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U. S. Nuclear Regulatory Commission
11555 Rockville Pike
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Subject: 2019 Annual Radiological Environmental Operating Report
River Bend Station – Unit 1
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, 2019 through December 31, 2019. 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,

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TAS/tf

Enclosure: 2019 Annual Radiological Environmental Operating Report

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NRC Senior Resident Inspector – River Bend Station, Unit 1
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Public Utility Commission of Texas, Attn: PUC Filing Clerk
NRC Project Manager

Enclosure
2019 Annual Radiological Environmental Operating Report



Plant: River Bend Station	Page 1 of 43
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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

Annual Radiological Environmental Operating Report

ATTACHMENTS

Attachment 1 - Sample Deviations	26
Attachment 2 - Monitoring Results Tables	27
Attachment 3 - Interlaboratory Comparison Program Results	38

TABLES

Table 1: Exposure Pathway - Airborne	8
Table 2: Exposure Pathway - Direct Radiation	9
Table 3: Exposure Pathway - Waterborne	12
Table 4: Exposure Pathway - Ingestion	13
Table 5: Land Use Census - 2018 Nearest Residence and Milk Animal Within 5 Miles	21
Table 6: Radiological Environmental Monitoring Program Summary	23
Table 7: Sample Deviations Table.....	26
Table 8: Air Particulate Data Table.....	27
Table 9: Radioiodine Cartridge Data Table	28
Table 10: Thermoluminescent Dosimeters - Indicators.....	29
Table 11: Thermoluminescent Dosimeters - Special Interest Areas	30
Table 12: Thermoluminescent Dosimeters - Controls.....	30
Table 13: Surface Water - Gamma.....	31
Table 14: Surface Water - Tritium	32
Table 15: Groundwater - Gamma.....	33
Table 16: Groundwater - Tritium	34
Table 17: Sediment - Gamma	35
Table 18: Fish - Gamma.....	36
Table 19: Food Products - Gamma	37
Table 20: Analytics Environmental Radioactivity Cross Check Program.....	40
Table 21: DOE's Mixed Analyte Performance Evaluation Program (MAPEP).....	42
Table 22: ERA Environmental Radioactivity Cross Check Program	43

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 (2019).....17

Figure 5: TLD Indicator Results (2019) Versus Control Data (1986-2019).....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, 2019. 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 2019, 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 2019 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 2019, environmental samples were collected for radiological analysis. The results of indicator locations were compared with control locations and previous studies. It was concluded that no significant relationship exists between RBS operation and effect on the area around the plant. The review of 2019 data showed radioactivity levels in the environment were undetectable in many locations and near background levels in significant pathways.

1.2 Reporting Levels

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 2019, environmental sampling was performed for seven media types addressed in the ODCM and for direct radiation. A total of 336 samples of the 336 scheduled were obtained. Of the scheduled samples, 100 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 2019 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 2020. Section 4.5 on the report contains a narrative on the results of the 2018 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. 	Quarterly	<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></p> <p>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

