ENCLOSURE 2

HADDAM NECK
INDEPENDENT SPENT FUEL STORAGE INSTALLATION
ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT
JANUARY – DECEMBER 2015

HADDAM NECK
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License Nos. DPR-61 and SFGL-21

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

January - December 2015

RSCS
Radiation Safety & Control Services

April 2016

Prepared by:
Radiation Safety & Control Services
91 Portsmouth Avenue
Stratham, NH 03885-2468

EXECUTIVE SUMMARY

Connecticut Yankee's Haddam Neck facility was permanently shutdown in 1996. All fuel has been transferred into dry storage casks and placed at the Independent Spent Fuel Storage Installation. The Radiological Environmental Monitoring Program (REMP) for the Connecticut Yankee Independent Spent Fuel Storage Installation (ISFSI) located in East Haddam, CT was continued for the period January through December 2015 in compliance with the Connecticut Yankee Offsite Dose Calculation Manual (ODCM).

By design, there are no liquid or gaseous effluents associated with the operation of the ISFSI. Therefore, the ODCM only requires monitoring of direct exposure from the facility. TLDs were used to measure direct gamma exposure at seven locations in the vicinity of the ISFSI and one control location 2.8 miles away. The results of these measurements showed no significant change in exposure rates and potential doses to members of the public during the monitoring period over the baseline measurements that were collected in 2003. The results of the monitoring performed in 2015 also show that operating the Haddam Neck ISFSI results in only a small fraction of the 40 CFR Part 190 and 10 CFR Part 72.104 direct radiation dose limit of 25 mrem/year to members of the public.

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1.0 INTRODUCTION

This report summarizes the findings of the Radiological Environmental Monitoring Program (REMP) conducted by Connecticut Yankee in the vicinity of the Haddam Neck Independent Spent Fuel Storage Installation. It is submitted annually in compliance with Section F, of the Offsite Dose Calculation Manual (ODCM). The remainder of this report is organized as follows:

Section 2: Provides a brief description of the Connecticut Yankee site and its environs.

Section 3: Provides a description of the overall REMP design. This section includes a summary of the ODCM requirements for REMP sampling, tables listing TLD monitoring locations with compass sectors and distances from the ISFSI Pad, and maps showing the location of each of the TLD monitoring locations.

Section 4: Provides a complete set of TLD data showing measured results (mR) and calculated doses (mrem per year). This section also provides the summarized exposure rate data in the format specified by the NRC Branch Technical Position on Environmental Monitoring (Reference 1).

Section 5: Provides the results of the monitoring program. The performance of the program in meeting ODCM requirements is discussed, and the data acquired during the year is analyzed.

Section 6: Provides the status of the Land Use Census.

Section 7: References

2.0 GENERAL ISFSI AND SITE INFORMATION

The Haddam Neck ISFSI site is located in the town of East Haddam, Middlesex County, Connecticut, at a point 22 miles south-southeast of Hartford, Connecticut; 25 miles northeast of New Haven, Connecticut; and 16 miles north of Long Island Sound. The site is situated on the east bank of the Connecticut River at an area known as Haddam Neck. The elevation of the site property varies from 10 to 300 feet above sea level, with the area occupied by the ISFSI Pad ranging between 45 and 50 feet above sea level.

The former plant was designed as a single unit pressurized water reactor which sustained its initial chain reaction in July 1967, with commercial operation beginning in January 1968 and a gross power output of 590 Mw(e). After 28 years of operation, the Connecticut Yankee Board of Directors voted in 1996 to permanently close and decommission the power plant. Following two years of planning and preparation, actual decommissioning began in 1998 and was completed in 2006. This site now consists of the Independent Spent Fuel Storage Installation where the fuel from the former plant reactor is stored.

The Radiological Environmental Monitoring Program (REMP) for the ISFSI began pre-operational direct radiation measurements in 2003 prior to the initial spent fuel transfer to the ISFSI. The ISFSI REMP has been in continuous operation since this transfer began.

3.0 PROGRAM DESIGN

The Radiological Environmental Monitoring Program (REMP) for the Haddam Neck ISFSI was designed to provide assurance to regulatory agencies and the public that the station's environmental impact is known and within anticipated limits. The direct dose limit for members of the public from operation of the ISFSI is 25 mrem per year (References 3 and 4).

The detailed sampling requirements of the REMP are given in the ODCM. The sampling requirements specified in the ODCM are summarized in Table 3.1 of this report. Details of the monitored locations are shown in Table 3.2, as well as Figure 3.1 of this report.

