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U.S. Nuclear Regulatory Commission
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Subject: Annual Radiological Environmental Operating Report -2020
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
Renewed Facility Operating License No. NPF-38

Attached is the Annual Radiological Environmental Operating Report for the period of January 1 through December 31, 2020. This report is submitted pursuant to the Requirements of Waterford 3 Technical Specification Section 6.9.1.7.

This report contains no new commitments. Please contact Paul Wood, Regulatory Assurance Manager, at (504) 464-3786 if you have questions regarding this information.

Respectfully,

Paul Wood

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PW/IIb

Attachment: Annual Radiological Environmental Operating Report – 2020

cc: NRC Region IV Regional Administrator
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Attachment to

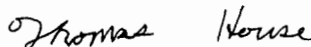
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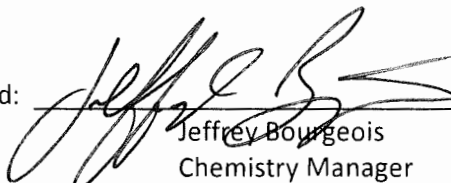
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**2020 Annual Radiological Environmental Operating Report
Waterford 3
Document Number: 50-382**

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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 Waterford 3 Radiological Environmental Monitoring Program (REMP) for the period January 1 through December 31, 2020. This report fulfills the requirements of Waterford 3 Technical Specification 6.9.1.7.

All required lower limit of detection (LLD) capabilities were achieved in all sample analyses during 2020, as required by Waterford 3's Technical Requirements Manual (TRM) Table 4.12-1. No measurable levels of radiation above baseline levels attributable to Waterford 3's operation were detected in the vicinity of Waterford 3. The 2020 Radiological Environmental Monitoring Program thus substantiated the adequacy of source control and effluent monitoring at Waterford 3 with no observed impact of plant operations on the environment.

Waterford 3 established the REMP prior to the station becoming operational in 1985 to provide data on background radiation and radioactivity normally present in the area. Waterford 3 has continued to monitor the environment by sampling air, water, sediment, fish and broad leaf, as well as measuring direct radiation. Waterford 3 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 31-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. Waterford 3 personnel compare indicator results with control and preoperational results to assess any impact Waterford 3 operation might have had on the surrounding environment.

In 2020, environmental samples were collected for radiological analysis. The results of indicator locations were compared with control locations and previous studies. It was concluded that no significant relationship exists between Waterford 3 operation and effect on the area around the plant. The review of 2020 data showed radioactivity levels in the environment were undetectable in many locations and near background levels in significant pathways.

1.2 Reporting Levels

Waterford 3's review indicates that no samples equaled or exceeded reporting levels for radioactivity concentration in environmental samples, as outlined in Technical Requirements Manual (TRM) Table 3.12-2 when averaged over any calendar quarter, due to Waterford 3 effluents. Therefore, 2020 results did not trigger any radiological monitoring program special reports.

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

Waterford 3 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 Environmental Radiological Laboratory – Department of Environmental Quality Laboratory Services Division (ERL-DEQLSD).

The NRC TLD Network Program was discontinued in 1998. Historically these results have compared to those from the Waterford 3 REMP. Waterford 3's 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 ERL-DEQLSD and the Waterford 3 REMP entail similar radiological environmental monitoring program requirements. These programs include collecting air samples and splitting or sharing sample media such as water, sediment and fish. Both programs have obtained similar results over previous years.

1.4 Sample Deviations

During 2020, environmental sampling was performed for eight media types addressed in the ODCM and for direct radiation. A total of 467 samples of the 468 scheduled were obtained. Of the scheduled samples, 99.8% were collected and analyzed in accordance with the requirements specified in the ODCM. Attachment 1 contains the listing of sample deviations and actions taken.

1.5 Program Modifications

There were no program modifications during the reporting period.

2.0 INTRODUCTION**2.1 Radiological Environmental Monitoring Program**

Waterford 3 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 Waterford 3.
- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

Annual Radiological Environmental Operating Report**2.2 Pathways Monitored**

The airborne, direct radiation, waterborne and ingestion pathways are monitored as required by Waterford 3 TRM Table 3.12-1. A description of the REMP utilized to monitor the exposure pathways is described in the attached Tables and Figures.

Section 4.0 of this report provides a discussion of 2020 sampling results with Section 5.0 providing a summary of results for the monitored exposure pathways.

2.3 Land Use Census

Waterford 3 conducts a land use census biennially, as required by Section 3.12.2 of the TRM. The purpose of this census is to identify changes in uses of land within five miles of Waterford 3 that would require modifications to the REMP and the Offsite Dose Calculation Manual (ODCM/TRM). The most important criteria during this census are to determine the location in each sector of the nearest:

- 1) Residence
- 2) Animal milked for human consumption
- 3) Garden of greater than 50 m² (500 ft²) producing broad leaf vegetation.

Waterford 3 conducts the land use census by:

- Field surveys in each meteorological sector out to five miles in order to confirm:
 - Nearest permanent residence
 - Nearest garden > 50 square meters
 - Nearest beef cow
 - Nearest food product
 - Nearest milking animal
- Identifying locations on maps, measuring distances to Waterford 3 and recording results on data sheets.
- Comparing current census results to previous results.

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></p> <p>Three samples from close to the three SITE BOUNDARY locations, in different sectors, in or near sectors having the highest calculated annual average ground-level D/Q.</p>	<ul style="list-style-type: none"> • APQ-1 (NW, 0.81 Miles) – (West bank) Located in soybean/sugarcane field off LA 18 east of LA 18/3141 intersection. • APF-1 (ESE, 0.35 Miles) – (West bank) Located on north side of Secondary Meteorological Tower. • APC-1 (NE, 0.67 Miles) – (East bank) Located inside Little Gypsy Cooling Water Intake Structure fence. 	<p>Continuous sampler operation with sample collection biweekly, or more frequently if required by dust loading.</p>	<ul style="list-style-type: none"> • Radioiodine Canisters – I-131 analysis biweekly. • Air Particulate – Gross beta radioactivity analysis following filter change. Gamma isotopic analysis of composite (by location) quarterly.
<p><u>RADIOIODINE AND PARTICULATES</u></p> <p>One sample from the vicinity of a community having the highest calculated annual average ground level D/Q.</p>	<ul style="list-style-type: none"> • APP-1 (WNW, 0.84 Miles) – (West bank) Located in soybean/sugarcane field on Short St. in Killona. 	<p>Continuous sampler operation with sample collection biweekly, or more frequently if required by dust loading.</p>	<ul style="list-style-type: none"> • Radioiodine Canisters – I-131 analysis biweekly. • Air Particulate – Gross beta radioactivity analysis following filter change. Gamma isotopic analysis of composite quarterly.
<p><u>RADIOIODINE AND PARTICULATES</u></p> <p>One 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"> • APE-26 (E, 25.8 Miles) – (West bank) Located at Entergy office on Virgil Street in Gretna. (Control) 	<p>Continuous sampler operation with sample collection biweekly, or more frequently if required by dust loading.</p>	<ul style="list-style-type: none"> • Radioiodine Canisters – I-131 analysis biweekly. • Air Particulate – Gross beta radioactivity analysis following filter change. Gamma isotopic analysis of composite 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> An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<ul style="list-style-type: none"> • A-2 (N, 1.27 Miles) – (East bank) Located on pole on LA 628 at Zephrin L. Perriloux Fire House. • B-1 (NNE, 0.75 Miles) – (East bank) Located on fence west of Little Gypsy. • C-1 (NE, 0.67 Miles) – (East bank) Located on fence at Little Gypsy Cooling Water Intake structure. • D-2 (ENE, 1.24 Miles) – (East bank) Located on pole on levee at west entrance to Bonnet Carre Spillway • E-1 (E, 0.41 Miles) – (West bank) Located on pole on LA 18 east of Waterford 3 plant entrance. • F-2 (ESE, 1.15 Miles) – (West bank) Located on fence on LA 3142 south of LA 18. • G-2 (SE, 1.26 Miles) – (West bank) Located on fence on LA 3142 north of railroad overpass. • H-2 (SSE, 1.54 Miles) – (West bank) Located on fence on LA 3142 north of LA 3127/3142 intersection. 	<p>Quarterly</p>	<ul style="list-style-type: none"> • Gamma dose 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> An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<ul style="list-style-type: none"> • J-2 (S, 1.38 Miles) – (West bank) Located on fence south of LA 3127 west of LA 3127/3142 intersection. • K-1 (SSW, 1.06 Miles) – (West bank) Located on stop sign at entrance to Energy Education Center on LA 3127. • L-1 (SW, 1.06 Miles) – (West bank) Located on gate on LA 3127 west of LA 3127/3142 intersection. • M-1 (WSW, 0.76 Miles) – (West bank) Located on south gate of Waterford 1 and 2. • N-1 (W, 0.98 Miles) – (West bank) Located on pole at corner of Railroad Avenue and School House Road. • P-1 (WNW, 0.84 Miles) – (West bank) Located on fence enclosing air sample station APP-1. • Q-1 (NW, 0.81 Miles) – (West bank) Located on fence enclosing air sample station APQ-1. • R-1 (NNW, 0.51 Miles) – (West bank) Located at Waterford 1 and 2 Cooling Water Intake Structure. 	<p>Quarterly</p>	<ul style="list-style-type: none"> • Gamma dose 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> An outer ring of stations, one in ten of the meteorological sectors in the 6 to 8 km ranges from the site.</p>	<ul style="list-style-type: none"> • A-5 (N, 4.59 Miles) – (East bank) Located on pole at intersection of Oswald Avenue and US 61. • B-4 (NNE, 3.75 Miles) – (East bank) Located on pole near weigh station on US 61. • D-5 (ENE, 4.09 Miles) – (East bank) Located on gate on shell road north of US 61/LA 48 intersection. • E-5 (E, 4.08 Miles) – (East bank) Located on fence on Wesco Street off LA 48. • F-4 (ESE, 3.53 Miles) – (West bank) Located on pole behind house at 646 Aquarius St. in Hahnville. • G-4 (SE, 3.30 Miles) – (West bank) Located on pole on LA 3160 north of railroad track. • H-8 (SSE, 8.13 Miles) – (West bank) Located on pole in front of Hahnville High School. • P-6 (WNW, 5.58 Miles) – (West bank) Located on fence at LA 640/railroad track intersection. • Q-5 (NW, 5.01 Miles) – (West bank) Located on pole on LA 18 across from Mississippi River marker 137. • R-6 (NNW, 5.52 Miles) – (East bank) Located on fence on LA 3223 near railroad crossing. 	Quarterly	<ul style="list-style-type: none"> • Gamma dose 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 (five) to be placed in special interest areas such as population centers, nearby residences, schools, and in one or two areas to serve as control locations.</p>	<ul style="list-style-type: none"> • E-15 (E, 11.7 Miles) – (East bank) Located on fence on Alliance Avenue. • F-9 (ESE, 8.18 Miles) – (East bank) Located on fence north of railroad tracks on Jonathan Street. • G-8 (SE, 7.74 Miles) – (West bank) Located on back fence of Luling Entergy Office. • J-15 (S, 11.7 Miles) - (West bank) Located on pole near LA 631/Hwy 90 intersection in Des Allemands. • E-26 (E, 25.8 Miles) - (West bank) Located at Entergy office on Virgil Street in Gretna. (Control) 	<p>Quarterly</p>	<ul style="list-style-type: none"> • Gamma dose 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> One sample upstream and one sample downstream.</p>	<ul style="list-style-type: none"> • SWP-7 (WNW, 7.37 Miles) - (West bank) Located at St. John Parish Waterworks in Edgard. (Control) • SWF-2 (ESE, 1.51 Miles) - (West bank) Located at Dow Chemical Plant drinking water canal. • SWE-5 (E, 4.59 Miles) - (East bank) Located at St. Charles Parish Waterworks in New Sarpy. • SWK-1 (SSW, 0.49 Miles) - (West bank) Located at 40 Arpent Canal south of the plant. 	<p>Composite sample over one quarter period.</p>	<ul style="list-style-type: none"> • Gamma isotopic analysis and tritium analysis quarterly.
<p><u>DRINKING WATER</u> One sample upstream and one sample downstream.</p>	<ul style="list-style-type: none"> • DWP-7 (WNW, 7.37 Miles) - (West bank) Located at St. John Parish Waterworks in Edgard. (Control) • DWF-2 (ESE, 1.51 Miles) - (West bank) Located at Dow Chemical Plant drinking water canal. • DWE-5 (E, 4.59 Miles) - (East bank) Located at St. Charles Parish Waterworks in New Sarpy. 	<p>Composite sample over one month period when I-131 analysis is performed, quarterly composite otherwise.</p>	<ul style="list-style-type: none"> • I-131 analysis on each composite when the dose calculated for the consumption of the water is greater than one mrem per year. Composite for gross beta and gamma isotopic analyses quarterly. Composite for tritium analysis quarterly.
<p><u>SEDIMENT FROM SHORELINE</u> One sample upstream and one sample downstream.</p>	<ul style="list-style-type: none"> • SHWQ-6 (NW, 5.99 Miles) – (East bank) Located on LA 628 east of Reserve ferry landing. (Control) • SHWE-3 (E, 2.99 Miles) – (West bank) Located at Foot Ferry landing on LA 18. • SHWK-1 (SSW, 0.49 Miles) – (West bank) Located at 40 Arpent Canal south of plant. 	<p>Annually</p>	<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"> • Samples from milking animals in the three locations within 5 km distance having the highest dose potential. If there are none, then, one sample from milking animals in each of the three areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per year. • One sample from milking animals at a control location 15 – 30 km distant and in the least prevalent wind direction. 	<ul style="list-style-type: none"> • MKE-3 (E, 2.35 Miles) - (West bank) Located at the Zeringue’s house on LA 18 in Taft. • MKA-31 (N, 31.2 Miles) – (East bank) Located at 18736 Sisters Road, Ponchatoula, LA. (Control) 	<p>Quarterly</p>	<ul style="list-style-type: none"> • Gamma isotopic and I-131 analysis quarterly.
<p><u>FISH AND INVERTEBRATES</u></p> <ul style="list-style-type: none"> • One sample of each commercially and/or recreationally important species in vicinity of plant discharge area. • One sample of same species in area not influenced by plant discharge. 	<ul style="list-style-type: none"> • FH-2 (Distance/Direction Not Applicable) – Downstream of the plant discharge structure. • FH-3 (Distance/Direction Not Applicable) - (Westbank) Waterways downstream of plant discharge directed to 40 Arpent Canal. • FH-1 (Distance/Direction Not Applicable) – Upstream of the plant intake structure. (Control) 	<p>Sample in season, or annually if they are not seasonal.</p>	<ul style="list-style-type: none"> • Gamma isotopic analysis on edible portions annually.
<p><u>BROAD LEAF VEGATATION</u></p> <ul style="list-style-type: none"> • Samples of one to three different types of broadleaf vegetation grown nearest each of the two different off-site locations of highest predicted annual average ground level D/Q if milk sampling is not performed. • One sample of each of the similar broadleaf vegetation grown 15 – 30 km distant in the least prevalent wind direction if milk sampling is not performed. 	<ul style="list-style-type: none"> • BLQ-1 (NW, 0.83 Miles) – (West bank) Located near air sample station. • BLB-1 (NNE, 0.81 Miles) – (East bank) Located west of Little Gypsy on LA 628 • BLE-20 (E, 19.7 Miles) – (West bank) Located on property of Nine Mile Point in Westwego. (Control) 	<p>Quarterly during the growing season.</p>	<ul style="list-style-type: none"> • Gamma isotopic and I-131 analysis quarterly.

