



**Pacific Gas and
Electric Company®**

James M. Welsch
Vice President, Nuclear Generation
and Chief Nuclear Officer

Diablo Canyon Power Plant
P.O. Box 56
Avila Beach, CA 93424

805.545.3242
E-Mail: JMW1@pge.com

April 26, 2018

PG&E Letter HIL-18-005

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

10CFR72.104

Docket No. 72-27, Materials License Number SNM-2514
Humboldt Bay Independent Spent Fuel Storage Installation
Annual Radiological Environmental Monitoring Report for 2017

Dear Commissioners and Staff:

Enclosed is the Humboldt Bay Independent Spent Fuel Storage Installation (HB ISFSI), "Annual Radiological Environmental Monitoring Report" for 2017. This report provides information regarding our compliance with 10CFR72.104, "Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI or MRS."

PG&E makes no new or revised regulatory commitments (as defined by NEI 99-04) in this letter.

If you have any questions regarding this submittal, please contact Mr. Matthew Hayes at (805) 545-4488.

Sincerely,

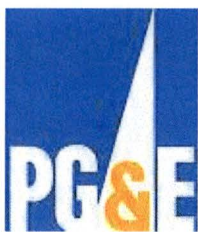
James M. Welsch

armb/4743/50947988-01

Enclosure

cc/enc: John B. Hickman, NRC Project Manager
Kriss M. Kennedy, NRC Region IV Administrator
NRC Document Control Desk
HBPP Humboldt Distribution

IEZ5
NMSS26
NMSS



**2017 Humboldt Bay
Independent Spent Fuel Storage Installation (ISFSI)
Annual Radiological Environmental Monitoring Report**

January 1, 2017 - December 31, 2017



This page intentionally left blank.

**2017 Humboldt Bay
Independent Spent Fuel Storage Installation
(ISFSI)**

**ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT
January 1, 2017 - December 31, 2017**

**Prepared By
Pacific Gas & Electric Company
Diablo Canyon Power Plant (DCPP)**

Prepared: Martin Wright **Date:** 2/8/18
Martin Wright, DCPP RP Senior Advising Engineer

Independent Tech Review: Tom Hook **Date:** 2/8/18
Tom Hook, DCPP RP Engineer

Reviewed and Approved: Matt Hayes **Date:** 2/8/18
Matt Hayes, DCPP Radiation Protection Manager

This page intentionally left blank.

EXECUTIVE SUMMARY

This report contains results from the radiological environmental monitoring of the Humboldt Bay (HB) Independent Spent Fuel Storage Installation (ISFSI) compiled for the period January 1, 2017 through December 31, 2017.

Pursuant to 10 CFR 72, the Nuclear Regulatory Commission (NRC) issued Materials License SNM-2514 to Pacific Gas and Electric Company (PG&E) on November 17, 2005, to build and operate the HB ISFSI. The license was issued for a period of 20 years in accordance with 10 CFR 72.42.

The HB ISFSI is located within the PG&E owner-controlled area at the Humboldt Bay Power Plant (HBPP). The HBPP is located near the coastal community of King Salmon on the shore of Humboldt Bay in Humboldt County, in northwestern California. Eureka, the largest city in Humboldt County, is located approximately 3 miles north of the HB ISFSI site.

The HB ISFSI is an interim storage facility consisting of an in-ground concrete vault structure with storage capacity for six shielded casks; five casks containing spent nuclear fuel (400 spent fuel assemblies in total) and one cask containing greater than class "C" (GTCC) waste. The HB ISFSI was designed to protect the stored fuel and prevent release of radioactive material under all normal, off-normal, and accident conditions of storage in accordance with all applicable regulatory requirements contained in 10 CFR 72. The spent fuel will be stored at the HB ISFSI until a Department of Energy (DOE) or other interim storage facility is available.

Dry cask storage of spent fuel is a passive storage process that does not require extensive operating equipment or personnel to maintain.