3.1 Monitoring Zones

The REMP is designed to allow comparison of levels of radioactivity in samples from the area possibly influenced by the ISFSI to levels found in areas not influenced by the ISFSI. The first area is called "indicator stations". The second area is called "control stations". The distinction between the two is based on relative direction from the facility and distance. Analysis of survey data from the two zones aids in determining if there is a significant difference between the two areas. It can also help in differentiating between radioactivity or radiation due to releases and that due to other fluctuations in the environment, such as seasonal variations in the natural background.

3.2 Pathways Monitored

Based on the design of the ISFSI, only the direct radiation exposure pathway is monitored by the REMP. This pathway is monitored by the collection of thermoluminescent dosimeters (TLDs) which are described in more detail below.

3.3 Description of the Monitoring Program

3.3.1 Direct Radiation

Direct gamma radiation exposure was continuously monitored during 2015 with the use of thermoluminescent dosimeters (TLDs). At each monitoring location, these TLDs are sealed in plastic bags and attached to an object such as a tree, fence or utility pole. The TLDs are posted and retrieved on a semi-annual basis. All TLDs are provided and processed by a National Voluntary Laboratory Accreditation Program (NVLAP) certified vendor. The TLDs are placed at various locations around the Independent Spent Fuel Storage Installation (ISFSI). Table 3.2 lists the Station ID Codes, distances and direction of the TLDs from the ISFSI.

3.3.2 Special Monitoring

Special samples are periodically taken. For this monitoring period, no special samples were collected as part of the Connecticut Yankee ISFSI Radiological Environmental Monitoring Program.

Table 3.1
Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample Media	Collection			Analysis	
	Number of Sample Locations	Routine Sampling Mode	Collection Frequency	Analysis Type	Analysis Frequency
Direct Radiation (TLD)	Total Locations: 8 (7 around perimeter of the site and 1 offsite control location)	Continuous	Semi-annual	Gamma dose	Semi-annual

Table 3.2
Radiological Environmental Monitoring Locations

Station Code	Station Description	Zone*	Distance From ISFSI (miles)	Direction From ISFSI
CY-1-IF	Mouth of Discharge Canal (I)**	1	0.5	SSE
CY-6-IF	Substation (I)**	1	0.6	NW
CY-48-IF	Near Historical Met Tower Shack (I)**	1	0.4	WSW
CY-53-IF	ISFSI Haul Route (I)**	1	0.2	SSW
CY-54-IF	Rt 149 Near Mouth of Salmon River (I)**	1	1.0	ESE
CY-55-IF	High Voltage Tower- NW of Pad (I)**	1	0.4	NW
CY-56-IF	Near Historical Borrow Pit (I)**	1	0.2	E
CY-10-IFC	Hurd Park Road (O)**	2	2.8	NNW

*2 = Control TLD; 1 = Indicator TLD

**I = Inner Ring TLD; O = Outer Ring TLD

Figure 3.1
Radiological Environmental Monitoring Locations

Note: Indicator Location 52 was removed from the REMP in 2014.

4.0 RADIOLOGICAL DATA SUMMARY TABLES

This section summarizes the analytical results of the environmental samples, which were collected during the monitoring period.

- Data from direct radiation measurements made by TLDs are presented in Table 4.1.
- The summarized TLD measurements, shown in Table 4.2, are presented in a format similar to that prescribed in the NRC's Radiological Assessment Branch Technical Position on Environmental Monitoring (Reference 1).
- Table 4.3 presents the estimated direct dose from ISFSI operations as determined by TLD data shown in Table 4.1.

Table 4.1 TLD Measurements by Half-Year
(mR)

Station ID	Direction	1st Half-Year	2nd Half-Year
CY-1-IF	SSE	30	34
CY-6-IF	NW	32	28
CY-48-IF	WSW	31	33
CY-53-IF	SSW	34	34
CY-54-IF	ESE	32	35
CY-55-IF	NW	32	36
CY-56-IF	E	33	38
CY-10-IFC	Control	34	36
CY-10-IFCa	Control Backup	36	37

Table 4.2 TLD Data Summary
(mR)

Indicator TLDs	Control TLDs	Indicator Station With Highest Mean	
Mean (Range) (No. Measurements)*	Mean (Range) (No. Measurements)*	Station #	Mean (Range) (No. Measurements)*
33	35.8	CY-56-IF	35.5
(28 – 38)	(34 – 37)		(33 – 38)
(14)	(4)		(2)

* Each "measurement" is based on semi-annual readings.

