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GNRO-2020/0012

April 17, 2020

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

SUBJECT: Grand Gulf Nuclear Station Annual Radiological Environmental Operating Report (AREOR)
Grand Gulf Nuclear Station, Unit 1
Docket Number 50-416
License Number NPF-29

Dear Sir or Madam:

In accordance with 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, 2019 through December 31, 2019.

This letter contains no new commitments. If you have any questions or require additional information, please contact Kevin Sanders at 601-6930.

Sincerely,

E. G. L.

Eric A. Larson
EAL/saw

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

cc: NRC Region IV - Regional Administrator
NRC Senior Resident Inspector, Grand Gulf Nuclear Station
State Health Officer, Mississippi Department of Health
NRC Project Manager

Attachment

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

Entergy

Plant: Grand Gulf Nuclear Station	Page 1 of 46
	YEAR: 2019
Document Number: GNRO 2020-00012	
Annual Radiological Environmental Operating Report	

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1.0 EXECUTIVE SUMMARY

1.1 Radiological Environmental Monitoring Program

The Annual Radiological Environmental Operating Report presents data obtained through analyses of environmental samples collected for Grand Gulf Nuclear Station (GGNS) Radiological Environmental Monitoring Program (REMP) for the period January 1 through December 31, 2019. This report fulfills the requirements of Grand Gulf Nuclear Station Technical Specification 5.6.2.

All required lower limit of detection (LLD) capabilities were achieved in all sample analyses during 2019, as required by the GGNS Offsite Dose Calculation Manual (ODCM) Specifications Table 6.12.1-3. No measurable levels of radiation above baseline levels attributable to GGNS operation were detected in the vicinity of GGNS. The 2019 Radiological Environmental Monitoring Program thus substantiated the adequacy of source control and effluent monitoring at GGNS with no observed impact of plant operations on the environment.

GGNS established the REMP in 1978 prior to the station's 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 direct radiation. GGNS also samples milk if milk-producing animals used for human consumption are present within five miles (8 km) of the plant.

The REMP includes sampling indicator and control locations within an approximate 20-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 the presence of only naturally occurring radioactivity. GGNS personnel compare indicator results with control and preoperational results to assess any impact GGNS operation might have had on the surrounding environment.

In 2019, environmental samples were collected for radiological analysis. The results of indicator locations were compared with control locations and previous studies. It was concluded that no significant relationship exists between GGNS operation and effect on the area around the plant. The review of 2019 data showed radioactivity levels in the environment were undetectable in many locations and near background levels in significant pathways.

1.2 Reporting Levels

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

1.3 Comparison to State and/or Federal Program

GGNS personnel compared REMP data to state monitoring programs as results became available. Historically, the programs used for comparison have 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.

The NRC TLD Network Program was discontinued in 1998. Historically these results have compared to those from the GGNS REMP. GGNS TLD results continue to remain similar to the historical average and continue to verify that plant operation is not affecting the ambient radiation levels in the environment.

The MSDH and the GGNS REMP entail similar radiological environmental monitoring program requirements. These programs include collecting air samples and splitting or sharing sample media such as water, sediment and fish. Both programs have obtained similar results over previous years.

1.4 Sample Deviations

During 2019, environmental sampling was performed for 5 media types addressed in the ODCM and for direct radiation. A total of 373 samples of the 379 scheduled were obtained. Of the scheduled samples, 98 percent were collected and analyzed in accordance with the requirements specified in the ODCM. Attachment 1 contains the listing of sample deviations and actions taken.

1.5 Program Modifications

There were no program modifications during the reporting period.

2.0 INTRODUCTION

2.1 Radiological Environmental Monitoring Program

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

Analyzing applicable pathways for anticipated types and quantities of radionuclides released into the environment.

- Considering the possibility of a buildup of long-lived radionuclides in the environment and identifying physical and biological accumulations that may contribute to human exposures.
- Considering the potential radiation exposure to plant and animal life in the environment surrounding GGNS.
- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

2.2 Pathways Monitored

The airborne, direct radiation, waterborne and ingestion pathways are monitored as required by GGNS ODCM Table 6.12.1-1. A description of the REMP utilized to monitor the exposure pathways is described in the attached Tables and Figures.

Section 4.0 of this report provides a discussion of 2019 sampling results with Section 5.0 providing a summary of results for the monitored exposure pathways.

2.3 Land Use Census

GGNS conducts a land use census biennially, as required by Section 6.12.2 of the ODCM. The purpose of this census is to identify changes in uses of land within five miles of GGNS that would require modifications to the REMP and the ODCM. The most important criteria during this census are to determine the location in each sector of the nearest occupied residence, unoccupied residence, garden, and milking animal.

3.0 RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM REQUIREMENTS

Table 1, Exposure Pathway – Airborne

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
RADIOIODINE AND PARTICULATES 1 sample close to the SITE BOUNDARY having the highest calculated annual average ground level D/Q.	AS-7 (Sector H, 0.5 miles) – South-southeast of GGNS at the IBEW Union Hall	7 days, or more frequently if required by dust loading.	• Radioiodine Canisters – I-131 analysis every 7 days • Air Particulate – Gross beta radioactivity analysis following filter change • Air Particulate – Gamma Isotopic composite (by location) every 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 (Sector G, 5.5 miles) – Southeast of GGNS at the Port Gibson City Barn		
RADIOIODINE AND PARTICULATES 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q.	AS-20 (Sector L, 0.9 miles) – South-southeast of GGNS at the former Glodjo residence		
RADIOIODINE AND PARTICULATES 1 sample from a control location 15 - 30 km distance.	AS-3 (Sector B, 18 miles) – North of the Vicksburg Airport		

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
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. • **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. • **M-95 (Sector F, Radius 0.5 mi)** – Spoils Area, fence of old storage area, near entrance gate	92 days	Gamma dose; 92 days

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
TLDS An inner ring of stations in the general areas of the SITE BOUNDARY.	• **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

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
TLDS An outer ring of stations 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. • **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

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
TLDS Additional stations in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control locations.	• **M-01 (Sector E, Radius 3.5 Miles)** – Across the road from Lake Claiborne Entry Gate. (Special) • **M-07 (Sector G, Radius 5.5 Miles)** – AS-1 PG, Port Gibson City Barn. (Special) • **M-09 (Sector D, Radius 3.5 Miles)** – Warner Tully Y-Camp. (Special) • **M-10 (Sector A, Radius 1.5 Miles)** – Grand Gulf Military Park. (Special) • **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. (Control) • **M-38 (Sector M, Radius 9.5 Miles)** – Lake Bruin State Park, Entrance Road. (Special) • **M-39 (Sector M, Radius 13.0 Miles)** – St. Joseph, Louisiana, Auxiliary Water Tank. (Special)	92 days	Gamma dose; 92 days

Table 3, Exposure Pathway – Waterborne

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
SURFACE WATER 1 sample upstream and 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 analysis; 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 analysis; 366 days
1 sample from Outfall 007	• **OUTFALL 007 (Sector N, Radius 0.2 Miles)** – Storm Drain System	31 days	Tritium; 31 days
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 analysis; 366 days

Table 3, Exposure Pathway – Waterborne

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
SEDIMENT FROM SHORELINE 1 sample from downstream area and 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

Table 4, Exposure Pathway – Ingestion

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
MILK • If commercially available, 1 sample from milking animals within 8 km distant • 1 sample from milking animals at a control location >8 km distant when an indicator location exists.	• 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. (Control)	92 days when required	Gamma isotopic and I-131; 92 days
FISH AND INVERTEBRATES • 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 portions; 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. (Control)	92 days when available	Gamma isotopic and I-131; 92 days

