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

Subject: Annual Radiological Environmental Operating Report – 2021

Waterford Steam Electric Station, Unit 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, 2021. This report is submitted pursuant to the requirements of Waterford 3 Technical Specification Section 6.9.1.7.

There are no commitments contained in this submittal.

If you have any questions, please contact John Lewis, Regulatory Assurance Manager, at 504-739-6028.

Respectfully,

John Lewis

JDL/llb

Enclosure: Annual Radiological Environmental Operating Report – 2021

cc: NRC Region IV Regional Administrator
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Enclosure to

W3F1-2022-0028

Annual Radiological Environmental Operating Report – 2021

(53 pages follow)

2021 Annual Radiological Environmental Operating Report
Waterford 3
Document Number: 50-382

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Plant: Waterford 3	Page 1 of 53
	YEAR: 2021
Docket Number: 50-382	
Annual Radiological Environmental Operating Report	

TABLE OF CONTENTS

ATTACHMENTS

TABLES

TABLES Cont'd

FIGURES

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, 2021. 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 2021, 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 2021 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 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 Waterford 3 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

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, 2021 results did not trigger any radiological monitoring program special reports.

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 2021, environmental sampling was performed for eight media types addressed in the ODCM and for direct radiation. A total of 464 samples of the 466 scheduled were obtained. Of the scheduled samples, 99.6% 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

Milk collection was removed from the 2021 sampling program due to the lack of indicator sampling locations. There were no other 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.

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 2021 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 m^2 (500 ft^2) 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 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
RADIOIODINE AND PARTICULATES 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.	• **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.	Continuous sampler operation with sample collection biweekly, or more frequently if required by dust loading.	• Radioiodine Canisters – I-131 analysis biweekly. • Air Particulate – Gross beta radioactivity analysis following filter change. Gamma isotopic analysis of composite (by location) quarterly.
RADIOIODINE AND PARTICULATES One sample from the vicinity of a community having the highest calculated annual average ground level D/Q.	• **APP-1 (WNW, 0.84 Miles)** – (West bank) Located in soybean/sugarcane field on Short St. in Killona.	Continuous sampler operation with sample collection biweekly, or more frequently if required by dust loading.	• Radioiodine Canisters – I-131 analysis biweekly. • Air Particulate – Gross beta radioactivity analysis following filter change. Gamma isotopic analysis of composite quarterly.
RADIOIODINE AND PARTICULATES One sample from a control location, as for example 15 - 30 km distance and in the least prevalent wind direction.	• **APE-26 (E, 25.8 Miles)** – (West bank) Located at Entergy office on Virgil Street in Gretna. (Control)	Continuous sampler operation with sample collection biweekly, or more frequently if required by dust loading.	• 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
TLDS An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.	• **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.	Quarterly	• 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
TLDS An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.	• **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 Entergy 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.	Quarterly	• 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
TLDS An outer ring of stations, one in ten of the meteorological sectors in the 6 to 8 km ranges from the site.	• **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	• 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
TLDS 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.	• **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)	Quarterly	• Gamma dose quarterly.

Table 3: Exposure Pathway – Waterborne

Requirement	Sample Point Description Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
SURFACE WATER One sample upstream and one sample downstream.	• **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.	Composite sample over one quarter period.	• Gamma isotopic analysis and tritium analysis quarterly.
DRINKING WATER One sample upstream and one sample downstream.	• **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.	Composite sample over one month period when I-131 analysis is performed, quarterly composite otherwise.	• 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.
SEDIMENT FROM SHORELINE One sample upstream and one sample downstream.	• **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.	Annually	• 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
MILK • 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.	• **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)	Quarterly (When Available)	• Gamma isotopic and I-131 analysis quarterly.
FISH AND INVERTEBRATES • 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.	• **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)	Sample in season, or annually if they are not seasonal.	• Gamma isotopic analysis on edible portions annually.
BROAD LEAF VEGATATION • 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.	• **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)	Quarterly during the growing season.	• Gamma isotopic and I-131 analysis quarterly.

