



Entergy Operations, Inc.
River Bend Station
5485 U.S. Highway 61N
St. Francisville, LA 70775
Tel 225-381-4177

Tim Schenk
Manager-Regulatory Assurance

RBG-48082

April 20, 2021

Attn: Document Control Desk
U. S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Subject: 2020 Annual Radiological Environmental Operating Report
River Bend Station – Unit 1
Renewed Operating License No. NPF-47
Docket No. 50-458

Enclosed is the River Bend Station (RBS) Annual Radiological Environmental Operating Report for the period of January 1, 2020 through December 31, 2020. This report is submitted in accordance with the RBS Technical Specifications, Section 5.6.2.

Should you have any questions regarding the enclosed, please contact Tim Schenk, at (225) 381-4177.

Sincerely,

Tim Schenk
Digitally signed by Tim Schenk
DN: cn=Tim Schenk, c=US, o=River Bend Station, ou=Manager Regulatory Assurance, email=tschenk@entergy.com
Date: 2021.04.19 15:20:23 -05'00'

Tim Schenk

TAS/tf

Enclosure: 2020 Annual Radiological Environmental Operating Report

cc: NRC Region IV Regional Administrator, w/o Enclosure
NRC Senior Resident Inspector – River Bend Station, Unit 1
Ji Young Wiley, Department of Environmental Quality, Office of Environmental Compliance, Radiological Emergency Planning and Response Section
Public Utility Commission of Texas, Attn: PUC Filing Clerk
NRC Project Manager

Enclosure
2020 Annual Radiological Environmental Operating Report



Plant: River Bend Station

Page 1 of 44

YEAR: 2020

Document Number: RBG-48082

Annual Radiological Environmental Operating Report

Annual Radiological Environmental Operating Report**TABLE OF CONTENTS**

1.0	EXECUTIVE SUMMARY.....	5
1.1	Radiological Environmental Monitoring Program.....	5
1.2	Reporting Levels.....	5
1.3	Comparison to State and Federal Program.....	6
1.4	Sample Deviations.....	6
1.5	Program Modifications.....	6
2.0	INTRODUCTION.....	7
2.1	Radiological Environmental Monitoring Program.....	7
2.2	Pathways Monitored.....	7
2.3	Land Use Census.....	7
3.0	RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM REQUIREMENTS.....	8
4.0	INTERPRETATION AND TRENDS OF RESULTS.....	17
4.1	Air Particulate and Radioiodine Sample Results.....	17
4.2	Thermoluminescent Dosimetry (TLD) Sample Results.....	18
4.3	Waterborne Sample Results.....	18
4.3.1	Surface Water Results.....	19
4.3.2	Groundwater Results.....	19
4.3.3	Sediment Sample Results.....	19
4.4	Ingestion Sample Results.....	19
4.4.1	Fish Sample Results.....	19
4.4.2	Food Products Sample Results.....	19
4.4.3	Milk Sample Results.....	20
4.5	Land Use Census Results.....	20
4.6	Interlaboratory Comparison Results.....	22
5.0	RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY.....	22

ATTACHMENTS

Attachment 1 - Sample Deviations26

Attachment 2 - Monitoring Results Tables28

Attachment 3 - Interlaboratory Comparison Program Results39

TABLES

Table 1: Exposure Pathway - Airborne8

Table 2: Exposure Pathway - Direct Radiation9

Table 3: Exposure Pathway - Waterborne12

Table 4: Exposure Pathway - Ingestion13

Table 5: Land Use Census - 2020 Nearest Residence and Milk Animal Within 5 Miles21

Table 6: Radiological Environmental Monitoring Program Summary23

Table 7: Sample Deviations Table.....26

Table 8: Air Particulate Data Table.....28

Table 9: Radioiodine Cartridge Data Table29

Table 10: Thermoluminescent Dosimeters - Indicators.....30

Table 11: Thermoluminescent Dosimeters - Special Interest Areas31

Table 12: Thermoluminescent Dosimeters - Controls.....31

Table 13: Surface Water - Gamma.....32

Table 14: Surface Water - Tritium33

Table 15: Groundwater - Gamma.....34

Table 16: Groundwater - Tritium35

Table 17: Sediment - Gamma36

Table 18: Fish - Gamma.....37

Table 19: Food Products - Gamma38

Table 20: Analytics Environmental Radioactivity Cross Check Program.....41

Table 21: DOE's Mixed Analyte Performance Evaluation Program (MAPEP).....43

Table 22: ERA Environmental Radioactivity Cross Check Program44

Annual Radiological Environmental Operating Report

FIGURES

Figure 1: Exposure Pathway14

Figure 2: Sample Collection Sites - Near Field15

Figure 3: Sample Collection Sites - Far Field16

Figure 4: Gross Beta Indicator Results (2020).....17

Figure 5: TLD Indicator Results (2020) Versus Control Data (1986-2020).....18

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 River Bend Station (RBS) Radiological Environmental Monitoring Program (REMP) for the period January 1 through December 31, 2020. This report fulfills the requirements of RBS Technical Specification 5.6.2 of Appendix A to RBS License Number NPF-47.

All required lower limit of detection (LLD) capabilities were achieved in all sample analyses during 2020, as required by the RBS Technical Requirement Manual (TRM). No measurable levels of radiation above baseline levels attributable to River Bend Station operation were detected in the vicinity of RBS. The 2020 Radiological Environmental Monitoring Program thus substantiated the adequacy of source control and effluent monitoring at River Bend Station with no observed impact of plant operations on the environment.

River Bend Station established the REMP prior to the station's becoming operational 1985 to provide data on background radiation and radioactivity normally present in the area. RBS has continued to monitor the environment by sampling air, water, sediment, fish and food products, as well as measuring direct radiation. RBS 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. RBS personnel compare indicator results with control and preoperational results to assess any impact RBS 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 RBS 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

No samples equaled or exceeded reporting levels.

Annual Radiological Environmental Operating Report**1.3 Comparison to State and Federal Program**

RBS 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 Louisiana Department of Environmental Quality – Office of Environmental Compliance (LDEQ-OEC).

The NRC TLD Network Program was discontinued in 1998. Historically these results have compared to those from the RBS REMP. RBS 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 LDEQ-OEC and the RBS REMP entail similar radiological environmental monitoring program requirements. These programs include co-located 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 seven media types addressed in the ODCM and for direct radiation. A total of 328 samples of the 329 scheduled were obtained. Of the scheduled samples, 99.7 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**

River Bend Station 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 River Bend Station.
- 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 RBS TRM 3.12.1. 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

RBS conducts a land use census biennially, as required by 3.12.2 of the TRM. The purpose of this census is to identify changes in uses of land within five miles of RBS that would require modifications to the REMP and the Offsite Dose Calculation Manual (ODCM/TRM). The next scheduled land use census will be performed in 2022. Section 4.5 on the report contains a narrative on the results of the 2020 land use census.

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> 2 samples from close to the 2 SITE BOUNDARY locations, in different sectors, of the highest calculated annual average ground level D/Q.</p>	<ul style="list-style-type: none"> • AN1 (0.9 km W) - RBS site Hwy 965; 0.4 km south of Activity Center. • AP1 (0.9 km WNW) – Behind River Bend Station Activity Center. 	<p>Continuous sampler operation with sample collection every two weeks, or more frequently if required by dust loading.</p>	<ul style="list-style-type: none"> • Radioiodine Canisters – I-131 analysis every two weeks. • Air Particulate – Gross beta radioactivity analysis following filter change.
<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>	<ul style="list-style-type: none"> • AQS2 (5.8 km NW) - St. Francis Substation on US Hwy. (Bus.) 61 in St. Francisville. 	<p>Continuous sampler operation with sample collection every two weeks, or more frequently if required by dust loading.</p>	<ul style="list-style-type: none"> • Radioiodine Canisters – I-131 analysis every two weeks. • Air Particulate – Gross beta radioactivity analysis following filter change.
<p><u>RADIOIODINE AND PARTICULATES</u> 1 sample from a control location, as for example 15 - 30 km distance and in the least prevalent wind direction.</p>	<ul style="list-style-type: none"> • AGC (17.0 km SE) – Entergy Service Center compound in Zachary. (Control) 	<p>Continuous sampler operation with sample collection every two weeks, or more frequently if required by dust loading.</p>	<ul style="list-style-type: none"> • Radioiodine Canisters – I-131 analysis every two weeks. • Air Particulate – Gross beta radioactivity analysis following filter change.

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> One ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<ul style="list-style-type: none"> • TA1 (1.7 km N) - River Bend Training Center. • TB1 (0.5 km NNE) - Utility pole near River Bend Station cooling tower yard area. • TC1 (1.7 km NE) - Telephone pole at Jct. US Hwy. 61 and Old Highway 61. • TD1 (1.6 km ENE) – Stub pole along WF7, 150m S of Jct. WF7 and US Hwy. 61. • TE1 (1.3 km E) – Stub pole along WF7, 1 km S of Jct. WF7 and US Hwy. 61. • TF1 (1.3 km ESE) – Stub pole along WF7, 1.6 km S of Jct. WF7 and US Hwy. 61. • TG1 (1.6 km SE) – Stub pole along WF7, 2 km S of Jct. WF7 and US Hwy. 61. • TH1 (1.7 km SSE) – Stub pole at power line crossing of WF7 (near Grants Bayou). • TJ1 (1.5 km S) – Stub pole near River Bend Station Gate #23 on Powell Station Road (LA Hwy. 965). 	<p>Quarterly</p>	<ul style="list-style-type: none"> • mR exposure quarterly.

