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

Subject: 2021 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, 2021, through December 31, 2021. 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,

A handwritten signature in black ink, appearing to read 'T. Schenk', written over a faint, illegible stamp.

Tim Schenk

TAS/twf

Enclosure: 2021 Annual Radiological Environmental Operating Report

cc: NRC Senior Resident Inspector – River Bend Station, Unit 1

Enclosure
2021 Annual Radiological Environmental Operating Report



Plant: River Bend Station	Page 1 of 44
	YEAR: 2021
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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, 2021. 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 2021, 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 2021 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 2021, 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 2021 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 2021, environmental sampling was performed for seven media types addressed in the ODCM and for direct radiation. A total of 328 samples of the 328 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 2021 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>TLDS 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.

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Table 2: Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
<p>TLDS</p> <p>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.

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Table 2: Exposure Pathway – Direct Radiation

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
<p>TLDS</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 NNW) – 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.

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Table 3: Exposure Pathway – Waterborne

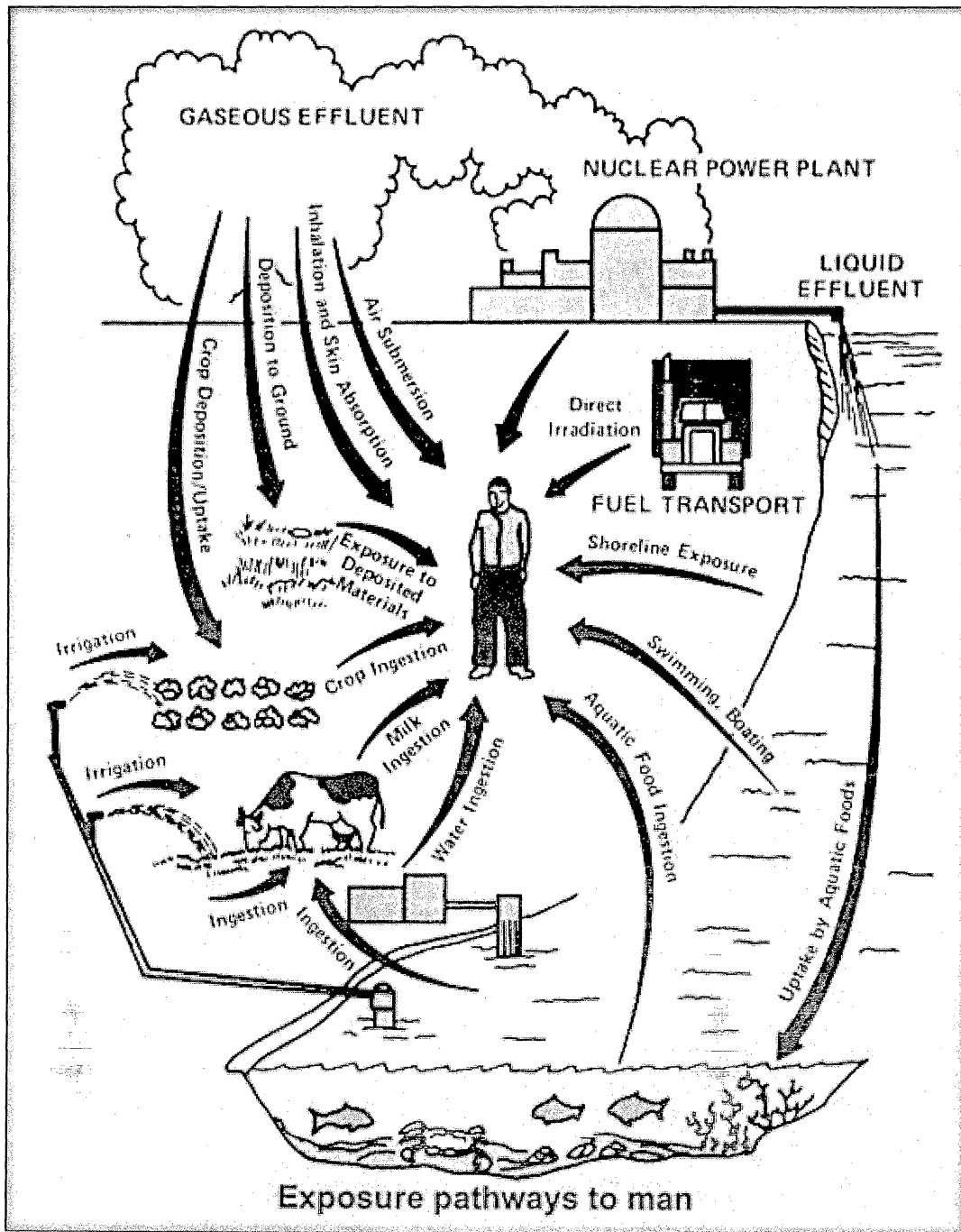
Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
<p><u>SURFACE WATER</u> 1 sample upstream and 1 sample downstream.</p>	<ul style="list-style-type: none"> • SWU (5.0 km W) - Mississippi River about 4 km upstream from the plant 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>

