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RADIOLOGICAL EFFLUENT MONITORING AND OFFSITE DOSE CALCULATION MANUAL AND PROCESS CONTROL PROGRAM

MILLSTONE UNIT NOS. 1, 2, & 3

Northeast Nuclear
Energy Company

January 1989

SECTION I

RADIOLOGICAL EFFLUENT

MONITORING MANUAL

FOR THE
MILLSTONE NUCLEAR POWER STATION
UNIT NOS. 1, 2, & 3

DOCKET NO. 50-245
50-336
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January 1989
Revision 1

RADIOLOGICAL EFFLUENT MONITORING MANUAL

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A. INTRODUCTION

The purpose of this manual is to provide the sampling and analysis programs which provide input to the ODCM for calculating liquid and gaseous effluent concentrations and offsite doses. Guidelines are provided for operating radioactive waste treatment systems in order that offsite doses are kept As-Low-As-Reasonably-Achievable (ALARA).

The *Radiological Environmental Monitoring Program* outlined within this manual provides confirmation that the measurable concentrations of radioactive material released as a result of operations at the Millstone Site are not higher than expected.

In addition, this manual outlines the information required to be submitted to the NRC in both the *Annual Radiological Environmental Operating Report* and the *Semiannual Radioactive Effluent Release Report*.

B. RESPONSIBILITIES

All changes to this manual shall be reviewed and approved by the Station Operations Review Committee and the Nuclear Regulatory Commission prior to implementation.

All changes and their rationale shall be documented in the *Semiannual Radioactive Effluent Release Report*.

It shall be the responsibility of the Station Superintendent to ensure that this manual is used in performance of the surveillance requirements and administrative controls of the *Technical Specifications*.

C. LIQUID EFFLUENTS

C.1 Liquid Effluent Sampling and Analysis Program

Radioactive liquid wastes shall be sampled and analyzed in accordance with the program specified in *Table C-1* for Millstone Unit No. 1, *Table C-2* for Millstone Unit No. 2, and *Table C-3* for Millstone Unit No. 3. The results of the radioactive analyses shall be input to the methodology of the ODCM to assure that the concentrations at the point of release are maintained within the limits of the *Technical Specification 3.8.C.1* for Millstone Unit No. 1 and within the limits of *Technical Specification 3.11.1* for Millstone Unit Nos. 2 and 3.

Table C-1

MILLSTONE 1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/ml)
A. Batch Release[f]				
1. Waste Sample Tanks	Prior to Each Batch	Prior to Each Batch	Principal Gamma Emitters[b]	5 x 10-7
			I-131, Mo-99	1 x 10-6
			Ce-141, Ce-144	5 x 10-6
2. Floor Drain Sample Tank	One Batch per Month	Monthly	Other Dissolved and Entrained Gases	1 x 10-5
3. Decontamination Solution Tank	Prior to Each Batch	Monthly Composite	H-3	1 x 10-5
			Gross alpha	1 x 10-7
	Prior to Each Batch	Quarterly Composite	Sr-89, Sr-90	[illegible]
			Fe-55	[illegible]
B. Continuous Release				
Reactor Building Service Water	Daily Grab Sample[d]	Weekly Composite[c]	Principal Gamma Emitters[b]	5 x 10-7
			I-131, Mo-99	1 x 10-6
			Ce-141, Ce-144	5 x 10-6
	Monthly Grab Sample	Monthly	Dissolved and Entrained Gases	1 x 10-5
	Weekly Grab Sample	Monthly Composite[c]	H-3[e]	1 x 10-5
			Gross alpha[e]	1 x 10-7
	Weekly Grab Sample	Quarterly Composite[c]	Sr-89[e], Sr-90[e]	5 x 10-8
			Fe-55[e]	1 x 10-6

TABLE C-1 (Cont'd.)

TABLE NOTATIONS

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal.

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

$$LLD = \frac{4.66\ S_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where:

LLD is the lower limit of detection as defined above (as pCi per unit mass or volume)

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 transformation)

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

2.22 x 10^6 is the number of transformations per minute per microcurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between midpoint of sample collection and midpoint of counting time

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.

Analyses shall be performed in such a manner that the stated LLD's 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 LLD's unachievable. In such cases, the contributing factors will be identified and recorded on the analysis sheet for the particular sample.

b. The LLD will be 5 x 10^{-7} pCi/ml. The principal gamma emitters for which this LLD applies are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Cs-134, and Cs-137.

This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level. When unusual circumstances result in a priori LLD's higher than required, the reasons shall be documented in the *Semiannual Radioactive Effluent Release Report*.

c. 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.

Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluents released.

d. Daily grab samples for service water taken at least five days per week.

e. These analyses are required only if weekly gamma analysis indicates a gamma activity greater than 5×10^{-7} µCi/ml.

f. A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling, each batch shall be isolated and at least two tank/sump volumes shall be recirculated or equivalent mixing provided.

Table C-2

MILLSTONE 2

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi ml)
A. Batch Release[b]				
1. Coolant Waste Monitor Tank	Prior to Each Batch	Prior to Each Batch	Principal Gamma Emitters[c]	5×10^{-7}
			I-131, Mo-99	1×10^{-6}
2. Aerated Waste Sample Tank			Ce-141, Ce-144	5×10^{-6}
3. Condensate Polishing Facility - Waste Neutralization Sump[e]	One Batch per Month	Monthly	Dissolved and Entrained Gases[d]	1×10^{-5}
	Prior to Each Batch	Monthly Composite[f,g]	H-3[d]	1×10^{-5}
			Gross alpha[d]	1×10^{-7}
	Prior to Each Batch	Quarterly Composite[f,g]	Sr-89[d], Sr-90[d]	5×10^{-8}
			Fe-55[d]	1×10^{-6}
B. Continuous Release				
1. Steam Generator Blowdown[h]	Daily Grab Sample[i]	Weekly Composite[g]	Principal Gamma Emitters[c]	5×10^{-7}
			I-131, Mo-99	1×10^{-6}
2. Service Water Effluent[k]			Ce-141, Ce-144	5×10^{-6}
	Monthly Grab Sample	Monthly	Dissolved and Entrained Gases[j]	1×10^{-5}
	Weekly Grab Sample	Monthly Composite[g]	H-3[j]	1×10^{-5}
3. Turbine Building Sumps[h]			Gross alpha[j]	1×10^{-7}
	Weekly Grab Sample	Quarterly Composite[g]	Sr-89[j], Sr-90[j],	5×10^{-8}
			Fe-55[j]	1×10^{-6}

Table C-2 (Cont'd.)

TABLE NOTATIONS

a. The LLD is the sr[illegible]entration of radioactive material in a sample that will be detected with [illegible]lity with 5% probability of falsely concluding that a blank observation re[illegible]real" signal.

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

$$LLD = \frac{4.66\ S_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

Where:

LLD is the lower limit of detection as defined above (as pCi per unit mass or volume)

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 transformation)

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

2.22×10^6 is the number of transformations per minute per microcurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between midpoint of sample collection and midpoint of counting time

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.

Analyses shall be performed in such a manner that the stated LLD's 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 LLD's unachievable. In such cases, the contributing factors will be identified and recorded on the analysis sheet for the particular sample.

b. A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling, each batch shall be isolated and at least two tank/sump volumes shall be recirculated or equivalent mixing provided.

c. The LLD will be 5×10^{-7} µCi/ml. The principal gamma emitters for which this LLD applies are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Cs-134, and Cs-137.

Table C-2 (Cont'd.)

TABLE NOTATIONS

This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level. When unusual circumstances result in a priori LLD's higher than required, the reasons shall be documented in the *Semiannual Radioactive Effluent Release Report*.

d. For the Condensate Polishing Facility (CPF) - Waste Neutralization Sump, these analyses are only required if the gamma analysis of the CPF - Waste Neutralization Sump indicates a gamma activity greater than 5×10^{-7} µCi/ml.

e. For the Condensate Polishing Facility - Waste Neutralization Sump, these analyses are only required when the steam generator gross activity (sampled and analyzed 3 times per week as per *Table 4.7-2* of the *Safety Technical Specifications*) exceeds 1×10^{-5} µCi/ml.

f. 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.

g. Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluents released.

h. For the Steam Generator Blowdown and the Turbine Building Sump, these analyses are only required when the steam generator gross activity (sampled and analyzed 3 times per week as per *Table 4.7-2* of the *Safety Technical Specifications*) exceeds 5×10^{-7} µCi/ml.

i. Daily grab samples shall be taken at least 5 days per week.

j. For the Service Water, these analyses are only required if a weekly gamma analysis indicates a gamma activity greater than 5×10^{-7} µCi/ml.

k. The daily and weekly grab sample frequencies for Service Water can be reduced to monthly if: *1)*, the reactor building closed cooling water is sampled weekly and these samples indicate gamma activity less than 2×10^{-6} µCi/ml and *2)*, the leakage from the reactor building closed cooling water is less than 350 gallons per minute.