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> One ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<ul style="list-style-type: none"> • TK1 (0.9 km SSW) – Utility pole on Powell Station Road (LA Hwy. 965), 20 m S of River Bend Station River Access Road. • TL1 (1.0 km SW) – First utility pole on Powell Station Road (LA Hwy . 965) S of former Illinois Central Gulf RR crossing. • TM1 (0.9 km WSW) - Third utility pole on Powell Station Road (LA Hwy. 965) N of former Illinois Central Gulf RR crossing. • TN1 (0.9 km W) – Utility pole along Powell Station Road (LA Hwy. 965), near garden and AN1 air sampler location. • TP1 (0.9 km WNW) - Behind River Bend Station Activity Center at AP1 air sampler location. • TQ1 (0.6 km NW) – Across from MA-1 on RBS North Access Road. • TR1 (0.8 km NNW) – River Bend Station North Access Road across from Main Plant entrance. 	<p>Quarterly</p>	<ul style="list-style-type: none"> • mR exposure quarterly.

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> The balance of the stations (8) to be placed 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"> • TAC (15.8 km N) – Utility pole at Jct. of US Hwy. 61 and LA Hwy. 421, 7.9 km north of Bains. (Control) • TCS (12.3 km NE) – Utility pole at gate to East Louisiana State Hospital in Jackson. (Special) • TEC (16.0 km E) – Stub pole at jct. of Hwy. 955 and Greenbrier Road, 4.8 km North of Jct. of Hwys 955 and 964. (Control) • TGS (17.0 km SE) – Entergy Service Center compound in Zachary. (Special) • TNS (6.0 km W) – Utility pole with electrical meter at west bank ferry landing (LA Hwy. 10). (Special) • TQS1 (4.0 km NW) – Utility pole front of Pentecostal church (opposite West Feliciana Parish Hospital) near Jct. US Hwy. 61 and Commerce Street. (Special) • TQS2 (5.8 km NW) – St. Francis Substation on business US Hwy. 61 in St. Francisville. (Special) • TRS (9.2 km NNW) - Stub pole at Jct. of US Hwy. 61 and WF2 near Bains (West Feliciana High School). (Special) 	<p>Quarterly</p>	<ul style="list-style-type: none"> • mR exposure quarterly.

Table 3: Exposure Pathway – Waterborne

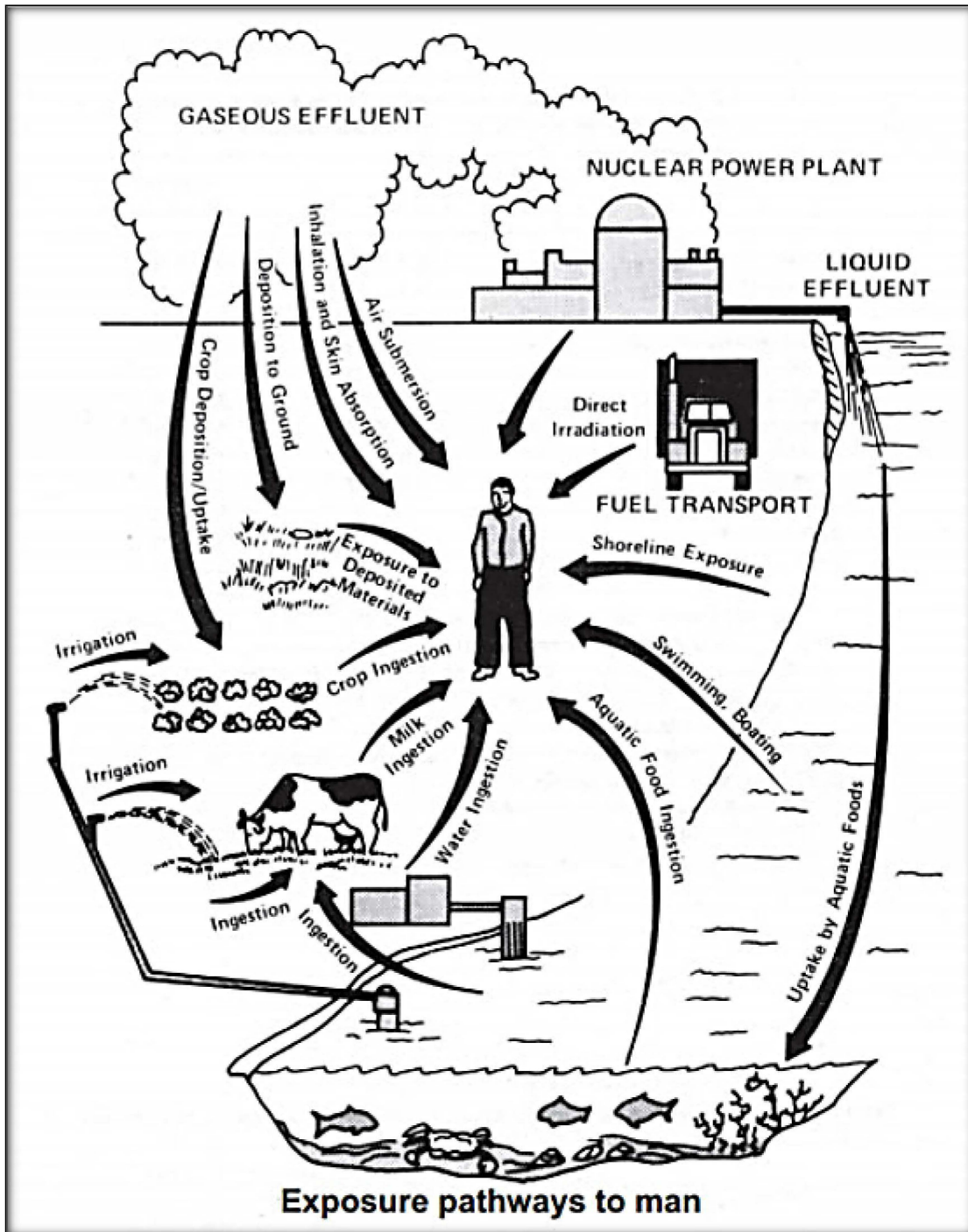
Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
<p><u>SURFACE WATER</u> 1 sample upstream and 1 sample downstream.</p>	<ul style="list-style-type: none"> • SWU (5.0 km W) - Mississippi River about 4 km upstream from the plant liquid discharge outfall, near LA Hwy. 10 ferry crossing. • SWD (7.75 km S) - Mississippi River about 4 km downstream from plant liquid discharge outfall, near paper mill. 	Grab samples quarterly	<ul style="list-style-type: none"> • Gamma isotopic analysis and tritium analysis quarterly.
<p><u>GROUNDWATER</u> Samples from 1 or 2 sources only if likely to be affected.</p>	<ul style="list-style-type: none"> • WU (~470 m NNE) - Upland Terrace Aquifer well upgradient from plant. • WD (~470 m SW) – Upland Terrace Aquifer well downgradient from plant. 	Semiannually	<ul style="list-style-type: none"> • Gamma isotopic and tritium analysis semiannually.
<p><u>SEDIMENT FROM SHORELINE</u> 1 sample from downstream area with existing or potential recreational value.</p>	<ul style="list-style-type: none"> • SEDD (7.75 km S) – Mississippi River about 4 km downstream from plant liquid discharge outfall, near paper mill. 	Annually	<ul style="list-style-type: none"> • Gamma isotopic analysis annually.

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 where doses are calculated to be greater than 1 mrem per year. • 1 sample from milking animals at a control location 15 – 30 km distant when an indicator location exists. 	<ul style="list-style-type: none"> • Currently, no available milking animals within 8 km of RBS. 	<p>Quarterly when animals are on pasture.</p>	<p>Gamma isotopic and I-131 analysis quarterly when animals are on pasture.</p>
<p><u>FISH AND INVERTEBRATES</u></p> <ul style="list-style-type: none"> • 1 sample of a commercially and/or recreationally important species in vicinity of plant discharge area. • 1 sample of similar species in area not influenced by plant discharge. 	<ul style="list-style-type: none"> • FD (7.75 km S) - One sample of a commercially and/or recreationally important species from downstream area influenced by plant discharge. • FU (4.0 km WSW) - One sample of a commercially and/or recreationally important species from upstream area not influenced by plant discharge. 	<p>Annually</p>	<p>Gamma isotopic analysis on edible portions annually</p>
<p><u>FOOD PRODUCTS</u></p> <ul style="list-style-type: none"> • 1 sample of one type of broadleaf vegetation grown near the SITE BOUNDARY location of highest predicted annual average ground level D/Q if milk sampling is not performed. • 1 sample of similar broadleaf vegetation grown 15 – 30 km distant, if milk sampling is not performed. 	<ul style="list-style-type: none"> • GN1 (0.9 km W) – Sampling will be performed in accordance with Table 3.12.1-1 Section 4.a of the Technical Requirements Manual. • GQC (32.0 km NW) - One sample of similar vegetables from LA State Penitentiary at Angola. (Control) 	<p>Quarterly during the growing season.</p>	<p>Gamma isotopic and I-131 analysis quarterly.</p>

