CONNECTICUT YANKEE ATOMIC POWER COMPANY

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January 18, 1979

Docket No. 50-213

Mr. Brian K. Grimes
Assistant Director for Engineering and Projects
Division of Operating Reactors
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

References: (1) B. K. Grimes letter to All Power Reactor Licensees dated July 11, 1978.
(2) W. G. Counsil letter to B. K. Grimes dated July 26, 1978.
(3) B. K. Grimes letter to All PWR Licensees dated November 15, 1978.

Gentlemen:

Haddam Neck Plant
Proposed Revisions to Technical Specifications
Radiological Effluents

In Reference (1), Connecticut Yankee Atomic Power Company (CYAPCO) was provided with model Appendix I Technical Specifications, and was requested to submit a license amendment application incorporating the applicable specifications into Appendix A. The response date requested in Reference (1) was November 8, 1978. In Reference (2), CYAPCO advised the NRC Staff of several factors complicating the effort, and indicated these could adversely affect the schedule.

By Reference (3), the Staff forwarded NUREG-0472, Draft Radiological Effluent Technical Specifications, and NUREG-0133, Preparation of Radiological Effluent Technical Specifications. Although Reference (3) is dated November 15, 1978, please note that the documents were not received by CYAPCO until December 18, 1978. Although CYAPCO personnel have been directly involved with the evolution of the changes of the model specifications through the AIF, this mailing delay did adversely affect the schedule.

In addition, Reference (3) revised the requested submittal date as specified in Reference (1) to January 15, 1979. In response to your requests, CYAPCO hereby provides the following:

(1) Attachment 1, Revised Appendix A Technical Specifications,
(2) Attachment 2, Revised Appendix B Technical Specifications, and
(3) Attachment 3, The Offsite Dose Calculation Manual for the Haddam Neck Plant.

ADD BRINKMAN w/ENCL
ADD 5 40/40 w/CHECK FOR $4000.00

The slight delay in docketing this submittal with respect to the date requested in Reference (3) was identified in a telephone conversation with the Staff, and is amply justified by Reference (2) and the above noted mailing delay.

It is noted that the typical CYAPCO philosophy regarding proposed revisions to Technical Specifications is that if the proposal is more conservative than existing Technical Specifications, they are implemented at the station when they are submitted. It is emphasized that this is not the case in this instance. As stated previously, CYAPCO has proposed substantive changes from the Reference (3) material. A significant number of procedure changes will be necessary before the attached material can be implemented at the station. The timing of making this transition is also quite important, as it would be most inconvenient and a wasteful use of manpower to initiate the change other than at the start of a calendar quarter. Accordingly, CYAPCO respectfully proposes to discuss this facet of the effort with the Staff as it evolves to ensure timely issuance of the license amendment. The ultimate resolution may involve an effective date of the amendment after the date of issuance.

CYAPCO has reviewed this proposal pursuant to the requirements of 10CFR170, and has determined that in accordance with the Reference (1) guidance, the proposal constitutes a Class III amendment. Accordingly, enclosed is payment in the amount of four thousand dollars ($4,000).

Very truly yours,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

W. G. Counsil
Vice President

Attachment

STATE OF CONNECTICUT)
) ss. Berlin
COUNTY OF HARTFORD)

Jan. 18, 1979

Then personally appeared before me, W. G. Counsil, who being duly sworn, did state that he is Vice President of Connecticut Yankee Atomic Power Company, the Licensee herein, that he is authorized to execute and file the foregoing information in the name and on behalf of the Licensee herein and that the statements contained in said information are true and correct to the best of his knowledge and belief.

Sheila M. Oates
Notary Public

My Commission Expires March 31, 1981

LIST OF CHANGES TO APPENDIX A
TECHNICAL SPECIFICATIONS

Section	Pages	Change
Index	I-V	Add Section Titles
1.26 - 1.30	1-5a, 1-5b	Add New Definitions
Table 1.2	1-7	Add New Frequency
3.23, 4.23	3/4-23-1 through 3/4-23-5	Add New Section on Liquid Effluent Instrumentation
B 3/4.23	B 3/4-23-1	Add Bases for Above Section
3.24, 4.24	3/4-24-1 through 3/4-24-4	Add New Section on Gaseous Effluent Instrumentation
B 3/4.24	B 3/4-24-1	Add Bases for Above Section
3.25, 4.25	3/4-25-1 through 3/4-25-7	Add New Section on Liquid Effluents
B 3/4.25	B 3/4-25-1 & 2	Add Bases for Above Section
3.26, 4.26	3/4-26-1 through 3/4-26-7	Add New Section on Gaseous Effluents
B 3/4.26	B 3/4.26-1 & 2 & 3	Add Bases for Above Section
3.27, 4.27	3/4.27.1	Hold for Solid Waste Specification
3.28, 4.28	3/4-28-1 through 3/4-28-10	Add New Section on Radiological Environmental Monitoring
B 3/4.28	B 3/4-28-1	Add Bases for Above Section
6	6-11, 6-13, 6-14, 6-15, 6-16, 6-16a, 6-16b, 6-20, 6.20a, 6-21, 6-22a, 6-25, 6-26, 6-27, 6-28	Add New Administrative Control Sections to Ensure Proper Administration of all of the New Sections Added Above

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DEFINITIONS

DOCKET NO. 50-213

ATTACHMENT 1

REVISED APPENDIX A
TECHNICAL SPECIFICATIONS

HADDAM NECK
PLANT

JANUARY, 1979

INDEX
(Continued)

INDEX

ADMINISTRATIVE CONTROLS

SOURCE CHECK

1.26
A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to radiation.

OFFSITE DOSE CALCULATION MANUAL (ODCM)

1.27
An OFFSITE DOSE CALCULATION MANUAL (ODCM) shall be a manual containing the methodology and parameters to be used in the calculation of offsite doses due to radioactive gaseous and liquid effluents and in the calculation of gaseous and liquid effluent monitoring instrumentation alarm/trip setpoints. Requirements of the ODCM are provided in Specification 6.15.

GASEOUS RADWASTE TREATMENT SYSTEM

1.28
A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

VENTILATION EXHAUST TREATMENT SYSTEM

1.29
A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment. Such a system is not considered to have any effect on noble gas effluents. Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

MAJOR CHANGES TO RADIOACTIVE WASTE SYSTEMS

1.30 The RADIOACTIVE WASTE SYSTEMS are those liquid, gaseous and solid waste systems which are required to maintain control over radioactive material in order to meet the LCO's set forth in these specifications.

MAJOR CHANGES to these systems shall include the following:

1) Major changes in process equipment, components, structures and effluent monitoring instrumentation from those described in the Facility Description and Safety Analysis and evaluated in the staff's Safety Evaluation Report (SER) (e.g., deletion of evaporators and installation of demineralizers; use of fluidized bed calciner/ incineration in place of cement solidification systems);

2) Major changes in the design of radwaste treatment systems (liquid, gaseous and solid) that could significantly alter the characteristics and/or quantities of effluents released or volumes of solid waste stored or shipped offsite from those previously considered in the FDSA and SER (e.g., use of asphalt system in place of cement);

3) Changes in system design which may invalidate the accident analysis as described in the SER (e.g., changes in tank capacity that would alter the curies released); and

4) Changes in system design that could potentially result in a significant increase in occupational exposure of operating personnel (e.g., use of skid mounted equipment, use of mobile processing equipment).

TABLE 1.2

FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 8 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
B/W	At least once per 14 days.
M	At least once per month.
6/W	At least once per 42 days.
Q	At least once per quarter.
SA	At least once per 6 months.
A	At least once per 12 months.
R	At least once per 18 months.
S/U	Prior to each reactor startup.
P	Prior to each release.
N/A	Not applicable.

3.23 RADIOACTIVE LIQUID EFFLUENT INSTRUMENTATION - Limiting Condition for Operation

3.23.1 The radioactive liquid effluent monitoring instrumentation channels shown in Table 3.23-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.25.1.1 are not exceeded. The setpoints shall be determined in accordance with procedures as described in the ODCM and shall be recorded.

Applicability: As shown in Table 3.23-1.

Action:

1. With a radioactive liquid effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits of 3.25.1.1 are met, immediately suspend the release of radioactive liquid effluents monitored by the affected channel or declare the channel inoperable.

2. With the number of channels less than the minimum channels operable requirement, take the action shown in Table 3.23-1. If the required actions are not taken, make a 30 day report per Section 6.9.2.b.

4.23 RADIOACTIVE LIQUID EFFLUENT INSTRUMENTATION - Surveillance

4.23.1.1 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.23-1.

4.23.1.2 Records - Auditable records shall be maintained of all radioactive liquid effluent monitoring instrumentation alarm/trip setpoints. Setpoints and setpoint calculations shall be traceable to ensure that the limits of Specification 3.25.1.1 are met.

TABLE 3.23-1

Radioactive Liquid Effluent Monitoring Instrumentation

Instrument	Minimum # Operable	Applicability	Action
1. Gross radioactivity monitors providing automatic termination of release			
a. Test Tank Discharge Line	(1)	*	a
2. Gross radioactivity monitors not providing automatic termination of release			
a. Steam Generator Blowdown Line	(1)	*	b
b. Service Water Effluent Line	(1)	*	c
3. Flow Rate Measurement			
a. Test Tank Discharge Line	(1)	*	d
b. Steam Generator Blowdown Line	**	*	NA
c. Discharge Canal	***	At all times	NA
4. Tank Level Monitors			
a. Refueling Water Storage Tank	(1)	During liquid additions	e
b. Waste Test Tank - A	(1)	During liquid additions	e
c. Waste Test Tank - B	(1)	During liquid additions	e

* - During releases via this pathway.

** - Flow is determined by the use of valve curves. The steam generator blowdown is a gravity system.

*** - Discharge canal flow is determined by the use of pump curves.

NA - Not Applicable.

TABLE 3.23-1
(Continued)

ACTION STATEMENTS

Action a: With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases may be resumed for up to 14 days, provided that prior to initiating a release:

1. At least two independent samples are analyzed in accordance with Specification 4.25.1.3, and;

2. At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge valving;

Otherwise, suspend release of radioactive effluents via this pathway.

Action b: With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 14 days provided grab samples are analyzed for gross radioactivity (beta or gamma) at a limit of detection of at least 10^{-7} uCi/ml;

1. At least once per 8 hours when the specific activity of the secondary coolant is > 0.01 uCi/ml DOSE EQUIVALENT I-131.

2. At least once per 24 hours when the specific activity of the secondary coolant is ≤ 0.01 uCi/ml DOSE EQUIVALENT I-131.

Action c: With the numbers of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 28 days provided that at least once per 8 hours grab samples are collected and analyzed for gross radioactivity (beta or gamma) at a lower limit of detection of at least 10^{-7} uCi/ml.

Action d: With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 14 days provided the flow rate is estimated at least once per 4 hours during actual releases.

Action e: With the numbers of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, liquid additions to this tank may continue for up to 28 days provided the tank liquid level is estimated during all liquid additions to the tank.

TABLE 4.23-1

Radioactive Liquid Effluent Monitoring Instrumentation Surveillance Requirements

Instrument	Channel Check	Source Check	Channel Calibration	Channel Functional
1. Gross radioactivity monitors providing automatic termination of release				
a. Test Tank Discharge Line	D(1)	P	R(2)	Q(3)
2. Gross radioactivity monitors not providing automatic termination of release				
a. Steam Generator Blowdown Line	D(1)	M	R(2)	Q(3)
b. Service Water Effluent Line	D(1)	M	R(2)	Q(3)
3. Flow Rate Measurement				
a. Test Tank Discharge Line	D(1)	NA	R	Q
b. Steam Generator Blowdown Line	D(5)	NA	NA	NA
c. Discharge Canal	D(6)	NA	NA	NA
4. Tank Level Monitors				
a. Refueling Water Storage Tank	D(4)	NA	R	Q
b. Waste Test Tank - A	D(4)	NA	R	Q
c. Waste Test Tank - B	D(4)	NA	R	Q

TABLE 4.23-1
(Continued)

TABLE NOTATION

(1) Channel check need only be performed daily when discharges are made from this pathway.

(2) Calibration shall be performed using a radioactive liquid source, the activity of which is determined using a gamma spectrometer calibrated to an NBS traceable source. The radioactive source shall be in a known, reproducible geometry.

(3) The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exist:

1. Instrument indicates measured levels above the alarm/trip setpoint*.

2. Instrument indicates a downscale failure or circuit failure.

3. Instrument controls not set in operate mode.

* Automatic isolation shall also be demonstrated for the test tank discharge monitor line.

(4) Channel check need only be performed daily during liquid additions to the tank.

(5) Valve position should be checked daily when discharges are being made via this pathway.

(6) Pump status should be checked at least daily.

3.23 & 4.23 - Radioactive Liquid Effluent Instrumentation

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

3.24 Radioactive Gaseous Effluent Monitoring Instrumentation - Limiting Condition for Operation

3.24.1 The radioactive gaseous effluent monitoring instrumentation channels shown in Table 3.24-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of Specification 3.26.1.1 are not exceeded. The setpoints shall be determined in accordance with procedures as described in the ODCM and shall be recorded.

Applicability: As shown in Table 3.24-1.

Action:

1. With a radioactive gaseous effluent monitoring instrumentation channel alarm/trip setpoint less conservative than a value which will ensure that the limits of 3.26.1.1 are met, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel or declare the channel inoperable.

2. With the number of channels less than the minimum channels operable requirement, take the action shown in Table 3.24-1. If the required actions are not taken, make a 30 day report per Section 6.9.2.b.

4.24 Radioactive Gaseous Effluent Instrumentation - Surveillance

4.24.1.1 Each radioactive gaseous process or effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and CHANNEL FUNCTIONAL TEST operations at the frequencies shown in Table 4.24-1.

4.24.1.2 Auditable records shall be maintained of the calculations made, of all radioactive process and effluent monitoring instrumentation alarm/ trip setpoints. Setpoints and setpoint calculations shall be traceable to ensure that the limits of Specification 3.26.1.1 are met.

TABLE 3.24-1

Radioactive Gaseous Effluent Monitoring Instrumentation

Instrument	Minimum # Operable	Applicability	Action
1. Main Stack			
a. Noble Gas Activity Monitor	(1)	*	a
b. Iodine Sampler	(1)	*	b
c. Particulate Sampler	(1)	*	b
d. Stack Flow Rate Monitor	(1)	*	c
e. Sampler Flow Rate Meter	(1)	*	c

* During releases via this pathway.

Action a: With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement:

1. Releases from the waste gas holdup system may continue for up to 48 hours provided that prior to initiating the release:

   (a) At least two independent samples of the tank's contents are analyzed; and,

   (b) At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve lineup; otherwise, suspend releases from the waste gas holdup system.

2. Releases from all pathways other than the waste gas holdup system may continue for up to 28 days provided grab samples are taken at least once per 8 hours and these samples are analyzed for gross radioactivity within 24 hours.

TABLE 3.24-1
(Continued)

Action b: With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 28 days, provided samples are continuously collected with auxiliary sampling equipment, and analyzed at least once every 7 days.

Action c: With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 28 days provided the flow rate is estimated at least once per 4 hours.

TABLE 4.24-1

Radioactive Gaseous Effluent Monitoring Instrumentation Surveillance Requirements

Instrument	Channel Check	Source Check	Channel Calibration	Channel Functional
1. Main Stack				
a. Noble Gas Activity Monitor	D(1)	M	R(2)	Q(3)
b. Iodine Sampler	D(4)	NA	NA	NA
c. Particulate Sampler	D(4)	NA	NA	NA
d. Stack Flow Rate Monitor	D(1)	NA	R	Q
e. Sampler Flow Rate Meter	D(4)	NA	R	NA

(1) Channel check daily when there exists releases via this pathway.

(2) Calibration shall be performed using a radioactive gaseous source which is traceable to the NBS and is in a known, reproducible geometry.

(3) The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exist:

a. Instrument indicates measured levels above the alarm/trip setpoint*.

b. Instrument indicates a downscale failure or circuit failure.

c. Instrument controls not set in operate mode.

* Automatic isolation of the waste gas holdup system releases by the noble gas monitor should also be demonstrated.

(4) Daily verification of the presence of the charcoal sampler, particulate filter and of sample flow rate.

3.24 & 4.24 - Radioactive Gaseous Effluent Instrumentation

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases. The alarm/trip setpoints for these instruments shall be calculated in accordance with NRC approved methods in the ODCM to ensure that the alarm/trip will occur prior to exceeding the limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

3.25 Radioactive Liquid Effluents - Limiting Conditions for Operations

3.25.1 Liquid Effluents Concentration

3.25.1.1 The concentration of radioactive material released at any time from the site to unrestricted areas (see Figure 3.25-1) shall be limited to the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} uCi/ml total activity.

APPLICABILITY: At all times.

ACTION:

With the concentration of radioactive material released from the site to unrestricted areas exceeding the above limits, immediately restore concentration within the above limits and provide prompt notification to the Commission pursuant to Specification 6.9.2.a.

4.25 Radioactive Liquid Effluents - Surveillance Requirements

4.25.1 Liquid Effluents Concentration

4.25.1.1 The instantaneous concentration of radioactive material in liquid effluents released from the site shall be monitored in accordance with Table 3.23-1.

4.25.1.2 The liquid effluent continuous monitors having provisions for automatic termination of liquid releases, as listed in Table 3.23-1 shall be used to limit the concentration of radioactive material released at any time from the site to unrestricted areas to the values given in Specification 3.25.1.1.

4.25.1.3 Sampling and analysis shall be performed in accordance with Table 4.25-1 to assure that the limits of Specification 3.25.1.1 are met.

4.25.1.4 Reports - A summary of the releases of radioactive liquid effluents shall be reported in the semiannual report per Section 6.9.1.g.

TABLE 4.25-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (uCi/ml)[a]
A. Waste Test Tanks and Recycle Test Tanks	P Each Batch	P Each Batch	Principal Gamma Emitters[f]	5×10^{-7}[b]
			I-131	1×10^{-6}
	P[e] One Batch/M	M	Dissolved and Entrained Gases	1×10^{-5}
	P Each Batch	M Composite[c]	H-3	1×10^{-5}
			P-32	1×10^{-6}
			Gross alpha	1×10^{-7}
	P Each Batch	Q Composite[c]	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}
B. Steam Generator Blowdown and Service Water Effluent	D[g] Grab Sample	W Composite[d]	Principal Gamma Emitters[f]	5×10^{-7}[b]
			I-131	1×10^{-6}
	M Grab Sample	M	Dissolved and Entrained Gases[h]	1×10^{-5}
	W Grab Sample	M Composite[d]	H-3[h]	1×10^{-5}
			P-32[h]	1×10^{-6}
			Gross alpha[h]	1×10^{-7}
	W Grab Sample	Q Composite[d]	Sr-89, Sr-90[h]	5×10^{-8}
			Fe-55[h]	1×10^{-6}

TABLE 4.25-1
(Continued)

TABLE NOTATIONS

a. The LLD is the smallest concentration of radioactive material in a sample that will be detected with 90% probability with 10% probability of faisely concluding that a blank observation represents a "real" signal.