Figure 1: Exposure Pathway

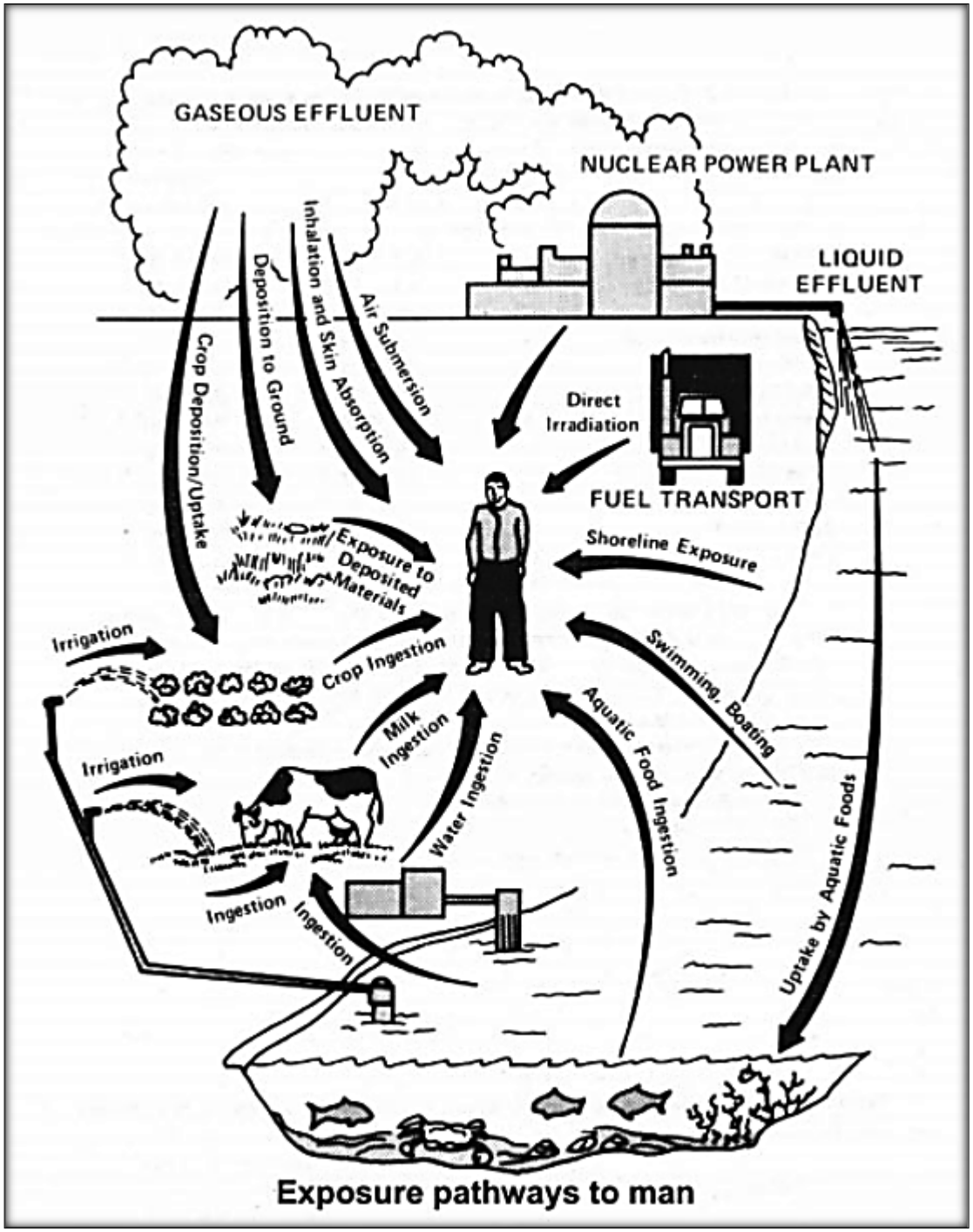


Figure 2: REMP Samples Within 2 Miles of Waterford 3

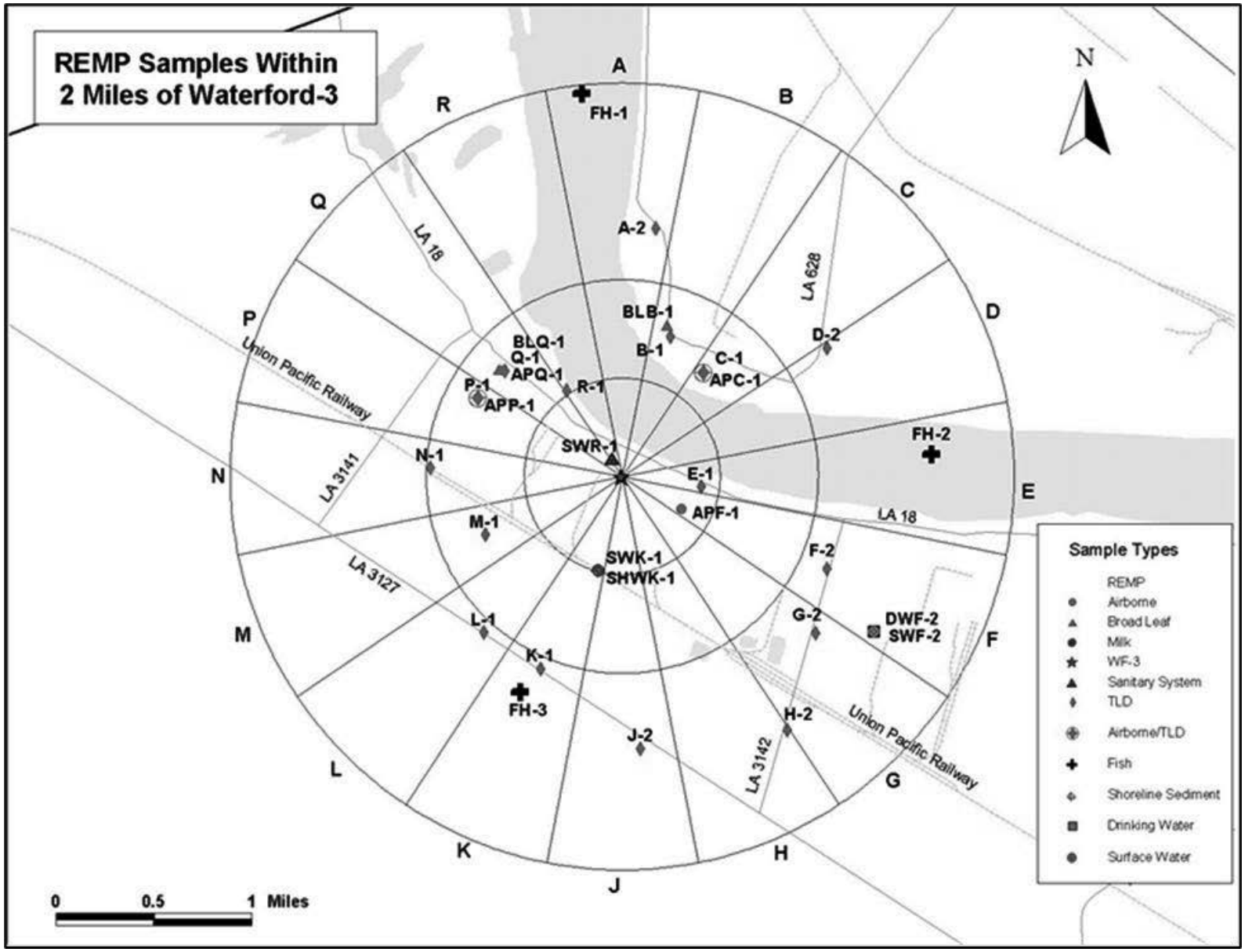