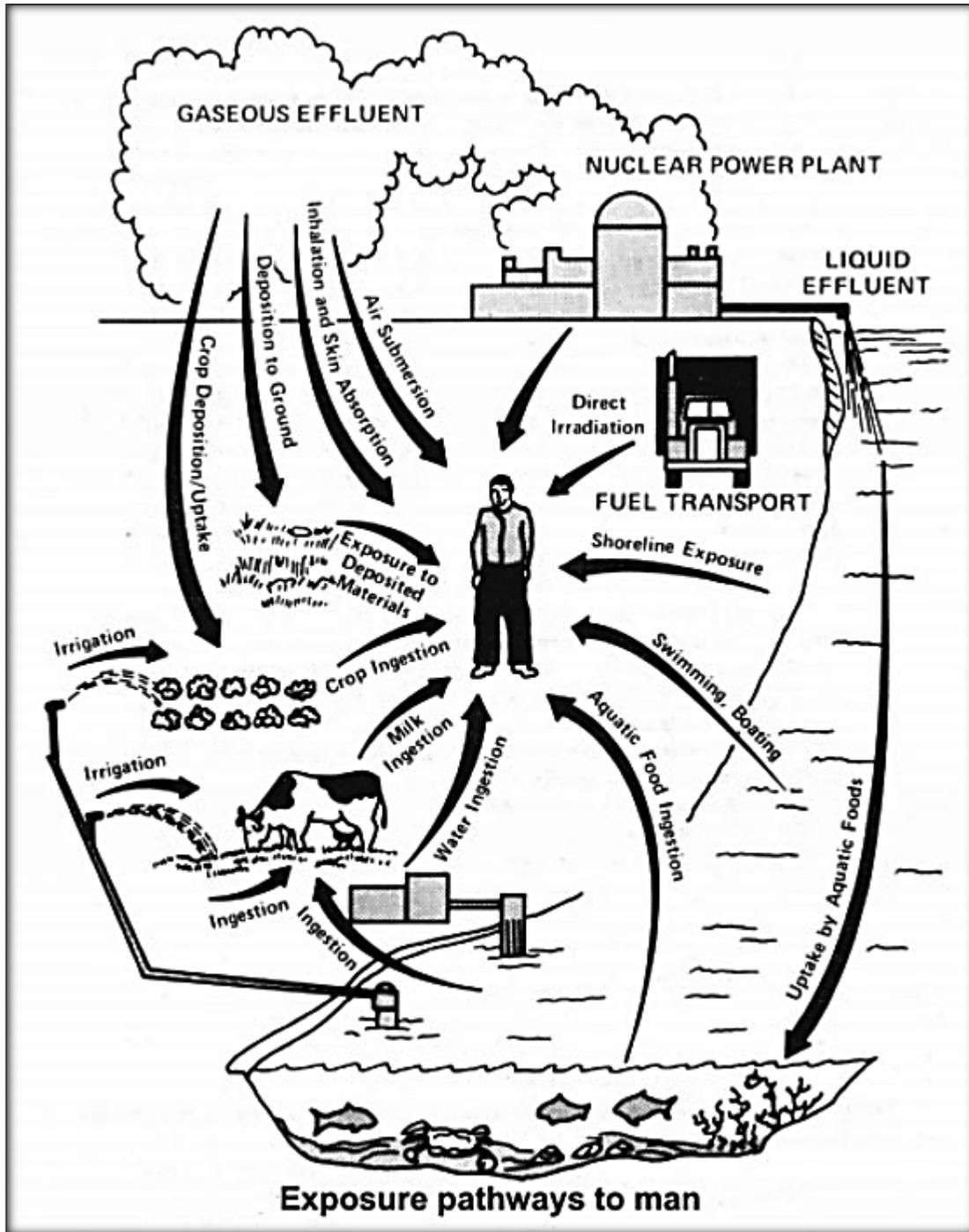
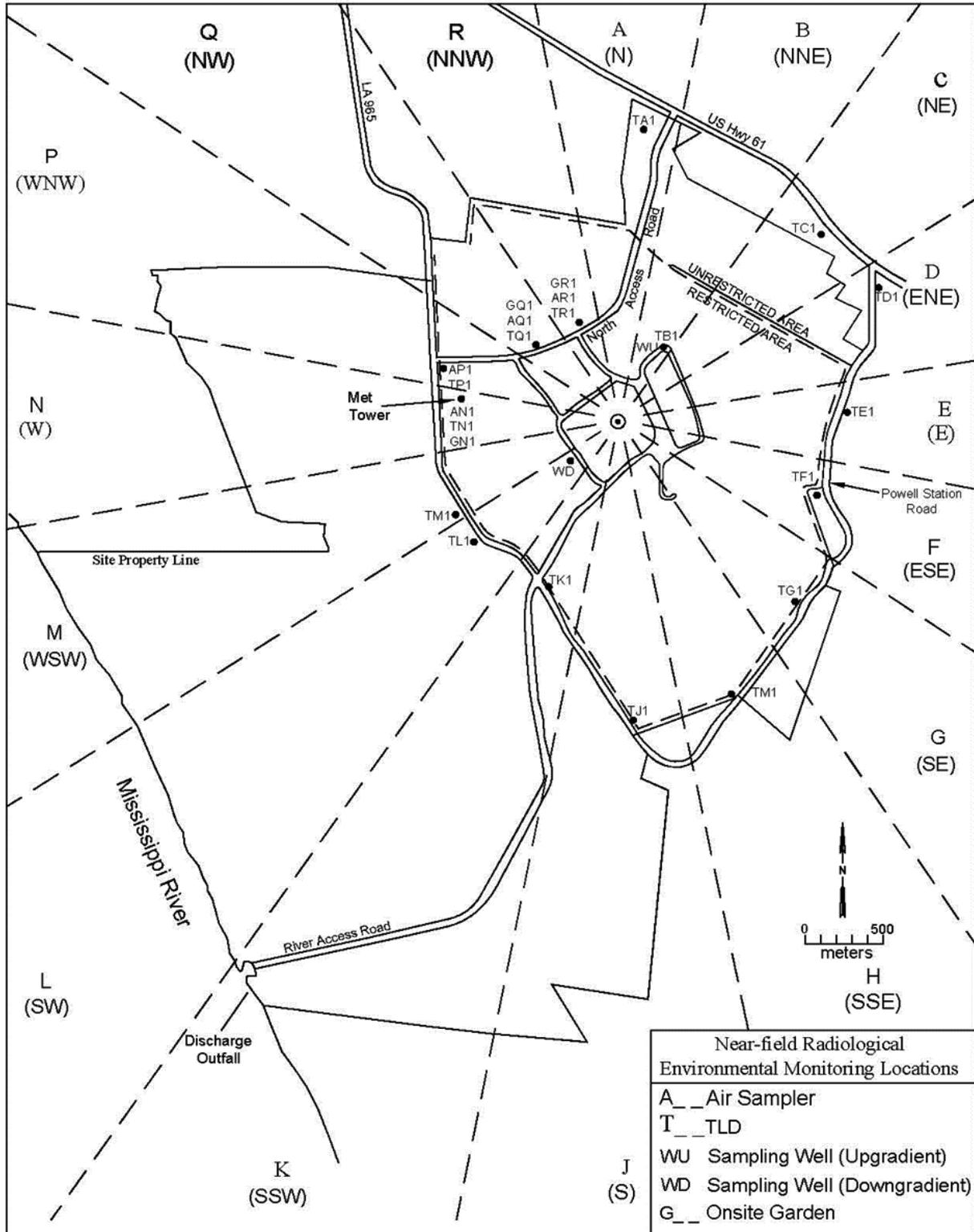


Figure 2: Sample Collection Sites – Near Field



Annual Radiological Environmental Operating Report

4.0 INTERPRETATION AND TRENDS OF RESULTS

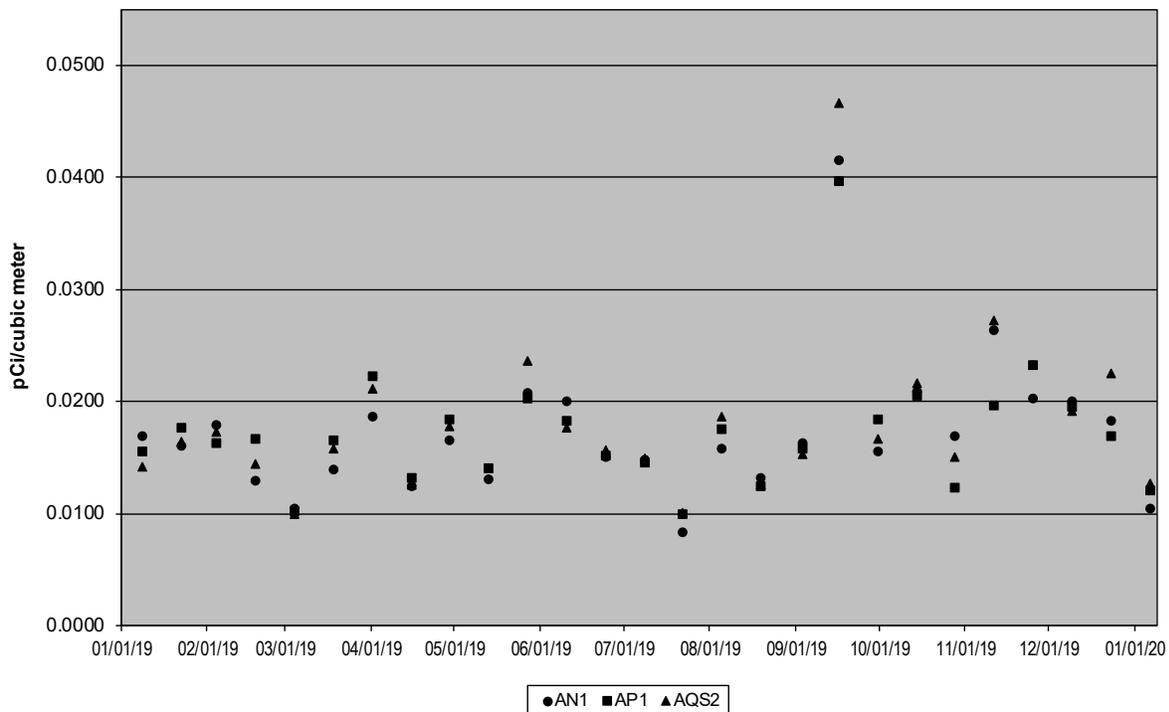
4.1 Air Particulate and Radioiodine Sample Results

