Entergy

Entergy Operations, Inc.
P. O. Box 756
Port Gibson, MS 39150

James Nadeau
Manager, Regulatory Assurance
Grand Gulf Nuclear Station
Tel. (601) 437-2103

GNRO-2016/00019

April 19, 2016

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

SUBJECT: Grand Gulf Nuclear Station 2015 Annual Radiological Environmental Operating Report (AREOR)
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

Dear Sir or Madam:

In accordance with the Grand Gulf Nuclear Station Unit 1 Technical Specification 5.6.2, attached is the Annual Radiological Environmental Operating Report (AREOR) for the time period of January 1, 2015 through December 31, 2015.

There are no new commitments contained in this submittal. If you have any questions or require any additional information, please contact Richard Sumrall at 601-437-2115.

Sincerely,

JJN/tmc

Attachment: Grand Gulf Nuclear Station 2015 Annual Radiological Environmental Operating Report (AREOR)

cc: (see next page)

cc:

NRC Senior Resident Inspector
Grand Gulf Nuclear Station
Port Gibson, MS 39150

U.S. Nuclear Regulatory Commission
ATTN: Mr. Marc Dapas (w/2)
Regional Administrator, Region IV
1600 East Lamar Boulevard
Arlington, TX 76011-4511

U.S. Nuclear Regulatory Commission
ATTN: Mr. James Kim, NRR/DORL (w/2)
Mail Stop OWFN/8 B1
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. B. J. Smith
Director, Division of Radiological Health
Mississippi State Department of Health
Division of Radiological Health
P.O. Box 1700
Jackson, MS 39205

Dr. Mary Currier, M.D., M.P.H
State Health Officer
Mississippi Department of Health
P.O. Box 1700
Jackson, MS 39205-1700

Attachment 1
to GNRO-2016/00019

Grand Gulf Nuclear Station 2015 Annual Radiological Environmental Operating Report
(AREOR)

ENTERGY OPERATIONS, INC.
GRAND GULF NUCLEAR STATION

ANNUAL
RADIOLOGICAL ENVIRONMENTAL
OPERATING REPORT

January 1, 2015 - December 31, 2015

3/30/16

Prepared By

4/8/16

Reviewed By

4-14-16

Approved By

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

Summary

The Annual Radiological Environmental Operating Report presents data obtained through analyses of environmental samples collected for Grand Gulf Nuclear Station's (GGNS) Radiological Environmental Monitoring Program (REMP) for the period January 1, 2015, through December 31, 2015. This report fulfills the requirements of GGNS Technical Specification 5.6.2.

To supplement the REMP, GGNS personnel installed duplicate TLDs and collected duplicate samples during the reporting period.

Radiological Environmental Monitoring Program

GGNS established the REMP in 1978 prior to the station becoming operational (1985) to provide data on background radiation and radioactivity normally present in the area. GGNS has continued to monitor the environment by sampling air, water, sediment, fish and food products, as well as measuring radiation directly. GGNS also samples milk, if commercial milk production occurs within five miles of the plant.

The REMP includes sampling indicator and control locations within an 18-mile radius of the plant. The REMP utilizes indicator locations near the site to show any increases or buildup of radioactivity that might occur due to station operation and control locations farther away from the site to indicate naturally occurring background radioactivity. GGNS personnel compare indicator results with control and preoperational results to assess any impact GGNS operation might have on the surrounding environment.

In 2015, GGNS personnel collected environmental samples for radiological analysis. The monitoring results for indicator locations when compared to control locations and previous studies show that GGNS has no significant effect on the local environment. The review of 2015 monitoring data, in many cases, showed undetectable radiation levels in the environment and near background levels in potential exposure pathways associated with GGNS.

Harmful Effects or Irreversible Damage

The REMP monitoring did not detect any harmful effects or evidence of irreversible damage in the current year.

Reporting Levels

When averaged over any calendar quarter, no environmental samples equaled or exceeded reporting levels for radioactivity as outlined in Offsite Dose Calculation Manual (ODCM) Specifications Table 6.12.1-2; the analytical results did not trigger any Radiological Monitoring Program Special Reports.

Radioactivity Not Attributable to GGNS

Over previous years, the GGNS REMP detected radioactivity attributable to other sources. These sources included the Chinese nuclear test in 1980 and the accident at the Chernobyl Nuclear Power Plant in 1986. In 2011, the GGNS REMP detected radioactivity released from the Fukushima Dai-ichi Nuclear Power Plant following the March 11, 2011, Tohoku earthquake. In 2015, the GGNS REMP detected no radioactivity attributable to other sources.

Comparison to Federal and State Programs

GGNS personnel compare REMP data to federal and state monitoring programs. Historically, the programs used for comparison included the U.S. Nuclear Regulatory Commission (NRC) Thermoluminescent Dosimeter (TLD) Direct Radiation Monitoring Network and the Mississippi State Department of Health (MSDH), Division of Radiological Health monitoring program.

Although the NRC TLD Network Program was discontinued in 1998, these results compared favorably to those from the GGNS REMP.

The MSDH and the GGNS REMP have similar monitoring requirements. These programs include co-located air sampling and sharing sample media such as water, sediment, fish and food products. Both programs have obtained similar results. The 2015 results of the MSDH monitoring program compared favorably with the GGNS REMP results.

Sample Deviations

- **Milk**

  The GGNS ODCM requires collection of milk samples if there is a commercially available source within 5 miles (8 km) of the plant. In 2015, the REMP did not include milk sampling because no commercial milk production occurred within 5 miles of GGNS. GGNS personnel instead collected vegetation samples to monitor the ingestion pathway, as specified in ODCM Specifications Table 6.12.1-1.

- **Required Lower Limit of Detection (LLD) Values**

  Analytical lower limit of detection (LLD) values required by the ODCM specifications achieved in 2015 were within the limits for all samples.

- **Thermoluminescent Dosimeters**

  There were no deviations in 2015.

- **Air Samples**

  The following air sample locations had reduced run times due to weather-related power outages or mechanical problems. As described in ODCM Specification Table 6.12.1-1, footnote (a), deviations from the required sampling schedule are permitted due to malfunction of sampling equipment and other legitimate reasons.

Table 1.1 Air Sampling Deviations in 2014

Sample Location	Date In	Date Out	Run Time (Hours)	Out-of-Service (Hours)	Comments
AS-7 UH	01/06/15	01/13/15	166.05	2.03	Power outage
AS-7 UH	01/20/15	01/27/15	165.44	2.39	Power outage
AS-7 UH	03/03/15	03/10/15	165.10	0.68	Power outage
AS-7 UH	03/31/15	04/07/15	169.67	2.15	Power outage
AS-7 UH	04/21/15	04/28/15	170.55	2.22	Power outage
AS-7 UH	04/28/15	05/05/15	160.28	2.80	Power outage
AS-3 61VA	06/09/15	06/16/15	130.46	37.31	Power outage
AS-7 UH	06/09/15	06/16/15	164.20	3.45	Power outage
AS-3 61VA	06/30/15	07/07/15	165.91	1.91	Power outage
AS-7 UH	06/30/15	07/07/15	166.66	1.17	Power outage
AS-7 UH	07/07/15	07/14/15	166.97	1.18	Power outage
AS-7 UH	07/28/15	08/04/15	166.10	1.22	Power outage
AS-7 UH	09/01/15	09/08/15	159.97	0.98	Power outage
AS-1 PG	09/08/15	09/15/15	166.80	0.62	Power outage
AS-3 61VA	09/22/15	09/29/15	155.62	22.21	Equipment Malfunction
AS-7 UH	10/20/15	10/27/15	165.38	2.47	Power outage
AS-3 61VA	12/08/15	12/15/15	166.49	1.56	Power outage
AS-7 UH	12/08/15	12/15/15	167.00	1.17	Power outage
AS-7 UH	12/22/15	12/29/15	158.86	7.26	Power outage

Based on the sample collection period reductions, air samples were collected the following percentages of the available time:

AS-1 PG	99.9%
AS-3 61VA	99.2%
AS-7 UH	99.6%

- **Missed Samples**

  All required samples were collected in accordance with REMP requirements. There were no missed samples.

- **Unavailable Results**

  GGNS received analytical results in adequate time for inclusion in this report.

Program Modifications

No REMP modifications took place during this sampling period.

During 2015, installation of an additional air monitoring station in the vicinity of a community located within the sector having the highest calculated X/Q was approved. Meteorological data indicates that Sector L is the sector with the highest calculated X/Q at the site boundary. Implementation of the new air sampling location will be completed in 2016. The additional

monitoring location will enhance the site's radiological environmental monitoring program, and will demonstrate robust compliance with the Offsite Dose Calculation Manual requirements. Discussion of the data collected from the new location will be included in the next Annual Radiological Environmental Operating Report.

Attachments

Attachment 1 contains results of TLD, air, water, sediment, fish, food products and special samples collected in the reporting period. TLDs were analyzed by Stanford Dosimetry of Sterling, MA. Other samples were analyzed by Teledyne Brown Engineering of Knoxville, TN. Tables A 9.1 and A 9.2 includes results from Stanford Dosimetry's and Teledyne Brown Engineering's participation in interlaboratory comparison programs.

1.0 Introduction

1.1 Radiological Environmental Monitoring Program

GGNS established the REMP to ensure that plant operating controls properly function to minimize any radiation that could endanger human health or the environment. The REMP is designed to:

- Analyze important pathways for anticipated types and quantities of radionuclides released into the environment,
- Consider the possibility of a buildup of long-lived radionuclides in the environment and identify any physical and biological accumulations that may contribute to human exposures,
- Consider the potential radiation exposure to plant and animal life in the environment surrounding GGNS,
- Correlate levels of radiation and radioactivity in the environment with radioactive releases from the operation of GGNS.

1.2 Pathways Monitored

The airborne, direct radiation, waterborne and ingestion pathways, as seen in Figure 1-1 are monitored as required by the GGNS ODCM Table 6.12.1-1. A description of the GGNS REMP utilized to monitor the exposure pathways is provided in Table 1.2 and shown in Figures 1-2 and 1-3. GGNS may supplement this program with additional sampling in order to provide a comprehensive and well-balanced program.

Section 2.0 of this report provides a discussion of sampling results, with Section 3.0 providing a summary of results for the monitored exposure pathways.

1.3 Land Use Census

GGNS personnel conduct a biennial land use census, as required by ODCM Specification 6.12.2. The most recent land use census data are included in Table 2.1. The purpose of this census is to identify land use changes within each of the 16 meteorological sectors and within a 5-mile radius of GGNS that would require modifications to the REMP or the ODCM. The census identifies the nearest:

1) Occupied and unoccupied residences
2) Garden of greater than 50 square meters (m^2) [500 square feet (ft^2)] producing broadleaf vegetation
3) Animal milked for human consumption

GGNS personnel conduct the land use census by:

- Conducting field surveys in each meteorological sector out to five miles in order to confirm:
    - Nearest occupied residence
    - Nearest unoccupied residence
    - Nearest garden and approximate size
    - Nearest milking animal
- Identifying locations on maps and aerial photographs, measuring distances to GGNS and recording results on surveillance data sheets
- Comparing current land use census results to previous results from the 2012 census
- Contacting the Claiborne County Agent for verification of nearest dairy animals

No significant changes between the biennial land use census performed in 2012 and the most recent census performed in 2014 were identified that would require modifications to the REMP or the ODCM.

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Airborne	**Radioiodine and Particulates** 1 sample close to the SITE BOUNDARY having the highest calculated annual average ground level D/Q.	**AS-7 UH (Sector H, Radius 0.5 Miles)** – South-southeast of GGNS at the IBEW Union Hall.	Continuous sampler operation with sample collection per 7 days or as required by dust loading, whichever is more frequent	Radioiodine Canister – I-131; 7 days Particulate Sampler – Gross beta radioactivity following filter change, composite (by location) for gamma isotopic; 92 days
	Radioiodine and Particulates 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q.	**AS-1 PG (Sector G, Radius 5.5 Miles)** – Southeast of GGNS at the Port Gibson City Barn.		
	Radioiodine and Particulates 1 sample from a control location 15 -30 km (10 - 20 miles) distance.	**AS-3 61VA (Sector B, Radius 18 Miles)** – North-northeast of GGNS on Hwy 61, North of the Vicksburg Airport.		
Direct Radiation	**TLDs** An inner ring of stations in the general areas of the SITE BOUNDARY.	**M-16 (Sector A, Radius 0.9 Miles)** – Meteorological Tower. **M-19 (Sector E, Radius 0.5 Miles)** – Eastern SITE BOUNDARY Property line, North-northeast of HWSA.	92 days	Gamma dose; 92 days

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	**TLDs** An inner ring of stations in the general areas of the SITE BOUNDARY.	**M-21 (Sector J, Radius 0.4 Miles)** – Near Former Training Center Building on Bald Hill Road. **M-22 (Sector G, Radius 0.5 Miles)** – Former RR Entrance Crossing On Bald Hill Road. **M-23 (Sector Q, Radius 0.5 Miles)** – Gin Lake Road 50 Yards North of Heavy Haul Road on Power Pole. **M-25 (Sector N, Radius 1.6 Miles)** – Radial Well Number 1. **M-28 (Sector L, Radius 0.9 Miles)** – Bald Hill Road. **M-94 (Sector R, Radius 0.8 Miles)** – Sector R Near Meteorological Tower.	92 days	Gamma dose; 92 days

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	**TLDs** An inner ring of stations in the general areas of the SITE BOUNDARY.	**M-95 (Sector F, Radius 0.5 mi)** – Spoils Area, fence of old storage area, near entrance gate **M-96 (Sector B, Radius 0.7 mi.)** – North Gate Fence **M-97 (Sector D, Radius 0.8 mi.)** – Grand Gulf Road entrance gate to spoils area **M-98 (Sector H, Radius 0.5 mi.)** – Bald Hill Road, across from Union Hall, in curve **M-99 (Sector K, Radius 0.4 mi.)** – North Fence of old Ball Field near utility pole **M-100 (Sector C, Radius 0.6 mi.)** – Grand Gulf Road	92 days	Gamma dose; 92 days
	TLDs An outer ring approximately 3 to 5 miles from the site.	**M-36 (Sector P, Radius 5.0 Miles)** – Curve on HW 608, Point Nearest GGNS at Power Pole. **M-40 (Sector M, Radius 2.3 Miles)** – Headly Drive, Near River Port Entrance.		