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Figure 1: Exposure Pathway

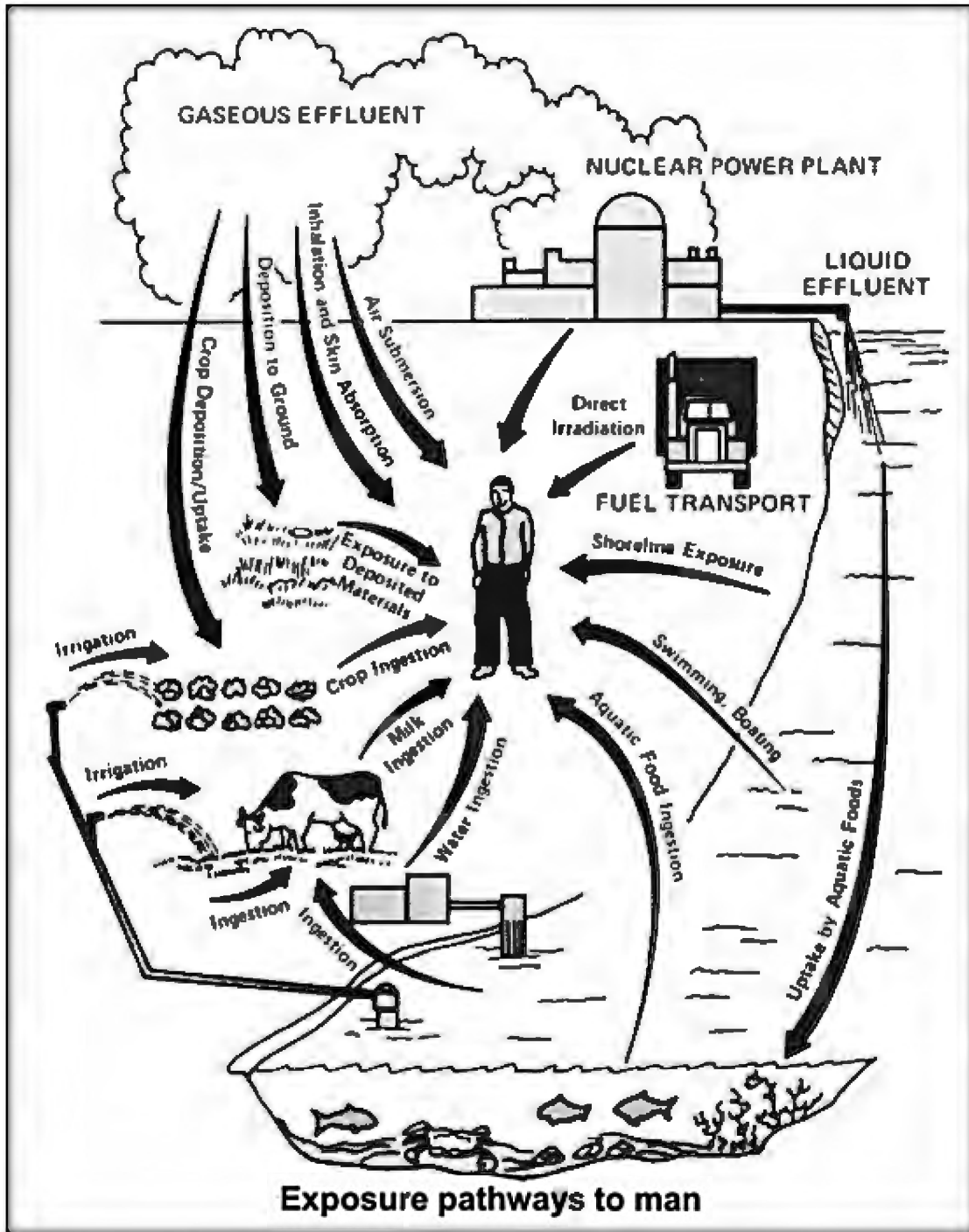


Figure 2: REMP Samples Within 2 Miles of Waterford 3

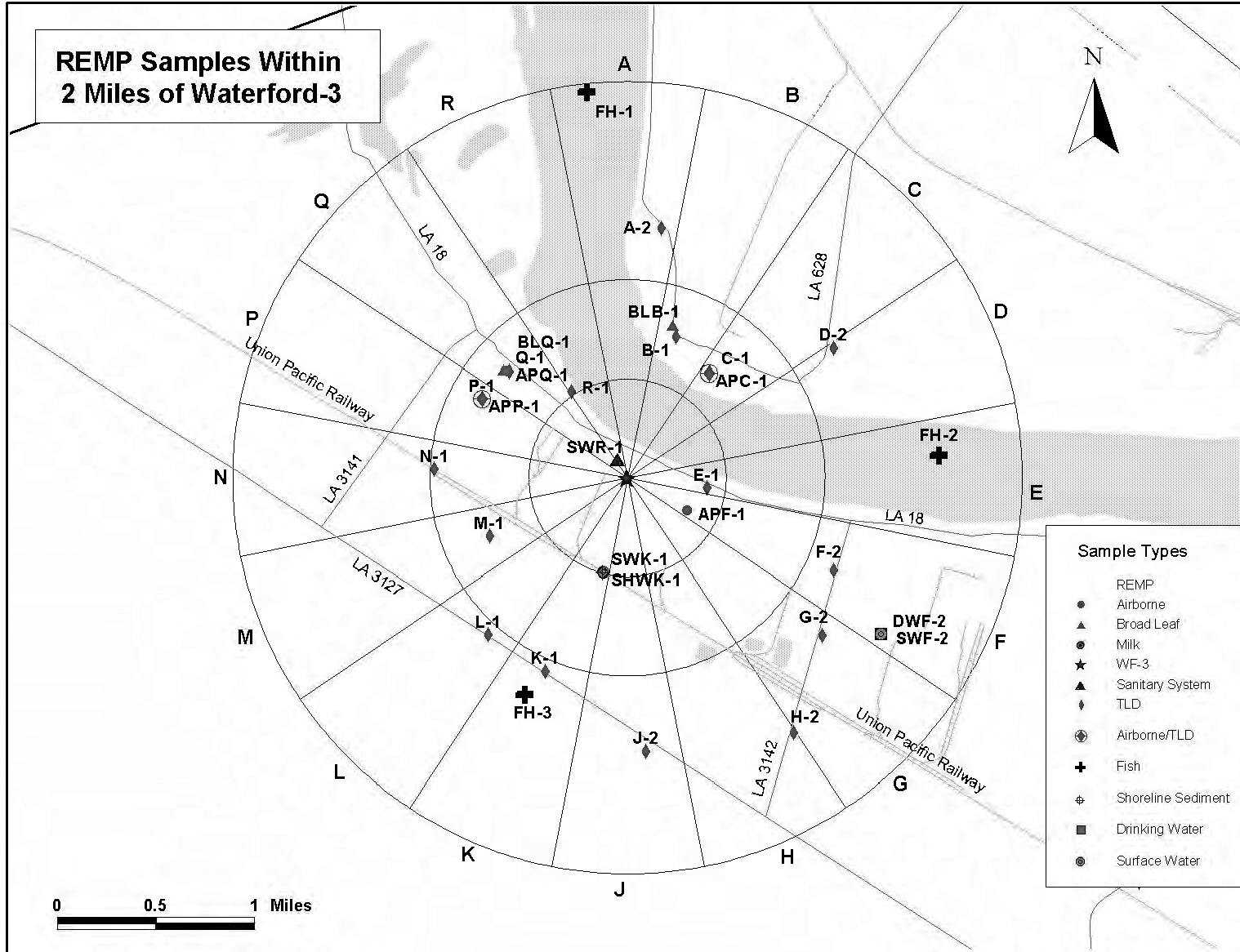


Figure 3: REMP Samples within 2 to 10 Miles of Waterford 3

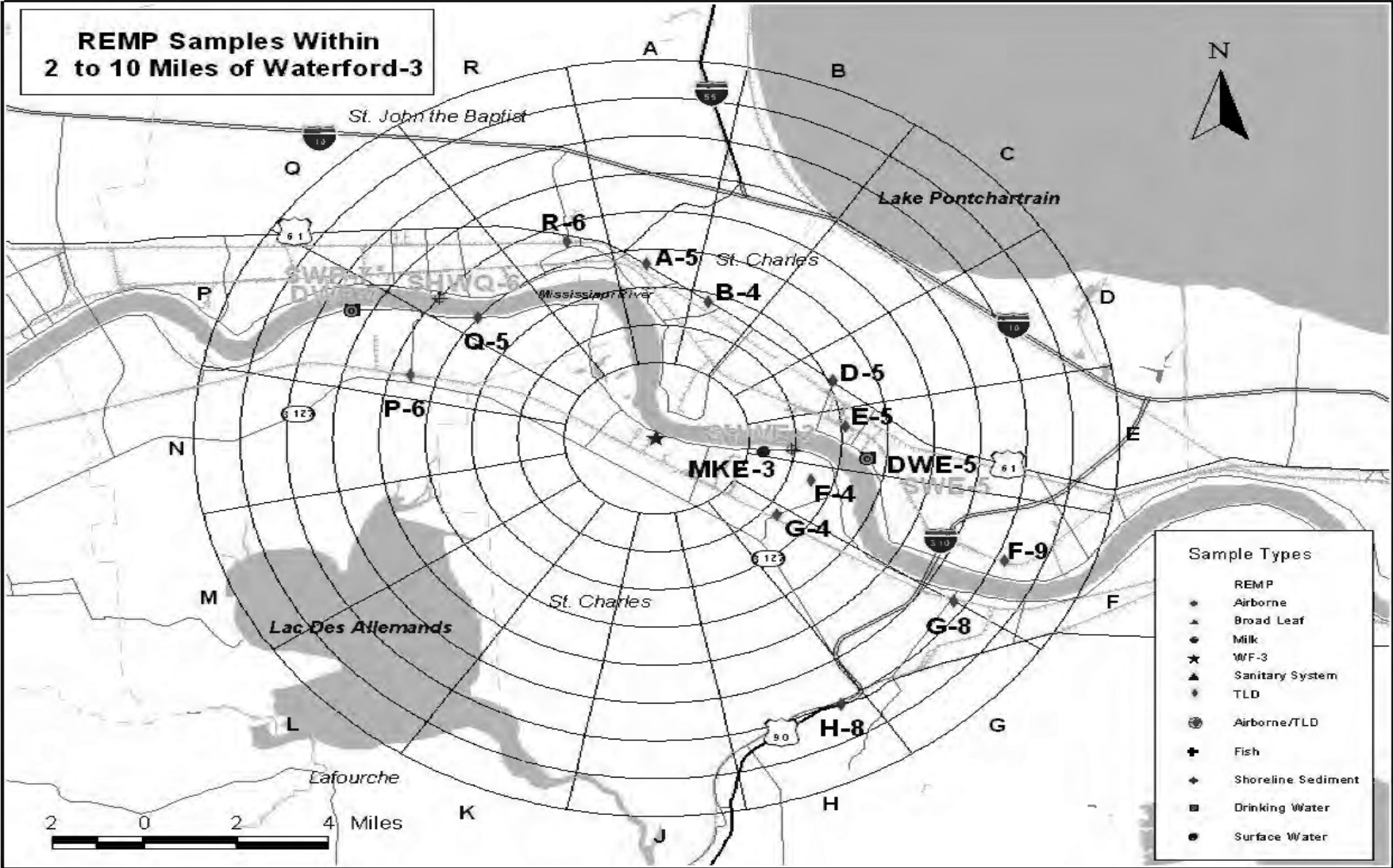
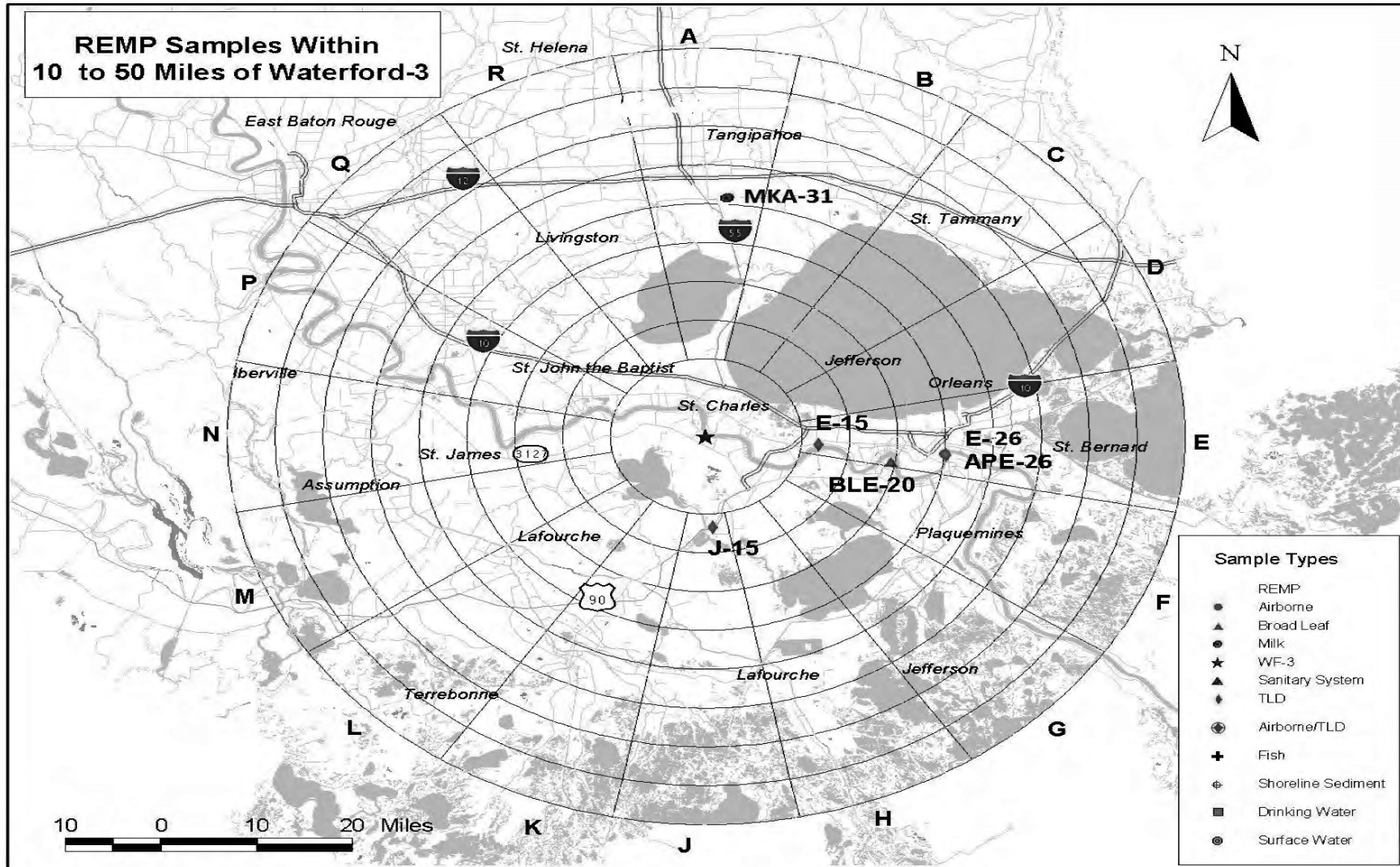


Figure 4: REMP Samples within 10 to 50 Miles of Waterford 3



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4.0 INTERPRETATION AND TRENDS OF RESULTS**4.1 Air Particulate and Radioiodine Sample Results**

Samples of airborne particulate and radioiodine were collected at four indicator locations and one control location and analyzed for gross beta radionuclides, Iodine-131 and gamma radionuclides (quarterly air particulate filter composites only). Waterford 3 did not detect any gamma radionuclides in the quarterly air particulate composites or Iodine-131 in the radioiodine cartridges during the reporting period as has been the case in previous years. Indicator gross beta air particulate results for 2020 were similar to background levels obtained during previous years of the operational REMP and well below preoperational levels as seen below. Results are reported as annual average pCi/m³.

