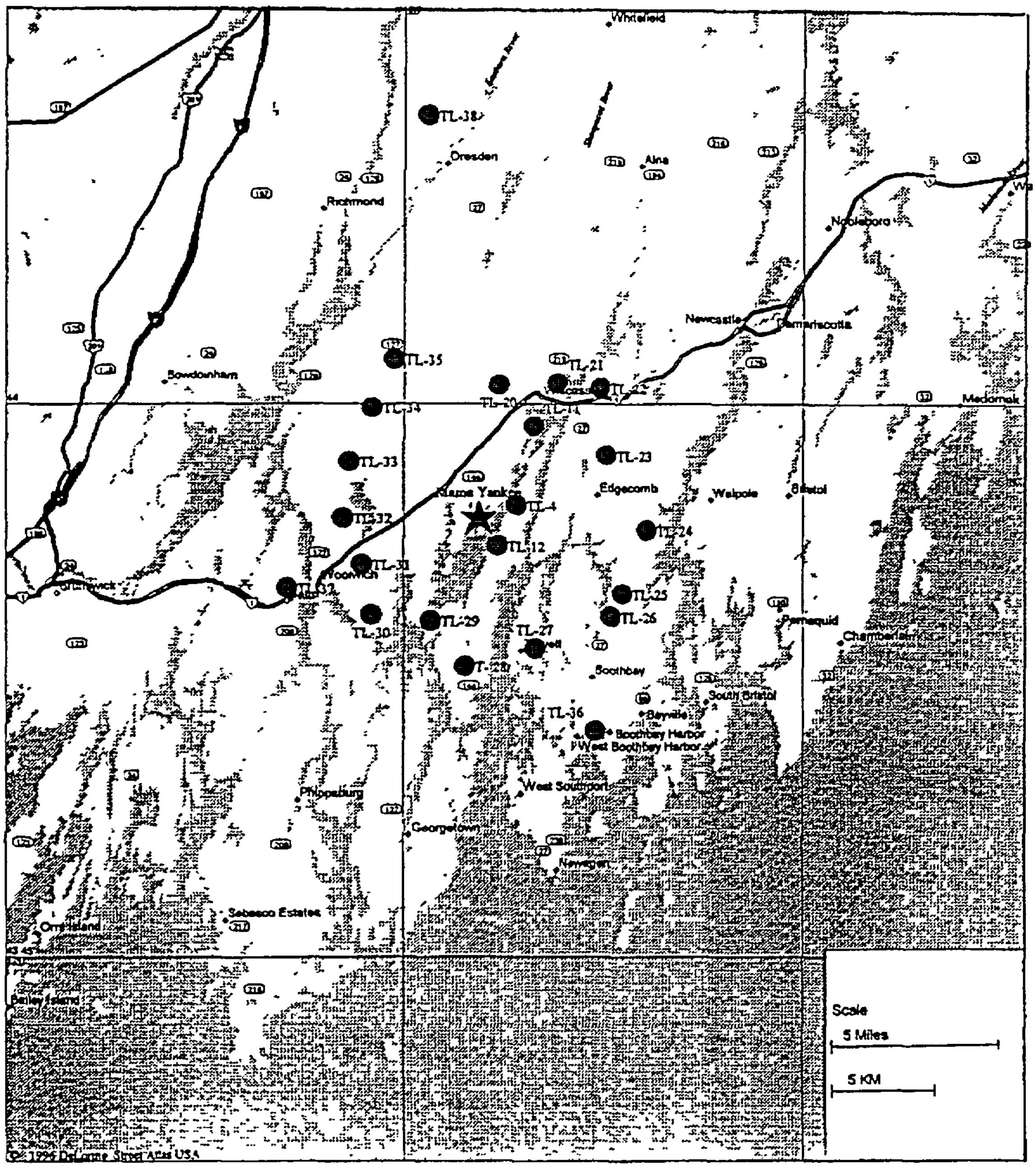
FIGURE 5.4

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 ten when calculated as follows:

$$R = \sum R_i = \sum \frac{C_i}{ECL_i} \quad \text{shall be equal to or less than 10} \qquad (6.1)$$

Where:

$R$ = Total ECL ratio (dimensionless)

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

$C_i$ = concentration of each radionuclide (i), in µCi/ml, 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)

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

$ECL_i$ = Effluent Concentration Limit (ECL) of radionuclide (i) in µCi/ml as specified in 10 CFR 20, Appendix B, Table 2, Column 2 (includes non-gamma emitters such as tritium).

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### 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 ten times the ECL for the most limiting isotope) using the relationship:

$$Setpoint_p = ECL_{gamma} * [(D + Q_p)/Q_p] * PF_p * RF * 10 \qquad (6.2)$$

Where:

$Setpoint_p$ = Monitor response (CPM) for the release pathway "p"

$ECL_{gamma}$ = Effluent Concentration Limit (ECL) as specified in 10 CFR 20, Appendix B, Table 2, Column 2 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 downstream from the monitor and prior to discharge into the Back River.

$Q_p$ = Maximum expected release flowrate through the monitored release pathway, "p" (gpm).

$PF_p$ = 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 ten, such that:

$\sum PF_p$ 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:

[

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

[ $$ER = [\sum (C_u)_i - (C_u)_{non\text{-}gamma}] * RF$$

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

[ [ $(C_u)_{non\text{-}gamma}$ = Undiluted activity concentration of Tritium and any other non-gamma emitters 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 $R \leq 5$, then:

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

- BUT -

[ If $R > 5$, then:

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

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) (1.75E-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.

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

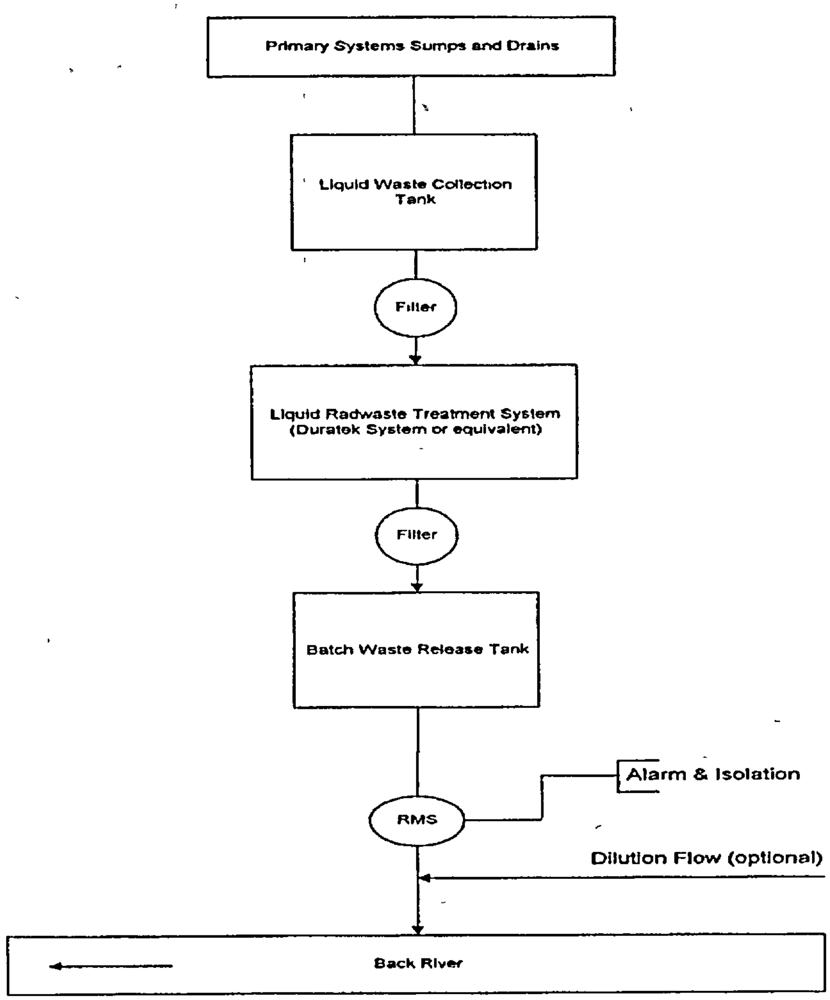
6.2.2 Monitor Response for Gaseous Effluents

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).