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	**TLDs** An outer ring approximately 3 to 5 miles from the site.	**M-48 (Sector K, Radius 4.8 Miles)** – 0.4 Miles South on Mont Gomer Road on West Side. **M-49 (Sector H, Radius 4.5 Miles)** – Fork in Bessie Weathers Road/Shaifer Road. **M-50 (Sector B, Radius 5.3 Miles)** – Panola Hunting Club Entrance. **M-55 (Sector D, Radius 5.0 Miles)** – Near Ingelside Karnac Ferry Road/Ashland Road Intersection. **M-57 (Sector F, Radius 4.5 Miles)** – Hwy 61, Behind the Welcome to Port Gibson Sign at Glensdale Subdivision.	92 days	Gamma dose; 92 days
	TLDs 8 stations in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control stations.	**M-01 (Sector E, Radius 3.5 Miles)** – Across the road from Lake Claiborne Entry Gate. (Special Interest) **M-07 (Sector G, Radius 5.5 Miles)** – AS-1 PG, Port Gibson City Barn. (Special Interest) **M-09 (Sector D, Radius 3.5 Miles)** – Warner Tully Y-Camp. (Special Interest) **M-10 (Sector A, Radius 1.5 Miles)** – Grand Gulf Military Park. (Special Interest)		

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	**TLDs** 8 stations in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control stations	**M-14 (Sector B, Radius 18.0 Miles)** – AS-3-61VA, Hwy 61, North of Vicksburg Airport. (Control) **M-33 (Sector P, Radius 12.5 Miles)** – Newellton, Louisiana Water Tower. (Special Interest) **M-38 (Sector M, Radius 9.5 Miles)** – Lake Bruin State Park, Entrance Road. (Special Interest) **M-39 (Sector M, Radius 13.0 Miles)** – St. Joseph, Louisiana, Auxiliary Water Tank. (Special Interest)	92 days	Gamma dose; 92 days

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Waterborne	**Surface Water** 1 sample upstream. 1 sample downstream.	**MRUP (Sector R, Radius 1.8 Miles) -** At least 4500 ft upstream of the GGNS discharge point into the Mississippi River to allow adequate mixing of the Mississippi and Big Black Rivers. **MRDOWN (Sector N, Radius 1.6 Miles) -** At least 5000 ft downstream of the GGNS discharge point in the Mississippi River near Radial Well No. 1.	92 days	Gamma isotopic and tritium analyses; 92 days
	1 sample downstream during a Liquid Radwaste Discharge.	**MRDOWN (Sector P, Radius 1.3 Miles)** – Downstream of the GGNS discharge point in the Mississippi River near Radial Well No. 5.	366 days	Gamma isotopic and tritium analyses; 366 days
	1 sample from Outfall 007	**OUTFALL 007 (Sector N, Radius 0.2 Miles)** – Storm Drain System	31 days	Tritium; 31 days

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Waterborne	**Groundwater** Samples from 2 sources.	**PGWELL (Sector G, Radius 5.0 Miles)** - Port Gibson Wells – Taken from distribution system or one of the five wells. **CONSTWELL (Sector Q, Radius 0.4 Miles)** – GGNS Construction Water Well – Taken from distribution system or the well.	366 days	Gamma isotopic and tritium analyses; 366 days
	Sediment From Shoreline 1 sample from downstream area. 1 sample from upstream area.	**SEDHAM (Sector N, Radius 1.6 Miles)** – Downstream of the GGNS discharge point in the Mississippi River near Hamilton Lake outlet. **SEDCONT (Minimum of 100 yds)** – Upstream of the GGNS discharge point in the Mississippi River.	366 days	Gamma isotopic; 366 days
Ingestion	**Milk** 1 sample from milking animals within 8 km (5 miles) if milk is available commercially. 1 control sample (only if indicator exists) >8 km if milk is available.	Currently, no available milking animals within 8 km of GGNS. **ALCONT (Sector K, Radius 10.5 Miles) -** Located South-southwest of GGNS at Alcorn State University.	92 days when required	Gamma isotopic and I-131; 92 days

Table 1.2
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Ingestion	**Fish** 1 sample in vicinity of GGNS discharge point. 1 sample uninfluenced by GGNS discharge.	**FISHDOWN** – Downstream of the GGNS discharge point into the Mississippi River **FISHUP** – Upstream of the GGNS discharge point into the Mississippi River uninfluenced by plant operations.	366 days	Gamma isotopic on edible portion; 366 days
	Food Products 1 sample of broadleaf vegetation grown in one of two different offsite locations with highest anticipated annual average ground level D/Q if milk sampling is not performed. 1 sample of similar vegetation grown 15 – 30 km distant if milk sampling is not performed.	**VEG-J (Sector J, Radius 0.4 Miles)** – South of GGNS near former Training Center on Bald Hill Road. **VEG-CONT (Sector K, Radius 10.5 Miles)** – Alcorn State University south-southwest of GGNS when available, otherwise a location 15-30 km distant.	92 days when available	Gamma isotopic and I-131; 92 days

Figure 1-1

Exposure Pathways

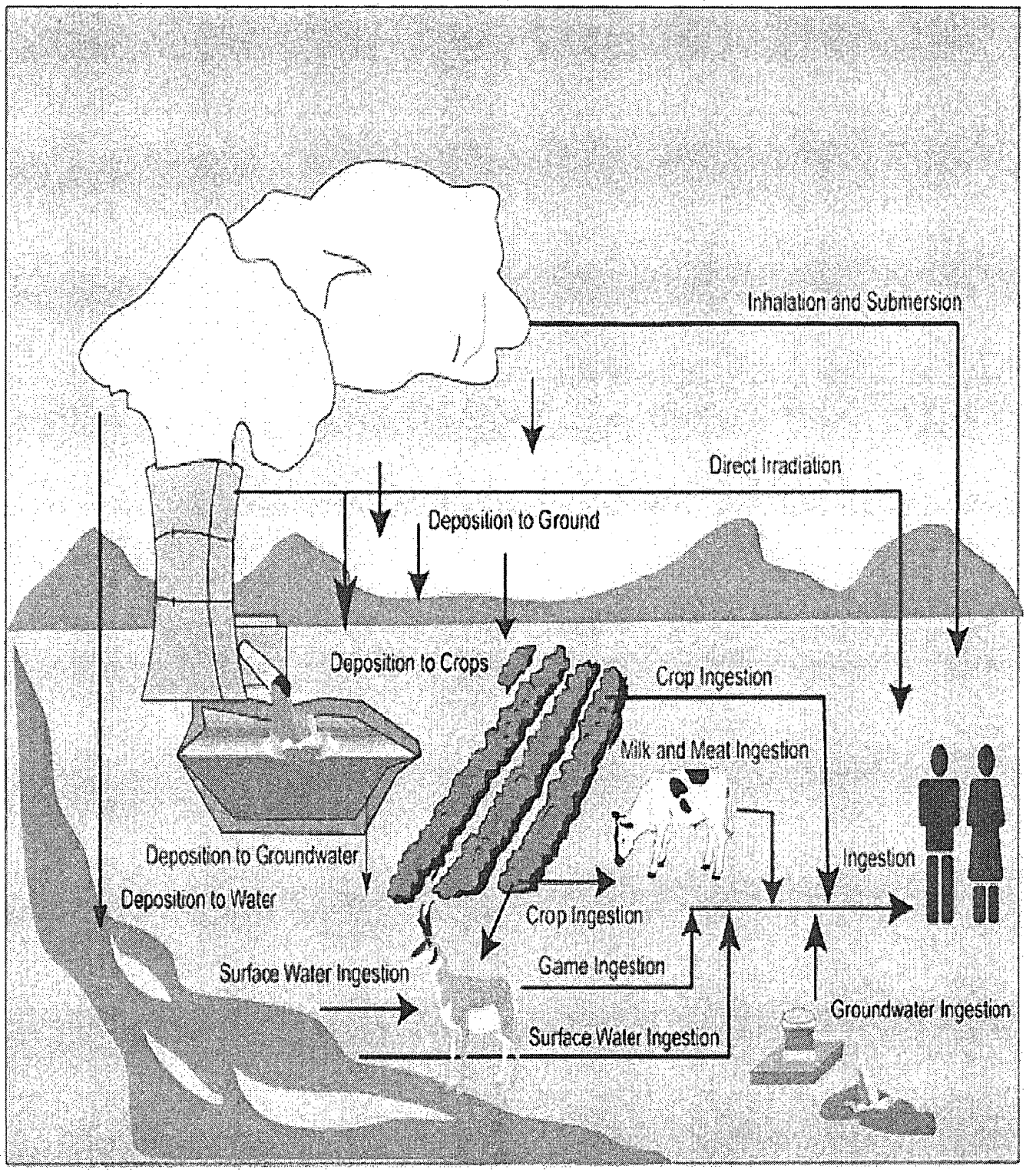


FIGURE 1-2
SAMPLE COLLECTION SITES – NEAR FIELD

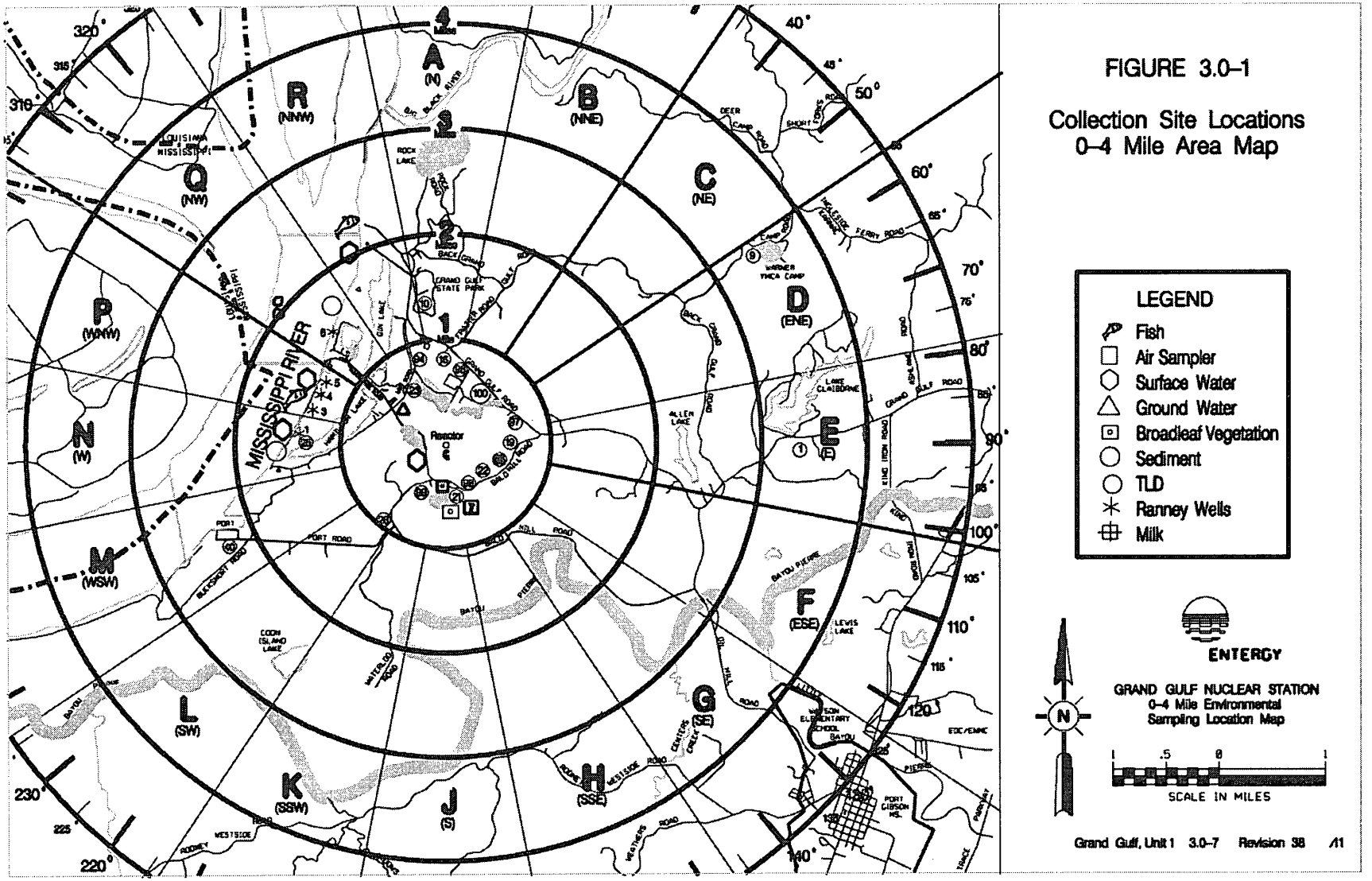
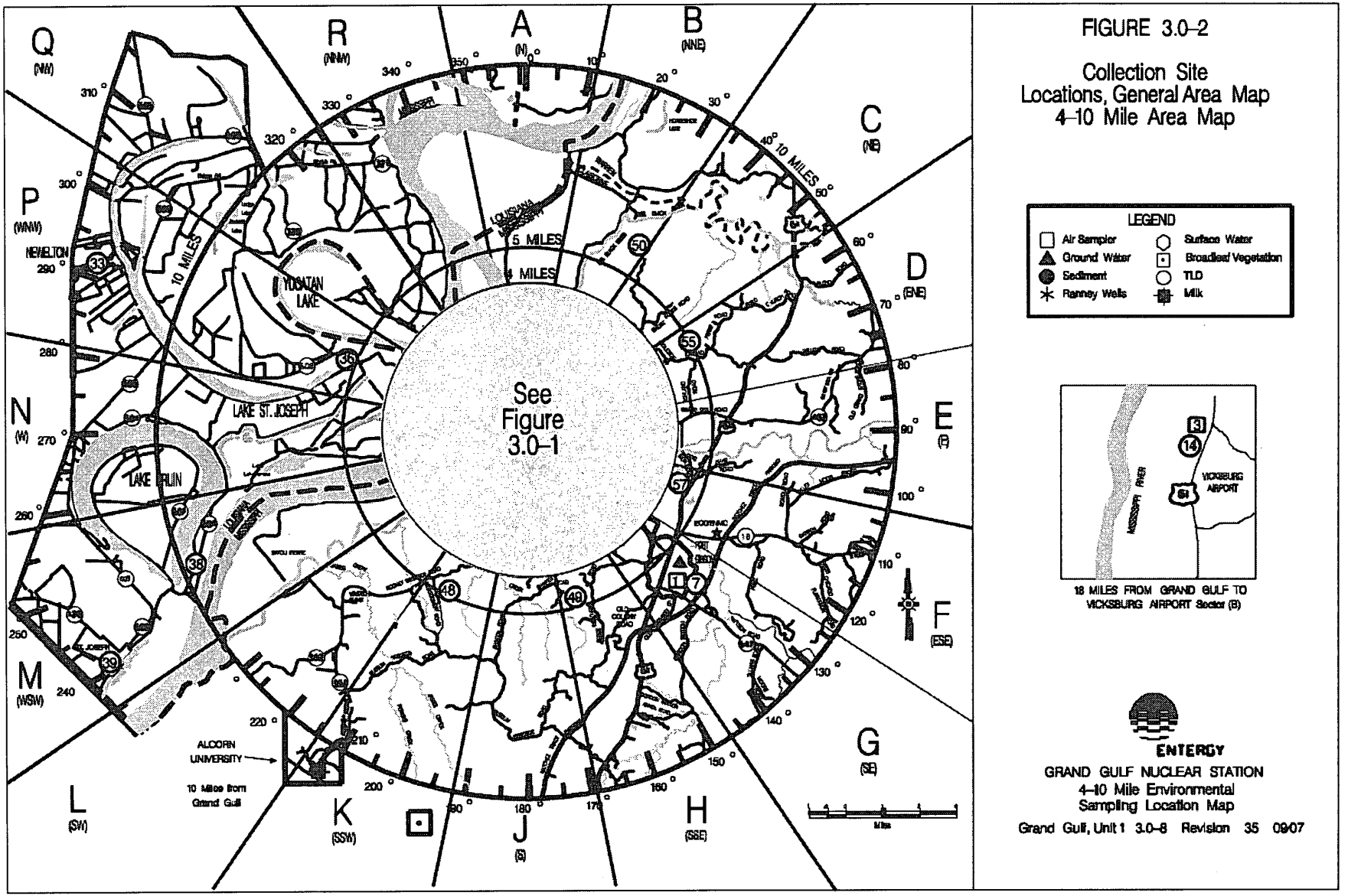


FIGURE 1-3
SAMPLE COLLECTION SITES – FAR FIELD



2.0 Interpretation and Trends of Results

2.1 Air Particulate and Radioiodine Sample Results

GGNS did not detect any plant related gamma emitting radionuclides in the quarterly air particulate composites.

The REMP had previously detected airborne radioactivity attributable to other sources in this pathway. These sources include the Chinese nuclear test in 1980 and the accident at the Chernobyl Nuclear Power Plant in 1986. The GGNS REMP detected radioactivity released from the Fukushima Dai-ichi Nuclear Power Plant following the March 11, 2011, Tohoku earthquake. No radioiodine was detected in 2015.

Table 3.1, which also includes gross beta activity, provides a comparison of the indicator and control means and ranges, further emphasizing that the airborne pathway remains at background levels. In the absence of plant-related gamma radionuclides, gross beta activity is attributed to naturally occurring radionuclides. Similar trends are present for control and indicator locations, which support the presence of naturally occurring radioactivity.