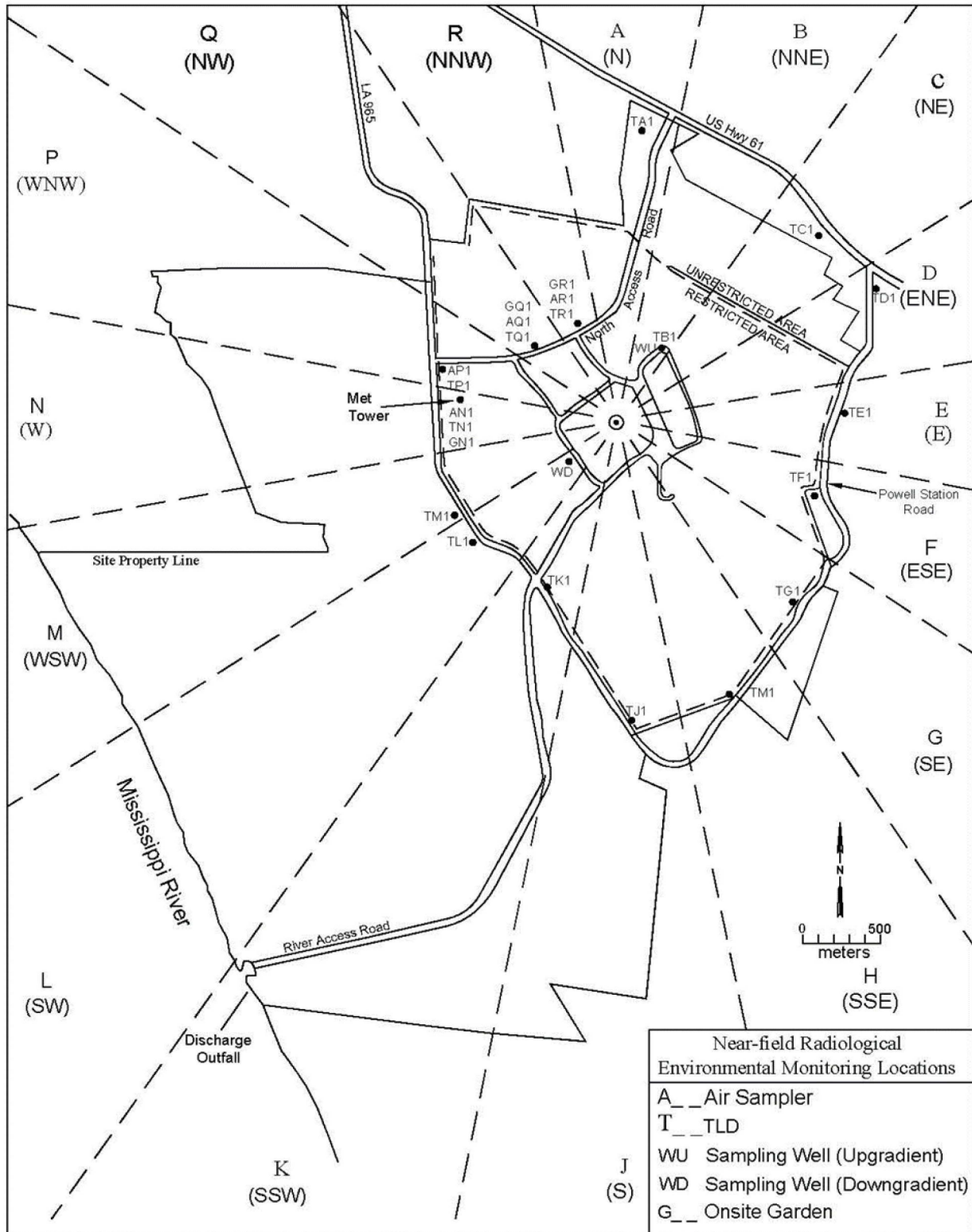
Annual Radiological Environmental Operating Report

Figure 1: Exposure Pathway



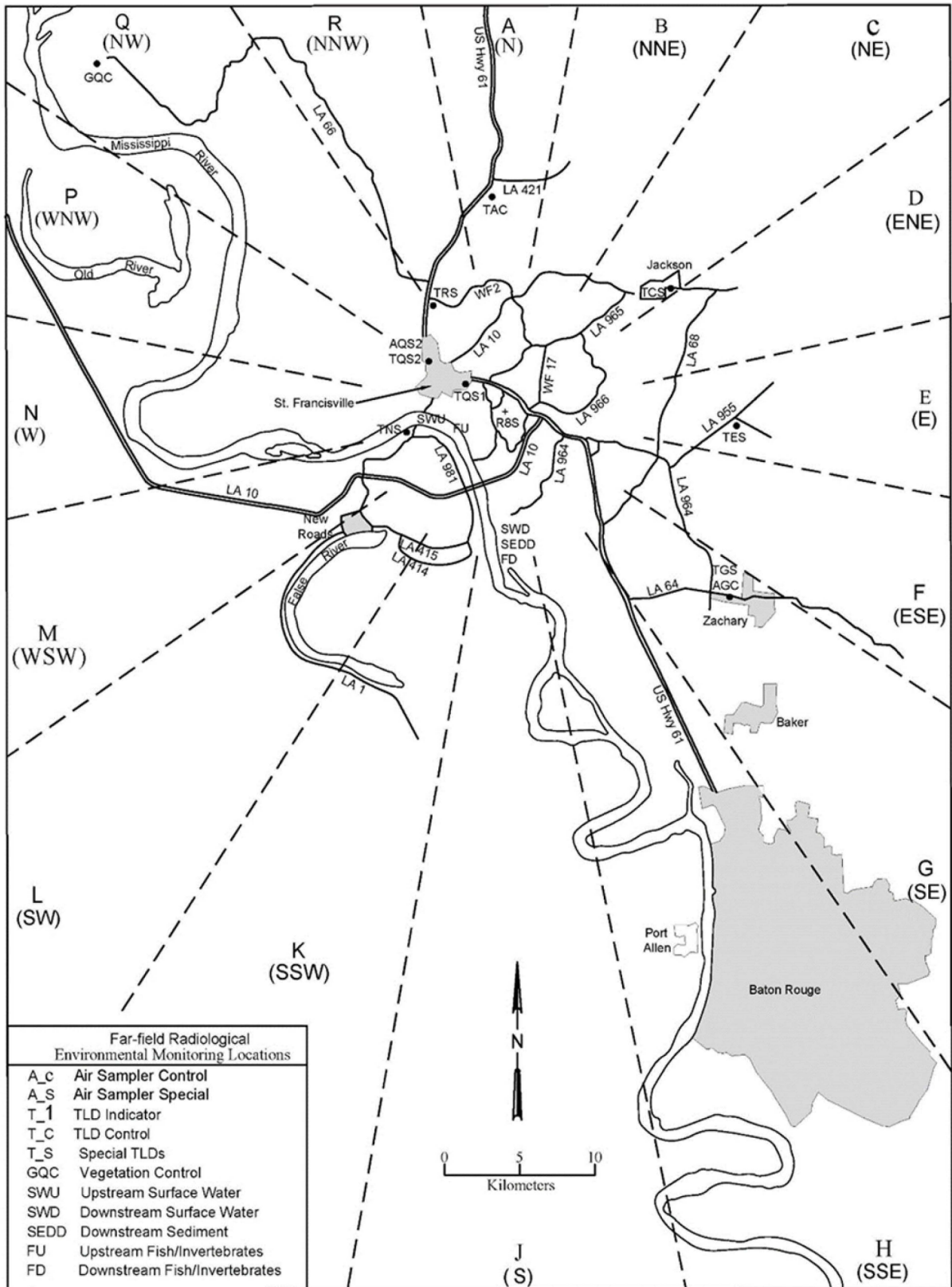
Annual Radiological Environmental Operating Report

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

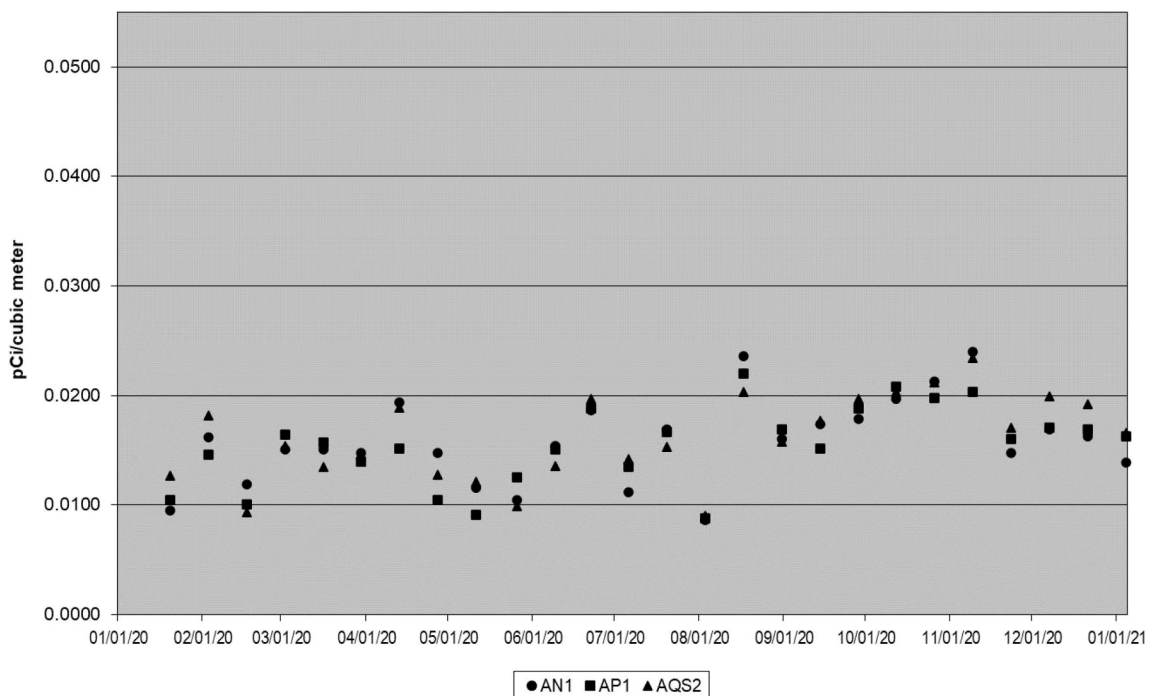
4.1 Air Particulate and Radioiodine Sample Results

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/m^3).