Figure 3: REMP Samples within 2 to 10 Miles of Waterford 3

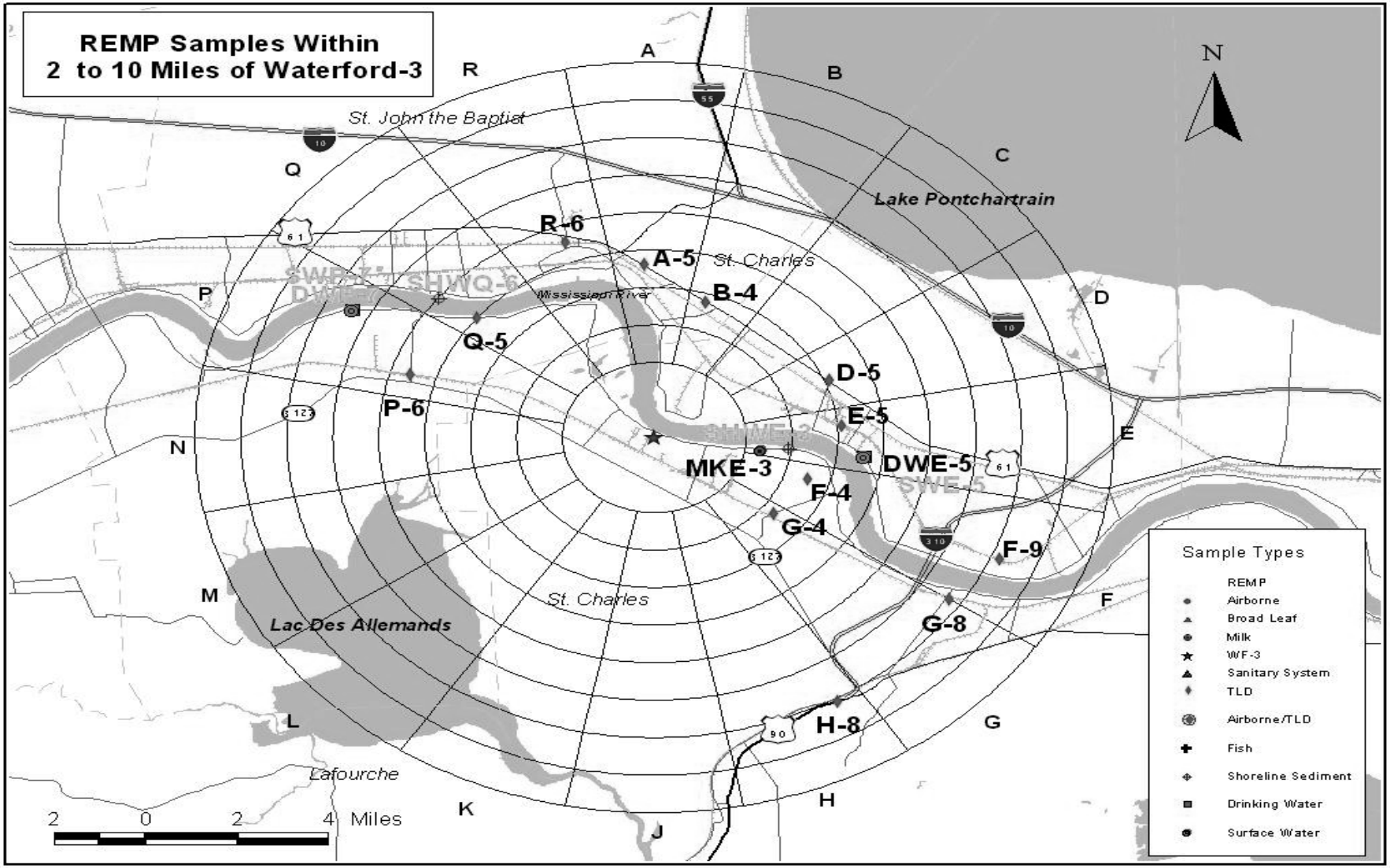
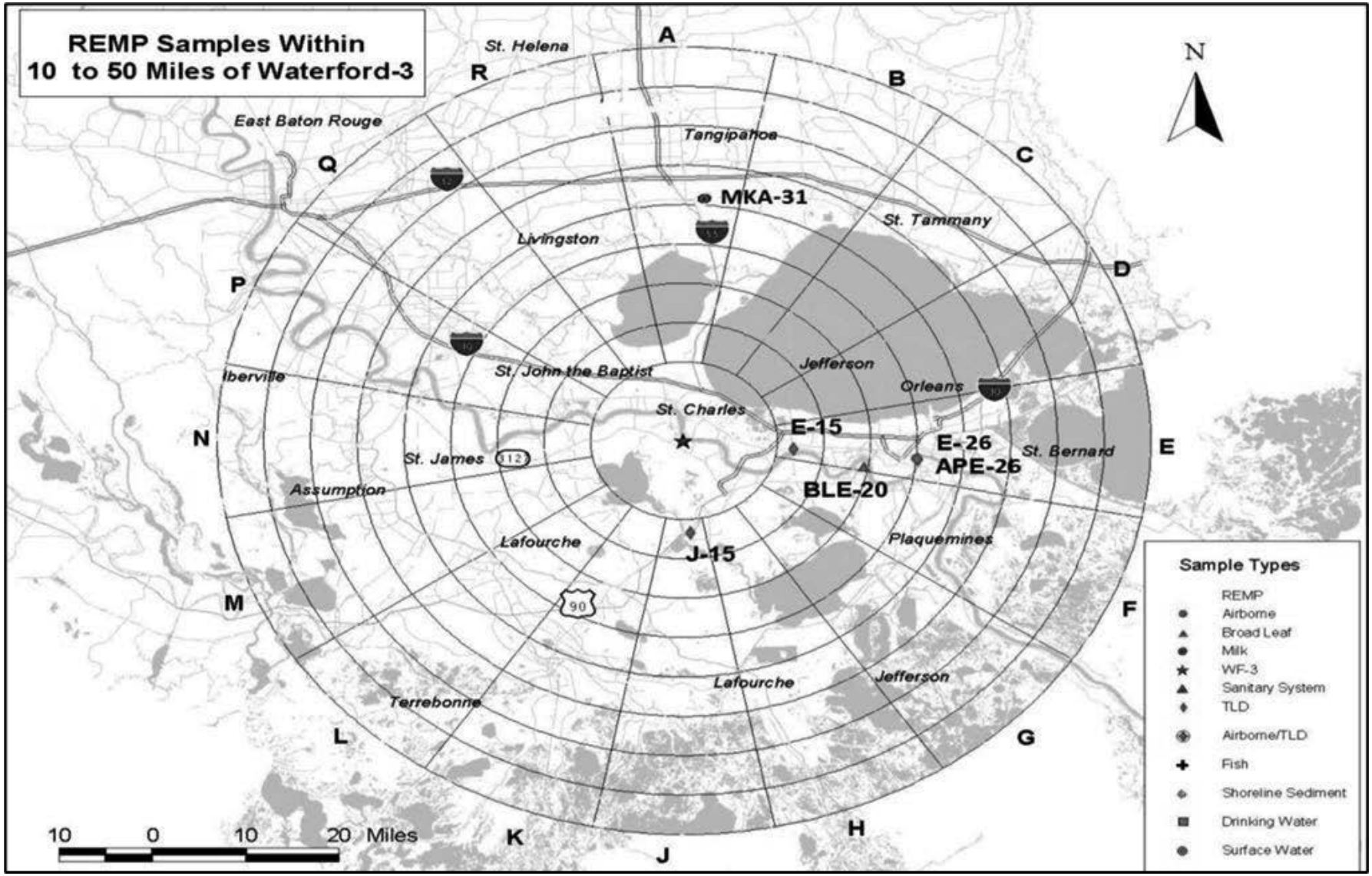