<u>Monitoring Period</u>	<u>Result</u>
2010 – 2019 (Minimum Value)	0.017
2020 Average Value	0.017
2010 – 2019 (Maximum Value)	0.026
Preoperational	0.080

In the absence of plant-related gamma radionuclides, gross beta activity is attributed to naturally occurring radionuclides. Table 6, which includes gross beta concentrations and provides 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 Waterford 3 operations.

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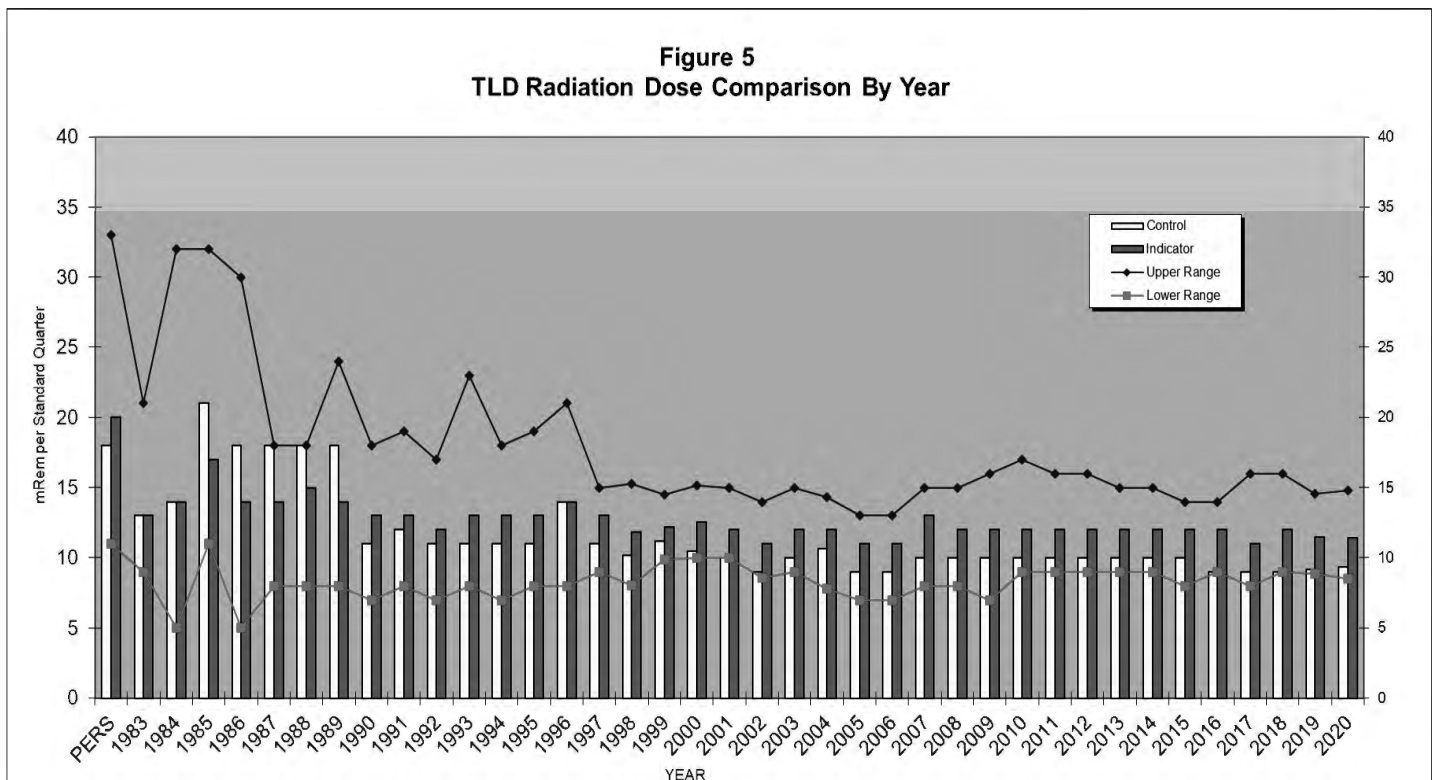
4.2 Thermoluminescent Dosimetry (TLD) Sample Results

Waterford 3 reports measured dose as net exposure (field reading less transit reading) normalized to 92 days and relies on comparison of the thirty indicator locations to the one control as a measure of plant impact. Waterford 3's comparison of the inner ring, outer ring, 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 11.4 millirem (mrem) shown in the TLD radiation dose comparison graph below shows the 2020 concentration is comparable to historic results. Overall, Waterford 3 concluded that the ambient radiation levels are not being affected by plant operations.

The average exposure rates during 2020 are consistent with those from the preoperational program and the previous five years of operation. In particular, the preoperational survey indicates that exposure rates ranged between 11 and 33 mrem/standard quarter with an average of 20 mrem/standard quarter. The range during the previous five years of operation was 9 to 15 mrem/standard quarter with an average exposure rate of 12 mrem/standard quarter.

A comparison of the indicator results to the control results, as seen in Table 6, shows that the average indicator locations are slightly higher than that of the control. As shown in Attachment 2, Tables 11-14, several indicator locations are higher than the control by a few mrem with a maximum difference of six mrem. The differences between indicator locations and the control, and TLD stations grouped by distance from the plant are expected due to a variety of factors not related to Waterford 3 plant operations that can affect background radiation in the vicinity of each TLD station.

Figure 5
TLD Radiation Dose Comparison By Year



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4.3 Waterborne Sample Results

Analytical results for 2020 drinking water/surface water samples were similar to those reported in previous years. Gamma radionuclides, iodine-131 and tritium analytical results for 2020 waterborne samples were below the ODCM-required LLD similar to those reported in previous years. Gross Beta continues to be detected in Waterford 3 drinking water samples consistent with historical results. These results are further explained below.

4.3.1 Surface Water Results

Samples were collected from one indicator location and analyzed for gamma radionuclides and tritium. Gamma radionuclides were below detectable limits which is consistent with results seen in previous operational years. Tritium was not detected in any of the quarterly samples. Therefore, the operation of Waterford 3 had no definable impact on this waterborne pathway in 2020.

4.3.2 Drinking/Surface Water Results

Drinking water samples also serve as surface water samples for Waterford 3. Therefore, monthly and quarterly gamma spectroscopy and tritium analyses of drinking water also satisfy the surface water sampling requirement.

Samples were collected from two indicators and one control location. Drinking/Surface water samples were analyzed for, gamma radionuclides, gross beta, iodine-131, and tritium. Gamma radionuclides, iodine-131, and tritium concentrations were below the LLD limits at the indicator and control locations. Gross beta was detected in both indicator and control locations. The average concentration of the indicator locations is comparable to the 2009 – 2019 operational years and below background preoperational data as shown below. Gross beta results from 2020 are summarized in Table 6. Results are reported as annual average pCi/L.

<u>Monitoring Period</u>	<u>Result</u>
2010 – 2019 (Minimum Value)	3.5
2020 Average Value	3.8
2010 – 2019 (Maximum Value)	6.6
Preoperational	7.0

Table 17, which includes gross beta concentrations for 2020, provides a comparison of the indicator and control means. It shows that the waterborne pathway continues to remain at background levels. Waterford 3 personnel have noted no definable trends associated with drinking water results at the indicator location. Therefore, the operation of Waterford 3 had no definable impact on this waterborne pathway in 2020 and levels of radionuclides remain similar to those obtained in previous operational years.

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4.3.3 Sediment Sample Results

Sediment samples were collected from two indicators and one control location in 2020 and analyzed for gamma radionuclides. Gamma radionuclides were below the LLD limits at both indicator and control locations. Listed below is a comparison of 2020 Cs-137 indicator results to the 2010-2019 operational years. Waterford 3 operations had no significant impact on the environment or public by this waterborne pathway.

<u>Monitoring Period</u>	<u>Result</u>
2010-2019 (Minimum Value)	<LLD
2020 Value	<LLD
2010-2019 (Maximum Value)	<LLD

4.4 Ingestion Sample Results

4.4.1 Fish Sample Results

Fish samples were collected from two indicator and one control location and analyzed for gamma radionuclides. In 2020, gamma radionuclides were below detectable limits which are consistent with the preoperational monitoring period and operational results. Therefore, based on these measurements, Waterford 3 operations had no significant radiological impact upon the environment or public by this ingestion pathway.

4.4.2 Broad Leaf Vegetation Sample Results

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

In 2020, broad leaf vegetation samples were collected from two indicator and one control location and analyzed for iodine-131 and gamma radionuclides. The 2020 levels remained undetectable, as has been the case in recent years. Therefore, based on these measurements, Waterford 3 operations had no significant radiological impact upon the environment or public by this ingestion pathway.

4.4.3 Milk Sample Results

Milk samples from the indicator location were unavailable for collection during 2020; therefore, broad leaf vegetation sampling was performed as required by TRM 3.12-1. Results are shown in section 4.4.2. Milk samples were collected from one control location and analyzed for iodine-131 and gamma radionuclides. Cesium-137 was not measured in any control samples in 2020. Therefore, Waterford 3 concluded that plant operations had no significant impact on this pathway in 2020.

Annual Radiological Environmental Operating Report**4.5 Land Use Census Results**

The latest land use census was conducted September 3 – September 7, 2020. The nearest residence, garden, beef cow, food product and milk animal in each sector within a five mile radius of the plant was located by visual inspection and verbal inquiry.

The land use census identified several changes in 2020. These changes include three nearest residence changes, 5 nearest garden changes, 1 milk animal change, and 1 meat animal change.

The three nearest residence changes identified were in sectors A, N, and P. The nearest residence in sector A has changed to 106 Evangeline Road at a distance of 1.24 miles from the plant. The nearest residence in sector N has changed to 262 School House Road at a distance of 0.94 miles from the plant. The nearest residence in sector P has changed to 100 School House Road at a distance of 0.86 miles from the plant.

The five nearest garden changes identified were in sectors A, B, G, P, and Q. The nearest garden in sector A has changed to 17834 River Road at a distance of 1.31 miles from the plant. The nearest garden in sector B has changed to 199 Evangeline Street at a distance of 1.40 miles from the plant. The nearest garden in sector G has changed to 694 Courthouse Lane at a distance of 4.01 miles from the plant. The nearest garden in sector P has changed to 244 School House Road at a distance of 0.92 miles from the plant. The nearest garden in sector Q has changed to 126 Post Street at a distance of 0.93 miles from the plant.

