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RADIOLOGICAL EFFLUENT MONITORING AND OFFSITE DOSE CALCULATION MANUAL

Millstone Unit Nos. 1, 2, & 3

Northeast Utilities
Berlin, Connecticut

June, 1985

SECTION 1

RADIOLOGICAL EFFLUENT

MONITORING MANUAL

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

DOCKET NOS. 50-245
50-336
50-423

June, 1985

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 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 EFFLUENT SAMPLING AND ANALYSIS PROGRAM

C.1 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 analysis 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 Specifications 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[(a)] (LLD) (uCi/ml)
A. BATCH RELEASE[f]				
1. Waste Sample Tanks	Prior to Each Batch	Prior to Each Batch	Principal Gamma Emitters[b]	5×10^{-7}
2. Floor Drain Sample Tank			I-131, Mo-99 Ce-141, Ce-144	1×10^{-6} 5×10^{-6}
	One Batch per month	Monthly	Other Dissolved and Entrained Gases	1×10^{-5}
3. Decon Solution Tank	Prior to Each Batch	Monthly Composite	H-3[(j)] Gross alpha[(j)]	1×10^{-5} 1×10^{-7}
	Prior to Each Batch	Quarterly Composite	Sr-89[(j)], Sr-90[(j)] Fe-55[(j)]	5×10^{-8} 1×10^{-6}
B. CONTINUOUS RELEASE				
Reactor Building Service Water	Daily Grab Sample[(d)]	Weekly Composite[(c)]	Principal Gamma Emitters[(b)]	5×10^{-7}
			I-131, Mo-99 Ce-141, Ce-144	1×10^{-6} 5×10^{-6}
	Monthly Grab Sample	Monthly	Dissolved and Entrained Gases	1×10^{-5}
	Weekly Grab Sample	Monthly Composite[c]	H-3[(e)] Gross alpha[(e)]	1×10^{-5} 1×10^{-7}
	Weekly Grab Sample	Quarterly Composite[(c)]	Sr-89[(e)], Sr-90[(e)] Fe-55[(e)]	5×10^{-8} 1×10^{-6}

TABLE C-1 (Continued)

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):

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

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 minutes per microcurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radio-nuclide

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 a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieve under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable.

b. The LLD will be 5×10^{-7} uCi/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 rsults 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 release.

d. Daily grab sample 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} uCi/ml.

f. A batch release is the discharge of liquid wastes of a discrete volume. Prioir 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[a] OF DETECTION (LLD) (uCi/ml)
A. BATCH RELEASE[b]	Prior to Each Batch	Prior to Each Batch	Principal Gamma Emitters[c]	5×10^{-7}
1. Coolant Waste Monitor Tank			I-131, Mo-99, Ce-141, Ce-144	1×10^{-6} 5×10^{-6}
2. Aerated Waste Monitor Tank	One Batch per month	Monthly	Dissolved and[d] Entrained Gases	1×10^{-5}
3. Condensate Polishing Facility - Waste Neut. Sump[e]	Prior to Each Batch	Monthly Composite[f,g]	H-3[d] Gross alpha[d]	1×10^{-5} 1×10^{-7}
	Prior to Each Batch	Quarterly Composite(f,g)	Sr-89[d], Sr-90[d] Fe-55[d]	5×10^{-8} 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 Ce-141, Ce-144	1×10^{-6} 5×10^{-6}
2. Reactor Building Closed Cooling Service Water Outlet	Monthly Grab Sample	Monthly	Dissolved and [j] Entrained Gases	1×10^{-5}
	Weekly Grab Sample	Monthly Composite[g]	H-3[j] Gross alpha[j]	1×10^{-5} 1×10^{-7}
3. Turbine Building Sumps[h]				
	Weekly Grab Sample	Quarterly Composite[g]	Sr-89[j], Sr-90[j] Fe-55[j]	5×10^{-8} 1×10^{-6}

TABLE C-2
(Continued)

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" signla.

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

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

where

LLD is the lower limit of detection as defined above (as uCi 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 transformation 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 a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occassionally background fluctuations, unavoidably small sample sizes, the presence of interferring nuclides, or other uncontrollable circumstances may render these LLDs 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.

TABLE C-2
(Continued)

Table Notations

c. The LLD will be 5×10^{-7} uCi/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.

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} uCi/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) exceeds 1×10^{-5} uCi/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 release.

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) exceeds 5×10^{-7} uCi/ml.

i. Daily grab sample for the service water shall be taken at least 5 days per week.

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

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[a] (LLD) (uCi/ml)
A. BATCH RELEASE[b]				
1. Condensate Polishing Facility - Waste Neutralization Sump [e]	Prior to Each Batch	Prior to Each Batch	Principle Gamma Emitters[c]	5×10^{-7}
			I-131, Mo-99	1×10^{-6}
			Ce-141, Ce-144	5×10^{-6}
2. Waste Test Tanks	One Batch per month	Monthly	Dissolved and (d) entrained gases	1×10^{-5}
3. Condensate Polishing Facility - Regenerate Distillate Task	Prior to each Batch	Monthly (f, g) Composite	H-3[d]	1×10^{-5}
			Gross Alpha[d]	1×10^{-7}
4. Low Level Waste Drain Tank	Prior to each Batch	Quarterly[f, g] Composite	Sr-89[d],	5×10^{-8}
			Sr-90[d], Fe-55[d]	1×10^{-6}
B. CONTINUOUS RELEASE				
1. Steam Generator Blowdown (h)	Daily grab sample (i)	Weekly Composite[g]	Principle Gamma Emitters(c)	5×10^{-7}
			I-131, Mo-99	1×10^{-6}
			Ce-141, Ce-144	5×10^{-6}
2. Service Water Effluent	Monthly grab sample	Monthly	Dissolved and (j) entrained gasses	1×10^{-5}
3. Turbine Building Sumps (h)	Weekly grab sample	Monthly Composite[g]	H-3 (j)	1×10^{-5}
			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-3
(Continued)

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):

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

where

LLD is the lower limit of detection as defined above (as uCi per unit mass of 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 transformation 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 collected 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 a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidable small sample sizes, the presence of interferring nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and recorded on the analysis sheet for the particular sample.

TABLE C-3
Continued)

Table Notations

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} uCi/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.

d. For the Condensate Polishing Facility (CPF) - Waste Neutralization Sump, these analyses are only required if the gamma analyses of the CPF - Waste Neutralization Sump indicates a gamma activity greater than 5×10^{-7} uCi/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) exceeds 1×10^{-5} uCi/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 releases.

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

i. Daily grab sample for the service water shall be taken at least 5 days per week.

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

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 systems equipment is specified below for each unit.

Millstone Unit No. 1

Waste concentrator A or B and Waste Demineralizer A or B.

Millstone Unit No. 2

Degasifier, clean liquid primary demineralyzer, boric acid evaporator, clean liquid secondary demineralizer and the aerated waste demineralizer.

Millstone Unit No. 3

Degasifier, ion exchanger, boron evaporator, boron demineralizer, waste evaporator or high waste demineralizer.

With radioactive 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 SAMPLING AND ANALYSIS PROGRAM

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

TABLE D-1
TABLE D-1 (Continued)

TABLE NOTATION

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

b. For gaseous samples, the LLD will be 1 x 10^{-4}, uCi/cc and for particulate samples, the LLD will be 1 x 10^{-11} uCi/cc. The principal gamma emitters for which these LLDs apply are exclusively 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. 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. Analyses 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 detertmination 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(A) (LLD) (UCI/CC)
A BATCH RELEASE				
1. Waste Gas Storage Tank(h)	Prior to Each Tank Discharge	Each Tank Discharge	Principal Gamma Emitters(b)	1×10^{-4}
2. Containment Purge			H-3	1×10^{-6}
B. CONTINUOUS RELEASE				
	Monthly Grab Sample(c) Gases	Monthly(c)	Principal Gamma Emitters[b]	1×10^{-4}
			H-3(g)	1×10^{-6}
	Continuous(d)	Weekly(f) Charcoal Sample	I 131	1×10^{-12}
			I-133(e)	1×10^{-10}
Vent	Continuous(d)	Weekly(f) Particulate Sample	Principal Gamma Emitters[b] (I-131, others with Half lives>8 days)	1×10^{-11}
	Continuous(d)	Monthly Composite Particulate Samples	Gross Alpha	1×10^{-11}
	Continuous(d)	Quarterly Composite Particulate Samples	Sr-89, Sr-90	1×10^{-11}
	Continuous(d)	Noble Gas Monitor	Noble Gas -Gross Activity	1×10^{-6}

TABLE D-2
(Continued)

TABLE NOTATION

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

b. For gaseous samples, the LLD will be 1×10^{-4} uCi/cc and for particulate samples, the LLD will be 1×10^{-11} uCi/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 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. 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. Analyses 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 detertmination 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 Tritum 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.

(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(A) (LLD) (UCI/ML)
A. BATCH RELEASES				
Containment Purge	Prior to Each Purge	Each Purge	Principal Gamma Emitters(b)	1×10^{-4}
			H-3	1×10^{-6}
B. CONTINUOUS RELEASES				
1. Unit 3 Ventillation Vent	Monthly(c) Grab samples Gases	Monthly(c)	Principal Gamma Emitters(b)	1×10^{-4}
			H-3(g)	1×10^{-6}
2. Engineered Safeguards Building	Continuous(d)	Weekly Charcoal Sample(f)	I-131	1×10^{-12}
			I-133(e)	1×10^{-10}
	Continuous(d)	Weekly Particulate Sample(f)	Principal Gamma(b) Emitters (I-131, others with half lives > 8 days)	1×10^{-11}
	Continuous(d)	Monthly Composite Particulate Samples	Gross Alpha	1×10^{-11}
	Continuous(d)	Quarterly Composite Particulate Samples	Sr 89, Sr 90	1×10^{-11}
	Continuous(d)	Noble Gas Monitor	Noble Gas Gross radioactivity	1×10^{-6}

TABLE D-3
(Continued)

TABLE NOTATION

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

b. For gaseous samples, the LLD will be 1 x 10^{-4}, uCi/cc and for particulate samples, the LLD will be 1 x 10^{-11} uCi/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 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. 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 Effluents Release Report.

c. Analyses shall also be done 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 detertmination 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 tritum shall be taken weekly whenever the refueling cavity is flooded and there is fuel in the cavity.

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 project dose. The gaseous radioactive waste treatment systems 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 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 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 inlcudes 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:

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

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.

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 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 "a posteriori" (after the fact) limit for a particular measurement. 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 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 both 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 types of vegetation) is sampled at the site boundary in each of 2 different direction sectors with relatively high D/Q's 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
1a.	Gamma Dose - Environmetal TLD	17	Monthly	Gamma Dose - Monthly
1b.	Gamma Dose - Accident TLD	22	Quarterly[(a)]	N/A[(a)]
2.	Airborne Particulate	8	Continuous sampler - weekly filter change	Gross Beta - Weekly, Gamma Spectrum - Monthly 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, I-131, Sr-89 and Sr-90 on each sample
6.	Sea Water	2	Quarterly - Composite of 6 Weekly Grab samples	Quarterly - Fractional Beta, Gamma Isotopic and Tritium on each composite
7.	Bottom Sediment	7	Semiannual	Gamma Isotopic on Each Sample

TABLE E-1 (Continued)

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.	Mussles	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.	Lobster	3	Quarterly	Gamma Isotopic on Each Sample

(a) Accident monitoring TLDs 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		
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	
Zr-95	4×10^2				
Nb-95	4×10^2				

(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}				
Factional 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
Be-140	120[c, e]			70		
La-140	30[c, e]			25		

TABLE NOTATION

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

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

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

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 transformation 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 sample collection (or end of the sample collection period) and time of counting

It should be recognized that the LLD is defined as a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particulate measurement.

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 a priori LLDs 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 Reports 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 reports 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 as soon as possible in a supplementary 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 supplemental 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 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 likely most 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 onsite in a file that shall be provided to the NRC upon request.

SECTION II

OFFSITE DOSE CALCULATION MANUAL

FOR THE

MILLSTONE NUCLEAR POWER STATION

UNITS 1, 2 and 3

DOCKETS: No. 50-245
No. 50-336
No. 50-423

June, 1985

OFFSITE DOSE CALCULATION MANUAL

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A. INTRODUCTION

The purpose of this manual is to provide the parameters and methodology to be used in calculating offsite doses and effluent monitor setpoints at the Millstone Nuclear Power Station. Included are methods for determining maximum individual whole body and organ doses due to liquid and gaseous effluents to assure compliance with the dose limitations in the Technical Specifications. Also included are methods for performing dose projections to assure compliance with the liquid and gaseous treatment system operability sections of the Radiological Effluent Monitoring Manual. The manual also includes the methods used for determining quarterly individual and population doses for inclusion in the Semiannual Radioactive Effluents Release Report.

Another section of this discusses the methodology to be used in determining effluent monitor alarm/trip setpoints to be used to ensure compliance with the instantaneous release rate limits in the Technical Specifications.

The basis for some of the factors in this manual are included as appendices to this manual.

This manual does not include the surveillance procedures and forms required to document compliance with the surveillance requirements in the Technical Specifications. All that is included here is the methodology to be used in performance of the surveillance requirements.

Most of the calculations in this manual have two or three methods given for the calculation of the same parameter. These methods are arranged in order of simplicity and conservatism, Method 1 being the easiest and most conservative. As long as releases remain low, one should be able to use Method 1 as a simple estimate of the dose. If release calculations approach the limit however, more detailed yet less conservative calculations may be used.

At any time a more detailed calculation may be used in lieu of a simple calculation.

This manual is written common to all three units since some release pathways are shared and there are also site release limits invovled. These facts make it impossible to completely separate the three units.

B. RESPONSIBILITIES

All changes to this manual shall be reviewed by the Site Operations Review Committee 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 specified in the Technical Specifications.

C. LIQUID DOSE CALCULATIONS

C.1 Quarterly - Total Body Dose

C.1.a Method 1 - Any Unit

Step 1 - Determine C_F = total gross curies of fission and activation products, excluding tritium and dissolved noble gases, released during the calendar quarter.

Step 2 - Determine C_T = total curies of tritium released during the calendar quarter.

Step 3 - Determine D_{QT} = quarterly dose to the total body in mrem.

$$D_{QT} = 1.9 \times 10^{-2} * C_F + 5.6 \times 10^{-7} * C_T \text{ (See Note 1)}$$

Step 4 - If D_{QT} is greater than 0.5 mrem, go to Method 2.

(Note 1) - See Appendix A for derivation of these factors.

C.1.b Method 2 - Any Unit

If the calculated dose using Method 1 is greater than 0.5 mrem, use the NRC computer code LADTAP to calculate the liquid doses. The use of this code and the input parameters are given in Radiological Assessment Branch Procedure RAB 4-3, Liquid Dose Calculations - LADTAP.

C.2 Quarterly - Maximum Organ Dose

C.2.a Method 1 - Any Unit

Step 1 - Determine C_F = total gross curies of fission and activation products, excluding tritium and dissolved noble gases, released during the calendar quarter - same as Step C.1.a.

Step 2 - Determine D_{QO} = quarterly dose to the maximum organ in mrem.

$D_{QO} = 0.2\ C_F$ (See Appendix B for derivation of factor)

Step 3 - If D_{QO} is greater than 2 mrem, go to Method 2.

C.2.b Method 2 - Any Unit

If the calculated dose using Method 1 is greater than 2 mrem, use the NRC computer code LADTAP to calculate the liquid doses. The use of this code, and the input parameters are given in Radiological Assessment Branch Procedure RAB 4-3, Liquid Dose Calculations - LADTAP.

C.3 Annual - Total Body Dose - Any Unit

Determine D_{YT} = dose to the total body for the calendar year as follows:

$D_{YT} = \sum D_{QT}$ where the sum is over the first quarter through the present quarter total body doses.

The following should be used as D_{QT}:

(1) If the detailed quarterly dose calculations required per Section C.6 for the semiannual effluent report are complete for any calendar quarter, use that result.

(2) If the detailed calculations are not complete for a particular quarter, use the results as determined in Section C.1.

(3) If D_{YT} is greater than 3 mrem and any D_{QT} determined as in Section C.1 was not calculated using Method 2 of that section, recalculate D_{QT} using Method 2 if this could reduce D_{YT} to less than 3 mrem.

C.4 Annual - Maximum Organ Dose - Any Unit

Determine D_{YO} = dose to the maximum organ for the calendar year as follows:

$D_{YO} = \sum D_{QO}$ where the sum is over the first quarter through the present quarter maximum organ doses.

The following guidelines should be used:

(1) If the detailed quarterly dose calculations required per Section C.6 for the semiannual effluent report are complete for any calendar quarter, use that result.

(2) If the detailed calculations are not complete for a particular quarter, use the results as determined in Section C.2.

(3) If different organs are the maximum for different quarters, they may be summed together and D_{YO} can be recorded as a less than value as long as the value is less than 10 mrem.

(4) If D_{YO} is greater than 10 mrem and any value used in its determination was calculated as in Section C.2 but not with Method 2, recalculate that value using Method 2 if this could reduce D_{YO} to less than 10 mrem.

C.5 Monthly Dose Projections

C.5.a Total Body & Maximum Organ - Unit 1

Step 1 - Determine D'_{MT} = total body dose from the last typical* previously completed month as calculated per the methods in Section C.1.

Step 2 - Determine D'_{MO} = maximum organ dose from the last typical* previously completed month as calculated per the methods in Section C.1.

Step 3 - Estimate R_1 = ratio of the total estimated volume of liquid batches to be released in the present month to the volume released in the past month.

Step 4 - Estimate R_2 = ratio of estimated primary coolant activity for the present month to that for the past month.

Step 5 - Determine F = factor to be applied to estimate ratio of final curie released if there are expected differences in treatment of liquid waste for the present month as opposed to the past month (e.g., bypass of filters or demineralizers). NUREG-0016 or past experience should be used to determine the effect of each form of treatment which will vary. F = 1 if there are no expected differences.

Step 6 - Determine D^E_{MT} = estimated monthly total body dose as follows:

$$D^E_{MT} = D'_{MT} * R_1 * R_2 * F$$

Step 7 - Determine D^E_{MO} = estimated monthly maximum organ dose as follows:

$$D^E_{MO} = D'_{MO} * R_1 * R_2 * F$$

* - The last typical month should be one without significant operational differences from the projected month.

For example, if the plant was down for refueling the entire month of February and startup is scheduled for March 3, use the last month of operation as the base month to estimate March's dose.

Or, if there were no releases during September, do not use September as the base month for October if it is estimated that there will be releases in October.

C.5.b Total Body & Maximum Organ - Unit 2 and Unit 3

Step 1 - Determine D'_{MT} = total body dose from the last typical* previously completed month as calculated per the method in Section C.1.

Step 2 - Determine D'_{MO} = maximum organ dose from the last typical* previously completed month as calculated per the methods in Section C.2.

* - See footnote in Section C.5.a.

Step 3 - Estimate R_1 = ratio of the total estimated volume of liquid batches to be released in the present month to the volume released in the past month.

Step 4 - Estimate R_2 = ratio of the total estimated volume of steam generator blowdown to be released in present month to the volume released in the past month.

Step 5 - Estimate F_1 = fraction of curies released last month coming from steam generator blowdown.

i.e. $F_1 = \dfrac{\text{curies from blowdown}}{\text{curies from blowdown + curies from batch tanks}}$

Step 6 - Estimate R_3 = ratio of estimated secondary coolant activity for the present month to that for the past month.