Table 4.3 Direct Dose from ISFSI Operations
(mrem)

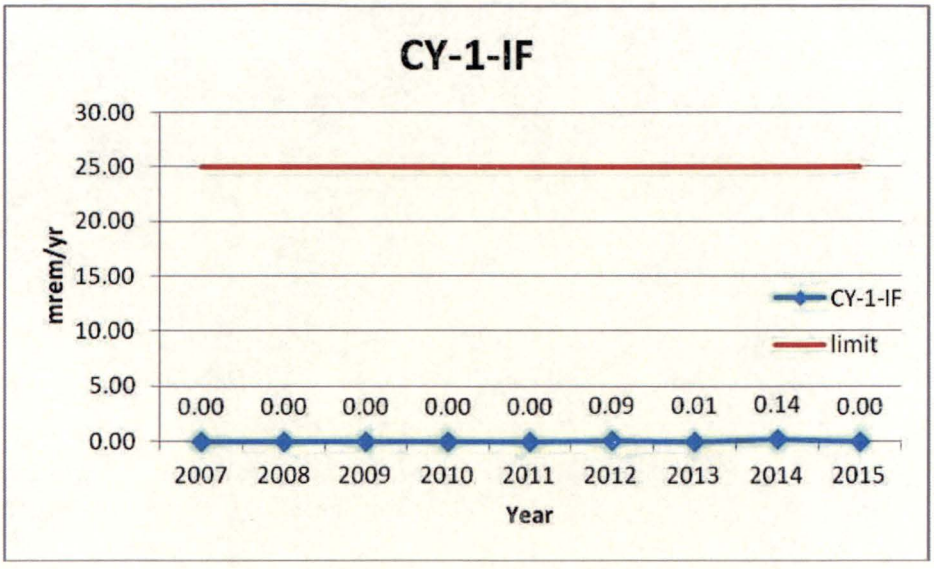
Station ID	1st Half-Year		2nd Half-Year		Annual Dose
	Net TLD Result	Calculated Dose	Net TLD Result	Calculated Dose	
CY-1-IF	0.00	0.00	0.00	0.00	0.00
CY-6-IF	0.00	0.00	0.00	0.00	0.00
CY-48-IF	0.00	0.00	0.00	0.00	0.00
CY-53-IF	0.00	0.00	0.00	0.00	0.00
CY-54-IF	0.00	0.00	0.00	0.00	0.00
CY-55-IF	0.00	0.00	0.00	0.00	0.00
CY-56-IF	0.00	0.00	1.50	0.09	0.09
				Max Dose =>	**0.09**

Note:
Doses based on a 250 hour occupancy in both of the first and second half-years.

Radiological Environmental Monitoring Program Trending

A series of graphs of REMP TLD data have been developed and are provided for trending purposes. The trending is developed for each of the indicator locations based on the annual historical doses. The trending is provided for the "real members of the public" based on the guidance provided in the ODCM. The analysis of the trends and associated data shows very small annual doses with minor fluctuations in the data. In this report, the uncorrected TLD results have been summarized and the annual doses, calculated for "real members of the public" based upon guidance in the ODCM, have been plotted for trending.

