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April 27, 2017

PG&E Letter HIL-17-003

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

10CFR72.44(d)(2)
10CFR72.126(c)(2)

Docket No. 72-27, Materials License No. SNM-2514
Humboldt Bay Independent Spent Fuel Storage Installation
Annual Radiological Environmental Monitoring Report for 2016

Dear Commissioners and Staff:

Enclosed is the Humboldt Bay Independent Spent Fuel Storage Installation (HB ISFSI), "Annual Radiological Environmental Monitoring Report" for 2016. This report provides the information required by HB ISFSI Technical Specification 5.1.2, "Radioactive Effluent Control Program," and the portion of Section 4.1 of the SAFSTOR/Decommissioning Offsite Dose Calculation Manual that is applicable to the HB ISFSI.

There are no new or revised regulatory commitments (as defined in NEI 99-04) made in this letter.

If you have any questions regarding this submittal, please contact Mr. Martin Wright at (805) 545-3821.

Sincerely,

James M. Welsch

Enclosure

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



**2016 Humboldt Bay
Independent Spent Fuel Storage Installation (ISFSI)
Annual Radiological Environmental Monitoring Report**

January 1, 2016 - December 31, 2016




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**2016 Humboldt Bay
Independent Spent Fuel Storage Installation
(ISFSI)**

**ANNUAL RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT
January 1, 2016 - December 31, 2016**

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

Prepared:  Date: 4/11/17
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Independent Tech Review:  Date: 4/11/17
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Reviewed and Approved:  Date: 4/12/17
Tim Irving, DCPP Radiation Protection Manager

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EXECUTIVE SUMMARY

This report contains results from radiological environmental monitoring for the Humboldt Bay (HB) Independent Spent Fuel Storage Installation (ISFSI) compiled for the period January 1, 2016 through December 31, 2016.

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, liquids, or gases from the operation of HB ISFSI. Direct radiation environmental monitoring was conducted in 2016 for the HB ISFSI.

Operation of HB ISFSI continued to have no detectable radiological monitoring program exposure during 2016.

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Figure 1 - Aerial view of HB ISFSI

1.0 INTRODUCTION

HBPP is owned by PG&E and consisted of five electric generation units. Units 1 and 2 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 was located in a separate building, but was adjacent to Unit 2. Unit 3, a boiling water reactor (BWR), operated for approximately 13 years before being shut down in July 1976. The reactor remained inactive since 1976. Unit 3 was in the process of decommissioning during 2016.

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 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 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 effluents, 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 HISTAR 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.