Figure 4: REMP Samples within 10 to 50 Miles of Waterford 3



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 2021 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.

Monitoring Period	Result
2011 – 2020 (Minimum Value)	0.017
2021 Average Value	0.019
2011 – 2020 (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.

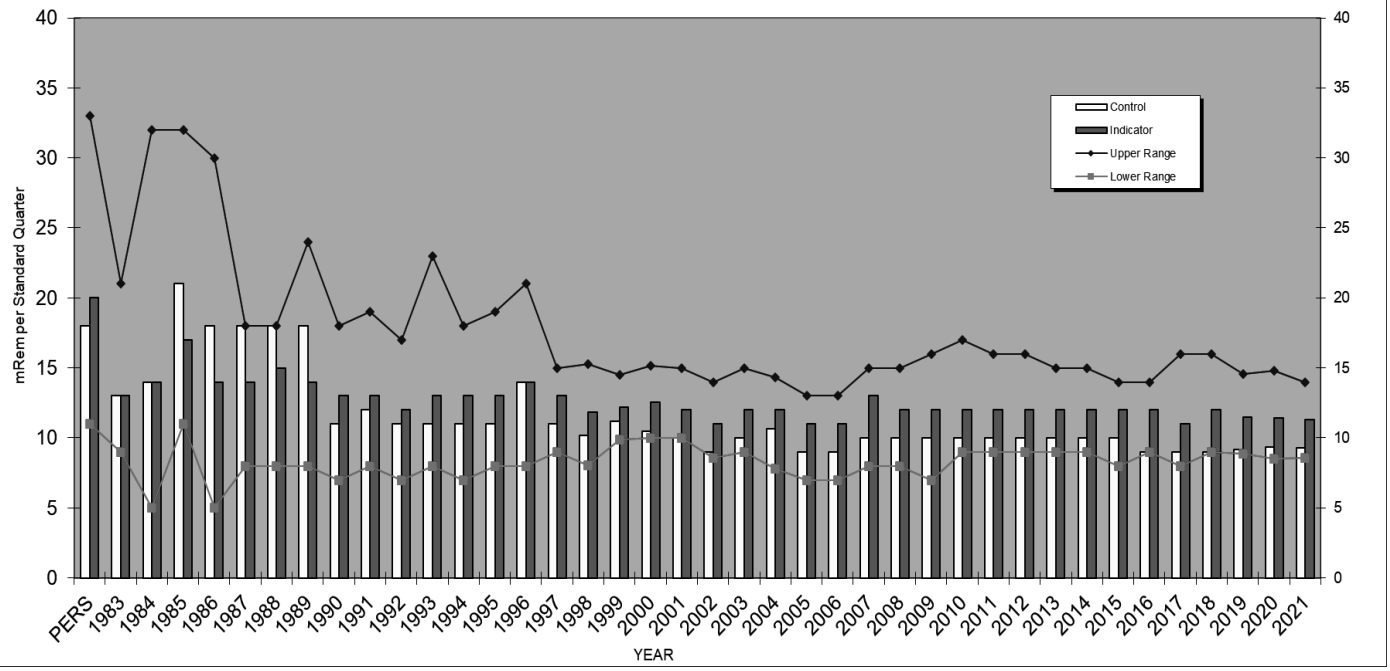
4.2 Thermoluminescent Dosimetry (TLD) Sample Results

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 11.3 millirem (mrem) shown in the TLD radiation dose comparison graph below shows the 2021 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 2021 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 5.1 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



4.3 Waterborne Sample Results

Analytical results for 2021 drinking water/surface water samples were similar to those reported in previous years. Gamma radionuclides, iodine-131 and tritium analytical results for 2021 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 2021.