In 2019 there were no samples above the LLD for I-131. Indicator gross beta air particulate results for 2019 were comparable to results obtained from 2009-2018 of the operational REMP. Also, the 2019 gross beta annual average was less than the average for preoperational levels. Results are reported as annual average picocuries per cubic meter (pCi/m³).

<u>Monitoring Period</u>	<u>Result</u>
2009 – 2018 (Minimum Value)	0.018
2019 Average Value	0.017
2009 – 2018 (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. The gross beta results in September and October samples of 2019 are higher than typical due to planned maintenance outages causing low volumes. Therefore, it can be concluded that the airborne pathway continues to be unaffected by River Bend Station operations.

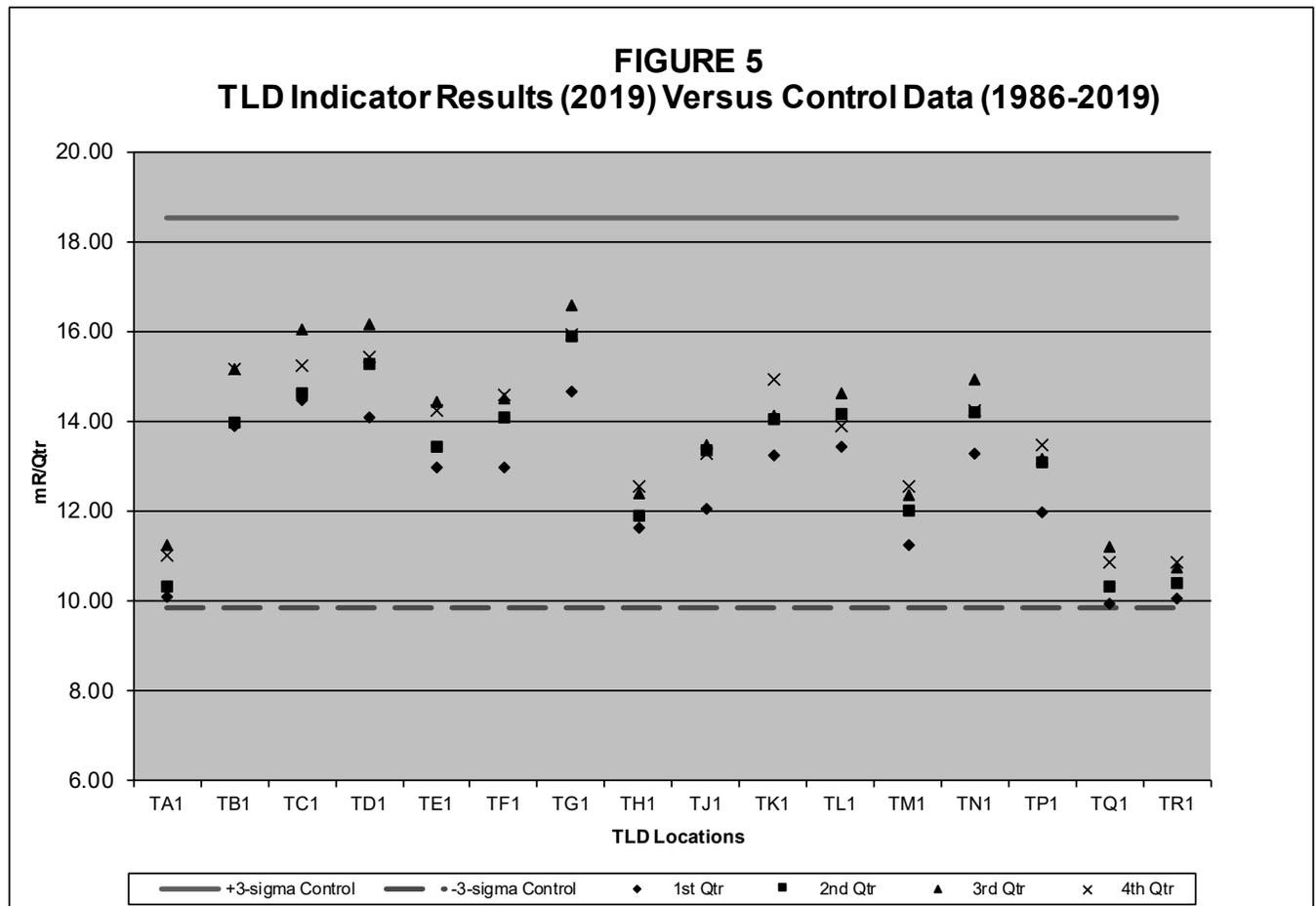
FIGURE 4
Gross Beta Indicator Results (2019)



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 13.3 millirem (mrem) shown in the TLD radiation dose comparison graph below shows the 2019 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 2019 surface water and groundwater water samples were similar to those reported in previous years. Gamma radionuclides and tritium analytical results for 2019 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 2019.

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 2019.