Step 7 - Estimate R_4 = ratio of estimated primary coolant activity for the present month to that for the past month.

Step 8 - Determine F_2 = factor to be applied to estimate ratio of final curie released if there are expected differences in treatment of liquid waste for the present month as opposed to the past month (e.g., bypass of filters or demineralizers). NUREG-0017 or past experience should be used to determine the effect of each form of treatment which will vary. $F_2 = 1$ if there are no expected differences.

Step 9 - Determine D^E_{MT} = estimated monthly total body dose as follows:

$$D^E_{MT} = D'_{MT} \left[(1 - F_1) R_1 R_4 F_2 + F_1 R_2 R_3 \right]$$

Step 10 - Determine D^E_{MO} = estimated monthly maximum organ dose as follows:

$$D^E_{MO} = D'_{MO} \left[(1 - F_1) R_1 R_4 F_2 + F_1 R_2 R_3 \right]$$

C.6 Quarterly Dose Calculations for Semiannual Radioactive Effluent Report

Detailed quarterly dose calculations required for the Semiannual Radioactive Effluent Report shall be done using the NRC computer code LADTAP. The use of this code, and the input parameters are given in Radiological Assessment Branch Procedure RAB 4-3, Liquid Dose Calculations - LADTAP.

D. GASEOUS DOSE CALCULATIONS

D.1 10CFR 20 Limits ("Instantaneous")

D.1.a Instantaneous Noble Gas Release Rate Limits - All Units

The instantaneous noble gas release rate limit from the site shall be:

$$\frac{Q_1}{790{,}000} + \frac{Q_2}{217{,}000} + \frac{Q_3}{217{,}000} \leq 1$$

where

Q_1 = Noble gas release rate from MP1 stack (uCi/sec)

Q_2 = Noble gas release rate from MP2 vent (uCi/sec)

Q_3 - Noble gas release rate from MP3 vent (uCi/sec)

See Appendix D for deviation of this limit.

As long as the above is less than or equal to 1, the doses will be less than or equal to 500 mrem to the total body and less than 3000 mrem to the skin.

D.1.o **Release Rate Limit - I-131, Particulates With Half Lives Greater than 8 Days, and Radionuclides Other Than Noble Gases With Half Lives Greater Than 8 Days - All Units**

(1) The release rate limit of I-131 and tritium from the site shall be:

$$\frac{Q_{I1}}{6.26} + \frac{Q_{I2}}{0.49} + \frac{Q_{I3}}{0.49} + \frac{Q_{T1}}{9.1\times10^5} + \frac{Q_{T2}}{4.0\times10^4} + \frac{Q_{T3}}{4.0\times10^4} \leq 1 \text{ where,}$$

Q_{I1} = Release of I-131 from MP1 Stack - (uCi/sec)

Q_{I2} = Release rate of I-131 from MP2 Vent - (uCi/sec)*

Q_{I3} = Release rate of I-131 from MP3 Vent - (uCi/sec)

Q_{T1} = Release rate of tritium from MP1 Stack - (uCi/sec)

Q_{T2} = Release rate of tritium from MP2 Vent - (uCi/sec)*

Q_{T3} = Release rate of tritium from MP3 Vent - (uCi/sec)

(2) The release rate limit for particulates with half lives greater than 8 days and tritium from the site shall be:

$$\frac{Q_1}{35} + \frac{Q_2}{4.2} + \frac{Q_3}{2.1} + \frac{Q_{T1}}{9.1\times10^5} + \frac{Q_{T2}}{4.0\times10^4} + \frac{Q_{T3}}{4.0\times10^4} \leq 1 \text{ where,}$$

Q_1 = Release rate of total particulates with half lives greater than 8 days from the MP1 Stack (uCi/sec).

Q_2 = Release rate of total particulates with half lives greater than 8 days from the MP2 Vent (uCi/sec).

Q_3 = Release rate of total particulates with half lives greater than 8 days from the MP3 Vent (uCi/sec).

Q_{T1} = Release rate of tritium from MP1 Stack - (uCi/sec)

Q_{T2} = Release rate of tritium from MP2 Vent - (uCi/sec)*

Q_{T3} = Release rate of tritium from MP3 Vent - (uCi/sec)

With releases within the above limits, the does rate to the maximum organ will be less than 1500 mrem/year.

*Includes releases via the steam generator blowdown tank vent.

D.2 Appendix I Noble Gas Limits

D.2.a Quarterly Air Dose - Method 1 - All Units

Step 1 - Determine C_{N1} = Total curies of noble gas released from Unit 1 during the calendar quarter.

Step 2 - Determine C_{N2} = Total curies of noble gas released from Unit 2 during the calendar quarter. Include all sources - ventilation, containment purges, and waste gas tanks.

Step 3 - Determine C_{N3} = Total curies of noble gas released from Unit 3 during the calendar quarter. Include all sources - ventilation, containment vacuum system, gaseous radwaste system, main condenser evacuation system, and turbine gland sealing system (for the latter two systems, see Appendix H for methods to determine the number of curies).

Step 4 - Determine D_{QG1} = quarterly gamma air dose from Unit 1 (mrad).

$$D_{QG1} = 7.6 \times 10^{-5} C_{N1}*$$

Step 5 - Determine D_{QB1} = quarterly beta air dose from Unit 1 (mrad).

$$D_{QB1} = 7.6 \times 10^{-7} C_{N1} *$$

Step 6 - Determine D_{QG2} = quarterly gamma air dose from Unit 2 (mrad).

$$D_{GB2} = 6.3 \times 10^{-4} C_{N2}*$$

Step 7 - Determine D_{QB2} = quarterly beta air dose from Unit 2 (mrad).

$$D_{QB2} = 1.8 \times 10^{-3} C_{N2}*$$

Step 8 Determine D_{QG3} = quarterly gamma air dose from Unit 3 (mrad).

$$D_{QG3} = 6.3 \times 10^{-4} C_{N3} *$$

Step 9 Determine D_{QB3} = quarterly beta air dose from Unit 3 (mrad).

$$D_{QB3} = 1.8 \times 10^{-3} C_{N3}*$$

Step 10 If D_{QG1}, D_{QG2}, or D_{QG3} are greater than 1.6 mrad; or D_{QB1}, D_{QB2}, or D_{QB3} are greater than 3.3 mrad, go to Method 2.

*See Appendix D for derivation of factors.

D.2.b Quarterly Air Dose - Method 2 - All Units

Unit 2, 3 - For MP2 and MP3 dose calculations use the GASPAR computer code to determine the critical site boundary air doses.

For the Special Location, enter the following worst case quarterly average meteorology:

$X/Q = 0.13 \times 10^{-4}$ sec/m^3

(See Appendix D)

$D/Q = 0.15 \times 10^{-6}$ m^{-2}

If the calculated air dose exceeds the Technical Specification limit use real time meterology.

Unit 1 - For MP1 dose calculations use the AIREM computer code to determine the critical location air doses.

The 3rd quarter 1979 joint frequency data should be used as input for the AIREM code. The reason for this is given in Appendix D.

If the calculated air dose exceeds the Technical Specification limit, use real time meteorology.

D.2.c Annual Air Dose Limit Due to Noble Gases - All Units

Determine D_{YG1}, D_{YG2}, D_{YG3}, D_{YB1}, D_{YB2} and D_{YB3} = gamma air dose and beta air dose for the calender year for Unit 1, 2 or 3 as follows:

$D_{YG1} = \sum D_{QG1}$, $D_{YB1} = \sum D_{QB1}$, $D_{YG2} = \sum D_{QG2}$, $D_{YB2} = \sum D_{QB2}$; $D_{YG3} = \sum D_{QG3}$, $D_{YB3} = \sum D_{QB3}$.

where the sum is over the first quarter through the present quarter doses.

The following should be used as the quarterly doses:

(1) If the detailed quarterly dose calculations required per the section for the semiannual effluent report are complete for any calendar quarter, use those results.

(2) If the detailed calculations are not complete for a particular quarter, use the results as determined above in Section D.2.a or D.2.b.

(3) If $D_{YG1, 2, or 3}$, are greater than 10 mrad or $D_{YB1, 2, or 3}$, are greater than 20 mrad and any corresponding quarterly dose was not calculated using Section D.2.b -real time meteorology, recalculate the quarterly dose using real time meteorology.

D.3 Appendix I - Iodine and Particulate Doses

D.3.a Quarterly Doses - Unit 1

(1) Method 1 - Unit 1

Step 1 - Determine C_I = total curies of I-131 released in gaseous effluents from Unit 1 during the quarter.

Step 2 - Determine Cp = total curies of particulates with half lives greater than 8 days released in gaseous effluents from Unit 1 during the calendar quarter.

Step 3 - Determine D_{QT} = quarterly thyroid dose as follows:

$D_{QT} = 13.7\ C_I$ (See Appendix D)

Step 4 - Determine D_{QO} = quarterly dose to the maximum organ other than the thyroid:

$D_{QO} = 2.4\ Cp$ (See Appendix D)

Step 5 - The maximum organ dose is the greater of D_{QT} or D_{QO}. If it is greater than 5 mrem, go to Method 2.

(2) Method 2 - Unit 1

Use the GASPAR code to determine the maximum organ dose. For the Special Location, enter the following worst case quarterly average meterology as taken from Appendix D:

$X/Q = 7.1 \times 10^{-8}$ Sec/M^3

$D/Q = 7.9 \times 10^{-9}$ M^{-2}

Use the goat milk, vegetation and inhalation pathway in totaling the dose. If the maximum organ dose is greater than 7.5 mrem, go to Method 3.

(3) Method 3 - Unit 1

Use the GASPAR code with actual locations, real-time meteorology and the pathways which actually exist at the time at those locations.

D.3.b Quarterly Doses - Unit 2 or Unit 3

(1) Method 1

Step 1 - Determine C_I = total curies of I-131 in gaseous effluents from Unit 2 or 3 during the quarter.

Step 2 - Determine C_P = total curies of particulates with half lives greater than 8 days released in gaseous effluents from Unit 2 or 3 during the calendar quarter.

Step 3 - Determine C_T = total curies of tritium released in gaseous effluents from Unit 2 or 3 during the calendar quarter.

Step 4 - Determine D_{QT} = quarterly thyroid dose as follows:

$$D_{QT} = 285\ C_I + 1.5 \times 10^{-3}\ C_T \text{ (See Appendix D)}$$

Step 5 - Determine D_{QO} = quarterly dose to the maximum organ other than the thyroid:

$$D_{QO} = 44\ C_P + 1.5 \times 10^{-3}\ C_T \text{ (See Appendix D)}$$

Step 6 - The maximum organ dose is the greater of D_{QT} or D_{QO}. If greater than 5 mrem, go to Method 2.

(2) Method 2

Use the GASPAR code to determine the maximum organ dose. For the Special Location, enter the following worst case quarterly average meteorology as taken from Appendix D:

$$X/Q = 0.13 \times 10^{-4} \text{ sec/M}^3$$

$$D/Q = 0.15 \times 10^{-6} \text{ M}^{-2}$$

As shown in Appendix D, the same meteorology can be used for both continuous and batch releases. Therefore, the program need only be run once using the total curies from all releases from Unit 2 or 3.

Use the goat milk, vegetation and inhalation pathways in totaling the dose. If the maximum organ dose is greater than 7.5 mrem, to to Method 3.

(3) Method 3 - Unit 2

Use the GASPAR code with the actual locations, real-time meteorology and the pathways which actually exist at the time at these locations. The code should be run separately for steam generator blowdown tank vents and ventilation releases, containment purges and waste gas tank releases.

(4) Method 3 - Unit 3

Use the GASPAR code with actual locations, real-time meteorology and the pathways which actually exist at these locations. This code should be run separately for ventilation, process gas, containment vacuum system, aerated ventilation and turbine gland sealing exhaust; and containment purges and main condenser evacuation system.

D.3.c Maximum Organ Annual Doses - All Units

Determine D_{YO1}, D_{YO2}, and D_{YO3} = maximum organ dose for the calendar year for Units 1, 2, and 3 respectively, as follows:

$D_{YO1, 2 \text{ or } 3} = \Sigma D_{QO}$ = sum of quarterly maximum organ doses where the sum is over the first quarter through the present quarter.

The following guidelines should be used for use of D_{QO}:

(1) If the detailed quarterly dose calculations required per the section for the semiannual effluent report are complete for any calendar quarter, use those results.

(2) If the detailed calculations are not complete for a particular quarter, use the results as determined above in Section D.3.a or D.3.b.

(3) If D_{YO} is greater than 15 mrem and quarterly dose was not calculated using Method 3 of Section D.3.a or D.3.b, recalculate the quarterly dose using Method 3.

(4) If different organs are the maximum organ for different quarters, they can be summed together and D_{YO} recorded as a less than value as long as the value is less than 15 mrem. If it is not, the sum for each organ involved should be determined.

D.4 Gaseous Effluent Monthly Dose Projections

D.4.a Unit 1

(1) Due to Gaseous Radwaste Treatment System (Offgas)

Step 1 - If it is expected that the augmented offgas treatment system will be out of service during the month, go to Step 7. Otherwise, continue with Steps 2 through 6.

Step 2 - Determine C'_N = number of curies of noble gas released during the most recent month of operation from the augmented offgas system.

Step 3 - Estimate R_1 = ratio of expected full power offgas rate at the air ejector for the upcoming month compared to the reference month of Step 2.

Step 4 - Estimate R_2 = ratio of expected unit production capacity for the upcoming month compared to the reference month of Step 2.

Step 5 - Determine D^E_{MG} = estimated monthly gamma air dose.

D^E_{MG} (mrad) = $7.6.\text{x}10^{-5}\, C'_N\, R_1, R_2$ (Factor is from Appendix D)

Step 6 - Determine D^E_{MB} = estimated monthly beta air dose.

$D^E_{MB} = 7.6 \times 10^{-7}\, C'_N\, R_1\, R_2$ (Factor is from Appendix D)

Step 7 - If the augmented offgas system is expected to be out of service during the month, determine the following:

Q = Estimated curies/sec at the air ejector at the expected maximum power for the month.

R = estimated curie reduction factor from air ejector to stack via the 30 minute (actual time is approximately 55 minutes) holdup line (in decimal fraction).

d = estimated number of days the 30 minute holdup pipe will be used.

D^E_{MG} = estimated monthly gamma air dose.

= 7.6×10^{-5} mrad/Ci x Q Ci/secx R x d (day) x 8.6×10^4 sec/day.

$D^E_{MG} = 6.5 \times Q \times R \times d$

D^E_{MB} = estimated monthly beta air dose.

$D^E_{MB} = 0.065 \times Q \times R \times d$

(2) Due to Ventilation System Releases

Step 1 - For the last quarter of operation, determine D_{QT} or D_{QO}* as determined per Section D.3.a.**

Step 2 - Estimate R_1 = expected ratio of primary coolant iodine level for the coming month as compared with the average level during the quarter used in Step 1.

Step 3 - Estimate R_2 = expected ratio of primary leakage rate for the coming month as compared with the average leakage rate during the quarter used in Step 1.

Step 4 - Determine D^E_{MO} = estimated monthly dose to the maximum.

$$D^E_{MO} = 1/3\ R_1\ R_2\ D_{QO}\ (\text{or } D_{QT})^*$$

* - Whichever was greater

** - Section D.3.b for Unit 2

D.4.b Unit 2

(1) Due to Gaseous Radwaste Treatment System

Step 1 - Estimate C_N^E = the number of curies of noble gas to be released from the waste gas storage tanks during the next month.

Step 2 - Determine D_{MG}^E = estimated monthly gamma air dose.

$$D_{MG}^E \text{ (mrad)} = 7.6 \times 10^{-5}\, C_N^E$$

(Factor is from Appendix D for the Unit 1 stack releases since the Unit 2 waste gas tanks are discharged via the Unit 1 stack. This factor should be conservative as the isotopic mix would only be the longer lived noble gases which would have lower dose conversion factors than the typical mix from Unit 1.)

Step 3 - Determine D_{MB}^E = estimated monthly beta air dose.

$$D_{MB}^E \text{ (mrad)} = 7.6 \times 10^{-7}\, D_N^E$$

(2) Due to Steam Generator Blowdown Tank Vents and Ventilation Releases

Use the same method as given in Section D.4.a (2) for Unit 1.

D.4.c Unit 3

(1) Due to Radioactive Gaseous Waste System, Steam Generator Blowdown Tank Vent.

Use the same method as given in Section D.4.b.(1).

(2) Due to Ventilation Releases

Use the same method as given in Section D.4.a.(2).

D.5 Quarterly Dose Calculations for Semiannual Report

Detailed quarterly dose calculations required for the Semiannual Radioactive Effluent Report shall be done using the computer codes GASPAR and AIREM.

D.6 Compliance with 40 CFR190

The following sources should be considered in determining the total dose to a real individual from uranium fuel cycle sources:

a) Gaseous Releases from units 1, 2, and 3.

b) Liquid Releases from units 1, 2, and 3.

c) Direct Radiation from the Site

d) Since all other uranium fuel cycle sources are greater than 5 miles away, they need not be considered.

E. LIQUID MONITOR SETPOINTS

E.1 Unit 1 Liquid Radwaste Effluent Line

The trip/alarm setting on the Unit 1 liquid radwaste discharge line depends on dilution water flow, radwaste discharge flow, the isotopic composition of the liquid, the background count rate of the monitor and the efficiency of the monitor. Due to the variability these parameters, an alarm/trip setpoint will be determined prior to the release of each batch. The following methodology will be used:

Step 1 - From the tank isotopic analysis and the MPC values for each identified nuclide (including noble gases) determine the required reduction factor, i.e.:

$$R = \text{Reduction Factor} = 1/\sum_i \frac{\text{uCi/ml of nuclide } i}{\text{MPC of nuclide } i}$$

Step 2 - Determine the existing dilution flow = D = circulating water pumps x 100,000 gpm + # service water pumps x 10,000 gpm.

Step 3 - Determine the allowable discharge flow = F

$F = 0.1 \times R \times D$

Note that discharging at this flow rate would yield a discharge concentration 10% of the Technical Specification Limit due to the safety factor of 0.1.

Step 4 - Determine the total uCi/ml in the tank.

Step 5 - Using the latest monitor calibration curve, determine the "cps" corresponding to two times the total uCi/ml determined in Step 4. This will be the trip setpoint.

Note: If discharging at the allowable discharge rate as determined in Step 3, this would yield a discharge concentration corresponding to 20% of the Technical Specification limit.

Step 6 - The allowable discharge flow rate calculated in Step 3 may be increased by up to a factor of 5 with appropriate administrative controls.

E.2 Unit 1 Service Water Effluent Line

The MP1 Reactor Building Service Water Monitor Hi alarm setting is approximately 1.5 times the ambient background and the Hi-Hi Alarm is approximately 2 times the ambient background reading on the monitor in counts per second.

E.3 Unit 2 Clean Liquid Radwaste Effluent Line

Same as Section E.1 of the MP1 Liquid Radwaste Monitor except for Step 2 where:

Dilution Flow = D = # circulating water pumps x 135,000 gpm + # service water pumps x 4,000 gpm.

E.4 Unit 2 Aerated Liquid Radwaste Effluent Line and Condensate Polishing Facility Waste Neut. Sump Effluent Line

Same as E.3 for Clean Liquid Monitor, except that for the Condensate Polishing Facility Waste Neut. Sump, the monitor has a digital readout of uCi/ml and the alarm setpoint is set directly on uCi/ml and not the corresponding count rate.