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 2011 – 2020 operational years and below background preoperational data as shown below. Gross beta results from 2021 are summarized in Table 6. Results are reported as annual average pCi/L.

Monitoring Period	Result
2011 – 2020 (Minimum Value)	3.8
2021 Average Value	3.8
2011 – 2020 (Maximum Value)	6.6
Preoperational	7.0

Table 17, which includes gross beta concentrations for 2021, 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 2021 and levels of radionuclides remain similar to those obtained in previous operational years.

4.3.3 Sediment Sample Results

Sediment samples were collected from two indicators and one control location in 2021 and analyzed for gamma radionuclides. Gamma radionuclides were below the LLD limits at both indicator and control locations. Listed below is a comparison of 2021 Cs-137 indicator results to the 2011-2020 operational years. Waterford 3 operations had no significant impact on the environment or public by this waterborne pathway.

Monitoring Period	Result
2011-2020 (Minimum Value)	<LLD
2021 Value	<LLD
2011-2020 (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 2021, 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 2021, broad leaf vegetation samples were collected from two indicator and one control location and analyzed for iodine-131 and gamma radionuclides. The 2021 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 2021; 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 the first half of 2021 and analyzed for iodine-131 and gamma radionuclides. Cesium-137 was not measured in any control samples in 2021. Therefore, Waterford 3 concluded that plant operations had no significant impact on this pathway in 2021.

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.

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)
A	N	1.2	1.3	^	3.6	*3.8
B	NNE	1.0	1.4	^	1.9	^
C	NE	0.9	1.1	^	^	^
D	ENE	0.9	0.9	^	^	^
E	E	2.3	2.3	^	2.3	^
F	ESE	3.2	2.3	^	2.3	^
G	SE	4.0	4.0	^	2.5	^
H	SSE	^	^	^	^	^
J	S	^	^	^	^	^
K	SSW	^	^	^	^	^
L	SW	^	^	^	^	^
M	WSW	^	^	^	^	^
N	W	0.9	1.2	^	^	^
P	WNW	0.9	0.9	^	^	^
Q	NW	0.9	0.9	^	^	^
R	NNW	3.1	3.4	^	5.0	^

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.

4.6 Interlaboratory Comparison Results

Attachment 3 contains result summary for Interlaboratory Comparison program for Teledyne Brown Engineering and Environmental Dosimetry services 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 2021 REMP.

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	0.0191 (104 / 104) [0.0090 - 0.0320]	APQ-1 (132° - 0.81 mi)	0.0193 (26 / 26) [0.0120 - 0.0290]	0.0203 (26/26) [0.0110 - 0.0330]	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 (63 / 63) [8.6 - 13.9]	D-2 (238°- 1.24 mi)	13.1 (4 / 4) [12.2 - 13.9]	N/A	0
Outer Ring TLD (mR/Qtr)	Gamma / 39	[6]	12.2 (39 / 39) [8.7 - 14]	P-6 (107°- 5.58 mi)	13.8 (4 / 4) [13.4 - 14.0]	N/A	0
Special Interest TLD (mR/Qtr)	Gamma / 16	[6]	10.5 (16 / 16) [9.8 - 11.4]	G-8 (305°- 7.74 mi)	10.9 (4 / 4) [10.2 - 11.4]	N/A	0
Control TLD (mR/Qtr)	Gamma / 4	[6]	N/A	N/A	N/A	9.3 (4 / 4) [8.9 - 9.9]	0

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 / 4	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

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 / 12	4	3.8 (8 / 8) [2.4 - 5.7]	DW/SWF-2 (302°- 1.51 mi)	4.0 (4 / 4) [2.6 - 5.7]	3.2 (4 / 4) [2.2 - 4.6]	0
	I-131 / 40	1	< LLD	N/A	N/A	< LLD	0
	H-3 / 12	2000	< LLD	N/A	N/A	< LLD	0
	GS / 12						
	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

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	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 / 2	1	N/A	N/A	N/A	< LLD	0
	GS / 2						
	Cs-134	15	N/A	N/A	N/A	< LLD	0
	Cs-137	18	N/A	N/A	N/A	< LLD	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 Table 4.12-1.

[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.

Attachment 1

Sample Deviations

Table 7: Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
1	Milk	MKE-3	2021	Sample Unavailable	Milk samples from indicator station MKE-3 were unavailable for all four quarters of 2021 due to there being no indicator milk animals within 8 km of the plant. Broad Leaf vegetation sampling was performed in place of the milk indicator sampling.
2	Milk	MKA-31	2021	Program Change	Milk samples from control station MKA-31 were not collected for 3rd and 4th quarters of 2021 due to there being no indicator milk animals within 8 km of the plant. Milk sampling was removed from the program. Broad Leaf vegetation sampling was performed in place of the milk indicator sampling.
3	AP/C	APP-1	02/08/21-02/22/21	Low Volume	The air particulate and charcoal sample collected from 02/08/21-02/22/21 had low volumes due to a broken sample pump. The sample pump was replaced on the same day it was found not working.
4	WT	SWR-1	08/29/21-09/03/21	Loss of Power	The surface water composite sampler had a loss of power due to Hurricane Ida. Dip samples were taken daily until the power was restored.
5	WT	SWK-1	08/29/21-09/03/21	Loss of Power	The surface water composite sampler had a loss of power due to Hurricane Ida. Dip samples were taken daily until the power was restored.
6	AP/C	APQ-1	08/29/21-09/27/21	Low Volume	The air particulate and charcoal sample collected from 08/29/21-09/27/21 had low volumes due to a loss of power during Hurricane Ida.