There are no radioactive effluents (particulates, liquids, or gases) from the operation of the HB ISFSI.

Environmental (Env) radiation monitoring was conducted for the HB ISFSI utilizing Env thermo-luminescent dosimeter (TLD) badges during 2017. No radiation was detected above normal statistical background values.

Twelve persons were monitored for occupational exposure on August 2, 2017 due to a cask #2 inspection evolution. Each person received 0 mrem during that evolution.

Operation of the HB ISFSI continued to have no detectable radiological monitoring program exposure during 2017.

This page intentionally left blank.

TABLE OF CONTENTS

Executive Summary	Page 5
1.0 Introduction	Page 9
2.0 General Description of Location	Page 12
3.0 Environmental Monitoring Program Design	
3.1 Direct Radiation	Page 13
4.0 Analysis of Environmental Monitoring Results	
4.1 Monitoring Variance / Deviations	Page 15
4.2 Monitoring Analysis	Page 16
 Figures and Tables	
Figure 1 - Aerial view of HB ISFSI	Page 9
Figure 2 - HB ISFSI Holtec International HI-STAR 100 dry cask system	Page 11
Figure 3 - HB ISFSI map showing Env TLD Stations	Page 14
Figure 4 - Picture of HB ISFSI installed vault lids	Page 15
Table 1 - HB ISFSI Env TLD Analysis Spreadsheet	Page 19

This page intentionally left blank.



Figure 1 - Aerial view of HB ISFSI

1.0 INTRODUCTION

Humboldt Bay Power Plant (HBPP) is owned by Pacific Gas and Electric (PG&E) and contained multiple electric generation units. Unit 1 (commissioned in 1956) and Unit 2 (commissioned in 1958) were co-located conventional 53 megawatt-electric (MWe) units capable of operating on fuel oil or natural gas. Units 1 and 2 have been demolished and removed. Unit 3 (commissioned in 1963) was a boiling water reactor (BWR) nuclear power plant located in a separate building adjacent to Unit 2. Unit 3 operated for approximately 13 years before being shut down in July 1976. The reactor has remained shut down since 1976. Unit 3 was in the process of decommissioning during 2017.

HBPP Unit 3 received a construction permit on October 17, 1960. Provisional Operating License DPR-7 was issued in August 1962 and commercial operation began in August 1963. On May 17, 1976, the NRC issued an order that required the satisfactory completion of a specified seismic design upgrade program and resolution of specified geologic and seismic concerns prior to power operation following the 1976 shutdown. In 1983, PG&E concluded that the seismic modifications and other modifications required (in response to the Three Mile Island accident in 1979) were not economical and opted to decommission the

nuclear power plant. In 1988, the NRC approved the SAFSTOR Plan for Unit 3 and revised the operating license to a possess-but-not-operate license.

The Nuclear Waste Policy Act (NWPA) of 1982, as amended, mandated that the DOE assume responsibility for the permanent disposal of spent nuclear fuel from the nation's commercial nuclear power plants beginning in January 1998, pending the availability of a permanent DOE repository. Nuclear power plant operators such as PG&E were given the responsibility under the NWPA to provide for the interim onsite storage of spent fuel until it is accepted by DOE. DOE has not met its NWPA mandate to have a repository in operation commencing in January 1998, and no interim spent fuel storage facility has been established. Thus, spent fuel stored at HBPP will need to remain at HBPP until a DOE or other interim storage facility is available. The HB ISFSI facilitated the dismantling of the Unit 3 structures and provided for earlier termination of the SAFSTOR 10 CFR 50 license.

Pursuant to 10 CFR 72, the NRC issued Materials License SNM-2514 to PG&E on November 17, 2005, to build and operate the HB ISFSI. In accordance with 10 CFR 72.42, the HB ISFSI license was issued for a term of 20 years. If near the end of the initial license term, permanent or interim DOE High Level Waste facilities are unavailable for acceptance of commercial nuclear spent fuel, PG&E expects to submit an application for HB ISFSI license renewal pursuant to 10 CFR 72.42(b).

