



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

Robert Franssen
Site Vice President
Grand Gulf Nuclear Station
Tel: 601-437-7500

GNRO2021/00013

April 28, 2021

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
NRC Docket No. 50-416
Renewed Facility Operating License No. NPF-29

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, 2020 through December 31, 2020.

This letter contains no new commitments. Should you have any questions concerning this letter or require additional information, please contact Kevin Sanders at 1-601-437-6930.

Sincerely,

A handwritten signature in black ink that reads "Robert Franssen".

Robert Franssen
RF/rm

Attachments: 1. 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
NRR Project Manager

Attachment 1

GNRO2021/00013
Annual Radiological Environmental Operating Report (AREOR)



Plant: Grand Gulf Nuclear Station	Page 1 of 46
	YEAR: 2020
Document Number: GNRO 2021-00013	
Annual Radiological Environmental Operating Report	

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY.....3

2.0 INTRODUCTION.....5

3.0 RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM REQUIREMENTS.....6

4.0 INTERPRETATION AND TRENDS OF RESULTS.....17

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY.....22

ATTACHMENTS

Attachment 1 - Sample Deviations.....28

Attachment 2 - Monitoring Results Tables29

Attachment 3 - Interlaboratory Comparison Program Results44

Annual Radiological Environmental Operating Report**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, 2020. 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 2020, 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 2020 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 2020, 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 2020 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.

Annual Radiological Environmental Operating Report**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 2020, environmental sampling was performed for 5 media types addressed in the ODCM and for direct radiation. A total of 371 samples of the 375 scheduled were obtained. Of the scheduled samples, 98.9 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.

Annual Radiological Environmental Operating Report**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 2020 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
<p><u>RADIOIODINE AND PARTICULATES</u> 1 sample close to the SITE BOUNDARY having the highest calculated annual average ground level D/Q.</p>	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.	<ul style="list-style-type: none"> • 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
<p><u>RADIOIODINE AND PARTICULATES</u> 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q.</p>	AS-1 (Sector G, 5.5 miles) – Southeast of GGNS at the Port Gibson City Barn		
<p><u>RADIOIODINE AND PARTICULATES</u> 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q.</p>	AS-20 (Sector L, 0.9 miles) – South-southeast of GGNS at the former Glodjo residence		
<p><u>RADIOIODINE AND PARTICULATES</u> 1 sample from a control location 15 - 30 km distance.</p>	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
<p><u>TLDS</u> An inner ring of stations in the general areas of the SITE BOUNDARY.</p>	<ul style="list-style-type: none"> • 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 	<p>92 days</p>	<p>Gamma dose; 92 days</p>

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency of Analyses
<p><u>TLDS</u> An inner ring of stations in the general areas of the SITE BOUNDARY.</p>	<ul style="list-style-type: none"> • 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 	<p>92 days</p>	<p>Gamma dose; 92 days</p>

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency of Analyses
<p><u>TLDS</u> An outer ring of stations approximately 3 to 5 miles from the site.</p>	<ul style="list-style-type: none"> • 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. 	<p>92 days</p>	<p>Gamma dose; 92 days</p>

Table 2, Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency of Analyses
<p><u>TLDS</u> Additional stations in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control locations.</p>	<ul style="list-style-type: none"> • 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, Auxilliary Water Tank. (Special) 	<p>92 days</p>	<p>Gamma dose; 92 days</p>

Table 3, Exposure Pathway – Waterborne

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency of Analyses
<p><u>SURFACE WATER</u> 1 sample upstream and 1 sample downstream.</p>	<ul style="list-style-type: none"> • 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
<p>1 sample downstream during a Liquid Radwaste Discharge.</p>	<ul style="list-style-type: none"> • 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
<p>1 sample from Outfall 007</p>	<ul style="list-style-type: none"> • OUTFALL 007 (Sector N, Radius 0.2 Miles) – Storm Drain System 	31 days	Tritium; 31 days
<p><u>GROUNDWATER</u> Samples from 2 sources</p>	<ul style="list-style-type: none"> • 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

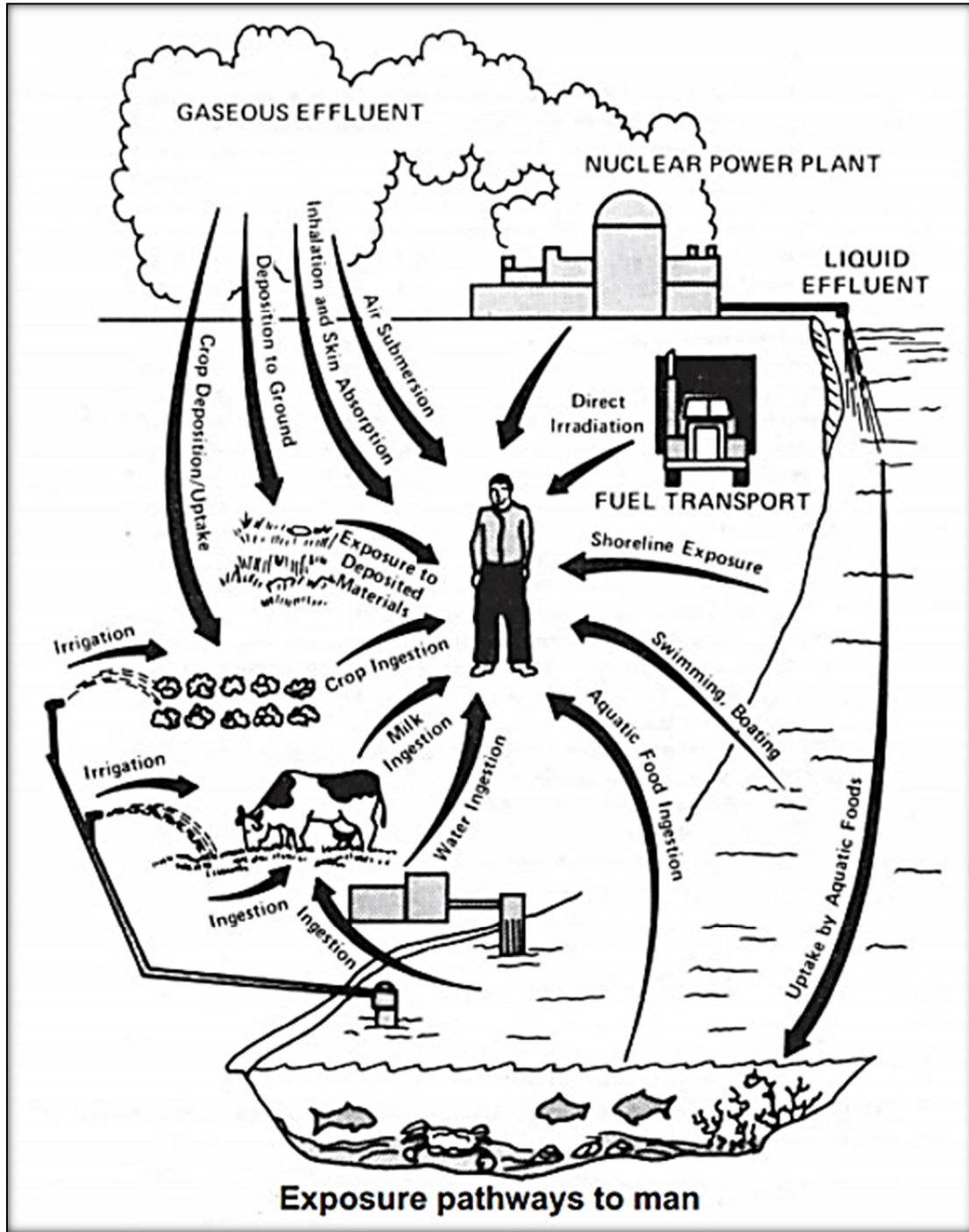
Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency of Analyses
<p><u>SEDIMENT FROM SHORELINE</u> 1 sample from downstream area and 1 sample from upstream area</p>	<ul style="list-style-type: none"> • SEHAM (Sector N, Radius 1.6 Miles) – Downstream 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. 	<p>366 days</p>	<p>Gamma isotopic; 366 days</p>