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

$$LLD = \frac{3.63\ s_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where

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

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

E is the counting efficiency (as counts per transformation)

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

2.22 is the number of 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 midpoint of sample collection and time of counting

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as 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 interferring nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Semiannual Radioactive Effluent Release Report.

TABLE 4.2[illegible]-1
(Continued)

TABLE NOTATIONS

b. For certain radionuclides with low gamma yield or low energies, or for certain radionuclide mixtures, it may not be possible to measure radionuclides in concentrations near the LLD. Under these circumstances, the LLD may be increased inversely proportionally to the magnitude of the gamma yield (i.e., $5 \times 10^{-7}/I$, where I is the photon abundance expressed as a decimal fraction), but in no case shall the LLD, as calculated in this manner for a specific radionuclide, be greater than 10% of the MPC value specified in 10 CFR 20, Appendix B, Table II, Column 2.

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

d. 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.

e. One batch per month means one batch from a waste test tank and one from a recycle test tank if they are discharged that month.

f. The principal gamma emitters for which the LLD specification will apply are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. 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 LLD's higher than required, the reasons shall be documented in the semiannual radioactive effluent release report.

g. At least 5 days per week.

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

3.25.2 Liquid Effluents - Dose

3.25.2.1 The dose or dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas (see Figure 3.25-1) shall be limited:

a. During any calendar quarter to ≤ 1.5 mrem to the total body and to ≤ 5 mrem to any organ; and,

b. During any calendar year to ≤ 3 mrem to the total body and to ≤ 10 mrem to any organ.

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report which identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce the releases of radioactive materials in liquid effluents during the remainder of the current calendar quarter and during the subsequent three calendar quarters so that the average dose or dose commitment to an individual from such releases during these four calendar quarters is within 3 mrem to the total body and 10 mrem to any organ.

4.25.2 Liquid Effluent - Dose

4.25.2.1.1 Dose Calculations. Cumulative dose contributions from liquid effluents shall be determined in accordance with the Offsite Dose Calculation Manual (ODCM) at least once per 31 days.

4.25.2.1.1 Reports. Calculated quarterly doses shall be reported in the semiannual Radioactive Release Report per Section 6.9.1.g.

3.25.3 Liquid Effluents - Waste Treatment

3.25.3.1 The appropriate subsystems of liquid radwaste treatment system shall be OPERABLE. The appropriate subsystems shall be used to reduce the radioactive materials in liquid wastes prior to their discharge when the projected dose due to liquid effluent releases to unrestricted areas (see Figure 3.25-1) when averaged over 31 days would exceed 0.06 mrem to the total body or 0.2 mrem to any organ.

APPLICABILITY: At all times.

ACTION:

a. With radioactive liquid waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.2, a Special Report which includes the following information:

   1. Identification of the appropriate equipment or subsystems not OPERABLE and the reason for inoperability.

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

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

4.2.5.3 Liquid Effluents - Waste Treatment

4.25.3.1.1 Doses due to liquid releases to unrestricted areas shall be projected at least once per 31 days.

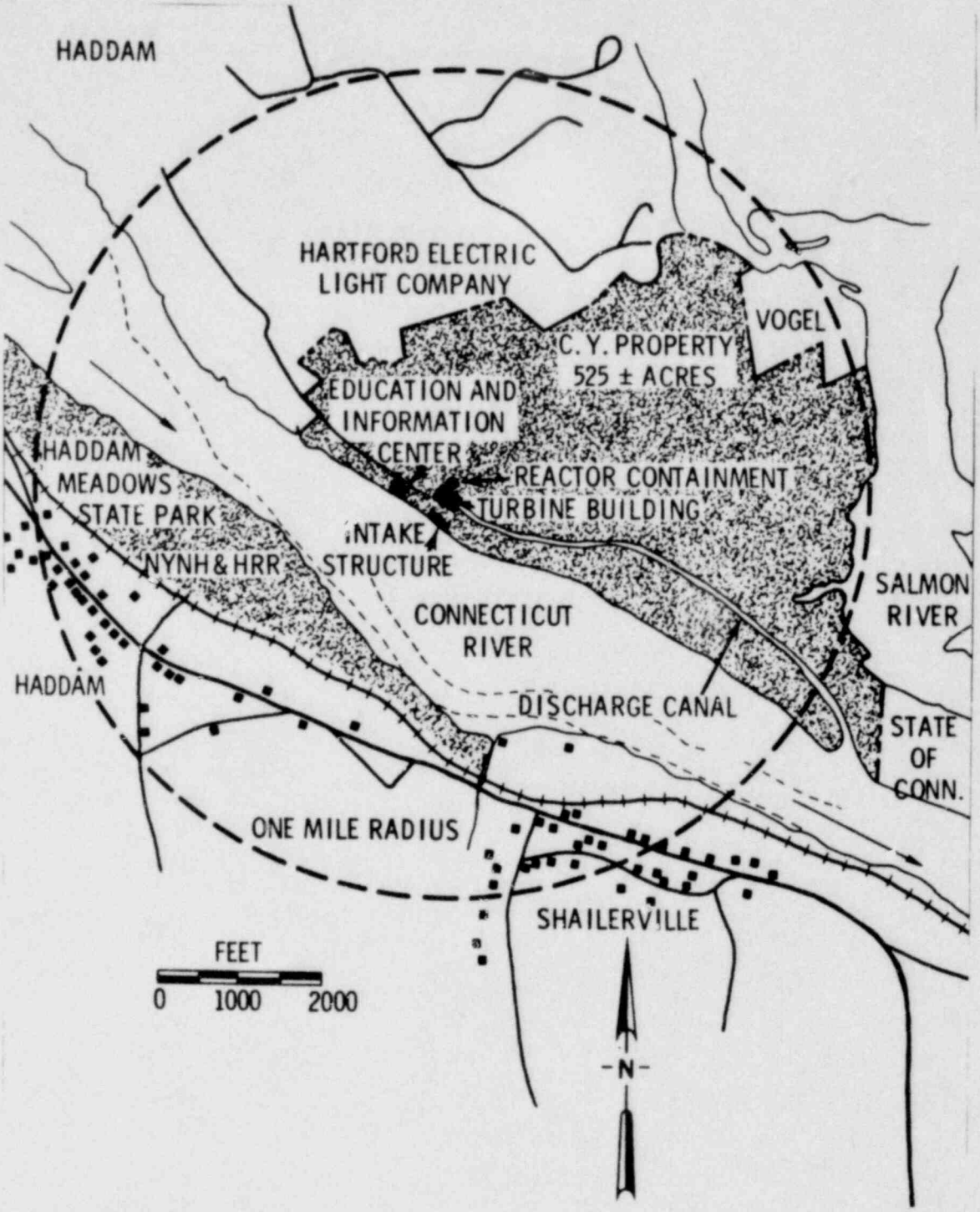
4.25.3.1.2 The appropriate liquid radwaste subsystems shall be demonstrated OPERABLE at least once per 92 days unless the appropriate liquid radwaste subsystem has been utilized to process radioactive liquid effluents during the previous 92 days.

3.25.4 Liquid Holdup Tanks

This section is not applicable to Haddam Neck as there are no potable or surface water supplies downstream of the discharge.

4.25.4 Liquid Holdup Tanks

This section is not applicable to Haddam Neck as there are no potable or surface water supplies downstream of the discharge.



Restricted Area = Shaded area on northeast side of Connecticut River

FIG. 3.25-1

3.25 & 4.25 - Radioactive Liquid Effluents

3/4.25.1 CONCENTRATION

This specification is provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site to unrestricted areas will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table II. This instantaneous limitation provides additional assurance that the levels of radioactive materials in bodies of water outside the site will not result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to an individual and (2) the limits of 10 CFR Part 20.106(e) to the population. The concentration limit for noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its MPC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

3/4.25.2 DOSE

This specification is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.A of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents will be kept "as low as is reasonably achievable." The dose calculations in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I is to be shown by calculational procedures based on models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents will be consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977, and Regulatory Guide 1,113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

3/4.25.3 LIQUID WASTE TREATMENT

The OPERABILITY of the liquid radwaste treatment system ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirements that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and design objective Section II.D of Appendix to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the guide set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

3/4.25.4 LIQUID HOLDUP TANKS

Not Applicable

3.26 Radioactive Gaseous Effluents - Limiting Conditions for Operation

3.26.1 Gaseous Effluents - Dose Rate

3.26.1.1 The instantaneous dose rate in the unrestricted areas (see Figure 3.25-1) due to radioactive materials released in gaseous effluents from the site shall be limited to the following values:

a. The dose rate limit for noble gases shall be $\leq$ 500 mrem/yr to the total body and $\leq$ 3000 mrem/yr to the skin; and,

b. The dose rate limit for all radioiodines and for all radioactive materials in particulate form and radionuclides other than noble gases with half lives greater than 8 days shall be $\leq$ 1500 mrem/yr to any organ.

APPLICABILITY: At all times.

ACTION:

With the dose rate(s) exceeding the above limits, immediately decrease the release rate to comply with the limit(s) given in Specification 3.26.1.1 and provide prompt notification to the Commission pursuant to Specification 6.9.2.a.

4.26 Radioactive Gaseous Effluents - Surveillance Requirements

4.26.1 Gaseous Effluents - Dose Rate

4.26.1.1.1 The instantaneous release rate corresponding to the above dose rate shall be determined in accordance with the methodology in the ODCM.

4.26.1.1.2 The instantaneous release rates shall be monitored in accordance with the requirements of Table 3.24-1.

4.26.1.1.3 The noble gas effluent monitor having provisions for automatic termination of gaseous releases, as given in Table 3.24-1, shall be used to limit releases to the specification given in 3.26.1.1.

4.26.1.1.4 Sampling and analysis shall be performed in accordance with Table 4.26-1 to assure that the limits of specification 3.26.1.1 are met.

4.26.1.1.5 Reports - A summary of the releases of radioactive gaseous effluents shall be reported in the semiannual report per section 6.9.1.g.

TABLE 4.26-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (uCi/ml)[a]
A. Waste Gas Storage Tank	P Each Tank Grab Sample	P Each Tank	Principal Gamma Emitters[e]	1×10^{-4}[b]
			H-3	1×10^{-6}
B. Containment Purge	P Each Purge Grab Sample	P Each Purge	Principal Gamma Emitters[e]	1×10^{-4}[b]
			H-3	1×10^{-6}
C. Main Stack	M[c] Grab Samples -Gases	M[c]	Principal Gamma Emitters[e]	1×10^{-4}[b]
			H-3	1×10^{-6}
	Continuous[d]	W Charcoal Sample	I-131	1×10^{-12}
			I-133	1×10^{-10}
	Continuous[d]	W Particulate Sample	Principal Gamma Emitters[e] (I-131, Others)	1×10^{-11}
	Continuous[d]	M Composite Particulate Sample	Gross	1×10^{-11}
	Continuous[d]	Q Composite Particulate Sample	Sr-89, Sr-90	1×10^{-11}

TABLE 4.26-1 (Continued)

TABLE NOTATION

a. The lower limit of detection (LLD) is defined in Table Notation a. of Table 4.25-1.

b. For certain radionuclides with low gamma yield or low energies, or for certain radionuclide mixtures, it may not be possible to measure radionuclides in concentrations near the LLD. Under these circumstances, the LLD may be increased inversely proportionally to the magnitude of the gamma yield (i.e., $1 \times 10^{-4}/I$, where I is the photon abundance expressed as a decimal fraction), but in no case shall the LLD, as calculated in this manner for a specific radionuclide, be greater than 10% of the MPC value specified in 10 CFR 20, Appendix B, Table II, Column 1.

c. Analyses shall also be performed following startup or similar operational occurrence which could significantly alter the mixture of radionuclides.

d. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with Specifications 3.26.1, 3.26.2, and 3.26.3.

e. The principal gamma emitters for which the LLD specification will 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. 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 for that nuclide. When unusual circumstances result in LLD's higher than required, the reasons shall be documented in the semi-annual effluent report.

3.26.2 Gaseous Effluents Dose, Noble Gases

3.26.2.1 The air dose in unrestricted areas (see Figure 3.25-1) due to noble gases released in gaseous effluents shall be limited to the following:

a. During any calendar quarter, to $\leq$ 5 mrad for gamma radiation and $\leq$ 10 mrad for beta radiation;

b. During any calendar year, to $\leq$ 10 mrad for gamma radiation and $\leq$ 20 mrad for beta radiation;

APPLICABILITY: At all times.

ACTION:

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.3, a Special Report which identifies the cause(s) for exceeding the limit(s) and defines the corrective actions to be taken to reduce the releases of radioactive noble gases in gaseous effluents during the remainder of the current calendar quarter and during the subsequent three calendar quarters so that the average dose during these four calendar quarters is within (10) mrad for gamma radiation and (20) mrad for beta radiation.

4.26.2 Gaseous Effluents - Dose, Noble Gases

4.26.2.1.1 Dose Calculations - Cumulative dose contributions for the total time period shall be determined in accordance with the Offsite Dose Calculation Manual (ODCM) at least once every 31 days.

4.26.2.1.2 Reports - Calculated quarterly doses shall be reported in the semiannual radioactive release report per Section 6.9.1.g.

3.26.3 Gaseous Effluents - Dose, Radioiodines, Radioactive Material In Particulate Form, and Radionuclides Other Than Noble Gases

3.26.3.1 The dose to an individual from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days in gaseous effluents released to unrestricted areas (see Figure 3.25.1) shall be limited to the following:

a. During any calendar quarter to ≤ 7.5 mrem;

b. During any calendar year to ≤ 15 mrem;

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of radioiodines, radioactive materials in particulate form, or radionuclides other than noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.3, a Special Report which identifies the cause(s) for exceeding the limit and defines the corrective actions to be taken to reduce the releases of radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than 8 days in gaseous effluents during the remainder of the current calendar quarter and during the subsequent three calendar quarters so that the average dose or dose commitment to an individual from such releases during these four calendar quarters is within (15) mrem to any organ.

4.26.3 Gaseous Effluents - Dose, Radioiodines, Radioactive Material In Particulate Form, and Radionuclides Other Than Noble Gases

4.26.3.1.1 Dose Calculations - Cumulative dose contributions for the total time period shall be determined in accordance with the ODCM at least once every 31 days.

4.26.3.1.2 Reports - Calculated quarterly doses shall be reported in the semiannual radioactive release report for Section 6.9.1.g.

3.26.4 Gaseous Effluents - Waste Treatment

3.26.4.1 The appropriate subsystems of the gaseous radwaste treatment system and the ventilation exhaust treatment system shall be OPERABLE. The gaseous radwaste treatment system shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected gaseous effluent doses due to gaseous effluent releases to unrestricted areas (see Figure 3.25-1) when averaged over 31 days exceeds 0.2 mrad for gamma radiation and 0.4 mrad for beta radiation. The ventilation exhaust treatment system shall be used to reduce radioactive materials in gaseous waste prior to their discharge when the projected gaseous effluent doses due to gaseous effluent releases to unrestricted areas (see Figure 5.1-1) when averaged over 31 days exceeds 0.3 mrem to any organ.

APPLICABILITY: At all times.

ACTION:

a. With gaseous waste being discharged for more than 31 days without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, pursuant to Specification 6.9.3, a Special Report which includes the following information:

   1. Identification of the appropriate equipment of subsystems not OPERABLE and the reason for inoperability.

   2. Action(s) taken to restore the inoperable equipment to OPERABLE STATUS.

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

4.26.4 Gaseous Effluents - Waste Treatment

4.26.4.1.1 Doses due to gaseous releases to unrestricted areas shall be projected at least once per 31 days.

4.26.4.1.2 The appropriate systems shall be demonstrated OPERABLE at least once per 92 days unless the appropriate system has been utilized to process radioactive gaseous effluents during the previous 92 days.

3.26.5 Radioactive Effluents - Total Dose

3.26.5.1 The dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to ≤ 25 mrem to the total body or any organ (except the thyroid, which is limited to ≤ 75 mrem) over a period of 12 consecutive months.

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specifications 3.25.2.1, 3.26.2.1, or 3.26.3.1, prepare and submit a Special Report to the Commission pursuant to Specification 6.9.3 and limit the subsequent releases such that the dose or dose commitment to a real individual from all uranium fuel cycle sources is limited to 25 mrem to the total body or any organ (except thyroid, which is limited to 75 mrem) over 12 consecutive months. This Special Report shall include an analysis which demonstrates that radiation exposures to all real individuals from all uranium fuel cycle sources (including all effluent pathways and direct radiation) are less than the 40 CFR Part 190 Standard. Otherwise, obtain a variance from the Commission to permit releases which exceeds the 40 CFR Part 190 Standard.

4.26.5 Radioactive Effluents - Total Dose

4.26.5.1.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with the ODCM.

BASES

3.26 & 4.26 - Radioactive Gaseous Effluents

3/4.26.1 Dose Rate

This specification is provided to ensure that the dose rate at any time at the exclusion area boundary from gaseous effluents from all units on the site will be within the annual dose limits of 10 CFR Part 20 for unrestricted areas. The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of an individual in an unrestricted area, either within or outside the exclusion area boundary, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR Part 20.106(b)). For individuals who may at times be within the exclusion area boundary, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the exclusion area boundary. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the exclusion area boundary to (500) mrem/year to the total body or to (3000) mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid dose rate above background to an infant via the cow-milk-infant pathway to 1500 mrem/year for the nearest cow to the plant.

3/4.26.2 Dose, Noble Gases

This specification is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents will be kept "as low as is reasonably achievable". The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I is to be shown by calculational procedures based on models and data such that the actual exposure of an individual through the appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents will be consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I", Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheri, Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors", Revision 1, July 1977. The ODCM equations provided for determining the air doses at the exclusion area boundary will be based upon the historical average atmospheric conditions.

3/4.26.3 Dose, Radioiodines, Radioactive Material in Particulate Form and Radionuclides Other Than Noble Gases

This specification is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable". The ODCM calculational methods specified in the surveillance requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methods approved by NRC for calculating the doses due to the actual release rates of the subject materials are required to be consistent with the methodology provided in Regulatory Guide 1.109, "Calculating of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors", Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for radioiodines, radioactive material in particulate form and radionuclides other than noble gases are dependent on the existing radionuclide pathways to man, in the unrestricted area. The pathways which are examined in the development of these calculations are: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

3/4.26.4 Gaseous Waste Treatment

The OPERABILITY of the gaseous radwaste treatment system and the ventilation exhaust treatment system ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of these sytems be used when specified provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable". This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and design objective Section IID of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the guide set forth in Sections II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

3/4.26.5 Total Dose

This specification is provided to meet the reporting requirements of 40 CFR 190.

