

EFFLUENT AND WASTE DISPOSAL  
SEMIANNUAL REPORT  
FOR  
THIRD AND FOURTH QUARTERS 1993

Yankee Atomic Electric Company  
Rowe, Massachusetts

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NOTES:

1. Yankee Nuclear Power Station's last day at any power level was October 1, 1991. The facility is permanently shut down for future decommissioning. Due to ceased operations, short-lived nuclides have been deleted from the gaseous and liquid effluent tables. Their activity concentrations in the fuel core inventory have decayed to zero values.
  
2. License Amendment No. 146 allowed the transfer of several technical specifications from the technical specification document into the Process Control Program and Off-Site Dose Calculation Manual. The transferred technical specifications are now designated as controls, and references to these technical specifications have been revised accordingly throughout the Effluent and Waste Disposal Semiannual Report. Details describing the changes were provided previously in Appendices F and G of the Effluent and Waste Disposal Semiannual Report for Third and Fourth Quarters 1992 Including Annual Radiological Impact on Man for 1992. Please note that the transfers did not involve any modifications to the technical specifications' contents or programmatic controls.

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TABLE 1A

Yankee Atomic Electric Company, Rowe, Massachusetts  
Effluent and Waste Disposal Semiannual Report  
Third and Fourth Quarters 1993  
Gaseous Effluents - Summation of All Releases

		Unit	Quarter 3	Quarter 4	Est. Total Error, %
<hr/>					
A.	<u>Fission and Activation Gases</u>				
1.	Total Release	Ci	0.00E+00	0.00E+00	±2.50E+01
2.	Average Release Rate for Period	uCi/sec	0.00E+00	0.00E+00	
3.	Percent of Control Limit <sup>(1)</sup>	%	0.00E+00	0.00E+00	
<hr/>					
B.	<u>Iodines<sup>(2)</sup></u>				
<hr/>					
C.	<u>Particulates</u>				
1.	Particulates with T-1/2 > 8 days	Ci	1.90E-07	1.84E-07	±3.00E+01
2.	Average Release Rate for Period	uCi/sec	2.42E-08	2.34E-08	
3.	Percent of Control Limit	%	3.73E-02	2.93E-02	
4.	Gross Alpha Radioactivity	Ci	<3.09E-02	<2.96E-02	
<hr/>					
D.	<u>Tritium</u>				
1.	Total Release	Ci	3.80E-01	3.03E-01	±3.00E+01
2.	Average Release Rate for Period	uCi/sec	4.83E-02	3.85E-02	
3.	Percent of Control Limit <sup>(3)</sup>	%			
<hr/>					

(1) Control 3.4.a for gamma-air dose. Percent values for Control 3.4.b for beta-air dose are approximately the same.

(2) Iodine data have been deleted. These nuclides are no longer available for discharge.

(3) Per Control 3.5, percent dose contribution from tritium is included in Part C.

TABLE 1B

Yankee Atomic Electric Company, Rowe, Massachusetts  
Effluent and Waste Disposal Semiannual Report  
Third and Fourth Quarters 1993  
Gaseous Effluents - Elevated Releases

Nuclides Released	Unit	Continuous Mode		Batch Mode <sup>(1)</sup>	
		Quarter 3	Quarter 4	Quarter 3	Quarter 4
1. <u>Fission Gases</u>					
Krypton-85	Ci	0.00E+00	0.00E+00		
Total for Period	Ci	0.00E+00	0.00E+00		
2. <u>Iodines<sup>(2)</sup></u>					
3. <u>Particulates</u>					
Strontium-89	Ci	<4.52E-07	<4.79E-07		
Strontium-90	Ci	<1.23E-07	<1.94E-07		
Cesium-134	Ci	<2.35E-07	<2.29E-07		
Cesium-137	Ci	<2.92E-07	8.38E-08		
Barium-Lanthanum-140	Ci	<7.69E-07	<7.75E-07		
Zinc-65	Ci	<6.00E-07	<5.95E-07		
Cobalt-58	Ci	<2.67E-07	<2.74E-07		
Cobalt-60	Ci	1.90E-07	1.00E-07		
Iron-59	Ci	<5.29E-07	<5.42E-07		
Chromium-51	Ci	<1.58E-06	<1.56E-06		
Zirconium-Niobium-95	Ci	<4.51E-07	<4.43E-07		
Cerium-141	Ci	<1.99E-07	<1.97E-07		
Cerium-144	Ci	<8.45E-07	<8.43E-07		
Antimony-124	Ci	<2.27E-07	<2.24E-07		
Manganese-54	Ci	<2.68E-07	<2.73E-07		
Silver-110m	Ci	<2.34E-07	<2.29E-07		
Molybdenum-99	Ci	<1.72E-06	<1.71E-06		
Ruthenium-103	Ci	<2.01E-07	<2.04E-07		
Total for Period	Ci	1.90E-07	1.84E-07		