MAINE YANKEE ATOMIC POWER COMPANY
OFF-SITE DOSE CALCULTAION MANUAL

FIGURE 6.1

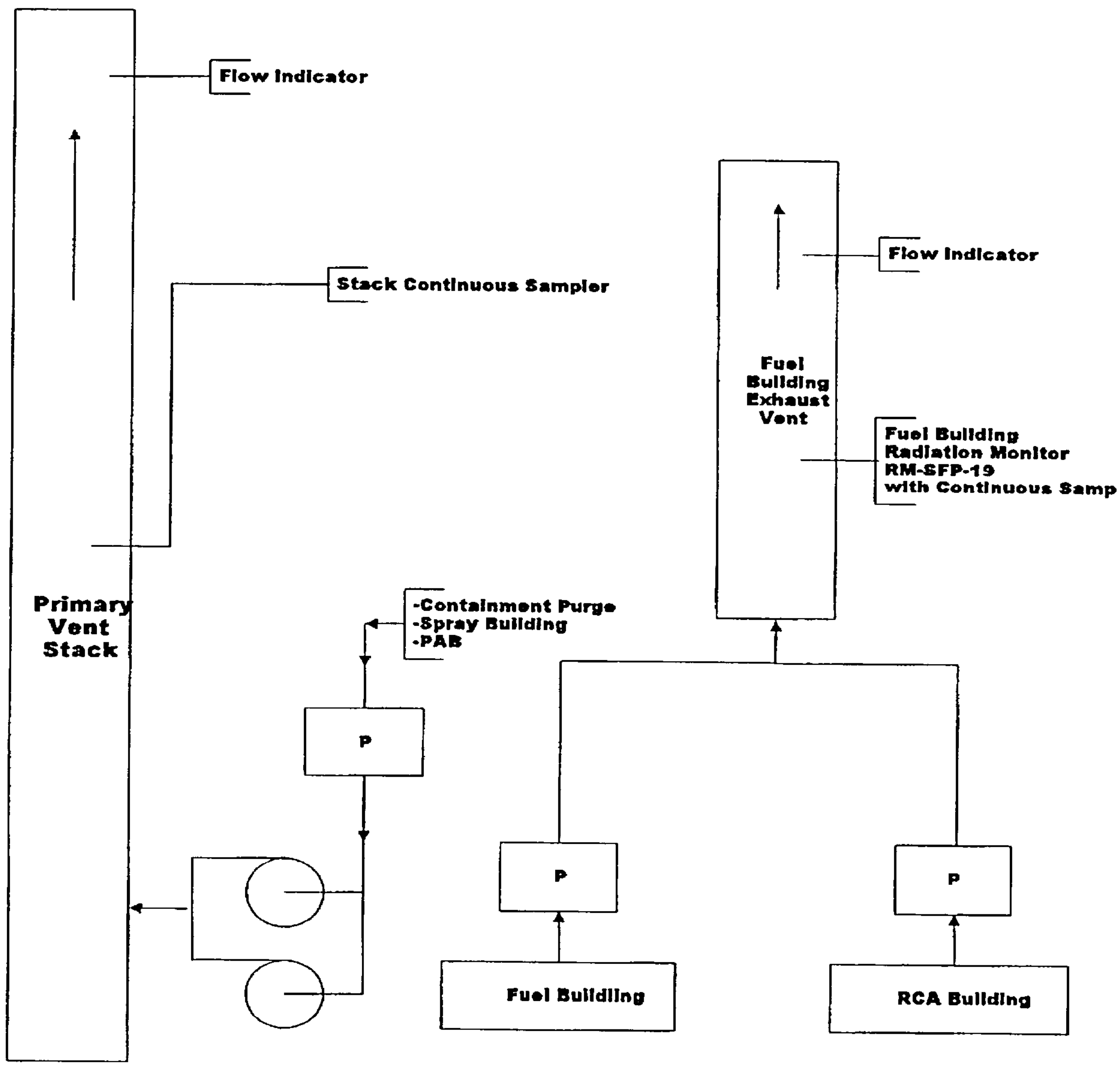
Maine Yankee
Liquid Radwaste System




08/02

[ FIGURE 6.2

[ Maine Yankee Gaseous Radwaste Treatment System




P = Particulate Filter

02/02

## 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 (Method I only) by the dose calculated for a full-time resident
[ living on a hypothetical milk farm 385 meters from the plant in the NNW 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$^3$) | 1.75E - 05 (385m NNW) |
| [ Depleted X/Q (sec/m$^3$) | 1.66E - 05 (385m NNW) |
| [ D/Q (1/m$^2$) | 5.31E - 08 (385m NNW) |
| [ Gamma X/Q (sec/m$^3$) | 4.14E - 06 (385m NNW) |

*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 previous 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. Therefore, the Method I dose factors (Table 3.1), which have not been revised to
[ incorporate a new mixing ratio, remain conservatively based on the lower 10 to 1 dilution. After the
[ forebay and diffuser are decommissioned and hence eliminated from the discharge path, the existing
[ dilution factors can be applied to liquid effluent discharged directly to the Back River. The continued
[ use of those dilution factors is supported by a dilution analysis (Reference 11) leading to the
[ conclusion that, when applied to liquid effluent discharged directly to the Back River, use of existing
[ dilution factors provide the same or greater level of conservatism as in prior dose calculations. 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).

APPENDIX A

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) | LEAFY VEG. (KG/YR) | 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 |

*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 4.14E-06 sec/m$^3$. The maximum gamma dilution factor was identified for an off-site point [ located 385 meters north-northwest of the plant. 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 land boundary 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:

[ $$\dot{D}_{tb} = 4.14 \sum_i \dot{Q}_i \, DFB_i \qquad \text{(A-2)}$$

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 - m³/pCi - yr, Table B-1, Ref. 5, the equation can be simplified to:

[ $$\dot{D}_{tb} = 6.66E\text{-}05 * \dot{Q}_{Kr\text{-}85} \quad (4\text{-}1A)$$

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/m³;

$Q_i$ is the annual release rate of radionuclide i, in Ci/yr;

$DF_i^{\gamma}$ is the gamma air dose factor for a uniform semi-infinite cloud of radionuclide i, in mrad-m³/pCi-yr;

$X/Q$ is the long term average undepleted dilution factor in sec/m³; 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 4.14E-06 sec/m³ (see Table 7.1), and the maximum five year
[ average undepleted dilution factor, X/Q, is 1.75E-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:

[ $$\dot{D}_{skin} = 4\ 6 \sum_i \dot{Q}_i\ DF_i^{\gamma} + 17.5 \sum_i \dot{Q}_i\ DFS_i$$

(A-4)

[ $$= \sum_i \dot{Q}_i\ [4.6\ DF_i^{\gamma} + 17.5\ DFS_i].$$

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

[ $$DF_i' = 4.6\ DF_i^{\gamma} + 17.5\ DFS_i.$$

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

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

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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-m³/pCi-yr) and $DFS_{Kr\text{-}85}$ equal to 1.34E-03 (mrad-m³/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:

[ $\dot{D}_{skin} = \dot{Q}_{Kr-85}\ (4.6(1.72E-05) + 17.5\ (1.34E-03)) = 2.35E-02\ \dot{Q}_{Kr-85}$

[ $\dot{D}_{skin} = 2.35E-02 * \dot{Q}_{Kr-85}$ (4 - 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.

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

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).

APPENDIX A

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.

$$\dot{D}_{co} = \sum_i \dot{Q}_i \, DFG'_{ico} \qquad \text{(A-3a)}$$

APPENDIX A

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

$DF_i^{\gamma}$ 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 4.14E-06 sec/m$^3$ (see Table 7.1) yields:

[ $D^{\gamma}_{air} = 0.131\ \Sigma_i\ Q_i\ DF_i^{\gamma}$

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

[ $D^{\gamma}_{air} = 0.131 * Q_{Kr-85} * 1.72E\text{-}05$

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

[ $D^{\gamma}_{air} = 2.26E\text{-}06 * Q_{Kr-85}$ (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.

APPENDIX A

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:

$D^{\beta}_{air}$ 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

$DF^{\beta}_i$ 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 1.75E-05 sec/m$^3$ (see Table 7.1) yields:

[ $$D^{\beta}_{air} = 0.55 \sum_{i} Q_i \; DF^{\beta}_i$$

$DF^{\beta}$ 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:

[ $$D^{\beta}_{air} = 1.08E-03 * Q_{Kr-85} \qquad \text{(4-5a)}$$

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.

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 and Bailey Cove, 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.

[ A.8 Direct Dose Calculation

[ With the calculated dose from the release of radioactive materials in liquid effluents exceeding
[ twice the limits in Section 2.1.4 or two times the gaseous 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.

[ The dose to the opposite shoreline of Bailey Cove from fixed direct radiation sources located in
[ or next to the primary structures in the original plant protected area can be calculated from:

[ $$D_{dir} = 0.087 * E_{tld} * OT$$

[ Where: $D_{dir}$ = Estimate of direct dose from fixed facility sources in the Protected Area during
[ the period for which area TLD measurements for $E_{tld}$ are included (mrem).

[ 0.087 = Proportionality factor to change on-site TLD field measurements in mR to mrem
[ along the opposite shoreline of the Bailey Cove (maximum off-site location).

[ $E_{tld}$ = The net average exposure rate of on-site TLD locations AM-31, AM-39, AM-71,
[ and AM-78 (in mR). In calculating the net average exposure rate, the
[ background exposure rate can be taken as the average of the TLD locations that
[ make up the outer ring of TLDs in the Radiological Environmental Monitoring
[ Program (REMP) as reported in the Maine Yankee annual REMP report.

[ OT = Assumed occupancy time along the opposite (western) shoreline of Bailey Cove
[ as the nearest off-site boundary with highest expected impact potential
[ (hours/year).

Basis:

[ An extensive network of on-site TLDs provides a near field direct measurement of radiation from adjacent
[ fixed sources in the plant's original Protected Area. Historical TLD measurements were used to
[ normalize a source–distance computer model using the MCNP4C computer code to predict exposures at a
[ distance typically beyond the ability of direct measurement. The closest off-site land boundary of
[ predicted maximum potential exposures is approximately 1000 feet along the WNW/NW opposite
[ shoreline of Bailey Cove. The predicted relationship between on-site TLD measurements and the far
[ shoreline are used to estimate the direct dose from primary plant structures and materials located in the
[ original Protected Area. Federal regulations (40 CFR 190) state that a dose limit of 25 mrem/year to the
[ total body or any organ from all uranium fuel cycle sources (including direct radiation) applies to real
[ individuals in the areas impacted at or beyond the site boundary. This allows for consideration of
[ occupancy time that members of the public may be subject to exposures. A time of 8760 hours/year
[ (hypothetical full time occupancy) would provide an upper estimate of potential impact. Table A-1
[ provides time for worm diggers while working on the mudflats during low tide. Other time estimates
[ based on projections of actual land use may be used.