3.27 RADIOACTIVE SOLID WASTE - Limiting Condition for Operation

Hold until a later date.

4.27 RADIOACTIVE SOLID WASTE - Surveillance Requirements

Hold until a later date.

3.28 Radiological Environmental Monitoring

3.28.1 Monitoring Program - This is strictly a surveillance program. There are no Limiting Conditions for Operation. See Specification 4.28.1.

4.28.1 Radiological Environmental Monitoring - Surveillance Requirements

4.28.1.1. The radiological environmental monitoring program shall be conducted as specified in Tables 4.28-1 and 4.28-2 from the locations shown in Figures 4.28-1 and 4.28-2. (Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, or to malfunction of automatic sampling equipment. If the latter, every effort shall be made to complete corrective action prior to the end of the next sampling period.)

APPLICABILITY: At all times.

ACTION:

a. With the radiological environmental monitoring program not being conducted as specified in Table 4.28-1, prepare and submit to the Commission, in the Annual Radiological Operating Report, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.

b. With the level of radioactivity in an environmental sampling medium at one or more of the locations specified in Table 4.28-1 exceeding the limits of Table 6.9-1 when averaged over any calendar quarter, prepare and submit to the Commission within 60 days from the end of the affected calendar quarter, a Special Report which includes an evaluation of any release conditions, environmental factors or other aspects which caused the limits of Table 6.9-1 to be exceeded. 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.

c. With milk samples unavailable from any of the sample locations required by Table 4.28-1, a grass sample shall be substituted until a suitable milk location is evaluated as a replacement. Such an occurrence will be documented in the annual report.

4.28.1.2 Reports - The results of analyses performed on the radiological environmental monitoring samples shall be summarized in the Annual Radiological Environmental Operating Report.

TABLE 4.28-1

CONNECTICUT YANKEE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Location	Distance & Direction[a]	Sample Type, Frequency[b] and Analysis[c]				
		Gamma Dose	Air Particulate[e]	Vegetation	Water	Milk
Terrestrial Stations						
5. On site - Injun Hollow Road	0.5 miles, NW	M	W1-M2[d]	-	-	-
6. On site - Substation	1.0 miles, ENE	M	W1-M2[d]	-	-	-
7. Haddam	2.0 miles, SE	M	W1-M2[d]	-	-	-
8. East Haddam	3.0 miles, ESE	M	W1-M2	-	-	-
9. Higganum	3.5 miles, WNW	M	W1-M2	-	-	-
10. Hurd Park Road - East Hampton	3.0 miles, NNW	M	W1-M2	-	-	-
11. Middletown	*10.0 miles, NW	M	W1-M2	-	-	-
12. Deep River	* 8.0 miles, SSE	M	W1-M2	-	-	-
13. North Madison	*12.0 miles, SW	M	W1-M2[d]	-	-	-
14. Colchester	*10.0 miles, ENE	M	W1-M2	-	-	-
15. On site - Wells	0.5 miles, SE	-	-	-	M1,2,4	-
16. Well - State Highway Dept. East Haddam	* 3.0 miles, S	-	-	-	Q1,2,4	-
17. Fruits & Vegetables greater than 10 miles				SA2, 3		
18. Site Boundary	0.5 miles, NW			SA2, 3		
19. Cow Location #1		-	-	-	-	M2,3
20. Cow Location #2		-	-	-	-	M2,3
21. Cow Location #3		-	-	-	-	M2,3
22. Cow Location #4	*	-	-	-	-	M2,3
23. Goat Location #1	*	-	-	-	-	M2,3
24. Goat Location #2		-	-	-	-	M2,3
25. Fruits & Vegatables	within 10 miles	-	-	SA2,3	-	-

3/4-28-3

TABLE 4.28-1 (continued)

Location	Distance & Direction(a)	Sample Type, Frequency(b) and Analysis(c)			
		Bottom Sediment	Water	Fish(f)	Shellfish
Aquatic Stations					
26. Conn. River - Vicinity of intake	0.5 miles, SSW	-	-	Q2	-
27. Conn. River - Higganum Light	*3 miles, NW	Q2	-	-	Q2
28. Conn. River - E. Haddam Bridge	*2 miles, SE	Q2	-	-	-
29. Vicinity of Plant Discharge Canal	0.75 miles, ESE	Q2	Q1,2,4	Q2	-
30. Conn. River - Middletown	*9 miles, NW	-	Q1,2,4	Q2	-
31. Mouth of the Salmon River	1.5 miles, SE	-	-	-	Q2

*Control Stations

(a) Distance to nearest half mile

(b) W - Weekly, M - Monthly, Q - Quarterly, SA - Semi-Annual, A - Annual

(c) 1 - Gross Beta, 2 - Gamma Spectrum, 3 - I-131, 4 - H-3

(d) Includes a charcoal filter that is to be analyzed weekly for I-131

(e) Gamma spectra analyses are done on the monthly composites. If gross beta activity is > 10 times the mean of the control samples, a gamma spectrum analysis is to be performed on the individual sample.

(f) Bullheads and when available perch

TABLE 4.28-2

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

Analysis	Well Water (pCi/l)	River Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
gross beta	5	5	2×10^{-2}				
^{3}H	2000	2000					
^{54}Mn	15	30		130			
^{59}Fe	30	60		260			
$^{58,60}Co$	15	30		130			
^{65}Zn	30	60		260			
^{95}Zr	30	60					
^{95}Nb	15	30					
^{131}I			7×10^{-2}		1	60[b]	
^{134}Cs	15	30	1×10^{-2}	130	15	65	150
^{137}Cs	18	40	1.2×10^{-2}	160	18	80	180
^{140}Ba					40		
^{140}La					20		

*To be achieved 98% of the time

TABLE 4.28-2 (Continued)

TABLE NOTATION

a - The LLD is the smallest concentration of radioactive material in a sample that will be detected with 95% probability.

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

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

where

LLD is the 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

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 interferring 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.

b - LLD for leafy vegetables.

3.28.2 LAND USE CENSUS - This is strictly a surveillance program. There are no Limiting Conditions for Operation. See Specification 4.28.2.

4.28.2 LAND USE CENSUS - Surveillance Requirements

4.28.2.1 A land use census shall be conducted and shall identify the location of the nearest milk animal and nearest residence in each of the 16 meteorological sectors within a distance of five miles.

APPLICABILITY: At all times.

ACTION:

a. 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 ODCM and make note of the changes in the next semi-annual effluent report.

b. 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.

   (2) If the D/Q is not 20% greater than the previously highest D/Q, consider both direction, distance and D/Q in deciding whether to replace one of the existing sample locations. If applicable, replacement should be within 30 days.

Sample location changes should be noted in the annual report.

4.28.2.2 The land use census shall be conducted 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.

4.28.2.3 Reports - The results of the land use census shall be included in the Annual Radiological Environmental Operating Report.

3.28.3 QUALITY ASSURANCE PROGRAM - This is strictly a surveillance program. There are no Limiting Conditions for Operation. See Specification 4.28.3.

4.28.3 QUALITY ASSURANCE PROGRAM - Surveillance Requirements

4.28.3.1 Analyses shall be performed on radioactive materials supplied as part of a Quality Assurance Program.

APPLICABILITY: At all times.

ACTION:

a. 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.

4.28.3.2 A summary of the results of analyses performed as part of the above required Quality Assurance Program shall be included in the Annual Radiological Environmental Operating Report.

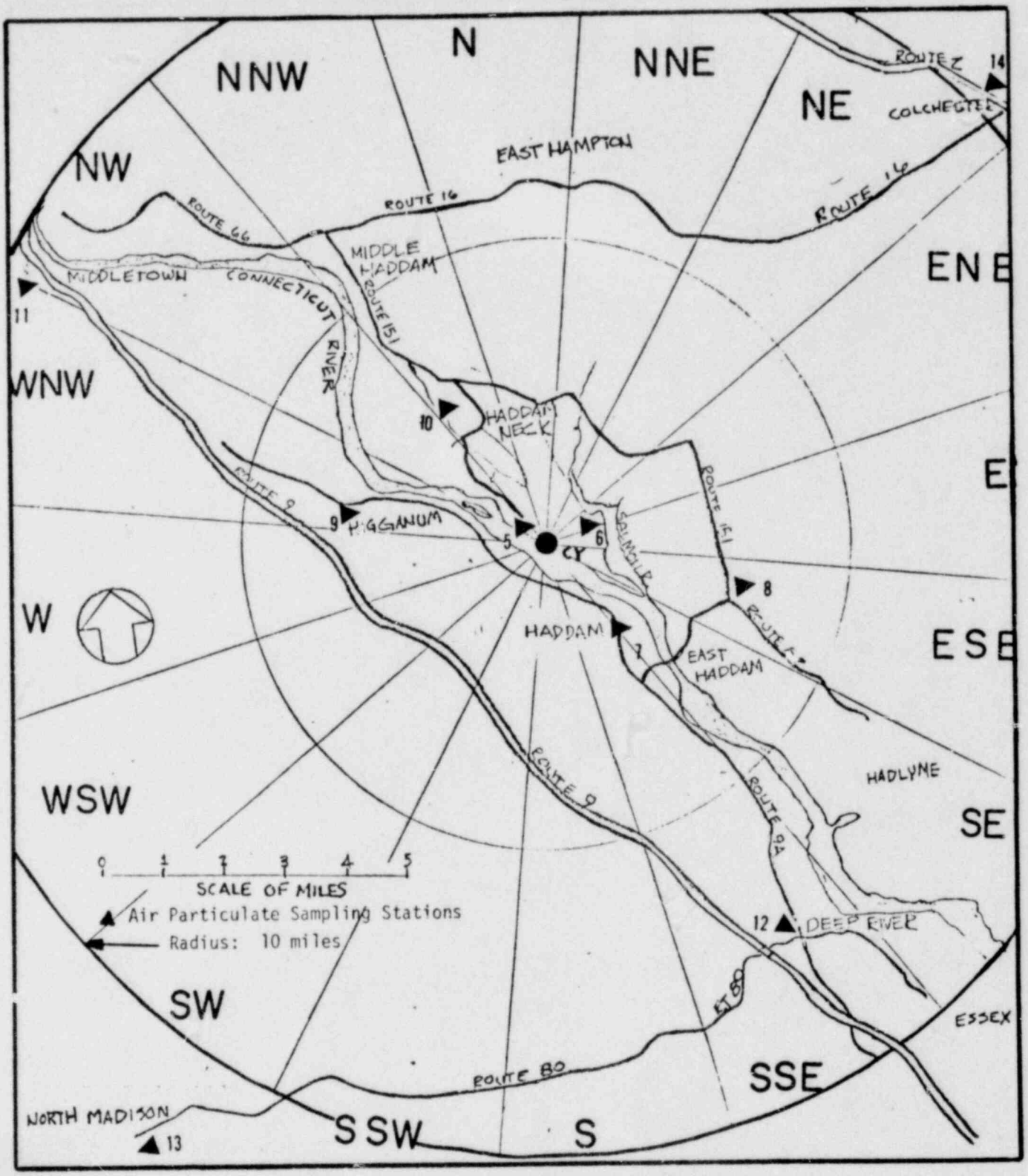


FIGURE 4.28-1
Inner and Outer Terrestrial Monitoring Stations
Haddam Neck Plant

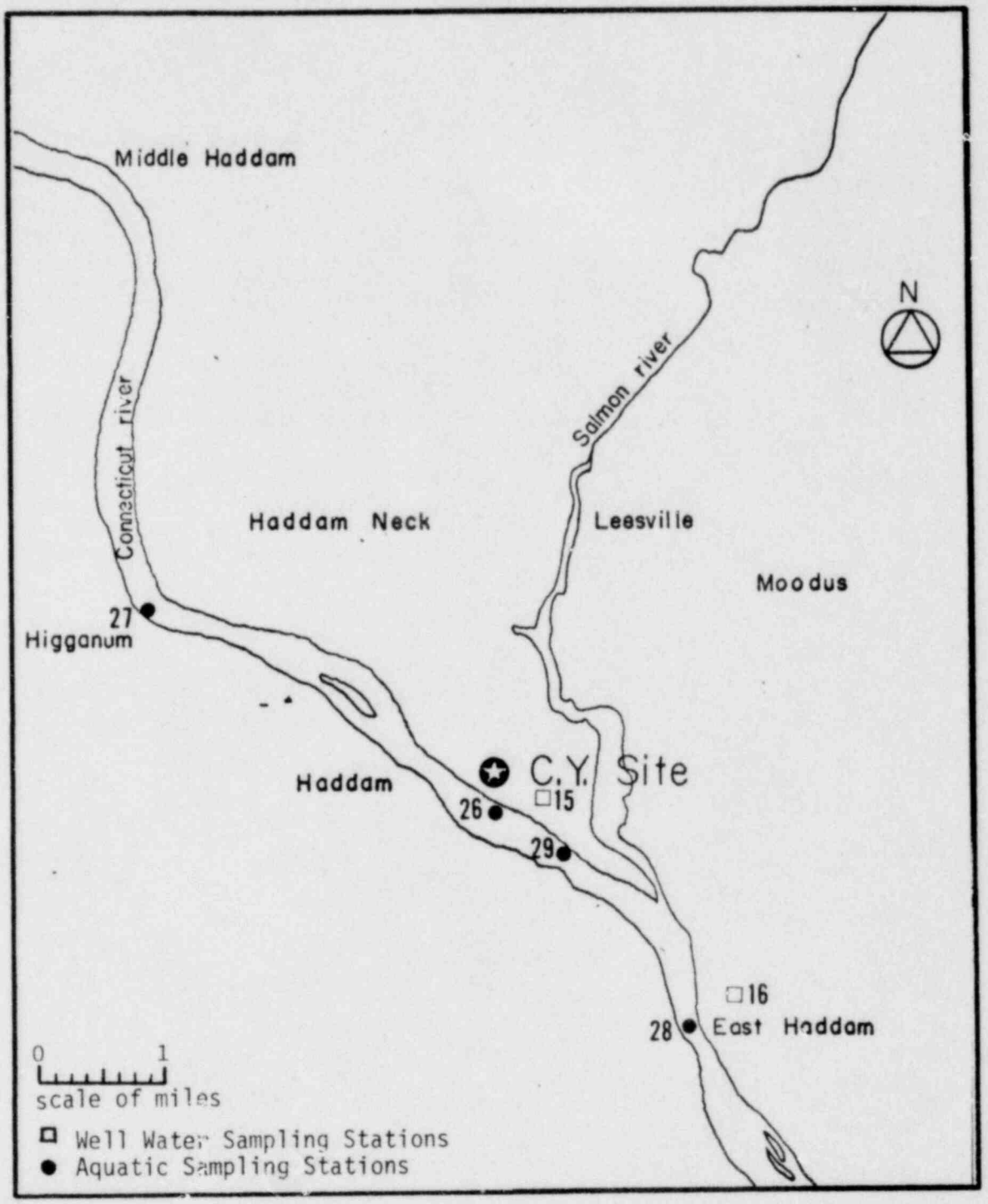


FIGURE 4.28-2
Aquatic and Well Water Sampling Stations
Haddam Neck Plant

3.28 RADIOLOGICAL ENVIRONMENTAL MONITORING

3.28.1 MONITORING PROGRAM

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

The detection capabilities required by Table 4.12.-1 are state-of-the-art for routine environmental measurements in industrial laboratories. The specified lower limits of detection for I-131 in water, milk and other food products correspond to approximately one-quarter of the Appendix I, 10 CFR Part 50 design objective dose-equivalent of 15 mrem/year for atmospheric releases and 10 mrem/year for liquid releases to the most sensitive organ and individual. They are based on the assumptions given in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," March 1976, except the change for an infant consuming 330 liters/year of drinking water instead of 510 liters/year.

The reporting levels given in Table 6.9-1 correspond to the annual Appendix I design dose limitations for the maximum individual.

3.28.2 LAND USE CENSUS

This specification is provided to ensure 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.

3.28.3 QUALITY ASSURANCE PROGRAM

The requirement for participation in a Quality Assurance 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.

AUDITS

6.5.2.8 Audits of facility activities shall be performed under the cognizance of the NRB. These audits shall encompass:

a. The conformance of facility operation to provisions contained within the Technical Specifications and applicable license conditions at least once per year.

b. The performance, training and qualifications of the entire facility staff at least once per year.

c. The results of all actions taken to correct deficiencies occurring in facility equipment, structures, systems or method of operation that affect nuclear safety at least once per six months.

d. The performance of all activities required by the Quality Assurance Program to meet the criteria of Appendix "B", 10 CFR 50, at least once per two years.

e. The Facility Emergency Plan and implementing procedures at least once per two years.

f. The Facility Security Plan and implementing procedures at least once per two years.

g. Any other area of facility operation considered appropriate by the NRB or the Vice President-Nuclear Engineering and Operations.

h. The Facility Fire Protection Program and implementing procedures at least once per two years.

i. An inspection and audit of the Fire Protection and loss prevention program shall be performed annually by an outside firm experienced in fire protection and loss prevention.

j. The Radiological Environmental Monitoring Program and the results thereof at least once per 12 months.

k. The OFFSITE DOSE CALCULATION MANUAL at least once per 24 months.

6.7 SAFETY LIMIT VIOLATION

6.7.1 The following actions shall be taken in the event a Safety Limit is violated:

a. The provisions of 10 CFR 50.36 (c) (1) (i) shall be complied with immediately.

b. The Safety Limit violation shall be reported to the Commission, the Superintendent of Nuclear Production and to the NRB immediately.

c. A Safety Limit Violation Report shall be prepared. The report shall be reviewed by the PORC. This report shall describe (1) applicable circumstances preceding the violation, (2) effects of the violation upon facility components, systems or structures, and (3) corrective action taken to prevent recurrence.

d. The Safety Limit Violation Report shall be submitted to the Commission, the NRB and the Superintendent of Nuclear Production within 14 days of the violation.

6.8 PROCEDURES

6.8.1 Written procedures and administrative policies shall be established, implemented and maintained that meet or exceed the requirements and recommendations of Sections 5.1 and 5.3 of ANSI N18.7-1972 and Appendix "A" of USAEC Regulatory Guide 1.33 except as provided in 6.8.2 and 6.8.3 below. Procedures shall be established and maintained for implementation of the Facility Fire Protection Program.

6.8.2 Except as specified in 6.8.4, each procedure and administrative policy of 6.8.1 above, and changes thereto, shall be reviewed by the PORC and approved by the Plant Superintendent prior to implementation and periodically as set forth in each document.

6.8.3 Except as specified in 6.8.4, temporary changes to procedures of 6.8.1 above may be made provided:

a. The intent of the original procedure is not altered.

b. The change is approved by two members of the plant management staff, at least one of whom holds a Senior Reactor Operator's License on the unit affected.

c. The change is documented, reviewed by the PORC and approved by the Plant Superintendent within 14 days of implementation.

6.8.4 All procedures and procedure changes required for Section 3/4.28 of these technical specifications (radiological environmental monitoring) do not require review as specified in Sections 6.8.2 and 6.8.3.

Rather, all such procedures shall be reviewed by a qualified discipline engineer, other than the author, and approved by supervision of the radiological assessment section. Temporary changes may be made provided the intent of the original procedure is not altered and the change is documented and reviewed by a qualified discipline engineer, other than the author, within 14 days of implementation.

(3) Identification of tubes plugged.

c. Occupational Exposure Report - The annual report shall be submitted prior to March 1 of each year and shall cover the previous calendar year. The initial report shall be submitted prior to March 1 of the year following initial criticality.

This annual report shall include a tabulation on an annual basis of the number of station, utility, and other personnel (including contractors) receiving exposures greater than 100 mrem/yr. and their associated man-rem exposure according to work and job functions, 4/e.g., reactor operations and surveillance; in-service inspection, routine maintenance, special maintenance (describe maintenance), waste processsing and refueling. The dose assignment to various duty functions may be estimated based on pocket dosimeter, TLD, or film badge measurements. Small exposures totalling less than 20% of the individual total dose need not be accounted for. In the aggregate, at least 80% of the total whole body dose received from external sources shall be assigned to specific major work functions.

d. Monthly Operating Report - Routine reports of operating statistics and shutdown experience shall be submitted on a monthly basis to the Office of Inspection and Enforcement, U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, with a copy to the appropriate Regional Office, to be postmarked no later than the tenth of each month following the calendar month covered by the report.

The monthly report shall include a narrative summary of operating experience during the report period relating to safe operation of the facility, including safety-related maintenance.

e. Reports required as per 10 CFR 50.59b.

f. Annual Radiological Environmental Monitoring Report - Routine radiological environmental monitoring reports covering the operation of the unit during the previous calendar year shall be submitted prior to May 1 of each year.

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 censuses required by Specification 3.28.2. 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 annual 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 summary description of the radiological environmental monitoring program including sampling methods for each sample type, size and physical characteristics of each sample type, sample preparation methods, analytical methods, and measuring equipment used. Previous reports containing this information may be referenced.

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 Quality Assurance Data required by Specification 3.28.3.

g. Semiannual Radioactive Effluent Release Report - In lieu of the time requirements of 10CFR 50.36a(a)(2) routine radioactive effluent release reports covering the operation of the unit during the previous 6 months shall be submitted within 90 days after January 1 and July 1 of each year.

The radioactive effluent release reports shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," with data summarized on a quarterly basis following the format of Appendix B thereof.

The radioactive effluent release reports shall include a summary of the meteorological conditions concurrent with the release of gaseous effluents during each quarter as outlined in Regulatory Guide 1.21, with data summarized on a quarterly basis following the format of Appendix B thereof.

The radioactive effluent release reports shall include a summary of the following information for all unplanned offsite releases of radioactive materials in gaseous and liquid effluents:

a. A brief 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.

The radioactive effluent release reports shall include an assessment of radiation doses from the radioactive liquid and gaseous effluents released from the unit during each calendar quarter as outlined in Regulatory Guide 1.21. The meteorological conditions concurrent with the releases of effluents shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the Offsite Dose Calculation Manual (ODCM).

The radioactive effluent release report shall also include changes to the ODCM made during the reporting period, as provided in Specification 6.15.

6.9.2 REPORTABLE OCCURRENCES

Reportable occurrences, including corrective actions and measures to prevent reoccurrence, shall be reported to the NRC. Supplemental reports may be required to fully describe final resolution of occurrence. In case of corrected or supplemental reports, a licensee event report shall be completed and reference shall be made to the original report date.

Note: This item is intended to provide for reporting of potentially generic problems.

b. Thirty-Day Written Reports. The reportable occurrences discussed below shall be the subject of written reports to the Director of the appropriate Regional Office within thirty days of occurrence of the event. The written report shall include, as a minimum, a completed copy of a licensee event report form. Information provided on the licensee event report form shall be supplemented, as needed, by additional narrative material to provide complete explanation of the circumstances surrounding the event.

(1) Reactor protection system or engineered safety feature instrument settings which are found to be less conservative than those established by the technical specifications but which do not prevent the fulfillment of the functional requirements of affected systems.

(2) Conditions leading to operation in a degraded mode permitted by a limiting condition for operation or plant shutdown required by a limiting condition for operation.

Note: Routine surveillance testing, instrument calibration, or preventative maintenance which require system configurations as described in Items 2.b(1) and 2.b(2) need not be reported except where test results themselves reveal degraded mode as described above.

(3) Observed inadequacies in the implementation of administrative or procedural controls which threaten to cause reduction of degree of redundancy provided in reactor protection systems or engineered safety feature systems.

(4) Abnormal degradation of systems other than those specified in Item 2.a(3) above designed to contain radioactive material resulting from the fission process.

Note: Sealed sources or calibration sources are not included under this item. Leakage of valve packing or gaskets within the limits for identified leakage set forth in technical specifications need not be reported under this item.

(5) An unplanned off-site release of 1) more than 1 curie of radioactive material in liquid effluents, 2) more than 150 curies of noble gas in gaseous effluents, or 3) more than 0.05 curies of radioiodine in gaseous effluents. The report of an unplanned off-site release of radioactive material shall include the following information:

1) A description of the event and equipment involved.

2) Cause(s) for the unplanned release.

3) Actions taken to prevent recurrence.

4) Consequences of the unplanned release.

(6) Measured levels of radioactivity in an environmental sampling medium determined to exceed the reporting level values of Table 6.9-1 when averaged over any calendar quarter sampling period. When more than one of the radionuclides in Table 6.9-1 are detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{concentration (1)}}{\text{limit level (1)}} + \frac{\text{concentration (2)}}{\text{limit level (2)}} + \ldots \geq 1.0$$

When radionuclides other than those in Table 6.9-1 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose to an individual is equal to or greater than the appropriate calendar year limit of Specifications 3.25.2.1, or 3.26.3.1. 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.

TABLE 6.9-1

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

	Reporting Levels			
Analysis	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/Kg, wet)	Milk (pCi/l)	Vegetables (pCi/Kg, wet)
Mn-54		3×10^4		
Fe-59		1×10^4		
Co-58		3×10^4		
Co-60		1×10^4		
Zn-65		2×10^4		
I-131	1		3	1×10^2
Cs-134	10	1×10^3	60	1×10^3
Cs-137	20	2×10^3	70	2×10^3
Ba-La-140			3×10^2	

6.14 PROCESS CONTROL PROGRAM

Hold until a later date.

6.15 OFFSITE DOSE CALCULATION MANUAL (ODCM)

6.15.1 The ODCM shall describe the methodology and parameters to be used in the calculation of offsite doses due to radioactive gaseous and liquid effluents and in the calculation of gaseous and liquid effluent monitoring instrumentation alarm/trip setpoints consistent with the applicable LCO's contained in these technical specifications.

The ODCM shall be submitted to the Commission at the time of proposed Radiological Effluent Technical Specifications and shall be subject to review and approval by the Commission prior to implementation.

Changes in parameters in the ODCM shall be reviewed by PORC prior to implementation. Changes in methodology shall be reviewed by PORC and the NRB prior to implementation. All such changes shall be submitted to the Commission by inclusion in the semiannual Radioactive Effluent Report for the period for which the change was made and should include sufficiently detailed information to support the rationale for the change.

6.16 MAJOR CHANGES TO RADIOACTIVE WASTE TREATMENT SYSTEMS (Liquid, Gaseous and Solid)

6.16.1 MAJOR CHANGES TO RADIOACTIVE WASTE SYSTEMS (liquid, gaseous and solid) shall be made by either of the following methods: "MAJOR CHANGES" is defined in Section 1 of these specifications.

A. Licensee initiated changes:

1) The Commission shall be informed of all changes by the inclusion of a suitable discussion of each change in the Semiannual Radioactive Effluent Release Report for the period in which the changes were made. The discussion of each change shall contain:

a) a summary of the evaluation that led to the determination that the change could be made (in accordance with 10 CFR 50.59);

b) sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

c) a detailed description of the equipment, components and processes involved and the interfaces with other plant systems;

d) an evaluation of the change which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste from those previously predicted in the license application and amendments thereto;

e) an evaluation of the change which shows the expected maximum exposures to individual in the restricted area and to the general population from those previously estimated in the license application and amendments thereto;

f) an estimate of the exposure to plant operating personnel as a result of the change; and

g) documentation of the fact that the change was reviewed and found acceptable by both the (PORC) and the (NRB).

2) The change shall become effective upon review and acceptance by both PORC and the NRB.

B. Commission initiated changes:

1) The applicability of the change to the facility shall be determined by (PORC) after consideration of the facility design.

2) The licensee shall provide the Commission with written notification of its determination of applicability including any necessary revisions to reflect facility design.

3) The change shall be reviewed by the (NRB) at its next regularly scheduled meeting.

4) The change shall become effective on a date specified by the Commission.

DOCKET NO. 50-213

ATTACHMENT 2

REVISED APPENDIX B
TECHNICAL SPECIFICATIONS

HADDAM NECK
PLANT

JANUARY, 1979

1. Proposed Changes

Section Number	Section Title	Page Nos.	Change
Table of Contents	---	i	Delete Sections 2.4 and 3.2 from Table of Contents
List of Figures	---	iii	Delete Fig. 3.2-1, 3.2-2, and 3.2-3 from list
List of Tables	---	iv	Delete all tables except table 3.1-1 from the list
1.0	Definitions & Abbreviations	1.2	Delete definition of MPC, blowdown, and Known Radioactive Source and abbrev. of MPC
2.4	Radioactive Effluents	2.4-1 through 2.4-19	Delete Entire Section
3.2	Radiological Environmental Monitoring	3.2-1 through 3.2-10	Delete Entire Section
5.6	Plant Reporting Requirements	5.6-1 through 5.6-5	Delete 5.6.1a - Part B - Radiological Report Delete 5.6.1.b - Radioactive Effluents Release Report Delete 5.6.2.b - Nonroutine Radiological Environmental Operating Report Delete 5.6.2.c - Nonroutine Radioactive Effluent Report Delete Table 5.6-1

JUSTIFICATION FOR CHANGES

These proposed changes in Attachment 1 incorporate all radioactive effluent monitoring and radiological environmental monitoring related specifications into Appendix A to DPR-61 Safety Technical Specifications. Accordingly, all corresponding sections currently a part of Appendix B, Environmental Technical Specifications, are proposed to be deleted, thereby eliminating unnecessary redundancy within the Specifications. Redundancy and conflicts between Appendices A and B can be minimized if the license amendment addresses both Appendices simultaneously.

DOCKET NO. 50-213

ATTACHMENT 3

OFFSITE DOSE CALCULATION MANUAL

HADDAM NECK PLANT

JANUARY, 1979

OFFSITE DOSE CALCULATION MANUAL

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APPENDICES

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 Haddam Neck Plant. 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 Technical Specifications. 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 manual 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 bases for some of the factors used in this manual are included as appendices to this manual, and as such are not considered part of 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 n 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.

B. RESPONSIBILITIES

All changes to this manual shall be reviewed by the Plant Operations Review Committee prior to implementation. Changes in methodology shall also be reviewed by the Nuclear Review Board prior to implementation. (The Nuclear Review Board does not have to review changes in parameters, only methodology.)

All changes and their rationale shall be documented in the subsequent 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

1. Compliance With Specification 3.25.2.1.a

a. Total Body Dose

(1) Method 1 - This method to be used until the calculated total body dose exceeds 0.15 mrem for the calendar quarter.

Step 1 - Determine C_F = total 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.

$$D_{QT} = 1.28 * C_F + 2.6 * 10^{-6} * C_T \text{ [Note 1]}$$

[Note 1] - See Appendix A for derivation of these factors.

Step 4 - If $D_{QT} > 0.15$ mrem, go to Method 2.

(2) Method 2 - This method to be used until the calculated total body dose exceeds 0.75 mrem for the calendar quarter.

Step 1 - Determine C_{134} = total curies of CS-134 released during the calendar quarter.

Step 2 - Determine C_{137} = total curies of CS-137 released during the calendar quarter.

Step 3 - Determine C_T = total curies of tritium released during the calendar quarter.

Step 4 - Determine V = total volume of dilution water discharged during the calendar quarter in gallons.

Step 5 - Determine D_{QT} = quarterly total body dose, in mrem:

$$D_{QT} = \frac{1}{V} (3.3 \times 10^{11} C_{134} + 1.9 \times 10^{11} C_{137} + 1.3 \times 10^{5} C_T) \text{[Note 1]}$$

Step 6 - If $D_{QT} > 0.75$ mrem, go to Method 3.

(3) Method 3

Step 1 - Determine C_i = total curies of nuclide i released during the calendar quarter. This should be determined for each nuclide identified during the quarter per analyses required by Table 4.25-1 of the Technical Specification. For nuclides which are routinely observed but are not readily identifiable (for example - Sr-89 and Sr-90), use the last quarter for which analyses have been completed

to determine an average μC/ml for each nuclide and multiply by the volume of undiluted waste discharged during the present quarter to determine an approximate curie estimate for the quarter.

Step 2 - Determine N = number of weeks which have passed during the present calendar quarter.

Step 3 - Determine V = total volume of dilution water discharged during the calendar quarter in gallons.

Step 4 - Determine A_{iT} (total body dose factor) from Table 1 for each nuclide determined in Step 1.

Step 5 - Determine D_{QT} = quarterly dose to the total body in mrem.

$$D_{QT} = (\frac{N}{52} * 21) * \frac{1}{V} * 2.6 \times 10^{11} * \sum_{i} C_i \cdot A_{iT} \text{ [Note 1]}$$

Caution: Be sure C_i is in curies and V is in gallons.

b. Maximum Organ Dose

(1) Method 1 - This method to be used until the calculated dose to the maximum organ exceeds 0.5 millirem for the calendar quarter.

Step 1 - Determine C_F - as in C.1.a(1) - Step 1

Step 2 - Determine C_T - as in C.1.a(2) - Step 2

Step 3 - Determine D_{QO} = quarterly dose to the maximum organ in mrem.

$$D_{QO} = 1.85 * C_F + 2.6 \times 10^{-6} * C_T \text{ [Note 2]}$$

[Note 2] - See Appendix B for derivation of these factors.

Step 4 - If $D_{QO} > 0.5$ mrem, go to Method 2.

(2) Method 2 - This method to be used until the calculated total body dose exceeds 2.5 mrem for the calendar quarter.

Step 1 - Determine C_{134} - as in C.1.a(2) - Step 1

Step 2 - Determine C_{137} - as in C.1.a(2) - Step 2

Step 3 - Determine C_T - as in C.1.a(2) - Step 3

Step 4 - Determine C_{131} - total curies of I-131 released during the calendar quarter.

Step 5 - Determine V = total volume of dilution water discharged during the calendar quarter in gallons.

Step 6 - Determine D_{QL} = quarterly liver dose, in mrem.

$$D_{QL} = \frac{1}{V} (4.0 \times 10^{11} C_{134} + 2.9 \times 10^{11} C_{137} + 1.3 \times 10^{5} C_{T}) \text{[Note 2]}$$

Step 7 - Determine D_{QI} = quarterly thyroid dose, in mrem

$$D_{QI} = \frac{1}{V} (4.0 \times 10^{10} C_{131}) \text{ [Note 2]}$$

Step 8 - Record maximum organ dose as the greater of D_{QL} or D_{QI}

Step 9 - If $D_{QL} > 2.5$ or $D_{QI} > 2.5$, go to method 3.

(3) Method 3

Step 1 - Determine C_i = total curies of each nuclide i as in C.1.a(3) - Step 1.

Step 2 - Determine N = number of weeks which have passed during the present calendar quarter.

Step 3 - Determine V = total volume of dilution water discharged during the calendar quarter in gallons.

Step 4 - Determine from Table 1 for each nuclide identified in Step 1 the following:

A_{iL} - liver dose factor

A_{iI} - thyroid dose factor

A_{iB} - bone dose factor

Step 5 - Determine D_{QL} = quarterly liver dose, in mrem.

$$D_{QL} = (\frac{N}{52} * 21) * 1/V * 2.6 \times 10^{11} * \sum_i C_i A_{iL} \text{ [Note 2]}$$

Step 6 - Determine D_{QI} = quarterly thyroid dose, in mrem.

$$D_{QI} = (\frac{N}{52} * 21) * 1/V * 2.6 \times 10^{11} * \sum_i C_i A_{iI} \text{ [Note 2]}$$

Step 7 - Determine D_{QB} = quarterly bone dose, in mrem.

$$D_{QB} = (\frac{N}{52} * 21) * 1/V * 2.6 \times 10^{11} * \sum_i C_i A_{iB} \text{ [Note 2]}$$

Step 8 - Record the maximum organ dose as the greater of D_{QL}, D_{QI} or D_{QB}.

2. Compliance With Specification 3.25.2.1.b

a. Total Body Dose

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.4 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.a.

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

b. Maximum Organ Dose

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

$D_{YO} = \sum D_{QO}$ or $\sum D_{QL}$ or $\sum D_{QI}$ or $\sum D_{QB}$ whichever is greater. The sum is over the first quarter through present quarter dose.

The following guidelines should be used:

(1) If the detailed quarterly dose calculations required per Section C.4 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.b.

(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 $D_{YO} > 10$ mrem and any value used in its determination was calculated as in Section C.1.b but not with Method 3, recalculate that value using Method 3 if this could reduce D_{YO} to less than 10 mrem.

3. Compliance With Specification 3.25.3.1

a. Monthly Dose Projections to the Total Body & Maximum Organ

Step 1 - Determine D'_{MT} = total body dose from the previously completed month as calculated per the methods in Section C1.a (see Note 3).

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

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.

ie) $$F_1 = \frac{\text{curies from blowdown}}{\text{curies from blowdown + curies from batch tanks}}$$

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 release if there are expected differences in treatment of liquid waste for the present month as opposed to the past month. NUREG-17 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:

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

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

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

Note 3 - If the past month is not typical of expected operations in the present month, go back to the last typical 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.

4. Quarterly Dose Calculations for Semi-Annual Radioactive Effluent Report

Detailed quarterly dose calculations required for the semi-annual Radioactive Effluent Report shall be done using the NRC computer code LADTAP. The use of this code, and the input parameters are given in Environmental Programs Branch Procedure #EPB-IV-5-8, Liquid Dose Calculations - LADTAP. This procedure is attached as Appendix C to this manual.

D. GASEOUS DOSE CALCULATIONS

1. Compliance With Specification 3.26.1.1

a. Determination of Noble Gas Release Rate Limit

Limit for Total Body:

$$1.32 \times 10^{-5} * \bar{K} * Q_N < 500 \text{ mrem/yr}$$

Limit for Skin:

$$1.32 \times 10^{-5} * \bar{S} * Q_N < 3000 \text{ mrem/yr.}$$

where:

1.32×10^{-5} = maximum annual average X/Q, sec/M^3 - 510 meters, NNW - See Appendix D.

$\bar{K}$ = Weighted average total body dose factor due to gamma emissions, mrem/yr per $\mu C/m^3$, as determined below.

$\bar{S}$ = Weighted average skin dose factor due to beta and gamma emissions, mrem/yr per $\mu C/m^3$, as determined below.

Q_N = release rate of noble gases in $\mu C/sec$.

Step 1 - Obtain results from last analysis of the flashed gases from primary coolant decay corrected to sample time.

Step 2 - For each noble gas radionuclide identified in Step 1, determine F_i = fraction nuclide i is of the total noble gas activity.

Step 3 - For each noble gas radionuclide identified in Step 1, determine K_i and S_i from Table 2.

Step 4 - Determine $\bar{K} = \sum_i F_i K_i$

Step 5 - Determine $\bar{S} = \sum_i F_i S_i$

Step 6 - Determine the release rate limit.

$$Q_N \text{ (}\mu\text{C/sec)} \quad \frac{500}{1.32 \times 10^{-5} \times \bar{K}} \quad \text{or}$$

$$Q_N \text{ (}\mu\text{C/sec)} \quad \frac{3000}{1.32 \times 10^{-5} \times \bar{S}}$$

whichever is lower.

Note - See Appendix D for justification of the method for determination of $\bar{S}$ and $\bar{K}$.

b. Determination of Iodine and Particulate Release Rate Limit

(1) Method 1 - The dose rate to the maximum organ will be less than 1500 mrem/yr provided:

(a) Release rate I-131 $< 8.0 \times 10^{-3}$ μC/sec

(b) Release rate of particulates with half lives greater than 8 days $< 8.3 \times 10^{-2}$ C/sec.

and (c) Release rate of tritium $< 1.2 \times 10^{4}$ μCi/sec

Step 1 - Verify that the release rates are less than the above values. If they are, the dose rate is < 1500 mrem/yr. If not, go to Method 2.

Note - See Appendix D for derivation of the above release rate limits.

(2) Method 2 - If any one of the above limits are exceeded, use the following method.

Step 1 - Determine Q_i (μCi/sec) for each of the following: I-131, H-3, and each particulate nuclide with a half life greater than 8 days identified in effluent samples.

Step 2 - Determine O_i = maximum organ dose factor for each nuclide identified in Step 1. These values can be determined from Table 3.

Step 3 - Determine D_O = dose rate to maximum organ (mrem/yr)

$$D_O = \sum_i Q_i \, O_i$$

D_O should be less than 1500 mrem/yr. If not go to Method 3.

(3) Method 3 - Use the GASPAR code - (procedure to use is given as Appendix E) to determine the maximum organ dose. For the Special Location, enter 1.32×10^{-5} for the X/Q's and 5.71×10^{-8} for the D/Q's. See Appendix D for the difference between Method 2 and 3.

2. Compliance With Specification 3.26.2.1

a. Quarterly Air Dose Limit Due to Noble Gases

(1) Method 1 - This method to be used until the calculated beta air dose exceeds 3 mrad.

Step 1 - Determine C_N = total curies from all sources of noble gases released during the calendar quarter.

Step 2 - Determine D_{QAG} = quarterly air gamma dose (mrad):

$$D_{QAG} = 1.9 \times 10^{-4} * C_N \text{ [See Note 4]}$$

Step 3 - Determine D_{QAB} = quarterly air beta dose (mrad):

$$D_{QAB} = 7.4 \times 10^{-4} * C_N \text{ [See Note 4]}$$

Step 4 - If D_{QAB} exceeds 3 mrad, go to Method 2.

[Note 4] - See Appendix F for derivation of these factors.

(2) Method 2 - This method to be used until the calculated gamma air dose exceeds 5 mrads or the beta air dose exceeds 10 mrads.

Step 1 - Determine C_i = total curies of each identified noble gas nuclide i released during the quarter from all sources, both continuous and batch.

Step 2 - Determine M_i = gamma air dose factor for each noble gas nuclide identified above. Values are given in Table 2.

Step 3 - Determine N_i = beta air dose factor for each noble gas nuclide identified above. Values are given in Table 2.

Step 4 - Determine D_{QAG} = quarterly air gamma dose (mrad):

$$D_{QAG} = 4.2 \times 10^{-7} * \sum_i M_i C_i \text{ [See Note 4]}$$

Step 5 - Determine D_{QAB} = quarterly air beta dose (mrad):

$$D_{QAB} = 4.2 \times 10^{-7} * \sum_i N_i C_i \quad \text{[See Note 4]}$$

Step 6 - If $D_{QAG} > 5$ mrad or $D_{QAB} > 10$ mrad, go to Method 3.

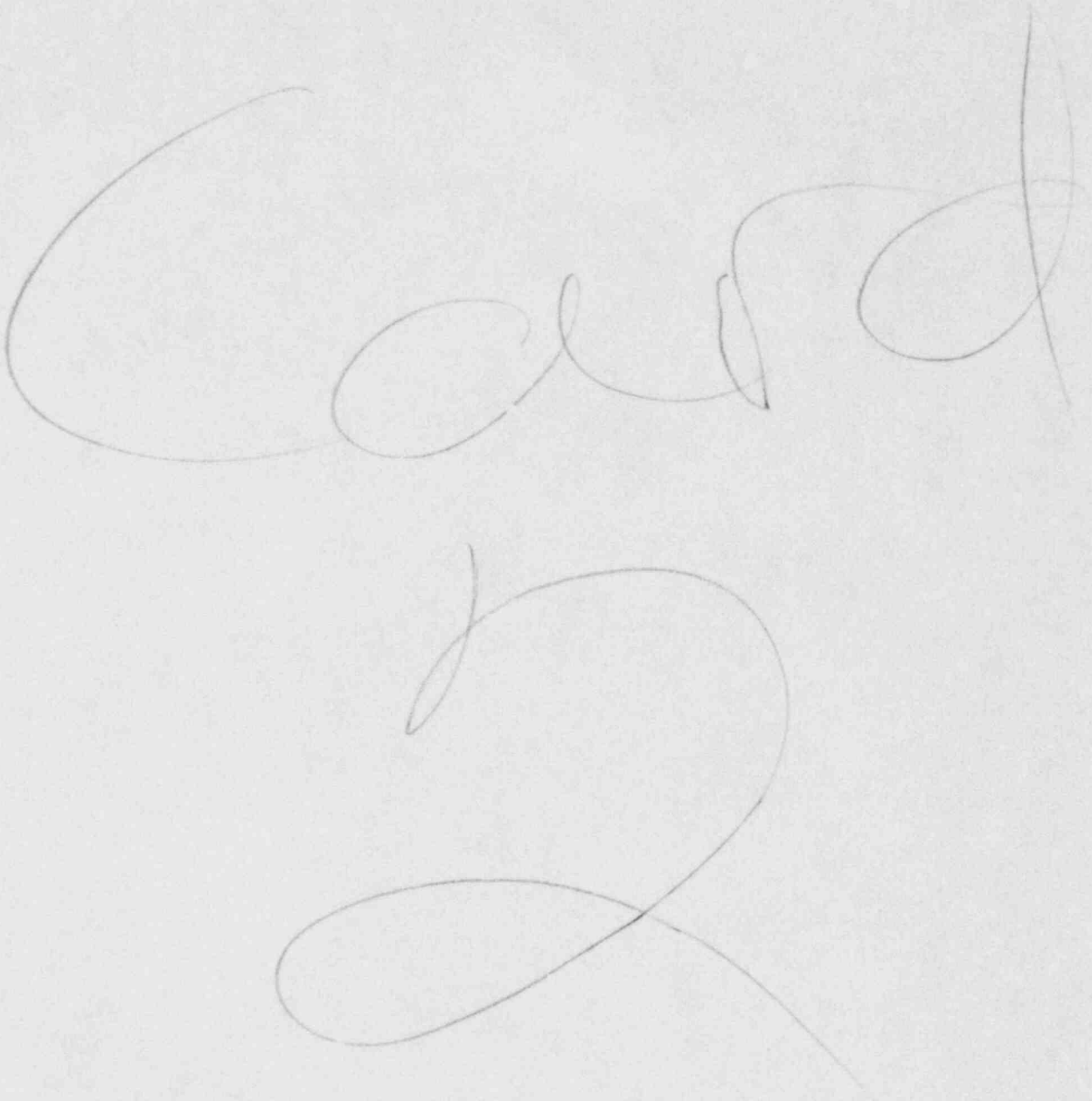
(3) Method 3

Step 1 - Determine C_{iC} = total curies of each identified noble gas nuclide i released during the quarter from all continuous releases.

Step 2 - Determine C_{iB} = total curies of each identified noble gas nuclide i released during the quarter from all batch releases.

Step 3 - Determine $(X/Q)_{CA}$ = maximum real time site boundary X/Q for continuous releases during the entire period for which doses are being calculated. Call this location A. Real time X/Q data is available from NUSCO - Environmental Programs Branch.

Step 4 - Determine $(X/Q)_{BB}$ = maximum real time site boundary X/Q for batch releases using the actual hours of batch release. Call this location B.



Step 5 - Determine $(X/Q)_{CB}$ = real time site boundary X/Q for continuous releases at location B.

Step 6 - Determine $(X/Q)_{BA}$ = real time site boundary X/Q for batch releases at location A.

Step 7 - Determine M_i and N_i - as in Method 2.

Step 8 - Determine the quarterly gamma air dose at locations A and B.

$$D_{QAG} \text{ (LOC A)} = 3.17 \times 10^{-2} \left[(X/Q)_{CA} \sum_i C_{iC} M_i + (X/Q)_{BA} \sum_i C_{iB} M_i\right]$$

$$D_{QAG} \text{ (LOC B)} = 3.17 \times 10^{-2} \left[(X/Q)_{CB} \sum_i C_{iC} M_i + (X/Q)_{BB} \sum_i C_{iB} M_i\right]$$

D_{QAG} = greater of the two values.

Step 9 - Determine the quarterly beta air dose at locations A and B.

$$D_{QAB} \text{ (LOC A)} = 3.17 \times 10^{-2} \left[(X/Q)_{CA} \sum_i C_{iC} N_i + (X/Q)_{BA} \sum_i C_{iB} N_i\right]$$

$$D_{QAB} \text{ (LOC B)} = 3.17 \times 10^{-2} \left[(X/Q)_{CB} \sum_i C_{iC} N_i + (X/Q)_{BB} \sum_i C_{iB} N_i\right]$$

D_{QAB} = greater of the two values.

b. Annual Air Dose Limit Due to Noble Gases

Determine D_{YAG} and D_{YAB} = gamma air dose and beta air dose for the calendar year as follows:

$$D_{YAG} = \sum D_{QAT} \text{ and } D_{YAB} = \sum D_{QAB}$$

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

The following should be used as D_{QAT} and D_{QAB}:

(1) If the detailed quarterly dose calculations required per Section D.4 for the semi-annual 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.

(3) If $D_{YAG} > 10$ mrad or $D_{YAB} > 20$ mrad and any corresponding quarterly dose was not calculated using Method 3 of Section D.2.a, recalculate the quarterly dose using Method 3 if this could reduce the annual dose below the allowable limits.

3. Compliance With Specification 3.26.3.1

a. Quarterly Organ Dose Limit

(1) Method 1 - This method to be used until the calculated maximum organ dose exceeds 7.5 mrem.

Step 1 - Determine Q_{I131} = average μCi/sec of I-131 released during the calendar quarter.

Step 2 - Determine Q_{H-3} = average μCi/sec if H-3 released during the calendar quarter.

Step 3 - Determine Q_P = average μCi/sec of all particulates with half lives greater than 8 days released during the calendar quarter.

Step 4 - Determine N = number of weeks for which the dose is being calculated. For example, after the 2nd month of the quarter, N would be approximately 9 weeks.

Step 5 - Determine D_{QT} = quarterly thyroid dose as follows:

$$D_{QT} = \frac{N}{52} * [6.3 \times 10^{4} * Q_{I-131} + 4.0 \times 10^{-2} Q_{H3}]$$ [See Note 6]

Step 6 - Determine D_{QO} = quarterly dose to maximum organ other than the thyroid:

$$D_{QO} = N/52 \ [4.0 \times 10^{-2} Q_{H3} + 6.0 \times 10^{3} Q_{P}]$$ [See Note 6]

Step 7 - D_{QMO} = Maximum organ dose equals the greater of D_{QT} or D_{QO}. If either is greater than 7.5 mrem, go to Method 2.

Note 6 - See Appendix F for derivation of the factors given here.

(2) Method 2 - The GASPAR code should be used to determine the maximum quarterly organ dose. Real time meteorology should be used. Specific curies for each iodine and particulate nuclide should be entered. Only continous releases and meteorology need be considered as they are the source of the iodines and particulates. Only those pathways which are actually in existence at the time should be used (for example - do not use milk pathway in 1st. quarter). Vegetation and milk pathway doses should be calculated only at real locations.

The procedure for use of the GASPAR code is presented in Appendix E.

b. Annual Organ Dose Limit

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

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

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

(1) If the detailed quarterly dose calculations required per Section D.4 for the semi-annual 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.

(3) If D_{YO} is greater than 15 mrem and any quarterly dose was not calculated using Method 2 of Section D.3.a, recalculate the quarterly dose using Method 2 if this could reduce the annual dose below 15 mrem.

(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.

4. Compliance With Specification 3.26.4.1

a. Monthly Dose Projections From Gaseous Radwaste Treatment System

Step 1 - Estimate C_N^E = the number of curies of gas to be processed during the next month.

Step - Determine D^{E}_{MAG} = estimated monthly gamma air dose for process gas:

$$D^{E}_{MAG} = 1.9 \times 10^{-4} * C^{E}_{N} \text{ (mrad)}$$

(Note - factor from section D.2.a.(1).)

Step 3 - Determine D^{E}_{MAB} = estimated monthly beta air dose for process gas:

$$D^{E}_{MAB} = 7.4 \times 10^{-4} C^{E}_{N} \text{ (mrad)}$$

(Note - factor from section D.2.a.(2).)

b. Monthly Dose Projections From Continuous Ventilation Releases

Step 1 - For the last quarter of operation, determine D_{QMO} 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 organ.

$$D^{E}_{MO} = 1/3\ R_1\ R_2\ D_{QMO}$$

5. Quarterly Dose Calculations for Semi-Annual Report

Detailed quarterly dose calculations required for the Semi-Annual Radioactive Effluent Report shall be done using the computer code GASPAR. The use of this code and required input parameters are given in Environmental Programs Branch Procedure #EPB-IV-5-9, Gaseous Dose Calculations - GASPAR. This procedure is attached as Appendix E.

6. Compliance With Specification 3.26.5.1

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

a. CY gaseous doses - as calculated in Section D above.

b. CY liquid doses - as calculated in Section C above.

c. CY - direct radiation from the site.

d. Since all other uranium fuel cycle sources are greater than 20 miles away, they need not be considered.

E. LIQUID MONITOR SETPOINTS

1. Test Tank Discharge Line Monitor

The trip/alarm setting on the test tank discharge line monitor depends on dilution water flow, test tank discharge flow, the isotopic composition of the liquid to be discharged, the background count rate of the monitor and the efficiency of the monitor. Due to the variability of 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 valves for each identified nuclide, determine the dilution required.

$$D.R. = \sum_i (C_i/MPC_i)$$

where:

D.R. = dilution required

C_i = concentration of nuclude i (u Ci/ml)

MPC_i = MPC value (10CFR20, Appendix B, Table 2, Column 2) for nuclide i (u Ci/ml)

Step 2. Determine the existing dilution ratio:

$$D.E. = \frac{\text{\# Circ. Pumps Running x } 92{,}000}{50}$$

where:

92,000 = GPM flow from 1 circ. pump

50 = maximum possible GPM from test tank line

D.E. = existing dilution ratio

Step 3. Determine A (u Ci/ml) = $\sum_i C_i$ = total u Ci/ml in tank.

Step 4. Determine monitor set point in u Ci/ml (S) as follows:

$$S \text{ (u Ci/ml)} = A \text{ (u Ci/ml)} \frac{D.E.}{D.R.}$$

Step 5. Using the monitor calibration curve, determine the CPM corresponding to S (u Ci/ml). The monitor alarm/trip setpoint should be set at less than this corresponding value plus the background count rate.

2. Steam Generator Blowdown Monitor

Step 1. Maximum possible liquid discharge rate = 70 GPM (maximum blowdown rate = 100 gpm of which 30% flashes to steam).

Step 2. Minimum possible dilution flow rate = 276,000 GPM (minimum of 3 circ. pumps during periods of blowdown).

Step 3. Unidentified MPC for unrestricted area = 1×10^{-7} u Ci/ml.

Step 4. Therefore, alarm/setpoint snould be:

$$S \text{ (u Ci/ml)} = 1 \times 10^{-7} \times \frac{276,000}{70} = 3.9 \times 10^{-4} \text{ u Ci/ml}$$

Step 5. Using the monitor calibration curve, determine the CPM corresponding to 3.9×10^{-4} u Ci/ml. The monitor alarm setpoint should be set at less than this corresponding value plus the background count rate.

3. Service Water Radiation Monitor

Step 1. Maximum possible service water flow from potentially contaminated areas = 5,000 GPM.

Step 2. Dilution flow F_D (gpm)

F_D = # Circ. pumps x 92,000 + # service water pumps x 6000 GPM.

Step 3. Unidentified MPC for unrestricted area = 1×10^{-7} u Ci/ml.

Step 4. Therefore alarm setpoint should be:

$$S \text{ (u Ci/ml)} = 1 \times 10^{-7} \times \frac{F_D}{5000}$$

Step 5. Using the monitor calibration curve, determine the CPM corresponding to S (u Ci/ml). The monitor alarm setpoint should be set at less than this corresponding value plus the background count rate.

4. Tank Level Monitors

Tank level alarms are set as follows:

Refueling water storage tank high alarm - 250,000 gallons

test tanks A & B - 13,700 gallons.

F. GASEOUS MONITOR SETPOINTS

1. Stack Noble Gas Activity Monitor

Step 1. As given in Section D.1.a. of this manual, determine the noble gas release rate limit Q_N in u Ci/sec.

Step 2. Estimate maximum possible stack flow rate = F_S (CC/sec) = 1.2 x # purge fans x 52,000 CFM x 472 CC/SEC/CFM.

Where 52,000 CFM = Flow from one purge flow and 1.2 = conservative factor for maximum possible flow.

$$F_S = 3 \times 10^7 \times \text{\# purge fans (CC/SEC)}$$

Step 3. Determine monitor alarm/trip setpoint

$$S = Q_N/F_S \text{ (u Ci/cc)}$$

Step 4. Using the monitor calibration curve, determine the CPM corresponding to S (u Ci/CC). The monitor alarm setpoint should be set at less than this corresponding value.

TABLE 1

LIQUID DOSE FACTORS - CY - ADULTS*

Radionuclide	Total Body A_{iT} (mrem.l/pCi.kg)	Liver A_{iL}	Thyroid A_{iI}	Bone A_{iB}
H-3	9.5×10^{-8}	9.5×10^{-8}	9.5×10^{-8}	-
P-32	7.5×10^{-1}	1.2×10^{0}	-	1.9×10^{1}
Cr-51	5.3×10^{-7}	-	3.2×10^{-7}	-
Mn-54	3.5×10^{-4}	1.8×10^{-3}	-	-
Fe-55	4.4×10^{-5}	1.9×10^{-4}	-	2.7×10^{-4}
Fe-59	3.9×10^{-4}	1.0×10^{-3}	-	4.3×10^{-4}
Co-58	8.4×10^{-5}	3.7×10^{-5}	-	-
Co-60	2.4×10^{-4}	1.1×10^{-4}	-	-
Zn-65	1.4×10^{-2}	3.1×10^{-2}	-	9.7×10^{-3}
Rb-86	2.0×10^{-2}	4.2×10^{-2}	-	-
Sr-89	2.7×10^{-4}	-	-	9.2×10^{-3}
Sr-90	5.6×10^{-2}	-	-	2.3×10^{-1}
Y-91	9.4×10^{-8}	-	-	3.5×10^{-6}
Zr-95	2.2×10^{-8}	3.2×10^{-8}	-	1.0×10^{-7}
Zr-97	5.1×10^{-10}	1.1×10^{-9}	-	5.5×10^{-9}
Nb-95	5.6×10^{-5}	1.0×10^{-4}	-	1.8×10^{-4}
Mo-99	8.2×10^{-6}	4.3×10^{-5}	-	-
Ru-103	8.0×10^{-7}	-	-	1.9×10^{-6}
Ru-106	3.5×10^{-6}	-	-	2.8×10^{-5}
Ag-110m	2.0×10^{-7}	3.4×10^{-7}	-	3.6×10^{-7}
Te-125m	1.4×10^{-4}	3.8×10^{-4}	3.2×10^{-4}	1.1×10^{-3}
Te-127m	3.3×10^{-4}	9.7×10^{-4}	6.9×10^{-4}	2.7×10^{-3}
Te-129m	7.3×10^{-4}	1.7×10^{-3}	1.6×10^{-3}	4.6×10^{-3}
Te-131m	2.8×10^{-4}	3.4×10^{-4}	5.4×10^{-4}	6.9×10^{-4}
Te-132	6.1×10^{-4}	6.5×10^{-4}	7.2×10^{-4}	1.0×10^{-3}
I-131	5.1×10^{-5}	8.9×10^{-5}	2.9×10^{-2}	6.2×10^{-5}
I-133	1.1×10^{-5}	3.7×10^{-5}	5.4×10^{-3}	2.1×10^{-5}
Cs-134	2.4×10^{-1}	3.0×10^{-1}	-	1.2×10^{-1}
Cs-136	3.7×10^{-2}	5.1×10^{-2}	-	1.3×10^{-2}
Cs-137	1.4×10^{-1}	2.2×10^{-1}	-	1.6×10^{-1}
Ba-140	5.3×10^{-6}	1.0×10^{-7}	-	8.1×10^{-5}
La-140	8.3×10^{-9}	1.0×10^{-8}	-	6.3×10^{-8}
Ce-141	7.18×10^{-10}	3.2×10^{-9}	-	9.4×10^{-9}
Ce-143	1.35×10^{-10}	6.3×10^{-9}	-	1.7×10^{-9}
Ce-144	2.62×10^{-8}	1.2×10^{-6}	-	4.9×10^{-7}
Np-239	6.5×10^{-10}	2.0×10^{-7}	-	1.2×10^{-8}
		1.2×10^{-9}		

* - Determined by multiplying the bioaccumulation factor for freshwater fish times the adult ingestion dose factor - both taken from Reg. Guide 1.109-Rev. 1.

TABLE 2

DOSE FACTORS FOR NOBLE GASES & DAUGHTERS

Radionuclide	(mrem/yr per μCi/m^3) Total Body Factor K_i	(mrem/yr per μCi/m^3) Skin Factor S_i**	(mrad/yr per μCi/m^3) Gamma Air Dose Factor M_i	(mrad/yr per μCi/m^3) Beta Air Dose Factor N_i
Kr-83m	7.56 (-2)*	2.12 (1)	1.93 (1)	2.88 (2)
Kr-85m	1.17 (3)	2.81 (3)	1.23 (3)	1.97 (3)
Kr-85	1.61 (1)	1.36 (3)	1.72 (1)	1.95 (3)
Kr-87	5.92 (3)	1.65 (4)	6.17 (3)	1.03 (4)
Kr-88	1.47 (4)	1.91 (4)	1.52 (4)	2.93 (3)
Kr-89	1.66 (4)	2.91 (4)	1.73 (4)	1.06 (4)
Kr-90	1.56 (4)	2.52 (4)	1.63 (4)	7.83 (3)
Xe-131m	9.15 (1)	6.48 (2)	1.56 (2)	1.11 (3)
Xe-133m	2.51 (2)	1.35 (3)	3.27 (2)	1.48 (3)
Xe-133	2.94 (2)	6.94 (2)	3.53 (2)	1.05 (3)
Xe-135m	3.12 (3)	4.41 (3)	3.36 (3)	7.39 (2)
Xe-135	1.81 (3)	3.97 (3)	1.92 (3)	2.46 (3)
Xe-137	1.42 (3)	1.39 (4)	1.51 (3)	1.27 (4)
Xe-138	8.83 (3)	(4)	9.21 (3)	4.75 (3)
Ar-41	8.84 (3)	1.29 (4)	9.30 (3)	3.28 (3)

* 7.56 (-2) = 7.56×10^{-2}

** $S_i = L_i + 1.1\ M_i$ from NRC proposed specifications.

TABLE 3

DOSE FACTORS FOR IODINES & PARTICULATES

Radionuclide	O_i* (mrem/yr per μCi/Sec)
H-3	4.0 (-2)
P-32	8.6 (3)
Mn-54	6.3 (1)
Fe-59	4.0 (1)
Co-58	3.3 (1)
Co-60	2.6 (2)
Zn-65	9.7 (2)
Rb-86	9.1 (2)
Sr-89	5.7 (2)
Sr-90	6.0 (3)
Y-91	1.1 (2)
Zr-95	2.0 (1)
Nb-95	2.1 (1)
Ru-103	1.9 (3)
Ru-106	2.5 (4)
Ag-110m	8.6 (2)
Cd-115m	3.7 (0)
Sm-123	2.0 (2)
Sm-126	7.9 (1)
Sb-124	6.4 (1)
Sb-125	6.3 (1)
Te-127m	4.2 (3)
Te-129m	7.5 (1)
Cs-134	3.0 (3)
Cs-136	3.1 (2)
Cs-137	2.7 (3)
Ba-140	1.4 (1)
Ce-141	5.1 (0)
Ce-144	3.9 (1)
I-131	6.3 (4)
I-133	6.0 (2)

* - O_i - determined by: $1.32 \times 10^{-5} \times P_i$ inhalation + $5.71 \times 10^{-8} \times P_i$ Food = O_i

Where 1.32×10^{-5} is max. X/Q and 5.71×10^{-8} is max. D/Q and P_i inhalation and food are from NRC draft spec. - NUREG 472 - May 1978.

APPENDIX A

DERIVATION OF FACTORS FOR SECTION C.1.a

1. Section (1) - Step 3

CY LIQUID DOSES

Year	Quarter	C'_F	$D'_{QT(F)}$	D'_{QT}/C'_F	C'_T	D'_{GT} (H_3)	D'_{QT} $(H'_3)/C'_T$
1976	1	0.040	0.0046	0.115	1800	1.2 (-3)	6.7 (-7)
	2	0.029	0.0038	0.131	2620	2.5 (-3)	9.5 (-7)
	3	0.018	0.043	2.391	130	4.3 (-4)	3.3 (-6)
	4	0.043	0.035	0.814	310	1.0 (-3)	3.2 (-6)
1977	1	0.021	0.038	1.81	600	2.0 (-3)	3.3 (-6)
	2	0.214	0.036	0.168	1010	3.3 (-3)	3.3 (-6)
	3	0.232	0.29	1.25	4050	1.3 (-2)	3.2 (-6)
	4	1.48	0.20	0.135	1010	3.2 (-3)	3.2 (-6)
1978	1	0.55	1.9	3.45	610	1.5 (-3)	2.5 (-6)
	2	0.27	0.68	2.52	540	1.4 (-3)	2.6 (-6)

C'_F - Curies of fission and activation products released during calendar quarter.

$D'_{QT(F)}$ - Calculated dose (mrem) due to fission and activation products. Dose calculated using computer code LADTAP total body dose to maximum individual.

C'_T - Curies of tritium released during calendar quarter.

$D'_{QT}(H'_3)$ - Calculated dose (mrem) due to tritium. Dose calculated using computer code LADTAP-total body dose to maximum individual.

Avg value of $D'_{QT(F)}/C'_F$ = $\boxed{1.28}$ mrem/Ci

Max value of $D'_{QT(F)}/C'_F$ = 3.45 mrem/Ci

or Max = 2.7 x Avg

$\therefore$ dose should not exceed 2.7 x 0.15 = 0.4 mrem with Method 1.

Avg value $D'_{QT(H3)}/C'_T$ = $\boxed{2.6 \times 10^{-6}}$ mrem/Ci

Max value of $D'_{QT(H3)}/C'_T = 3.3 \times 10^{-6}$ or 1.3 x Avg.

$\therefore$ dose should not exceed 1.3 x 0.15 = 0.2 mrem with Method 1.

2. Section (2) - Justification for Only Using 3 Nuclides

Year	Quarter	Nuclide - % of Total Body Dose				
		Cs-134	Cs-137	H-3	Co-60	Sr-90
1976	1	14	59	25	-	-
	2	-	30	68	-	-
	3	1	97	1	-	-
	4	37	58	2	-	-
1977	1	14	79	5	-	-
	2	19	66	9	3	-
	3	23	61	4	-	10
	4	63	33	1	-	-
1978	1	60	38	-	-	-
	2	59	40	-	-	-
	Avg =	29	56	11	< 1	1

Only Cs-134, Cs-137 and H-3 have contributed more than 10% of the dose in any one quarter and on the average they constitute 99% of the dose.

Therefore, using only these three nuclides for Method 2, the real dose should not exceed 1.1 x 0.75 = 0.83 mrem.

3. Section (2) - Step 5

$$\text{Dose Cs-134} = \frac{\text{C134 (Ci)}}{\text{V (gal)}} \times 10^{12}\ \text{pCi/Ci} \times 2.0 \times 10^{3}\ \text{pCi/kg} - \frac{\text{liter}}{\text{pCi}}$$

$$\times\ 1.21 \times 10^{-4}\ \text{mrem/pCi} \times 21/4\ \text{kg} \times 0.26\ \text{gal/liter}$$

where

2.0×10^{3} = Bioaccumulation factor for Cs for freshwater fish - Table A-1 Reg. Guide 1.109.

1.21×10^{-4} = Ingestion dose factor for adults total body - Cs-134 - Table E-11, Reg. Guide 1.109.

21/4 = Quarterly usage factor - adult - fish

$$\text{Dose Cs-134} = \frac{\text{C134}}{\text{V}} \times \boxed{3.3 \times 10^{11}}$$

$$\text{Dose Cs-137} = \frac{\text{C137 (Ci)}}{\text{V (gal)}} \times 10^{12}\ \text{pCi/Ci} \times 2.0 \times 10^{3}\ \text{pCi/kg liter/pCi}$$

$$\times\ 7.14 \times 10^{-5}\ \text{mrem/pCi} \times 21/4\ \text{kg} \times 0.26\ \text{gal/liter}$$

where 7.14×10^{-5} = ingestion dose factor for adults total body - Cs-137 - Table E-11 - Reg. Guide 1.109.

$$\text{Dose Cs-137} = \frac{C137}{V} \times \boxed{1.9 \times 10^{11}}$$

$$\text{Dose H-3} = \frac{CT\ (Ci)}{V\ (gal)} \times 10^{12}\ \text{pCi/Ci} \times 0.9\ \text{pCi/kg liter/pCi}$$

$$\times 1.05 \times 10^{-7}\ \text{mrem/pCi} \times 2\text{1/4 kg} \times 0.26\ \text{gal/liter}$$

where 0.9 = bioaccumulation factor for H3 for freshwater fish - Table A-1 - Reg. Guide 1.109

1.05×10^{-7} = ingestion dose factor for adult total body - H-3 - Table E-11 - Reg. Guide 1.109

$$\text{Dose H-3} = \frac{CT}{V} \times \boxed{1.3 \times 10^{5}}$$

4. Section (3) - Step 5

10^{12} pCi/Ci x 0.26 gal/l = $\boxed{2.6 \times 10^{11}}$

APPENDIX B

DERIVATION OF FACTORS FOR SECTION C.1.b

1. Section (1) - Step 3

CY LIQUID DOSES

Year	Quarter	C'_F	Max Organ	D'_{QO}	D'_{QO}/C'_F	C'_T	$D'_{QO}(H_3)$	$D'_{QO}(H_3)/C'_T$
1976	1	0.040	Liver	0.0062	0.155	1800	1.2 (-3)	6.7 (-7)
	2	0.029	Liver	0.0044	0.152	2620	2.5 (-3)	9.5 (-7)
	3	0.018	Liver	0.066	3.66	130	4.3 (-4)	3.3 (-6)
	4	0.043	Liver	0.049	1.13	310	1.0 (-3)	3.2 (-6)
1977	1	0.021	Liver	0.055	2.62	600	2.0 (-3)	3.3 (-6)
	2	0.213	Liver	0.052	0.24	1010	3.3 (-3)	3.3 (-6)
	3	0.232	Bone	0.39	1.67	4050	1.3 (-2)	3.2 (-6)
	4	1.48	Thyroid	0.82	0.55	1010	3.2 (-3)	3.2 (-6)
1978	1	0.55	Liver	2.65	4.82	610	1.5 (-3)	2.5 (-6)
	2	0.27	Liver	0.94	3.48	540	1.4 (-3)	2.6 (-6)

C'_F = Curies of fission and activation products released during calendar quarter.

D'_{QO} = Calculated dose (mrem) to the maximum adult organ dose calculated using the computer code LADTAP.

C'_T = Curies of tritium released during calendar quarter.

$D'_{QO(H3)}$ = Calculated dose (mrem) to the maximum organ due to tritium dose calculated using computer code LADTAP.

Avg. value of D'_{QO}/C'_F = $\boxed{1.85}$ mrem/Ci

Max. value of D'_{QO}/C'_F = 4.82 mrem/Ci or 2.6 x Avg. value.

∴ Dose should not exceed 2.6 x 0.5 = 1.3 mrem with Method 1.

Avg. value of $D'_{QO\ (H3)}/C'_Y$ = $\boxed{2.6 \times 10^{-6}}$ mrem/Ci

Max. value of $D'_{QO\ (H3)}/C'_T$ = 3.3×10^{-6} or 1.3 x Avg. value.

∴ Dose should not exceed 1.3 x 0.5 = 0.65 mrem with Method 1.

2. Section (2) - Justification for Organ and Nuclide Selection

Year	Quarter	Organ	Nuclide - % of Organ Dose					
			Cs-134	Cs-137	H-3	Co-60	Sr-90	I-131
1976	1	Liver	12	67	18	-	-	-
	2	Liver	-	40	59	-	-	-
	3	Liver	1	98	-	-	-	-
	4	Liver	33	64	2	-	-	-
1977	1	Liver	12	83	3	-	-	-
	2	Liver	17	73	6	1	-	-
	3	Liver	22	73	3	-	-	-
	3	Bone	9	54	-	-	35	-
	4	Liver	59	38	1	-	-	-
	4	Thyroid	-	-	-	-	-	99
1978	1	Liver	55	44	-	-	-	-
	2	Liver	54	45	-	-	-	-

The above listed nuclides are the only ones which have contributed more than 1% to the maximum organ dose. Eight out of ten times the maximum organ was the liver, to which only three nuclides have contributed more than 1% of the dose. Since Sr-90 is not readily determined, one can not routinely determine if the Sr-90 concentrations are relatively higher than normal. Therefore, one only needs to do a thyroid calculation using I-131 and a liver calculation using Cs-134, Cs-137 and H-3.

3. Section (2) - Step 6

See Appx. A - Section 3.

Cs-134

$$\text{Liver dose factor} = \text{total body dose factor} \times \frac{\text{Liver Dose Conv. Factor}}{\text{Total Body Dose Conv. Factor}}$$

$$= 3.3 \times 10^{11} \times \frac{1.48 \times 10\text{-}4}{1.21 \times 10^{-4}} = \boxed{4.0 \times 10^{11}}$$

Likewise

$$\text{Cs-137} = 1.9 \times 10^{11} \times \frac{1.09 \times 10\text{-}4}{7.14 \times 10^{-5}} = \boxed{2.9 \times 10^{11}}$$

For

H-3 - dose factor the same for liver and total body = $\boxed{1.3 \times 10^{5}}$

4. Section (2) - Step 7

$$\text{Thyroid Dose} = \text{I-131} = \frac{\text{C131 (Ci)}}{\text{V (gal)}} \times 10^{12}\ \text{pCi/Ci} \times 1.5 \times 10^{1}\ \text{pCi/kg} \frac{\text{liter}}{\text{pCi}}$$

$$\times 1.95 \times 10^{-3}\ \text{mrem/pCi} \times 21/4 \times 0.26\ \text{gal/liter}$$

Where

1.5×10^{1} - bioaccumulation factor for I for freshwater fish - Table A-1 - Reg. Guide 1.109 - Rev. 1.

1.95×10^{-3} - Ingestion dose factor for adults thyroid - I-131 - Table E-11 - Reg. Guide 1.109.

21/4 - Quarterly usage factor - adult fish.

$$\therefore \text{Thyroid dose due to I-131} = \frac{\text{C131}}{\text{V}} \times \boxed{4.0 \times 10^{10}}$$

5. Section (3) - Steps 5, 6 & 7

10^{12} pCi/Ci x 0.26 gal/l = $\boxed{2.6 \times 10^{11}}$

APPENDIX C

LIQUID DOSE CALCULATIONS - LADTAP

A. PURPOSE

This procedure may be used to calculate the quarterly (or any other time period) doses to both the maximum individual and the 50 mile population due to radionuclides released in liquid effluents from either Connecticut Yankee or Millstone Units 1 or 2. The procedure involves the use of the computer code LADTAP which was developed by the NRC in order to perform dose calculations in accordance with Regulatory Guide 1.109.

B. REFERENCES

1. User's Manual for the LADTAP Program - 8 page printout.
2. U.S. N.R.C. Regulatory Guide 1.109.
3. U.S. N.R.C. Regulatory Guide 1.113.
4. Millstone 3 - Demonstration of Compliance with 10CFR50, Appendix I - Part 2B - Nov. 76.
5. Final Environmental Statements - CY and Millstone 1 and 2.

C. PREREQUISITES

The plant must supply the total number of Curies released for each radionuclide during the time period involved.

D. PRECAUTIONS

None.

E. LIMITATIONS AND ACTIONS

None.

F. PROCEDURE

1. Review the plant curie tables for accuracy and completeness. If the strontium results are not yet available, but the calculations must be performed in order to meet the semiannual effluent report schedule, the code may be run without the strontium values and the doses due to strontium ratioed by hand by comparison with the previous quarter's results.
2. Obtain the computer deck for the proper site - there is one deck for Connecticut Yankee and one deck for Millstone. The Millstone deck may be used for both Units 1 and 2, however the quarterly doses must be calculated for each plant separately.

3. The following control cards are required for either deck:

```
// 082), 'CRANDALL', MSGLEVEL = 1, CLASS = B
//STEP1 EXEC PGM = PFLADTAP
//FT10F001 DD DSN=FANG.DOSE.FACTOR.FOR.PFLADTAP, DISP=OLD
//FTØ6FØØ1 DD SYSOUT = A
//FTØ5FØØ1 DD *

          INPUT CARDS

/*
```

4. The deck should be in the order as used during the previous quarter. If not, refer to reference 1 to ensure the proper input cards are used. Pay particular attention to the number of blank cards required.

5. The following values are incorporated in the input cards and need not be revised routinely. Check the basis as given below used to generate these values. If there has not been a change in the basis, proceed to step 6 - if there has been a change, revise the appropriate card (and the procedure if the change is permanent).

Card 2

a. Site type - CY = 0 = fresh MP = 1 = salt

b. Release multiplier - CY & MP = 1 - calculation done for 1 unit at a time.

c. Percentage dose printout - CY & MP = 1 - prints nuclide breakdown of dose.

Card 3

a. 50 mile population - CY = 3.83E+06 - 1980 population estimate-ER
MP = 3.03E+06 - 1980 population estimate-ER

b. Change the standard population distribution - CY & MP = 0 = NO

Assumes population around CY & MP is typical as far as fraction which is adult, teenager and child.

Card 6

a. CY = no reconcentration - river site - blank card.

b. MP = Model #2 - ocean site.
Cycle Time = 12 hr. - total cycle.
Recycle Fraction = 0.025 - from MP 1&2 FES.

Card 7

a. Change the standard usage factors CY & MP = 1 - factors must be changed.

b. Shorewidth factor -

CY = 0.1 - canal shorewidth factor from reference 1 - using for max individual dose.
MP = 0.5 - ocean site from reference 1.

c. Dilution for aquatic foods -

CY = 1 - From table A-1 of Reg Guide 1.109 - Surface - Low Velocity discharge.
MP = 5 - From table A-1 of Reg Guide 1.109 - Surface - High Velocity discharge.

d. Dilution for shoreline -

CY = 1 - Same as 7c.
MP = 5 - Same as 7c.

e. Dilution for drinking water -

CY = 5 - Arbitrary number since usage factor is zero.
MP = 5 - Arbitrary number since usage factor is zero.

f. Discharge transit time.

CY = 1 hr - From FES canal transit time is 50-100 min.
MP = 1 hr - Estimated quarry transit time from chlorine study.

g. Transit time to drinking water intake.

CY = 5 hr - arbitrary number since usage factor is zero.
MP = 5 hr - arbitrary number since usage factor is zero.

Card 7a - Adult usage factor - max individual

a. Fish consumption - CY & MP = 21 kg/yr - from reference 1.

b. Invertebrate consumption -

CY = 0 - river site.
MP = 5 kg/yr - from reference 1.

c. Algae consumption - CY & MP = 0 - no body eats algae.

d. Water - CY & MP = 0 - no drinking water source for either plant.

e. Shoreline - CY & MP - 12 hr/yr - from reference 1.

f. Swimming - CY & MP - 12 hr/yr - assume the same as shoreline recreation.

g. Boating - CY & MP - 52 hr/yr - from Reg Guide 1.109.

Card 7b Teenager usage factors - max individual (basis are the same as 7a).

a. Fish consumption - CY & MP = 16 kg/yr.

b. Invertebrate consumption - CY = 0
MP = 3.8 kg/yr

c. Algae consumption - CY & MP = 0

d. Water - CY & MP = 0

e. Shoreline - CY & MP = 67 hr/yr

f. Swimming CY & MP - 67 hr/yr

g. Boating CY & MP - 52 hr/yr

Card 7c - Child usage factors - max individual (basis are the same as 7a).

a. Fish consumption - CY & MP = 6.9 kg/yr

b. Invertebrate consumption - CY = 0
MP = 1.7 kg/yr

c. Algae consumption - CY & MP = 0

d. Water - CY & MP = 0

e. Shoreline - CY & MP = 14 hr/yr

f. Swimming - CY & MP = 14 hr/yr

g. Boating - CY & MP = 29 hr/yr

Card 7d - Infant usage factors - max individual.

a. Fish consumption - CY & MP = 0 - infants don't eat fish.

b. Invertebrates consumption - CY & MP = 0 - infants don't eat invertebrates.

c. Algae consumption - CY & MP = 0 - infants don't eat algae.

d. Water - CY & MP = 0 - no drinking water supply.

e. Shoreline - CY & MP = 14 hr/yr - assume same as child.

f. Swimming - CY & MP = 0

g. Boating - CY & MP = 29 hr/yr - assume same as child.

Card 8 - Leave blank unless special calculation is desired.

Card 9 - Sport fish harvest.

a. Fish harvest.

CY - 83,000 kg/yr

Based on pg. 109 - The Connecticut River Ecological Study - Merriman & Thorpe Jan.-Jun. 1973 - 16,000 fish caught in discharge canal. Add 30% for July-Dec. = 16,000 x 1.3 = 20,800 fish.

Assume 4 kg/fish = 83,000 kg/yr.

MP = 1.54 E + 05 kg/yr.

Based on U.S. Dept. of Interior - Commercial Landing Record for New London County 1971-1973. Used 1973 data (highest of 3 years). Commercial fish (excluding menhaden) = 1.54×10^5 kg/yr.

Assume an equal amount of sport fish.

b. Dilution.

CY = 1 - dilution factor for discharge canal.

MP = Based on Section 1.3 of reference 4.

Assume 50% caught - near field dilution = 5
50% caught - far field dilution = 18.6

Average dilution factor = 11.8.

c. Transit Time.

CY = 0.5 hrs. - half way through canal.

MP = 1 hr. = quarry transit time.

Card 10 - Commercial fish harvest.

a. Fish harvest.

CY - 470,000 kg/yr

Based on U.S. Dept. of Interior Commercial Fish Landing Records for 1972 and 1973 @ Middlesex County.

Avg. of 2 years = 470,000 kg/yr.

MP - 1.54 E + 0.5 - See card 9 for basis.

b. Dilution.

CY = 5 - assumed dilution for Conn. River.

MP = 11.8 - See card 9.

c. Transit Time.

CY = 1 hr. - canal transit time.

MP - 1 hr. - quarry transit time.

Card 11 - Sport Invertebrate harvest.

a. CY - Blank card - no significant invertebrate catch.

b. MP - harvest 8.6×10^4 kg/yr.

Based on U.S. Dept. of Interior Commercial Shellfish catch for New London County for 1973.

Commercial catch = 5.72×10^5 kg/yr.
Assume sport catch = 15% of commercial catch.

Dilution = 11.8 - see card 9.
Transit Time = 1 hr.

Card 12 - Commercial Invertebrate Harvest.

a. CY - Blank card - see card 11.

b. MP - Harvest = 5.72×10^5 kg/yr. See card 11.
Dilution = 11.8 - See card 9.
Transit Time = 1 hr.

Card 13 - Population Drinking Water.

CY & MP - Blank card - no drinking water source for either site.

Card 14 - Population Shoreline.

a. Usage (manhours).

CY = 100,000 manhours.

Based on 2 Parks - Gilette Castle State Park and Selden Neck State Park 26 weeks x 1000 persons/wk x 4 hours/person = 104,000 manhours.

Millstone = 1.5×10^6 manhours.

Based on table 1.1.2-5 of reference 4.

b. Dilution.

CY = 5 - Assumed river dilution.

MP = 11.6 - Average dilution factor for 7 beaches - See Table 1.3.2-1 of reference 4.

c. Transit Time-Hrs.

CY = 10 hrs. - assumed river transit time to 2 beaches.

MP = 1 hr. - quarry transit time.

d. Shorewidth factor.

CY = 0.2 - river shorewidth factor.

MP = 0.5 - ocean shorewidth factor.

e. Location Identification

CY & MP - Parks - rather than doing each park separately, this card combines them all and uses average dilution factor.

Card 15 - Population Swimming

a. CY - blank card - no swimming in Connecticut River.

b. MP - Usage - 1.4×10^6 manhours - Table 1.1.2-4 of reference 4.
Dilution = 11.6 - See card 14.
Transit Time = 1 hr. - See card 14.
Location ID = Beaches.

Card 16 - Population Boating

a. Usage

CY - 100,000 manhours = from Environmental Statement.

MP - 5.8×10^5 manhours = from Table 1.1.2-3 of reference 4.

b. Dilution

CY = 5 - See card 13.

MP = 11.8 - See card 9.

c. Transit Time

CY = 10 hrs. - See card 13.

MP = 1 hr. - quarry transit time.

d. Location ID

CY = river
MP = ocean

Cards 17 & 18 - Irrigated Foods

CY & MP - blank card - no irrigation pathway.

Card 19 - Biota

a. Dilution

CY = 5
MP = 11.8

b. Transit time

CY = 1 hr.
MP = 1 hr.

6. The following input cards must be changed routinely for each quarterly run of the program:

Card 1 - Title card - Format - 2X, A78

Enter the plant name, "Liquid Dose Calculation", and the time period of the dose calculation.

Card 2 - Columns 11-20 - Format E10 - Dilution Flow.

Determine the average dilution flow rate (ft 3/sec) for the quarter by:

a. Determine the total dilution volume for the quarter.

This should be the total dilution volume for the entire quarter and not just for the periods of discharge. It should be on the order of 1 x 10" liters.

b. Divide by the number of seconds in the quarter.

c. Convert liters/sec to ft^3/sec by dividing by 28.32.

For CY the normal full power flow is 882 ft^3/sec.

For M1 plus M2 the normal full power flow is 2265 ft^3 /sec.

Card 4 - Source term identification - Format 2X, A78.

Identify the time period of the releases.

Cards 5.1, 5.2 - Source terms - Format 2X, A2, A5, 1X, E10

One card is required for each nuclide.

Enter the nuclides chemical symbol beginning in column 3 -left justified.

Enter the isotopes number beginning in column 5 - left justified.

Enter the number of curies released in scientific notation beginning in column 11 and ending in column 20. Be sure to sum the totals from all continuous and batch release tables.

Examples:

Column No:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
			H		3						2	.	6	2			E	+	Ø	3
			I		1	3	1				6	.	9	9			E	-	Ø	4
			C	0	6	Ø					1	.	8	Ø			E	-	Ø	2

There is no need to enter the dissolved noble gases as they will not be included in the calculation. The last nuclide is followed by a blank card.

7. Save the old cards for approximately 1 year in case doses must be recalculated.

8. Submit the cards in order to run the program on the IBM-370.

G. ACCEPTANCE CRITERIA

None.

H. CHECKLISTS

None.

I. DEFINITIONS

LADTAP = Liquid Annual Doses to all Persons.

J. RESPONSIBILITY

Environmental Programs Branch.

APPENDIX D

DERIVATION OF FACTORS FOR SECTION D.1

1. Section a. - X/Q Value

CY - Annual Average X/Q's

Downwind Sector	Site Boundary (Meters)	Annual Avg X/Q's - @ Site Boundary 1976	1977	Average	
SSW	120	0.129(-6)	0.215(-6)	0.172(-6)	
SW	120	0.612(-6)	0.434(-6)	0.523(-6)	
WSW	130	0.167(-5)	0.497(-5)	0.332(-5)	
W	170	0.104(-5)	0.130(-5)	0.117(-5)	
WNW	310	0.101(-5)	0.102(-5)	0.102(-5)	
NW	550	0.563(-5)	0.561(-5)	0.562(-5)	
NNW	510	0.129(-4)	0.134(-4)	0.132(-4)	Maximum
N	630	0.103(-4)	0.753(-5)	0.892(-5)	
NNE	690	0.947(-5)	0.730(-5)	0.839(-5)	
NE	710	0.653(-5)	0.547(-5)	0.600(-5)	
ENE	1240	0.169(-5)	0.142(-5)	0.156(-5)	
E	1510	0.171(-5)	0.164(-5)	0.168(-5)	
ESE	1370	0.107(-5)	0.102(-5)	0.105(-5)	
SE	340	0.235(-5)	0.293(-5)	0.264(-5)	
SSE	230	0.846(-6)	0.166(-5)	0.126(-5)	
S	150	0.262(-6)	0.678(-6)	0.470(-6)	

2. Section a - Justification for Method Used to Determine $\bar{K}$ & $\bar{S}$

There are many different sources contributing to the releases from the ventilation stack. These include releases from the building ventilation, condenser air ejector, containment purges, flashed gases which occur while obtaining primary coolant samples, and discharges from the waste gas tanks. These sources may exist in any possible combination and each has its own particular, but changing, nuclide mixture. Thus, the ratio of nuclides being released is a constantly changing parameter.

It is impractical to change the value of $\bar{K}(\bar{S})$ and thus the release rate limit and monitor set-points each time a source stream is initiated or terminated or an isotopic analysis is performed on any of the source streams. Instead, we can choose a conservative value for $\bar{K}(\bar{S})$ such that whatever combination of source streams exists, the actual value of $\bar{S}$ or $\bar{K}$ will be less than that assumed.

Table 2 indicates that the highest values of $K_i(S_i)$ occur for the shorter half-life nuclide gases. Therefore, the highest value of $\bar{K}(\bar{S})$ would be obtained with a sample having the least amount of decay. Thus, if we determine $\bar{K}(\bar{S})$ using the gas mixture in the primary coolant we will be conservative because the mixture from any other source will be decayed from this value.

3. Section b. - X/Q and D/Q Values

CY - Annual Average X/Q's & D/Q's

Downwind Sector	Land Boundary (Meters)	Annual Avg. X/Q's 1976	1977	Avg.	Annual Avg. D/Q's 1976	1977	Avg.
SSW	700	0.126(-6)	0.211(-6)	0.169(-6)	0.130(-8)	0.266(-8)	0.198(-8)
SW	580	0.349(-6)	0.336(-6)	0.343(-6)	0.416(-8)	0.357(-8)	0.387(-8)
WSW	580	0.276(-6)	0.663(-6)	0.470(-6)	0.128(-7)	0.298(-7)	0.213(-7)
W	620	0.173(-6)	0.251(-6)	0.212(-6)	0.110(-7)	0.127(-7)	0.119(-7)
WNW	550	0.481(-6)	0.475(-6)	0.478(-6)	0.278(-7)	0.250(-7)	0.264(-7)
NW	550	0.536(-5)	0.561(-5)	0.562(-5)	0.549(-7)	0.592(-7)	0.571(-7)
NNW	510	0.129(-4)	0.134(-4)	0.132(-4)	0.388(-7)	0.381(-7)	0.385(-7)
N	630	0.103(-4)	0.753(-5)	0.892(-5)	0.430(-7)	0.284(-7)	0.357(-7)
NNE	690	0.947(-5)	0.730(-5)	0.839(-5)	0.581(-7)	0.373(-7)	0.477(-7)
NE	710	0.653(-5)	0.547(-5)	0.600(-5)	0.327(-7)	0.279(-7)	0.303(-7)
ENE	1240	0.169(-5)	0.142(-5)	0.156(-5)	0.118(-7)	0.105(-7)	0.112(-7)
E	1970	0.133(-5)	0.126(-5)	0.130(-5)	0.103(-7)	0.934(-8)	0.982(-8)
ESE	1970	0.879(-6)	0.869(-6)	0.874(-6)	0.194(-7)	0.177(-7)	0.186(-7)
SE	1300	0.361(-5)	0.404(-5)	0.383(-5)	0.183(-7)	0.208(-7)	0.196(-7)
SSE	890	0.401(-6)	0.606(-6)	0.504(-6)	0.858(-8)	0.128(-7)	0.107(-7)
S	740	0.111(-6)	0.125(-6)	0.118(-6)	0.359(-8)	0.510(-8)	0.435(-8)

4. Section b - Determination of Release Rate Limits - Method 1

From above:

Maximum X/Q for inhalation pathway = 1.32×10^{-5} sec/m^3

Maximum D/Q for food pathway = 5.71×10^{-8} M^{-2}

For iodine-131 releases - dose parameters from NRC proposed (May 1978) tech spec - Table 4.11-4.

$P_{I\text{-}131}$ (inhalation) = 1.5×10^{7} mrem/yr per μCi/M^3

$P_{I\text{-}131}$ (food & ground) = 1.1×10^{12} m^2 mrem/yr per μCi/sec

$\therefore$ maximum organ dose rate from I-131

$= [1.32 \times 10^{-5} \times 1.5 \times 10^{7} + 5.71 \times 10^{-8} \times 1.1 \times 10^{12}]\ Q_{I131} < 1500$ mrem/yr

$$Q_{I\text{-}131}\ (\mu Ci/sec) < \frac{1500}{6.3 \times 10^{4}}$$

$$Q_{I\text{-}131}\ (\mu Ci/sec) < 2.4 \times 10^{-2}$$

Assume 1/3 of allowable dose due to I-131

$$\therefore \text{limit for I-131} < \frac{2.4 \times 10\text{-}2}{3} = \boxed{8.0 \times 10^{-3}}\ \mu Ci/sec$$

For particulates with half lives greater than 8 days

Sr-90 has the most restrictive dose parameter of all particulates in Table 4.11-4. Therefore, assume all releases are Sr-90.

P_{Sr-90} (inhalation) = 4.1×10^{7} mrem/yr per $\mu Ci/M^3$

P_{Sr-90} (food & ground) = 9.5×10^{10} m^2 mrem/yr per $\mu Ci/sec$

$\therefore$ maximum organ dose rate

$= [1.32 \times 10^{-5} \times 4.1 \times 10^{7} + 5.71 \times 10^{-8} \times 9.5 \times 10^{10}] Q_{particulate} < 1500$ mrem/yr

$Q_{particulates}$ ($\mu Ci/sec$) $< 2.5 \times 10^{-1}$

Assume 1/3 of allowable dose due to particulates

$\therefore$ limit for particulates $< \boxed{8.3 \times 10^{-2}}$ $\mu Ci/sec$

For tritium

Food pathway is based on X/Q and not D/Q

P_{H-3} (inhalation) = 6.5×10^{2} mrem/yr per $\mu Ci/M^3$

P_{H-3} (food & ground) = 2.4×10^{3} mrem/yr per $\mu Ci/M^3$

$\therefore$ maximum organ dose rate

$= 1.32 \times 10^{-5} (6.5 \times 10^{2} + 2.4 \times 10^{3}) Q_{H-3} < 1500$ mrem/yr

Q_{H3} ($\mu Ci/sec$) $< 3.7 \times 10^{4}$

Assume 1/3 of allowable dose rate due to H-3

$\therefore$ limit for tritium $< \boxed{1.2 \times 10^{4}}$ $\mu Ci/sec$)

5. Section b - Determination of Release Rate Limit - Methods 2 & 3

Method 2 still uses the super organ technique in that the dose factors given in Table 3 are for the critical organ for that particular nuclide, yet they are all summed together as if they were all the same organ.

Method 3, by use of the GASPAR code, eliminates some of this conservatism by calculating the dose to each organ using the dose factor for that particular organ for each nuclide, then the critical organ can be determined.

APPENDIX E

GASEOUS DOSE CALCULATIONS - GASPAR

A. PURPOSE

This procedure is used to implement the NRC computer code GASPAR in order to calculate the maximum individual and population doses due to radionuclides released in gaseous effluents. The code implements the semi-infinite cloud model and the dose calculation models of Reg Guide 1.109 and is used to calculate the following:

1. All maximum individual and population doses from Connecticut Yankee.

2. All maximum individual and population doses from Millstone Unit 2.

3. Population doses from Millstone Unit 1.

4. Maximum individual organ doses from Millstone Unit 1.

The maximum individual whole body and skin doses due to elevated releases from Millstone 1 should be calculated using the finite cloud model as performed by the EPA code AIREM.

A more detailed description of the GASPAR code can be found in reference 1.

B. REFERENCES

1. GASPAR dose code manuals - dated 10/17/75 and 2/20/76.

2. U.S. NRC Regulatory Guide 1.109.

3. U.S. NRC Regulatory Guide 1.111.

C. PREREQUISITES

1. The plant must supply the total number of Curies released for each radionuclide during the time period involved.

2. The meteorological programs must be run to generate the required input cards for X/Q, decayed X/Q, depleted X/Q and D/Q.

D. PRECAUTIONS

None.

E. LIMITATIONS AND ACTIONS

None.

F. PROCEDURE

1. Review the plant curie release tables for accuracy and completeness. If the strontium results are not yet available, but the calculations must be performed in order to meet the semi-annual effluent report schedule, the code may be run without the strontium values and the doses due to strontium ratioed by hand by comparison with the previous quarters results.

2. Obtain the computer deck for the GASPAR code for the nuclear site involved.

3. The deck should be in the following order:

```
// 082), 'CRANDALL', MSGLEVEL=1, CLASS=B
// STEP 1 EXEC PGM=PFGASPAR
// FT06F001 DI SYSOUT=A
// FT05F001 DD *
```

Adult, teenager, child and infant dose factor cards.

Blank Card.

Input cards as discussed below.

3 blank cards
/ *

4. Due to different meteorology calculations, the code must be run separately for each of the following cases:

   a. CY - continuous, semi-elevated releases - ventilation.

   b. CY - batch mode, semi-elevated releases - waste gas tanks.

   c. M1 - continuous, elevated releases - ventilation and off gas.

   d. M2 - continuous, semi-elevated releases - ventilation.

   e. M2 - batch mode, semi-elevated releases - containment purges.

   f. M2 - batch mode, elevated releases - waste gas tanks and some containment purges.

   The resulting doses must then be summed by hand for each unit.

5. The input cards are as follows. Those parameters which must be changed each quarter are enclosed in blocks /[ ]/.

   a. [CARD 1] - Title card - Format - 2X, 78A1

      Millstone Unit One - Gaseous [Identify Release Type]
      [1st] Quarter [1976.]

b. CARD 2 - Job control card - Format 10I2.

Column 2=0 - will calculate population doses and maximum individual.
Column 4=1 - number of source terms - done for each unit separately.
Column 6=1 - arbitrary if number in column 4 is 1.

c. CARD 3 - Site parameters - Format 10E8.0 - Same for CY and Millstone.

Columns 1-5=500.0 - distance from site to NE corner of U.S.
Columns 14-16=1.0 - fraction of fresh leafy vegetation grown locally.
Columns 22-24=0.5 - fraction of year milk animals on pasture.
Columns 29-32=0.76 - fraction of veg. intake grown in garden - from Reg Guide 1.109.
Columns 38-40=1.0 - fraction of animals intake from pasture when on pasture.
Columns 46-48=8.0 - air water concentration (g/m^3).

d. CARD 4 - Population title card - Format = 2X, 78A1.

Population Data

e. CARD 4.1 - Population data format - Format = 3I5.

Column 5=0 - Population data starts in north sector.
Column 10=5 - Number of radial locations for which data is supplied on first card.
Columns 14&15=10 - Total number of radial locations.

f. CARDS 4.2---4.33

32 cards of population data - based on 1980 population estimates from Conn. Yankee and Millstone Environmental Reports.

g. CARD 5 - Milk data title card - Format = 2X, 78A1.

Milk data - NRC Memo - 10-15-75 - State of CT.

h. CARD 5.1 - Milk data format.

Columns 9&10 = 16 - Dummy number since using default values.

i. CARD 5.2 - Milk data.

Columns 3-10=4.4E + 08 - 50 mile milk usage from reference 1.

j. CARDS 6-6.2 - Same as 5-5.2 except for meat instead of milk usage factor = 2.0E+07.

k. CARDS 7-7.2 - Same as 5-5.2 except for vegetation instead of milk usage factor = 3.2E+07.

l. CARD 8 - Source term title card - Format - 2X, 78A1.

Source Terms - 1ST QUARTER 1976.

m. CARD 8.1 - Source description - Format = (E10, 2(9X,I1)).

Columns 8-10 = 1.0 - release point multiplier
Column 20 = 0 - see reference 1.
Column 30 = 0 - see reference 1.

n. CARDS 8.2 - 8.X - Source data - Format = 2X, A2, 5A1, 1X, E10.0.

Enter total curies released for each nuclide for the particular release mode as listed in step 4 of this procedure.

One card per nuclide. Isotope chemical symbol and atomic number and curies released are all left justified.

The following are examples of the input format:

Column No.:	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20
			I		1	3	1				Ø	.	5	7	9					
			H		3						3	.	7	1						
			K	R	8	5	M				7	1	2	Ø	.	Ø				
			K	R	8	7					1	9	Ø	Ø	Ø	.	Ø			
			C	O	6	Ø					Ø	.	Ø	Ø	Ø	8	9			

o. CARD 8.n - blank card following source data.

p. CARD 9 - X/Q title card.

q. CARD 9.1 - X/Q format - Format = 3I5.

Column 5=0 - Data starts with north as the downwind sector (south wind).
Column 10=5 - There are 5 X/Q values on the first card for each sector.
Column 14&15=10 - There are a total of 10 X/Q values for each sector.

NOTE WELL - There are two possible computer codes used to generate the X/Q cards - one was written by the NRC (XOQDOQ) and one by NUSCO (PFAADRG). The NRC code punches cards such that they start with the south downwind sector and have 7 values on the first card and 3 on the second.

Changing 0 to 1 in column five will designate that south is the first sector, and changing 5 to 7 in column ten will indicate that there are 7 values on the first card, also change

cards 10.1, 11. and 12.1. The NUSCO code should start with the north downwind sector and have five values per card.

r. CARDS 9.2 to 9.33 - X/Q Data - Format - Alternate (5X, 7E10.0) and (8E10.0) insert the 32 X/Q cards as generated by the meteorological program. Be certain the sectors are in the proper order as required by card 9.1.

s. CARD 10 - Decayed X/Q title card.

t. CARD 10.1 - Same as 9.1 except for decayed X/Q's.

u. CARDS 10.2 to 10.33 - Same as 9.2 to 9.33 expect for decayed X/Q's.

v. CARD 11 - Depleted X/Q title card.

w. CARD 11.1 - Same as 9.1 except for depleted X/Q's.

x. CARDS 11.2 to 11.33 - Same as 9.2 to 9.33 except for depleted X/Q's.

y. CARD 12 - D/Q title card.

z. CARD 12.1 - Same as 9.1 except for D/Q.

aa. CARDS 12.2 to 12.33 - Same as 9.2 to 9.33 except for D/Q.

bb. CARDS 13.1 to 13.n - Special locations for Maximum Individual.

These cards are submitted to calculate whole body and organ doses to the maximum individual. One card is required for each location at which these doses are to be calculated. A maximum of 5 is all that can be done.

The meteorological program outputs the X/Q, decayed X/Q, depleted X/Q, and D/Q for the site boundary, nearest land, nearest residence and vegetable garden, goat farms and cow farms in each sector.

The following locations should be entered:

1) The nearest land with highest decayed X/Q.

2) The nearest residence with highest depleted X/Q.

3) The goat farm with highest D/Q - 2nd & 3rd quarters only.

4) The cow farm with highest D/Q - 2nd & 3rd quarters only.

The GASPAR program will calculate the whole body and organ doses for each pathway at each location. There is no way to control this with the input, but rather the final results will have to be selectively analyzed. For example, for the nearest residence location, one should only sum the dose due to the plume, ground deposition, inhalation and vegetation pathways and not from the cow's milk, goat's milk, and meat pathways.

NOTE 1: For elevated releases from the Millstone 1 stack, the nearest land boundary and nearest residence may not be the location of highest X/Q's. Therefore the meteorological output table of X/Q's from 0-50 miles must be used and interpolated to determine these locations.

NOTE 2: For CY and M2 which have more than one type of release (batch, continuous, semi-elevated), the locations of highest X/Q's or D/Q's for one type of release may not be the same as the locations for a different type of release.

In that case, the location of highest X/Q or D/Q for one type of release should also be entered for the other releases along with their highest locations, such that the total sum from all releases may determined at each location to determine the location of maximum dose. However, a maximum of 5 locations can be done. Thus, to prevent using the program more than once, some prejudgement might be necessary.

The format for the Special Location cards is as follows:

Column 2= 1 - Eliminates pages of printout of nuclide breakdown for each pathway and age group.

Columns 3-18 - Location name - Example - Nearest Land.

Columns 19-22 - Compass direction - Example - ENE

Columns 23-29 - Distance in miles - Example - 1.9.

Columns 30-39 - X/Q for that location - right justified - Example 0.273 E-07.

Columns 40-49 - Same as 30-39 except for decayed X/Q.

Columns 50-59 - Same as 30-39 except for depleted X/Q.

Columns 60-69 - Same as 30-39 except for D/Q.

Columns 70, 71, 72, 73, 74, 75 and 76 - 0 in each column - controls printout.

Last special location card is followed by 3 blank cards.

6. Save the old cards for approximately 1 year in case doses must be recalculated.

7. Submit the cards in order to run the program on the IBM-370.

C. ACCEPTANCE CRITERIA

None.

H. CHECKLISTS

None.

I. DEFINITIONS

None.

J. RESPONSIBILITY

Environmental Programs Branch.

APPENDIX F

DERIVATION OF FACTORS FOR SECTIONS D.2 & D.3

1. Section D.2.a(1)

CY - Noble Gas Air Doses

Year	Qtr.	Curies Noble Gas	(mrad)* Gamma Air Dose	(mrad)* Beta Air Dose	Gamma mrad per Curie	Beta mrad per Curie
1976	1	128	0.0048	0.0249	3.8(-5)	1.9(-4)
	2	160	0.034	0.098	2.1(-4)	6.1(-4)
	3	112	0.026	0.161	2.3(-4)	1.4(-3)
	4	92	0.030	0.147	3.3(-4)	1.6(-3)
1977	1	248	0.112	0.349	4.5(-4)	1.4(-3)
	2	260	0.015	0.050	5.8(-5)	1.9(-4)
	3	443	0.117	0.490	2.6(-4)	1.1(-3)
	4	2170	0.272	0.892	1.3(-4)	4.1(-4)
1978	1	599	0.041	0.150	6.8(-5)	2.5(-4)
	2	592	0.045	0.147	7.6(-5)	2.5(-4)
				Avg. =	1.9(-4)	7.4(-4)

*Calculated maximum air dose (mrad) due to noble gases calculated using NRC computer code GASPAR.

Since the beta dose is always more than 2 times the gamma dose it should always be controlling.

Avg. value of gamma air dose per curie = $\boxed{1.9 \times 10^{-4}}$ mrad/Ci

Max. value of gamma air dose per curie = 4.5×10^{-4}

Ratio Max./Avg. = 2.4

Avg. value of beta air dose per curie = $\boxed{7.4 \times 10^{-4}}$ mrad/Ci

Max. value of beta air dose per curie = 1.6×10^{-3}

Ratio max./avg. = 2.2

∴ Beta air dose should not exceed 3 mrad x 2.2 = 6.6 mrad

∴ Gamma air dose should not exceed $\frac{3}{7.4 \times 10^{-4}} \times 1.9 \times 10^{-4} \times 2.4 = 1.85$ mrad

2. Section D.2(a)(2)

a. Justification for the use of only annual average X/Q's for both continuous and batch releases:

Number of hours during which batch releases were in progress during the period 1/1/77 - 9/30/78 between the hours of:

Time	# Hours	Time	# Hours
0000-0100	20	1200-1300	20
0100-0200	19	1300-1400	19
0200-0300	21	1400-1500	20
0300-0400	20	1500-1600	22
0400-0500	20	1600-1700	24
0500-0600	20	1700-1800	25
0600-0700	21	1800-1900	27
0700-0800	21	1900-2000	25
0800-0900	21	2000-2100	25
0900-1000	23	2100-2200	24
1000-1100	22	2200-2300	25
1100-1200	22	2300-2400	23

Avg. = 22 Hours Range 19-27

The above table is a compilation of 28 batches with durations ranging from 0 to 65 hours.

The table shows that the time period for batch releases is random when compared with time of day and thus the avg. X/Q and D/Q for batch releases should be approximately equal to the annual average X/Q's and D/Q's.

b. Derivation of factors for D.2.(a)(2) - Method 2

(1) Step 4

D_{QAGi} = Quarterly gamma air dose due to nuclide i

$$= C_i \text{ (Ci)} \times M_i \left(\frac{\text{mrad}}{\text{yr}} \cdot \frac{\text{m3}}{\text{Ci}}\right) \times 1.32 \times 10^{-5} \text{ sec/m}^3 \times$$

$$10^6 \ \mu\text{Ci/Ci} \times 3.17 \times 10^{-8} \text{ (yr/sec)}$$

where 1.32×10^{-5} = maximum site boundary annual average X/Q as determined in Appendix D. As indicated in Section 2.a. above, the same X/Q can be used for both batch and continuous releases due to the random nature of batch releases.

10^6 = conversion from Ci to μCi.

3.17×10^{-8} = conversion from seconds to years

$$D_{QAGi} = 4.2 \times 10^{-7} M_i C_i$$

$$D_{QAG} = \sum \text{over all nuclides} = \boxed{4.2 \times 10^{-7}} * \sum_i M_i C_i$$

(2) Step 5

Likewise for the beta air dose, all factors are the same except the dose conversion factor M_i should be replaced with N_i.

$$D_{QAB} = \boxed{4.2 \times 10^{-7}} * \sum_i N_i C_i$$

3. Derivation of Factors for Section D.3.a(1)

From Appendix D:

Maximum X/Q for inhalation pathway = 1.32×10^{-5} sec/M^3

Maximum D/Q for food pathway = 5.71×10^{-8} M^{-2}

From NRC proposed tech spec (May 1978) - dose parameters are:

For I-131 - inhalation - 1.5×10^{7} mrem/yr per μCi/M^3
For I-131 - food 1.1×10^{12} m^2 mrem/yr per μCi/sec
For H-3 - inhalation - 6.5×10^{2} mrem/yr per μCi/M^3
For H-3 - food - 2.4×10^{3} mrem/yr per μCi/M^3

For particulates the most critical nuclide is Sr-90
Assume all particulates are Sr-90.

For Sr-90 - inhalation - 4.1×10^{7} mrem/yr per μCi/M^3
For Sr-90 - food - 9.5×10^{10} m^2 mrem/yr per μCi/sec

Iodine and tritium are the only two nuclides which would contribute to the thyroid dose. If another nuclide could add a significant percent to the dose, some other organ will be critical. Iodine will not add to the other organs. If it could add a significant percent, the thyroid will be the critical organ.

The use of these dose factors gives an annual dose assuming an average Ci/sec release rate. Since these dose calculations are for a period less than a year, a correction factor equal to the fraction of the year must be applied.

Therefore, thyroid dose =

$$N/52 \left[1.32 \times 10^{-5} \times 1.5 \times 10^{7} + 5.71 \times 10^{-8} \times 1.1 \times 10^{12}\right] Q_{I\text{-}131}$$

$$+ N/52 \left[(1.32 \times 10^{-5})(6.5 \times 10^{2} + 2.4 \times 10^{3})\right] Q_{H\text{-}3}$$

$$= N/52 \left[6.3 \times 10^{4} Q_{I\text{-}131} + 4.0 \times 10^{-2} Q_{H\text{-}3}\right]$$

Maximum organ dose =

$$N/52\ (1.32 \times 10^{-5})(6.5 \times 10^{2} + 2.4 \times 10^{3})\ Q_{H-3}$$

$$+ N/52\ [1.32 \times 10^{-5} \times 4.1 \times 10^{7} + 5.71 \times 10^{-8} \times 9.5 \times 10^{10}]\ Q_{p}$$

$$= N/52\ [4.0 \times 10^{-2}\ Q_{H-3} + 6.0 \times 10^{3}\ Q_{p}]$$