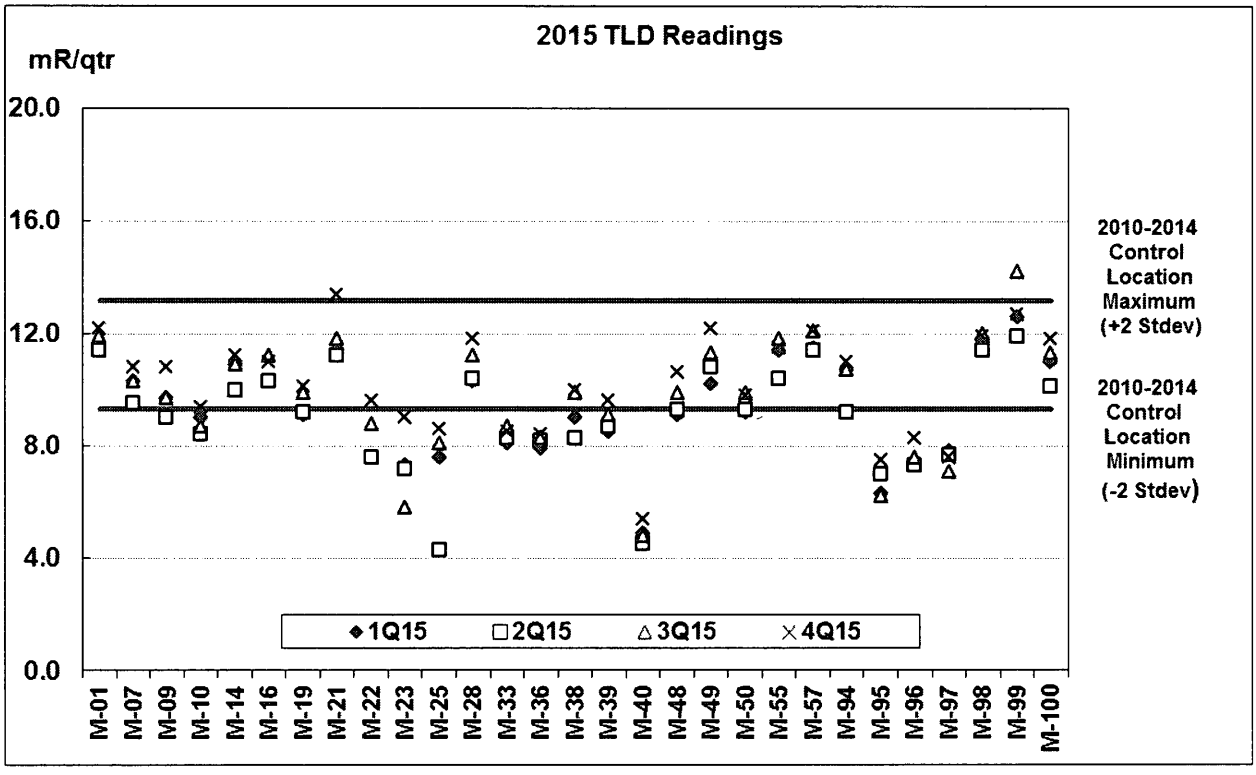
2.2 Thermoluminescent Dosimetry Sample Results

GGNS calculates dose by subtracting shield readings from control and indicator location readings and reports measured dose as net exposure, normalized to 92 days. GGNS relies on the comparison of the indicator locations to the control location as an indication of plant impact. Gamma radiation dose in the reporting period is compared to control location readings for previous years as shown in Figure 2-1.

The comparison of the indicator results to the control, and to previous indicator results, as seen in Figure 2-1 and Table 3.1, indicates that plant operation has had no significant impact on ambient radiation levels during the reporting period.

In previous years, TLD locations M-21 (Sector J, 0.4 miles), M-98 (Sector H, 0.5 miles), and M-99 (Sector K, 0.4 miles) were above background. The dose rates at these three locations were the result of Nitrogen-16 (N-16) associated with the injection of hydrogen and subsequent N-16 production. Hydrogen injection into the feedwater system provides protection against Intergranular Stress Corrosion of plant components. Since November 2010, the hydrogen injection rate has been reduced and the dose rates at TLD locations M-21, M-98, and M-99 have returned to near background levels.

Figure 2-1



2.3 Water Sample Results

Surface water samples were collected from three indicator locations (Outfall 007, MRDOWN, and MRDOWN During Discharge) and one control location (MRUP) and analyzed for gamma emitting radionuclides and tritium. Plant related gamma emitting radionuclides and tritium remained undetectable in the upstream and downstream Mississippi River locations, which is consistent with preoperational and previous operational years. Storm waters contribute to Outfall 007 and can include tritium as a result of washout and entrainment of normal, previously monitored gaseous effluents. As a result, tritium is occasionally observed. Tritium was measured during February (5280 ± 961 pCi/L), April (950 ± 554 pCi/L), October (607 ± 339 pCi/L), and December (449 ± 280 pCi/L) at the Outfall 007 (indicator) location. Duplicate samples from Outfall 007 during February (5090 ± 950 pCi/L) and April (1200 ± 586 pCi/L) showed similar tritium activity. Tritium was not observed in the remaining Outfall 007 samples collected during 2015.

In addition to the tritium samples required by the REMP, four special surface water samples for gamma emitting radionuclides were collected at the Outfall 007 location (Table A 8.1). Plant related gamma emitting radionuclides remained undetectable in these samples.

Based on review of results and historical data, plant operations had no significant impact on this pathway during the reporting period.

Groundwater samples were collected from two locations (indicator and control) and analyzed for gamma emitting radionuclides and tritium (Tables A 4.1 and A 4.2). In addition to the samples required by the REMP, an extra sample from the locations was analyzed for Iodine-131 (Table A 4.3). GGNS did not detect any plant related gamma emitting radionuclides or tritium in groundwater samples during the reporting period.

Based on review of results and historical data, plant operations had no significant impact on this pathway during the reporting period.

2.4 Sediment Sample Results

Sediment samples were collected from two locations (indicator and control) and analyzed for gamma emitting radionuclides. GGNS did not detect any plant related gamma emitting radionuclides or tritium in sediment samples during the reporting period.

Based on review of results and historical data, plant operations had no significant impact on this pathway during the reporting period.

2.5 Milk Sample Results

Milk samples were not collected within five miles of the site in the reporting period due to the absence of milking animals. Since there are no dairies within five miles of GGNS, and based on non-detectable radioiodine and gamma radionuclides in air and vegetation samples, plant operations had no impact on this pathway during the reporting period.

2.6 Fish Sample Results

Fish samples were collected from two locations (indicator and control) and analyzed for gamma emitting radionuclides. GGNS did not detect any plant related gamma emitting radionuclides in fish samples (edible portions) during the reporting period, as has been the case in preoperational and previous operational years. These results indicate that this pathway has not been affected by plant operations.

2.7 Food Product (Vegetation) Sample Results

Food product samples were collected from two locations (indicator and control) and analyzed for Iodine-131 and gamma emitting radionuclides. GGNS did not detect any plant related Iodine-131 or gamma emitting radionuclides in vegetation samples during the reporting period. These results indicate that this pathway has not been affected by plant operations.

2.8 Land Use Census Results

Results from the most recent Land Use Census performed in 2014 are included in this report. Methods utilized to perform the Land Use Census include: visual surveys, door to door surveys, telephone interviews, Global Positioning System (GPS), Aerial Photography, and consultation with the local county agent concerning dairy production in Claiborne County.

During the survey the following information was obtained:

1) nearest location of occupied and unoccupied residences

2) nearest location of dairy production
3) nearest location of gardens

Changes from the previous Land Use Census were evaluated in accordance with GGNS surveillance "Land Use Census", 06-EN-S000-O-0002. The differences were compared to the locations and assumptions used in calculations for compliance with the ODCM Limiting Condition for Operation 6.11.6 and 6.12.2. The locations and assumptions currently used in ODCM were determined more conservative than any of the changes. Determinations from the most recent Land Use Census results are:

- Because of downwind location and/or distance from the site, in no case will the occupancy of an existing unoccupied residence cause any existing ODCM critical receptor calculation results to be less conservative.
- No additional sampling locations are required as the onsite vegetation sampling location (Sector J, 0.4 miles) is more conservative than changes identified in the land use census.
- Cattle are raised for human consumption (most notably in Sectors F, H, J, and K). GGNS uses the Grass/Cow/Meat pathway.
- The milk pathway does not need to be activated because no commercial dairy production is occurring within 5 miles, as referenced by ODCM Table 6.12.1-1.
- Sectors M, N, P, and Q are remote areas in which the primary use is hunting. Areas were surveyed by vehicle, aerial photographs, and interviews.
- Gardens, regardless of size, were included in the census data

Although not procedurally required, it is recommended that the next ODCM revision include an update to Table 2.2-3 to reflect the latest Land Use Census results.

Table 2.1
2014 Land Use Census

Parameter		Sector A*	Sector B	Sector C*	Sector D*
I. Nearest Occupied Residence	a. Distance (mile) b. Degrees from true north	1.76 351.6	1.51 23.7	0.70 42.3	2.60 60.8
II. Nearest Unoccupied Residence (closer than occupied residence)	a. Distance (mile) b. Degrees from true north	0.94 8.0	0.83 15.1	None	None
III. Nearest Milk Animal	a. Distance	None	None	None	None
IV. Nearest Broadleaf Garden	a. Distance (mile) b. Garden size (ft^2) c. Degrees from true north	1.02 ≈ 400 355.4	1.52 ≈ 4050 21.9	4.53 ≈ 25 49.1	3.06 ≈ 1200 58.8
V. Census Comparison	a. Is nearest occupied residence in same location as last census? b. Is nearest milk animal in same location as last census? c. Is nearest broadleaf garden in same location as last census?	No N/A No	Yes N/A Yes[1]	Yes N/A No	Yes N/A No

1 Retained previous garden location. Located no other gardens in the sector.

* Change from last census. See table of Land Use Census Changes

Table 2.1
2014 Land Use Census, continued.

Parameter		Sector E	Sector F*	Sector G*	Sector H
I. Nearest Occupied Residence	a. Distance (miles) b. Degrees from true north	0.89 86.9	2.25 101.3	3.72 134.1	1.10 151.4
II. Nearest Unoccupied Residence (closer than occupied residence)	a. Distance (miles) b. Degrees from true north	None	None	3.71 131.8	1.07 151.0
III. Nearest Milk Animal	a. Distance	None	None	None	None
IV. Nearest Broadleaf Garden	a. Distance (miles) b. Garden size (ft^2) c. Degrees from true north	0.89 ≈ 1000 86.9	4.50 ≈ 450 110.0	4.20 ≈ 1600 130.1	4.39 ≈ 200 155.0
V. Census Comparison	a. Is nearest occupied residence in same location as last census? b. Is nearest milk animal in same location as last census? c. Is nearest broadleaf garden in same location as last census?	Yes[1] N/A Yes	Yes N/A No	No N/A No	Yes N/A Yes

1 – Nearest occupied residence location is the same as last census. Location data revised due to new mapping method.

* - Change from last census. See table of Land Use Census Changes

Table 2.1
2014 Land Use Census, continued.

Parameter		Sector J	Sector K	Sector L	Sector M
I. Nearest Occupied Residence	a. Distance (miles) b. Degrees from true north	3.14 174.2	2.20 197.0	0.89 219.7	None
II. Nearest Unoccupied Residence (closer than occupied residence)	a. Distance (miles) b. Degrees from true north	None	1.70 203.3 (Hunting Lodge-Info Only)	None	None
III. Nearest Milk Animal	a. Distance (miles)	None	None	None	None
IV. Nearest Broadleaf Garden	a. Distance (miles) b. Garden size (ft^2) c. Degrees from true north	3.16 ≈ 500 174.0	2.18 ≈ 2500 196.3	0.89 ≈ 400 219.5	None
V. Census Comparison	a. Is nearest occupied residence in same location as last census? b. Is nearest milk animal in same location as last census? c. Is nearest broadleaf garden in same location as last census?	Yes N/A Yes	Yes N/A Yes	Yes N/A Yes	N/A N/A N/A

Table 2.1
2014 Land Use Census, continued.

Parameter		Sector N	Sector P	Sector Q	Sector R
I. Nearest Occupied Residence	a. Distance (miles) b. Degrees from true north	None	None	None	1.11 346.1
II. Nearest Unoccupied Residence (closer than occupied residence)	a. Distance (miles) b. Degrees from true north	None	None	None	None
III. Nearest Milk Animal	a. Distance (miles)	None	None	None	None
IV. Nearest Broadleaf Garden	a. Distance (miles) b. Garden size (ft^2) c. Degrees from true north	None	None	None	None
V. Census Comparison	a. Is nearest occupied residence in same location as last census? b. Is nearest milk animal in same location as last census? c. Is nearest broadleaf garden in same location as last census?	N/A N/A N/A	N/A N/A N/A	N/A N/A N/A	Yes N/A N/A

2014 Land Use Census Changes

SECTOR	PARAMETER	Reason for Change
A	Nearest Occupied Residence	Nearest occupied residence from 2012 census no longer occupied. New nearest occupied residence identified in 2014.
A	Nearest Broadleaf Garden	No garden location identified in 2012 census. New garden location identified in 2014.
C	Nearest Broadleaf Garden	Garden location identified in 2012 census no longer planted. New nearest garden location identified in 2014.
D	Nearest Broadleaf Garden	New nearest garden location identified in 2014.
E	Nearest Occupied Residence	Nearest occupied residence is the same as previous census. Location data revised due to new mapping method.
F	Nearest Broadleaf Garden	New nearest garden location identified in 2014.
G	Nearest Occupied Residence	Nearest occupied residence from 2012 census no longer occupied. New nearest occupied residence identified in 2014.
G	Nearest Broadleaf Garden	Nearest garden location from 2012 census no longer planted. New nearest garden location identified in 2014.

2.9 Interlaboratory Comparison Results

Stanford Dosimetry Company analyzed interlaboratory comparison thermoluminescent dosimeters to fulfill the requirements of ODCM Specification 6.12.1. The results are shown in Table A.9.1.

GEL Laboratories analyzed interlaboratory comparison samples to fulfill the requirements of ODCM Specification 6.12.1. The results are shown in Table A.9.2.

3.0 Radiological Environmental Monitoring Program Summary

3.1 Program Results Summary

Table 3.1 summarizes the REMP results. Values reported as less than the lower limit of detection (<LLD) were not used when determining ranges and means for indicator and control locations.