Attachment 1

Sample Deviations

Table 7: Sample Deviations Table

Comment No.	Sample Media Affected	Sample Location	Date	Problem	Evaluation / Actions
7	AP/C	APP-1	08/29/21-09/27/21	Low Volume	The air particulate and charcoal sample collected from 08/29/21-09/27/21 had low volumes due to a loss of power during Hurricane Ida.
8	TLD	B-4	08/29/21	Sample Missing	TLD from station B-4 was unable to be analyzed due to the sample missing after Hurricane Ida. A new TLD was ordered and put in its place on 09/16/21.
9	AP/C	APE-26	09/20/21-10/04/21	Low Volume	The air particulate and charcoal sample collected from 09/20/21-10/04/21 had low volumes due to a power outage at the sample location. The power was restored 10/04/21.
10	TLD	Q-5	10/06/21	Sample Missing	TLD from station Q-5 was unable to be analyzed due to the sample missing at the time of collection. The disappearance seemed to be because of recovery work of power lines and poles that were damaged during Hurricane Ida. 4th Qtr. TLD was put in place.
11	TLD	N-1	10/06/21	Sample Missing	TLD from station N-1 was unable to be analyzed due to the sample missing at the time of collection. The disappearance seemed to be because of recovery work of power lines and poles that were damaged during Hurricane Ida. 4th Qtr. TLD was put in place.
12	TLD	N-1	11/03/21	Sample Missing	TLD from station N-1 was unable to be analyzed due to the sample missing at the time of collection. A new TLD was ordered and put in its place on 11/05/21.

Monitoring Results Tables

Table 8: Air Particulate Data Table

Analysis: Gross Beta					Units: pCi/m^3	
Start Date	End Date	APF-1 (Indicator)	APQ-1[(1)] (Indicator)	APP-1 (Indicator)	APC-1 (Indicator)	APE-26 (Control)
REQUIRED LLD ➔		0.01	0.01	0.01	0.01	0.01
12/28/2020	01/11/2021	0.021	0.021	0.019	0.019	0.020
01/11/2021	01/25/2021	0.020	0.023	0.020	0.021	0.023
01/25/2021	02/08/2021	0.023	0.022	0.023	0.023	0.024
02/08/2021	02/22/2021	0.022	0.019	0.021	0.017	0.020
02/22/2021	03/08/2021	0.019	0.020	0.019	0.020	0.022
03/08/2021	03/22/2021	0.019	0.018	0.017	0.015	0.019
03/22/2021	04/05/2021	0.018	0.018	0.018	0.017	0.021
04/05/2021	04/19/2021	0.017	0.022	0.019	0.018	0.018
04/19/2021	05/03/2021	0.020	0.020	0.020	0.022	0.021
05/03/2021	05/17/2021	0.016	0.015	0.018	0.017	0.017
05/17/2021	05/31/2021	0.017	0.016	0.014	0.016	0.016
05/31/2021	06/14/2021	0.012	0.012	0.012	0.011	0.012
06/14/2021	06/28/2021	0.015	0.014	0.015	0.014	0.015
06/28/2021	07/12/2021	0.015	0.012	0.009	0.010	0.011
07/12/2021	07/26/2021	0.014	0.014	0.014	0.015	0.014
07/26/2021	08/09/2021	0.020	0.019	0.024	0.021	0.026
08/09/2021	08/23/2021	0.015	0.016	0.013	0.014	0.016
08/23/2021	09/06/2021	0.016	0.025	0.022	0.020	0.017
09/06/2021	09/20/2021	0.017	0.014	0.014	0.016	0.018
09/20/2021	10/04/2021	0.017	0.016	0.018	0.018	0.023
10/04/2021	10/18/2021	0.022	0.021	0.020	0.021	0.022
10/18/2021	11/01/2021	0.026	0.022	0.024	0.023	0.023
11/01/2021	11/15/2021	0.032	0.029	0.032	0.028	0.033
11/15/2021	11/29/2021	0.026	0.028	0.022	0.021	0.026
11/29/2021	12/13/2021	0.022	0.023	0.022	0.025	0.026
12/13/2021	12/27/2021	0.020	0.023	0.027	0.022	0.026

(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**	**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**
12/28/2020	01/11/2021	< 0.014	< 0.015	< 0.013	< 0.014	< 0.015
01/11/2021	01/25/2021	< 0.014	< 0.014	< 0.015	< 0.011	< 0.014
01/25/2021	02/08/2021	< 0.016	< 0.016	< 0.018	< 0.013	< 0.017
02/08/2021	02/22/2021	< 0.021	< 0.021	< 0.016	< 0.020	< 0.020
02/22/2021	03/08/2021	< 0.014	< 0.012	< 0.014	< 0.013	< 0.014
03/08/2021	03/22/2021	< 0.014	< 0.015	< 0.014	< 0.013	< 0.012
03/22/2021	04/05/2021	< 0.013	< 0.014	< 0.013	< 0.013	< 0.011
04/05/2021	04/19/2021	< 0.021	< 0.021	< 0.020	< 0.020	< 0.009
04/19/2021	05/03/2021	< 0.019	< 0.019	< 0.018	< 0.018	< 0.008
05/03/2021	05/17/2021	< 0.014	< 0.015	< 0.014	< 0.014	< 0.006
05/17/2021	05/31/2021	< 0.014	< 0.014	< 0.014	< 0.013	< 0.012
05/31/2021	06/14/2021	< 0.022	< 0.023	< 0.021	< 0.021	< 0.010
06/14/2021	06/28/2021	< 0.016	< 0.016	< 0.015	< 0.015	< 0.007
06/28/2021	07/12/2021	< 0.020	< 0.020	< 0.019	< 0.008	< 0.020
07/12/2021	07/26/2021	< 0.012	< 0.013	< 0.012	< 0.012	< 0.009
07/26/2021	08/09/2021	< 0.012	< 0.013	< 0.012	< 0.006	< 0.013
08/09/2021	08/23/2021	< 0.016	< 0.017	< 0.016	< 0.016	< 0.007
08/23/2021	09/06/2021	< 0.013	< 0.026	< 0.029	< 0.016	< 0.013
09/06/2021	09/20/2021	< 0.010	< 0.022	< 0.035	< 0.013	< 0.014
09/20/2021	10/04/2021	< 0.015	< 0.016	< 0.015	< 0.014	< 0.017
10/04/2021	10/18/2021	< 0.013	< 0.014	< 0.013	< 0.013	< 0.007
10/18/2021	11/01/2021	< 0.014	< 0.014	< 0.014	< 0.011	< 0.014
11/01/2021	11/15/2021	< 0.018	< 0.009	< 0.018	< 0.017	< 0.018
11/15/2021	11/29/2021	< 0.016	< 0.016	< 0.016	< 0.012	< 0.016
11/29/2021	12/13/2021	< 0.010	< 0.009	< 0.010	< 0.009	< 0.010
12/13/2021	12/27/2021	< 0.018	< 0.008	< 0.018	< 0.017	< 0.018