Table C-3

MILLSTONE 3

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/ml)
A. Batch Release[b]				
1. Condensate Polishing Facility - Waste Neutralization Sumpe	Prior to Each Batch	Prior to Each Batch	Principal Gamma Emitters[c]	5 x 10-7
			I-131, Mo-99	1 x 10-6
			Ce-141, Ce-144	5 x 10-6
2. Waste Test Tanks				
3. Condensate Polishing Facility - Regenerate Distillate Tank	One Batch per Month	Monthly	Dissolved and Entrained Gases[d]	1 x 10-5
	Prior to Each Batch	Monthly Composite[f,g]	H-3[d]	1 x 10-5
			Gross alpha[d]	1 x 10-7
4. Low Level Waste Drain Tank	Prior to Each Batch	Quarterly Composite[f,g]	Sr-89[d], Sr-90[d]	5 x 10-8
			Fe-55[d]	1 x 10-6
5. Boron Test Tanks				
B. Continuous Release				
1. Steam Generator Blowdown[h]	Daily Grab Sample[i]	Weekly Composite[g]	Principal Gamma Emitters[c]	5 x 10-7
			I-131, Mo-99	1 x 10-6
			Ce-141, Ce-144	5 x 10-6
2. Service Water Effluent[k]	Monthly Grab Sample	Monthly	Dissolved and Entrained Gases[j]	1 x 10-5
3. Turbine Building Sumps[h]	Weekly Grab Sample	Monthly Composite[g]	H-3[j]	1 x 10-5
			Gross alpha[j]	1 x 10-7
	Weekly Grab Sample	Quarterly Composite[g]	Sr-89[j], Sr-90[j],	5 x 10-8
			Fe-55[j]	1 x 10-6

Table C-3 (Cont'd.)

TABLE NOTATIONS

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal.

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

$$LLD = \frac{4.66\ S_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where:

LLD is the lower limit of detection as defined above (as pCi per unit mass or volume)

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 transformation)

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

2.22 x 10^6 is the number of transformations per minute per microcurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between midpoint of sample collection and midpoint of counting time

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.

Analyses shall be performed in such a manner that the stated LLD's 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 LLD's unachievable. In such cases, the contributing factors will be identified and recorded on the analysis sheet for the particular sample.

b. A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling, each batch shall be isolated and at least two tank/sump volumes shall be recirculated or equivalent mixing provided.

c. The LLD will be 5 x 10^{-7} µCi/ml. The principal gamma emitters for which this LLD applies are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Cs-134, and Cs-137.

Table C-3 (Cont'd.)

TABLE NOTATIONS

This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level. When unusual circumstances result in a prior LLD's higher than required, the reasons shall be documented in the *Semiannual Radioactive Effluent Release Report*.

d. For the Condensate Polishing Facility (CPF) - Waste Neutralization Sump, these analyses are only required if the gamma analysis of the CPF - Waste Neutralization Sump indicates a gamma activity greater than 5×10^{-7} µCi/ml.

e. For the Condensate Polishing Facility - Waste Neutralization Sump, these analyses are only required when the steam generator gross activity (sampled and analyzed 3 times per week as per *Table 4.7-1* of the *Safety Technical Specifications*) exceeds 1×10^{-5} µCi/ml.

f. 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.

g. Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluents released.

h. For the Steam Generator Blowdown and the Turbine Building Sump, these analyses are only required when the steam generator gross activity (sampled and analyzed 3 times per week as per *Table 4.7-1* of the *Safety Technical Specifications*) exceeds 5×10^{-7} µCi/ml.

i. Daily grab samples shall be taken at least 5 days per week.

j. For the Service Water, these analyses are only required if a weekly gamma analysis indicates a gamma activity greater than 5×10^{-7} µCi/ml.

k. The daily and weekly grab sample frequencies for Service Water can be reduced to monthly if *1)*, the reactor plant closed cooling water is sampled weekly and these samples indicate gamma activity less than 2×10^{-6} µCi/ml and *2)*, the leakage from the reactor plant component cooling water system is less than 100 gallons per minute.

C.2 Liquid Radioactive Waste Treatment

All applicable liquid radioactive waste treatment systems will be operated when the projected dose due to liquid effluents averaged over 31 days exceeds 0.06 mrem to the total body or 0.2 mrem to any organ.

The term "all applicable liquid radioactive waste treatment" is defined as that equipment applicable to a waste stream responsible for greater than ten percent (10%) of the total projected dose. The liquid radioactive waste treatment system equipment is specified below for each unit.

Millstone Unit No. 1

Filtration and ion exchange system and waste demineralizer A or B.

Millstone Unit No. 2

1. Degasifier, clean liquid primary demineralizer, boric acid evaporator, clean liquid secondary demineralizer and filter.