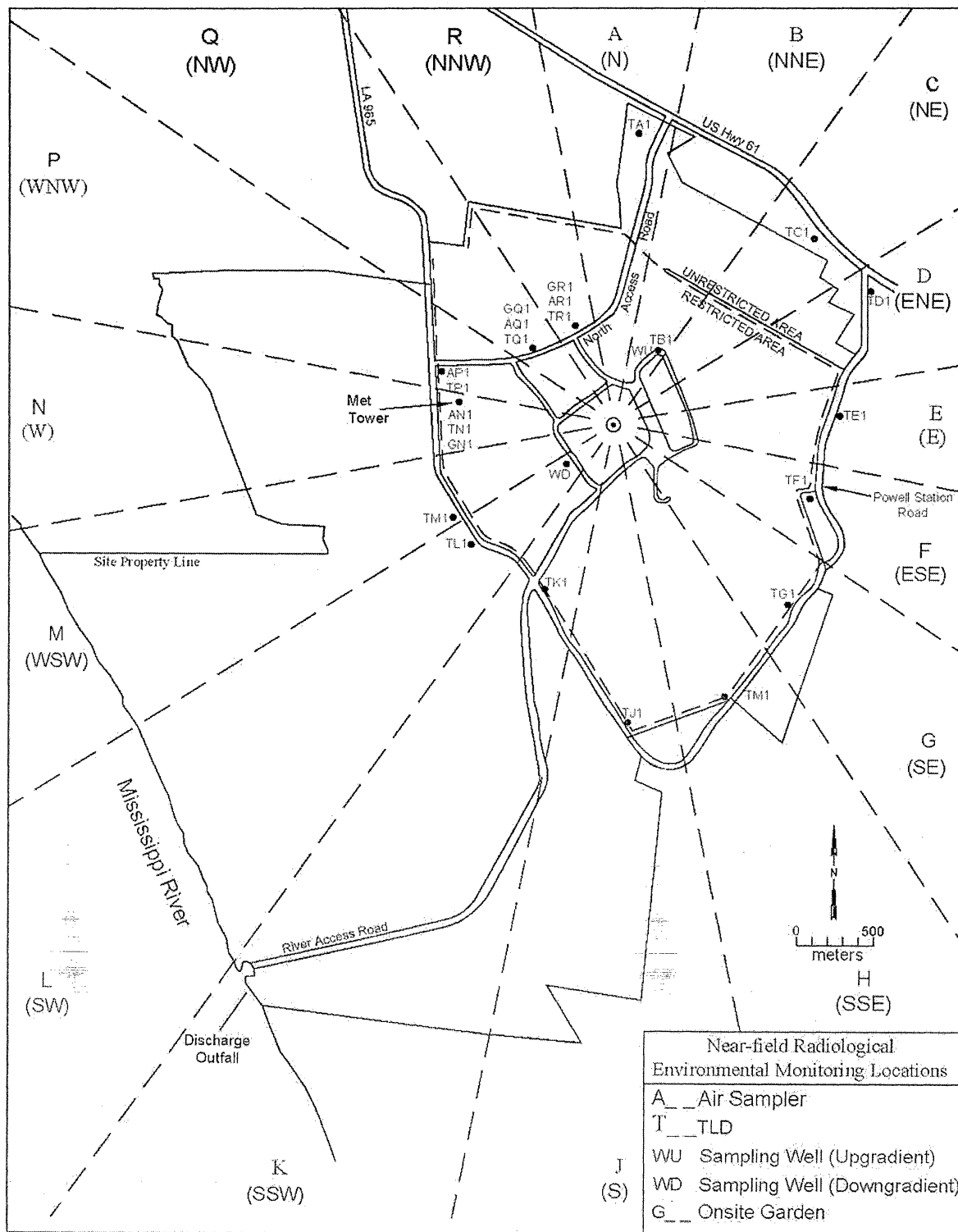
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Figure 1: Exposure Pathway



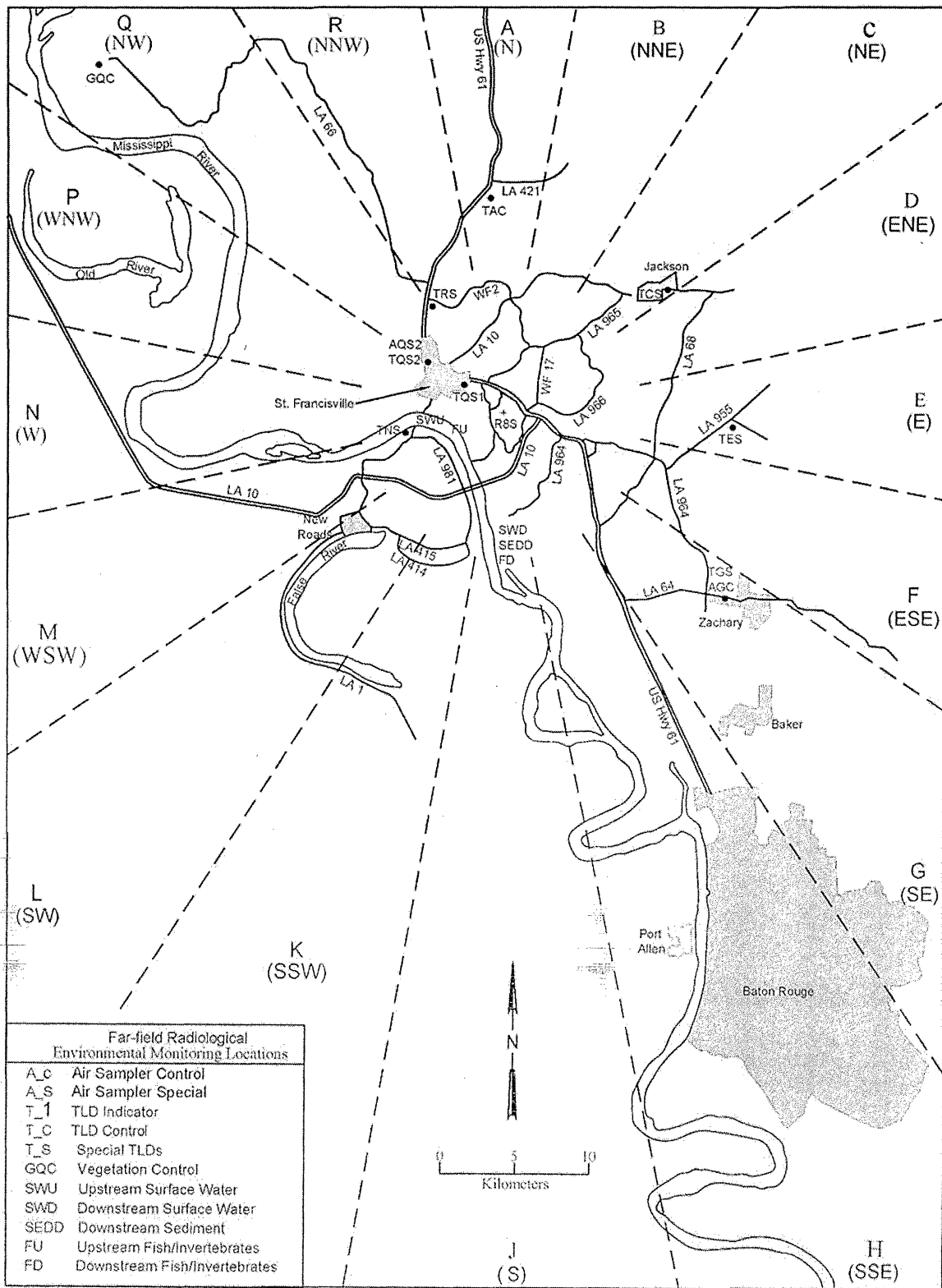
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Figure 2: Sample Collection Sites – Near Field



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Figure 3: Sample Collection Sites - Far Field



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4.0 INTERPRETATION AND TRENDS OF RESULTS