E.5 Unit 2 Steam Generator Blowdown

Assumptions used in determining the Alarm setpoint for this monitor are:

a. Maximum possible total S.G. blowdown flow rate = 500 gpm.

b. Minimum possible circulating water dilution flow during periods of blowdown = 270,000 gpm (2 pumps).

c. Unidentified MPC for unrestricted areas = 1×10^{-7} uCi/ml*.

Therefore, the alarm setpoint should correspond to a concentration of:

$$\text{Alarm (uCi/ml)} = \frac{270{,}000}{500} \times 1 \times 10^{-7} = 5.4 \times 10^{-5} \text{ uCi/ml}$$

The latest monitor calibration curve should be used to determine the alarm setpoint in cpm corresponding to 1.1×10^{-4} uCi/ml.

This setpoint may be increased through proper administrative controls if the steam generator blowdown rate is maintained less than 500 gpm and/or more than 2 circulating water pumps are available. The percent increase would correspond to the ratio of flows to those assumed above or:

$$\text{Alarm (uCi/ml)} = 5.4 \times 10^{-5} \text{ uCi/ml} \times \frac{\text{\# Circ water pumps}}{2} \times \frac{500}{\text{S/G Blowdown (gpm)}}$$

$$= \frac{1.4 \times 10^{-2} \text{ uCi/ml} \times \text{\# Circ water pumps}}{\text{total S/G Blowdown (gpm)}}$$

Note: The Steam Generator Blowdown alarm criteria is in practice based on setpoints required to detect allowable levels of primary to secondary leakage. This alarm criteria is typically more restrictive than that required to meet discharge limits. This fact should be verified however whenever the alarm setpoint is recalculated.

*In lieu of using the unidentified MPC value, the identified MPC valves for unrestricted areas may be used.

E.6 Unit 2 Condenser Air Ejector

This monitor is included as a liquid monitor since the reason it's in the Technical Specifications is for control of the Steam Generator Blowdown liquid activity. It can be used in conjunction with or in place of the blowdown monitor to ensure that the blowdown concentration is within 10CFR20 limits.

Gaseous release limits are not controlled by this monitor but rather by the monitor at the final discharge point.

A detailed study was performed to determine the equilibrium steam generator blowdown activity as a function of blowdown rate and primary to secondary leakage rate. It turns out that in order to reach 10CFR20 limits as determined in Section E.5 the minimum primary to secondary leakage rate required is 0.4 gpm. The air ejector monitor is set to alarm at a level corresponding to approximately 0.2 gpm. leakage. Thus it ensures adequate control of blowdown. The above values are for primary coolant activity level used at the time of the study. However, if the coolant activity increased such that the leakage rate required to reach 10CFR20 limits was less, there would be an equal increase in the sensitivity of the air ejector monitor.

E.7 Unit 2 Reactor Building Closed Cooling Water

The alarm setting is approximately 2 times the ambient background reading of the monitor.

E.8 Unit 3 Liquid Waste Monitor

Similar to the Unit 1 liquid discharge line, the setpoints on the Unit 3 liquid waste monitor depend on dilution water flow, radwaste discharge flow, the isotopic composition of the liquid, the background count rate of the monitor and the efficiency of the monitor. Due to the variability these parameters, the alert and alarm setpoints will be determined prior to the release of each batch. The following methodology will be used:

Step 1 - From the tank isotopic and the MPC values for each identified nuclide (including noble gases) determine the required reduction factor, i.e.:

$$R - \text{Reduction Factor} - 1/_i \frac{\text{uCi/ml of nuclide i}}{\text{MPC of nuclide i}}$$

Step 2 - Determine the existing dilution flow = D = # circulating water pumps x 150,000 gpm + # service water pumps x 15,000 gpm.

Step 3 - Determine the allowable discharge flow = F

F = 0.1 x R x D

Note that discharging at this flow rate would yield a discharge concentration 10% of the Technical Specification Limit due to the safety factor of 0.1.

Step 4 - Determine the total uCi/ml in the tank.

Step 5 - Using the latest monitor calibration curve, determine the "cps" corresponding to 1.5 times the total uCi/ml determined in Step 4. This will be the Alert setpoint.

Step 6 - Using the latest monitor calibration curve, determine the "cps" corresponding to two times the total uCi/ml determined in Step 4. This will be the Alarm setpoint.

Note: If discharging at the allowable discharge rate as determined in Step 3, this would yield a discharge concentration corresponding to 20% of the Technical Specification limit.

Step 7 - The allowable discharge flow rate calculated in Step 3 may be increased by up to a factor of 5 with appropriate administrative controls.

E.9 Unit 3 Regenerant Evaporator Effluent Line

The MP3 Regenerant Evaporator Monitor alert setting is approximately 1.5 times the normal reading and the alarm setting is 2 times the normal reading.

E.10 Unit 3 Waste Neutralization Sump Effluent Line

Same as Section E.8.

E.11 Unit 3 Steam Generator Blowdown

The Alarm setpoint for this monitor assumes:

a. steam generator blowdown rate of 76 gpm for each steam generator for a total of 304 gpm.

b. the release rate limit is conservatively set at 10% of the 10CFR Part 20 limit (0.1 times the unidentified MPC* for unrestricted areas which equals $0.1 \times 1 \times 10^{-7}$ uCi/ml - 1×10^{-8} uCi/ml).

c. minimum possible circulating and service water dilution flow during periods of blowdown = 456,000 gpm (3 circulating water pumps) + 30,000 gpm (2 service water pumps) = 486,000 gpm.

Therefore, the Alarm setpoint should correspond to a concentration of:

$$\text{Alarm (uCi/ml)} = \frac{486{,}000}{340} \times 1 \times 10^{-8} = 1.6 \times 10^{-5} \text{ uCi/ml}$$

This setpoint may be increased through proper administrative controls if the steam generator blowdown rate is maintained less than 304 gpm and/or more than 3 circulating and 2 service water pumps are available. The amount of the increase would correspond to the ratio of flows to those assumed above or:

$$\text{Alarm (uCi/ml)} = 1.6 \times 10^{-5} \text{ uCi/ml} \times \frac{\text{circulating \& service water flow (gpm)}}{486{,}000 \text{ gpm}}$$

$$\times \frac{304 \text{ gpm}}{\text{S/G Blowdown (gpm)}}$$

$$= 1 \times 10^{-8} \text{ uCi/ml} \times \frac{\text{circulating \& service wate flow (gpm)}}{\text{total S/G Blowdown (gpm)}}$$

Note: The Steam Generator Blowdown alarm criteria is in practice based on setpoints required to detect allowable levels of primary to secondary leakage. This alarm criteria is typically more restrictive than that required to meet discharge limits. This fact should be verified however whenever the alarm setpoint is recalculated.

*In lieu of using the unidentified MPC value, the identified MPC values for unrestricted areas may be used.

E.12 Unit 3 Turbine Building Floor Drains Effluent Line

The Alarm setpoint for this monitor assumes:

a. Drinking water is not a real pathway at this site. Therefore the NRC code, LADTAP, is used to calculate the dose to the maximum individual.

b. The dilution flow is 5 gpm (1.11×10^{-2} ft^3/sec)

c. Near field dilution factor = 13,000.
Far field dilution factor = 32,000.
(Reference: Millstone 3 FSAR, Section 2.4.13)

d. Isotopic concentrations were taken from the Millstone 3 FSAR, Table 11.2-4 (See column under Turbine Building).

e. Each concentration above was multiplied by the total annual flow (9.95×10^9 cm^3, conservatively assuming 5 gpm continuous).

f. The maximum individual organ dose is set equal to 0.1% of 1500 mrem. The limiting individual is the child; maximum organ is the thyroid.

The setpoint corresponding to 1.5 mrem to the child's thyroid is 7.6×10^{-5} uCi/ml.

F. GASEOUS MONITOR SETPOINTS

F.1 Unit 1 Hydrogen Monitor

Per Section 3.8.D.6 of the Technical Specifications, the alarm setpoint shall be less than or equal to 4% hydrogen by volume.

F.2 Unit 1 Steam Jet Air Ejector Offgas Monitor

Per Section 3.8.D.7 of the Technical Specifications, the maximum allowed noble gas in-process activity rate shall not exceed 1.47×10^6 uCi/Sec. This value will be more limiting than the instantaneous stack release rate limit.

Using the latest offgas monitor calibration curve, determine the reading in mR/HR corresponding to 1.47×10^6 uCi/sec. The alarm setpoint should be set at less than or equal to this value.

F.3 Unit 1 Stack Noble Gas Monitor

Per Technical Specifications 3.8.D.1 and ODCM Section D.1.a, the instantaneous release rate limit from the site shall be:

$$\frac{Q_1}{790{,}000} + \frac{Q_2}{217{,}000} + \frac{Q_3}{217{,}000} \leq 1$$

where Q_1 = noble gas release rate from MP1 stack (uCi/sec)

Q_2 = noble gas release rate from MP2 vent (uCi/sec)

Q_3 = noble gas release rate from MP3 vent (uCi/sec)

Assume 33% of the limit is from MP1 stack.

Therefore Q_1 should be less than 260,000 uCi/sec.

The MP1 stack noble gas monitor calibration curve (given as uCi/sec per cps) is determined by assuming a maximum ventilation flow of 170,000.

Therefore, the alarm setpoint should be set at or below the "cps" corresponding to 260,000 uCi/sec from the calibration curve.

The alarm setpoint may be increased if the MP2 or MP3 vent setpoints are at levels corresponding to less than 33% of the site limit.

F.4 Unit 1 Main Stack Sampler Flow Rate Monitor

The MP1 main stack sampler flow control alarms on low pressure indicating loss of flow, or on high pressure indicating restricted flow.

The alarm will occur with either:

a) Pressure Switch #1 less than 2" Hg
or
b) Pressure Switch #1 greater than 18" Hg and Pressure Switch #2 less than 20" Hg

F.5 Unit 2 Vent - Noble Gas Monitor

Per Section D.1.a of this manual, the instantaneous release rate limit from the site shall be:

$$\frac{Q_1}{790,000} + \frac{Q_2}{217,000} + \frac{Q_3}{217,000} \leq 1$$

Assuming 33% of the limit is from the MP2 vent, the release rate limit for Unit 2 is 71,000 uCi/sec.

The MP2 vent noble gas monitor calibration curve (given as uCi/sec per cpm) is determined by assuming the maximum possible ventilation flow for various fan combinations. Curves for 3 different fan combinations are normally given.

The "cpm" corresponding to 71,000 uCi/sec should be determined from the appropriate curve. The alarm setpoint should be set at less than or equal to this value.

The alarm setpoint may be increased if the MP1 stack or MP3 vent setpoints are at levels corresponding to less than 33% of the site limit.

F.6 Unit 2 Waste Gas Decay Tank Monitor

Per Section D.1.a of this manual, the instantaneous release rate limit from the site shall be:

$$\frac{Q_1}{790,000} + \frac{Q_2}{217,000} + \frac{Q_3}{217,000} \leq 1$$

Administratively all waste gas decay tank releases are via the MP1 stack. Assuming 33% of the limit is from the MP1 stack, the release rate limit for MP1 is 260,000 uCi/sec.

Releases from waste gas decay tanks are much lower than this limit and are based upon ventilation dilution, conservative meteorology ($X/Q = 10^{-3}$) and release flow rates to maintain off site concentration below MPC values.

The MP2 waste gas decay tank monitor (given as uCi/cc per cpm) calibration curve is used to assure that the concentration of gaseous activity being released from a waste gas decay tank is not greater than the concentration used in discharge permit calculations.

F.7 Unit 3 Vent Noble Gas Monitor

Per Section D.1.a of this manual, the instantaneous release rate limit from the site shall be:

$$\frac{Q_1}{790{,}000} + \frac{Q_2}{217{,}000} + \frac{Q_3}{217{,}000} \leq 1$$

Assuming 33% of the limit is from the MP3 vent, the release rate limit for Unit 3 is 71,000 uCi/sec. Based on the maximum ventilation flow rate of 280,680 CFM (1.325 x 10^8 cc/sec, see Table 3.5-16 of MP3 FSAR) this converts to:

Alarm setpoint= 71,000 uCi/sec/1.325 x 10^8 cc/sec
= 5.3 x 10^{-4} uCi/sec

F.8 Unit 3 Engineering Safeguards Building Monitor

Per Section D.1.a of this manual, the instantaneous release rate limit from the site shall be:

$$\frac{Q_1}{790,000} + \frac{Q_2}{217,000} + \frac{Q_3}{217,000} \leq 1$$

Assuming releases less than 10% of the MP3 FSAR design releases of noble gases (Table 11.3-11, 1.4×10^4 Ci/year which is equal to 450 uCi/sec) assures that less than 1% of the above instantaneous release rate is added by this intermittent pathway (450/217,000 = 0.21%). Assuming a flow rate of 6,500 CFM (3.05×10^{-6} cc/sec) for this pathway translates this limit to:

$$0.1 \times 450/3.05 \times 10^6 = 1.5 \times 10^{-5} \text{ uCi/cc}$$

The Alarm setpoint should be set at or below this value.

G. EFFLUENT FLOW DIAGRAMS

Figures G-1, G-2, G-3, G-4, G-5 and G-6 present simplified flow diagrams for the liquid and gaseous radwaste systems for Units 1, 2 and 3. They also indicate the location of the radiation monitors listed in the Technical Specifications.

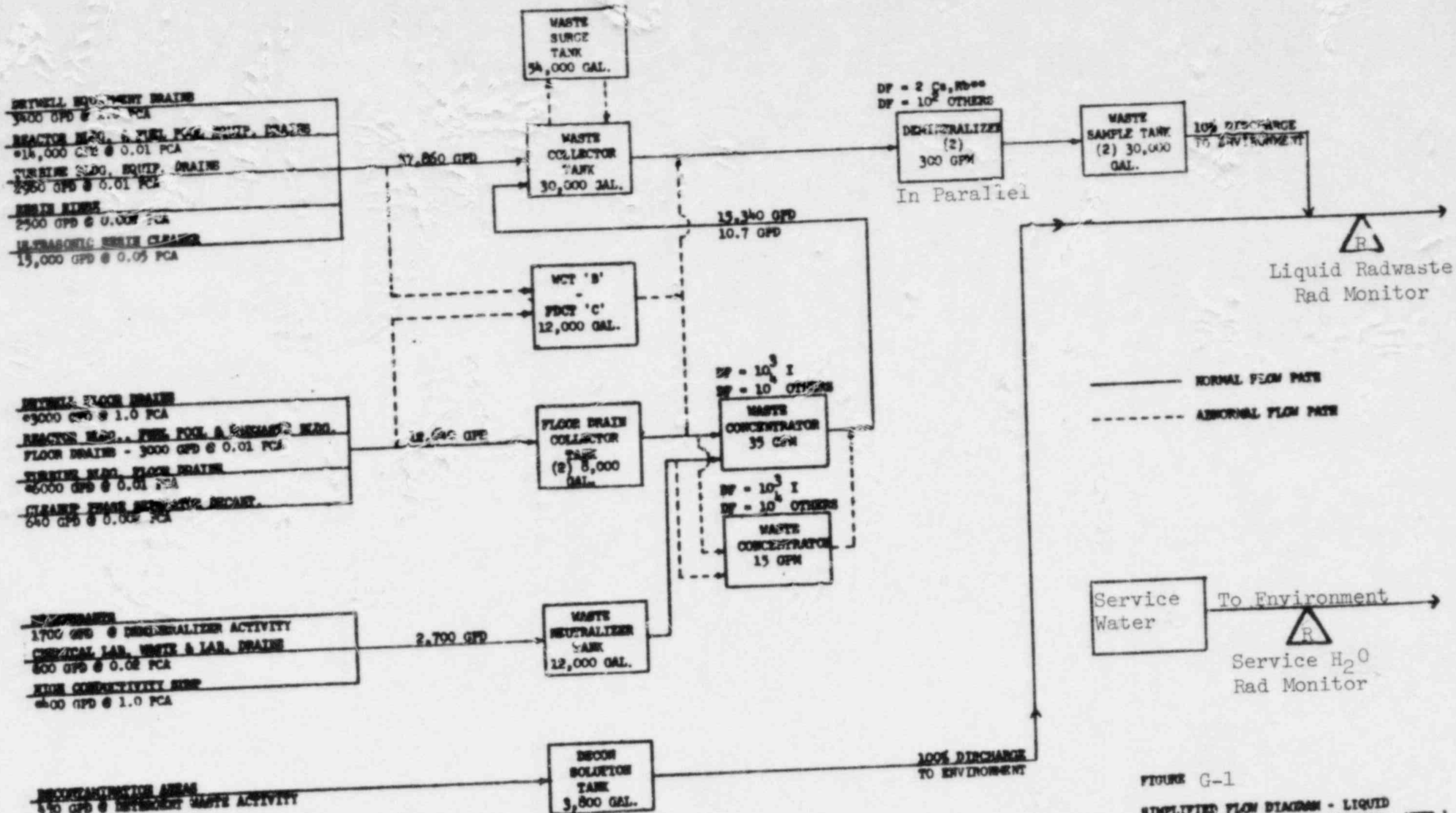


FIGURE G-1

SIMPLIFIED FLOW DIAGRAM - LIQUID
MILLSTONE NUCLEAR POWER STATION - UNIT 1
NORTHEAST UTILITIES SERVICE COMPANY

* - Flow rate based on operating experience.

