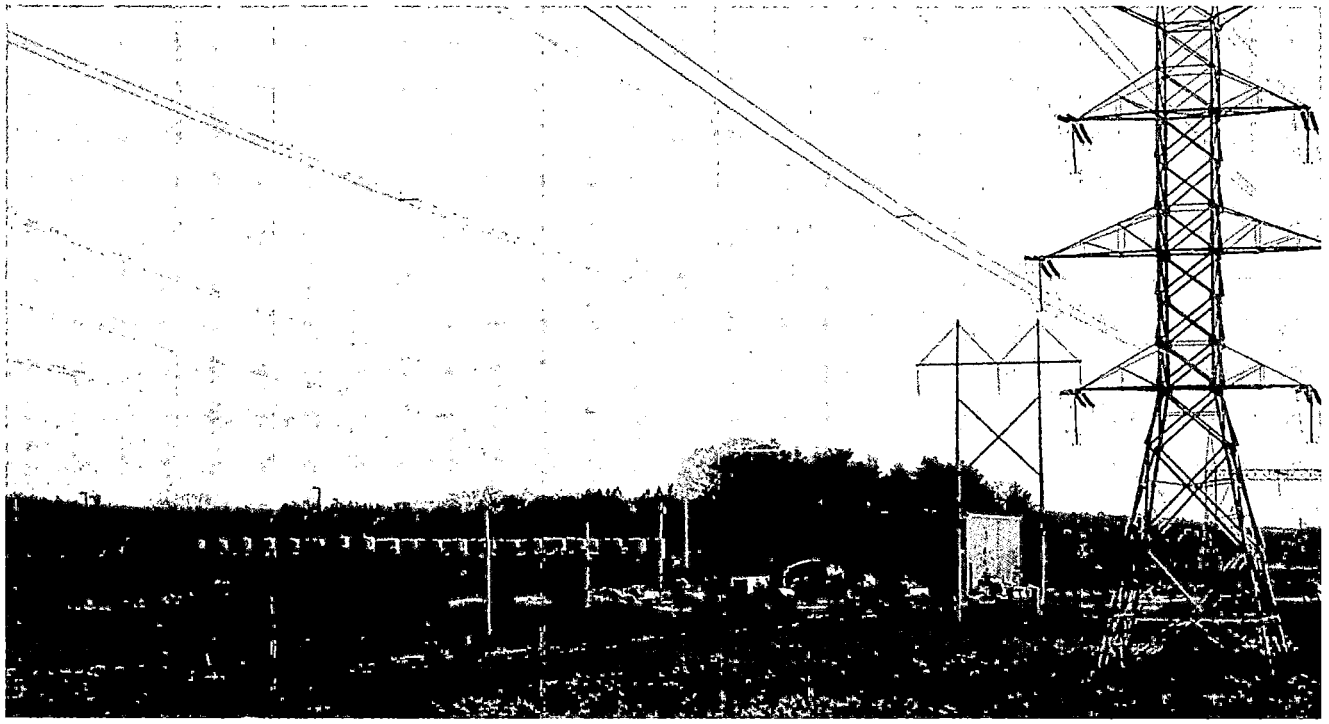
MAINE YANKEE
INDEPENDENT SPENT FUEL STORAGE INSTALLATION
License Nos. DPR-36 and SFGL-14

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

January - December 2019



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EXECUTIVE SUMMARY

The Maine Yankee Independent Spent Fuel Storage Installation (ISFSI) has been in operation since 2001. 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 Maine Yankee ISFSI located in Wiscasset, ME was continued for the period January through December 2019 in compliance with the Maine 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 nine locations in the vicinity of the ISFSI and one control location 5.2 kilometers 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. The results of the monitoring performed in 2019 also show that operating the Maine Yankee 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.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