The HB ISFSI is located on the same property as the existing HBPP facility. The HB ISFSI storage vault is an interim facility consisting of an in-ground concrete vault structure with storage capacity for six shielded casks. The HB ISFSI was designed to store up to 400 spent fuel assemblies in 5 casks, with a sixth cask to store greater than class "C" (GTCC) waste. The maximum average fuel burn-up per assembly of any fuel that was stored at the HB ISFSI was less than 23,000 MWD/MTU. The maximum average initial fuel assembly enrichment was equal to or less than 2.51 percent. The spent fuel will be stored there until the DOE takes possession of the spent fuel and transports it to a long-term repository. In contrast with the previous SAFSTOR wet storage method, dry storage of spent fuel was a passive storage process that did not require extensive operating equipment or personnel to maintain. There were no radiological effluents (particulates, liquids, or gases) from the operation of the HB ISFSI, as compared to the allowable effluents in SAFSTOR.

PG&E used the Holtec International HI-STAR 100 dry cask system, as modified for the HBPP spent fuel. The HB-specific design was referred to as the HI-STAR HB. The HI-STAR HB is both a storage and transport cask that provides structural protection and radiation shielding for the multi-purpose canister (MPC-HB) containing the spent fuel. The HI-STAR HB will be licensed under 10 CFR 71 for transport of the spent fuel offsite to a federal repository.

The HB ISFSI was designed to protect the stored fuel and prevent release of radioactive material under all normal, off-normal, and accident conditions of storage in accordance with all applicable regulatory requirements contained in 10 CFR 72.