Table 4, Exposure Pathway – Ingestion

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency of Analyses
<p><u>MILK</u></p> <ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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
<p><u>FISH AND INVERTEBRATES</u></p> <ul style="list-style-type: none"> 1 sample in vicinity of GGNS discharge point. 1 sample uninfluenced by GGNS discharge. 	<ul style="list-style-type: none"> 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
<p><u>FOOD PRODUCTS</u></p> <ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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

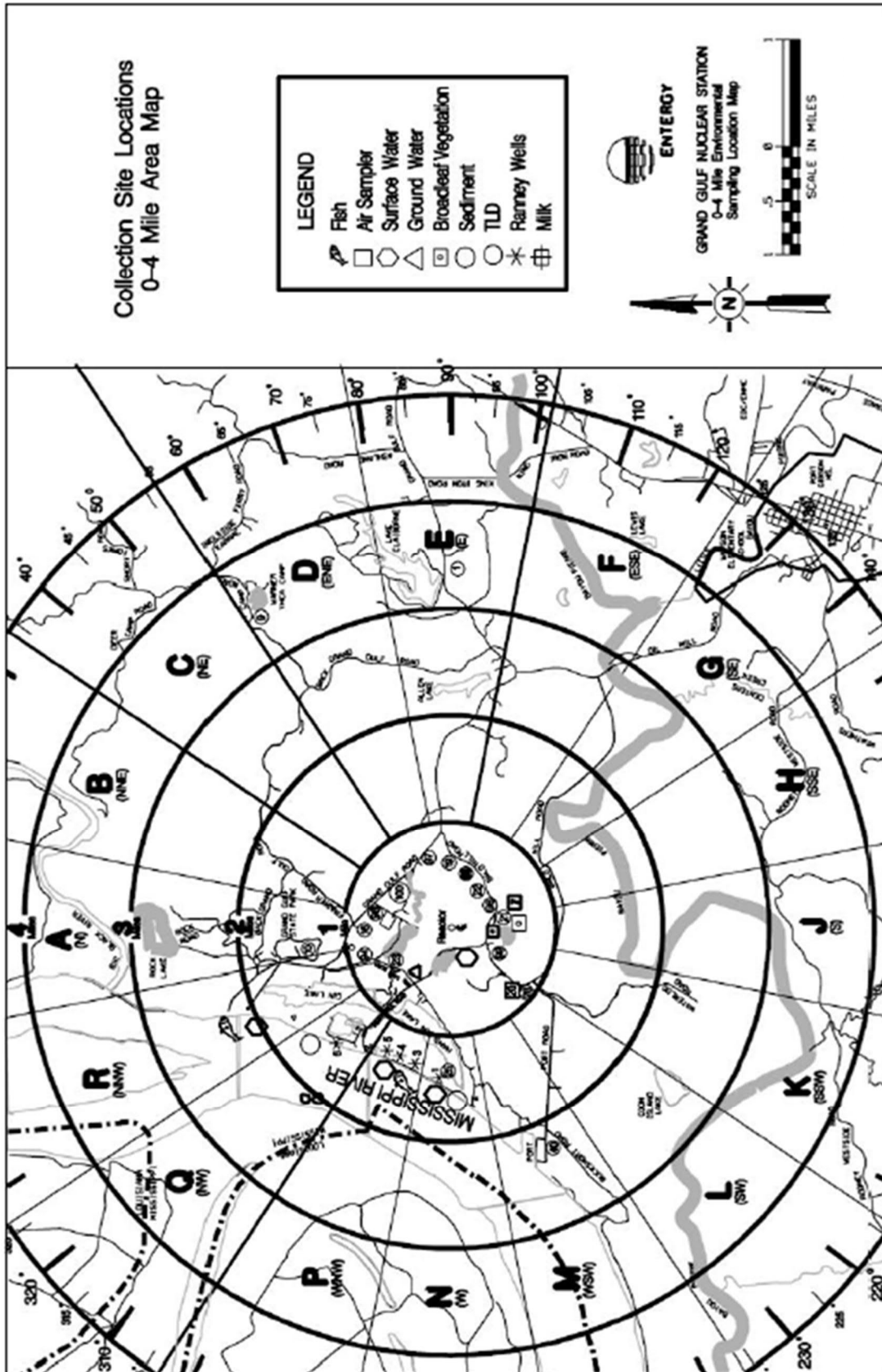
Annual Radiological Environmental Operating Report