Figure 1, Exposure Pathway

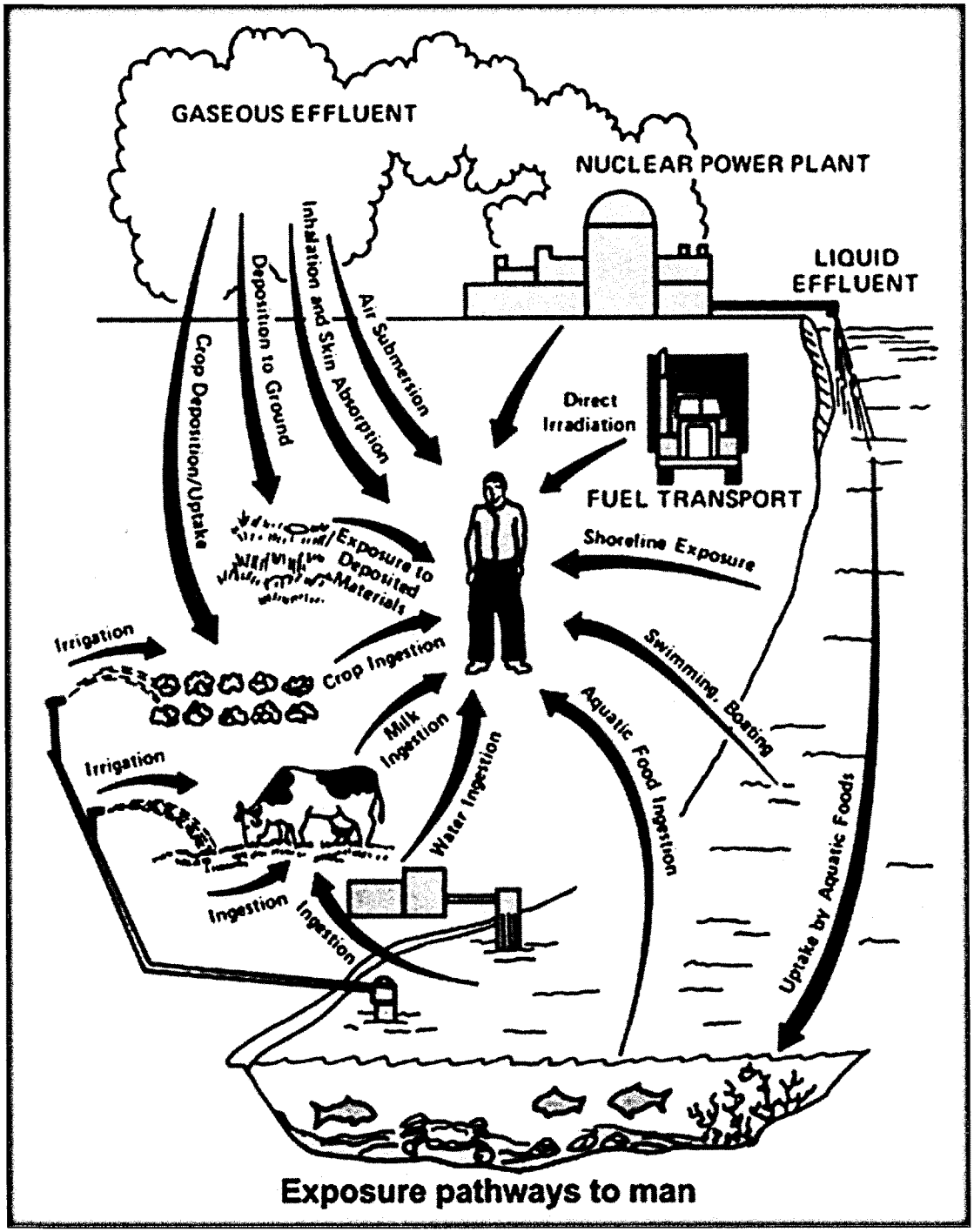


Figure 2, Sample Collection Sites –Near Field

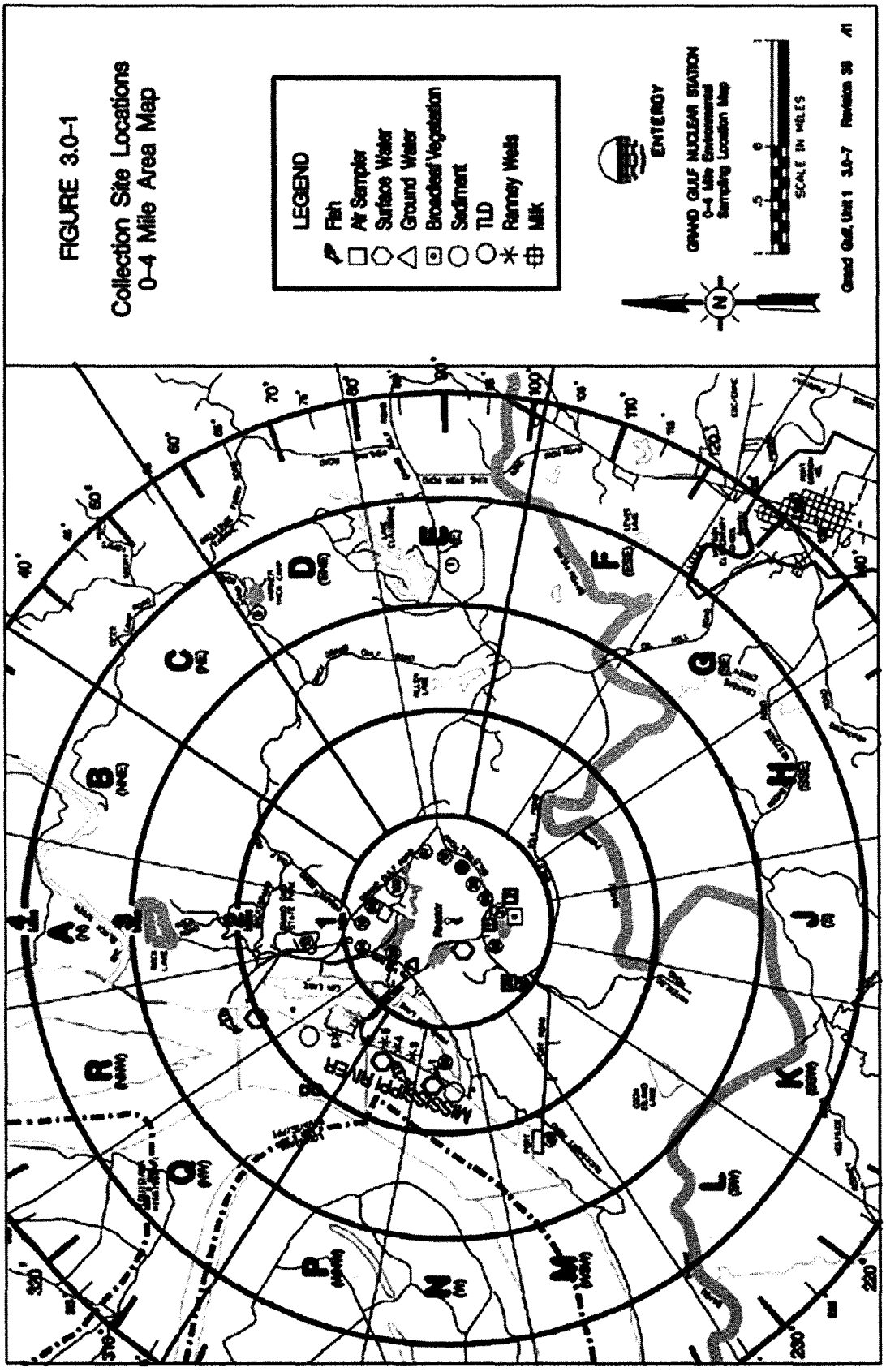
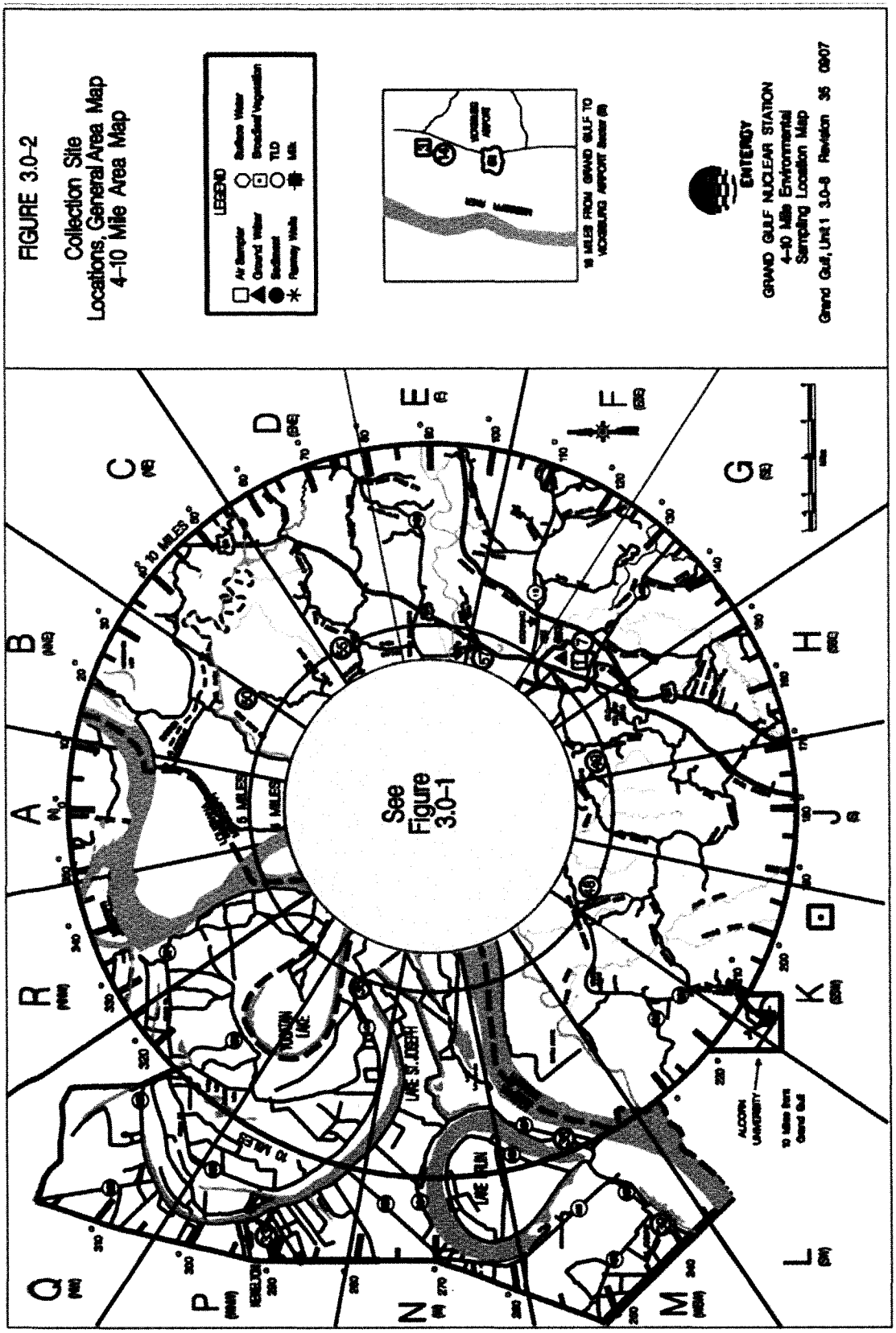