4.3.3 Sediment Sample Results

Sediment samples were collected from one indicator and one control location in 2019 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 2019, 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 2019, food products samples were collected when available from one indicator and one control location and analyzed for gamma radionuclides. The 2019 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 2019 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 2018) 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 one change. A new resident, located at a distance of 1.7 km in Sector A, was identified in 2018. This occupied residence is 0.2 km closer to the site than the residence reported in previous census. There were no changes in the milk cows or food products in 2018.

Annual Radiological Environmental Operating Report

Table 5: Land Use Census –2018 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 2019 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 / 108	0.01	0.0175 (81 / 81) [0.008 – 0.047]	AGC (17.0 km SE)	0.0183 (27 / 27) [0.011 - 0.045]	0.0183 (27 / 27) [0.011 - 0.045]	0
Airborne Iodine (pCi/m ³)	I-131 / 108	0.07	< LLD	N/A	N/A	< LLD	0
Indicator TLDs (mR/Qtr)	Gamma / 64	⁽⁶⁾	13.3 (64 / 64) [9.9 – 16.6]	TG1 (1.6 km SE)	15.7 (4 / 4) [14.6 – 16.6]	N/A	0
Special Interest TLDs (mR/Qtr)	Gamma / 24	⁽⁶⁾	13.9 (24 / 24) [12.0 – 16.3]	TGS (17.0 km SE)	15.4 (4 / 4) [14.8 – 16.3]	N/A	0
Control TLDs (mR/Qtr)	Gamma / 8	⁽⁶⁾	N/A	TAC (15.8 km N)	15.1 (4 / 4) [14.2-16.4]	14.5 (8 / 8) [12.9 – 16.4]	0
Surface Water (pCi/L)	H-3 / 8	700	< LLD	N/A	N/A	< LLD	0
	GS / 8						
	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	700	< 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	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	AR1	07/01/19	Power Outage	Environmental air samplers at location AR1 indicated a loss of power for approximately 6 days 22 hours and 44 minutes. The power outage was due to a faulty GFCI outlet. Sample volumes are sufficient to meet lower limit of detection requirements. (CR-RBS-2019-4964)
2	Air Sample	AR1	07/22/19	Power Outage	Environmental air sampler at location AR1 indicated a loss of power for approximately 2 days, 6 hours, and 48 minutes on 07/22/19. The air sampler was operating normally at the time of sample collection. The sample volume is sufficient to meet the lower limit of detection requirements. (CR-RBS-2020-01351)
3	Air Sample	AP1	08/05/19	Faulty Equipment	Sample volume indication for Radiological Environmental Monitoring Program (REMP) air sampler at location AP1 was low for the last sampling period. Troubleshooting indicates that the issue is not with the calibrated flow electronics, but with the air sample pump thermal protection circuitry. The air pump was replaced with a functional unit and the air sampler was returned to service. Sample volume was sufficient to meet lower limit of detection requirements. (CR-RBS-2019-5341)
4	Air Sample	AP1, AQ1, AR1, AN1	09/30/19	Power Outage	Environmental air sampler locations AP1, AQ1, AR1, and AN1 were short 7.9 hours during the sample period from 9/16/19 thru 9/30/19 due to planned maintenance outages on Grant Substation. Samplers were operating normally at time of sample collection. The sample volume is sufficient to meet the lower limit of detection requirements. (CR-RBS-2019-6322)
5	Air Sample	AP1, AQ1, AR1, AN1	10/28/19	Power Outage	Environmental air sampler locations AN1, AP1, AQ1, and AR1 were short 3.75 hours during the sample period from 10/14/19 thru 10/28/19 due to planned maintenance outages on Grant Substation. Samplers were operating normally at time of sample collection. The sample volume is sufficient to meet the lower limit of detection requirements. (CR-RBS-2019-6901)

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)
<u>REQUIRED LLD →</u>		<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>
12/26/2018	01/08/2019	0.017	0.016	0.014	0.016
01/08/2019	01/22/2019	0.016	0.018	0.016	0.017
01/22/2019	02/04/2019	0.018	0.016	0.017	0.018
02/04/2019	02/18/2019	0.013	0.017	0.014	0.017
02/18/2019	03/04/2019	0.011	0.010	0.010	0.011
03/04/2019	03/18/2019	0.014	0.017	0.016	0.017
03/18/2019	04/01/2019	0.019	0.022	0.021	0.023
04/01/2019	04/15/2019	0.012	0.013	0.013	0.012
04/15/2019	04/29/2019	0.017	0.018	0.018	0.020
04/29/2019	05/13/2019	0.013	0.014	0.014	0.015
05/13/2019	05/27/2019	0.021	0.020	0.024	0.023
05/27/2019	06/10/2019	0.020	0.018	0.018	0.019
06/10/2019	06/24/2019	0.015	0.015	0.016	0.016
06/24/2019	07/08/2019	0.015	0.015	0.015	0.014
07/08/2019	07/22/2019	0.008	0.010	0.010	0.011
07/22/2019	08/05/2019	0.016	0.018	0.019	0.016
08/05/2019	08/19/2019	0.013	0.012	0.013	0.013
08/19/2019	09/03/2019	0.016	0.016	0.015	0.017
09/03/2019	09/16/2019	0.042	0.040	0.047	0.045
09/16/2019	09/30/2019	0.016	0.018	0.017	0.018
09/30/2019	10/14/2019	0.021	0.021	0.022	0.023
10/14/2019	10/28/2019	0.017	0.012	0.015	0.015
10/28/2019	11/11/2019	0.026	0.020	0.027	0.025
11/11/2019	11/25/2019	0.020	0.023	0.023	0.021
11/25/2019	12/09/2019	0.020	0.020	0.019	0.020
12/09/2019	12/23/2019	0.018	0.017	0.023	0.020
12/23/2019	01/06/2020	0.010	0.012	0.013	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>
12/26/2018	01/08/2019	< 0.013	< 0.013	< 0.017	< 0.017
01/08/2019	01/22/2019	< 0.013	< 0.014	< 0.016	< 0.017
01/22/2019	02/04/2019	< 0.014	< 0.014	< 0.017	< 0.017
02/04/2019	02/18/2019	< 0.018	< 0.019	< 0.016	< 0.017
02/18/2019	03/04/2019	< 0.013	< 0.013	< 0.008	< 0.019
03/04/2019	03/18/2019	< 0.024	< 0.024	< 0.021	< 0.021
03/18/2019	04/01/2019	< 0.005	< 0.012	< 0.014	< 0.014
04/01/2019	04/15/2019	< 0.021	< 0.021	< 0.013	< 0.013
04/15/2019	04/29/2019	< 0.009	< 0.009	< 0.015	< 0.015
04/29/2019	05/13/2019	< 0.024	< 0.024	< 0.014	< 0.014
05/13/2019	05/27/2019	< 0.012	< 0.011	< 0.018	< 0.018
05/27/2019	06/10/2019	< 0.014	< 0.013	< 0.020	< 0.020
06/10/2019	06/24/2019	< 0.020	< 0.018	< 0.008	< 0.009
06/24/2019	07/08/2019	< 0.010	< 0.010	< 0.019	< 0.008
07/08/2019	07/22/2019	< 0.017	< 0.017	< 0.017	< 0.017
07/22/2019	08/05/2019	< 0.010	< 0.016	< 0.008	< 0.024
08/05/2019	08/19/2019	< 0.016	< 0.009	< 0.016	< 0.017
08/19/2019	09/03/2019	< 0.009	< 0.018	< 0.018	< 0.007
09/03/2019	09/16/2019	< 0.010	< 0.010	< 0.023	< 0.023
09/16/2019	09/30/2019	< 0.022	< 0.022	< 0.021	< 0.008
09/30/2019	10/14/2019	< 0.011	< 0.008	< 0.018	< 0.019
10/14/2019	10/28/2019	< 0.006	< 0.015	< 0.015	< 0.013
10/28/2019	11/11/2019	< 0.023	< 0.023	< 0.010	< 0.005
11/11/2019	11/25/2019	< 0.012	< 0.012	< 0.010	< 0.009
11/25/2019	12/09/2019	< 0.012	< 0.014	< 0.014	< 0.008
12/09/2019	12/23/2019	< 0.010	< 0.010	< 0.005	< 0.009
12/23/2019	01/06/2020	< 0.008	< 0.016	< 0.016	< 0.014