2. The aerated waste demineralizer and filter.

Millstone Unit No. 3

1. Degasifier, ion exchanger, boron evaporator, boron demineralizer, and boron demineralizer filter.

2. High level waste demineralizer or waste evaporator, waste demineralizer and waste demineralizer filter.

3. Regenerant evaporator, regenerant demineralizer, and regenerant demineralizer filter.

4. Condensate polishing filter system.

With radioactive liquid waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission a report that includes the following information:

1. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,

2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

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

If the above treatment systems are not routinely operating, doses due to liquid effluents to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM.

D. GASEOUS EFFLUENTS

D.1 Gaseous Effluents Sampling and Analysis Program

Radioactive gaseous wastes shall be sampled and analyzed in accordance with the program specified in *Table D-1* for Millstone Unit No. 1, *Table D-2* for Millstone Unit No. 2, and *Table D-3* for Millstone Unit No. 3. The results of the radioactive analyses shall be input to the methodology of the ODCM to assure that the offsite dose rates are maintained within the limits of the *Technical Specifications 3.8.D.1* for Unit No. 1 and within the *Specifications of 3.11.2.1* for Unit Nos. 2 and 3.

TABLE D-1

MILLSTONE 1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi cc)
A. Steam Jet Air Ejector Discharge	Monthly - Gaseous Grab Sample[c]	Monthly[c]	Principal Gaseous Gamma Emitters[b]	1 x 10-4
B. Main Stack	Monthly - Gaseous Grab Sample	Monthly	Principal Gaseous Gamma Emitters[b]	1 x 10-4
			H-3	1 x 10-6
	Continuous[d]	Weekly Charcoal Sample[f]	I-131	1 x 10-12
			I-133[e]	1 x 10-10
	Continuous[d]	Weekly[f] Particulate Sample	Principal Particulate Gamma Emitters - Half Lives Greater Than 8 Days[b]	1 x 10-11
	Continuous[d]	Monthly Composite Particulate Sample	Gross Alpha	1 x 10-11
	Continuous[d]	Quarterly Composite Particulate Sample	Sr-89, Sr-90	1 x 10-11
	Continuous[d]	Noble Gas Monitor	Noble Gases - Gross Activity	1 x 10-6

TABLE D-1 (Cont'd.)

TABLE NOTATIONS

a. The lower limit of detection (LLD) is defined in *Table Notations, Item a,* of *Tables C-1, C-2, or C-3*

b. For gaseous samples, the LLD will be 1 x 10^{-4} µCi/cc and for particulate samples, the LLD will be 1 x 10^{-11} µCi/cc. The principal gamma emitters for which these LLD's apply are exclusively the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135 and Xe-138 for gaseous emission 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. The list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level for that nuclide. When unusual circumstances result in a priori LLD's higher than required, the reasons shall be documented in the *Semiannual Radioactive Effluent Release Report*.

c. Sampling and analysis shall also be performed within 24 hours following an increase, as indicated by the steam jet air ejector off-gas monitor, of greater than 50%, after factoring out increases due to changes in THERMAL POWER level.

d. The ratio of the sample flow rate to the sampled stream flow rate shall be known.

e. Analyses for I-133 will not be performed on each charcoal sample. Instead, at least once per month, the ratio of I-133 to I-131 will be determined from a charcoal sample changed after 24 hours of sampling. This ratio, along with the routine I-131 activity determination will be used to determine the release rate of I-133.

f. Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing. Special sampling and analysis of iodine and particulate filters shall also be performed whenever subsequent reactor coolant I-131 samples show an increase of greater than a factor of 5. These filters shall be changed following such a five-fold increase in coolant activity and every 24 hours thereafter until the reactor coolant I-131 levels are less than a factor of 5 greater than the original coolant levels or until seven days have passed, whichever is shorter. Sample analyses shall be completed within 48 hours of changing. The LLD's may be increased by a factor of 10 for these samples.

TABLE D-2

MILLSTONE 2

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/cc)
A. Batch Release				
1. Waste Gas Storage Tank[h]	Prior to Each Tank Discharge	Each Tank Discharge	Principal Gamma Emitters[b]	1 x 10-4
2. Containment Purge			H-3	1 x 10-6
B. Continuous Release				
Vent	Monthly - Gaseous Grab Sample[c]	Monthly[c]	Principal Gamma Emitters[b]	1 x 10-4
			H-3[g]	1 x 10-6
	Continuous[d]	Weekly[f] Charcoal Sample	I-131	1 x 10-12
			I-133[e]	1 x 10-10
	Continuous[d]	Weekly[f] Particulate Sample	Principal Gamma Emitters[b] (I-131, others with Half lives > 8 days)	1 x 10-11
	Continuous[d]	Monthly Composite Particulate Samples	Gross Alpha	1 x 10-11
	Continuous[d]	Quarterly Composite Particulate Samples	Sr-89, Sr-90	1 x 10-11
	Continuous[d]	Noble Gas Monitor	Noble Gases - Gross Activity	1 x 10-6

TABLE D-2 (Cont'd.)