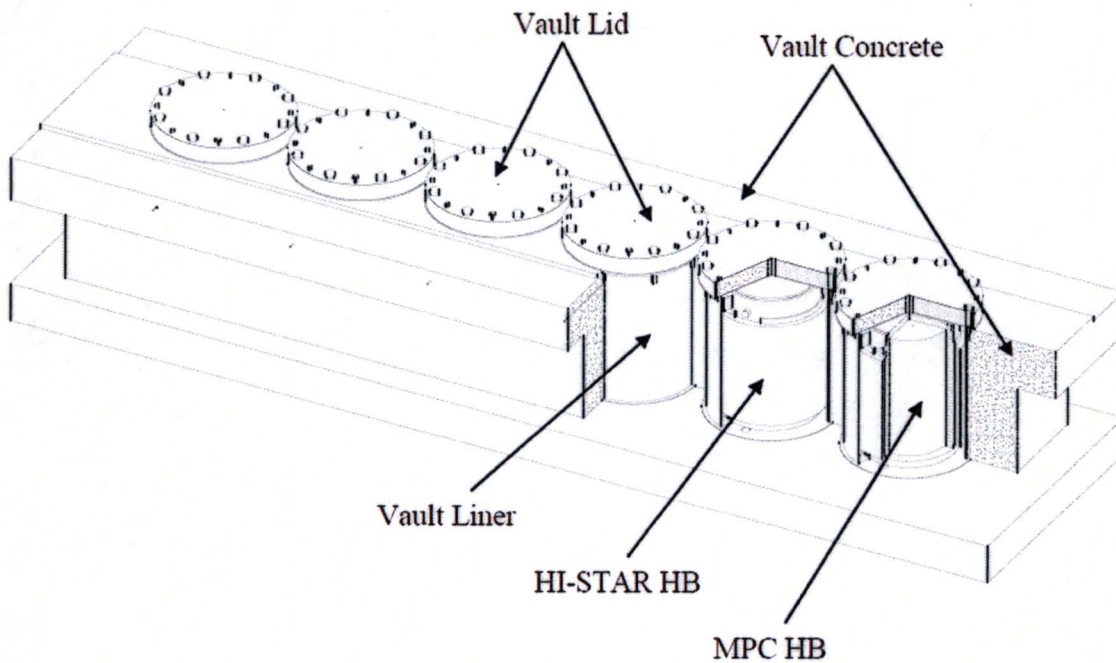


Figure 2 - HB ISFSI Holtec International HI-STAR 100 dry cask system

2.0 GENERAL DESCRIPTION OF LOCATION

The HB ISFSI is located within the PG&E owner-controlled area at the HBPP. There are no "important-to-safety" structures, systems, or components that are shared between the HB ISFSI and HBPP. PG&E has full authority to control all activities within the HB ISFSI Security Area Fence, HB ISFSI Security Boundary Fence, and the PG&E owner-controlled area boundaries.

The HBPP is located near the coastal community of King Salmon on the shore of Humboldt Bay in Humboldt County, in northwestern California. Eureka (the largest city in Humboldt County) is located approximately 3 miles north of the HB ISFSI site.

There are several small residential communities within 5 miles of the HB ISFSI site, including King Salmon, Humboldt Hill, Fields Landing, and the suburban communities surrounding the City of Eureka.

The terrain in the vicinity of the HBPP rises rapidly from the bay on the north side to an elevation of approximately 65 ft mean lower low water (MLLW) at Buhne Point peninsula. Terrain to the north and east of the site is generally flat. To the south and east, the terrain rises rapidly forming Humboldt Hill, which reaches an elevation of over 500 ft MLLW within 2 miles of the HB ISFSI and is the site of several small neighborhoods. Humboldt County is mostly mountainous except for the level plain that surrounds Humboldt Bay. The coastal mountains extend to the central valley. The PG&E owner controlled area is not traversed by public highway or railroad. The only access to the HB ISFSI site is from the south via King Salmon Avenue, which also serves the community of King Salmon situated on the western part of the peninsula. Public trails run along the shoreline and along the fence to the northwest of the PG&E owner-controlled area.

The major access in the vicinity of the HB ISFSI and other communities of Humboldt County is via US Highway 101, which generally traverses north-south through Humboldt County. This highway passes about 0.3 mile east of the HB ISFSI site and is accessible at approximately 0.35 mile to the southeast of the site.

There are several landings in the community of King Salmon, located just west of the entrance gate to the PG&E owner-controlled area. The community of King Salmon serves frequent commercial and recreational boat traffic.

3.0 ENVIRONMENTAL MONITORING PROGRAM DESIGN

3.1 DIRECT RADIATION

Environmental (Env) thermo-luminescent dosimeter (TLD) badge packets were distributed and collected quarterly from the HB ISFSI Security Area Fence and HB ISFSI Security Boundary Fence stations by PG&E Diablo Canyon Power Plant (DCPP) personnel. These Env TLDs were shipped to Mirion Technologies for processing. Control badges accompanied the station badges during vendor shipment to measure any non-station dose received during transit time periods.

Direct ambient radiation was measured at 10 stations surrounding the HB ISFSI using Panasonic type UD814 Env TLD badges. The Security Area Fence stations were labeled T-18, T-19, T-20, and T-21 (see Figure 3). The Security Boundary Fence stations were labeled T-2, T-3, T-4, T-5, T-23, and T-24 (see Figure 3). The Security Boundary Fence Env TLD station monitoring was initiated during the third quarter 2017 for this report. The Env TLD badges had valid element correction factors (ECFs), were calibrated using a National Institute of Standards and Technology (NIST) traceable caesium-137 source, were annealed prior to placement, and were sealed in watertight packaging. Three TLD badges were placed at each station and each badge contained 3 calcium sulfate phosphors for a total of 9 calcium sulfate phosphors at each station. The 9 phosphors were analyzed and then averaged to provide a single station reading. Transit process exposure was subtracted and that single reading was converted into a microrem per hour ($\mu\text{rem/hr}$) doserate dependent on the in-field exposure time period. Then the $\mu\text{rem/hr}$ doserate was converted into millirem (mrem) per standard (91 day) quarter. This millirem result was reported in Table 1 as "Standard Quarter TLD Results" for each station.

