CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD • EAST HAMPTON, CT 06424-3099

Russell A. Mellor
Vice President Operations
and Decommissioning

Telephone (860) 267-3690
Facsimile (860) 267-3535
ramellor@aol.com

April 28, 2000

Docket No. 50-213
CY-00-069

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Haddam Neck Plant
Annual Radioactive Effluent Report

In accordance with the requirements of 10CFR50.36a and Technical Specifications, Section 6.7.3, a copy of the Annual Radioactive Effluent Report is included as Attachment 1. It covers the period of January through December 1999.

This report includes a summary of the quantities of solid radioactive waste and liquid and gaseous effluents, as well as a summary of the assessment of maximum individual and population dose resulting from routine radioactive airborne and liquid effluents.

In addition, included as Attachment 2, is a complete copy of the Radiological Effluent Monitoring and Offsite Dose Calculation Manual (REMODCM), as of December 31, 1999.

If you should have any questions, please call G. P. van Noordennen at (860) 267-3938.

Sincerely,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

KJ Heider for RA Mellor

R. A. Mellor
Vice President - Operations and Decommissioning

cc: H. J. Miller, NRC Region I Administrator
T. L. Fredrichs, NRC Project Manager, Haddam Neck Plant
R. R. Bellamy, Chief, Decommissioning and Laboratory Branch, NRC Region I
E. L. Wilds, Jr., Director, CT DEP Monitoring and Radiation Division
J. Cherniack, USEPA, Region 1

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Docket No. 50-213
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Attachment 1

Haddam Neck Plant
Annual Radioactive Effluent Report

April 2000

Annual Radioactive Effluent Report 1999

Connecticut Yankee Atomic Power Company
Haddam Neck Plant

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Introduction

This report, for the period of January through December of 1999, is being submitted for Connecticut Yankee Atomic Power Company's Haddam Neck Plant in accordance with 10CFR50.36a, the Radiological Effluent Monitoring and Offsite Dose Calculation Manual (REMODCM), the Technical Specifications for the Haddam Neck Plant and US NRC Regulatory Guide 1.21.

The report provides radioactivity information for airborne and liquid effluents and solid waste. Doses and regulatory limits are provided for airborne and liquid effluents. Any changes to the REMODCM, description of any effluent monitors inoperable for more than 30 days, and any corrections to previous reports are also included.

The Haddam Neck plant had a permanent cessation of operation in December 1996. The plant is currently in the process of decommissioning.

1.0 Doses

This report provides a summary of the 1999 off-site radiation doses from releases of radioactive materials in airborne and liquid effluents released from the Haddam Neck Plant. Included are the annual population dose commitments (person-rem) for the area within 50 miles of the site, the annual average dose commitment (mrem) to the population, and the annual maximum dose commitment (mrem) to any real member of the public. Also provided are the maximum gamma and beta air doses.

The doses are compared with the regulatory limits and with the annual average population dose commitments from natural background and other sources to provide perspective.

1.1 Dose Calculations

The off-site dose to humans from radioactive airborne and liquid effluents have been calculated using measured radioactive effluent data, measured or calculated meteorological data, and dose computer models developed by the US Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA). These doses generally tend to be conservative because of the conservative assumptions used in these models. More realistic estimates of the off-site dose can be obtained by analysis of environmental monitoring data. A comparison of doses estimated by each of the above methods will be presented in the Annual Radiological Environmental Operating Report.

1.1.1 Population and Maximum Individual Dose Commitment

Population dose commitment is defined as the total radiation dose received by the specified population in a specified time period from an identified radiation source. For this report, the specified population is defined as the population within 50 miles of the Haddam Neck Plant. The doses are based upon exposure to the airborne and liquid effluents over a one year period and an associated dose commitment over a 50-year period from initial exposure due to inhalation and ingestion, taking into account radioactive decay and biological elimination of the radioactive materials contributing to the dose. The population dose commitment (person-rem) is the integration of the doses for each compass sector in each of the radial distances with the population distribution in those areas.

Maximum Individual dose commitment is defined as the dose to the individual within the 50 mile population who would receive the maximum dose from releases of airborne and liquid effluents. The doses are based upon exposure to the airborne and liquid effluents over a one year period and an associated dose commitment over a 50-year period from initial exposure due to inhalation and ingestion, taking into account radioactive decay and biological elimination of the radioactive materials contributing to the dose. Although the location of the maximum individual dose may vary, the total maximum individual dose is the sum of each of the calculated maximum individual doses. This conservatively assumes that an individual is at the location of maximum dose during each quarter.

The dose calculations are based upon these three types of input: radioactive source term, site specific data, and generic factors. The radioactive source terms (Curies) are characterized in the Radioactivity section of this report. The site specific data includes: meteorological data (e.g. wind speed, direction, stability, etc.) to calculate the transport and dispersion of airborne effluents, dilution factors for liquid effluents, the population distribution and demographic profile surrounding the site by compass sector. Other site specific data include the average annual production of milk, meat, vegetation, fish, and shellfish. The generic factors include the average annual consumption rates (for inhalation of air and ingestion of fruits, vegetables, leafy vegetables, grains, milk, poultry, meat, fish, and shellfish) and occupancy factors (for air submersion and ground

irradiation, shoreline activity, swimming, boating, etc.). All these inputs are used in the appropriate dose models to calculate the population and individual dose commitments from radioactive airborne and liquid effluents.

1.1.1.1 Airborne Effluents

Maximum individual doses and population doses due to the release of noble gases, radioiodines, and particulates were calculated using the computer code GASPAR (Ref 1).

The GASPAR code is an NRC code which uses a semi-infinite cloud model to implement the NRC Regulatory Guide 1.109 (Ref 2) dose models.

The values of average relative effluent concentration (χ/Q) and average relative deposition (D/Q) used in the GASPAR code to determine population doses were generated using a meteorological computer code which implements the assumptions cited in Section C, NRC Regulatory Guide 1.111 (Ref 3). The annual summary of hourly meteorological data (in 15-minute increments), which includes wind speed, direction, atmospheric stability, and joint frequency distribution, is not provided in the report but can be retrieved from computer storage. The values of average relative effluent concentration (χ/Q) and average relative deposition (D/Q) used in the GASPAR code to determine maximum individual doses were obtained from Appendix F of the REMODCM. Separate values were used for the growing season (defined as April-December) and non-growing season (defined as January-March).

The Main Stack (175 ft) releases are considered continuous mixed mode (partially elevated and partially ground) releases which include the Auxiliary Building Ventilation and Containment Purge. The values of average relative effluent concentration (χ/Q) and average relative deposition (D/Q) used in the GASPAR code to determine maximum individual doses were obtained from Table F2 (using the Primary Vent Stack - Long-Term), Appendix F of the REMODCM.

The Spent Fuel Pool Spray Cooling, Spent Fuel Building Exhaust, Alternate Containment Access, and the Cable Vault Lower Level Exhaust were considered continuous ground level releases. The values of average relative effluent concentration (χ/Q) and average relative deposition (D/Q) used in the GASPAR code to determine maximum individual doses were obtained from Table F1 (using the Maximum Ground Level Point - Long-Term), Appendix F of the REMODCM.

GASPAR was used to calculate doses to the maximum individual and 50 mile population from each of the airborne releases.

1.1.1.2 Liquid Effluents

Maximum individual and population doses from the release of radioactive liquid effluents were calculated using the LADTAP II (Ref 4) code, which uses the dose models and parameters cited in NRC Regulatory Guide 1.109 and site specific inputs.

1.1.2 Gamma and Beta Air Doses

Maximum gamma and beta air doses from the release of noble gases are calculated using the GASPAR code.

1.2 Dose Results

1.2.1 Airborne Effluents

For population doses, the GASPAR code calculates the dose to the whole body, GI-tract, bone, liver, kidney, thyroid, lung, and skin from each of the following pathways: direct exposure from the plume and from ground deposition, inhalation, and ingestion of vegetation, cow's milk, and meat. The values derived are a total from all pathways; however, only the whole body, skin, and maximum organ dose are presented.

For the dose to the maximum individual, the GASPAR code calculates the dose to the same organs listed above for the following pathways: direct exposure to the plume, exposure from ground deposition, inhalation, and ingestion of vegetation, meat, cow's milk, and goat's milk. The doses are calculated for adults, teenagers, children, and infants separately.

To determine compliance with 10CFR50, Appendix I (Ref 5), the maximum individual whole body dose only includes the external pathways (i.e. plume and ground exposure) while the maximum individual organ dose only includes the internal pathways (inhalation and ingestion). Population doses include all applicable pathways.

The air dose includes only the dose from noble gases in the plume. Hence, if the ground shine contribution was significant, there may be cases where the maximum whole body or skin dose is greater than the maximum gamma or beta air dose respectively.

The off-site dose commitments from airborne effluents are presented in Table 1-1. These doses are the maximum doses observed.

1.2.2 Liquid Effluents

The LADTAP II code performs calculations for the following pathways: shoreline activity, swimming, and boating, as well as the ingestion of fish, shellfish, algae, drinking water, and irrigated food. At Haddam Neck, the algae, drinking water, and irrigated food pathways do not exist; and, thus, only the other pathways are included in the totals. Doses are calculated for the whole body, skin, thyroid, GI-LLI, bone, liver, kidney, and lung. Calculations are performed separately for adults, teenagers, and children.

The off-site dose commitments from liquid effluents are presented in Table 1-2. These doses are the maximum doses observed.

1.2.3 Analysis of Results

The quarterly doses presented in Table 1-1 and 1-2 are well below the permissible levels in 10CFR50 and the applicable Radiological Effluent Technical Specifications and are small in comparison to the dose from natural background radiation.

Refer to Table 1-3 for the summary of annual doses for the 50 mile population, the maximum, and average individual due to airborne and liquid effluents. Table 1-4 provides a quantitative comparison between the doses from the Haddam Neck Nuclear Plant and those doses from other sources such as naturally occurring background radiation.

For compliance with 40CFR190, (Reference 6), any direct dose from the site must be added to the dose due effluents to a "real member of the public." At Haddam Neck, the only potential direct dose of significance would be from radwaste storage. However, all radwaste storage during this year was within storage criteria that ensures the public dose to be less than 1 mrem/yr for each storage area. Table 1-4 indicates the total dose to a member of the public from the site and all sources of the fuel cycle is well within the 40CFR190 limits.

References

1. NUREG-0597 User Guide to GASPAR Code, KF Eckerman, FJ Congel, AK Roecklien, WJ Pasciak, Division of Site Safety and Environmental Analysis, Office of Nuclear Reactor Regulation, US Nuclear Regulatory Commission, Washington, DC 20555, manuscript completed January 1980, published June 1980.

2. NRC 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.

3. NRC 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.

4. NUREG/CR-1276, ORNL/NUREG/TDMC-1 User's Manual for LADTAP II - A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents, DB Simpson, BL McGill, prepared by Oak Ridge National Laboratory, Oak Ridge, TN 37830, for Office of Administration, US Nuclear Regulatory Commission, manuscript completed 17 March 1980.

5. 10 CFR Energy, Part 50 Domestic Licensing of Production and Utilization Facilities, Appendix I Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.

6. 40 CFR Environmental Protection Agency, Part 190 Environmental Radiation Protection Standard for Nuclear Power Operation.

7. Engineering Record of Correspondence No. 16103-ER-00-0002, Connecticut Yankee Radioactive Release Data for SAB Dose Assessment / Annual Radioactive Effluent Report , Rev 0, April 27, 2000.

Table 1-1

1999 Off-Site Dose Commitments from Airborne Effluents
Connecticut Yankee

CY	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Max Air	(mrad)	(mrad)	(mrad)	(mrad)
Beta	0	0	0	0
Gamma	0	0	0	0
Max Individual	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body[+]	4.21E-04	3.07E-03	1.64E-03	1.89E-03
Skin[+]	4.92E-04	3.59E-03	1.92E-03	2.21E-03
Thyroid	1.25E-02	1.17E-03	1.17E-03	6.06E-03
Max Organ[++]	1.26E-02	1.88E-03	1.66E-03	6.32E-03
Population	(person-rem)	(person-rem)	(person-rem)	(person-rem)
Whole Body	2.55E-02	3.93E-03	3.49E-03	6.98E-03
Skin	2.55E-02	3.82E-03	3.46E-03	6.89E-03
Thyroid	2.55E-02	3.70E-03	3.39E-03	6.82E-03
Max Organ[++]	2.55E-02	4.27E-03	3.63E-03	7.24E-03
Avg Individual	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	6.66E-06	1.03E-06	9.10E-07	1.82E-06
Skin	6.66E-06	9.97E-07	9.03E-07	1.80E-06
Thyroid	6.66E-06	9.65E-07	8.84E-07	1.78E-06
Max Organ[++]	6.66E-06	1.11E-06	9.48E-07	1.89E-06

[+] External doses only
[++] Maximum of the following organs: Bone, GI-LLI, Kidney, Liver, Lung, Thyroid

Table 1-2

1999 Off-Site Dose Commitments from Liquid Effluents
Connecticut Yankee

CY	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Max Individual	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	1.35E-02	8.36E-02	9.75E-03	8.47E-04
Thyroid	1.25E-03	4.73E-03	1.57E-04	8.96E-05
Max Organ	2.00E-02	1.25E-01	1.52E-02	1.30E-03
Population	(person-rem)	(person-rem)	(person-rem)	(person-rem)
Whole Body	2.07E-01	1.31E+00	1.61E-01	1.29E-02
Thyroid	1.15E-03	2.01E-03	2.18E-04	1.18E-04
Max Organ	3.72E-01	2.36E+00	2.96E-01	2.43E-02
Avg Individual	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	5.40E-05	3.42E-04	4.20E-05	3.37E-06
Thyroid	3.00E-07	5.25E-07	5.69E-08	3.08E-08
Max Organ	9.71E-05	6.16E-04	7.73E-05	6.34E-06

Table 1-3

1999 Off-Site Dose Summary fom Effluents
Haddam Neck Plant

Airborne Effluents

Population Dose Commitments *(person-rem)*

Whole Body	Thyroid	Max Organ	Skin
0.0399	0.0394	0.0406	0.0397

Max Individual Dose/Dose Commitments vs
Annual Radiological Effluent Technical Specifications

	Whole Body *(mrem)*	Thyroid *(mrem)*	Max Organ *(mrem)*	Skin *(mrem)*	Beta Air Dose *(mrad)*	Gamma Air Dose *(mrad)*
Unit RETS	*5 **	*15*	*15*	*15 **	*20*	*10*
Site Total	0.0070	0.0209	0.0224	0.0082	0.0000	0.0000

* 10CFR50, Appendix I limits

Liquid Effluents

Population Dose Commitments *(person-rem)*

Whole Body	Thyroid	Max Organ
1.69	0.0035	3.05

Max Individual Dose/Dose Commitments vs
Annual Radiological Effluent Technical Specifications

	Whole Body *(mrem)*	Thyroid *(mrem)*	Max Organ *(mrem)*
Unit RETS	*3*	*10*	*10*
Site Total	0.11	0.0062	0.16

Table 1-4

1999 Off-Site Dose Comparison
Haddam Neck Plant

Max Individual Dose/Dose Commitments vs 40CFR190 Limits

	Whole Body *(mrem)*	Max Organ *(mrem)*
40CFR190 Limit	25	75
Airborne Effluents	0.0070	0.0224
Liquid Effluents	0.1077	0.1615
Radwaste Storage	3.0000	3.0000
Station Total	3.115	3.184

Whole Body Dose from Haddam Neck Plant vs. Background Radiation

Sources of Background Radiation:	
Cosmic	27
Cosmogenic	1
Terrestial (Atlantic and Gulf Coastal Plain)	16
Inhaled	200
In the Body	40
CT Resident Whole Body Dose from Background **	**284 mrem**

CT Resident (within 50 miles) Whole Body Dose from Haddam Neck Plant Airborne and Liquid Effluents	**0.000452 mrem**
Maximum Individual (within 50 miles) Whole Body Dose from Haddam Neck Plant Airborne and Liquid Effluents	**0.115 mrem**
Maximum Individual (within 50 miles) Whole Body Dose from Haddam Neck Plant and all sources of the fuel cycle	**3.115 mrem**

2.0 Radioactivity

2.1 Airborne Effluents

2.1.1 Fission and Activation Gases

Main Stack effluents were continuously monitored for gaseous fission and activation gases with an in-line scintillation detector until mid December. Gaseous grab samples were collected and analyzed for radioactivity with the gamma spectroscopy system.

Beginning in December 1999, gaseous sampling and monitoring were moved to the Spent Fuel Building Exhaust ventilation following a modification to the Spent Fuel Building and implementation of Technical Specification Amendment 195. The Spent Fuel Building contains the only potential source of noble gases. The exhaust from the Spent Fuel Building is now continuously monitored for fission and activation gases. This change is reflected in revision 13 to the REMODCM, effective 12/14/99.

2.1.2 Iodines

Main Stack effluents were continuously sampled with an in-line charcoal cartridge until mid December. Iodine samples were analyzed with the gamma spectroscopy system. Iodine sampling of airborne effluents was discontinued in March 1999. Due to the length of time the plant has been shutdown, all iodine present at shutdown has been removed by radioactive decay. Additionally, with the fuel now stored in the Spent Fuel Pool, the potential for new iodine being generated no longer exists. This change is reflected in revision 13 to the REMODCM, effective 12/14/99.

2.1.3 Particulates

Main Stack effluents were continuously sampled with an in-line particulate filter. Particulate filters were analyzed for gamma activity, gross alpha, 90. Amercium-241 was conservatively assumed for any positive gross alpha samples.

In December 1999, the Spent Fuel Pool Spray Cooling system was added as an effluent release pathway. This system had previously been monitored as a potential release pathway under the IE Bulletin 80-10 monitoring program. During the week of 12/26/99, a weekly sample of this pathway was missed when the system was operated for a single 20 minute period. An estimation of the discharge, using historical data, has been included in Table 2-3 for completeness.

2.1.4 New Effluent Release Points

In mid-December 1999, gaseous sampling and monitoring program was initiated for the Spent Fuel Building Ventilation Exhaust. The exhaust of the Spent Fuel Building is now continuously monitored for fission and activation gases, tritium and particulates.

In June, 1999, it was determined that the Spray Cooling system, which is part of the Spent Fuel Pool Cooling System, was concentrating low level radioactivity from the makeup water system. The operation of the Spray Cooling system with radioactive water created an airborne release of radioactivity in the 'drift'. The 'drift' consists of small water droplets carried away from the system by the cooling air flow. The Spray Cooling system is operated periodically to maintain the Spent Fuel Pool temperature. The source of the release was determined to be residual radioactivity, which was below environmental detection limits, in the makeup water storage tanks. The Spray Cooling system concentrates contaminates in the makeup water as a natural function

of its design. The makeup water source to the Spray Cooling system was isolated from all other plant inputs to prevent further contamination ingress. The radioactive releases from the Spray Cooling system were included in the sampling/monitoring program of the REMODCM. All radioactivity released from the system was included in the summations and dose assessments contained in this Annual report.

In 1999, to facilitate the removal of large components from the Containment building, access hatch was unavailable for use. A new entryway was cut into the building on an upper level of the Containment. Air sampling at the doorway was initiated to provide continuous monitoring of the air which potentially could escape from the Containment building. In October 1999, during cutting operations on the steam generators, radioactivity was detected on the air samples. The Containment building was being ventilated through normal ventilation pathways during these evolutions, however, locally higher atmospheric pressures in the upper levels of the Containment building caused small releases of airborne particulate radioactivity when the new alternate personnel access hatch was used. The radioactive releases from this Alternate Containment hatch were included in the sampling/monitoring program of the REMODCM. All radioactivity released from the system was included in the summations and dose assessments contained in this Annual report.

In December 1999, decommissioning activities began in the lower level of the Cable Vault. This activity included extended periods with the access to this facility propped open allowing a flow of air to the environment. Air sampling in Cable Vault Lower Level was initiated to provide continuous monitoring of the air which could escape out of the Cable Vault. The radioactive releases from Cable Vault Lower Level were included in the sampling/monitoring program of the REMODCM. All radioactivity released from the system was included in the summations and dose assessments contained in this Annual report.

2.2 Liquid Effluents

2.2.1 Batches

Liquid Batch releases were sampled and analyzed prior to discharge for gamma and tritium activity. Liquids were monitored during release by two in-line scintillation detectors. Composite samples were analyzed for gross alpha, Fe-55, Sr-89 and 90. Amercium-241 was conservatively assumed for any positive gross alpha samples. All batch releases were discharged with a dilution flow of 189,000 gpm from two circulating water pumps (93,000 gpm each) and 1 service water pump (3000 gpm).

2.2.2 Continuous

Liquid Continuous release pathways were sampled and analyzed for gamma and tritium activity. If required, composite samples were analyzed for gross alpha, Fe-55, Sr-89 and Sr-90. Amercium-241 was conservatively assumed for any positive gross alpha samples. Continuous liquid releases include the External Containment Sump (ECS) and Cable Vault Sump (CVS) discharges. Engineering assessments of flow in ECS of 225,000 gallons per week and CVS flow of 20 gallons per minute were used to determine the total curies discharged through these pathways. In late March of 1999, the ECS and CVS discharge paths were incorporated into and monitored as part of Yard Drain #6. The continuous liquid releases were discharged with available dilution flow based on the number of Service Water Pumps and Circulating Water Pumps operating.

2.3 Estimate of Errors

2.3.1 Airborne

Fission and Activation Gases	14%
Iodines	13%
Particulates	14%
Tritium	8%

2.3.2 Liquid

Fission and Activation Products	11%
Tritium	3.5%
Dissolved and Entrained Gases	19%
Gross Alpha	8%

2.4 Batch Releases

2.4.1 Airborne Effluents

	Ctmt Purge	WGDT	Summary
Number of Batches	*	0	0
Total Time (min)	*	0	0
Maximum Time (min)	*	0	0
Average Time (min)	*	0	0
Minimum Time (min)	*	0	0

* Note: Containment Purges have been incorporated into the Main Stack continuous releases and are no longer considered a separate batch release.

2.4.2 Liquid Effluents

Number of Batches	40
Total Time (min)	11,587
Maximum Time (min)	490
Average Time (min)	290
Minimum Time (min)	10
Average Stream Flow (ft3/sec)	15,800

2.5 Abnormal Releases

None

List of Effluent Release Tables

Table 2-1

Haddam Neck

Airborne Effluents - Release Summary

	Units	1999 1st Qtr	1999 2nd Qtr	1999 3rd Qtr	1999 4th Qtr	1999 Total
A. Fission & Activation Gases						
1. Total Activity Released	Ci	n/a	n/a	n/a	1.76E-05	1.76E-05
2. Average Period Release Rate	uCi/sec	n/a	n/a	n/a	2.21E-06	5.58E-07
B. Iodine-131						
1. Total Activity Released	Ci	n/a	n/a	n/a	n/a	n/a
		No Activity Detected				
2. Average Period Release Rate	uCi/sec	n/a	n/a	n/a	n/a	n/a
C. Particulates						
1. Total Activity Released	Ci	8.82E-06	3.46E-05	1.67E-05	2.30E-05	8.32E-05
2. Average Period Release Rate	uCi/sec	1.13E-06	4.40E-06	2.11E-06	2.90E-06	2.64E-06
D. Gross Alpha						
1. Total Activity Released	Ci	n/a	n/a	n/a	n/a	n/a
		No Activity Detected				
E. Tritium						
1. Total Activity Released	Ci	1.53E+01	1.02E+00	1.58E+00	1.49E+00	1.94E+01
2. Average Period Release Rate	uCi/sec	1.97E+00	1.30E-01	1.99E-01	1.88E-01	6.15E-01

n/a = Not applicable

Table 2-2

Haddam Neck

Airborne Effluents - Mixed Continuous

Main Stack (Aux Bldg Ventilation, Containment Purge)

Nuclides Released	Units	1999				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
Kr-85	Ci	-	-	-	1.76E-05	1.76E-05
Total Activity	Ci	n/a	n/a	n/a	1.76E-05	1.76E-05
B. Iodines						
I-131	Ci	-	-	-	-	n/a
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
C. Particulates						
I-131	Ci	-	-	-	-	n/a
Cs-137	Ci	3.87E-06	-	-	-	3.87E-06
Total Activity	Ci	3.87E-06	n/a	n/a	n/a	3.87E-06
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	n/a
E. Tritium						
H-3	Ci	1.53E+01	1.02E+00	1.58E+00	1.11E+00	1.90E+01

- = Less than minimum detectable activity

n/a = Not applicable

Table 2-3

Haddam Neck

Airborne Effluents - Ground Continuous - Spent Fuel Pool Spray Cooling

Nuclides Released	Units	1999				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
B. Iodines						
I-131	Ci	-	-	-	-	n/a
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
C. Particulates						
I-131	Ci	-	-	-	-	n/a
Co-60	Ci	1.22E-06	8.34E-06	5.92E-06	5.73E-07	1.61E-05
Cs-134	Ci	6.08E-07	4.06E-06	1.70E-06	2.03E-07	6.57E-06
Cs-137	Ci	3.12E-06	2.22E-05	9.12E-06	1.95E-06	3.64E-05
Total Activity	Ci	4.95E-06	3.46E-05	1.67E-05	2.73E-06	5.90E-05
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	n/a
E. Tritium						
H-3	Ci	-	-	-	6.79E-07	6.79E-07

- = Less than minimum detectable activity

n/a = Not applicable

Table 2-4

Haddam Neck

Airborne Effluents - Ground Continuous - Spent Fuel Building Exhaust

Nuclides Released	Units	1999				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
B. Iodines						
I-131	Ci	-	-	-	-	n/a
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
C. Particulates						
I-131	Ci	-	-	-	-	n/a
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	n/a
E. Tritium						
H-3	Ci	-	-	-	3.84E-01	3.84E-01

- = Less than minimum detectable activity

n/a = Not applicable

Table 2-5

Haddam Neck

Airborne Effluents - Ground Continuous - Miscellaneous (Alternate Containment Access)

Nuclides Released	Units	1999				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
B. Iodines						
I-131	Ci	-	-	-	-	n/a
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
C. Particulates						
I-131	Ci	-	-	-	-	n/a
Co-60	Ci	-	-	-	2.32E-06	2.32E-06
Cs-137	Ci	-	-	-	1.71E-05	1.71E-05
Total Activity	Ci	n/a	n/a	n/a	1.94E-05	1.94E-05
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	n/a
E. Tritium						
H-3	Ci	-	-	-	-	n/a

- = Less than minimum detectable activity

n/a = Not applicable

Table 2-6

Haddam Neck

Airborne Effluents - Ground Continuous - Miscellaneous (Cable Vault Lower Level)

Nuclides Released	Units	1999				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
B. Iodines						
I-131	Ci	-	-	-	-	n/a
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
C. Particulates						
I-131	Ci	-	-	-	-	n/a
Cs-137	Ci	-	-	-	8.96E-07	8.96E-07
Total Activity	Ci	n/a	n/a	n/a	8.96E-07	8.96E-07
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	n/a
E. Tritium						
H-3	Ci	-	-	-	-	n/a

- = Less than minimum detectable activity

n/a = Not applicable

Table 2-7

Haddam Neck

Liquid Effluents - Release Summary

	Units	1999 1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission and Activation Products						
1. Total Activity Released	Ci	2.13E-02	7.33E-02	1.04E-02	3.43E-03	1.08E-01
2. Average Period Diluted Activity	uCi/ml	3.87E-09	1.27E-08	2.97E-09	1.04E-09	6.00E-09
B. Tritium						
1. Total Activity Released	Ci	5.85E+00	9.97E-01	2.51E-01	4.77E-02	7.15E+00
2. Average Period Diluted Activity	uCi/ml	1.06E-06	1.73E-07	7.20E-08	1.45E-08	3.96E-07
C. Dissolved and Entrained Gases						
1. Total Activity Released	Ci	n/a	n/a	n/a	n/a	n/a
		No Activity Detected				
2. Average Period Diluted Activity	uCi/ml	n/a	n/a	n/a	n/a	n/a
D. Gross Alpha						
1. Total Activity Released	Ci	2.34E-04	1.14E-04	7.73E-05	2.55E-05	4.51E-04
E. Volume						
1. Released Waste Volume	Liters	4.06E+05	5.45E+05	2.24E+05	2.52E+05	1.43E+06
2. Dilution Volume During Releases	Liters	2.21E+09	3.32E+09	1.29E+09	1.47E+09	8.29E+09
3. Dilution Volume During Period	Liters	5.50E+09	5.76E+09	3.49E+09	3.30E+09	1.81E+10

n/a = Not applicable

Table 2-8

Haddam Neck
Liquid Effluents - Continuous
(Yard Drain #6, Service Water Effluent)

Nuclides Released	Units	1999				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
Co-60	Ci	4.37E-07	-	-	-	4.37E-07
Cs-137	Ci	1.08E-08	-	1.57E-05	-	1.57E-05
Total Activity	Ci	4.48E-07	n/a	1.57E-05	n/a	1.61E-05
B. Tritium						
H-3	Ci	5.99E-02	3.25E-02	5.14E-02	2.88E-02	1.73E-01
C. Dissolved & Entrained Gases						
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	n/a

- = Less than minimum detectable activity
n/a = Not applicable

Table 2-9

Haddam Neck
Liquid Effluents - Batch
(Test Tanks, Steam Generator Secondary Side Water, Waste Neutralization Tanks)

Nuclides Released	Units	1999				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
Ag-110m	Ci	1.31E-03	2.21E-03	9.55E-05	1.34E-05	3.63E-03
Co-60	Ci	1.52E-02	5.83E-02	1.43E-03	1.09E-03	7.60E-02
Cs-134	Ci	1.41E-04	9.14E-04	7.08E-05	3.41E-06	1.13E-03
Cs-137	Ci	1.27E-03	8.25E-03	6.53E-04	8.66E-05	1.03E-02
Eu-154	Ci	1.29E-04	5.50E-05	-	-	1.84E-04
Fe-55	Ci	3.08E-03	3.15E-03	8.09E-03	2.24E-03	1.66E-02
Mn-54	Ci	3.11E-05	1.59E-04	-	-	1.90E-04
Np-237	Ci	2.59E-05	-	-	-	2.59E-05
Ru-106	Ci	7.09E-05	-	-	-	7.09E-05
Sb-125	Ci	4.61E-05	2.67E-04	-	-	3.13E-04
Total Activity	Ci	2.13E-02	7.33E-02	1.03E-02	3.43E-03	1.08E-01
B. Tritium						
H-3	Ci	5.79E+00	9.64E-01	2.00E-01	1.89E-02	6.97E+00
C. Dissolved & Entrained Gases						
	Ci	-	-	-	-	n/a
Total Activity	Ci	n/a	n/a	n/a	n/a	n/a
D. Gross Alpha						
Gross Alpha	Ci	2.34E-04	1.14E-04	7.73E-05	2.55E-05	4.51E-04

- = Less than minimum detectable activity
n/a = Not applicable

2.2 Solid Waste

Refer to Table 2-10 for a solid waste shipment radioactivity summary. The principal radionuclides considered were those included on shipping manifests.

Waste is being shipped for offsite processing and disposal.

Table 2-10

Haddam Neck

1999 Solid Waste and Irradiated Fuel Shipments

Solidification Agent(s):

No solidification on site for 1999

Types of Containers Used and Typical Container Volumes:

Container Type	Typical Volume (ft3)
20' Sea / Land Container	1280
Poly High Integrity Container (HIC)	120.3
Steam Domes (Self Contained)	1600
B-25 Boxes (4' x 4' x 6')	96
Oil Bins (6 pack)	157

A. Solid waste shipped offsite for burial or disposal (not irradiated fuel)

1. Type of Waste		Units	12-Month Period Total	Est Total Error %
a.	Spent Resins, Filter Sludges, Evaporator Bottom, etc.	m3 Ci	2.38E+01 5.41E+02	2.50E+01
b.	Dry Active Waste, Contaminated Equipment, etc.	m3 Ci	3.64E+03 2.85E-01	2.50E+01
c.	Irradiated Components	m3 Ci	- -	2.50E+01
d.	Other: SFB Soil, Steam Dome, CCW Tanker	m3 Ci	6.64E+02 1.59E-01	2.50E+01

	Type of Waste (percent of total)			
Nuclide	a.	b.	c.	d.
Ac-228	-	-	-	2.60E-02
Ag-110M	-	-	-	-
Am-241	5.30E-02	1.98E-01	-	3.00E-03
C-14	3.20E-02	-	-	6.00E-03
Ce-144	1.92E+00	4.84E+00	-	4.50E-01
Cm-242	-	1.00E-03	-	-
Cm-243	2.00E-02	7.40E-02	-	1.00E-03
Co-57	-	-	-	-
Co-58	-	-	-	-
Co-60	2.69E+01	2.92E+01	-	2.08E+00
Cs-134	5.00E+00	2.64E+00	-	5.60E-02
Cs-137	3.12E+01	2.35E+01	-	1.34E+01
Fe-55	1.81E+01	2.79E+01	-	6.35E-01
H-3	-	5.73E-01	-	6.72E+01
K-40	-	-	-	2.89E-01
Mn-54	5.85E-01	-	-	-
Ni-59	-	-	-	-
Ni-63	1.50E+01	7.94E+00	-	6.58E+00
Np-237	-	-	-	1.94E-01
Pb-212	-	-	-	6.00E-02
Pu-238	5.20E-02	1.37E-01	-	2.00E-03
Pu-239	1.70E-02	4.70E-02	-	1.00E-03
Pu-240	-	-	-	-
Pu-241	8.38E-01	2.69E+00	-	6.89E-01
Sr-89	2.00E-03	-	-	-
Sr-90	2.25E-01	2.21E-01	-	2.00E-03
Tc-99	-	-	-	6.45E+00
Th-228	-	-	-	5.15E-01
Th-230	-	-	-	1.36E+00

Table 2-10

(Continued)

Haddam Neck

1999 Solid Waste and Irradiated Fuel Shipments

3. Solid Waste Disposition

Mode of Transportation	No. Shipments	Destination
Hittman Transport	6	Barnwell Waste Management Facility for burial
Hittman Transport	1	Chem-Nuclear Consolidation Facility for processing
Marino Crane	4	Frank W Hake Associates for processing
Hittman Transport	28	GTS Duratek Inc BCO for processing
Hittman Transport	43	GTS Duratek Inc GR for processing
Kindrick Trucking Co	2	GTS Duratek Inc GR for processing
TAG Transport Inc	2	GTS Duratek Inc GR for processing

B. Irradiated Fuel Shipments (Disposition)

C. Offsite Processing

Vendor	No. Shipments	Volume (m^3)	Activity (Ci)
Chem-Nuclear Consolidation Facility	1	3.41E+00	4.75E+01
Frank W Hake Associates	4	1.81E+02	2.18E-03
GTS Duratek Inc BCO	28	1.30E+03	3.86E-01
GTS Duratek Inc GR	47	2.82E+03	5.66E-02

3.0 REMODCM Changes

In 1999, there were three changes to the REMODCM.