<u>Monitoring Period</u>	<u>Result</u>
2010 – 2019 (Minimum Value)	0.018
2020 Average Value	0.016
2010 – 2019 (Maximum Value)	0.026
Preoperational	0.030

Gross beta activity is attributed to naturally occurring radionuclides. Table 6, 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 River Bend Station operations.

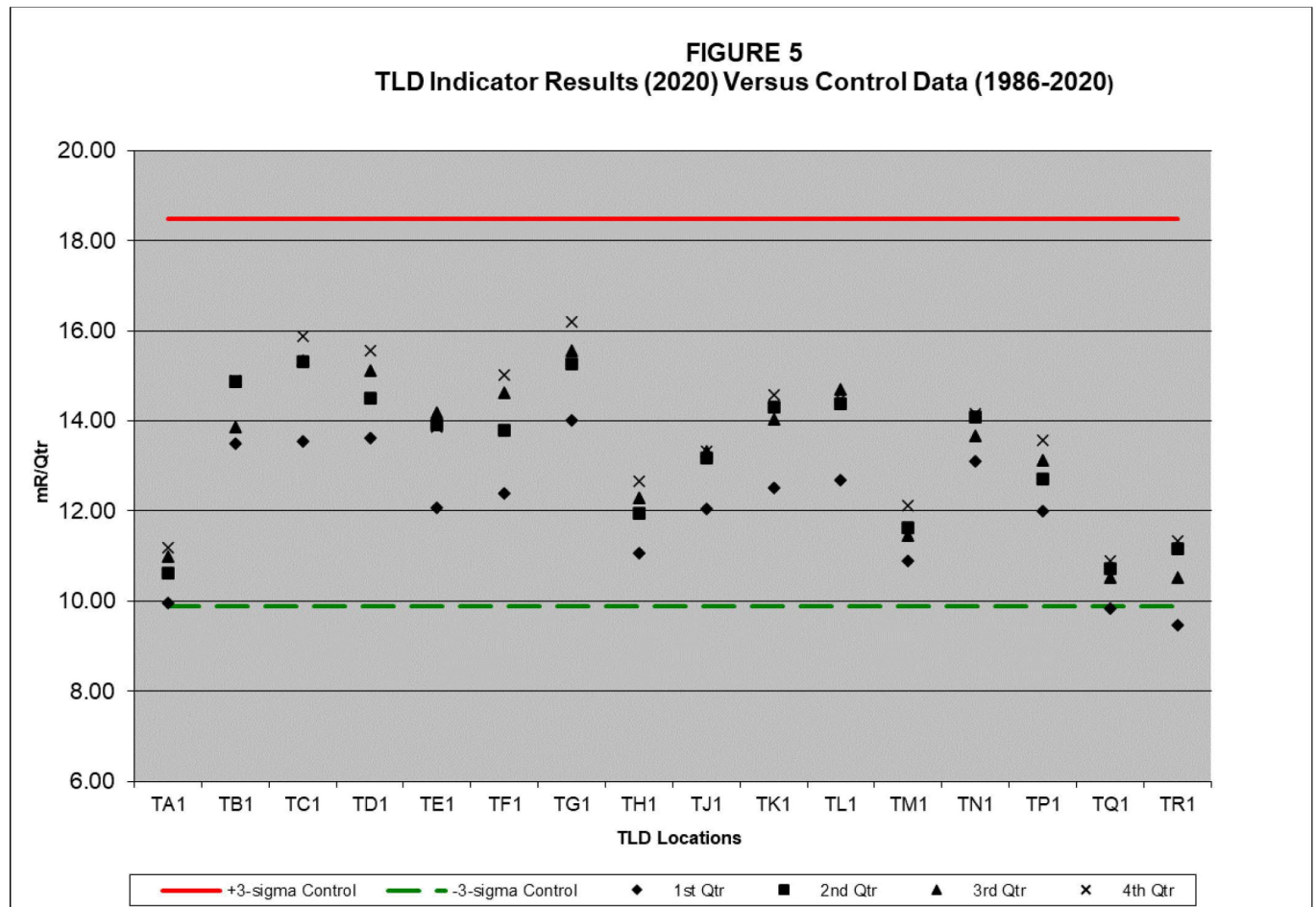
FIGURE 4
Gross Beta Indicator Results (2020)



Annual Radiological Environmental Operating Report

4.2 Thermoluminescent Dosimetry (TLD) Sample Results

River Bend Station reports measured dose as net exposure (field reading less transit reading) normalized to 90 days and relies on comparison of the indicator locations to the control as a measure of plant impact. River Bend Station's comparison of the indicator and special interest area TLD results to the control, as seen in Table 6, identified no noticeable trend that would indicate that the ambient radiation levels are being affected by plant operations. In addition, the indicator value of 13.1 millirem (mrem) shown in the TLD radiation dose comparison graph below shows the 2020 concentration is comparable to historic results. Overall, River Bend Station concluded that the ambient radiation levels are not being affected by plant operations.



4.3 Waterborne Sample Results

Analytical results for 2020 surface water and groundwater water samples were similar to those reported in previous years. Gamma radionuclides and tritium analytical results for 2020 waterborne samples were below the ODCM-required LLD similar to those reported in previous years. These results are further explained below.

Annual Radiological Environmental Operating Report**4.3.1 Surface Water Results**

Samples were collected from one indicator and one control location and analyzed for gamma radionuclides and tritium. Tritium and gamma radionuclides were below detectable limits which is consistent with results seen in previous operational years. Therefore, the operation of River Bend Station had no definable impact on this waterborne pathway during 2020.

4.3.2 Groundwater Results

Samples were collected from one indicator and one control location. Groundwater samples were analyzed for gamma radionuclides and tritium. Gamma radionuclides and tritium concentrations were below the LLD limits at the indicator and control locations. The operation of River Bend Station had no definable impact on this waterborne pathway during 2020.

4.3.3 Sediment Sample Results

Sediment samples were collected from one indicator and one control location in 2020 and analyzed for gamma radionuclides. Gamma radionuclides were below the LLD limits at both indicator and control locations. River Bend Station operations had no significant impact on the environment or public by this waterborne pathway.

4.4 Ingestion Sample Results**4.4.1 Fish Sample Results**

Fish samples were collected from one indicator and one control location and analyzed for gamma radionuclides. In 2020, gamma radionuclides were below detectable limits which are consistent with the preoperational monitoring period and operational results. Therefore, based on these measurements, River Bend Station operations had no significant radiological impact upon the environment or public by this ingestion pathway.

4.4.2 Food Products 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 products samples were collected when available from one indicator and one control location and analyzed for gamma radionuclides. The 2020 levels remained undetectable, as has been the case in previous years. Therefore, based on these measurements, River Bend Station operations had no significant radiological impact upon the environment or public by this ingestion pathway.

Annual Radiological Environmental Operating Report**4.4.3 Milk Sample Results**

In 2020 milk samples within five miles (8 km) of River Bend Station were unable to be collected due to the unavailability of milk-producing animals used for human consumption. The River Bend Station Technical Requirements Manual requires collection of milk samples if available commercially within 8 km (5 miles) of the plant. River Bend Station personnel collected food product samples to monitor the ingestion pathway, as specified in River Bend Station Technical Requirements Manual Table 3.12.1-1, because of milk unavailability. Food product sample results are in section 4.4.2.

4.5 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 (see Table 5).

A garden census is not conducted pursuant to the note in the TRM (TLCO 3.12.2) that allows the sampling of broad leaf vegetation in the highest calculated average ground-level D/Q sector near site boundary in lieu of the garden census.

The land use census identified no changes in the new resident census.

There were no changes in the milk cows or food products in 2020.