This report summarizes the findings of the Radiological Environmental Monitoring Program (REMP) conducted by Maine Yankee in the vicinity of the Independent Spent Fuel Storage Installation in Wiscasset, Maine during the calendar year 2019. It is submitted annually in compliance with Appendix A of the Offsite Dose Calculation Manual (ODCM). The remainder of this report is organized as follows:

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

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

Section 4: Provides a complete set of TLD data in the exposure units of milliroentgen (mR). These TLD data are then converted to a calculated dose equivalent in units of 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: References

2.0 GENERAL ISFSI AND SITE INFORMATION

The Maine Yankee Independent Spent Fuel Storage Installation (ISFSI) is located in the town of Wiscasset, Lincoln County, Maine, approximately six miles northeast of Bath, Maine. The site vicinity is rural and lightly populated.

The ISFSI site is located near Bailey Point, a peninsula bounded to the east by the Back River and to the west by a shallow inlet known as Bailey Cove, both of which are part of the Montsweag Bay-Sheepscot River Estuary. Bailey point is an elongated bedrock ridge with flat or gently rolling topography rising to an average elevation of about 25 feet above sea level.

The REMP for the ISFSI began pre-operational measurements in the 4th quarter of 1999, approximately 2 years 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 REMP for the Maine Yankee 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 Figures 3.1 and 3.2 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 Monitoring Program

3.3.1 Direct Radiation

Direct gamma radiation exposure was continuously monitored during 2019 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 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 can be taken that are not required in the ODCM. No special samples were collected in 2019.

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:10 (9 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 (km)	Direction From ISFSI
TL-I-02	Spent Fuel Storage (I)**	1	< 0.28	N
TL-I-04	Spent Fuel Storage (I)**	1	< 0.28	NE
TL-I-06	Spent Fuel Storage (I)**	1	< 0.28	E
TL-I-08	Spent Fuel Storage (I)**	1	< 0.28	SE
TL-I-10	Spent Fuel Storage (I)**	1	< 0.28	S
TL-I-12	Spent Fuel Storage (I)**	1	< 0.28	SW
TL-I-14	Spent Fuel Storage (I)**	1	< 0.28	W
TL-I-15	Spent Fuel Storage (I)**	1	< 0.28	WNW
TL-I-16	Spent Fuel Storage (I)**	1	< 0.28	NW
TL-O-36	Wiscasset Fire Station (O)	2	5.2	NW

*2 = Control TLD; 1 = Indicator TLD

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

Figure 3.1
Radiological Environmental Monitoring Locations (within 0.28 km)