Figure 3, Sample Collection Sites - Far Field



4.0 INTERPRETATION AND TRENDS OF RESULTS

4.1 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.

In 2019 there were no samples above the LLD for I-131. Indicator gross beta air particulate results for 2019 were comparable to results obtained from 2009-2018 of the operational REMP. Also, the 2019 gross beta annual average was less than the average for preoperational levels. Results are reported as annual average picocuries per cubic meter (pCi/m^3).

Monitoring Period	Result
2009 – 2018 (Minimum Value)	0.009
2019 Average Value	0.017
2009 – 2018 (Maximum Value)	0.043
Preoperational	0.032

In the absence of plant-related gamma radionuclides, gross beta activity is attributed to naturally occurring radionuclides. Table 3.1, which include gross beta concentrations and provide a comparison of the indicator and control means and ranges emphasizes the consistent trends seen in this pathway to support the presence of naturally occurring activity. Therefore, it can be concluded that the airborne pathway continues to be unaffected by Grand Gulf Nuclear Station operations.

4.2 Thermoluminescent Dosimetry (TLD) Sample Results

Grand Gulf Nuclear Station reports measured dose as net exposure (field reading less transit reading) normalized to 92 days and relies on comparison of the indicator locations to the control as a measure of plant impact. Grand Gulf Nuclear Station's comparison of the inner ring and special interest area TLD results to the control, as seen in Table 7, identified no noticeable trend that would indicate that the ambient radiation levels are being affected by plant operations. In addition, the inner ring value of 10.0 millirem/quarter (mR/Qtr) shown in Table 7 for 2019 is within the historical bounds of 2009 – 2018 annual average results, which have ranged from 9.3 to 10.9 mrem. Overall, Grand Gulf Nuclear Station concluded that the ambient radiation levels are not being affected by plant operations.

Table 5, Direct Radiation Annual Summary

Year	Inner Ring (mR/Qtr)	Outer Ring (mR/Qtr)	Control Location (mR/Qtr)
2009	10.9	10.2	11.3
2010	10.8	10.5	12.1
2011	10.0	10.2	11.4
2012	9.5	9.7	11.0
2013	9.8	9.7	10.8
2014	10.0	9.9	11.0
2015	9.6	9.5	10.8
2016	9.3	9.3	10.7
2017	9.9	9.9	11.3
2018	9.7	9.8	10.6
2019	10.0	9.7	10.7

4.3 Waterborne Sample Results

Analytical results for 2019 surface water and drinking water samples were similar to those reported in previous years. Gamma radionuclides analytical results for 2019 surface water samples were similar to those reported in previous years. Tritium in Grand Gulf Nuclear Station surface water indicator samples continues to be detected, but is attributed to washout and entrainment of normal, previously monitored gaseous effluents. These results are further explained below.

4.3.1 Surface Water

Samples were collected from two indicator locations (Outfall 007, MRDOWN) 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 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 at during June (1850 pCi/L), July (1700 pCi/L), and December (1660 pCi/L) at the Outfall 007 location. Tritium was also measured in the duplicate samples collected during June (2020 pCi/L) and December (1570 pCi/L). Tritium was not observed in the remaining Outfall 007 samples collected during 2019. Results are reported as annual average pCi/l.

Monitoring Period	Result
2009 – 2018 (Minimum Value)	729
2019 Value	1760
2009 – 2018 (Maximum Value)	2020
Preoperational	2739

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

Grand Gulf Nuclear Station personnel have noted no definable increasing trends associated with the tritium levels at the discharge location. Levels detected during 2019 and previous operational years have been well below regulatory reporting limits. Therefore, the operation of Grand Gulf Nuclear Station had no definable impact on this waterborne pathway during 2019 and levels of radionuclides remain similar to those obtained in previous operational years.

4.3.2 Drinking Water

Drinking water samples were collected from two locations, CONSTWELL (indicator) and PGWELL (control). Drinking water samples were analyzed for I-131, gamma radionuclides and tritium. During 2019, gamma radionuclides, I-131, and tritium concentrations were below the LLD limits at the indicator and control locations, which is consistent with previous operational years. Results are reported as annual average pCi/L.

Radionuclide	2019	2009 – 2018*	Preoperational
Gross Beta	< LLD	< LLD	<LLD
Iodine-131	< LLD	< LLD	< LLD
Gamma	< LLD	< LLD	< LLD
Tritium	< LLD	< LLD	<LLD

Grand Gulf Nuclear Station personnel have noted no definable trends associated with drinking water results at the indicator location. Therefore, the operation of Grand Gulf Nuclear Station had no definable impact on this waterborne pathway during 2019 and levels of radionuclides remain similar to those obtained in previous operational years. Results from 2019 are summarized in Table 7.

4.3.3 Groundwater

Groundwater monitoring data collected during administration of the Groundwater Protection Initiative (GPI) site program are included in the Annual Radioactive Effluent Release Report.

4.4 Soil Sample Results

Sediment samples were collected from two locations in 2019 and analyzed for gamma radionuclides. Listed below is a comparison of 2019 indicator results to the 2009 – 2018 operational years. Grand Gulf Nuclear Station operations had no significant impact on the environment or public by this waterborne pathway. Results are reported as pCi/kg.