The one nearest milk animal change identified was in sector E. The nearest milk animal location in sector E no longer has any milk animals. Therefore, there are no identified nearest milk animal locations in 2020.

The one nearest meat animal location change identified was in sector A. The nearest meat animal in sector A has changed to 614 HWY 628 in LaPlace at a distance of 3.56 miles from the plant.

Based upon the locations identified in this survey, the locations identified in previous surveys and the locations currently being used to calculate dose commitments from liquid and gaseous effluents released from Waterford 3, no REMP sampling location changes are necessary. Results of the 2020 biennial census are shown in Table 5.

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Table 5: 2020 Land Use Census Results

Sector	Direction	Nearest Residence (miles)	Nearest Garden (miles)	Nearest Milk Cow (miles)	Nearest Beef Cow (miles)	Nearest Goat (miles)	Nearest Food Products (miles)
A	N	1.2	1.3	^	3.6	*3.8	1.3
B	NNE	1.0	1.4	^	1.9	^	1.4
C	NE	0.9	1.1	^	^	^	1.1
D	ENE	0.9	0.9	^	^	^	0.9
E	E	2.3	2.3	^	2.3	^	2.3
F	ESE	3.2	2.3	^	2.3	^	2.3
G	SE	4.0	4.0	^	2.5	^	4.0
H	SSE	^	^	^	^	^	^
J	S	^	^	^	^	^	^
K	SSW	^	^	^	^	^	^
L	SW	^	^	^	^	^	^
M	WSW	^	^	^	^	^	^
N	W	0.9	1.2	^	^	^	1.2
P	WNW	0.9	0.9	^	^	^	0.9
Q	NW	0.9	0.9	^	^	^	0.9
R	NNW	3.1	3.4	^	5.0	^	3.4

Symbol	Comment
^	Nothing was located within a five-mile radius of Waterford 3.
*	Animals were located at this distance from Waterford 3, but the milk is not used for human consumption.

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 section 5.7.2 of the ODCM.

5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

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

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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]	Indicator ⁽⁴⁾ Location [Highest Annual Mean]	Mean (F) ⁽³⁾ [Range]	Control Locations Mean (F) ⁽³⁾ [Range]	Number of Non Routine Results ⁽⁵⁾
Air Particulate (pCi/m ³)	GB / 130	0.01	0.0167 (104 / 104) [0.0100 - 0.0311]	APP-1 (119°, 0.84 mi)	0.0170 (26 / 26) [0.0108 - 0.0282]	0.0169 (26 / 26) [0.0101 - 0.0305]	0
	GS / 20						
	Cs-134	0.05	< LLD	N/A	N/A	< LLD	0
	Cs-137	0.06	< LLD	N/A	N/A	< LLD	0
Airborne Iodine (pCi/m ³)	I-131 / 130	0.07	< LLD	N/A	N/A	< LLD	0
Inner Ring TLD (mR/Qtr)	Gamma / 63	⁽⁶⁾	11.4 (63 / 63) [8.5 - 14.8]	L-1 (42°, 1.06 mi.)	13.3 (4 / 4) [12.7 - 14.0]	N/A	0
Outer Ring TLD (mR/Qtr)	Gamma / 40	⁽⁶⁾	12.3 (40 / 40) [9.0 - 14.8]	P-6 (107°, 5.58 mi.)	13.8 (4 / 4) [12.8 - 14.5]	N/A	0
Special Interest TLD (mR/Qtr)	Gamma / 16	⁽⁶⁾	10.6 (16 / 16) [9.6 - 11.4]	G-8 (305°, 7.74 mi.)	10.9 (4 / 4) [9.8 - 11.4]	N/A	0
Control TLD (mR/Qtr)	Gamma / 4	⁽⁶⁾	N/A	N/A	N/A	9.3 (4 / 4) [8.9 - 9.7]	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]	Indicator ⁽⁴⁾ Location [Highest Annual Mean]	Mean (F) ⁽³⁾ [Range]	Control Locations Mean (F) ⁽³⁾ [Range]	Number of Non Routine Results ⁽⁵⁾
Surface Water (pCi/L)	H-3 / 5	2000	< LLD	N/A	N/A	N/A	0
	GS / 13						
	Mn-54	15	< LLD	N/A	N/A	N/A	0
	Co-58	15	< LLD	N/A	N/A	N/A	0
	Fe-59	30	< LLD	N/A	N/A	N/A	0
	Co-60	15	< LLD	N/A	N/A	N/A	0
	Zn-65	30	< LLD	N/A	N/A	N/A	0
	Nb-95	15	< LLD	N/A	N/A	N/A	0
	I-131	15	< LLD	N/A	N/A	N/A	0
	Zr-95	15	< LLD	N/A	N/A	N/A	0
	Cs-134	15	< LLD	N/A	N/A	N/A	0
	Cs-137	18	< LLD	N/A	N/A	N/A	0
	Ba-140	15	< LLD	N/A	N/A	N/A	0
	La-140	15	< LLD	N/A	N/A	N/A	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]	Indicator ⁽⁴⁾ Location [Highest Annual Mean]	Mean (F) ⁽³⁾ [Range]	Control Locations Mean (F) ⁽³⁾ [Range]	Number of Non Routine Results ⁽⁵⁾
Drinking/Surface Water (pCi/L)	GB / 15	4	3.8 (8/10) [2.8 - 5.2]	DW/SWF-2 (302°, 1.51 mi.)	4.0 (4/5) [2.8 - 5.2]	4.9 (4/5) [4.3 - 5.6]	0
	I-131 / 40	1	< LLD	N/A	N/A	< LLD	0
	H-3 / 15	2000	< LLD	N/A	N/A	< LLD	0
	GS / 15						
	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
	Zr-95	15	< LLD	N/A	N/A	< LLD	0
	Cs-134	15	< LLD	N/A	N/A	< LLD	0
	Cs-137	18	< LLD	N/A	N/A	< LLD	0
	Ba-140	15	< LLD	N/A	N/A	< LLD	0
La-140	15	< LLD	N/A	N/A	< LLD	0	
Sediment (pCi/kg dry)	GS / 3						
	Cs-134	150	< LLD	N/A	N/A	< LLD	0
	Cs-137	180	< 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]	Indicator ⁽⁴⁾ Location [Highest Annual Mean]	Mean (F) ⁽³⁾ [Range]	Control Locations Mean (F) ⁽³⁾ [Range]	Number of Non Routine Results ⁽⁵⁾
Fish (pCi/kg wet)	GS / 12						
	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
Broad Leaf (pCi/kg wet)	GS / 12						
	I-131	60	< LLD	N/A	N/A	N/A	0
	Cs-134	60	< LLD	N/A	N/A	N/A	0
	Cs-137	80	< LLD	N/A	N/A	N/A	0
Milk (pCi/L)	I-131 / 4	1	N/A	N/A	N/A	< LLD	0
	GS / 4						
	Cs-134	15	N/A	N/A	N/A	< LLD	0
	Cs-137	18	N/A	N/A	N/A		0
	Ba-140	15	N/A	N/A	N/A	< LLD	0
	La-140	15	N/A	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 Waterford 3 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) degrees 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 Waterford 3 TRM.

Sample Deviations

Table 7: Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
1	Milk	MKE-3	2020	Sample Unavailable	Milk samples from indicator station MKE-3 were unavailable for all four quarters of 2020 due to the cows not producing enough milk. Broad Leaf vegetation sampling was performed in place of the milk indicator sampling.
2	TLD	D-2	07/08/20	Sample Missing	TLD from station D-2 was unable to be analyzed due to sample being missing at time of collection.
3	AP/C	APC-1	11/02/20-11/16/20	Low Volume	The air particulate and charcoal sample collected from 11/02/20-11/16/20 had low volumes due to power being temporarily secured during construction at the sample location.
4	AP/C	APQ-1	11/30/20-12/14/20	Low Volume	The air particulate and charcoal sample collected from 11/30/20-12/14/20 had low volumes due to the sample pump found not working. The sample pump was replaced on the same day the pump was found not working.

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Table 8: Air Particulate Data Table

Analysis: Gross Beta				Units: pCi/m ³		
Start Date	End Date	APF-1 (Indicator)	APQ-1 (Indicator)	APP-1 ⁽¹⁾ (Indicator)	APC-1 (Indicator)	APE-26 (Control)
REQUIRED LLD →		<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>
12/30/2019	01/13/2020	0.012	0.012	0.015	0.011	0.012
01/13/2020	01/27/2020	0.013	0.013	0.014	0.015	0.010
01/27/2020	02/10/2020	0.020	0.019	0.019	0.017	0.018
02/10/2020	02/24/2020	0.011	0.011	0.013	0.012	0.010
02/24/2020	03/09/2020	0.015	0.015	0.020	0.015	0.017
03/09/2020	03/23/2020	0.013	0.012	0.014	0.011	0.013
03/23/2020	04/06/2020	0.013	0.012	0.014	0.015	0.016
04/06/2020	04/20/2020	0.013	0.015	0.014	0.016	0.015
04/20/2020	05/04/2020	0.015	0.013	0.013	0.014	0.014
05/04/2020	05/18/2020	0.019	0.017	0.016	0.017	0.018
05/18/2020	06/01/2020	0.018	0.018	0.022	0.019	0.020
06/01/2020	06/15/2020	0.010	0.011	0.011	0.011	0.011
06/15/2020	06/29/2020	0.020	0.020	0.018	0.018	0.019
06/29/2020	07/13/2020	0.019	0.018	0.018	0.017	0.018
07/13/2020	07/27/2020	0.015	0.014	0.014	0.012	0.012
07/27/2020	08/10/2020	0.022	0.022	0.019	0.020	0.021
08/10/2020	08/23/2020	0.020	0.024	0.023	0.022	0.024
08/23/2020	09/07/2020	0.011	0.010	0.011	0.010	0.012
09/07/2020	09/21/2020	0.019	0.017	0.019	0.016	0.018
09/21/2020	10/05/2020	0.019	0.017	0.016	0.017	0.012
10/05/2020	10/19/2020	0.020	0.018	0.020	0.019	0.020
10/19/2020	11/02/2020	0.021	0.019	0.024	0.016	0.017
11/02/2020	11/16/2020	0.015	0.014	0.013	0.020 ⁽³⁾	0.015
11/16/2020	11/30/2020	0.017	0.016	0.013	0.015	0.017
11/30/2020	12/14/2020	0.030	0.031 ⁽⁴⁾	0.028	0.029	0.031
12/14/2020	12/28/2020	0.012	0.027	0.025	0.026	0.028

⁽¹⁾ Station with highest annual mean.