Annual Radiological Environmental Operating Report

Table 5: Land Use Census –2020 Nearest Residence And Milk Animal Within Five Miles

Sector	Direction	Nearest Residence	Range (Unit)	Nearest Milk Animal	Range (Unit)	Comment
A	N	5637 Hwy 61 St. Francisville, LA 70775	1.7	-	-	2
B	NNE	4549 Old Hwy 61 St. Francisville, LA 70775	1.4	-	-	2
C	NE	4553 Old Hwy 61 St. Francisville, LA 70775	1.5	-	-	2
D	ENE	12657 Powell Station Rd. St. Francisville, LA 70775	1.4	-	-	2
E	E	4635 Hwy 61 St. Francisville, LA 70775	2.4	-	-	2
F	ESE	12019 Fairview Way Jackson, LA 70748	2.6	-	-	2
G	SE	3319 Hwy 964 Jackson, LA 70748	3.7	-	-	2
H	SSE	11813 Powell Station Rd. St. Francisville, LA 70775	1.7	-	-	2
J	S	11649 Powell Station Rd. St. Francisville, LA 70775	1.8	-	-	2
K	SSW	8909 Hwy 981 New Roads, LA 70760	6.6	-	-	2
L	SW	--		-	-	1, 2
M	WSW	8809 Hwy 981 New Roads, LA 70760	5.1	-	-	2
N	W	--		-	-	1, 2
P	WNW	10426 Old Field Rd. St. Francisville, LA 70775	3.7	-	-	2
Q	NW	9537 Hwy 965 St. Francisville, LA 70775	1.3	-	-	2
R	NNW	9794 Hwy 965 St. Francisville, LA 70775	1.6	-	-	2

#	Comment
1	No Residence was located within a five-mile (8 km) radius of River Bend Station 3.
2	No Milk animals were found located within a five-mile (8 km) radius of River Bend Station 3.

Annual Radiological Environmental Operating Report**4.6 Interlaboratory Comparison Results**

Attachment 3 contains result summary for Interlaboratory Comparison program for Teledyne Brown Engineering to fulfill the requirements of River Bend Station's Technical Requirements Manual 3.12.3.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

1. Table 6, Radiological Environmental Monitoring Program Summary, summarizes data for the 2020 REMP program.

Annual Radiological Environmental Operating Report

Table 6: Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses ⁽¹⁾	LLD ⁽²⁾	Indicator Locations Mean (F) ⁽³⁾ [Range]	Location ⁽⁴⁾ [Highest Annual Mean]	Mean (F) ⁽³⁾ [Range]	Control Locations Mean (F) ⁽³⁾ [Range]	Number of Non Routine Results ⁽⁵⁾
Air Particulates (pCi/m ³)	GB / 104	0.01	0.0158 (78/78) [0.009 - 0.024]	AQS2 (5.8 km NW)	0.016 (26/26) [0.009 - 0.023]	0.0160 (26/26) [0.009 - 0.025]	0
Airborne Iodine (pCi/m ³)	I-131 / 104	0.07	< LLD	N/A	N/A	< LLD	0
Indicator TLDs (mR/Qtr)	Gamma / 64	⁽⁶⁾	13.1 (64/64) [9.5 - 16.2]	TG1 (1.6 km SE)	15.3 (4/4) [14.0 - 16.2]	N/A	0
Special Interest TLDs (mR/Qtr)	Gamma / 23	⁽⁶⁾	13.7 (23/23) [11.4 - 15.7]	TGS (17.0 km SE)	15.1 (4/4) [13.9 - 15.7]	N/A	0
Control TLDs (mR/Qtr)	Gamma / 8	⁽⁶⁾	N/A	TAC (15.8 km N)	15.3 (4/4) [14.3 - 15.8]	14.5 (8/8) [12.4 - 15.8]	0
Surface Water (pCi/L)	H-3 / 9	700	< LLD	N/A	N/A	< LLD	0
	GS / 9						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Co-58	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	N/A	N/A	< LLD	0
	Co-60	15	< LLD	N/A	N/A	< LLD	0
	Zn-65	30	< LLD	N/A	N/A	< LLD	0
	Nb-95	15	< LLD	N/A	N/A	< LLD	0
	I-131	15	< LLD	N/A	N/A	< LLD	0
	Zr-95	30	< LLD	N/A	N/A	< LLD	0
	Cs-134	15	< LLD	N/A	N/A	< LLD	0
	Cs-137	18	< LLD	N/A	N/A	< LLD	0
	Ba-140	60	< LLD	N/A	N/A	< LLD	0
La-140	15	< LLD	N/A	N/A	< LLD	0	

Annual Radiological Environmental Operating Report

Table 6: Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses ⁽¹⁾	LLD ⁽²⁾	Indicator Locations Mean (F) ⁽³⁾ [Range]	Location ⁽⁴⁾ [Highest Annual Mean]	Mean (F) ⁽³⁾ [Range]	Control Locations Mean (F) ⁽³⁾ [Range]	Number of Non Routine Results ⁽⁵⁾
Groundwater (pCi/L)	H-3 / 4	2000	< LLD	N/A	N/A	< LLD	0
	GS / 4						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Co-58	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	N/A	N/A	< LLD	0
	Co-60	15	< LLD	N/A	N/A	< LLD	0
	Zn-65	30	< LLD	N/A	N/A	< LLD	0
	Nb-95	15	< LLD	N/A	N/A	< LLD	0
	I-131	15	< LLD	N/A	N/A	< LLD	0
	Zr-95	30	< LLD	N/A	N/A	< LLD	0
	Cs-134	15	< LLD	N/A	N/A	< LLD	0
	Cs-137	18	< LLD	N/A	N/A	< LLD	0
	Ba-140	60	< LLD	N/A	N/A	< LLD	0
	La-140	15	< LLD	N/A	N/A	< LLD	0

Annual Radiological Environmental Operating Report

Table 6: Radiological Environmental Monitoring Program Summary

Sample Type (Units)	Type / Number of Analyses ⁽¹⁾	LLD ⁽²⁾	Indicator Locations Mean (F) ⁽³⁾ [Range]	Location ⁽⁴⁾ [Highest Annual Mean]	Mean (F) ⁽³⁾ [Range]	Control Locations Mean (F) ⁽³⁾ [Range]	Number of Non Routine Results ⁽⁵⁾
Sediment (pCi/kg dry)	GS / 2						
	Cs-134	150	< LLD	N/A	N/A	< LLD	0
	Cs-137	180	< LLD	N/A	N/A	< LLD	0
Fish (pCi/kg wet)	GS / 2						
	Mn-54	130	< LLD	N/A	N/A	< LLD	0
	Co-58	130	< LLD	N/A	N/A	< LLD	0
	Fe-59	260	< LLD	N/A	N/A	< LLD	0
	Co-60	130	< LLD	N/A	N/A	< LLD	0
	Zn-65	260	< LLD	N/A	N/A	< LLD	0
	Cs-134	130	< LLD	N/A	N/A	< LLD	0
Cs-137	150	< LLD	< LLD	N/A	N/A	< LLD	0
Food Products (pCi/kg wet)	GS / 8						
	I-131	60	< LLD	N/A	N/A	< LLD	0
	Cs-134	60	< LLD	N/A	N/A	< LLD	0
Cs-137	80	< LLD	< LLD	N/A	N/A	< LLD	0

LEGEND:

⁽¹⁾ - GB = Gross beta; I-131 = Iodine-131; H-3 = Tritium; GS = Gamma scan.

⁽²⁾ - LLD = Required lower limit of detection based on River Bend Station TRM.

⁽³⁾ - Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parenthesis (F).

⁽⁴⁾ - Locations are specified (1) by name and (2) direction relative to reactor site.

⁽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.

⁽⁶⁾ - LLD is not defined in River Bend Station TRM.

Sample Deviations

Table 7: Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
1	Air Sample	AGC	07/20/20-08/03/20	Mechanical Failure	Environmental air sampler at location AGC failed to collect an adequate sample volume for the period of 07/20/20 to 08/03/20. A visual inspection of the sampler revealed that the inadequate sample volume was due to a mechanical failure of the vacuum pump. The sampler data stored on the digital controller revealed that the failure occurred on 07/21/20 at approximately 14:45. The sampler has been replaced with a spare that is operable. (CR-RBS-2020-03228)
2	Air Sample	AP1	07/28/20	Power Outage	Environmental air sampler at location AP1 experienced two momentary losses of power. The sampler was running normally at the time of discovery. These power failures occurred on 7/28/2020 at 1338 and 1800 respectively. The duration of both power failures was less than one second each, and it was verified that an adequate sample volume was obtained. (CR-RBS-2020-03230)
3	Air Sample	AP1, AQ1, AR1, AN1	08/13/20	Power Outage	Environmental air samplers at location AP1, AQ1, AR1, and AN1 experienced a momentary loss of power on 08-13-2020 at 1628. The duration of this power loss was less than one second. It was verified that adequate sample volume was collected. (CR-RBS-2020-03420)
4	Air Sample	AP1, AQ1, AR1, AN1	08/27/20	Power Outage	Environmental air samplers at location AP1, AQ1, AR1, and AN1 experienced a momentary loss of power on 8/27/2020 at 0842. The duration of this power outage was less than one second. It was verified that sufficient sample volume was obtained. (CR-RBS-2020-03660)
5	Air Sample	AP1, AQ1, AR1, AN1	09/01/20	Power Outage	Environmental air samplers at location AP1, AQ1, AR1, and AN1 experienced a loss of power for 5 minutes and 40 seconds. The power outage occurred on 09/01/20 at approximately 01:15. It was verified that there was enough sample volume collected to obtain the required LLD. (CR-RBS-2020-03861)