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$^3$) | | | | | | | | |

* Regulatory Guide 1.09

3/93

## APPENDIX A

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.

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*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.

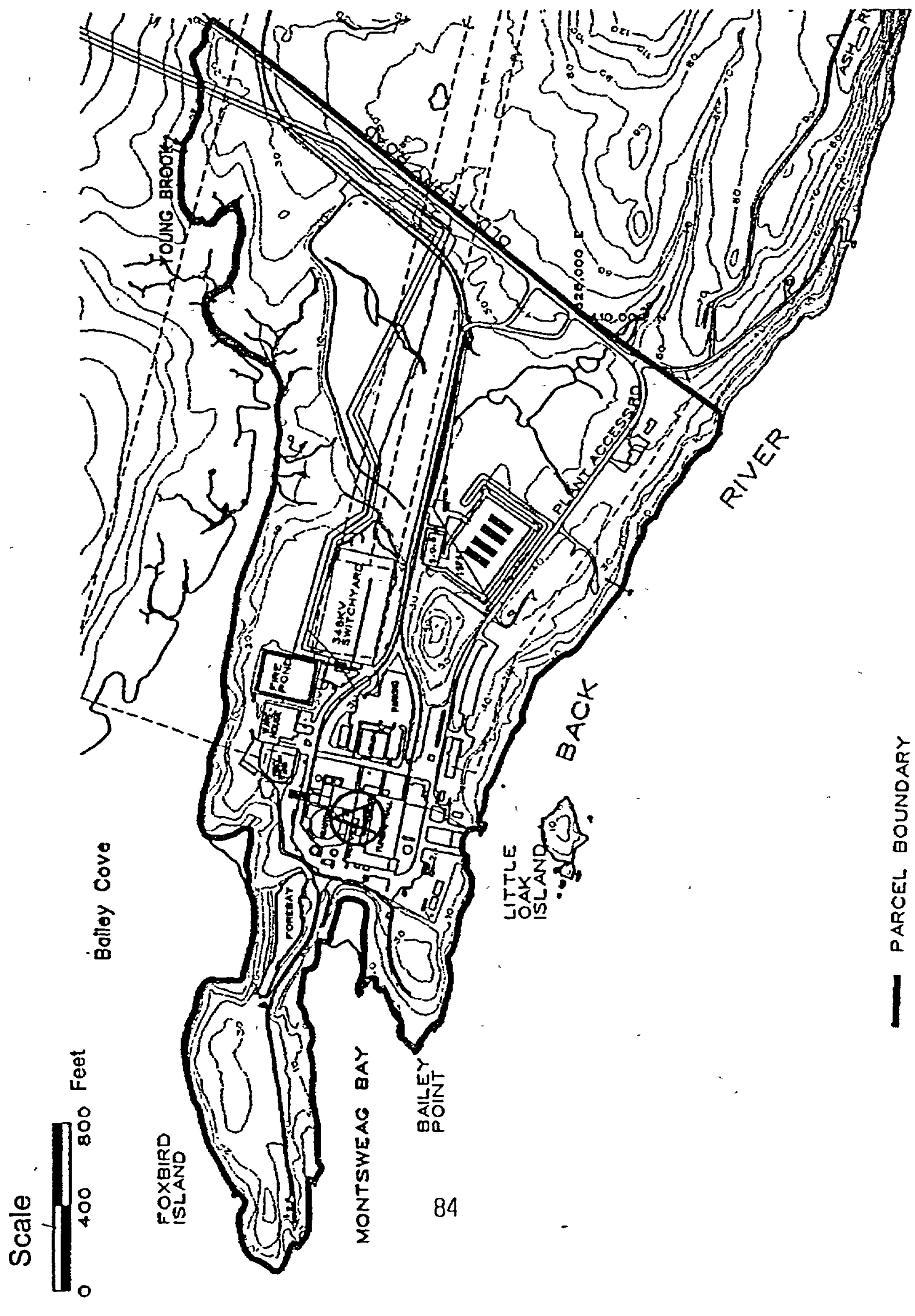
[ 3. Estimated Dose Report

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.

4. Title 40, Code of Federal Regulations. The Office of the Federal Register, National Archives and Records Administration.

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-2085, Revision 1, "ODCM Dilution Analysis for Removal of Forebay," Duke Engineering and Services, April, 2002.

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.

14. TE 013-01, Radiological Consequence of Hot Side Building Demolition, Revision 1

[ 15. ODCM Change 01-05, dated June 19, 2001

**Revision number: Change # 18**

Date. 02-02

Summary: Controls and sampling requirements were included in the ODCM to minimize the dose to the public, resulting from on-site building demolition activities.

# ODCM PAGE CHANGE SUMMARY

[ CHANGE NO. 22 DATE: ________

| PAGE | DATE | PAGE | DATE | PAGE | DATE | PAGE | DATE |
|---|---|---|---|---|---|---|---|
| Cover | 08/02 | 24 | 04/01 | 54 | 08/02 | 84 | 08/02 |
| i | 2/96 | 25 | 1/92 | 55 | 08/02 | 85 | 08/02 |
| ii | 04/01 | 26 | 04/01 | 56 | 08/02 | | |
| iii | 4/98 | 27 | 02/02 | 57 | 11/99 | | |
| iv | 08/02 | 28 | 06/02 | 58 | 2/98 | | |
| v | 11/99 | 29 | 06/02 | 59 | 08/02 | | |
| vi | 04/01 | 30 | 02/02 | 60 | 08/02 | | |
| 1 | 04/01 | 31 | 10/02 | 61 | 02/02 | | |
| 2 | 08/02 | 32 | 04/01 | 62 | 08/02 | | |
| 3 | 08/02 | 33 | 06/02 | 63 | 08/02 | | |
| 4 | 06/02 | 34 | 06/02 | 64 | 06/02 | | |
| 5 | 10/98 | 35 | 06/02 | 65 | 3/93 | | |
| 6 | 02/02 | 36 | 08/02 | 66 | 04/01 | | |
| 7 | 10/98 | 37 | 08/02 | 67 | 08/02 | | |
| 8 | 04/01 | 38 | 08/02 | 68 | 08/02 | | |
| 9 | 4/98 | 39 | 08/02 | 69 | 08/02 | | |
| 10 | 02/02 | 40 | 08/02 | 70 | 08/02 | | |
| 11 | 10/98 | 41 | 08/02 | 71 | 08/02 | | |
| 12 | 02/02 | 42 | 08/02 | 72 | 08/02 | | |
| 13 | 02/02 | 43 | 08/02 | 73 | 08/02 | | |
| 14 | 08/02 | 44 | 3/00 | 74 | 08/02 | | |
| 15 | 02/02 | 45 | 04/01 | 75 | 08/02 | | |
| 16 | 02/02 | 46 | 08/02 | 76 | 3/93 | | |
| 17 | 02/02 | 47 | 04/01 | 77 | 3/93 | | |
| 18 | 1/92 | 48 | 06/02 | 78 | 3/93 | | |
| 19 | 1/92 | 49 | 06/02 | 79 | 3/93 | | |
| 20 | 06/02 | 50 | 06/02 | 80 | 04/01 | | |
| 21 | 2/99 | 51 | 2/99 | 81 | 3/93 | | |
| 22 | 1/92 | 52 | 4/98 | 82 | 10/98 | | |
| 23 | 1/92 | 53 | 4/98 | 83 | 04/01 | | |

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ISSUED
Date: 10-21-02

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, fuel building exhaust, and building demolition activities) 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.

2.2.6 Gaseous Radwaste Treatment System

1. The Gaseous Radwaste 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 Gaseous Radwaste 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.

Exception: Structures may be isolated from the Gaseous Radwaste Treatment System and released for demolition provided the pre-demolition contamination levels specified in Table 2.7, Radioactive Gaseous Waste Sampling and Analysis Program, are met. Reduction of contamination to those levels by any of various source term reduction and/or decontamination methods shall be deemed as "Treatment" for purposes of this specification. To further minimize the potential for release of radioactive material during demolition, however, engineering controls should be employed as additional treatment options and may include use of a non-soluble fixative or application of a water mist spray to minimize fugitive emissions.

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 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.

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 effluent monitoring instrumentation channels shown in Table 2.2 shall be operable to demonstrate that the limits in Section 2.2.3.1 are not exceeded during release of radioactive material via this pathway.

   The alarm setpoint of the Fuel Building exhaust ventilation monitor shall be determined in accordance with the methodology in this ODCM.

Remedial Action: With a radioactive gaseous effluent monitoring instrumentation channel alarm 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 the releases of radioactive materials in gaseous effluents during actual or potential releases of gaseous effluents. The alarm setpoint for the Fuel Building exhaust ventilation monitor is established at a level to ensure that the alarm 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 2.2
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. Consider ventilation conditions and work activities when placing sampling equipment.

** 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 I 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.

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.

<u>Basis</u>: 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.