(1) There are no longer any batch mode gaseous releases.

(2) Iodine-131, Iodine-133, and Iodine-135 activities have been deleted. These nuclides are no longer available for discharge.

TABLE 1C

Yankee Atomic Electric Company, Rowe, Massachusetts  
Effluent and Waste Disposal Semiannual Report  
Third and Fourth Quarters 1993  
Gaseous Effluents - Ground Level Releases

There were no routine measured ground level continuous or batch mode gaseous releases during the third or fourth quarters of 1993.

TABLE 2A

Yankee Atomic Electric Company, Rowe, Massachusetts  
Effluent and Waste Disposal Semiannual Report  
Third and Fourth Quarters 1993  
Liquid Effluents - Summation of All Releases

		Unit	Quarter 3	Quarter 4	Est. Total Error, %
A.	<u>Fission and Activation Products</u>				
1.	Total Release (not including tritium, gases, alpha)	Ci	2.28E-05	3.16E-04	±2.00E+01
2.	Average Diluted Concentration During Period	uCi/ml	1.48E-09	3.19E-09	
3.	Percent of Applicable Limit <sup>(1)</sup>	%	7.61E-03	1.67E-03	
B.	<u>Tritium</u>				
1.	Total Release	Ci	<2.47E-04	7.33E-02	±1.00E+01
2.	Average Diluted Concentration During Period	uCi/ml	<1.60E-08	7.39E-09	
3.	Percent of Applicable Limit <sup>(1)</sup>	%	<5.33E-04	2.46E-04	
C.	<u>Dissolved and Entrained Gases</u>				
1.	Total Release	Ci	<1.22E-04	<1.53E-03	±2.00E+01
2.	Average Diluted Concentration During Period	uCi/ml	<7.92E-09	<1.54E-08	
3.	Percent of Applicable Limit <sup>(2)</sup>	%	<3.96E-03	<7.70E-03	
D.	<u>Gross Alpha Radioactivity</u>				
1.	Total Release	Ci	<2.16E-08	<1.45E-07	±3.50E+01
E.	<u>Volume of Waste Released (prior to dilution)</u>				
		liters	5.96E+04	3.93E+05	±3.00E+01
F.	<u>Volume of Dilution Water Used During Period</u>				
		liters	1.54E+07	9.92E+07	±1.50E+01

(1) Concentration limits specified in 10CFR20, Appendix B, Table II, Column 2 (Control 2.1). The percent of applicable limit reported is based on the average diluted concentration during the period. At no time did any release exceed the concentration limit.

(2) Concentration limits for dissolved and entrained noble gases is 2.00E-04 uCi/ml (Control 2.1). The percent of applicable limit reported is based on the average diluted concentration during the period. At no time did any release exceed the concentration limit.