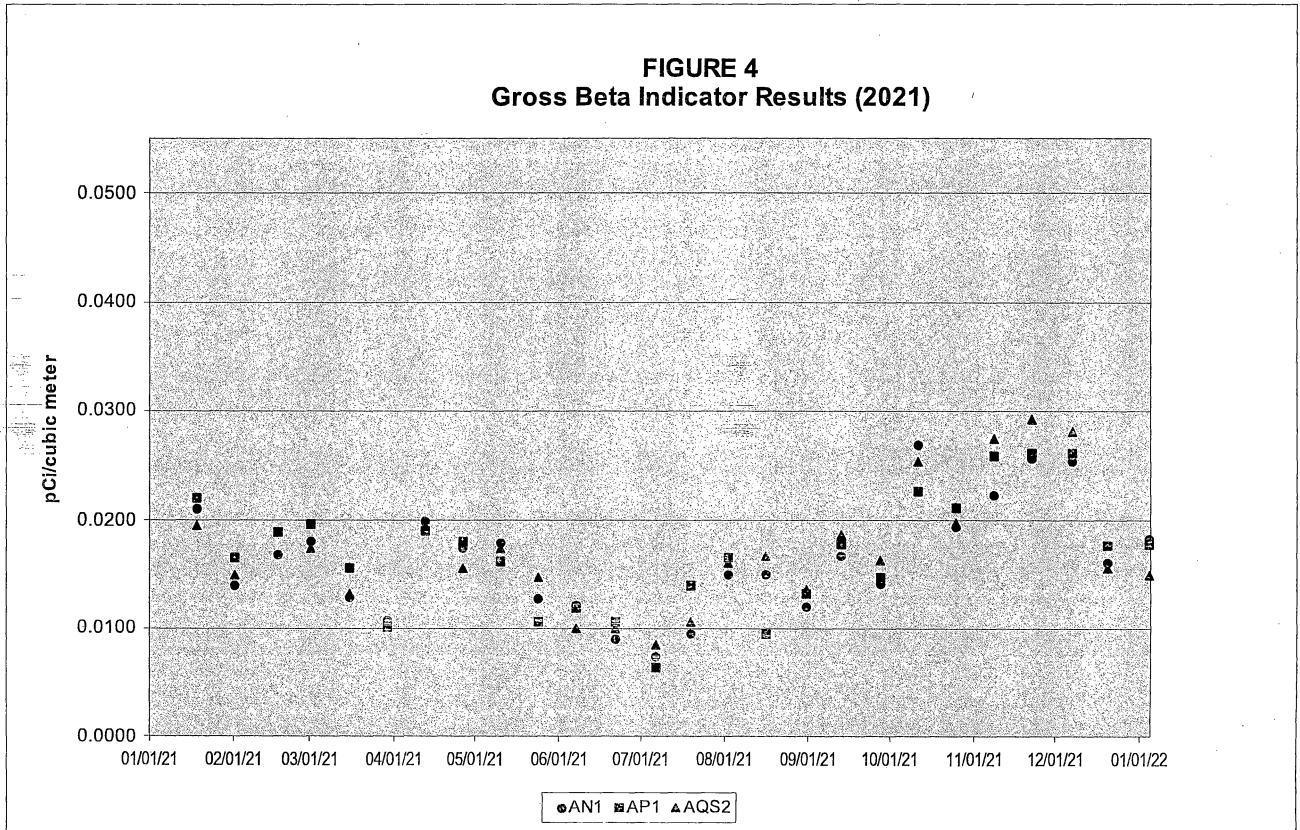
4.1 Air Particulate and Radioiodine Sample Results

In 2021 there were no samples above the LLD for I-131. Indicator gross beta air particulate results for 2021 were comparable to results obtained from 2011-2020 of the operational REMP. Also, the 2021 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>
2011 – 2020 (Minimum Value)	0.016
2021 Average Value	0.017
2011 – 2020 (Maximum Value)	0.025
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 (2021)

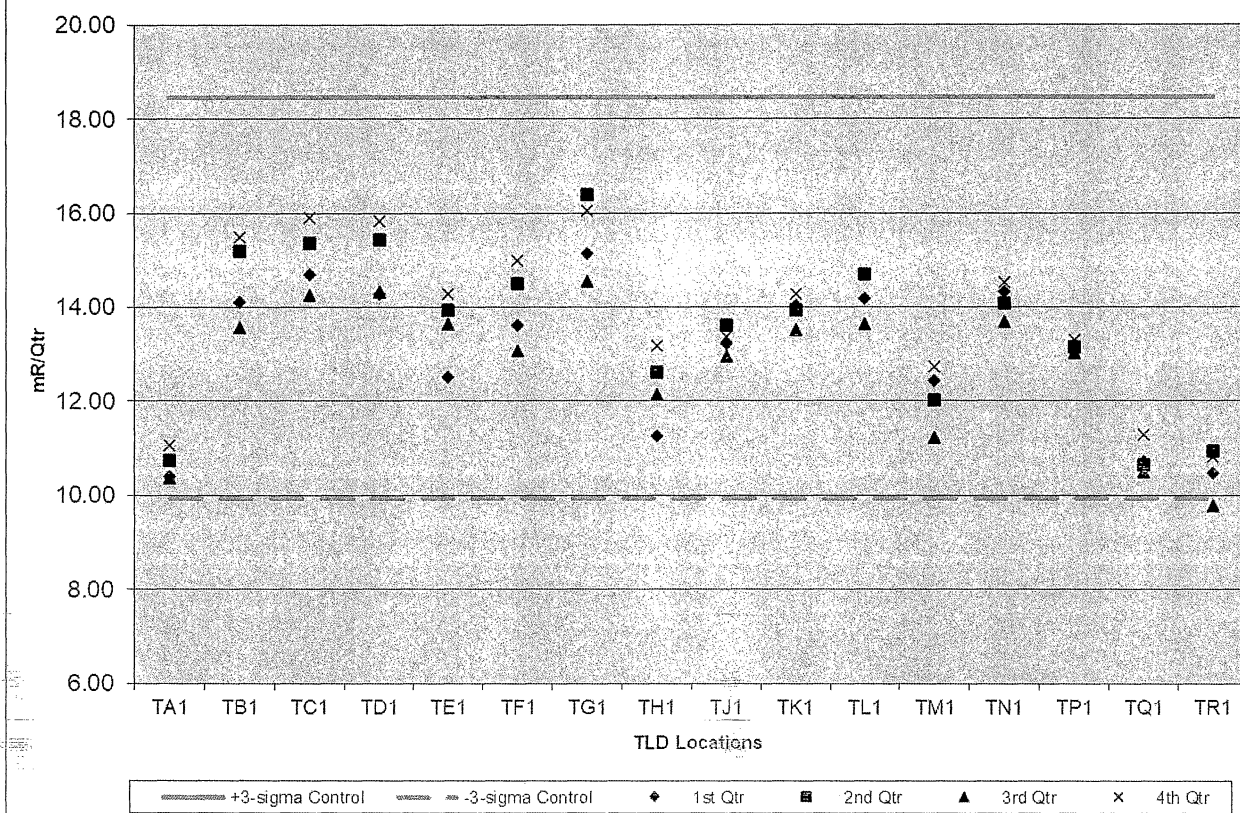


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4.2 Thermoluminescent Dosimetry (TLD) Sample Results