Section I (REMM)	Change 98-01	Rev 11	Effective March 23, 1999
	Change 99-01	Rev 12	Effective December 14, 1999
	Change 99-03	Rev 13	Effective December 14, 1999
Section II (ODCM)	Change 98-02	Rev 11	Effective March 23, 1999
	Change 99-02	Rev 12	Effective December 14, 1999
	Change 99-04	Rev 13	Effective December 14, 1999

REMODCM changes are reviewed by PORC and approved by the Unit Director. The description of the changes for each REMODCM revision are included in this report. In addition, a complete updated copy of the REMODCM, as of 12/31/99, is provided to the Nuclear Regulatory Commission as an attachment to this report.

4.0 Inoperable Effluent Monitors

During the period January 1 through December 31, 1999, the following effluent monitors were inoperable for more than 30 consecutive days:

4.1 **Test Tank Release Monitor (R-22)** - from 11/16/98 to 3/10/99

The R-22 monitor was made inoperable during efforts to replace the monitor with a new Victoreen liquid radiation monitor. Efforts to install and calibrate the new monitor required removal of the old monitor. Processing of the design change documentation and performance of the calibration and procedure upgrades caused this monitor to be inoperable for greater than 30 days. Compensatory sampling, calculations, and valve lineup verifications were performed during the inoperability period. The new monitor has been installed, calibrated, and was placed in service in March 1999.

4.2 **Stack Flow Monitor (FE-1101)** - from 5/11/98 to 3/11/99

On May 11, 1998, the stack flow monitor (FE-1101) was determined to be reading lower than expected for the ventilation configuration. An engineering evaluation of the plant ventilation systems determined that the flow monitor had an insufficient range for all plant operating conditions. Additionally, there were no repair parts available since the manufacturer was no longer in business. The stack flow rate was being monitored by a temporary instrument which was verified by plant operators periodically. A design change was being processed to replace the stack flow monitor with a newer, more accurate model which had sufficient range for all plant conditions. The new stack flow monitor was installed, calibrated and placed in service in March 1999.

5.0 Errata

The following information was inadvertently left out of the Solid Radioactive Waste Section of the 1996 Annual Radioactive Effluent Report

C. Offsite Processing

Vendor	No. Shipments	Volume (m3)	Activity (Ci)
F.W. Hake	16	1.90E+01	4.59E+04

REMODCM Changes

Revision 11

March 23, 1999

RADIOLOGICAL ENVIRONMENTAL REVIEW

for Change 98-01 to
CY REMODCM, Section I
Radiological Effluent Monitoring Manual (REMM)

Summary of Changes:

A detailed summary of the changes to the CY REMM is provided in the memorandum CH-98-618 from Allen Yates to Kerry Harner, Subject: Description of proposed changes to REMODCM Section 1, dated May 4, 1998.

The aforementioned REMM changes were principally made to reflect the following:

(1) Unit Director, instead of Station Vice President, responsible for implementation of this manual.
(2) Effects of pending plant decommissioning, i.e. effluent pathways, sampling, analysis and radwaste treatment systems.
(3) Source term decay since plant shutdown.
(4) Inclusion of the Yard Drain 6 (Catch Basin 11) pathway and shift of the Steam Generator pathway from continuous to batch.
(5) Use of previous month's doses, instead of monthly dose projections, to determine required operation of radwaste systems for the current month and remainder of current quarter and year.
(6) Change from monthly to weekly gas grab sampling as is currently being done.
(7) Efforts to reduce redundant radioactivity accounting for containment purges.
(8) Inclusion of Co-60 LLD for sediment.
(9) Inclusion of nearest resident and garden for land use census.
(10) Format, grammatical and editorial corrections and enhancements. Document was consolidated into a single file with a standardized format and layout.

These changes were made to reflect the accurate, current and expected future status of the plant and to increase the reliability of effluent, dose and setpoint calculations.

Radiological Environmental Statement:

The above proposed changes do not constitute an unreviewed radiological environmental impact based upon a review of each proposed change. Therefore, the following statement is being made in accordance with Nuclear Group Procedure 6.09 "Changes to the Radiological Effluent Monitoring Manual and the Off-Site Dose Calculation Manual, Section 6.2.4: "A determination has been made that the change will maintain the level of radioactive effluent control required by 10 CFR Part 20.106, 40 CFR Part 190, 10 CFR Part 50.36a, and Appendix I to 10 CFR Part 50 and not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations."

Prepared by: 6/2/98
D.M. Flick, Sr Engineer
Radiological Engineering

Reviewed by: 6/3/98
W.J. Eakin, Supervisor
Radiological Engineering

RADIOLOGICAL ENVIRONMENTAL REVIEW

for Change 98-02 to
CY REMODCM, Section II
Offsite Dose Calculation Manual (ODCM)

Summary of Changes:

A detailed summary of the changes to the CY REMM is provided in the memorandum CH-98-620 from Allen Yates to Kerry Harner, Subject: Description of proposed changes to REMODCM Section 2, dated May 27, 1998.

The aforementioned ODCM changes were principally made to reflect the following:

(1) Unit Director, instead of Station Vice President, responsible for implementation of this manual.
(2) Citing and expanding upon specific Technical Specifications throughout the manual.
(3) Source term decay since plant shutdown affects radionuclides present.
(4) Replacement of Method 1 for liquid dose calculations with a methodology that takes into account the actual release source term and dilution flow. The new method is based upon the NRC computer code LADTAP II, which is used for Method 2 by the Radiological Assessment Branch.
(5) Deletion of monthly dose projections for both gaseous and liquid effluent releases to consistent with Section I REMM.
(6) Updated Service Water per pump flow from 6,000 gpm to 3,000 gpm and the fact that Service Water system flow has an upper limit of approximately 3,000 gpm.
(7) Administrative Factor for the Waste and Recycle Test Tank Discharge Line Monitor (R-22) was changed from 0.1 to a range of 0.1 to 0.7 but is administratively set in the Chemistry procedures at 0.1 and can only be increased with PORC approval.
(8) The setpoint determination steps were updated to reflect the current condition of the monitors.
(9) Format, grammatical and editorial corrections and enhancements.

These changes were made to reflect the accurate, current and expected future status of the plant and to increase the reliability of effluent, dose and setpoint calculations.

Radiological Environmental Statement:

The above proposed changes do not constitute an unreviewed radiological environmental impact based upon a review of each proposed change. Therefore, the following statement is being made in accordance with Nuclear Group Procedure 6.09 "Changes to the Radiological Effluent Monitoring Manual and the Off-Site Dose Calculation Manual, Section 6.2.4: "A determination has been made that the change will maintain the level of radioactive effluent control required by 10 CFR Part 20.106, 40 CFR Part 190, 10 CFR Part 50.36a, and Appendix I to 10 CFR Part 50 and not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations."

Prepared by: _____ 6/2/98
D.M. Flick, Sr Engineer
Radiological Engineering

Reviewed by: _____ 6/3/98
W.J. Eakin, Supervisor
Radiological Engineering

CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD EAST HAMPTON, CT 06424-3099

May 4, 1998

CH-98-618

TO: Kerry Harner

FROM: Allen Yates

SUBJECT Description of proposed changes to REMODCM Section 1.

This memo describes the changes being submitted to RAB for inclusion in the upcoming REMODCM revision. This memo supercedes CH-97-652, issued to Scott Herd on Dec. 27, 1997.

1. Page A-1, first paragraph

Reworded introduction to reflect Technical Specification requirements for Section 1 of the REMODCM.

2. Page B-1, third paragraph

Change responsibility from Station Vice President to Unit Director, per Nuclear Licensing Department. This is the responsible party identified in Technical Specifications.

3. Page C-2, Table C-1

1. Format of table changed (cleaned up) so that personnel can find information easier.
2. Column for Liquid Release Type:

   a. Moved Steam Generator from Continuous Release to Batch Release to reflect current and future operation of the Steam Generators as a liquid release pathway.

   b. Added Yard Drain 6 (Catch Basin 11) as a continuous release pathway for the RCA yard drain system. The release of activity (mostly Tritium) from this pathway has been accounted for since late November 1996. A 50.59 safety evaluation has been performed on this pathway for its continued operation as a radioactive system (SY-EV-97-0130). The incorporation of this pathway as a continuous release pathway will include composite sampling and analysis as designated. Release volumes will be calculated in accordance with SUR 5.4-13 by run time meters on the Mat Sump pumps and a conservative volume added for discharges from the other Yard Drains in the system.

   c. Table Notation H (h) for Batch Release is a requirement for batch release recirculation. The inclusion of "where possible" is for the Waste Transfer (NPDES) Sump that is considered a batch release but has limited if not any

recirculation capabilities. The small size of the sump and the sampling prior to each release is considered conservative. The previous requirement was for the sump to be sampled only if Steam Generator activity was above 5E-07 uCi/ml. With this revision it will require sampling, analysis and a permit generated (if necessary) prior to any release from this pathway.

3. Column for Sampling Frequency:

   a. Changed "One Batch per Month" requirement for Dissolved and Entrained Gases to "Prior to Each Batch Release". Due to plant conditions, only the long lived gas Kr-85 can still be available for identification by gamma spectroscopy analysis and then released. This isotope will be sampled and analyzed prior to each batch release.

   b. Table Notation E (e) for continuous release describes the sampling frequency for samples used in the composite. The notation includes the potential use of an autosampler for obtaining the sample.

4. Column for Minimum Analysis Frequency

   a. Changes already described in Column for Sampling Frequency (3.).

5. Column for Type of Activity Analysis

   a. Principal Gamma Emitters listed in Table Notation D (d) changed to reflect current plant conditions. Fe-59 (45 day half-life) was removed. Gamma Emitters that have a different LLD requirement (directly under Principal Gamma Emitters on table) were also modified, removed were I-131 (8.04 day half-life), Mo-99 (66.02 hour half-life), Cr-51 (27.70 day half-life) and Ce-141 (32.5 day half-life). Zn-65 is now included in the list for PGE's, with an LLD of 5E-07. Ru-106 was removed because it is not included as a PGE in NUREG 1301 and will be identified if other PGE's meet their required LLD.

   b. Removed Sr-89 (50.5 days) due to half-life considerations.

   c. Table Notation F (f) specifies the analysis for Sr-90, Fe-55 and Gross Alpha are required for WNT and NPDES Sump only if gamma activity had been identified. The activity limit is representative of the gamma LLD requirement.

   d. Table Notation G (g) specifies the same requirement as Notation F (f) for Service Water and the Yard Drain 6 continuous release pathways.

6. Column for Lower Limit of Detection (LLD)

   a. Table Notation A (a) was modified to correct radioactivity unit to uCi per unit volume. This reflects the result obtained by using the equation for these samples.

   b. Table Notation A (a) was modified to correct delta t definition.

   c. Table Notation A (a), last paragraph was removed. This contradicted the requirement for not meeting the LLD as specified in Notation D (d). Notation D (d) reflects the actual reporting requirement in the event of not satisfying the LLD requirement.

4. Page C-3, Table C-1 Notations

The changes identified for Table C-1 included all the changes to the Notations. The lettering is different due to the incorporation and deletion of requirements as noted above.

5. Page C-5

1. Revised monthly dose projection into a monthly dose requirement. If the limits are exceeded on the monthly dose calculation, then the site will ensure all waste systems are in operation until the limits have returned to the required levels. This change is to reflect the status of the site's radwaste capabilities at this time. The only radwaste treatment systems available are demineralizers, that for the processing of test tanks, have to be in operation for NPDES parameter constraints. This will be reflected in SUR 5.4-13 procedure as a review requirement with the potential initiating of an ACR as its outcome

2. Modified the liquid radioactive waste treatment systems available to process liquid waste for current plant condition. Removed the evaporators and degasifier from the list. Although these components have not been abandoned, but are in layup, they no longer are used or are being considered to be used as part of radioactive liquid treatment.

6. Page D-2, Table D-1

1. Format of table changed (cleaned up) so that personnel can find information easier.
2. Column Gaseous Release Type
    a. No change
3. Column Sampling Frequency
    a. Changed Monthly gaseous grab sample to a weekly requirement. This is the current practice in the department, and a weekly sample is being provided for the proposed change to containment purge sampling requirements discussed next.
    b. Table Notation D (d) specifies that prior to the containment purge, a sample must be obtained from the refueling floor. The sampling requirement for once every 24 hours while the cavity is flooded has been removed due to current plant conditions (no fuel). This revision will require a sample prior to a containment purge, only if the Reactor Cavity is flooded. The accounting for activity released has been changed to reflect the first twelve hours as a containment purge permit, after twelve hours as a continuous release that will be accounted for by the weekly sampling of the main stack (3.a.).
4. Column Minimum Analysis Frequency
    a. Table Notation E (e) requires samples to be changed every 7 days and analyses completed with 48 hours. Includes the allowance of a factor of 10 increase in LLD requirements is collection period is less than 24 hours. This Notation is a combination of previous footnotes that deal with this sample point. The Notations for power changes and increase in Iodine activity have been removed due to current plant conditions.

5. Column Type of Activity Analysis

a. Removed the Principal Gamma Emitter Notation for Waste Gas Decay Tanks, Containment Purge and Main Stack Gaseous Grab Sample . Kr-85 is listed seperately with its required LLD value. Isotopes that were removed are Kr-87 (76 minute half-life), Kr-88 (2.8 hour half-life), Xe-133 (5.24 day half-life), Xe-133m (2.1 day half-life), Xe-135 (9.1 hour half-life) and Xe-138 (14 minute half-life).

b. Principal Gamma Emitters listed in Table Notation C (c) changed to reflect current plant conditions. Isotopes removed are Fe-59, Mo-99 and Ce-141, all for half-life considerations.

c. Removed Sr-89 due to half life considerations.

6. Column for Lower Limit of Detection (LLD)

a. Corrections the same as previously described for liquid table.

7. Page D-3, Table D-1 Notations

The table was revised as per previous section discussion for Table D-1. Sampling Requirements associated with at power conditions were removed to reflect current plant condition.

8. Page D-4

1. Revised monthly dose projection into a monthly dose requirement. If the limits are exceeded on the monthly dose calculation, then the site will ensure all waste systems are in operation until the limits have returned to the required levels. This change is to reflect the status of the site's radwaste capabilities at this time. The only gaseous radwaste treatment systems in operation are the HEPA and Charcoal filters. This will be reflected in SUR 5.4-14 procedure as a review requirement with the potential initiating of an ACR as its outcome

2. Modified the gaseous waste treatment systems available to process gaseous waste for current plant conditions. Removed the Waste Gas Surge Tank, Compressors and Waste Gas Decay Tanks. These components are no longer being used or considered to be used for the treatment of gaseous waste. The Waste Gas Decay Tanks are still included in the gaseous sampling program due to unknown variables in the future decommissioning may require their venting or potential release. They are not considered a waste treatment system, only a release point.

9. Page E-3, Table E-1

1. Changed number of locations for 1b from 27 to 25.

2. Inserted into 8. Fish (edible portion), this was to close previous audit finding.

10. Page E-4, Table E-2

Modified isotopes to required analyses to reflect current plant condition. Removed isotopes are Fe-59 (44.6 day half-life), Zr-95 (64 day half-life), Nb-95 (35 day half-life), I-131 (8 day half-life), Ba-140 (12.8 day half-life) and La-140 (40 hour half-life).

11. Page E-5, Table E-3

1. Modified isotopes for required analyses to reflect current plant conditions as identified for Page E-4, Table E-2.

2. Listed Co-58 and Co-60 seperately and added an LLD requirement for Co-60 in Sediment. Did not previously have an LLD requirement.

12. Page E-6, Table E-3 Notations

1. Table Notation A (a) was modified to correct delta t definition.

13. Page E-7

1. First paragraph, last sentence revised to include nearest resident and garden.

2. Second paragraph, removed the asterisk at end of the sentence, not needed.

14. Page F-2 and F-3

1. First paragraph, third sentence deleted "REAL" to be consistent with Technical Specifications.

2. Wording on F-2 cleaned up and page modified for better viewing. As a result, page F-3 is new.

This concludes the changes to the Section I of the REMODCM.

CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD EAST HAMPTON, CT 06424-3099

May 27, 1998

CH-98-620

TO: Kerry Harner

FROM: Allen Yates

SUBJECT Description of proposed changes to REMODCM Section 2.

This memo describes the changes being submitted to RAB for inclusion in the upcoming REMODCM revision.

1. Section A "Introduction" pg. A-1

Reworded introduction to reflect Technical Specification requirements for Section II of the REMODCM. This format will match revision for Section I Introduction.

2. Section B " Responsibilities" pg. B-1

Change responsibility from Station Vice President to Unit Director, per Nuclear Licensing Department. This is the responsible party identified in Technical Specifications.

3. Section C "Liquid Dose Calculations" pg. C-1 through C-3

Section C completely reformatted and rewritten to include Technical Specification requirements and a new method for calculating liquid dose. The Method 1 (for liquid discharges) used prior to this change was based upon a default operating radionuclide mix and liquid dilution flow which are no longer valid. The new Method 1 is based upon dose conversion factors derived from LADTAP II which is the software program used for the more precise Method 2. By using this approach, the new Method 1 dose calculation can take into account the exact radionuclide mix and dilution flow for each individual liquid discharge, or period of discharges. An Excel Spreadsheet template has been created to make the calculation process more accurate and timely. Since Method 1 will account for activity for the exact radionuclide mix and dilution flow, the dose limit for it's use was removed. Removed the Monthly Dose Projection section since dose projections will no longer be required by the REMM. Dose Projection Limit associated with the use of radwaste processing equipment has been changed to a monthly total, not a monthly projection. Procedural steps will be included in the SUR that require an ACR to be written if this limit is exceeded. The quarterly dose will be calculated by summing the monthly doses and the yearly dose calculated by summing the quarterly doses.

4. Section D.4 "Gaseous Effluent Monthly Dose Projections" pg. D-8 through D-9

Removed the section D.4 that calculated monthly dose projection. Dose projection will no longer be required in the REMM. See discussion above (3). Section D.5 and D.6 were renumbered to reflect this removal to D.4 and D.5. Revision date for these sections has been updated.

5. Section E "Liquid Effluent Instrumentation Setpoints" pg. E-1 through E-4

Section was reworded and reformatted to better describe the Technical Specifications that govern the required calculations. Reworded to better describe the actual process of how to calculate the setpoints and where the data comes from. The methodology used here will help the site adapt to upcoming site specific changes (dilution flow). The conservative administrative parameters will be controlled by SUR procedure and will require PORC approval prior to change. The Service Water flow was changed to 3000 gpm. Engineering has provided information that includes this flowrate to be pretty much a constant, can't go too much lower or higher. For the calculation of Service Water R-18, Service Water flow is calculated by multiplying the number of operating pumps by 3000 gpm. In this case it is more conservative to have more flow, procedurally this calculation will be performed as if four service water pumps are running. Variables of decommissioning project may favor a less conservative approach in the future, any of which will include PORC approval.

6. Appendix A "Section C Method 1 Dose Conversion Factors"

The contents of this new appendix reflect the LADTAP II derived dose converion factors for the new Method 1 cited above.

7. Appendix B, "Section C Method 1 Dose Conversion Factors Basis"

This appendix was modified to explain the basis behind the conversion factors and methodology used for the new Method 1. Detailed explanation of this change is explained in the appendix.

8. Appendix C "Liquid Dose Calculations - LADTAP

Added note to clarify zero usage pathways.

This concludes the proposed changes to Section II of the REMODCM.

REMODCM Changes

Revision 12

December 14, 1999

RADIOLOGICAL ENVIRONMENTAL REVIEW

RER-99-009

for

Haddam Neck REMODCM Rev 12

June 15, 1999

Total Number of Pages: 4

Claude Flory Claude Flory 6/14/99
Preparer Date

William Eakin W J Eakin 6/18/99
Supervisor Date

1.0 BACKGROUND

Revision 12 to the Haddam Neck REMODCM is a major change. The bulk of the change is due to incorporation of the Haddam Neck Radiological Effluent Technical Specifications (RETS) into the REMODCM. Other changes are being made due to technical reasons, organizational changes, decommissioning needs, and corrections and enhancements to the REMODCM.

2.0 DISCUSSION

The changes being made to the REMODCM are listed below with a discussion of impacts on the radiological effluent control program:

General Structure

A. Section A, Introduction, and Section B, Responsibilities, are being combined into a new Section A, Introduction and Responsibilities. The combination of sections will be a non-intent change; specific changes within the new Section A are discussed below.
B. New sections will be added to Section I to incorporate the RETS. These include:
   1. Section B, Definitions
   2. Section C.3/4, Liquid Effluent Controls and Surveillance Requirements
   3. Section D.3/4, Gaseous Effluent Controls and Surveillance Requirements
   4. Section F.3, Special Reports
   5. Section G, Total Dose
   6. Section H, Figures

   Addition of new sections will be a non-intent change. Content of the new sections will contain the RETS with no changes except for editorial changes needed to merge RETS into the REMODCM and one minor change in Section C.3/4 as described below. There are no changes to the effluent control program due to REMODCM changes being made to incorporate the RETS.
C. Section D.5 of Part II, Compliance with 40CFR190 Limits, is being duplicated as new Section G.2 of Part I.

Part I Section A: Introduction and Responsibilities

A. There are non-intent, editorial changes being made to incorporate RETS.
B. There are non-intent, editorial changes being made to the first paragraph.
C. The requirement to document changes in the Annual Radioactive Effluent Report is being deleted. This requirement is already contained in Section F.2, the appropriate place for it.

Part I Section B: Definitions

A. Definitions B.31 and B.32, which were not in RETS, are being added for definition of applicable waste treatment systems. These definitions are being transferred from Sections C.2 and D.2.

Part I Section C-2: Liquid Radioactive Waste Treatment

A. Requirement to 'calculate' a dose is being changed to 'project' a dose. This will be strictly a terminology change; methods to determine doses will remain the same as specified in the REMODCM.
B. The phrase 'only if one or all of the gaseous radioactive waste treatment systems will not be routinely operated' is being added to the end of the first sentence. This will provide relief from the requirement when it is not needed.
C. The requirement that waste treatment systems be operated until the dose calculated every 31 days are reduced to below the limits will be removed. Deleting this requirement will allow the flexibility of calculating doses anytime the systems are required to be operating in order to show that system operation is no longer needed.

D. Definition for 'all applicable liquid radioactive waste treatments' will be moved to Section B. In the definition the following changes are being made:
   1. The word 'any' will be added before 'waste stream responsible' to clarify that the criteria could apply to more than one waste stream at a time.
   2. 'Total dose' is being changed to 'total projected dose' to ensure internal consistency when describing doses.
   3. 'Vendor' is being removed after 'portable demineralizer.' This will ensure that the requirement is applied to the portable demineralizer whether it be an in-house or vendor supplied system.
   4. 'Borated Waste Ion Exchanger' is being changed to 'borated waste ion demineralizer' to be consistent with plant terminology.

Part I Section C.3/4: Liquid Effluents Controls and Surveillance Requirements

A. In Table C.3.3 the asterisk footnote is being revised to say that discharge canal flow will be determined by the number of pumps running, instead of by the use of pump curves. The new and old statements are equivalent. The method to determine discharge canal flow will remain the same.
B. In Note 2 for Table C.4.3 the initials 'NBS' for National Bureau of Standards is being changed to 'NIST' for National Institute for Standards and Technology because of a name change.

Part I Section D.2: Gaseous Radioactive Waste Treatment

A. Requirement to 'calculate' a dose will be changed to 'project' a dose. This will be strictly a terminology change; methods to determine doses will remain the same as specified in the REMODCM.
B. The phrase 'only if one or all of the gaseous radioactive waste treatment systems will not be routinely operated' is being added to the end of the first sentence. This will provide relief from the requirement when it is not needed.
C. The requirement that waste treatment systems be operated until the dose calculated every 31 days is reduced to below the limits will be removed. Deleting this requirement will allow the flexibility of calculating doses anytime the systems are required to be operating in order to show that system operation is no longer needed.
D. Definition for 'all applicable gaseous radioactive waste treatments' will be moved to Section B. In the definition the following change is being made:
   1. 'Primary' is being removed from 'Primary Ventilation System.' This will make the requirement applicable to both the main stack and the Spent Fuel Building ventilation.

Part I Section D.3/4: Gaseous Effluents Controls and Surveillance Requirements

A. In bases for dose rate (page D-6) phrase 'from all units' is being changed to 'from all sources' because Haddam Neck is a one unit station.
B. In Note 2 for Table D.4.4 the initials 'NBS' for National Bureau of Standards is being changed to 'NIST' for National Institute for Standards and Technology because of a name change.

Part I Section E: Radiological Environmental Monitoring Sampling And Analysis

A. The last sentence in the sixth paragraph of Section E.1 (middle of Page E-2) is being completed. Wording in the present revision was inadvertently left out making the sentence incomplete.
B. In Table E-1 for river water sampling and collection frequency requirements the word 'gram' is being changed to 'grab' to correct a typographical error.

Part I Section F.2: Annual Radioactive Effluent Report

A. Will make the following changes to be consistent with Regulatory Guidance 1.21: In the third paragraph will delete "exceeding Technical Specification instantaneous release limits" as a condition for reporting abnormal releases. This was an inappropriate use of the instantaneous release rate as a limit or trigger to determine whether or not an abnormal release had occurred or needed to be reported. All abnormal (non-routine) releases will be reported.

Part II Section A: Introduction

A. Reference to the Radiological Assessment Branch in the last paragraph will be deleted. This organization was reorganized and the section servicing the REMODCM was absorbed into the Safety Analysis Branch (SAB). Reference to the SAB was not added to allow flexibility of service provider.

Part II Section B: Responsibilities

A. Definitions B.31 and B.32, which were not in RETS, will be added for definition of applicable waste treatment systems. These definitions are being transferred from Sections C.2 and D.2.

Part II Section D.2 10CFR50 Appendix I - Noble Gas Limits

A. The requirement to document changes in the Annual Radioactive Effluent Report will be deleted. This requirement is already contained in Section F.2, the appropriate place for it.

Part II Section C: Liquid Dose Calculations

A. Reference to the Radiological Assessment Branch at the bottom of Page C-2 will be deleted. This organization was reorganized and the section servicing the REMODCM was absorbed into the Safety Analysis Branch (SAB). Reference to the SAB was not added to allow flexibility of service provider.

Part II Section E.2: Service Water Effluent Line Monitor (R-18)

A. In Step 2 will change the background at which decontamination is required from 200 to 500 cpm. The technical basis for this change is in ERC 16103-ER-99-0010. Based on this ERC the change will not reduce the effectiveness of the effluent control program.

Part II Section F.1: Stack Noble Gas Activity Monitor

A. In Step 2 will change the number of purge fans running and flow rate of 52,000 CFM to a total flow rate of 120,000 which is based on Calculation CY-SW-M-0490. This change will simplify the calculation of the setpoint and will base it on the maximum possible flow rate. The change will not reduce the effectiveness of the effluent control program.

3.0 CONCLUSION

The changes in Revision 12 to the Haddam Neck REMODCM would not cause an increase in release of radioactivity to the environment or of dose to the public and they do not deviate from the design bases for an effluent control program in the FSAR for Haddam Neck. The changes will not affect the level of radioactive effluent control required by Technical Specifications, the FSAR, 10CFR20, 40CFR190, 10CFR50.36a, 10CFR50 GDCs 60 and 64, and Appendix I of 10CFR50 and will not adversely impact the accuracy or reliability of effluent, dose or setpoint calculations. The changes do not cause an Unreviewed Radiological Environmental Impact (UREI).

CONNECTICUT YANKEE ATOMIC POWER COMPANY

HADDAM NECK PLANT
362 INJUN HOLLOW ROAD EAST HAMPTON, CT 06424-3099

June 1, 1999
CH-99-384

To: G. Bouchard, PORC Chairman

From: D. A. Montt, Chemistry Project Manager

Subject: **Revision 12 to the REMODCM** (CYAPCo **R**adiological **E**nvironmental **M**onitoring and **O**ffsite **D**oes **C**alculation **M**anual) **:**
SUMMARY OF PROPOSED CHANGES

Reference: ACP 1.2-2.48, "Changes to the Radiological Effluent Monitoring Manual and the Offsite Dose Calculation Manual"

SECTION I: Radiological Environmental Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Cover Page	Changed to Revision 12 from Revision 11	Latest Revision
Table of Contents	Changed to reflect combination of the Introduction and Responsibility Sections into a single Section, the addition of a Definition Section (taken from T.S.), the addition of an new Control sub-section to the Liquid and Gaseous Effluent Control Sections (the former LCO's and Bases from RETS), an additional "Special Reports" sub-section, and new Total Dose and Figures Sections.	Removal of Radiological Technical Specifications (RETS) from Technical Specifications (T.S.).
Page A-1	Changed to reflect combination of the Introduction and Responsibilities sections into a single section entitled Introduction and Responsibilities. The first paragraph was clarified.	Removal of RETS from T.S. and placement in the REMODCM
Page A-2	New Responsibility sub-section in Section A with clarification of Unit Director (or equivalent) responsibilities	Removal of RETS from T.S. and placement in the REMODCM

SECTION I: Radiological Environmental Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Pages B-1 through B-4	New Definition Section developed using RETS/REMP related definitions taken directly from T.S. Section 1.0. Non-applicable frequencies were not included.	Removal of RETS from T.S. and placement in the REMODCM
Page C-1	Reference to "limits of the Technical Specification" was replaced with "Controls of the REMODCM".	Removal of RETS from T.S. and placement in the REMODCM
Page C-5	Second paragraph describing the Liquid radioactive waste treatments was moved to the definition section.	Removal of RETS from T.S. and placement in the REMODCM
Page C-6	New Liquid Effluent Control (C.3.1) & Surveillance (C.4.1.1,2) Sections for Concentration. This was formerly (Limiting Condition of Operation (LCO) Section 3.11.1.1 and (Surveillance) 4 .11.1.1.1,2 of the T.S., "Liquid Effluents, Concentration"	Removal of RETS from T.S. and placement in the REMODCM
Page C-7	New Liquid Effluent Basis (C.3/4.1) Section for Concentration. This was formerly Bases Section 3 /4.11.1.1 of the T.S., "Liquid Effluents, Concentration"	Removal of RETS from T.S. and placement in the REMODCM
Page C-8	New Liquid Effluent Control (C.3.2) & Surveillance (C.4.2.1) Sections for Dose, Liquids. This was formerly (Limiting Condition of Operation (LCO) Section 3.11.1.2 and (Surveillance) 4 .11.1.2.1,2 of the Technical Specifications, "Liquid Effluents, Dose Liquids"	Removal of RETS from T.S. and placement in the REMODCM
Page C-9	New Liquid Effluent Bases (C.3/4.2) Section for Dose, Liquids. This was formerly Bases Section 3 /4.11.2.1 of the T.S., "Dose, Liquids"	Removal of RETS from T.S. and placement in the REMODCM
Page C-10	New Liquid Effluent Monitoring Instrumentation Control (C.3.3) & Surveillance (C.4.3) Section for Instrumentation. This was formerly (Limiting Condition of Operation (LCO) Section 3.3.3.7 and (Surveillance) 4 .3.3.7.1 of the T.S., "Liquid Effluent Monitoring Instrumentation"	Removal of RETS from T.S. and placement in the REMODCM
Page C-11	New Liquid Effluent Bases (C.3/4.3) Section for Radioactive Liquid Effluent Monitoring Instrumentation. This was formerly Bases Section 3 /4.3.3.7 of the T.S., "Radioactive Liquid Effluent Monitoring Instrumentation"	Removal of RETS from T.S. and placement in the REMODCM
Page C-12	New Radioactive Liquid Effluent Monitoring Instrumentation Table (C.3.3), formerly T.S. Table 3.3-9.	Removal of RETS from T.S. and placement in the REMODCM

SECTION I: Radiological Environmental Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Page C-13	New Action Statements for Table C.3.3, formerly Action Statements for Table 3.3-9 in T.S.	Removal of RETS from T.S. and placement in the REMODCM
Page C-14	New Channel Check, Calibration and Test Frequency Table (C.4.3), formerly T. S. Table 4.3-7.	Removal of RETS from T.S. and placement in the REMODCM
Page C-15	New page for Notation used in Table C.4.3, formerly notation for Table 4.3-7 in T.S. Replaced NBS (National Bureau of Standards - now the NIST) with NIST (National Institute of Standards & Testing).	Removal of RETS from T.S. and placement in the REMODCM
Page D-1	Replaced phrase "the limits of the Technical Specifications" with "the Controls of the REMODCM"	Removal of RETS from T.S. and placement in the REMODCM
Page D-3	Replaced reference to "Technical Specifications" with "REMODCM"	Removal of RETS from T.S. and placement in the REMODCM
Page D-4	Moved Definition of all Applicable Gaseous Radioactive Waste Treatment Equipment to the Definition Section (definition B.32)	Removal of RETS from T.S. and placement in the REMODCM
Page D-5	New Gaseous Effluent Control (D.3.1) & Surveillance (D.4.1.1,2,3) Sections. This was formerly (Limiting Condition of Operation (LCO) Section 3.11.2.1 and (Surveillance) 4 .11.2.1.1,2, & 3 of the T.S., "Gaseous Effluent Controls, Dose Rate"	Removal of RETS from T.S. and placement in the REMODCM
Page D-6	New Gaseous Effluents Basis (D.3/4.1) Section for Dose Rate. This was formerly Bases Section 3 /4.11.2.1 of the T.S., "Gaseous Effluents, Dose Rate". The Phrase "from all units", was changed to "from all sources" to reflect the fact CY is a one unit site.	Removal of RETS from T.S. and placement in the REMODCM
Page D-7	New Radioactive Effluents Control (D.3.2) & Surveillance (D.4.2.1,2) Sections for Dose, Noble Gases. This was formerly (Limiting Condition of Operation (LCO) Section 3.11.2.2 and (Surveillance) 4 .11.2.2.1 & .2 of the T.S., "Radioactive Effluents - Dose, Noble Gases"	Removal of RETS from T.S. and placement in the REMODCM
Page D-8	New Gaseous Effluents Basis (D.3/4.2) Section for Dose, Noble Gases. This was formerly Bases Section 3 /4.11.2.2 of the T.S., "Gaseous Effluents, Dose, Noble Gases".	Removal of RETS from T.S. and placement in the REMODCM
Page D-9	New Radioactive Effluents Control (D.3.3) & Surveillance (C.4.3.1 & .2) Sections for Dose,	Removal of RETS from T.S. and placement in the REMODCM