TABLE 2B

Yankee Atomic Electric Company, Rowe, Massachusetts  
 Effluent and Waste Disposal Semiannual Report  
 Third and Fourth Quarters 1993  
 Liquid Effluents - Routine Releases

Nuclides Released	Unit	Continuous Mode		Batch Mode	
		Quarter 3	Quarter 4	Quarter 3	Quarter 4
Strontium-89	Ci	<1.44E-06	<1.10E-06	<1.08E-06	<1.09E-05
Strontium-90	Ci	<7.57E-07	<6.19E-07	<6.30E-07	<9.80E-06
Cesium-134	Ci	<1.66E-07	<1.91E-07	5.07E-07	5.32E-07
Cesium-137	Ci	<2.24E-07	1.29E-07	2.23E-05	1.55E-05
Cobalt-58	Ci	<1.97E-07	<1.97E-07	<1.51E-07	<3.32E-06
Cobalt-60	Ci	<2.21E-07	2.02E-07	<1.64E-07	1.37E-05
Iron-59	Ci	<3.92E-07	<3.87E-07	<2.71E-07	<6.86E-06
Zinc-65	Ci	<4.20E-07	<4.34E-07	<3.47E-07	<8.57E-06
Manganese-54	Ci	<2.08E-07	3.78E-08	<1.37E-07	<3.41E-06
Chromium-51	Ci	<1.34E-06	<1.39E-06	<1.92E-06	<2.37E-05
Zirconium-Niobium-95	Ci	<3.26E-07	<3.41E-07	<2.34E-07	<5.89E-06
Molybdenum-99	Ci	<1.34E-06	<1.40E-06	<1.08E-06	<2.51E-05
Technetium-99m	Ci	<1.43E-07	<1.53E-07	<2.01E-07	<2.51E-06
Barium-Lanthanum-140	Ci	<6.37E-07	<6.52E-07	<8.28E-07	<1.12E-05
Cerium-141	Ci	<2.25E-07	<2.39E-07	<3.24E-07	<3.95E-06
Ruthenium-103	Ci	<1.64E-07	<1.73E-07	<2.54E-07	<3.12E-06
Cerium-144	Ci	<1.01E-06	<1.07E-06	<1.50E-06	<1.77E-05
Selenium-75	Ci	<1.82E-07	<1.94E-07	<2.68E-07	<3.25E-06
Silver-110m	Ci	<1.74E-07	<1.86E-07	<1.75E-07	<3.26E-06
Antimony-124	Ci	<1.66E-07	<1.85E-07	<2.10E-07	<3.47E-06
Carbon-14	Ci	-	-	-	2.86E-04
Iron-55	Ci	<9.98E-06	<9.29E-06	<6.80E-06	<1.32E-04
Antimony-125	Ci	<4.84E-07	<5.05E-07	<7.86E-07	<8.97E-06
Unidentified	Ci	-	-	-	-
Total for Period (above)	Ci	<2.02E-05	3.69E-07	2.28E-05	3.16E-04
Krypton-85	Ci	<5.81E-05	<5.92E-05	<6.35E-05	<9.38E-04



TABLE 3

Yankee Atomic Electric Company, Rowe, Massachusetts  
 Effluent and Waste Disposal Semiannual Report  
 Third and Fourth Quarters 1993  
 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.	Evaporator bottoms, Class A waste, LSA containers, 55-gallon drums <sup>(1)</sup>	m <sup>3</sup> Ci (Est.)	0.00E+00 0.00E+00	
b1.	Dry compressible waste, contaminated equipment, etc., Class A unstable waste, DOT 7A STC, 2560 ft <sup>3(2)</sup>	m <sup>3</sup> Ci (Est.)	1.41E+01 1.07E-01	±1.00E+02
b2.	Dry compressible waste, contaminated equipment, etc., Class A unstable waste, DOT 7A STC, 2560 ft <sup>3(2)</sup>	m <sup>3</sup> Ci (Est.)	4.82E+01 2.24E-01	±1.00E+02
c.	Irradiated components, Class B waste, Type A, 126 ft <sup>3</sup>	m <sup>3</sup> Ci (Est.)	1.43E+01 2.05E+02	±3.00E+01
d.	Coolant pump, Class A unstable waste, DOT 7A STC, 2560 ft <sup>3</sup>	m <sup>3</sup> Ci (Est.)	1.47E+00 8.40E-01	±3.00E+01
e.	Steam generator, Class A stable waste, Type A, 1767 ft <sup>3(3)</sup>	m <sup>3</sup> Ci (Est.)	2.00E+02 1.30E+03	±3.00E+01
f.	Pressurizer, Class A unstable waste, DOT 7A STC, 682 ft <sup>3</sup>	m <sup>3</sup> Ci (Est.)	1.62E+01 3.01E+00	±3.00E+01

(1) Solidification agent is cement.