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 2021 concentration is comparable to historic results. Overall, River Bend Station concluded that the ambient radiation levels are not being affected by plant operations.

FIGURE 5
TLD Indicator Results (2021) Versus Control Data (1986-2021)



4.3 Waterborne Sample Results

Analytical results for 2021 surface water and groundwater water samples were similar to those reported in previous years. Gamma radionuclides and tritium analytical results for 2021 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 2021.

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 2021.

4.3.3 Sediment Sample Results

Sediment samples were collected from one indicator and one control location in 2021 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 2021, 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 2021, food products samples were collected when available from one indicator and one control location and analyzed for gamma radionuclides. The 2021 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 2021 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.

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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 2021 REMP program.

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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	0.0168 (78/78) [0.006 - 0.029]	AGC (17.0 km SE)	0.0174 (26/26) [0.007 - 0.027]	0.0174 (26/26) [0.007 - 0.027]	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⁾	13.3 (64/64) [9.8 - 16.4]	TG1 (1.6 km SE)	15.5 (4/4) [14.6 - 16.4]	N/A	0
Special Interest TLDs (mR/Qtr)	Gamma / 24	⁽⁶⁾	14.1 (24/24) [11.7 - 17.2]	TGS (17.0 km SE)	15.8 (4/4) [14.8 - 17.2]	N/A	0
Control TLDs (mR/Qtr)	Gamma / 8	⁽⁶⁾	N/A	TAC (15.8 km N)	15.3 (4/4) [14.7 - 16.0]	14.7 (8/8) [13.2 - 16.0]	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	< LLD	N/A	N/A	< LLD	0

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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

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	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.

Table 7: Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
1	Air Sample	AGC	05/13/2021	Power Outage	During the performance of REMP-3 it was discovered that the environmental air sampler at location AGC experienced a loss of power on 4/29/21 1315 for approximately 19 minutes. The sampler was operating normally at the time of discovery, and it was verified that an adequate sample volume was obtained for the sample period. This condition will be reported in the 2021 AREOR as a sample deviation. No further actions are needed at this time. (CR-RBS-2021-03642)
2	Air Sample	AR1 AQ1 AP1 AN1	05/25/2021	Power Outage	During the performance of REMP-3 it was noted that the environmental air samplers at locations AR1, AQ1, AP1, and AN1 experienced multiple power outages during the 5-10-21 to 5-24-21 sample period. The first outage occurred for all four of the previously named samplers on 5-17-21 at 2135 for approximately 1 minute. This outage is due to an electrical transient due to severe weather. All four samplers experienced a second outage on 5-18-21 for approximately 3 hours. This was due to a planned outage of Grant Substation for construction loop repairs. AR1 experienced a third outage for 9 hours and 38 minutes on 5-22-21 at 1004. The cause of this power loss is unknown. All samplers were operating normally on 5-24-21. It was verified that all samplers obtained a sufficient sample volume for the period to meet required LLDs. This condition will be reported in the AREOR as a sample deviation. No further actions are needed at this time. (CR-RBS-2021-03840)

Sample Deviations

Table 7: Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
3	Air Sample	AGC	06/22/2021	Power Outage	During the performance of REMP-3, it was discovered that the environmental air sampler at location AGC experienced a power outage on 6/12/21 15:22 for one hour and twenty-two minutes. The cause of this power outage is suspected to be due to an electrical transient that occurred in the area. It was verified that an adequate sample volume was collected for the sample period, and the sampler was operating normally at the time of discovery. In addition, the LADEQ air sampler at the same location was found not running and had a blown fuse. LADEQ was contacted to replace the sampler and/or fuse. The condition of the REMP air sampler will be evaluated and reported in the 2021 AREOR as a sample deviation. No further actions are needed at this time. (CR-RBS-2021-04446)
4	Air Sample	AGC	8/31/2021	Power Outage	During the performance of REMP-3, it was discovered that air sampler at location AGC experienced three losses of power from 08/28/21 1655 to 08/29/21 2144. The power losses were one, four, and two minutes in duration, respectively for a total of 7 minutes during the sample period. The cause of these power losses is attributed to severe weather conditions caused by Hurricane Ida affecting the area. It was verified that a sufficient sample volume was collected to meet the required LLD. This condition will be evaluated and reported in the 2021 AREOR as a sample deviation. No further actions are needed at this time. (CR-RBS-2021-05612)

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 (Indicator)	AGC ⁽¹⁾ (Control)
REQUIRED LLD →		0.01	0.01	0.01	0.01
01/04/2021	01/18/2021	0.021	0.022	0.020	0.025
01/18/2021	02/01/2021	0.014	0.017	0.015	0.015
02/01/2021	02/17/2021	0.017	0.019	0.019	0.020
02/17/2021	03/01/2021	0.018	0.020	0.018	0.019
03/01/2021	03/15/2021	0.013	0.016	0.013	0.015
03/15/2021	03/29/2021	0.011	0.010	0.011	0.009
03/29/2021	04/12/2021	0.020	0.019	0.020	0.017
04/12/2021	04/26/2021	0.018	0.018	0.016	0.017
04/26/2021	05/10/2021	0.018	0.016	0.018	0.018
05/10/2021	05/24/2021	0.013	0.011	0.015	0.013
05/24/2021	06/07/2021	0.012	0.012	0.010	0.015
06/07/2021	06/21/2021	0.009	0.011	0.010	0.009
06/21/2021	07/06/2021	0.007	0.006	0.009	0.007
07/06/2021	07/19/2021	0.009	0.014	0.011	0.012
07/19/2021	08/02/2021	0.015	0.017	0.016	0.012
08/02/2021	08/16/2021	0.015	0.009	0.017	0.015
08/16/2021	08/31/2021	0.012	0.013	0.014	0.015
08/31/2021	09/13/2021	0.017	0.018	0.019	0.021
09/13/2021	09/27/2021	0.014	0.015	0.016	0.015
09/27/2021	10/11/2021	0.027	0.023	0.025	0.025
10/11/2021	10/25/2021	0.019	0.021	0.020	0.025
10/25/2021	11/08/2021	0.022	0.026	0.028	0.026
11/08/2021	11/22/2021	0.026	0.026	0.029	0.026
11/22/2021	12/07/2021	0.025	0.026	0.028	0.027
12/07/2021	12/20/2021	0.016	0.018	0.016	0.017
12/20/2021	01/04/2022	0.018	0.018	0.015	0.021