ISFSI Env TLD "Standard Quarter TLD Results" were measurements of all environmental gamma radiation sources (cosmic, terrestrial, radon, man-made, etc) at each station during the in-field deployment period.

ANSI/HPS N13.37-2014 "Environmental Dosimetry - Criteria for System Design and Implementation" methodology was used to report "Quarterly / Annual Investigation Level Dose" as a means to quantify facility related exposure above natural statistical background exposure.

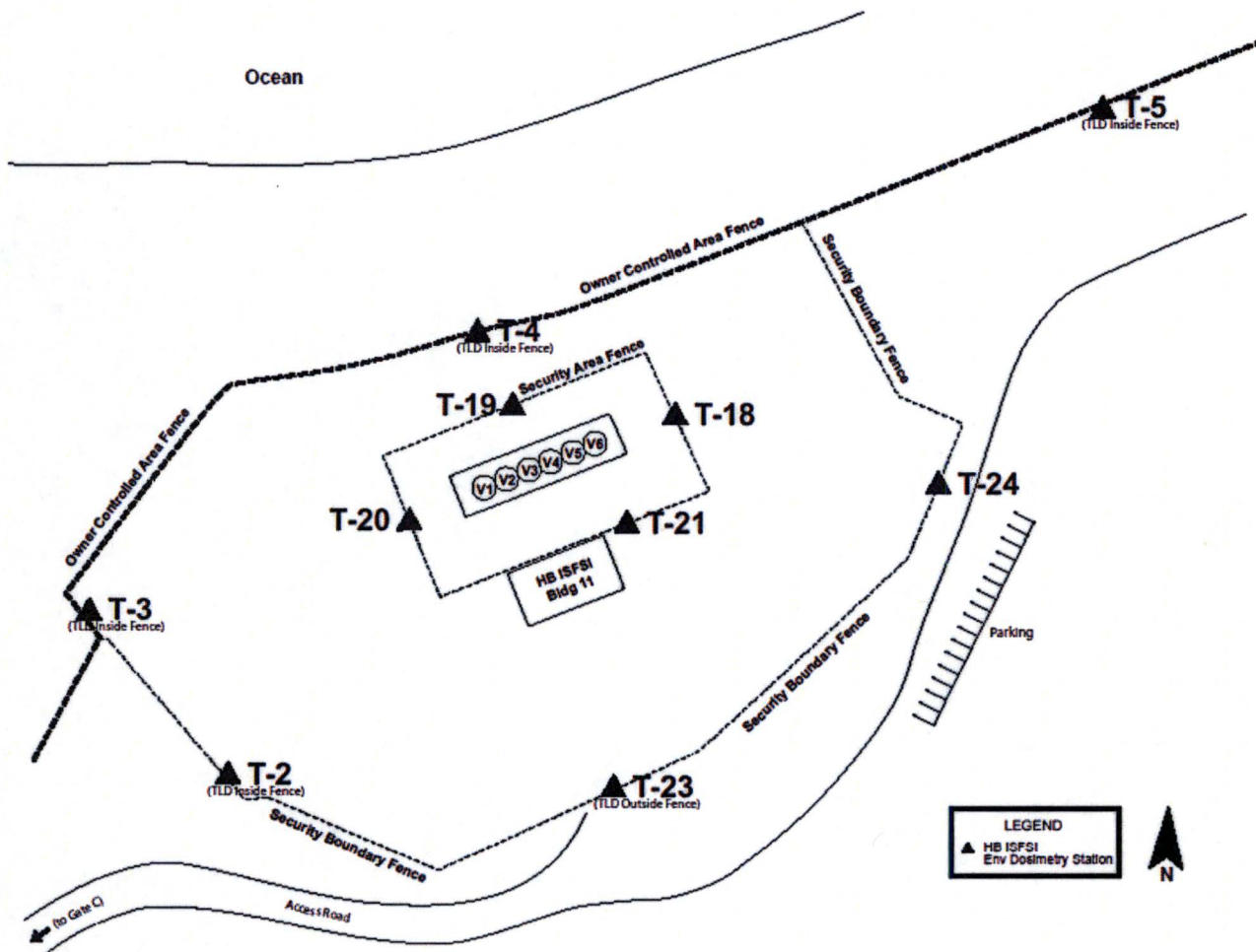


Figure 3 - HB ISFSI map showing Env TLD Stations

4.0 ANALYSIS OF ENVIRONMENTAL MONITORING RESULTS

The HB ISFSI radiological environmental monitoring allowed for deviations in the sampling schedule if samples were unobtainable due to hazardous conditions or malfunction of sampling equipment. Such deviations did not compromise the monitoring effectiveness and were normally anticipated for any environmental monitoring.

4.1 MONITORING VARIANCE / DEVIATION

On January 1st of 2016, the HB ISFSI Radiation Protection (RP) program ownership was transferred to DCPD RP staff to facilitate HBPP Unit 3 decommissioning and the 10 CFR 50 license termination. HB ISFSI Env TLD monitoring and reporting was also transferred to DCPD RP staff at that time. The 2017 HB ISFSI Env TLD monitoring report was created and submitted by DCPD RP staff.

HB ISFSI Security Boundary Fence monitoring was transferred to DCPD during third quarter of 2017 to facilitate HBPP Unit 3 decommissioning and 10 CFR 50 license termination. Env TLD stations T-2, T-3, T-4, T-5, T-23, and T-24 were added to this report beginning third quarter of 2017.

The vault shield lid for cask #2 was removed on August 2, 2017 for an external inspection of cask #2. Twelve workers were monitored for occupational exposure during this evolution resulting in each person receiving 0 mrem.



Figure 4 - Picture of HB ISFSI installed vault lids

4.2 MONITORING ANALYSIS