Sample Deviations

Table 7: Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
6	Air Sample	AP1, AQ1, AR1, AN1	09/28/20-10/12/20	Power Outage	Environmental air samplers at location AP1, AQ1, AR1, and AN1 experienced a loss of power for approximately one day, twenty hours, and thirty-seven minutes beginning on 10/09/20 at 20:51. AN1 experienced an additional power outage for two hours and fifty-six minutes beginning on 10/11/20 at 14:31. This power interruption was caused by a severe weather event as a result of Hurricane Delta impacting the area. It was verified that an adequate sample volume was obtained to meet required LLD. (CR-RBS-2020-04495)
7	Air Sample	AP1, AQ1, AR1, AN1	10/12/20-10/26/20	Power Outage	Environmental air samplers at location AP1, AQ1, AR1, and AN1 experienced a loss of power for approximately two hours and fifty-nine minutes beginning on 10/24/20 at 03:14. This power interruption was caused by the loss of Grant Substation during a severe weather event. It was verified that an adequate sample volume was obtained to meet required LLD. (CR-RBS-2020-04495)
8	Air Sample	AN1	11/23/20	Mechanical Failure	Environmental air sampler at location AN1 was found running at a lower flowrate than expected. This sampler, SN# 26086, was running at 33.3 SLPM. By procedure the samplers are set to run at 40 SLPM and are adjusted every two weeks to maintain this set flow. It was verified that a sufficient sample volume was obtained to meet the required LLDs. This sampler was removed from service for rebuild/inspection and calibration. It was replaced by sampler SN#26034 which is operating satisfactorily. (CR-RBS-2020-05223)
9	TLD	TCS	4 th Quarter	Sample Lost	Environmental TLD at location TCS, serial #3467 and its holder were missing from the post. Debris and markings in the immediate vicinity suggest that this TLD was knocked off during the removal of adjacent trees. No evidence of malicious tampering was found. An immediate search of the surrounding area was unsuccessful at locating the missing TLD. (CR-RBS-2020-00252)

Monitoring Results Tables

Table 8: Air Particulate Data Table

Analysis: Gross Beta		Units: pCi/m ³			
Start Date	End Date	AN1 (Indicator)	AP1 (Indicator)	AQS2 ⁽¹⁾ (Indicator)	AGC (Control)
REQUIRED LLD →		<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>
01/06/2020	01/20/2020	0.010	0.011	0.013	0.012
01/20/2020	02/03/2020	0.016	0.015	0.018	0.018
02/03/2020	02/17/2020	0.012	0.010	0.009	0.009
02/17/2020	03/02/2020	0.015	0.016	0.015	0.016
03/02/2020	03/16/2020	0.015	0.016	0.014	0.011
03/16/2020	03/30/2020	0.015	0.014	0.015	0.016
03/30/2020	04/13/2020	0.019	0.015	0.019	0.018
04/13/2020	04/27/2020	0.015	0.011	0.013	0.014
04/27/2020	05/11/2020	0.012	0.009	0.012	0.013
05/11/2020	05/26/2020	0.011	0.013	0.010	0.012
05/26/2020	06/09/2020	0.015	0.015	0.014	0.009
06/09/2020	06/22/2020	0.019	0.019	0.020	0.021
06/22/2020	07/06/2020	0.011	0.014	0.014	0.013
07/06/2020	07/20/2020	0.017	0.017	0.015	0.018
07/20/2020	08/03/2020	0.009	0.009	0.009	0.014
08/03/2020	08/17/2020	0.024	0.022	0.020	0.020
08/17/2020	08/31/2020	0.016	0.017	0.016	0.017
08/31/2020	09/14/2020	0.017	0.015	0.018	0.018
09/14/2020	09/28/2020	0.018	0.019	0.020	0.019
09/28/2020	10/12/2020	0.020	0.021	0.020	0.021
10/12/2020	10/26/2020	0.021	0.020	0.021	0.018
10/26/2020	11/09/2020	0.024	0.020	0.023	0.025
11/09/2020	11/23/2020	0.015	0.016	0.017	0.017
11/23/2020	12/07/2020	0.017	0.017	0.020	0.016
12/07/2020	12/21/2020	0.016	0.017	0.019	0.019
12/21/2020	01/04/2021	0.014	0.016	0.017	0.014

⁽¹⁾ Station with highest annual mean.

Monitoring Results Tables

Table 9: Radioiodine Cartridge Data Table

Analysis: I-131		Units: pCi/m ³			
Start Date	End Date	AN1 (Indicator)	AP1 (Indicator)	AQS2 (Indicator)	AGC (Control)
REQUIRED LLD →		<u>0.07</u>	<u>0.07</u>	<u>0.07</u>	<u>0.07</u>
01/06/2020	01/20/2020	< 0.019	< 0.019	< 0.020	< 0.016
01/20/2020	02/03/2020	< 0.012	< 0.015	< 0.014	< 0.011
02/03/2020	02/17/2020	< 0.022	< 0.022	< 0.022	< 0.007
02/17/2020	03/02/2020	< 0.013	< 0.011	< 0.013	< 0.010
03/02/2020	03/16/2020	< 0.013	< 0.020	< 0.020	< 0.008
03/16/2020	03/30/2020	< 0.021	< 0.022	< 0.009	< 0.020
03/30/2020	04/13/2020	< 0.018	< 0.008	< 0.018	< 0.009
04/13/2020	04/27/2020	< 0.022	< 0.022	< 0.022	< 0.017
04/27/2020	05/11/2020	< 0.014	< 0.014	< 0.015	< 0.009
05/11/2020	05/26/2020	< 0.016	< 0.017	< 0.017	< 0.007
05/26/2020	06/09/2020	< 0.007	< 0.020	< 0.020	< 0.009
06/09/2020	06/22/2020	< 0.008	< 0.013	< 0.013	< 0.008
06/22/2020	07/06/2020	< 0.006	< 0.019	< 0.019	< 0.008
07/06/2020	07/20/2020	< 0.015	< 0.016	< 0.015	< 0.009
07/20/2020	08/03/2020	< 0.010	< 0.018	< 0.019	< 0.093 ⁽¹⁾
08/03/2020	08/17/2020	< 0.014	< 0.016	< 0.012	< 0.013
08/17/2020	08/31/2020	< 0.020	< 0.020	< 0.020	< 0.007
08/31/2020	09/14/2020	< 0.006	< 0.010	< 0.024	< 0.024
09/14/2020	09/28/2020	< 0.016	< 0.016	< 0.007	< 0.010
09/28/2020	10/12/2020	< 0.028	< 0.011	< 0.022	< 0.022
10/12/2020	10/26/2020	< 0.010	< 0.023	< 0.023	< 0.008
10/26/2020	11/09/2020	< 0.021	< 0.021	< 0.022	< 0.017
11/09/2020	11/23/2020	< 0.013	< 0.011	< 0.011	< 0.018
11/23/2020	12/07/2020	< 0.024	< 0.023	< 0.023	< 0.009
12/07/2020	12/21/2020	< 0.006	< 0.011	< 0.026	< 0.026
12/21/2020	01/04/2021	< 0.021	< 0.010	< 0.021	< 0.009

(1) See Sample Deviations Table.

Annual Radiological Environmental Operating Report

Attachment 2

Page 3 of 11

Monitoring Results Tables

Table 10: Thermoluminescent Dosimeters – Indicators

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1 st Qtr 2020	2 nd Qtr 2020	3 rd Qtr 2020	4 th Qtr 2020	Annual Mean 2020
TA1	10.0	10.6	11.0	11.2	10.7
TB1	13.5	14.9	13.9	14.9	14.3
TC1	13.5	15.3	15.3	15.9	15.0
TD1	13.6	14.5	15.1	15.6	14.7
TE1	12.1	13.9	14.2	13.9	13.5
TF1	12.4	13.8	14.6	15.0	14.0
TG1⁽¹⁾	14.0	15.3	15.6	16.2	15.3
TH1	11.1	12.0	12.3	12.7	12.0
TJ1	12.0	13.2	13.3	13.3	13.0
TK1	12.5	14.3	14.0	14.6	13.9
TL1	12.7	14.4	14.7	14.5	14.1
TM1	10.9	11.6	11.5	12.1	11.5
TN1	13.1	14.1	13.7	14.2	13.8
TP1	12.0	12.7	13.1	13.6	12.8
TQ1	9.8	10.7	10.5	10.9	10.5
TR1	9.5	11.2	10.5	11.3	10.6

⁽¹⁾ Indicator station with highest annual mean.

Monitoring Results Tables

Table 11: Thermoluminescent Dosimeters – Special Interest Areas

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1st Qtr 2020	2nd Qtr 2020	3rd Qtr 2020	4th Qtr 2020	Annual Mean 2020
TCS	11.4	12.2	13.0	12.2 ⁽²⁾	12.2
TGS⁽¹⁾	13.9	15.7	15.3	15.4	15.1
TNS	11.8	13.1	14.0	13.1	13.0
TRS	13.3	14.3	14.2	14.3	14.0
TQS1	13.7	15.0	15.5	15.4	14.9
TQS2	11.8	12.7	12.4	12.6	12.4

⁽¹⁾ Special interest station with highest annual mean.

⁽²⁾ See Sample Deviations Table.