(2) Disposal volume and activity by processor.

(3) Stabilized with low density cement.

TABLE 3  
(Continued)

Yankee Atomic Electric Company, Rowe, Massachusetts  
Effluent and Waste Disposal Semiannual Report  
Third and Fourth Quarters 1993  
Solid Waste and Irradiated Fuel Shipments

2. Estimate of Major Nuclide Composition (by type of waste)<sup>(4)</sup>

a. Non-Applicable

b1.	Iron-55	6.56E+01%
	Cobalt-60	1.29E+01%
	Nickel-63	1.02E+01%
	Iron-59	4.51E+00%
	Manganese-54	1.67E+00%
	Plutonium-241	1.57E+00%
	Cerium-144	1.33E+00%
	Ruthenium-106	1.16E+00%

b2.	Iron-55	8.03E+01%
	Cobalt-60	1.01E+01%
	Nickel-63	6.84E+01%
	Manganese-54	2.79E+00%

c.	Cobalt-60	4.61E+01%
	Iron-55	4.48E+01%
	Nickel-63	8.34E+00%

d.	Nickel-63	6.58E+01%
	Cobalt-60	1.78E+01%
	Iron-55	1.51E+01%
	Nickel-59	1.32E+00%

e.	Iron-55	5.01E+01%
	Cobalt-60	2.22E+01%
	Nickel-63	2.53E+01%
	Manganese-54	1.30E+00%

f.	Iron-55	7.93E+01%
	Cobalt-60	1.04E+01%
	Nickel-63	7.47E+00%
	Manganese-54	2.08E+00%

(4) Excluding radionuclides with half-lives less than 12.8 days.

TABLE 3  
(Continued)

Yankee Atomic Electric Company, Rowe, Massachusetts  
Effluent and Waste Disposal Semiannual Report  
Third and Fourth Quarters 1993  
Solid Waste and Irradiated Fuel Shipments

3. Solid Waste Disposition

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
2	Railroad	Barnwell, South Carolina
11	Truck	Barnwell, South Carolina
58 <sup>(5)</sup>	Truck	Barnwell, South Carolina

8. Irradiated Fuel Shipments (Disposition): None

(5) Partial shipments from processor to waste disposal facility.

APPENDIX A

Radioactive Liquid Effluent Monitoring Instrumentation

Requirement: Radioactive liquid effluent monitoring instrumentation channels are required to be operable in accordance with Control 5.1. With less than the minimum number of channels operable and reasonable efforts to return the instrument(s) to operable status within 30 days being unsuccessful, Control 5.1 requires an explanation for the delay in correcting the inoperability in the next Effluent and Waste Disposal Semiannual Report.

Response: Steam Generator Effluent Monitor (Permanent Inoperability) - On October 26, 1993, the last liquid release occurred via the steam generator effluent flow path. Due to the removal of the steam generators, there is no longer a liquid release flow path through the steam generator effluent monitor. Thus, the monitor has been removed from operable status.

APPENDIX B

Radioactive Gaseous Effluent Monitoring Instrumentation

Requirement: Radioactive gaseous effluent monitoring instrumentation channels are required to be operable in accordance with Control 5.2. With less than the minimum number of channels operable and reasonable efforts to return the instrument(s) to operable status within 30 days being unsuccessful, Control 5.2 requires an explanation for the delay in correcting the inoperability in the next Effluent and Waste Disposal Semiannual Report.

Response: The requirements of Control 5.2 governing the operability of radioactive gaseous effluent monitoring instrumentation were met for this reporting period.

APPENDIX C

Liquid Holdup Tanks

Requirement: Defueled Technical Specification 3.4 limits the quantity of radioactive material contained in any outside temporary tank. With the quantity of radioactive material in any outside temporary tank exceeding the limits of Technical Specification 3.4, a description of the events leading to this condition is required in the next Effluent and Waste Disposal Semiannual Report.