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 2019	2 nd Qtr 2019	3 rd Qtr 2019	4 th Qtr 2019	Annual Mean 2019
TA1	10.1	10.3	11.2	11.0	10.7
TB1	13.9	14.0	15.1	15.1	14.5
TC1	14.5	14.6	16.0	15.2	15.1
TD1	14.1	15.3	16.1	15.4	15.2
TE1	12.9	13.4	14.4	14.2	13.8
TF1	12.9	14.1	14.5	14.6	14.0
TG1⁽¹⁾	14.6	15.9	16.6	15.9	15.7
TH1	11.6	11.9	12.4	12.5	12.1
TJ1	12.0	13.4	13.5	13.3	13.0
TK1	13.2	14.0	14.1	14.9	14.1
TL1	13.4	14.2	14.6	13.9	14.0
TM1	11.2	12.0	12.3	12.5	12.0
TN1	13.3	14.2	14.9	14.2	14.2
TP1	11.9	13.1	13.2	13.5	12.9
TQ1	9.9	10.3	11.2	10.8	10.6
TR1	10.0	10.4	10.7	10.8	10.5

⁽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 2019	2nd Qtr 2019	3rd Qtr 2019	4th Qtr 2019	Annual Mean 2019
TCS	12.1	12.0	13.0	12.6	12.4
TGS⁽¹⁾	15.4	14.8	16.3	15.1	15.4
TNS	12.7	12.6	13.4	13.9	13.2
TRS	14.3	14.3	15.1	14.3	14.5
TQS1	14.0	15.4	16.0	15.8	15.3
TQS2	12.3	12.3	12.7	13.3	12.6

⁽¹⁾ Special interest station with highest annual mean.

Table 12: Thermoluminescent Dosimeters – Control

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1st Qtr 2019	2nd Qtr 2019	3rd Qtr 2019	4th Qtr 2019	Annual Mean 2019
TAC⁽¹⁾	14.2	15.4	16.4	14.5	15.1
TEC	12.9	13.5	14.5	14.3	13.8

⁽¹⁾ Control station with highest annual mean.

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)	02/25/2019	02/25/2019	< 6.55	< 6.48	< 13.4	< 7.02	< 13.9	< 6.01	< 14.0	< 14.1	< 5.16	< 5.96	< 26.5	< 10.1
SWU (Control)	02/25/2019	02/25/2019	< 5.63	< 6.47	< 12.6	< 6.25	< 9.27	< 6.27	< 12.5	< 10.5	< 6.83	< 5.33	< 32.3	< 10.7
SWD (Indicator)	06/11/2019	06/11/2019	< 5.03	< 3.82	< 8.69	< 5.61	< 9.66	< 5.08	< 6.55	< 7.62	< 5.73	< 4.79	< 20.5	< 6.72
SWU (Control)	06/11/2019	06/11/2019	< 4.50	< 3.83	< 7.76	< 3.85	< 9.19	< 4.10	< 5.53	< 6.82	< 4.96	< 4.38	< 17.9	< 5.12
SWD (Indicator)	09/09/2019	09/09/2019	< 5.72	< 6.48	< 12.0	< 5.75	< 12.4	< 6.89	< 9.19	< 9.08	< 6.11	< 4.97	< 19.3	< 7.93
SWU (Control)	09/09/2019	09/09/2019	< 6.87	< 4.82	< 13.6	< 6.05	< 12.4	< 6.23	< 10.5	< 12.5	< 7.86	< 6.98	< 29.1	< 9.91
SWD (Indicator)	11/11/2019	11/11/2019	< 4.41	< 4.58	< 11.4	< 5.11	< 8.26	< 4.84	< 14.2	< 8.19	< 5.18	< 4.84	< 35.8	< 10.0
SWU (Control)	11/11/2019	11/11/2019	< 4.00	< 4.72	< 9.63	< 4.46	< 8.95	< 5.20	< 12.6	< 8.10	< 4.14	< 4.27	< 25.7	< 9.90