** - DF's for an evaporator polishing demineralizer are 10 for all isotopes (Pg. C-94, Reg. Guide 1.CC)

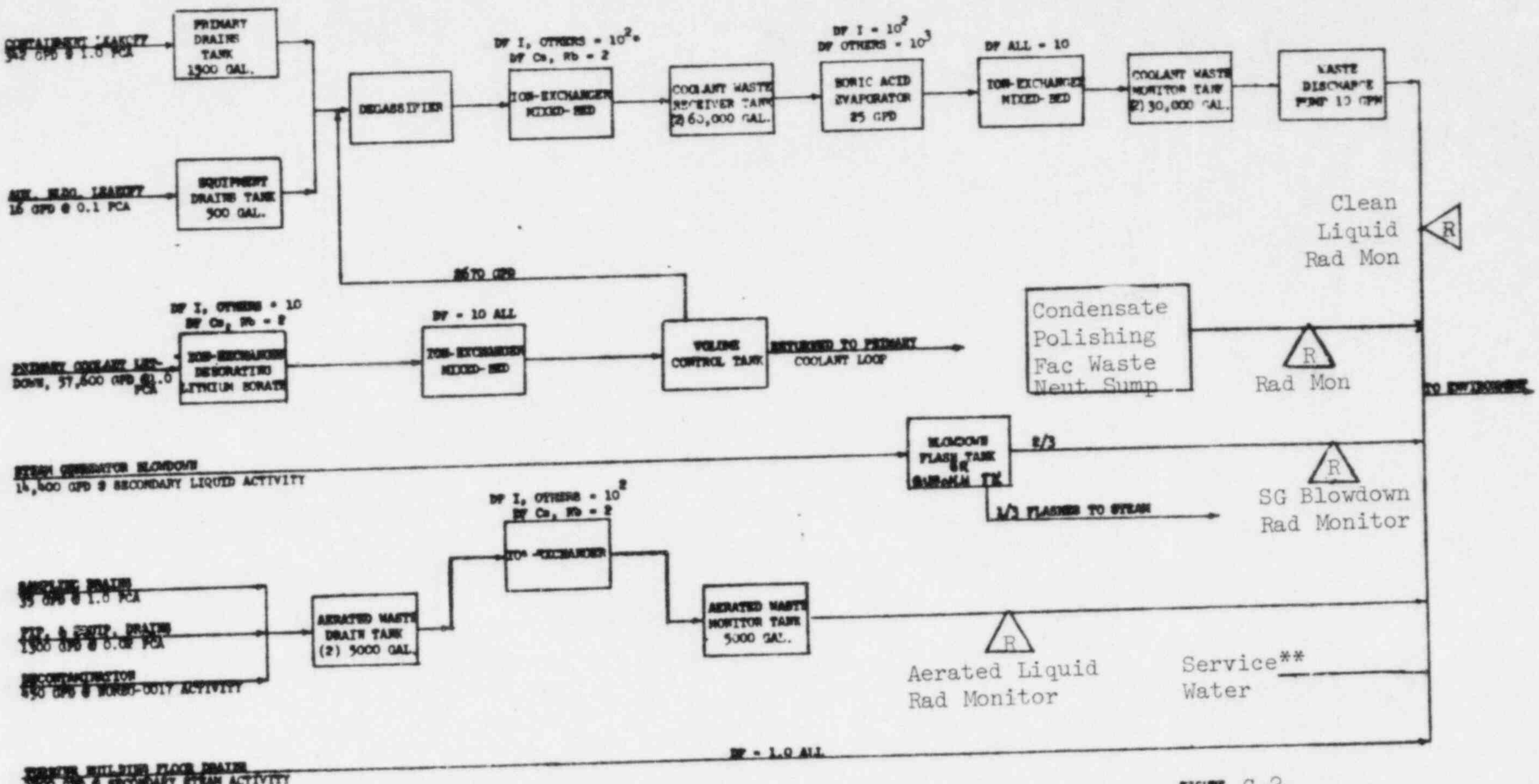
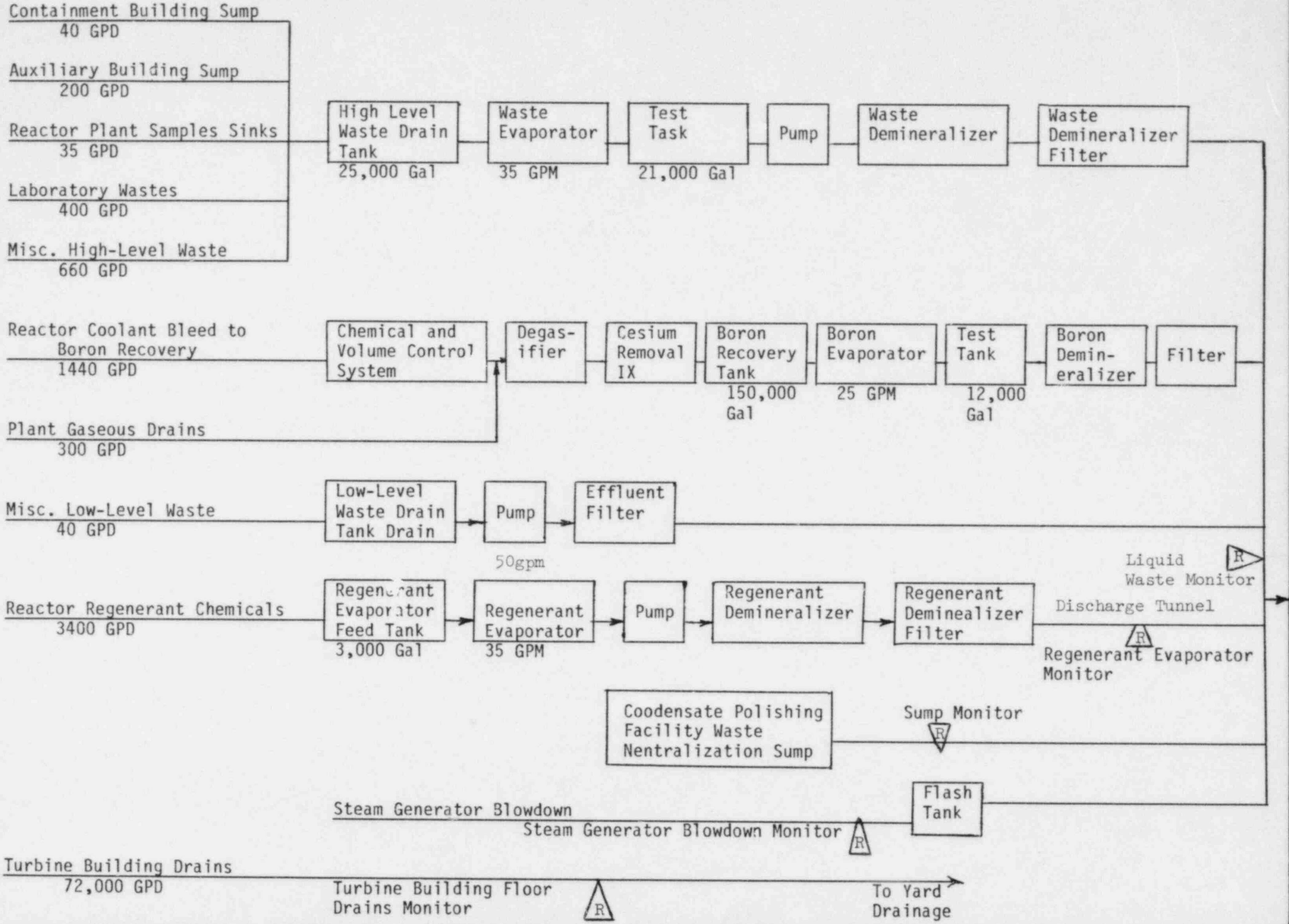


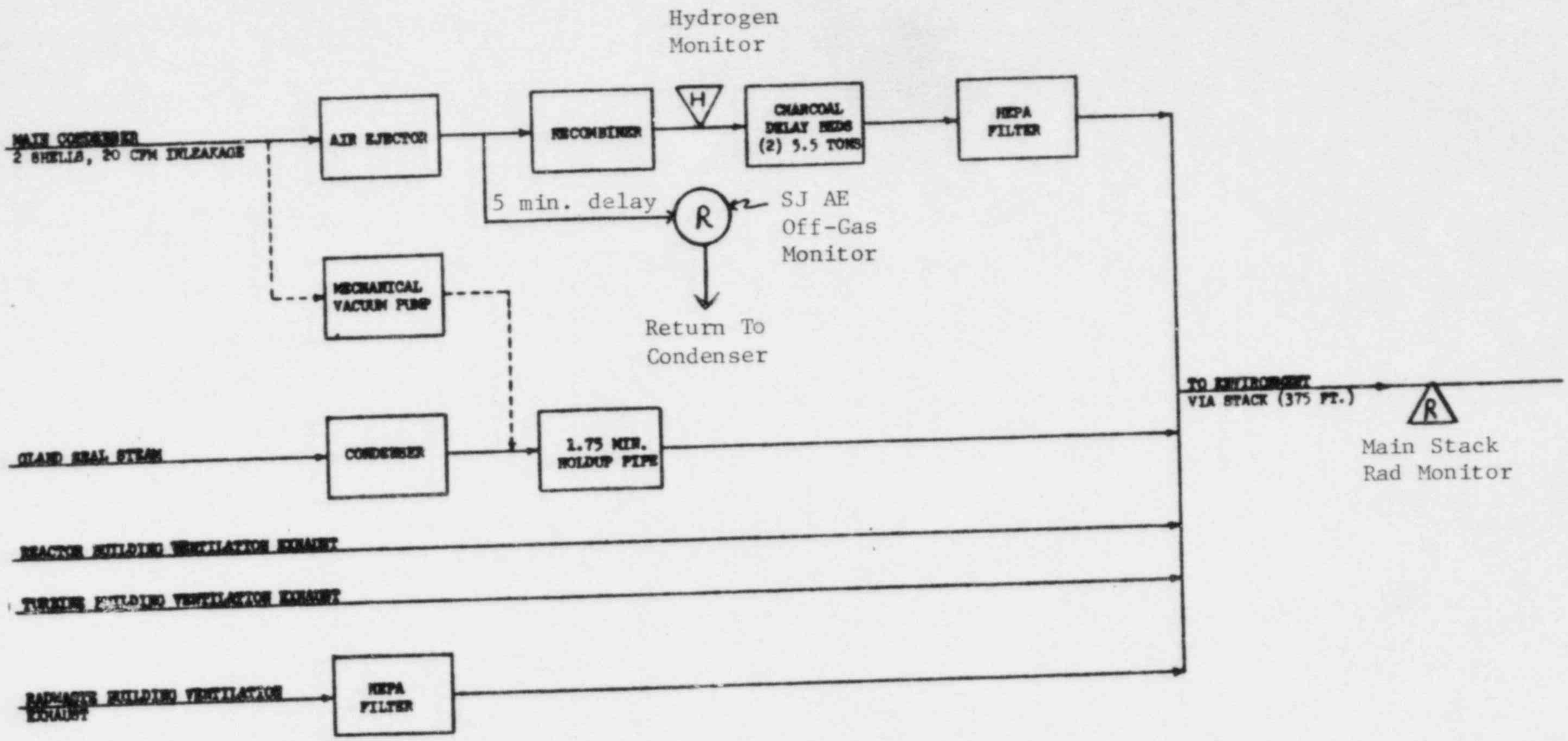
FIGURE G-2
SIMPLIFIED FLOW DIAGRAM - LIQUID
MILLSTONE NUCLEAR POWER STATION - UNIT 2
NORTHEAST UTILITIES SERVICE COMPANY

* DF FOR REACTOR COOLANT LETDOWN: DF = 10 ALL

** Monitored by the Reactor Building Closed Cooling Water Monitor

Figure G-3 Simplified Flow Diagram - Liquid - Millstone Unit #3





The offgas system is based on the proposed augment which replaces a 100 minute holdup pipe with a recombiner & charcoal delay beds.

The mechanical vacuum pump is not a normal flow path (intermittent operation).

FIGURE G 4
SIMPLIFIED FLOW DIAGRAM - GASEOUS
MILLSTONE NUCLEAR POWER STATION - UNIT 1
NORTHEAST UTILITIES SERVICE COMPANY

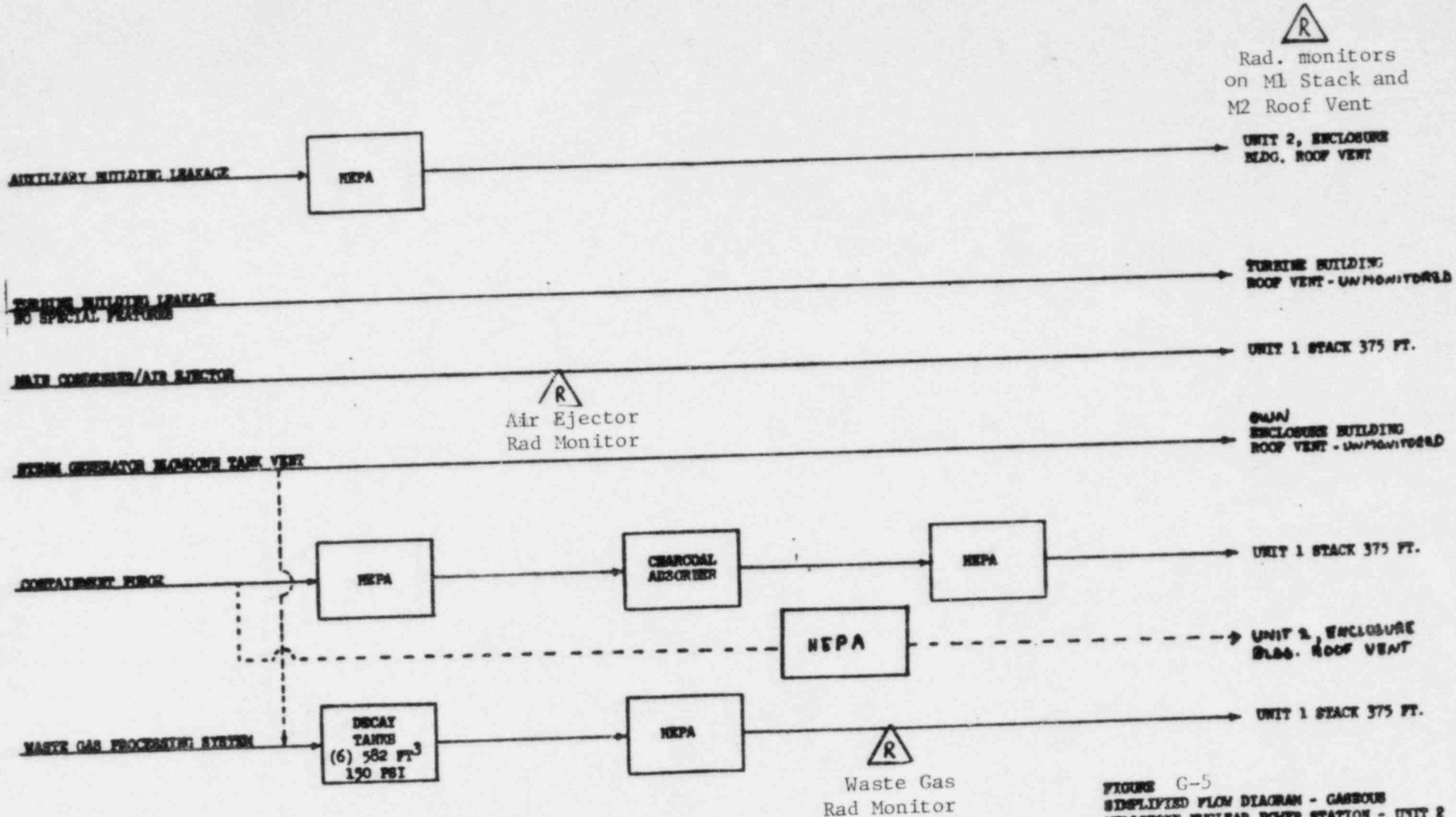
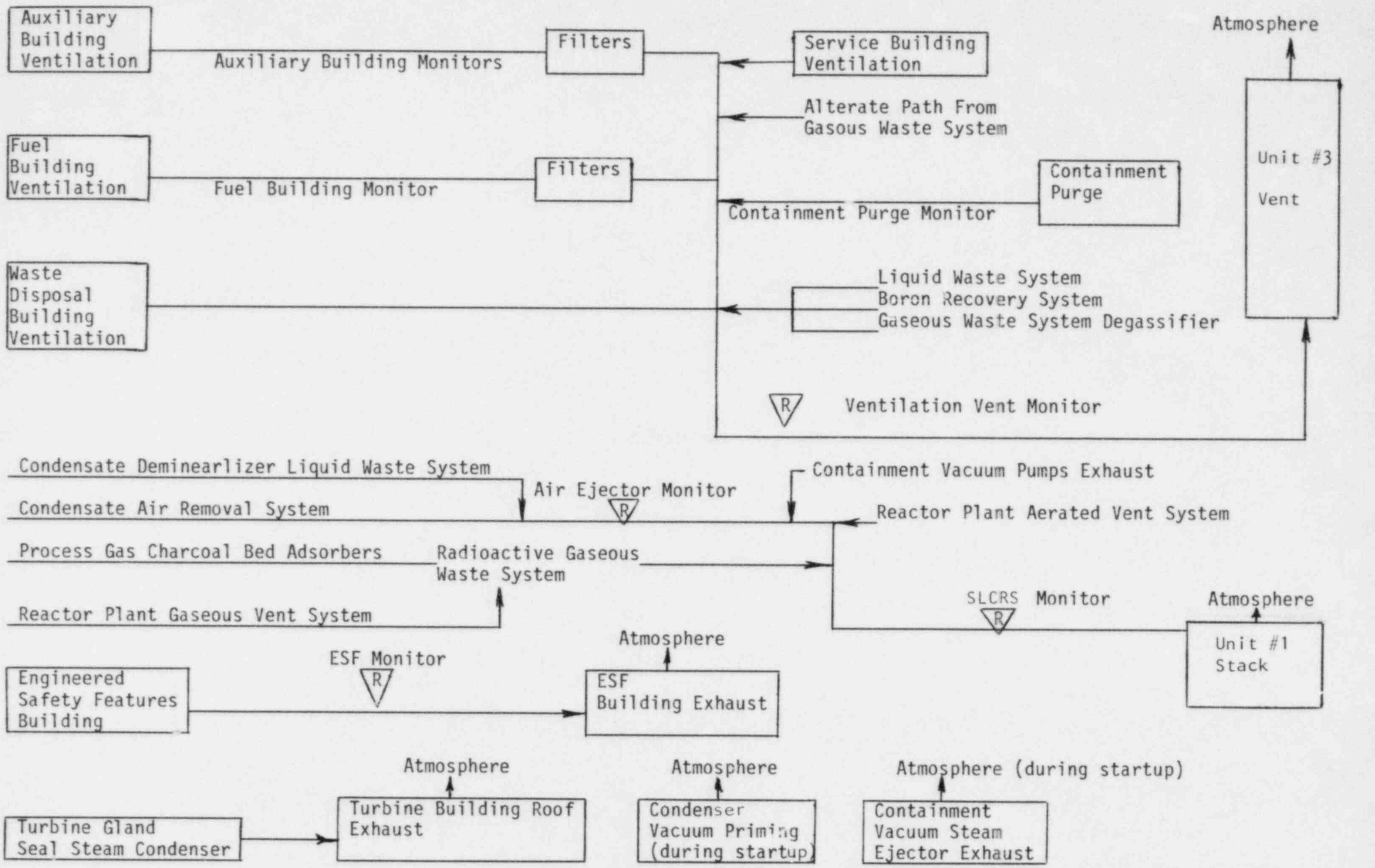


FIGURE G-5
SIMPLIFIED FLOW DIAGRAM - GASEOUS
MILLSTONE NUCLEAR POWER STATION - UNIT 2
NORTHEAST UTILITIES SERVICE COMPANY

Figure G-6 - Simplified Flow Diagram - Gaseous - Millstone Unit #3



APPENDIX A

DERIVATION OF FACTORS FOR SECTION C.1 - LIQUID DOSES*

1. Section C.1.a - Step 3

Unit 1 - Liquid - Whole Body Doses

Year	Qtr.	C_F	$D_{QT(F)}$	$D_{QT(F)}/C_F$ (mrem/Ci)	C_H	$D_{QT(H)}$	$D_{QT(H)}/C_H$ (mrem/Ci)
1976	1	8.60	7.6(-2)	8.8(-3)	5.12	ND	-
	2	0.053	1.3(-4)	2.5(-3)	9.19	2.1(-6)	2.3(-7)
	3	0.48	6.8(-3)	1.4(-2)	1.33	ND	-
	4	0.15	1.3(-3)	8.7(-3)	4.42	1.9(-6)	4.3(-7)
1977	1	0.12	1.1(-3)	9.2(-3)	3.11	7.3(-7)	2.3(-7)
	2	0.36	4.6(-3)	1.3(-2)	0.64	1.3(-7)	2.0(-7)
	3	0.012	1.1(-4)	9.2(-3)	0.002	8.0(-10)	3.5(-7)
	4	0.028	1.5(-4)	5.4(-3)	0.66	2.3(-7)	3.5(-7)
1978	1	0.119	1.3(-3)	1.1(-2)	0.98	3.9(-7)	3.9(-7)
	2	0.049	5.2(-4)	1.1(-2)	1.29	2.9(-7)	2.2(-7)
	3	0.002	2.1(-5)	1.1(-2)	0.93		
	4	0.005	5.8(-5)	1.2(-2)	0.0002		
1979	1	0.045	4.4(-4)	1.0(-2)	1.78		
	2	0.146	1.5(-3)	1.0(-2)	2.83		
	3	0.009	9.7(-5)	1.1(-2)	0.94		
	4	0.010	4.6(-5)	4.6(-3)	2.37		
1980	1	0.013	6.2(-5)	4.8(-3)	2.40	3.04(-7)	1.27(-7)
	2	0.014	1.6(-4)	1.1(-2)	4.96	1.54(-6)	3.10(-7)
	3	0.011	1.2(-4)	1.1(-2)	6.45	1.67(-6)	2.59(-7)
	4	0.686	1.2(-2)	1.8(-2)	13.50		
1981	1	0.314	5.8(-3)	1.9(-[illegible])	1.42		
	2	0.042	7.6(-4)	1.1(-2)	0.88		
	3	0.029	3.5(-4)	1.2(-2)	0.31		
	4	0.009	1.2(-4)	1.3(-2)	0.006		
1982	1	0.008	1.2(-4)	1.5(-2)	0.12		
	2	0.030	1.8(-4)	6.0(-3)	0.12		
	3	0.577	7.4(-3)	1.3(-2)	3.88		
	4	0.538	6.1(-3)	1.1(-2)	2.08		
1983	1	0.777	3.9(-3)	5.0(-3)	1.61		
	2	0.007	7.3(-5)	1.0(-2)	1.87	3.96(-7)	2.12(-7)
	3	0.007	1.0(-4)	1.4(-2)	3.64	1.16(-6)	3.19(-7)
	4	0.016	2.0(-4)	1.3(-2)	1.26		

