CONNECTICUT YANKEE ATOMIC POWER COMPANY

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

May 1, 2002

Docket No. 50-213
CY-02-064

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 2001.

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.

The Radiological Effluent Monitoring and Offsite Dose Calculation Manual (REMODCM) was not modified in calendar year 2001. The REMODCM as of December 31, 2001, was the same as the version of the REMODCM submitted on May 1, 2001.(1)

If you should have any questions regarding this submittal, please call Mr. Gerry P. van Noordennen at (860) 267-3938.

Sincerely,

Noah W. Fetherston
Site Manager

cc: H. J. Miller, NRC Region I Administrator
J. E. Donoghue, NRC Senior Project Manager
R. R. Bellamy, Chief, Decommissioning and Laboratory Branch, NRC Region I
E. L. Wilds, Jr., Director, CT DEP Monitoring and Radiation Division
J. Cherniack, US EPA, Region 1

(1) CYAPCO letter to USNRC, "Haddam Neck Plant, Annual Radioactive Effluent Report," dated May 1, 2001 (CY-01-070).

IE48
A009

Docket No. 50-213
CY-02-064

Attachment 1

Haddam Neck Plant
Annual Radioactive Effluent Report

ANNUAL RADIOACTIVE EFFLUENT REPORT

HADDAM NECK STATION

RADIOLOGICAL EFFLUENT CONTROLS PROGRAM

JANUARY 1, 2001 - DECEMBER 31, 2001

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

CONNECTICUT YANKEE ATOMIC POWER COMPANY
Haddam, Connecticut

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 Introduction

As required by the Haddam Neck Plant Technical Specification Safety Manual (TSSM), Section 6.7.3, this Annual Radioactive Effluent Release Report for the year 2001 is submitted in accordance with 10 CFR 50.36a, "Technical Specifications on effluents from nuclear power reactors." A summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the Haddam Neck Facility is presented in this document. The material provided is consistent with the objectives outlined in the Radiological Effluent Monitoring and Offsite Dose Calculation Manual (REMODCM). The information submitted is formatted to the general outline described in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light–Water–Cooled Nuclear Power Plants."

Haddam Neck is currently in the process of decommissioning. In support of the decommissioning effort, a total of 227,360 gallons of radioactive liquid was processed and batch released in 2001. The radwaste system utilized filters and demineralizers to process radioactive liquid prior to release to the environment. The Chemistry Department reviews and trends information pertaining to liquid releases on a continual basis. Table 15 and Figures 1 - 3 are included to show parameters that are trended to assist in evaluating liquid releases by the Chemistry Department.

As the decommissioning project creates new potential gaseous release pathways, baseline data will be collected and, if necessary, the release point will be added to the monitoring program. The Alternate Containment Access and the Cable Vault are examples of miscellaneous pathways that are included in the monitoring program.

2.0 Summary

The radioactive effluent monitoring program for 2001 was conducted in accordance with Haddam Neck TSSM section 6.6.4. The results of the monitoring program indicate that the Haddam Neck Plant was successful in maintaining radioactive effluent releases to the environment as low as reasonably achievable.

A general overview of the radioactive gaseous releases to the environment during 2001 produced the following results:

- The total whole body dose due to gaseous radioactivity released was 3.79E-03 mrem. This is approximately 0.10% of the allowable limit.
- The maximum organ dose due to gaseous radioactivity was 7.89E-02 mrem. This is approximately 0.53% of the allowable limit.
- The calculated beta air dose due to noble gases was 0 mrad.
- The calculated gamma air dose due to noble gases was 0 mrad.
- The total gaseous tritium released was 2.59 curies.

- The total gaseous particulate activity released was 9.63E-05 curies.
- The total gaseous gross alpha activity released was 0 curies.
- The total gaseous Sr-90 activity released was 0 curies.

A review of the radioactive liquid releases to the environment during 2001 produced the following results:

- The total whole body dose due to liquid radioactivity released was 0.587 mrem. This is approximately 20% of the allowable limit.
- The maximum organ dose due to liquid radioactivity released was 0.923 mrem. This is approximately 10% of the allowable limit.
- The total volume of radioactive liquid processed and released was 227,360 gallons.
- The total amount of radioactivity from liquids released to the environment was 2.83 curies.
- Of the total curies released, 2.70 were attributed to tritium and 0.13 curies from all other nuclides.

The effluent dose contributions for this report period are less than regulatory limits and natural background dose contributions.

A review of the radioactive waste program showed 8,700 cubic meters of solid waste containing 5,510 curies of radioactivity was shipped offsite for processing or disposal.

3.0 Supplemental Information

3.1 Radioactive Effluent Controls Program

This program conforms to 10 CFR 50.36a for the control of radioactive effluents and for maintaining the dose to MEMBERS OF THE PUBLIC from radioactive effluents as low as reasonably achievable. The program shall be contained in the REMODCM, shall be implemented by procedures, and shall include remedial actions to be taken whenever the program limits are exceeded. The program shall include the following elements:

a. Limitations on the functional capability of radioactive liquid and gaseous monitoring instrumentation, including surveillance tests and setpoint determinations, in accordance with the methodology described in the REMODCM;

b. Limitations on the concentrations of radioactive material released in liquid effluents to unrestricted areas, conforming to the pre-1994 concentration values in 10 CFR Part 20, Appendix B (to 20.1 to 20.602), Table II, Column 2;

c. Monitoring, sampling, and analysis of radioactive liquid and gaseous effluents in accordance with 10 CFR 20.1302 and with the methodology and parameters described in the REMODCM;

d. Limitations on the annual and quarterly doses or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released from the facility to unrestricted areas, conforming to 10 CFR Part 50, Appendix I;

e. Determination of cumulative and projected dose contributions from radioactive effluents for the current calendar quarter and current calendar year in accordance with the methodology and parameters described in the REMODCM (performed at least every 92 days);

f. Limitations on the functional capability and use of the liquid and gaseous effluent treatment systems to ensure that appropriate portions of these systems are used to reduce releases of radioactivity when the projected doses in a period of 31 days would exceed 2% of the guidelines for the annual dose or dose commitment, conforming to 10 CFR Part 50, Appendix I;

g. Limitations on the dose rate resulting from radioactive material released in gaseous effluents from the site to areas at or beyond the SITE BOUNDARY shall be as follows;

   1. for noble gases: less than or equal a dose rate of 500 mrem/yr to the total body and less than or equal a dose of 3000 mrem/yr to the skin; and

   2. for tritium and all radionuclides in particulate form with half-lives greater than 8 days: less than or equal to a dose rate of 1500 mrem/yr. to any organ;

h. Limitations on the annual and quarterly air doses from noble gases released in gaseous effluents from the unit to areas beyond the SITE BOUNDARY, conforming to 10 CFR Part 50, Appendix I;

i. Limitations on the annual and quarterly doses to a MEMBER OF THE PUBLIC from tritium and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released from each facility to areas beyond the SITE BOUNDARY, conforming to 10 CFR Part 50, Appendix I; and

j. Limitations on the annual dose or dose commitment to any MEMBER OF THE PUBLIC at points beyond the SITE BOUNDARY due to releases of radioactivity and to radiation from uranium fuel cycle sources, conforming to 40 CFR Part 190.

3.2 Maximum Permissible Concentration

3.2.1 Gaseous Effluents

The applicable limits for gaseous effluents are expressed in terms of dose rate at the site boundary.

3.2.2 Liquid Effluents

The values specified in 10 CFR Part 20, Appendix B, Table 2, Column 2, (pre-1994 edition), were used as the limits for radioactive effluents released to unrestricted areas.

3.3 Measurements and Approximation of Total Activity

3.3.1 Gaseous Radioactive Effluents

Gaseous effluent release pathways were sampled and analyzed weekly for tritium and noble gas. Particulate release pathways were continuously sampled using air filters. The particulate filters were analyzed weekly for gamma radioactivity, monthly for gross alpha activity, and quarterly for Sr-90. Noble gas and tritium, and particulate filter results and the effluent flow rate were used to determine the total amount of activity released.

The following estimates for the uncertainty associated with gaseous sample analysis stem from a composite of variances in effluent flow rates, instrumentation tolerances and low level counting statistics.

Tritium	25%
Fission and Activation Products	25%
Gross Alpha, Sr-90	25%
Noble Gas	25%

3.3.2 Liquid Radioactive Effluents

Each batch release was sampled and analyzed for gamma emitting radionuclides prior to release. Composite samples were analyzed monthly for gross alpha and quarterly for Fe-55 and Sr-90. The results of the composite analyses from the previous month or quarter were used to estimate the quantities of these radionuclides in liquid effluents during the current month or quarter. The total radioactivity in liquid effluent releases was determined from the measured concentrations of each radionuclide present and the total volume of the effluent released during periods of discharge.