Response: The limits of Technical Specification 3.4 were not exceeded during this reporting period.

APPENDIX D

Radiological Environmental Monitoring Program

Requirement: The Radiological Environmental Monitoring Program is conducted in accordance with Control 4.1. With milk or fresh leafy vegetation samples no longer available from one or more of the required sample locations, Control 4.1 requires the identification of the new location(s) for obtaining replacement sample(s) in the next Effluent and Waste Disposal Semiannual Report and inclusion of revised Off-Site Dose Calculation Manual figure(s) and table(s) reflecting the new location(s).

Response: No milk or fresh leafy vegetation samples were found to be unavailable during this reporting period.

## APPENDIX E

### Land Use Census

Requirement: A land use census is conducted in accordance with Control 4.2. With a land use census identifying a location(s) which yields at least a 20 percent greater dose or dose commitment than the values currently being calculated in Control 3.5, Control 4.2 requires the identification of the new location(s) in the next Effluent and Waste Disposal Semiannual Report.

Response: The land use census for this reporting period did not identify any locations yielding at least a 20 percent greater dose or dose commitment than the values currently being calculated in Control 3.5.

Requirement: With a land use census identifying a location(s) which yields a calculated dose or dose commitment (via the same exposure pathway) at least 20 percent greater than at a location from which samples are currently being obtained in accordance with Control 4.1, Control 4.2 requires that the new location(s) be added to the Radiological Environmental Monitoring Program if permission from the owner to collect samples can be obtained and sufficient sample volume is available. The identification of the new location(s) is required in the next Effluent and Waste Disposal Semiannual Report.

Response: No changes were made in the Radiological Environmental Monitoring Program as a result of the 1993 land use census.



APPENDIX F

Process Control Program (PCP)

Requirement: PCP Control 2.0 requires that licensee-initiated changes to the PCP be submitted to the Commission in the Effluent and Waste Disposal Semiannual Report for the period in which the change(s) was made.

Response: There were no licensee-initiated changes to the PCP during this reporting period.

APPENDIX G

Off-Site Dose Calculation Manual (ODCM)

Requirement: Control 7.2 requires that licensee-initiated changes to the ODCM be submitted to the Commission in the Effluent and Waste Disposal Semiannual Report for the period in which the change(s) was made effective.

Response: There were no licensee-initiated changes to the ODCM during this reporting period.

APPENDIX H

Radioactive Liquid, Gaseous, and Solid Waste Treatment Systems

Requirement: Control 7.3 requires that licensee-initiated major changes to the radioactive waste systems (liquid, gaseous, and solid) be reported to the Commission in the Effluent and Waste Disposal Semiannual Report for the period in which the evaluation was reviewed by the Plant Operation Review Committee.

Response: There were no licensee-initiated major changes to a radioactive waste system(s) during this reporting period.

APPENDIX I

Supplemental Information  
Third and Fourth Quarters 1993

1. Control Limits - Dose and Dose Rate

<u>Control and Category</u>	<u>Limit</u>
a. <u>Noble Gases</u>	
Control 3.3, Total body dose rate	500 mrem/year
Control 3.3, Skin dose rate	3000 mrem/year
Control 3.4, Gamma air dose	5 mrad/quarter
Control 3.4, Gamma air dose	10 mrad/year
Control 3.4, Beta air dose	10 mrad/quarter
Control 3.4, Beta air dose	20 mrad/year
b. <u>Iodine-131, Tritium, and Radionuclides in Particulate Form With Half-Lives Greater Than 8 Days</u>	
Control 3.3, Organ dose rate	1500 mrem/year
Control 3.5, Organ dose	7.5 mrem/quarter
Control 3.5, Organ dose	15 mrem/year
c. <u>Liquids</u>	
Control 3.1, Total body dose	1.5 mrem/quarter
Control 3.1, Total body dose	3 mrem/year
Control 3.1, Organ dose	5 mrem/quarter
Control 3.1, Organ dose	10 mrem/year

