HADDAM NECK
INDEPENDENT SPENT FUEL STORAGE INSTALLATION
License No. DPR-61

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

January - December 2010

RSCS
Radiation Safety & Control Services

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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 2010 in compliance with the Connecticut Yankee Off-Site Dose Calculation Manual (ODCM).

No changes were made to the ODCM during 2010. 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 eight 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 2010 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 Off-site 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), TLD data converted to exposure rates (μR per hour) 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 2010 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 quarterly 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 taken that are not required in the ODCM. The sample locations do not appear in Table 3.1 or 3.2 of this report. Three Dibble Creek Sediment samples, three ISFSI Outfall soil samples and three ISFSI Runoff water samples were collected during this period. The results of these samples are available for review at the site.

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: 9 (8 around perimeter of the site and 1 offsite control location)	Continuous	Quarterly	Gamma dose	Each TLD

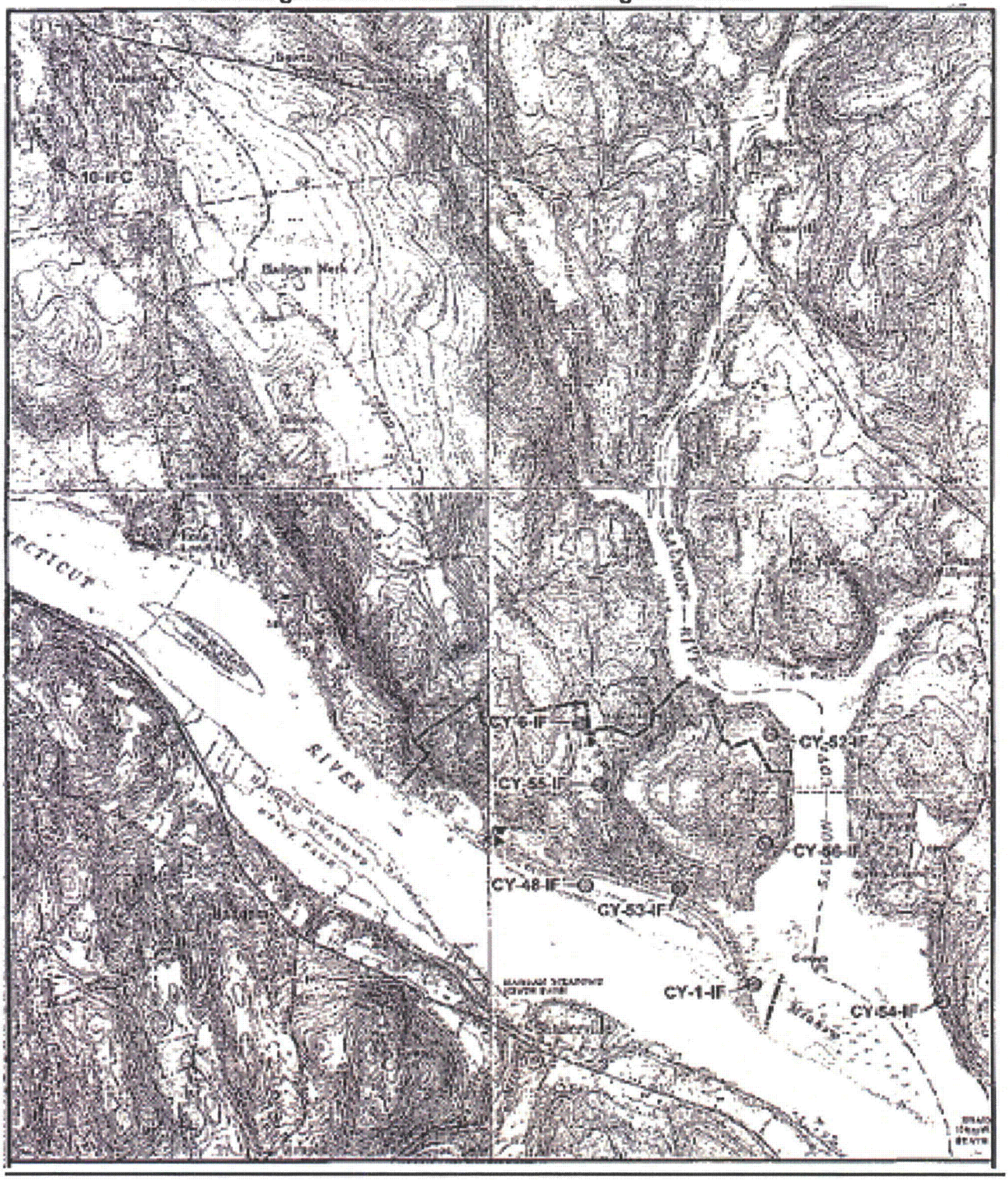
Table 3.2
Radiological Environmental Monitoring Locations (TLD)

Station Code	Station Description	Zone*	Distance From ISFSI (miles)	Direction From ISFSI
CY-10-IFC	Hurd Park Road (O)*	2	2.8	NNW
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-52-IF	Schmidt Cemetery (I)**	1	0.5	NNE
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 Burrow Pit (I)**	1	0.2	E

*2 = Control TLD; 1 = Indicator TLD

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

Figure 3.1
Radiological Environmental Monitoring Locations



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 provided in Table 4.1. The direct measurements converted to exposure rates are provided in Table 4.2. The summarized exposure rate results, shown in Table 4.3, are presented in a format similar to that prescribed in the NRC's Radiological Assessment Branch Technical Position on Environmental Monitoring (Reference 1). Table 4.4 provides the estimated direct dose from ISFSI operations as determined by TLDs.

Table 4.1
TLD Measurements by Quarter
(mR)

Station ID	Direction	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr
CY-1-IF	SSE	26	24	22	27
CY-6-IF	NW	25	25	20	26
CY-48-IF	WSW	24	25	20	24
CY-52-IF	NNE	26	25	23	29
CY-53-IF	SSW	30	26	27	32
CY-54-IF	ESE	26	26	23	28
CY-55-IF	NW	28	26	24	30
CY-56-IF	E	27	26	24	28
CY-10-IFC	Control	30	25	23	30
CY-10-IFCa	Control Backup	29	25	21	29

Table 4.2
Exposure Rates from TLD Measurements
(μR per hour)

Station ID	Direction	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Annual Ave
CY-1-IF	SSE	6.1	3.2	5.0	4.8	4.8
CY-6-IF	NW	5.6	3.7	4.1	4.4	4.4
CY-48-IF	WSW	5.2	3.7	4.1	3.5	4.1
CY-52-IF	NNE	6.1	3.7	5.4	5.6	5.2
CY-53-IF	SSW	7.8	4.2	7.3	6.9	6.6
CY-54-IF	ESE	6.1	4.2	5.4	5.2	5.2
CY-55-IF	NW	7.0	4.2	5.9	6.1	5.8
CY-56-IF	E	6.5	4.2	5.9	5.2	5.5
CY-10-IFC	Control	7.6	3.7	5.0	5.9	5.5

Table 4.3
TLD Data Summary
(μR per hour)

Indicator TLDs	Control TLDs	Station With Highest Mean	
Mean (Range) (No. Measurements)*	Mean (Range) (No. Measurements)*	Station #	Mean (Range) (No. Measurements)*
5.2	5.5	CY-53-IF	6.6
(3.2 – 7.8)	(3.7 – 7.6)		(4.2 – 7.8)
(32)	(8)		(4)

* Each "measurement" is based on quarterly readings

Table 4.4
Direct Dose from ISFSI Operations
(mrem)