APPENDIX A

DERIVATION OF FACTORS FOR SECTION C.1 - LIQUID DOSES*

1. Section C.1.a - Step 3

Unit 2 - Liquid - Whole Body Doses

Year	Qtr.	C_F	$D_{QT(F)}$	$D_{QT(F)}/C_F$ (mrem/Ci)	C_H	$D_{QT(H)}$	$D_{QT(H)}/C_H$ (mrem/Ci)
1976	1	0.102	1.8(-4)	1.8(-3)	34.7	1.2(-5)	3.4(-7)
	2	0.179	2.4(-4)	1.3(-3)	87.3	2.7(-5)	3.1(-7)
	3	0.037	0.9(-4)	2.4(-3)	70.0	2.0(-5)	2.8(-7)
	4	0.025	1.0(-4)	4.0(-3)	85.4	3.7(-5)	4.3(-7)
1977	1	0.217	7.0(-4)	3.2(-3)	60.1	2.1(-5)	3.4(-7)
	2	0.802	6.1(-3)	7.6(-3)	73.3	3.0(-5)	4.1(-7)
	3	0.037	1.6(-4)	1.6(-4)	42.1	1.5(-5)	3.5(-7)
	4	0.509	1.9(-3)	3.7(-3)	35.(	1.1(-5)	3.3(-7)
1978	1	0.432	5.2(-3)	1.2(-2)	1.8	8.9(-7)	4.9(-7)
	2	1.27	6.6(-3)	5.2(-3)	43.6	1.2(-5)	2.7(-7)
	3	0.715	4.8(-3)	6.7(-3)	91.3		
	4	0.372	1.8(-3)	4.8(-3)	72.0		
1979	1	1.65	9.6(-3)	5.8(-3)	64.6		
	2	2.48	2.8(-2)	1.1(-2)	27.8		
	3	0.331	2.8(-3)	8.5(-3)	68.4		
	4	0.411	3.0(-3)	7.3(-3)	93.0		
1980	1	0.635	4.0(-3)	6.3(-3)	97.7		
	2	0.285	1.7(-3)	6.0(-3)	57.0	1.09(-5)	1.91(-7)
	3	1.17	7.9(-3)	6.8(-3)	48.8		
	4	0.723	1.2(-2)	1.7(-2)	64.8	2.28(-5)	3.52(-7)
1981	1	0.435	6.8(-3)	1.6(-2)	55.3		
	2	0.343	5.8(-3)	1.7(-2)	149.0	541.(-5)	3.63(-7)
	3	0.265	1.6(-3)	6.0(-3)	87.2	1.77(-5)	2.03(-7)
	4	3.14	1.0(-2)	3.2(-3)	79.9		
1982	1	1.65	1.0(-2)	6.1(-3)	7.4		
	2	9.94	8.4(-3)	8.5(-4)	88.3	491.(-5)	5.56(-7)
	3	1.14	8.1(-3)	7.1(-3)	113.0		
	4	1.14	1.3(-2)	1.1(-2)	82.6		

APPENDIX A

DERIVATION OF FACTORS FOR SECTION C.1 - LIQUID DOSES*

1. Section C.1.a - Step 3

Unit 2 - Liquid - Whole Body Doses

Year	Qtr.	C_F	$D_{QT(F)}$	$D_{QT(F)}/C_F$ (mrem/Ci)	C_H	$D_{QT(H)}$	$D_{QT(H)}/C_H$ (mrem/Ci)
1983	1	1.48	1.1(-2)	7.4(-3)	70.7		
	2	0.685	7.2(-3)	1.1(-2)	36.7		
	3	2.42	3.6(-2)	1.5(-2)	6.5		
	4	3.22	4.5(-2)	1.4(-2)	6.8		

Unit 3 - Liquid Whole Body Doses

Projected Releases*	Ci/yr	Dose (mrem)	Dose/Ci
Total Fission and Activation (ex.H-3)	0.18	8.8(-4)	4.9(-3)
H-3	730	1.6(-4)	2.2(-7)

Since the maximum values $D_{QT(F)}/C_F$ and $D_{QT(H)}/C_H$ are not much different for Units 1 and 2, the same factor can be used for all three units (for simplicity). Also, the maximum values are less than four times the average values, this indicates that the dose per total curie does not fluctuate greatly; hence this method is not overconservative.

*from Unit 3 ER Table 5.2-4.

where,

C_F = Curies of fission and activation products released during calendar quarter.

$D_{QT(F)}$ = Calculated total body dose to the maximum individual (mrem) due to fission and activation products. Dose calculated using computer code LADTAP.

C_H = Curies of tritium released during calendar quarter.

$D_{QT(H)}$ = Calculated total body does to the maximum individual (mrem) due to tritium releases. Dose calculated using computer code LADTAP.

Maximum Value of $D_{QT(F)}/C_F$ - Unit 1 = 1.9×10^{-2} mrem/Ci
Unit 2 = 1.7×10^{-2} mrem/Ci
Unit 3 = unknown

Average Value of $D_{QT(F)}/C_F$ - Unit 1 = 1.1×10^{-2} mrem/Ci
Unit 2 = 7.4×10^{-3} mrem/Ci
Unit 3 = 4.9×10^{-3} mrem/Ci

Maximum Value of $D_{QT(H)}/C_H$ - Unit 1 = 4.3×10^{-7} mrem/Ci
Unit 2 = 5.6×10^{-7} mrem/Ci
Unit 3 = unknwon

Average Value of $D_{QT(H)}/C_H$ - Unit 1 = 2.8×10^{-7} mrem/Ci
Unit 2 = 3.5×10^{-7} mrem/Ci
Unit 3 = 2.2×10^{-7} mrem/Ci

$$D_{QT(F)}/C_F = 1.9 \times 10^{-2} \text{ mrem/Ci}$$

$$D_{QT(H)}/C_H = 5.6 \times 10^{-7} \text{ mrem/Ci}$$

*Note: Although operation of Unit 3 increases the dilution flow, the near field dilution factor is reduced from 5 to 3. Therefore, the net effect is to reduce the doses only by a factor of 0.86. For conservatism, this factor will be neglected.

APPENDIX B

DERIVATION OF FACTORS FOR SECTION C2 - LIQUID DOSES

1. Section C.2.a - Step 2

Unit 1 - Liquid Doses

Year	Qtr.	C_F	Max. Organ	D_{QO}	D_{QO}/C_F
1976	1	8.60	GI (LLI)	0.054	0.0062
	2	0.053	GI (LLI)	0.0003	0.0056
	3	0.48	GI (LLI)	0.059	0.123
	4	0.15	GI (LLI)	0.0057	0.038
1977	1	0.12	GI (LLI)	0.0021	0.018
	2	0.36	GI (LLI)	0.0041	0.011
	3	0.012	Liver	0.00017	0.014
	4	0.028	GI (LLI)	0.00086	0.031
1978	1	0.119	GI (LLI)	0.024	0.202
	2	0.049	GI (LLi)	0.0031	0.063
	3	0.002	GI (LLI)	4.0(-5)	0.02
	4	0.005	GI (LLI)	1.3(-4)	0.026
1979	1	0.045	GI(LLI)	1.8(-3)	0.04
	2	0.146	GI(LLI)	9.3(-3)	0.064
	3	0.009	GI(LLI)	9.0(-4)	0.10
	4	0.01	GI(LLI)	2.1(-4)	0.021
1980	1	0.013	GI(LLI)	1.7(-4)	0.013
	2	0.014	GI(LLI)	5.5(-4)	0.039
	3	0.011	GI(LLI)	3.0(-4)	0.027
	4	0.686	Liver	1.7(-2)	0.025
1981	1	0.314	GI(LLI)	9.75(-3)	0.031
	2	0.042	GI(LLI)	1.88(-3)	0.045
	3	0.029	GI(LLI)	7.94(-4)	0.027
	4	0.009	GI(LLI)	2.58(-4)	0.029
1982	1	0.008	GI(LLI)	2.58(-4)	0.032
	2	0.030	GI(LLI)	3.09(-4)	0.010
	3	0.577	Liver	1.24(-2)	0.021
			Thyroid	1.42(-2)	0.025
	4	0.538	GI(LLI)	1.17(-2)	0.022
1983	1	0.777	GI(LLI)	1.26(-2)	0.016
	2	0.007	GI(LLI)	1.73(-4)	0.025
	3	0.007	GI(LLI)	2.15(-4)	0.031
	4	0.016	GI(LLI)	4.12(-4)	0.026

APPENDIX B

DERIVATION OF FACTORS FOR SECTION C2 - LIQUID DOSES

1. Section C.2.a - Step 2

Unit 2 - Liquid Doses

Year	Qtr.	C_F	Max. Organ	D_{QO}	D_{QO}/C_F
1976	1	0.102	GL (LLI)	0.0017	0.016
	2	0.179	GI (LLI)	0.0051	0.028
	3	0.037	GI (LLI)	0.0024	0.065
	4	0.025	GI (LLI)	0.00075	0.030
1977	1	0.217	GI (LLI)	0.012	0.055
	2	0.802	GI (LLI)	0.036	0.045
	3	0.035	GI (LLI)	0.0014	0.040
	4	0.509	GI (LLI)	0.012	0.024
1978	1	0.432	GI (LLI)	0.039	0.090
	2	1.27	GI (LLI)	0.13	0.120
	3	0.715	GI (LLI)	4.2(-2)	0.059
	4	0.372	GI (LLI)	9.0(-3)	0.024
1979	1	1.65	GI (LLI)	4.1(-2)	0.025
	2	2.48	GI (LLI)	2.3(-1)	0.097
	3	0.331	GI (LLI)	1.8(-2)	0.054
	4	0.411	GI (LLI)	1.6(-2)	0.039
1980	1	0.635	GI (LLI)	1.1(-2)	0.017
	2	0.285	GI (LLI)	3.9(-3)	0.014
	3	1.17	GI (LLI)	1.0(-1)	0.085
	4	0.723	GI (LLI)	7.4(-2)	0.102
1981	1	0.435	GI (LLI)	2.91(-2)	0.067
	2	0.343	GI (LLI)	2.91(-2)	0.085
	3	0.265	GI (LLI)	7.47(-3)	0.028
	4	3.14	Liver	1.67(-2)	0.005
1982	1	1.65	GI (LLI)	9.6(-2)	0.058
	2	9.94	GI (LLI)	5.76(-2)	0.006
			Thyroid	3.59(-1)	0.036
	3	1.14	GI (LLI)	2.43(-2)	0.210
			Thyroid	2.84(-2	0.025
	4	1.14	Liver	1.09(-2)	0.010
1983	1	1.48	Liver	1.66(-2)	0.011
	2	0.685	Liver	1.14(-2)	0.017
	3	2.42	GI (LLI)	6.36(-2)	0.026
	4	3.22	GI (LLI)	7.74(-2)	0.024

Unit 3 - Liquid Doses

Projected Releases from ER Ci/yr	Maximum Organ	Dose (mrem/yr)	Dose/Ci
0.18	Thyroid	6.3(-3)	0.035

where,

C_F = Curies of fission and activation products released during calendar quarter.

GI (LLI) = Gastro - Intestinal Tract - Lower Large Intestine.

D_{QO} = Calculated critical organ dose to the maximum individual (mrem) for the calendar quarter. Dose was calculated using the computer code LADTAP.

Note = Tritium has never contributed more than 1% to the maximum organ dose and thus is it not included in the calculation.

Maximum Value of D_{QO}/C_F - Unit 1 - 0.202 mrem/Ci
Unit 2 - 0.120 mrem/Ci
Unit 3 - unknown

Average Value of D_{QO}/C_F - Unit 1 - 0.038 mrem/Ci
Unit 2 - 0.044 mrem/Ci
Unit 3 - 0.035 mrem/Ci

Since the maximum value of D_{QO}/C_F is within a factor of two for Unit 1 and 2, the same factor can be used for all units for simplicity. Also, since the maximum value is within a fator of 6 of the average value, this indicates that the dose per total curie does not fluctual greatly, hence this method is not over-conservative.

Thus, D_{QO}/C_F = 0.2 mrem/Ci

APPENDIX C

LADTAP - LIQUID DOSE CALCULATIONS

The LADTAP code was written by the NRC to compute doses from liquid releases using the models given in Regulatory Guide 1.109. There is no revision date on the copy of the code which was obtained, but it was purchased in March 1976. The only change made to the code since that time was a change in the ingestion dose factors from those given in Rev. 0 of Reg. Guide 1.109 to those in Rev. 1.

For calculating the maximum individual dose at Millstone, the following options and parameters are used:

1. Real time, measured dilution flow
2. Salt water site
3. Reconcentration - cycle time - 12 hrs. (MP1 and 2 FES)
   Recycle fraction = 0.025 (MP1 and 2 FES)
4. Shorewidth factor = 0.5 (Table A-9, Regulatory Guide 1.109)
5. Dilution for Max. Individual Pathways = 3 (page 5.2-5 of MP3 Environmental Report)
6. 30 min. Discharge Transit Time - time to transit quarry; estimated from chloride study.
7. Reg. Guide 1.109 usage factors for Max. Individual for fish, shellfish, shoreline, swimming and boating pathways.
8. Zero usage for algae, drinking water, and irrigated food pathways.

APPENDIX D

DERIVATION OF FACTORS FOR SECTION D GASEOUS DOSES

1. X/Q's, D/Q's

Unit 1 Stack
Elevated X/Q's, D/Q's

Quarterly Averages - Maximum Values

1976	1	2.7(-8)	1.3(-9)
	2	2.8(-8)	2.1(-9)
	3	4.7(-8)	5.5(-9)
	4	2.6(-8)	7.9(-9)
1977	1	2.3(-8)	1.4(-9)
	2	4.1(-8)	4.2(-10)
	3	4.8(-8)	2.2(-9)
	4	5.4(-8)	4.8(-9)
1978	1	4.7(-8)	6.6(-9)
	2	5.3(-8)	1.2(-9)
	3	4.0(-8)	2.2(-9)
	4	7.1(-8)	4.3(-9)
1979	1	4.2(-8)	5.1(-9)
	2	5.2(-8)	1.5(-9)
	3	3.2(-8)	2.4(-9)
	4	5.7(-8)	4.9(-9)
1980	1	5.3(-8)	2.8(-9)
	2	4.0(-8)	1.7(-9)
	3	4.6(-8)	1.8(-9)
	4	6.3(-8)	4.0(-9)
1981	1	4.5(-8)	4.8(-9)
	2	1.6(-8)	9.1(-10)
	3	6.3(-8)	1.6(-9)
	4	4.9(-8)	6.2(-9)
1982	1	5.9(-8)	2.4(-9)
	2	2.6(-8)	2.4(-9)
	3	4.8(-8)	2.2(-9)
	4	5.1(-8)	1.2(-9)

Year	Quarter	Maximum X/Q	Maximum D/Q
1983	1	3.7(-8)	3.3(-10)
	2	6.0(-8)	3.9(-10)
	3	4.4(-8)	5.5(-10)
	4	6.0(-8)	1.8(-9)

Maximum Quarterly Average X/Q = 7.1×10^{-8} sec/M^3
Maximum Quarterly Average D/Q = 7.9×10^{-9} M^{-2}

Unit 2 and Unit 3 - Vents*

Quarterly Average X/Q's - D/Q's
Maximum Values

Year	Qtr	Maximum X/Q		Maximum D/Q	
		Continuous	Batch	Continuous	Batch
1976	1	5.0(-6)	ND	4.3(-8)	ND
	2	1.3(-5)	ND	6.7(-8)	ND
	3	4.4(-6)	8.1(-6)	4.5(-8)	8.0(-8)
	4	2.2(-6)	5.9(-6)	2.5(-8)	6.5(-8)
1977	1	2.8(-6)	4.1(-6)	3.2(-8)	5.4(-8)
	2	1.9(-6)	1.4(-6)	1.3(-8)	1.3(-8)
	3	8.2(-6)	7.5(-6)	1.5(-7)	1.5(-7)
	4	3.5(-6)	2.6(-6)	6.9(-8)	5.2(-8)
1978	1	2.5(-6)	ND	4.3(-8)	ND
	2	5.3(-6)	1.6(-6)	8.7(-8)	2.9(-8)
	3	9.1(-6)	8.2(-6)	1.4(-7)	1.1(-7)
	4	3.3(-6)	4.2(-6)	8.7(-8)	8.0(-8)
1979	1	2.2(-6)	ND	3.8(-8)	ND
	2	5.1(-6)	5.0(-6)	8.0(-8)	6.2(-8)
	3	7.5(-6)	5.1(-6)	1.3(-7)	9.4(-8)
	4	3.8(-6)	4.6(-6)	9.3(-8)	1.0(-7)
1980	1	2.3(-6)	9.5(-7)	5.1(-8)	6.5(-8)
	2	6.9(-6)	6.8(-6)	1.1(-7)	1.3(-7)
	3	7.3(-6)	ND	1.2(-7)	ND
	4	3.2(-6)	ND	7.6(-8)	ND
1981	1	3.9(-6)	1.3(-7)	6.5(-8)	1.1(-8)
	2	7.9(-6)	8.8(-9)	1.0(-7)	7.0(-10)
	3	4.9(-6)	7.3(-8)	9.6(-8)	4.9(-9)
	4	1.7(-6)	3.5(-8)	4.1(-8)	5.1(-9)
1982	1	2.9(-6)	5.4(-8)	4.5(-8)	2.1(-9)
	2	6.5(-6)	ND	9.2(-8)	ND
	3	6.7(-6)	4.5(-8)	1.2(-7)	2.1(-9)
	4	4.2(-6)	2.9(-8)	1.0(-7)	1.4(-9)
1983	1	1.3(-6)	9.1(-8)	2.6(-8)	6.7(-10)
	2	5.4(-6)	1.7(-7)	1.1(-7)	2.0(-9)
	3	8.1(-6)	2.4(-7)	1.5(-7)	4.4(-9)
	4	2.3(-6)	1.2(-7)	6.2(-8)	6.4(-9)

Maximum Quarterly Average = 1.3×10^{-5} Sec/M^3

Maximum Quarterly Average D/Q = 1.5×10^{-7} M^{-2}

From the above data we can also see that the batch releases are of a random enough nature such that the batch release meteorology approximates the continuous meteorology as shown by the average of the above values:

Average Max. Qtr. X/Q - Continuous Release - 5.0×10^{-6}

Average Max. Qtr. D/Q - Batch Releases - 2.7×10^{-6}

Average Max. Qtr. D/Q - Continuous Releases - 7.8×10^{-8}

Average Max. Qtr. D/Q - Batch Releases - 4.5×10^{-8}

Therefore, the same X/Q's and D/Q's can be used for both batch and continuous releases.