The RCA Yard Drain continuous release pathway was sampled with an automatic composite sampler or by obtaining daily grab samples. Composites were analyzed each week for gamma emitting radionuclides and tritium. Analyses were performed to the minimum

detection levels for environmental media. Due to the absence of gamma activity, analyses for gross alpha, Fe-55 and Sr-90 were not required by the REMODCM during the period of this report. The External Containment Sump contribution to the Yard Drain release was secured in October 2001 due to the identification of Sr-90 in the External Containment Sump. In response, CR-01-0406 was generated and is discussed in section 6.2.2.

The following estimates for the uncertainty associated with liquid sample analysis stem from a composite of variances in effluent flow rates, instrumentation tolerances and low level counting statistics.

Tritium	25%
Fission and Activation Products	25%
Gross Alpha	25%
Sr-90, Fe-55	25%

3.4 Batch Releases

3.4.1 Airborne Effluents

None

3.4.2 Liquid Effluents

Number of Batches:	25
Total Time (min.):	5999
Maximum Time (min.):	413
Average Time (min.):	240
Minimum Time (min.):	3
Average dilution flow during releases:	Batch = 214 cfs
	Continuous = 6.68 cfs
	Tidal Influence = 34.5 cfs

3.5 Abnormal Releases

None

4.0 Dose Calculation Methodology

4.1 Airborne Effluents

Maximum individual doses and population doses due to the release of noble gases and particulates were calculated using the computer program GASPAR II. GASPAR II is used by the staff of the NRC to perform environmental dose analyses for releases of radioactive effluents from nuclear power plants into the

atmosphere. The program estimates radiation dose to individuals and population groups from inhalation, ingestion (terrestrial foods), and external-exposure (ground and plume) pathways. Additional information related to the GASPAR II program is in NUREG/CR-4653, "GASPAR II –Technical Reference and User Guide".

The values of average relative effluent concentration (χ/Q) and average relative deposition (D/Q) used in GASPAR II to determine population doses were generated using a meteorological computer code which implements the assumptions cited in Section C, NRC Regulatory Guide 1.111. These values were generated in 1999, the last year that real time data was collected. The χ/Q and D/Q values used in the GASPAR II program 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).

Continuous mixed mode releases from the Main Stack (175 ft) include the Reactor Containment and Primary Auxiliary Building Ventilation. The Spent Fuel Pool Spray Cooling, Spent Fuel Building Exhaust, Alternate Containment Access, and the Cable Vault Lower Level Exhaust are considered continuous ground level releases.

GASPAR II calculates the maximum individual and population doses 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 ground deposition, inhalation, and ingestion of vegetation, cow's milk, and meat. The doses are calculated for adults, teenagers, children, and infants separately.

To determine compliance with 10CFR50, Appendix I, the maximum whole body dose to an individual only includes the external pathways (i.e. plume and ground exposure) while the maximum organ dose to an individual only includes the internal pathways (inhalation and ingestion). All applicable pathways were included for the population doses.

The off-site dose commitments from airborne effluents are presented in Table 1.

4.2 Liquid Effluents

Maximum individual and population doses from the release of radioactive liquid effluents were calculated using the computer program LADTAP II. LADTAP II is a NRC computer program, which performs environmental dose analyses for releases of radioactive effluents from nuclear power plants into surface waters. The program estimates radiation dose to individuals, population groups, and biota from ingestion (aquatic foods, water, and terrestrial irrigated foods) and external

exposure (shoreline, swimming, and boating) pathways. Additional information relating to the LADTAP II program is in NUREG/CR-4013, "LADTAP II – Technical Reference and User Guide".

At Haddam Neck, the algae, drinking water, and irrigated food pathways do not exist; and therefore were not 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 liquid doses calculated by LADTAP II for this report were corrected for the dilution water discrepancy identified in Condition Report 01-0483, discussed in section 6.2.4. Bechtel Health Physics Technical Support Document, 24265-000-G65-GEHH-P0102, "Radioactivity Effluent Analysis for the Year 2001", contains the correction factors and the bases for implementation.

The off-site dose commitments from liquid effluents are presented in Table 2.

5.0 Evaluation of Results

5.1 Total Offsite Dose

The dose commitments calculated using the release data for this report period are compared to 10 CFR Part 50, Appendix I, in Table 3, and compared to 40 CFR Part 190 limits in Table 4.

The whole body and maximum organ total doses for each month in this report period are presented in Figure 9. The contributions shown were calculated using Method 1 in the REMODCM for gaseous contributions and corrected LADTAP II doses for liquid contributions. As expected, the total dose increased in the months corresponding to larger volumes of liquid being released.

The effluent dose contributions for this report period are significantly less than regulatory limits and natural backgrounds dose contribution.

5.2 Gaseous Effluents

The total activity released from all gaseous effluent pathways is summarized in Table 5. Each pathway's contribution to the total activity released is shown in Tables 6-10. The figures described below were used to identify trends for this report period:

- The monthly maximum organ dose compared to the total year to date dose is presented in Figure 4. The calculations were performed using Method 1 in the REMODCM. The contribution for each month remained consistent throughout this report period.

- The tritium released for each month from the Main Stack pathway is presented in Figure 5. Periods of increased tritium releases correspond with variations in containment ventilation, and environmental conditions (changes in outside weather, temperature inversions, conditions in the Containment).
- The tritium released for each month from the Spent Fuel Building pathway is presented in Figure 6.
- Specific contributions, from individual nuclides released from the Alternate Containment Access, are presented in Figure 7. The Alternate Containment Access sample point is located in an enclosed structure that could discharge to the environment only when the door is opened. The methodology used in release calculations, assumes the door is left open 24 hours a day with a conservative release rate. Since the door is opened only for personnel entry or exit, the reported quantity of radioactivity released is very conservative.
- The release rate (uCi/hr) for specific nuclides when the Spray Cooling System is operated is shown in Figure 8. The release rates are consistent for this report period.

The monthly doses calculated using Method 1 in the REMODCM were conservatively higher than the calculations using GASPAR II for this report. The REMODCM includes adjustment factors for Method 1 that if used, would have corrected the monthly dose calculations to be within 5% of the doses calculated for this report (GASPAR II). This indicates the methodology currently used in the monthly calculations includes the necessary conservatism to ensure limitations are not exceeded.

5.3 Liquid Effluents

The total activity released from all liquid effluent pathways is summarized in Table 11. Each pathway's contribution to the total activity released is presented in Tables 12 and 13. Total volume of batch discharges for this report period are presented in Table 15. The figures described below were used to identify trends for this report period:

- The monthly whole body and maximum organ doses compared against the total year to date is presented in Figure 1. The dose calculations were performed using corrected LADTAP II results. As expected, the doses increase for the periods corresponding to large volumes of liquid waste being discharged.
- Specific contributions, from individual nuclides released during batch discharges, are presented in Figure 2. The radionuclide concentrations of the waste stream were consistent throughout this report period. As expected, increases in radioactivity released corresponded to larger volumes of water being discharged.

- The tritium released for each month from the RCA Yard Drain pathway is presented in Figure 3. The major contributor to this release point is the discharge of the External Containment Sump, when in operation. A conservative estimate for the effluent volume is used in release calculations for this pathway.

Liquid doses for this report period are calculated using Method 2 (LADTAP II). If necessary, the results are corrected for inconsistent dilution water flow, as documented by Condition Report 01-0483. Condition Report 01-0483 is discussed in section 6.2.4.

5.4 Solid Wastes

The quantities of radioactive material shipped offsite for processing or disposal are summarized in Table 14.

6.0 Related Information

6.1 Radiation Monitors Out of Service for Greater than Thirty Days.

None

6.2 Radioactive Effluent Condition Reports

6.2.1 Alternate Containment Access air particulate sample was not analyzed for gamma activity within 48 hours as required by REMODCM Table D-1, due to personnel error. A Condition Report (01-0236) was generated in response to this finding.

6.2.2 A sample from the External Containment Sump, obtained during site groundwater monitoring, identified Sr-90 at a concentration significantly less than the REMODCM required Lower Limit of Detection. The External Containment Sump discharges to the RCA yard drain system, which is a monitored location included in the REMODCM. The External Containment Sump pumps will be secured until appropriate sample methodology is included in the REMODCM to account for the low concentrations. A Condition Report (01-0406) was generated in response to the positive result.

6.2.3 The second quarter Spray Cooling composite analysis identified Fe-55. The second quarter composite was analyzed for a second time and the positive result was confirmed. Since the first, third and fourth quarter results were less than the detection limits, it is believed the positive second quarter result was due to onsite laboratory sample contamination. The second quarter positive result was included in the

dose calculations performed for this report. A Condition Report (01-0425) was generated in response to the positive result.

6.2.4 A discrepancy with the application of the dose model used for calculating liquid release doses was identified. The liquid dose model assumes the dilution flow used for calculation purposes is constant for the buildup and removal phases of the release. The liquid release practice during historical plant shutdown periods and the decommissioning has been to secure the dilution flow when the release was stopped, thus the buildup and removal rates were not equal as assumed in the model. To adjust the liquid doses for this report, correction factors were applied to the LADTAP II results. The method of generating the correction factors and the bases are contained in Bechtel Health Physics Technical Support Document, 24265-000-G65-GEHH-P0102, "Radioactivity Effluent Analysis for the Year 2001". A Condition Report (01-0483) was generated in response to this deficiency. In the Reportability Evaluation (memo SOV-02-010) it was determined that no applicable limits were exceeded in 2001 or in historically calculated doses.