⁽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 →		0.07	0.07	0.07	0.07
01/04/2021	01/18/2021	< 0.014	< 0.014	< 0.011	< 0.008
01/18/2021	02/01/2021	< 0.020	< 0.009	< 0.020	< 0.015
02/01/2021	02/17/2021	< 0.005	< 0.012	< 0.012	< 0.010
02/17/2021	03/01/2021	< 0.024	< 0.010	< 0.024	< 0.010
03/01/2021	03/15/2021	< 0.023	< 0.022	< 0.022	< 0.022
03/15/2021	03/29/2021	< 0.023	< 0.023	< 0.010	< 0.017
03/29/2021	04/12/2021	< 0.016	< 0.016	< 0.016	< 0.012
04/12/2021	04/26/2021	< 0.025	< 0.024	< 0.025	< 0.011
04/26/2021	05/10/2021	< 0.013	< 0.019	< 0.019	< 0.008
05/10/2021	05/24/2021	< 0.009	< 0.022	< 0.022	< 0.009
05/24/2021	06/07/2021	< 0.011	< 0.026	< 0.026	< 0.023
06/07/2021	06/21/2021	< 0.006	< 0.023	< 0.023	< 0.011
06/21/2021	07/06/2021	< 0.017	< 0.017	< 0.017	< 0.008
07/06/2021	07/19/2021	< 0.017	< 0.017	< 0.014	< 0.025
07/19/2021	08/02/2021	< 0.007	< 0.018	< 0.019	< 0.019
08/02/2021	08/16/2021	< 0.012	< 0.018	< 0.019	< 0.008
08/16/2021	08/31/2021	< 0.006	< 0.014	< 0.015	< 0.016
08/31/2021	09/13/2021	< 0.009	< 0.022	< 0.022	< 0.008
09/13/2021	09/27/2021	< 0.009	< 0.018	< 0.018	< 0.019
09/27/2021	10/11/2021	< 0.016	< 0.016	< 0.007	< 0.011
10/11/2021	10/25/2021	< 0.016	< 0.007	< 0.016	< 0.010
10/25/2021	11/08/2021	< 0.013	< 0.019	< 0.020	< 0.020
11/08/2021	11/22/2021	< 0.009	< 0.015	< 0.013	< 0.016
11/22/2021	12/07/2021	< 0.006	< 0.013	< 0.010	< 0.013
12/07/2021	12/20/2021	< 0.018	< 0.018	< 0.018	< 0.015
12/20/2021	01/04/2022	< 0.012	< 0.012	< 0.012	< 0.012

Monitoring Results Tables

Table 10: Thermoluminescent Dosimeters – Indicators

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1 st Qtr 2021	2 nd Qtr 2021	3 rd Qtr 2021	4 th Qtr 2021	Annual Mean 2021
TA1	10.4	10.7	10.4	11.1	10.6
TB1	14.1	15.2	13.6	15.5	14.6
TC1	14.7	15.4	14.3	15.9	15.1
TD1	14.3	15.4	14.3	15.8	15.0
TE1	12.5	14.0	13.6	14.3	13.6
TF1	13.6	14.5	13.1	15.0	14.1
TG1⁽¹⁾	15.1	16.4	14.6	16.1	15.5
TH1	11.3	12.6	12.1	13.2	12.3
TJ1	13.2	13.6	13.0	13.4	13.3
TK1	14.0	14.0	13.5	14.3	14.0
TL1	14.2	14.7	13.7	14.7	14.3
TM1	12.4	12.0	11.2	12.7	12.1
TN1	14.3	14.1	13.7	14.5	14.2
TP1	13.2	13.1	13.0	13.3	13.2
TQ1	10.7	10.7	10.5	11.3	10.8
TR1	10.5	11.0	9.8	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 2021	2nd Qtr 2021	3rd Qtr 2021	4th Qtr 2021	Annual Mean 2021
TCS	13.1	13.2	11.7	12.7	12.7
TGS⁽¹⁾	15.1	16.0	14.8	17.2	15.8
TNS	13.8	13.2	12.3	14.0	13.3
TRS	14.9	14.9	13.1	14.7	14.4
TQS1	15.2	16.0	14.7	15.5	15.3
TQS2	13.0	13.2	12.2	13.5	13.0

⁽¹⁾ Special interest station with highest annual mean.

Table 12: Thermoluminescent Dosimeters – Control

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1st Qtr 2021	2nd Qtr 2021	3rd Qtr 2021	4th Qtr 2021	Annual Mean 2021
TAC⁽¹⁾	14.7	15.6	14.7	16.0	15.3
TEC	13.9	13.9	13.2	15.5	14.1

⁽¹⁾ Control station with highest annual mean.

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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)	03/01/2021	03/01/2021	< 4.98	< 4.89	< 13.7	< 4.97	< 10.4	< 6.10	< 11.5	< 10.1	< 6.09	< 4.80	< 33.5	< 10.6
SWU (Control)	03/01/2021	03/01/2021	< 4.90	< 5.97	< 14.1	< 6.83	< 14.9	< 6.91	< 14.7	< 11.8	< 7.11	< 5.55	< 27.4	< 10.8
SWD (Indicator)	05/06/2021	05/06/2021	< 3.45	< 6.27	< 7.88	< 4.36	< 9.46	< 4.23	< 13.7	< 7.07	< 5.14	< 4.48	< 34.0	< 8.36
SWU (Control)	05/06/2021	05/06/2021	< 5.07	< 5.59	< 13.9	< 4.20	< 10.8	< 4.51	< 12.4	< 6.91	< 4.40	< 4.64	< 30.1	< 8.80
SWD (Indicator)	08/02/2021	08/02/2021	< 6.02	< 4.52	< 12.1	< 8.42	< 9.69	< 5.58	< 9.40	< 10.3	< 7.49	< 6.15	< 22.5	< 8.31
SWU (Control)	08/02/2021	08/02/2021	< 5.75	< 6.38	< 9.77	< 7.44	< 7.25	< 5.08	< 6.86	< 10.8	< 4.99	< 5.05	< 19.2	< 6.32
SWD (Indicator)	11/08/2021	11/08/2021	< 5.91	< 7.44	< 11.2	< 7.01	< 12.5	< 7.74	< 10.9	< 11.1	< 8.59	< 6.30	< 32.0	< 11.6
SWU (Control)	11/08/2021	11/08/2021	< 6.03	< 6.18	< 12.6	< 7.38	< 15.3	< 6.96	< 11.2	< 11.3	< 8.06	< 5.83	< 37.1	< 8.79