* Release heights for these two vents are approximately the same. Tables D-2a and D-2b of the NRC Draft Environmental Statement for Millstone 3 show that the average X/Q for Unit 3 to be less than Unit 2 (because of location), however the D/Q's are equal.

2. Section D.1.a - Noble Gas Release Rate Limits

Unit 1 Stack Gaseous Releases - Curies vs. Dose

Year	Quarter	Avg. Noble Gas Release Rate (uCi/Sec)	Max. Individual Dose (Mrem) W. B.	Skin	mrem per uCi/Sec W.B. and Skin
1976	1	17,400	1.9	1.9	1.1 (-4)
	2	25,600	4.2	4.3	1.6 (-4)
	3	20,100	3.4	3.4	1.7 (-4)
	4	2,600	0.3	0.3	1.0 (-4)
	1-4	16,400	9.8	9.9	6.0 (-4)
1977	1	11,600	1.1	1.1	8.6 (-5)
	2	13,000	1.9	1.9	1.5 (-4)
	3	24,000	4.6	4.6	1.9 (-4)
	4	29,700	2.2	2.2	7.4 (-5)
	1-4	19,600	9.8	9.8	5.0 (-4)
1978	1	50,800	4.4	4.4	8.7 (-5)
	2	20,800	3.1	3.1	1.5 (-4)
	3	350	0.04	0.04	1.3 (-4)
	4	530	0.03	0.03	6.4 (-5)
	1-4	18,100	7.6	7.6	4.2 (-4)
1979	1	1,180	0.032	0.032	2.7 (-5)
	2	380	0.024	0.024	6.3 (-5)
	3	640	0.061	0.061	9.5 (-5)
	4	420	0.024	0.024	5.7 (-5)
	1-4	655	0.14	0.14	2.1 (-4)
1980	1	360	0.018	0.020	5.0 (-5)
	2	230	0.019	0.019	8.2 (-5)
	3	880	0.20	0.20	2.3 (-4)
	4	40	6.4(-4)	6.4(-4)	1.6 (-5)
	1-4	380	0.24	0.24	6.3 (-4)
1981	1	1.2	6.0 (-6)	6.0 (-6)	5.0 (-6)
	2	25	0.004	0.004	1.6 (-4)
	3	1580	0.19	0.19	1.2 (-4)
	4	220	0.015	0.016	6.8 (-5)
	1-4	460	0.21	0.21	4.6(-4)
1982	1	160	0.004	0.004	2.5 (-5)
	2	140	0.042	0.042	3.0 (-4)
	3	490	0.051	0.052	1.0 (-4)
	4	240	0.002	0.002	8.3 (-6)
	1-4	260	0.10	0.10	3.8 (-4)

Year	Quarter	Avg. Noble Gas Release Rate (uCi/Sec)	Max. Individual Dose (Mrem) W. B.	Skin	mrem per uCi/Sec W.B. and Skin
1983	1	560	0.002	0.002	3.6 (-6)
	2	120	0.014	0.014	1.2 (-4)
	3	74	0.012	0.012	1.6 (-4)
	4	56	0.003	0.003	5.4 (-5)
	1-4	200	0.031	0.031	1.6 (-4)

Unit 2 Stack-Gaseous Releases - Curies vs. Dose

Year	Quarter	Avg. Noble Gas Release Rate (uCi/Sec)	Max. Individual Dose (mrem) W. B.	Skin	mrem per uCi/Sec. W. B.	Ratio Skin/W.B.
1976	1	0.63	0.00016	0.00047	2.5 (-4)	2.9
	2	83	0.058	0.16	7.0 (-4)	2.8
	3	54	0.015	0.055	2.8 (-4)	3.7
	4	63	0.022	0.035	3.5 (-4)	1.6
	1-4	50	0.095	0.25	1.9 (-3)	2.6
1977	1	134	0.023	0.058	1.7 (-4)	2.5
	2	70	0.007	0.018	1.0 (-4)	2.8
	3	39	0.019	0.056	4.9 (-4)	2.9
	4	69	0.010	0.030	1.4 (-4)	3.0
	1-4	78	0.059	0.162	7.6 (-4)	2.7
1978	1	10	0.0068	0.012	6.8 (-4)	1.8
	2	91	0.019	0.058	2.1 (-4)	3.1
	3	313	0.13	0.37	4.2 (-4)	2.8
	4	21	0.0054	0.011	2.6 (-4)	2.0
	1-4	109	0.16	0.45	1.5 (-3)	2.8
1979	1	7.1*	0.0081	0.019	1.1 (-3)	2.3
	2	2.6	0.0066	0.0021	2.5 (-4)	3.2
	3	38	0.013	0.037	3.4 (-4)	2.8
	4	23	0.0052	0.015	2.3 (-4)	2.9
	1-4	18	0.027	0.073	1.5 (-3)	2.7
1980	1	54	0.0086	0.022	1.7 (-4)	2.6
	2	47	0.020	0.056	4.3 (-4)	2.8
	3	67	0.066	0.13	9.9 (-4)	2.0
	4	1.7	0.0028	0.0043	1.8 (-3)	1.5
	1-4	42	0.098	0.212	2.3 (-3)	2.2
1981	1	16	0.0061	0.014	3.8 (-4)	2.3
	2	124	0.075	0.20	6.0 (-4)	2.7
	3	64	0.030	0.078	4.7 (-4)	2.6
	4	74	0.013	0.033	1.6 (-4)	2.5
	1-4	70	0.124	0.325	1.8(-3)	2.6

Year	Quarter	Avg. Noble Gas Release Rate (Ci/Sec)	Max. Individual Dose (Mrem) W. B.	Skin	mrem per Ci/Sec W. B.	Ratio Skin/W.B.
1982	1	5.3**	0.013	0.022	2.5 (-3)	1.7
	2	322	0.18	0.49	5.6 (-4)	2.7
	3	205	0.13	0.34	6.3 (-4)	2.6
	4	191	0.074	0.18	3.9 (-4)	2.4
	1-4	180	0.397	1.032	2.2 (-3)	2.6
1983	1	464	0.041	0.11	8.8 (-5)	2.7
	2	659	0.22	0.62	3.3 (-4)	2.8
	3	0	0.0045	0.0053	--	1.2
	4	0	0.0020	0.0023	--	1.2
	1-4	280	0.268	0.737	9.6 (-4)	2.8

* Only continuous ventilation (purge data leads to an unconservative value).

** Beginning in 1982, purges are released through Unit 1 stack.

Unit 3 Vent - Gaseous Releases - Curies vs. Dose

Release Projection	Noble Gas Release Rate (uCi/Sec)	Max. Individual Dose (mrem) W.B.	Skin	mrem per uCi/Sec W. B.	Ratio Skin/W. B.
Unit 3 FSAR and ER	14.2	0.16	0.29	1.1 (-2)	1.8

Design releases from Unit 3 FSAR Table 11.3-11 and Unit 3 ER Table 3.5-14: 14,141 Ci/yr = 448 uCi/sec.

Expected releases from Table 11.3-1: 448 Ci/yr which equals 14.2 uCi/sec.

Maximum value of mrem/year per uCi/sec is for 1980 for Units 1 and 2. Since the average X/Q's are less for Unit 3 than for Unit 2, a conservative estimate for Unit 3 would be to assume its value would be the same as for Unit 2. These values for whole body doses are:

Unit 1: 6.0×10^{-4} mrem/yr. per uCi/sec
Unit 2: 2.3×10^{-3} mrem/yr. per uCi/Sec
Unit 3: 2.3×10^{-3} mrem/yr per uCi/Sec.

The 10CFR20 limit is 500 mrem to the whole body and 3000 mrem to the skin. Since the skin dose has never been as much a six times the whole body dose for Unit 1 or Unit 2 releases, we can use the 500 mrem as the limiting dose. Therefore, the release rate limits would be:

Unit 1: $500/6.3 \times 10^{-4}$ = 790,000 uCi/sec.
Unit 2: $500/2.3 \times 10^{-3}$ = 217,000 uCi/sec.
Unit 3: $500/2.3 \times 10^{-3}$ = 217,000 uCi/sec.

However, 10CFR20 is a site limit, therefore the limit is:

$$\frac{Q1}{790,000} + \frac{Q2}{217,000} + \frac{Q3}{217,000} \leq 1$$

where,

Q_1 = noble gas release rate from MP1 stack (uCi/sec)
Q_2 = noble gas release rate from MP2 vent (uCi/sec)
Q_3 = noble gas release rate from MP3 vent (uCi/sec)

Justification for Above Method

The above method of determining instantaneous release rates will ensure compliance with 10CFR20 for the following reasons:

1. The doses presented for Unit 1 were calculated using the EPA AIREM code, which uses a finite cloud model similar to that in Reg. Guide 1.109. This code has compared very favorable with data actually measured at the critical site boundary with a pressurized ion chamber. Plant related quarterly doses measured by the ion chamber were calculated using a model developed by ERDA's Health and Safety Lab. These doses have always been within 30% of those calculated by AIREM. The average difference has been 14%, with the AIREM code calculating the higher dose. Thus, we are ensured that the AIREM code yields reasonable, if not slightly conservative, estimates of the maximum individual whole body dose.

2. The doses presented for Unit 2 were calculated using the NRC GASPAR code which uses the methodology of Reg. Guide 1.109.

3. The dose per curie release can be seen from the tables not to vary significantly from one quarter to the next.

   Unit 1: Minimum Value - 3.6×10^{-6} mrem/qtr. per uCi/sec
   Average Value - 1.0×10^{-4} mrem/qtr. per uCi/sec
   Maximum Value - 3.0×10^{-4} mrem/qtr per uCi/sec

   Unit 2: Minimum Value - 8.8×10^{-5} mrem/qtr. per uCi/sec
   Average Value - 5.2×10^{-4} mrem/qtr. per uCi/sec
   Maximum Value - 2.5×10^{-3} mrem/qtr. per uCi/sec

It can be seen that the maximum value observed is only a factor of 3 greater than the average value even though there have been significant changes in the isotopic compositions of the releases and/or the meteorological frequencies.

The isotopic changes include significant operational changes such as:

a. Operation with and without the recombiner-charcoal delay system on the Unit 1 off-gas.

b. Period when a unit was down the entire quarter for refueling.

c. Quarters with many MP2 containment purges and quarters with no purges.

d. Quarters with relatively high and relatively low fuel leakage from MP1.

Thus, the dose per curie released is not that sensitive to operational changes such that a gross curie release ratio can be used. We have been conservative in taking the worst annual ratio observed.

4. It should also be recognized that there is a great deal of conservatism between this method and the actual requirements of 10CFR20 for the following reasons:

   a. 10CFR20 states that release rates may be averaged over a year, however we are using this as an instantaneous release rate limit.

   b. 10CFR20 limits are gound level concentration limits, which for elevated releases from the Units 1 stack would be less restrictive than the use of the elevated finite cloud model as used here.

5. It must also be recognized that the type of empircal method given above is the only practical operational method. The use of a method similar to that given in NUREG-0133 would be an operational nightmare, would be next to impossible to implement and could yield allowable release rates many times that given above.

   For example, releases from the Unit 1 stack could include any of the following releases:

   MP1 ventilation from radiological areas
   MP1 off-gass release from the off-gas treatment system
   MP1 off-gas releases via the 30 minute holdup pipe
   MP1 mechanical vacuum pump
   MP1 gland seal condenser
   MP2 waste gas tank discharge
   MP2 containment purges
   MP2 ventilation from radiological areas
   MP2 condenser air ejector
   MP2 mechanical vacuum pump

MP3 ventilation from radiological areas
MP3 condenser air ejector
MP3 reactor plant gaseous vents
MP3 radioactive gaseous waste system
MP3 containment vacuum pump
MP3 reactor plant aerated vents
MP3 steam generator blowdown tank vent

These sources may exist in any possible combination and each has its own particular, but changing, nuclide mixtures. Thus, the ratio of nuclides being released is a constantly changing parameter.

It is impractical to recalculate a stack release rate based on isotope specific dose conversion factors each time a source stream is initiated or terminated or a new isotopic analysis is performed on any of the source streams. This could require 4 or 5 recalculations and monitor set point changes each day. The plant could not operate in this manner.

It would als be unnecessarily restrictive to assume the worst possible mixture and use that as the limit for all situations. The only practical solution is to use a conservatively determined empirical method as given above.

3. Section D.1.b - Iodine, Particulate and Other Limits

a. Iodine

Iodine Release vs. Dose - Unit 1

Year	Quarter	Curies I-131	Thyroid Dose mrem	mrem/Ci
1976	1	0.58	0.6	1.0
	2	0.75	3.8	5.1
	3	0.58	4.9	8.4
	4	0.29	0.6	2.1
	1-4	2.20	9.9	4.5
1977	1	0.39	0.3	0.8
	2	0.59	1.2	2.0
	3	1.57	5.4	3.4
	4	2.1	4.6	2.2
	1-4	4.65	11.5	2.5
1978	1	1.70	8.7	5.1
	2	1.15	3.1	2.7
	3	0.18	0.6	3.3
	4	0.16	0.3	1.9
	1-4	3.19	12.7	4.0
1979	1	0.21	0.01	0.05
	2	0.10	0.60	6.3
	3	0.04	0.44	10.2
	4	0.06	0.004	0.07
	1-4	0.41	1.05	2.6
1980	1	0.021	0.004	0.19
	2	0.048	0.32	6.7
	3	0.111	0.59	5.3
	4	0.034	0.002	0.06
	1-4	0.214	0.916	4.3
1981	1	2.4 (-5)	1.9 (-5)	0.79
	2	0.001	0.004	4.0
	3	0.042	0.50	11.9
	4	0.032	0.002	0.06
	1-4	0.075	0.51	6.8
1982	1	0.032	0.002	0.06
	2	0.027	0.23	8.5
	3	0.038	0.52	13.7
	4	0.002	1.2 (-4)	0.05
	1-4	0.099	0.752	7.6

Iodine Release vs. Dose - Unit 1

Year	Quarter	Curies I-131	Thyroid Dose mrem	mrem/Ci
1983	1	0.006	2.3 (-4)	0.04
	2	0.007	0.054	7.7
	3	0.010	0.10	10.0
	4	0.007	5.7 (-4)	0.08
	1-4	0.030	0.155	5.2

Iodine Release vs. Dose - Unit 2

Year	Quarter	Curies I-131	Dose mrem	mrem/Ci
1976	1	3.3 (-3)	0.015	4.5
	2	4.0 (-3)	0.076	19.0
	3	1.8 (-3)	0.077	43.7
	4	4.2 (-4)	0.023	54.8
	1-4	9.5 (-3)	0.191	20.1
1977	1	2.6 (-4)	0.010	38.5
	2	1.8 (-3)	0.047	26.1
	3	6.9 (-4)	0.037	53.6
	4	2.5 (-3)	0.064	25.6
	1-4	5.2 (-3)	0.158	30.4
1978	1	6.9 (-4)	0.024	34.8
	2	1.0 (-3)	0.051	51.0
	3	5.7 (-3)	0.52	91.2
	4	6.7 (-5)	0.017	253.8
	1-4	7.5 (-3)	0.612	81.6
1979	1	1.2 (-2)	0.004	0.3
	2	7.4 (-4)	0.054	73.0
	3	9.1 (-4)	0.16	175.8
	4	1.2 (-3)	0.006	6.0
	1-4	1.5 (-2)	0.22	14.9
1980	1	6.4 (-4)	0.003	4.7
	2	2.1 (-3)	0.21	80.8
	3	3.2 (-3)	0.30	93.8
	4	3.3 (-4)	0.094	284.8
	1-4	6.3 (-3)	0.61	96.8
1981	1	4.6 (-4)	0.007	15.2
	2	7.8 (-4)	0.13	166.7
	3	3.4 (-4)	0.041	120.6
	4	1.0 (-1)	0.093	0.9
	1-4	1.0 (-1)	0.27	2.7

Iodine Release vs. Dose - Unit 2

Year	Quarter	Curies I-131	Dose mrem	mrem/Ci
1982	1	4.8 (-3)	0.009	1.9
	2	1.1 (-2)	0.677	61.5
	3	3.2 (-2)	2.81	87.8
	4	8.7 (-3)	0.022	2.5
	1-4	5.7 (-2)	3.52	61.8
1983	1	1.1 (-2)	0.009	0.8
	2	1.1 (-2)	0.83	75.5
	3	1.3 (-3)	0.17	130.8
	4	9.5 (-5)	0.003	31.6
	1-4	2.3 (-2)	1.01	43.9

Iodine Release vs. Dose - Unit 3

Release Projection*	Curies I-131/year	mrem/yr	mrem/Curie
Unit 3 FSAR	0.065	3.6	55.4

*Expected releases from Unit 3 FSAR Table 11.3-1 and from Unit 3 ER Table 3.5-14.

Maximum Value for MP1 is for 1982 = 7.6 mrem/Ci I-131

Maximum Value for MP2 is for 1980 = 96.8 mrem/Ci I-131

Since D/Q's for Unit 2 and Unit 3 are equal (See NRC Draft Environmental Statement for Unit 3) this value should be approximately equal to Unit 2's value. Therefore, the Maximum Value for MP3 = 96.8 mrem/Ci I-131.