SECTION I: Radiological Environmental Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
	Radioactive Material in Particulate Form and Radionuclides other than Noble Gases. This was formerly (Limiting Condition of Operation (LCO) Section 3.11.2.3. and (Surveillance) 4 .11.2.3.1 & .2 of the T.S., "Radioactive Effluents - Dose, Radioactive Material in Particulate Form and Radionuclides other than Noble Gases "	
Page D-10	New Gaseous Effluents Basis (D.3/4.3) Section for Dose, Radioactive Material in Particulate Form and Radionuclides other than Noble Gases. This was formerly Bases Section 3 /4.11.2.3 of the T.S., "Gaseous Effluents, Dose, Radioactive Material in Particulate Form and Radionuclides other than Noble Gases".	Removal of RETS from T.S. and placement in the REMODCM
Page D-11	New Radioactive Gaseous Effluent Monitoring Instrumentation (D.3.4) & Surveillance (D.4.4) Section for Instrumentation. This was formerly (Limiting Condition of Operation (LCO) Section 3.3.3.8 and (Surveillance) 4 .3.3.8.1 of the T.S., "Radioactive Gaseous Effluent Monitoring Instrumentation"	Removal of RETS from T.S. and placement in the REMODCM
Page D-12	New Radioactive Gaseous Bases (D.3/4.4) Section for Radioactive Gaseous Effluent Monitoring Instrumentation. This was formerly Bases Section 3 /4.3.3.7 of the T.S., "Radioactive Liquid Effluent Monitoring Instrumentation"	Removal of RETS from T.S. and placement in the REMODCM
Page D-13	New Radioactive Gaseous Effluent Monitoring Instrumentation Table (D.3.4), formerly T.S. Table 3.3-10.	Removal of RETS from T.S. and placement in the REMODCM
Page D-14	New Action Statements for Table D.3.4, formerly Action Statements for Table 3.3-10 in T.S.	Removal of RETS from T.S. and placement in the REMODCM
Page D-15	New Radioactive Gaseous Effluent Monitoring Instrumentation Instrument Surveillance Requirements Table (D.4.4), formerly T. S. Table 4.3-8.	Removal of RETS from T.S. and placement in the REMODCM
Page D-16	New page for Notation used in Table D.4.4, formerly Notation for Table 4.3-8 in T.S. Replaced NBS (National Bureau of Standards - now the NIST) with NIST (National Institute of Standards & Testing).	Removal of RETS from T.S. and placement in the REMODCM
Page E-2	Replaced "limit of the Technical	Removal of RETS from T.S. and

SECTION I: Radiological Environmental Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
	Specification" with "limit of the REMODCM"	placement in the REMODCM
Page E-3	Replaced "Gram" (item 7. in column 3) with "Grab" to describe correct sample type.	Correct previous spelling error.
Page F-2	Removed phrase in parentheses in third paragraph "(i.e., exceeding Technical Specification instantaneous release limits)". Also replaced "Radiological Effluent Technical Specifications" with "REMODCM" in the second sentence.	This was an inappropriate use of the instantaneous release rate as a limit or trigger to determine whether or not an abnormal release had, 1) occurred, or 2) would need to be reported. All abnormal (non-routine) releases must be reported.
Page F-3	New Section F.3 taken from Section 6.9.2 of the Technical Specifications. Also, removed the "NRC Resident Inspector" from the distribution for Special Reports.	There is no longer an NRC Resident Inspector at CY.
Page G-1	New "Total Dose From all Sources", Section G.1 that includes the limits of 40CFR190.	Removal of RETS from T.S. and placement in the REMODCM.
Page G-2	New Section G.2, "Compliance with 40CFR190 Limits" taken from section D.5 in the ODCM.	Clarification and presentation of all controls and their bases in the REMM.
Page G-3	New Total Dose Control (G.3) & Surveillance (G.4) Sections for Total Dose. This was formerly (Limiting Condition of Operation (LCO) Section 3.11.3 and (Surveillance) 4.11.3 "Radioactive Effluents - Total Dose"	Removal of RETS from T.S. and placement in the REMODCM
Page G-4	New Gaseous Effluents Basis (D.3/4.2) Section for Dose, Noble Gases. This was formerly Bases Section 3 /4.11.3 of the T.S., "Radioactive Effluents, Total Dose".	Removal of RETS from T.S. and placement in the REMODCM
Page H-1	New Map of Exclusion Area and Site Area Boundary for Liquid and Gaseous Effluents, Figure H-1. Formerly Figure 5.1-1 in the Design features Section of the Technical Specifications.	Removal of RETS from T.S. and placement in the REMODCM

SECTION II: Off Site Dose Calculation Manual (ODCM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Cover Page	New Revision Number & Date	Latest Revision
Table of Contents	Table updated to reflect new and revised sections where the primary changes support the removal of RETS from Tech. Specs and placement in the REMODCM	To facilitate updates and changes in plant status and configuration as decommissioning moves forward.

SECTION II: Off Site Dose Calculation Manual (ODCM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Page A-1	References to Technical Specifications and surveillance have been replaced with "Control requirement(s) in Part I of the REMODCM", and Technical Specification surveillance has been replaced with "Control Surveillance". Reference to RAB (Radiological Assessment Branch) was removed. Reference to Technical Specification 6.13 was changed to 6.63 to reflect this current change to T.S.	With the proposed change to the Technical Specifications, the Technical Specifications, Limiting Conditions for Operation and surveillance's are now referred to as Controls and surveillance's in the REMODCM. Reference to RAB was removed as the DOC may, or may not continue to use RAB to support CY's REMP/RETS Program in the future.
Page B-1	The requirement to submit the rationale for all changes to the REMODCM in the Annual Radioactive Effluent Report was moved to Section F.2. The Responsibility of the Unit Director was clarified to reflect this change.	Was not listed as a responsibility; it was listed as a requirement. This requirement was moved to section F.2 of the REMM which summarizes all required information to be included in the Annual Report.
Page C-1	Removed reference to Technical Specification Surveillance Requirement and replaced it with reference to applicable Control in the REMM.	Removal of the Radiological Technical Specifications (RETS) from Technical Specifications and placement as Controls in the REMM.
Page C-2	Removed reference to Technical Specification Surveillance Requirement and replaced it with reference to applicable Control in the REMM. Also removed reference to the Radiological Assessment Branch (RAB).	Removal of the Radiological Technical Specifications (RETS) from Technical Specifications and placement as Controls in the REMM. CY and/or Decommissioning Operations Contractor needed flexibility in selecting a group responsible for CY REMODCM revisions.
Page D-5	Removed the reference to Technical Specifications and replaced it with "Part I of this manual", which is the REMM.	The requirements are no longer contained in the Technical Specifications; these have been moved to the REMM (Part I of this manual)
Page E-1	Removed the reference to the Technical Specification Surveillance Requirement and Table and replaced it with a reference to the applicable Control & Table in the REMM.	Removal of the Radiological Technical Specifications (RETS) from Technical Specifications and placement as Controls in the REMM.
Page E-3	Updated R -18 background determination limitation (from 200 cpm to 500 cpm), and referenced ERC where technical basis is documented.	CY Engineering Record of Correspondence (ERC) number: 16103-ER-99-0010
Page F-1	Changed from use of # of fans running and assumed configuration, to actual maximum Stack Flow (cfm - from CY calc.), in worst case configuration, to estimate maximum stack flow using roundup and 20% additional conservatism.	DCR CY-97026, calculation CY-SW-M-0490 identified a max flow of 115,500 cfm which was rounded up to 120,000 cfm. The 1.2 multiplier added and additional 20% in conservatism.

REMODCM Changes

Revision 13

December 14, 1999

RADIOLOGICAL ENVIRONMENTAL REVIEW

RER-99-021

for

Haddam Neck

REMODCM Rev 13

December 9, 1999

Total Number of Pages: 13

Claude Flory Claude Flory 12/9/99
Preparer Date

William Eakin W.J. Eakin 12/9/99
Supervisor Date

1.0 DESCRIPTION OF CHANGE

The Haddam Neck REMODCM for Revision 13 has extensive changes. Each change can be designated significant or non-significant to the Radiological Effluent Control Program. The following list of changes highlight in bold those changes considered significant. Significant changes are discussed further in Section 2.0.

1. Throughout the REMODCM:
   - Made minor format changes to establish consistent formatting.
   - The individual page revision numbers were replaced with a single revision number for the entire document. Revision control of individual pages is not required. Less complicated for reviewing and future editing/revisions. Changes/revisions are still tracked and will be summarized in the Annual Radioactive Effluent Report
2. For both the REMM and the ODCM, reformatted the tables of contents to remove revision control of individual pages. Revision control individual pages is not required. Revisions to REMODCM will be controlled at a document level. This practice is consistent with other plant documents.
3. In Section A.1 of the REMM, "Introduction," capitalized "RADIOACTIVE WASTE TREATMENT SYSTEMS" to be consistent with use of special defined terms throughout document.
4. In Section A.2, "Responsibilities," of the REMM:
   - Added the Unit Director as having specific responsibility for ensuring all changes and their rationale are documented in the Annual Radioactive Effluent Report. The previous revision was deficient in that it listed the responsibility but not the person responsible.
   - Changed the words "that this manual is used in performance of the surveillance requirements and administrative controls contained herein" to "compliance with all requirements of the REMODCM" in order to make the statement of responsibility less vague.
5. In Section B, "Definitions," of the REMM:
   - Reformatted B-1 thru B-3 to bring item number (e.g. B.1) up to the term being defined vice the definition for the term. This was done for clarification.
   - Renumbered the definitions so that the numbering is sequential.
   - In Item B.9 changed Technical Specification reference from 6.13 to 6.6.3 to match new numbering in Technical Specification for Administrative Control of the REMODCM.
   - Added the word "SYSTEMS" to "ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENT." Due to a typographical error, this word was inadvertently omitted.
   - **Deleted charcoal filters from the list of ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENT SYSTEMS. THIS IS A SIGNIFICANT CHANGE.**
6. **In REMM Table C-1, deleted Kr-85 and it's associated LLD. THIS IS A SIGNIFICANT CHANGE.**
7. **In Footnote d to REMM Table C-1, deleted Co-58 in the list of radionuclides with specified LLDs. THIS IS A SIGNIFICANT CHANGE.**

8. In Section C.2 of the REMM, "Liquid Radioactive Waste Treatment":
   - In the first paragraph deleted the words "in accordance with the methodology and parameters in the *ODCM.* "
   - Capitalized "RADIOACTIVE WASTE TREATMENT SYSTEMS" and "OPERABLE" to be consistent with use of special defined terms throughout document.
   - Added the words "within 30 days in accordance with Section F.3" after "submit to the Commission" to clarify the time frame the report is required and type of report that is involved. Section F.3 contains administrative requirements for submittal of reports to the NRC (the Commission).
9. **In Control C.3.1, deleted the sentence "For dissolved or entrained noble gases, the concentration shall not exceed 2 x 10^{-4} microCi/ml total activity." THIS IS A SIGNIFICANT CHANGE.**
10. In Basis for C.3/4.1, "Liquid Effluents Concentration" deleted the sentence "The concentration limit for dissolved or entrained 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." Requirement for analyzing for dissolved or entrained noble gases have been removed.
11. In the Action statements for Control C.3.2, deleted "b. DELETED." This is an artifact carried over with the Radiological Effluent Tech Specs which is no longer needed.
12. In Surveillance Requirement C.4.2.1 added the words specifying that cumulative dose contributions from liquid effluents must be performed every 31 days for the current calendar quarter and for the current calendar year. This transfers a requirement which was previously in SECTION II (ODCM) of the REMODCM.
13. In Surveillance Requirement C.4.2.2 changed "as detailed in the REMODCM" to "as detailed in Section I of the REMODCM" in order to provide more specific reference.
14. In the Action statements for Control C.3.3, deleted "c. DELETED." This is an artifact carried over with the Radiological Effluent Tech Specs which is no longer needed.
15. In Surveillance Requirement C.4.3 changed "Table C.4.4" to "Table C.4.3" to correct an wrong reference.
16. In the Action statements for REMM Table C.3.3, deleted "Action 47 - DELETED." This is an artifact carried over with the Radiological Effluent Tech Specs which is no longer needed. Along with this change renumbered Actions 48 and 49 to Actions 47 and 48.
17. In REMM Table C.4.3, C-14 added title for enhancement.
18. In REMM Table C.4.3, deleted "b. DELETED" under "GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE" and "FLOW RATE MEASUREMENT." These are artifacts carried over with the Radiological Effluent Tech Specs which is no longer needed. Along with this change relettered "Discharge Canal" under "FLOW RATE MEASUREMENT" from "c" to "b."

19. In REMM Table D-1, "Radioactive Gaseous Waste Sampling and Analysis Program":
    - **Deleted the Waste Gas Decay Tank as a gaseous release type. THIS IS A SIGNIFICANT CHANGE.**
    - **Added release type "Spent Fuel Pool Spray Cooling" with weekly sampling and weekly analysis for principle gamma emitters, monthly analysis for gross alpha emitters, and quarterly analysis for Sr-90 and Fe-55. Footnotes f and g were added to specify composite samples and require mixing of composite samples prior to analyses. THIS IS A SIGNIFICANT CHANGE.**
    - **Deleted Kr-85 and it's associated LLD from analysis requirement for containment purge samples. THIS IS A SIGNIFICANT CHANGE.**
    - **Added release type "Spent Fuel Building Exhaust" with weekly sampling and analysis for Kr-85 and H-3; continuous sampling followed by weekly analysis of particulates for principal gamma emitters, monthly particulate composite with analysis for gross alpha, quarterly particulate composite with analysis for Sr-90; and continuous monitoring of noble gas gross activity using the noble gas monitor. THIS IS A SIGNIFICANT CHANGE.**
    - **Added release type "Misc. Points" with weekly particulate sampling followed by monthly analysis for principal gamma emitters and quarterly analysis for Sr-90. Added notation h to provide clarification and criteria for establishing Miscellaneous Points. THIS IS A SIGNIFICANT CHANGE.**
    - **From the Main Stack gaseous release type, deleted weekly analysis of Kr-85 and of charcoal filters for I-131 and I-133 and continuous monitoring of noble gas gross activity using the noble gas monitor. THIS IS A SIGNIFICANT CHANGE.**
20. In Section D.2 of the REMM, "Gaseous Radioactive Waste Treatment":
    - In the first paragraph deleted the words "in accordance with the methodology and parameters in the *ODCM.* "
    - Capitalized "RADIOACTIVE WASTE TREATMENT SYSTEMS" and "OPERABLE" to be consistent with use of special defined terms throughout document.
    - Added the words "within 30 days in accordance with Section F.3" after "submit to the Commission." Section F.3 contains administrative requirements for submittal of reports to the NRC (the Commission).
21. In Bases D.3/4.1 of the REMM capitalized "SITE BOUNDARY" to be consistent with use of special defined terms throughout document.
22. In Control D.3.2 of the REMM, deleted reference to ACTION b which was an artifact from the Technical Specifications.
23. In Bases D.3/4.2 of the REMM, in the last paragraph, capitalized "SITE BOUNDARY" and deleted "The methods used, in order are, previously determined air dose per released activity ratio, historical meteorological data and actual radionuclide mix released, or real time meteorology and actual radionuclides released."
24. In Control D.3.3 of the REMM, deleted reference to ACTION b which was an artifact from the Technical Specifications.

25. In Control D.3.4 of the REMM:
    - deleted reference to ACTION c which was an artifact from the Technical Specifications.
    - Capitalized "OPERABLE" to be consistent with use of special defined terms throughout document.
26. In REMM Table D.3.4, "Radioactive Gaseous Effluent Monitoring Instrumentation":
    - **Added the Spent Fuel Building (SFB) Exhaust radiation monitor (R-1) with requirements for noble gas monitoring, particulate sampling, and stack and sample flow rate monitoring. THIS IS A SIGNIFICANT CHANGE.**
    - **Deleted "Noble Gas Activity Monitor Providing Alarm" from the Main Stack instrumentation. THIS IS A SIGNIFICANT CHANGE.**
    - For "Main Stack", deleted "b. DELETED." This is an artifact carried over with the Radiological Effluent Tech Specs which is no longer needed.
    - **Reworded ACTION 50 to remove all references to the Waste Gas Decay Tanks. THIS IS A SIGNIFICANT CHANGE.**
27. In REMM Table D.4.4:
    - **Added instrumentation surveillance requirements for the Spent Fuel Building Exhaust Monitor. THIS IS A SIGNIFICANT CHANGE.**
    - **Deleted Noble Gas Activity Monitor instrument surveillance requirements for the noble gas activity monitor from the Main Stack. THIS IS A SIGNIFICANT CHANGE.**
    - deleted reference to ACTION b which was an artifact from the Technical Specifications.
28. In REMM Table E-1 changed "gram" to "grab" in sampling and collection frequency for river water to correct a typographical error.
29. **In REMM Table E-2, deleted Co-58 reporting levels for detected radioactivity in environmental samples of water, fish, and shellfish. THIS IS A SIGNIFICANT CHANGE.**
30. **In REMM Table E-3, deleted Mn-54 and Co-58 maximum values for LLD for analyses of environmental samples of water and fish. THIS IS A SIGNIFICANT CHANGE.**
31. In Section F.2, "Annual Radioactive Effluent Report," of the REMM:
    - **In the first paragraph, deleted the sentence "Gaseous pathway doses shall use meteorological conditions concurrent with the time of radioactive gaseous effluent releases." THIS IS A SIGNIFICANT CHANGE.**
    - **In the first paragraph, deleted the sentence "The licensee shall maintain an annual summary of the hourly meteorological data (i.e. wind speed, wind direction and atmospheric stability) either in the form of an hour-by-hour listing on a magnetic medium or in the form of a joint frequency distribution. The licensee has the option of submitting this annual meteorological summary with the ARER, or retaining it and providing it to the NRC upon request." THIS IS A SIGNIFICANT CHANGE.**
32. In Section D, "Gaseous Dose Calculations" of the ODCM, added a paragraph which explains the purpose and method of this section for calculation of off-site doses due to gaseous releases.

33. In Section D.1, "Site Dose Rate Limits ("Instantaneous")" of the ODCM, added a paragraph explaining the Tech Spec requirement which this section implements.
34. **Replaced Section D.1.a, "Noble Gas Release Rate Limit" of the ODCM with new Sections D.1.a, "Total Body Dose Rate Due to Kr-85," D.1.b, "Skin Dose Rate Due to Kr-85," and D.1.c, "Site Release Rate Limits for Noble Gas ("Instantaneous")." This revises the methods of calculation for total body and skin dose rates from noble gas releases and provides a release rate limit based on the skin dose which is the limiting dose. The new methods use only Kr-85 release rates, not total noble gases release rate, conservatively assuming ground level releases. For calculation of the dose rates the new methods replaces average meteorological dispersion (X/Q) and factors for dose weighing and finite cloud correction with a site specific dose conversion factor. Derivation of dose conversion factors are shown in Appendix H. THIS IS A SIGNIFICANT CHANGE.**
35. In Section D.1.d, "Critical Organ Dose Rate from Particulates and Tritium" (old Section D.1.b, "Iodine and Particulate Release Rate Limit") of the ODCM added a sentence explaining critical organ dose rate limit and the applicable sources which now do not include I-131 and I-133.
36. **Replaced Section D.1.b, of the ODCM with new Section D.1.d. This revises Method 1 of calculation for maximum organ dose rate from iodine, tritium and particulates. The new method calculates dose to a critical organ from particulates and tritium based on a site specific critical organ dose rate factor. Derivation of this factor is shown in a revised Appendix D. THIS IS A SIGNIFICANT CHANGE.**
37. In Section D.2, "10CFR20 Appendix I Limits (Noble Gases)," of the ODCM, added a paragraph which explains quarterly and annual limits and method of this section for calculation of off-site doses due to noble gas releases to ensure that the limits are not exceeded.
38. **Replaced Section D.2.a, "Quarterly Air Dose Limit Due to Noble Gases," of the ODCM with new Sections D.2.a, "Gamma Air Dose Due to Kr-85," and D.2.b, "Beta Air Dose Due to Kr-85." This revises the methods of calculation for quarterly air gamma and air beta doses from noble gas releases. The new methods use only Kr-85 releases, not total noble gases releases, and conservatively assumes ground level only releases. For calculation of the doses the new methods replaces the factor for conversion from curie release to dose with two new factors, one for conversion from radioactivity concentration to annual dose and one for site specific dose conversion. Methods 2 and 3 are no longer used. Derivations of these factors are shown in Appendix H. THIS IS A SIGNIFICANT CHANGE.**
39. Section D.2.b of the ODCM was renumbered to D.2.c.
40. In Section D.2.c, "Annual Air Dose Due to Kr-85," (old D.2.b, "Annual Air Dose Limit Due to Noble Gases") of the ODCM:
    - **Changed source term on which annual dose is based from all noble gases to Kr-85 only. THIS IS A SIGNIFICANT CHANGE.**
    - Deleted Note (3) which required recalculation of the quarterly dose using Method 3 because Method 3 has been eliminated.

41. In Section D.3, "10CFR50 Appendix I Limits (Particulates and Tritium)," of the ODCM, added a paragraph which explains quarterly and annual limits and method of this section for calculation of off-site doses due to particulates and tritium releases to ensure that the limits are not exceeded. It also explains that the applicable sources do not include I-131 and I-133.
42. **Revised Section D.3.a, "Critical Organ Doses" (formerly "Quarterly Organ Dose Limit"), of the ODCM by changing the methods of calculation for quarterly organ doses from iodine, particulates and tritium releases. The new methods use only particulates and tritium releases, not iodine releases. For calculation of the doses the new methods revises the factor for dose conversion which was based on historical data to a new site and radionuclide specific factor. Different factors are used for ground level and elevated releases. For the ground level method, additional factors for duration of release and, for releases from special locations, adjustments to dose conversion are also applied. Derivations of these factors are shown in Appendix D. Methods 2 and 3 are no longer used and the old Method 4 is relabeled Method 2. THIS IS A SIGNIFICANT CHANGE.**
43. In Section D.3.a of the ODCM, Method 2 now uses a method equivalent to the old Methods 2 through 4 in this section. In addition, it now allows the use of an code equivalent to GASPAR for calculation of the dose.
44. Section D.3.b of the ODCM is revised by adding "Estimation of" at the start of the section title and rephrasing the section. There is no change in technical requirements.
45. In Section D.4 of the ODCM replaced the sentence "The use of this code and required input parameters are given in Radiological Assessment Branch Procedure, Gaseous Dose Calculations - GASPAR" with the phrase "or equivalent mode code implementing Regulatory Guide 1.109, Revision 1" in parentheses at the end of the first sentence. This change makes this section consistent with the other changes.
46. **In Section D.5, "Compliance with 40CFR190 Limits," of the ODCM, the justification for not including direct dose in the total site dose to determine compliance with 40CFR190 has been deleted. Direct dose will not be routinely included in the annual dose assessment. Instead, the annual environmental report will include an evaluation of the direct dose utilizing results of environmental TLDs. THIS IS A SIGNIFICANT CHANGE.**
47. Deleted Table 1 (page D-10) and Table 2 (page D-11) of the ODCM. These tables are no longer needed because of other changes.
48. **Section F.1, "Stack Noble Gas Activity Monitor," had been deleted and replaced with a new Section F.1, "Spent Fuel Pool Building Noble Gas Activity Monitor (R-1)." THIS IS A SIGNIFICANT CHANGE.**
49. **Appendix D, "Derivation of Factors for Section D.1" is replaced with a completely new Appendix D, "Gaseous Dose Conversion Factors (Tritium and Particulates)." This supports the changes to Sections D.1.d and D.2.a. THIS IS A SIGNIFICANT CHANGE.**
50. **Appendix E, "Gaseous Dose Calculations - GASPAR," was revised by replacing GASPAR version with GASPAR - 2 version of software code and updated the revision date. Also added the option of using an equivalent,**

alternate code. Removed the reference to the use of real time meteorology and added the new method of using 5 year averages for atmospheric dispersion. Dose receptor was move to the nearest land site boundary where a resident, vegetable garden, milk and meat animal are assumed. THIS IS A SIGNIFICANT CHANGE.

51. **Appendix F, "Derivation of Factors for Sections D.2 & D.3" is replaced with a completely new Appendix F, "Meteorological Dispersion Factors." This supports the changes to Sections D.1.a, D.1.b and D.1.c. THIS IS A SIGNIFICANT CHANGE.**
52. **Appendix H, "Derivation of Factors for Table 2" is replaced with a completely new Appendix H, "Dose Factors for Kr-85." This supports the changes to Section D.1.a, D.1.b, D.1.c, D.2.a and D.2.b. THIS IS A SIGNIFICANT CHANGE.**

REFERENCES:

1. NUREG/CR-4653, "GASPAR-II - Technical Reference and User Guide," March, 1987.
2. DE&S Memo from T. Messier to D. Montt dated November 30, 1999, "Evaluation of CY Meteorological Data."
3. CY Calculation REMODCM-01686-SY-00, "Connecticut Yankee Haddam Neck Plant, ODCM Atmospheric Dispersion Factors."
4. CY Calculation REMODCM-01688-SY-00, "CY Defueled State - ODCM Conversion Factors for Gaseous Releases."
5. CY Calculation REMODCM-01689-SY-00, "Connecticut Yankee Method I Dose Equations for ODCM Revision 13."

2.0 DISCUSSION

There are 30 significant changes in Revision 13 to the Haddam Neck REMODCM.

1. In Section B, "Definitions," of the REMM deleted charcoal filters from the list of ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENT SYSTEMS because Iodine releases in effluents, due to the short half-life of radioiodines, are no longer a concern at Haddam Neck.
2. In REMM Table C-1, deleted Kr-85 and it's associated LLD. There is no longer a source term for Kr-85 in liquid release pathways.
3. In Footnote d to REMM Table C-1, deleted Co-58 in the list of radionuclides with specified LLDs because of it's short half-life.
4. In Control C.3.1, deleted the sentence "For dissolved or entrained noble gases, the concentration shall not exceed 2×10^{-4} microCi/ml total activity." Dissolved and entrained noble gases in liquids are no longer a concern in non-operating and defueled plants.
5. In REMM Table D-1, "Radioactive Gaseous Waste Sampling and Analysis Program," deleted the Waste Gas Decay Tank as a gaseous release type because of changes in plant configuration. Being permanently shutdown and defueled, the plant no longer produces shorter half life radioactive gases which need to be decayed before release. It should be noted that liquid samples are collected and analyzed for the Spray Cooling system and used to calculate a gaseous release.

6. In REMM Table D-1, "Radioactive Gaseous Waste Sampling and Analysis Program," added release type "Spent Fuel Pool Spray Cooling" with weekly sampling and weekly analysis for principle gamma emitters, monthly analysis for gross alpha emitters, and quarterly analysis for Sr-90 and Fe-55. Footnotes f and g were added to specify composite samples and require mixing of composite samples prior to analyses. The Spent Fuel Pool Spray Coolers represent a new source of release of gamma and alpha emitters and the beta only emitters of Sr-90 and Fe-55 in radioactive gases from contaminated spray water. Small amounts of radioactivity become airborne during the spraying operation. The sampling and analyses frequencies are adequate for the level of expected releases for each radiation type.
7. Deleted Kr-85 and it's associated LLD from analysis requirement for containment purge samples. There is no longer a source term for Kr-85 in the containment purge gaseous release pathway.
8. In REMM Table D-1, "Radioactive Gaseous Waste Sampling and Analysis Program," Added release type "Spent Fuel Building Exhaust" with weekly sampling and analysis for Kr-85 and H-3; continuous sampling followed by weekly analysis of particulates for principal gamma emitters, monthly particulate composite with analysis for gross alpha, quarterly particulate composite with analysis for Sr-90; and continuous monitoring of noble gas gross activity using the noble gas monitor. The Spent Fuel Building exhaust used to go to the main stack. A new vent release has been added for the building. The sources of concern from the spent fuel pool are Kr-85, tritium, particulates, alpha emitting radiation, and Sr-90. The frequency of sampling and analyses are adequate for monitoring of these sources.
9. In REMM Table D-1, "Radioactive Gaseous Waste Sampling and Analysis Program," from the Main Stack gaseous release type, deleted weekly analysis for Kr-85, I-131, and I-133 and deleted the continuous monitoring by a noble gas monitor. With the Spent Fuel Pool Building exhaust isolated from the main stack and venting to it's own discharge path, there will be no source of any noble gases, including Kr-85, or radioiodines going to the main stack.
10. In REMM Table D-1, "Radioactive Gaseous Waste Sampling and Analysis Program," added release type "Miscellaneous Points" listing "Alternate Containment Access" and "Tented Enclosures" as examples. For these release types continuous sampling with weekly analysis for principal gamma emitters, monthly analysis for gross alpha and quarterly analysis for Sr-90 are required. During decommissioning of the Haddam Neck plant there will be operations which will result in transient radioactive effluent sources. These need to be monitored as they occur. Particulates are the only radioactive effluents generated during these sort of operations. The frequency of sampling and analysis is adequate for monitoring of these sources. Footnote h provides adequate guidance for identification of miscellaneous release points which must be included. This guidance includes a task and/or facility evaluation using criteria specified in Technical Support Document CY-HP-0029 and CY Memo HP 99-108.
11. In REMM Table D.3.4, "Radioactive Gaseous Effluent Monitoring Instrumentation," added the Spent Fuel Building (SFB) Exhaust radiation monitor (R-1) with requirements for noble gas monitoring, particulate sampling, and stack and sample

flow rate monitoring. This new radiation monitor is needed to provide monitoring and sampling of radioactivity in effluents from the new SFB vent.

12. In REMM Table D.3.4, "Radioactive Gaseous Effluent Monitoring Instrumentation," deleted "Noble Gas Activity Monitor Providing Alarm" from the Main Stack instrumentation. This alarm is no longer needed. See discussion for change #9 above.
13. Reworded ACTION 50 to remove all references to the Waste Gas Decay Tanks. With changes in plant configuration, the Waste Gas system has been abandoned.
14. In REMM Table D.4.4, added instrumentation surveillance requirements for the Spent Fuel Building Exhaust Monitor. This is a new radiation monitor. The new surveillance requirements are consistent with the equivalent main stack radiation monitor.
15. In REMM Table D.4.4, deleted Noble Gas Activity Monitor instrument surveillance requirements for the noble gas activity monitor from the Main Stack. Because this monitoring was deleted for the reasons given in change #9 above, the surveillance requirements are no longer needed.
16. In REMM Table E-2, deleted Co-58 reporting levels for detected radioactivity in environmental samples of water, fish, and shellfish. Being permanently shutdown and defueled, the plant no longer produces or releases the shorter half life Co-58.
17. In REMM Table E-3, deleted Mn-54 and Co-58 maximum values for LLD for analyses of environmental samples of water and fish. Being permanently shutdown and defueled, the plant no longer produces or releases the shorter half life Mn-54 or Co-58.
18. In Section F.2 of the REMM, in the first paragraph, deleted the sentence "Gaseous pathway doses shall use meteorological conditions concurrent with the time of radioactive gaseous effluent releases." With the new gaseous dose calculation method, concurrent meteorological parameters are not needed. See discussion for items #28-30 below.
19. In Section F.2 of the REMM, in the first paragraph, deleted the sentence "The licensee shall maintain an annual summary of the hourly meteorological data (i.e. wind speed, wind direction and atmospheric stability) either in the form of an hour-by-hour listing on a magnetic medium or in the form of a joint frequency distribution. The licensee has the option of submitting this annual meteorological summary with the ARER, or retaining it and providing it to the NRC upon request." With the new gaseous dose calculation method, hourly meteorological parameters are not needed. See discussion for items #28-30 below.
20. Replaced Section D.1.a of the ODCM with new Sections D.1.a, D.1.b, and D.1.c. This revises the methods of calculation for total body and skin dose rates from noble gas releases and provides a release rate limit based on the skin dose which is the limiting dose. The new methods use only Kr-85 release rates, not total noble gases release rate. For calculation of the dose rates the new methods replaces average meteorological dispersion (X/Q) and factors for dose weighing and finite cloud correction with a site specific dose conversion factor. Derivations of dose conversion factors are shown in Appendix H. The total body dose rate calculation was derived from equation B-8 in Reg Guide 1.109 and the skin dose rate calculation was derived from equation B-9 in Reg Guide 1.109. Dose factors from

Table B-1 of Reg Guide 1.109 for individual radionuclides were used. The skin dose factor, DF', is calculated for individual radionuclides (i.e., Kr-85 here) by combining the gamma air dose and beta skin dose factors to give a combined skin dose factor. Details of the derivation are contained in the new Appendix H.

21. Replaced Section D.1.b of the ODCM with new Section D.1.d. This revises Method 1 of calculation for maximum organ dose rate from iodine, tritium and particulates. The new method calculates dose to a critical organ from particulates and tritium based on site specific critical organ dose rate factors. Because alpha emitters are measured as gross alpha radioactivity a conservative approach is taken by using the highest transuranic DCF (Am-241) with the gross alpha result when calculating doses. Derivation of this factor is shown in a revised Appendix D (see discussion on Appendix D below). The dose rate factors are for gaseous releases to the atmosphere of tritium and particulate radionuclides, and reflect the following conditions:
    (a) On-ground receptors at the closest distance to the site boundary (SB) for ground-level releases, and at the worst-case offsite receptor for elevated releases,
    (b) Long-lived radionuclides (in view of the extended decay time since permanent plant shutdown on July 22, 1996),
    (c) The inhalation pathway for dose-rate calculations, and all pathways combined for dose calculations (ground-shine, inhalation, meat ingestion, goat milk ingestion, and vegetable ingestion), and
    (d) The associated worst-case hypothetical individual (adult, teenager, child or infant) and critical organ (Total Body, GI Tract, Bone, Liver, Kidney, Thyroid, Lung, or Skin).