6.2.5 Third and fourth quarter composite sample results were not received onsite in a timely manner. Although the analyses were completed at the vendor laboratory, results were not forwarded. Both results were eventually received and the results included in this report. Condition Reports (01-0521 and 02-0144) were generated in response to these delays.

7.0 Bechtel Health Physics Technical Support Document

Bechtel Health Physics Technical Support Document, 24265-000-G65-GEHH-P0102, "Radioactivity Effluent Analysis for the Year 2001", was generated to document the calculations performed for this report. Site specific, environmental information and other input data that was necessary to complete this report are listed and discussed in the technical support document.

8.0 REMODCM Revisions in the Year 2001

None

Table 1

2001 Off-Site Dose Commitments from Airborne Effluents

Haddam Neck

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[+]	**3.92E-04**	**1.13E-03**	**1.89E-03**	**3.88E-04**
Skin[+]	**1.14E-02**	**1.36E-02**	**1.25E-02**	**1.65E-02**
Thyroid	**1.14E-02**	**1.36E-02**	**1.25E-02**	**1.65E-02**
Max Organ[++]	**1.14E-02**	**2.26E-02**	**2.59E-02**	**1.90E-02**
Population	(person-rem)	(person-rem)	(person-rem)	(person-rem)
Whole Body	**2.20E-03**	**2.65E-03**	**3.90E-03**	**2.95E-03**
Skin	**2.20E-03**	**2.63E-03**	**3.86E-03**	**2.94E-03**
Thyroid	**2.18E-03**	**2.58E-03**	**3.78E-03**	**2.93E-03**
Max Organ[++]	**2.24E-03**	**2.77E-03**	**4.08E-03**	**2.98E-03**
Avg Individual	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	**5.73E-07**	**6.92E-07**	**1.02E-06**	**7.69E-07**
Skin	**5.73E-07**	**6.85E-07**	**1.01E-06**	**7.66E-07**
Thyroid	**5.70E-07**	**6.74E-07**	**9.86E-07**	**7.63E-07**
Max Organ[++]	**5.84E-07**	**7.23E-07**	**1.06E-06**	**7.78E-07**

[+] External doses only

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

Table 2

2001 Off-Site Dose Commitments from Liquid Effluents
Haddam Neck

CY	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Max Individual	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	**7.12E-02**	**2.93E-01**	**3.92E-04**	**2.22E-01**
Thyroid	**1.37E-03**	**1.49E-02**	**5.67E-06**	**4.89E-02**
Max Organ	**1.11E-01**	**4.50E-01**	**1.92E-02**	**3.43E-01**
Population	(person-rem)	(person-rem)	(person-rem)	(person-rem)
Whole Body	**1.19E+00**	**4.73E+00**	**8.02E-03**	**2.97E+00**
Thyroid	**2.24E-04**	**8.14E-04**	**1.08E-04**	**3.73E-04**
Max Organ	**2.20E+00**	**8.67E+00**	**3.94E-01**	**5.93E+00**
Avg Individual	(mrem)	(mrem)	(mrem)	(mrem)
Whole Body	**3.10E-04**	**1.23E-03**	**2.09E-06**	**7.75E-04**
Thyroid	**5.84E-08**	**2.12E-07**	**2.82E-08**	**9.73E-08**
Max Organ	**5.74E-04**	**2.26E-03**	**1.03E-04**	**1.55E-03**

Table 3

2001 Off-Site Dose Summary
Haddam Neck

Airborne Effluents

Population Dose Commitments
(total person-rem within 50 miles)

Whole Body	Thyroid	Max Organ
1.17E-02	1.15E-02	1.21E-02

Max Individual Dose/Dose Commitments vs 10CFR50, Appendix I

	Whole Body (mrem)	Max Organ (mrem)	Skin (mrem)	Gamma Air Dose (mrad)	Beta Air Dose (mrad)
II.B and II.C Limits	*5*	*15*	*15*	*10*	*20*
Haddam Neck Total	3.79E-03	7.89E-02	5.40E-02	0	0

Liquid Effluents

Population Dose Commitments
(total person-rem within 50 miles)

Whole Body	Thyroid	Max Organ
8.90	1.52E-03	17.19

Max Individual Dose/Dose Commitments vs 10CFR50, Appendix I

	Whole Body (mrem)	Max Organ (mrem)
II.A Limits	*3*	*10*
Haddam Neck Total	5.87E-01	9.23E-01

Table 4

2001 Off-Site Dose Comparison
Haddam Neck

Max Individual Annual Dose vs 40CFR190 Limits

	Whole Body (mrem)	Any Organ (mrem)	Thyroid (mrem)
40CFR190 Limit	*25*	*25*	*75*
Airborne Effluents	3.79E-03	7.89E-02	5.40E-02
Liquid Effluents	5.87E-01	9.23E-01	6.52E-02
Direct Dose*	0	0	0
Haddam Neck Total	5.90E-01	1.00E+00	1.19E-01

* Direct radiation results from indicator TLDs (those considered to be under the influence of the plant) were indistinguishable from the results of control TLDs (those located far enough away from the plant, an average of 10 miles distant, to not be influenced by the plant; the control TLDs measure weapons testing fallout and naturally occurring radiation). These results are discussed in the 2001 CY Annual Radiological Environmental Operating Report.

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	**2.32E-03 mrem**

Maximum Individual (within 50 miles) Whole Body Dose from Haddam Neck Plant Airborne and Liquid Effluents	**5.90E-01 mrem**

Table 5
Haddam Neck
Airborne Effluents - Total Release Summary

	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
1. Total Activity Released	Ci	-	-	-	-	-
2. Average Release Rate	uCi/sec	-	-	-	-	-
B. Iodines						
1. Total Activity Released	Ci	-	-	-	-	-
2. Average Release Rate	uCi/sec	-	-	-	-	-
C. Particulates						
1. Total Activity Released	Ci	2.44E-06	6.53E-05	2.44E-05	4.19E-06	9.63E-05
2. Average Release Rate	uCi/sec	3.14E-07	8.30E-06	3.07E-06	5.27E-07	3.05E-06
D. Gross Alpha						
1. Total Activity Released	Ci	-	-	-	-	-
E. Tritium						
1. Total Activity Released	Ci	1.09E+00	6.37E-01	8.79E-01	7.09E-01	3.31E+00
2. Average Release Rate	uCi/sec	1.40E-01	8.10E-02	1.11E-01	8.92E-02	1.05E-01

- (For Fission & Act Gas) = < Lower Limit of Detection as specified in the REMODCM
- (For Iodine's) = Not Required to be analyzed.
- (For Gross Alpha) = < Lower Limit of Detection as specified in the REMODCM

Table 6

Haddam Neck

Airborne Effluents - Mixed Mode Continous

Main Stack

Nuclides Released	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines						
I-131	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Co-60	Ci	-	1.44E-06	5.03E-06	-	6.47E-06
Cs-137	Ci	2.38E-07	1.82E-07	2.49E-06	7.45E-07	3.65E-06
Total Activity	Ci	2.38E-07	1.62E-06	7.52E-06	7.45E-07	1.01E-05
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	7.23E-01	1.58E-01	4.68E-01	1.20E-01	1.47E+00

- (For Fission & Act Gas) = Not Required to be analyzed.
- (For Iodine's) = Not Required to be analyzed.
- (For Particulates) = < Lower Limit of Detection as specified in the REMODCM
- (For Gross Alpha) = < Lower Limit of Detection as specified in the REMODCM

Table 7

Haddam Neck

Airborne Effluents - Ground Continuous

Spent Fuel Building Exhaust

Nuclides Released	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines						
I-131	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Cs-137	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	3.33E-01	4.79E-01	4.11E-01	5.89E-01	1.81E+00

- (For Fission & Act Gas) = < Lower Limit of Detection as specified in the REMODCM
- (For Iodine's) = Not Required to be analyzed
- (For Particulates) = < Lower Limit of Detection as specified in the REMODCM
- (For Gross Alpha) = < Lower Limit of Detection as specified in the REMODCM

Table 8

Haddam Neck

Airborne Effluents - Ground Continuous

Spent Fuel Spray Cooling

Nuclides Released	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines						
I-131	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Fe-55	Ci	-	5.29E-05	-	-	5.29E-05
Co-60	Ci	1.08E-08	2.12E-06	2.78E-06	4.50E-07	5.36E-06
Cs-134	Ci	8.42E-10	8.20E-07	1.25E-06	1.94E-07	2.27E-06
Cs-137	Ci	1.46E-08	7.79E-06	1.16E-05	2.21E-06	2.16E-05
Total Activity	Ci	2.62E-08	6.36E-05	1.56E-05	2.86E-06	8.21E-05
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	1.32E-06	2.11E-04	5.32E-04	1.82E-04	9.26E-04