Monitoring Results Tables

Table 10: Air Particulate Composite Data Table

Analysis: Gamma Isotopic		Units: pCi/m^3	
Location	**Collection Date**	**Cs-134**	**Cs-137**
	REQUIRED LLD ➔	**0.05**	**0.06**
APF-1 (Indicator)	04/19/2021	< 0.004	< 0.003
APQ-1 (Indicator)	04/19/2021	< 0.002	< 0.002
APP-1 (Indicator)	04/19/2021	< 0.001	< 0.002
APC-1 (Indicator)	04/19/2021	< 0.003	< 0.002
APE-26 (Control)	04/19/2021	< 0.003	< 0.004
APF-1 (Indicator)	07/12/2021	< 0.003	< 0.002
APQ-1 (Indicator)	07/12/2021	< 0.003	< 0.003
APP-1 (Indicator)	07/12/2021	< 0.002	< 0.002
APC-1 (Indicator)	07/12/2021	< 0.003	< 0.003
APE-26 (Control)	07/12/2021	< 0.002	< 0.002
APF-1 (Indicator)	10/04/2021	< 0.005	< 0.004
APQ-1 (Indicator)	10/04/2021	< 0.003	< 0.002
APP-1 (Indicator)	10/04/2021	< 0.004	< 0.004
APC-1 (Indicator)	10/04/2021	< 0.002	< 0.002
APE-26 (Control)	10/04/2021	< 0.003	< 0.003
APF-1 (Indicator)	12/27/2021	< 0.005	< 0.004
APQ-1 (Indicator)	12/27/2021	< 0.003	< 0.003
APP-1 (Indicator)	12/27/2021	< 0.002	< 0.002
APC-1 (Indicator)	12/27/2021	< 0.002	< 0.002
APE-26 (Control)	12/27/2021	< 0.002	< 0.002

Monitoring Results Tables

Table 11: Thermoluminescent Dosimeters – Inner Ring

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	**1st Qtr 2021**	**2nd Qtr 2021**	**3rd Qtr 2021**	**4th Qtr 2021**	**Annual Mean 2021**
A-2	12.2	12.2	12.5	13.0	**12.5**
B-1	12.5	12.7	12.5	13.7	**12.9**
C-1	9.2	8.6	9.2	9.8	**9.2**
D-2(1)	**12.3**	**12.2**	**13.9**	**13.9**	**13.1**
E-1	11.7	11.5	11.8	12.7	**11.9**
F-2	10.6	10.6	11.3	11.8	**11.1**
G-2	10.4	10.0	10.5	10.9	**10.5**
H-2	9.9	10.0	10.9	10.9	**10.4**
J-2	10.1	8.8	9.5	10.2	**9.7**
K-1	11.1	10.1	11.2	11.8	**11.1**
L-1	12.3	11.7	12.2	12.2	**12.1**
M-1	10.2	9.6	10.1	10.0	**10.0**
N-1	10.2	10.1	(2)	9.5	**9.9**
P-1	10.5	10.2	10.5	11.3	**10.6**
Q-1	12.0	11.6	12.4	12.4	**12.1**
R-1	9.0	9.0	9.5	9.3	**9.2**

(1) Inner ring station with highest annual mean.
(2) See Attachment 1, Table 7, Samples Deviations Table, Comment 11

Table 12: Thermoluminescent Dosimeters – Outer Ring

Analysis: Gamma Dose			Units: mrem/Std. Qtr.		
Station	**1st Qtr 2021**	**2nd Qtr 2021**	**3rd Qtr 2021**	**4th Qtr 2021**	**Annual Mean 2021**
A-5	12.4	12.1	12.4	13.0	**12.5**
B-4	13.1	13.1	13.8	14.0	**13.5**
D-5	11.5	11.0	11.2	12.9	**11.7**
E-5	12.7	12.3	12.5	12.6	**12.5**
F-4	13.6	13.2	13.2	13.3	**13.3**
G-4	10.3	9.7	10.4	11.4	**10.5**
H-8	12.7	12.1	11.8	13.9	**12.6**
P-6(1)	**13.8**	**13.4**	**13.8**	**14.0**	**13.8**
Q-5	11.4	11.2	(2)	12.7	**11.8**
R-6	10.1	8.7	9.7	9.7	**9.6**

(1) Outer ring station with highest annual mean.
(2) See Attachment 1, Table 7, Samples Deviations Table, Comment 10

Monitoring Results Tables

Table 13: 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**
E-15	9.9	9.9	10.2	10.6	**10.2**
F-9	10.3	10.3	11.1	11.1	**10.7**
G-8(1)	**10.9**	**10.2**	**11.1**	**11.4**	**10.9**
J-15	9.9	9.8	10.0	10.7	**10.1**

(1) Special interest station with highest annual mean.