⁽³⁾ See Attachment 1, Table 7, Samples Deviations Table, Comment 3

⁽⁴⁾ See Attachment 1, Table 7, Samples Deviations Table, Comment 4

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Table 9: Radioiodine Cartridge Data Table

Analysis: I-131				Units: pCi/m ³		
Start Date	End Date	APF-1 (Indicator)	APQ-1 (Indicator)	APP-1 (Indicator)	APC-1 (Indicator)	APE-26 (Control)
REQUIRED LLD →		0.07	0.07	0.07	0.07	0.07
12/30/2019	01/13/2020	< 0.018	< 0.019	< 0.008	< 0.017	< 0.017
01/13/2020	01/27/2020	< 0.014	< 0.014	< 0.007	< 0.013	< 0.013
01/27/2020	02/10/2020	< 0.012	< 0.013	< 0.013	< 0.006	< 0.012
02/10/2020	02/24/2020	< 0.012	< 0.012	< 0.006	< 0.011	< 0.011
02/24/2020	03/09/2020	< 0.018	< 0.018	< 0.019	< 0.007	< 0.017
03/09/2020	03/23/2020	< 0.018	< 0.019	< 0.008	< 0.017	< 0.018
03/23/2020	04/06/2020	< 0.020	< 0.021	< 0.009	< 0.019	< 0.021
04/06/2020	04/20/2020	< 0.022	< 0.023	< 0.010	< 0.021	< 0.022
04/20/2020	05/04/2020	< 0.017	< 0.017	< 0.015	< 0.016	< 0.017
05/04/2020	05/18/2020	< 0.017	< 0.017	< 0.007	< 0.016	< 0.017
05/18/2020	06/01/2020	< 0.016	< 0.017	< 0.014	< 0.015	< 0.016
06/01/2020	06/15/2020	< 0.018	< 0.019	< 0.008	< 0.017	< 0.018
06/15/2020	06/29/2020	< 0.023	< 0.024	< 0.010	< 0.022	< 0.023
06/29/2020	07/13/2020	< 0.018	< 0.019	< 0.008	< 0.018	< 0.019
07/13/2020	07/27/2020	< 0.023	< 0.024	< 0.010	< 0.021	< 0.024
07/27/2020	08/10/2020	< 0.016	< 0.016	< 0.009	< 0.015	< 0.016
08/10/2020	08/23/2020	< 0.025	< 0.026	< 0.011	< 0.024	< 0.026
08/23/2020	09/07/2020	< 0.019	< 0.020	< 0.008	< 0.018	< 0.020
09/07/2020	09/21/2020	< 0.019	< 0.020	< 0.009	< 0.018	< 0.020
09/21/2020	10/05/2020	< 0.018	< 0.019	< 0.008	< 0.017	< 0.018
10/05/2020	10/19/2020	< 0.014	< 0.014	< 0.013	< 0.013	< 0.014
10/19/2020	11/02/2020	< 0.016	< 0.016	< 0.014	< 0.014	< 0.016
11/02/2020	11/16/2020	< 0.019	< 0.020	< 0.021	< 0.012 ⁽³⁾	< 0.019
11/16/2020	11/30/2020	< 0.022	< 0.023	< 0.010	< 0.021	< 0.022
11/30/2020	12/14/2020	< 0.016	< 0.025 ⁽⁴⁾	< 0.017	< 0.012	< 0.016
12/14/2020	12/28/2020	< 0.012	< 0.015	< 0.016	< 0.014	< 0.015

⁽³⁾ See Attachment 1, Table 7, Samples Deviations Table, Comment 3⁽⁴⁾ See Attachment 1, Table 7, Samples Deviations Table, Comment 4

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Table 10: Air Particulate Composite Data Table

Analysis: Gamma Isotopic		Units: pCi/m³	
Location	Collection Date	Cs-134	Cs-137
<u>REQUIRED LLD →</u>		<u>0.05</u>	<u>0.06</u>
APF-1 (Indicator)	02/24/2020	< 0.003	< 0.003
APQ-1 (Indicator)	02/24/2020	< 0.003	< 0.003
APP-1 (Indicator)	02/24/2020	< 0.002	< 0.002
APC-1 (Indicator)	02/24/2020	< 0.003	< 0.003
APE-26 (Control)	02/24/2020	< 0.003	< 0.002
APF-1 (Indicator)	05/18/2020	< 0.003	< 0.002
APQ-1 (Indicator)	05/18/2020	< 0.002	< 0.002
APP-1 (Indicator)	05/18/2020	< 0.003	< 0.003
APC-1 (Indicator)	05/18/2020	< 0.003	< 0.001
APE-26 (Control)	05/18/2020	< 0.005	< 0.003
APF-1 (Indicator)	08/10/2020	< 0.003	< 0.003
APQ-1 (Indicator)	08/10/2020	< 0.002	< 0.002
APP-1 (Indicator)	08/10/2020	< 0.002	< 0.002
APC-1 (Indicator)	08/10/2020	< 0.002	< 0.002
APE-26 (Control)	08/10/2020	< 0.003	< 0.002
APF-1 (Indicator)	11/02/2020	< 0.003	< 0.003
APQ-1 (Indicator)	11/02/2020	< 0.002	< 0.002
APP-1 (Indicator)	11/02/2020	< 0.003	< 0.002
APC-1 (Indicator)	11/02/2020	< 0.003	< 0.002
APE-26 (Control)	11/02/2020	< 0.003	< 0.002

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Table 11: Thermoluminescent Dosimeters – Inner Ring

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1 st Qtr 2020	2 nd Qtr 2020	3 rd Qtr 2020	4 th Qtr 2020	Annual Mean 2020
A-2	12.5	11.8	12.2	12.8	12.3
B-1	13.1	12.5	12.2	12.7	12.6
C-1	9.1	8.6	8.8	9.6	9.0
D-2	12.2	Lost ⁽²⁾	12.2	12.7	12.4
E-1	12.3	10.9	11.3	12.5	11.8
F-2	11.3	10.6	10.4	11.3	10.9
G-2	10.2	10.0	10.0	11.0	10.3
H-2	10.7	10.3	9.9	10.6	10.4
J-2	10.2	10.9	9.6	10.6	10.3
K-1	11.3	11.5	10.5	11.4	11.2
L-1⁽¹⁾	13.7	14.0	12.8	12.7	13.3
M-1	10.2	10.1	9.6	10.5	10.1
N-1	10.3	10.4	10.2	10.5	10.4
P-1	10.8	10.7	9.8	10.8	10.5
Q-1	12.1	12.5	11.7	12.8	12.3
R-1	9.3	9.0	8.5	9.6	9.1

⁽¹⁾ Inner ring station with highest annual mean.⁽²⁾ See Attachment 1, Table 7, Samples Deviations Table, Comment 2

Table 12: Thermoluminescent Dosimeters – Outer Ring

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1 st Qtr 2020	2 nd Qtr 2020	3 rd Qtr 2020	4 th Qtr 2020	Annual Mean 2020
A-5	13.4	12.1	12.3	12.8	12.7
B-4	14.2	12.9	13.1	13.8	13.5
D-5	12.2	10.9	11.2	11.6	11.5
E-5	12.8	13.3	11.7	12.8	12.7
F-4	13.7	13.0	13.2	14.8	13.7
G-4	11.0	10.6	10.1	11.1	10.7
H-8	13.0	12.8	12.7	13.1	12.9
P-6⁽¹⁾	14.0	13.7	12.8	14.5	13.8
Q-5	11.7	12.6	11.7	12.4	12.1
R-6	9.9	9.9	9.0	9.8	9.7

⁽¹⁾ Outer ring station with highest annual mean.

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Table 13: Thermoluminescent Dosimeters – Special Interest Areas

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1st Qtr 2020	2nd Qtr 2020	3rd Qtr 2020	4th Qtr 2020	Annual Mean 2020
E-15	10.5	9.7	9.6	10.4	10.1
F-9	11.2	10.0	10.1	11.2	10.6
G-8⁽¹⁾	9.8	11.4	10.9	11.3	10.9
J-15	11.2	11.1	10.1	10.6	10.8

⁽¹⁾ Special interest station with highest annual mean.

Table 14: Thermoluminescent Dosimeters – Control

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	1st Qtr 2020	2nd Qtr 2020	3rd Qtr 2020	4th Qtr 2020	Annual Mean 2020
E-26	9.6	8.9	9.1	9.7	9.3

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Table 15: 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	15	15	18	15	15
SWK-1 (Indicator)	12/23/2019	01/20/2020	< 1.44	< 1.55	< 3.28	< 1.86	< 3.18	< 1.59	< 2.26	< 2.92	< 1.68	< 1.68	< 6.95	< 2.60
SWK-1 (Indicator)	01/20/2020	02/17/2020	< 1.78	< 1.91	< 3.63	< 2.03	< 3.34	< 1.74	< 2.51	< 2.95	< 1.99	< 1.83	< 7.35	< 2.52
SWK-1 (Indicator)	02/17/2020	03/16/2020	< 3.29	< 2.43	< 6.42	< 3.15	< 5.84	< 3.15	< 3.55	< 5.32	< 3.75	< 3.53	< 11.8	< 4.34
SWK-1 (Indicator)	03/16/2020	04/14/2020	< 1.98	< 1.92	< 3.88	< 2.09	< 3.77	< 1.96	< 2.25	< 3.46	< 2.11	< 2.11	< 7.44	< 2.43
SWK-1 (Indicator)	04/14/2020	05/12/2020	< 1.88	< 1.84	< 4.05	< 1.92	< 4.10	< 2.02	< 2.27	< 3.60	< 2.15	< 2.18	< 7.34	< 2.27
SWK-1 (Indicator)	05/12/2020	06/08/2020	< 2.14	< 2.00	< 4.31	< 2.06	< 4.21	< 2.01	< 2.72	< 3.61	< 2.42	< 2.20	< 8.32	< 2.92
SWK-1 (Indicator)	06/08/2020	07/07/2020	< 1.80	< 1.74	< 3.57	< 2.02	< 3.64	< 1.88	< 2.36	< 3.01	< 1.98	< 1.95	< 7.27	< 2.51
SWK-1 (Indicator)	07/07/2020	08/04/2020	< 1.86	< 1.86	< 3.69	< 1.96	< 3.65	< 1.87	< 2.51	< 3.08	< 2.17	< 2.00	< 7.54	< 2.51
SWK-1 (Indicator)	08/04/2020	09/01/2020	< 3.26	< 3.29	< 7.17	< 3.76	< 6.27	< 3.22	< 4.23	< 5.93	< 4.12	< 3.87	< 14.3	< 5.79
SWK-1 (Indicator)	09/01/2020	09/29/2020	< 3.16	< 3.28	< 7.23	< 3.55	< 6.50	< 3.59	< 4.24	< 5.56	< 3.71	< 3.30	< 13.3	< 4.56
SWK-1 (Indicator)	09/29/2020	10/27/2020	< 2.21	< 2.02	< 4.45	< 2.17	< 4.21	< 2.29	< 3.76	< 4.05	< 2.28	< 2.34	< 11.0	< 3.43
SWK-1 (Indicator)	10/27/2020	11/24/2020	< 3.48	< 3.12	< 7.00	< 3.20	< 6.57	< 3.59	< 5.06	< 5.69	< 3.54	< 3.83	< 14.8	< 5.00
SWK-1 (Indicator)	11/24/2020	12/22/2020	< 1.85	< 2.15	< 4.05	< 2.44	< 4.22	< 2.00	< 3.53	< 3.61	< 2.11	< 2.08	< 9.87	< 3.10