    The DFGs were computed using the GASPAR-II computer code, along with site specific atmospheric dispersion and deposition factors. Derivation of the dispersion and deposition factors are shown in Appendix F (see discussion on Appendix F below).
22. Replaced Section D.2.a of the ODCM with new Sections D.2.a and D.2.b. This revises the methods of calculation for quarterly air gamma and air beta doses from noble gas releases. The new methods use only Kr-85 releases, not total noble gases releases, and conservatively assumes ground level only releases. For calculation of the doses the new methods replaces the factor for conversion from curie release to dose with two new factors, one for conversion from radioactivity concentration to annual dose and one for site specific dose conversion. Methods 2 and 3 are no longer used. Derivations of these factors are shown in Appendix H. Calculation for gamma air dose from Kr-85 dose is derived from Equations B-4 and B-5 of Reg Guide 1.109 and for beta air dose is derived from Equation B-9 of Reg Guide 1.109. Details of the derivation are shown in Appendix H.
23. In Section D.2.c (old D.2.b) of the ODCM changed source term on which annual dose is based from all noble gases to Kr-85 only. Being permanently shutdown and defueled, the plant no longer produces or releases any of the other shorter half life radioactive noble gases.

24. Revised Section D.3.a of the ODCM by changing the methods of calculation for quarterly organ doses from iodine, particulates and tritium releases. The new methods use only particulates and tritium releases, not iodine releases. Because alpha emitters are measured as gross alpha radioactivity a conservative approach is taken by using the highest transuranic DCF (Am-241) with the gross alpha result when calculating doses. For calculation of the doses the new methods revises the factor for dose conversion which was based on historical data to a new site and radionuclide specific factor. Different factors are used for ground level and elevated releases. For the ground level method, additional factors for duration of release and, for releases from special locations, adjustments to dose conversion are also applied. Derivations of these factors are shown in Appendix D. Methods 2 and 3 are no longer used and the old Method 4 is relabeled Method 2. See discussion under change #22 above for bases of factors for this section.
25. In Section D.5 of the ODCM, the justification for not including direst dose in the total site dose to determine compliance with 40CFR190 has been deleted. Direct dose will not be routinely included in the annual dose assessment. Instead, the annual environmental report will include an evaluation of the direct dose utilizing results of environmental TLDs. This will be sufficient to address the direct dose complement of total site dose for the purpose of determining compliance with 40CFR190.
26. In Section F.1 of the ODCM requirements for determination of the stack noble gas radiation monitor setpoint has been replaced by requirements and method to determine the setpoint for the spent fuel building radiation monitor setpoint. The Main Stack releases now consist of particulate activity only and are measured using a particulate filter and flow monitor. The new spent fuel pool radiation monitor setpoint is based on limiting release of Kr-85 to10% of the skin dose rate limit of 3,000 mrem per year.
27. Appendix D, "Derivation of Factors for Section D.1" is replaced with a completely new Appendix D, "Gaseous Dose Conversion Factors (Tritium and Particulates)." This supports the changes to Sections D.1.d and D.2.a. It reflects the use of the appropriate dose and dose rate conversion factors from Reg Guide 1.109 and the change in radionuclide mix with a decommissioning plant (principally 30 long lived radionuclides including tritium, Iodine 129, and 29 other particulate radionuclides). Two radionuclides in the basis calculations not used in the REMODCM are C-14 and Ni-63. Because these are beta only emitters they are difficult to analyze. Given their relatively low dose consequence, and difficulty of analysis, it is acceptable to not include these two radionuclides in the dose calculation methodology. It also includes a listing of the new X/Q's, pathway parameters, and conservative adjustment factors which allow for the removal of built in conservatism from the simplified dose calculations used in the ODCM when the need arises. The NRC approved code GASPAR-II (Reference 1) was used to derive the dose conversion factors. GASPAR-II default parameters were used with the following exceptions: (1) accumulation time for ground contamination was changed from 20 years to 15 years, (2) transfer rate to meat products for Ni was changed from 5.3E-3 to 5.3E-2 d/kg, and (3) transfer rate to goat milk for Fe was changed from 1.3E-3 to 1.3E-4 D/L. These exceptions were made to make the parameters consistent with Reg Guide 1.109. Details of the calculation are in

Reference 4.

28. Appendix E was revised by replacing GASPAR version with GASPAR-II version of software code and updated the revision date. Also added the option of using an equivalent alternate code. Removed the reference to the use of real time meteorology and added the new method of using 5 year averages for atmospheric dispersion. Met data after 1986 showed an unusual amount of still air (at the lower instrument level) which was the result of undergrowth proliferation. Recent upper level met data was compared with earlier met data (pre 1986) to confirm no significant changes, and 5 year averages (vs. real time met data) were developed from pre-1986 (1976-1980) data to develop new X/Q's. The move to use of 5 year averages is acceptable and eliminated the need for maintaining the Met Tower for this purpose. The use of older data has been validated and verified in referenced documentation, and negates the need to defoliate the met tower peninsula visible from the river. This was a good neighbor consideration. Dose receptor was moved to the nearest land site boundary where a resident, vegetable garden, milk and meat animal are assumed. This is more conservative than assuming actual receptors with atmospheric modeling.
29. Appendix F, "Derivation of Factors for Sections D.2 & D.3" is replaced with a completely new Appendix F, "Meteorological Dispersion Factors." Met data after 1986 showed an unusual amount of still air (at the lower instrument level) which was the result of undergrowth proliferation (see Reference 2). Recent upper level met data was compared with earlier met data (pre 1986) to confirm no significant changes, and 5 year averages (vs. real time met data) were developed from pre-1986 data to develop new X/Q's. These new X/Q's were generated for both elevated and ground release points. The most conservative of all X/Q's were used, as were the most conservative dose conversion factors to simplify the calculation process and eliminate the need for computer calculations. Details of the calculation are in Reference 3.
30. Appendix H, "Derivation of Factors for Table 2" is replaced with a completely new Appendix H, "Dose Factors for Kr-85." This supports the changes to Section D.1.a, D.1.b, D.1.c, D.2.a and D.2.b. Should a period of higher than expected releases occur, less conservative and more accurate doses can be calculated using the actual specific X/Q's and dose conversion factors, as these were all provided in the dose calculation package, and other basis documents. Details of the calculation are Reference 5. The bases for Appendix H is described in change #22 above.

3.0 CONCLUSION

The changes in Revision 13 to the Haddam Neck REMODCM would not cause an increase in release of radioactivity to the environment or of dose to the public and they do not deviate from any of the design bases for an effluent control program in the FSAR. The changes will not affect the level of radioactive effluent control required by Technical Specifications and the FSAR, 10CFR20, 40CFR190, 10CFR50.36a, 10CFR50 GDCs 60 and 64, and Appendix I of 10CFR50 and will not adversely impact the accuracy or reliability of effluent, dose or setpoint calculations. The changes do not cause an Unreviewed Radiological Environmental Impact (UREI).

Proc Type	Proc Number	Responsible	Title	Drafted	Chemistry Review	Operations/Site Review	Validator	Bechtel Proc. Format	Comments Incorporated	Montt Approval	PORC Approved	Implemented
ACP	1.0-90	J	Radiological Environmental Reviews			x	x	N/A				
ACP	1.2-2.48	J	Changes to the Radiological Effluent Monitoring Manual and the Offsite Dose Calculation Manual			x	x	N/A				
CHDP	1.2-3.0	C	Offsite Dose Calculations					x			N/A	
CHDP	1.2-3.1	C	Liquid Effluent Accountability					x			N/A	
CHDP	1.2-3.2	C	Gaseous Effluent Compilation					x			N/A	
CHDP	1.2-3.3	C	Monthly Particulate Data Reporting					x			N/A	
CHDP	1.2-4	C	Annual Radioactive Effluent Report									
CHDP	1.2-6	C	Reporting Limits for RMS Alarm Points					x			N/A	x
CHM	7.2-1	C	Radiologically Controlled Area (RCA) Sampling and Operations					x				
CHM	7.4-1	C	Spent Fuel Island Chemistry Control					x				
REM	17.4-1A	J	Test Tank Discharge					x				
REM	17.4-1B	J	Waste Neutralization Tank/Waste Transfer (NPDES) Sump Discharge					x				
~~REM~~	~~17.4-1C~~	~~J~~	~~Steam Generator Discharge~~					x				
REM	17.4-1D	J	Service Water Effluent Sampling and Analysis					x				
REM	17.4-1E	J	Yard Drain #6 (Catch Basin 11) Effluent Sampling and Analysis					x				
REM	17.4-1F	J	Monthly/Quarterly Liquid Effluent Analysis					x				
REM	17.4-2A	C	Spent Fuel Building Ventilation Exhaust Sampling					x				
REM	17.4-2B	C	Spent Fuel Building Spray Cooler Sampling					x				
REM	17.4-2C	C	Main Stack Sampling					x				
REM	17.4-2D	C	Containment Purge Sampling					x				
REM	17.4-2E	C	Miscellaneous Gaseous Effluent Sampling					x				
REM	17.4-2F	C	Monthly/Quarterly Gaseous Effluent Analysis					x				
REM	17.4-3	C	Total Offsite Dose Determination					x				
REM	17.4-4	J	Compensatory Sampling/Analysis for Inoperable Radiation Monitors					x				
CHDP	6.4-2	C	Gaseous Discharge Data Handling					x			N/A	
CHDP	6.4-3	C	Calculation of Liquid Permits by Hand					x			N/A	
CHDP	6.4-4	C	Particulate Discharge Data Handling					x			N/A	
CHM	7.7-24	J	Yard Drain Sampling					x				
~~ACP~~	~~1.0-91~~	~~J~~	~~IE 80-10 Program~~					x			x	

CONNECTICUT YANKEE ATOMIC POWER COMPANY
HADDAM NECK PLANT
362 INJUN HOLLOW ROAD • EAST HAMPTON, CT 06424-3099

December 9, 1999
CH-99-393

To: G. Bouchard, PORC Chairman

From: D. A. Montt, CY Chemistry Manager

Subject: **Revision 13 to the REMODCM** (CYAPCo Radiological Environmental Monitoring and Offsite Does Calculation Manual) **:SUMMARY OF PROPOSED CHANGES**

Reference: ACP 1.2-2.48, "Changes to the Radiological Effluent Monitoring Manual and the Offsite Dose Calculation Manual"

The following tables summarize the changes made to the CYAPCo REMODCM in revision 13. This revision reflects the implementation of the Spent Fuel Island Modification, the use of more accurate meteorological data, a new and simpler method for calculating gaseous effluent doses, multiple ground release pathways and a modified elevated release pathway, new and more current radionuclide mixes that reflect our decommissioning status and the addition of all references and technical basis documents as an overall program improvement to facilitate traceability.

Revision 12 removed RETS from the Technical Specifications. Collectively, these two revisions facilitate Connecticut Yankees ability to maintain the REMODM current in a rapidly changing environment while maintaining a high level of quality and an appropriate level of conservatism.

SECTION I: Radiological Environmental Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Throughout	Minor format changes. Due to the nature and number of these changes, changes bars have not been included.	Establish consistent format throughout document.
Throughout	Minor format changes. Due to the nature and number of these changes, changes bars have not been included.	Establish consistent format throughout document.
Table of Contents	Reformatted to remove revision control of individual pages.	Revision control individual pages is not required. Revisions to REMODCM will be controlled at a document level. This practice is consistent with other plant documents.
A-1	Capitalized "RADIOACTIVE WASTE TREATMENT SYSTEMS"	Consistent with use of special defined terms throughout document.
B-1 thru B-3	Reformatted to bring item number (e.g. B.1) up to the term being defined vice the definition for the term.	Clarification.

SECTION I: Radiological Effluent Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
B-2	Item B.9 - Technical Specification changed from 6.13 to 6.6.3.	New numbering in Technical Specification for Administrative Control of the REMODCM.
B-3	Removed reference to the use of charcoal filters.	Charcoal filters were removed as there is no longer any source of iodine's captured by charcoal in the plant. This has been verified by monitoring performed since permanent shutdown.
C-2	Table C-1, Section A: Deleted Kr-85 and it's associated LLD.	No source term for Kr-85 in liquid Batch Release pathways.
C-2	Table C-1, Section B: Deleted Kr-85 and it's associated LLD.	No source term for Kr-85 in liquid Continuous Release pathways.
C-3	Table C-1, Table Notation d.: Deleted Co-58 as a principle gamma emitter.	Relatively short half-life isotope (71 days). No longer present.
C-5	First paragraph: Changed first sentence from "...once per 31 days in accordance with the methodology and parameters in the *ODCM* only if ..." to "...once per 31 days only if ..."	Reflects the requirement section now being in the REMODCM, and no longer in Technical Specifications.
C-5	Capitalized "ALL APPLICABLE LIQUID RADIOACTIVE WASTE TREATMENT SYSTEMS"	Consistent with use of special defined terms throughout document.
C-5	Second paragraph: Changed first sentence from "...prepare and submit to the Commission a report that..." to "prepare and submit to the Commission, within 30 days, pursuant to Subsection F.3, a special report..."	Clarify the time frame the report is required and type of report that is involved.
C-6	C.3.1: At the end of the first sentence, deleted "for radionuclides other than dissolved or entrained noble gases." Deleted last sentence "For dissolved or entrained noble gases, the concentration shall not exceed $2x10^{-4}$ microCi/ml total activity."	No source term for noble gases in liquid effluents.
C-7	C.3/4.1: Deleted last sentence "The concentration limit for dissolved or entrained 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."	No source term for noble gases in liquid effluents.
C-8	Deleted reference to ACTION b. which was an artifact from the Technical Specifications.	Enhancement to clean-up document.
C-8	C.4.2.1: Added "for the current calendar quarter and current calendar year" and "once every 31 days."	Clarify Surveillance Requirement and required frequency; consistent with D.4.2.1.

SECTION I: Radiological Effluent Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
C-8	C.4.2.2: Added "Section I of"	Clarify location of REMP.
C-10	Deleted reference to ACTION c. which was an artifact from the Technical Specifications.	Enhancement to clean-up document.
C-10	C.4.3: Changed "Table C.4.4" to "Table C.4.3"	Typographical - correct table designation.
C-12	Deleted reference to Instruments 1.b. & 3.b, which were artifacts from the Technical Specifications. Renumbered flow rate measurement instruments to account for deletion. Renumbered ACTION numbers to coincide with changed on page C-13.	Enhancement to clean-up document.
C-13	Deleted reference to ACTION 47. which was an artifact from the Technical Specifications. Renumbered remaining ACTION Statements.	Enhancement to clean-up document.
C-14	Deleted reference to Instruments 1.b. & 3.b, which were artifacts from the Technical Specifications. Renumbered flow rate measurement instruments to account for deletion.	Enhancement to clean-up document.
C-14	Added title for Table C.4.3	Enhancement
D-2	Table D-1, Section A: Deleted all sampling and analysis requirements for Waste Gas Decay Tanks and inserted sampling and analysis requirements for Spent Fuel Pool Spray Cooling.	Changes in plant configuration. It should be noted that liquid samples are collected and analyzed for the Spray Cooling system and used to calculate a gaseous release.
D-2	Table D-1, Section B: Deleted Kr-85 and it's associated LLD.	No source term for Kr-85 in the Containment Purge gaseous release pathway.
D-2	Table D-1, Section C: Inserted sampling and analysis requirements for the Spent Fuel Building Exhaust	Changes in plant configuration.
D-3	Table D-1, Section D: Revised sampling and analysis requirements for Main Stack. Deleted Kr-85 and it's associated LLD from the weekly gaseous grab sample. Deleted weekly charcoal analysis for iodines and their associated LLDs.	Changes in plant configuration, no source term for Kr-85 and iodines.
D-3	Table D-1, Section E: Added sampling and analysis requirements for Miscellaneous Points.	Supports current and future decommissioning activities
D-4	Table D-1, Table Notations: Added notations f and g to provide clarification and requirements for Spray Cooling System composite samples.	Changes in plant configuration.
D-4	Table D-1, Table Notations: Added notation h to provide clarification and criteria for establishing Miscellaneous Points	Clarification

SECTION I: Radiological Effluent Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
D-5	First paragraph: Changed first sentence from "...once per 31 days in accordance with the methodology and parameters in the *ODCM* only if ..." to "...once per 31 days only if ..."	Reflects the requirement section now being in the REMODCM, and no longer in Technical Specifications.
D-5	Capitalized "ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENT SYSTEMS" and "OPERABLE"	Consistent with use of special defined terms throughout document.
D-5	Second paragraph: Changed first sentence from "...prepare and submit to the Commission a report that..." to "prepare and submit to the Commission, within 30 days, pursuant to Subsection F.3, a special report..."	Clarify the time frame the report is required and type of report that is involved.
D-7	Capitalized "SITE BOUNDARY"	Consistent with use of special defined terms throughout document.
D-8	Deleted reference to ACTION b. which was an artifact from the Technical Specifications.	Enhancement to clean-up document.
D-9	Last paragraph: Capitalized "SITE BOUNDARY" and deleted "The methods used, in order are, previously determined air dose per released activity ratio, historical meteorological data and actual radionuclide mix released, or real time meteorology and actual radionuclides released."	Removed description of older method for calculating dose and summarized the new, simpler method. Site Boundary was capitalized to direct the reader to the definition section for any necessary clarifications.
D-10	Deleted reference to ACTION b. which was an artifact from the Technical Specifications.	Enhancement to clean-up document.
D-12	Deleted reference to ACTION c. which was an artifact from the Technical Specifications.	Enhancement to clean-up document.
D-14	Table D.3.4: Added instrumentation requirements (minimum channels and actions) for the Spent Fuel Building Exhaust Monitor and deleted Noble Gas Activity Monitor from the Main Stack instrumentation.	Changes in plant configuration
D-15	Table D.3.4, Action Statements: Reworded ACTION 50 to remove all references to the Waste Gas Decay Tanks	Changes in plant configuration, Waste Gas system is abandoned.
D-16	Table D.4.4: Added instrumentation surveillance requirements for the Spent Fuel Building Exhaust Monitor and deleted Noble Gas Activity Monitor instrument surveillance requirements for the from the Main Stack.	Changes in plant configuration
E-4	Table E-2: Deleted Co-58 and associated reporting levels.	Relatively short half-life isotope (71 days). No longer present.
E-5	Table E-3: Deleted Co-58 and associated reporting levels.	Relatively short half-life isotope (71 days). No longer present.

SECTION I: Radiological Effluent Monitoring Manual (REMM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
F-2	First paragraph: Deleted "Gaseous pathway doses shall use meteorological conditions concurrent with the time of radioactive gaseous effluent releases." And deleted "The licensee shall maintain an annual summary of the hourly meteorological data (i.e. wind speed, wind direction and atmospheric stability) either in the form of an hour-by-hour listing on a magnetic medium or in the form of a joint frequency distribution. The licensee has the option of submitting this annual meteorological summary with the ARER, or retaining it and providing it to the NRC upon request."	Reflects change to use of 5 year meteorological averages for atmospheric dispersion. The use of real time meteorological data is not required. EP programs reflect this change now , as well.
G-2	At the end of item c, deleted "Since conservative calculations indicate that yearly site boundary dose will be less than 0.026 mrem, dose from this pathway will be at most a very small fraction of the total dose and hence not need to be considered."	This statement was removed and the method used to determine 40CFR190 compliance in the REMODCM clarified. The basis document is referenced in section G of the ODCM.

SECTION II: Off Site Dose Calculation Manual (ODCM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Throughout	Minor format changes. Due to the nature and number of changes, change bars have not been included for format changes.	Establish consistent format throughout document.
Throughout	The individual page revision numbers were replaced with a revision number for the entire document.	Revision control of individual pages is not required. Less complicated for reviewing and future editing/revisions. Changes/revisions are still tracked and will be summarized in the Annual Operating Report
Table of Contents	Section D is essentially new and this is reflected in the table of contents. Section F is also new and reflects the new R-1 Spent Fuel Pool Noble Gas Activity Monitor which replaced the Main Stack Noble Gas Activity Monitor R-14A.	Revision control of individual pages is not required.
Section A. Introduction	No Change	
Section B. Responsibilities	No Change	
Section C. Liquid Dose Calculations	No Change	
Section D. Gaseous Dose Calculations	Section D. is essentially all new and reflects the additional release points (SFPI stack, alternate containment access, potential chemistry lab hood in the "b" switchgear building, spray cooling loop, and other misc. ground release points). The main stack is still included, but now only measures particulate releases with a filter and flow meter. Met data after 1986 showed an unusual amount of still air (at the lower instrument level) which was the result of undergrowth proliferation. Recent upper level met data was compared with earlier met data (pre 1986) to confirm no significant changes, and 5 year averages (vs. real time met data) were developed from pre-1986 data to develop new X/Q's. These new X/Q's were generated for both elevated and ground release points. The most conservative of all X/Q's were used, as were the most conservative dose conversion factors to simplify the calculation process and eliminate the need for computer calculations. Should a period of higher than expected releases occur, less conservative and more accurate doses can be calculated using the actual specific X/Q's and dose conversion factors, as these were all provided in the dose calculation package, and other basis documents summarized and referenced in the body of the REMODCM.	The basis for all of these changes is contained in the body of the REMODCM. Additionally, the calculational packages, Technical Evaluations, Engineering Records of Correspondence, developed for this revision, and regulatory documents are referenced as an overall program improvement to enhance the traceability of the technical bases.

SECTION II: Off Site Dose Calculation Manual (ODCM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Section D. Gaseous Dose Calculations (cont.)	Additional changes include the elimination of Co-58 (short lived - none left), entrained noble gases in liquid discharge streams (no sources with the SFPI isolated from the discharge path), and the need for charcoal filters (no iodine gaseous sources). Method 1 for calculating dose from gaseous effluent is now a simplified algorithm that can be performed by hand or by using a spreadsheet. Method 2 will be either the GASBAR - 2 code, or any calculational code equivalent which implements R.G. 1.109, Rev. 1, dose equations and maximum individual assumptions. Method 2 would be utilized when a more accurate, less conservative result is necessary. Also removed Tables 1&2 from Section D. which listed Dose Factors for gases, iodines and particulates.	The basis for all of these changes is contained in the body of the REMODCM and in the calculational packages, Technical Evaluations and Engineering Records of Correspondence (developed for this revision), and regulatory documents are referenced as an overall program improvement to enhance the traceability of the technical bases.
Section E. Liquid Effluent Instrumentation Setpoints	No Change	
Section F. Gaseous Monitor Setpoints	Section revised in its entirety to reflect the new Spent Fuel Building Noble Gas Activity Monitor (R-1) and the new setpoint calculation for this. The Main Stack releases now consist of particulate activity only and are measured using a particulate filter and flow monitor.	Changes in plant configuration which reflect the decommissioning status of the plant.
Appendix A	No Change	
Appendix B	No Change	
Appendix C	No change	
Appendix D	Revised in its entirety. It reflects the use of the appropriate dose and dose rate conversion factors from R.G. 1.109 and the change in radionuclide mix with a decommissioning plant (principally 32 long lived radionuclides including tritium, Iodine 129, and 30 other particulate radionuclides). It also includes a listing of the new X/Q's, pathway parameters, and conservative adjustment factors which allow for the removal of built in conservatism from the simplified dose calculation Method 1 when the need arises.	Changes in plant configuration which reflect the decommissioning status of the plant. The bases for the new methods and factors used are contained in the body of the REMODCM and the references cited (calculations, technical evaluations, engineering records of correspondence, and regulatory documents).

SECTION II: Off Site Dose Calculation Manual (ODCM)

Affected Page/Section	Summary of Change	Reason/Basis for Change
Appendix E	Replaced GASBAR version with GASBAR - 2 version of software code and updated the revision date. Removed the reference to the use of real time meteorology and added the new method of using 5 year averages for atmospheric dispersion. Dose Receptor was move to the nearest land site boundary where a resident, vegetable garden, milk and meat animal are assumed. This is more conservative than assuming actual receptors with atmospheric modeling.	The move to use of 5 year averages is acceptable and eliminated the need for maintaining the Met Tower for this purpose. The use of older data has been validated and verified in referenced documentation, and negates the need to defoliate the met tower peninsula visible from the river. This was a good neighbor consideration.
Appendix F	Deleted derivation of factors for dose/curie method (no longer used) and added the new meteorology section utilized in the time adjusted Method 1 with the new algorithms for ground and elevated releases.	All bases for this change are included/summarized in the appendix, and the basis documents are referenced.
Appendix G	No Changes	
Appendix H	Removed "Derivation factors for Table 2" from Section D (these were the dose factors for iodines and particulates). Added description of derivation for all new dose components utilized in the new Method 1.	No longer used. Basis for new Method 1 is summarized in this Appendix and the basis documents are now referenced in the REMODCM.

Form 1 - 10 CFR 50.59 Applicability Review
Page 1 of 2

Document Number : N/A Rev. : 13

Document Title: Radiological Effluent Monitoring Manual & Offsite Dose Calculation Manual

1. Does the proposal fall into one of the following categories (see Procedure Step 1.6.1e)? [ ] YES [X] NO
   [ ] TPC incorp. * [ ] Typographic error [ ] Format change [ ] Title/Name change
   [ ] Minor admin. or editorial corrections to drawings**
   If Yes, check applicable category and proceed to Section 11. If No, complete remainder of the form.
2. Describe the change, reason and expected effects: The revision of the REM/ODCM incorporates: 1) DCR CY-98-042 for the Spent Fuel Island Ventilation system, 2) new radiation monitors/samplers R-1, and R-2, 3) new release points including HEPA tents, SFB Spray Cooler Exhaust, and Alternate Containment Access, 4) Ground level Chi/Q and D/Q values, 5) New elevated Chi/Q and D/Q values using a new 5 year period, 6) New dose calculation methodology, eliminating the use of historical release data and incorporating conservative methods calculating dose at the site boundary fence (except for river sectors which use the far bank). This revision permits the elimination of the CY Effluents Calculation software which was not Y2K compliant and implements the use of simplified calculation methodologies.
3. List SAR and LB/DB document items/sections reviewed: UFSAR Chapters 2.1, 2.3, 9.1, 9.4, 11, and 13.5. LB/DB entire document reviewed.
4. Does the activity require a change to the Operating License or Technical Specifications? [ ] YES [X] NO
   Basis Technical Specification Amendment 195 was included in Revision 12 to the REM/ODCM. Revision 13 to the REM/ODCM adds several new release points and radiation monitors/samplers to the program. These modifications do not require a change to the OL or TS since Amendment 195 removed the monitors from the TS. The use of new dose calculation methodologies does not require a change to the OL or TS. TS requires a program which describes the site effluent controls but does not specify the details.
   List TS/OL Sections reviewed: Section ¾.11, 5.0, and 6.0 of T.S. and entire OL.
   If Yes, contact Licensing before implementing the change, obtain a PTSCR and complete remainder of form.
   PTSCR No.
5. Is the activity bounded by a previously performed 10 CFR 50.59 Safety Evaluation?*** [ ] YES [X] NO
   SE No.:
   If Yes, sections 6, 7 and 8 may be omitted.
6. Does the activity make changes to the facility as described in the SAR? [ ] YES [X] NO
   Basis This REM/ODCM revision implements controls and sampling for changes which are described in DCR CY-98-042 for the Spent Fuel Ventilation (including the new R-1 and R-2 radiation monitor/samplers). There are no physical changes to any component in the facility caused by this revision.
7. Does the activity make changes to procedures as described in the SAR? [ ] YES [X] NO
   Basis The SAR and Technical Specifications require that a program be in place to implement the effluent controls and dose calculations. There are no programmatic details specified in the SAR. Therefore, this revision does not make changes to a procedure described in the SAR.
8. Does the activity involve a test or experiment not described in the SAR? [ ] YES [X] NO
   Basis This revision implements new programs required to describe the operational controls for effluent samplers and methods to monitor the total release of radioactivity to the environment as well as the calculation of dose to the public. There is no test or experiment conducted as part of this program. The methodologies utilized in this program are standard industry techniques.

9a. Does the activity require a change to the LB/DB Document? [ ] YES [X] NO

9b. If YES, does this change constitute a change that affects the Licensing Basis or Design Basis Sections of any chapter of the LB/DB Document, to the extent that it impacts the ability of the SSC to satisfy any Licensing Basis statement (see Section 1.6.1d)? [ ] YES [ ] NO
   Basis

10. Does the activity involve (a) contamination of a non-radioactive system and the resulting potential for unmonitored, uncontrolled release of radioactivity to the environment (IE Bulletin 80-10), OR (b) movement and subsequent storage of radioactive material in an unshielded area without evaluating high radiation area controls (Technical Specification 6.12 and 10 CFR 20.1601), RCA boundary dose rate and site boundary dose limitations (10 CFR 20.1301, 40 CFR 190)?
    If Yes, Identify (a) and/or (b) as applicable: [ ] YES [X] NO

Form 1 - 10 CFR 50.59 Applicability Review
Page 2 of 2

11. Complete, if applicable: FSARCR No.__ TRMCR No._____ LB/DBCR No._____
12. Does the proposed change foreclose (preclude) release of the site for possible unrestricted use?[ ] YES [X] NO
Discussion: This program revision does not create a potential for restricting future access to the site. It is implementing changes to the plant and Technical Specifications which have already been evaluated for their environmental impact. There is no significant affect on the environment from this revision. This revision is a part of the overall environmental monitoring program by monitoring and evaluating releases of radioactivity to the environment.
13. Does the proposed change result in a significant environmental impact not previously reviewed? [ ] YES [X] NO
Discussion: This program revision does not cause a significant environmental impact. It is implementing changes to the plant and Technical Specifications which have already been evaluated for their environmental impact. There is no significant affect on the environment from this revision. This revision is a part of the overall environmental monitoring program by monitoring and evaluating releases of radioactivity to the environment.
14. Does the proposed change result in there no longer being reasonable assurance that adequate funds will be available for decommissioning? [ ] YES [X] NO
Discussion: This program revision implements design and Technical Specification changes which create new release points, new dose calculational methodologies, and new radiation monitoring systems. None of the changes in this procedure affect the available funds for decommissioning in a significant measure.

DISCIPLINE	PRINT NAME	SIGNATURE	
Preparer:	Christopher Shelton		Date: 12/9/99
Approver [1]	Dave Montt		Date: 12/9/99

Attach additional sheets if needed

NOTE: If any response to Sections 6, 7, 8, 9b or 10 is answered Yes, a Safety Evaluation is required, unless Section 5 is "Yes". If a Safety Evaluation is required, complete Form 2 and attach this form to Form 2.
Preparer attach this form to the parent document.
If any answer in Section 12, 13, or 14 is Yes, the proposed change involves a UDQ.
If a UDQ is involved, STOP. Obtain assistance from Licensing for additional processing.
* Incorporation of Temporary Procedure Changes which have a completed screening sheet.
** See Attachment 5, Section B.5 for guidance.
*** For partially bounding previous safety evaluations, see Attachment 4, Section B.7 for guidance.
[1]Decommissioning Director or Unit Director shall review this form in the event an Engineering recommendation regarding Tech. Spec. changes is modified.

Docket No. 50-213
CY-00-069

Attachment 2

Haddam Neck Plant
Radiological Effluent Monitoring and Offsite Dose Calculation Manual

April 2000

Northeast
Utilities

RADIOLOGICAL EFFLUENT MONITORING
&
OFFSITE DOSE CALCULATION MANUAL

REMODCM

CONNECTICUT YANKEE ATOMIC POWER COMPANY
HADDAM NECK PLANT
Haddam, Connecticut

DOCKET NO. 50-213
LICENSE NO. DPR-61

SECTION I

RADIOLOGICAL EFFLUENT MONITORING MANUAL

For The

HADDAM NECK PLANT

Docket No. 50-213

HADDAM NECK PLANT

RADIOLOGICAL EFFLUENT MONITORING MANUAL

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

A. INTRODUCTION AND RESPONSIBILITIES

A.1 Introduction

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

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

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

A.2 Responsibilities

All changes to this manual shall be reviewed by the Plant Operations Review Committee prior to implementation.

All changes and their rationale shall be documented in the Annual Radioactive Effluent Report in accordance with the administrative controls of Technical Specification 6.6.3.

It shall be the responsibility of the Unit Director to ensure that this manual is used in the implementation of the Radiological Effluent Monitoring, Radioactive Effluent Controls, and the Radiological Environmental Monitoring Programs. The Unit Director shall ensure that the REMODCM is maintained and controlled in accordance with Technical Specification 6.6.3.

B. DEFINITIONS

The defined terms of this section appear in capitalized type and are applicable throughout the REMODCM.

B.1 ACTION

ACTION shall be that part of a Control which prescribes remedial measures required under designated conditions.

B.2 ANALOG CHANNEL OPERATIONAL TEST

An ANALOG CHANNEL OPERATIONAL TEST shall be the injection of a simulated signal into the channel as close to the sensor as practicable to verify OPERABILITY of alarm, interlock and/or trip functions. The ANALOG CHANNEL OPERATIONAL TEST shall include adjustments, as necessary, of the alarm, interlock and/or Trip Setpoints such that the Setpoints are within the required range and accuracy.

B.3 CHANNEL CALIBRATION

A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel such that it responds within the required range and accuracy to known values of input. The CHANNEL CALIBRATION shall encompass the entire channel including the sensors and alarm, interlock and/or trip functions, and may be performed by any series of sequential, overlapping or total channel steps such that the entire channel is calibrated.

B.4 CHANNEL CHECK

A CHANNEL CHECK shall be the qualitative assessment of channel behavior during operation by observation. This determination shall include, where possible, comparison of the channel indication and/or status with other indications and/or status derived from independent instrument channels measuring the same parameter.

B.5 FREQUENCY NOTATION

The FREQUENCY NOTATION specified for the performance of Surveillance Requirements shall correspond to the intervals defined in Table B.1.

B.6 MEMBER(S) OF THE PUBLIC

MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the licensee, its contractors, or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational, or other purposes not associated with the plant.

B.7 OPERABLE - OPERABILITY

A system, subsystem, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component or device to perform its function(s) are also capable of performing their related support function(s).