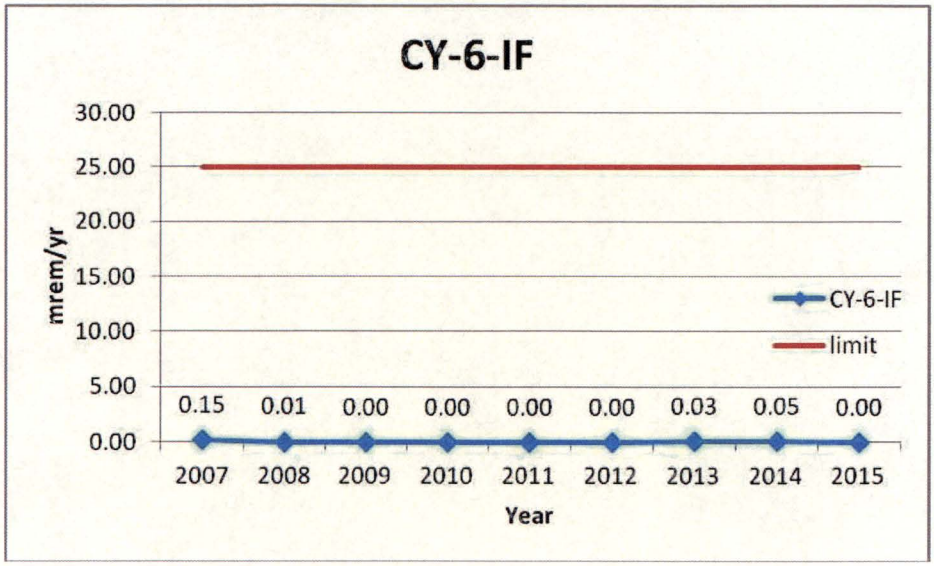
Figure 4.1 Annual Dose Trend at CY-1-IF



Annual Doses (mrem/yr)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY-1-IF	0.00	0.00	0.00	0.00	0.00	0.09	0.01	0.14	0.00

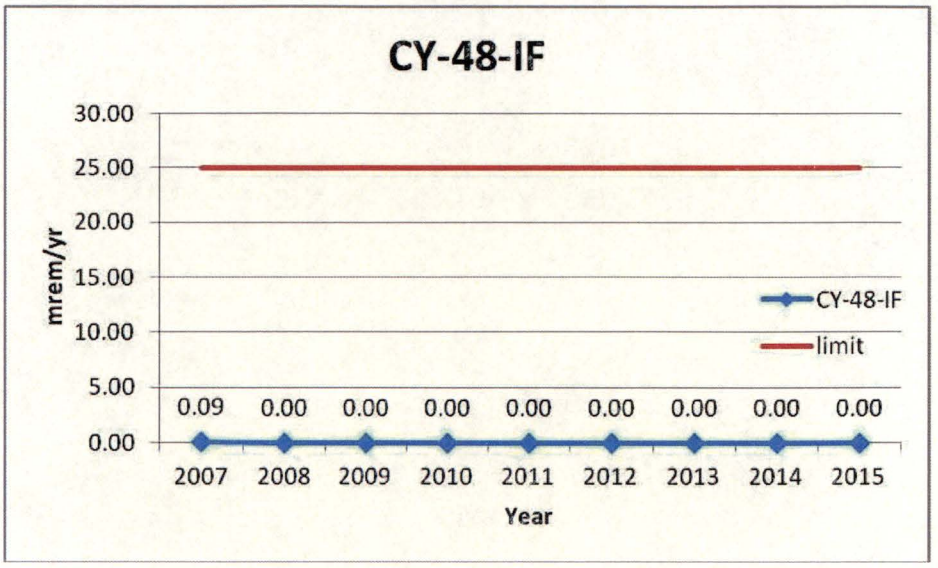
Figure 4.2 Annual Dose Trend at CY-6-IF



Annual Doses (mrem/yr)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY-6-IF	0.15	0.01	0.00	0.00	0.00	0.00	0.03	0.05	0.00

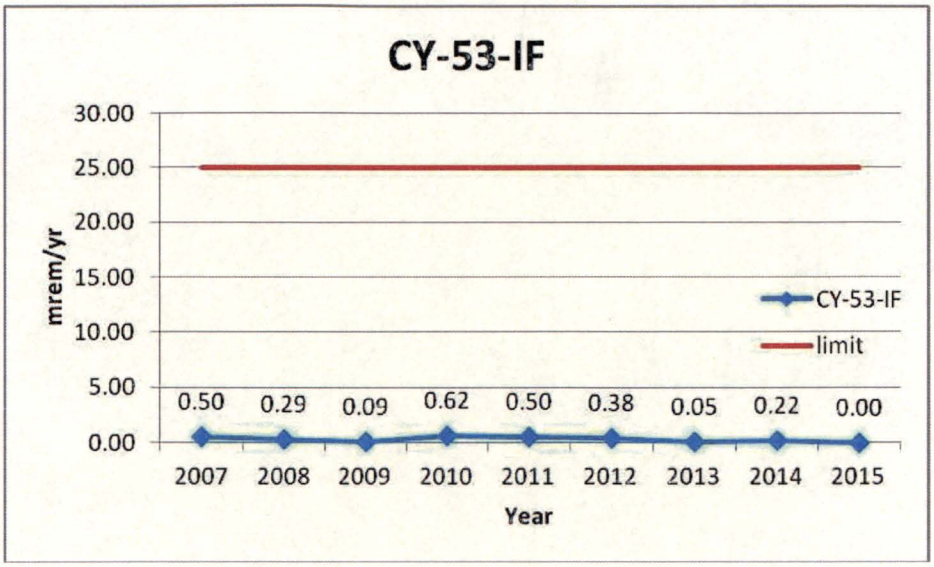
Figure 4.3 Annual Dose Trend at CY-48-IF