## 2. Control Limits - Concentration

<u>Control and Category</u>	<u>Limit</u>
a. <u>Liquids</u>	
Control 2.1, Total sum of the fraction of MPC (10CFR20, Appendix B, Table II, Column 2), excluding noble gases less than:	1.0
Control 2.1, Total noble gas concentration	2.00E-04 $\mu\text{Ci/cc}$

## 3. Measurements and Approximations of Total Radioactivity

### a. Noble Gases, Krypton-85

Continuous discharges are determined by direct measurements. A primary vent stack gas sample is taken monthly and analyzed for Krypton-85. A review of the weekly primary vent stack noble gas integrator readings for any increase in values above the background level also is used as a reference. There are no longer any batch discharges. Errors associated with the above measurements are estimated to be  $\pm 25$  percent.

### b. Iodines, Particulates

There are no longer any iodine isotopes available for discharge. The sampling system design requires the use of a charcoal cartridge for particulate collection. The sampling system continuously draws a sample from the primary vent stack through a filter and charcoal cartridge. Both the filter and charcoal cartridge are removed and analyzed weekly. The errors associated with the determination of particulate effluents are estimated to be  $\pm 30$  percent.

### c. Liquid Effluents

A gamma isotopic analysis is performed on a representative sample using a Marinelli Beaker geometry for both a batch or continuous discharge. Composite samples for batch and continuous discharges are analyzed for strontium-89, strontium-90, iron-55, gross alpha activity, and carbon-14.

Tritium analysis is performed on composite samples for continuous discharges and on each batch discharge. The errors associated with these measurements are as follows: fission and activation products,  $\pm 20$  percent; tritium,  $\pm 10$  percent; dissolved fission gases,  $\pm 20$  percent; and alpha activity,  $\pm 35$  percent.

4. Batch Releases

a. Liquids

The batch release data is presented in two categories to provide accurate average discharge rate values.

<u>Third Quarter</u>	Outdoor	
	<u>Routine Batches</u>	<u>Tank Moats</u>
Number of batch releases:	2	0
Total time period for batch releases (minutes):	255	
Maximum time period for a batch release (minutes):	155	
Average time period for batch releases (minutes):	127	
Minimum time period for a batch release (minutes):	100	
Average stream flow (Sherman Dam) during period (cfs):	209	
Average discharge rate (gpm):	26	

<u>Fourth Quarter</u>	Outdoor	
	<u>Routine Batches</u>	<u>Tank Moats</u>
Number of batch releases:	10	4
Total time period for batch releases (minutes):	2441	7709
Maximum time period for a batch release (minutes):	440	2090
Average time period for batch releases (minutes):	244	1927
Minimum time period for a batch release (minutes):	93	1815
Average stream flow (Sherman Dam) during period (cfs):	652	652
Average discharge rate (gpm):	24	4.7

b. Gases

There are no longer any gaseous batch discharges.

5. Abnormal Releases

Control 7.2 requires the reporting of any unplanned releases from the site to the site boundary of radioactive material in gaseous and liquid effluents made during the reporting period.

a. Liquid

There were no nonroutine liquid releases during the reporting period.

b. Gases

There were no nonroutine gaseous releases during the reporting period.

APPENDIX J

Sewage Sludge Disposal

Requirement: For periods in which disposal of septage occurs, the licensee shall report in the Effluent and Waste Disposal Semiannual Report, the volume discharged, liquid and solid fractions, nuclide content in the liquid and solid fractions, and total activity discharged.

Response: The following information is provided for the disposal of sewage sludge during the reporting period:

Volume Discharged (gallons): 7000  
Liquid Fraction of Waste: 9.08E-01  
Solid Fraction of Waste: 9.15E-02  
Nuclide Content in Liquid Fraction (uCi/g): ND<sup>(1)</sup>

Nuclide Content in Solid Fraction (uCi/g):  
Cesium-137 = 1.67E-07  
Cobalt-60 = 3.14E-06  
Manganese-54 = 5.10E-07

Total Activity Discharged (uCi):  
Cesium-137 = 4.10E-01  
Cobalt-60 = 7.61E+00  
Manganese-54 = 1.24E+00  
TOTAL 9.26E+00

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(1) ND = Not Detectable