Monitoring Period	Result
2009 – 2018 (Minimum Value)	<LLD
2019 Value	< LLD
2009 – 2018 (Maximum Value)	40.3
Preoperational	295.0

4.5 Ingestion Sample Results

4.5.1 Milk Sample Results

Milk samples were not collected during 2019 due to the unavailability of indicator locations within five miles of Grand Gulf Nuclear Station.

4.5.2 Fish Sample Results

Fish samples were collected from two locations and analyzed for gamma radionuclides. In 2019, gamma radionuclides were below detectable limits which are consistent with preoperational and operational years. Therefore, based on these measurements, Grand Gulf Nuclear Station operations had no significant radiological impact upon the environment or public by this ingestion pathway.

4.5.3 Food Product Sample Results

The REMP has detected radionuclides prior to 1990 that are attributable to other sources. These include the radioactive plume release due to reactor core degradation at Chernobyl Nuclear Power Plant in 1986 and atmospheric weapons testing.

In 2019, food product samples were collected from two locations and analyzed for plant related Iodine-131 and gamma radionuclides. The 2019 levels remained undetectable, as has been the case in previous years. Therefore, based on these measurements, Grand Gulf Nuclear Station operations had no significant radiological impact upon the environment or public by this ingestion pathway.

4.6 Land Use Census Results

The latest land use census, performed in 2018, did not identify any new locations that yielded a calculated dose or dose commitment greater than those currently calculated.

The land use census identified no milk-producing animals within a five-mile radius of the plant site. In accordance with ODCM Section 6.12.1, Grand Gulf Nuclear Station personnel sampled broadleaf vegetation.

Table 6, Land Use Census – 2019 Nearest Residence Within Five Miles

Sector	Direction	Nearest Residence (miles)	Nearest Garden (miles)
A	N	1.02	1.02
B	NNE	1.51	1.52
C	NE	0.70	4.14
D	ENE	2.60	4.50
E	E	0.83	0.91
F	ESE	2.25	4.51
G	SE	3.72	4.20
H	SSE	1.10	4.31
J	S	3.14	3.16
K	SSW	2.20	2.18
L	SW	0.89	0.89
M	WSW	none within 5 miles	none within 5 miles
N	W	none within 5 miles	none within 5 miles
P	WNW	none within 5 miles	none within 5 miles
Q	NW	none within 5 miles	none within 5 miles
R	NNW	1.44	none within 5 miles

A land use census was not conducted for the year 2019. The next land use census is scheduled to be conducted in 2020.

4.7 Interlaboratory Comparison Results

Attachment 3 contains result summary for Interlaboratory Comparison program for Teledyne Brown Engineering.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

1. Table 7, Radiological Environmental Monitoring Program Summary, summarizes data for the 2019 REMP program.

Table 7, Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses [Note 1]	LLD [Note 2]	Indicator Locations Mean (F)[Note 3] [Range]	Location with the Highest Annual Mean		Control Locations Mean (F)[Note 3] [Range]	Number of Non-Routine Results [Note 5]
				Location [Note 4]	Mean (F)[Note 3] [Range]		
Air Particulates (pCi/m^3)	GB / 212	0.01	0.0172 (159 / 159) [0.0085 – 0.0387]	AS-1 PG (Sector G, 5.5 mi)	0.0179 (53 / 53) [0.0086 - 0.0394]	0.0175 (52 / 52) [0.0085 - 0.0387]	0
	GS / 16						
	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 / 212	0.07	< LLD	N/A	N/A	< LLD	0
Inner Ring TLDs (mR/Qtr)	Gamma / 50	[Note 6]	10.12 (50 / 50) [6.9 – 13.2]	M-99 (Sector J, 0.4 mi.)	12.9 (4 / 4) [7.9 – 13.2]	N/A	0
Outer Ring TLDs (mR/Qtr)	Gamma / 28	[Note 6]	9.7 (28 / 28) [4.5 – 12.4]	M-57 (Sector F, 4.5 mi.)	11.7 (4 / 4) [11.3 – 12.4]	N/A	0
Special Interest TLDs (mR/Qtr)	Gamma / 28	[Note 6]	9.5 (28 / 28) [7.5 – 12.2]	M-01 (Sector E, 3.5 mi.)	11.4 (4 / 4) [10.7 – 12.2]	N/A	0
Control TLD (mR/Qtr)	Gamma / 4	[Note 6]	N/A	N/A	N/A	10.7 (4 / 4) [10.0 – 11.3]	0

Table 7, Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses [Note 1]	LLD [Note 2]	Indicator Locations Mean (F)[Note 3] [Range]	Location with the Highest Annual Mean		Control Locations Mean (F)[Note 3] [Range]	Number of Non-Routine Results [Note 5]
				Location [Note 4]	Mean (F)[Note 3] [Range]		
Surface Water (pCi/l)	H-3 / 38	3000	1760 (5 / 30) [1570 – 2020]	Outfall 007 (Sector N, 0.2 mi.)	797 (5 / 20) [1570 – 2020]	< LLD	0
	GS / 16						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	N/A	N/A	< LLD	0
	Co-58	15	< 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
	Zr-95	30	< LLD	N/A	N/A	< LLD	0
	Nb-95	15	< 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 7, Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses [Note 1]	LLD [Note 2]	Indicator Locations Mean (F)[Note 3] [Range]	Location with the Highest Annual Mean		Control Locations Mean (F)[Note 3] [Range]	Number of Non-Routine Results [Note 5]
				Location [Note 4]	Mean (F)[Note 3] [Range]		
Drinking Water (pCi/1)	I-131 / 4	1	< LLD	N/A	N/A	< LLD	0
	H-3 / 4	2000	< LLD	N/A	N/A	< LLD	0
	GS / 4						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	N/A	N/A	< LLD	0
	Co-58	15	< 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
	Zr-95	30	< LLD	N/A	N/A	< LLD	0
	Nb-95	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
Sediment (pCi/kg)	GS / 4						
	Cs-134	150	< LLD	N/A	N/A	N/A	0
	Cs-137	180	< LLD	N/A	N/A	N/A	0

Table 7, Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses [Note 1]	LLD [Note 2]	Indicator Locations Mean (F)[Note 3] [Range]	Location with the Highest Annual Mean		Control Locations Mean (F)[Note 3] [Range]	Number of Non-Routine Results [Note 5]
				Location [Note 4]	Mean (F)[Note 3] [Range]		
Fish (pCi/kg)	GS / 4						
	Mn-54	130	< LLD	N/A	N/A	< LLD	0
	Fe-59	260	< LLD	N/A	N/A	< LLD	0
	Co-58	130	< 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 (pCi/kg)	I-131 / 12	60	< LLD	N/A	N/A	N/A	0
	GS / 12						
	Cs-134	60	< LLD	N/A	N/A	N/A	0
	Cs-137	80	< LLD	N/A	N/A	N/A	0

Table 7, Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses [Note 1]	LLD [Note 2]	Indicator Locations Mean (F)[Note 3] [Range]	Location with the Highest Annual Mean		Control Locations Mean (F)[Note 3] [Range]	Number of Non-Routine Results [Note 5]
				Location [Note 4]	Mean (F)[Note 3] [Range]		
Surface Water (Special) (pCi/l)	GS / 5						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	N/A	N/A	< LLD	0
	Co-58	15	< 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
	Zr-95	30	< LLD	N/A	N/A	< LLD	0
	Nb-95	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 7, Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses [Note 1]	LLD [Note 2]	Indicator Locations Mean (F)[Note 3] [Range]	Location with the Highest Annual Mean		Control Locations Mean (F)[Note 3] [Range]	Number of Non-Routine Results [Note 5]
				Location [Note 4]	Mean (F)[Note 3] [Range]		
Meat (Special) (pCi/kg)	GS / 1						
	Mn-54	130	< LLD	N/A	N/A	< LLD	0
	Fe-59	260	< LLD	N/A	N/A	< LLD	0
	Co-58	130	< 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

LEGEND:

[Note 1] - GB = Gross beta; I-131 = Iodine-131; H-3 = Tritium; GS = Gamma scan.
[Note 2] - LLD = Required lower limit of detection based on ODCM Table 6.12.1-3.
[Note 3] - Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parenthesis (F).
[Note 4] – Where applicable, locations are specified (1) by name, (2) distance from reactor site, and (3) meteorological sector.
[Note 5] - 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.
[Note 6] - LLD is not defined in ODCM Table 6.12.1-3.