Table 12: Thermoluminescent Dosimeters – Control

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1st Qtr 2020	2nd Qtr 2020	3rd Qtr 2020	4th Qtr 2020	Annual Mean 2020
TAC⁽¹⁾	14.3	15.8	15.4	15.7	15.3
TEC	12.4	14.3	14.4	13.7	13.7

⁽¹⁾ Control station with highest annual mean.

Annual Radiological Environmental Operating Report

Attachment 2

Page 5 of 11

Monitoring Results Tables

Table 13: Surface Water – Gamma

Analysis: Gamma Isotopic								Units: pCi/L						
Location	Start Date	End Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	I-131	Zr-95	Cs-134	Cs-137	Ba-140	La-140
REQUIRED LLD →			15	15	30	15	30	15	15	30	15	18	60	15
SWD (Indicator)	02/18/2020	02/18/2020	< 3.95	< 4.01	< 10.7	< 4.90	< 8.64	< 4.44	< 13.6	< 6.93	< 4.19	< 4.41	< 3.60	< 10.4
SWU (Control)	02/18/2020	02/18/2020	< 3.90	< 4.13	< 8.24	< 4.43	< 7.31	< 5.01	< 11.3	< 8.89	< 4.20	< 3.96	< 26.5	< 9.32
SWD (Indicator)	05/18/2020	05/18/2020	< 6.83	< 6.36	< 15.7	< 9.23	< 16.4	< 7.25	< 9.43	< 11.4	< 8.43	< 7.91	< 34.8	< 9.68
SWU (Control)	05/18/2020	05/18/2020	< 6.72	< 6.73	< 15.9	< 9.37	< 11.3	< 7.13	< 11.1	< 12.1	< 7.27	< 9.01	< 38.6	< 11.6
SWD (Indicator)	08/13/2020	08/13/2020	< 6.45	< 8.77	< 15.8	< 6.68	< 16.7	< 7.87	< 12.4	< 15.4	< 8.52	< 8.17	< 38.5	< 12.2
SWU (Control)	08/13/2020	08/13/2020	< 6.59	< 6.66	< 14.6	< 6.62	< 12.7	< 7.95	< 14.2	< 13.6	< 8.48	< 7.29	< 34.9	< 11.9
SWD (Indicator)	11/23/2020	11/23/2020	< 1.67	< 1.93	< 4.66	< 1.70	< 3.44	< 2.02	< 14.3	< 3.55	< 1.89	< 1.68	< 20.3	< 7.31
SWD DUP (Indicator)	11/23/2020	11/23/2020	< 1.49	< 1.78	< 4.02	< 1.58	< 3.05	< 1.95	< 12.9	< 3.12	< 1.74	< 1.56	< 18.9	< 6.65
SWU (Control)	11/23/2020	11/23/2020	< 1.61	< 1.91	< 4.50	< 1.61	< 3.35	< 1.87	< 13.4	< 3.57	< 1.88	< 1.61	< 21.0	< 6.54

Monitoring Results Tables

Table 14: Surface Water – Tritium

Analysis: H-3		Units: pCi/L	
Location	Start Date	End Date	H-3
<u>REQUIRED LLD →</u>			<u>2000</u>
SWD (Indicator)	02/18/2020	02/18/2020	< 452
SWU (Control)	02/18/2020	02/18/2020	< 453
SWD (Indicator)	05/18/2020	05/18/2020	< 488
SWU (Control)	05/18/2020	05/18/2020	< 500
SWD (Indicator)	08/13/2020	08/13/2020	< 516
SWU (Control)	08/13/2020	08/13/2020	< 514
SWD (Indicator)	11/23/2020	11/23/2020	< 519
SWD DUP (Indicator)	11/23/2020	11/23/2020	< 573
SWU (Control)	11/23/2020	11/23/2020	< 566

Annual Radiological Environmental Operating Report

Attachment 2

Page 7 of 11

Monitoring Results Tables

Table 15: Groundwater – Gamma

Analysis: Gamma Isotopic		Units: pCi/L											
Location	Collection Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	I-131	Zr-95	Cs-134	Cs-137	Ba-140	La-140
REQUIRED LLD →		15	15	30	15	30	15	15	30	15	18	60	15
WD (Indicator)	05/18/2020	< 7.42	< 6.40	< 17.5	< 8.43	< 14.7	< 8.94	< 9.62	< 13.8	< 8.81	< 9.81	< 32.0	< 6.93
WU (Control)	05/18/2020	< 6.54	< 8.07	< 15.9	< 7.96	< 16.2	< 8.17	< 8.52	< 13.5	< 8.64	< 8.61	< 31.3	< 9.31
WD (Indicator)	11/23/2020	< 1.83	< 2.03	< 5.09	< 1.93	< 3.83	< 2.16	< 14.6	< 3.66	< 1.85	< 1.77	< 22.2	< 7.69
WU (Control)	11/23/2020	< 1.70	< 1.88	< 4.86	< 1.94	< 3.71	< 2.13	< 13.8	< 3.82	< 1.88	< 1.80	< 22.6	< 8.65

Monitoring Results Tables

Table 16: Groundwater – Tritium

Analysis: H-3		Units: pCi/L	
Location	Start Date	End Date	H-3
REQUIRED LLD →			<u>2000</u>
WD (Indicator)	05/18/2020	05/18/2020	< 490
WU (Control)	05/18/2020	05/18/2020	< 495
WD (Indicator)	11/23/2020	11/23/2020	< 591
WU (Control)	11/23/2020	11/23/2020	< 580

Monitoring Results Tables

Table 17: Sediment - Gamma

Analysis: Gamma Isotopic		Units: pCi/kg (dry)	
Location	Collection Date	Cs-134	Cs-137
<u>REQUIRED LLD →</u>		<u>150</u>	<u>180</u>
SEDD (Indicator)	10/12/2020	< 93.09	< 79.56
SEDU (Control)	10/12/2020	< 107.2	< 95.94

Monitoring Results Tables

Table 18: Fish - Gamma

Analysis: Gamma Isotopic				Units: pCi/kg (wet)				
Location	Collection Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Cs-134	Cs-137
REQUIRED LLD →		<u>130</u>	<u>130</u>	<u>260</u>	<u>130</u>	<u>260</u>	<u>130</u>	<u>150</u>
FD (Indicator)	09/28/2020	< 61.96	< 75.42	< 151.6	< 55.79	< 102.8	< 65.53	< 51.70
FU (Control)	09/28/2020	< 81.15	< 99.36	< 216.9	< 73.70	< 126.0	< 72.84	< 74.35

Monitoring Results Tables

Table 19: Food Products - Gamma

Analysis: Gamma Isotopic		Units: pCi/kg (wet)		
Location	Collection Date	I-131	Cs-134	Cs-137
REQUIRED LLD →		60	60	80
GN1 (Indicator)	02/18/2020	< 58.27	< 24.21	< 22.21
GQC (Control)	02/18/2020	< 42.74	< 16.12	< 16.25
GN1 (Indicator)	05/18/2020	< 34.24	< 35.82	< 39.23
GQC (Control)	05/18/2020	< 18.07	< 15.05	< 15.18
GN1 (Indicator)	08/17/2020	< 59.86	< 13.06	< 13.87
GQC (Control)	08/18/2020	< 54.17	< 13.88	< 12.76
GN1 (Indicator)	10/26/2020	< 49.01	< 22.84	< 26.79
GQC (Control)	10/27/2020	< 28.41	< 20.92	< 19.63

Annual Radiological Environmental Operating Report

Attachment 3

Page 1 of 6

Interlaboratory Comparison Program Results

1.0 Summary

For the Teledyne Brown Engineering (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.

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.

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

Annual Radiological Environmental Operating Report

Attachment 3

Page 2 of 6

Interlaboratory Comparison Program Results

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.

**Table 20: Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services**

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Value	Known Value ^(a)	Ratio of TBE to Known Result	Evaluation ^(b)		
September 2020	E13247	Milk	Sr-89	pCi/L	62.8	95.4	0.66	N ⁽¹⁾		
			Sr-90	pCi/L	12.0	12.8	0.94	A		
	E13248	Milk	Ce-141	pCi/L	156	150	1.04	A		
			Co-58	pCi/L	172	180	0.96	A		
			Co-60	pCi/L	369	379	0.97	A		
			Cr-51	pCi/L	372	372	1.00	A		
			Cs-134	pCi/L	171	200	0.85	A		
			Cs-137	pCi/L	241	250	0.96	A		
			Fe-59	pCi/L	217	200	1.08	A		
			I-131	pCi/L	84.6	95.0	0.89	A		
			Mn-54	pCi/L	175	180	0.97	A		
			Zn-65	pCi/L	252	270	0.93	A		
			E13249	Charcoal	I-131	pCi	70.2	75.8	0.93	A
			E13250	AP	Ce-141	pCi	101	101	1.00	A
					Co-58	pCi	111	120	0.92	A
Co-60	pCi	249			254	0.98	A			
Cr-51	pCi	287			249	1.15	A			
Cs-134	pCi	114			134	0.85	A			
Cs-137	pCi	159			168	0.95	A			
Fe-59	pCi	127			134	0.95	A			
Mn-54	pCi	114			121	0.94	A			
E13251	Soil	Ce-141	pCi/g	0.241	0.191	1.26	W			
		Co-58	pCi/g	0.211	0.228	0.93	A			
		Co-60	pCi/g	0.466	0.481	0.97	A			
		Cr-51	pCi/g	0.450	0.472	0.95	A			
		Cs-134	pCi/g	0.273	0.254	1.07	A			
		Cs-137	pCi/g	0.370	0.390	0.95	A			
		Fe-59	pCi/g	0.233	0.254	0.92	A			
E13252	AP	Sr-89	pCi	79.9	100.0	0.80	A			
		Sr-90	pCi	12.1	13.4	0.90	A			