Annual Doses (mrem/yr)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY-48-IF	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

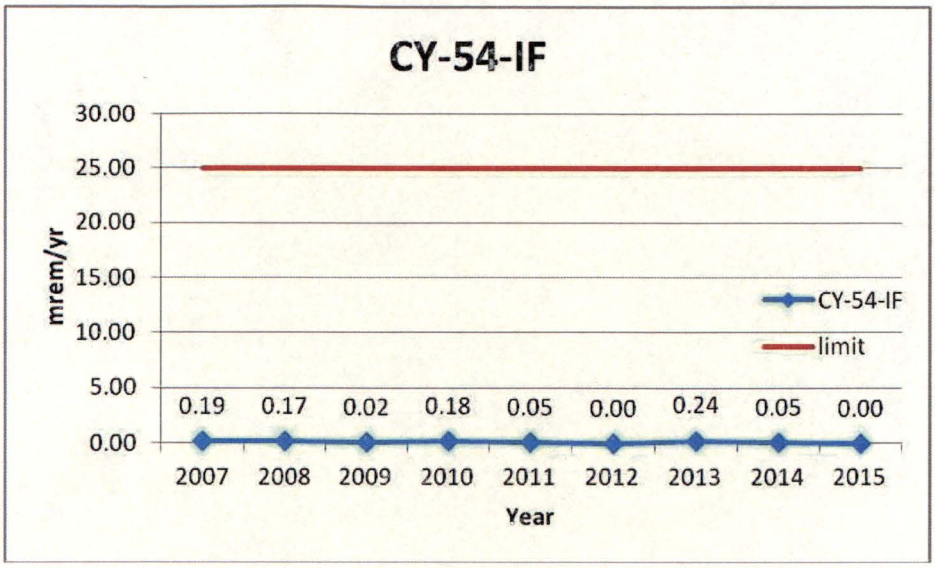
Figure 4.4 Annual Dose Trend at CY-53-IF



Annual Doses (mrem/yr)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY-53-IF	0.50	0.29	0.09	0.62	0.50	0.38	0.05	0.22	0.00

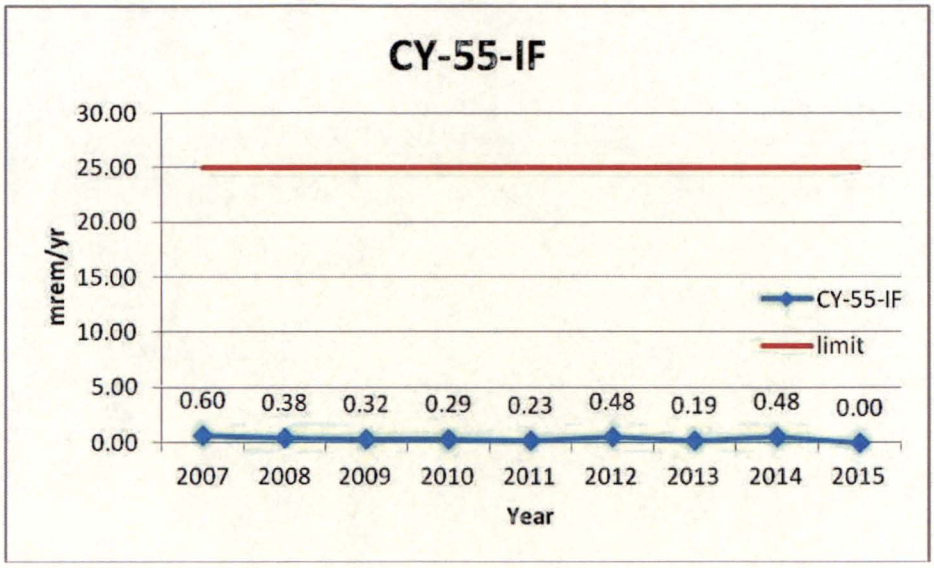
Figure 4.5 Annual Dose Trend at CY-54-IF



Annual Doses (mrem/yr)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY-54-IF	0.19	0.17	0.02	0.18	0.05	0.00	0.24	0.05	0.00