TABLE NOTATIONS

a. The lower limit of detection (LLD) is defined in *Table Notations, Item a,* of *Tables C-1, C-2, or C-3.*

b. For gaseous samples, the LLD will be 1×10^{-4} µCi/cc and for particulate samples, the LLD will be 1×10^{-11} µCi/cc. The principal gamma emitters for which these LLD's apply are exclusively the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135 and Xe-138 for gaseous emission 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. The list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level for that nuclide. When unusual circumstances result in a priori LLD's higher than required, the reasons shall be documented in the *Semiannual Radioactive Effluent Release Report.*

c. Sampling and analysis shall also be performed within 24 hours following an unexplained increase, as indicated by the Unit 2 stack noble gas monitor, of greater than 50%, after factoring out increases due to changes in THERMAL POWER levels, containment purges, or other explainable increases.

d. The ratio of the sample flow rate to the sampled stream flow rate shall be known.

e. Analyses for I-133 will not be performed on each charcoal sample. Instead, at least once per month, the ratio of I-133 to I-131 will be determined from a charcoal sample changed after 24 hours of sampling. This ratio, along with the routine I-131 activity determination will be used to determine the release rate of I-133.

f. Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing. Special sampling and analysis of iodine and particulate filters shall also be performed whenever reactor coolant I-131 samples, which are taken 2-6 hours following a THERMAL POWER change exceeding 15 percent of RATED THERMAL POWER in one hour, show an increase of greater than a factor of 5. These filters shall be changed following such a five-fold increase in coolant activity and every 24 hours thereafter until the reactor coolant I-131 levels are less than a factor of 5 greater than the original coolant levels or until seven days have passed, whichever is shorter. Sample analyses shall be completed within 48 hours of changing. The LLD's may be increased by a factor of 10 for these samples.

g. Grab samples for tritium shall be taken weekly whenever the refueling cavity is flooded and there is fuel in the cavity. The grab sample shall be taken from the stack (Unit 1 and 2) where the containment ventilation is being discharged at the time of sampling.

h. Waste Gas Storage Tanks are normally released on a batch basis. However, for the purpose of tank maintenance, inspection, or reduction of oxygen concentration, a waste gas tank may be continuously purged with nitrogen provided the following conditions are met:

(1) The previous batch of radioactive waste gas has been discharged to a final tank pressure of less than 5 PSIG.

TABLE D-2 (Cont'd.)

TABLE NOTATIONS

(2) No radioactive waste gases have been added to the tank since the previous discharge.

(3) Valve lineups are verified to ensure that no radioactive waste gases will be added to the tank.

(4) After pressurizing the tank with nitrogen, a sample of the gas in the tank will be taken and analyzed for any residual gamma emitters and tritium prior to initiation of the nitrogen purge. The measured activity will be used to calculate the amount of activity released during the purge.

TABLE D-3

MILLSTONE 3

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/cc)
A. Batch Release				
Containment Purge or Drawdown	Prior to Each Purge or Drawdown[h]	Each Purge or Drawdown	Principal Gamma Emitters[b] H-3	1 x 10-4 1 x 10-6
B. Continuous Release				
1. Unit 3 Ventilation Vent	Monthly[c] Gaseous Grab Sample	Monthly[c]	Principal Gamma Emitters[b] H-3[g]	1 x 10-4 1 x 10-6
2. Engineered Safeguards Building	Continuous[d]	Weekly Charcoal Sample[f]	I-131 I-133[e]	1 x 10-12 1 x 10-10
	Continuous[d]	Weekly Particulate Sample[f]	Principal Gamma Emitters[b] (I-131, others with Half lives >8 days)	1 x 10-11
	Continuous[d]	Monthly Composite Particulate Samples	Gross Alpha	1 x 10-11
	Continuous[d]	Quarterly Composite Particulate Samples	Sr-89, Sr-90	1 x 10-11
	Continuous[d]	Noble Gas Monitor	Noble Gases - Gross Activity	1 x 10-6

TABLE D-3 (Cont'd.)