- (For Fission & Act Gas) = Not Required to be analyzed.
- (For Iodine's) = Not Required to be analyzed.
- (For Particulates) = < Lower Limit of Detection as specified in the REMODCM
- (For Gross Alpha) = < Lower Limit of Detection as specified in the REMODCM

Table 9

Haddam Neck

Airborne Effluents - Ground Continuous

Alternate Containment Access

Nuclides Released	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines						
I-131	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Co-60	Ci	2.18E-06	-	9.17E-07	2.22E-07	3.32E-06
Total Activity	Ci	2.18E-06	-	9.17E-07	2.22E-07	3.32E-06
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	3.40E-02	-	-	-	3.40E-02

- (For Fission & Act Gas) = Not Required to be analyzed.
- (For Iodine's) = Not Required to be analyzed.
- (For Particulates) = < Lower Limit of Detection as specified in the REMODCM
- (For tritium) = < Lower Limit of Detection as specified in the REMODCM
- (For Gross Alpha) = < Lower Limit of Detection as specified in the REMODCM

Table 10

Haddam Neck

Airborne Effluents - Ground Continuous

Cable Vault

Nuclides Released	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Gases						
	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
B. Iodines						
I-131	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
C. Particulates						
Co-60	Ci	-	-	3.15E-07	3.64E-07	6.79E-07
Total Activity	Ci	-	-	3.15E-07	3.64E-07	6.79E-07
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-
E. Tritium						
H-3	Ci	-	-	-	-	-

- (For Fission & Act Gas) = Not Required to be analyzed
- (For Iodine's) = Not Required to be analyzed
- (For Particulates) = < Lower Limit of Detection as specified in the REMODCM
- (For tritium) = Not Required to be analyzed.
- (For Gross Alpha) = < Lower Limit of Detection as specified in the REMODCM

Table 11
Haddam Neck
Liquid Effluents - Total Release Summary

		2001				
	Units	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission and Activation Products						
1. Total Activity Released	Ci	6.23E-03	3.68E-02	2.13E-05	8.67E-02	1.30E-01
2. Average Period Diluted Activity	uCi/ml	2.97E-09	1.33E-08	1.87E-11	6.67E-08	1.78E-08
B. Tritium						
1. Total Activity Released	Ci	2.53E-01	1.74E+00	3.04E-02	7.73E-01	2.80E+00
2. Average Period Diluted Activity	uCi/ml	1.20E-07	6.28E-07	2.67E-08	5.94E-07	3.82E-07
C. Dissolved and Entrained Gases						
1. Total Activity Released	Ci	-	-	-	-	-
2. Average Diluted Activity	uCi/ml	-	-	-	-	-
D. Gross Alpha						
1. Total Activity Released	Ci	1.43E-04	3.55E-04	-	2.97E-03	3.47E-03
E. Volume						
1. Released Waste Volume	Liters	1.12E+07	1.14E+07	1.19E+07	1.24E+06	3.57E+07
2. Dilution Volume During Releases	Liters	2.10E+09	2.77E+09	1.14E+09	1.30E+09	7.31E+09
3. Dilution Volume During Period	Liters	2.10E+09	2.77E+09	1.14E+09	1.30E+09	7.31E+09

- (For Dissolved & Entrained Gases) = < Lower Limit of Detection as specified in the REMODCM
- (For Gross Alpha) = Not required to be analyzed in 3rd quarter

Table 12
Haddam Neck
Liquid Effluents - Batch
(Test Tanks)

Nuclides Released	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
Am-241	Ci	1.04E-04	2.78E-04	-	2.13E-03	2.51E-03
Co-60	Ci	1.62E-03	2.23E-02	-	7.00E-02	9.39E-02
Cs-134	Ci	6.82E-05	2.57E-04	-	8.36E-05	4.09E-04
Cs-137	Ci	1.11E-03	4.33E-03	-	2.30E-03	7.74E-03
Eu-154	Ci	4.03E-05	8.58E-05	-	8.38E-04	9.64E-04
Eu-155	Ci	-	-	-	7.45E-05	7.45E-05
Fe-55	Ci	2.73E-03	8.85E-03	-	1.11E-02	2.27E-02
Mn-54	Ci	-	3.14E-05	-	-	3.14E-05
Sb-125	Ci	5.27E-04	7.08E-04	-	1.11E-04	1.35E-03
Sr-90	Ci	2.97E-05	-	-	5.15E-05	8.12E-05
Total Activity	Ci	6.23E-03	3.68E-02	-	8.67E-02	1.30E-01
B. Tritium						
H-3	Ci	2.15E-01	1.71E+00	-	7.71E-01	2.70E+00
C. Dissolved & Entrained Gases						
	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	1.43E-04	3.55E-04	-	2.97E-03	3.47E-03

- (3^{rd} quarter) = Test Tanks were not released in 3^{rd} quarter, analysis not performed
- (For Fission & Act Products) = < Lower Limit of Detection as specified in the REMODCM
- (For Dissolved & Entrained Gases) = < Lower Limit of Detection as specified in the REMODCM
- (For Gross Alpha) = Not required to be analyzed

Table 13

Haddam Neck

Liquid Effluents - Continuous

(Yard Drain 6)

Nuclides Released	Units	2001				
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Total
A. Fission & Activation Products						
Sr-90	Ci	-	-	2.13E-05	-	2.13E-05
Total Activity	Ci	-	-	2.13E-05	-	2.13E-05
B. Tritium						
H-3	Ci	3.78E-02	2.92E-02	3.04E-02	1.75E-03	9.92E-02
C. Dissolved & Entrained Gases						
	Ci	-	-	-	-	-
Total Activity	Ci	-	-	-	-	-
D. Gross Alpha						
Gross Alpha	Ci	-	-	-	-	-

- (For Fission & Act Products), Sr-90 = Not Required to be analyzed
- (For Fission & Act Products), Gamma Activity = < Lower Limit of Detection as specified in the REMODCM
- (For Dissolved & Entrained Gases) = < Lower Limit of Detection as specified in the REMODCM
- (For Gross Alpha) = Not Required to be analyzed

Table 14
Haddam Neck
2001 Solid Waste and Irradiated Fuel Shipments

A. Solid Waste Shipped Offsite for Disposal and Estimates of Major Nuclides by Waste Class and Stream

1. Type of Waste

a. Waste Stream : Resins, Filters, and Evap Bottoms

Fuel Pool Carbon	Legacy Low Level Resin	8-120 Cavity Filters
L500472-1 Filters	Legacy High Level Resin	

Waste Class	Volume M^3	Curies Shipped	%Error (Ci)
A	2.34E+01	6.49E+01	+/-25%
B	1.02E+01	1.83E+02	-
C	9.38E+00	1.52E+02	+/-25%
All	**4.30E+01**	**4.00E+02**	**+/-25%**

b. Waste Stream : Dry Active Waste

Dry Active Waste 20'	Dry Active Waste 40'	Bus 10 Concrete	RCP's
DAW in Intermodal	DAW in B-25	Primary piping Sea/Land	SGSA#3
Bus 10 Soil in B-25	D Box of Cavity Waste	Cavity waste in 20' Shielded C-Van	
High Cs:Co DAW 20' High Top			

Waste Class	Volume M^3	Curies Shipped	%Error (Ci)
A	8.19E+03	2.62E+01	+/-25%
B	0.00E+00	0.00E+00	-
C	2.03E+02	1.26E+03	+/-25%
All	**8.40E+03**	**1.28E+03**	**+/-25%**

Table 14

(continued)

c. Waste Stream : Irradiated Components

CRD's	Thermal Sleeves in L4 Excores

Waste Class	Volume M^3	Curies Shipped	% Error (Ci)
A	1.08E+00	4.03E+00	+/-25%
B	0.00E+00	0.00E+00	-
C	1.20E+01	2.82E+01	+/-25%
All	**1.31E+01**	**3.23E+01**	**+/-25%**

d. Waste Stream : Other Waste

Combined Packages	Oil Bin/Six Pack	Garnet HIC #5	Concrete Block
RV Head	Garnet/Char HIC #7	Contaminated Liquid 55 gal.	