	Q1		Q2		Q3		Q4		
Station ID	Net TLD Result	Calculated Dose	Net TLD Result	Calculated Dose	Net TLD Result	Calculated Dose	Net TLD Result	Calculated Dose	Annual Dose
CY-1-IF	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00
CY-6-IF	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00
CY-48-IF	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.00
CY-52-IF	0.0	0.00	0.0	0.00	1.0	0.09	0.0	0.00	0.09
CY-53-IF	0.5	0.01	1.0	0.09	5.0	0.46	2.5	0.06	0.62
CY-54-IF	0.0	0.00	1.0	0.09	1.0	0.09	0.0	0.00	0.18
CY-55-IF	0.0	0.00	1.0	0.09	2.0	0.18	0.5	0.01	0.29
CY-56-IF	0.0	0.00	1.0	0.09	2.0	0.18	0.0	0.00	0.27

Max Dose => **0.62**

NOTES:

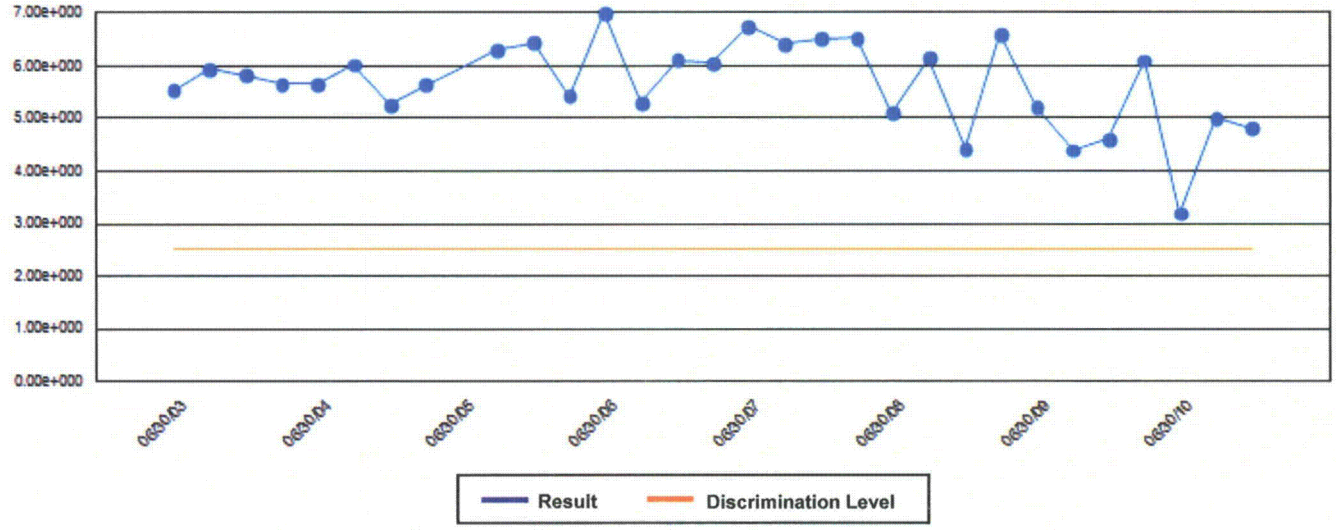
1. Doses based on a 50 hour occupancy in both of the first and fourth quarters and a 200 hour occupancy in both of the second and third quarters.
2. Some of the net TLD results were negative and rounded up to zero.

Figure 4.1
Exposure Rate Trend at CY-1-IF

Trend Report 3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-1-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-1-IF-001	06/30/2003	5.5E+000 µR/h † *	7.60E-001	2.5E+000
CY-1-IF-002	09/30/2003	5.9E+000 µR/h † *	5.60E-001	2.5E+000
CY-1-IF-003	12/31/2003	5.8E+000 µR/h † *	3.00E-001	2.5E+000
CY-1-IF-004	03/31/2004	5.7E+000 µR/h † *	4.80E-001	2.5E+000
CY-1-IF-005	06/30/2004	5.7E+000 µR/h † *	8.20E-001	2.5E+000
CY-1-IF-006	09/30/2004	6.0E+000 µR/h † *	8.80E-001	2.5E+000
CY-1-IF-007	12/31/2004	5.3E+000 µR/h † *	3.40E-001	2.5E+000
CY-1-IF-008	03/31/2005	5.6E+000 µR/h † *	5.20E-001	2.5E+000
CY-1-IF-010	09/30/2005	6.3E+000 µR/h † *	7.40E-001	2.5E+000
CY-1-IF-011	12/31/2005	6.4E+000 µR/h † *	7.00E-001	2.5E+000
CY-1-IF-012	03/31/2006	5.4E+000 µR/h † *	6.60E-001	2.5E+000
CY-1-IF-013	06/30/2006	7.0E+000 µR/h † *	9.80E-001	2.5E+000
CY-1-IF-014	09/30/2006	5.3E+000 µR/h † *	6.80E-001	2.5E+000
CY-1-IF-015	12/31/2006	6.1E+000 µR/h † *	5.00E-001	2.5E+000
CY-1-IF-016	03/31/2007	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-1-IF-017	06/30/2007	6.8E+000 µR/h † *	6.80E-001	2.5E+000
CY-1-IF-018	09/30/2007	6.4E+000 µR/h † *	6.40E-001	2.5E+000
CY-1-IF-019	12/31/2007	6.5E+000 µR/h † *	6.60E-001	2.5E+000
CY-1-IF-020	03/31/2008	6.5E+000 µR/h † *	6.60E-001	2.5E+000
CY-1-IF-021	06/30/2008	5.1E+000 µR/h † *	5.00E-001	2.5E+000
CY-1-IF-022	09/30/2008	6.2E+000 µR/h † *	6.20E-001	2.5E+000
CY-1-IF-023	12/31/2008	4.4E+000 µR/h † *	4.40E-001	2.5E+000
CY-1-IF-024	03/31/2009	6.6E+000 µR/h † *	6.00E-001	2.5E+000
CY-1-IF-025	06/30/2009	5.2E+000 µR/h † *	6.00E-001	2.5E+000
CY-1-IF-026	09/30/2009	4.4E+000 µR/h † *	4.00E-001	2.5E+000
CY-1-IF-027	12/31/2009	4.6E+000 µR/h † *	4.00E-001	2.5E+000
CY-1-IF-028	03/31/2010	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-1-IF-029	06/30/2010	3.2E+000 µR/h † *	4.00E-001	2.5E+000
CY-1-IF-030	09/30/2010	5.0E+000 µR/h † *	4.00E-001	2.5E+000
CY-1-IF-031	12/31/2010	4.8E+000 µR/h † *	4.00E-001	2.5E+000

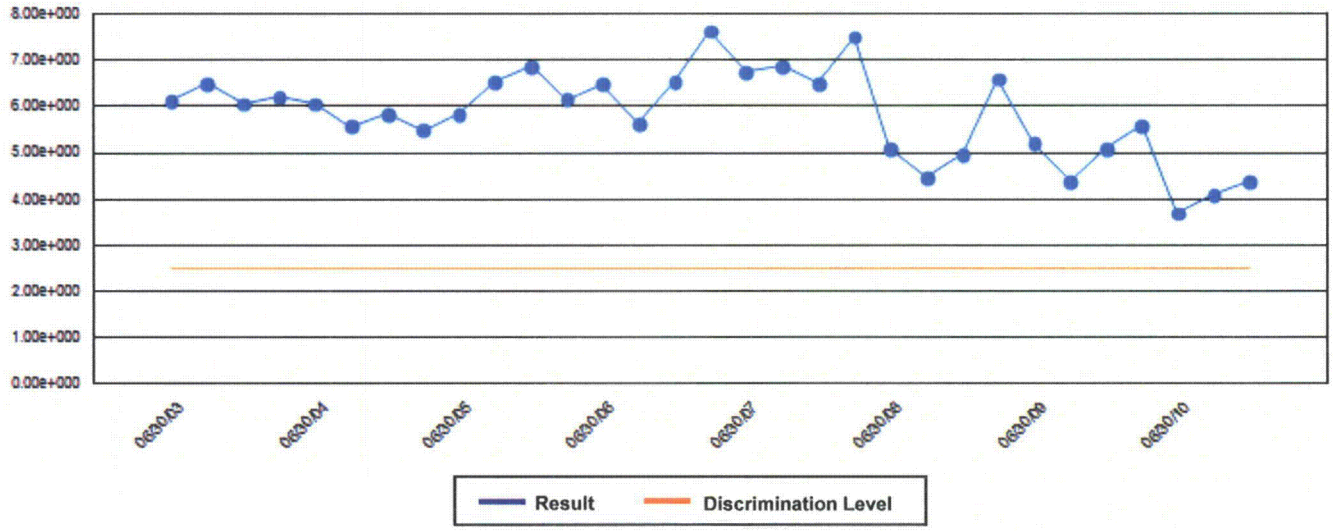
Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