Direct radiation was continuously measured at 10 Env station locations surrounding the HB ISFSI using Panasonic type UD-814 TLDs. These station Env TLD dosimeters were distributed and collected every calendar quarter for processing. Methodology from ANSI/HPS N13.37-2014 was used to evaluate and report the Env TLD data in Table 1. Historical background baseline values for each Env station were established utilizing quarterly Env TLD station data from 2011 to 2015.

HB ISFSI "Standard Quarter TLD Results" were measurements of all environmental gamma radiation sources (cosmic, terrestrial, radon, and man-made) at each station during the deployment period. Transient and lab storage background dose contributions were subtracted prior to reporting the "Standard Quarter TLD Results". Technically, these TLDs read out in units of milliroentgen. Because gamma radiation has a quality factor of approximately 1 for conversion from milliroentgen to millirem, the Env TLD unit of reporting was converted to millirem (mrem) for consistency of unit reporting and ease of exposure communications.

- Direct radiation measurements and member of public occupancy times within the HB ISFSI Security Area Fence and Security Boundary Fence indicated all federal criteria for member of public dose limits (10 CFR 20.1301) were conservatively met and not exceeded.
- No conditions existed during normal HB ISFSI configuration requiring individual monitoring of external or internal occupational dose per 10 CFR 20.1502.
- Twelve persons were monitored for occupational exposure on August 2, 2017 due to a cask #2 inspection evolution. The shielded vault lid for cask #2 was removed for approximately 10 hours and then reinstalled. Each person received 0 mrem during that evolution.
- Direct radiation measurements indicated all federal Environmental Protection Agency (EPA) 40 CFR 190 criteria were conservatively met and not exceeded.
- Dose limits in 10 CFR 72.104 and 10 CFR 72.106 were conservatively met and not exceeded.

Table 1 reports the 2017 environmental "Standard Quarter TLD Results" for each individual station. These individual station results were compared to their "Historical Quarterly Baseline" values to determine investigation level dose.