Limit is 15000 mrem/yr. to the thyroid

MP1 allowable release rate

= 1500 mrem/7.6 mrem x 10^6 uCi/Ci x 3.17 x 10^{-8} yr/sec = 6.26 uCi/sec

MP2 and MP3 allowable release rate

= 1500 mrem/96.8 mrem x 10^6 x 3.17 x 10^{-8} = 0.49 uCi/sec

Since this is a site limit, the allowable release rate for I-131 is:

$$\frac{Q_{I1}}{6.26} + \frac{Q_{I2}}{0.49} + \frac{Q_{I3}}{0.49} \leq 1$$

where

Q_{I1} = Release rate of I-131 from MP1 Stack (uCi/sec)

Q_{I2} = Release rate of I-131 from MP2 Vent (uCi/sec)

Q_{I3} = Release rate of I-131 from MP3 Vent (uCi/sec)

b. Particulates with Half Lives Greater Than 8 Days

Particulate Releases vs. Dose - Unit 1

Year	Quarter	Total Curves Particulates	Max. Organ Ex. Thyroid	Max. Organ Dose	mrem/Ci
1976	1	0.040	Bone	7.9 (-3)	0.20
	2	0.043	Bone	2.1 (-2)	0.49
	3	0.051	Bone	1.7 (-2)	0.33
	4	0.014	Bone	1.1 (-2)	0.79
	1-4	0.148	-	5.7 (-2)	0.39
1977	1	0.009	Bone	3.2 (-3)	0.36
	2	0.014	Liver	4.3 (-3)	0.31
	3	0.075	Bone	1.8 (-2)	0.24
	4	0.103	Bone	5.0 (-2)	0.49
	1-4	0.201	-	7.6 (-2)	0.38
1978	1	0.156	Bone	1.6 (-1)	1.02
	2	0.963	Bone	9.5 (-2)	0.10
	3	0.131	Bone	2.7 (-2)	0.21
	4	0.105	Bone	2.8 (-2)	0.27
	1-4	1.355	-	3.1 (-1)	0.23
1979	1	0.083	Bone	3.4 (-2)	0.41
	2	0.038	Bone	3.5 (-3)	0.09
	3	0.031	Bone	1.2 (-2)	0.39
	4	0.037	Bone	1.1 (-2)	0.30
	1-4	0.189	-	6.1 (-2)	0.32
1980	1	0.028	Bone	1.6 (-2)	0.57
	2	0.020	Bone	5.1 (-3)	0.26
	3	0.063	Bone	3.0 (-2)	0.48
	4	0.008	Bone	1.2 (-2)	1.50
	1-4	0.119	-	6.3 (-2)	0.53

Year	Quarter	Total Curves Particulates	Max. Organ Ex. Thyroid	Max. Organ Dose	mrem/Ci
1981	1	0.002	Bone	1.2(-3)	0.60
	2	0.008	Bone	1.7(-3)	0.21
	3	0.24	Bone	6.3(-3)	0.26
	4	0.039	Bone	9.5(-2)	2.44
	1-4	0.073	-	1.0(-1)	1.37
1982	1	0.038	Bone	1.1(-2)	0.29
	2	0.033	Bone	1.0(-2)	0.30
	3	0.031	Bone	7.7(-3)	0.25
	4	0.009	Bone	1.3(-3)	0.14
	1-4	0.111	-	3.0(-2)	0.27
1983	1	0.007	Bone	4.4(-4)	0.06
	2	0.006	Bone	8.2(-4)	0.14
	3	0.010	Bone	1.4(-3)	0.14
	4	0.010	Bone	4.0(-3)	0.40
	1-4	0.033	-	6.7(-3)	0.20

Particulate Releases vs. Dose - Unit 2

Year	Quarter	Total Curies Particulates	Max. Organ Ex. Thyroid	Max. Organ Dose	mrem/Ci
1976	1	3.2(-5)	Lung	3.3(-4)	10.2
	2	3.6(-5)	GI-Tract	5.4(-5)	1.5
	3	1.2(-5)	Bone	3.1(-4)	25.8
	4	1.8(-4)	Bone	6.3(-4)	3.5
	1-4	2.6(-4)	--	1.3(-3)	5.1
1977	1	1.6(-4)	Liver	1.0(-3)	6.5
	2	4.1(-7)	Bone	1.9(-4)	463.4*
	3	1.3(-5)	GI-Tract	2.9(-5)	2.2
	4	2.2(-4)	GI-Tract	7.1(-4)	3.2
	1-4	3.9(-4)	--	1.9(-3)	4.9
1978	1	2.5(-4)	GI Tract	8.9(-4)	3.6
	2	4.1(-5)	Bone	1.8(-3)	44.0
	3	1.0(-4)	Bone	2.0(-3)	20.1
	4	6.4(-5)	Bone	5.5(-4)	8.6
	1-4	4.6(-4)	--	5.2(-3)	11.4

*Outlier

Year	Quarter	Total Curies Particulates	Max. Organ Ex. Thyroid	Max. Organ Dose	mrem/Ci
1979	1	9.8(-5)	Bone	1.5(-4)	1.5
	2	1.3(-4)	Bone	4.6(-4)	3.5
	3	9.4(-5)	Bone	8.5(-4)	9.1
	4	5.5(-5)	Lung	1.8(-5)	0.3
	1-4	3.8(-4)	--	1.5(-3)	3.9
1980	1	5.4(-5)	Lung	1.3(-5)	0.24
	2	6.9(-5)	Bone	5.6(-4)	8.2
	3	7.9(-5)	Bone	7.6(-5)	1.0
	4	4.0(-5)	Lung	8.9(-5)	2.2
	1-4	2.4(-4)	--	7.4(-4)	3.1
1981	1	4.4(-5)	Lung	2.2(-5)	0.5
	2	5.3(-5)	GI-Tract	1.7(-4)	3.2
	3	3.2(-5)	Bone	8.8(-5)	2.8
	4	3.6(-5)	GI-Tract	1.9(-5)	0.5
	1-4	1.7(-4)	--	3.0(-4)	1.8
1982	1	3.5(-4)	Lung	1.2(-4)	0.3
	2	5.4(-5)	Bone	1.0(-4)	1.9
	3	1.7(-4)	Bone	1.4(-3)	8.1
	4	3.6(-4)	Lung	3.0(-5)	0.08
	1-4	9.3(-4)	--	1.7(-3)	1.8
1983	1	3.4(-4)	Bone	7.4(-6)	0.02
	2	1.5(-4)	Bone	3.1(-3)	20.7
	3	5.8(-5)	Bone	1.1(-3)	19.0
	4	5.4(-5)	Lung	1.4(-5)	0.3
	1-4	6.0(-4)	--	4.2(-3)	7.0

Particulate Releases vs. Dose - Unit 3

Release Projection*	Total Particulate Curies	Maximum Organ Excluding Thyroid	Maximum Organ Dose (mrem)	mrem/Ci
Unit 3 FSAR	0.16	Liver**	3.6	22.5

* Expected releases - from Unit 3 FSAR Table 11.3-1 and from Unit 3 ER Table 3.5-14.

** From Unit 3 ER Table 5.2-10 (Note: some of the liver dose may be from H-3, however the bone dose is 3.2 mrem, all of which should be due to particulates).

Maximum Value for MP1 is for 1981 = 1.37 mrem/Ci

Maximum Value for MP2 is for 1976 = 11.4 mrem/Ci

Limit is 1500 mrem/yr to the maximum organ

MP1 allowable release rate

$= 1500 \text{ mrem}/1.37 \text{ mrem/Ci} \times 10^6 \text{ uCi/Ci} \times 3.17 \times 10^{-8} \text{ yr/sec} = 35 \text{ uCi/sec}$

MP2 allowable release rate

$= 1500/11.4 \times 10^6 \times 3.17 \times 10^{-8} = 4.2 \text{ uCi/sec}$

MP3 allowabe release rate

$= 1500/22.5 \times 10^6 \times 3.17 \times 10^{-8} = 2.1 \text{ uCi/sec}$

Since this is a site limit, the allowable release rate for particulates is:

$$\frac{Q_1}{35} + \frac{Q_2}{4.2} + \frac{Q_3}{2.1} \leq 1$$

where

Q_1 = Release rate of total particulates with half lives greater than 8 days from the MP1 Stack (uCi/sec)

Q_2 = Release rate of total particulates with half lives greater than 8 days from the MP2 Stack (uCi/sec)

Q_3 = Release rate of total particulates with half lives greater than 8 days from the MP3 Stack (uCi/sec)

c. Tritium

Unit 1 Tritium Releases - Curies vs. Dose

Year	Quarter	Curies	Dose (mrem) Due to Tritium	mrem/Ci
1976	1	3.71	2.5(-5)	6.7(-6)
	2	1.47	8.1(-6)	5.5(-6)
	3	11.4	8.2(-5)	7.2(-6)
	4	12.1	6.2(-5)	5.1(-6)
	1-4	28.7	1.8(-4)	6.3(-6)
1977	1	7.17	3.2(-5)	4.5(-6)
	2	9.24	7.5(-5)	8.1(-6)
	3	19.3	1.8(-4)	9.4(-6)
	4	29.5	1.9(-4)	6.3(-6)
	1-4	65.2	4.8(-4)	7.4(-6)
1978	1	16.8	1.7(-4)	1.0(-5)
	2	7.68	8.6(-5)	1.1(-5)
	3	13.1	1.1(-4)	8.5(-6)
	4	11.1	1.7(-4)	1.5(-5)
	1-4	48.7	5.4(-4)	1.1(-5)
1978	1	14.1	4.4(-6)	3.1(-7)
	2	11.8	7.8(-4)	6.6(-5)
	3	24.2	2.3(-3)	9.5(-5)
	4	9.22	2.8(-6)	3.0(-7)
	1-4	59.3	3.1(-3)	5.2(-5)
1980	1	15.2	7.9(-6)	5.2(-7)
	2	11.3	6.7(-4)	5.9(-5)
	3	27.2	8.1(-4)	3.0(-5)
	4	41.8	7.1(-4)	1.7(-5)
	1-4	95.5	2.2(-3)	2.3(-5)
1981	1	9.96*	-	-
	2	26.9	1.0(-4)	3.7(-6)
	3	26.9*	-	-
	4	30.9*	-	-
	1-4	26.9	1.0(-4)	3.7(-6)
1982	1	18.6	6.0(-6)	3.2(-7)
	2	11.6	1.2(-3)	1.0(-4)
	3	12.5	8.2(-4)	6.6(-5)
	4	11.1	1.8(-6)	1.6(-7)
	1-4	53.8	2.0(-3)	3.8(-5)

Year	Quarter	Curies	Dose (mrem) Due to Tritium	mrem/Ci
1983	1	15.6	1.8(-6)	1.2(-7)
	2	17.0	5.1(-4)	3.0(-5)
	3	20.7	1.2(-3)	5.8(-5)
	4	22.6	6.9(-6)	3.1(-7)
	1-4	75.9	1.7(-3)	2.3(-5)

*Note: These were, inaderverently left out of the GASPAR runs for these quarters (dose consequence is insignificant), therefore total is for 2nd quarter only.

Unit 2 Tritium Releases - Curies vs. Dose

Year	Quarter	Curies	Dose (mrem) Due to Tritium	mrem/Ci
1976	1	0.16	2.6(-5)	1.6(-4)
	2	2.15	1.8(-3)	8.4(-4)
	3	4.34	1.7(-3)	3.9(-4)
	4	1.79	6.2(-4)	3.5(-4)
	1-4	8.4	4.1(-3)	4.9(-4)
1977	1	--	--	--
	2	--	--	--
	3	2.80	3.4(-3)	1.2(-3)
	4	1.89	1.3(-3)	7.1(-4)
	1.4	4.69	4.7(-3)	1.0(-3)
1978	1	--	--	--
	2	--	--	--
	3	16.9	2.6(-2)	1.5(-3)
	4	22.7	1.2(-2)	5.5(-4)
	1-4	39.6	3.8(-2)	9.6(-4)
1979	1	20.5	7.3(-3)	3.6(-4)
	2	12.4	1.1(-2)	8.9(-4)
	3	57.4	7.1(-2)	1.2(-3)
	4	13.5	2.1(-3)	1.5(-4)
	1-4	103.8	9.1(-2)	8.8(-4)
1980	1	9.8	9.0(-4)	9.2(-5)
	2	10.8	1.3(-2)	1.2(-3)
	3	103.0	3.5(-2)	3.4(-4)
	4	725.0	3.8(-1)	5.2(-4)
	1-4	848.6	4.3(-1)	5.1(-4)

Year	Quarter	Curies	Dose (mrem) Due to Tritium	mrem/Ci
1981	1	39.4	6.2(-3)	1.6(-4)
	2	53.4	7.0(-2)	1.3(-3)
	3	23.7	1.9(-2)	8.0(-4)
	4	22.3	6.2(-3)	2.8(-4)
	1-4	138.3	1.0(-1)	7.3(-4)
1982	1	13.8	1.6(-3)	1.2(-4)
	2	9.1	1.0(-2)	1.1(-3)
	3	20.8	3.1(-2)	1.5(-3)
	4	24.1	4.1(-3)	1.7(-4)
	1-4	67.8	4.7(-2)	6.9(-4)
1983	1	34.4	1.6(-3)	4.7(-5)
	2	50.5	4.6(-2)	9.1(-4)
	3	21.7	2.9(-2)	1.3(-3)
	4	30.3	2.8(-3)	9.2(-5)
	1-4	136.9	7.9(-2)	5.8(-4)

Unit 3 Tritium Releases - Curies vs. Dose

The Unit 3 Environmental Report (ER) does not include an isotopic breakdown of the dose consequences. Therefore this cannot be calculated from the FSAR or ER. However, since Unit 2 has a similar release point as Unit 3, the Unit 2 value can be used here.

Maximum value for MP1 is for 1979 = 5.2×10^{-5} mrem/curie - H-3

Maximum Value for MP2 is for 1978 = 1.0×10^{-3} mrem/curie - H-3

Limit is 1500 mrem/yr to the maximum organ

MP1 allowable release rate

= (1500 mrem/5.2×10^{-5} mrem/Ci) x 10^6 uCi/Ci x 3.17×10^{-8} yr/sec = 9.1×10^5 uCi/sec

MP2 and MP3 allowable release rates

= $(1500/1.0 \times 10^{-3}) \times 10^6 \times 3.17 \times 10^{-8} = 4.0 \times 10^4$ uCi/sec

Since this is a site limit, the allowable release rate for tritium is:

$$\frac{Q_{T1}}{9.1\text{x}10^5} + \frac{Q_{T2}}{4.0\text{x}10^4} + \frac{Q_{T3}}{4\text{x}10^4} \leq 1$$

where

Q_{T1} = Release rate of tritium from MP1 Stack - (uCi/sec)
Q_{T2} = Release rate of tritium from MP2 Stack - (uCi/sec)
Q_{T3} = Release rate of tritium from M3 Stack - (uCi/sec)

Since exposure to tritium produces whole body exposure, the release rate fraction for tritium must be added to the release rate for I-131 and particulates. The combined release rate limits then are:

I-131 and tritium

$$\frac{Q_{i1}}{6.26} + \frac{Q_{I2}}{0.49} + \frac{Q_{I3}}{0.49} + \frac{Q_{T1}}{9.1 \times 10^5} + \frac{Q_{T2}}{4.0\times10^4} + \frac{Q_{T3}}{4.0\times10^4} \leq 1$$

Particulates and tritium

$$\frac{Q_1}{35} + \frac{Q_2}{4.2} + \frac{Q_3}{2.1} + \frac{Q_{3T1}}{9.1\times10^5} + \frac{Q_{T2}}{4.0\times10^4} + \frac{Q_{T3}}{4.0\times10^4} \leq 1$$

4. <u>Section D.2.a - Noble Gas - Quarterly Air Dose Method 1</u>

(1) <u>Unit 1</u>

From the table in Section D.1.a of this Appendix, the maximum quarterly value of mrem/qtr. per uCi/sec is 3.0×10^{-4}. This value is mrem to the whole body. To convert to mrad air dose we must multiply by 2 because there is a factor of 0.7 to go from mrad to whole body mrem (The Distribution of Absorbed Dose Rates in Humans From Exposure to Environmental Gamma Rays, Health Physics, January 1976) and also a factor of 0.7 for building shielding and occupancy (Regulatory Guide 1.109, Rev. 1, Pg. 43) used to originally calculate the whole body results. Therefore, the conversion factor for the air dose is:

6.0×10^{-4} mrad/qtr. per uCi/sec or

$$6.0 \times 10^{-4} \frac{\text{mrad-sec}}{\text{qtr. - uCi}} \times 10^6 \text{ uCi/Ci} \times 1.26 \times 10^{-7} \text{ qtr./sec}$$

$= 7.6 \times 10^{-5}$ mrad/Ci

This is the gamma air dose at the critical location. Since the critical location is the site boundary and is only 0.5 miles from a 375 foot stack, the beta air dose at the critical location is near zero as the dose is from the overhead finite cloud (see earlier discussion in Section D.1.a). The

beta air dose at the critical location has always been less than 0.01 times the gamma dose. Thus, the beta dose can be recorded as:

less than 7.6×10^{-7} mrad/Ci

(2) Unit 2

Likewise, for Unit 2 from Section D.1.a, the maximum quarterly value of mrem/qtr. per uCi/sec is 2.5×10^{-3}.

Converting to mrad/Ci we have

$$2.5 \times 10^{-3} \times 2 \times 10^{6} \times 1.26 \times 10^{-7} = 6.3 \times 10^{-4} \text{ mrad/Ci}$$

This is the gamma air dose. The following is the ratio of the beta air dose to the gamma air dose at the critical location as calculated by the GASPAR code:

Ratio

	1976	1977	1978	1979	1980
1st qtr.	2.9	3.1	6.9	3.1	2.8
2nd qtr.	2.9	3.0	2.8	3.3	2.7
3rd qtr.	3.5	2.5	3.0	3.1	1.7
4th qtr.	3.0	3.0	3.0	3.0	1.8

	1981	1982	1983
1st qtr.	2.5	1.3	2.6
2nd qtr.	2.4	2.3	2.7
3rd qtr.	2.2	2.2	*
4th qtr.	2.2	2.4	*

The average ratio = 2.8

Beta air dose = 1.8×10^{-3} mrad/Ci

*No continuous releases these quarters

(3) Unit 3

Again, as mentioned in Section D.1.a, since the average X/Q's are less for Unit 3 than for Unit 2, a conservative estimate for Unit 3 would be to assume its values would be the same as for Unit 2.

5. Section D.2.b

Unit 1 Finite Cloud Code

Year	Quarter	Xe-138	Due to Xe-138	Dose/Curie
1976	1	2.4 (+4)	0.29	1.2 (-5)
	2	3.9 (+4)	0.61	1.6 (-5)
	3	3.3 (+4)	0.52	1.6 (-5)
	4	7.5 (+3)	0.08	1.0 (-5)
1977	1	2.1 (+4)	0.19	8.9 (-6)
	2	1.9 (+4)	0.22	1.2 (-5)
	3	3.4 (+4)	0.52	1.5 (-5)
	4	3.4 (+4)	0.22	6.4 (-6)
1978	1	6.5 (+4)	0.31	4.8 (-6)
	2	4.7 (+4)	0.57	1.2 (-5)
	3	9.0 (+2)	0.019	2.1 (-5)
	4	1.6 (+3)	0.015	9.2 (-6)
1979	1	1.98 (+3)	0.010	5.1 (-6)
	2	8.42 (+2)	0.013	1.5 (-5)
	3	1.05 (+3)	0.028	2.7 (-5)
	4	1.06 (+3)	0.019	1.8 (-5)
1980	1	1.09 (+3)	0.011	1.0 (-5)
	2	5.42 (+2)	0.013	2.4 (-5)
	3	2.43 (+3)	0.052	2.1 (-5)
	4	3.54 (+1)	4.0 (-4)	1.1 (-5)
1981	1	-	-	-
	2	1.41 (+2)	2.7 (-3)	1.9 (-5)
	3	3.77 (+3)	0.033	8.8 (-6)
	4	8.48 (+2)	0.004	4.7 (-6)
1982	1	2.40 (+2)	2.3 (-3)	9.6 (-6)
	2	3.59 (+1)	6.1 (-4)	1.7 (-5)
	3	1.09 (+3)	0.012	1.1 (-5)
	4	-	-	-
1983	1	8.89 (+1)	2.8 (-4)	3.1 (-6)
	2	4.52 (+2)	7.8 (-3)	1.7 (-5)
	3	3.55 (+2)	7.7 (-3)	2.2 (-5)
	4	2.11 (+2)	2.1 (-3)	1.0 (-5)

The above table normalizes the dose for each quarter to the same location from a particular radionuclide. Thus, the only variance in dose per curie should be due to the quarterly meteorology. Using this method, we can determine that the worst case meteorology occurred during the 3rd quarter 1979. Thus, the 3rd quarter joint frequencies should be used as input for the AIREM code.

6. Section D.3

a. Unit 1

The only significant contributor to the thyroid dose is I-131. If the particulates were significant a different organ would be limiting. Tritium releases have never contributed more than 1% of the doses from Unit 1.