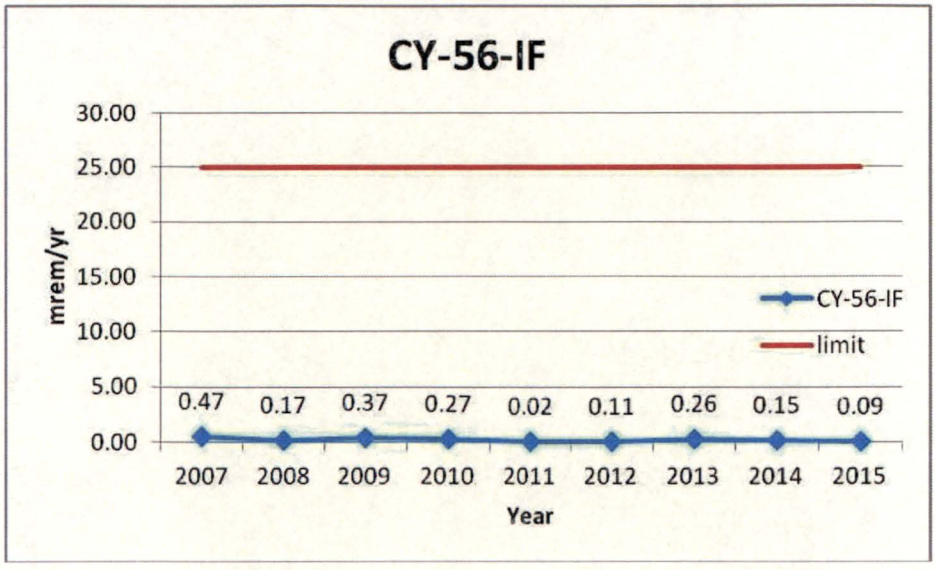
Figure 4.6 Annual Dose Trend at CY-55-IF



Annual Doses (mrem/yr)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY-55-IF	0.60	0.38	0.32	0.29	0.23	0.48	0.19	0.48	0.00

Figure 4.7 Annual Dose Trend at CY-56-IF



Annual Doses (mrem/yr)

Location	2007	2008	2009	2010	2011	2012	2013	2014	2015
CY-56-IF	0.47	0.17	0.37	0.27	0.02	0.11	0.26	0.15	0.09

5.0 ANALYSIS OF ENVIRONMENTAL RESULTS

5.1 Sampling Program Deviations

A sampling program deviation is defined as samples that are unobtainable due to hazardous conditions or to malfunction of sampling equipment. Such deviations do not compromise the program's effectiveness and in fact are considered insignificant with respect to what is normally anticipated for this Radiological Environmental Monitoring Program.

There were no deviations of the sampling program in 2015.

5.2 Direct Radiation Pathway

5.2.1 Annual Dose Trends

Direct radiation is continuously measured at 7 indicator locations surrounding the Haddam Neck ISFSI, along with 1 control location (Hurd Park Road) using thermoluminescent dosimeters (TLDs). These dosimeters are collected every six months for readout at the NVLAP certified dosimetry services vendor.

Review of the data in Figures 4.1 through 4.7 shows no significant difference in annual doses over time at the indicator locations and their relation to the 25 mrem/yr limit.

5.2.2 Direct Doses from ISFSI Operations

The ODCM specifies that a cumulative dose estimate from direct radiation is required to be determined semi-annually. This dose estimate is the potential dose to any real member of the public that could use portions of the site or be present adjacent to the site for recreational activities throughout the year. The ODCM states that direct exposure above background can be estimated by subtracting the average TLD value of the control station from the indicator location measurements. As in previous years, the 2015 dose estimate assumes a total of 500 hours occupancy for the dose calculation; of which 250 hours are used in both the first and second half-years. The most likely location for exposure to a member of the public from the ISFSI is either along the discharge canal or the Connecticut or Salmon Rivers for boating and fishing; however, the time estimates are conservatively applied to all monitoring locations.

Table 4.3 presents the results of the dose calculations. The highest calculated dose is at location Station ID number CY-56-IF. The maximum calculated annual dose at that location is 0.09 mrem. This value is less than 1 percent of the 25 mrem per year limit.

6.0 LAND USE CENSUS

The most recent census remained in effect for 2015; therefore, no changes were made to the monitoring program.

7.0 REFERENCES

1. USNRC Radiological Assessment Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program," Revision 1, November 1979.
2. Haddam Neck Offsite Dose Calculation Manual, Revision 25.
3. 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation".
4. 10 CFR Part 72.104, "Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS".