CONNECTICUT YANKEE ATOMIC POWER COMPANY

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March 30, 1987

Docket No. 50-213
B12472
Re: 10 CFR 50.36a

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Reference: (1) E. J. Mroczka letter to the U. S. Nuclear Regulatory Commission, "Semiannual Radioactive Effluent Release Report," dated February 27, 1987.

Gentlemen:

Haddam Neck Plant
Annual Radioactive Effluents Dose Report

In accordance with the requirements of 10 CFR 50.36a and the Radiological Effluent Technical Specifications, a copy of the Annual Radioactive Effluents Dose Report is herewith submitted.

This report includes a summary of the assessment of maximum individual and population dose commitment resulting from routine radioactive airborne and liquid effluents for the period of January - December, 1986. Copies of the report are being forwarded in accordance with the provisions of 10 CFR 50.4(b)(1).

Delayed sample analysis of Sr-89, Sr-90, and gross alpha for the last quarter of 1986, as noted in Reference (1), have been completed, and updated tables are included as Appendix A in this report.

Very truly yours,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

E. J. Mroczka
Senior Vice President

cc: Dr. T. E. Murley, Region 1 Administrator
F. M. Akstulewicz, NRC Project Manager, Haddam Neck Plant
P. D. Swetland, Resident Inspector, Haddam Neck Plant

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1.0 INTRODUCTION

This annual report presents a summary of the estimated offsite radiation doses from routine releases of radioactive materials in airborne and liquid effluents for each unit. These include the annual population dose commitments (Person-Rem) for the annular region out to 50 miles from 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.

The radiation doses resulting from the calendar year of airborne and liquid effluents are integrated over a 50 year time span, taking into account the effective decay and removal of the radioactive materials contributing to the dose for each individual in the population. The population dose commitment is the summation of the calculated individual doses with units of Person-Rem.

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.

2.0 OFFSITE DOSE INFORMATION

In accordance with the requirements of the Technical Specifications and Regulatory Guide 1.21, the offsite dose to humans from the airborne and liquid radioactive effluents of Haddam Neck have been calculated.

These estimations are performed using measured radioactive effluent data, measured meteorological data, and calculational models developed by the U.S. Nuclear Regulatory Commission (NRC) and Environmental Protection Agency (EPA).

The dose estimates generally tend to be conservative due to the use of conservative assumptions in the calculational models. More realistic estimates of the offsite dose are obtained by analysis of the environmental monitoring data. A comparison of the doses estimated by each of the above methods will be presented in the Annual Radiological Environmental Monitoring Report.

Calculation of Population & Maximum Individual Dose Commitment

Population dose commitment is defined as the total radiation dose received by the specified population during a specified period of time from an identified source of radiation. For purposes of this report, the population is taken to be within the annular area surrounding the nuclear site out to a 50 mile outer radius. Figure 1 illustrates this area.

The radiation doses resulting from one calendar year of airborne and liquid effluents are integrated over a 50 year period, taking into account the radioactive decay and biological elimination of the radioactive materials contributing to the dose. The population dose commitment (units of person-rem) is the sum of the calculated individual doses.

The dose calculations involved the input of three types; radioactive source term data, site specific data, and generic factors. The radioactive source term (units of Curies) is obtained from the Semiannual Radioactive Effluents Report. The site specific data includes the meteorological data (wind speed, direction, stability, etc.) to calculate the transport and dispersion of airborne radioactive effluents, dilution factors for liquid effluents, the population distribution and demographic profile surrounding the site divided into 16 compass sectors. Other site specific data include the annual average production of milk, meat, vegetation, fish and shellfish. The generic data includes the annual average consumption rates (inhalation of air and ingestion of fruits, vegetables, leafy vegetables, grains, milk, poultry, meat, fish, and shellfish), and occupancy factors (air submersion and ground irradiation, shoreline activity, swimming, boating, etc) for determination of dose to the individual who would receive the maximum dose (maximum individual).

All these factors are input into the appropriate dose model for converting radioactive airborne and liquid effluents data into population and individual dose commitments.

a. Airborne Radioactive Effluents

Maximum individual doses and population doses due to the release of noble gases, radiodines and particulates were calculated using the computer code GASPAR[1].

The GASPAR code uses the semi-infinite cloud model to implement the dose models of U.S.N.R.C. Regulatory Guide 1.109 (October, 1977).

The values of average relative effluent concentration (X/Q) and average relative deposition (D/Q) used in the GASPAR code were generated using a meteorological computer code which implements the assumptions given in Section C of NRC Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."

The annual summary of hourly meteorological (15 minute increments) data collected for the year is not included in this report but is available from computer storage. This data includes, wind speed, direction and atmospheric stability and joint frequency distributions.