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Grand Gulf Nuclear Station **Docket No:** 50-416
Location of Facility: Claiborne County, Mississippi **Reporting Period:** January - December 2015

Sample Type (Units)	Type & Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] [Range]	Location with Highest Annual Mean		Control Locations Mean (F) [c] [Range]	Number of Nonroutine Results [e]
				Location [d]	Mean (F) [c] [Range]		
Air Particulates (pCi/m^3)	GB 156	0.01	0.0172 (104/104) [0.00535 - 0.0280]	AS-1 PG (Sector G, 5.5 mi)	0.01779 (52/52) [0.00535-0.0276]	0.0175 (52/52) [0.0051-0.0273]	0
	GS 12						
	Cs-134	0.05	<LLD	N/A	N/A	<LLD	0
	Cs-137	0.06	<LLD	N/A	N/A	<LLD	0
Airborne Iodine (pCi/m^3)	I-131 156	0.07	<LLD	N/A	N/A	<LLD	0
Inner Ring TLDs (mR/Qtr)	Gamma 56	f	9.6 (56/56) [4.3 – 14.2]	M-99 (Sector J, 0.4 mi.)	12.8 (4/4) [11.9 – 14.2]	N/A	0
Outer Ring TLDs (mR/Qtr)	Gamma 28	f	9.5 (28/28) [4.5 – 12.2]	M-57 (Sector F, 4.5 mi.)	11.8 (4/4) [11.4 – 12.1]	N/A	0
Special Interest TLDs (mR/Qtr)	Gamma 28	f	9.6 (28/28) [8.1 – 12.2]	M-01 (Sector E, 3.5 mi.)	11.8 (4/4) [11.4 – 12.2]	N/A	0
Control TLDs (mR/Qtr)	Gamma 4	f	N/A	N/A	N/A	10.8 (4/4) [10.0 – 11.2]	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Grand Gulf Nuclear Station **Docket No:** 50-416
Location of Facility: Claiborne County, Mississippi **Reporting Period:** January - December 2015

Sample Type (Units)	Type & Number of Analyses [a]	LLD [b]	Indicator Location Mean (F) [c] [Range]	Location with Highest Annual Mean		Control Locations Mean (F) [c] [Range]	Number of Nonroutine Results [e]
				Location [d]	Mean (F) [c] [Range]		
Surface Water (pCi/l)	H-3 32	3000	2263 (6/26) [449 - 5280]	Outfall 007 (Sector N, Radius 0.2 mi.)	2263 (6/18) [449 - 5280]	<LLD	0
	GS 14						
	Mn-54	15	<LLD	N/A	N/A	<LLD	0
	Co-58	15	<LLD	N/A	N/A	<LLD	0
	Fe-59	30	<LLD	N/A	N/A	<LLD	0
	Co-60	15	<LLD	N/A	N/A	<LLD	0
	Zn-65	30	<LLD	N/A	N/A	<LLD	0
	Nb-95	15	<LLD	N/A	N/A	<LLD	0
	Zr-95	30	<LLD	N/A	N/A	<LLD	0
	I-131	15	<LLD	N/A	N/A	<LLD	0
	Cs-134	15	<LLD	N/A	N/A	<LLD	0
	Cs-137	18	<LLD	N/A	N/A	<LLD	0
	Ba-140	60	<LLD	N/A	N/A	<LLD	0
	La-140	15	<LLD	N/A	N/A	<LLD	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Grand Gulf Nuclear Station **Docket No:** 50-416
Location of Facility: Claiborne County, Mississippi **Reporting Period:** January - December 2015

Sample Type (Units)	Type & Number of Analyses [a]	LLD [b]	Indicator Locations Mean (F) [c] [Range]	Location with Highest Annual Mean		Control Locations Mean (F) [c] [Range]	Number of Nonroutine Results [e]
				Location [d]	Mean (F) [c] [Range]		
Groundwater (pCi/1)	H-3 6	2000	<LLD	N/A	N/A	<LLD	0
	I-131 3	1	<LLD	N/A	N/A	<LLD	0
	GS 3						
	Mn-54	15	<LLD	N/A	N/A	<LLD	0
	Co-58	15	<LLD	N/A	N/A	<LLD	0
	Fe-59	30	<LLD	N/A	N/A	<LLD	0
	Co-60	15	<LLD	N/A	N/A	<LLD	0
	Zn-65	30	<LLD	N/A	N/A	<LLD	0
	Nb-95	15	<LLD	N/A	N/A	<LLD	0
	Zr-95	30	<LLD	N/A	N/A	<LLD	0
	Cs-134	15	<LLD	N/A	N/A	<LLD	0
	Cs-137	18	<LLD	N/A	N/A	<LLD	0
	Ba-140	60	<LLD	N/A	N/A	<LLD	0
	La-140	15	<LLD	N/A	N/A	<LLD	0
Sediment (pCi/kg)	GS 4						
	Cs-134	150	<LLD	N/A	N/A	<LLD	0
	Cs-137	180	<LLD	N/A	N/A	<LLD	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Grand Gulf Nuclear Station **Docket No:** 50-416
Location of Facility: Claiborne County, Mississippi **Reporting Period:** January - December 2015

Sample Type (Units)	Type & Number of Analyses [a]	LLD [b]	Indicator Location Mean (F) [c] [Range]	Location with Highest Annual Mean		Control Locations Mean (F) [c] [Range]	Number of Nonroutine Results [e]
				Location [d]	Mean (F) [c] [Range]		
Fish (pCi/kg)	GS 2						
	Mn-54	130	<LLD	N/A	N/A	<LLD	0
	Co-58	130	<LLD	N/A	N/A	<LLD	0
	Fe-59	260	<LLD	N/A	N/A	<LLD	0
	Co-60	130	<LLD	N/A	N/A	<LLD	0
	Zn-65	260	<LLD	N/A	N/A	<LLD	0
	Cs-134	130	<LLD	N/A	N/A	<LLD	0
	Cs-137	150	<LLD	N/A	N/A	<LLD	0
Food Products/Vegetation (pCi/kg)	I-131 8	60	<LLD	N/A	N/A	<LLD	0
	GS 8						
	Cs-134	60	<LLD	N/A	N/A	<LLD	0
	Cs-137	80	<LLD	N/A	N/A	<LLD	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Grand Gulf Nuclear Station **Docket No:** 50-416
Location of Facility: Claiborne County, Mississippi **Reporting Period:** January - December 2015

Sample Type (Units)	Type & Number of Analyses [a]	LLD [b]	Indicator Location Mean (F) [c] [Range]	Location with Highest Annual Mean		Control Locations Mean (F) [c] [Range]	Number of Nonroutine Results [e]
				Location [d]	Mean (F) [c] [Range]		
Surface Water (Special) (pCi/l)	GS 4						
	Mn-54	15	<LLD	N/A	N/A	<LLD	0
	Co-58	15	<LLD	N/A	N/A	<LLD	0
	Fe-59	30	<LLD	N/A	N/A	<LLD	0
	Co-60	15	<LLD	N/A	N/A	<LLD	0
	Zn-65	30	<LLD	N/A	N/A	<LLD	0
	Nb-95	15	<LLD	N/A	N/A	<LLD	0
	Zr-95	30	<LLD	N/A	N/A	<LLD	0
	I-131	15	<LLD	N/A	N/A	<LLD	0
	Cs-134	15	<LLD	N/A	N/A	<LLD	0
	Cs-137	18	<LLD	N/A	N/A	<LLD	0
	Ba-140	60	<LLD	N/A	N/A	<LLD	0
	La-140	15	<LLD	N/A	N/A	<LLD	0

[a] GB = Gross beta; I-131 = Iodine-131; H-3 = Tritium; GS = Gamma scan.

[b] LLD = Required lower limit of detection based on ODCM Table 6.12.1-3.

[c] Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parenthesis (F).

[d] Where applicable, locations are specified by name, distance from reactor site and meteorological sector.

[e] Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.

[f] LLD is not defined in ODCM Table 6.12.1-3.

Attachment 1

Radiological Monitoring Report

Summary of Monitoring Results

TABLE OF CONTENTS

Table A1.1
Sample Type: Air Particulate Filter and Radioiodine Cartridge
Analysis: Gross Beta and I-131
Units: pCi/m3
AIR SAMPLE AS-1 PG

LLD (pCi/m3)			0.07	0.01	
LAB ID	START DATE	END DATE	I-131	GROSS BETA	
L61599-1/4	12/30/14	01/06/15	<0.04997	0.01960	±0.00357
L61733-1/4	01/06/15	01/13/15	<0.04536	0.02190	±0.00391
L61809-1/4	01/13/15	01/20/15	<0.05241	0.02240	±0.00383
L61916-1/4	01/20/15	01/27/15	<0.05868	0.01810	±0.00341
L62010-1/4	01/27/15	02/03/15	<0.05293	0.01920	±0.00342
L62084-1/4	02/03/15	02/10/15	<0.05899	0.02760	±0.00417
L62140-1/4	02/10/15	02/16/15	<0.03465	0.02380	±0.0041
L62223-1/4	02/16/15	02/24/15	<0.05227	0.02010	±0.0033
L62301-1/4	02/24/15	03/03/15	<0.06146	0.02070	±0.00364
L62369-1/4	03/03/15	03/10/15	<0.03657	0.01470	±0.00317
L62445-1/4	03/10/15	03/17/15	<0.05801	0.00868	±0.00271
L62533-1/4	03/17/15	03/24/15	<0.0492	0.01760	±0.00343
L62626-1/4	03/24/15	03/31/15	<0.05153	0.01490	±0.00331
L62742-1/4	03/31/15	04/07/15	<0.0428	0.01770	±0.00346
L62826-1/4	04/07/15	04/14/15	<0.05923	0.01500	±0.00324
L62920-1/4	04/14/15	04/21/15	<0.03069	0.00766	±0.00262
L63084-1/4	04/21/15	04/28/15	<0.04648	0.01570	±0.00328
L63140-1/4	04/28/15	05/05/15	<0.05171	0.01950	±0.00336
L63240-1/4	05/05/15	05/12/15	<0.03923	0.01750	±0.00318
L63338-1/4	05/12/15	05/19/15	<0.04185	0.01280	±0.00319
L63432-1/4	05/19/15	05/26/15	<0.01745	0.01410	±0.00321
L63525-1/4	05/26/15	06/02/15	<0.03267	0.01150	±0.00319
L63626-1/4	06/02/15	06/09/15	<0.02177	0.02280	±0.00404
L63729-1/4	06/09/15	06/16/15	<0.05543	0.01380	±0.0031
L63867-1/4	06/16/15	06/23/15	<0.06472	0.02160	±0.00375
L63906-1/4	06/23/15	06/30/15	<0.06786	0.01330	±0.00307
L63992-1/4	06/30/15	07/07/15	<0.0477	0.01390	±0.00306
L64149-1/4	07/07/15	07/14/15	<0.05783	0.01880	±0.00333
L64283-1/4	07/14/15	07/21/15	<0.05458	0.01640	±0.00328
L64303-1/4	07/21/15	07/28/15	<0.06074	0.01980	±0.00357
L64409-1/4	07/28/15	08/04/15	<0.06292	0.02330	±0.00391
L64500-1/4	08/04/15	08/11/15	<0.04584	0.02400	±0.00382
L64614-1/4	08/11/15	08/18/15	<0.05042	0.01580	±0.00309
L64658-1/4	08/18/15	08/25/15	<0.04001	0.01180	±0.00313
L64770-1/4	08/25/15	09/01/15	<0.06471	0.02460	±0.00377

Table A1.1

Sample Type: Air Particulate Filter and Radioiodine Cartridge

Analysis: Gross Beta and I-131

Units: pCi/m3

AIR SAMPLE AS-1 PG

LLD (pCi/m3)			0.07	0.01	
LAB ID	START DATE	END DATE	I-131	GROSS BETA	
L64856-1/4	09/01/15	09/08/15	<0.05645	0.02710	±0.00411
L64946-1/4	09/08/15	09/15/15	<0.04999	0.02020	±0.00359
L65032-1/4	09/15/15	09/22/15	<0.05491	0.02390	±0.00393
L65136-1/4	09/22/15	09/29/15	<0.03989	0.01920	±0.00353
L65243-1/4	09/29/15	10/06/15	<0.02673	0.01230	±0.0029
L65340-1/4	10/06/15	10/13/15	<0.05476	0.02760	±0.00396
L65499-1/4	10/13/15	10/20/15	<0.06206	0.02270	±0.00398
L65551-1/4	10/20/15	10/27/15	<0.03386	0.01120	±0.00279
L65669-1/4	10/27/15	11/03/15	<0.03082	0.01600	±0.00385
L65765-1/4	11/03/15	11/10/15	<0.06763	0.01420	±0.00309
L65830-1/4	11/10/15	11/17/15	<0.05215	0.01580	±0.00336
L65909-1/4	11/17/15	11/24/15	<0.02428	0.02040	±0.00383
L65959-1/4	11/24/15	12/01/15	<0.04273	0.00766	±0.00285
L66076-1/4	12/01/15	12/08/15	<0.02887	0.02550	±0.00389
L66152-1/4	12/08/15	12/15/15	<0.02851	0.02220	±0.00368
L66241-1/4	12/15/15	12/22/15	<0.05834	0.01330	±0.00309
L66284-1/4	12/22/15	12/29/15	<0.06672	0.00535	±0.00255
Average:				0.01779	
Maximum:				0.02760	
Minimum:				0.00535	

Table A1.2
Sample Type: Air Particulate Filter and Radioiodine Cartridge
Analysis: Gross Beta and I-131
Units: pCi/m3
AIR SAMPLE AS-3 61VA

LLD (pCi/m3)			0.07	0.01	
LAB ID	START DATE	END DATE	I-131	GROSS BETA	
L61599-2/5	12/30/14	01/06/15	<0.05007	0.0191	±0.0036
L61733-2/5	01/06/15	01/13/15	<0.04543	0.0211	±0.0039
L61809-2/5	01/13/15	01/20/15	<0.05258	0.0239	±0.0039
L61916-2/5	01/20/15	01/27/15	<0.05879	0.0175	±0.0034
L62010-2/5	01/27/15	02/03/15	<0.05298	0.0187	±0.0034
L62084-2/5	02/03/15	02/10/15	<0.0591	0.0258	±0.0041
L62140-2/5	02/10/15	02/16/15	<0.03438	0.0223	±0.0040
L62223-2/5	02/16/15	02/24/15	<0.05264	0.0213	±0.0034
L62301-2/5	02/24/15	03/03/15	<0.02729	0.0216	±0.0037
L62369-2/5	03/03/15	03/10/15	<0.03664	0.0124	±0.0030
L62445-2/5	03/10/15	03/17/15	<0.02439	0.0087	±0.0027
L62533-2/5	03/17/15	03/24/15	<0.04929	0.0134	±0.0031
L62626-2/5	03/24/15	03/31/15	<0.05172	0.0118	±0.0031
L62742-2/5	03/31/15	04/07/15	<0.04317	0.0170	±0.0034
L62826-2/5	04/07/15	04/14/15	<0.05911	0.0100	±0.0028
L62920-2/5	04/14/15	04/21/15	<0.03075	0.0085	±0.0027
L63084-2/5	04/21/15	04/28/15	<0.04839	0.0152	±0.0033
L63140-2/5	04/28/15	05/05/15	<0.05074	0.0170	±0.0031
L63240-2/5	05/05/15	05/12/15	<0.03942	0.0159	±0.0031
L63338-2/5	05/12/15	05/19/15	<0.04182	0.0103	±0.0030
L63432-2/5	05/19/15	05/26/15	<0.04963	0.0094	±0.0029
L63525-2/5	05/26/15	06/02/15	<0.03319	0.0103	±0.0031
L63626-2/5	06/02/15	06/09/15	<0.008403	0.0219	±0.0040
L63729-2/5	06/09/15	06/16/15	<0.06907	0.0201	±0.0042
L63867-2/5	06/16/15	06/23/15	<0.06487	0.0178	±0.0035
L63906-2/5	06/23/15	06/30/15	<0.06799	0.0145	±0.0032
L63992-2/5	06/30/15	07/07/15	<0.04834	0.0127	±0.0030
L64149-2/5	07/07/15	07/14/15	<0.05795	0.0170	±0.0032
L64283-2/5	07/14/15	07/21/15	<0.05468	0.0194	±0.0035
L64303-2/5	07/21/15	07/28/15	<0.06108	0.0196	±0.0036
L64409-2/5	07/28/15	08/04/15	<0.02639	0.0230	±0.0039
L64500-2/5	08/04/15	08/11/15	<0.04588	0.0211	±0.0036
L64614-2/5	08/11/15	08/18/15	<0.04804	0.0159	±0.0030
L64658-2/5	08/18/15	08/25/15	<0.04198	0.0100	±0.0031

Table A1.2
Sample Type: Air Particulate Filter and Radioiodine Cartridge
Analysis: Gross Beta and I-131
Units: pCi/m3
AIR SAMPLE AS-3 61VA