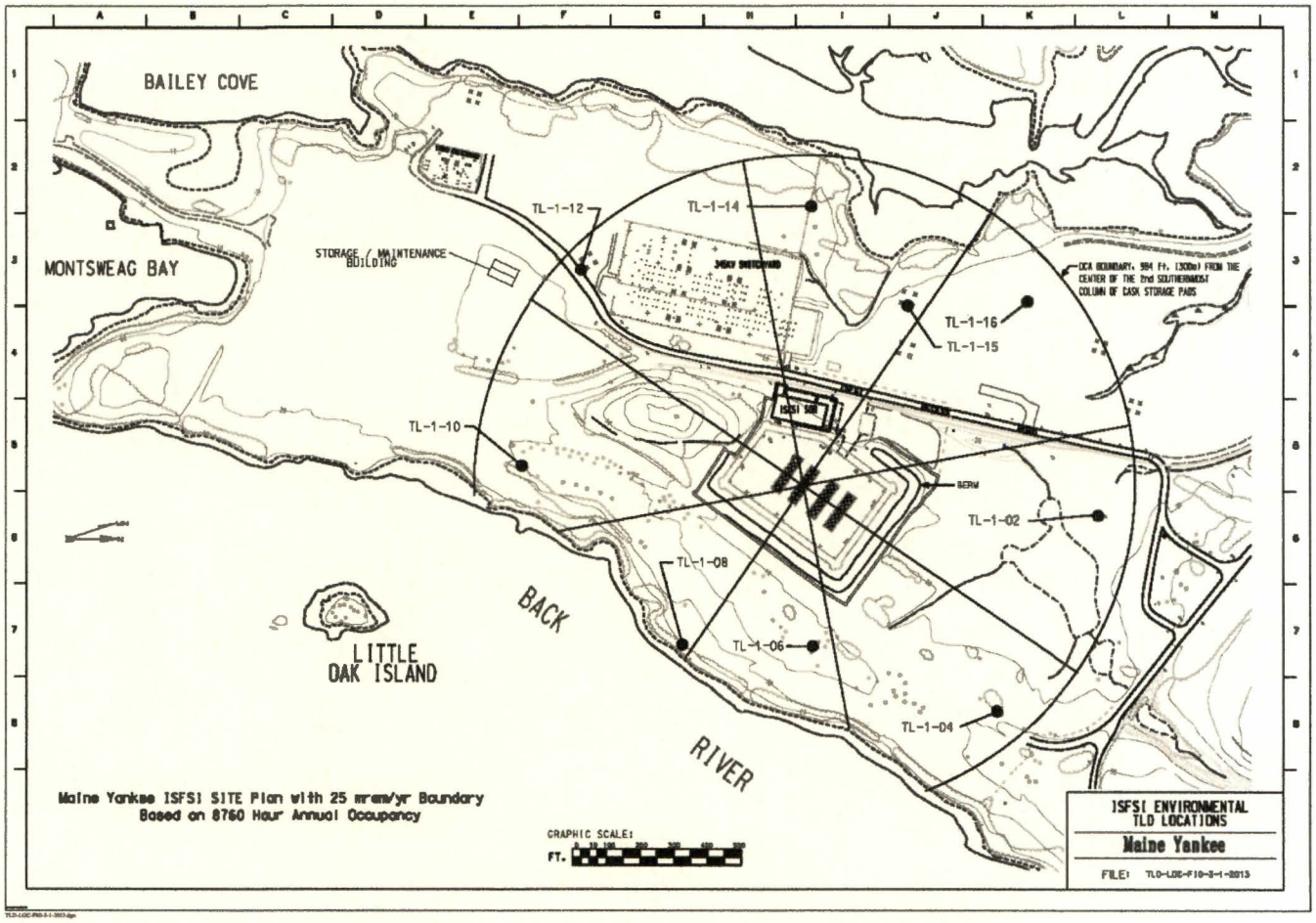


Figure 3.2
Direct Radiation Monitoring Locations (outside 1 km)

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
TL-I-02	N	41	39
TL-I-04	NE	45	39
TL-I-06	E	47	51
TL-I-08	SE	39	44
TL-I-10	S	55	46
TL-I-12	SW	49	40
TL-I-14	W	48	45
TL-I-15	WNW	53	47
TL-I-16	NW	54	38
TL-O-36	Control	51	38
TL-O-36a	Control Backup	42	-

Note: Control backup TLD TL-O-36a was missing at the time of TLD changeout.

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)*
45.6	43.7	TL-I-010	50.5
(38 – 55)	(38 – 51)		(46 – 55)
(18)	(3)		(2)

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

Table 4.3 Direct Dose from ISFSI Operations (mrem)