Monitoring Results Tables

Table 16: Surface Water – Tritium

Analysis: H-3		Units: pCi/L	
Location	Start Date	End Date	H-3
REQUIRED LLD →			<u>3000</u>
SWK-1 (Indicator)	10/29/2019	01/20/2020	< 538
SWK-1 (Indicator)	01/20/2020	04/14/2020	< 495
SWK-1 (Indicator)	04/14/2020	07/07/2020	< 518
SWK-1 (Indicator)	07/07/2020	09/29/2020	< 544
SWK-1 (Indicator)	09/29/2020	12/22/2020	< 560

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Table 17: Drinking/Surface Water – Gamma and Gross Beta

Analysis: Gamma Isotopic, Gross Beta							Units: pCi/L						
Location	Collection Date	Gross Beta	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
REQUIRED LLD →		4	15	15	30	15	30	15	15	15	18	15	15
DWF/SWF-2 ⁽¹⁾ (Indicator)	01/20/2020	5.23	< 1.71	< 1.75	< 3.81	< 1.79	< 3.68	< 1.78	< 3.09	< 1.87	< 1.76	< 7.49	< 2.42
DWE/SWE-5 (Indicator)	01/20/2020	4.27	< 1.67	< 1.60	< 3.39	< 1.61	< 3.07	< 1.77	< 2.91	< 1.86	< 1.80	< 7.22	< 2.30
DWP/SWP-7 (Control)	01/20/2020	4.65	< 2.69	< 2.57	< 5.29	< 2.93	< 5.55	< 2.65	< 4.52	< 2.87	< 2.85	< 11.8	< 3.53
DWF/SWF-2 ⁽¹⁾ (Indicator)	04/14/2020	< 2.33	< 1.52	< 1.42	< 3.10	< 1.63	< 3.14	< 1.56	< 2.63	< 1.80	< 1.52	< 7.62	< 2.30
DWE/SWE-5 (Indicator)	04/14/2020	3.16	< 1.56	< 1.58	< 3.66	< 1.64	< 3.49	< 1.70	< 2.89	< 1.73	< 1.78	< 7.85	< 2.65
DWP/SWP-7 (Control)	04/14/2020	< 1.96	< 1.64	< 1.70	< 3.55	< 1.75	< 3.47	< 1.75	< 3.11	< 1.92	< 1.79	< 7.62	< 2.52
DWF/SWF-2 ⁽¹⁾ (Indicator)	07/07/2020	2.82	< 1.76	< 1.86	< 3.98	< 1.84	< 3.72	< 1.88	< 3.32	< 2.04	< 1.85	< 8.66	< 2.92
DWE/SWE-5 (Indicator)	07/07/2020	< 2.27	< 1.82	< 1.82	< 3.79	< 1.93	< 3.69	< 1.91	< 3.11	< 2.05	< 1.94	< 8.82	< 3.13
DWP/SWP-7 (Control)	07/07/2020	4.33	< 1.92	< 1.95	< 3.85	< 2.05	< 3.96	< 2.04	< 3.57	< 2.06	< 2.10	< 10.0	< 3.00
DWF/SWF-2 ⁽¹⁾ (Indicator)	09/29/2020	3.45	< 2.24	< 2.25	< 4.75	< 2.41	< 4.37	< 2.47	< 4.06	< 2.57	< 2.48	< 11.1	< 4.16
DWE/SWE-5 (Indicator)	09/29/2020	3.90	< 2.17	< 2.44	< 4.97	< 2.42	< 4.7	< 2.35	< 3.82	< 2.64	< 2.48	< 11.6	< 2.97
DWP/SWP-7 (Control)	09/29/2020	5.63	< 2.18	< 2.18	< 4.65	< 2.08	< 4.01	< 2.28	< 3.76	< 2.2	< 2.31	< 9.98	< 3.12
DWF/SWF-2 ⁽¹⁾ (Indicator)	12/22/2020	4.46	< 1.93	< 1.93	< 4.09	< 2.3	< 4.19	< 2.26	< 3.45	< 2.29	< 2.07	< 9.76	< 3.80
DWE/SWE-5 (Indicator)	12/22/2020	3.32	< 1.94	< 1.92	< 3.79	< 1.9	< 3.84	< 2.02	< 3.43	< 1.96	< 1.89	< 9.96	< 3.03
DWP/SWP-7 (Control)	12/22/2020	4.84	< 1.99	< 2.00	< 4.31	< 2.24	< 4.11	< 2.13	< 3.51	< 2.15	< 2.00	< 10.3	< 3.28

⁽¹⁾ Station with highest annual Gr-B mean.

Monitoring Results Tables

Table 18: Drinking/Surface Water- Iodine-131

Analysis: Iodine-131		Units: pCi/L	
Location	Start Date	End Date	I-131
REQUIRED LLD →			1.0
DWF/SWF-2 (Indicator)	12/23/2019	01/20/2020	< 0.888
DWE/SWE-5 (Indicator)	12/23/2019	01/20/2020	< 0.838
DWE/SWE-5 (Indicator) Dup.	12/23/2019	01/20/2020	< 0.829
DWP/SWP-7 (Control)	12/23/2019	01/20/2020	< 0.763
DWF/SWF-2 (Indicator)	01/20/2020	02/17/2020	< 0.683
DWE/SWE-5 (Indicator)	01/20/2020	02/17/2020	< 0.779
DWP/SWP-7 (Control)	01/20/2020	02/17/2020	< 0.762
DWF/SWF-2 (Indicator)	02/17/2020	03/16/2020	< 0.708
DWE/SWE-5 (Indicator)	02/17/2020	03/16/2020	< 0.838
DWP/SWP-7 (Control)	02/17/2020	03/16/2020	< 0.693
DWF/SWF-2 (Indicator)	03/16/2020	04/14/2020	< 0.813
DWE/SWE-5 (Indicator)	03/16/2020	04/14/2020	< 0.684
DWP/SWP-7 (Control)	03/16/2020	04/14/2020	< 0.514
DWF/SWF-2 (Indicator)	04/14/2020	05/12/2020	< 0.846
DWE/SWE-5 (Indicator)	04/14/2020	05/12/2020	< 0.696
DWP/SWP-7 (Control)	04/14/2020	05/12/2020	< 0.530
DWF/SWF-2 (Indicator)	05/12/2020	06/08/2020	< 0.520
DWE/SWE-5 (Indicator)	05/12/2020	06/08/2020	< 0.709
DWP/SWP-7 (Control)	05/12/2020	06/08/2020	< 0.693
DWF/SWF-2 (Indicator)	06/08/2020	07/07/2020	< 0.896
DWE/SWE-5 (Indicator)	06/08/2020	07/07/2020	< 0.793
DWP/SWP-7 (Control)	06/08/2020	07/07/2020	< 0.854
DWF/SWF-2 (Indicator)	07/07/2020	08/04/2020	< 0.775
DWE/SWE-5 (Indicator)	07/07/2020	08/04/2020	< 0.667
DWP/SWP-7 (Control)	07/07/2020	08/04/2020	< 0.586
DWF/SWF-2 (Indicator)	08/04/2020	09/01/2020	< 0.880
DWE/SWE-5 (Indicator)	08/04/2020	09/01/2020	< 0.787
DWP/SWP-7 (Control)	08/04/2020	09/01/2020	< 0.751
DWF/SWF-2 (Indicator)	09/01/2020	09/29/2020	< 0.649
DWE/SWE-5 (Indicator)	09/01/2020	09/29/2020	< 0.589
DWP/SWP-7 (Control)	09/01/2020	09/29/2020	< 0.707
DWF/SWF-2 (Indicator)	09/29/2020	10/27/2020	< 0.797
DWE/SWE-5 (Indicator)	09/29/2020	10/27/2020	< 0.768
DWP/SWP-7 (Control)	09/29/2020	10/27/2020	< 0.702
DWF/SWF-2 (Indicator)	10/27/2020	11/24/2020	< 0.791
DWE/SWE-5 (Indicator)	10/27/2020	11/24/2020	< 0.891
DWP/SWP-7 (Control)	10/27/2020	11/24/2020	< 0.773
DWF/SWF-2 (Indicator)	11/24/2020	12/22/2020	< 0.708
DWE/SWE-5 (Indicator)	11/24/2020	12/22/2020	< 0.529
DWP/SWP-7 (Control)	11/24/2020	12/22/2020	< 0.589

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Table 19: Drinking/Surface Water – Tritium

Analysis: H-3		Units: pCi/L	
Location	Start Date	End Date	H-3
REQUIRED LLD →			2000
DWF/SWF-2 (Indicator)	10/29/2019	01/20/2020	< 541
DWE/SWE-5 (Indicator)	10/29/2019	01/20/2020	< 535
DWP/SWP-7 (Control)	10/29/2019	01/20/2020	< 537
DWF/SWF-2 (Indicator)	01/20/2020	04/14/2020	< 498
DWE/SWE-5 (Indicator)	01/20/2020	04/14/2020	< 502
DWP/SWP-7 (Control)	01/20/2020	04/14/2020	< 511
DWF/SWF-2 (Indicator)	04/14/2020	07/07/2020	< 476
DWE/SWE-5 (Indicator)	04/14/2020	07/07/2020	< 478
DWP/SWP-7 (Control)	04/14/2020	07/07/2020	< 477
DWF/SWF-2 (Indicator)	07/07/2020	09/29/2020	< 548
DWE/SWE-5 (Indicator)	07/07/2020	09/29/2020	< 538
DWP/SWP-7 (Control)	07/07/2020	09/29/2020	< 552
DWF/SWF-2 (Indicator)	09/29/2020	12/22/2020	< 548
DWE/SWE-5 (Indicator)	09/29/2020	12/22/2020	< 547
DWP/SWP-7 (Control)	09/29/2020	12/22/2020	< 555