LLD (pCi/m3)			0.07	0.01	
LAB ID	START DATE	END DATE	I-131	GROSS BETA	
L64770-2/5	08/25/15	09/01/15	<0.06832	0.0252	±0.0039
L64856-2/5	09/01/15	09/08/15	<0.05467	0.0272	±0.0040
L64946-2/5	09/08/15	09/15/15	<0.04985	0.0184	±0.0035
L65032-2/5	09/15/15	09/22/15	<0.05515	0.0246	±0.0040
L65136-2/5	09/22/15	09/29/15	<0.04228	0.0205	±0.0038
L65243-2/5	09/29/15	10/06/15	<0.02796	0.0224	±0.0038
L65340-2/5	10/06/15	10/13/15	<0.05547	0.0271	±0.0040
L65499-2/5	10/13/15	10/20/15	<0.0613	0.0206	±0.0038
L65551-2/5	10/20/15	10/27/15	<0.03455	0.0117	±0.0029
L65669-2/5	10/27/15	11/03/15	<0.03101	0.0167	±0.0039
L65765-2/5	11/03/15	11/10/15	<0.06728	0.0158	±0.0032
L65830-2/5	11/10/15	11/17/15	<0.05224	0.0178	±0.0035
L65909-2/5	11/17/15	11/24/15	<0.06365	0.0178	±0.0037
L65959-2/5	11/24/15	12/01/15	<0.04241	0.0094	±0.0030
L66076-2/5	12/01/15	12/08/15	<0.02893	0.0273	±0.0040
L66152-2/5	12/08/15	12/15/15	<0.06884	0.0218	±0.0037
L66241-2/5	12/15/15	12/22/15	<0.05836	0.0161	±0.0033
L66284-2/5	12/22/15	12/29/15	<0.06696	0.0051	±0.0025
Average:				0.0175	
Maximum:				0.0273	
Minimum:				0.0051	

Table A1.3
Sample Type: Air Particulate Filter and Radioiodine Cartridge
Analysis: Gross Beta and I-131
Units: pCi/m3
AIR SAMPLE AS-7 UH

LLD (pCi/m3)			0.07	0.01	
LAB ID	START DATE	END DATE	I-131	GROSS BETA	
L61599-3/6	12/30/14	01/06/15	<0.04989	0.0228	±0.0038
L61733-3/6	01/06/15	01/13/15	<0.04588	0.0204	±0.0038
L61809-3/6	01/13/15	01/20/15	<0.05232	0.0218	±0.0038
L61916-3/6	01/20/15	01/27/15	<0.05948	0.0202	±0.0036
L62010-3/6	01/27/15	02/03/15	<0.05291	0.0176	±0.0033
L62084-3/6	02/03/15	02/10/15	<0.05893	0.0240	±0.0040
L62140-3/6	02/10/15	02/16/15	<0.03463	0.0224	±0.0040
L62223-3/6	02/16/15	02/24/15	<0.05218	0.0188	±0.0032
L62301-3/6	02/24/15	03/03/15	<0.06145	0.0199	±0.0036
L62369-3/6	03/03/15	03/10/15	<0.03669	0.0138	±0.0031
L62445-3/6	03/10/15	03/17/15	<0.05793	0.0071	±0.0026
L62533-3/6	03/17/15	03/24/15	<0.04914	0.0113	±0.0030
L62626-3/6	03/24/15	03/31/15	<0.02161	0.0143	±0.0033
L62742-3/6	03/31/15	04/07/15	<0.04321	0.0158	±0.0034
L62826-3/6	04/07/15	04/14/15	<0.05927	0.0093	±0.0028
L62920-3/6	04/14/15	04/21/15	<0.03065	0.0086	±0.0027
L63084-3/6	04/21/15	04/28/15	<0.04704	0.0140	±0.0032
L63140-3/6	04/28/15	05/05/15	<0.05257	0.0179	±0.0033
L63240-3/6	05/05/15	05/12/15	<0.03919	0.0143	±0.0029
L63338-3/6	05/12/15	05/19/15	<0.04178	0.0125	±0.0032
L63432-3/6	05/19/15	05/26/15	<0.04948	0.0085	±0.0028
L63525-3/6	05/26/15	06/02/15	<0.03258	0.0101	±0.0031
L63626-3/6	06/02/15	06/09/15	<0.02177	0.0184	±0.0038
L63729-3/6	06/09/15	06/16/15	<0.05656	0.0191	±0.0036
L63867-3/6	06/16/15	06/23/15	<0.06463	0.0185	±0.0035
L63906-3/6	06/23/15	06/30/15	<0.06782	0.0098	±0.0028
L63992-3/6	06/30/15	07/07/15	<0.015	0.0129	±0.0030
L64149-3/6	07/07/15	07/14/15	<0.05819	0.0137	±0.0030
L64283-3/6	07/14/15	07/21/15	<0.05452	0.0166	±0.0033
L64303-3/6	07/21/15	07/28/15	<0.06046	0.0167	±0.0034
L64409-3/6	07/28/15	08/04/15	<0.06344	0.0240	±0.0040
L64500-3/6	08/04/15	08/11/15	<0.01776	0.0221	±0.0037
L64614-3/6	08/11/15	08/18/15	<0.05066	0.0165	±0.0032
L64658-3/6	08/18/15	08/25/15	<0.04008	0.0132	±0.0032
L64770-3/6	08/25/15	09/01/15	<0.02504	0.0280	±0.0040

Table A1.3
Sample Type: Air Particulate Filter and Radioiodine Cartridge
Analysis: Gross Beta and I-131
Units: pCi/m3
AIR SAMPLE AS-7 UH

LLD (pCi/m3)			0.07	0.01	
LAB ID	START DATE	END DATE	I-131	GROSS BETA	
L64856-3/6	09/01/15	09/08/15	<0.05673	0.0228	±0.0038
L64946-3/6	09/08/15	09/15/15	<0.04977	0.0186	±0.0035
L65032-3/6	09/15/15	09/22/15	<0.05486	0.0245	±0.0040
L65136-3/6	09/22/15	09/29/15	<0.0398	0.0197	±0.0036
L65243-3/6	09/29/15	10/06/15	<0.02672	0.0124	±0.0029
L65340-3/6	10/06/15	10/13/15	<0.02304	0.0279	±0.0040
L65499-3/6	10/13/15	10/20/15	<0.0623	0.0213	±0.0039
L65551-3/6	10/20/15	10/27/15	<0.03444	0.0098	±0.0027
L65669-3/6	10/27/15	11/03/15	<0.03054	0.0126	±0.0036
L65765-3/6	11/03/15	11/10/15	<0.06777	0.0158	±0.0032
L65830-3/6	11/10/15	11/17/15	<0.05212	0.0174	±0.0035
L65909-3/6	11/17/15	11/24/15	<0.06299	0.0143	±0.0034
L65959-3/6	11/24/15	12/01/15	<0.04247	0.0071	±0.0028
L66076-3/6	12/01/15	12/08/15	<0.02886	0.0235	±0.0038
L66152-3/6	12/08/15	12/15/15	<0.06843	0.0203	±0.0036
L66241-3/6	12/15/15	12/22/15	<0.0583	0.0154	±0.0033
L66284-3/6	12/22/15	12/29/15	<0.06972	0.0060	±0.0027
Average:				0.0166	
Maximum:				0.0280	
Minimum:				0.0060	

Table A1.4
Sample Type: Air Particulate Filter
Analysis: Gamma Isotopic
Units: pCi/m3
AIR PARTICULATE FILTER SAMPLES (GAMMA)

LLD (pCi/m3) LAB ID	LOCATION	DATE	0.05 CS-134	0.06 CS-137
L62771-1	AS-1 PG	02/13/15	<0.002665	<0.002108
L62771-2	AS-3 61VA	02/13/15	<0.002512	<0.002137
L62771-3	AS-7 UH	02/13/15	<0.002694	<0.002222
L64087-1	AS-1 PG	05/15/15	<0.003325	<0.002582
L64087-2	AS-3 61VA	05/15/15	<0.001724	<0.002033
L64087-3	AS-7 UH	05/15/15	<0.003231	<0.002898
L65183-1	AS-1 PG	08/14/15	<0.002141	<0.002077
L65183-2	AS-3 61VA	08/15/15	<0.001331	<0.001341
L65183-3	AS-7 UH	08/14/15	<0.001891	<0.002219
L66362-1	AS-1 PG	11/13/15	<0.002132	<0.001742
L66362-2	AS-3 61VA	11/13/15	<0.003417	<0.003152
L66362-3	AS-7 UH	11/13/15	<0.002692	<0.001344

Table A 2.1
Sample Type: **Thermoluminescent Dosimeters**
Analysis: Gamma Dose
Units: mrem/Qtr

Inner Ring - Within General Area of Site Boundary					
Station	**1st Qtr**	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	**Annual Mean**
M-16	10.3	10.3	11.2	11.0	10.7
M-19	9.1	9.2	9.9	10.1	9.6
M-21	11.4	11.2	11.8	13.4	11.9
M-22	7.6	7.6	8.8	9.6	8.4
M-23	7.3	7.2	5.8	9.0	7.4
M-25	7.6	4.3	8.1	8.6	7.2
M-28	10.3	10.4	11.2	11.8	10.9
M-94	10.7	9.2	10.7	11.0	10.4
M-95	6.3	7.0	6.2	7.5	6.8
M-96	7.4	7.3	7.6	8.3	7.6
M-97	7.8	7.7	7.1	7.6	7.6
M-98	11.8	11.4	12.0	11.9	11.8
M-99*	12.6	11.9	14.2	12.7	12.8
M-100	11.0	10.1	11.3	11.8	11.1

*Location with highest annual mean

Outer Ring – Approximately Three (3) to Five (5) Miles from the Site					
Station	**1st Qtr**	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	**Annual Mean**
M-36	7.9	8.2	8.3	8.4	8.2
M-40	4.9	4.5	4.8	5.4	4.9
M-48	9.1	9.3	9.9	10.6	9.7
M-49	10.2	10.8	11.3	12.2	11.1
M-50	9.2	9.3	9.9	9.8	9.6
M-55	11.4	10.4	11.8	11.5	11.3
M-57*	11.5	11.4	12.1	12.1	11.8

*Location with highest annual mean

Table A 2.2
Sample Type: **Thermoluminescent Dosimeters**
Analysis: Gamma Dose
Units: mrem/Qtr

Special Interest Areas – Population Centers & Schools					
Station	**1st Qtr**	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	**Annual Mean**
M-01*	11.5	11.4	11.9	12.2	11.8
M-07	10.3	9.5	10.3	10.8	10.2
M-09	9.7	9.0	9.7	10.8	9.8
M-10	9.0	8.4	8.7	9.4	8.9
M-33	8.1	8.3	8.7	8.5	8.4
M-38	9.0	8.3	9.9	10.0	9.3
M-39	8.5	8.7	9.1	9.6	9.0

*Location with highest annual mean

Table A 2.3
Sample Type: **Thermoluminescent Dosimeters**
Analysis: Gamma Dose
Units: mrem/Qtr

Special Interest Areas – Control					
Station	**1st Qtr**	**2nd Qtr**	**3rd Qtr**	**4th Qtr**	**Annual Mean**
M-14	10.9	10.0	10.9	11.2	10.8

Table A3.1

Sample Type: Surface Water

Analysis: Gamma Isotopic

Units: pCi/L

SURFACE WATER SAMPLES (GAMMA)

LLD (pCi/L) LAB ID	LOCATION	DATE	15 MN-54	15 CO-58	30 FE-59	15 CO-60	30 ZN-65	15 NB-95	30 ZR-95	15 I-131	15 CS-134	18 CS-137	60 BA-140	15 LA-140
L62109-1	MRDOWN	02/10/15	<5.768	<6.045	<13.38	<6.275	<11.82	<6.44	<9.982	<14.74	<4.895	<5.919	<40.61	<12.8
L62109-3	MRUP	02/10/15	<3.257	<3.935	<8.441	<4.424	<8.312	<4.402	<8	<13.29	<3.738	<3.456	<28.03	<8.488
L63181-1	MRDOWN	05/07/15	<3.695	<4.034	<8.489	<4.172	<8.4	<3.804	<7.878	<11.76	<3.713	<4.078	<26.27	<8.839
L63181-3	MRUP	05/07/15	<4	<3.468	<8.245	<4.244	<8.519	<3.9	<7.461	<11.65	<4.195	<4.049	<25.76	<9.071
L63181-5	MRDOWN GG	05/07/15	<4.52	<4.657	<10.16	<5.387	<8.821	<5.095	<8.773	<11.36	<4.273	<4.682	<30.02	<9.097
L63181-7	MRUP GG	05/07/15	<3.397	<4.017	<7.492	<3.623	<7.885	<3.901	<7.325	<10.14	<3.36	<3.898	<23.16	<6.94
L64668-1	MRDOWN	08/26/15	<5.967	<7.661	<17.18	<8.563	<15.01	<8.014	<13.39	<13.2	<8.182	<8.487	<39.24	<11.72
L64668-3	MRUP	08/26/15	<11	<8.877	<22.01	<8.56	<16.7	<9.379	<17.75	<12.28	<9.56	<9.681	<38.45	<14.92
L65733-1	MRDOWN	11/05/15	<4.001	<4.88	<8.607	<3.616	<9.81	<5.419	<7.589	<12.1	<4.891	<4.665	<28.63	<8.372
L65733-2	MRDOWN GG	11/05/15	<3.958	<3.421	<8.705	<3.373	<7.235	<4.362	<7.398	<9.519	<3.021	<3.794	<24.17	<5.049
L65733-5	MRUP	11/05/15	<4.707	<4.18	<10.49	<5.469	<10.8	<4.893	<5.719	<12.56	<4.693	<5.339	<31.4	<8.028
L65733-6	MRUP GG	11/05/15	<5.369	<5.081	<12.32	<6.356	<10.7	<6.405	<7.882	<14.48	<5.655	<5.253	<32.5	<11
L65734-1	MRDOWN *	11/06/15	<6.792	<7.568	<13.75	<7.562	<15.05	<7.409	<14.34	<10.84	<6.716	<7.91	<31.64	<10.28
L65734-3	MRDOWN GG *	11/06/15	<6.149	<5.967	<12.61	<6.481	<14.5	<5.616	<11.2	<10.71	<5.374	<6.062	<26.73	<7.142

"GG" – indicates duplicate sample

* Annual Sample collected during liquid discharge

Table A3.2
Sample Type: Surface Water
Analysis: Tritium
Units: pCi/L
SURFACE WATER SAMPLES (TRITIUM)

LLD (pCi/L) LAB ID	LOCATION	DATE	3000 H-3	
L61841-1	OUTFALL 007	01/21/15	<393	
L62109-2	MRDOWN	02/10/15	<577	
L62109-4	MRUP	02/10/15	<573	
L62141-1C1	OUTFALL 007	02/16/15	5280	±961
L62141-2C1	OUTFALL 007 GG	02/16/15	5090	±950
L62468-1	OUTFALL 007	03/17/15	<527	
L62864-1	OUTFALL 007	04/15/15	950	±554
L62864-2	OUTFALL 007 GG	04/15/15	1200	±586
L63181-2	MRDOWN	05/07/15	<539	
L63181-4	MRUP	05/07/15	<539	
L63181-6	MRDOWN GG	05/07/15	<557	
L63181-8	MRUP GG	05/07/15	<542	
L63339-1	OUTFALL 007	05/19/15	<576	
L63655-1	OUTFALL 007	06/10/15	<581	
L63655-2	OUTFALL 007 GG	06/10/15	<585	
L64010-1C1	OUTFALL 007	07/08/15	<570	
L64440-1	OUTFALL 007	08/06/15	<554	
L64668-2	MRDOWN	08/26/15	<598	
L64668-4	MRUP	08/26/15	<598	
L64790-1	OUTFALL 007	09/02/15	<382	
L64790-2	OUTFALL 007 GG	09/02/15	<392	
L65170-1	OUTFALL 007	09/30/15	<437	
L65600-1	OUTFALL 007	10/29/15	607	±339
L65733-3	MRDOWN	11/05/15	<512	
L65733-4	MRDOWN GG	11/05/15	<505	
L65733-7	MRUP	11/05/15	<511	
L65733-8	MRUP GG	11/05/15	<508	
L65734-2	MRDOWN *	11/06/15	<512	
L65734-4	MRDOWN GG *	11/06/15	<506	
L65912-1	OUTFALL 007	11/24/15	<477	
L65912-2	OUTFALL 007 GG	11/24/15	<475	
L66227-1	OUTFALL 007	12/22/15	449	±280

* Annual Sample collected during liquid discharge
"GG" – indicates duplicate sample.