B.8 RADIOACTIVE WASTE TREATMENT SYSTEMS

RADIOACTIVE WASTE TREATMENT SYSTEMS are those liquid, gaseous and solid waste systems which are required to maintain control over radioactive material in order to meet the Controls set forth in the REMODCM.

B.9 RADIOLOGICAL EFFLUENT MONITORING AND OFFSITE DOSE CALCULATION MANUAL (REMODCM)

A RADIOLOGICAL EFFLUENT MONITORING MANUAL (REMM) shall be a manual containing the site and environmental sampling and analysis programs for measurements of radiation and radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures to individuals from station operation. 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 REMODCM are provided in Technical Specification 6.6.3.

B.10 SITE BOUNDARY

The SITE BOUNDARY shall be that line beyond which the land is neither owned, nor leased, nor otherwise controlled by the licensee.

B.11 SOURCE CHECK

A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radio-activity.

B.12 ALL APPLICABLE LIQUID RADIOACTIVE WASTE TREATMENT SYSTEMS

ALL APPLICABLE LIQUID RADIOACTIVE WASTE TREATMENT SYSTEMS is defined as that equipment applicable to any waste stream responsible for greater than ten percent (10%) of the total projected dose. The liquid radioactive waste treatment system equipment at the Haddam Neck Plant consists of: portable demineralizer, waste liquid polishing demineralizer, borated waste ion demineralizer, and boron recovery polishing demineralizer.

B.13 ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENTS SYSTEMS

ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENT SYSTEMS is defined as that equipment applicable to a waste stream responsible for greater than ten percent 10% of the total projected dose. The gaseous radioactive waste treatment equipment at the Haddam Neck Plant consists of ventilation system HEPA..

TABLE B.1
FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days.
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 184 days.
R	At least once per 18 months.
P	Prior to each release.
N.A.	Not applicable.

C. LIQUID EFFLUENTS

C.1 Liquid Effluents Sampling and Analysis Program

Radioactive liquid wastes shall be sampled and analyzed in accordance with the program specified in Table C-1 for the Haddam Neck Plant. The results of the radioactive analyses shall be input to the methodology of the ODCM to assure that the concentrations at the point of release are maintained within the Controls of the REMODCM.

Table C-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection[a] (LLD) (μCi/cc)
A. Batch Release[h] *From these sources:* Waste Test Tank Recycle Test Tank Waste Neutralization Tank Waste Transfer (NPDES) Sump	Prior to Each Batch Release	Prior to Each Batch Release	Principal Gamma Emitters[d] Ce-144	5.00E-07 5.00E-06
		Monthly Composite[b,c]	Gross Alpha[f] H-3	1.00E-07 1.00E-05
		Quarterly Composite[b,c]	Sr-90[f] Fe-55[f]	5.00E-08 1.00E-06
B. Continuous Release *From these sources:* Service Water Effluent Yard Drain #6 (Catch Basin 11)	Daily Grab Sample[e]	Weekly Composite[c]	Principal Gamma Emitters[d] Ce-144 H-3	5.00E-07 5.00E-06 1.00E-05
		Monthly Composite[c]	Gross Alpha[g]	1.00E-07
		Quarterly Composite[c]	Sr-90[g] Fe-55[g]	5.00E-08 1.00E-06

TABLE C-1
(Continued)

TABLE NOTATIONS

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

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

$$LLD = \frac{4.66 S_b}{E \cdot V \cdot (2.22E+06) \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where:

LLD is the lower limit of detection as defined above (microcuries per unit volume)

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

E is the counting efficiency (counts per transformation)

V is the sample size (volume)

2.22E+06 is the number of transformations per minute per microcurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between sample collection (or 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 an a posteriori (after the fact) limit for a particular measurement.

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

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

d. The principal gamma emitters for which the LLD specification will apply are exclusively the following nuclides: Mn-54, Co-60, Zn-65, Cs-134 and Cs-137. This does not mean that only these nuclides are to be reported. Other nuclides that are identified shall be 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 an a priori LLD being higher than required, the reasons shall be documented in the Annual Radioactive Effluent Report.

e. A grab sample will be obtained daily at least five (5) days per week. A composite sampler may be used in lieu of the daily grab sample for Yard Drain #6.

f. These analyses are performed for the Waste and Recycle Test Tanks. They are not required for WNT or NPDES Sump unless gamma activity analysis identifies radioactivity above 5.00E-07 μCi/ml.

g. These analyses are only required when the weekly gamma analysis identifies radioactivity above 5.00E-07 μCi/ml.

h. Prior to sampling, each batch shall be isolated; and, where design permits, at least two tank or sump volumes shall be recirculated or equivalent mixing provided.

C.2 Liquid Radioactive Waste Treatment

Monthly doses due to liquid effluents to unrestricted areas shall be projected at least once per 31 days only if one or ALL APPLICABLE LIQUID RADIOACTIVE WASTE TREATMENT SYSTEMS will not be routinely operated. When the projected monthly dose due to liquid effluents exceeds 0.06 mrem to the total body or 0.2 mrem to any organ, ALL APPLICABLE LIQUID RADIOACTIVE WASTE TREATMENT SYSTEMS will be operated.

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 Subsection F.3, a special report that includes the following information:

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

b. Actions taken to restore the inoperable equipment to OPERABLE status; and

c. Summary description of actions taken to prevent a recurrence.

C.3/4 LIQUID EFFLUENT CONTROLS AND SURVEILLANCE REQUIREMENTS

CONCENTRATION

CONTROLS

C.3.1 The concentration of radioactive material released from the site (see Figure H-1) shall not exceed the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2.

APPLICABILITY: At all times.

ACTION:

With the concentration of radioactive material released from the site exceeding the above limits, restore the concentration to within the above limits within 15 minutes.

SURVEILLANCE REQUIREMENTS

C.4.1.1 Radioactive liquid wastes shall be sampled and analyzed in accordance with the sampling and analysis program specified in Section I of the REMODCM.

C.4.1.2 The results of the radioactive analysis shall be used in accordance with the methods of Section II of the REMODCM to assure that the concentration of the point of release are maintained within the limits of Control C.3.1.

RADIOACTIVE EFFLUENTS

BASIS

C.3/4 LIQUID EFFLUENTS

C.3/4.1 CONCENTRATION

This Control is provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table II, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water outside the site will result in exposures within: (1) the Section II.A design objectives of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC, and (2) the limits of 10 CFR 20.106(e) to the population.

RADIOACTIVE EFFLUENTS

DOSE, LIQUIDS

CONTROLS

C.3.2 The dose or dose commitment to any MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released from the site (see Figure H-1) shall be limited:

a. During any calendar quarter to less than or equal to 1.5 mrem to the total body and to less than or equal to 5 mrem to any organ, and

b. During any calendar year to less than or equal to 3 mrem to the total body and to less than or equal 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 Control F.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 materials in liquid effluents during the remainder of the current calendar quarter and during the remainder of the calendar year so that the cumulative dose or dose commitment to any MEMBER OF THE PUBLIC from such release during the calendar year is within 3 mrem to the total body and 10 mrem to any organ.

SURVEILANCE REQUIREMENTS

C.4.2.1 Cumulative dose contributions for the current calendar quarter and current calendar year from liquid effluents shall be determined in accordance with Section II of the REMODCM once every 31 days.

C.4.2.2 Relative accuracy or conservatisms of the calculations shall be confirmed by performance of the Radiological Environmental Monitoring Program as detailed in Section I of the REMODCM.

RADIOACTIVE EFFLUENTS

BASIS

C.3/4 LIQUID EFFLUENTS

C.3/4.2 DOSE, LIQUIDS

This Control 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 calculation methodology and parameters in the REMODCM 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 a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the REMODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are 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.

INSTRUMENTATION

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

C.3.3 The radioactive liquid effluent monitoring instrumentation channels shown in Table C.3.3 shall be OPERABLE with applicable Alarm/Trip Setpoints set to ensure that the limits of Control C.3.1 are not exceeded. The Alarm/Trip Setpoints shall be determined in accordance with methodology and parameters described in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY: At all times*.

ACTION:

a. With a radioactive liquid effluent monitoring instrumentation channel Alarm/Trip Setpoint less conservative than required by the above Control, without delay suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable, or change the Alarm/Trip Setpoint so it is acceptably conservative.

b. With the number of channels less than the minimum channels OPERABLE requirement, take the ACTION shown in Table C.3.3. Exert best efforts to restore the inoperable monitor to OPERABLE status within 30 days, and, if unsuccessful, explain in the next Annual Effluent Report why the inoperability was not corrected in a timely manner. Releases need not be terminated after 30 days provided the specified actions are continued.

SURVEILLANCE REQUIREMENTS

C.4.3 Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and ANALOG CHANNEL OPERATIONAL TEST operations at the frequencies shown in Table C.4.3.

* At all times means that channel shall be OPERABLE and in service on a continuous, uninterrupted basis, except that outages of monitoring channels are permitted for a maximum of 12 hours each time for the purpose of maintenance and performance of required tests, checks, calibrations or sampling.

INSTRUMENTATION

BASES

C.3/4.3 RADIOACTIVE LIQUID EFFLUENT MONITORING 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 of liquid effluents. The Alarm/Trip Setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters 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.

TABLE C.3.3

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM # OPERABLE	ACTION
1. GROSS RADIOACTIVITY MONITORS PROVIDING AUTOMATIC TERMINATION OF RELEASE		
a. Waste and Recycle Test Tank Discharge Line	1	46
2. GROSS RADIOACTIVITY MONITORS NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE		
a. Service Water Effluent Line	1	47
3. FLOW RATE MEASUREMENT		
a. Waste and Recycle Test Tank Discharge Line	1	48
b. Discharge Canal	*	N.A.

* Discharge canal flow is determined by the number of pumps running.

TABLE C.3.3
(Continued)

ACTION STATEMENTS

ACTION 46 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirements, effluent releases may continue provided that best efforts are made to repair the instrument and that prior to initiating a release:

a. At least two independent samples of the tank to be discharged are analyzed in accordance with Control C.4.1.1, and;

b. The original release rate calculations and discharge valving are independently verified by a second individual.

ACTION 47 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that best efforts are made to repair the instrument and that once per 12 hours grab samples of the service water effluent are collected and analyzed for gross radioactivity (beta or gamma) at a lower limit of detection of at least 3×10^{-7} microcuries/ml.

ACTION 48 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that best efforts are made to repair the instrument and that the flow rate is estimated once per 4 hours during actual releases. Pump performance curves generated insitu may be used to estimate flow.

TABLE C.4.3

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1. GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE				
a. Waste and Recycle Test Tank Discharge Line	D(1)	P	R(2)	Q(3)
2. GROSS RADIOACTIVITY MONITORS PROVIDING ALARM BUT NOT PROVIDING AUTOMATIC TERMINATION OF RELEASE				
a. Service Water Effluent Line	D(1)	M	R(2)	Q(3)
3. FLOW RATE MEASUREMENT				
a. Waste and Recycle Test Tank Discharge Line	D(1)	N.A.	R	N.A.
b. Discharge Canal	D(4)	N.A.	N.A.	N.A.

TABLE C.4.3
(Continued)

TABLE NOTATIONS

(1) CHANNEL CHECK need only be performed daily when discharges are made from this pathway. The CHANNEL CHECK should be done when the discharge is in process.

(2) CHANNEL CALIBRATION shall be performed using a known radioactive liquid or solid source whose strength is determined by a detector which has been calibrated to an NIST source. The radioactive source shall be in a known, reproducible geometry.

(3) The ANALOG CHANNEL OPERATIONAL 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.

(4) Pump status should be checked at least once per 24 hours for the purpose of determining flow rate.

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

D. GASEOUS EFFLUENTS

D.1 Gaseous Effluents Sampling and Analysis Program

Radioactive gaseous wastes shall be sampled and analyzed in accordance with the program specified in Table D-1 for the Haddam Neck Plant. The results of the radioactive analyses shall be input to the methodology of the ODCM to assure that the offsite dose rates are maintained within the Controls of the REMODCM.

TABLE D-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/cc)
A. Spent Fuel Pool Spray Cooling	Weekly	Weekly Liquid Grab	Principal Gamma Emitters[c]	3.00E-08
		Monthly Liquid Composite[f,g]	Gross Alpha	1.00E-07
		Quarterly Liquid Composite[f,g]	Sr-90 Fe-55	5.00E-08 1.00E-06
B. Containment Purge	Prior to Each Purge[d]	Prior to Each Purge	H-3	1.00E-06
C. Spent Fuel Building Exhaust	Weekly	Weekly Gaseous Grab	Kr-85 H-3	1.00E-04 1.00E-06
	Continuous[b]	Weekly Particulate[e]	Principal Gamma Emitters[c]	1.00E-11
		Monthly Particulate Composite	Gross Alpha	1.00E-11
		Quarterly Particulate Composite	Sr-90	1.00E-11
		Noble Gas Monitor	Noble Gas Gross Activity	1.00E-06

TABLE D-1
(Continued)

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD)[a] (μCi/cc)
D. Main Stack	Weekly	Weekly Gaseous Grab	H-3	1.00E-06
	Continuous[b]	Weekly Particulate[e]	Principal Gamma Emitters[c]	1.00E-11
		Monthly Particulate Composite	Gross Alpha	1.00E-11
		Quarterly Particulate Composite	Sr-90	1.00E-11
E. Miscellaneous Points[h] For example: • Alternate Containment Access • Tented Enclosures	Continuous[b]	Weekly Particulate[e]	Principal Gamma Emitters[c]	1.00E-11
		Monthly Particulate Composite	Gross Alpha	1.00E-11
		Quarterly Particulate Composite	Sr-90	1.00E-11

Table D-1
(Continued)

TABLE NOTATIONS

a. The lower limit of detection (LLD) is defined in *Table Notations* of *Table C-1*.

b. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with *REMODCM*.

c. The principal gamma emitters for which the LLD specification will apply are exclusively the following radionuclides: Mn-54, Co-60, Zn-65, Cs-134, Cs-137 and Ce-144. The list does not mean that only these nuclides are to be detected and reported. Other nuclides, which are identified, shall be reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD. When unusual circumstances result in an a priori (before the fact) LLD being higher than required, the reasons shall be documented in the *Annual Radioactive Effluent Report*.

d. Sample prior to purge will be obtained from the charging floor (refueling floor). Only required if reactor cavity is flooded.

   Sample results from the charging floor will be used to account for gaseous radioactivity released for the first 12 hours; after 12 hours, the radioactivity released will be accounted for from the Main Stack.

e. Samples shall be changed at least once per 7 days and analyses completed within 48 hours. The LLDs may be increased by a factor of 10 if sample collection is for less than 24 hours.

f. A composite sample is one in which the quantity of liquid sampled is proportional to system operational time and in which the method of sampling employed results in a specimen which is representative of the liquid released.

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

h. Release points included in this category are added if the radiological evaluation of the job or building indicates a potential for significant airborne radioactivity. This evaluation shall be performed in accordance with applicable radiological engineering programs. Technical Support Document CY-HP-0029 and CY memorandum HP 99-108 define the limits and controls used in this evaluation.

D.2 Gaseous Radioactive Waste Treatment

Monthly doses due to gaseous effluents to unrestricted areas shall be projected at least once per 31 days only if one or ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENT SYSTEMS will not be routinely operated. When the projected monthly dose due to gaseous effluents exceeds 0.2 mrad for gamma radiation, 0.4 mrad for beta radiation or 0.3 mrem to any organ due to gaseous particulate effluents, ALL APPLICABLE GASEOUS RADIOACTIVE WASTE TREATMENT SYSTEMS will be operated.

With radioactive gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission, within 30 days, pursuant to Subsection F.3, a special report that includes the following information:

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

b. Actions taken to restore the inoperable equipment to OPERABLE status; and

c. Summary description of actions taken to prevent a recurrence.

D.3/4 GASEOUS EFFLUENT CONTROLS AND SURVEILLANCE REQUIREMENTS

DOSE RATE

CONTROLS

D.3.1 The dose rate, at any time, offsite (see Figure H-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 less than or equal to 500 mrem/yr to the total body and less than or equal to 3000 mrem/yr to the skin, and

b. The dose rate limit due to inhalation for tritium and for all radioactive materials in particulate form with half-lives greater than 8 days shall be less than or equal to 1500 mrem/yr to any organ.

APPLICABILITY: At all times.

ACTION:

With the dose rate(s) exceeding the above limits, decrease the release rate within 15 minutes to comply with the limit(s) given in Control D.3.1.

SURVEILLANCE REQUIREMENTS

D.4.1.1 The release rate, at any time, of noble gases in gaseous effluents shall be controlled by the offsite dose rate as established above in Control D.3.1. The corresponding release rate shall be determined in accordance with the methodology of Section II of the REMODCM.

D.4.1.2 The noble gas effluent monitors of Control D.3.4 shall be used to control release rates to limit offsite doses within the values established in Control D.3.1.

D.4.1.3 The release rate of radioactive materials in gaseous effluents shall be determined by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Section I of the REMODCM (Table D-1). The corresponding dose rate shall be determined using the methodology and parameters given in the ODCM (Section II of the REMODCM).

RADIOACTIVE EFFLUENTS

BASES

D.3/4 GASEOUS EFFLUENTS

D.3/4.1 DOSE RATE

This Control is provided to ensure that the dose rate at anytime from gaseous effluents from the site will be within the annual dose limits of 10 CFR Part 20 for all areas offsite. 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 offsite to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR 20.106(b)). For individuals who may at times be within the SITE BOUNDARY, the occupancy of that individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to an individual at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the total body or to less than or equal to 3000 mrem/year to the skin. These release rate limits also restrict, at all times, the corresponding thyroid or other organ dose rate above background to a child to less than or equal to 1500 mrem/year from inhalation.

RADIOACTIVE EFFLUENTS

DOSE, NOBLE GASES

CONTROLS

D.3.2 The air dose offsite (see Figure H-1) due to noble gases released in gaseous effluents shall be limited to the following:

a. During any calendar quarter, to less than or equal to 5 mrad for gamma radiation and less than or equal to 10 mrad for beta radiation, and

b. During any calendar year to less than or equal to 10 mrad for gamma radiation and less than or equal to 20 mrad for beta radiation.

APPLICABILITY: At all times.

ACTION:

a. 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 Control F.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 remainder of the calendar year so that the cumulative dose during the calendar year is within 10 mrad for gamma radiation and 20 mrad for beta radiation.

SURVEILLANCE REQUIREMENTS

D.4.2.1 Cumulative dose contributions for the current calendar quarter and current calendar year for noble gases shall be determined in accordance with Section II of the REMODCM once every 31 days.

D.4.2.2 Relative accuracy or conservatism of the calculations shall be confirmed by performance of the Radiological Environmental Monitoring Program as detailed in Section I of the REMODCM.

RADIOACTIVE EFFLUENTS

BASES

D.3/4 GASEOUS EFFLUENTS

D.3/4.2 DOSE, NOBLE GASES

This Control 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 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 conform 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 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 are consistent with the methodology provided in Regulatory Guide 1.109, "Calculational 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.

The ODCM equations provided for determining the air doses at the SITE BOUNDARY are based upon utilizing successively more realistic dose calculational methodologies. More realistic dose calculational methods are used whenever simplified calculations indicate a dose approaching a substantial portion of the regulatory limits.

RADIOACTIVE EFFLUENTS

DOSE, RADIOACTIVE MATERIAL IN PARTICULATE FORM AND RADIONUCLIDES OTHER THAN NOBLE GASES

CONTROLS

D.3.3 The dose to any MEMBER OF THE PUBLIC from tritium and radioactive materials in particulate form with half lives greater than 8 days in gaseous effluents released offsite (see Figure H-1) shall be limited to the following:

a. During any calendar quarter to less than or equal to 7.5 mrem to any organ;

b. During any calendar year to less than or equal to 15 mrem to any organ.

APPLICABILITY: At all times.

ACTION:

a. With the calculated dose from the release of radionuclides, 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 Control F.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 during the remainder of the current calendar quarter and during the remainder of the calendar year so that the cumulative dose or dose commitment to any MEMBER OF THE PUBLIC from such releases during the calendar year is within 15 mrem to any organ.

SURVEILLANCE REQUIREMENTS

D.4.3.1 Cumulative dose contributions for the current calendar quarter and current calendar year shall be determined in accordance with Section II of the REMODCM once every 31 days.

D.4.3.2 Relative accuracy or conservatism of the calculations shall be confirmed by performance of the Radiological Environmental Monitoring Program as detailed in the REMODCM.

RADIOACTIVE EFFLUENTS

BASES

D.3/4.3 DOSE, RADIOACTIVE MATERIAL IN PARTICULATE FORM AND RADIONUCLIDES OTHER THAN NOBLE GASES

This Control 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 for 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 for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculating of Annual Dose to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision I, 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 I, July 1977. The release rate Controls for radioactive material in particulate form and radionuclides other than noble gases are dependent on the existing radionuclide pathways to man. 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.

INSTRUMENTATION

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

CONTROLS

D.3.4 The radioactive gaseous effluent monitoring instrumentation channels shown in Table D.3.4 shall be OPERABLE with applicable Alarm Setpoints set to ensure that the limits of Control D.3.1 are not exceeded. The setpoints shall be determined in accordance with the methodology and parameters as described in the ODCM.

APPLICABILITY: At all times*

ACTION:

a. With a radioactive gaseous effluent monitoring instrumentation channel Alarm Setpoint less conservative than required by the above Control, without delay suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable, or change the Alarm Setpoint so it is acceptably conservative.

b. With the number of channels less than the minimum channels OPERABLE requirement, take the ACTION shown in Table D.3.4. Exert best efforts to restore the inoperable monitor to OPERABLE status within 30 days and, if unsuccessful, explain in the next Annual Effluent Report why the inoperability was not corrected in a timely manner. Releases need not be terminated after 30 days provided the specified actions are continued.

SURVEILLANCE REQUIREMENT

D.4.4 Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION, and ANALOG CHANNEL OPERATIONAL TEST operations at the frequencies shown in Table D.4.4.

* At all times means that the channel shall be operable and in service on a continuous basis, except that outages are permitted for a maximum of 12 hours each time for the purpose of maintenance and performance of required tests, checks, calibrations.

INSTRUMENTATION

BASES

D.3/4.4RADIOACTIVE GASEOUS EFFLUENT MONITORING 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 of gaseous effluents. The Alarm/Trip Setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the REMODCM 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.

TABLE D.3.4

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. SPENT FUEL BUILDING EXHAUST MONITOR		
a. Noble Gas Activity Monitor Providing Alarm	1	50
b. Particulate Sampler	1	51
c. Stack Flow Rate Monitor	1	52
d. Sample Flow Rate Monitor	1	52
2. MAIN STACK MONITOR		
a. Particulate Sampler	1	51
b. Stack Flow Rate Monitor	1	52
c. Sample Flow Rate Monitor	1	52

TABLE D.3.4
(Continued)

ACTION STATEMENTS

ACTION 50 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that best efforts are made to repair the instrument and grab samples are taken at least once per 12 hours and these samples are analyzed for radioactivity within 24 hours.

ACTION 51 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that best efforts are made to repair the instrument and that samples are continuously collected with auxiliary sampling equipment for periods of seven (7) days and analyzed for principal gamma emitters with half lives greater than 8 days within 48 hours after the end of the sampling period. Auxiliary sampling shall be established within 12 hours of declaring the channel inoperable.

ACTION 52 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue provided that the best efforts are made to repair the instrument and that the flow rate is estimated once per 4 hours.

TABLE D.4.4

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT		CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL FUNCTIONAL TEST
1.	SPENT FUEL BUILDING EXHAUST MONITOR				
a.	Noble Gas Activity Monitor	D(1)	M	R(2)	Q(3)
b.	Particulate Sampler	W	N.A.	N.A.	N.A.
c.	Stack Flow Rate Monitor	D(1)	N.A.	R	N.A.
d.	Sample Flow Rate Monitor	D	N.A.	R	N.A.
2.	MAIN STACK MONITOR				
a.	Particulate Sampler	W	N.A.	N.A.	N.A.
b.	Stack Flow Rate Monitor	D(1)	N.A.	R	N.A.
c.	Sample Flow Rate Monitor	D	N.A.	R	N.A.

TABLE D.4.4
(Continued)

TABLE NOTATIONS

(1) CHANNEL CHECK daily when releases exist via this pathway.

(2) Calibration shall be performed using a known source whose strength is determined by a detector which has been calibrated to an NIST source. These sources 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:

a. Instrument indicates measured levels above the Alarm Setpoint.

b. Instrument indicates a downscale failure or circuit failure.

c. Instrument controls not set in operate mode.

E. RADIOLOGICAL ENVIRONMENTAL MONITORING

E.1 Sampling and Analysis

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

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

All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report pursuant to Section F.1. It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice (excluding milk) at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathways in questions and appropriate substitutions made within 30 days in the radiological environmental monitoring program.

If milk samples are temporarily unavailable from any one or more of the milk sample locations required by Table E-1, a grass sample shall be substituted during the growing season (Apr. - Dec.) and analyzed for gamma isotopes until milk is again available. Upon notification that milk samples will be unavailable for a prolonged period (> 9 months) from any one or more of the milk sample locations required by Table E-1, a suitable replacement milk location shall be evaluated and appropriate changes made in the radiological environmental monitoring program. Reasonable attempts shall be made to sample the replacement milk location prior to the end of the next sampling period. Any of the above occurrences shall be documented in the Annual Radiological Environmental Operating Report which is submitted to the U.S. Nuclear Regulatory Commission prior to May 1 of each year.

Changes to sampling locations shall be identified in a revised table and figure(s) in Appendix G of the ODCM.

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

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

When radionuclides other than those in Table E-2 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 the REMODCM. This report is not required if the measured level of radioactivity was not the result of plant effluents, however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report.

The detection capabilities required by Table E-3 are state-of-the-art for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement. All analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

TABLE E-1

HADDAM NECK RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Locations	Sampling and Collection Frequency	Type and Frequency of Analysis
1a. Gamma Dose - Environmental TLD	14	Monthly	Gamma Dose - Monthly
1b. Gamma Dose - Accident TLD	25	Quarterly[a]	N/A[a]
2. Airborne Particulate	7	Continuous sampler - weekly filter change	Gross Beta - Weekly Gamma Spectrum - Quarterly on composite (by location), and on individual sample if gross beta is greater than 10 times the mean of the weekly control station's gross beta results
3. Vegetation	4	One sample near middle and one near end of growing season	Gamma Isotopic on each sample
4. Milk	6	Monthly	Gamma Isotopic on each sample - Monthly Sr-89 and Sr-90 - Quarterly
4a. Pasture Grass	6	Sample as necessary to substitute for unavailable milk	Gamma Isotopic
5. Well Water	2	Quarterly	Gamma Isotopic, and Tritium on each composite
6. Bottom Sediment	3	Semiannual	Gamma Isotopic
7. River Water	2	Quarterly Sample - Indicator is continuous Composite; Background is Composite of Six Weekly *Grab* Samples	Quarterly - Gamma Isotopic and Tritium
8. Fish (edible portion) - bullheads and, when available, Perch or other edible fish	3	Quarterly	Gamma Isotopic - Quarterly
9. Shellfish	2	Quarterly	Gamma Isotopic - Quarterly

a. Accident monitoring TLDs to be dedosed at least quarterly.

TABLE E-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Reporting Levels

Analysis	**Water** (pCi/l)	**Airborne Particulate or Gas** (pCi/m^3)	**Fish** (pCi/kg, wet)	**Milk** (pCi/l)	**Vegetables** (pCi/kg, wet)	**Shellfish** (pCi/kg, wet)
H-3	2.00E+04					
Mn-54	1.00E+03		3.00E+04			1.40E+05
Co-60	3.00E+02		1.00E+04			5.00E+04
Zn-65	3.00E+02		2.00E+04			8.00E+04
Cs-134	3.00E+01	1.00E+01	1.00E+03	6.00E+01	1.00E+03	5.00E+03
Cs-137	5.00E+01	2.00E+01	2.00E+03	7.00E+01	2.00E+03	8.00E+03

TABLE E-3

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

Analysis	**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		1.00E-02				
H-3	2.00E+03					
Mn-54	1.50E+01		1.30E+02			
Co-60	1.50E+01		1.30E+02			1.50E+02
Zn-65	3.00E+01		2.60E+02			
Cs-134	1.50E+01	5.00E-02	1.30E+02	1.50E+01	6.00E+01	1.50E+02
Cs-137	1.80E+01	6.00E-02	1.50E+02	1.80E+01	8.00E+01	1.80E+02

TABLE E-3
(Continued)

TABLE NOTATIONS

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

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

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

where:

LLD is the lower limit of detection as defined above (microcuries per unit volume)

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

E is the counting efficiency (counts per transformation)

V is the sample size (volume)

2.22 is the number of transformations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δ**t** is the elapsed time between sample collection (or 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 an a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

E.2 Land Use Census

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

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

With a land use census identifying a location(s) which yields a calculated dose or dose commitment greater than the doses currently being calculated in the off-site dose models, make the appropriate changes in the sample locations used.

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

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

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

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

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

E.3 Interlaboratory Comparison Program

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

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

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

F. REPORT CONTENT

F.1 Annual Radiological Environmental Operating Report

The Annual Radioactive Environmental Operating Report shall include summaries, interpretations and statistical evaluation of the results of the radiological environmental surveillance activities for the report period, including a comparison with the previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The report shall also include the results of the land use census required by Section E.2 of this manual. If levels of radioactivity are detected that result in calculated doses greater than 10 CFR Part 50 Appendix I Guidelines, the report shall provide an analysis of the cause and a planned course of action to alleviate the cause.

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

a. Total number of analyses performed at indicator locations;

b. Total number of analyses performed at control locations;

c. Lower limit of detection (LLD);

d. Mean and range of all indicator locations together;

e. Mean and average of all control locations together;

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

g. Number of nonroutine reported measurements as defined in these specifications.

In the event that some results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted in the next annual report.

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

F.2 Annual Radioactive Effluent Report

The Annual Radioactive Effluent Report (ARER) shall include quarterly quantities of and an annual summary of radioactive liquid and gaseous effluents released from the unit in the Regulatory Guide 1.21 (Rev 1, 06/74) format. Radiation dose assessments for these effluents shall be provided in accordance with 10 CFR Part 50.36a and the REMODCM. An annual assessment of the radiation dose from the site to the most likely exposed MEMBER OF THE PUBLIC shall be included to demonstrate conformance with 40 CFR Part 190. Doses shall be calculated in accordance with the OFFSITE DOSE CALCULATION MANUAL. The ARER shall be submitted by May 1 of each year for the period covering the previous calendar year.

The ARER shall include a summary of each type of solid radioactive waste shipped offsite for burial or final disposal during the report period and shall include the following information for each type:

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

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

c. Total curies;

d. Total volume and typical container volumes;

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

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

The ARER shall include the following information for each abnormal release of radioactive liquid and gaseous effluents from the site to unrestricted areas:

a. Description of the events and equipment involved;

b. Causes for the abnormal release;

c. Actions taken to prevent recurrence; and

d. Consequences of the abnormal release.

Changes to the RADIOLOGICAL EFFLUENT MONITORING AND OFFSITE DOSE CALCULATION MANUAL (REMODCM) shall be submitted to the NRC as appropriate, as part of or concurrent with the *ARER* for the period in which the changes were made.

F.3 SPECIAL REPORTS

Special reports shall be submitted to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, D.C. 20555, with a copy to the appropriate Regional Office of the NRC, within the time period specified for each report.

G. TOTAL DOSE

G.1 Total Dose from All Sources

In addition to the dose limitations specified in sections C & D of the REMM, 40 CFR 190 limits the total dose to an individual from all sources (liquid effluents, gaseous effluents, and direct dose from fixed sources) to less than or equal to 25 mrem per year to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrem per year.

G.2 Compliance with 40CFR190 Limits

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

a. CY gaseous doses from all release pathways.

b. CY liquid doses from all release pathways.

c. CY direct dose from the site (see Section D.5 in the ODCM).

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

G.3/4 TOTAL DOSE CONTROLS AND SURVEILLANCE REQUIREMENTS

CONTROLS

G.3 The dose or dose commitment from the site to a MEMBER OF THE PUBLIC is limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which is limited to less than or equal to 75 mrem) over a period of 12 consecutive months.

APPLICABILITY: At all times.

ACTION:

With the calculated dose from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Specification C.3.2, D.3.2, or D.3.3, prepare and submit a Special Report to Commission pursuant to Control F.3 and limit the subsequent releases such that the dose or dose commitment from the site to any MEMBER OF THE PUBLIC is limited to less than or equal to 25 mrem to the total body or any organ (except thyroid, which is limited to less than or equal to 75 mrem) over 12 consecutive months. This Special Report shall include an analysis which demonstrates that radiation exposures from the site to any MEMBER OF THE PUBLIC (including all effluent pathways and direct radiation) are less than the 40 CFR Part 190 Standard. If the estimated doses exceed the above limits, the special report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

SURVEILLANCE REQUIREMENTS

G.4 Cumulative dose contributions from liquid and gaseous effluents and direct radiation shall be determined in Specifications C.4.2.1, D.4.2.1 and D.4.3.1 and in accordance with Section II of the REMODCM once per 31 days.