Figure 1, Exposure Pathway



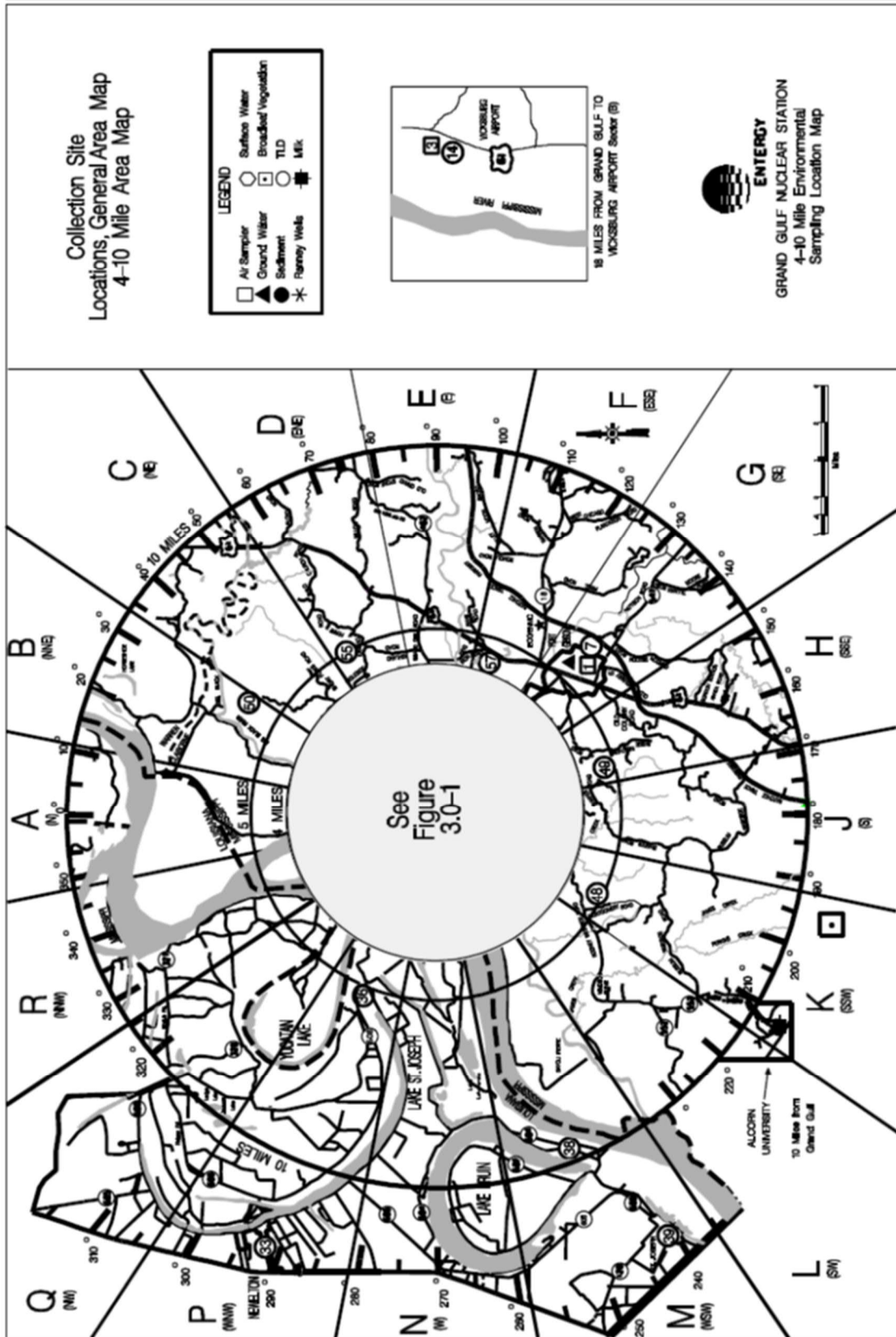
Annual Radiological Environmental Operating Report

Figure 2, Sample Collection Sites –Near Field



Annual Radiological Environmental Operating Report

Figure 3, Sample Collection Sites - Far Field



Annual Radiological Environmental Operating Report

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 2020 there were no samples above the LLD for I-131. Indicator gross beta air particulate results for 2020 were comparable to results obtained from 2010-2019 of the operational REMP. Also, the 2020 gross beta annual average was less than the average for preoperational levels. Results are reported as annual average picocuries per cubic meter (pCi/m³).

<u>Monitoring Period</u>	<u>Result</u>
2010 – 2019 (Minimum Value)	0.009
2020 Average Value	0.018
2010 – 2019 (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.

Annual Radiological Environmental Operating Report

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 9.6 millirem/quarter (mR/Qtr) shown in Table 7 for 2020 is within the historical bounds of 2010 – 2019 annual average results, which have ranged from 9.3 to 10.8 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)
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
2020	9.6	9.4	10.7

4.3 Waterborne Sample Results

Analytical results for 2020 surface water and drinking water samples were similar to those reported in previous years. Gamma radionuclides analytical results for 2020 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

Annual Radiological Environmental Operating Report

entrainment of normal, previously monitored gaseous effluents. As a result, tritium is occasionally observed. Tritium was measured during February (1480 pCi/L) at the Outfall 007 location. Tritium was also measured in the duplicate samples collected during February (1640 pCi/L). Tritium was not observed in the remaining Outfall 007 samples collected during 2020. Results are reported as annual average pCi/l.

<u>Monitoring Period</u>	<u>Result</u>
2010 – 2019 (Minimum Value)	795
2020 (Value)	1560
2010 – 2019 (Maximum Value)	8863
Preoperational	2739

In addition to the tritium samples required by the REMP, six 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 2020 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 2020 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 2020, 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.

<u>Radionuclide</u>	<u>2020</u>	<u>2010 – 2019</u>	<u>Preoperational</u>
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 2020 and levels of radionuclides remain similar to those obtained in previous operational years. Results from 2020 are summarized in Table 7.

Annual Radiological Environmental Operating Report

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 2020 and analyzed for gamma radionuclides. Listed below is a comparison of 2020 indicator results to the 2010 – 2019 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.