TABLE NOTATIONS

a. The lower limit of detection (LLD) is defined in *Table Notations, Item a*, of *Tables C-1, C-2, or C-3*.

b. For gaseous samples, the LLD will be 1×10^{-4} µCi/cc and for particulate samples, the LLD will be 1×10^{-11} µCi/cc. The principal gamma emitters for which these LLD's apply are exclusively the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135 and Xe-138 for gaseous emission 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. The list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level for that nuclide. When unusual circumstances result in a priori LLD's higher than required, the reasons shall be documented in the *Semiannual Radioactive Effluent Release Report*.

c. Sampling and analysis shall also be performed within 24 hours following an unexplained increase, as indicated by the Unit 3 vent noble gas monitor, of greater than 50%, after factoring out increases due to changes in THERMAL POWER levels, containment purges, or other explainable increases.

d. The ratio of the sample flow rate to the sampled stream flow rate shall be known.

e. Analyses for I-133 will not be performed on each charcoal sample. Instead, at least once per month, the ratio of I-133 to I-131 will be determined from a charcoal sample changed after 24 hours of sampling. This ratio, along with the routine I-131 activity determination will be used to determine the release rate of I-133.

f. Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing. Special sampling and analysis of iodine and particulate filters shall also be performed whenever reactor coolant I-131 samples (which are taken 2-6 hours following a THERMAL POWER change exceeding 15 percent of RATED THERMAL POWER in one hour per *Table 4.4-4* of the *Safety Technical Specifications*) show an increase of greater than a factor of 5. These filters shall be changed following such a five-fold increase in coolant activity and every 24 hours thereafter until the reactor coolant I-131 levels are less than a factor of 5 greater than the original coolant levels or until seven days have passed, whichever is shorter. Sample analyses shall be completed within 48 hours of changing. The LLD's may be increased by a factor of 10 for these samples.

g. Grab samples for tritium shall be taken weekly from the ventilation vent whenever the refueling cavity is flooded and there is fuel in the cavity.

h. Subsequent to medical emergencies, for initial determination of isotopic content of the containment air, a Health Physics sample may be used in place of the normal chemistry sample.

D.2 Gaseous Radioactive Waste Treatment

All applicable gaseous radioactive waste treatment systems shall be operated when the projected dose due to gaseous effluents averaged over 31 days exceeds 0.2 mrad for gamma radiation, 0.4 mrad for beta radiation or 0.3 mrem to any organ due to gaseous particulate effluents.

The term "all applicable gaseous radioactive treatment" is defined as that equipment applicable to a waste stream responsible for greater than ten percent (10%) of the total projected dose. The gaseous radioactive waste treatment system equipment is specified below for each Unit.

Millstone Unit No. 1

Offgas System - Recombiner Train A or B
Charcoal Bed Train A or B
and the HEPA filter

Radwaste Ventilation Exhaust Treatment System Radwaste ventilation HEPA filters

Millstone Unit No. 2

Gaseous Radwaste Treatment System - at least two (2) gas decay tanks, the waste gas filter and one waste gas compressor.

Ventilation Exhaust Treatment System - Auxiliary building ventilation HEPA filter (L26), containment purge HEPA filter (L25).

Millstone Unit No. 3

Gaseous Radwaste Treatment System - charcoal bed adsorbers, one HEPA filter, and one process gas compressor.

Building Ventilation - Auxiliary building ventilation filter, fuel building ventilation filter, SLCRS filter.

With radioactive gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission a report that includes the following information.

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

2. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

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

If the above treatment systems are not routinely operating, doses due to gaseous effluents to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the methodology and parameters in the ODCM.

E. RADIOLOGICAL ENVIRONMENTAL MONITORING

E.1 Sampling and Analysis

The radiological sampling and analyses provide 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 plant 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 measurements and modeling of the environmental exposure pathways. Program changes may be made based on operational experience.

The sampling and analyses shall be conducted as specified in *Table E-1* for the locations shown in *Appendix G* of the ODCM. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment or other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period.

All deviations from the sampling schedule shall be documented in the *Annual Radiological Environmental Operating Report* pursuant to *Section F.1*. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program. In these instances, identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next *Semiannual Radioactive Effluent Release Report* and also include in the report a revised figure(s) and table for the ODCM reflecting the new location(s).

If milk samples are unavailable from any one or more of the milk sample locations required by *Table E-1*, a grass sample shall be substituted until a suitable milk location is evaluated as a replacement or until milk is available from the original location. Such an occurrence will be documented in the *Annual Radiological Environmental Operating Report*.

If the level of radioactivity in an environmental sampling medium at one or more of the locations specified in *Table E-1* exceeds the report levels of *Table E-2* when averaged over any calendar quarter, prepare and submit to the Commission within 30 days from the end of the affected calendar quarter, a Special Report which includes an evaluation of any release conditions, environmental factors or other aspects which caused the limits of *Table E-2* to be exceeded. When more than one of the radionuclides in *Table E-2* are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \cdots \geq 1.0$$

When radionuclides other than those in *Table E-2* are detected and are the result of plant effluents, this Special Report shall be submitted if the potential annual dose to an individual is equal to or greater than the appropriate calendar year limit of the *Technical Specifications* 3.8.C.2.1, 3.8.D.2.1 or 3.8.D.3.1 for Millstone Unit No. 1 or *3.11.1.2, 3.11.2.2 or 3.11.2.3* for Millstone Unit Nos. 2 and 3. 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*.