Figure 4.2
Exposure Rate Trend at CY-6-IF

Trend Report 3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-6-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-6-IF-001	06/30/2003	6.1E+000 µR/h † *	6.20E-001	2.5E+000
CY-6-IF-002	09/30/2003	6.5E+000 µR/h † *	5.00E-001	2.5E+000
CY-6-IF-003	12/31/2003	6.1E+000 µR/h † *	4.00E-001	2.5E+000
CY-6-IF-004	03/31/2004	6.2E+000 µR/h † *	6.60E-001	2.5E+000
CY-6-IF-005	06/30/2004	6.1E+000 µR/h † *	1.06E+000	2.5E+000
CY-6-IF-006	09/30/2004	5.6E+000 µR/h † *	4.80E-001	2.5E+000
CY-6-IF-007	12/31/2004	5.8E+000 µR/h † *	3.00E-001	2.5E+000
CY-6-IF-008	03/31/2005	5.5E+000 µR/h † *	5.20E-001	2.5E+000
CY-6-IF-009	06/30/2005	5.8E+000 µR/h † *	5.60E-001	2.5E+000
CY-6-IF-010	09/30/2005	6.5E+000 µR/h † *	8.80E-001	2.5E+000
CY-6-IF-011	12/31/2005	6.9E+000 µR/h † *	9.00E-001	2.5E+000
CY-6-IF-012	03/31/2006	6.2E+000 µR/h † *	4.20E-001	2.5E+000
CY-6-IF-013	06/30/2006	6.5E+000 µR/h † *	5.60E-001	2.5E+000
CY-6-IF-014	09/30/2006	5.6E+000 µR/h † *	5.60E-001	2.5E+000
CY-6-IF-015	12/31/2006	6.5E+000 µR/h † *	6.00E-001	2.5E+000
CY-6-IF-016	03/31/2007	7.6E+000 µR/h † *	7.60E-001	2.5E+000
CY-6-IF-017	06/30/2007	6.8E+000 µR/h † *	6.80E-001	2.5E+000
CY-6-IF-018	09/30/2007	6.9E+000 µR/h † *	6.80E-001	2.5E+000
CY-6-IF-019	12/31/2007	6.5E+000 µR/h † *	6.60E-001	2.5E+000
CY-6-IF-020	03/31/2008	7.5E+000 µR/h † *	7.60E-001	2.5E+000
CY-6-IF-021	06/30/2008	5.1E+000 µR/h † *	5.00E-001	2.5E+000
CY-6-IF-022	09/30/2008	4.5E+000 µR/h † *	4.40E-001	2.5E+000
CY-6-IF-023	12/31/2008	5.0E+000 µR/h † *	5.00E-001	2.5E+000
CY-6-IF-024	03/31/2009	6.6E+000 µR/h † *	6.00E-001	2.5E+000
CY-6-IF-025	06/30/2009	5.2E+000 µR/h † *	6.00E-001	2.5E+000
CY-6-IF-026	09/30/2009	4.4E+000 µR/h † *	4.00E-001	2.5E+000
CY-6-IF-027	12/31/2009	5.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-6-IF-028	03/31/2010	5.6E+000 µR/h † *	6.00E-001	2.5E+000
CY-6-IF-029	06/30/2010	3.7E+000 µR/h † *	4.00E-001	2.5E+000
CY-6-IF-030	09/30/2010	4.1E+000 µR/h † *	4.00E-001	2.5E+000
CY-6-IF-031	12/31/2010	4.4E+000 µR/h † *	4.00E-001	2.5E+000

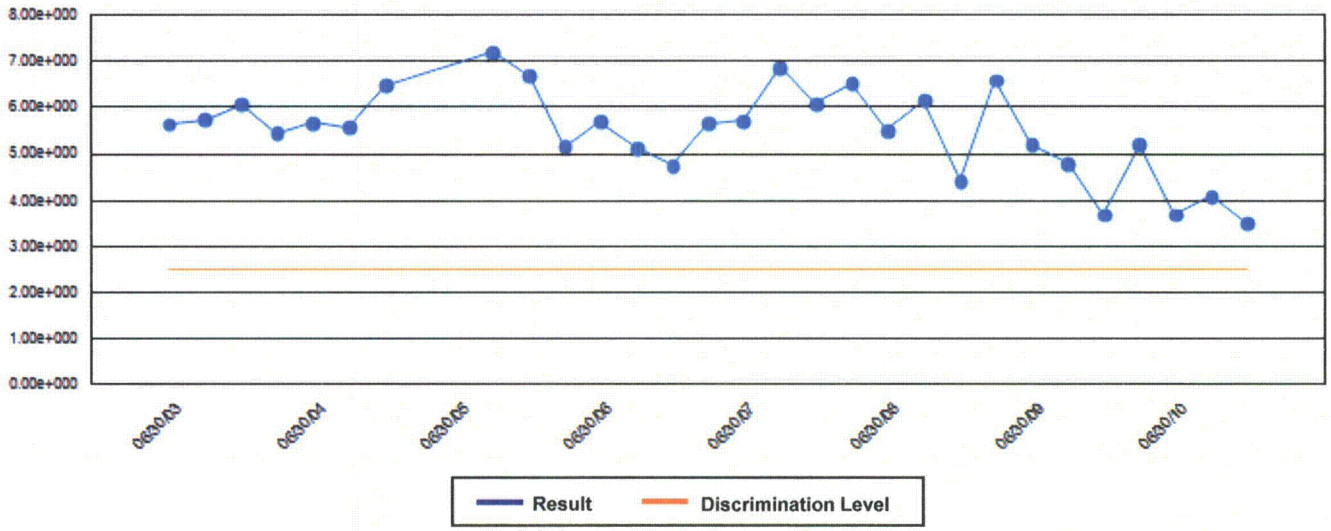
Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