[ Routine particulate samples are collected in Zone I and II. In addition, sampling is performed in locations in Zone I when a building is no longer tied into existing ventilation systems as described in the ODCM Figure 6.2, Maine Yankee Gaseous Radwaste Treatment System, has large permanent openings to the environment, and is subject to active demolition activities. Demolition occurs after source term has been removed from these buildings and decontamination performed as necessary. No significant effluent release is expected during demolition activities. The number and location of sampling points is dependent on the activities performed. Air samplers are placed in or within close proximity of buildings undergoing demolition activities to provide reasonably assessment of the airborne activity that may be generated. Sampling during demolition activities is performed to validate models and assumptions used to bound demolition effluent releases.

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 from buildings serviced by the Gaseous Radwaste Treatment
[ System shall be continuously monitored. The alarm setpoint of the Fuel Building exhaust ventilation
[ monitor shall be 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. Calculations (Reference 14) have been
[ performed that indicate that no significant effluent releases will occur during the demolition of
[ structures during decommissioning. Prior to demolition, source term is removed and the structure is
[ isolated from the Gaseous Radwaste Treatment System. Confirmation of the calculation results and
[ assumptions is provided by REMP Demolition particulate sampling.

## 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] | $1 \times 10^{-4}$ |
| | Continuous[b] | W Particulate Sample | Principal Gamma Emitters[c] (I-131, Others) | $1 \times 10^{-11}$ |
| | Continuous[b] | M Composite Particulate Sample | Gross Alpha | $1 \times 10^{-11}$ |
| | Continuous[b] | Q Composite Particulate Sample | Sr-89, Sr-90 | $1 \times 10^{-11}$ |
| | M[e] Grab | M | Tritium | $1 \times 10^{-6}$ |
| B. Fuel Building Exhaust Vent | M Grab | M | Principal Gamma Emitters[c] | $1 \times 10^{-4}$ |
| | Continuous[b] | W Particulate Sample | Principal Gamma Emitters[c] (I-131, Others) | $1 \times 10^{-11}$ |
| | Continuous[b] | M Composite Particulate Sample | Gross Alpha | $1 \times 10^{-11}$ |
| | Continuous[b] | Q Composite Particulate Sample | Sr-89, Sr-90 | $1 \times 10^{-11}$ |
| | Continuous[b] | Noble Gas Monitor | Noble Gases Gross Beta Or Gamma | $1.0 \times 10^{-5}$ |
| | W Grab | W | Tritium | $1 \times 10^{-6}$ |
| [ C. Building [ Demolition | Notation [f] | Notation [f] | Notation [f] | Notation [f] |

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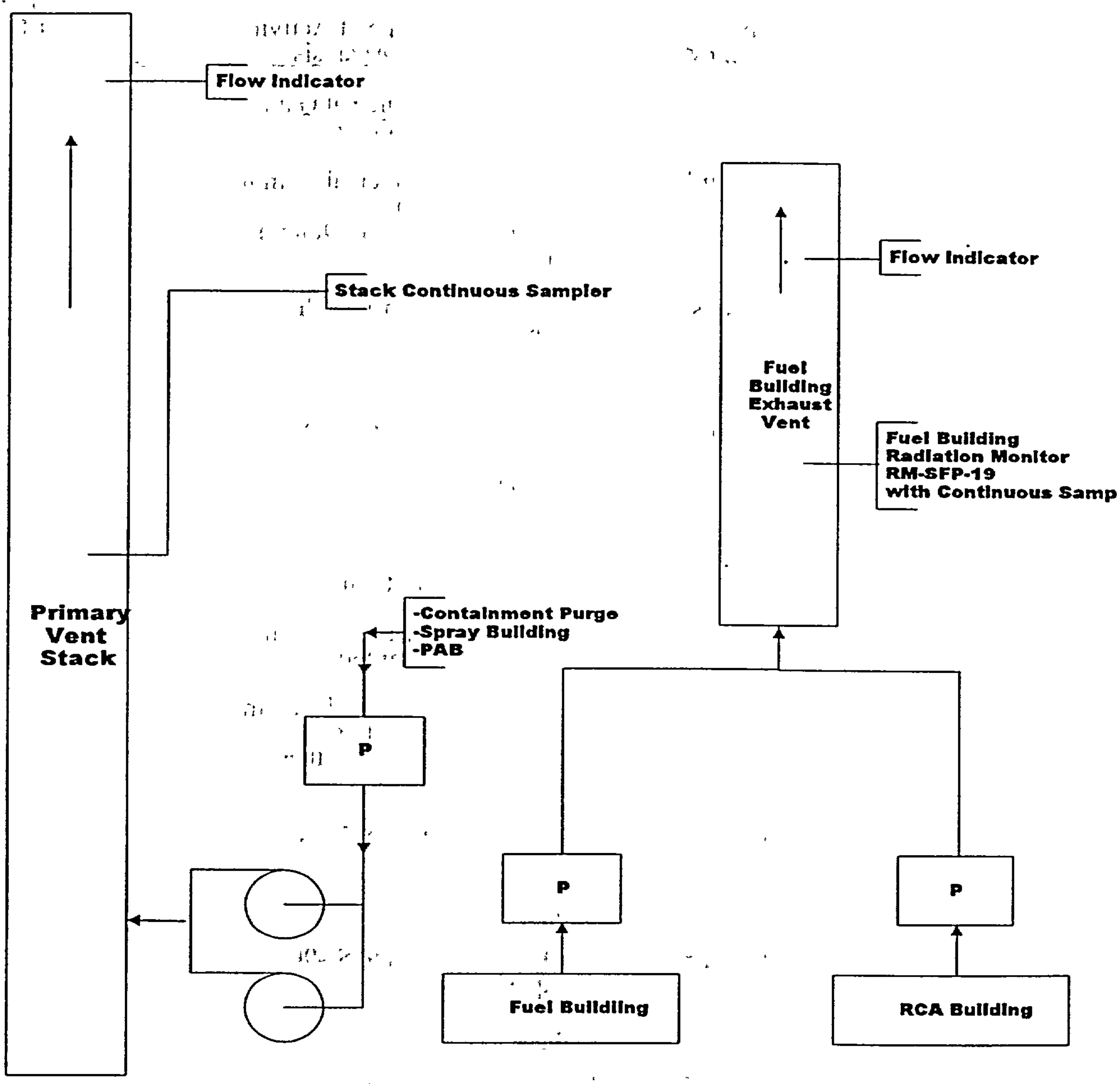
FIGURE 6.2

Maine Yankee Gaseous Radwaste Treatment System




P = Particulate Filter

Revision number: 19

Date: 05-02

Summary: Table 2.7 of the ODCM was revised to provide clarification as to when alpha smear analysis should be performed to support the release of buildings for demolition.

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.

f. Prior to release of buildings for demolition after isolation from the Gaseous Radwaste Treatment System, contamination levels on all structural surfaces must meet the criteria specified in Reference 14, as follows:

Loose surface contamination
Average: Less than 500 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 1,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 20 dpm/100 $cm^2$ $\alpha$
Fixed contamination
Average: Less than 50,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 500,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 100 dpm/100 $cm^2$ $\alpha$

Loose surface contamination levels shall be counted on an instrument having a minimum detectable activity (MDA) of less than 100 dpm/100 $cm^2$ $\beta$ and 8 dpm/100 $cm^2$ $\alpha$. Alpha measurements are only required in plant areas of known or suspected alpha contamination or when the $\beta / \gamma$ to $\alpha$ ratio is less than 5,000:1. Actual values of all results above MDA will be recorded. The average shall be established by taking the mean of all the samples in a given building, or any subdivision thereof, with the MDA value used for all samples that are less than MDA.

Revision number: 20

Date; 06-02

Summary: Sections 2.1.4, 3.1.1, 3.1.2, Tables 2.3, 2.6, 3.1, 5.1, Figure 5.1 and Appendix A were all revised to eliminate the use of the Forebay from a licensed release path and incorporated the new liquid waste discharge path to the back river. Justification for this change is contained within Calculation MYC-2083 Rev.1.

# ODCM PAGE CHANGE SUMMARY

[ CHANGE NO. 22 DATE: ______

| PAGE | DATE | PAGE | DATE | PAGE | DATE | PAGE | DATE |
|---|---|---|---|---|---|---|---|
| Cover | 08/02 | 24 | 04/01 | 54 | 08/02 | 84 | 08/02 |
| i | 2/96 | 25 | 1/92 | 55 | 08/02 | 85 | 08/02 |
| ii | 04/01 | 26 | 04/01 | 56 | 08/02 | | |
| iii | 4/98 | 27 | 02/02 | 57 | 11/99 | | |
| iv | 08/02 | 28 | 06/02 | 58 | 2/98 | | |
| v | 11/99 | 29 | 06/02 | 59 | 08/02 | | |
| vi | 04/01 | 30 | 02/02 | 60 | 08/02 | | |
| [ 1 | 04/01 | 31 | 10/02 | 61 | 02/02 | | |
| 2 | 08/02 | 32 | 04/01 | 62 | 08/02 | | |
| 3 | 08/02 | 33 | 06/02 | 63 | 08/02 | | |
| 4 | 06/02 | 34 | 06/02 | 64 | 06/02 | | |
| 5 | 10/98 | 35 | 06/02 | 65 | 3/93 | | |
| 6 | 02/02 | 36 | 08/02 | 66 | 04/01 | | |
| 7 | 10/98 | 37 | 08/02 | 67 | 08/02 | | |
| 8 | 04/01 | 38 | 08/02 | 68 | 08/02 | | |
| 9 | 4/98 | 39 | 08/02 | 69 | 08/02 | | |
| 10 | 02/02 | 40 | 08/02 | 70 | 08/02 | | |
| 11 | 10/98 | 41 | 08/02 | 71 | 08/02 | | |
| 12 | 02/02 | 42 | 08/02 | 72 | 08/02 | | |
| 13 | 02/02 | 43 | 08/02 | 73 | 08/02 | | |
| 14 | 08/02 | 44 | 3/00 | 74 | 08/02 | | |
| 15 | 02/02 | 45 | 04/01 | 75 | 08/02 | | |
| 16 | 02/02 | 46 | 08/02 | 76 | 3/93 | | |
| 17 | 02/02 | 47 | 04/01 | 77 | 3/93 | | |
| 18 | 1/92 | 48 | 06/02 | 78 | 3/93 | | |
| 19 | 1/92 | 49 | 06/02 | 79 | 3/93 | | |
| 20 | 06/02 | 50 | 06/02 | 80 | 04/01 | | |
| 21 | 2/99 | 51 | 2/99 | 81 | 3/93 | | |
| 22 | 1/92 | 52 | 4/98 | 82 | 10/98 | | |
| 23 | 1/92 | 53 | 4/98 | 83 | 04/01 | | |

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Date: 10-21-02

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 impact of discharging liquid effluent directly to the Back River has been modeled and assessed (Reference 11), which provide the basis for a dilution factor equal to 110. This factor provides conservative Method I dose estimates for liquid effluent discharged directly to the Back River. The dilution model assumes that liquid effluent discharges are approximately 2,000 gallons and made no more frequently than once per tide cycle. One of the limiting conditions on this model is a restriction on the size of the near field-mixing zone. The model does not allow the edge of the 10:1 dilution isopleth (which is equivalent to the original near field mixing credit) to reach the shoreline where members of the public could have access. The rationale behind this is to limit the shoreline exposure to gamma emitters that might be present in the liquid waste. If liquid effluent contains only low concentrations of tritium (beta emitter only), then the shoreline exposure limitation does not apply and the discharge volume can be larger than 2,000 gallons per tide cycle.

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.

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. Routine Particulate | 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. |
| b. Demolition Particulate | Dependent† | Continuous operation+ of sampler with sample collection as required by dust loading but at least once weekly. | Particulate sampler. Analyze for gross beta radioactivity at least 24 hours following filer change. Perform gamma isotopic analysis on any filter indicating activity greater than 5 times the yearly mean of the control samples. Perform gamma isotopic analysis on a composite of the samples collected at least once per quarter. |
| 2. Direct Radiation | 38 | Quarterly. | Gamma dose quarterly. |
| 3. Waterborne | | | |
| a. Surface (Estuary) | 2 | Weekly grab samples for a monthly composite sample*. | 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. |

* For the indicator station, grab samples shall be collected on the tide cycle when the direction of river flow is from the point of discharge toward the collection point.

** 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.

† The number and location of sampling points is dependent on the activities performed. Air samplers are placed in or within close proximity of buildings undergoing demolition activities to provide reasonably assessment of the airborne activity that may be generated.

\+ Continuous operation during periods when a building is no longer tied into existing ventilation systems, has large permanent openings to the environment, and is subject to active demolition activities.

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 Each Batch | PR Each Batch | Principal Gamma Emitters[f] | $5 \times 10^{-7}$ |
| | | | I-131 | $1 \times 10^{-6}$ |
| | PR One Batch/M | M | Dissolved and Entrained Gases (Gamma Emitters) | $1 \times 10^{-5}$ |
| [ | PR Each Batch | M Composite[b] | H-3<br>Gross Alpha | $1 \times 10^{-5}$<br>$1 \times 10^{-7}$ |
| | PR Each Batch | Q Composite[b] | Sr-89, Sr-90<br>Fe-55[g] | $5 \times 10^{-8}$<br>$1 \times 10^{-6}$ |

[

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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, Co-60, Zn-65, Cs-134, and Cs-137. Ce-144 shall also be measured, but with an LLD of $5 \times 10^{-6}$. 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

# 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:

[ $$D_{tb} = 110 \sum_i Q_i \, DFL_{itb} \tag{3-1}$$

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).

[ 110 is the dilution factor generated through effluent discharge modeling and dilution analysis
[ (Reference 11). This factor provides conservative Method I dose estimates for liquid
[ effluent discharge directly to the Back River.

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3.1.1.b Dose to the Total Body (Method II)

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 past 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 and the discharge
[ forebay and submerged diffuser are removed from operational status, the mixing ratio may be reduced
[ to 0.024 in Method II calculations based on an alternate discharge configuration that includes a
[ submerged offshore 3-inch diameter hose situated at least 20 feet offshore from the low water tide line
[ with at least 4 feet of water over the release point at low tide (Reference 11, Table 2).

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

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

[ $$D_{co} = 110 \sum_i Q_i DFL_{ico} \qquad (3-2)$$

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).

[ 110 is as defined in Section 3.1.1.a.
[

3.1.2.b Dose to the Critical Organ (Method II)

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 past 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 and the discharge
[ forebay and submerged diffuser are removed from operational status, the mixing ratio may be reduced
[ to 0.024 in Method II calculations based on an alternate discharge configuration that includes a
[ submerged offshore 3-inch diameter hose situated at least 20 feet offshore from the low water tide line
[ with at least 4 feet of water over the release point at low tide (Reference 11, Table 2).

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 |
| [ Mn-54 | 4.26E-03 | 2.55E-02 |
| [ Fe-55 | 1.24E-02 | 7.53E-02 |
| [ Co-60 | 4.79E-02 | 7.80E-02 |
| Zn-65 | 2.68E-01 | 5.38E-01 |
| [ Sr-90 | 3.16E-02 | 1.29E-01 |
| [ Cs-134 | 2.79E-02 | 3.12E-02 |
| Cs-137 | 2.92E-02 | 3.41E-02 |
| [ Ag-110m | 7.92E-03 | 6.26E-01 |
| Sb-125 | 4.81E-03 | 6.81E-03 |
| [ Other - β / γ | 7.27E-02 | 4.02E+00 |
| [ Other - α | 3.49E-01 | 5.03E+00 |

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 |
| [ (DEMOLITION PARTICULATE)[c] | AP-3X | <.1 | Various |
| 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 | WE-14 Boat Dock | 0.5 | NE |
| [ (Estuary) | WE-20 Kennebec River | 9.5 | WSW |
| b. Groundwater | WG-13 Bailey Farm (ESL) | 0.7 | NE |
| | WG-24 Morse Well | 9.9 | W |
| c. Sediment from | SE-18 Foxbird Island | 0.6 | S |
| Shoreline | 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[c] | FH/MU/CA/HA-11 Long Ledge Area | 0.9 | S |
| | FH/MU/CA/HA-24 | 11.1 | S |
| [ c. Food Crop[d] | TV-1X Indicator (to be determined) | - | - |
| Vegetation | 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.

[

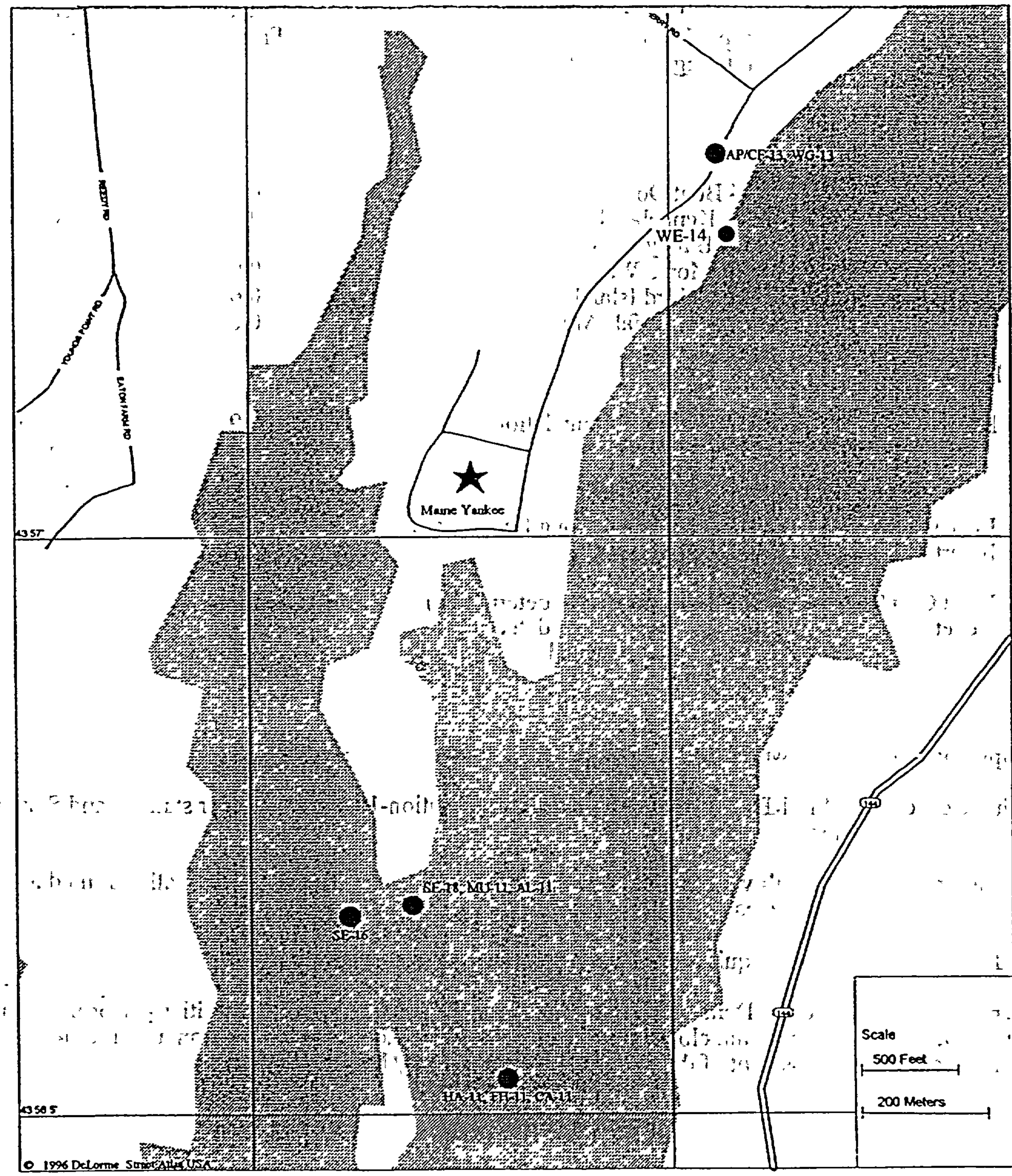
c The station code letters will vary with the sample media collected. The sampling of all four media types is not required during each sampling period.

d Food crop sampling is not required while milk sampling is being done.

e The number and location of Demolition sampling points is dependent on the activities performed. Air samplers are placed in or within close proximity of buildings undergoing demolition activities to provide reasonable assessment of the airborne activity that may be generated.

## FIGURE 5.1

### Environmental Radiological Sampling Locations Within 1 Kilometer of Maine Yankee



# 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 previous 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. Therefore, the Method I dose factors (Table 3.1), which have not been revised to incorporate a new mixing ratio, remain conservatively based on the lower 10 to 1 dilution. After the forebay and diffuser are decommissioned and hence eliminated from the discharge path, the existing dilution factors can be applied to liquid effluent discharged directly to the Back River. The continued use of those dilution factors is supported by a dilution analysis (Reference 11) leading to the conclusion that, when applied to liquid effluent discharged directly to the Back River, use of existing dilution factors provide the same or greater level of conservatism as in prior dose calculations. 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).

Revision number: 21

Date: 08-02

Summary: Section 2.1.3 was revised to incorporate the reserved technical specification limit of 10 times the concentration levels specified in 10 CFR 20, Appendix B, Table 2, Column 2 and to address the use of dilution to meet concentration limits for liquid waste releases.

# ODCM PAGE CHANGE SUMMARY

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## 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 doses to the public resulting from all such releases are within the
[ limits specified 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 not more than ten times the concentrations
[ specified in 10 CFR, Part 20, Appendix B, Table 2, Column 2.

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 limitations apply to the concentration of radioactive materials released in the
[ liquid waste effluents from the site to unrestricted areas at the point of discharge into the
[ Back River. Concentration levels specified in 10 CFR 20, Appendix B, Table 2, Column 2
[ were established to control the dose to the public to within the limits specified in 10 CFR
[ 20.1301 and 20.1302. Those values assure a continuous discharge at those concentrations
[ (8760 hours per year). Pursuant to the requirements of 10 CFR 50.36a to maintain effluents
[ as low as reasonably achievable (ALARA), Appendix I to 10 CFR 50 specifies dose values
[ that are a small percentage of the dose limits in 10 CFR 20.1301. Consistent with Appendix
[ I to 10 CFR 50, to allow operational flexibility, this specification in conjunction with the
[ dose specification in Section 2.1.4.1 permits an instantaneous concentration release rate up to
[ a factor of ten times greater than specified in 10 CFR 20, Appendix B, Table 2, Column 2
[ while continuing to limit the total annual discharge to a small fraction of the allowable annual
[ dose as specified in Appendix I.

For determining compliance, it must be demonstrated that the concentrations of radionuclides in liquid effluent prior to discharge to the Back River (Reference Section 6.1) meet the limits specified. The release path for liquid effluent allows direct discharge into the Back River through a submerged discharge line. Additional dilution flow may be added into the discharge line (as shown in Figure 6.1) to ensure concentration limits are met. The volume of dilution water is not included in the 2,000 gallons per tide cycle waste volume limit described in the Section 2.1.4.1 Basis. Liquid effluent must be discharged in a horizontal offshore direction through a 3-inch diameter hose from a position that is at least 1 foot above the riverbed in order to ensure sufficient localized mixing (Reference 11). In addition, the discharge end of the line must be positioned at least 20 feet offshore beyond the low tide line and, during releases of liquid effluent, must be covered by at least 4 feet of water. Those criteria provide assurance that sufficient dilution is available to minimize shoreline doses (Reference 11). Any dilution or mixing that occurs after the effluent has exited the discharge pipe, however, can not be used for determining compliance with effluent concentration limits.

2.1.4 Liquid Effluents: Dose

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.

Remedial Action: 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.

Remedial Action: 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.

## 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 |
| [ | 2. Flow Rate Measurement Devices [(a)] | | |
| [ | a. Liquid Radwaste Effluent Line [(a)] | (1) | 2 |
| [ | b. Dilution Flow or Total Flow [(a)] | (1) | 2 |

### 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.

[ ACTION 2 With the number of channels operable less than required by the minimum
[ channels operable requirement, effluent releases may continue provided that
[ flow is estimated by other means at least once per hour during the release. Other
[ means may include but are not limited to insitu generated pump curves, or
[ volume/time measurements.

[ [(a)] Instrumentation required only if dilution flow is used to ensure discharge limit compliance

# 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:

[ $$\dot{D}_{tb} = 6.66E-05 * \dot{Q}_{kr-85} \quad (4\text{-}1a)$$

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

[ 6.66E - 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.

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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:

[ $$\dot{D}_{skin} = 2.35E-02 * \dot{Q}_{Kr-85} \qquad (4\text{-}2a)$$

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

[ 2.35E - 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 and Bailey Cove, 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:

$$\dot{D}_{co} = \Sigma_i \dot{Q}_i DFG'_{ico} \qquad (4\text{-}3a)$$

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.

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 and Bailey Cove 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, $D^{\gamma}_{air}$, in mrad from Kr-85 released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

[ $$D^{\gamma}_{air} = 2.26E-06 * Q_{Kr-85} \qquad (4\text{-}4a)$$

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

[ 2.26E - 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 and
[ Bailey Cove, 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, $D^{\beta}_{air}$, in mrad from Kr-85 released via the Fuel Building Exhaust Vent or the Primary Vent Stack is:

[ $$D^{\beta}_{air} = 1.08E-03 * Q_{Kr-85} \qquad (4\text{-}5a)$$

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

[ 1.08E - 03 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 and Bailey Cove, 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 and the Bailey Cove are 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-m$^3$/pCi-yr) $DFB_i$ | Combined Skin Dose Rate Factor (mrem-sec/uCi-yr) $DF_i^{\prime}$ | Gamma Air Dose Factor (mrad-m$^3$/pCi-yr) $DF^{\gamma}_i$ | Beta Air Dose Factor (mrad-m$^3$/pCi-yr) $DF_i^{\beta}$ |
|---|---|---|---|---|
| [ Kr-85 | 1.61E-05 | 2.35E-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.

MAINE YANKEE ATOMIC POWER COMPANY
OFF-SITE DOSE CALCULATION MANUAL

## 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 | 5.27E - 03 | 1.66E - 01 |
| C-14 | 3.20E + 00 | 1.01E + 02 |
| Mn-54 | 3.98E + 00 | 1.57E + 02 |
| Fe-55 | 1.78E + 00 | 5.61E + 01 |
| Co-60 | 4.31E + 01 | 1.92E + 03 |
| Zn-65 | 2.02E + 01 | 6.53E + 02 |
| Sr-90 | 2.47E + 03 | 7.79E + 04 |
| Ag-110m | 3.72E + 01 | 1.25E + 03 |
| Sb-125 | 7.07E + 00 | 2.76E + 02 |
| Cs-134 | 8.83E + 01 | 2.94E + 03 |
| Cs-137 | 9.06E + 01 | 3.09E + 03 |
| Ce-144 | 2.20E + 01 | 6.97E + 02 |
| Other - β / γ | 7.03E + 01 | 2.57E + 03 |
| Other - α | 3.62E + 04 | 1.16E + 06 |

*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.

## 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 ten when calculated as follows:

[ $$R = \sum R_i = \sum \frac{C_i}{ECL_i} \quad \text{shall be equal to or less than 10} \qquad (6.1)$$

Where:

$R$ = Total ECL ratio (dimensionless)

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

[ $C_i$ = concentration of each radionuclide (i), in µCi/ml, 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)

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

[ $ECL_i$ = Effluent Concentration Limit (ECL) of radionuclide (i) in µCi/ml as
[ specified in 10 CFR 20, Appendix B, Table 2, Column 2 (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 ten times the ECL for the most limiting isotope) using the relationship:

$$Setpoint_p = ECL_{gamma} * [(D + Q_p)/Q_p] * PF_p * RF * 10 \quad (6.2)$$

Where:

$Setpoint_p$ = Monitor response (CPM) for the release pathway "p"

$ECL_{gamma}$ = Effluent Concentration Limit (ECL) as specified in 10 CFR 20, Appendix B, Table 2, Column 2 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 downstream from the monitor and prior to discharge into the Back River.

$Q_p$ = Maximum expected release flowrate through the monitored release pathway, "p" (gpm).