<u>Monitoring Period</u>	<u>Result</u>
2010 – 2019 (Minimum Value)	<LLD
2020 Value	< LLD
2010 – 2019 (Maximum Value)	40.3
Preoperational	295.0

4.5 Ingestion Sample Results

4.5.1 Milk Sample Results

Milk samples were not collected during 2020 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 2020, 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 2020, food product samples were collected from two locations and analyzed for plant related Iodine-131 and gamma radionuclides. The 2020 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.

Annual Radiological Environmental Operating Report

4.6 Land Use Census Results

The latest land use census, performed in 2020, 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 – 2020 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

The next land use census is scheduled to be conducted in 2022.

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 2020 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/m³)	GB / 208	0.01	0.0177 (156 / 156) [0.0060 – 0.0340]	AS-1 PG (Sector G, 5.5 mi)	0.0182 (52 / 52) [0.0071 - 0.0340]	0.0185 (52 / 52) [0.0084 - 0.0338]	0
	GS / 16	0.05	<LLD	N/A	N/A	<LLD	0
	Cs-134 CS-137	0.06	<LLD	N/A	N/A	<LLD	0
Airborne Iodine (pCi/ m³)	I-131 / 208	0.07	< LLD	N/A	N/A	< LLD	0
Inner Ring TLDs (mR/Qtr)	Gamma / 52	^[Note 6]	9.57 (52 / 52) [5.3 – 14.6]	M-99 (Sector J, 0.4 mi.)	11.9 (4 / 4) [10.2 – 14.6]	N/A	0
Outer Ring TLDs (mR/Qtr)	Gamma / 28	^[Note 6]	9.4 (28 / 28) [3.6 – 12.2]	M-57 (Sector F, 4.5 mi.)	11.3 (4 / 4) [9.4 – 12.2]	N/A	0
Special Interest TLDs (mR/Qtr)	Gamma / 28	^[Note 6]	9.2 (28 / 28) [6.3 – 12.5]	M-01 (Sector E, 3.5 mi.)	11.3 (4 / 4) [10.0 – 12.5]	N/A	0
Control TLD (mR/Qtr)	Gamma / 4	^[Note 6]	N/A	N/A	N/A	10.7 (4 / 4) [9.3 – 11.4]	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 / 37	3000	1560 (2 / 30) [1480 – 1640]	Outfall 007 (Sector N, 0.2 mi.)	1560 (2 / 21) [1480 – 1640]	< 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/l)	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	< LLD	N/A	N/A	< LLD
Sediment (pCi/kg)	GS / 4	150	< LLD	N/A	N/A	N/A	0
	Cs-134 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 / 2						
	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 / 10	60	< LLD	N/A	N/A	N/A	0
	GS / 10						
	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 / 6						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	< LLD	N/A	< LLD	0
	Co-58	15	< LLD	< LLD	N/A	< LLD	0
	Co-60	15	< LLD	< LLD	N/A	< LLD	0
	Zn-65	30	< LLD	< LLD	N/A	< LLD	0
	Zr-95	30	< LLD	< LLD	N/A	< LLD	0
	Nb-95	15	< LLD	< LLD	N/A	< LLD	0
	Cs-134	15	< LLD	< LLD	N/A	< LLD	0
	Cs-137	18	< LLD	< LLD	N/A	< LLD	0
	Ba-140	60	< LLD	< LLD	N/A	< LLD	0
	La-140	15	< LLD	< LLD	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	< LLD	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.

Sample Deviations

Table 8, Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
1	TLD	M-23, M-25	04/08/20	Inaccessible	During collection of first quarter 2020 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 July 2020. CR-GGN-2020-04888 documents the condition.
2	TLD	M-23, M-25	07/07/20	Unavailable	During collection of second quarter 2020 TLDs, two locations, M-23 and M-25, were unavailable for collection. Due to high Mississippi River water level in April 2020, second quarter TLDs were not installed at these locations. New TLDs were installed when the locations became accessible in July 2020. CR-GGN-2020-07873 documents the condition.
3	TLD	M-100	10/06/20	Displaced	During collection of third quarter 2020 TLDs, one location, M-100, was found on the ground. The TLD was knocked to the ground by a fallen tree. The TLD was collected and analyzed. A new TLD was installed. CR-GGN-2020-10407 documents the condition.
4	TLD	M-60	01/05/21	Wet	During collection of fourth quarter 2020 TLDs, one location, M-60, was found wet. The TLD was collected and analyzed. A new TLD was installed. CR-GGN-2021-00046 documents the condition.

Annual Radiological Environmental Operating Report

Attachment 2

Page 1 of 16

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
12/31/19	01/07/20	0.01230	0.01290	0.01620	0.01290
01/07/20	01/14/20	0.01050	0.01230	0.00944	0.01250
01/14/20	01/21/20	0.01220	0.01360	0.01560	0.01720
01/21/20	01/28/20	0.01840	0.02050	0.01570	0.01740
01/28/20	02/04/20	0.01940	0.01800	0.02260	0.01990
02/04/20	02/11/20	0.01250	0.01460	0.01110	0.01380
02/11/20	02/18/20	0.00714	0.00770	0.00867	0.00842
02/18/20	02/25/20	0.01600	0.01360	0.01630	0.01940
02/25/20	03/03/20	0.01970	0.01600	0.01750	0.01460
03/03/20	03/10/20	0.01410	0.01630	0.01140	0.01450
03/10/20	03/17/20	0.01220	0.01350	0.01170	0.01460
03/17/20	03/24/20	0.01390	0.01350	0.01230	0.01130
03/24/20	03/31/20	0.01560	0.01520	0.01300	0.01270
03/31/20	04/07/20	0.02440	0.02180	0.01940	0.02110
04/07/20	04/14/20	0.01680	0.01290	0.01890	0.01630
04/14/20	04/21/20	0.01780	0.01350	0.01880	0.01530
04/21/20	04/28/20	0.01190	0.01180	0.01380	0.01760
04/28/20	05/05/20	0.01760	0.01760	0.01490	0.02010
05/05/20	05/12/20	0.01560	0.01080	0.01140	0.01180
05/12/20	05/19/20	0.01220	0.01210	0.01650	0.02220
05/19/20	05/26/20	0.01880	0.01510	0.01610	0.01510
05/26/20	06/02/20	0.01710	0.01410	0.01640	0.01720
06/02/20	06/09/20	0.01530	0.01310	0.01460	0.01540
06/09/20	06/16/20	0.01910	0.02010	0.01940	0.02190
06/16/20	06/23/20	0.02390	0.02390	0.02170	0.02240
06/23/20	06/30/20	0.01480	0.01440	0.01680	0.01470
06/30/20	07/07/20	0.01680	0.01880	0.01730	0.01910