The detection capabilities required by *Table E-3* are state-of-the-art 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. All analyses shall be performed in such a manner that the stated LLD's 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 LLD's unachievable. In such cases, the contributing factors will be identified and described in the *Annual Radiological Environmental Operating Report*.

E.2 Land Use Census

The land use census ensures that changes in the use of unrestricted areas are identified and that modifications to the monitoring program are made if required by the results of this census. This census satisfies the requirements of *Section IV.B.3* of *Appendix I* to *10 CFR Part 50*. The land use census shall be maintained and shall identify the location of the milk animals in each of the 16 meteorological sectors within a distance of five miles.*

The validity of the land use census shall be verified at least once per 12 months by either a door-to-door survey, aerial survey, consulting local agriculture authorities, or any combination of these methods.*

With a land use census identifying a location(s) which yields a calculated dose or dose commitment greater than the doses currently being calculated in the ODCM, make the appropriate changes in the sample locations of *Table E-2*.

With a land use census identifying a location(s) which has a higher D/Q than a current indicator location the following shall apply:

(1) If the D/Q is at least 20% greater than the previously highest D/Q, replace one of the present sample locations with the new one within 30 days if milk is available.

(2) If the D/Q is not 20% greater than the previously highest D/Q, consider direction, distance, availability of milk, and D/Q in deciding whether to replace one of the existing sample locations. If applicable, replacement should be within 30 days. If no replacement is made, sufficient justification should be given in the annual report.

Sample location changes shall be noted in the *Annual Radiological Environmental Operating Report*.

*Broad leaf vegetation (a composite of at least 3 different kinds of vegetation) is sampled at the site boundary in each of 2 different direction sectors with the highest D/Q in lieu of a garden census.

E.3 Interlaboratory Comparison Program

The Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of a quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

Analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program which has been approved by the Commission. A summary of the results obtained as part of the above required Interlaboratory Comparison Program shall be included in the *Annual Radiological Environmental Operating Report*.

With analyses not being performed as required above, report the corrective actions taken to prevent a recurrence to the Commission in the *Annual Radiological Environmental Operating Report*.

TABLE E-1

MILLSTONE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
1.a. Gamma Dose - Environmental TLD	17	Monthly	Gamma Dose - Monthly
1.b. Gamma Dose - Accident TLD	22	Quarterly(a)	N/A(a)
2. Airborne Particulate	8	Continuous sampler - weekly filter change	Gross Beta - Weekly Gamma Spectrum - Quarterly on composite (by location), and on individual sample if gross beta is greater than 10 times the mean of the weekly control station's gross beta results.
3. Airborne Iodine	8	Continuous sampler - weekly canister change	I-131 - Weekly
4. Vegetation	5	One sample near middle and one near end of growing season	Gamma Isotopic on each sample
5. Milk	6	Monthly for all animals except semi-monthly for goats when on pasture	Gamma Isotopic and I-131 on each sample Sr-89 and Sr-90 on monthly composite
6. Sea Water	2	Quarterly - Composite of 6 weekly grab samples	Quarterly - Fractional Beta, Gamma Isotopic, and Tritium on each composite
7. Bottom Sediment	5	Semiannual	Gamma Isotopic on each sample

TABLE E-1 (Cont'd.)

MILLSTONE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
8. Fin Fish - Flounder and one other type of edible fin fish	2	Quarterly	Gamma Isotopic on each sample
9. Mussels	2	Quarterly	Gamma Isotopic on each sample
10. Oysters	4	Quarterly	Gamma Isotopic on each sample
11. Clams	2	Quarterly	Gamma Isotopic on each sample
12. Lobsters	2	Quarterly	Gamma Isotopic on each sample

(a) Accident monitoring TLD's to be dedosed at least quarterly.

TABLE E-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Vegetables (pCi/kg, wet)
H-3	2×10^4 (a)				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-95	4×10^2				
Nb-95	4×10^2				
I-131	(b)	0.9		3	1×10^2
Cs-134	30	10	1×10^3	60	1×10^3
Cs-137	50	20	2×10^3	70	2×10^3
Ba-140	2×10^2			3×10^2	
La-140	2×10^2			3×10^2	

(a) For drinking water samples. This is 40 CFR Part 141 value.