Monitoring Results Tables

Table 14: Surface Water – Tritium

Analysis: H-3		Units: pCi/L	
Location	Start Date	End Date	H-3
REQUIRED LLD →			2000
SWD (Indicator)	02/25/2019	02/25/2019	< 566
SWU (Control)	02/25/2019	02/25/2019	< 552
SWD (Indicator)	06/11/2019	06/11/2019	< 388
SWU (Control)	06/11/2019	06/11/2019	< 382
SWD (Indicator)	09/09/2019	09/09/2019	< 543
SWU (Control)	09/09/2019	09/09/2019	< 540
SWD (Indicator)	11/11/2019	11/11/2019	< 573
SWU (Control)	11/11/2019	11/11/2019	< 552

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)	05/27/2019	< 5.31	< 6.13	< 10.8	< 7.26	< 12.5	< 5.76	< 11.5	< 7.95	< 6.88	< 6.34	< 27.9	< 11.5
WU (Control)	05/27/2019	< 5.43	< 4.75	< 10.3	< 6.40	< 8.43	< 4.82	< 10.3	< 10.8	< 5.90	< 6.36	< 26.3	< 9.30
WD (Indicator)	11/18/2019	< 5.38	< 5.32	< 13.7	< 7.27	< 11.4	< 5.87	< 8.96	< 9.16	< 4.68	< 4.67	< 26.4	< 8.76
WU (Control)	11/11/2019	< 3.76	< 4.46	< 9.39	< 4.50	< 8.12	< 4.92	< 14.5	< 7.46	< 4.55	< 4.31	< 30.6	< 10.9

Monitoring Results Tables

Table 16: Groundwater – Tritium

Analysis: H-3		Units: pCi/L	
Location	Start Date	End Date	H-3
REQUIRED LLD →			2000
WD (Indicator)	05/27/2019	05/27/2019	< 570
WU (Control)	05/27/2019	05/27/2019	< 564
WD (Indicator)	11/18/2019	11/18/2019	< 569
WU (Control)	11/11/2019	11/11/2019	< 566

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)	09/09/2019	< 58.68	< 43.73
SEDU (Control)	09/09/2019	< 89.94	< 82.33

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)	09/09/2019	< 70.85	< 72.75	< 118.9	< 67.76	< 135.9	< 52.05	< 72.19
FU (Control)	09/09/2019	< 48.89	< 41.20	< 102.2	< 47.63	< 102.7	< 42.37	< 55.17

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)	02/25/2019	< 34.04	< 18.26	< 18.11
GQC (Control)	02/25/2019	< 38.81	< 23.78	< 23.42
GN1 (Indicator)	06/10/2019	< 23.09	< 17.49	< 16.32
GQC (Control)	06/11/2019	< 16.10	< 15.52	< 15.00
GN1 (Indicator)	09/04/2019	< 37.14	< 24.78	< 18.58
GQC (Control)	09/04/2019	< 23.92	< 17.47	< 15.16
GN1 (Indicator)	11/11/2019	< 48.54	< 21.23	< 18.94
GQC (Control)	11/11/2019	< 32.49	< 18.58	< 14.81

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 ERA April 2019 water Cs-134 result was evaluated as Not Acceptable. The reported value was 15.2 pCi/L (error 2.82 pCi/L) and the known result was 12.1 pCi/L (acceptance range of 8.39 - 14.4 pCi/L). With the error, the reported result overlaps the acceptable range. This sample was run as the workgroup duplicate on a different detector with a result of 10.7 pCi/L (within acceptable range). (NCR 19-10)
2. The ERA April 2019 water Sr-89 result was evaluated as Not Acceptable. The reported value was 44.9 pCi/L and the known result was 33.3 pCi/L (acceptance range of 24.5 - 40.1 pCi/L). The sample was only counted for 15 minutes instead of 200 minutes. The sample was re-prepped in duplicate and counted for 200 minutes with results of 30.7 ± 5.37 pCi/L and 33.0 ± 8.71 pCi/L. This was the 1st "high" failure for Sr-89 in 5 years. (NCR 19-11)
3. The MAPEP February 2019 soil Sr-90 result was not submitted and therefore evaluated as Not Acceptable. The sample was run in duplicate, with results of -1.32 ± 4.09 Bq/kg (<6.87) and -1.030 ± 3.55 Bq/kg (<5.97). The known result was a false positive test (no significant activity). TBE did not submit a result because it appeared that the results may not be accurate. TBE analyzed a substitute soil Sr-90 sample from another vendor, with a result within the acceptable range. (NCR 19-12)
4. The MAPEP February 2019 water Am-241 result was evaluated as Not Acceptable. The reported value was 0.764 ± 0.00725 Bq/L with a known result of 0.582 Bq/L (acceptable range 0.407 - 0.757 Bq/L). TBE's result falls within the upper acceptable range with the error. It appeared that a non-radiological interference was added and lead to an increased mass and higher result. (NCR 19-13)
5. The MAPEP February 2019 vegetation Sr-90 result was evaluated as Not Acceptable. The reported result was -0.1060 ± 0.0328 Bq/kg and the known result was a false positive test (no significant activity). TBE's result was correct in that there was no activity. MAPEP's evaluation was a "statistical failure" at 3 standard deviations. (NCR 19-14)