Thus, to determine the quarterly thyroid dose we can use the maximum quarterly value observed of mrem/curie of I-131 as presented in Section 3 of this appendix.

This maximum value is :

13.7 mrem/curie - I-131

The critical organ dose due to particulates with half lives greater than 8 days can also be determined from the maximum quarterly dose per cure given in Section 3 of this appendix.

This maximum value is:

2.4 mrem/curie of particulates

b. Unit 2

For Unit 2, we must consider tritium in both the calculation of the thyroid and other organ doses. The dose factor for all organs for tritium is the same.

The maximum values of mrem per curie as presented in Section 3 of the appendix are as follows:

For I-131, 285 mrem/Ci - I-131

For Particulates, 44mrem/Ci - Particulates

For Tritium, 1.5×10^{-3} mrem/Ci - H-3

c. Unit 3

As previously discussed, for conservatism, assume the conversion factors for Unit 3 are the same as for Unit 2.

APPENDIX E

GASEOUS DOSE CALCULATIONS - GASPAR

The GASPAR code was written by the NRC to compute doses from gaseous releases using the models given in Regulatory Guide 1.109. The revision date of the code which was purchased is February 20, 1976. The only changes made to the code were to change the dose factors and inhalation rates from those given in Rev. 0 of Reg. Guide 1.109 to those in Rev. 1.

For calculating the maximum individual dose at Millstone, the following options and parameters are used:

1. Real time meteorology using a X/Q, D/Q model which incorporates the methodology of Reg. Guide 1.111. Meteorology is determined separately for continuous releases and batch releases and for elevated releases and vent releases.

2. 100% of vegetation grown locally, 76% of vegetation intake from garden.

3. Animals on pasture April through December - 100% pasture intake.

4. Air water concentration equals 8 g/m^3.

5. Maximum individual dose calculations are performed at the land location with maximum decayed X/Q, at the nearest vegetable garden (assumed to be nearest residence) with the maximum D/Q, and at the cow and goat farms with maximum D/Q's.

APPENDIX F

GASEOUS DOSE CALCULATIONS - AIREM

The AIREM code was written by the EPA to compute doses from atmospheric emissions of radionuclides. The code is composed of two basic parts - a diffusion calculation and a dose calculation.

For the maximum individual dose at Millstone, cloud gamma doses are calculated using dose tables from a model which considers the finite extent of the cloud in the vertical direction. Beta doses are calculated assuming semi-infinite cloud concentrations which are based upon a standard sector averaged diffusion equation.

APPENDIX G

ENVIRONMENTAL MONITORING PROGRAM

SAMPLING LOCATIONS

The following lists the environmental sampling locations and the types of samples obtained at each location. Sampling locations are also shown on Figures G-1, G-2, and G-3.

Location Number	Location Name	Direction & Distance From Release Point**	Sample Types
1-I*	Onsite - Old Millstone Rd.	0.6 Mi. - NNW	TLD, Air Particulate, Iodine, Vegetation
2-I	Onsite - Weather Shack	0.3 Mi. - SSE	TLD, Air Particulate, Iodine
3-I	Onsite - Bird Sanctuary	0.3 Mi. - NE	TLD, Air Particulate, Iodine
4-I	Onsite - Albacore Drive	1.0 Mi. - N	TLD, Air Particulate, Iodine
5-I	Floating Barge	0.2 Mi. - SSE	TLD
6-I	Quarry Discharge	0.3 Mi. - SSE	TLD
7-I	Fox Island	0.3 Mi. - ESE	TLD
8-I	Environmental Lab	0.3 Mi. - SE	TLD
9-I	Bay Point Beach	0.4 Mi. - W	TLD
10-I	Pleasure Beach	1.4 Mi. - E	TLD, Air Particulate, Iodine
11-I	New London Country Club	1.6 Mi. - ENE	TLD, Air Particulate, Iodine
12-C	Fisher's Island, NY	8.7 Mi. - ESE	TLD
13-C	Mystic, CT	12.0 Mi. - ENE	TLD
14-C	Ledyard, CT	12.0 Mi. - NE	TLD
15-C	Montville, CT	14.0 Mi. - N	TLD, Air Particulate, Iodine
16-C	Old Lyme, CT	8.5 Mi. - W	TLD
17-I	Site Boundary	0 5 Mi. - NE	Vegetation
18-I	New London Country Club	1.6 Mi. - ENE	Vegetation
19-I	Cow Location #1	6.0 Mi. - N	Milk
20-I	Cow Location #2	9.5 Mi. - NW	Milk
21-I	Cow Location #3	11.5 Mi. - NE	Milk
22-C	Cow Location #4	16.0 Mi. - NNW	Milk
23-I	Goat Location #1	2.0 Mi. - ENE	Milk
24-C	Goat Location #2	14.0 Mi. - NE	Milk
25-I	Fruits & Vegetables	Within 10 Miles	Vegetation
26-C	Fruits & Vegetables	Byond 10 Miles	Vegetation
27-I	Niantic	1.7 Mi. - WNW	TLD, Air Particulate, Iodine
28-I	Two Tree Island	0.8 Mi. - SSE	Mussels
29-I	Jordan Cove	0.4 Mi. - NNE	Clams
30-C	Golden Spur	4.7 Mi. - NNW	Bottom Sediment
31-I	Niantic Shoals	1.8 Mi. - NW 1.5 Mi. - NNW	Bottom Sediment, Oysters Mussels
32-I	Vicinity of Discharge		Bottom Sediment Oysters, Lobster, Fish, Seawater
33-I	Seaside Point	1.8 Mi. - ESE	Bottom Sediment
34-I	Thames River Yacht Club	4.0 Mi. - ENE	Bottom Sediment
35-I	Niantic Bay	0.3 Mi. - W	Lobster, Fish
36-I	Black Point	3.0 Mi. - WSW	Bottom Sediment, Oysters

Location Number	Name	Direction & Distance From Release Point**	Sample Types
37-C	Giant's Neck	3.5 Mi. - WSW	Bottom Sediment, Oysters, Lobster, Seawater
38-I	Waterford Shellfish Bed #1	1.5 Mi. - NNW	Clams

*I = Indicator C - Control

** For terrestial locations, this is the MP1 stack, for aquatic it is the quarry cut.

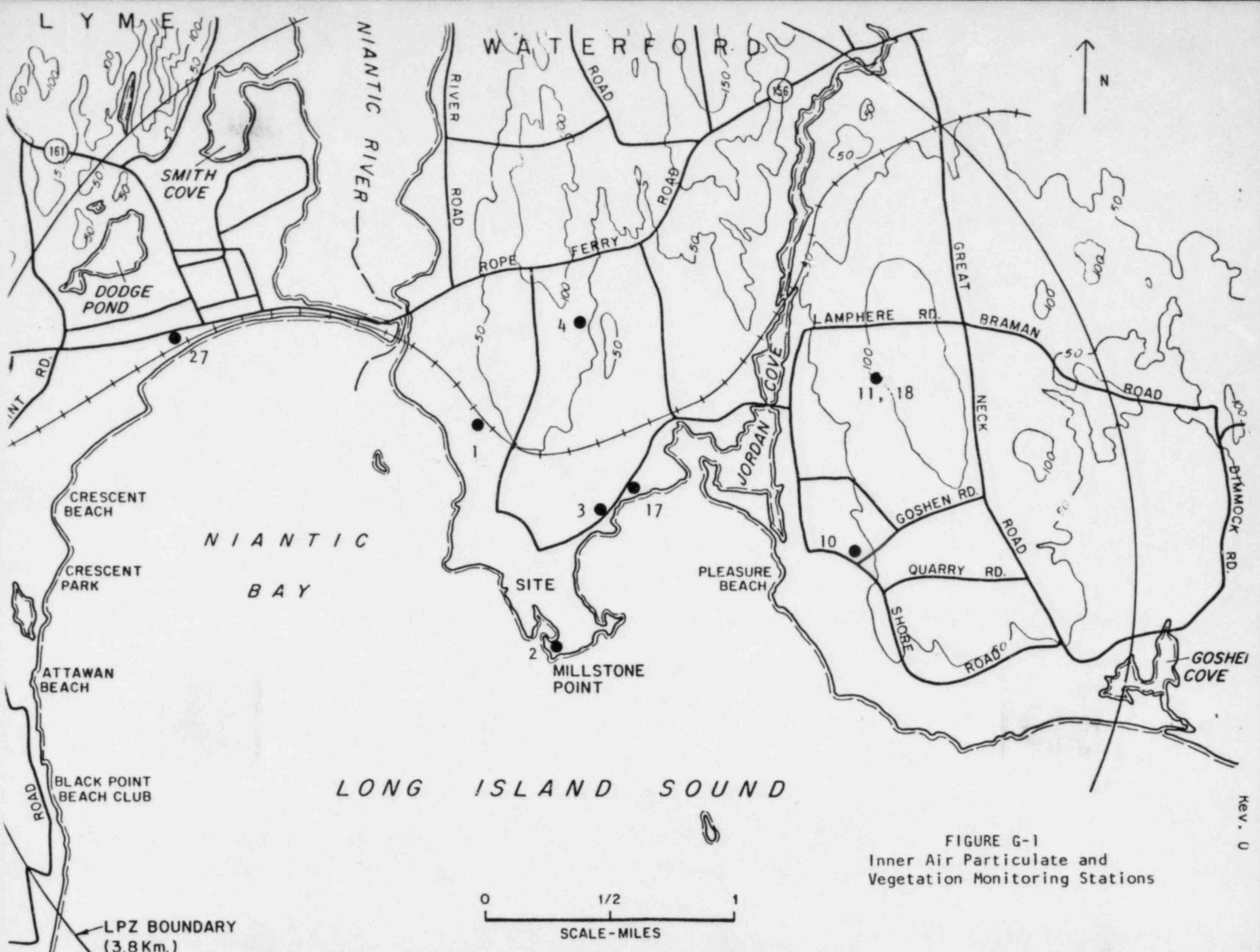


FIGURE G-1
Inner Air Particulate and Vegetation Monitoring Stations

Rev. 0

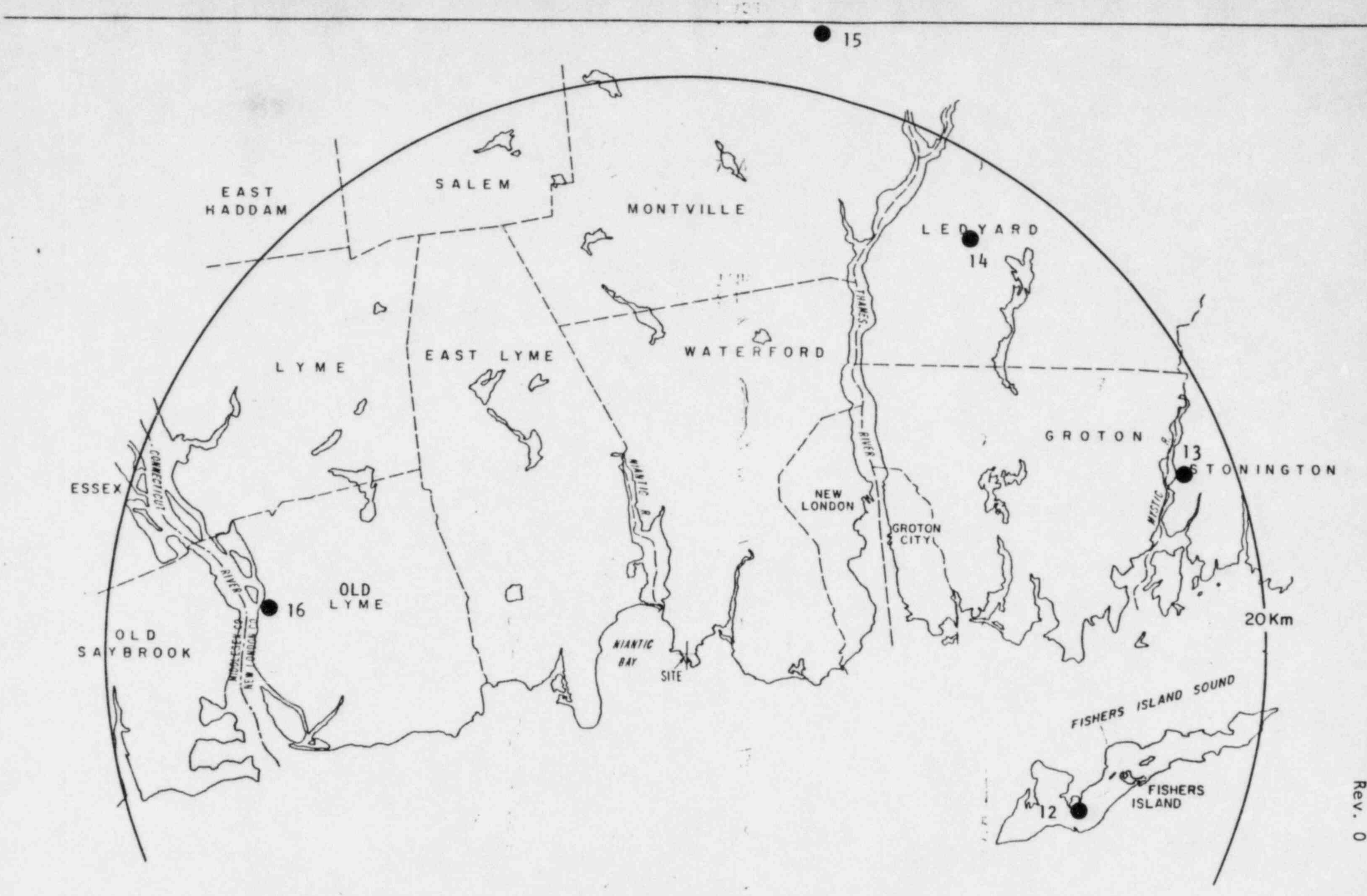


FIGURE G-2
Outer Terrestrial Monitoring Stations

Rev. 0

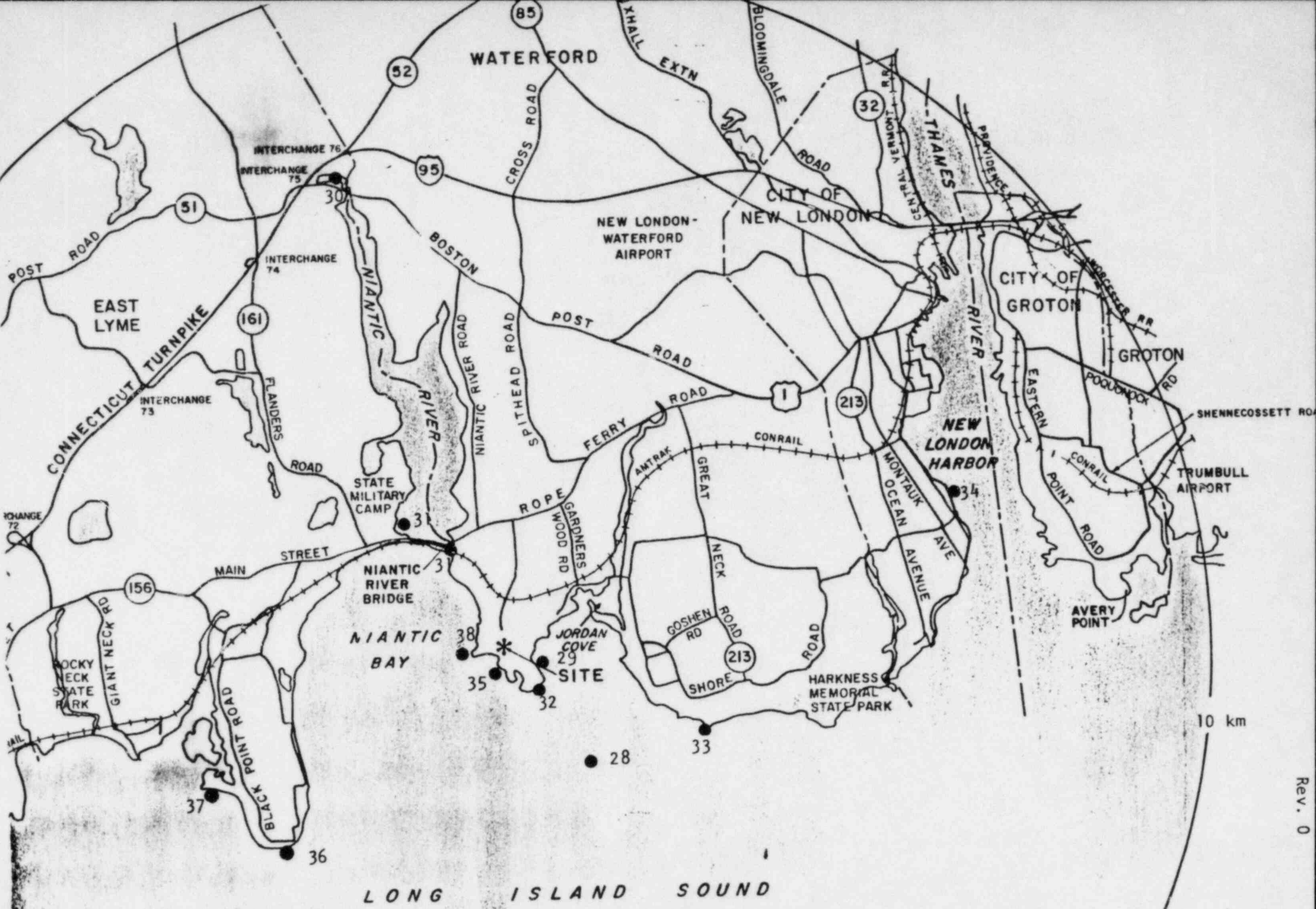


FIGURE G-3
Aquatic Sampling Stations

Rev. 0

APPENDIX H

METHODS FOR CALCULATING RELEASES FROM UNIT 3 "UNMONITORED" RELEASES - FOR SECTION D2 and D3

1. Main Condenser Air Removal Mechanical Vacuum Pump Exhaust

   This system only operates during startup operation.

$$\text{uCi of Noble Gas} = \left(\text{Grab Sample from* Air Ejection, uCi/cc}\right)\left(\text{Condenser Volume, cc}\right)$$

*Grab sample from air ejector adjusted by monitor reading prior to shutdown and decay corrected from shutdown.

$$\text{uCi of Iodines and Particulates} = \left(\text{Grab Sample during Mechanical Vacuum Pump Exhaust, uCi/cc}\right)\left(\text{Flow rate from Mechanical Pumps}\right)\left(\text{minutes of operation}\right)\left(\text{units conversion (if necessary)}\right)$$

2. Turbine Gland Sealing System Exhaust

$$\text{uCi of Noble Gases} = \left(\text{Air Ejector Monitor uCi/cc}\right)\left(\text{Air Ejector Flow Rate cc/min}\right)\left(\frac{\text{Steam to Gland Seal Condenser}}{\text{Steam to Main Condenser}} = 0.001\right)\left(\text{minutes of operation}\right)$$

$$\text{uCi of Iodines and Particulates} = \left(\text{Steam Generator Blowdown concentration uCi/cc}\right)\left(\frac{1}{\text{carry-over fraction**}}\right)\left(\text{Steam to Gland Seal Condenser cc/min.}\right)\left(\frac{1}{\text{DF for Gland Seal Condenser}} = 100\right)\left(\text{minutes of operation}\right)$$

**carry-over fraction = 100 for Iodines and 1000 for particulates.