BASES

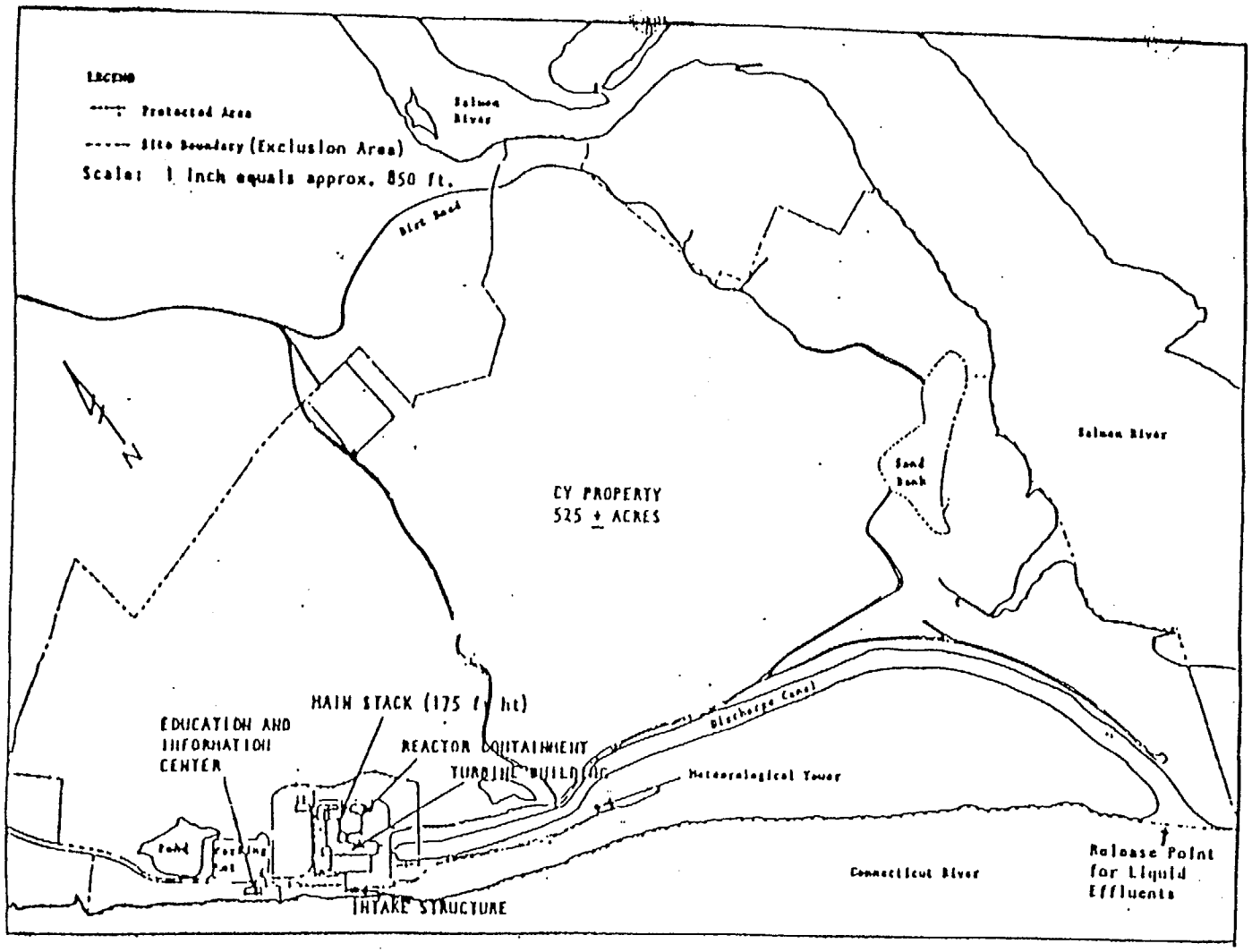
G.3/4 TOTAL DOSE

This specification is provided to meet the reporting requirements of 40 CFR Part 190. For the purposes of the Special Report, it may be assumed that the dose commitment to any MEMBER OF THE PUBLIC from other fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 5 miles must be considered.

Figure H – 1

Exclusion Area Boundary and Site Boundary for Liquid and Gaseous Effluents

(Formerly Figure 5.1-1 of the Technical Specifications)



SECTION II

OFFSITE DOSE CALCULATION MANUAL

For The

HADDAM NECK PLANT

Docket No. 50-213

HADDAM NECK PLANT

OFFSITE DOSE CALCULATION MANUAL

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APPENDICES

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A. INTRODUCTION

Technical Specification 6.6.3, Radiological Effluent Monitoring and Offsite Dose Calculation Manual (REMODCM), requires that Section II contain the Offsite Dose Calculation Manual. This manual shall describe the methodology and parameters to be used in the following:

1. Calculation of offsite doses due to radioactive gaseous and liquid effluents.

2. Calculation of gaseous and liquid effluent monitoring instrumentation alarm/trip setpoints consistent with the applicable limiting conditions of operation contained in Part I of the REMODCM .

This manual contains the methods to be used in performance of the Control surveillance requirements in Part I of the REMODCM but does not include the procedures and forms needed to document compliance with the surveillance requirements.

In some sections, several methods may exist to perform the required Control. Generally, the methods are listed in order of simplicity and conservatism (i.e. Method 1 being the most simple and most conservative). If a limit is approached, then more detailed calculations need to be performed. A more detailed calculation may be used at any time in lieu of a more simple method.

B. RESPONSIBILITIES

All changes to this manual shall be reviewed by the Plant Operations Review Committee prior to implementation.

It is the responsibility of the Unit Director to ensure compliance with all the requirements of this manual.

C. LIQUID DOSE CALCULATIONS

Liquid dose calculations are performed once every 31 days to comply Controls C.3.2 and G.3 of Part I of this manual . The basis for the Method 1 used to calculate liquid dose is explained in Appendix B. The methods described below use source terms totaled by similar dilution flows. For example; If, during a period, there were releases at flows of 3,000 gpm and 189,000 gpm, then dose calculations must be performed for each different dilution flow and then summed to calculate the total doses.

(Note: Method 2 can be used at any time in lieu of Method 1.)

C.1 Method 1

a. Monthly

Method 1 is used primarily for calculating monthly liquid doses; however, it can also be used for any release period if both the radionuclide activities and dilution flow are for that same period.

Step 1

Determine the total activity (*Ci*) of each nuclide released with the same dilution flow (ft^3/sec).

Step 2

Determine the maximum total body and maximum organ doses by using the following calculation logic:

(a) For each nuclide from Step 1 that is in Appendix A, calculate its age-organ dose contribution (e.g. Adult Thyroid) by dividing its activity (*Ci*) by the dilution flow (ft^3/sec) and then multiplying that result by each of the age-organ dose conversion factors (DCFs) from Appendix A (3 ages x 7 organs = 21 DCFs per nuclide).

(b) Sum all individual nuclide age-organ dose contributions by age-organ (e.g. Adult Thyroid) for all the nuclides in Step 1.

(c) Select the maximum summed total body dose for Adult, Teen and Child as the whole body dose. Likewise, select the maximum summed organ dose for Adult, Teen and Child as the maximum organ dose.

Repeat Steps 1 and 2 for each different dilution flow, as required.

Step 3

Sum the whole body doses for each different dilution flow to derive the total whole body dose. Likewise, sum the maximum organ doses for each different dilution flow to derive the total maximum organ dose.

b. Quarterly and Annually

Quarterly total body and maximum organ liquid doses are calculated by summing the appropriate monthly total body and maximum organ doses, respectively. Likewise, annual total body and maximum organ liquid doses are calculated by summing the appropriate quarterly total body and maximum organ doses, respectively.

Control C.3.2 of Part I of this manual specifies the following limitations and actions for liquid effluent doses:

> The dose or dose commitment to any MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released from site shall be limited:
>
> > During any calendar quarter to less than or equal to 1.5 mrem to the total body and to less than or equal to 5 mrem to any organ, and
> >
> > During any calendar year to less than or equal to 3 mrem to the total body and to less than or equal to 10 mrem to any organ.
>
> 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 Subsection F.3 of the REMM, 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 remainder of the current calendar year so that the cumulative dose or dose commitment to any MEMBER OF THE PUBLIC from such release during the calendar year is within 3 mrem to the total body and 10 mrem to any organ.

If the quarterly or annual liquid doses exceed, or are expected to exceed, the limits cited above, then Method 2 is to be used to refine liquid doses.

C.2 Method 2

This method uses the methodology of NRC Regulatory Guide 1.109 (Rev 1) to calculate liquid effluent doses. The use of this model and its associated input parameters are discussed in Appendix C and in the Radiological Assessment Branch Procedure titled "Liquid Dose Calculations - LADTAP II."

By design, Method 2 is to be used to calculate quarterly and annual liquid effluent doses for the Annual Radioactive Effluent Report; however, Method 2 should be used whenever Method 1 is determined to be inadequate or inappropriate. Method 2 can be used at any time in lieu of Method 1.

C.3 Quarterly Dose Calculations for Annual Radioactive Effluent Report

Detailed quarterly dose calculations required for the Annual Radioactive Effluent Report shall be done using the NRC computer code LADTAP II, i.e. Method 2. The use of this model and its associated input parameters are discussed in Appendix C and in the Radiological Assessment Branch Procedure titled "Liquid Dose Calculations - LADTAP II."

D. GASEOUS DOSE CALCULATIONS

The determination of doses from radioactive gaseous effluents to the maximum off-site receptor are typically divided into two methods representing different levels of conservatism. All hand calculation approaches discussed below (i.e., Method 1) provide simplified, conservative operational tools to ensure that effluent releases are not likely to cause quarterly and annual off-site dose or dose rate limits to be exceeded. Site specific dose factors used in Method 1 are based on long-term historical on-site meteorological dispersion estimates as described in Appendix H. In cases where additional analyses can justify a more accurate determination of dose, a Method 2 approach is also listed. Method 2 provides for a more detailed calculation using accepted computer models along with historical atmospheric dispersion parameters, to demonstrate regulatory compliance. Method 2 can be used whenever the Method 1 estimation approaches a regulatory limit, or if a more refined dose estimate is desired. Method 2 is also used for preparation of the Annual Radioactive Effluent Report that includes the quarterly and annual dose impacts for all effluents recorded discharged to the atmosphere during the year of record.

D.1. Site Dose Rate Limits ("Instantaneous")

Technical Specifications require that the instantaneous off-site dose rate from noble gas (Kr-85 is the only remaining isotope) released to the atmosphere be limited not exceed 500 mrem/year at any time to the whole body or 3000 mrem/year to the skin from the external cloud. With the abandonment of the Waste Gas Decay System and isolation of the Spent Fuel Building ventilation from the plant stack, noble gas release potential is associated only with ground level sources.

For tritium and particulates (half-lives > 8 days), the inhalation pathway critical organ dose rate shall not exceed 1500 mrem/year at any time.

a. Total Body Dose Rate Due to Kr-85

The total body dose rate limit (500 mrem/yr) applies to the combination of all concurrent ground level sources on site.

For **ground-level** releases (i.e., all releases points other than the plant stack), the total body dose rate is:

$$\dot{D}_{tb(g)} = 309 * \dot{Q}_g * DFB$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{pCi - \sec}{\mu Ci - m^3}\right) * \left(\frac{\mu Ci}{\sec}\right) * \left(\frac{mrem - m^3}{pCi - yr}\right)$$

where:

$\dot{Q}_g$ = Total release rate (μCi/second) to the environment of Kr-85 via ground-level release pathways.

309 = Site specific total body dose rate conversion constant for ground level releases (see Appendix H for derivation).

DFB = Total body dose factor from Appendix H, Table H-1 = 1.61E-5 mrem-m^3/pCi-yr.

b. **Skin Dose Rate Due to Kr-85**

The skin dose rate limit (3000 mrem/yr) applies to the combination of all concurrent ground level sources.

For **ground-level** release points (i.e., all releases other than the plant stack), the skin dose rate:

$$\dot{D}_{skin(g)} = \dot{Q}_g * DF'_g .$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{\mu Ci}{\sec}\right) * \left(\frac{mrem - \sec}{\mu Ci - yr}\right)$$

where:

$\dot{Q}_g$ = The total release rate (μCi/second) of Kr-85 from all ground-level release points.

DF'_g = The combined skin dose rate factor from Appendix H, Table H-1 = 4.20 E-1 mrem-sec/μCi-yr.

c. **Site Release Rate Limits For Noble Gas ("Instantaneous")**

The site noble gas dose rate limits (500 mrem/yr total body and 3000 mrem/yr skin) apply to the combination of concurrent effluents from all releases points, and are directly related to the radioactivity release rates measured for each discharge point. By limiting gaseous release rates to within values which correlate to the above dose rate limits, assurance is provided that the site effluent control dose rate limits are not exceeded. Since the only remaining noble gas isotope is Kr-85, the above dose rate equations and site dose rate limits show that the skin dose is the limiting exposure pathway.

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

$$\frac{Q_g}{7{,}143} \leq 1$$

where:

Q_g = Kr-85 release rate from all ground level sources (μCi/sec).

7,143 = The Kr-85 release rate (μCi/sec) from the ground-level sources equivalent to a skin dose rate of 3000 mrem/year.

As long as the above is less than or equal to 1, the dose rate from Kr-85 will be less than or equal to 3000 mrem/yr to the skin (and 500 mrem/yr to the total body).

d. **Critical Organ Dose Rate from Particulates and Tritium**

The critical organ rate limit (1500 mrem/yr) applies to the combination of the plant stack releases and all concurrent ground level sources. It includes particulates with half lives greater than 8 days, and tritium (Iodine-131 and 133 have been removed from the potential source term due to decay). Results of gross alpha analyses shall be considered as Am-241 for dose calculations. Dose rates from all concurrent ground sources and the plant stack are determined independently, and then summed to obtain the overall critical organ dose rate.

(1) Method 1

For **elevated** (mixed mode) releases from the plant stack, the critical organ dose rate to the maximum off-site receptor is determined as follows:

$$\dot{D}_{co(e)} = \sum_i (\dot{Q} * DFG'_{ico(e)})$$

$$\left(\frac{mrem}{yr}\right) = \sum \left(\frac{\mu Ci}{\sec}\right) * \left(\frac{mrem - \sec}{\mu Ci - yr}\right)$$

where:

$\dot{D}_{co(e)}$ = The off-site critical organ dose rate (mrem/yr) due to particulates and tritium from plant stack releases;

$\dot{Q}_i$ = The release rate (μCi/second) of radionuclide "i" (i.e., total activity measured of radionuclide "i" averaged over the time period for which the filter sample collector was in the effluent stream (plant stack).

$DFG'_{ico(e)}$ = The site-specific critical organ dose rate factor for an elevated (plant stack) release (see Appendix D, Table D-5) $\left(\frac{mrem - \sec}{\mu Ci - yr}\right)$.

For ground-level releases (i.e., all releases point other than the plant stack), the critical organ dose rate to the maximum off-site receptor is determined as follows:

$$\dot{D}_{co(g)} = \sum_i (\dot{Q}^* DFG'_{ico(g)})$$

$$\left(\frac{mrem}{yr}\right) = \sum \left(\frac{\mu Ci}{\sec}\right) * \left(\frac{mrem - \sec}{\mu Ci - yr}\right)$$

where:

$\dot{D}_{co(g)}$ = The off-site critical organ dose rate (mrem/yr) due to particulates and tritium from a ground-level release.

$\dot{Q}_i$ = The release rate (μCi/second) of radionuclide "i".

$DFG'_{ico(g)}$ = The site-specific critical organ dose rate factor for a ground-level release (i.e., all releases other than from the plant stack) (see Appendix D, Table D-5) $\left(\frac{mrem - \sec}{\mu Ci - yr}\right)$.

Note: For ground-level releases from other than a Temporary Tent Exhaust, the ground-level DFG values may be decreased, if desired, by multiplying them by a correction factor applicable to the specific ground-level release point being evaluated. The correction factors are listed in Appendix D, Table D.4.

(2) Method 2

If necessary, determine the maximum organ dose rate for the identified mix of particulates utilizing the GASPAR code (or equivalent code model that implements Regulatory Guide 1.109, Rev. 1 dose equations and maximum individual assumptions) to estimate the dose rate from tritium and particulates with half-lives greater than 8 days. For the identified radionuclide mix, dose rates by critical organ and age group should be assessed to determine the limiting organ dose rate at the maximum exposure point offsite.

D.2 10CFR50 Appendix I Limits (Noble Gases)

Effluent controls limit the off-site air dose from noble gases released in gaseous effluents to 5 mrad gamma, and 10 mrad beta for a calendar quarter (10 and 20 mrad gamma and beta, respectively, per calendar year). Effluent dose calculations are calculated at least once every 31 days. This part of the ODCM provides the calculation methodology for determining air doses from noble gases.

a. **Gamma Air Dose Due to Kr-85**

For **ground-level** releases (i.e., all release points other than the plant stack), the gamma air dose is calculated:

$$D^{\gamma}_{air(g)} = (9.8E-06) * Q_g * DF^{\gamma}$$

$$(mrad) = \left(\frac{pCi-yr}{\mu Ci-m^3}\right) * (\mu Ci) * \left(\frac{mrad-m^3}{pCi-yr}\right)$$

where:

Q_g = Total quantity of Kr-85 (μCi) released from the ground-level release points (all release points other than the plant stack) during the period of interest.

9.8E-6 = Site specific gamma air dose conversion constant for ground level releases. See Appendix H for derivation.

DF^{γ} = Gamma air dose factor for a uniform semi-infinite cloud of Kr-85 from Appendix H, Table H-1 = 1.72 E-5 mrad-m^3/pCi-yr.

b. **Beta Air Dose Due to Kr-85**

For **ground-level** release points (i.e., all release points other than the plant stack), the beta air dose is calculated:

$$D^{\beta}_{air(g)} = (9.8E-06) * (Q_g) * (DF^{\beta})$$

$$(mrad) = \left(\frac{pCi-yr}{\mu Ci-m^3}\right) * (\mu Ci) * \left(\frac{mrad-m^3}{pCi-yr}\right)$$

where:

DF^{β} = Beta air dose factors for a uniform semi-infinite cloud of Kr-85 from Appendix H, Table H-1 = 1.95 E-3 mrad-m^3/pCi-yr.

9.8E-6 = Site specific beta air dose conversion constant for ground level releases. See Appendix H for derivation.

Q_g = Quantity of Kr-85 (μCi) released from the ground-level release points during the period of interest.

c. **Annual Air Dose Due to Kr-85**

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

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

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

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

(1) If the detailed quarterly dose calculations required per Section D.5 for the Annual Radioactive 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 and b.

D.3. 10CFR50 Appendix I Limits (Particulates and Tritium)

Effluent control requirements limit the off-site dose to a critical organ from tritium and particulates with half-lives greater than 8 days released in gaseous effluents to 7.5 mrem for a calendar quarter and 15 mrem per calendar year. These dose limits apply to the combination of plant stack and all concurrent ground level sources. (Iodine-131 and 133 have been removed from the potential sources term due to radioactive decay.) Effluent dose calculations are performed at least once every 31 days. This part of the ODCM provides the calculation methodology for determining critical organ doses from atmospheric releases of tritium and particulates. Results of gross alpha analyses shall be considered as Am-241 for dose calculations.

a. **Critical Organ Doses**

(1) Method 1a

For an **elevated** (mixed mode) release from the plant stack, the critical organ dose during a release period of interest (such as 31 days, quarterly, etc.) at the postulated maximum off-site receptor location can be calculated from:

$$D_{co(e)} = \sum_i \left(Q_{i(e)} * DFG_{ico(e)} \right)$$

$$(mrem) = \sum \left(\mu Ci * \frac{mrem}{\mu Ci} \right)$$

where:

$Q_{i(e)}$ = The total activity in μCi of radionuclide "i" released to the atmosphere from the elevated release point (plant stack) during the period of interest.

$DFG_{ico(e)}$ = The site-specific critical organ dose factor for radionuclide "i" and the elevated release point, based on the age group and organ with the largest dose factor (see Appendix D, Table D-6).

For **ground-level** releases (i.e., all release points other than the plant stack) the critical organ dose during a release period of interest (such as 31 days, quarterly, etc) at the postulated maximum off-site receptor location is calculated:

$$D_{co(g)} = \sum_i \left(Q_{i(g)} * DFG_{ico(g)}\right)$$

$$(mrem) = \sum \left(\mu Ci * \frac{mrem}{\mu Ci}\right)$$

where:

$Q_{i(g)}$ = The total activity in μCi of radionuclide "i" released to the atmosphere from ground-level release points during the period of interest.

$DFG_{ico(g)}$ = The site-specific critical organ dose factor for radionuclide "i" and ground-level release points, based on the age group and organ with the largest dose factor (see Appendix D, Table D-6).

Note: For ground-level releases from other than a Temporary Tent Exhaust, the ground-level DFG values may be decreased, if desired, by multiplying them by a correction factor applicable to the specific ground-level release point being evaluated. The correction factors are listed in Appendix D, Table D.4.

(2) Method 1b (For ground level releases only)

With the elimination of the waste gas system operation as a batch mode release source, an additional dose equation has been provided for the situations where routine discharges are impacted with an identifiable short duration release of particulate radioactivity, such as the breakthrough of activity on a temporary HEPA filter used during dismantlement activities. The time-adjusted X/Q value provides additional conservatism to the dose calculation by substituting a short-term X/Q estimate for the standard annual average value (ground-level releases only). The time-adjusted Method 1 dose equation for Particulate and Tritium releases is:

$$D_{co(g)} = 9.86 * t^{-.252} * \sum_i \left(Q_{i(g)} * DFG_{ico(g)}\right)$$

$$(mrem) = (\ ) * (\ ) * \sum \left(\mu Ci * \frac{mrem}{\mu Ci}\right)$$

where:

D_{co} = The maximum critical organ dose from particulates and tritium accounting for single event short duration discrete release.

9.86 = The ratio of the 1 hour depleted X/Q (2.89E-03 sec/m3) at the maximum receptor location to the long term average (growing season) depleted X/Q (2.93E-04 sec/m3).

$t^{-0.252}$ = A unitless adjustment factor to account for a release with a total duration of "t" hours.

Q_i = The total activity in μCi of radionuclide "i" released to the atmosphere during the short term period of interest.

DFG_{ico} = The site-specific critical organ dose factor for radionuclide "i", based on the age group and organ with the largest dose factor (see Appendix D, Table D.6).

Note: For ground-level releases from other than a Temporary Tent Exhaust, the ground-level DFG values may be decreased, if desired, by multiplying them by a correction factor applicable to the specific ground-level release point being evaluated. The correction factors are listed in Appendix D, Table D.4.

(3) Method 2

The maximum critical organ dose can be calculated utilizing the GASPAR code (or equivalent code model that implements Regulatory Guide 1.109, Rev. 1 dose equations and maximum individual assumptions) to estimate the dose from tritium and particulates with half-lives greater than 8 days. The dose to the

critical organ and age group should be assessed using the most recent land use census data to identify which exposure pathways need to be considered at actual receptor locations. Doses from vegetation consumption can be neglected during the 1st and 4th quarters and the doses from milk consumption can be neglected during the first quarter since winter conditions eliminate the out door growing of vegetation during these time frames.

b. **Estimation of Annual Critical Organ Dose**

The determination of the annual (calendar year) critical organ dose, D_{YO}, from tritium and particulates released in gaseous effluents is the sum over the first quarter to the present quarter doses to the maximum organ.

c. **Annual Organ Dose Limit**

Determine D_{YO} which is the maximum organ dose for the calendar year, as follows:

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

D.4 Quarterly Dose Calculations for Annual Radioactive Effluent Report

Detailed quarterly dose calculations required for the Annual Radioactive Effluent Report shall be done using the computer code GASPAR (or equivalent code implementing Regulatory Guide 1.109, Revision 1).

D.5 Compliance with 40CFR190 Limits

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

a. CY gaseous effluents (doses calculated in Section D above).

b. CY liquid effluents (doses calculated in Section C above).

c. CY direct radiation from the site. Based on ERC-16103-ER-99-012, direct dose will not be routinely included in the dose assessment. An evaluation of the direct dose aspect will be discussed in the Annual Environmental Operating Report. This evaluation will include the dose recorded on control TLDs and TLDs located near residents.

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

E. LIQUID EFFLUENT INSTRUMENTATION SETPOINTS

Control C.3.3 of Part I of this manual requires that the radioactive liquid effluent instrumentation in Table C.3.3 have alarm setpoints in order to ensure that the limits of Control C.3.1 are not exceeded. Control C.3.1 of Part I of this manual requires that the concentration of radioactive material released from the site shall not exceed the concentrations specified in 10 CFR Part 20, Appendix B, Table II, Column 2. Connecticut Yankee uses MPC values obtained from 10 CFR Part 20 revision prior to Jan 1, 1994.

E.1 Waste and Recycle Test Tank Discharge Line Monitor (R-22)

The Waste and Recycle Test Tank effluent monitor provides alarm and automatic termination of release prior to exceeding the concentration limits. Normally the setpoint for R-22 is at twice the gamma activity in the tank to be released. This verifies that the sample results used in release calculations were from a homogenous mixture.

The alarm/trip setpoint is determined prior to each batch release taking into account current values for each variable parameter. The following steps are used in determining the monitor setpoint:

Step 1

Determine the maximum allowable discharge flow (F_{max}) in gpm, at which the test tank can be released.

$$F_{max} = \frac{F_d}{\Sigma_i \frac{C_i}{MPC_i}}$$

where: F_d = The actual or conservative estimate of the flow out of the discharge canal (gpm). The flow for 1 Circulating Water pump is 93,000 gpm and the flow for the Service Water system is set at 3,000 gpm.

C_i = Activity concentration of each radionuclide "i" (uCi/ml) determined to be in the test tank. This includes gross alpha, Tritium, Fe-55 and Sr-90 either measured or estimated from the most recent composite sample analysis.

MPC_i = The concentration limit (uCi/ml) above background at the point of discharge to the environment for radionuclides "i", taken from 10 CFR Part 20 Appendix B, Table II, Column 2. For Gross Alpha use the MPC for Am-241.

Step 2

The selection of the actual discharge flow rate (F_m) from the test tanks compared to the maximum allowable discharge rate F_{max} must satisfy the following:

$F_m \leq F_{max} \times AF$

where: AF = Administrative limiting factor for the maximum allowable discharge rate (usually between 0.1 and 0.7). This factor is conservative and will account for ongoing releases from other sources and the presence of beta emitters that cannot be detected by the radiation monitor.

If $F_{max} \times AF > F_m$, then reduce discharge flow rate, increase dilution flow or reprocess tank to lower activity levels.

Step 3

Determine the monitor response (R_m) in cpm corresponding to two times the total concentration of gamma emitters.

$R_m = 2 \times E \times A_{gam}$

where: E = Current monitor efficiency (cpm per μCi/ml)

A_{gam} = Total concentration of gamma emitters in the tank (μCi/ml). If isotopic analysis of tank does not identify gamma emitters use 5E-07 μCi/ml (LLD requirement) for A_{gam}.

Step 4

Determine the limiting monitor response (R_{lim}) in cpm. The limiting monitor response is the calculated alarm setpoint at which an administrative MPC concentration limit would be exceeded.

$R_{lim} = E \times A_{mpc} \times (F_d / F_m)$

where: A_{mpc} = Administrative MPC associated with assumed worse case mix of nuclides in accordance with 10 CFR 20 Appendix B, Footnotes.

Step 5

Determine test tank discharge monitor alarm setpoint (S) in cpm, where
B = Background count rate of monitor (cpm).

If $R_m + B > R_{lim}$, Then reduce discharge flow rate, increase dilution flow or reprocess tank to lower activity levels.

If $2 \times B > R_{lim}$, Then decontaminate monitor

If $R_{lim} > R_m + B$ Then If $R_m > B$, Then $S = R_m + B$

Else $S = 2 \times B$

At no time can the monitor setpoint (*S*) be greater than *R_{lim}*.

E.2 Service Water Effluent Line Monitor (R-18)

The Service Water Effluent Line monitor provides an alarm prior to exceeding the concentration limits.

The alarm setpoint is determined prior to each batch release taking into account current values for each variable parameter. The following steps are used in determining the monitor setpoint:

Step 1

Determine the limiting monitor response (R_{lim}) in cpm.

$R_{lim} = E \times A_{mpc} \times (F_d / F_{sw})$

where: E = Current monitor efficiency in cpm per μCi/ml.

A_{mpc} = Administrative MPC associated with assumed worse case mix of nuclides in accordance with 10 CFR 20 Appendix B, Footnotes.

F_d = The actual or conservative estimate of the flow out of the discharge canal (gpm). The flow for 1 Circulating Water pump is 93,000 gpm and the flow for the Service Water system is set at 3,000 gpm.

F_{sw} = Service Water dilution flow (number of Service Water pumps running x 3,000 gpm).

Step 2

Determine the Service Water alarm setpoint (S) in cpm, where B = Background count rate of monitor (cpm).

If $R_{lim} > B$, Then $S = R_{lim} + B$

Else $S = 2 \times B$

If *$B > 500$ cpm*, Then decontaminate monitor.

(Note: The 500 cpm count rate is based upon being able to detect Cs-134 at approximately 54% of its MPC if the monitor is set at $2 \times B$ with no Circulating Water in service – ERC 16103-ER-99-0010.)

F. GASEOUS MONITOR SETPOINTS

F.1 Spent Fuel Building Noble Gas Activity Monitor (R-1)

As discussed in D.1.c, Site Release Limits for Noble Gas ("Instantaneous"), the skin dose rate of 3000 mrem/year is the limiting value. With the fuel stored in the Spent Fuel Building with an independent ventilation system, the only source of noble gas release is the Spent Fuel Building which is continuously monitored by the R-1 noble gas activity monitor. The SFB noble gas monitor will be set to alarm before the release rate exceeds 1% of this limit.

$$\text{R-1 Setpoint} = \frac{7143 * 0.01 * 60 * 5E7}{9000 * 1.2 * 2.83E4} = 7.00\text{E2 cpm}$$

Where: 7143 = the Kr-85 release rate (μCi/sec) from the ground-level sources equivalent to a skin dose rate of 3000 mrem/year (see Section D.1.c).

0.01 = 1% factor applied to the dose rate limit.

60 = seconds per minute conversion factor.

5E7 = conservative radiation monitor efficiency for Kr-85 (cpm/μCi/cc).

9000 cfm = nominal Spent Fuel Building ventilation flow rate.

1.2 = a conservative factor applied to the ventilation flow rate.

2.83E4 = cubic centimeters per cubic foot conversion factor.

G. REFERENCES

1. Health Physics Technical Support Document, CY-HP-0029, HEPA Units Environmental Release Evaluation

2. CY Memorandum HP-99-108, Justification To Eliminate HEPA Unit Exhaust Airborne Radioactivity Sampling Based On Work Location Contamination Levels.

3. CY Calculation REMODCM-01686-RY-00, Connecticut Yankee Haddam Neck Plant ODCM, Atmospheric Dispersion Factors.

4. CY Calculation REMODCM-01687-RY-00, Connecticut Yankee Haddam Neck Plant ODCM, Terrain Data.

5. CY Calculation REMODCM-01688-RY-00, CY Defueled State- ODCM Dose Conversion Factors for Gaseous Releases.

6. CY Calculation REMODCM-01689-RY-00, Connecticut Yankee Method 1 Dose Equations for ODCM Revision 13.

7. ERC 16103-ER-99-0010, R18 Background Limitation Determination

8. Northeast Utilities Service Company Document Transmittal CY-DE-DT-0021-97, Spent Fuel Island, Resorcon Inc. Operating Manual

9. ERC 16103-ER-99-0011, Input Data for Offsite Dose Calculation

10. CY Memorandum CY-TS-97-0640, ATS 9700548/ACR 97-0716, Unmonitored Release Path from the External Containment Sump Pumps (Containment Mat Sump Pumps).

11. DCR CY-98-042, Spent Fuel Building Ventilation.

12. ERC-16103-ER-99-012, Basis for 40CFR190 Doses Used to Implement CY REMM/ODCM.

APPENDIX A

SECTION C.1 - METHOD 1 DOSE CONVERSION FACTORS

LADTAP II Age-Organ Dose Conversion Factors (mrem/yr per Ci/ft3/sec)

[For Activity = 1 Curie; Dilution Flow = 1 cfs]

ADULT							
NUCLIDE	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.66E+00	5.66E+00	5.66E+00	5.65E+00	5.67E+00	5.65E+00	8.91E+00
Am-241	4.44E+02	4.15E+02	3.25E+01	7.48E-01	2.40E+02	7.48E-01	4.43E+01
Ce-144	1.24E-01	1.17E-01	1.13E-01	1.12E-01	1.15E-01	1.12E-01	3.98E+00
Co-57	3.02E-01	5.07E-01	6.43E-01	3.02E-01	3.02E-01	3.02E-01	5.51E+00
Co-58	8.00E-01	1.67E+00	2.74E+00	8.00E-01	8.00E-01	8.00E-01	1.84E+01
Co-60	3.16E+01	3.41E+01	3.71E+01	3.16E+01	3.16E+01	3.16E+01	7.88E+01
Cs-134	2.93E+03	6.96E+03	5.69E+03	1.02E+01	2.26E+03	7.57E+02	1.32E+02
Cs-137	3.76E+03	5.14E+03	3.37E+03	1.50E+01	1.75E+03	5.93E+02	1.14E+02
Eu-152	2.19E+01	2.18E+01	2.18E+01	2.17E+01	2.19E+01	2.17E+01	3.68E+01
Eu-154	1.96E+01	1.93E+01	1.92E+01	1.92E+01	1.94E+01	1.92E+01	5.14E+01
Eu-155	7.29E-01	6.85E-01	6.83E-01	6.78E-01	7.11E-01	6.78E-01	6.32E+00
Fe-55	6.46E+00	4.46E+00	1.04E+00	9.02E-06	9.02E-06	2.49E+00	2.56E+00
H-3	0.00E+00	2.22E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03
Mn-54	2.20E+00	4.51E+01	1.04E+01	2.20E+00	1.50E+01	2.20E+00	1.33E+02
Np-239	3.61E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	4.19E+00
Ru-106	1.25E+00	6.07E-01	6.89E-01	6.07E-01	1.85E+00	6.07E-01	4.24E+01
Sb-124	1.43E+00	1.37E+00	1.40E+00	1.37E+00	1.37E+00	1.42E+00	3.22E+00
Sb-125	3.52E+00	3.47E+00	3.48E+00	3.47E+00	3.47E+00	3.51E+00	3.94E+00
Sn-125	5.45E+02	1.10E+01	2.48E+01	9.12E+00	2.85E-02	2.85E-02	6.80E+03
Sr-89	2.14E+02	6.79E-04	6.14E+00	6.79E-04	6.79E-04	6.79E-04	3.43E+01
Sr-90	5.34E+03	7.61E-05	1.31E+03	7.61E-05	7.61E-05	7.61E-05	1.54E+02
Zn-65	2.28E+02	7.23E+02	3.27E+02	1.23E+00	4.84E+02	1.23E+00	4.56E+02

TEEN							
NUCLIDE	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.66E+00	5.66E+00	5.66E+00	5.65E+00	5.67E+00	5.65E+00	7.89E+00
Am-241	3.58E+02	3.38E+02	2.65E+01	7.48E-01	1.94E+02	7.48E-01	3.60E+01
Ce-144	1.25E-01	1.17E-01	1.13E-01	1.12E-01	1.15E-01	1.12E-01	3.24E+00
Co-57	3.02E-01	5.15E-01	6.58E-01	3.02E-01	3.02E-01	3.02E-01	4.27E+00
Co-58	8.00E-01	1.66E+00	2.78E+00	8.00E-01	8.00E-01	8.00E-01	1.27E+01
Co-60	3.16E+01	3.41E+01	3.72E+01	3.16E+01	3.16E+01	3.16E+01	6.43E+01
Cs-134	3.00E+03	7.06E+03	3.28E+03	1.02E+01	2.25E+03	8.65E+02	9.79E+01
Cs-137	4.03E+03	5.35E+03	1.87E+03	1.50E+01	1.83E+03	7.20E+02	9.09E+01
Eu-152	2.18E+01	2.18E+01	2.18E+01	2.17E+01	2.19E+01	2.17E+01	3.15E+01
Eu-154	1.96E+01	1.93E+01	1.92E+01	1.92E+01	1.94E+01	1.92E+01	4.33E+01
Eu-155	7.56E-01	6.86E-01	6.83E-01	6.78E-01	7.08E-01	6.78E-01	4.36E+01
Fe-55	6.76E+00	4.79E+00	1.12E+00	9.02E-06	9.02E-06	3.04E+00	2.08E+00
H-3	0.00E+00	1.71E-03	1.71E-03	1.71E-03	1.71E-03	1.71E-03	1.71E-03
Mn-54	2.20E+00	4.44E+01	1.06E+01	2.20E+00	1.48E+01	2.20E+00	8.87E+01
Np-239	3.61E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	3.56E+00
Ru-106	1.31E+00	6.07E-01	6.95E-01	6.07E-01	1.96E+00	6.07E-01	3.42E+01
Sb-124	1.44E+00	1.37E+00	1.40E+00	1.37E+00	1.37E+00	1.43E+00	2.75E+00
Sb-125	3.52E+00	3.47E+00	3.48E+00	3.47E+00	3.47E+00	3.51E+00	3.82E+00
Sn-125	5.93E+02	1.18E+01	2.68E+01	9.30E+00	2.85E-02	2.85E-02	5.58E+03
Sr-89	2.33E+02	6.79E-04	6.67E+00	6.79E-04	6.79E-04	6.79E-04	2.77E+01
Sr-90	4.46E+03	7.61E-05	1.10E+03	7.61E-05	7.61E-05	7.61E-05	1.25E+02
Zn-65	2.07E+02	7.15E+02	3.34E+02	1.23E+00	4.58E+02	1.23E+00	3.04E+02

CHILD							
NUCLIDE	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	3.17E+00	3.17E+00	3.17E+00	3.17E+00	3.18E+00	3.17E+00	3.93E+00
Am-241	2.63E+02	2.26E+02	2.01E+01	4.19E-01	1.21E+02	4.19E-01	1.52E+01
Ce-144	7.89E-02	6.79E-02	6.37E-02	6.28E-02	6.56E-02	6.28E-02	1.37E+00
Co-57	1.69E-01	3.59E-01	5.53E-01	1.69E-01	1.69E-01	1.69E-01	1.72E+00
Co-58	4.48E-01	1.14E+00	2.55E+00	4.48E-01	4.48E-01	4.48E-01	4.46E+00
Co-60	1.77E+01	1.97E+01	2.37E+01	1.77E+01	1.77E+01	1.77E+01	2.90E+01
Cs-134	3.62E+03	5.93E+03	1.26E+03	5.73E+00	1.84E+03	6.64E+02	3.77E+01
Cs-137	5.06E+03	4.84E+03	7.22E+02	8.38E+00	1.58E+03	5.75E+02	3.86E+01
Eu-152	1.23E+01	1.22E+01	1.22E+01	1.22E+01	1.23E+01	1.22E+01	1.57E+01
Eu-154	1.12E+01	1.08E+01	1.08E+01	1.08E+01	1.09E+01	1.08E+01	2.00E+01
Eu-155	4.73E-01	3.86E-01	3.85E-01	3.80E-01	4.05E-01	3.80E-01	1.71E+01
Fe-55	8.87E+00	4.71E+00	1.46E+00	5.05E-06	5.05E-06	2.66E+00	8.72E-01
H-3	0.00E+00	1.41E-03	1.41E-03	1.41E-03	1.41E-03	1.41E-03	1.41E-03
Mn-54	1.23E+00	3.42E+01	1.00E+01	1.23E+00	1.05E+01	1.23E+00	2.89E+01
Np-239	2.04E-02	2.01E-02	2.01E-02	2.01E-02	2.01E-02	2.01E-02	1.61E+00
Ru-106	1.24E+00	3.40E-01	4.52E-01	3.40E-01	1.56E+00	3.40E-01	1.44E+01
Sb-124	8.51E-01	7.68E-01	7.96E-01	7.67E-01	7.67E-01	8.14E-01	1.30E+00
Sb-125	2.00E+00	1.95E+00	1.96E+00	1.95E+00	1.95E+00	1.98E+00	2.08E+00
Sn-125	7.63E+02	1.15E+01	3.42E+01	1.19E+01	1.60E-02	1.60E-02	2.36E+03
Sr-89	3.01E+02	3.80E-04	8.61E+00	3.80E-04	3.80E-04	3.80E-04	1.17E+01
Sr-90	3.94E+03	4.26E-05	9.98E+02	4.26E-05	4.26E-05	4.26E-05	5.30E+01
Zn-65	2.12E+02	5.63E+02	3.50E+02	6.87E-01	3.55E+02	6.87E-01	9.94E+01

APPENDIX A

SECTION C.1 - METHOD 1 DOSE CONVERSION FACTORS

LADTAP II Age-Organ Dose Conversion Factors (mrem/yr per Ci/ft3/sec)

[For Activity = 1 Curie; Dilution Flow = 1 cfs]

ADULT							
NUCLIDE	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.66E+00	5.66E+00	5.66E+00	5.65E+00	5.67E+00	5.65E+00	8.91E+00
Am-241	4.44E+02	4.15E+02	3.25E+01	7.48E-01	2.40E+02	7.48E-01	4.43E+01
Ce-144	1.24E-01	1.17E-01	1.13E-01	1.12E-01	1.15E-01	1.12E-01	3.98E+00
Co-57	3.02E-01	5.07E-01	6.43E-01	3.02E-01	3.02E-01	3.02E-01	5.51E+00
Co-58	8.00E-01	1.67E+00	2.74E+00	8.00E-01	8.00E-01	8.00E-01	1.84E+01
Co-60	3.16E+01	3.41E+01	3.71E+01	3.16E+01	3.16E+01	3.16E+01	7.88E+01
Cs-134	2.93E+03	6.96E+03	5.69E+03	1.02E+01	2.26E+03	7.57E+02	1.32E+02
Cs-137	3.76E+03	5.14E+03	3.37E+03	1.50E+01	1.75E+03	5.93E+02	1.14E+02
Eu-152	2.19E+01	2.18E+01	2.18E+01	2.17E+01	2.19E+01	2.17E+01	3.68E+01
Eu-154	1.96E+01	1.93E+01	1.92E+01	1.92E+01	1.94E+01	1.92E+01	5.14E+01
Eu-155	7.29E-01	6.85E-01	6.83E-01	6.78E-01	7.11E-01	6.78E-01	6.32E+00
Fe-55	6.46E+00	4.46E+00	1.04E+00	9.02E-06	9.02E-06	2.49E+00	2.56E+00
H-3	0.00E+00	2.22E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03
Mn-54	2.20E+00	4.51E+01	1.04E+01	2.20E+00	1.50E+01	2.20E+00	1.33E+02
Np-239	3.61E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	4.19E+00
Ru-106	1.25E+00	6.07E-01	6.89E-01	6.07E-01	1.85E+00	6.07E-01	4.24E+01
Sb-124	1.43E+00	1.37E+00	1.40E+00	1.37E+00	1.37E+00	1.42E+00	3.22E+00
Sb-125	3.52E+00	3.47E+00	3.48E+00	3.47E+00	3.47E+00	3.51E+00	3.94E+00
Sn-125	5.45E+02	1.10E+01	2.48E+01	9.12E+00	2.85E-02	2.85E-02	6.80E+03
Sr-89	2.14E+02	6.79E-04	6.14E+00	6.79E-04	6.79E-04	6.79E-04	3.43E+01
Sr-90	5.34E+03	7.61E-05	1.31E+03	7.61E-05	7.61E-05	7.61E-05	1.54E+02
Zn-65	2.28E+02	7.23E+02	3.27E+02	1.23E+00	4.84E+02	1.23E+00	4.56E+02

TEEN							
NUCLIDE	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	5.66E+00	5.66E+00	5.66E+00	5.65E+00	5.67E+00	5.65E+00	7.89E+00
Am-241	3.58E+02	3.38E+02	2.65E+01	7.48E-01	1.94E+02	7.48E-01	3.60E+01
Ce-144	1.25E-01	1.17E-01	1.13E-01	1.12E-01	1.15E-01	1.12E-01	3.24E+00
Co-57	3.02E-01	5.15E-01	6.58E-01	3.02E-01	3.02E-01	3.02E-01	4.27E+00
Co-58	8.00E-01	1.66E+00	2.78E+00	8.00E-01	8.00E-01	8.00E-01	1.27E+01
Co-60	3.16E+01	3.41E+01	3.72E+01	3.16E+01	3.16E+01	3.16E+01	6.43E+01
Cs-134	3.00E+03	7.06E+03	3.28E+03	1.02E+01	2.25E+03	8.65E+02	9.79E+01
Cs-137	4.03E+03	5.35E+03	1.87E+03	1.50E+01	1.83E+03	7.20E+02	9.09E+01
Eu-152	2.18E+01	2.18E+01	2.18E+01	2.17E+01	2.19E+01	2.17E+01	3.15E+01
Eu-154	1.96E+01	1.93E+01	1.92E+01	1.92E+01	1.94E+01	1.92E+01	4.33E+01
Eu-155	7.56E-01	6.86E-01	6.83E-01	6.78E-01	7.08E-01	6.78E-01	4.38E+01
Fe-55	6.76E+00	4.79E+00	1.12E+00	9.02E-06	9.02E-06	3.04E+00	2.08E+00
H-3	0.00E+00	1.71E-03	1.71E-03	1.71E-03	1.71E-03	1.71E-03	1.71E-03
Mn-54	2.20E+00	4.44E+01	1.06E+01	2.20E+00	1.48E+01	2.20E+00	8.87E+01
Np-239	3.61E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	3.59E-02	3.56E+00
Ru-106	1.31E+00	6.07E-01	6.95E-01	6.07E-01	1.96E+00	6.07E-01	3.42E+01
Sb-124	1.44E+00	1.37E+00	1.40E+00	1.37E+00	1.37E+00	1.43E+00	2.75E+00
Sb-125	3.52E+00	3.47E+00	3.48E+00	3.47E+00	3.47E+00	3.51E+00	3.82E+00
Sn-125	5.93E+02	1.18E+01	2.68E+01	9.30E+00	2.85E-02	2.85E-02	5.58E+03
Sr-89	2.33E+02	6.79E-04	6.67E+00	6.79E-04	6.79E-04	6.79E-04	2.77E+01
Sr-90	4.46E+03	7.61E-05	1.10E+03	7.61E-05	7.61E-05	7.61E-05	1.25E+02
Zn-65	2.07E+02	7.15E+02	3.34E+02	1.23E+00	4.58E+02	1.23E+00	3.04E+02

CHILD							
NUCLIDE	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
Ag-110m	3.17E+00	3.17E+00	3.17E+00	3.17E+00	3.18E+00	3.17E+00	3.93E+00
Am-241	2.63E+02	2.26E+02	2.01E+01	4.19E-01	1.21E+02	4.19E-01	1.52E+01
Ce-144	7.89E-02	6.79E-02	6.37E-02	6.28E-02	6.56E-02	6.28E-02	1.37E+00
Co-57	1.69E-01	3.59E-01	5.53E-01	1.69E-01	1.69E-01	1.69E-01	1.72E+00
Co-58	4.48E-01	1.14E+00	2.55E+00	4.48E-01	4.48E-01	4.48E-01	4.46E+00
Co-60	1.77E+01	1.97E+01	2.37E+01	1.77E+01	1.77E+01	1.77E+01	2.90E+01
Cs-134	3.62E+03	5.93E+03	1.26E+03	5.73E+00	1.84E+03	6.64E+02	3.77E+01
Cs-137	5.06E+03	4.84E+03	7.22E+02	8.38E+00	1.58E+03	5.75E+02	3.86E+01
Eu-152	1.23E+01	1.22E+01	1.22E+01	1.22E+01	1.23E+01	1.22E+01	1.57E+01
Eu-154	1.12E+01	1.08E+01	1.08E+01	1.08E+01	1.09E+01	1.08E+01	2.00E+01
Eu-155	4.73E-01	3.86E-01	3.85E-01	3.80E-01	4.05E-01	3.80E-01	1.71E+01
Fe-55	8.87E+00	4.71E+00	1.46E+00	5.05E-06	5.05E-06	2.66E+00	8.72E-01
H-3	0.00E+00	1.41E-03	1.41E-03	1.41E-03	1.41E-03	1.41E-03	1.41E-03
Mn-54	1.23E+00	3.42E+01	1.00E+01	1.23E+00	1.05E+01	1.23E+00	2.89E+01
Np-239	2.04E-02	2.01E-02	2.01E-02	2.01E-02	2.01E-02	2.01E-02	1.61E+00
Ru-106	1.24E+00	3.40E-01	4.52E-01	3.40E-01	1.56E+00	3.40E-01	1.44E+01
Sb-124	8.51E-01	7.68E-01	7.96E-01	7.67E-01	7.67E-01	8.14E-01	1.30E+00
Sb-125	2.00E+00	1.95E+00	1.96E+00	1.95E+00	1.95E+00	1.98E+00	2.08E+00
Sn-125	7.63E+02	1.15E+01	3.42E+01	1.19E+01	1.60E-02	1.60E-02	2.36E+03
Sr-89	3.01E+02	3.80E-04	8.61E+00	3.80E-04	3.80E-04	3.80E-04	1.17E+01
Sr-90	3.94E+03	4.26E-05	9.98E+02	4.26E-05	4.26E-05	4.26E-05	5.30E+01
Zn-65	2.12E+02	5.63E+02	3.50E+02	6.87E-01	3.55E+02	6.87E-01	9.94E+01

APPENDIX B

SECTION C.1 - METHOD 1 DOSE CONVERSION FACTORS BASIS

Refer to memorandum RB-98-069, subject: Verification of the PCLADTAP.xlt Excel Spreadsheet in Support of the Proposed New CY REMODCM Method 1 Calculation for Liquid Effluent Doses, March 27, 1998 for the Method 1 liquid effluent dose calculation basis.

The basis substantiates the use of: (1) dilution flow, (2) radionuclide activities and (3) "composite" radionuclide age-organ dose conversion factors (DCFs) (derived from the NRC LADTAP II software program) to calculate age-organ doses. These "composite" DCFs include the contributions from all pathways (including pathway age usage's and radionuclide age-organ DCFs) and LADTAP II site-specific parameters, and are acceptable because LADTAP II is used for Method 2.

APPENDIX C

LIQUID DOSE CALCULATIONS - LADTAP

The LADTAP code was written by the NRC to compute doses from liquid releases. The actual model used is LADTAP II which performs calculations in accordance with Regulatory Guide 1.109, Revision 1.

For calculating the maximum individual dose from Haddam Neck, the following options and parameters are used:

1. Real time, measured dilution flow
2. Fresh water site, no reconcentration
3. Shorewidth factor = 0.1 for discharge canal
4. No dilution for maximum individual pathways
5. One-hour discharge transit time - approximate time to reach 1/2 canal length
6. Regulatory Guide 1.109 usage factors for maximum individual for fish, shoreline, swimming and boating
7. Zero usage for shellfish, algae, drinking water and irrigated food pathways. Shellfish, algae and water are not consumed from the river. Bottled water is provided onsite. The river is not used for irrigation

APPENDIX D

GASEOUS DOSE CONVERSION FACTORS (TRITIUM AND PARTICULATE)

This appendix contains a listing of the dose and dose rate conversion factors (DFG and DFG') for use in the application of the CY ODCM during the decommissioning phase of the plant. The DFGs are for gaseous releases to the atmosphere of tritium and particulate radionuclides, and reflect the following conditions:

(a) On-ground receptors at the closest distance to the site boundary (SB) for ground-level releases, and at the worst-case offsite receptor for elevated releases,
(b) Long-lived radionuclides (in view of the extended decay time since permanent plant shutdown on July 22, 1996),
(c) The inhalation pathway for dose-rate calculations, and all pathways combined for dose calculations (ground-shine, inhalation, meat ingestion, goat milk ingestion, and vegetable ingestion), and
(d) The associated worst-case hypothetical individual (adult, teenager, child or infant) and critical organ (Total Body, GI Tract, Bone, Liver, Kidney, Thyroid, Lung, or Skin).

The DFGs were computed using the GASPAR-2 computer code [1], along with site-specific atmospheric dispersion and deposition factors. Details on the basic data and assumptions employed in the derivations of these conversion factors are presented in Section D.1 and the final tabulations are presented in Section D.2.

D.1 Basic Data and Assumptions

(a) A total of 32 long-lived radionuclides were selected for computation of the DFGs. The list includes tritium, I129, and 30 other particulate radionuclides.

(b) Use was made of the GASPAR-2 default built-in data libraries for physical parameters, transfer data and usage factors, with the following exceptions (which were implemented for consistency with Reg. Guide 1.109[1]):

1. The accumulation time for ground contamination (t_b) was changed from 20 years to 15 years
2. The transfer rate to meat products (F_f) for Ni was changed from 5.3E-03 (d/kg) to 5.3E-02 (d/kg)
3. The transfer rate to goat-milk (F_m) for Fe was changed from 1.3E-03 (D/L) to 1.3E-04 (D/L)

(c) The pathway parameters were assigned the values shown in Table D.1 [from GASPAR-2, with the exceptions identified under item (b) above].

(1) "GASPAR-2 - A Code System for Evaluation of Radiological Impacts Due to the Release of Radioactive Material to the Atmosphere During Normal Operation of Light Water Reactors," Oak Ridge National Laboratory, RSIC Computer Code Collection CCC-463 (also released as NUREG/CR-4653, "GASPAR-II - Technical Reference and User Guide," March 1987)
(2) NRC 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", (Rev. 1, 10/77)

Table D.1

PATHWAY PARAMETER	VEGETATION INGESTION PATHWAY	
	Stored	Leafy
Agricultural Productivity (kg/m^2)	2	2
Soil Surface Density (kg/m^2)	240	240
Transport Time to User(hrs)	NA	NA
Soil Exposure Time (yrs)	15	15
Crop Exposure Time to Plume (hrs)	1440	1440
Holdup after Harvest (hrs)	336	24
Animal Daily Feed(kg/day)	NA	NA
PATHWAY PARAMETER	**GOAT-MILK INGESTION PATHWAY**	
	Pasture	**Stored Feed**
Agricultural Productivity (kg/m^2)	0.7	2
Soil Surface Density (kg/m^2)	240	240
Transport Time to User (hrs)	48	48
Soil Exposure Time (yrs)	15	15
Crop Exposure Time to Plume (hrs)	720	1440
Holdup after Harvest (hrs)	0	2160
Animal Daily Feed (kg/day)	6	6
PATHWAY PARAMETER	**MEAT INGESTION PATHWAY**	
	Pasture	**Stored Feed**
Agricultural Productivity (kg/m^2)	0.7	2
Soil Surface Density (kg/m^2)	240	240
Transport Time to User (hrs)	480	480
Soil Exposure Time (yrs)	15	15
Crop Exposure Time to Plume (hrs)	720	1440
Holdup after Harvest (hrs)	0	2160
Animal Daily Feed (kg/day)	50	50

(d) Site-specific pathway variables were assigned the following values:

Absolute humidity:	8.0 (g/m^3)
Fraction of time leafy vegetables are grown:	0.50
Fraction of individual vegetable consumption from home garden:	0.76
Fraction of time milk goats are on pasture:	0.75
Fraction of goat feed from pasture:	1.0
Fraction of time beef cattle are on pasture:	0.75
Fraction of beef-cattle feed from pasture:	1.0

[Note: The cow-milk pathway is less restrictive than the goat-milk pathway and was not used in the definition of the final DFGs.]

(e) The usage factors and breathing rates are as listed in Table D.2.

Table D.2

Individual	Ingestion Pathway Usage Factors				Inhalation (m^3/yr)
	Crop (kg/yr)	Leafy Vegetables (kg/yr)	Milk (liters/yr)	Meat (kg/yr)	
Adult	520	64	310	110	8000
Teenager	630	42	400	65	8000
Child	520	26	330	41	3700
Infant	0	0	330	0	1400

(f) The applicable site-specific long-term atmospheric dispersion and deposition factors are presented in Table D.3. It is noted that there are four distinct release points at CY which are classifiable as ground-level releases. The values in Table D.3 are for the worst-case release point.

Table D.3

RELEASE POINT		Undepleted (X/Q) (sec/m^3)	Depleted (X/Q) (sec/m^3)	Deposition Factor (D/Q) (m^{-2})
Ground-Level Releases	Temporary Tent Exhaust (worst-case release point)	3.09E-04	2.93E-04	2.22E-07
Elevated Releases	Primary Vent Stack	2.85E-05	2.85E-05	3.45E-08

D.2 DFG Tabulations

The DFGs for tritium and particulate radionuclides were computed through use of GASPAR-2, along with the data and assumptions listed in Section D.1. Summaries of the results are presented in Table D.5 for the inhalation pathway (dose rate calculations), and Table D.6 for all pathways combined (dose calculations).

It is noted that the DFGs for ground-level releases were based on the worst-case atmospheric dispersion and deposition factors, and as such are conservatively applicable to all ground-level releases from the site. Should some reduction be required to ensure that specified dose limits are not exceeded, then the ground-level DFGs in Tables D.5 and D.6 can be multiplied by the conservative adjustment factors in Table D.4.

Table D.4

Ground-Level Release Point	Conservative Adjustment Factor Applicable to the Ground-Level DFG in ...	
	Inhalation Pathway	All Pathways Combined
Spent Fuel Bldg Ventilation Exhaust and Spray Cooler	0.39	0.51
Containment Bldg Personnel Access Hatch	0.30	0.56
'B' Switchgear Bldg (potential Chemistry Fume Hood)	0.54	0.65
Temporary Tent Exhaust (*)	1.0	1.0

* Worst-case release point

For instance, the Cs-137 limiting DFG for Containment Building releases and all exposure pathways combined is 9.64E-04 (Table D.6) x 0.56 (Table D.4) = 5.40E-04 (mrem-sec/μCi-yr).

Table D.5
CY ODCM - Dose Rate Conversion Factors (DFG')
for Critical Receptor and Organ (Inhalation Pathway)

Radionuclide[b]	Dose Rate Conversion Factor (mrem-sec/μCi-yr)	
	Ground-Level Releases [a] $DFG'_{ico(g)}$	Elevated Releases $DFG'_{ico(e)}$
H 3	2.24E-01	2.07E-02
MN 54	5.80E+02	5.65E+01
FE 55	3.63E+01	3.53E+00
FE 59	4.48E+02	4.35E+01
CO 57	1.72E+02	1.67E+01
CO 58	3.94E+02	3.82E+01
CO 60	2.55E+03	2.49E+02
ZN 65	3.63E+02	3.53E+01
SR 90	1.13E+04	1.10E+03
ZR 95	7.89E+02	7.66E+01
NB 95	2.20E+02	2.14E+01
TC 99	4.07E+02	3.97E+01
RU103	2.29E+02	2.23E+01
RU106	4.70E+03	4.57E+02
AG110M	1.98E+03	1.92E+02
SB125	8.01E+02	7.79E+01
CS134	3.31E+02	3.22E+01
CS137	2.66E+02	2.58E+01
CE144	3.91E+03	3.82E+02
EU152	1.17E+03	1.14E+02
EU154	2.97E+03	2.89E+02
PU238	3.50E+06	3.41E+05
PU239	4.07E+06	3.94E+05
PU240	4.04E+06	3.91E+05
PU241	8.77E+04	8.52E+03
AM241	4.16E+06	4.04E+05
CM242	1.58E+05	1.54E+04
CM243	2.79E+06	2.71E+05
CM244	2.15E+06	2.09E+05

(a) Worst-case release point. Refer to Table D.4 for optional adjustments.

(b) C14, Ni63, and I129 are not included in this table as they do not pose a significant source for dose and are not included in the sampling tables of the REMM.

Table D.6
CY ODCM - Dose Conversion Factors (DFG)
for Critical Receptor and Organ (All Pathways Combined)

Radionuclide[b]	Dose Conversion Factor (mrem/μCi)	
	Ground-Level Releases [a] $DFG_{ico(g)}$	Elevated Releases $DFG_{ico(e)}$
H 3	4.76E-08	4.39E-09
MN 54	2.81E-05	3.30E-06
FE 55	7.94E-06	1.21E-06
FE 59	2.43E-05	3.67E-06
CO 57	6.78E-06	7.36E-07
CO 58	1.52E-05	1.67E-06
CO 60	2.32E-04	3.14E-05
ZN 65	3.97E-05	6.12E-06
SR 90	1.64E-02	2.54E-03
ZR 95	2.67E-05	3.52E-06
NB 95	4.48E-05	6.90E-06
TC 99	9.17E-05	1.42E-05
RU103	6.63E-05	1.02E-05
RU106	9.65E-04	1.49E-04
AG110M	8.70E-05	1.28E-05
SB125	4.33E-05	5.24E-06
CS134	1.01E-03	1.57E-04
CS137	9.64E-04	1.50E-04
CE144	1.24E-04	1.58E-05
EU152	1.42E-04	1.99E-05
EU154	1.88E-04	2.37E-05
PU238	1.11E-01	1.09E-02
PU239	1.29E-01	1.26E-02
PU240	1.28E-01	1.25E-02
PU241	2.79E-03	2.72E-04
AM241	1.32E-01	1.29E-02
CM242	5.02E-03	4.89E-04
CM243	8.88E-02	8.67E-03
CM244	6.86E-02	6.69E-03

(a) Worst-case release point. Refer to Table D.4 for optional adjustments

(b) C14, Ni63, and I129 are not included in this table as they do not pose a significant source for dose and are not included in the sampling tables of the REMM.

APPENDIX E

GASEOUS DOSE CALCULATIONS – GASPAR-2 (OR EQUIVALENT)

The GASPAR-2 code was written by the NRC to compute doses from gaseous releases using the models given in Regulatory Guide 1.109. The revision date of the code is December 1986.

For calculating the maximum individual dose from Haddam Neck, the following options and parameters are used (Method 1):

1. Historical meteorology using a χ/Q, D/Q model which incorporates the methodology of Regulatory Guide 1.111. The five year period of 1976 – 1980 was used to determine dispersion estimates.

2. 100% of vegetation grown locally, 76% of vegetation intake from garden, harvest season from April through September.

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

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

5. Maximum individual dose calculations for Method 1 were performed at the nearest land site boundary with maximum χ/Q. For conservatism in the Method 1 model, this location is assumed to have a resident, vegetable garden, and milk and meat animal with the maximum D/Q value.

APPENDIX F

METEOROLOGICAL DISPERSION FACTORS

The ODCM atmospheric dispersion factors were derived using the AEOLUS-3 computer code. AEOLUS-3 was written to implement regulatory guidance for continuous (Regulatory Guide 1.111) and intermittent releases (NRC computer code XOQDOQ). The code has various options including building wake effects, plume depletion via dry deposition, and an effective plume height that accounts for physical release height, plume downwash, plume rise, and terrain features.

A set of atmospheric dispersion factors which are a function of release duration were generated. NUREG/CR-2919 (the documentation package for the NRC atmospheric dispersion computer code XOQDOQ, Reference 1) presents a methodology for determining atmospheric dispersion factors (CHI/Q values) for intermittent releases at user specified receptor locations (intermittent releases being defined as releases with durations between 1 and 8760 hours). The CHI/Q values for intermittent releases are determined by linearly interpolating (on a log-log basis) between an hourly 15-percentile CHI/Q value and an annual average CHI/Q value as a function of release duration. These time-dependent factors were derived using one-hour 15 percentile and long-term average atmospheric dispersion factors.

The following assumptions were used in executing AEOLUS-3 to determine one-hour 15 percentile and long-term average atmospheric dispersion factors for each of the two release pathway categories (ground-level and Primary Vent Stack):

- Plume centerline CHI/Q and D/Q values were used to generate the one-hour 15 percentile dispersion factors (an AEOLUS-3 default assumption); sector average CHI/Q and D/Q values were used to generate the long-term average dispersion factors.

- AEOLUS-3 default open terrain recirculation correction factors (Regulatory Guide 1.111) were used to generate the long-term average dispersion factors in order to consider the effects of recirculation of effluent.

- The ground level release pathways (e.g., Spent Fuel Building ventilation exhaust vent, Spent Fuel Building component spray cooler, Personnel Access Hatch on the Containment Building, potential Chemistry Fume Hood exhaust out of 'B' Switchgear Building, and for a limiting condition associated with temporary tent exhaust for work on contaminated components) were treated as Reg Guide 1.111 (Rev 1) ground-mode releases with releases emitted below the height of adjacent buildings.

- The Primary Vent Stack was treated as a Reg Guide 1.111 mix-mode release since the vent is above (but less that 2 times above) the height of adjacent buildings. A stack conservative exit flow rate of 117,000 cfm was assumed.

- Lower level wind speed data were provided to the code for both types of release pathways. These data were used without adjustment to disperse the plume for the ground level release pathways. For the mix-mode Primary Vent Stack release pathway,

the lower level wind speed data were extrapolated up to the Primary Vent Stack release height for evaluating plume entrainment effects and for determining plume rise and dispersion for the elevated-mode portion of the plume. The lower level wind speed data were used to disperse the ground-mode portion of the Primary Vent Stack plumes.

- Lower level wind direction data were provided to the code to determine plume transport for both types of release pathways.

- The 196'-33' delta-temperature data were provided to the code to determine atmospheric stability for both types of release pathways.

- The Reg Guide 1.111 (Rev. 1) depletion/deposition model was used for determining depleted CHI/Q and D/Q values for both types of release pathways. Wet depletion/deposition and decay-in-transit were not considered.

Meteorological data measured by the onsite monitoring system from January 1976 through December 1980 were used as input to the AEOLUS-3 computer code. Analysis of meteorological data measured at the Haddam Neck Plant during the following five-year periods, 1976-1980, 1988-1992, 1993-1997, indicated that the lower level wind speed data have been influenced by foliage growth over the years and that the older data set (1976-1980) is most appropriate for use in analyses.

Atmospheric dispersion factors were calculated for three time periods:
- Annual
- Growing season (defined as April through December)
- Non-growing season (January through March)

The most conservative values from the three time periods were used to develop the dose factors.

The one-hour 15-percentile undepleted CHI/Q, depleted CHI/Q, and D/Q dispersion factors used in the time dependent equations were derived by averaging the highest one-hour 15-percentile dispersion factors which occurred in each downwind sector, weighted by the fraction of the time the wind blew towards each downwind sector. The long-term average undepleted CHI/Q, depleted CHI/Q, and D/Q dispersion factors used in the time dependent equations were the highest long-term average dispersion factors calculated for receptors at and beyond the Site Boundary.

The time-dependent equation is:

$$X/Q = X/Q_{hr}\, t^{-0.11 \ln\left(\frac{X/Q_{hr}}{X/Q_{lt}}\right)}$$

where X/Q_{hr} is the weighted one-hour 15-percentile value and X/Q_{lt} is the long-term average value. For the derivation of the time-dependent equation, see Reference 1.

The time-adjusted Method 1 dose equation for Particulate and Tritium releases can be written as:

$$D_{co} = \frac{\left(\frac{X}{Q}\right)_{depl,1\,hr}}{\left(\frac{X}{Q}\right)_{depl,Apr-Dec}} * t^{-a} * \sum_i \left(Q_i * DFG_{ico}\right)$$

$$(mrem) = \left(\frac{\sec/m^3}{\sec/m^3}\right) * (\,) * \sum(\mu Ci) * \left(\frac{mrem}{\mu Ci}\right)$$

where

D_{co} = The critical organ dose from particulates and tritium;

$\left(\frac{X}{Q}\right)_{depl,1\,hr}$ = The 1-hour depleted atmospheric dispersion factor;

$\left(\frac{X}{Q}\right)_{depl,Apr-Dec}$ = The depleted atmospheric dispersion factor for the growing season (see Section Table F.1);

t^{-a} = A unitless adjustment factor to account for a release with a total duration of t hours;

Q_i = The total activity in μCi of radionuclide "i" released to the atmosphere during the period of interest;

DFG_{ico} = The site-specific critical organ dose factor for radionuclide "i", based on the age group and organ with the largest dose factor (see Table 3).

Incorporating location-specific (i.e., temporary tent release point) atmospheric dispersion factors and the time-adjustment factor (t^{-a}) yields an equation for the determination of critical organ dose. The substituted values are as follows:

$\left(\frac{X}{Q}\right)_{depl,1\,hr}$ = 2.89E-03 (sec/m^3)

$\left(\frac{X}{Q}\right)_{depl,Apr-Dec}$ = 2.93E-04 (sec/m^3)

$$\frac{\left(\frac{X}{Q}\right)_{depl,1hr}}{\left(\frac{X}{Q}\right)_{depl,Apr-Dec}} = 9.86$$

$t^{-a} = t^{-0.252}$

For the maximum off-site receptor location and a **ground level** release condition, the above values were used to simplify the above time-dependent equation as follows:

$$D_{co(g)} = 9.86 * t^{-.252} * \sum_i \left(Q_{i(g)} * DFG_{ico(g)}\right)$$

$$(mrem) = (\ ) * (\ ) * \sum \left(\mu Ci * \frac{mrem}{\mu Ci}\right)$$

The long term and 1 hour site specific atmospheric dispersion factors are listed on Tables F.1 and F.2.