Table A4.1
Sample Type: Ground Water
Analysis: Gamma Isotopic
Units: pCi/L
GROUND WATER SAMPLES (GAMMA)

LLD (pCi/L)			15	15	30	15	30	15	30	15	18	60	15
LAB ID	LOCATION	DATE	MN-54	CO-58	FE-59	CO-60	ZN-65	NB-95	ZR-95	CS-134	CS-137	BA-140	LA-140
L65815-1	PGWELL	11/16/15	<8.964	<5.698	<10.43	<4.605	<15.79	<7.858	<12.46	<7.007	<8.887	<27.88	<6.487
L65815-5	CONSTWELL 3	11/16/15	<5.389	<5.646	<9.286	<5.125	<10.68	<5.533	<12.89	<5.873	<6.424	<23.3	<6.182
L65815-9	CONSTWELL 4	11/16/15	<5.369	<5.325	<10.35	<6.158	<15.13	<6.665	<11.89	<5.243	<5.927	<39.01	<13.12

Table A4.2
Sample Type: Ground Water
Analysis: Tritium
Units: pCi/L
GROUND WATER SAMPLES (TRITIUM)

LLD (pCi/L) LAB ID	LOCATION	DATE	2000 H-3
L65815-3	PGWELL	11/16/15	<461
L65815-4	PGWELL GG	11/16/15	<458
L65815-7	CONSTWELL 3	11/16/15	<465
L65815-8	CONSTWELL 3 GG	11/16/15	<466
L65815-11	CONSTWELL 4	11/16/15	<462
L65815-12	CONSTWELL 4 GG	11/16/15	<463

"GG" – indicates duplicate sample.

Table A4.3
Sample Type: Ground Water
Analysis: Iodine-131
Units: pCi/L
GROUND WATER SAMPLES (IODINE-131)

LLD (pCi/L) LAB ID	LOCATION	DATE	1 I-131
L65815-2	PGWELL	11/16/15	<0.293
L65815-6	CONSTWELL 3	11/16/15	<0.28
L65815-10	CONSTWELL 4	11/16/15	<0.3

Table A5.1
Sample Type: Sediment
Analysis: Gamma Isotopic
Units: pCi/kg
SEDIMENT SAMPLES (GAMMA)

LLD (pCi/kg) LAB ID	LOCATION	DATE	150 CS-134	180 CS-137
L65751-1	SEDHAM	11/05/15	<34.47	<41.29
L65751-2	SEDCONT	11/05/15	<74.66	<78.88
L65751-3	SEDHAM GG	11/05/15	<67.28	<84.58
L65751-4	SEDCONT GG	11/05/15	<45.2	<43.31

"GG" – indicates duplicate sample.

Table A6.1
Sample Type: Fish
Analysis: Gamma Isotopic
Units: pCi/kg
FISH SAMPLES (GAMMA)

LLD (pCi/kg) LAB ID	LOCATION	DATE	130 MN-54	130 CO-58	260 FE-59	130 CO-60	260 ZN-65	130 CS-134	150 CS-137
L65167-1	FISHUP	09/24/15	<56.01	<43.59	<89.19	<42.55	<116.5	<47.55	<48.26
L65167-2	FISHDOWN	09/24/15	<63.65	<64.9	<78.64	<78.44	<150.2	<41.3	<86.93

Table A7.1
Sample Type: Vegetation
Analysis: Gamma Isotopic
Units: pCi/kg
VEGETATION SAMPLES (GAMMA)

LLD (pCi/kg) LAB ID	LOCATION	DATE	60 I-131	60 CS-134	80 CS-137
L62519-1	VEG-CONT	03/19/15	<13.26	<6.718	<7.887
L62519-2	VEG-J	03/17/15	<49.25	<19.4	<22.02
L63651-1	VEG-CONT	06/05/15	<52.83	<20.66	<21.94
L63651-2	VEG-J	06/08/15	<49.69	<21.06	<21.98
L65137-1	VEG-CONT	09/28/15	<59.6	<25.41	<31.27
L65137-2	VEG-J	09/28/15	<49.91	<27.81	<42.83
L66045-1	VEG-CONT	12/04/15	<57.38	<29.45	<27.2
L66045-2	VEG-J	12/03/15	<54.23	<29.73	<27.87

Table A 8.1
Sample Type: **Special Samples**
Analysis: Gamma Isotopic
Units: pCi/L

SPECIAL SURFACE WATER SAMPLES (GAMMA)

LLD LAB ID	LOCATION	DATE	15 MN-54	15 CO-58	30 FE-59	15 CO-60	30 ZN-65	15 NB-95	30 ZR-95	15 I-131	15 CS-134	18 CS-137	60 BA-140	15 LA-140
L62512-1	OUTFALL 007	03/17/15	<4.157	<3.6	<8.896	<3.594	<8.021	<4.836	<6.36	<8.263	<3.716	<3.95	<19.66	<6.244
L64009-1	OUTFALL 007	06/19/15	<1.574	<1.824	<4.251	<1.679	<3.388	<1.933	<3.44	<11.84	<1.518	<1.605	<18.99	<6.489
L65134-1	OUTFALL 007	09/29/15	<6.343	<6.113	<11	<6.801	<14.54	<5.951	<12.49	<10.7	<5.015	<5.767	<29.93	<11.13
L66341-1	OUTFALL 007	12/29/15	<5.139	<5.233	<11.69	<5.215	<10.03	<5.007	<8.626	<11.73	<4.718	<5.708	<25.77	<8.199

Table A 9.1
Sample Type: Quality Assurance Report
Analysis: Environmental Dosimeters

STANFORD DOSIMETRY

ENVIRONMENTAL DOSIMETRY COMPANY

ANNUAL QUALITY ASSURANCE STATUS REPORT

January - December 2015

Prepared By: _____ Date: 2/29/16

Approved By: _____ Date: 2/29/16

Environmental Dosimetry Company
10 Ashton Lane
Sterling, MA 01564

TABLE OF CONTENTS

LIST OF TABLES

EXECUTIVE SUMMARY

Routine quality control (QC) testing was performed for dosimeters issued by the Environmental Dosimetry Company (EDC) .

During this annual period, 100% (72/72) of the individual dosimeters, evaluated against the EDC internal performance acceptance criteria (high-energy photons only), met the criterion for accuracy and 100% (72/72) met the criterion for precision (Table 1). In addition, 100% (12/12) of the dosimeter sets evaluated against the internal tolerance limits met EDC acceptance criteria (Table 2) and 100% (6/6) of independent testing passed the performance criteria (Table 3). Trending graphs, which evaluate performance statistic for high-energy photon irradiations and co-located stations are given in Appendix A.

One internal assessment was performed in 2015. There were no findings.

I. INTRODUCTION

The TLD systems at the Environmental Dosimetry Company (EDC) are calibrated and operated to ensure consistent and accurate evaluation of TLDs. The quality of the dosimetric results reported to EDC clients is ensured by in-house performance testing and independent performance testing by EDC clients, and both internal and client directed program assessments.

The purpose of the dosimetry quality assurance program is to provide performance documentation of the routine processing of EDC dosimeters. Performance testing provides a statistical measure of the bias and precision of dosimetry processing against a reliable standard, which in turn points out any trends or performance changes. Two programs are used:

A. QC Program

Dosimetry quality control tests are performed on EDC Panasonic 814 Environmental dosimeters. These tests include: (1) the in-house testing program coordinated by the EDC QA Officer and (2) independent test perform by EDC clients. In-house test are performed using six pairs of 814 dosimeters, a pair is reported as an individual result and six pairs are reported as the mean result. Results of these tests are described in this report.

Excluded from this report are instrumentation checks. Although instrumentation checks represent an important aspect of the quality assurance program, they are not included as process checks in this report. Instrumentation checks represent between 5-10% of the TLDs processed.

B. QA Program

An internal assessment of dosimetry activities is conducted annually by the Quality Assurance Officer (Reference 1). The purpose of the assessment is to review procedures, results, materials or components to identify opportunities to improve or enhance processes and/or services.

II. PERFORMANCE EVALUATION CRITERIA

A. Acceptance Criteria for Internal Evaluations

1. Bias

For each dosimeter tested, the measure of bias is the percent deviation of the reported result relative to the delivered exposure. The percent deviation relative to the delivered exposure is calculated as follows:

$$\frac{(H_i' - H_i)}{H_i} 100$$

where:

H_i' = the corresponding reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

H_i = the exposure delivered to the i^{th} irradiated dosimeter (i.e., the delivered exposure)

2. Mean Bias

For each group of test dosimeters, the mean bias is the average percent deviation of the reported result relative to the delivered exposure. The mean percent deviation relative to the delivered exposure is calculated as follows:

$$\sum\left(\frac{(H_i' - H_i)}{H_i}\right)100\left(\frac{1}{n}\right)$$

where:

H_i' = the corresponding reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

H_i = the exposure delivered to the i^{th} irradiated test dosimeter (i.e., the delivered exposure)

n = the number of dosimeters in the test group

3. Precision

For a group of test dosimeters irradiated to a given exposure, the measure of precision is the percent deviation of individual results relative to the mean reported exposure. At least two values are required for the determination of precision. The measure of precision for the i^{th} dosimeter is:

$$\left(\frac{(H_i' - \bar{H})}{\bar{H}}\right)100$$

where:

H_i' = the reported exposure for the i^{th} dosimeter (i.e., the reported exposure)

$\bar{H}$ = the mean reported exposure; i.e., $\bar{H} = \sum H_i'\left(\frac{1}{n}\right)$

n = the number of dosimeters in the test group

4. EDC Internal Tolerance Limits

All evaluation criteria are taken from the "EDC Quality System Manual," (Reference 2). These criteria are only applied to individual test dosimeters irradiated with high-energy photons (Cs-137) and are as follows for Panasonic Environmental dosimeters: ± 15% for bias and ± 12.8% for precision.

B. QC Investigation Criteria and Result Reporting

EDC Quality System Manual (Reference 2) specifies when an investigation is required due to a QC analysis that has failed the EDC bias criteria. The criteria are as follows:

1. No investigation is necessary when an individual QC result falls outside the QC performance criteria for accuracy.

2. Investigations are initiated when the mean of a QC processing batch is outside the performance criterion for bias.

C. Reporting of Environmental Dosimetry Results to EDC Customers

1. All results are to be reported in a timely fashion.

2. If the QA Officer determines that an investigation is required for a process, the results shall be issued as normal. If the QC results, prompting the investigation, have a mean bias from the known of greater than ±20%, the results shall be issued with a note indicating that they may be updated in the future, pending resolution of a QA issue.

3. Environmental dosimetry results do not require updating if the investigation has shown that the mean bias between the original results and the corrected results, based on applicable correction factors from the investigation, does not exceed ±20%.

III. DATA SUMMARY FOR ISSUANCE PERIOD JANUARY-DECEMBER 2015

A. General Discussion

Results of performance tests conducted are summarized and discussed in the following sections. Summaries of the performance tests for the reporting period are given in Tables 1 through 3 and Figures 1 through 4.

Table 1 provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons only. During this period, 100% (72/72) of the individual dosimeters, evaluated against these criteria met the tolerance limits for accuracy and 100% (72/72) met the criterion for precision. A graphical interpretation is provided in Figures 1 and 2.

Table 2 provides the Bias + Standard deviation results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. Overall,100% (12/12) of the dosimeter sets evaluated against the internal tolerance performance criteria met these criteria. A graphical interpretation is provided in Figures 3

Table 3 presents the independent blind spike results for dosimeters processed during this annual period. All results passed the performance acceptance criterion. Figure 4 is a graphical interpretation of Seabrook Station blind co-located station results.

B. Result Trending

One of the main benefits of performing quality control tests on a routine basis is to identify trends or performance changes. The results of the Panasonic environmental dosimeter performance tests are presented in Appendix A. The results are evaluated against each of the performance criteria listed in Section II, namely: individual dosimeter accuracy, individual dosimeter precision, and mean bias.

All of the results presented in Appendix A are plotted sequentially by processing date.

IV. STATUS OF EDC CONDITION REPORTS (CR)

No condition reports were issued during this annual period.

V. STATUS OF AUDITS/ASSESSMENTS

A. Internal

EDC Internal Quality Assurance Assessment was conducted during the fourth quarter 2015. There were no findings identified.

B. External

None.

VI. PROCEDURES AND MANUALS REVISED DURING JANUARY - DECEMBER 2015

Procedure 1052 was revised on December 23, 2015. Several procedures were reissued with no changes as part of the 5 year review cycle.

VII. CONCLUSION AND RECOMMENDATIONS

The quality control evaluations continue to indicate the dosimetry processing programs at the EDC satisfy the criteria specified in the Quality System Manual. The EDC demonstrated the ability to meet all applicable acceptance criteria.

VIII. REFERENCES

1. EDC Quality Control and Audit Assessment Schedule, 2015.

2. EDC Manual 1, Quality System Manual, Rev. 3, August 1, 2012.

TABLE 1

PERCENTAGE OF INDIVIDUAL DOSIMETERS THAT PASSED EDC INTERNAL CRITERIA JANUARY – DECEMBER 2015[1], [2]

Dosimeter Type	Number Tested	% Passed Bias Criteria	% Passed Precision Criteria
Panasonic Environmental	72	100	100

[1]This table summarizes results of tests conducted by EDC.
[2]Environmental dosimeter results are free in air.

TABLE 2

MEAN DOSIMETER ANALYSES (N=6) JANUARY – DECEMBER 2015[1], [2]

Process Date	Exposure Level	Mean Bias %	Standard Deviation %	Tolerance Limit +/- 15%
4/16/2015	55	4.5	1.1	Pass
4/28/2015	91	2.7	1.6	Pass
05/07/2015	48	0.3	1.3	Pass
7/22/2015	28	1.5	1.4	Pass
7/24/2015	106	2.9	1.8	Pass
8/06/2015	77	-3.3	1.3	Pass
10/30/2015	28	3.7	2.2	Pass
11/04/2015	63	2.5	1.0	Pass
11/22/2015	85	-2.9	1.7	Pass
1/27/2016	61	3.1	0.9	Pass
1/31/2016	112	2.2	1.3	Pass
2/05/2016	36	3.2	1.4	Pass

[1]This table summarizes results of tests conducted by EDC for TLDs issued in 2015.
[2]Environmental dosimeter results are free in air.