Annual Radiological Environmental Operating Report

Interlaboratory Comparison Program Results

6. The ERA October 2019 water Gross Alpha result was evaluated as Not Acceptable. TBE's reported result was 40.5 ± 10.3 pCi/L and the known result was 27.6 pCi/L (ratio of TBE to known result at 135%). With the associated error, the result falls within the acceptable range (14.0 - 36.3 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 30.8 ± 9.17 pCi/L (within the acceptable range). This was the first failure for drinking water Gr-A since 2012. (NCR 19-23)
7. The ERA October 2019 water Sr-90 result was evaluated as Not Acceptable. TBE's reported result was 32.5 ± 2.12 pCi/L and the known result was 26.5 pCi/L (ratio of TBE to known result at 123%). With the associated error, the result falls within the acceptable range (19.2 - 30.9 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 20.0 ± 1.91 pCi/L (within the acceptable range). Both TBE results are within internal QC limits. A substitute "quick response" sample was analyzed with an acceptable result of 18.6 pCi/L (known range of 13.2 - 22.1 pCi/L). (NCR 19-24)
8. The MAPEP August 2019 soil Ni-63 result of 436 ± 22.8 Bq/kg was evaluated as Not Acceptable. The known result was 629 Bq/kg (acceptable range 440 - 818 Bq/sample). With the associated error, the TBE result falls within the lower acceptance range. All associated QC was acceptable. No reason for failure could be found. This is the first failure for soil Ni-63 since 2012. (NCR 19-25).
9. The MAPEP August 2019 water Am-241 result was not reported and therefore evaluated as Not Acceptable. Initial review of the results showed a large peak where Am-241 should be (same as the February, 2019 sample results). It is believed that Th-228 was intentionally added as an interference. The sample was re-prepped and analyzed using a smaller sample aliquot. The unusual large peak (Th-228) was seen again and also this time a smaller peak (Am-241). The result was 436 ± 22.8 Bq/L (acceptable range 0.365 ± 0.679 Bq/L). Th-228 is not a typical nuclide requested by clients, so there is no analytical purpose to take samples through an additional separation step. TBE will pursue using another vendor for Am-241 water cross-checks that more closely reflects actual customer samples. (NCR 19-26)
10. The Analytics September 2019 soil Cr-51 sample was evaluated as Not Acceptable. TBE's reported result of 0.765 ± 0.135 pCi/g exceeded the upper acceptance range (140% of the known result of 0.547 pCi/g). The TBE result was within the acceptable range (0.63 - 0.90 pCi/g) with the associated error. The Cr-51 result is very close to TBE's normal detection limit. In order to get a reportable result, the sample must be counted for 15 hours (10x longer than client samples). There is no client or regulatory requirement for this nuclide and TBE will remove Cr-51 from the reported gamma nuclides going forward. (NCR 19-27)

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

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

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Ratio of TBE to Analytics Result	Evaluation ^(b)		
March 2019	E12468A	Milk	Sr-89	pCi/L	87.1	96	0.91	A		
			Sr-90	pCi/L	12.6	12.6	1.00	A		
	E12469A	Milk	Ce-141	pCi/L	113	117	0.97	A		
			Co-58	pCi/L	153	143	1.07	A		
			Co-60	pCi/L	289	299	0.97	A		
			Cr-51	pCi/L	233	293	0.80	A		
			Cs-134	pCi/L	147	160	0.92	A		
			Cs-137	pCi/L	193	196	0.98	A		
			Fe-59	pCi/L	153	159	0.96	A		
			I-131	pCi/L	91.5	89.5	1.02	A		
			Mn-54	pCi/L	149	143	1.04	A		
			Zn-65	pCi/L	209	220	0.95	A		
			E12470	Charcoal	I-131	pCi	77.5	75.2	1.03	A
			E12471	AP	Ce-141	pCi	60.7	70.2	0.87	A
					Co-58	pCi	87.9	85.8	1.02	A
Co-60	pCi	175			179	0.98	A			
Cr-51	pCi	165			176	0.94	A			
Cs-134	pCi	91.2			95.9	0.95	A			
Cs-137	pCi	120			118	1.02	A			
Fe-59	pCi	108			95.3	1.13	A			
Mn-54	pCi	94.2			85.7	1.10	A			
Zn-65	pCi	102			132	0.77	W			
E12472	Water	Fe-55	pCi/L	2230	1920	1.16	A			
E12473	Soil	Ce-141	pCi/g	0.189	0.183	1.03	A			
		Co-58	pCi/g	0.209	0.224	0.93	A			
		Co-60	pCi/g	0.481	0.466	1.03	A			
		Cr-51	pCi/g	0.522	0.457	1.14	A			
		Cs-134	pCi/g	0.218	0.250	0.87	A			
		Cs-137	pCi/g	0.370	0.381	0.97	A			
		Fe-59	pCi/g	0.263	0.248	1.06	A			
		Mn-54	pCi/g	0.248	0.223	1.11	A			
E12474	AP	Sr-89	pCi	88.3	95.2	0.93	A			
		Sr-90	pCi	11.7	12.5	0.94	A			
August 2019	E12562	Soil	Sr-90	pCi/g	4.710	6.710	0.70	W		

(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

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

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Ratio of TBE to Analytics Result	Evaluation ^(b)		
September 2019	E12475	Milk	Sr-89	pCi/L	70.0	93.9	0.75	W		
			Sr-90	pCi/L	12.0	12.9	0.93	A		
	E12476	Milk	Ce-141	pCi/L	150	167	0.90	A		
			Co-58	pCi/L	170	175	0.97	A		
			Co-60	pCi/L	211	211	1.00	A		
			Cr-51	pCi/L	323	331	0.98	A		
			Cs-134	pCi/L	180	207	0.87	A		
			Cs-137	pCi/L	147	151	0.97	A		
			Fe-59	pCi/L	156	148	1.05	A		
			I-131	pCi/L	81.1	92.1	0.88	A		
			Mn-54	pCi/L	160	154	1.04	A		
			Zn-65	pCi/L	303	293	1.03	A		
			E12477	Charcoal	I-131	pCi	95.9	95.1	1.01	A
			E12478	AP	Ce-141	pCi	129	138	0.93	A
					Co-58	pCi	128	145	0.88	A
Co-60	pCi	181			174	1.04	A			
Cr-51	pCi	292			274	1.07	A			
Cs-134	pCi	166			171	0.97	A			
Cs-137	pCi	115			125	0.92	A			
Fe-59	pCi	119			123	0.97	A			
Mn-54	pCi	129			128	1.01	A			
Zn-65	pCi	230	242	0.95	A					
E12479	Water	Fe-55	pCi/L	1810	1850	0.98	A			
E12480	Soil	Ce-141	pCi/g	0.305	0.276	1.10	A			
		Co-58	pCi/g	0.270	0.289	0.93	A			
		Co-60	pCi/g	0.358	0.348	1.03	A			
		Cr-51	pCi/g	0.765	0.547	1.40	N ⁽¹⁾			
		Cs-134	pCi/g	0.327	0.343	0.95	A			
		Cs-137	pCi/g	0.308	0.321	0.96	A			
		Fe-59	pCi/g	0.257	0.245	1.05	A			
		Mn-54	pCi/g	0.274	0.255	1.07	A			
Zn-65	pCi/g	0.536	0.485	1.11	A					
E12481	AP	Sr-89	pCi	95.9	91.9	1.04	A			
		Sr-90	pCi	12.3	12.6	0.97	A			
E12563	Soil	Sr-90	pCi/g	0.392	0.360	1.09	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 19-27