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

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) See **NCR 20-19**

**Table 20: Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services**

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Value	Known Value ^(a)	Ratio of TBE to Known Result	Evaluation ^(b)		
December 2020	E13254	Milk	Sr-89	pCi/L	82.2	89.7	0.92	A		
			Sr-90	pCi/L	12.4	13.0	0.96	A		
	E13255	Milk	Ce-141	pCi/L	91.1	100	0.91	A		
			Co-58	pCi/L	77.5	84.3	0.92	A		
			Co-60	pCi/L	147	152	0.97	A		
			Cr-51	pCi/L	259	253	1.02	A		
			Cs-134	pCi/L	97.1	108	0.90	A		
			Cs-137	pCi/L	117	127	0.92	A		
			Fe-59	pCi/L	114	112	1.02	A		
			I-131	pCi/L	84.3	91.9	0.92	A		
			Mn-54	pCi/L	137	143	0.96	A		
			Zn-65	pCi/L	175	190	0.92	A		
			E13256	Charcoal	I-131	pCi	70.2	78.2	0.90	A
			E13257A	AP	Ce-141	pCi	67.4	74.6	0.90	A
					Co-58	pCi	57.9	62.9	0.92	A
Co-60	pCi	108			113	0.95	A			
Cr-51	pCi	162			189	0.86	A			
Cs-134	pCi	68.1			80.4	0.85	A			
Cs-137	pCi	82.4			95.0	0.87	A			
Fe-59	pCi	80.5			83.7	0.96	A			
Mn-54	pCi	102			107	0.95	A			
E13258	Soil	Ce-141	pCi/g	0.167	0.170	0.98	A			
		Co-58	pCi/g	0.125	0.143	0.87	A			
		Co-60	pCi/g	0.245	0.257	0.95	A			
		Cr-51	pCi/g	0.393	0.429	0.92	A			
		Cs-134	pCi/g	0.147	0.183	0.80	A			
		Cs-137	pCi/g	0.260	0.288	0.90	A			
		Fe-59	pCi/g	0.199	0.190	1.05	A			
		Mn-54	pCi/g	0.229	0.243	0.94	A			
E13259	AP	Sr-89	pCi	85.0	78.6	1.08	A			
		Sr-90	pCi	13.1	11.4	1.15	A			

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

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

Annual Radiological Environmental Operating Report

Attachment 3

Page 5 of 6

**Table 21: DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services**

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Value	Known Value ^(a)	Acceptance Range	Evaluation ^(b)	
February 2020	20-GrF42	AP	Gross Alpha	Bq/sample	0.676	1.24	0.37 - 2.11	A	
			Gross Beta	Bq/sample	2.03	2.00	1.00 - 3.00	A	
	20-MaS42	Soil	Ni-63	Bq/kg	0.01		(1)	A	
			Sr-90	Bq/kg	348	340	238 - 442	A	
	20-MaW42	Water	Ni-63	Bq/L	11.6	11.1	7.8 - 14.4	A	
			Pu-238	Bq/L	0.926	0.94	0.66 - 1.22	A	
			Pu-239/240	Bq/L	0.712	0.737	0.516 - 0.958	A	
	20-RdF42	AP	U-234/233	Bq/sample	0.0416	0.075	0.053 - 0.098	N ⁽³⁾	
			U-238	Bq/sample	0.0388	0.078	0.055 - 0.101	N ⁽³⁾	
	20-RdV42	Vegetation	Cs-134	Bq/sample	3.23	3.82	2.67 - 4.97	A	
			Cs-137	Bq/sample	2.64	2.77	1.94 - 3.60	A	
			Co-57	Bq/sample	0.0281		(1)	A	
			Co-60	Bq/sample	2.62	2.79	1.95 - 3.63	A	
			Mn-54	Bq/sample	4.3	4.58	3.21 - 5.95	A	
			Sr-90	Bq/sample	0.396	0.492	0.344 - 0.640	A	
			Zn-65	Bq/sample	3.93	3.79	2.65 - 4.93	A	
	August 2020	20-GrF43	AP	Gross Alpha	Bq/sample	0.267	0.528	0.158 - 0.989	A
				Gross Beta	Bq/sample	0.939	0.915	0.458 - 1.373	A
		20-MaS43	Soil	Ni-63	Bq/kg	438	980	686 - 1274	N ⁽⁴⁾
Tc-99				Bq/kg	1.11		(1)	A	
20-MaW43		Water	Ni-63	Bq/L	0.175		(1)	A	
			Tc-99	Bq/L	8.8	9.4	6.6 - 12.2	A	
20-RdV43		Vegetation	Cs-134	Bq/sample	3.635	4.94	3.46 - 6.42	W	
			Cs-137	Bq/sample	0.0341		(1)	A	
			Co-57	Bq/sample	5.855	6.67	4.67 - 8.67	W	
			Co-60	Bq/sample	3.122	4.13	2.89 - 5.37	W	
			Mn-54	Bq/sample	4.524	5.84	4.09 - 7.59	A	
			Sr-90	Bq/sample	1.01	1.39	0.97 - 1.81	W	
Zn-65		Bq/sample	4.706	6.38	4.47 - 8.29	W			

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

(b) DOE/MAPEP evaluation:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) False positive test

(2) Sensitivity evaluation

(3) See **NCR 20-13**

(4) See **NCR 20-20**

Annual Radiological Environmental Operating Report

Attachment 3

Page 6 of 6

**Table 22: ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services**

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Value	Known Value ^(a)	Acceptance Limits	Evaluation ^(b)	
March 2020	MRAD-32	Water	Am-241	pCi/L	52.5	45.3	31.1 - 57.9	A	
			Fe-55	pCi/L	155	152	89.3 - 221	A	
			Pu-238	pCi/L	34.0	36.4	21.9 - 47.2	A	
			Pu-239	pCi/L	30.9	33.6	20.8 - 41.4	A	
April 2020	RAD-121	Water	Ba-133	pCi/L	41.8	41.8	34.0 - 46.7	A	
			Cs-134	pCi/L	42.9	46.3	37.1 - 50.9	A	
			Cs-137	pCi/L	226	234	211 - 259	A	
			Co-60	pCi/L	52.4	50.3	45.3 - 57.9	A	
			Zn-65	pCi/L	83.3	86.8	78.1 - 104	A	
			GR-A	pCi/L	20.1	23.6	11.9 - 31.6	A	
			GR-B	pCi/L	45.6	60.5	41.7 - 67.2	A	
			U-Nat	pCi/L	18.45	18.6	14.9 - 20.9	A	
			H-3	pCi/L	14200	14100	12300 - 15500	A	
			Sr-89	pCi/L	58.0	60.1	48.3 - 67.9	A	
			Sr-90	pCi/L	34.1	44.7	33.0 - 51.2	A	
I-131	pCi/L	27.4	28.9	24.1 - 33.8	A				
September 2020	MRAD-33	Soil	Sr-90	pCi/Kg	4360	4980	1550 - 7760	A	
			AP	Fe-55	pCi/Filter	189	407	149 - 649	A
				U-234	pCi/Filter	17.9	18.3	13.6 - 21.4	A
				U-238	pCi/Filter	19.1	18.1	13.7 - 21.6	A
		Water	Am-241	pCi/L	160	176	121 - 225	A	
			Fe-55	pCi/L	299	298	175 - 433	A	
			Pu-238	pCi/L	200	191	115 - 247	A	
			Pu-239	pCi/L	105	100	61.9 - 123	A	
October 2020	RAD-123	Water	Ba-133	pCi/L	37.1	37.0	29.8 - 41.6	A	
			Cs-134	pCi/L	50.6	52.7	42.5 - 58.0	A	
			Cs-137	pCi/L	131	131	118 - 146	A	
			Co-60	pCi/L	62.9	60.5	54.4 - 69.1	A	
			Zn-65	pCi/L	167	162	146 - 191	A	
			GR-A	pCi/L	40.0	26.2	13.3 - 34.7	N ⁽¹⁾	
			GR-B	pCi/L	47.5	69.1	48.0 - 76.0	N ⁽¹⁾	
			U-Nat	pCi/L	17.2	20.3	16.3 - 22.7	A	
			H-3	pCi/L	23800	23200	20,300 - 25,500	A	
			Sr-89	pCi/L	41.1	43.3	33.4 - 50.5	A	
			Sr-90	pCi/L	28.5	30.2	22.0 - 35.0	A	
I-131	pCi/L	22.9	28.2	23.5 - 33.1	N ⁽²⁾				
November 2020	QR111920K	Water	GR-A	pCi/L	50.7	52.4	27.3 - 65.6	A	
			GR-B	pCi/L	24.9	24.3	15.0 - 32.3	A	

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

(b) ERA evaluation:

A = Acceptable - Reported value falls within the Acceptance Limits

N = Not Acceptable - Reported value falls outside of the Acceptance Limits

(1) See **NCR 20-18**

(2) See **NCR 20-17**