Attachment 1

Sample Deviations

Table 8, Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
1	TLD	M-23, M-25	04/09/19	Inaccessible	During collection of 1st quarter 2019 TLDs, two locations, M-23 and M-25, were inaccessible due to high Mississippi River water level. New TLDs were installed when the locations became accessible in October 2019. CR-GGN-2019-02900 documents the condition.
2	TLD	M-23, M-25	07/10/19	Inaccessible	During collection of 2nd quarter 2019 TLDs, two locations, M-23 and M-25, were inaccessible due to high Mississippi River water level. New TLDs were installed when the locations became accessible in October 2019. CR-GGN-2019-05597 documents the condition.
3	TLD	M-23, M-25	10/09/19	Inaccessible	During collection of 3rd quarter 2019 TLDs, two locations, M-23 and M-25, were not available due to high Mississippi River water level. New TLDs were installed when the locations became accessible in October 2019. CR-GGN-2019-08312 documents the condition.

Attachment 2

Monitoring Results Tables

Table 9, Air Particulate Data Summary Table

Analysis: Gross Beta				Units: pCi/m^3	
Start Date	End Date	Station AS-1 (Indicator)	Station AS-7 (Indicator)	Station AS-20 (Indicator)	Station AS-3 [Note 1] (Control)
REQUIRED LLD →		0.01	0.01	0.01	0.01
12/26/18	01/02/19	0.01670	0.01660	0.01430	0.01540
01/02/19	01/08/19	0.01310	0.01370	0.01710	0.01720
01/08/19	01/15/19	0.01330	0.01300	0.01320	0.01440
01/15/19	01/22/19	0.01360	0.01470	0.01430	0.01630
01/22/19	01/29/19	0.01730	0.01850	0.01780	0.01920
01/29/19	02/05/19	0.01600	0.01080	0.01480	0.01390
02/05/19	02/12/19	0.01390	0.01530	0.01710	0.01760
02/12/19	02/19/19	0.01780	0.01690	0.01650	0.01560
02/19/19	02/26/19	0.01450	0.01170	0.01280	0.01070
02/26/19	03/05/19	0.01500	0.01100	0.01480	0.01190
03/05/19	03/12/19	0.01530	0.01740	0.01670	0.01750
03/12/19	03/19/19	0.01440	0.01350	0.01180	0.01470
03/19/19	03/26/19	0.01680	0.01740	0.01250	0.01680
03/26/19	04/02/19	0.01630	0.01610	0.01660	0.01710
04/02/19	04/09/19	0.01140	0.01030	0.00981	0.01050
04/09/19	04/16/19	0.01310	0.01290	0.01200	0.01220
04/16/19	04/23/19	0.01050	0.01370	0.01240	0.01450
04/23/19	04/30/19	0.02040	0.02420	0.01710	0.02540
04/30/19	05/07/19	0.01540	0.01460	0.01310	0.01350
05/07/19	05/14/19	0.00946	0.01180	0.01220	0.00856
05/14/19	05/21/19	0.01940	0.02010	0.01950	0.02080
05/21/19	05/28/19	0.01580	0.01430	0.01740	0.02080
05/28/19	06/04/19	0.01490	0.02000	0.01800	0.01700
06/04/19	06/11/19	0.01620	0.01480	0.01760	0.01600
06/11/19	06/18/19	0.01240	0.01490	0.01420	0.01540
06/18/19	06/25/19	0.01470	0.01090	0.01180	0.01130
06/25/19	07/02/19	0.02180	0.02000	0.01930	0.02210

Monitoring Results Tables

Table 9, Air Particulate Data Summary Table

Analysis: Gross Beta			Units: pCi/m^3		
Start Date	End Date	Station AS-1 (Indicator)	Station AS-7 (Indicator)	Station AS-20 (Indicator)	Station AS-3 [Note 1] (Control)
REQUIRED LLD →		0.01	0.01	0.01	0.01
07/02/19	07/09/19	0.01330	0.01380	0.01200	0.01460
07/09/19	07/16/19	0.01350	0.01120	0.00895	0.01130
07/16/19	07/23/19	0.01180	0.01120	0.01000	0.01110
07/23/19	07/30/19	0.01440	0.01050	0.01290	0.01470
07/30/19	08/06/19	0.01920	0.02230	0.01890	0.02140
08/06/19	08/13/19	0.01540	0.01850	0.01330	0.01670
08/13/19	08/20/19	0.02060	0.01800	0.01740	0.01940
08/20/19	08/27/19	0.01400	0.01180	0.01140	0.01230
08/27/19	09/03/19	0.02280	0.02230	0.02570	0.02460
09/03/19	09/10/19	0.03870	0.03660	0.03780	0.03940
09/10/19	09/17/19	0.03470	0.03420	0.03380	0.03570
09/17/19	09/24/19	0.01970	0.01670	0.01650	0.01710
09/24/19	10/01/19	0.02390	0.02420	0.02140	0.02610
10/01/19	10/08/19	0.02760	0.02450	0.02110	0.02630
10/08/19	10/15/19	0.01820	0.01650	0.01610	0.01670
10/15/19	10/22/19	0.01970	0.02340	0.02130	0.02150
10/22/19	10/29/19	0.00852	0.01160	0.01050	0.01140
10/29/19	11/05/19	0.01970	0.01590	0.01760	0.02010
11/05/19	11/12/19	0.02400	0.02460	0.02650	0.02750
11/12/19	11/19/19	0.03290	0.02880	0.03170	0.03190
11/19/19	11/26/19	0.02040	0.02040	0.01500	0.02110
11/26/19	12/03/19	0.01260	0.01250	0.01430	0.01290
12/03/19	12/10/19	0.02560	0.02220	0.01960	0.02150
12/10/19	12/17/19	0.01940	0.01620	0.01800	0.01820
12/17/19	12/23/19	0.01870	0.02240	0.02190	0.01860
12/23/19	12/31/19	0.01030	0.01220	0.01230	0.01010

[Note 1] — Station with highest annual mean.

Monitoring Results Tables

Table 10, Radioiodine Cartridge Data Table Summary

Analysis: I-131				Units: pCi/m^3	
Start Date	End Date	AS-1 (Indicator)	AS-7 (Indicator)	AS-20 (Indicator)	AS-3 (Control)
12/26/18	01/02/19	<0.03822	<0.04010	<0.03819	<0.03829
01/02/19	01/08/19	<0.04828	<0.04948	<0.04877	<0.04834
01/08/19	01/15/19	<0.03529	<0.03686	<0.03633	<0.03534
01/15/19	01/22/19	<0.03160	<0.03992	<0.03820	<0.03778
01/22/19	01/29/19	<0.02140	<0.02264	<0.02168	<0.01770
01/29/19	02/05/19	<0.04847	<0.04765	<0.04899	<0.04652
02/05/19	02/12/19	<0.03234	<0.03186	<0.03332	<0.03149
02/12/19	02/19/19	<0.04843	<0.04699	<0.04985	<0.04711
02/19/19	02/26/19	<0.04028	<0.03901	<0.04140	<0.03921
02/26/19	03/05/19	<0.02643	<0.02601	<0.02759	<0.02610
03/05/19	03/12/19	<0.05818	<0.05736	<0.06082	<0.05735
03/12/19	03/19/19	<0.04205	<0.04188	<0.04249	<0.04235
03/19/19	03/26/19	<0.05138	<0.05054	<0.05285	<0.05071
03/26/19	04/02/19	<0.04473	<0.04344	<0.04607	<0.04352
04/02/19	04/09/19	<0.06263	<0.05975	<0.06423	<0.06045
04/09/19	04/16/19	<0.05670	<0.05667	<0.05597	<0.05660
04/16/19	04/23/19	<0.03025	<0.04344	<0.01568	<0.02981
04/23/19	04/30/19	<0.03424	<0.03324	<0.03229	<0.03381
04/30/19	05/07/19	<0.04033	<0.03939	<0.03858	<0.04045
05/07/19	05/14/19	<0.01344	<0.01339	<0.01332	<0.01325
05/14/19	05/21/19	<0.02826	<0.02781	<0.02767	<0.02873
05/21/19	05/28/19	<0.02017	<0.01986	<0.01931	<0.02112
05/28/19	06/04/19	<0.02012	<0.01980	<0.01949	<0.02129
06/04/19	06/11/19	<0.04642	<0.04637	<0.04571	<0.05112
06/11/19	06/18/19	<0.04469	<0.04596	<0.04519	<0.04520
06/18/19	06/25/19	<0.03106	<0.03098	<0.03108	<0.03116
06/25/19	07/02/19	<0.02560	<0.02560	<0.02585	<0.02563
07/02/19	07/09/19	<0.01979	<0.01931	<0.01949	<0.01965