Releases from the 175-foot vent stack were considered as a mixed mode release (partially elevated and partially ground). The Pasquill stability classes were determined using the temperature

gradient between the 33-foot and the 196-foot levels of the meteorological tower.

The GASPAR code was run for continuous releases through the vent (building ventilation) and batch releases through the vent (waste gas tanks, vent header, volume control tanks, and containment purge). The resulting doses were then summed to determine the total dose.

b. Liquid Radioactive Effluents

Maximum individual and population doses due to the release of radioactive liquid effluents were calculated using the computer code LADTAP[4]. The code implements the dose models and parameters given in Regulatory Guide 1.109 (October 1977).

3.0 DISCUSSION OF RESULTS

a. 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 depositon, inhalation, vegetation, cow's milk and meat.

The values presented are a total from all pathways, however, only the whole body, skin and maximum organ dose are presented. The maximum organ dose in all cases was to the thyroid, and thus, the dose to all other organs was less than that shown for the thyroid.

For the dose to the maximum individual, the GASPAR program 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.

For the plume and inhalation pathways, the maximum individual dose is calculated at the offsite location of highest decayed X/Q where a potential for dose exists.

For the ground deposition, the maximum individual dose is calculated at the offsite maximum land location of highest

decayed X/Q and highest D/Q where a potential for dose exists. For the vegetation pathway, the maximum individual dose is calculated at the vegetable garden of highest D/Q. For the meat, cow's milk and goat's milk pathways, the calculated dose is included for the maximum individuals dose only at locations and times where these pathways actually exist. Doses were calculated at the cow farm and goat farm of maximum deposition. The doses presented in Table 1 are the maximum doses observed. To demonstrate compliance with 10CFR50 Appendix I, the maximum individual whole body dose only includes the external pathways (plume and ground exposure) while the maximum individual organ dose only includes the internal pathways. Population doses include all applicable pathways.

Maximum individual and population doses are presented in Table 1.

b. Liquid Effluents

The LADTAP code performs calculations for the following pathways: fish, shellfish, algae, drinking water, irrigated food, shoreline activity, swimming and boating. In the vicinity of Connecticut Yankee, the shellfish, algae, drinking water and irrigated food pathways do not exist. Therefore, the maximum individual doses do not consider these pathways. The population doses considers all applicable pathways within 50 miles.

Doses are calculated for the whole body, skin, thyroid, GI-LLI, bone, liver, kidney and lungs. Calculations are performed separately for adults, teenagers, and children.

Table 2 presents the doses to the whole body, thyroid, and the maximum organ dose. Unless otherwise noted in the table, the doses given are adult doses.

c. Analysis of Results

The doses are well below permissible levels and small in comparison to the dose from natural background radiation. The statistical expectation of health effects from the calculated radiation dose due to plant operations is insignigicant. For perspective, Table 3 presents a comparison between the doses due to plant operation and doses received from other sources such as the naturally occurring background levels. The table also presents the legally allowed levels from 40CFR190.

FOOTNOTES

(1) GASPAR Dose Code, K. F. Eckerman, Radiological Assessment Branch, U.S. Nuclear Regulatory Commission, Washington, D.C., - Revised 2/20/76.

(2) AIREM Program Manual - A computer Code for Calculating Doses, Population Doses; and Ground Depositions due to Atmospheric Emissions of Radionuclides, J. A. Marlin, Jr., C. B. Nelson and P. A. Cuny, U.S. EPA Office of Radiation Programs, Washington, D.C., May, 1974.

(3) Cooper, R. E., EGAD - A Computer Program to Compute Dose Integrals from External Gamma Emitters, DF-1304. Mathematics and Computers (TID-4500, VC32), Savannah River Laboratory, Aiken, S.C., September, 1972.

(4) LADTAP - U. S. Nuclear Regulatory Commission; Washington, D. C.