Figure 4.3
Exposure Rate Trend at CY-48-IF

Trend Report 3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-48-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-48-IF-001	06/30/2003	5.7E+000 µR/h † *	5.40E-001	2.5E+000
CY-48-IF-002	09/30/2003	5.8E+000 µR/h † *	4.60E-001	2.5E+000
CY-48-IF-003	12/31/2003	6.1E+000 µR/h † *	4.20E-001	2.5E+000
CY-48-IF-004	03/31/2004	5.5E+000 µR/h † *	1.00E+000	2.5E+000
CY-48-IF-005	06/30/2004	5.7E+000 µR/h † *	9.60E-001	2.5E+000
CY-48-IF-006	09/30/2004	5.6E+000 µR/h † *	5.20E-001	2.5E+000
CY-48-IF-007	12/31/2004	6.5E+000 µR/h † *	7.20E-001	2.5E+000
CY-48-IF-010	09/30/2005	7.2E+000 µR/h † *	7.80E-001	2.5E+000
CY-48-IF-011	12/31/2005	6.7E+000 µR/h † *	9.40E-001	2.5E+000
CY-48-IF-012	03/31/2006	5.2E+000 µR/h † *	1.00E+000	2.5E+000
CY-48-IF-013	06/30/2006	5.7E+000 µR/h † *	6.00E-001	2.5E+000
CY-48-IF-014	09/30/2006	5.1E+000 µR/h † *	5.20E-001	2.5E+000
CY-48-IF-015	12/31/2006	4.8E+000 µR/h † *	4.20E-001	2.5E+000
CY-48-IF-016	03/31/2007	5.7E+000 µR/h † *	5.60E-001	2.5E+000
CY-48-IF-017	06/30/2007	5.7E+000 µR/h † *	5.80E-001	2.5E+000
CY-48-IF-018	09/30/2007	6.9E+000 µR/h † *	6.80E-001	2.5E+000
CY-48-IF-019	12/31/2007	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-48-IF-020	03/31/2008	6.5E+000 µR/h † *	6.60E-001	2.5E+000
CY-48-IF-021	06/30/2008	5.5E+000 µR/h † *	5.60E-001	2.5E+000
CY-48-IF-022	09/30/2008	6.2E+000 µR/h † *	6.20E-001	2.5E+000
CY-48-IF-023	12/31/2008	4.4E+000 µR/h † *	4.40E-001	2.5E+000
CY-48-IF-024	03/31/2009	6.6E+000 µR/h † *	6.00E-001	2.5E+000
CY-48-IF-025	06/30/2009	5.2E+000 µR/h † *	6.00E-001	2.5E+000
CY-48-IF-026	09/30/2009	4.8E+000 µR/h † *	4.00E-001	2.5E+000
CY-48-IF-027	12/31/2009	3.7E+000 µR/h † *	4.00E-001	2.5E+000
CY-48-IF-028	03/31/2010	5.2E+000 µR/h † *	6.00E-001	2.5E+000
CY-48-IF-029	06/30/2010	3.7E+000 µR/h † *	4.00E-001	2.5E+000
CY-48-IF-030	09/30/2010	4.1E+000 µR/h † *	4.00E-001	2.5E+000
CY-48-IF-031	12/31/2010	3.5E+000 µR/h † *	4.00E-001	2.5E+000

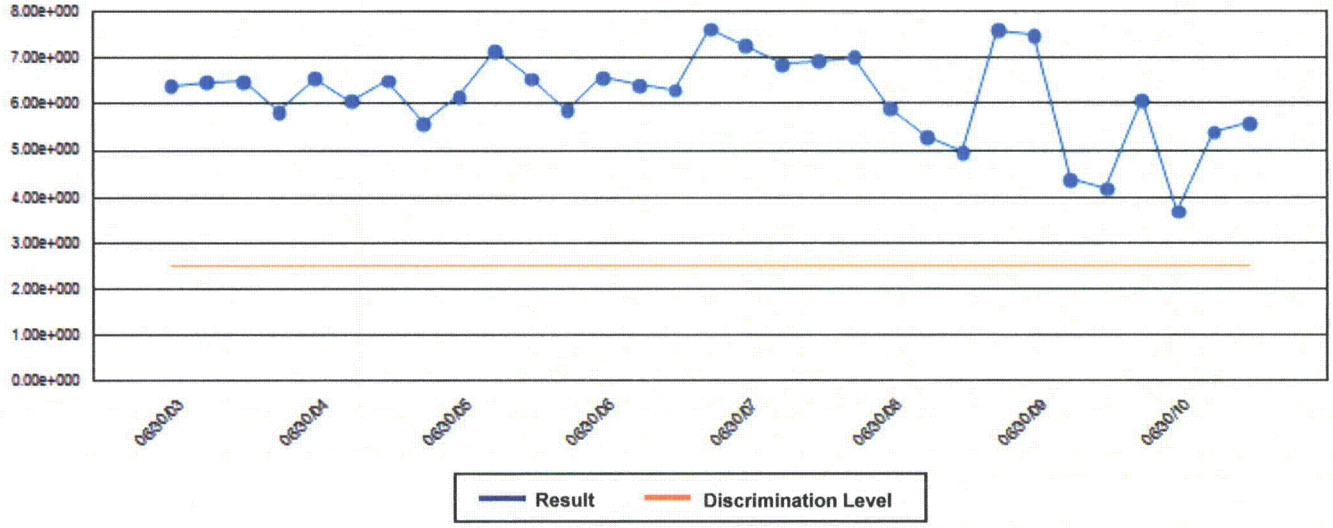
Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

Figure 4.4
Exposure Rate Trend at CY-52-IF

Trend Report 3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-52-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-52-IF-001	06/30/2003	6.4E+000 µR/h † *	9.00E-001	2.5E+000
CY-52-IF-002	09/30/2003	6.5E+000 µR/h † *	4.60E-001	2.5E+000
CY-52-IF-003	12/31/2003	6.5E+000 µR/h † *	4.60E-001	2.5E+000
CY-52-IF-004	03/31/2004	5.8E+000 µR/h † *	6.20E-001	2.5E+000
CY-52-IF-005	06/30/2004	6.6E+000 µR/h † *	8.80E-001	2.5E+000
CY-52-IF-006	09/30/2004	6.1E+000 µR/h † *	5.20E-001	2.5E+000
CY-52-IF-007	12/31/2004	6.5E+000 µR/h † *	7.20E-001	2.5E+000
CY-52-IF-008	03/31/2005	5.6E+000 µR/h † *	5.00E-001	2.5E+000
CY-52-IF-009	06/30/2005	6.2E+000 µR/h † *	4.60E-001	2.5E+000
CY-52-IF-010	09/30/2005	7.2E+000 µR/h † *	8.80E-001	2.5E+000
CY-52-IF-011	12/31/2005	6.6E+000 µR/h † *	7.60E-001	2.5E+000
CY-52-IF-012	03/31/2006	5.9E+000 µR/h † *	3.80E-001	2.5E+000
CY-52-IF-013	06/30/2006	6.6E+000 µR/h † *	1.02E+000	2.5E+000
CY-52-IF-014	09/30/2006	6.4E+000 µR/h † *	1.24E+000	2.5E+000
CY-52-IF-015	12/31/2006	6.3E+000 µR/h † *	6.80E-001	2.5E+000
CY-52-IF-016	03/31/2007	7.6E+000 µR/h † *	7.60E-001	2.5E+000
CY-52-IF-017	06/30/2007	7.3E+000 µR/h † *	7.20E-001	2.5E+000
CY-52-IF-018	09/30/2007	6.9E+000 µR/h † *	6.80E-001	2.5E+000
CY-52-IF-019	12/31/2007	6.9E+000 µR/h † *	7.00E-001	2.5E+000
CY-52-IF-020	03/31/2008	7.0E+000 µR/h † *	7.00E-001	2.5E+000
CY-52-IF-021	06/30/2008	5.9E+000 µR/h † *	6.00E-001	2.5E+000
CY-52-IF-022	09/30/2008	5.3E+000 µR/h † *	5.40E-001	2.5E+000
CY-52-IF-023	12/31/2008	5.0E+000 µR/h † *	5.00E-001	2.5E+000
CY-52-IF-024	03/31/2009	7.6E+000 µR/h † *	8.00E-001	2.5E+000
CY-52-IF-025	06/30/2009	7.5E+000 µR/h † *	8.00E-001	2.5E+000
CY-52-IF-026	09/30/2009	4.4E+000 µR/h † *	4.00E-001	2.5E+000
CY-52-IF-027	12/31/2009	4.2E+000 µR/h † *	4.00E-001	2.5E+000
CY-52-IF-028	03/31/2010	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-52-IF-029	06/30/2010	3.7E+000 µR/h † *	4.00E-001	2.5E+000
CY-52-IF-030	09/30/2010	5.4E+000 µR/h † *	6.00E-001	2.5E+000
CY-52-IF-031	12/31/2010	5.6E+000 µR/h † *	6.00E-001	2.5E+000

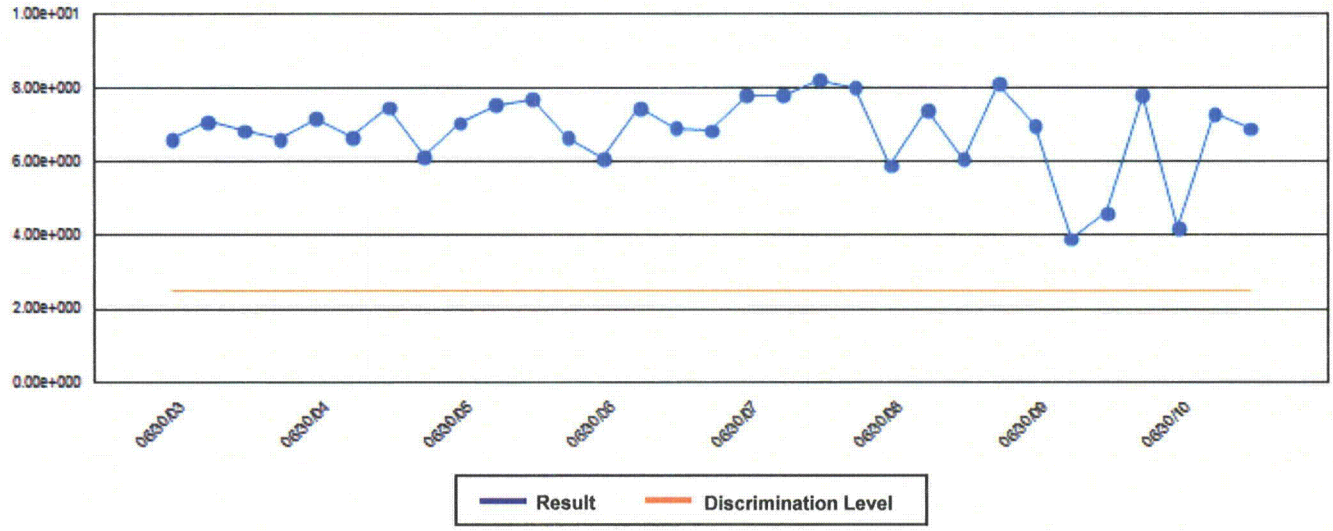
Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

Figure 4.5
Exposure Rate Trend at CY-53-IF

Trend Report 3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-53-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-53-IF-001	06/30/2003	6.6E+000 µR/h † *	6.60E-001	2.5E+000
CY-53-IF-002	09/30/2003	7.1E+000 µR/h † *	4.60E-001	2.5E+000
CY-53-IF-003	12/31/2003	6.8E+000 µR/h † *	4.00E-001	2.5E+000
CY-53-IF-004	03/31/2004	6.6E+000 µR/h † *	5.20E-001	2.5E+000
CY-53-IF-005	06/30/2004	7.2E+000 µR/h † *	1.00E+000	2.5E+000
CY-53-IF-006	09/30/2004	6.7E+000 µR/h † *	6.60E-001	2.5E+000
CY-53-IF-007	12/31/2004	7.5E+000 µR/h † *	3.60E-001	2.5E+000
CY-53-IF-008	03/31/2005	6.2E+000 µR/h † *	7.20E-001	2.5E+000
CY-53-IF-009	06/30/2005	7.1E+000 µR/h † *	1.08E+000	2.5E+000
CY-53-IF-010	09/30/2005	7.5E+000 µR/h † *	8.20E-001	2.5E+000
CY-53-IF-011	12/31/2005	7.7E+000 µR/h † *	1.04E+000	2.5E+000
CY-53-IF-012	03/31/2006	6.7E+000 µR/h † *	4.20E-001	2.5E+000
CY-53-IF-013	06/30/2006	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-53-IF-014	09/30/2006	7.5E+000 µR/h † *	8.60E-001	2.5E+000
CY-53-IF-015	12/31/2006	6.9E+000 µR/h † *	5.80E-001	2.5E+000
CY-53-IF-016	03/31/2007	6.8E+000 µR/h † *	6.80E-001	2.5E+000
CY-53-IF-017	06/30/2007	7.8E+000 µR/h † *	7.80E-001	2.5E+000
CY-53-IF-018	09/30/2007	7.8E+000 µR/h † *	7.80E-001	2.5E+000
CY-53-IF-019	12/31/2007	8.2E+000 µR/h † *	8.20E-001	2.5E+000
CY-53-IF-020	03/31/2008	8.0E+000 µR/h † *	8.00E-001	2.5E+000
CY-53-IF-021	06/30/2008	5.9E+000 µR/h † *	6.00E-001	2.5E+000
CY-53-IF-022	09/30/2008	7.4E+000 µR/h † *	7.40E-001	2.5E+000
CY-53-IF-023	12/31/2008	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-53-IF-024	03/31/2009	8.1E+000 µR/h † *	8.00E-001	2.5E+000
CY-53-IF-025	06/30/2009	7.0E+000 µR/h † *	8.00E-001	2.5E+000
CY-53-IF-026	09/30/2009	3.9E+000 µR/h † *	4.00E-001	2.5E+000
CY-53-IF-027	12/31/2009	4.6E+000 µR/h † *	4.00E-001	2.5E+000
CY-53-IF-028	03/31/2010	7.8E+000 µR/h † *	8.00E-001	2.5E+000
CY-53-IF-029	06/30/2010	4.2E+000 µR/h † *	4.00E-001	2.5E+000
CY-53-IF-030	09/30/2010	7.3E+000 µR/h † *	8.00E-001	2.5E+000
CY-53-IF-031	12/31/2010	6.9E+000 µR/h † *	6.00E-001	2.5E+000

Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

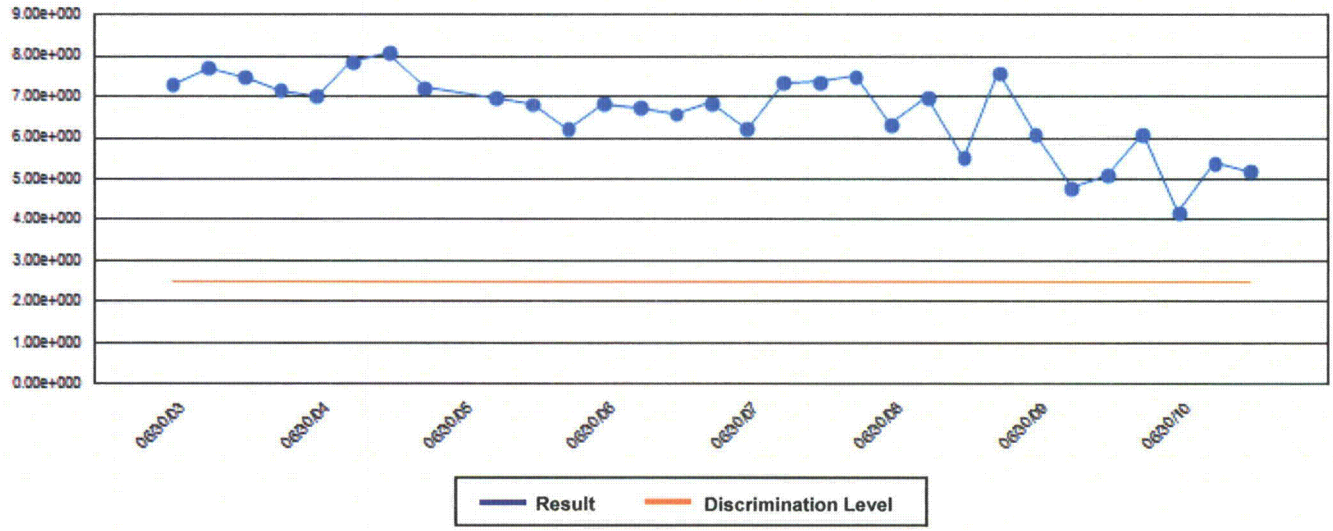
Figure 4.6
Exposure Rate Trend at CY-54-IF

Trend Report

3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-54-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-54-IF-001	06/30/2003	7.3E+000 µR/h † *	7.40E-001	2.5E+000
CY-54-IF-002	09/30/2003	7.7E+000 µR/h † *	6.80E-001	2.5E+000
CY-54-IF-003	12/31/2003	7.5E+000 µR/h † *	5.20E-001	2.5E+000
CY-54-IF-004	03/31/2004	7.2E+000 µR/h † *	4.60E-001	2.5E+000
CY-54-IF-005	06/30/2004	7.0E+000 µR/h † *	9.40E-001	2.5E+000
CY-54-IF-006	09/30/2004	7.9E+000 µR/h † *	1.40E+000	2.5E+000
CY-54-IF-007	12/31/2004	8.1E+000 µR/h † *	5.00E-001	2.5E+000
CY-54-IF-008	03/31/2005	7.2E+000 µR/h † *	1.12E+000	2.5E+000
CY-54-IF-010	09/30/2005	7.0E+000 µR/h † *	1.02E+000	2.5E+000
CY-54-IF-011	12/31/2005	6.8E+000 µR/h † *	8.00E-001	2.5E+000
CY-54-IF-012	03/31/2006	6.2E+000 µR/h † *	4.40E-001	2.5E+000
CY-54-IF-013	06/30/2006	6.8E+000 µR/h † *	7.60E-001	2.5E+000
CY-54-IF-014	09/30/2006	6.7E+000 µR/h † *	7.60E-001	2.5E+000
CY-54-IF-015	12/31/2006	6.6E+000 µR/h † *	5.40E-001	2.5E+000
CY-54-IF-016	03/31/2007	6.8E+000 µR/h † *	6.80E-001	2.5E+000
CY-54-IF-017	06/30/2007	6.2E+000 µR/h † *	6.20E-001	2.5E+000
CY-54-IF-018	09/30/2007	7.3E+000 µR/h † *	7.40E-001	2.5E+000
CY-54-IF-019	12/31/2007	7.4E+000 µR/h † *	7.40E-001	2.5E+000
CY-54-IF-020	03/31/2008	7.5E+000 µR/h † *	7.60E-001	2.5E+000
CY-54-IF-021	06/30/2008	6.3E+000 µR/h † *	6.40E-001	2.5E+000
CY-54-IF-022	09/30/2008	7.0E+000 µR/h † *	7.00E-001	2.5E+000
CY-54-IF-023	12/31/2008	5.5E+000 µR/h † *	5.60E-001	2.5E+000
CY-54-IF-024	03/31/2009	7.6E+000 µR/h † *	8.00E-001	2.5E+000
CY-54-IF-025	06/30/2009	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-54-IF-026	09/30/2009	4.8E+000 µR/h † *	4.00E-001	2.5E+000
CY-54-IF-027	12/31/2009	5.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-54-IF-028	03/31/2010	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-54-IF-029	06/30/2010	4.2E+000 µR/h † *	4.00E-001	2.5E+000
CY-54-IF-030	09/30/2010	5.4E+000 µR/h † *	6.00E-001	2.5E+000
CY-54-IF-031	12/31/2010	5.2E+000 µR/h † *	6.00E-001	2.5E+000

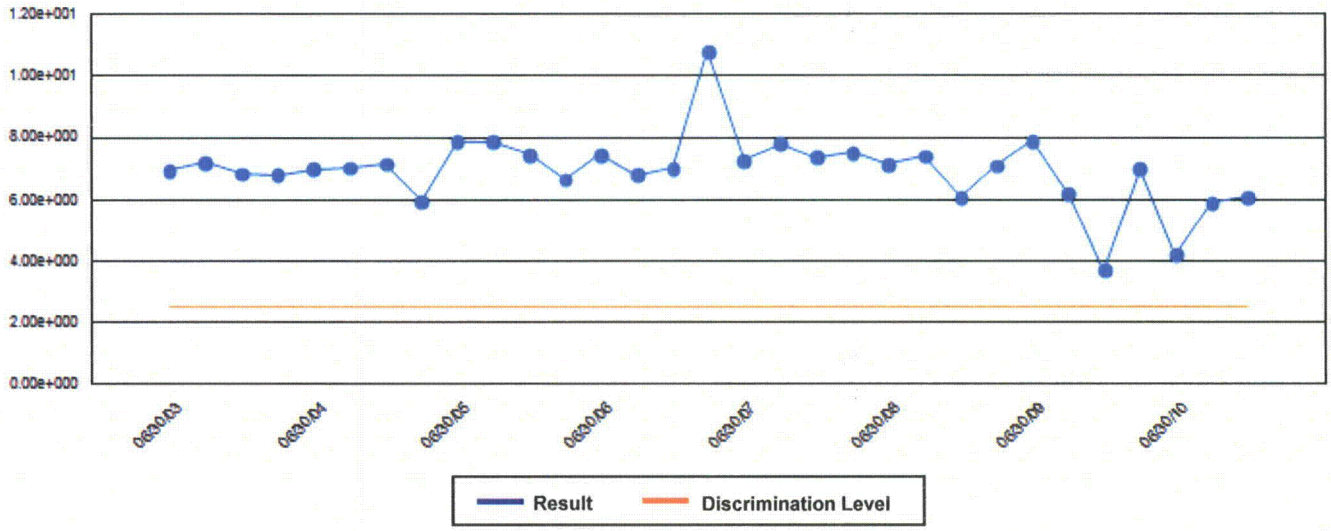
Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

Figure 4.7
Exposure Rate Trend at CY-55-IF

Trend Report 3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-55-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-55-IF-001	06/30/2003	7.0E+000 µR/h † *	6.60E-001	2.5E+000
CY-55-IF-002	09/30/2003	7.2E+000 µR/h † *	4.40E-001	2.5E+000
CY-55-IF-003	12/31/2003	6.8E+000 µR/h † *	5.40E-001	2.5E+000
CY-55-IF-004	03/31/2004	6.8E+000 µR/h † *	1.04E+000	2.5E+000
CY-55-IF-005	06/30/2004	7.0E+000 µR/h † *	1.10E+000	2.5E+000
CY-55-IF-006	09/30/2004	7.0E+000 µR/h † *	1.26E+000	2.5E+000
CY-55-IF-007	12/31/2004	7.2E+000 µR/h † *	4.40E-001	2.5E+000
CY-55-IF-008	03/31/2005	6.0E+000 µR/h † *	4.80E-001	2.5E+000
CY-55-IF-009	06/30/2005	7.9E+000 µR/h † *	1.60E+000	2.5E+000
CY-55-IF-010	09/30/2005	7.9E+000 µR/h † *	1.52E+000	2.5E+000
CY-55-IF-011	12/31/2005	7.5E+000 µR/h † *	9.00E-001	2.5E+000
CY-55-IF-012	03/31/2006	6.7E+000 µR/h † *	6.40E-001	2.5E+000
CY-55-IF-013	06/30/2006	7.5E+000 µR/h † *	7.60E-001	2.5E+000
CY-55-IF-014	09/30/2006	6.8E+000 µR/h † *	7.80E-001	2.5E+000
CY-55-IF-015	12/31/2006	7.0E+000 µR/h † *	5.80E-001	2.5E+000
CY-55-IF-016	03/31/2007	1.1E+001 µR/h † *	1.08E+000	2.5E+000
CY-55-IF-017	06/30/2007	7.3E+000 µR/h † *	7.20E-001	2.5E+000
CY-55-IF-018	09/30/2007	7.8E+000 µR/h † *	7.80E-001	2.5E+000
CY-55-IF-019	12/31/2007	7.4E+000 µR/h † *	7.40E-001	2.5E+000
CY-55-IF-020	03/31/2008	7.5E+000 µR/h † *	7.60E-001	2.5E+000
CY-55-IF-021	06/30/2008	7.2E+000 µR/h † *	7.20E-001	2.5E+000
CY-55-IF-022	09/30/2008	7.4E+000 µR/h † *	7.40E-001	2.5E+000
CY-55-IF-023	12/31/2008	6.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-55-IF-024	03/31/2009	7.1E+000 µR/h † *	8.00E-001	2.5E+000
CY-55-IF-025	06/30/2009	7.9E+000 µR/h † *	8.00E-001	2.5E+000
CY-55-IF-026	09/30/2009	6.2E+000 µR/h † *	6.00E-001	2.5E+000
CY-55-IF-027	12/31/2009	3.7E+000 µR/h † *	4.00E-001	2.5E+000
CY-55-IF-028	03/31/2010	7.0E+000 µR/h † *	6.00E-001	2.5E+000
CY-55-IF-029	06/30/2010	4.2E+000 µR/h † *	4.00E-001	2.5E+000
CY-55-IF-030	09/30/2010	5.9E+000 µR/h † *	6.00E-001	2.5E+000
CY-55-IF-031	12/31/2010	6.1E+000 µR/h † *	6.00E-001	2.5E+000