TABLE F.1
ATMOSPHERIC DISPERSION FACTORS
GROUND LEVEL RELEASES

Dispersion Factor	Met Data Period	Spent Fuel Bldg 1-Hour	Spent Fuel Bldg Long-Term	Cont. Bldg Access Hatch 1-Hour	Cont. Bldg Access Hatch Long-Term	'B" Switch gear/new Chem Fume Hood 1-Hour	'B" Switch gear/new Chem Fume Hood Long-Term	Temporary Tent 1-Hour	Temporary Tent Long-Term	Max Ground Level Pt. 1-Hour	Max Ground Level Pt. Long-Term
Undepl. X/Q (sec/m^3)	Jan-Dec	1.41E-03	1.14E-04 (537 m WNW)	8.80E-04	8.98E-05 (503 m WNW)	1.73E-03	1.60E-04 (457 m WNW)	2.82E-03	2.75E-04 (360 m WNW)	2.82E-03	2.75E-04
	Apr-Dec	1.53E-03	1.19E-04 (537 m WNW)	9.56E-04	9.35E-05 (503 m WNW)	1.88E-03	1.67E-04 (457 m WNW)	3.07E-03	3.09E-04 (383 m W)	3.07E-03	3.09E-04
	Jan-Mar	1.08E-03	9.75E-05 (537 m WNW)	6.75E-04	7.89E-05 (503 m WNW)	1.34E-03	1.38E-04 (457 m WNW)	2.18E-03	2.42E-04 (360 m WNW)	2.18E-03	2.42E-04
									Max-All Seasons	3.07E-03	3.09E-04
Depl.X/Q (sec/m^3)	Jan-Dec	1.30E-03	1.06E-04 (537 m WNW)	8.14E-04	8.42E-05 (503 m WNW)	1.61E-03	1.51E-04 (457 m WNW)	2.66E-03	2.61E-04 (360 m WNW)	2.66E-03	2.61E-04
	Apr-Dec	1.41E-03	1.11E-04 (537 m WNW)	8.85E-04	8.76E-05 (503 m WNW)	1.75E-03	1.58E-04 (457 m WNW)	2.89E-03	2.93E-04 (383 m W)	2.89E-03	2.93E-04
	Jan-Mar	9.95E-04	9.11E-05 (537 m WNW)	6.24E-04	7.39E-05 (503 m WNW)	1.25E-03	1.30E-04 (457 m WNW)	2.05E-03	2.31E-04 (360 m WNW)	2.05E-03	2.31E-04
									Max-All Seasons	2.89E-03	2.93E-04
D/Q ($1/m^2$)	Jan-Dec	8.95E-07	1.11E-07 (537 m WNW)	7.56E-07	1.22E-07 (503 m WNW)	1.05E-06	1.42E-07 (457 m WNW)	1.48E-06	2.12E-07 (383 m W)	1.48E-06	2.12E-07
	Apr-Dec	9.25E-07	1.13E-07 (537 m WNW)	7.77E-07	1.25E-07 (503 m WNW)	1.09E-06	1.45E-07 (457 m WNW)	1.54E-06	2.22E-07 (383 m W)	1.54E-06	2.22E-07
	Jan-Mar	7.05E-07	1.03E-07 (537 m WNW)	6.21E-07	1.14E-07 (503 m WNW)	8.34E-07	1.33E-07 (457 m WNW)	1.17E-06	1.90E-07 (360 m WNW)	1.17E-06	1.90E-07
									Max-All Seasons	1.54E-06	2.22E-07

TABLE F2
ATMOSPHERIC DISPERSION FACTORS
ELEVATED (MIXED MODE) RELEASES

Dispersion Factor	Met Data Period	Primary Vent Stack 1-Hour	Primary Vent Stack Long-Term
Undepl. X/Q (sec/m^3)	Jan-Dec	2.64E-04	2.64E-05 (617 m NE)
	Apr-Dec	2.86E-04	2.85E-05 (617 m NE)
	Jan-Mar	2.19E-04	2.02E-05 (617 m NE)
	Max - All Seasons	2.86E-04	2.85E-05
Depl.X/Q (sec/m^3)	Jan-Dec	2.65E-04	2.64E-05 (617 m NE)
	Apr-Dec	2.86E-04	2.85E-05 (617 m NE)
	Jan-Mar	2.19E-04	2.01E-05 (617 m NE)
	Max - All Seasons	2.86E-04	2.85E-05
D/Q ($1/m^2$)	Jan-Dec	1.54E-07	2.33E-08 (932 m E)
	Apr-Dec	1.56E-07	2.24E-08 (583 m NNE)
	Jan-Mar	1.56E-07	3.45E-08 (1572 m ESE)
	Max - All Seasons	1.56E-07	3.45E-08

References:

1. NUREG/CR-2919, "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations", September 1982.

APPENDIX G

ENVIRONMENTAL MONITORING PROGRAM

Sampling Locations

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

Location Number	Name	Direction & Distance From Release Point***	Sample Types
1-I*	On-site-Mouth of Discharge Canal	1.1 Mi, ESE	TLD
2-1	Haddam-Park Rd.	0.8 Mi, S	TLD
3-I	Haddam-Jail Hill Rd.	0.8 Mi, WSW	TLD
4-I	Haddam-Ranger Rd.	1.8 Mi, SW	TLD, Air Particulate
5-I	On-site-Injun Hollow Rd.	0.4 Mi, NW	TLD, Air Particulate
6-I	On-site-Substation	0.5 Mi, NE	TLD, Air Particulate, Vegetation
7-I	Haddam	1.8 Mi, SE	TLD, Air Particulate
8-I	East Haddam	3.1 Mi, ESE	TLD, Air Particulate
9-I	Higganum	4.3 Mi, WNW	TLD, Air Particulate
10-I	Hurd Park Rd.	2.8 Mi, NNW	TLD
11-C**	Middletown	9.0 Mi, NW	TLD
12-C	Deep River	7.1 Mi, SSE	TLD
13-C	North Madison	12.5 Mi, SW	TLD, Air Particulate
14-C	Colchester	10.5 Mi, NE	TLD
15-I	On-site Wells	0.5 MI, ESE****	Well Water
16-C	Well-State Highway Dept. E. Haddam	2.8 Mi, SE	Well Water
17-C	Fruits & Vegetables	Beyond 10 Miles	Vegetation
18-I	Site Boundary	0.4 Mi, NW	Vegetation
19-I	Cow Location #1	6.5 Mi, ENE	Milk
20-I	Cow Location #2	8.0 Mi, NE	Milk
21-I	Cow Location #3	11.0 Mi, SE	Milk
22-C	Cow Location #4	11.0 Mi, ENE	Milk
23-C	Goat Location #1	16.0 Mi, NNE	Milk
24-I	Goat Location #2	3.6 Mi, SSE	Milk
25-I	Fruits & Vegetables	Within 10 Miles	Vegetation
26-I	Conn. River-Near Intake	1.0 Mi, WNW	Fish
27-C	Conn. River-Higganum Light	4.0 Mi, WNW	Shellfish
28-I	Conn. River-E. Haddam Bridge	1.8 Mi, SE	Bottom Sediment, River Water
29-I	Vicinity of Discharge	_ _ _ _ _ _	Bottom Sediment, Fish
30-C	Conn. River-Middletown	9.0 Mi, NW	River Water, Bottom Sediment
		7.6 Mi, NW	Fish
31-I	Mouth of Salmon River	0.8 Mi, ESE	Shellfish

*I = Indicator **C = Control
***The release points are the stack for terrestrial locations and the end of the discharge canal for aquatic locations..
****New wells at 0.4 miles SE may be used as a replacement for this location.

The following lists the accident TLD sampling locations. Sampling locations are shown on Figure G-3.

ACCIDENT TLD SAMPLING LOCATIONS

Direction and Distance	Location Description (Town and Street)
0.8 Mi, N	Haddam Neck, Cove Road
4.0 Mi, N	East Haddam, Quitewood Road and Route 196
0.7 Mi, NNE	Haddam Neck, Jenks Hill Road
2.6 Mi, NNE	Leesville Substation, Intersection of 151 and 196
4.8 Mi, NE	Colchester, Waterhole Road
0.3 Mi, ENE	Haddam Neck, Jenks Hill Road
4.4 Mi, ENE	East Haddam, Falls Bashen Road
0.3 Mi, E	Haddam Neck, Road to Canal
4.4 Mi, E	East Haddam, Smith Road
2.8 Mi, SE	East Haddam, Creamery Road (off Route 82)
0.9 Mi, SSE	Haddam, Route 9A, Corner of Plains Road
3.2 Mi, SSE	Haddam, Old Chester Road
3.1 Mi, S	Haddam, Int. Turkey Hill and Dickinson Road
0.7 Mi, SSW	Haddam, Route 9A, Parking Lot Agr. Building
5.2 Mi, SSW	Killingworth, Parker Hill Road
0.7 Mi, SW	Haddam, Route 9A, Quarry Hill Road
4.0 Mi, SW	Haddam, Route 81, North of Woods Road
3.2 Mi, WSW	Haddam, Route 81, after Route 9 Underpass
0.9 Mi, W	Haddam, Route 9A, South End of Walkely Hill
1.1 Mi, W	Haddam, Island Dock Road
4.6 Mi, W	Haddam, Spencer Road
1.2 Mi, WNW	Haddam, Route 9A, North of Town Dump
0.7 Mi, NW	Haddam Neck, Injun Hollow Road
4.6 Mi, NW	Middletown, Maromas Meteorological Tower
1.0 Mi, NNW	Haddam Neck, Ague Spring Road

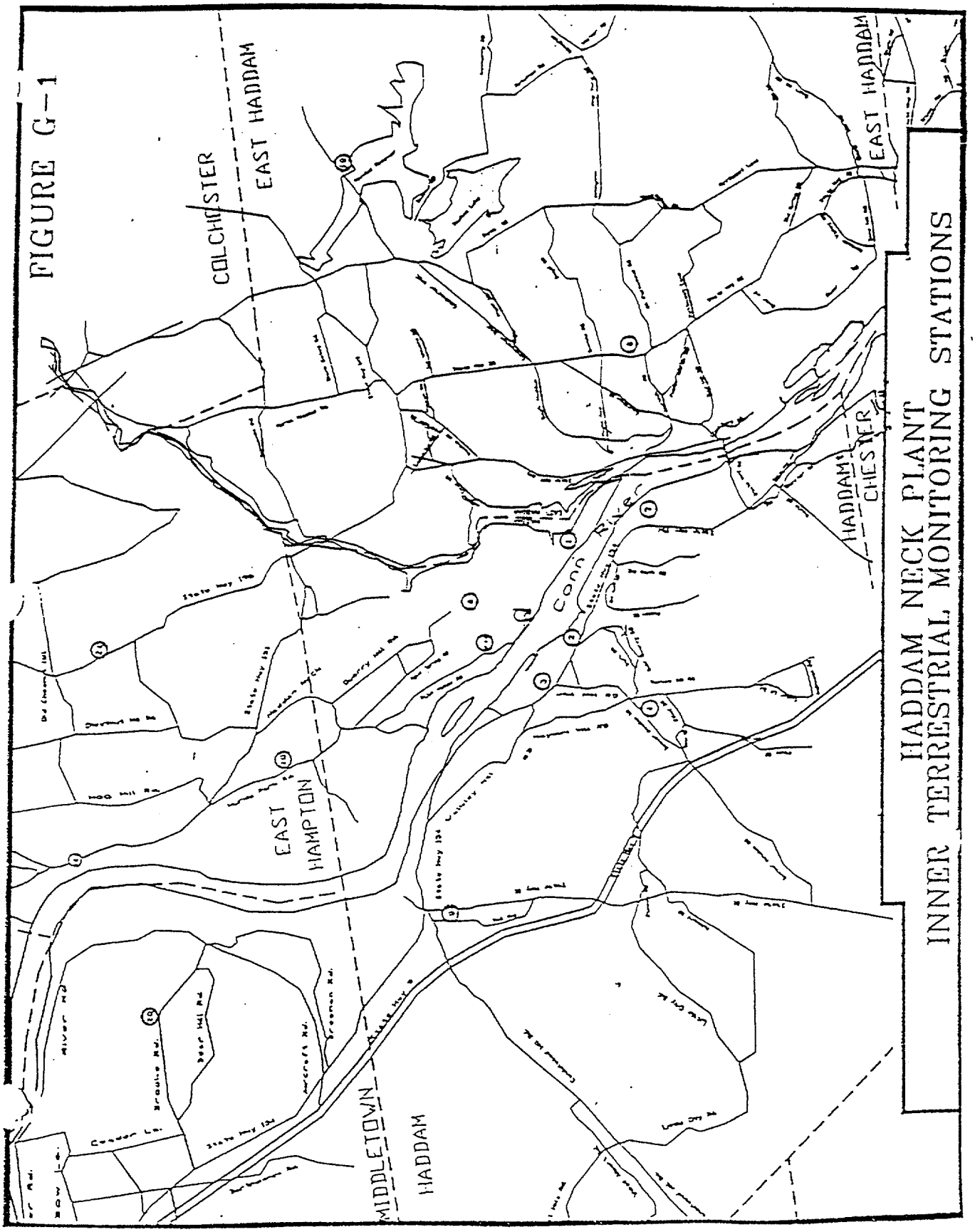
FIGURE G-1
COLCHESTER
EAST HADDAM
EAST HADDAM
HADDAM
CHESTER
Conn. River
EAST HAMPTON
MIDDLETOWN
HADDAM
HADDAM NECK PLANT
INNER TERRESTRIAL MONITORING STATIONS

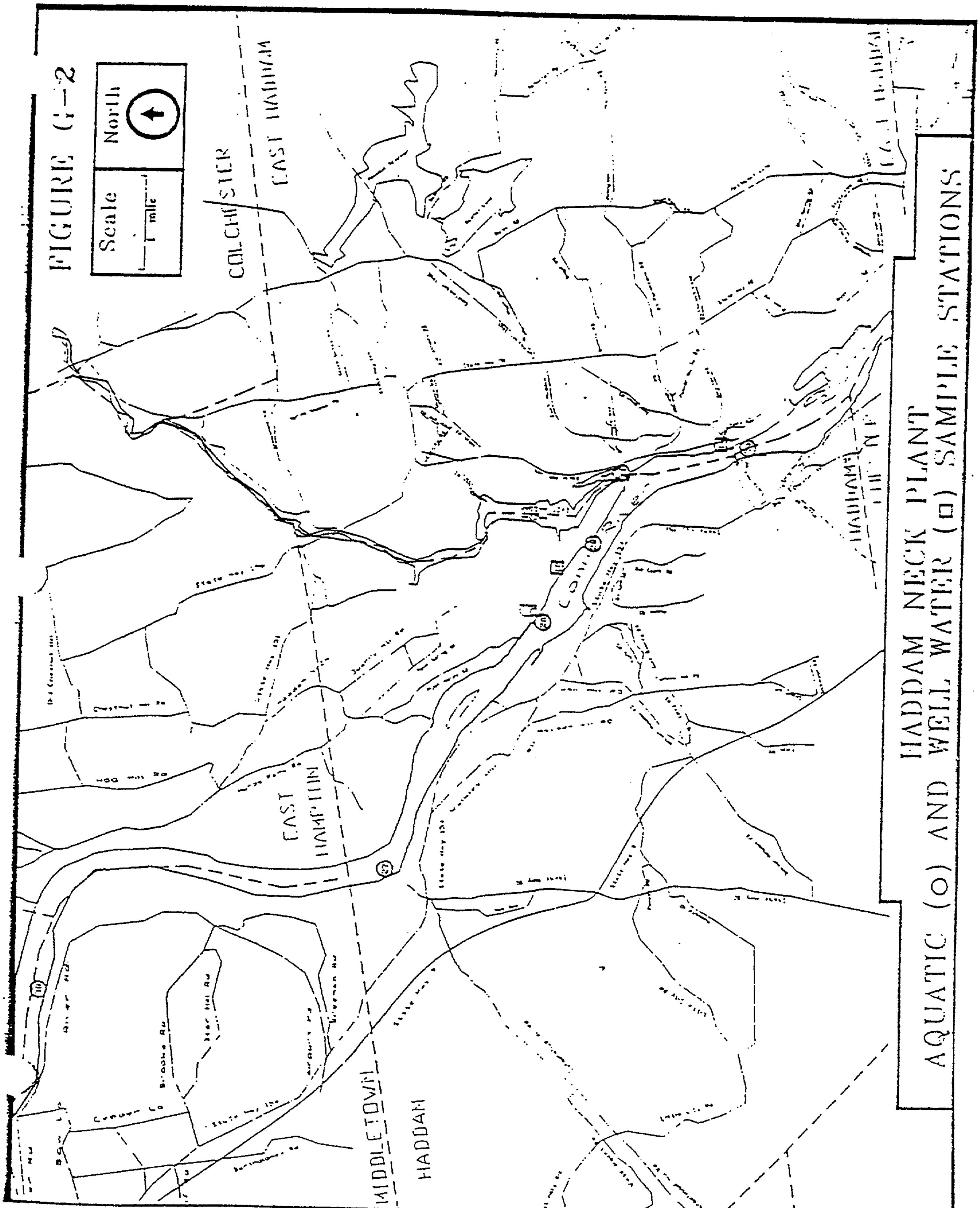
FIGURE G-2
Scale
1 mile
North
COLCHESTER
EAST HADDAM
EAST HAMPTON
MIDDLETOWN
HADDAM
HADDAM NECK PLANT
AQUATIC (O) AND WELL WATER (□) SAMPLE STATIONS

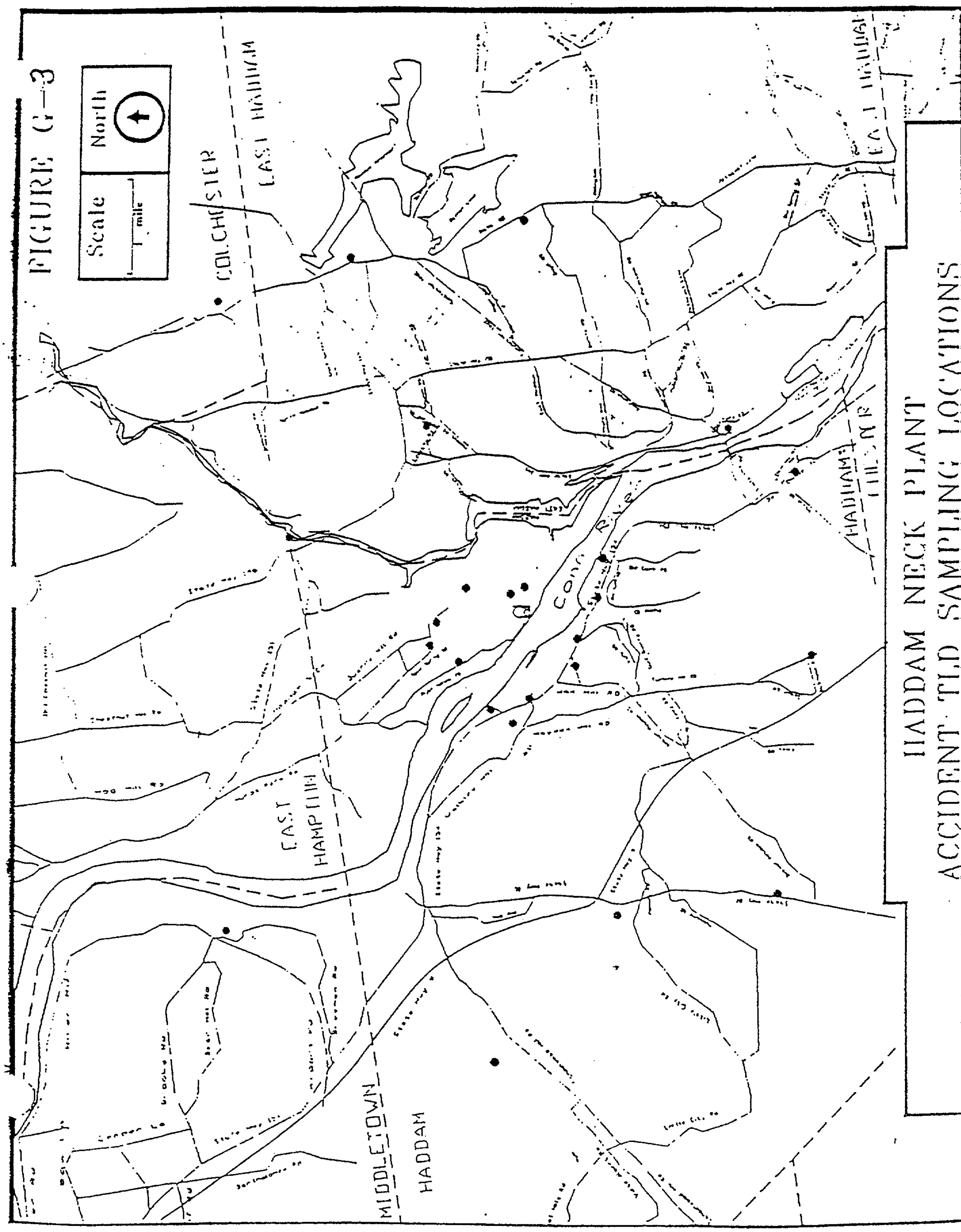
FIGURE G-3
Scale
mile
North
HADDAM NECK PLANT
ACCIDENT TLD SAMPLING LOCATIONS
COLCHESTER
EAST HADDAM
EAST HAMPTON
MIDDLETOWN
HADDAM
Conn River

APPENDIX H

DOSE FACTORS FOR Kr-85

H.1 Approach

The REMM requires the calculation of gamma and beta air doses, and total body and skin dose rates resulting from the release of noble gases (i.e., Kr-85) to the atmosphere.

The gamma air and beta air doses, as well as the total body dose rates, will be determined using the dose factors taken from Table B-1 of Reg. Guide 1.109 for individual radionuclides. The skin dose factor, DF', is calculated for individual radionuclides (i.e., Kr-85 here) by combining the gamma air dose and beta skin dose factors to give a combined skin dose factor. The following subsections detail the development of these dose factors and the equation for calculating site specific doses with them.

Meteorological dispersion factors are calculated for the CY site as described in Appendix F, and are summarized in Tables F.1 and F.2. These represent a long-term (5 years) site average meteorological history that was used to determine the location of minimum dispersion (maximum dose) for off-site receptors.

The Kr-85 dose factors to be used in the ODCM Method 1 calculations are listed in Table H-1.

H.2 Total Body Dose Rate

Method 1 was derived from general equation B-8 in Regulatory Guide 1.109 as follows:

$$\dot{D}_{tb} = (1E+06) * \left[\frac{X}{Q}\right] * \dot{Q} * DFB \qquad \text{(H-1)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{pCi}{\mu Ci} * \frac{\sec}{m^3}\right) * \left(\frac{\mu Ci}{\sec} * \frac{mrem - m^3}{pCi - yr}\right)$$

where:

$\frac{X}{Q}$ = Maximum undepleted X/Q for release point of interest (see Tables F.1 & F.2),

$\dot{Q}$ = Release rate to the environment of Kr-85 (μCi/sec);

DFB = Total body dose factor (see Table H.1 and Reg. Guide 1.109, Table B-1).

Equation H-1 reduces to the following for **elevated** (mixed mode) releases:

$$\dot{D}_{tb(e)} = 28.5 * \dot{Q}_e * DFB \qquad \text{(H-2)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{pCi - \sec}{\mu Ci - m^3}\right) * \left(\frac{\mu Ci}{\sec}\right) * \left(\frac{mrem - m^3}{pCi - yr}\right)$$

Note: Since the permanent shutdown of the station, the Spent Fuel Building ventilation has been isolated from the plant stack. In addition, the waste gas decay system, which was used for gas holdup before release to the stack during plant operations, has been abandoned. The result is that the potential for noble gas release via the plant stack has been removed.

and for **ground level** releases:

$$\dot{D}_{tb(g)} = 309 * \dot{Q}_g * DFB \qquad \text{(H-3)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{pCi - \sec}{\mu Ci - m^3}\right) * \left(\frac{\mu Ci}{\sec}\right) * \left(\frac{mrem - m^3}{pCi - yr}\right)$$

H.3 Gamma Dose to Air

For any Kr-85 release, in any period, the increment in dose is taken from Equations B-4 and B-5 of Regulatory Guide 1.109, as follows:

$$D^{\gamma}_{air} = (3.17E-02) * \left(\frac{X}{Q}\right) * (Q) * \left(DF^{\gamma}\right) \qquad \text{(H-4)}$$

$$(mrad) = \left(\frac{pCi - yr}{\mu Ci - \sec}\right) * \left(\frac{\sec}{m^3}\right) * (\mu Ci) * \left(\frac{mrad - m^3}{pCi - yr}\right)$$

where:

3.17E-02	=	Number of pCi per μCi divided by the number of seconds per year;
$\left(\frac{X}{Q}\right)$	=	Maximum undepleted X/Q for the release point of interest,
Q	=	Quantity of Kr-85 released (μCi);
DF^{γ}	=	Gamma air dose factor for a uniform semi-infinite cloud of Kr-85 (from Regulatory Guide 1.109, Table B-1, 1.72 E-5).

For **elevated** (mixed mode) releases, this leads to:

$$D^{\gamma}_{air(e)} = (9.0E-07) * Q_e * DF^{\gamma}\ ; \qquad \text{(H-5)}$$

$$(mrad) = \left(\frac{pCi-yr}{\mu Ci-m^3}\right) * (\mu Ci) * \left(\frac{mrad-m^3}{pCi-yr}\right)$$

However, as noted above, the expectation for noble gas (Kr-85) releases from the stack have been removed.

and for **ground level** releases:

$$D^{\gamma}_{air(g)} = (9.8E-06) * Q_g * DF^{\gamma} \qquad \text{(H-6)}$$

$$(mrad) = \left(\frac{pCi-yr}{\mu Ci-m^3}\right) * (\mu Ci) * \left(\frac{mrad-m^3}{pCi-yr}\right)$$

H.4 Beta Dose to Air

For any Kr-85 release, in any period, the increment in dose is taken from Equations B-4 and B-5 of Regulatory Guide 1.109:

$$D^{\beta}_{air} = (3.17E-02) * \left(\frac{X}{Q}\right) * (Q) * \left(DF^{\beta}\right) \qquad \text{(H-7)}$$

$$(mrad) = \left(\frac{pCi-yr}{\mu Ci-\sec}\right) * \left(\frac{\sec}{m^3}\right) * (\mu Ci) * \left(\frac{mrad-m^3}{pCi-yr}\right)$$

where:

DF^{β} = Beta air dose factors for a uniform semi-infinite cloud of Kr-85 (from Regulatory Guide 1.109, Table B-1, 1.95 E-3);

Q = Quantity of Kr-85 released (μCi);

$\left(\frac{X}{Q}\right)$ = Maximum undepleted X/Q for the release point of interest.

Substituting the X/Q value, we have for **elevated** (mixed mode) releases:

$$D^{\beta}_{air(e)} = (9.0E-07) * (Q_e) * \left(DF^{\beta}\right); \qquad \text{(H-8)}$$

$$(mrad) = \left(\frac{pCi-yr}{\mu Ci-m^3}\right) * (\mu Ci) * \left(\frac{mrad-m^3}{pCi-yr}\right)$$

As noted above, the expectation for noble gas (Kr-85) releases from the plant stack have been removed due to changes in plant configuration since permanent shutdown.

And for **ground level** releases:

$$D^{\beta}_{air(g)} = (9.8E-06)*(Q_g)*(DF^{\beta}). \quad \text{(H-9)}$$

$$(mrad) = \left(\frac{pCi-yr}{\mu Ci-m^3}\right)*(\mu Ci)*\left(\frac{mrad-m^3}{pCi-yr}\right)$$

H.5 Skin Dose Rate

Method 1 was derived from the general equation B-9 in Regulatory Guide 1.109, as follows:

$$D_{skin} = (1.11)*D^{\gamma}_{air} + \left[(3.17E+04)*(Q)*\left(\frac{X}{Q}\right)*(DFS)\right] \quad \text{(H-10)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{mrem}{mrad}\right)*\left(\frac{mrad}{yr}\right) + \left(\left(\frac{pCi-yr}{Ci-\sec}\right)*\left(\frac{Ci}{yr}\right)*\left(\frac{\sec}{m^3}\right)*\left(\frac{mrem-m^3}{pCi-yr}\right)\right)$$

where:

1.11 = Average ratio of tissue to air absorption coefficients (will convert mrad in air to mrem in tissue);

3.17E+04 = Conversion factor for curies to picocuries and seconds to years;

DFS = Beta skin dose factor for a semi-infinite cloud of Kr-85 which includes the attenuation by the outer "dead" layer of the skin;

$$D^{\gamma}_{air} = (3.17E+04)*(Q)*\left(\frac{X}{Q}\right)*(DF^{\gamma}) \quad \text{(H-11)}$$

$$\left(\frac{mrad}{yr}\right) = \left(\frac{pCi-yr}{Ci-\sec}\right)*\left(\frac{Ci}{yr}\right)*\left(\frac{\sec}{m^3}\right)*\left(\frac{mrad-m^3}{pCi-yr}\right)$$

DF^{γ} = Gamma air dose factor for a uniform semi-infinite cloud of Kr-85 (see Table H-1).

Q = Annual release of Kr-85 in curies per year.

Since $Q = 31.54\dot{Q}$ where 31.54 is the conversion factor for Ci to μCi and from years to seconds, then

$$\dot{D}_{skin} = (1.11)(1E+06)\left(\frac{X}{Q}\right)*(\dot{Q})*(DF^{\gamma}) \quad + \quad (1E+06)\left(\frac{X}{Q}\right)*(\dot{Q})*(DFS) \qquad \text{(H-12)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{mrem}{mrad}\right)\left(\frac{pCi}{\mu Ci}\right)\left(\frac{\sec}{m^3}\right)\left(\frac{\mu Ci}{\sec}\right)\left(\frac{mrad-m^3}{pCi-yr}\right) + \left(\frac{pCi}{\mu Ci}\right)\left(\frac{\sec}{m^3}\right)\left(\frac{\mu Ci}{\sec}\right)\left(\frac{mrem-m^3}{pCi-yr}\right)$$

Substituting the X/Q value (2.85E-05 sec/m^3), we have, for an **elevated** (mixed mode) release point:

$$\dot{D}_{skin(e)} = (31.6)*(\dot{Q}_e)*(DF^{\gamma}) \quad + \quad (28.5)*(\dot{Q}_e)*(DFS) \qquad \text{(H-13)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{pCi-\sec-mrem}{\mu Ci-m^3-mrad}\right)\left(\frac{\mu Ci}{\sec}\right)\left(\frac{mrad-m^3}{pCi-yr}\right) + \left(\frac{pCi-\sec}{\mu Ci-m^3}\right)\left(\frac{\mu Ci}{\sec}\right)\left(\frac{mrem-m^3}{pCi-yr}\right)$$

or,

$$\dot{D}_{skin(e)} = \dot{Q}\left(31.6DF^{\gamma} + 28.5DFS\right). \qquad \text{(H-14)}$$

For an elevated (mixed mode) release we substitute the "combined skin dose rate factor" for the expression in parentheses above, as follows:

$$\text{"Combined Skin Dose Rate Factor"} = DF_e' = 31.6DF^{\gamma} + 28.5DFS\ , \qquad \text{(H-15)}$$

where $DF_e' = (31.6)*(1.72E-5) + (28.5)*(1.34E-3) = 3.87E-2\ \left(\frac{mrem-\sec}{\mu Ci-yr}\right)$

Then:

$$\dot{D}_{skin(e)} = \dot{Q}_e * DF_e'$$

(H-16)

$$\left(\frac{mrem}{yr}\right) = \left(\frac{\mu Ci}{\sec}\right)*\left(\frac{mrem-\sec}{\mu Ci-yr}\right).$$

Values of DF_e may be found in Table H-1.

As noted above, noble gas (Kr-85) releases from the plant stack have been eliminated due to changes in plant configuration since permanent shutdown. However, the same methodology for the development of a combined skin dose rate equation can be applied to ground level releases.

Substituting the ground level *X/Q* value (3.09E-04 sec/m^3), we have, for a **ground level** release point:

$$\dot{D}_{skin(g)} = (343)*(\dot{Q}_g)*(DF^{\gamma}) \quad + \quad (309)*(\dot{Q}_g)*(DFS) \qquad \text{(H-17)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{pCi-\sec-mrem}{\mu Ci-m^3-mrad}\right)\left(\frac{\mu Ci}{\sec}\right)\left(\frac{mrad-m^3}{pCi-yr}\right) + \left(\frac{pCi-\sec}{\mu Ci-m^3}\right)\left(\frac{\mu Ci}{\sec}\right)\left(\frac{mrem-m^3}{pCi-yr}\right)$$

or,

$$\dot{D}_{skin(g)} = \dot{Q}\left(343DF^{\gamma} + 309DFS\right). \qquad \text{(H-18)}$$

For an ground-level release we substitute the "combined skin dose rate factor" for the expression in parentheses above, as follows:

$$\text{"Combined Skin Dose Rate Factor"} = DF'_g = 343DF^{\gamma} + 309DFS\ , \qquad \text{(H-19)}$$

$$\text{where } DF'_e = (343)*(1.72E-5) + (309)*(1.34E-3) = 0.42\ \left(\frac{mrem-\sec}{\mu Ci-yr}\right)$$

then:

$$\dot{D}_{skin(g)} = \dot{Q}_g * DF'_g\ . \qquad \text{(H-20)}$$

$$\left(\frac{mrem}{yr}\right) = \left(\frac{\mu Ci}{\sec}\right)*\left(\frac{mrem-\sec}{\mu Ci-yr}\right).$$

Values of DF'_g may be found in Table H-1.

TABLE H.1

DOSE AND DOSE RATE FACTORS FOR Kr-85
(Combined Skin dose Rate Factors are derived in Sect. H.5; all other Dose Factors taken from Regulatory Guide 1.109.)

Gamma Total Body Dose Factor $DFB\left(\frac{mrem-m^3}{pCi-yr}\right)$	Beta Skin Dose Factor $DFS\left(\frac{mrem-m^3}{pCi-yr}\right)$	Combined Skin Dose Rate Factor Elevated Releases $DF_e'\left(\frac{mrem-\sec}{\mu Ci-yr}\right)$	Combined Skin Dose Rate Factor Ground Level Releases $DF_g'\left(\frac{mrem-\sec}{\mu Ci-yr}\right)$	Beta Air Dose Factor $DF^{\beta}\left(\frac{mrad-m^3}{pCi-yr}\right)$	Gamma Air Dose Factor $DF^{\gamma}\left(\frac{mrad-m^3}{pCi-yr}\right)$
1.61E-05	1.34E-03	3.87E-02	4.20E-01	1.95E-03	1.72E-05