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)	03/01/2021	03/01/2021	< 551
SWU (Control)	03/01/2021	03/01/2021	< 547
SWD (Indicator)	05/06/2021	05/06/2021	< 487
SWU (Control)	05/06/2021	05/06/2021	< 506
SWD (Indicator)	08/02/2021	08/02/2021	< 502
SWU (Control)	08/02/2021	08/02/2021	< 508
SWD (Indicator)	11/08/2021	11/08/2021	< 525
SWU (Control)	11/08/2021	11/08/2021	< 489

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)	05/13/2021	< 5.08	< 6.42	< 12.8	< 5.42	< 12.0	< 6.34	< 8.74	< 10.2	< 5.64	< 5.69	< 27.4	< 11.5
WU (Control)	05/13/2021	< 7.08	< 6.68	< 13.3	< 6.96	< 10.9	< 7.01	< 10.6	< 9.69	< 8.02	< 7.41	< 32.5	< 11.2
WD (Indicator)	11/08/2021	< 5.88	< 4.94	< 13.5	< 5.62	< 11.9	< 7.27	< 12.2	< 9.09	< 6.39	< 6.93	< 34.5	< 11.9
WU (Control)	11/08/2021	< 5.44	< 7.32	< 16.2	< 6.94	< 15.1	< 6.23	< 10.8	< 11.7	< 7.77	< 6.75	< 35.0	< 10.2

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)	05/13/2021	05/13/2021	< 499
WU (Control)	05/13/2021	05/13/2021	< 500
WD (Indicator)	11/08/2021	11/08/2021	< 459
WU (Control)	11/08/2021	11/08/2021	< 472

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)	11/08/2021	< 68.47	< 71.89
SEDU (Control)	11/08/2021	< 103.4	< 100.6

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 →		130	130	260	130	260	130	150
FD (Indicator)	09/21/2021	< 59.74	< 50.52	< 135.2	< 69.52	< 122.4	< 47.40	< 54.08
FU (Control)	09/21/2021	< 49.79	< 41.77	< 86.25	< 48.12	< 92.22	< 38.84	< 53.67

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)	02/01/2021	< 30.17	< 32.59	< 34.49
GQC (Control)	02/01/2021	< 27.55	< 19.77	< 24.35
GN1 (Indicator)	05/06/2021	< 33.17	< 13.47	< 11.96
GQC (Control)	05/06/2021	< 23.51	< 8.269	< 7.463
GN1 (Indicator)	08/16/2021	< 42.21	< 34.95	< 29.29
GQC (Control)	08/16/2021	< 28.55	< 24.85	< 26.22
GN1 (Indicator)	11/09/2021	< 32.69	< 30.77	< 32.24
GQC (Control)	11/09/2021	< 31.85	< 31.61	< 24.23

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Interlaboratory Comparison Program Results

1.0 Summary

For the Teledyne Brown Engineering (TBE) laboratory, 146 out of 153 analyses performed met the specified acceptance criteria. Seven analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program. *NOTE: One analysis (soil for Tc-99) that did not meet acceptance criteria was performed for TBE information and is not on the list of required ICP analyses.*

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 MRAD March 2021 Water Fe-55 result was evaluated as *Not Acceptable*. The reported value for Fe-55 was 579 pCi/L and the known result was 275 pCi/L (acceptance range 162 - 400). When reviewing the original sample data, it was found that the carrier yield was 52.6% (lower than typical water samples). Looking at the etched plate that was counted, it appeared that some loss of sample could have occurred. The sample was logged for reanalysis and used as the workgroup duplicate. The results were acceptable at 197 and 221 respectively. Yields were 97.4% and 105.7% and the plated samples were centered with no apparent loss of sample. The loss of sample during plating resulted in a low yield which produced an artificially high sample result. (NCR 21-01)
2. The MAPEP February 2021 AP Gross Alpha result was evaluated as *Not Acceptable*. The reported value was 0.371 Bq/sample and the known result was 1.77 Bq/sample (acceptance range 0.53 - 3.01). A similar failure had occurred several years prior due to the filter being placed with the wrong side up on the detector. At that time, a small dot was placed on the top of the filter prior to removal from the package to indicate the correct side for counting. The current sample was still in the detector when the result was received (dot side facing the detector). The sample was recounted with a similar result and was flipped and recounted. The flipped result was 0.661 Bq/sample, within the acceptable range. Because TBE cannot rely on receiving correct packaging from the provider, MAPEP AP cross-checks will be counted on both sides going forward. *NOTE: The August sample had the same packaging issue (upside down).* (NCR 21-02)
3. The MAPEP February 2021 soil Ni-63 was evaluated as *Not Acceptable*. The reported value was 310 Bq/kg and the known result was 689 (acceptance range 482 - 896). All workgroup QC was reviewed with no anomalies. The analytical procedure had been revised prior to this analysis to eliminate added interferences. The sample yield was >100%, indicative of incomplete separation from interferences, leading to a lower result. The procedure was again revised after acceptable results were obtained. (NCR 21-03)

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Interlaboratory Comparison Program Results