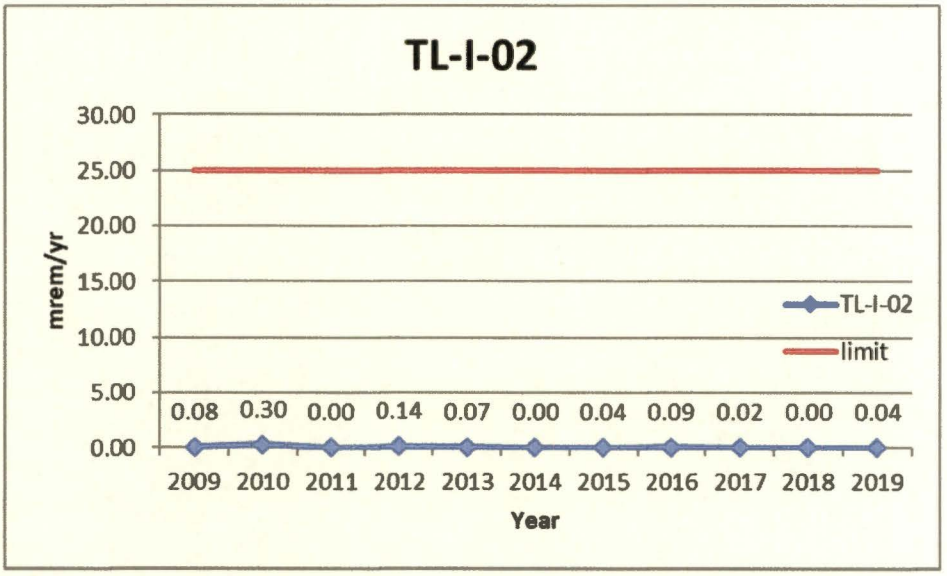
Station ID	1st Half-Year		2nd Half-Year		Annual Dose
	Net TLD Result	Calculated Dose	Net TLD Result	Calculated Dose	
TL-I-02	0.00	0.00	1.00	0.04	0.04
TL-I-04	0.00	0.00	1.00	0.04	0.04
TL-I-06	0.50	0.02	13.00	0.48	0.50
TL-I-08	0.00	0.00	6.00	0.22	0.22
TL-I-10	8.50	0.32	8.00	0.30	0.62
TL-I-12	2.50	0.09	2.00	0.07	0.16
TL-I-14	1.50	0.06	7.00	0.26	0.32
TL-I-15	6.50	0.24	9.00	0.33	0.57
TL-I-16	7.50	0.28	0.00	0.00	0.28
				Max Dose =>	**0.62**

Note:
Doses based on a 162.5 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.

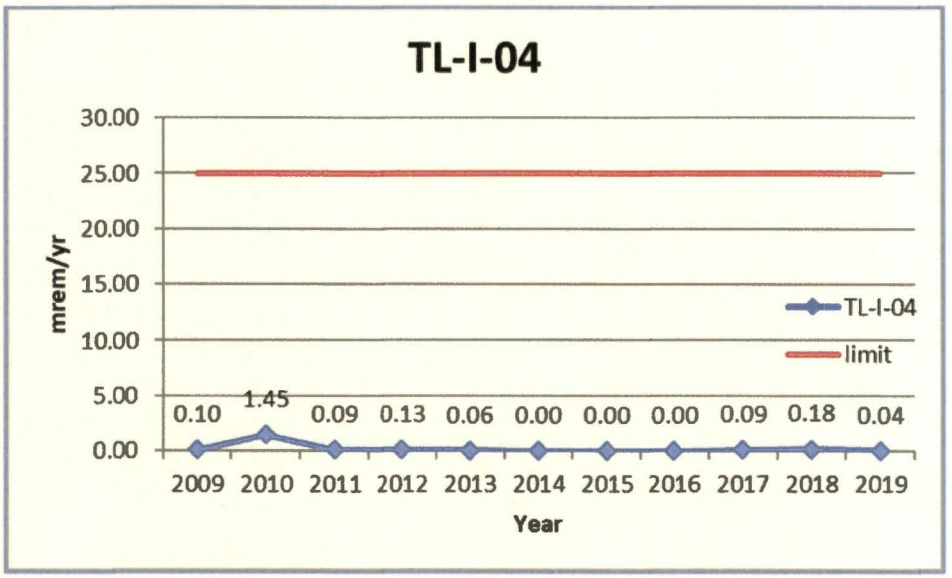
Figure 4.1 Annual Dose Trend at TL-I-02



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-02	0.08	0.30	0.00	0.14	0.07	0.00	0.04	0.09	0.02	0.00	0.04