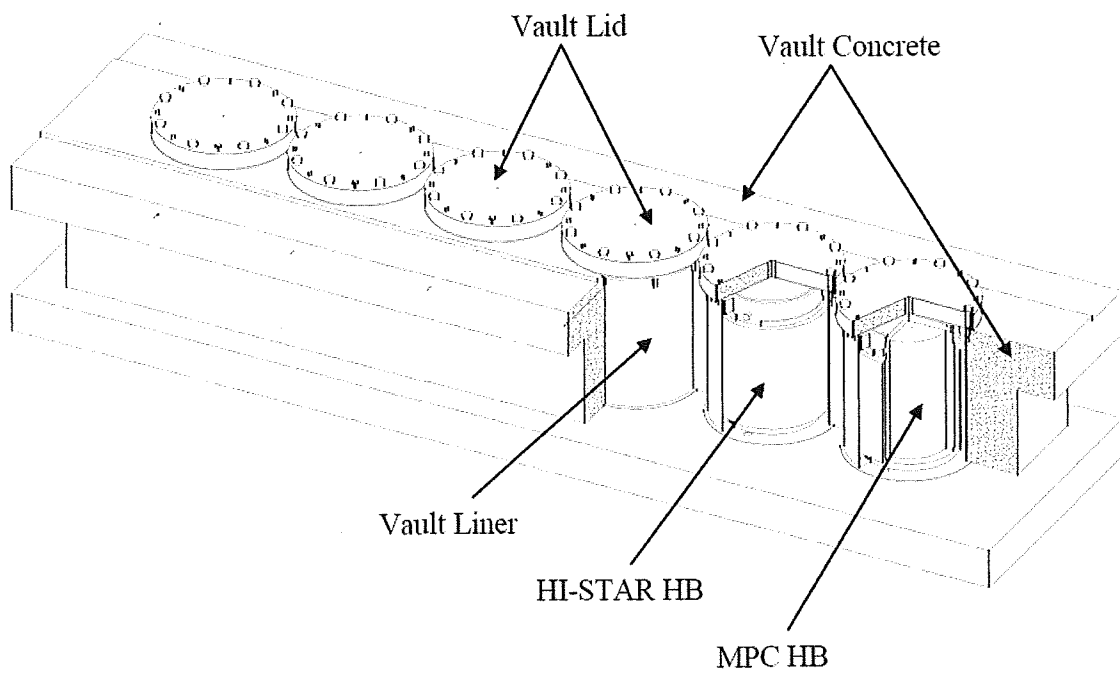


Figure 2 - HB ISFSI Holtec International HI-STAR 100 dry cask system

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 site, HB ISFSI-controlled area, and 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 from the HB ISFSI Security Area fence line stations by PG&E Diablo Canyon Power Plant (DCPP) personnel and then shipped to Mirion Technologies for processing on a quarterly basis. Control badges accompanied the field badges during shipment and deployment to measure any non-station dose received during transit time periods.

Direct ambient radiation was measured at 4 stations surrounding the HB ISFSI using Panasonic type UD814 TLD badges. The fence line stations were labeled T-18, T-19, T-20, and T-21 (see Figure 3). The 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 (urem/hr) doserate dependent on the in-field exposure time period. Then the urem/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.