TABLE 3
SUMMARY OF INDEPENDENT DOSIMETER TESTING JANUARY – DECEMBER 2015[1], [2]

Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass / Fail
1st Qtr. 2015	Millstone	-6.5	2.9	Pass
2nd Qtr.2015	Millstone	-2.2	3.7	Pass
2nd Qtr.2015	Seabrook	1.4	0.9	Pass
3rd Qtr. 2015	Millstone	-3.4	1.1	Pass
4th Qtr.2015	Millstone	-1.5	2.3	Pass
4th Qtr.2015	Seabrook	0.8	1.8	Pass

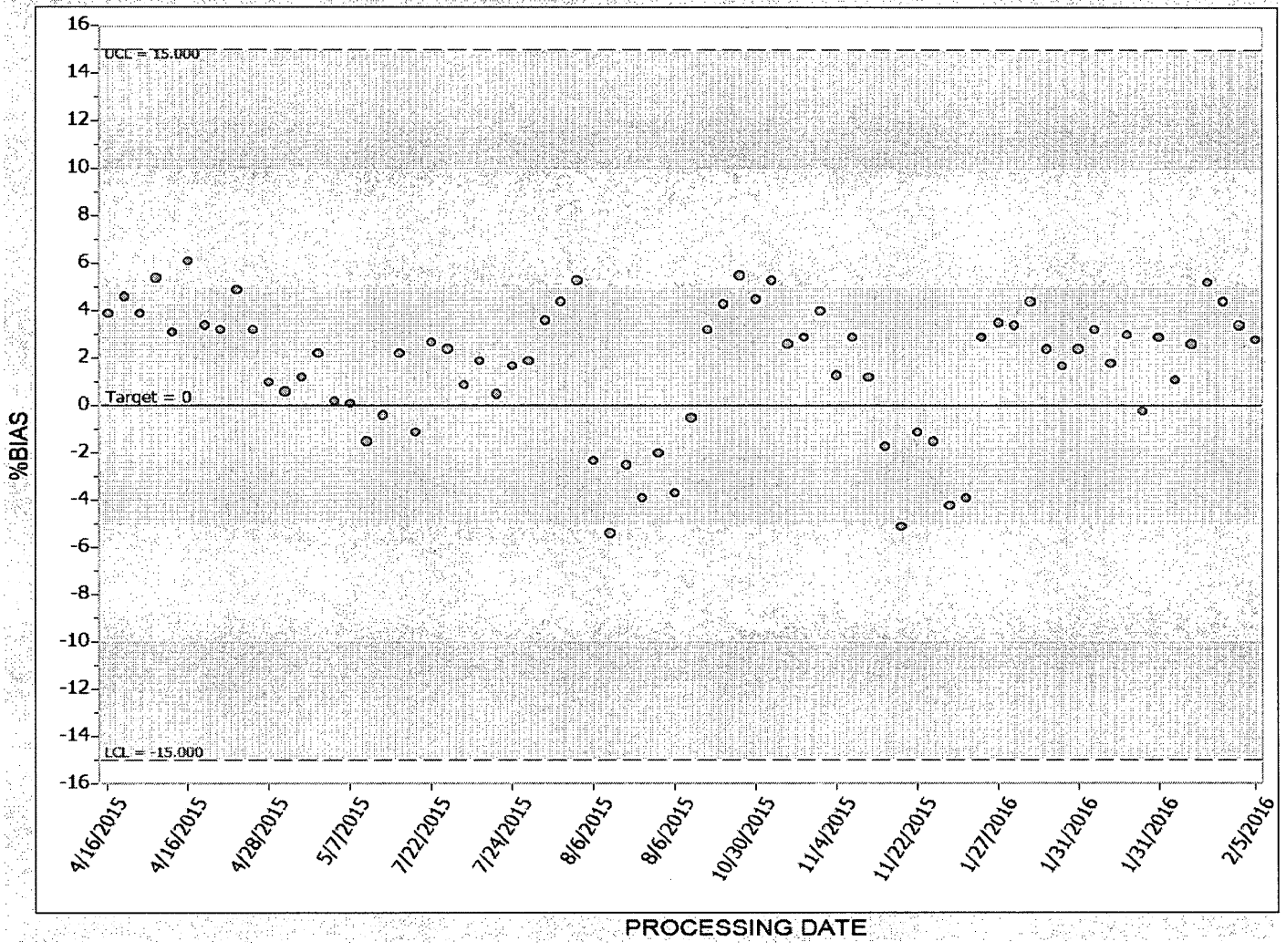
[1]Performance criteria are +/- 30%.
[2]Blind spike irradiations using Cs-137

APPENDIX A

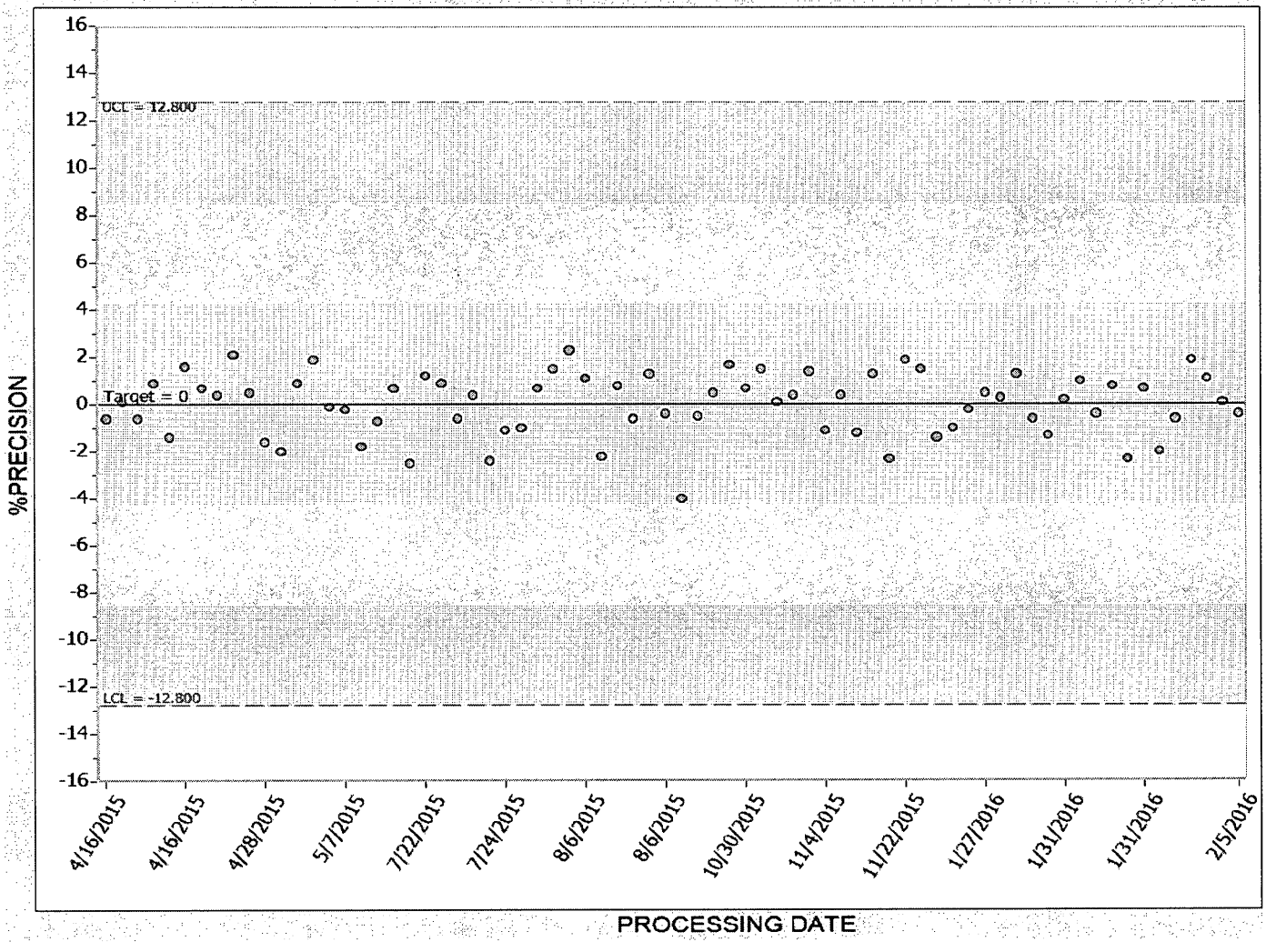
DOSIMETRY QUALITY CONTROL TRENDING GRAPHS

ISSUE PERIOD JANAURY - DECEMBER 2015

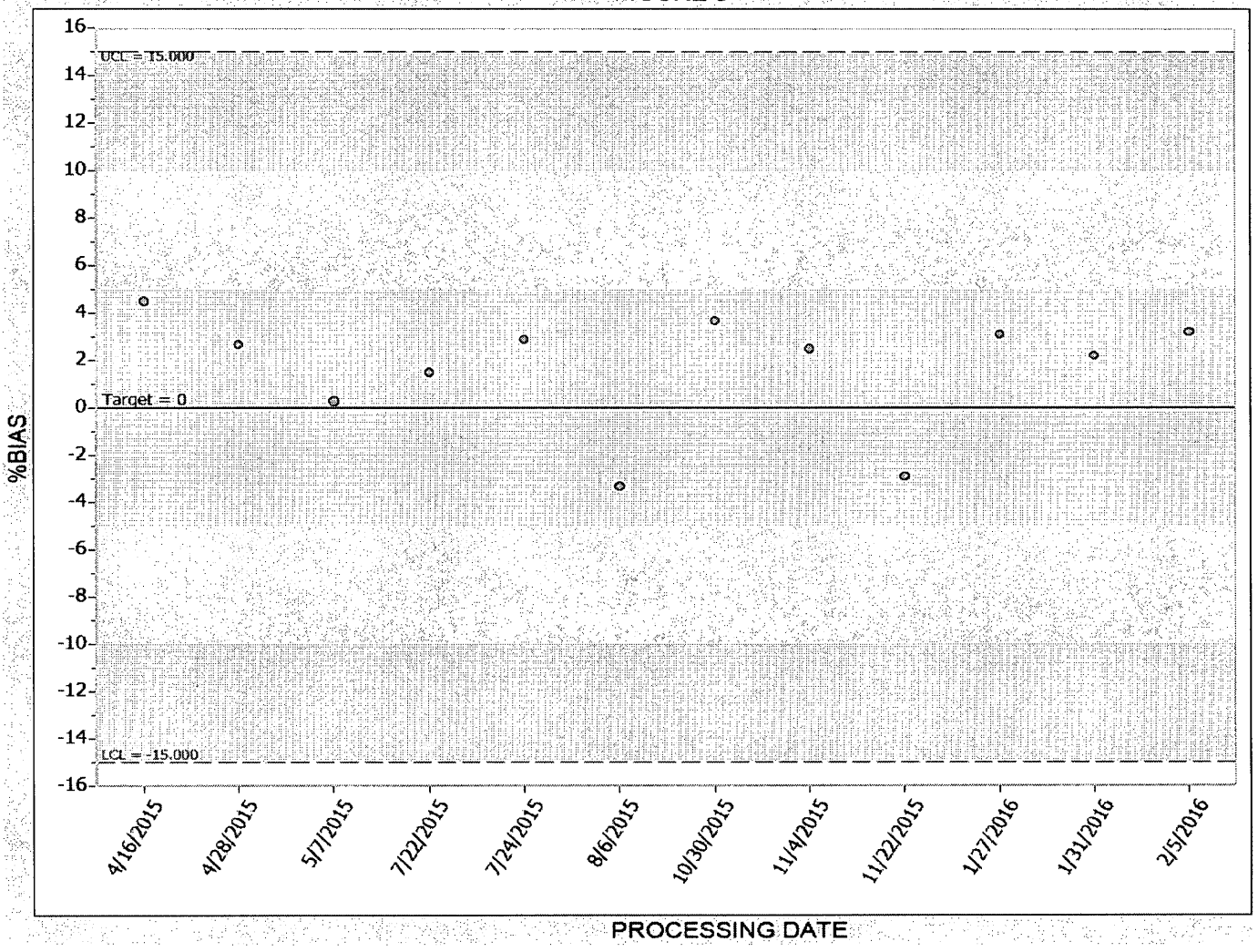
INDIVIDUAL ACCURACY ENVIRONMENTAL
FIGURE 1



INDIVIDUAL PRECISION ENVIRONMENTAL
FIGURE 2



MEAN ACCURACY ENVIRONMENTAL
FIGURE 3



SEABROOK CO-LOCATE ACCURACY
FIGURE 4

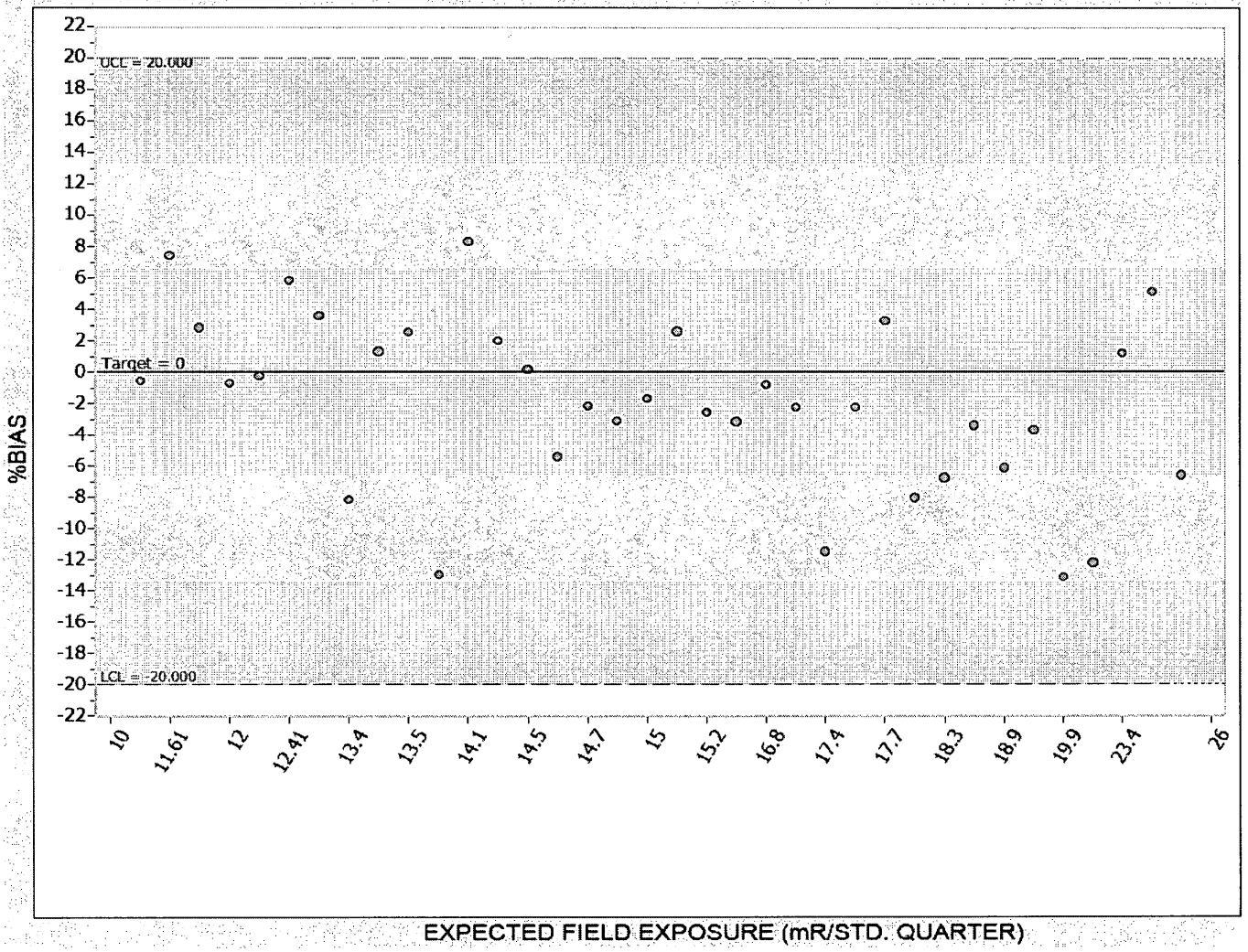


Table A.9.2
Sample Type: Quality Assurance Report
Matrix: Milk, Soil, Liquid, Vegetation, Air Charcoal, Air Particulate, Water