Annual Radiological Environmental Operating Report

Attachment 2

Page 2 of 15

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
07/07/20	07/14/20	0.01620	0.01710	0.01400	0.01770
07/14/20	07/21/20	0.01840	0.02300	0.01670	0.02250
07/21/20	07/28/20	0.00758	0.00769	0.00604	0.00896
07/28/20	08/04/20	0.01720	0.01950	0.01790	0.01970
08/04/20	08/11/20	0.03280	0.03010	0.03000	0.03240
08/11/20	08/18/20	0.01730	0.01680	0.01890	0.01590
08/18/20	08/25/20	0.02340	0.02470	0.02520	0.02680
08/25/20	09/01/20	0.01110	0.00922	0.01130	0.00983
09/01/20	09/08/20	0.02270	0.02620	0.02350	0.02850
09/08/20	09/15/20	0.01700	0.01140	0.01420	0.01380
09/15/20	09/22/20	0.03400	0.02950	0.02610	0.03150
09/22/20	09/29/20	0.01300	0.01480	0.01230	0.01610
09/29/20	10/06/20	0.02630	0.02550	0.02450	0.02280
10/06/20	10/13/20	0.02040	0.02100	0.01780	0.02090
10/13/20	10/20/20	0.02350	0.02060	0.02220	0.01940
10/20/20	10/27/20	0.01860	0.01590	0.01600	0.01670
10/27/20	11/03/20	0.03280	0.02800	0.03090	0.03380
11/03/20	11/10/20	0.02100	0.02200	0.02000	0.01900
11/10/20	11/17/20	0.02140	0.01790	0.01770	0.01870
11/17/20	11/24/20	0.02040	0.01510	0.01760	0.01570
11/24/20	12/01/20	0.02330	0.02540	0.02340	0.02060
12/01/20	12/08/20	0.01700	0.01670	0.01750	0.01750
12/08/20	12/15/20	0.02320	0.02720	0.02630	0.02870
12/15/20	12/22/20	0.02170	0.02190	0.02270	0.02370
12/22/20	12/29/20	0.01980	0.01620	0.01810	0.02050

[Note 1] – Station with highest annual mean.

Annual Radiological Environmental Operating Report

Attachment 2

Page 3 of 15

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)
<u>REQUIRED LLD →</u>		<u>0.07</u>	<u>0.07</u>	<u>0.07</u>	<u>0.07</u>
12/31/19	01/07/20	<0.03956	<0.03864	<0.04058	<0.04008
01/07/20	01/14/20	<0.03111	<0.03104	<0.03127	<0.03095
01/14/20	01/21/20	<0.02404	<0.02362	<0.02316	<0.02422
01/21/20	01/28/20	<0.02812	<0.02769	<0.02789	<0.02803
01/28/20	02/04/20	<0.02914	<0.02845	<0.02895	<0.02892
02/04/20	02/11/20	<0.06609	<0.06655	<0.06696	<0.06611
02/11/20	02/18/20	<0.02780	<0.02762	<0.02765	<0.02803
02/18/20	02/25/20	<0.02898	<0.02919	<0.02916	<0.02909
02/25/20	03/03/20	<0.02175	<0.02152	<0.02183	<0.02147
03/03/20	03/10/20	<0.02622	<0.02697	<0.02706	<0.02708
03/10/20	03/17/20	<0.03238	<0.03243	<0.03293	<0.03256
03/17/20	03/24/20	<0.02138	<0.02134	<0.02183	<0.02127
03/24/20	03/31/20	<0.03323	<0.03332	<0.01379	<0.03308
03/31/20	04/07/20	<0.06084	<0.06323	<0.06083	<0.06056
04/07/20	04/14/20	<0.02973	<0.02951	<0.03051	<0.02933
04/14/20	04/21/20	<0.03027	<0.02981	<0.02993	<0.02976
04/21/20	04/28/20	<0.03288	<0.03556	<0.03245	<0.0326
04/28/20	05/05/20	<0.02591	<0.02553	<0.02535	<0.02545
05/05/20	05/12/20	<0.02887	<0.02848	<0.02850	<0.02840
05/12/20	05/19/20	<0.02483	<0.02433	<0.02445	<0.02437
05/19/20	05/26/20	<0.04481	<0.04419	<0.04445	<0.04398
05/26/20	06/02/20	<0.03742	<0.03655	<0.01531	<0.03733
06/02/20	06/09/20	<0.03529	<0.03487	<0.03477	<0.03484
06/09/20	06/16/20	<0.05028	<0.04922	<0.04867	<0.04970
06/16/20	06/23/20	<0.03504	<0.03464	<0.03440	<0.03484
06/23/20	06/30/20	<0.01710	<0.01707	<0.01716	<0.01733
06/30/20	07/07/20	<0.02212	<0.02243	<0.02203	<0.02214