(b) Level for I-131 not included since no radioactivity discharged to any drinking water pathways; other reporting levels are included for trending of long-lived isotopes only.

TABLE E-3

MAXIMUM VALUES FOR LOWER LIMITS OF DETECTION (LLD)[a]

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish, Shellfish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
Gross beta		1×10^{-2}				
Fractional beta	4					
H-3	2000					
Mn-54	30[c]		130			
Fe-59	60[c]		260			
Co-58,60	30[c]		130			
Zn-65	60[c]		260			
Zr-95	60[c]					
Nb-95	30[c]					
I-131	d	7×10^{-2}		1	60[b]	
Cs-134	30[c]	5×10^{-2}	130	15	60	150
Cs-137	40[c]	6×10^{-2}	150	18	80	180
Ba-140	120[c,e]			70		
La-140	30[c,e]			25		

TABLE E-3 (Cont'd.)

TABLE NOTATIONS

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal.

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

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

where:

LLD is the lower limit of detection as defined above (as pCi per unit mass or volume)

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 transformation)

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

2.22 is the number of transformations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between midpoint of sample collection (or end of the sample collection period) and time of counting

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.

Analyses shall be performed in such a manner that the stated LLD's 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 LLD's unachievable. In such cases, the contributing factors will be identified and described in the *Annual Radiological Environmental Operating Report*.

b. LLD for leafy vegetables.

c. To be reduced by a factor of two if the fractional beta for the sample exceeds 15 pCi/l.

d. Level for I-131 not included since no radioactivity discharged to any drinking water pathway.

e. From end of sample period.

F. REPORT CONTENT

F.1 Annual Radiological Environmental Operating Report

The *Annual Radiological Environmental Operating Report* shall include summaries, interpretations, and statistical evaluation of the results of the radiological environmental surveillance activities for the report period, including a comparison with previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The report shall also include the results of the land use census required by *Section E.2* of this manual. If harmful effects are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

The report shall include a summary table of all radiological environmental samples which shall include the following information for each pathway sampled and each type of analysis:

(1) Total number of analyses performed at indicator locations.

(2) Total number of analyses performed at control locations.

(3) Lower limit of detection (LLD).

(4) Mean and range of all indicator locations together.

(5) Mean and range of all control locations together.

(6) Name, distance and direction from discharge, mean and range for the location with the highest annual mean (indicator or control).

(7) Number of nonroutine reported measurements as defined in these specifications.

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 in the next annual report.

The report shall also include a map of sampling locations keyed to a table giving distances and directions from the discharge; the report shall also include a summary of the Interlaboratory Comparison Data required by *Section E.3* of this manual.

F.2 Semiannual Radioactive Effluent Release Report

The *Semiannual Radioactive Effluent Release Report* shall include a summary of the quantities of radioactive liquid and gaseous effluents released from the unit as outlined in *Regulatory Guide 1.21, Revision 1*, June 1974, with data summarized on a quarterly basis following the format of *Appendix B* thereof.

In addition, a report to be submitted 90 days after January 1 of each year, shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, and atmospheric stability, or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.** This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the site during the previous calendar year. The meteorological conditions concurrent with the time of release of radioactive material in gaseous effluents shall be used for determining the gaseous pathway doses. Dose calculations shall be performed in accordance with the *Offsite Dose Calculation Manual*.

In addition, the report to be submitted 90 days after January 1 of each year shall include an assessment of radiation doses to the most likely exposed REAL MEMBER OF THE PUBLIC from the site for the previous 12 consecutive months to show conformance with *40 CFR 190*. Doses shall be calculated in accordance with the *Offsite Dose Calculation Manual*.

The semiannual effluent report shall also include a summary of each type of solid radioactive waste shipped offsite for burial or final disposal during the report period. This summary shall include the following information for each type of waste:

a. Type of waste (e.g., spent resin, compacted dry waste, irradiated components, etc.).

b. Solidification agent (e.g., cement).

c. Total curies.

d. Total volume and typical container volumes.

e. Principal radionuclides (those greater than 10% of total activity).

f. Types of containers used (e.g., LSA, Type A, etc.).

The semiannual effluent report shall include the following information for all unplanned releases from the site to unrestricted areas of radioactive materials in gaseous and liquid effluents:

a. A description of the event and equipment involved.

b. Cause(s) for the unplanned release.

c. Actions taken to prevent recurrence.

d Consequences of the unplanned release.

Any changes to the *RADIOLOGICAL EFFLUENT* and *OFFSITE DOSE CALCULATION MANUAL* and *Process Control Program* shall be submitted in the *Semiannual Radioactive Effluent Release Report*.

** In lieu of submission with the *Radioactive Effluent Release Report*, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.