Waste Class	Volume M^3	Curies Shipped	% Error (Ci)
A	2.36E+02	4.77E+01	+/-25%
B	6.81E+00	1.14E+03	+/-25%
C	1.02E+01	2.61E+03	+/-25%
All	**2.53E+02**	**3.80E+03**	**+/-25%**

e. Waste Stream : Sum of all 4 Waste Streams

Waste Class	Volume M^3	Curies Shipped	% Error (Ci)
A	8.45E+03	1.43E+02	+/-25%
B	1.70E+01	1.32E+03	+/-25%
C	2.35E+02	4.05E+03	+/-25%
All	**8.70E+03**	**5.51E+03**	**+/-25%**

Table 14

(continued)

2. Estimate of Major Nuclide Composition (by waste stream)

	Composition in % for each waste stream					Total
Nuclide	a.	b.	c.	d.	e.	Curies
H-3	0.005%	0.000%	0.033%	0.001%	0.002%	9.17E-02
C-14	0.016%	0.001%	0.008%	0.009%	0.007%	4.08E-01
K-40	0.000%	0.002%	0.000%	0.000%	0.001%	4.40E-02
Mn-54	0.819%	0.075%	0.008%	0.447%	0.385%	2.12E+01
Fe-55	33.517%	15.186%	43.753%	42.908%	35.777%	1.97E+03
Co-57	0.007%	0.005%	0.011%	0.000%	0.002%	1.04E-01
Co-58	0.062%	0.000%	0.000%	0.000%	0.004%	2.48E-01
Co-60	35.322%	74.193%	38.505%	45.565%	51.446%	2.84E+03
Ni-59	0.065%	0.025%	1.956%	0.123%	0.107%	5.87E+00
Ni-63	9.135%	6.801%	14.167%	10.255%	9.392%	5.18E+02
Sr-89	0.000%	0.000%	0.000%	0.000%	0.000%	3.68E-03
Sr-90	0.056%	0.017%	0.006%	0.040%	0.036%	1.97E+00
Nb-94	0.000%	0.000%	0.048%	0.000%	0.001%	3.28E-02
Tc-99	0.000%	0.001%	0.022%	0.000%	0.001%	3.25E-02
Ru-106	0.000%	0.000%	0.012%	0.000%	0.000%	3.97E-03
Sb-124	0.004%	0.000%	0.000%	0.000%	0.000%	1.46E-02
I-129	0.000%	0.000%	0.001%	0.000%	0.000%	3.71E-03
Cs-134	6.061%	0.004%	0.000%	0.001%	0.442%	2.43E+01
Cs-137	14.764%	0.036%	0.022%	0.007%	1.084%	5.98E+01
Ce-144	0.081%	0.009%	0.007%	0.617%	0.433%	2.39E+01
Eu-152	0.000%	0.000%	0.000%	0.000%	0.000%	3.09E-03
Eu-154	0.000%	0.000%	0.044%	0.000%	0.001%	3.18E-02
Pb-212	0.000%	0.000%	0.000%	0.000%	0.000%	5.30E-48
Ac-228	0.000%	0.000%	0.000%	0.000%	0.000%	4.28E-48
Th-228	0.000%	0.000%	0.000%	0.000%	0.000%	7.77E-04
Th-230	0.000%	0.000%	0.000%	0.000%	0.000%	2.84E-03
U-233	0.000%	0.000%	0.000%	0.000%	0.000%	1.47E-03
U-234	0.000%	0.000%	0.000%	0.000%	0.000%	1.47E-03
U-238	0.000%	0.000%	0.000%	0.000%	0.000%	2.80E-03
Np-237	0.000%	0.000%	0.006%	0.000%	0.000%	3.16E-03
Pu-238	0.003%	0.196%	0.063%	0.001%	0.047%	2.60E+00
Pu-239	0.000%	0.032%	0.010%	0.000%	0.008%	4.24E-01
Pu-240	0.000%	0.032%	0.010%	0.000%	0.008%	4.23E-01
Pu-241	0.074%	3.108%	1.187%	0.019%	0.749%	4.13E+01
Am-241	0.003%	0.211%	0.093%	0.001%	0.051%	2.79E+00
Cm-242	0.000%	0.000%	0.000%	0.000%	0.000%	1.67E-03
Cm-243	0.002%	0.033%	0.013%	0.001%	0.009%	4.84E-01
Cm-244	0.000%	0.032%	0.014%	0.001%	0.008%	4.66E-01

Table 14

(continued)

3. Solid Waste Disposition

Mode of Transportation	No. Shipments	Destination
Hittman Transport	24	Barnwell Waste Management Facility
Hittman Transport	2	Chem-Nuclear Consolidation Facility
Hittman Transport	1	Diversified Scientific Service, Inc.
Hittman Transport	7	Envirocare of Utah, Inc.
Hittman Transport	43	GTS Duratek, Inc. (BCO)
Hittman Transport	139	GTS Duratek, Inc. (GR)
Hittman Transport	1	Perma Fix of Florida
Lockwood Marine	2	Barnwell Waste Management Facility
Lomma	3	Envirocare of Utah, Inc.
Robbins	1	Envirocare of Utah, Inc.

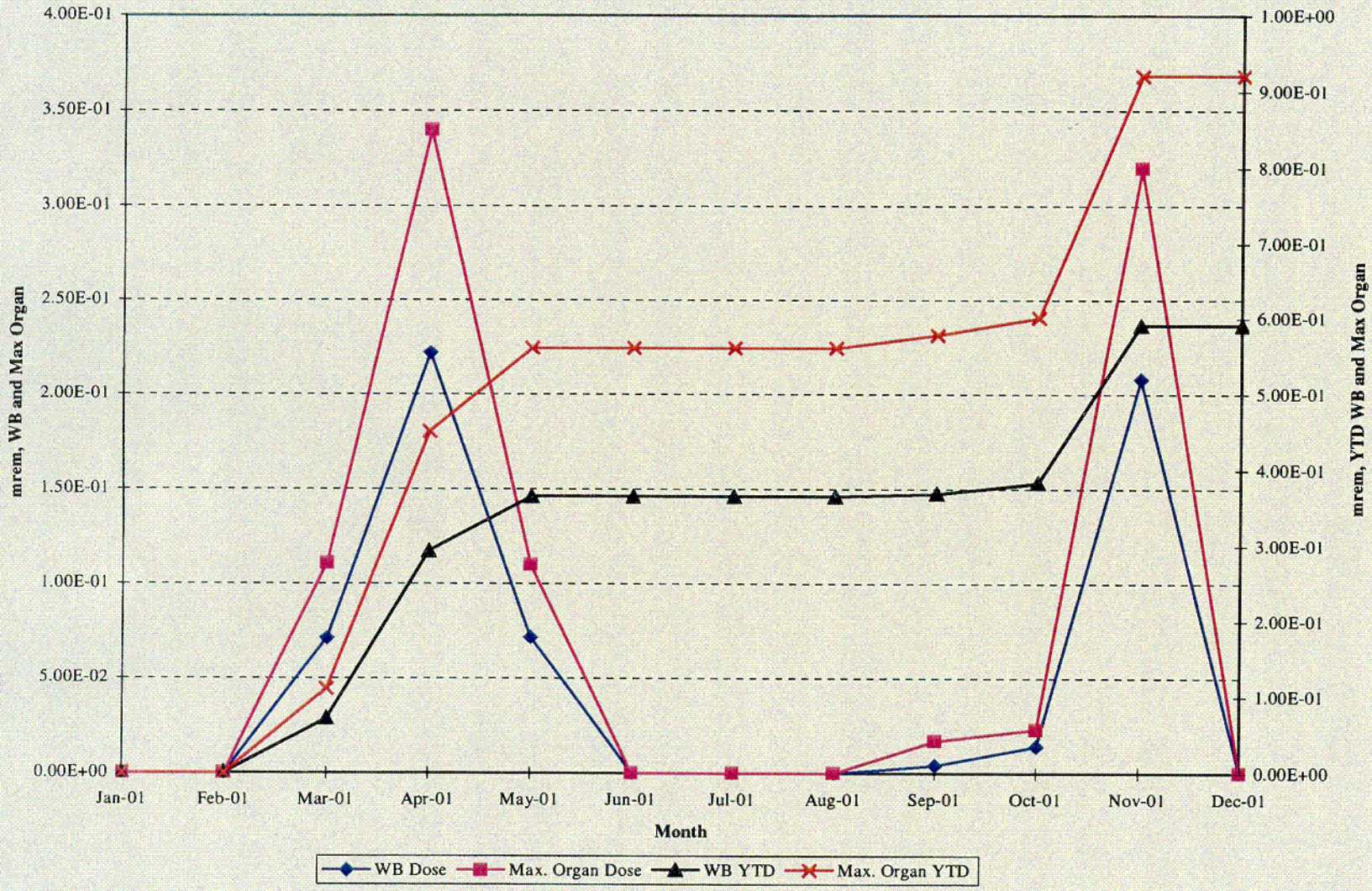
B. Irradiated Fuel Shipments (disposition)

NONE

Table 15
Monthly Liquid Release Volumes for the Waste or Recycle Test Tanks for 2001