4. The ERA October 2021 water Gross Beta result was evaluated as Not Acceptable. The reported value was 63.0 pCi/L and the known was 55.7 (acceptance range 38.1 - 62.6) or 113% of the known. The 2-sigma error was 6.8, placing the reported result well within the acceptable range. All QA was reviewed with no anomalies. A follow-up Quick Response cross-check was analyzed with a 120% ratio (see item 7). (NCR 21-10)
5. The ERA October 2021 water Tritium result was evaluated as Not Acceptable. The reported value was 13,800 pCi/L and the known was 17,200 (acceptance range 15,000 - 18,900). The 2-sigma error was 1,430, placing the result within the acceptable range. TBE's internal QC acceptance is 70% - 130%, while ERA's for this sample was 87% - 110%. All QA was reviewed with no anomalies. A Quick Response follow-up cross-check was analyzed with a result of 17,500 pCi/L (known 17,800 pCi/L). (NCR 21-11)
6. The MAPEP August 2021 soil Ni-63 result was evaluated as Not Acceptable. The reported value was 546 Bq/kg and the known result was 1,280 Bq/kg (acceptance range 896 - 1,664). All QC was reviewed and no anomalies found. The procedure revision to remove added MAPAP interferences was ineffective for this sample. No client soil matrix samples were analyzed for Ni-63 in 2020 or 2021. The root cause investigation is still ongoing at this time. (NCR 21-13)
7. The ERA December 2021 Quick Response water Gross Beta result was evaluated as Not Acceptable. The reported value was 47.6 pCi/L and the known was 39.8 pCi/L or 120% of the known (acceptance range of 26.4 - 47.3). The 2-sigma error was 6.1, placing the reported result well within the acceptable range. All QA was reviewed with no anomalies. The original sample was recounted on a different detector with a result of 40.3 ± 6.27 pCi/L. The "failure" of this sample and the RAD-127 was due to the narrow upper acceptance ranges assigned (119% and 112%) (NCR 21-14)

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 2021	E13466	Milk	Sr-89	pCi/L	84.6	87.1	0.97	A		
			Sr-90	pCi/L	11.5	12.6	0.91	A		
March 2021	E13467	Milk	Ce-141	pCi/L	111	125	0.89	A		
			Co-58	pCi/L	123	128	0.96	A		
			Co-60	pCi/L	140	154	0.91	A		
			Cr-51	pCi/L	252	242	1.04	A		
			Cs-134	pCi/L	130	151	0.86	A		
			Cs-137	pCi/L	110	110	1.00	A		
			Fe-59	pCi/L	105	109	0.96	A		
			I-131	pCi/L	77.6	86.9	0.89	A		
			Mn-54	pCi/L	111	112	0.99	A		
			Zn-65	pCi/L	200	211	0.95	A		
			E13468	Charcoal	I-131	pCi	83.5	88.5	0.94	A
			E13469	AP	Ce-141	pCi	103.0	103	1.00	A
					Co-58	pCi	93.3	105	0.89	A
					Co-60	pCi	136	126	1.08	A
Cr-51	pCi	213			198	1.07	A			
Cs-134	pCi	123.0			124	0.99	A			
Cs-137	pCi	86.3			90.1	0.96	A			
Fe-59	pCi	81.3			89.6	0.91	A			
Mn-54	pCi	93.5			92.0	1.02	A			
E13470	Soil	Ce-141	pCi/g	0.232	0.262	0.89	A			
		Co-58	pCi/g	0.251	0.268	0.94	A			
		Co-60	pCi/g	0.306	0.322	0.95	A			
		Cr-51	pCi/g	0.517	0.506	1.02	A			
		Cs-134	pCi/g	0.263	0.317	0.83	A			
		Cs-137	pCi/g	0.278	0.301	0.92	A			
		Fe-59	pCi/g	0.228	0.229	1.00	A			
		Mn-54	pCi/g	0.221	0.235	0.94	A			
E13471	AP	Sr-89	pCi	92.2	95.5	0.97	A			
		Sr-90	pCi	11.7	13.9	0.84	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

**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 2021	E13472	Milk	Sr-89	pCi/L	66.4	85.4	0.78	W		
			Sr-90	pCi/L	11.9	14.0	0.85	A		
September 2021	E13473	Milk	Ce-141	pCi/L	118	114	1.03	A		
			Co-58	pCi/L	116	118	0.98	A		
			Co-60	pCi/L	142	145	0.98	A		
			Cr-51	pCi/L	244	236	1.03	A		
			Cs-134	pCi/L	81	93.1	0.87	A		
			Cs-137	pCi/L	105	112	0.94	A		
			Fe-59	pCi/L	105	102	1.03	A		
			I-131	pCi/L	65.1	85.6	0.76	W		
			Mn-54	pCi/L	128	128	1.00	A		
			Zn-65	pCi/L	158	153	1.03	A		
			E13474	Charcoal	I-131	pCi	85.2	90.9	0.94	A
			E13475	AP	Ce-141	pCi	126	135	0.94	A
					Co-58	pCi	148	139	1.07	A
					Co-60	pCi	183	171	1.07	A
					Cr-51	pCi	322	278	1.16	A
Cs-134	pCi	118			110	1.08	A			
Cs-137	pCi	147			132	1.12	A			
Fe-59	pCi	131			120	1.09	A			
Mn-54	pCi	161			151	1.06	A			
E13476	Soil	Ce-141	pCi/g	0.215	0.219	0.98	A			
		Co-58	pCi/g	0.208	0.226	0.92	A			
		Co-60	pCi/g	0.277	0.277	1.00	A			
		Cr-51	pCi/g	0.388	0.452	0.86	A			
		Cs-134	pCi/g	0.157	0.178	0.88	A			
		Cs-137	pCi/g	0.270	0.284	0.95	A			
		Fe-59	pCi/g	0.218	0.195	1.12	A			
		Mn-54	pCi/g	0.239	0.246	0.97	A			
E13477	AP	Sr-89	pCi	85.6	68.3	1.25	W			
		Sr-90	pCi	12.6	11.2	1.13	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