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

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Acceptance Range	Evaluation ^(b)
February 2019	19-GrF40	AP	Gross Alpha	Bq/sample	0.184	0.528	0.158 - 0.898	A
			Gross Beta	Bq/sample	0.785	0.948		0.474 - 1.422
	19-MaS40	Soil	Ni-63	Bq/kg	420	519.0	363 - 675 (1)	A
			Sr-90	Bq/kg				
	19-MaW40	Water	Am-241	Bq/L	0.764	0.582	0.407 - 0.757 4.1 - 7.5 0.316 - 0.586 (2)	N ⁽⁴⁾
			Ni-63	Bq/L	4.72	5.8		A
			Pu-238	Bq/L	0.443	0.451		A
			Pu-239/240	Bq/L	-0.00161	0.0045		A
	19-RdF40	AP	U-234/233	Bq/sample	0.1138	0.106	0.074 - 0.138	A
			U-238	Bq/sample	0.107	0.110		0.077 - 0.143
	19-RdV40	Vegetation	Cs-134	Bq/sample	2.14	2.44	1.71 - 3.17 1.61 - 2.99 1.45 - 2.69 (1) (1) (1) 1.20 - 2.22	A
			Cs-137	Bq/sample	2.22	2.30		A
			Co-57	Bq/sample	2.16	2.07		A
			Co-60	Bq/sample	0.02382			A
			Mn-54	Bq/sample	-0.03607			A
			Sr-90	Bq/sample	-0.1060			N ⁽⁵⁾
			Zn-65	Bq/sample	1.35	1.71		1.20 - 2.22
August 2019	19-GrF41	AP	Gross Alpha	Bq/sample	0.192	0.528	0.158 - 0.898	W
			Gross Beta	Bq/sample	0.722	0.937		0.469 - 1.406
	19-MaS41	Soil	Ni-63	Bq/kg	436	629	440 - 818 400 - 744	N ⁽⁶⁾
			Sr-90	Bq/kg	444	572		400 - 744
	19-MaW41	Water	Am-241	Bq/L			6.8 - 12.6 (2) 0.509 - 0.945	NR ⁽⁷⁾
			Ni-63	Bq/L	7.28	9.7		W
			Pu-238	Bq/L	0.0207	0.0063		A
			Pu-239/240	Bq/L	0.741	0.727		A
	19-RdF41	AP	U-234/233	Bq/sample	0.0966	0.093	0.065 - 0.121	A
			U-238	Bq/sample	0.0852	0.096		0.067-0.125
	19-RdV41	Vegetation	Cs-134	Bq/sample	0.0197		(1) 2.30 - 4.26 3.20 - 5.94 3.71 - 6.89 3.14 - 5.84 0.70 - 1.30 2.00 - 3.71	A
			Cs-137	Bq/sample	3.21	3.28		A
			Co-57	Bq/sample	4.62	4.57		A
			Co-60	Bq/sample	4.88	5.30		A
			Mn-54	Bq/sample	4.54	4.49		A
			Sr-90	Bq/sample	0.889	1.00		A
			Zn-65	Bq/sample	2.78	2.85		2.00 - 3.71

(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 19-12**

(4) See **NCR 19-13**

(5) See **NCR 19-14**

(6) See **NCR 19-25**

(7) See **NCR 19-26**

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

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Acceptance Limits	Evaluation ^(b)
April 2019	Rad-117	Water	Ba-133	pCi/L	26.3	24.1	18.6 - 27.8	A
			Cs-134	pCi/L	15.2	12.1	8.39 - 14.4	N ⁽¹⁾
			Cs-137	pCi/L	33.6	33.1	28.8 - 39.4	A
			Co-60	pCi/L	11.9	11.5	8.67 - 15.5	A
			Zn-65	pCi/L	87.1	89.2	80.3 - 107	A
			GR-A	pCi/L	19	19.3	9.56 - 26.5	A
			GR-B	pCi/L	20.2	29.9	19.1 - 37.7	A
			U-Nat	pCi/L	55.5	55.9	45.6 - 61.5	A
			H-3	pCi/L	21500	21400	18700 - 23500	A
			Sr-89	pCi/L	44.9	33.3	24.5 - 40.1	N ⁽²⁾
			Sr-90	pCi/L	24.5	26.3	19.0 - 30.7	A
			I-131	pCi/L	28.9	28.4	23.6 - 33.3	A
October 2019	Rad-119	Water	Ba-133	pCi/L	42.7	43.8	35.7 - 48.8	A
			Cs-134	pCi/L	53.5	55.9	45.2 - 61.5	A
			Cs-137	pCi/L	77.7	78.7	70.8 - 89.2	A
			Co-60	pCi/L	51.5	53.4	48.1 - 61.3	A
			Zn-65	pCi/L	36.6	34.0	28.5 - 43.1	A
			GR-A	pCi/L	40.5	27.6	14.0 - 36.3	N ⁽³⁾
			GR-B	pCi/L	36.3	39.8	26.4 - 47.3	A
			U-Nat	pCi/L	27.66	28.0	22.6 - 31.1	A
			H-3	pCi/L	22800	23400	20500 - 25700	A
			Sr-89	pCi/L	47.1	45.5	35.4 - 52.7	A
			Sr-90	pCi/L	32.5	26.5	19.2 - 30.9	N ⁽⁴⁾
			I-131	pCi/L	26.0	23.9	19.8 - 28.4	A
December 2019	QR 120419D	Water	Sr-90	pCi/L	20.1	18.6	13.2 - 22.1	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 19-10**

(2) See **NCR 19-11**

(3) See **NCR 19-23**

(4) See **NCR 19-24**