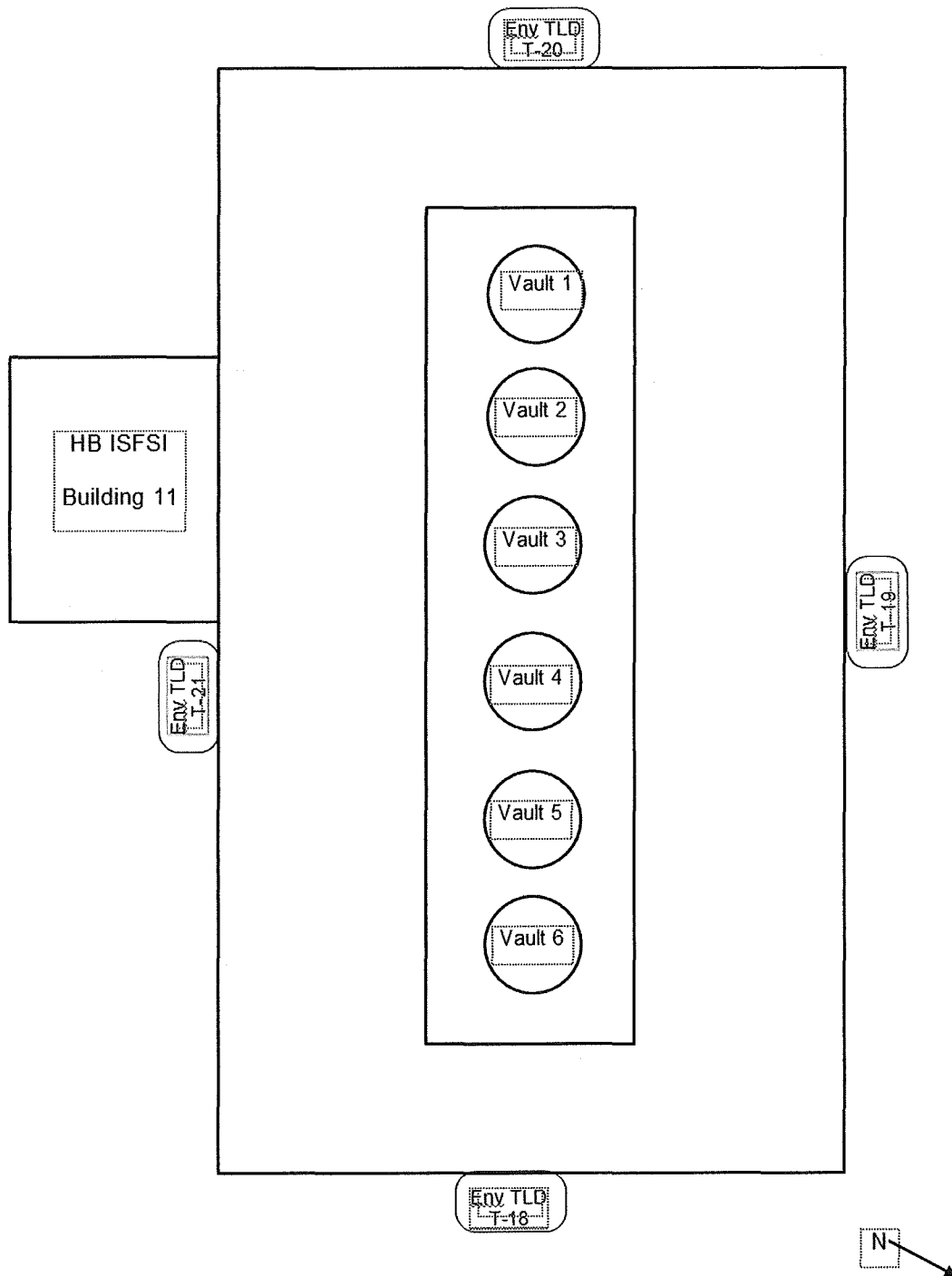


Figure 3 - HB ISFSI map showing Env TLD Stations T-18, T-19, T-20, and T-21

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, PG&E Radiation Protection (RP) program ownership of the HB ISFSI 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 2016 HB ISFSI Env TLD monitoring report was created and submitted by DCPD RP staff.

No Env TLD monitoring deviations occurred in 2016.



Figure 4 - Picture of HB ISFSI installed vault lids

4.2 MONITORING ANALYSIS

Direct radiation was continuously measured at 4 locations surrounding the HB ISFSI using Panasonic type UD-814 TLDs. These 4 locations were station codes T18, T-19, T-20, and T-21. These station 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 station were established from 2010 to 2016 Env TLD data.

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 PG&E owner controlled area and HB ISFSI Security Area indicated all federal criteria for member of public dose limits (10 CFR 20.1301) were conservatively met. No conditions existed requiring individual monitoring of external or internal occupational dose per 10 CFR 20.1502. Direct radiation measurements indicated all federal Environmental Protection Agency (EPA) 40 CFR 190 criteria were conservatively met. Dose limits in 10 CFR 72.104 and 10 CFR 72.106 were conservatively met.

Table 1 reports the 2016 environmental "Standard Quarter TLD Results" for each individual station (T-18 through T-21). These individual station results were compared to their "Historical Quarterly Baseline" values to determine investigation level dose.

Table 1 also reports the 2016 environmental "Annual TLD Result" for each individual station (T-18 through T-21). 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 monitoring exposure during 2016.

Table 1 dose detection methodology was as follows:

- **ND** = Not Detected
- **Quarterly Investigation Level Dose** = Standard Quarter TLD result - Historical Quarterly Baseline; If ≤ 6 , report "ND". If > 6 , 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 ≤ 18 , report "ND". If > 18 , report value (mrem).

2016 Quarterly HB ISFSI Env TLD Analysis										2016 Annual HB ISFSI Env TLD Analysis		
HB ISFSI Station ID	Historical Quarterly Baseline (mrem)	2016 Standard Quarter TLD Results (mrem)				2016 Quarterly Investigation Level Dose (mrem)				Historical Annual Baseline (mrem)	2016 Annual TLD Result (mrem)	2016 Annual Investigation Level Dose (mrem)
		Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4			
T-18	14.3	11.9	12.9	12.8	12.5	ND	ND	ND	ND	57.0	50.1	ND
T-19	14.8	12.7	13.2	14.0	12.8	ND	ND	ND	ND	59.1	52.7	ND
T-20	14.7	11.8	12.5	13.9	12.9	ND	ND	ND	ND	58.6	51.1	ND
T-21	14.3	11.7	13.3	13.6	12.8	ND	ND	ND	ND	56.9	51.4	ND

ND = Not Detected

The 2016 Humboldt Bay ISFSI historical baselines have been determined using ANSI/HPS N13.37-2014 methodology.

The historical baselines were calculated using Env TLD station results from approximately 2010 to 2016.

Quarterly Investigation Level Dose = Standard Quarter TLD result - Historical Quarterly Baseline. If ≤ 6 , report "ND". If > 6 , 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 ≤ 18 , report "ND". If > 18 , 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