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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 2021	21-GrF44	AP	Gross Alpha	Bq/sample	0.371	1.77	0.53 - 3.01	N ⁽³⁾
			Gross Beta	Bq/sample	0.731	0.65	0.325 - 0.974	A
	21-MaS44	Soil	Ni-63	Bq/kg	310	689.0	482 - 896	N ⁽⁴⁾
			Tc-99	Bq/kg	457	638	447 - 829	W
	21-MaSU44	Urine	Cs-134	Bq/L	2.34	2.73	1.91 - 3.55	A
			Cs-137	Bq/L	2.54	2.71	1.90 - 3.52	A
			Co-57	Bq/L	0.4100		(1)	A
			Co-60	Bq/L	2.24	2.44	1.71 - 3.17	A
			Mn-54	Bq/L	2.03	2.03	1.42 - 2.64	A
			K-40	Bq/L	52.8	54.0	38 - 70	A
			U-234	Bq/L	0.108	0.0877	0.0614 - 0.114	W
			U-238	Bq/L	0.101	0.091	0.064 - 0.118	A
			Zn-65	Bq/L	1.06	1.34	(2)	A
	21-MaW44	Water	Ni-63	Bq/L	6.7	8.2	5.7 - 10.7	A
			Tc-99	Bq/L	3.850	4.01	2.81 - 5.21	A
	21-RdV44	Vegetation	Cs-134	Bq/sample	3.13	3.60	2.5 - 4.7	A
			Cs-137	Bq/sample	4.64	4.69	3.28 - 6.10	A
			Co-57	Bq/sample	5.25	5.05	3.54 - 6.57	A
			Co-60	Bq/sample	2.86	2.99	2.09 - 3.89	A
			Mn-54	Bq/sample	5.02	5.25	3.68 - 6.83	A
Sr-90			Bq/sample	0.631	0.673	0.471 - 0.875	A	
Zn-65			Bq/sample	-0.233		(1)	A	
August 2021	21-GrF45	AP	Gross Alpha	Bq/sample	0.368	0.960	0.288 - 1.632	A
			Gross Beta	Bq/sample	0.595	0.553	0.277 - 0.830	A
	21-MaS45	Soil	Ni-63	Bq/kg	546	1280	896 - 1664	N ⁽⁵⁾
			Tc-99	Bq/kg	453	777	544 - 1010	N ⁽⁶⁾
	21-MaSU45	Urine	Cs-134	Bq/L	3.10	3.62	2.53 - 4.71	A
			Cs-137	Bq/L	0.083		(1)	A
			Co-57	Bq/L	0.844	0.87	0.606 - 1.125	A
			Co-60	Bq/L	0.0535		(1)	A
			Mn-54	Bq/L	0.459	0.417	(2)	A
			K-40	Bq/L	48.8	54.0	38 - 70	A
			U-234	Bq/L	0.133	0.116	0.081 - 0.151	A
			U-238	Bq/L	0.137	0.121	0.085 - 0.157	A
			Zn-65	Bq/L	0.339	0.420	(2)	A
	21-MaW45	Water	Ni-63	Bq/L	33.5	39.5	27.7 - 51.4	A
			Tc-99	Bq/L	3.5	3.7	2.60 - 4.82	A
	21-RdV45	Vegetation	Cs-134	Bq/sample	3.42	4.34	3.04 - 5.64	W
			Cs-137	Bq/sample	2.14	2.21	1.55 - 2.87	A
			Co-57	Bq/sample	4.08	4.66	3.26 - 6.06	A
			Co-60	Bq/sample	2.81	3.51	2.46 - 4.56	A
			Mn-54	Bq/sample	0.035		(1)	A
Sr-90			Bq/sample	1.15	1.320	0.92 - 1.72	A	
Zn-65			Bq/sample	2.05	2.43	1.70 - 3.16	A	

(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 21-02

(4) See NCR 21-03

(5) See NCR 21-13

(6) Tc-99 cross-checks done for TBE information only - not required

**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)
March 2021	MRAD-34	Water	Am-241	pCi/L	175	157	108 - 201	A
			Fe-55	pCi/L	579	275	162 - 400	N ⁽¹⁾
			Pu-238	pCi/L	181	171	103 - 222	A
			Pu-239	pCi/L	153	142	87.9 - 175	A
		Soil	Sr-90	pCi/kg	6570	9190	2860 - 14,300	A
		AP	Fe-55	pCi/filter	107	121	44.2 - 193	A
			U-234	pCi/filter	25.99	25.5	18.9 - 29.9	A
			U-238	pCi/filter	24.7	25.3	19.1 - 30.2	A
		April 2021	RAD-125	Water	Ba-133	pCi/L	92.3	90.5
Cs-134	pCi/L				62.9	70.5	57.5 - 77.6	A
Cs-137	pCi/L				161	168	151 - 187	A
Co-60	pCi/L				22.5	20.9	17.7 - 25.8	A
Zn-65	pCi/L				183	177.0	159 - 208	A
GR-A	pCi/L				30.8	30.2	15.4 - 39.4	A
GR-B	pCi/L				60.1	67.5	46.8 - 74.2	A
U-Nat	pCi/L				36.45	36.9	30.0 - 40.8	A
H-3	pCi/L				13,400	14,600	12,800 - 16,100	A
Sr-89	pCi/L				64.5	63.5	51.4 - 71.5	A
Sr-90	pCi/L				22.8	23.0	16.5 - 27.0	A
I-131	pCi/L				28.2	26.7	22.2 - 31.4	A
September 2021	MRAD-35				Water	Am-241	pCi/L	68
		Fe-55	pCi/L	179		246	145 - 358	A
		Pu-238	pCi/L	102		114	68.5 - 148	A
		Pu-239	pCi/L	32		34.3	21.2 - 42.3	A
		Soil	Sr-90	pCi/kg	6160	6090	1,900 - 9,490	A
		AP	Fe-55	pCi/filter	493	548	200 - 874	A
			Pu-238	pCi/filter	28	28.5	21.5 - 35.0	A
			Pu-239	pCi/filter	21	21.6	16.1 - 26.1	A
			U-234	pCi/filter	7.95	7.76	5.75 - 9.09	A
			U-238	pCi/filter	8.0	7.69	5.81 - 9.17	A
October 2021	RAD-127		Water	Ba-133	pCi/L	82.8	87.5	73.6 - 96.2
		Cs-134		pCi/L	64.0	70.1	57.1 - 77.1	A
		Cs-137		pCi/L	145	156	140 - 174	A
		Co-60		pCi/L	83.2	85.9	77.3 - 96.8	A
		Zn-65		pCi/L	133	145	130 - 171	A
		GR-A		pCi/L	76.0	66.7	35.0 - 82.5	A
		GR-B		pCi/L	63.0	55.7	38.1 - 62.6	N ⁽²⁾
		U-Nat		pCi/L	52.88	55.5	45.3 - 61.1	A
		H-3		pCi/L	13,800	17,200	15,000 - 18,900	N ⁽³⁾
		Sr-89		pCi/L	54.9	61.0	49.1 - 68.9	A
		Sr-90		pCi/L	24.8	29.3	21.3 - 34.0	A
I-131	pCi/L	27.4	26.4	21.9 - 31.1	A			
December 2021	QR 120121Y	Water	GR-B	pCi/L	47.6	39.8	26.4 - 47.3	N ⁽⁴⁾
			H-3	pCi/L	17,500	17,800	15,600 - 19,600	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 21-01

(2) See NCR 21-10

(3) See NCR 21-11

(4) See NCR 21-14