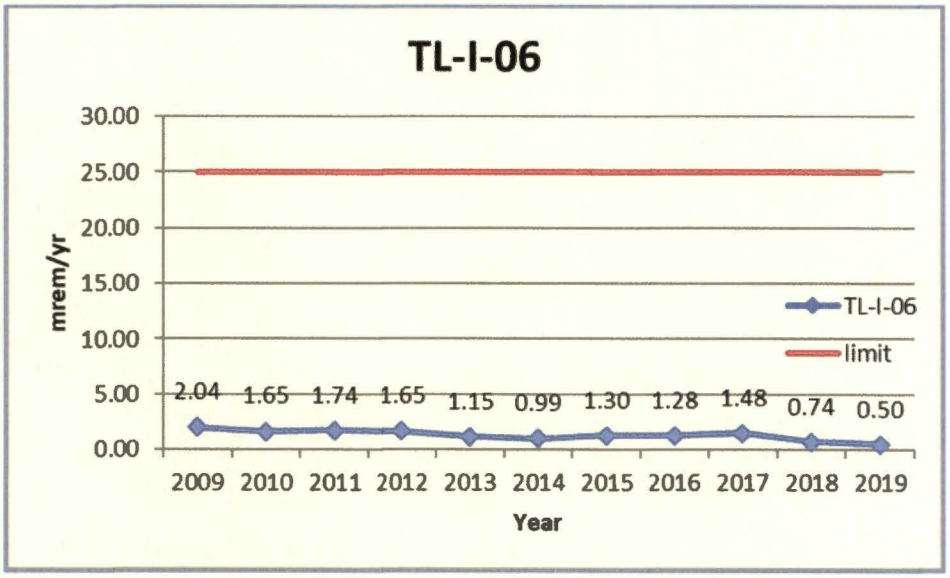
Figure 4.2 Annual Dose Trend at TL-I-04



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-04	0.10	1.45	0.09	0.13	0.06	0.00	0.00	0.00	0.09	0.18	0.04

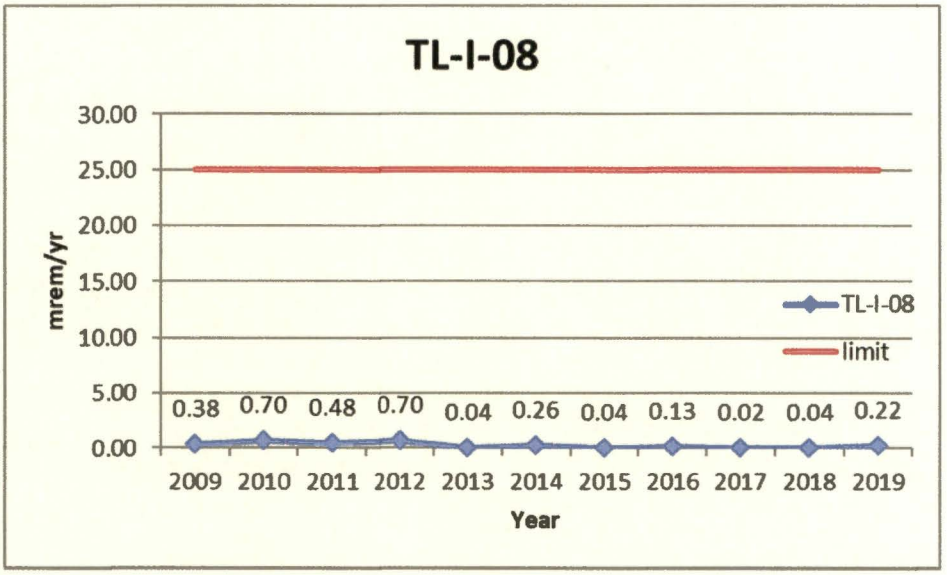
Figure 4.3 Annual Dose Trend at TL-I-06



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-06	2.04	1.65	1.74	1.65	1.15	0.99	1.30	1.28	1.48	0.74	0.50

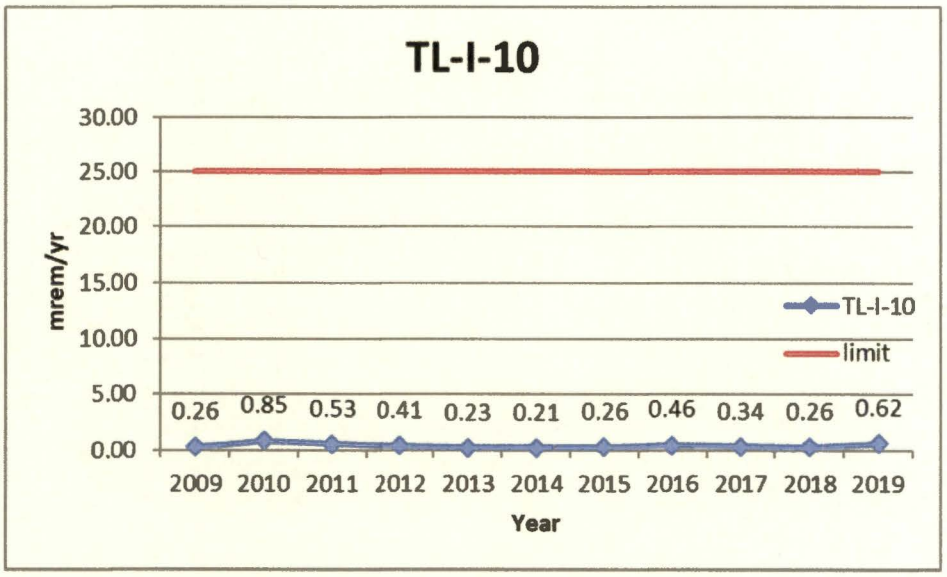
Figure 4.4 Annual Dose Trend at TL-I-08



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-08	0.38	0.70	0.48	0.70	0.04	0.26	0.04	0.13	0.02	0.04	0.22

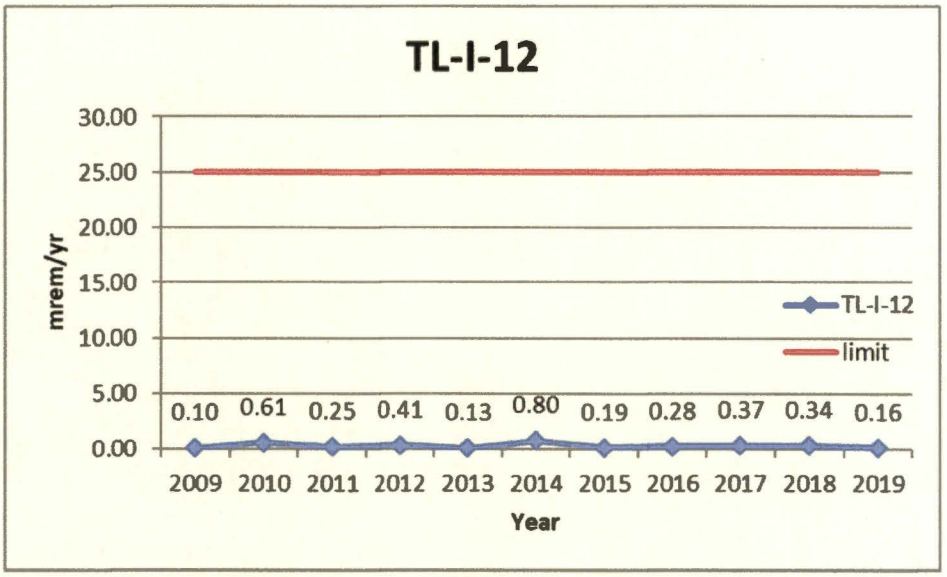
Figure 4.5 Annual Dose Trend at TL-I-10



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-10	0.26	0.85	0.53	0.41	0.23	0.21	0.26	0.46	0.34	0.26	0.62

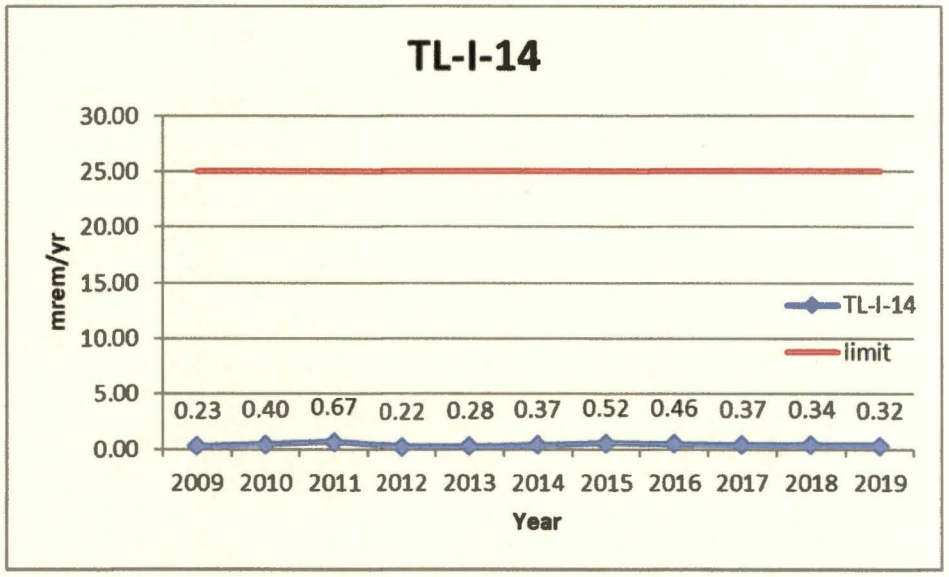
Figure 4.6 Annual Dose Trend at TL-I-12



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-12	0.10	0.61	0.25	0.41	0.13	0.80	0.19	0.28	0.37	0.34	0.16

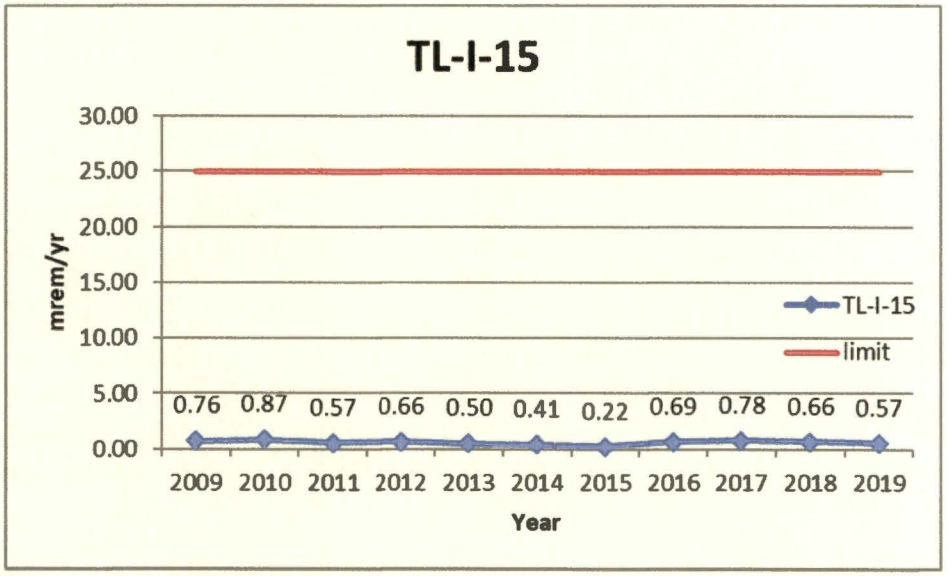
Figure 4.7 Annual Dose Trend at TL-I-14



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-14	0.23	0.40	0.67	0.22	0.28	0.37	0.52	0.46	0.37	0.34	0.32

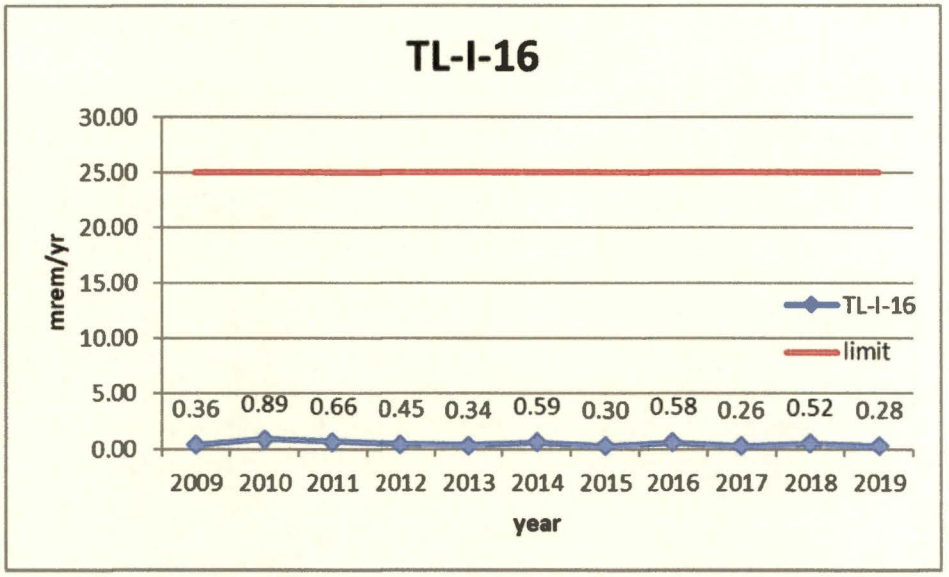
Figure 4.8 Annual Dose Trend at TL-I-15



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-15	0.76	0.87	0.57	0.66	0.50	0.41	0.22	0.69	0.78	0.66	0.57

Figure 4.9 Annual Dose Trend at TL-I-16



Annual Doses (mrem/yr)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
TL-I-16	0.36	0.89	0.66	0.45	0.34	0.59	0.30	0.58	0.26	0.52	0.28

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 was one deviation of the sampling program documented in 2019. While performing the semi-annual REMP TLD changeout, it was discovered that the backup Control TLD was missing. This condition has no impact on the REMP because the Control TLD was available for use.

5.2 Direct Radiation Pathway

5.2.1 Annual Dose Trends

Direct radiation is continuously measured at 9 indicator locations surrounding the Maine Yankee ISFSI, along with 1 control location (Wiscasset Fire Station) 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 4.9 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

A 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. 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 2019 dose estimate assumes a total of 325 hours occupancy for the dose calculation; of which 162.5 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 along the Back River, Bailey Cove or Montsweag Bay for boating and fishing and the mud flats in the Cove or Bay

exposed at low tides which is worked by clam diggers and worm diggers; 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 Station ID number TL-I-10. The maximum calculated annual dose at that location is 0.62 mrem. This value is only 2.5 percent of the 25 mrem per year limit. It is noted that most of the mud flat region in Bailey Cove that is used by the public is situated further away from this Station. As a result, actual exposures from direct radiation would be much less than the maximum calculated value.

6.0 REFERENCES

1. USNRC Radiological Assessment Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program," Revision 1, November 1979.

2. Maine Yankee Offsite Dose Calculation Manual, Revision 36.

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".