$PF_p$ = 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 ten, such that:

$\sum PF_p$ 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:

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

$$ER = [\sum (C_u)_i - (C_u)_{non\text{-}gamma}] * RF$$

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

$(C_u)_{non\text{-}gamma} =$ Undiluted activity concentration of Tritium and any other non-gamma emitters 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 $R \leq 5$, then:

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

- BUT -

If $R > 5$, then:

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

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.

### 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) (1.75E-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.

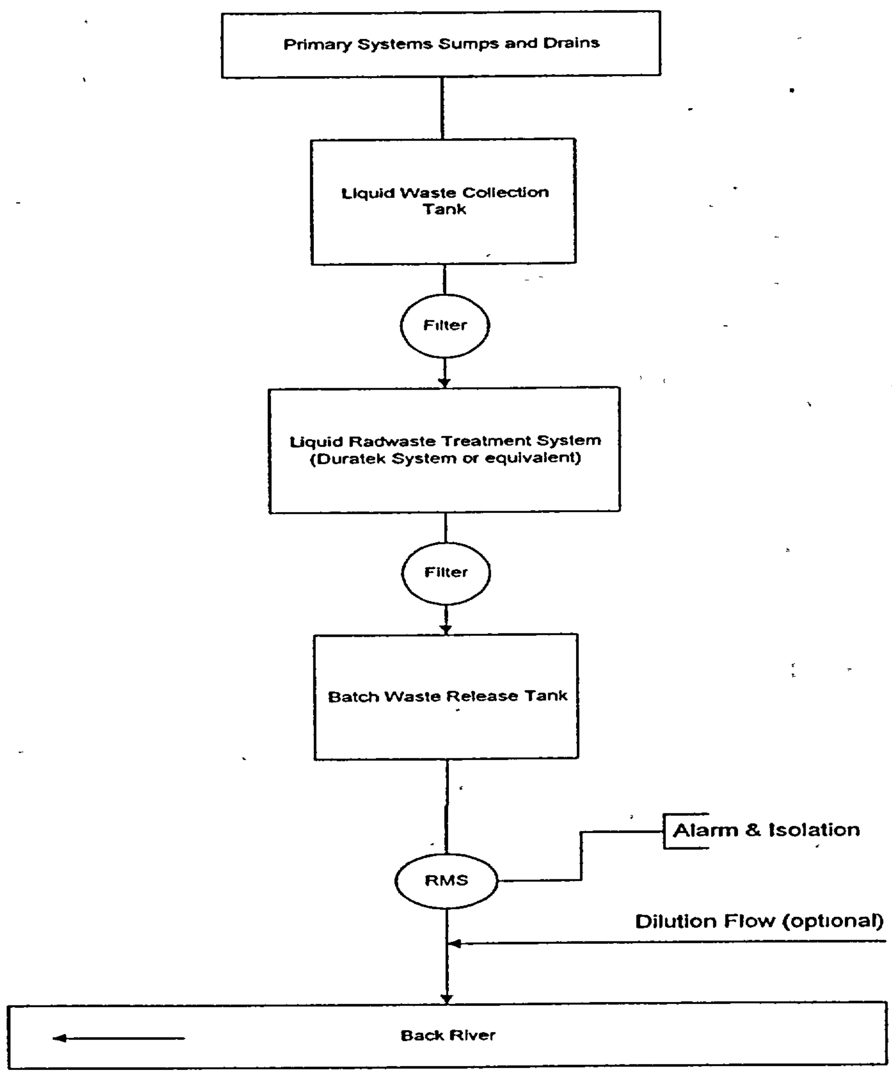
$$R \leq 1. \qquad (6\text{-}7)$$

### 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




08/02

## 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 (Method I only) by the dose calculated for a full-time resident [ living on a hypothetical milk farm 385 meters from the plant in the NNW sector.

TABLE 7.1

Maximum Off-Site Long Term Average Atmospheric Dispersion Factors

| | Maximum Long-Term Dispersion Factor | Fuel Building Vent* |
|---|---|---|
| [ | Undepleted X/Q ($sec/m^3$) | 1.75E - 05 (385m NNW) |
| [ | Depleted X/Q ($sec/m^3$) | 1.66E - 05 (385m NNW) |
| [ | D/Q ($1/m^2$) | 5.31E - 08 (385m NNW) |
| [ | Gamma X/Q ($sec/m^3$) | 4.14E - 06 (385m NNW) |

*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).

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:

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

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 4.14E-06 sec/m$^3$. The maximum gamma dilution factor was identified for an off-site point [ located 385 meters north-northwest of the plant. 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 land boundary 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:

[ $$\dot{D}_{tb} = 4.14 \sum_i \dot{Q}_i \, DFB_i \quad \text{(A-2)}$$

Since the only noble gas applicable to Maine Yankee due to the permanent plant shutdown is Kr-85, $DFB_{Kr-85}$ = 1.61E-05 mrem - m³/pCi - yr, Table B-1, Ref. 5, the equation can be simplified to:

[ $$\dot{D}_{tb} = 6.66E{-}05 * \dot{Q}_{Kr-85} \qquad \text{(4-1A)}$$

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:

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

where:

$D_{skin}$ 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/m³;

$Q_i$ is the annual release rate of radionuclide i, in Ci/yr;

$DF_i^{\gamma}$ is the gamma air dose factor for a uniform semi-infinite cloud of radionuclide i, in mrad-m³/pCi-yr;

$X/Q$ is the long term average undepleted dilution factor in sec/m³; 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 4.14E-06 sec/m³ (see Table 7.1), and the maximum five year average undepleted dilution factor, X/Q, is 1.75E-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:

$$[\quad \dot{D}_{skin} = 4.6 \sum_i \dot{Q}_i DF_i^{\gamma} + 17.5 \sum_i \dot{Q}_i DFS_i$$

$$[\quad = \sum_i \dot{Q}_i [4.6 DF_i^{\gamma} + 17.5 DFS_i]. \qquad (A-4)$$

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

$$[\quad DF_i' = 4.6 DF_i^{\gamma} + 17.5 DFS_i.$$

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 $DF_{KR-85}^{\gamma}$ equal to 1.72E-05 (mrad-m³/pCi-yr) and $DFS_{Kr-85}$ equal to 1.34E-03 (mrad-m³/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:

[ $$\dot{D}_{skin} = \dot{Q}_{Kr-85} \,(4.6(1.72E-05) + 17.5\,(1.34E-03)) = 2.35E-02\ \dot{Q}_{Kr-85}$$

[ $$\dot{D}_{skin} = 2.35E-02 * \dot{Q}_{Kr-85} \qquad (4-2a)$$

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.

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

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).

APPENDIX A

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.

$$\dot{D}_{co} = \sum_i \dot{Q}_i \, DFG'_{ico} \qquad \text{(A-3a)}$$

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

$DF_i^{\gamma}$ 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 4.14E-06 sec/m$^3$ (see Table 7.1) yields:

[ $D^{\gamma}_{air} = 0.131\ \Sigma_i\ Q_i\ DF_i^{\gamma}$

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

[ $D^{\gamma}_{air} = 0.131 * Q_{Kr-85} * 1.72E{-}05$

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

[ $D^{\gamma}_{air} = 2.26E{-}06 * Q_{Kr-85}$ (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:

$D^{\beta}_{air}$ 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

$DF^{\beta}_i$ 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 1.75E-05 sec/m$^3$ (see Table 7.1) yields:

[ $$D^{\beta}_{air} = 0.55 \sum_{i} Q_i\ DF^{\beta}_i$$

$DF^{\beta}$ 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:

[ $$D^{\beta}_{air} = 1.08E-03 * Q_{Kr\text{-}85} \qquad \text{(4-5a)}$$

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 and Bailey Cove, 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

[ A.8 Direct Dose Calculation

[ With the calculated dose from the release of radioactive materials in liquid effluents exceeding [ twice the limits in Section 2.1.4 or two times the gaseous 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.

[ The dose to the opposite shoreline of Bailey Cove from fixed direct radiation sources located in [ or next to the primary structures in the original plant protected area can be calculated from:

[ $$D_{dir} = 0.087 * E_{tld} * OT$$

[ Where: $D_{dir}$ = Estimate of direct dose from fixed facility sources in the Protected Area during [ the period for which area TLD measurements for $E_{tld}$ are included (mrem).

[ 0.087 = Proportionality factor to change on-site TLD field measurements in mR to mrem [ along the opposite shoreline of the Bailey Cove (maximum off-site location).

[ $E_{tld}$ = The net average exposure rate of on-site TLD locations AM-31, AM-39, AM-71, [ and AM-78 (in mR). In calculating the net average exposure rate, the [ background exposure rate can be taken as the average of the TLD locations that [ make up the outer ring of TLDs in the Radiological Environmental Monitoring [ Program (REMP) as reported in the Maine Yankee annual REMP report.

[ OT = Assumed occupancy time along the opposite (western) shoreline of Bailey Cove [ as the nearest off-site boundary with highest expected impact potential [ (hours/year).