Annual Radiological Environmental Operating Report

Attachment 2

Page 4 of 15

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)
<u>REQUIRED LLD →</u>		<u>0.07</u>	<u>0.07</u>	<u>0.07</u>	<u>0.07</u>
07/07/20	07/14/20	<0.04587	<0.04501	<0.04540	<0.04563
07/14/20	07/21/20	<0.03037	<0.03006	<0.03048	<0.03049
07/21/20	07/28/20	<0.03601	<0.03439	<0.03550	<0.03631
07/28/20	08/04/20	<0.02991	<0.02937	<0.02930	<0.03008
08/04/20	08/11/20	<0.02795	<0.02794	<0.02766	<0.02778
08/11/20	08/18/20	<0.04350	<0.01784	<0.04273	<0.04343
08/18/20	08/25/20	<0.02914	<0.02874	<0.02861	<0.03088
08/25/20	09/01/20	<0.03568	<0.03477	<0.03408	<0.03346
09/01/20	09/08/20	<0.06094	<0.05954	<0.05926	<0.05921
09/08/20	09/15/20	<0.04277	<0.04297	<0.04299	<0.04330
09/15/20	09/22/20	<0.04861	<0.04871	<0.04884	<0.05028
09/22/20	09/29/20	<0.03268	<0.03187	<0.03270	<0.03370
09/29/20	10/06/20	<0.03530	<0.03516	<0.03554	<0.03668
10/06/20	10/13/20	<0.03180	<0.03501	<0.03186	<0.03294
10/13/20	10/20/20	<0.00738	<0.00742	<0.00742	<0.00755
10/20/20	10/27/20	<0.02091	<0.05006	<0.05084	<0.05141
10/27/20	11/03/20	<0.03837	<0.03821	<0.03888	<0.03914
11/03/20	11/10/20	<0.03785	<0.03851	<0.03735	<0.03819
11/10/20	11/17/20	<0.02562	<0.02533	<0.02537	<0.02522
11/17/20	11/24/20	<0.04461	<0.04450	<0.01849	<0.04462
11/24/20	12/01/20	<0.04990	<0.05062	<0.04928	<0.05029
12/01/20	12/08/20	<0.04663	<0.04672	<0.04561	<0.04673
12/08/20	12/15/20	<0.04025	<0.03929	<0.01625	<0.03965
12/15/20	12/22/20	<0.04841	<0.04717	<0.04676	<0.04840
12/22/20	12/29/20	<0.06227	<0.06302	<0.02516	<0.06162

Annual Radiological Environmental Operating Report

Attachment 2

Page 5 of 15

Monitoring Results Tables

Table 11, Air Gamma Quarterly Composite

Analysis: Gamma Isotopic		Units: pCi/cu.m	
Location	Date	CS-134	CS-137
<u>REQUIRED LLD →</u>		<u>0.05</u>	<u>0.06</u>
AS-1	02/14/20	<0.002539	<0.00174
AS-3		<0.001585	<0.00154
AS-7		<0.001922	<0.002001
AS-20		<0.002483	<0.002295
AS-1	05/15/20	<0.002383	<0.002191
AS-3		<0.001544	<0.001507
AS-7		<0.001777	<0.001508
AS-20		<0.001599	<0.001395
AS-1	08/14/20	<0.003479	<0.002381
AS-3		<0.001957	<0.001658
AS-7		<0.001395	<0.001622
AS-20		<0.001787	<0.001378
AS-1	11/13/20	<0.001754	<0.00134
AS-3		<0.001342	<0.00154
AS-7		<0.001819	<0.002058
AS-20		<0.003241	<0.002657

Annual Radiological Environmental Operating Report

Attachment 2

Page 6 of 15

Monitoring Results Tables

Table 12, Thermoluminescent Dosimeters – Inner Ring

Analysis: Gamma Dose				Units: mrem	
Station	1 st Qtr 2020	2 nd Qtr 2020	3 rd Qtr 2020	4 th Qtr 2020	Annual Mean 2020
M-16	10.8	9.1	11.3	11.6	10.7
M-19	8.5	9.9	9.9	10.0	9.0
M-21	11.2	12.5	12.5	11.9	11.4
M-22	8.3	8.5	8.5	8.6	7.9
M-23	Lost ^[Note 2]	Lost ^[Note 3]	9.3	8.8	9.0
M-25	Lost ^[Note 2]	Lost ^[Note 3]	8.4	8.7	8.5
M-28	10.7	8.9	12.1	11.3	10.7
M-94	10.8	8.4	10.7	10.5	10.1
M-95	6.2	5.3	7.4	7.0	6.5
M-96	7.3	6.8	9.1	8.3	7.9
M-97	7.2	5.9	7.3	8.1	7.1
M-98	10.1	9.6	14.1	12.3	11.5
M-99 ^[Note 1]	10.2	10.3	14.6	12.4	11.9
M-100	10.0	10.2	12.1	11.0	10.8

[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

Annual Radiological Environmental Operating Report

Attachment 2

Page 7 of 15

Monitoring Results Tables

Table 13, Thermoluminescent Dosimeters – Outer Ring

Analysis: Gamma Dose			Units: mrem		
Station	1 st Qtr 2020	2 nd Qtr 2020	3 rd Qtr 2020	4 th Qtr 2020	Annual Mean 2020
M-36	8.6	6.4	9.0	8.6	8.1
M-40	4.5	3.6	5.6	6.5	5.1
M-48	10.3	8.4	10.8	10.5	10.0
M-49	11.3	9.4	11.0	11.8	10.9
M-50	9.6	7.9	10.3	9.7	9.4
M-55	11.0	9.1	11.5	12.2	10.9
M-57 ^[Note 1]	11.4	9.4	12.2	12.2	11.3

[Note 1] – Station with highest annual mean.

Table 14, Thermoluminescent Dosimeters – Special Interest Areas

Analysis: Gamma Dose			Units: mrem		
Station	1 st Qtr 2020	2 nd Qtr 2020	3 rd Qtr 2020	4 th Qtr 2020	Annual Mean 2020
M-01 ^[Note 1]	10.4	10.0	12.5	12.4	11.3
M-07	10.5	9.3	10.4	11.5	10.4
M-09	9.6	8.4	9.7	10.6	9.6
M-10	7.7	7.5	8.3	9.6	8.3
M-33	7.5	6.3	7.3	7.9	7.3
M-38	9.3	7.1	9.4	10.5	9.1
M-39	8.6	7.3	8.9	9.6	8.6

[Note 1] – Station with highest annual mean.