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Table 20: 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>
SHWK-1 (Indicator)	09/08/2020	< 84.20	< 89.40
SHWE-3 (Indicator)	09/08/2020	< 73.90	< 65.10
SHWQ-6 (Control)	09/08/2020	< 76.00	< 72.00

Monitoring Results Tables

Table 21: 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>
FH-1 (Control)	11/21/2020	< 66.25	< 68.25	< 172.2	< 56.15	< 114.2	< 79.09	< 68.38
FH-2 (Indicator)	11/21/2020	< 56.76	< 50.76	< 129.5	< 50.59	< 115.8	< 63.06	< 55.99
FH-3 (Indicator)	11/10/2020	< 81.95	< 83.40	< 248.0	< 54.81	< 158.3	< 66.52	< 86.44
FH-1 (Control)	11/21/2020	< 70.46	< 80.21	< 138.5	< 64.70	< 219.4	< 75.07	< 72.54
FH-2 (Indicator)	11/21/2020	< 50.71	< 62.66	< 129.7	< 57.18	< 126.0	< 72.05	< 68.87
FH-3 (Indicator)	11/10/2020	< 73.04	< 70.97	< 151.1	< 53.30	< 106.5	< 71.15	< 57.14
FH-1 (Control)	11/21/2020	< 64.55	< 59.37	< 116.3	< 36.01	< 108.0	< 68.51	< 61.52
FH-2 (Indicator)	11/21/2020	< 68.57	< 65.40	< 149.8	< 96.31	< 152.4	< 80.72	< 69.71
FH-3 (Indicator)	11/10/2020	< 52.12	< 74.37	< 135.9	< 65.34	< 115.5	< 57.77	< 57.53
FH-1 (Control)	11/21/2020	< 63.42	< 59.51	< 140.0	< 63.99	< 120.2	< 49.89	< 51.24
FH-2 (Indicator)	11/21/2020	< 79.33	< 71.95	< 180.9	< 75.25	< 165.1	< 102.6	< 72.07
FH-3 (Indicator)	11/10/2020	< 39.76	< 67.00	< 180.5	< 44.62	< 120.3	< 69.67	< 54.74

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Table 22: Broad Leaf Vegetation - Gamma

Analysis: Gamma Isotopic		Units: pCi/kg (wet)		
Location	Collection Date	I-131	Cs-134	Cs-137
REQUIRED LLD →		60	60	80
BLQ-1 (Indicator)	03/10/2020	< 21.61	< 19.18	< 16.06
BLB-1 (Indicator)	03/10/2020	< 29.18	< 27.18	< 25.96
BLE-20 (Control)	03/10/2020	< 20.81	< 17.46	< 16.40
BLQ-1 (Indicator)	06/09/2020	< 41.32	< 29.01	< 32.23
BLB-1 (Indicator)	06/09/2020	< 23.90	< 32.59	< 32.61
BLE-20 (Control)	06/09/2020	< 38.94	< 40.27	< 35.99
BLQ-1 (Indicator)	09/08/2020	< 30.05	< 27.47	< 29.42
BLB-1 (Indicator)	09/08/2020	< 24.14	< 22.98	< 21.80
BLE-20 (Control)	09/08/2020	< 39.95	< 36.56	< 38.99
BLQ-1 (Indicator)	12/08/2020	< 47.88	< 37.81	< 45.03
BLB-1 (Indicator)	12/08/2020	< 43.52	< 47.03	< 51.79
BLE-20 (Control)	12/08/2020	< 38.31	< 45.81	< 36.43

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Table 23: Milk - Gamma and Iodine-131

Analysis: Gamma Isotopic, Iodine-131			Units: pCi/L			
Location	Collection Date	I-131	Cs-134	Cs-137	Ba-140	La-140
REQUIRED LLD →		<u>1</u>	<u>15</u>	<u>18</u>	<u>15</u>	<u>15</u>
MKE-3 (Indicator)	03/10/2020	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	03/10/2020	< 0.669	< 3.76	< 4.01	< 13.3	< 3.63
MKE-3 (Indicator)	06/09/2020	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	06/09/2020	< 0.604	< 3.25	< 3.56	< 11.2	< 2.95
MKE-3 (Indicator)	09/08/2020	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	09/08/2020	< 0.759	< 4.06	< 4.41	< 15.0	< 3.72
MKE-3 (Indicator)	12/08/2020	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	12/08/2020	< 0.851	< 3.98	< 3.99	< 14.6	< 3.71

⁽¹⁾ See Attachment 1, Table 7, Samples Deviations Table, Comment 1

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Interlaboratory Comparison Program Results

1.0 Summary

For the Teledyne Brown Engineering (TBE) laboratory, 126 out of 133 analyses performed met the specified acceptance criteria. Seven analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program.

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

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

	<u>Reported</u>	<u>Known</u>	<u>Range</u>
Gross Alpha	40.0	26.6	13.3 – 34.7
Gross Beta	47.5	69.1	48.0 – 76.0

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Interlaboratory Comparison Program Results

All QC data was reviewed with no anomalies and a cause for failure could not be determined. This was the first failure for water Gross Beta. A Quick Response follow-up cross-check was analyzed as soon as possible with acceptable results at 96.8% for Gross Alpha and 102% for Gross Beta. (NCR 20-18)

5. The MAPEP August 2020 soil Ni-63 result was evaluated as Not Acceptable. The reported value was 438 ± 21.1 Bq/kg and the known result was 980 Bq/kg (acceptance range 686 - 1274). It is believed that some Ni-63 loss occurred during the sample prep step. (NCR 20-20)

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

**Table 24: Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services**

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Value	Known Value ^(a)	Ratio of TBE to Known Result	Evaluation ^(b)			
September 2020	E13247	Milk	Sr-89	pCi/L	62.8	95.4	0.66	N ⁽¹⁾			
			Sr-90	pCi/L	12.0	12.8	0.94	A			
September 2020	E13248	Milk	Ce-141	pCi/L	156	150	1.04	A			
			Co-58	pCi/L	172	180	0.96	A			
			Co-60	pCi/L	369	379	0.97	A			
			Cr-51	pCi/L	372	372	1.00	A			
			Cs-134	pCi/L	171	200	0.85	A			
			Cs-137	pCi/L	241	250	0.96	A			
			Fe-59	pCi/L	217	200	1.08	A			
			I-131	pCi/L	84.6	95.0	0.89	A			
			Mn-54	pCi/L	175	180	0.97	A			
			Zn-65	pCi/L	252	270	0.93	A			
			E13249	Charcoal	I-131	pCi	70.2	75.8	0.93	A	
			September 2020	E13250	AP	Ce-141	pCi	101	101	1.00	A
						Co-58	pCi	111	120	0.92	A
Co-60	pCi	249				254	0.98	A			
Cr-51	pCi	287				249	1.15	A			
Cs-134	pCi	114				134	0.85	A			
Cs-137	pCi	159				168	0.95	A			
Fe-59	pCi	127				134	0.95	A			
Mn-54	pCi	114				121	0.94	A			
September 2020	E13251	Soil	Ce-141	pCi/g	0.241	0.191	1.26	W			
			Co-58	pCi/g	0.211	0.228	0.93	A			
			Co-60	pCi/g	0.466	0.481	0.97	A			
			Cr-51	pCi/g	0.450	0.472	0.95	A			
			Cs-134	pCi/g	0.273	0.254	1.07	A			
			Cs-137	pCi/g	0.370	0.390	0.95	A			
			Fe-59	pCi/g	0.233	0.254	0.92	A			
			Mn-54	pCi/g	0.217	0.229	0.95	A			
September 2020	E13252	AP	Sr-89	pCi	79.9	100.0	0.80	A			
			Sr-90	pCi	12.1	13.4	0.90	A			

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

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

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

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

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

(1) See NCR 20-19

Annual Radiological Environmental Operating Report

Attachment 3

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**Table 24: Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services**

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Value	Known Value ^(a)	Ratio of TBE to Known Result	Evaluation ^(b)			
December 2020	E13254	Milk	Sr-89	pCi/L	82.2	89.7	0.92	A			
			Sr-90	pCi/L	12.4	13.0	0.96	A			
December 2020	E13255	Milk	Ce-141	pCi/L	91.1	100	0.91	A			
			Co-58	pCi/L	77.5	84.3	0.92	A			
			Co-60	pCi/L	147	152	0.97	A			
			Cr-51	pCi/L	259	253	1.02	A			
			Cs-134	pCi/L	97.1	108	0.90	A			
			Cs-137	pCi/L	117	127	0.92	A			
			Fe-59	pCi/L	114	112	1.02	A			
			I-131	pCi/L	84.3	91.9	0.92	A			
			Mn-54	pCi/L	137	143	0.96	A			
			Zn-65	pCi/L	175	190	0.92	A			
			E13256	Charcoal	I-131	pCi	70.2	78.2	0.90	A	
			December 2020	E13257A	AP	Ce-141	pCi	67.4	74.6	0.90	A
						Co-58	pCi	57.9	62.9	0.92	A
Co-60	pCi	108				113	0.95	A			
Cr-51	pCi	162				189	0.86	A			
Cs-134	pCi	68.1				80.4	0.85	A			
Cs-137	pCi	82.4				95.0	0.87	A			
Fe-59	pCi	80.5				83.7	0.96	A			
Mn-54	pCi	102				107	0.95	A			
Zn-65	pCi	115				142	0.81	A			
December 2020	E13258	Soil	Ce-141	pCi/g	0.167	0.170	0.98	A			
			Co-58	pCi/g	0.125	0.143	0.87	A			
			Co-60	pCi/g	0.245	0.257	0.95	A			
			Cr-51	pCi/g	0.393	0.429	0.92	A			
			Cs-134	pCi/g	0.147	0.183	0.80	A			
			Cs-137	pCi/g	0.260	0.288	0.90	A			
			Fe-59	pCi/g	0.199	0.190	1.05	A			
			Mn-54	pCi/g	0.229	0.243	0.94	A			
December 2020	E13259	AP	Sr-89	pCi	85.0	78.6	1.08	A			
			Sr-90	pCi	13.1	11.4	1.15	A			

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

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

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

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

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

**Table 25: DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services**

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

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

(b) DOE/MAPEP evaluation:

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

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

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

(1) False positive test

(2) Sensitivity evaluation

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

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

**Table 26: ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services**

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

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

(b) ERA evaluation:

A = Acceptable - Reported value falls within the Acceptance Limits

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

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

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