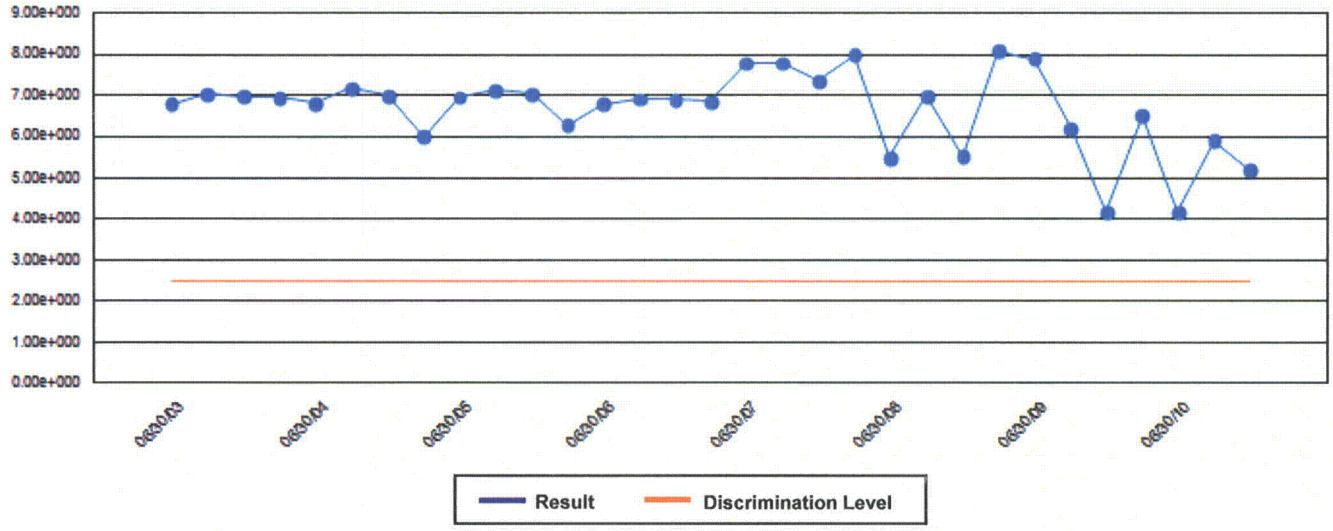
Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

Figure 4.8
Exposure Rate Trend at CY-56-IF

Trend Report 3/17/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Indicator Locations - CY-56-IF : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-56-IF-001	06/30/2003	6.8E+000 µR/h † *	7.00E-001	2.5E+000
CY-56-IF-002	09/30/2003	7.0E+000 µR/h † *	4.80E-001	2.5E+000
CY-56-IF-003	12/31/2003	7.0E+000 µR/h † *	8.00E-001	2.5E+000
CY-56-IF-004	03/31/2004	6.9E+000 µR/h † *	6.80E-001	2.5E+000
CY-56-IF-005	06/30/2004	6.8E+000 µR/h † *	1.00E+000	2.5E+000
CY-56-IF-006	09/30/2004	7.2E+000 µR/h † *	2.68E+000	2.5E+000
CY-56-IF-007	12/31/2004	7.0E+000 µR/h † *	3.40E-001	2.5E+000
CY-56-IF-008	03/31/2005	6.0E+000 µR/h † *	4.40E-001	2.5E+000
CY-56-IF-009	06/30/2005	7.0E+000 µR/h † *	5.80E-001	2.5E+000
CY-56-IF-010	09/30/2005	7.1E+000 µR/h † *	1.10E+000	2.5E+000
CY-56-IF-011	12/31/2005	7.0E+000 µR/h † *	9.00E-001	2.5E+000
CY-56-IF-012	03/31/2006	6.3E+000 µR/h † *	6.40E-001	2.5E+000
CY-56-IF-013	06/30/2006	6.8E+000 µR/h † *	7.60E-001	2.5E+000
CY-56-IF-014	09/30/2006	6.9E+000 µR/h † *	6.60E-001	2.5E+000
CY-56-IF-015	12/31/2006	6.9E+000 µR/h † *	5.60E-001	2.5E+000
CY-56-IF-016	03/31/2007	6.8E+000 µR/h † *	6.80E-001	2.5E+000
CY-56-IF-017	06/30/2007	7.8E+000 µR/h † *	7.80E-001	2.5E+000
CY-56-IF-018	09/30/2007	7.8E+000 µR/h † *	7.80E-001	2.5E+000
CY-56-IF-019	12/31/2007	7.4E+000 µR/h † *	7.40E-001	2.5E+000
CY-56-IF-020	03/31/2008	8.0E+000 µR/h † *	8.00E-001	2.5E+000
CY-56-IF-021	06/30/2008	5.5E+000 µR/h † *	5.60E-001	2.5E+000
CY-56-IF-022	09/30/2008	7.0E+000 µR/h † *	7.00E-001	2.5E+000
CY-56-IF-023	12/31/2008	5.5E+000 µR/h † *	5.60E-001	2.5E+000
CY-56-IF-024	03/31/2009	8.1E+000 µR/h † *	8.00E-001	2.5E+000
CY-56-IF-025	06/30/2009	7.9E+000 µR/h † *	8.00E-001	2.5E+000
CY-56-IF-026	09/30/2009	6.2E+000 µR/h † *	6.00E-001	2.5E+000
CY-56-IF-027	12/31/2009	4.2E+000 µR/h † *	4.00E-001	2.5E+000
CY-56-IF-028	03/31/2010	6.5E+000 µR/h † *	6.00E-001	2.5E+000
CY-56-IF-029	06/30/2010	4.2E+000 µR/h † *	4.00E-001	2.5E+000
CY-56-IF-030	09/30/2010	5.9E+000 µR/h † *	6.00E-001	2.5E+000
CY-56-IF-031	12/31/2010	5.2E+000 µR/h † *	6.00E-001	2.5E+000

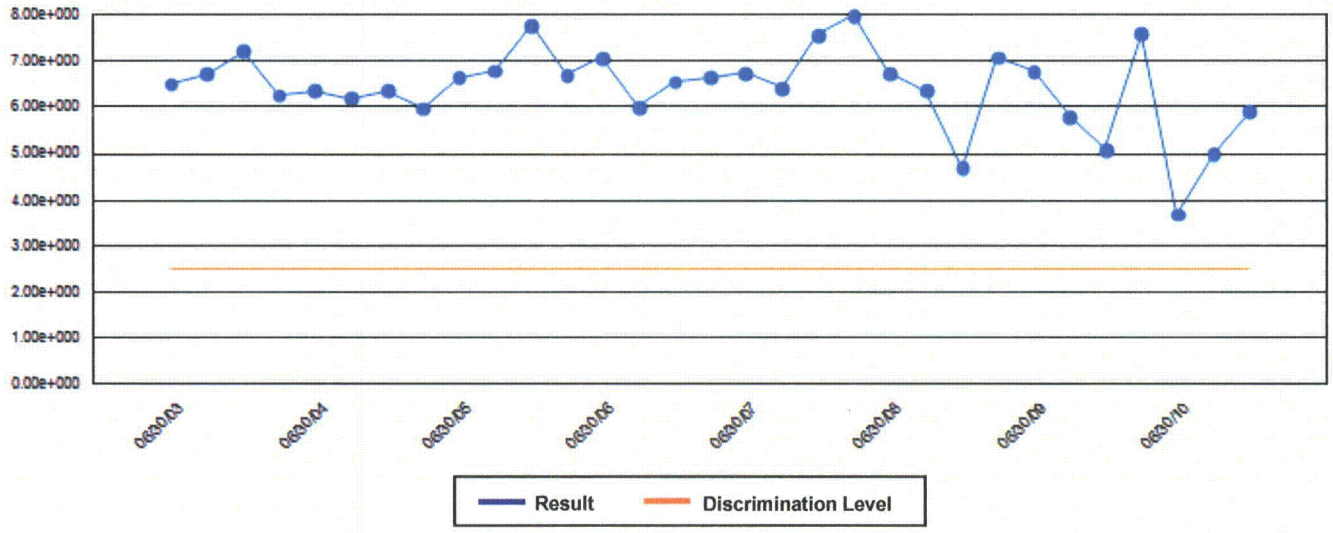
Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

Figure 4.9
Exposure Rate Trend at Control Location CY-10-IFC

Trend Report 4/4/2011

Displays: Samples collected between 06/30/2003 and 12/31/2010

Control Location - CY-10-IFC : REMP TLD [Exposure Rate]



Sample Name	Date Collected	Result	2 Sigma Error	Discrimination Level
CY-10-IFC-001	06/30/2003	6.5E+000 µR/h † *	7.00E-001	2.5E+000
CY-10-IFC-002	09/30/2003	6.7E+000 µR/h † *	6.00E-001	2.5E+000
CY-10-IFC-003	12/31/2003	7.2E+000 µR/h † *	9.00E-001	2.5E+000
CY-10-IFC-004	03/31/2004	6.3E+000 µR/h † *	5.80E-001	2.5E+000
CY-10-IFC-005	06/30/2004	6.4E+000 µR/h † *	1.12E+000	2.5E+000
CY-10-IFC-006	09/30/2004	6.2E+000 µR/h † *	5.80E-001	2.5E+000
CY-10-IFC-007	12/31/2004	6.4E+000 µR/h † *	3.80E-001	2.5E+000
CY-10-IFC-008	03/31/2005	6.0E+000 µR/h † *	6.00E-001	2.5E+000
CY-10-IFC-009	06/30/2005	6.7E+000 µR/h † *	4.60E-001	2.5E+000
CY-10-IFC-010	09/30/2005	6.8E+000 µR/h † *	6.60E-001	2.5E+000
CY-10-IFC-011	12/31/2005	7.8E+000 µR/h † *	9.00E-001	2.5E+000
CY-10-IFC-012	03/31/2006	6.7E+000 µR/h † *	5.40E-001	2.5E+000
CY-10-IFC-013	06/30/2006	7.1E+000 µR/h † *	5.60E-001	2.5E+000
CY-10-IFC-014	09/30/2006	6.0E+000 µR/h † *	5.80E-001	2.5E+000
CY-10-IFC-015	12/31/2006	6.6E+000 µR/h † *	7.80E-001	2.5E+000
CY-10-IFC-016	03/31/2007	6.7E+000 µR/h † *	6.60E-001	2.5E+000
CY-10-IFC-017	06/30/2007	6.8E+000 µR/h † *	6.80E-001	2.5E+000
CY-10-IFC-018	09/30/2007	6.4E+000 µR/h † *	6.40E-001	2.5E+000
CY-10-IFC-019	12/31/2007	7.6E+000 µR/h † *	7.60E-001	2.5E+000
CY-10-IFC-020	03/31/2008	8.0E+000 µR/h † *	8.00E-001	2.5E+000
CY-10-IFC-021	06/30/2008	6.8E+000 µR/h † *	6.80E-001	2.5E+000
CY-10-IFC-022	09/30/2008	6.4E+000 µR/h † *	6.40E-001	2.5E+000
CY-10-IFC-023	12/31/2008	4.7E+000 µR/h † *	4.80E-001	2.5E+000
CY-10-IFC-024	03/31/2009	7.1E+000 µR/h † *	8.00E-001	2.5E+000
CY-10-IFC-025	06/30/2009	6.8E+000 µR/h † *	6.00E-001	2.5E+000
CY-10-IFC-026	09/30/2009	5.8E+000 µR/h † *	6.00E-001	2.5E+000
CY-10-IFC-027	12/31/2009	5.1E+000 µR/h † *	6.00E-001	2.5E+000
CY-10-IFC-028	03/31/2010	7.6E+000 µR/h † *	8.00E-001	2.5E+000
CY-10-IFC-029	06/30/2010	3.7E+000 µR/h † *	4.00E-001	2.5E+000
CY-10-IFC-030	09/30/2010	5.0E+000 µR/h † *	4.00E-001	2.5E+000
CY-10-IFC-031	12/31/2010	5.9E+000 µR/h † *	6.00E-001	2.5E+000

Results marked with * are greater than 2 Sigma Error.
Results marked with † are greater than the Discrimination Level

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.

No deviations of the sampling requirements occurred during this monitoring period.

5.2 Direct Radiation Pathway

5.2.1 Exposure Rates

Direct radiation is continuously measured at 8 indicator locations surrounding the Haddam Neck ISFSI, along with 1 control location (Hurd Park Road) using thermoluminescent dosimeters (TLDs). These dosimeters are collected every calendar quarter for readout at the NVLAP certified dosimetry services vendor.

Review of the data in Tables 4.2 and 4.3 shows no significant difference between the indicator and control location exposure rates. Figures 4.1 through 4.9 show exposure rate trends of the monitoring locations since 2003. Review of Figures 4.1 through 4.9 shows no significant difference between the pre-operational and operational exposure rates at either the indicator or control locations. The data listed under each of the trend graphs show values for the result errors and discrimination levels. Note that these values are estimated and are shown only for information.

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 2010 dose estimate assumes a total of 500 hours occupancy for the dose calculation; of which 50 hours are used in both the first and fourth quarters and 200 hours are used in both the second and third quarters. The most likely location for exposure to a member of the public from the ISFSI is along the Connecticut or Salmon Rivers for boating and fishing; however, the time estimates are conservatively applied to all monitoring locations.

Table 4.4 presents the results of the dose calculations. The highest calculated dose is not along either river but at a location near the center of the site at Station ID number CY-53-IF. The maximum calculated annual dose at that location is 0.66 mrem. This value is only 3 percent of the 25 mrem per year limit. The calculated annual dose to members of the public at the mouth of the Discharge Canal was zero. The calculated annual dose to members of the public at Route 149 near the mouth of the Salmon River was 0.23 mrem.

6.0 LAND USE CENSUS

The most recent census remained in effect for 2010; 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 Off-site Dose Calculation Manual, Revision 23.

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”.