Table 15, Thermoluminescent Dosimeters – Control

Analysis: Gamma Dose			Units: mrem		
Station	1 st Qtr 2020	2 nd Qtr 2020	3 rd Qtr 2020	4 th Qtr 2020	Annual Mean 2020
M-14	10.7	9.3	11.3	11.4	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 →		<u>15</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>18</u>	<u>60</u>	<u>15</u>
MRDOWN (Indicator)	02/04/20	<5.151	<6.112	<14.03	<5.607	<10.59	<5.535	<11.18	<9.03	<5.711	<6.03	<25.86	<7.505
MRDOWN GG (Indicator)	02/04/20	<5.885	<6.385	<8.826	<5.159	<10.79	<4.508	<10.26	<7.929	<4.648	<5.334	<28.09	<7.745
MRUP (Control)	02/04/20	<4.311	<5.22	<10.88	<5.322	<9.462	<5.284	<7.966	<7.951	<4.976	<4.561	<28.63	<7.463
MRUP GG (Control)	02/04/20	<5.202	<6.186	<12.85	<6.41	<10.48	<5.628	<9.314	<9.046	<5.648	<5.585	<24	<9.3
MRDOWN (Indicator)	05/05/20	<7.588	<8.095	<11.28	<7.962	<17.21	<9.156	<15.85	<9.986	<9.177	<9.624	<34.82	<12.4
MRUP (Control)	05/05/20	<8.903	<7.711	<16.76	<7.362	<18.89	<8.31	<12.06	<12.16	<7.108	<8.446	<37.88	<8.503
MRDOWN (Indicator)	08/03/20	<7.388	<7.356	<10.37	<7.03	<10.7	<7.105	<13.41	<12.05	<7.578	<7.572	<36.87	<8.773
MRUP (Control)	08/03/20	<5.591	<3.808	<11.96	<5.834	<13.33	<5.883	<8.737	<9.34	<6.914	<5.963	<30.36	<6.7
MRDOWN GG (Indicator)	08/03/20	<5.423	<5.138	<10.94	<6.583	<11.46	<5.55	<9.985	<9.752	<5.383	<5.136	<25.15	<8.553
MRUP GG (Control)	08/03/20	<6.452	<4.35	<13.99	<6.877	<11.41	<5.868	<12.18	<7.899	<5	<6.565	<28.67	<11.02

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)	10/27/20	<3.052	<3.42	<8.274	<3.352	<6.71	<3.424	<6.507	<9.53	<3.239	<3.689	<25.58	<8.031
MRUP (Control)	10/27/20	<2.836	<2.88	<7.103	<2.583	<5.475	<3.1	<5.113	<8.007	<3.412	<2.687	<18.46	<5.315
MRDOWN GG (Indicator)	10/27/20	<2.789	<3.063	<5.867	<3.35	<5.499	<2.784	<5.71	<8.299	<3.145	<2.83	<18.48	<7.159
MRUP GG (Control)	10/27/20	<2.524	<2.562	<6.472	<2.751	<5.015	<2.919	<5.243	<7.319	<2.88	<2.648	<17.27	<5.737
MRDOWN* (Indicator)	10/27/20	<2.51	<2.706	<5.852	<2.95	<4.812	<2.588	<4.364	<7.669	<2.453	<2.442	<16.59	<5.919
MRDOWN GG* (Indicator)	10/27/20	<2.753	<2.868	<6.12	<3.005	<5.517	<2.945	<4.913	<7.937	<2.944	<2.897	<16.1	<6.644

GG - indicates duplicate sample

* - indicates Annual Sample collected during liquid discharge

Annual Radiological Environmental Operating Report

Attachment 2

Page 10 of 15

Monitoring Results Tables

Table 17, Surface Water – Tritium

Analysis: H-3		Units: pCi/L
Location	Date	H-3
<u>REQUIRED LLD →</u>		<u>3000</u>
OUTFALL 007	01/22/20	<533
MRDOWN	02/04/20	<545
MRDOWN GG	02/04/20	<563
MRUP	02/04/20	<542
MRUP GG	02/04/20	<540
OUTFALL 007	02/19/20	1480
OUTFALL 007 GG	02/19/20	1640
OUTFALL 007	03/17/20	<491
OUTFALL 007	04/21/20	<494
OUTFALL 007 GG	04/21/20	<506
MRDOWN	05/05/20	<488
MRUP	05/05/20	<511
OUTFALL 007	05/19/20	<489
OUTFALL 007	06/16/20	<538
OUTFALL 007	06/26/20	<517
OUTFALL 007	07/21/20	<400
OUTFALL 007 GG	07/21/20	<404
MRDOWN	08/03/20	<551
MRDOWN GG	08/03/20	<551
MRUP	08/03/20	<558
MRUP GG	08/03/20	<550
OUTFALL 007	08/18/20	<517
OUTFALL 007	09/15/20	<392
OUTFALL 007 GG	09/15/20	<397
OUTFALL 007	10/20/20	<519

Annual Radiological Environmental Operating Report

Attachment 2

Page 11 of 15

Monitoring Results Tables

Table 17, Surface Water – Tritium

Analysis: H-3		Units: pCi/L
Location	Date	H-3
OUTFALL 007 GG	10/20/20	<521
MRDOWN	10/27/20	<486
MRDOWN*	10/27/20	<494
MRDOWN GG	10/27/20	<503
MRDOWN GG*	10/27/20	<486
MRUP	10/27/20	<495
MRUP GG	10/27/20	<496
OUTFALL 007	11/18/20	<543
OUTFALL 007 GG	11/18/20	<535
OUTFALL 007	12/02/20	<591
OUTFALL 007 GG	12/02/20	<573
OUTFALL 007	12/15/20	<526

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 4	11/10/20	<0.918	<8.092	<4.651	<13.13	<6.476	<11.35	<4.977	<9.832	<6.963	<6.838	<31.3	<6.172
CONSTWELL 4 GG	11/10/20	<0.851	<6.461	<5.792	<13.81	<7.236	<12.68	<6.57	<8.969	<6.348	<7.277	<23.81	<7.581
PGWELL	11/10/20	<0.653	<6.648	<6.003	<12.61	<8.275	<13	<5.661	<12.83	<6.581	<6.357	<27.9	<9.853
PGWELL GG	11/10/20	<0.788	<8.209	<6.721	<12.04	<6.922	<13.45	<9.792	<11.86	<8.022	<7.867	<26.19	<10.7

GG - indicates duplicate sample

Annual Radiological Environmental Operating Report

Attachment 2

Page 13 of 15

Monitoring Results Tables

Table 19, Drinking Water – Tritium

Analysis: H-3		Units: pCi/L
Location	Date	H-3
<u>REQUIRED LLD →</u>		<u>2000</u>
CONSTWELL 4	11/10/20	<531
CONSTWELL 4 GG	11/10/20	<526
PGWELL	11/10/20	<518
PGWELL GG	11/10/20	<536