Table 1 also reports the 2017 environmental "Annual TLD Result" for each individual station. The individual station result was compared to the "Historical Annual Baseline" value to determine investigation level dose.

If "Quarterly / Annual Investigation Level Dose" was detected, an evaluation of the HB ISFSI contribution was conducted and explained within this report.

Operation of the HB ISFSI continued to have no detectable radiological environmental monitoring exposure during 2017.

Table 1 HB ISFSI dose detection methodology was as follows:

- **ND** = Not Detected
- **Quarterly Investigation Level Dose** = Standard Quarter TLD result - Historical Quarterly Baseline; If ≤ 5.1 , report "ND". If > 5.1 , report value (mrem).
- **Annual TLD Result** = Qtr 1 + Qtr 2 + Qtr 3 + Qtr 4 Standard Quarter TLD Results
- **Annual Investigation Level Dose** = Annual TLD Result - Historical Annual Baseline; If ≤ 19.2 , report "ND". If > 19.2 , report value (mrem).

This page intentionally left blank.

HB ISFSI Station ID	2017 Quarterly HB ISFSI Env TLD Analysis										2017 Annual HB ISFSI Env TLD Analysis		
	Historical Quarterly Baseline (mrem/qtr)	2017 Standard Quarter TLD Results (mrem/qtr)				2017 Quarterly Investigation Level Dose (mrem/qtr)					Historical Annual Baseline (mrem/yr)	2017 Annual TLD Result (mrem/yr)	2017 Annual Investigation Level Dose (mrem/yr)
		Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4				
T-18	13.9	11.2	10.7	12.9	10.3	ND	ND	ND	ND	59.3	45.1	ND	
T-19	14.5	13.0	11.2	13.4	11.1	ND	ND	ND	ND	61.3	48.7	ND	
T-20	14.3	12.2	11.1	14.5	10.0	ND	ND	ND	ND	61.1	47.8	ND	
T-21	14.0	13.1	10.5	14.1	10.8	ND	ND	ND	ND	59.3	48.5	ND	
T-2	13.1	NM	NM	14.2	10.5	NM	NM	ND	ND	56.3	24.7	ND	
T-3	13.0	NM	NM	13.4	11.0	NM	NM	ND	ND	55.8	24.4	ND	
T-4	13.5	NM	NM	13.3	9.9	NM	NM	ND	ND	57.8	23.2	ND	
T-5	12.5	NM	NM	13.8	9.4	NM	NM	ND	ND	54.3	23.2	ND	
T-23	13.6	NM	NM	13.6	10.5	NM	NM	ND	ND	58.1	24.1	ND	
T-24	13.6	NM	NM	12.6	9.6	NM	NM	ND	ND	58.1	22.2	ND	

ND = Not Detected

NM = Not Monitored

The 2017 Humboldt Bay ISFSI historical station baselines have been determined using ANSI/HPS N13.37-2014 methodology.

The station historical baselines were calculated using Environmental TLD station results from approximately 2011 to 2015.

Station monitoring at T-2, T-3, T-4, T-5, T-23, and T-24 began during third quarter of 2017.

Quarterly Investigation Level Dose = Standard Quarter TLD result - Historical Quarterly Baseline. If ≤ 5.1 , report "ND". If > 5.1 , report value (mrem).

Annual TLD Result = Qtr 1 + Qtr 2 + Qtr 3 + Qtr 4 Standard Quarter TLD Results

Annual Investigation Level Dose = Annual TLD Result - Historical Annual Baseline. If ≤ 19.2 , report "ND". If > 19.2 , report value (mrem).

Dose limits in 10 CFR 20.1301 onsite member of public exposure and 40 CFR 190 unrestricted area exposure were conservatively met and not exceeded.

Dose limits in 10 CFR 72.104 and 10 CFR 72.106 were conservatively met and not exceeded.

Table 1 - HB ISFSI Env TLD Analysis Spreadsheet