TELEDYNE BROWN ENGINEERING

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
March 2015	E11181	Milk	Sr-89	pCi/L	88.9	97.2	0.91	A
			Sr-90	pCi/L	12.2	17.4	0.70	W
	E11182	Milk	I-131	pCi/L	61.3	65.1	0.94	A
			Ce-141	pCi/L	104	113	0.92	A
			Cr-51	pCi/L	265	276	0.96	A
			Cs-134	pCi/L	138	154	0.90	A
			Cs-137	pCi/L	205	207	0.99	A
			Co-58	pCi/L	178	183	0.97	A
			Mn-54	pCi/L	187	188	0.99	A
			Fe-59	pCi/L	182	177	1.03	A
			Zn-65	pCi/L	345	351	0.98	A
			Co-60	pCi/L	379	405	0.94	A
	E11184	AP	Ce-141	pCi	107	85.0	1.26	W
			Cr-51	pCi	261	224	1.17	A
			Cs-134	pCi	74.6	77.0	0.97	A
			Cs-137	pCi	99.6	102	0.98	A
			Co-58	pCi	99.8	110	0.91	A
			Mn-54	pCi	99.2	96.9	1.02	A
			Fe-59	pCi	109	119	0.92	A
			Zn-65	pCi	188	183	1.03	A
			Co-60	pCi	200	201	1.00	A
	E11183	Charcoal	I-131	pCi	82.9	85.4	0.97	A
	E11185	Water	Fe-55	pCi/L	1950	1900	1.03	A
June 2015	E11234	Milk	Sr-89	pCi/L	94.9	92.6	1.02	A
			Sr-90	pCi/L	14.3	12.7	1.13	A
	E11238	Milk	I-131	pCi/L	93.2	95.9	0.97	A
			Ce-141	pCi/L	Not provided for this study			
			Cr-51	pCi/L	349	276	1.26	W
			Cs-134	pCi/L	165	163	1.01	A
			Cs-137	pCi/L	143.0	125	1.14	A
			Co-58	pCi/L	82.0	68.4	1.20	A
			Mn-54	pCi/L	113	101	1.12	A
			Fe-59	pCi/L	184	151	1.22	W
			Zn-65	pCi/L	269	248	1.08	A
			Co-60	pCi/L	208	193	1.08	A
	E11237	AP	Ce-141	pCi	Not provided for this study			
			Cr-51	pCi	323	233	1.39	N (1)
			Cs-134	pCi	139	138	1.01	A
			Cs-137	pCi	111	106	1.05	A
			Co-58	pCi	54.0	57.8	0.93	A
			Mn-54	pCi	96.8	84.9	1.14	A
			Fe-59	pCi	162	128	1.27	W
			Zn-65	pCi	198	210	0.94	A
			Co-60	pCi	178	163	1.09	A
	E11236	Charcoal	I-131	pCi	93.9	80	1.17	A

ANALYTICS ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Matrix	Nuclide	Units	Reported Value (a)	Known Value (b)	Ratio (c) TBE/Analytics	Evaluation (d)
June 2015	E11238	Water	Fe-55	pCi/L	1890	1790	1.06	A
December 2015	E11354	Milk	Sr-89	pCi/L	96.2	86.8	1.11	A
			Sr-90	pCi/L	14.8	12.5	1.18	A
	E11355	Milk	I-131	pCi/L	95.1	91.2	1.04	A
			Ce-141	pCi/L	117	129	0.91	A
			Cr-51	pCi/L	265	281	0.94	A
			Cs-134	pCi/L	153	160	0.96	A
			Cs-137	pCi/L	119	115	1.03	A
			Co-58	pCi/L	107	110	0.97	A
			Mn-54	pCi/L	153	145	1.06	A
			Fe-59	pCi/L	117	108	1.08	A
			Zn-65	pCi/L	261	248	1.05	A
			Co-60	pCi/L	212	213	1.00	A
	E11357	AP	Ce-141	pCi	89.9	84.0	1.07	A
			Cr-51	pCi	215	184	1.17	A
			Cs-134	pCi	103	105	0.98	A
			Cs-137	pCi	76.6	74.8	1.02	A
			Co-58	pCi	76.2	71.9	1.06	A
			Mn-54	pCi	91.4	94.4	0.97	A
			Fe-59	pCi	78.6	70.3	1.12	A
			Zn-65	pCi	173	162	1.07	A
			Co-60	pCi	138	139	0.99	A
	E11422	AP	Sr-89	pCi	98.0	96.9	1.01	A
			Sr-90	pCi	10.0	14.0	0.71	W
	E11356	Charcoal	I-131	pCi	74.9	75.2	1.00	A
	E11358	Water	Fe-55	pCi/L	2160	1710	1.26	W
	E11353	Soil	Ce-141	pCi/kg	252	222	1.14	A
			Cr-51	pCi/kg	485	485	1.00	A
			Cs-134	pCi/kg	319	277	1.15	A
			Cs-137	pCi/kg	292	276	1.06	A
			Co-58	pCi/kg	193	190	1.02	A
			Mn-54	pCi/kg	258	250	1.03	A
			Fe-59	pCi/kg	218	186	1.17	A
			Zn-65	pCi/kg	457	429	1.07	A
			Co-60	pCi/kg	381	368	1.04	A

(1) AP Cr-51 - Cr-51 has the shortest half-life and the weakest gamma energy of the mixed nuclide sample, which produces a large error. Taking into account the error, the lowest value would be 119% of the reference value, which would be considered acceptable. NCR 15-18

(a) Teledyne Brown Engineering reported result.

(b) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) Ratio of Teledyne Brown Engineering to Analytics results.

(d) Analytics evaluation based on TBE internal QC limits: A= Acceptable, reported result falls within ratio limits of 0.80-1.20. W-Acceptable with warning, reported result falls within 0.70-0.80 or 1.20-1.30. N = Not Acceptable, reported result falls outside the ratio limits of < 0.70 and > 1.30.

DOE's MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Media	Nuclide*	Units	Reported Value (a)	Known Value (b)	Acceptance Range	Evaluation (c)
March 2015	15-MaW32	Water	Am-241	Bq/L	0.632	0.654	0.458 - 0.850	A
			Ni-63	Bq/L	2.5		(1)	A
			Pu-238	Bq/L	0.0204	0.0089	(2)	A
			Pu-239/240	Bq/L	0.9	0.8	0.582 - 1.082	A
	15-MaS32	Soil	Ni-63	Bq/kg	392	448.0	314 - 582	A
			Sr-90	Bq/kg	286	653	487 - 849	N (3)
	15-RdF32	AP	Sr-90	Bq/sample	-0.0991		(1)	A
			U-234/233	Bq/sample	0.0211	0.0155	0.0109 - 0.0202	N (3)
			U-238	Bq/sample	0.095	0.099	0.069 - 0.129	A
	15-GrF32	AP	Gr-A	Bq/sample	0.448	1.77	0.53 - 3.01	N (3)
			Gr-B	Bq/sample	0.7580	0.75	0.38 - 1.13	A
	15-RdV32	Vegetation	Cs-134	Bq/sample	8.08	7.32	5.12 - 9.52	A
			Cs-137	Bq/sample	11.6	9.18	6.43 - 11.93	W
			Co-57	Bq/sample	-0.0096		(1)	A
			Co-60	Bq/sample	6.53	5.55	3.89 - 7.22	A
			Mn-54	Bq/sample	0.0058		(1)	A
			Sr-90	Bq/sample	0.999	1.08	0.76 - 1.40	A
			Zn-65	Bq/sample	-0.108		(1)	A
September 2015	15-MaW33	Water	Am-241	Bq/L	1.012	1.055	0.739 - 1.372	A
			Ni-63	Bq/L	11.8	8.55	5.99 - 11.12	N (4)
			Pu-238	Bq/L	0.727	0.681	0.477 - 0.885	A
			Pu-239/240	Bq/L	0.830	0.900	0.630 - 1.170	A
	15-MaS33	Soil	Ni-63	Bq/kg	635	682	477 - 887	A
			Sr-90	Bq/kg	429	425	298 - 553	A
	15-RdF33	AP	Sr-90	Bq/sample	1.48	2.18	1.53 - 2.83	N (4)
			U-234/233	Bq/sample	0.143	0.143	0.100 - 0.186	A
			U-238	Bq/sample	0.149	0.148	0.104 - 0.192	A
	15-GrF33	AP	Gr-A	Bq/sample	0.497	0.90	0.27 - 1.53	A
			Gr-B	Bq/sample	1.34	1.56	0.78 - 2.34	A
	15-RdV33	Vegetation	Cs-134	Bq/sample	6.10	5.80	4.06 - 7.54	A
			Cs-137	Bq/sample	0.0002		(1)	A
			Co-57	Bq/sample	8.01	6.62	4.63 - 8.61	W
			Co-60	Bq/sample	4.97	4.56	3.19 - 5.93	A
			Mn-54	Bq/sample	8.33	7.68	5.38 - 9.98	A
			Sr-90	Bq/sample	0.386	1.30	0.91 - 1.69	N (4)
			Zn-65	Bq/sample	6.07	5.46	3.82 - 7.10	A

(1) False positive test.

(2) Sensitivity evaluation.

(3) Soil Sr-90 - incomplete digestion of the sample resulted in low results; AP U-234/233 - extremely low activity was difficult to quantify AP Gr-A - the MAPEP filter has the activity embedded in the filter. To corrected the low bias, TBE will create an attenuated efficiency for MAPEP samples. NCR 15-13

(4) Water Ni-63 extremely low activity was difficult to quantify; AP & Vegetation Sr-90 was lost during separation, possible from substance added by MAPEP NCR 15-21.

(a) Teledyne Brown Engineering reported result.

(b) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) DOE/MAPEP evaluation: A=acceptable, W=acceptable with warning, N=not acceptable.

ERA ENVIRONMENTAL RADIOACTIVITY CROSS CHECK PROGRAM
TELEDYNE BROWN ENGINEERING ENVIRONMENTAL SERVICES

Month/Year	Identification Number	Media	Nuclide	Units	Reported Value (a)	Known Value (b)	Acceptance Limits	Evaluation (c)
May 2015	RAD-101	Water	Sr-89	pCi/L	45.2	63.2	51.1 - 71.2	N (1)
			Sr-90	pCi/L	28.0	41.9	30.8 - 48.1	N (1)
			Ba-133	pCi/L	80.6	82.5	63.9 - 90.8	A
			Cs-134	pCi/L	71.7	75.7	61.8 - 83.3	A
			Cs-137	pCi/L	187	189	170 - 210	A
			Co-60	pCi/L	85.7	84.5	76.0 - 95.3	A
			Zn-65	pCi/L	197	203	183 - 238	A
			Gr-A	pCi/L	26.1	42.6	22.1 - 54.0	A
			Gr-B	pCi/L	28.8	32.9	21.3 - 40.6	A
			I-131	pCi/L	23.5	23.8	19.7 - 28.3	A
			U-Nat	pCi/L	6.19	6.59	4.99 - 7.83	A
			H-3	pCi/L	3145	3280	2770 - 3620	A
	MRAD-22	Filter	Gr-A	pCi/filter	28.3	62.2	20.8 - 96.6	A
011/01/2015	RAD-103	Water	Sr-89	pCi/L	40.9	35.7	26.7 - 42.5	A
			Sr-90	pCi/L	29.3	31.1	22.7 - 36.1	A
			Ba-133	pCi/L	31.5	32.5	25.9 - 36.7	A
			Cs-134	pCi/L	59.65	62.3	50.6 - 68.5	A
			Cs-137	pCi/L	156	157	141 - 175	A
			Co-60	pCi/L	70.6	71.1	64.0 - 80.7	A
			Zn-65	pCi/L	145	126	113 - 149	A
			Gr-A	pCi/L	38.2	51.6	26.9 - 64.7	A
			Gr-B	pCi/L	42.0	36.6	24.1 - 44.2	A
			I-131	pCi/L	24.8	26.3	21.9 - 31.0	A
			U-Nat	pCi/L	146.90	56.2	45.7 - 62.4	N (2)
			H-3	pCi/L	21100	21300	18700 - 23400	A
	MRAD-23	Filter	Gr-A	pCi/filter	Lost during processing			

(1) Yield on the high side of our acceptance range indicates possibility of calcium interference. NCR 15-09

(2) Technician failed to dilute original sample. If dilulted, the result would have been 57.1, which fell within the acceptance limits. NCR 15-19

(a) Teledyne Brown Engineering reported result.

(b) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(c) ERA evaluation: A=acceptable. Reported result falls within the Warning Limits. NA=not acceptable. Reported result falls outside of the Control Limits. CE=check for Error. Reported result falls within the Control Limits and outside of the Warning Limit.

For the TBE laboratory, 131 out of 139 analyses performed met the specified acceptance criteria. Eight analyses (AP - Cr-51, U-234/233, Gr A, Sr-90; Soil Sr-90; Water - Ni-3 and U natural; Vegetation Sr-90 samples) did not meet the specified acceptance criteria for the following reasons:

1. Teledyne Brown Engineering's Analytics' June 2015 air particulate Cr-51 result of 323 ± 45.5 pCi was higher than the known value of 233 pCi with a ratio of 1.39. The upper ratio of 1.20 was exceeded. The air particulate sample is counted on a shelf (above the detector), which is the ideal geometry for this sample. But due to the fact that Cr-51 has the shortest half-life and the weakest gamma energy of the mixed nuclide sample, this geometry produces a larger error for the Cr-51. Taking into consideration the uncertainty, the activity of Cr-51 overlaps with the known value at a ratio of 1.19, which would be considered acceptable. NCR 15-18

2. Teledyne Brown Engineering's MAPEP March 2015 soil Sr-90 result of 286 Total Bq/kg was lower than the known value of 653 Bq/kg, exceeding the lower acceptance range of 487 Bq/kg. The failure was due to incomplete digestion of the sample. NCR 15-13

3. Teledyne Brown Engineering's MAPEP March 2015 air particulate U-234/233 result of 0.0211 Bq/sample was higher than the known value of 0.0155 Bq/sample, exceeding the upper acceptance range of 0.0202 Bq/sample. Due to the extremely low activity, it was difficult to quantify the U-234/233. Taking into consideration the uncertainty, the activity of U-234/233 overlaps with the known value, which is statistically considered the same value. NCR 15-13

4. Teledyne Brown Engineering's MAPEP March 2015 air particulate gross alpha result of 0.448 Bq/sample was lower than the known value of 1.77 Bq/sample, exceeding the lower acceptance range of 0.53 Bq/sample. The efficiency used for gross alpha is made from a non-attenuated alpha standard. The MAPEP filter has the alphas embedded in the filter, requiring an attenuated efficiency. In order to correct the low bias, TBE will create an attenuated efficiency for MAPEP air particulate filters. NCR 15-13

5. Teledyne Brown Engineering's MAPEP September water Ni-63 result of 11.8 ± 10.8 Bq/L was higher than the known value of 8.55 Bq/L, exceeding the upper acceptance range of 11.12 Bq/L. The original sample was run with a 10 mL aliquot which was not sufficient for the low level of Ni-63 in the sample. The rerun aliquot of 30 mL produced an acceptable result of 8.81 Bq/L. NCR 15-21

6. Teledyne Brown Engineering's MAPEP September air particulate Sr-90 result of 1.48 Bq/sample was lower than the known value of 2.18 Bq/sample, exceeding the lower acceptance range of 1.53

Bq/sample. In the past, MAPEP has added substances (unusual compounds found in DOE complexes) to various matrices that have resulted in incomplete removal of the isotope of interest for the laboratories analyzing the cross checks. We feel that this is possibly the case with this sample. NCR 15-21

7. Teledyne Brown Engineering's MAPEP September vegetation Sr-90 result of 0.386 Bq/sample was lower than the known value of 1.30 Bq/sample, exceeding the lower acceptance range of 0.91 Bq/sample. In the past, MAPEP has added substances (unusual compounds found in DOE complexes) to various matrices that have resulted in incomplete removal of the isotope of interest for the laboratories analyzing the cross checks. We feel that this is possibly the case with this sample. NCR 15-21

8. Teledyne Brown Engineering's ERA November water Uranium natural result of 146.9 pCi/L was higher than the known value of 56.2 pCi/L, exceeding the upper acceptance limit of 62.4 pCi/L. The technician failed to dilute the original sample, but used the entire 12 mL sample. When recalculated using the 12 mL aliquot, the result of 57.16 agreed with the assigned value of 56.2. NCR 15-19