Monitoring Results Tables

Table 10, Radioiodine Cartridge Data Table Summary

Analysis: I-131				Units: pCi/m^3	
Start Date	End Date	AS-1 (Indicator)	AS-7 (Indicator)	AS-20 (Indicator)	AS-3 (Control)
07/09/19	07/16/19	<0.03666	<0.03778	<0.03720	<0.03660
07/16/19	07/23/19	<0.03090	<0.03117	<0.03112	<0.03080
07/23/19	07/30/19	<0.04742	<0.04838	<0.04870	<0.04817
07/30/19	08/06/19	<0.06683	<0.06739	<0.06779	<0.06594
08/06/19	08/13/19	<0.02965	<0.06246	<0.02971	<0.02969
08/13/19	08/20/19	<0.02613	<0.02694	<0.02615	<0.02580
08/20/19	08/27/19	<0.02470	<0.02515	<0.03188	<0.02495
08/27/19	09/03/19	<0.04095	<0.04088	<0.04079	<0.04041
09/03/19	09/10/19	<0.02638	<0.02552	<0.02555	<0.02626
09/10/19	09/17/19	<0.03998	<0.04088	<0.04091	<0.03994
09/17/19	09/24/19	<0.03815	<0.03900	<0.03834	<0.03817
09/24/19	10/01/19	<0.05204	<0.05180	<0.05238	<0.05138
10/01/19	10/08/19	<0.03706	<0.03786	<0.03722	<0.03080
10/08/19	10/15/19	<0.05350	<0.05401	<0.05368	<0.02198
10/15/19	10/22/19	<0.04360	<0.04327	<0.04317	<0.04222
10/22/19	10/29/19	<0.02916	<0.02888	<0.02878	<0.02911
10/29/19	11/05/19	<0.02173	<0.02165	<0.02151	<0.02183
11/05/19	11/12/19	<0.01530	<0.01535	<0.01538	<0.01530
11/12/19	11/19/19	<0.02687	<0.02664	<0.02677	<0.02682
11/26/19	11/26/19	<0.04537	<0.04466	<0.04539	<0.04483
11/26/19	12/03/19	<0.03003	<0.03003	<0.02990	<0.02505
12/03/19	12/10/19	<0.03032	<0.03015	<0.03020	<0.03051
12/10/19	12/17/19	<0.02788	<0.02755	<0.02743	<0.02768
12/17/19	12/23/19	<0.02717	<0.02695	<0.02684	<0.02740
12/23/19	12/31/19	<0.02954	<0.02930	<0.01641	<0.02958

Monitoring Results Tables

Table 11, Air Gamma Quarterly Composite

Analysis: Gamma Isotopic		Units: pCi/cu.m	
Location	Date	CS-134	CS-137
REQUIRED LLD →		0.05	0.06
AS-1	02/16/19	<0.002094	<0.001558
AS-3		<0.001674	<0.001407
AS-7		<0.002557	<0.002632
AS-20		<0.002976	<0.002238
AS-1	05/17/19	<0.00275	<0.001860
AS-3		<0.001959	<0.001704
AS-7		<0.001661	<0.001826
AS-20		<0.002166	<0.000899
AS-1	08/16/19	<0.001822	<0.001110
AS-3		<0.001403	<0.001292
AS-7		<0.002082	<0.001854
AS-20		<0.002082	<0.001036
AS-1	11/15/19	<0.002292	<0.00883
AS-3		<0.003055	<0.002902
AS-7		<0.001694	<0.001147
AS-20		<0.002143	<0.001166

Monitoring Results Tables

Table 12, Thermoluminescent Dosimeters – Inner Ring

Analysis: Gamma Dose			Units: mrem		
Station	1st Qtr 2019	2nd Qtr 2019	3rd Qtr 2019	4th Qtr 2019	Annual Mean 2019
M-16	9.9	10.8	10.1	10.9	10.4
M-19	8.6	9.3	9.9	9.2	9.2
M-21	12.7	11.8	11.9	12.5	12.2
M-22	8.2	8.4	8.4	8.4	8.4
M-23	Lost[Note 2]	Lost[Note 3]	Lost[Note 4]	9.5	9.5
M-25	Lost[Note 2]	Lost[Note 3]	Lost[Note 4]	7.7	7.7
M-28	11.5	10.9	11.1	12.0	11.4
M-94	10.8	10.9	10.3	11.0	10.7
M-95	7.1	7.6	6.9	8.4	7.5
M-96	8.2	9.0	8.0	8.9	8.5
M-97	7.8	8.3	7.1	9.0	8.1
M-98	11.3	11.8	11.3	12.1	11.6
M-99[Note 1]	12.8	13.2	12.6	13.2	12.9
M-100	11.4	10.8	11.2	11.7	11.3

[Note 1] – Station with highest annual mean.
[Note 2] - Reference Attachment 1, Sample Deviations, Table 8, Sample Deviations Table, Comment 1
[Note 3] - Reference Attachment 1, Sample Deviations, Table 8, Sample Deviations Table, Comment 2
[Note 4] - Reference Attachment 1, Sample Deviations, Table 8, Sample Deviations Table, Comment 3

Monitoring Results Tables

Table 13, Thermoluminescent Dosimeters – Outer Ring

Analysis: Gamma Dose			Units: mrem		
Station	1st Qtr 2019	2nd Qtr 2019	3rd Qtr 2019	4th Qtr 2019	Annual Mean 2019
M-36	8.6	9.4	8.3	8.8	8.7
M-40	4.5	4.6	4.9	5.6	4.9
M-48	10.1	10.9	10.1	10.5	10.4
M-49	11.2	11.7	10.7	11.3	11.3
M-50	9.7	10.0	10.2	10.0	10.0
M-55	11.1	11.0	10.9	11.5	11.1
M-57[Note 1]	11.3	12.4	11.4	11.7	11.7

[Note 1] – Station with highest annual mean.

Table 14, Thermoluminescent Dosimeters – Special Interest Areas

Analysis: Gamma Dose			Units: mrem		
Station	1st Qtr 2019	2nd Qtr 2019	3rd Qtr 2019	4th Qtr 2019	Annual Mean 2019
M-01[Note 1]	10.7	11.8	10.8	12.2	11.4
M-07	9.9	10.6	10.7	11.0	10.6
M-09	8.8	9.6	9.7	10.1	9.6
M-10	8.1	8.5	8.3	9.5	8.6
M-33	7.6	8.0	7.5	8.5	7.9
M-38	9.1	9.9	8.9	9.8	9.4
M-39	8.5	9.3	9.2	9.5	9.1

[Note 1] – Station with highest annual mean.