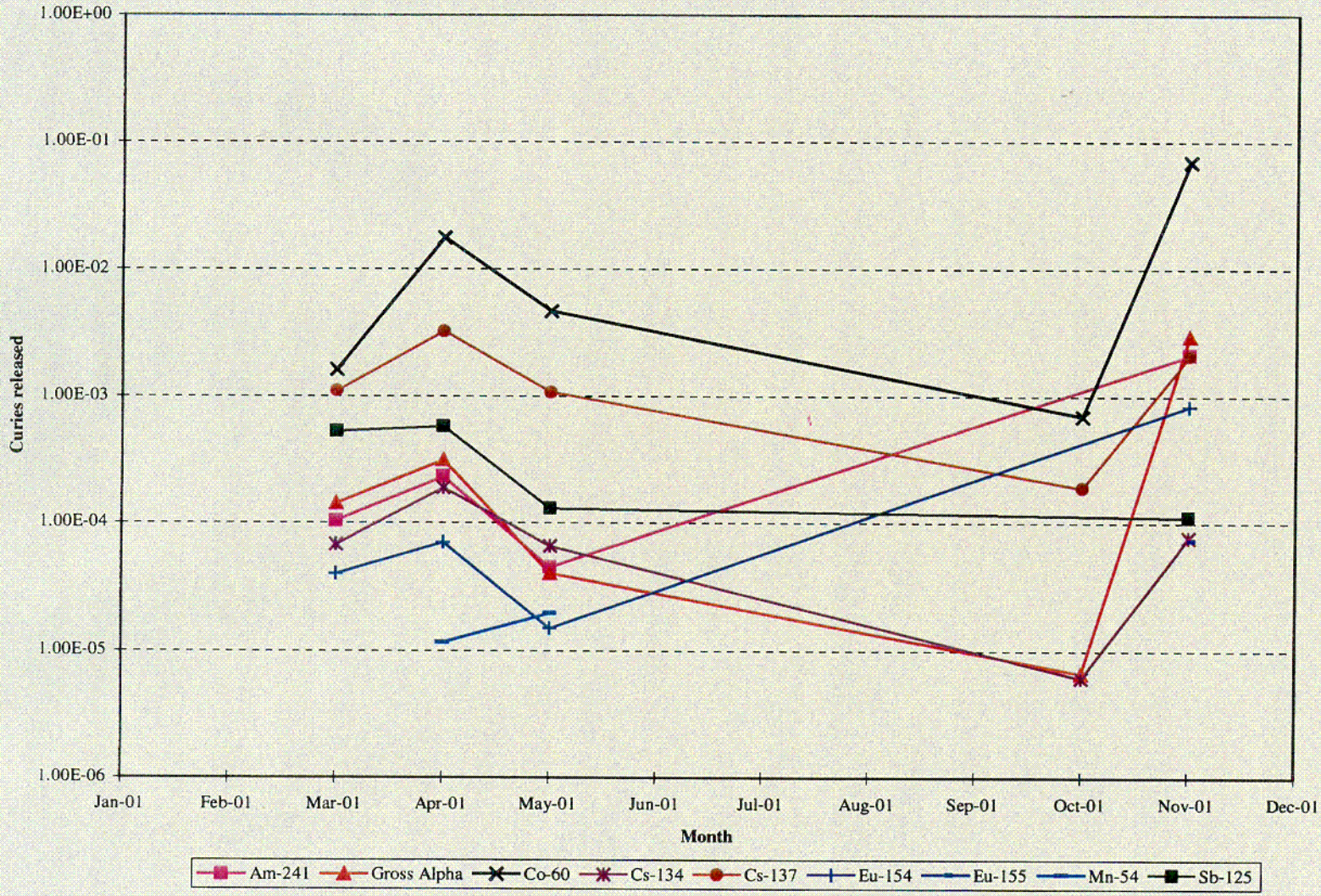
Month	***Volume Released (gallons)***
January	0
February	0
March	34,600
April	67,600
May	23,700
June	0
July	0
August	0
September	0
October	40,760
November	60,700
December	0
YTD	***227,360***