Figure 1

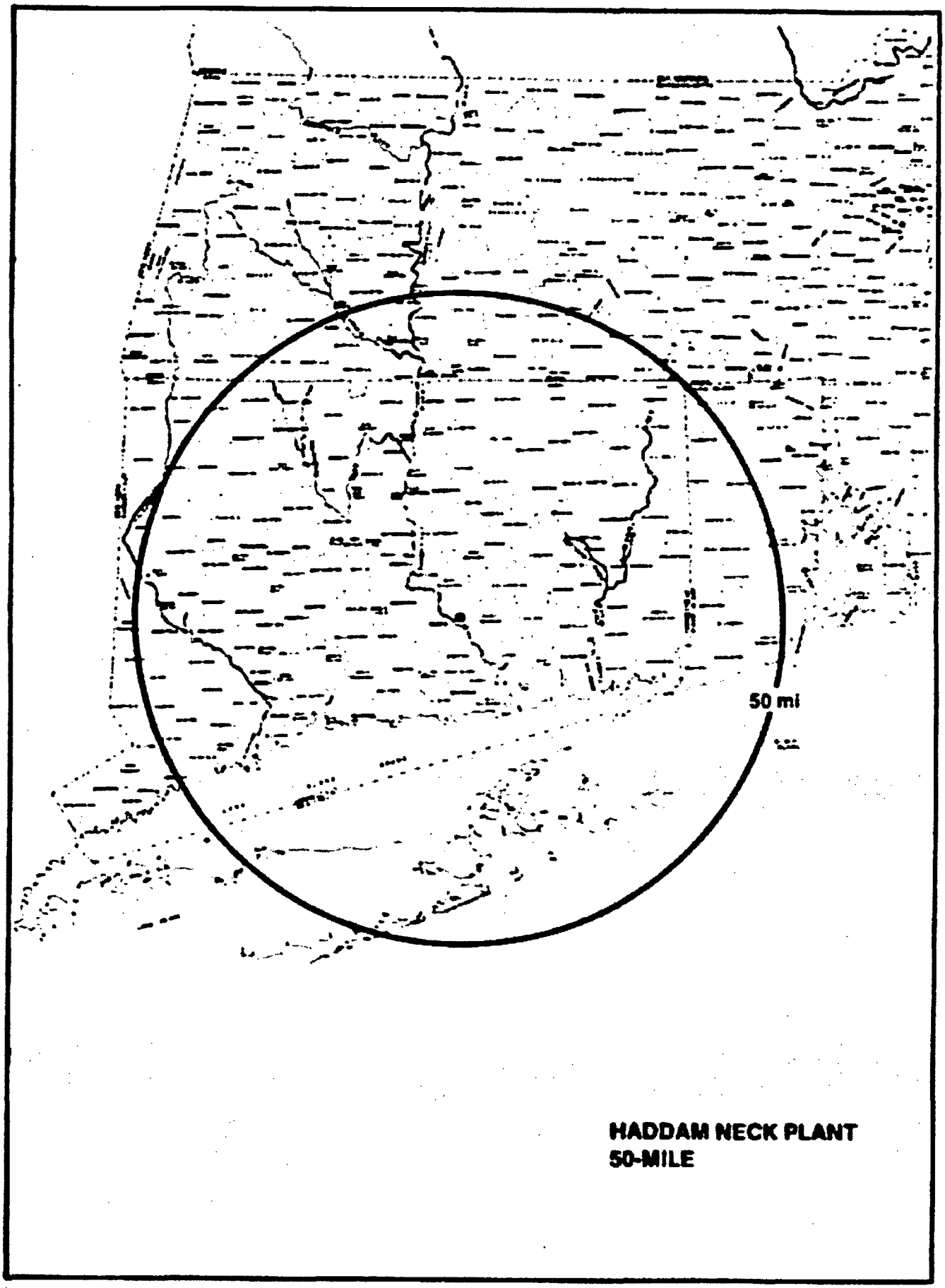

TABLE 1

OFFSITE DOSE COMMITMENTS (AIRBORNE)

Connecticut Yankee - 1986

AIRBORNE EFFLUENTS	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1. Maximum Individual Dose (mrem)				
a. Whole Body (External)	2.53E-1 @.4mi NNE	1.23E-2 @.4mi NNE	8.40E-2 @.3mi NNW	4.34E-2 @.4mi NE
b. Skin (External)	7.44E-1 @.4mi NNE	3.41E-2 @.4mi NNE	2.28E-1 @.3mi NNW	8.36E-2 @.4mi NNE
c. Thyroid (Internal)	5.41E-2 @.3mi NNW (teen)	5.88E-3 @.9mi SE (child)	9.01E-2 @1.5mi NW (infant)	3.30E-3 @.4mi NNE (teen)
2. Population Dose (Person-Rem) (0-50 Miles)				
a. Whole Body	1.15E+0	4.02E-2	1.75E-1	8.05E-2
b. Skin	3.93E+0	1.03E-1	6.14E-1	1.99E-1
c. Thyroid	1.27E+0	4.00E-2	1.70E-1	8.02E-2
3. Average Dose (mrem) (0-50 Miles)				
a. Whole Body	2.45E-4	8.57E-6	3.73E-5	1.72E-5
b. Skin	8.30E-4	2.20E-5	1.31E-4	4.24E-5
c. Thyroid	2.71E-4	8.53E-6	3.62E-5	1.71E-5

TABLE 2

OFFSITE DOSE COMMITMENTS (LIQUID)