GG - indicates duplicate sample

Table 20, Sediment

Analysis: Gamma Isotopic		Units: pCi/kg	
Location	Date	Cs-134	Cs-137
<u>REQUIRED LLD →</u>		<u>150</u>	<u>180</u>
SEDCONT	09/10/20	<70.51	<64.27
SEDCONT GG	09/10/20	<66.61	<53.72
SEDHAM	09/10/20	<69.99	<66.05
SEDHAM GG	09/10/20	<61.7	<48.17

GG - indicates duplicate sample

Annual Radiological Environmental Operating Report

Attachment 2

Page 14 of 15

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
FISHUP	09/21/20	<28.17	<32.85	<45.17	<53.67	<54.24	<51.19	<45.41
FISHDOWN	09/21/20	<29.75	<33.09	<95.58	<45.1	<62.37	<30.82	<41.33

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	02/21/20	<35.5	<32.42	<30.67
VEG-J	02/21/20	<45.64	<32.8	<30.17
VEG-CONT	05/19/20	<29.53	<26.97	<31.34
VEG-J	05/19/20	<28.85	<29.59	<28.42
VEG-CONT	08/19/20	<27.69	<31.52	<22.34
VEG-J	08/19/20	<25.7	<28.99	<24.17
VEG-CONT	11/16/20	<20.89	<27.29	<24.76
VEG-CONT GG	11/16/20	<25.19	<27.96	<27.47
VEG-J	11/16/20	<25.74	<28.23	<24.01
VEG-J GG	11/16/20	<30.85	<35.53	<34.3

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
<u>REQUIRED LLD →</u>		<u>15</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>18</u>	<u>60</u>	<u>15</u>
OUTFALL 007	03/21/20	<6.799	<5.552	<12.08	<6.479	<11.86	<5.479	<10.44	<8.474	<7.325	<7.322	<27.06	<6.656
OUTFALL 007 GG	03/21/20	<9.88	<6.548	<16.36	<9.058	<15.79	<7.193	<9.564	<11.14	<8.567	<8.34	<27.44	<11.27
OUTFALL 007	06/26/20	<4.388	<4.272	<10.22	<4.458	<10.77	<5.178	<7.806	<13.19	<4.138	<5.015	<26.39	<10.21
OUTFALL 007	09/29/20	<5.132	<5.811	<8.343	<6.061	<12.14	<6.53	<11.22	<11.03	<7.431	<5.289	<23.65	<9.397
OUTFALL 007	12/02/20	<5.482	<5.528	<12.06	<6.701	<12.2	<4.728	<8.601	<9.65	<4.56	<6.151	<27.92	<7.528
OUTFALL 007 GG	12/02/20	<5.669	<3.876	<10.83	<6.709	<13.21	<6.339	<8.664	<9.15	<5.86	<4.785	<26.45	<6.592

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
<u>REQUIRED LLD →</u>		<u>130</u>	<u>130</u>	<u>260</u>	<u>130</u>	<u>260</u>	<u>130</u>	<u>150</u>
DEER	11/13/20	<56.1	<47.13	<97.51	<56.33	<123.7	<59.17	<55.15

Annual Radiological Environmental Operating Report

Attachment 3

Page 1 of 2

Interlaboratory Comparison Program Results

TELEDYNE BROWN ENGINEERING

1.0 Summary

The TBE Laboratory analyzed Performance Evaluation (PE) samples of air particulate (AP), 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 $\pm 20\%$ of the reference value
- Acceptable with Warning (flag = "W") - result falls in the $\pm 20\%$ to $\pm 30\%$ 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, 126 out of 133 analyses performed met the specified acceptance criteria. Seven 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:

Annual Radiological Environmental Operating Report

Attachment 3

Page 2 of 2

Interlaboratory Comparison Program Results

1. The MAPEP February 2020 AP U-233/234 and U-238 results were evaluated as *Not Acceptable*. The reported value for U-233/234 was 0.0416 ± 0.0102 Bq/sample and the known result was 0.075 Bq/sample (acceptance range 0.053 - 0.098). The reported value for U-238 was 0.0388 ± 0.00991 Bq/sample and the known result was 0.078 Bq/sample (acceptance range 0.055 - 0.101). This sample was run as the workgroup duplicate and had RPD's of 10.4% (U-234) and 11.7% (U-238). After the known results were obtained, the sample was relogged. The filter was completely digested with tracer added originally; the R1 results were almost identical. It was concluded that the recorded tracer amount was actually double, causing the results to be skewed. Lab worksheets have been modified to verify actual tracer amount vs. LIMS data. TBE changed vendors for this cross-check to ERA MRAD during the 2nd half of 2020. Results were acceptable at 97.8% for U-234 and 106% for U-238. (NCR 20-13)
2. The Analytics September 2020 milk Sr-89 result was evaluated as *Not Acceptable*. The reported value was 62.8 pCi/L and the known result was 95.4 (66%). All QC data was reviewed and there were no anomalies. This was the first failure for milk Sr-89 since 2013 and there have only been 3 upper/lower boundary warnings since that time. It is believed that there may have been some Sr-89 loss during sample prep. The December 2020 result was at 92% of the known. (NCR 20-19)
3. The ERA October 2020 water I-131 result was evaluated as *Not Acceptable*. The reported value was 22.9 pCi/L and the known result was 28.2 (acceptance range 23.5 - 33.1). The reported result was 81% of the known, which passes TBE QC criteria. This was the first failure for water I-131. (NCR 20-17)
4. The ERA October 2020 water Gross Alpha and Gross Beta results were evaluated as *Not Acceptable*. The reported/acceptable values and ranges are as follows:

	<u>Reported</u>	<u>Known</u>	<u>Range</u>
Gross Alpha	40.0	26.2	13.3 - 34.7
Gross Beta	47.5	69.1	48.0 - 76.0

All QC data was reviewed with no anomalies and a cause for failure could not be determined. This was the first failure for water Gross Beta. A Quick Response follow-up cross-check was analyzed as soon as possible with acceptable results at 96.8% for Gross Alpha and 102% for Gross Beta. (NCR 20-18)
5. The MAPEP August 2020 soil Ni-63 result was evaluated as *Not Acceptable*. The reported value was 438 ± 21.1 Bq/kg and the known result was 980 Bq/kg (acceptance range 686 - 1274). It is believed that some Ni-63 loss occurred during the sample prep step. (NCR 20-20)

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