Figure 1
Liquid Dose 2001
Haddam Neck



C01

Figure 2
Test Tank Activity Released 2001
Haddam Neck



C02

Figure 3
ECS Tritium Released 2001
Haddam Neck

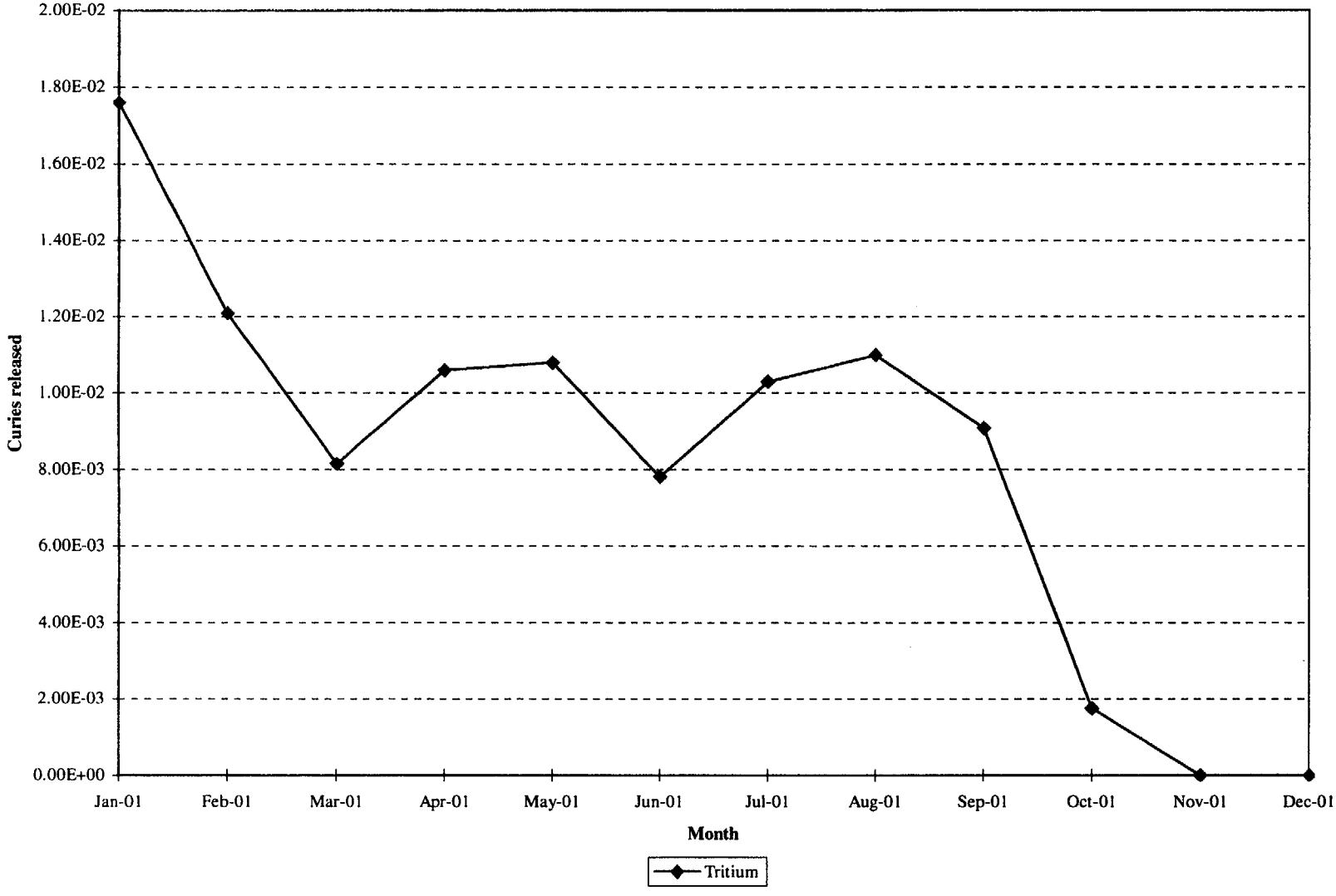


Figure 4
Gaseous Effluent Dose 2001
Haddam Neck

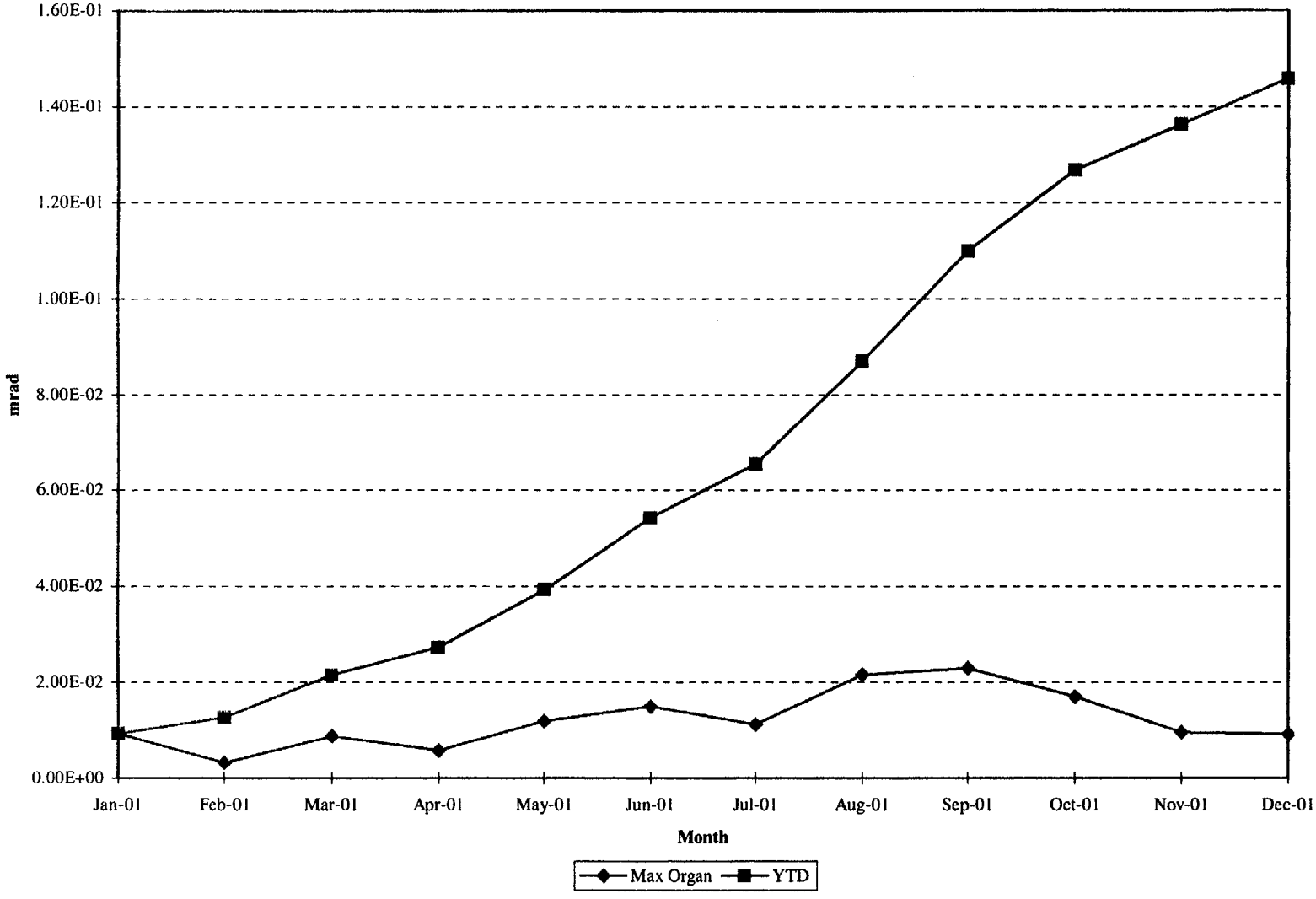


Figure 5
Main Stack Gaseous Tritium Actvitiy Released 2001
Haddam Neck

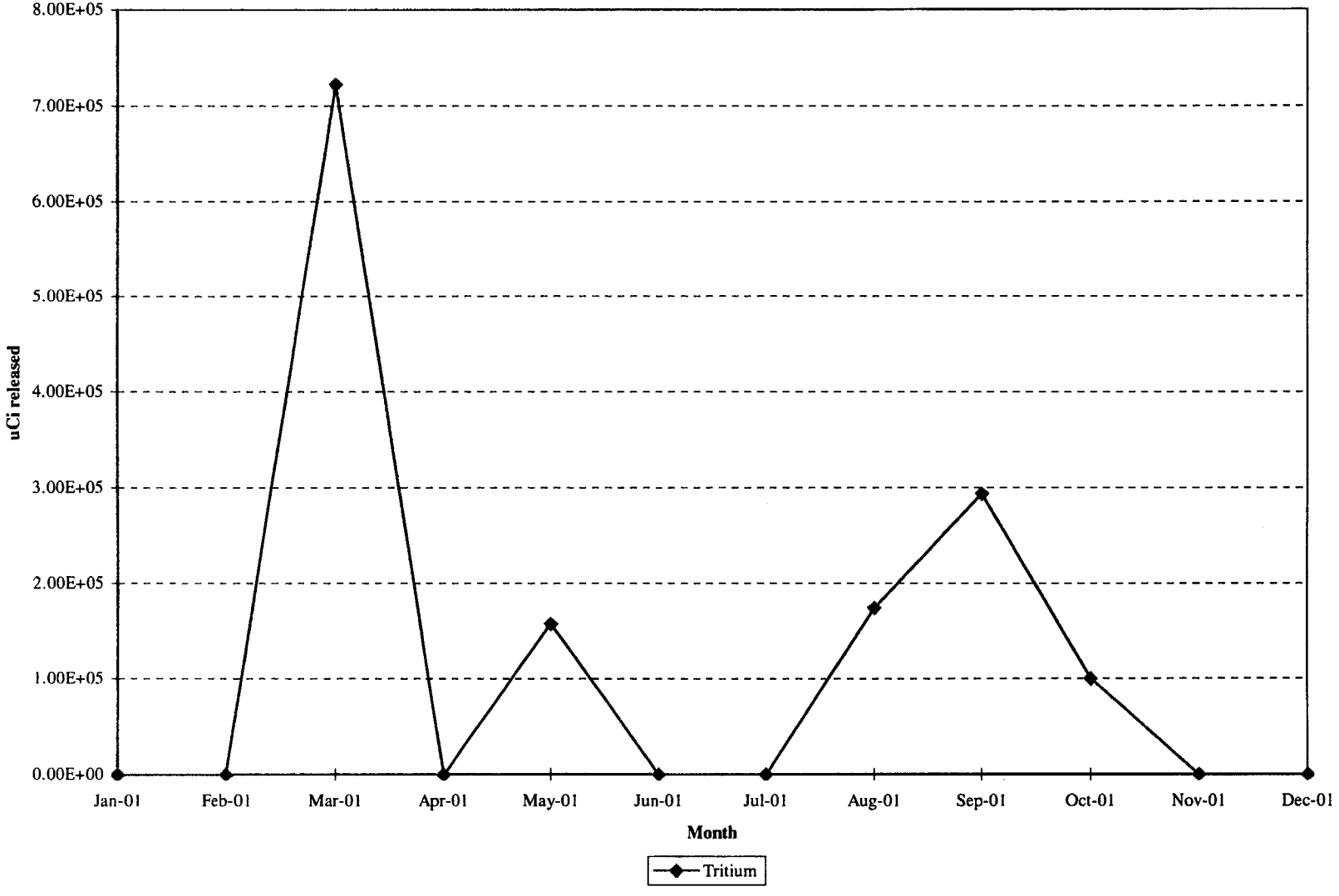


Figure 6