Table 15, Thermoluminescent Dosimeters – Control

Analysis: Gamma Dose			Units: mrem		
Station	1st Qtr 2019	2nd Qtr 2019	3rd Qtr 2019	4th Qtr 2019	Annual Mean 2019
M-14	10.0	10.9	11.3	10.5	10.7

Monitoring Results Tables

Table 16, Surface Water – Gamma

Analysis: Gamma Isotopic			Units: pCi/L										
Location	Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
REQUIRED LLD →		15	15	30	15	30	15	30	15	15	18	60	15
MRDOWN (Indicator)	02/04/19	<5.378	<6.151	<8.907	<8.885	<9.608	<5.69	<11.41	<10.69	<7.122	<5.592	<31.77	<12.27
MRUP (Control)	02/04/19	<6.285	<6.282	<10.7	<6.186	<11.28	<6.502	<11.18	<10.57	<6.110	<5.571	<33.32	<10.94
MRDOWN (Indicator)	05/01/19	<5.493	<6.611	<13.42	<8.033	<12.09	<6.928	<11.44	<11.1	<5.409	<5.894	<25.56	<7.213
MRDOWN GG (Indicator)	05/01/19	<6.52	<7.462	<14.89	<6.851	<13.3	<7.449	<13.41	<12.75	<7.704	<6.325	<33.98	<9.87
MRUP (Control)	05/01/19	<5.319	<6.094	<11.28	<6.396	<10.58	<4.862	<7.9	<11.42	<5.354	<5.859	<22.21	<9.849
MRUP GG (Control)	05/01/19	<5.281	<3.763	<10.47	<5.088	<9.184	<5.134	<9.041	<8.199	<4.644	<5.222	<21.92	<8.648
MRDOWN (Indicator)	08/08/19	<5.801	<8.109	<13.72	<5.867	<13.51	<7.51	<14.46	<12.24	<5.537	<7.102	<34.71	<7.711
MRDOWN GG (Indicator)	08/08/19	<8.534	<8.466	<15.37	<7.213	<16.24	<7.364	<12.71	<12.48	<7.469	<8.73	<38.35	<11.63
MRUP (Control)	08/08/19	<4.172	<7.829	<11.8	<7.760	<10.16	<6.009	<14.35	<10.11	<6.362	<8.444	<29.67	<13.16
MRUP GG (Control)	08/08/19	<8.692	<7.261	<11.89	<7.129	<10.63	<8.301	<13.24	<14.3	<9.200	<9.137	<37.15	<11.43

Monitoring Results Tables

Table 16, Surface Water – Gamma

Analysis: Gamma Isotopic			Units: pCi/L										
Location	Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
MRDOWN* (Indicator)	10/10/19	<6.28	<6.369	<13.39	<7.013	<14.32	<7.989	<10.14	<14.16	<6.530	<6.099	<31.77	<13.05
MRDOWN GG* (Indicator)	10/10/19	<6.634	<6.209	<14.25	<8.744	<10.48	<6.978	<12.71	<14.15	<7.674	<6.559	<40.81	<9.316
MRDOWN (Indicator)	11/06/19	<6.846	<7.266	<11.52	<5.136	<14.56	<7.563	<14.1	<10.15	<8.293	<7.861	<34.53	<12.19
MRDOWN GG (Indicator)	11/06/19	<5.75	<5.599	<12.04	<4.829	<13.23	<6.67	<10.11	<10.19	<5.638	<7.143	<31.73	<9.418
MRUP (Control)	11/06/19	<5.985	<5.706	<13.36	<5.909	<15.23	<5.988	<8.467	<11.85	<7.238	<7.426	<26.73	<10.38
MRUP GG (Control)	11/06/19	<5.237	<6.342	<11.43	<7.460	<11.79	<6.169	<10.82	<10.46	<6.352	<6.173	<24.60	<7.39

GG - indicates duplicate sample

* - indicates Annual Sample collected during liquid discharge

Monitoring Results Tables

Table 17, Surface Water – Tritium

Analysis: H-3		Units: pCi/L
Location	Date	H-3
REQUIRED LLD →		3000
OUTFALL 007	01/24/19	<569
MRDOWN	02/04/19	<560
MRDOWN GG	02/04/19	<571
MRUP	02/04/19	<582
MRUP GG	02/04/19	<573
OUTFALL 007	02/18/19	<533
OUTFALL 007 GG	02/18/19	<542
OUTFALL 007	03/20/19	<593
OUTFALL 007	04/24/19	<447
OUTFALL 007 GG	04/24/19	<447
MRDOWN	05/01/19	<494
MRDOWN GG	05/01/19	<510
MRUP	05/01/19	<498
MRUP GG	05/01/19	<494
OUTFALL 007	05/21/19	<514
OUTFALL 007	06/20/19	1850
OUTFALL 007 GG	06/20/19	2020
OUTFALL 007	07/23/19	1700
MRDOWN	08/08/19	<490
MRDOWN GG	08/08/19	<493
MRUP	08/08/19	<494
MRUP GG	08/08/19	<492
OUTFALL 007	08/21/19	<532
OUTFALL 007 GG	08/21/19	<534
OUTFALL 007	09/25/19	<504

Monitoring Results Tables

Table 17, Surface Water – Tritium

Analysis: H-3		Units: pCi/L
Location	**Date**	**H-3**
OUTFALL 007 GG	09/25/19	<510
MRDOWN*	10/10/19	<565
MRDOWN GG*	10/10/19	<559
OUTFALL 007	10/23/19	<558
OUTFALL 007 GG	10/23/19	<544
MRDOWN	11/06/19	<531
MRDOWN GG	11/06/19	<529
MRUP	11/06/19	<537
MRUP GG	11/06/19	<521
OUTFALL 007	11/29/19	<586
OUTFALL 007 GG	11/29/19	<570
OUTFALL 007	12/19/19	1660
OUTFALL 007 GG	12/19/19	1570

GG - indicates duplicate sample
* - indicates Annual Sample collected during liquid discharge

Monitoring Results Tables

Table 18, Drinking Water - Gamma, I-131

Analysis: Gamma Isotopic, I-131						Units: pCi/L							
Location	Date	I-131	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
REQUIRED LLD →		1	15	15	30	15	30	15	30	15	18	60	15
CONSTWELL 3	11/13/19	<0.798	<6.168	<6.418	<14.56	<6.594	<12.29	<7.964	<13.16	<6.541	<6.667	<25.98	<10.72
CONSTWELL 3 GG	11/13/19	<0.756	<6.952	<6.692	<12.62	<8.3	<17.8	<6.106	<9.767	<7.917	<5.793	<25.45	<6.679
PGWELL	11/13/19	<0.759	<6.669	<6.092	<12.17	<8.774	<17.36	<8.993	<12.56	<8.448	<7.687	<26.85	<9.866
PGWELL GG	11/13/19	<0.805	<5.317	<6.968	<12.17	<8.732	<14.32	<6.438	<10.4	<8.317	<7.8	<28.42	<11.16

GG - indicates duplicate sample

Monitoring Results Tables

Table 19, Drinking Water – Tritium

Analysis: H-3		Units: pCi/L
Location	Date	H-3
REQUIRED LLD →		2000
CONSTWELL 3	11/13/19	<516
CONSTWELL 3 GG	11/13/19	<534
PGWELL	11/13/19	<534
PGWELL GG	11/13/19	<524

GG - indicates duplicate sample

Table 20, Sediment

Analysis: Gamma Isotopic		Units: pCi/kg	
Location	Date	Cs-134	Cs-137
REQUIRED LLD →		150	180
SEDCONT	09/12/19	<49.59	<46.67
SEDCONT GG	09/12/19	<71.56	<72.99
SEDHAM	09/12/19	<60.12	<46.72
SEDHAM GG	09/12/19	<69.58	<54.31

GG - indicates duplicate sample

Monitoring Results Tables

Table 21, Fish

Analysis: Gamma Isotopic				Units: pCi/kg				
Location	Collection Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137
REQUIRED LLD →		130	130	260	130	260	130	150
FISHDOWN	09/09/19	<78.56	<71.83	<159.3	<47.8	<103.2	<86.42	<85.66
FISHDOWN GG	09/09/19	<72.55	<68.6	<129.5	<85.93	<145.5	<79.13	<79.49
FISHUP	09/09/19	<53.87	<56.01	<107.3	<58.49	<106.4	<63.92	<47.87
FISHUP GG	09/09/19	<55.76	<50.96	<99.02	<55.83	<95.6	<49.8	<64.44

GG - indicates duplicate sample

Table 22, Food Products

Analysis: Gamma Isotopic, I-131		Units: pCi/kg		
Location	Collection Date	I-131	Cs-134	Cs-137
REQUIRED LLD →		60	60	80
VEG-CONT	02/18/19	<37.4	<32.85	<28.46
VEG-J	02/18/19	<34.12	<25.63	<31.57
VEG-CONT	05/22/19	<27.05	<26.88	<23.05
VEG-CONT GG	05/22/19	<25.81	<26.29	<20.65
VEG-J	05/22/19	<21.78	<19.47	<17.8
VEG-J GG	05/22/19	<22.4	<23.17	<19.84
VEG-CONT	08/21/19	<35.92	<23.52	<27.55
VEG-J	08/21/19	<32.15	<23.14	<25.26
VEG-CONT	11/20/19	<38.6	<32.89	<30.79
VEG-CONT GG	11/20/19	<45.19	<34.4	<27.32
VEG-J	11/20/19	<35.97	<27.02	<22.17
VEG-J GG	11/20/19	<37.03	<25.42	<29.5