CONNECTICUT YANKEE - 1986

LIQUID EFFLUENTS	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
1. Maximum Individual Dose (mrem)				
a. Whole Body	7.46E-2	2.53E-1	5.54E-1	1.60E-1
b. Maximum Organ (Liver)	$1.04E\text{-}1_{teen}$	$3.55E\text{-}1_{teen}$	$7.04E\text{-}1_{teen}$	$2.31E\text{-}1_{teen}$
c. Thyroid	4.58E-3	6.13E-2	3.67E-2	4.15E-3
2. Population Dose (Person-Rem) (0-50 miles)				
a. Whole Body	5.96E-2	2.01E-1	4.41E-1	1.28E-1
b. Maximum Organ (Liver)	9.74E-2	3.38E-1	6.61E-1	2.25E-1
c. Thyroid	3.10E-3	3.26E-2	1.93E-2	3.20E-3
3. Average Dose (mrem) (0-50 miles)				
a. Whole Body	1.27E-5	4.28E-5	9.40E-5	2.73E-5
b. Maximum Organ (Liver)	2.08E-5	7.21E-5	1.41E-4	4.80E-5
c. Thyroid	6.61E-7	6.95E-6	4.11E-6	6.82E-7

TABLE 3

COMPARISON OF WHOLE BODY DOSES

		mrem
I.	**Doses from Station Effluents - 1986**	
	A. Maximum Individual - Liquids	1.04E+0
	B. Maximum Individual - Airborne	3.93E-1
	C. Average Individual - (0-50 miles)	3.1 E-4
	D. Average Individual - (0-50 miles)	1.8 E-4
II.	**Limits from Nuclear Power Plants**	
	A. Maximum Individual	25
III.	**Doses from Other Sources**	
	A. Natural Background in Connecticut - Cosmic, Terrestrial and Food Products	125
	B. Radioactivity from Building Materials (varies from Wood to Stone House)	12-34
	C. Medical X Ray	30-70
	D. Air Travel (Round Trip - Cross Country)	4

APPENDIX A

UPDATED TABLES FOR THE SEMIANNUAL EFFLUENT RELEASE REPORT: JULY - DECEMBER 1986

The following tables with the required data (Sr-89, Sr-90 and gross α) are included to update your copy of the Semiannual Effluent Release Report for the period July - December 1986.

EFFLUENT AND WASTE DISPOSAL SEMI-ANNUAL REPORT - 1986

GASEOUS EFFLUENTS-SUMMATION OF ALL RELEASES

	UNIT	Third QUARTER	Fourth QUARTER	EST. TOTAL ERROR ±
A. FISSION & ACTIVATION GASES				
1. Total release	Ci	3.93E+02	1.50E+02	1.40E+01
2. Average release rate for period	µCi/sec	4.94E+01	1.89E+01	
B. IODINES				
1. Total iodine - 131	Ci	8.09E-04	< MDL	1.30E+01
2. Average release rate for period	µCi/sec	1.02E-04	< MDL	
C. PARTICULATES				
1. Particulates with half-lives > 8 days	Ci	1.49E-04	8.84E-04	1.40E+01
2. Average release rate for period	µCi/sec	1.87E-05	1.11E-04	
3. Gross alpha radioactivity	Ci	1.59E-08	3.43E-08	
D. TRITIUM				
1. Total release	Ci	8.05E+00	6.79E+00	8.00E+00
2. Average release rate for period	µCi/sec	1.01E+00	8.54E-01	

EFFLUENT AND WASTE DISPOSAL SEMI-ANNUAL REPORT - 1986

LIQUID EFFLUENTS-SUMMATION OF ALL RELEASES

	UNIT	Third QUARTER	Fourth QUARTER	EST. TOTAL ERROR %
A. FISSION AND ACTIVATION PRODUCTS				
1. Total release (not including tritium, gases, alpha)	Ci	1.01E-01	4.42E-02	1.10E+01
2. Average diluted concentration during period	uCi/ml	5.49E-10	2.43E-10	
B. TRITIUM				
1. Total release	Ci	5.09E+02	1.07E+03	3.50E+00
2. Average diluted concentration during period	uCi/ml	2.77E-06	5.86E-06	
C. DISSOLVED AND ENTRAINED GASES				
1. Total release	Ci	8.81E-02	3.05E-02	1.90E+01
2. Average diluted concentration during period	uCi/ml	4.79E-10	1.67E-10	
D. GROSS ALPHA RADIOACTIVITY				
1. Total release	Ci	1.31E-04	1.97E-05	8.00E+00
E. Volume of waste released (prior to dilution)	Liters	4.20E+07	4.57E+07	3.00E+00
F. Volume of dilution water used during period	Liters	1.839E+11	1.825E+11	2.50E+00
G. Volume of dilution water used during releases (batch)	Liters	2.94E+10	2.21E+10	2.50E+00