Basis:

[ An extensive network of on-site TLDs provides a near field direct measurement of radiation from adjacent [ fixed sources in the plant's original Protected Area. Historical TLD measurements were used to [ normalize a source–distance computer model using the MCNP4C computer code to predict exposures at a [ distance typically beyond the ability of direct measurement. The closest off-site land boundary of [ predicted maximum potential exposures is approximately 1000 feet along the WNW/NW opposite [ shoreline of Bailey Cove. The predicted relationship between on-site TLD measurements and the far [ shoreline are used to estimate the direct dose from primary plant structures and materials located in the [ original Protected Area. Federal regulations (40 CFR 190) state that a dose limit of 25 mrem/year to the [ total body or any organ from all uranium fuel cycle sources (including direct radiation) applies to real [ individuals in the areas impacted at or beyond the site boundary. This allows for consideration of [ occupancy time that members of the public may be subject to exposures. A time of 8760 hours/year [ (hypothetical full time occupancy) would provide an upper estimate of potential impact. Table A-1 [ provides time for worm diggers while working on the mudflats during low tide. Other time estimates [ based on projections of actual land use may be used.

Revision number 22

Date: 10-02

Summary: Table 2.7 was revised to increase the maximum loose surface contamination limit for surveys performed to turn site buildings over for demolition. The averaged average contamination levels remain the same. The change maintained the same level of control and did not result in an increase of dose to the public.

# ODCM PAGE CHANGE SUMMARY

[ CHANGE NO. 22 DATE: ______________

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| 9 | 4/98 | 39 | 08/02 | 69 | 08/02 | | |
| 10 | 02/02 | 40 | 08/02 | 70 | 08/02 | | |
| 11 | 10/98 | 41 | 08/02 | 71 | 08/02 | | |
| 12 | 02/02 | 42 | 08/02 | 72 | 08/02 | | |
| 13 | 02/02 | 43 | 08/02 | 73 | 08/02 | | |
| 14 | 08/02 | 44 | 3/00 | 74 | 08/02 | | |
| 15 | 02/02 | 45 | 04/01 | 75 | 08/02 | | |
| 16 | 02/02 | 46 | 08/02 | 76 | 3/93 | | |
| 17 | 02/02 | 47 | 04/01 | 77 | 3/93 | | |
| 18 | 1/92 | 48 | 06/02 | 78 | 3/93 | | |
| 19 | 1/92 | 49 | 06/02 | 79 | 3/93 | | |
| 20 | 06/02 | 50 | 06/02 | 80 | 04/01 | | |
| 21 | 2/99 | 51 | 2/99 | 81 | 3/93 | | |
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| 23 | 1/92 | 53 | 4/98 | 83 | 04/01 | | |

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ISSUED
Date: 10-21-02

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.

f. Prior to release of buildings for demolition after isolation from the Gaseous Radwaste Treatment System, contamination levels on all structural surfaces must meet the criteria specified in Reference 14, as follows:

Loose surface contamination
Average: Less than 500 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 5,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 20 dpm/100 $cm^2$ $\alpha$
Fixed contamination
Average: Less than 50,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 500,000 dpm/100 $cm^2$ $\beta / \gamma$
Maximum: Less than 100 dpm/100 $cm^2$ $\alpha$

Loose surface contamination levels shall be counted on an instrument having a minimum detectable activity (MDA) of less than 100 dpm/100 $cm^2$ $\beta$ and 8 dpm/100 $cm^2$ $\alpha$. Alpha measurements are only required in plant areas of known or suspected alpha contamination or when the $\beta / \gamma$ to $\alpha$ ratio is less than 5,000:1. Actual values of all results above MDA will be recorded. The average shall be established by taking the mean of all the samples in a given building, or any subdivision thereof, with the MDA value used for all samples that are less than MDA.


ISSUED
Date. 10-21-02

# MAINE YANKEE ATOMIC POWER COMPANY
# ESTIMATED DOSE REPORT FOR 2002

FANP Doc # 47-5026682-00

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# MAINE YANKEE ATOMIC POWER COMPANY

## ESTIMATED DOSE REPORT FOR 2002

## 1.0 INTRODUCTION

This report summarizes the radiological dose commitments resulting from all radioactive liquid and gaseous effluent discharges during the 2002 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 2002. 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 2002. 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 2002 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 2002. 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 2002.

## 3.3 Doses From Tritium and Radionuclides in Particulate Form

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 2002 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 2002 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 2002. 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 0.62 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 (0.62 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 2002, 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 0.62 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. 23, Approved March 31, 2003.

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 2002
## (10CFR50, Appendix I)

| | Dose (mrem) | | | | |
|---|---|---|---|---|---|
| Source | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | Year[b] |
| Liquid Effluents | | | | | |
| Total Body Dose[a] | 6.8E-5 | 1.4E-3 | 8.2E-4 | 3.2E-4 | 2.6E-3 |
| Footnotes | (1) | (2) | (1) | (1) | |
| Organ Dose[a] | 1.3E-4 | 8.0E-3 | 1.6E-3 | 1.5E-3 | 1.1E-2 |
| Footnotes | (3) | (4) | (5) | (4) | |
| Airborne Effluents | | | | | |
| Organ Dose[a] (Tritium + Part.) | 1.1E-4 | 9.9E-5 | 3.1E-4 | 1.5E-4 | 6.7E-4 |
| Footnotes | (6) | (6) | (6) | (6) | |
| Noble Gases | | | | | |
| Beta Air[a] (mrad) | ND | ND | ND | ND | ND |
| Footnotes | (7) | (7) | (7) | (7) | |
| Gamma Air[a] (mrad) | ND | ND | ND | ND | ND |
| Footnotes | (7) | (7) | (7) | (7) | |

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

(1) Adult
(2) Child
(3) Adult/GI-LLI
(4) Child/Bone
(5) Adult/Bone
(6) Child/All Organs/SE, 700 meters
(7) 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 2002[a]
### (40CFR190)

| Pathway | Total Body (mrem) | Maximum Organ (mrem) | Thyroid (mrem) |
|---|---|---|---|
| Direct External | 6.2E-1 | 6.2E-1 | 6.2E-1 |
| Liquids | 2.6E-3 | 1.1E-2 | 9.1E-4 |
| Gases | 2.0E-5 | 2.0E-5 | 2.0E-5 |
| Annual Total[b] | 6.2E-1 | 6.3E-1 | 6.2E-1 |

(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 | 1860 | -- |
| 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 | -- |
| 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 2002 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 FRÈQUENCY (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
(2)=PERCENT OF ALL GOOD OBSERVATIONS FOR THIS PERIOD
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

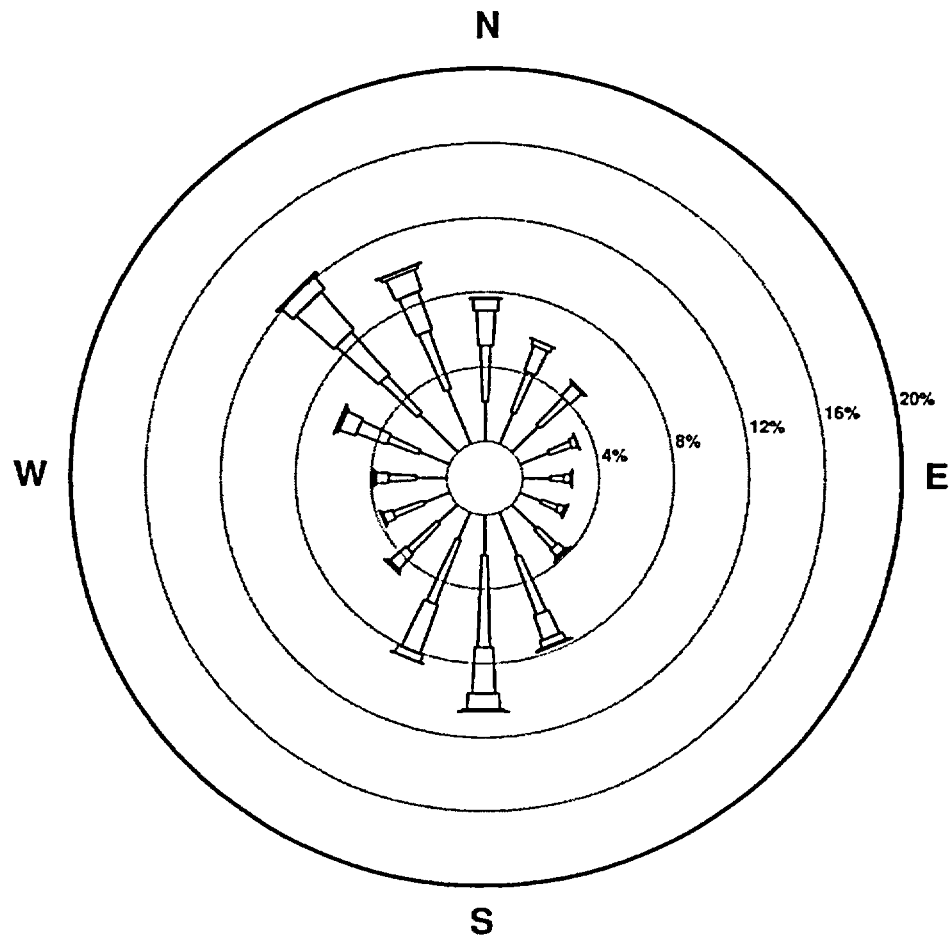
| SPEED MPH | N | NNE | NE | ENE | E | ESE | SE | SSE | S | SSW | SW | WSW | W | WNW | NW | NNW | VRBL | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CALM | 30 | 29 | 25 | 20 | 17 | 10 | 11 | 10 | 12 | 16 | 14 | 20 | 31 | 29 | 29 | 23 | 0 | 326 |
| (1) | 08 | .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**

**WIND SPEED (MPH)**