Spent Fuel Building Gaseous Tritium Released 2001
Haddam Neck

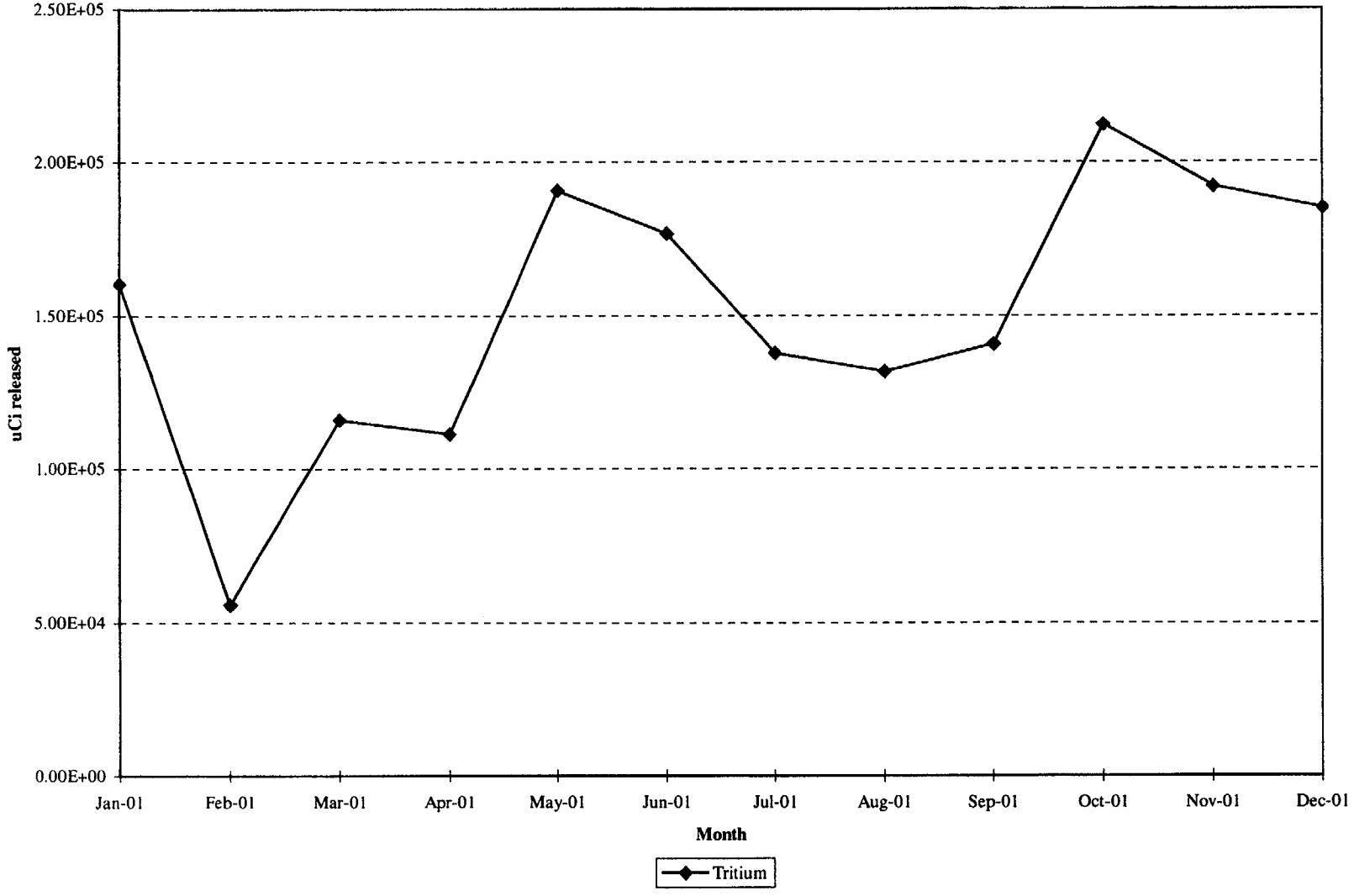


Figure 7
Alt. Containment Access Gamma Activity Released 2001
Haddam Neck

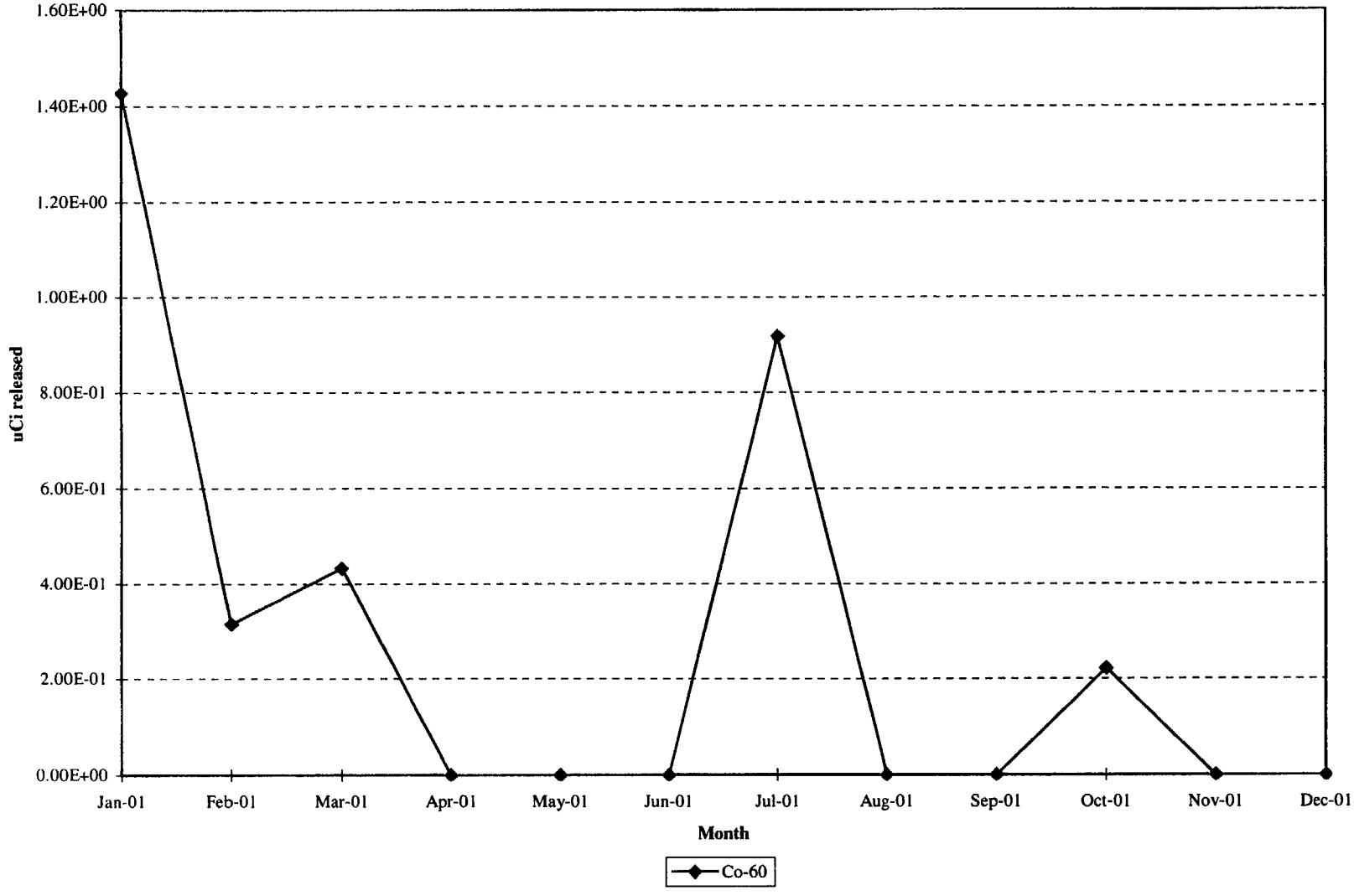


Figure 8
Spray Cooling Release Rates During 2001 System Operation (uCi/hr)
Haddam Neck

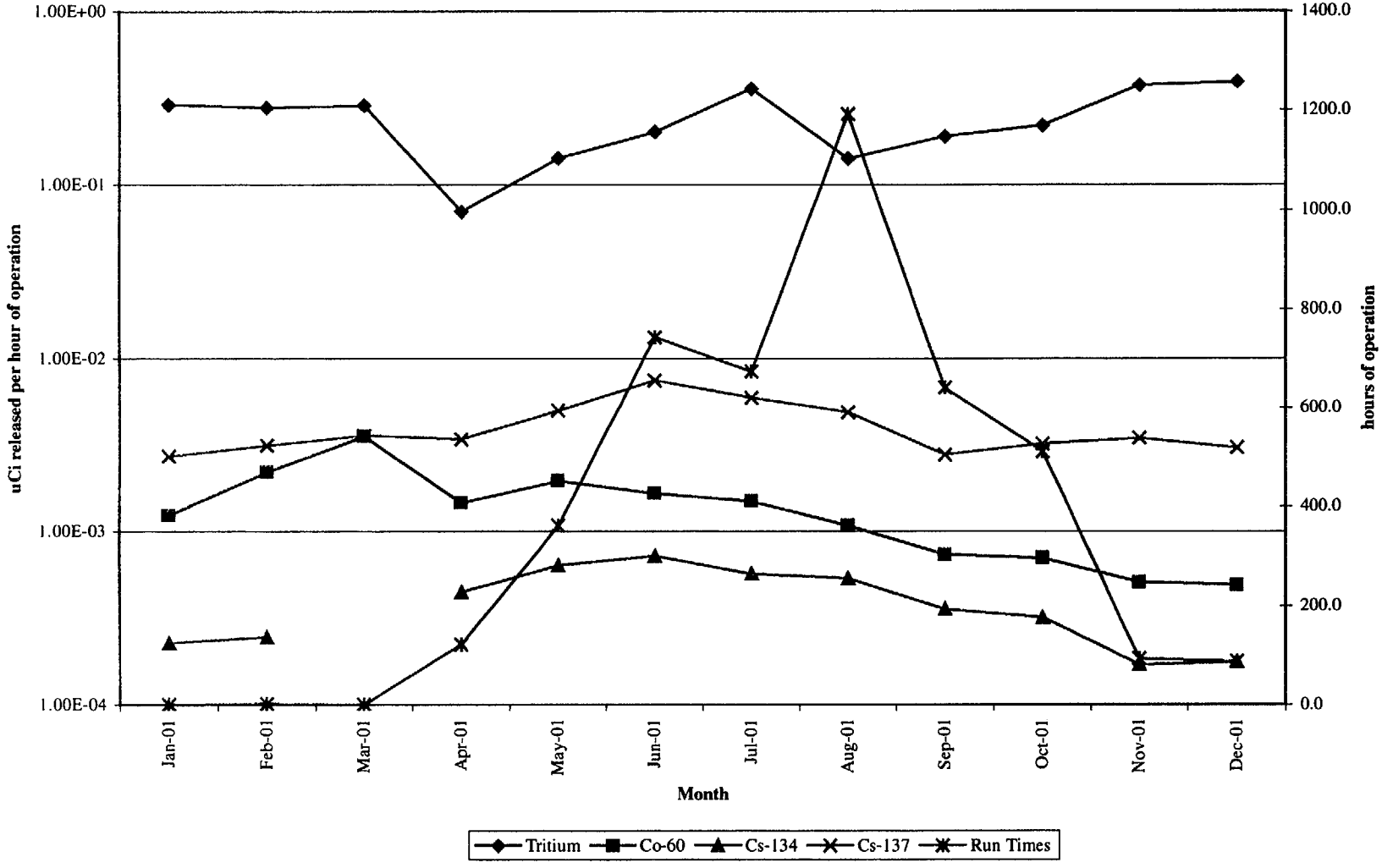


Figure 9
Total Dose 2001 for 40 CFR Part 190
Haddam Neck