GG - indicates duplicate sample

Monitoring Results Tables

Table 23, Special Samples, Surface Water

Analysis: Gamma Isotopic			Units: pCi/L										
Location	Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
REQUIRED LLD →		15	15	30	15	30	15	30	15	15	18	60	15
OUTFALL 007	03/20/19	<4.877	<7.898	<11.23	<9.876	<17.94	<7.095	<13.15	<14.62	<8.379	<7.225	<34.95	<13.58
OUTFALL 007	06/12/19	<5.078	<4.676	<8.725	<3.151	<11.4	<5.632	<8.462	<13.85	<3.390	<4.737	<30.97	<10.85
OUTFALL 007 GG	06/12/19	<5.041	<4.657	<8.527	<4.716	<6.261	<4.611	<8.926	<13.46	<5.124	<4.894	<34.04	<10.9
OUTFALL 007	09/25/19	<3.54	<4.541	<7.592	<4.810	<8.601	<4.713	<7.984	<13.8	<4.047	<4.318	<32.86	<10.31
OUTFALL 007 GG	09/25/19	<3.946	<4.628	<9.181	<4.307	<8.539	<5.049	<7.767	<13.37	<4.407	<4.025	<32.04	<10.16

GG - indicates duplicate sample

Table 24, Special Samples, Meat

Analysis: Gamma Isotopic			Units: pCi/kg					
Location	Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137
REQUIRED LLD →		130	130	260	130	260	130	150
DEER	10/11/19	<28.97	<27.14	<59.6	<27.64	<56.74	<26.29	<26.01

Attachment 3

Interlaboratory Comparison Program Results

TELEDYNE BROWN ENGINEERING

1.0 Summary

The TBE Laboratory analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation, and water matrices for various analytes. The PE samples supplied by Analytics Inc., Environmental Resource Associates (ERA) and Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP), were evaluated against the following pre-set acceptance criteria:

A. Analytics Evaluation Criteria

Analytics' evaluation report provides a ratio of TBE's result and Analytics' known value. Since flag values are not assigned by Analytics, TBE evaluates the reported ratios based on internal QC requirements based on the DOE MAPEP criteria.

B. ERA Evaluation Criteria

ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established per the US EPA, National Environmental Laboratory Accreditation Conference (NELAC), state-specific Performance Testing (PT) program requirements or ERA's SOP for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

C. DOE Evaluation Criteria

MAPEP's evaluation report provides an acceptance range with associated flag values. MAPEP defines three levels of performance:

- Acceptable (flag = "A") - result within ± 20% of the reference value
- Acceptable with Warning (flag = "W") - result falls in the ± 20% to ± 30% of the reference value
- Not Acceptable (flag = "N") - bias is greater than 30% of the reference value

Note: The Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) samples are created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities.

For the TBE laboratory, 119 out of 129 analyses performed met the specified

acceptance criteria. Ten analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program. A summary is found below:

1. The ERA April 2019 water Cs-134 result was evaluated as *Not Acceptable*. The reported value was 15.2 pCi/L (error 2.82 pCi/L) and the known result was 12.1 pCi/L (acceptance range of 8.39 - 14.4 pCi/L). With the error, the reported result overlaps the acceptable range. This sample was run as the workgroup duplicate on a different detector with a result of 10.7 pCi/L (within acceptable range). (NCR 19-10)

2. The ERA April 2019 water Sr-89 result was evaluated as *Not Acceptable*. The reported value was 44.9 pCi/L and the known result was 33.3 pCi/L (acceptance range of 24.5 - 40.1 pCi/L). The sample was only counted for 15 minutes instead of 200 minutes. The sample was re-prepped in duplicate and counted for 200 minutes with results of 30.7 ± 5.37 pCi/L and 33.0 ± 8.71 pCi/L. This was the 1st "high" failure for Sr-89 in 5 years. (NCR 19-11)

3. The MAPEP February 2019 soil Sr-90 result was not submitted and therefore evaluated as *Not Acceptable*. The sample was run in duplicate, with results of -1.32 ± 4.09 Bq/kg (<6.87) and -1.030 ± 3.55 Bq/kg (<5.97). The known result was a false positive test (no significant activity). TBE did not submit a result because it appeared that the results may not be accurate. TBE analyzed a substitute soil Sr-90 sample from another vendor, with a result within the acceptable range. (NCR 19-12)

4. The MAPEP February 2019 water Am-241 result was evaluated as *Not Acceptable*. The reported value was 0.764 ± 0.00725 Bq/L with a known result of 0.582 Bq/L (acceptable range 0.407 - 0.757 Bq/L). TBE's result falls within the upper acceptable range with the error. It appeared that a non-radiological interference was added and lead to an increased mass and higher result. (NCR 19-13)

5. The MAPEP February 2019 vegetation Sr-90 result was evaluated as *Not Acceptable*. The reported result was -0.1060 ± 0.0328 Bq/kg and the known result was a false positive test (no significant activity). TBE's result was correct in that there was no activity. MAPEP's evaluation was a "statistical failure" at 3 standard deviations. (NCR 19-14)

6. The ERA October 2019 water Gross Alpha result was evaluated as *Not Acceptable*. TBE's reported result was 40.5 ± 10.3 pCi/L and the known result was 27.6 pCi/L (ratio of TBE to known result at 135%). With the associated error, the result falls within the acceptable range (14.0 - 36.3 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 30.8 ± 9.17 pCi/L (within the acceptable range).

This was the first failure for drinking water Gr-A since 2012. (NCR 19-23)

7. The ERA October 2019 water Sr-90 result was evaluated as *Not Acceptable*. TBE's reported result was 32.5 ± 2.12 pCi/L and the known result was 26.5 pCi/L (ratio of TBE to known result at 123%). With the associated error, the result falls within the acceptable range (19.2 - 30.9 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 20.0 ± 1.91 pCi/L (within the acceptable range). Both TBE results are within internal QC limits. A substitute "quick response" sample was analyzed with an acceptable result of 20.1 pCi/L (known range of 13.2 - 22.1 pCi/L). (NCR 19-24)

8. The MAPEP August 2019 soil Ni-63 result of 436 ± 22.8 Bq/kg was evaluated as Not Acceptable. The known result was 629 Bq/kg (acceptable range 440 - 818 Bq/kg). With the associated error, the TBE result falls within the lower acceptance range. All associated QC was acceptable. No reason for failure could be found. This is the first failure for soil Ni-63 since 2012. (NCR 19-25).

9. The MAPEP August 2019 water Am-241 result was not reported and therefore evaluated as *Not Acceptable*. Initial review of the results showed a large peak where Am-241 should be (same as the February, 2019 sample results). It is believed that Th-228 was intentionally added as an interference. The sample was re-prepped and analyzed using a smaller sample aliquot. The unusual large peak (Th-228) was seen again and also this time a smaller peak (Am-241). The result was 436 ± 22.8 Bq/L (acceptable range 0.365 ± 0.679 Bq/L). Th-228 is not a typical nuclide requested by clients, so there is no analytical purpose to take samples through an additional separation step. TBE will pursue using another vendor for Am-241 water cross-checks that more closely reflects actual customer samples. (NCR 19-26)

10. The Analytics September 2019 soil Cr-51 sample was evaluated as *Not Acceptable*. TBE's reported result of 0.765 ± 0.135 pCi/g exceeded the upper acceptance range (140% of the known result of 0.547 pCi/g). The TBE result was within the acceptable range (0.63 - 0.90 pCi/g) with the associated error. The Cr-51 result is very close to TBE's normal detection limit. In order to get a reportable result, the sample must be counted for 15 hours (10x longer than client samples). There is no client or regulatory requirement for this nuclide and TBE will remove Cr-51 from the reported gamma nuclides going forward. (NCR 19-27)

The Inter-Laboratory Comparison Program provides evidence of "in control" counting systems and methods, and that the laboratories are producing accurate and reliable data.