Table 14: 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**
E-26	9.2	8.9	9.2	9.9	**9.3**

Monitoring Results Tables

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)	12/22/2020	01/18/2021	< 1.91	< 1.86	< 4.07	< 2.16	< 3.93	< 1.89	< 2.17	< 3.54	< 2.24	< 2.25	< 7.35	< 2.70
SWK-1 (Indicator)	01/18/2021	02/15/2021	< 1.96	< 2.12	< 4.54	< 2.35	< 4.38	< 2.02	< 3.94	< 3.43	< 1.99	< 2.05	< 10.2	< 3.76
SWK-1 (Indicator)	02/15/2021	03/15/2021	< 3.99	< 3.16	< 6.86	< 4.44	< 7.33	< 3.80	< 4.54	< 5.89	< 3.84	< 3.72	< 14.3	< 4.20
SWK-1 (Indicator)	03/15/2021	04/13/2021	< 1.65	< 1.80	< 3.91	< 1.84	< 3.49	< 1.69	< 2.16	< 2.91	< 1.82	< 1.75	< 6.60	< 1.97
SWK-1 (Indicator)	04/13/2021	05/11/2021	< 2.12	< 1.93	< 4.10	< 2.03	< 4.16	< 1.94	< 1.99	< 3.24	< 2.03	< 1.99	< 6.65	< 2.35
SWK-1 (Indicator)	05/11/2021	06/07/2021	< 1.77	< 1.82	< 3.69	< 1.85	< 3.70	< 1.77	< 2.22	< 3.11	< 2.00	< 1.96	< 7.11	< 2.21
SWK-1 (Indicator)	06/07/2021	07/06/2021	< 1.87	< 1.88	< 4.13	< 1.90	< 3.75	< 1.96	< 2.23	< 3.37	< 2.27	< 2.03	< 7.41	< 2.83
SWK-1 (Indicator)	07/06/2021	08/03/2021	< 2.10	< 1.88	< 3.79	< 2.35	< 3.54	< 1.90	< 2.07	< 3.72	< 2.24	< 2.05	< 7.01	< 2.34
SWK-1 (Indicator)	08/03/2021	09/01/2021	< 1.99	< 1.88	< 3.96	< 2.28	< 3.82	< 1.82	< 2.03	< 3.24	< 2.26	< 1.97	< 6.89	< 2.48
SWK-1 (Indicator)	09/01/2021	09/28/2021	< 3.03	< 2.74	< 5.80	< 3.81	< 5.93	< 3.19	< 4.18	< 5.11	< 3.27	< 4.04	< 14.6	< 4.18
SWK-1 (Indicator)	09/28/2021	10/25/2021	< 2.94	< 3.36	< 6.04	< 3.45	< 6.44	< 2.66	< 4.25	< 5.26	< 3.75	< 3.33	< 14.7	< 4.87
SWK-1 (Indicator)	10/25/2021	11/23/2021	< 1.98	< 2.02	< 4.20	< 1.99	< 3.98	< 2.00	< 2.20	< 3.33	< 2.22	< 2.04	< 7.56	< 2.32
SWK-1 (Indicator)	11/23/2021	12/21/2021	< 1.61	< 1.57	< 3.32	< 1.75	< 3.46	< 1.66	< 2.80	< 2.97	< 1.86	< 1.82	< 8.15	< 2.49

Monitoring Results Tables

Table 16: Surface Water – Tritium

Analysis: H-3		Units: pCi/L	
Location	**Start Date**	**End Date**	**H-3**
		REQUIRED LLD ➔	**3000**
SWK-1 (Indicator)	12/22/2020	03/15/2021	< 520
SWK-1 (Indicator)	03/15/2021	06/07/2021	< 488
SWK-1 (Indicator)	06/07/2021	09/01/2021	< 539
SWK-1 (Indicator)	09/01/2021	11/23/2021	< 493

Monitoring Results Tables

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)	03/15/2021	2.61	< 2.11	< 2.31	< 4.64	< 1.88	< 4.38	< 2.12	< 3.60	< 2.28	< 2.25	< 10.4	< 3.45
DWE/SWE-5 (Indicator)	03/15/2021	2.41	< 2.00	< 1.90	< 4.20	< 2.36	< 3.57	< 2.18	< 3.64	< 2.32	< 2.09	< 9.74	< 3.74
DWP/SWP-7 (Control)	03/15/2021	2.19	< 2.35	< 2.47	< 5.16	< 2.39	< 4.67	< 2.66	< 4.20	< 2.58	< 2.37	< 12.1	< 3.79
DWF/SWF-2[(1)] (Indicator)	06/07/2021	4.32	< 1.54	< 1.59	< 3.20	< 1.71	< 3.23	< 1.66	< 2.85	< 1.75	< 1.70	< 6.85	< 2.27
DWE/SWE-5 (Indicator)	06/07/2021	4.14	< 2.21	< 2.23	< 4.46	< 2.43	< 4.26	< 2.38	< 3.95	< 2.54	< 2.40	< 11.2	< 3.73
DWP/SWP-7 (Control)	06/07/2021	2.84	< 3.96	< 3.59	< 7.11	< 3.31	< 9.14	< 3.85	< 7.11	< 4.31	< 4.64	< 14.8	< 5.04
DWF/SWF-2[(1)] (Indicator)	09/01/2021	5.66	< 1.93	< 1.80	< 3.89	< 1.98	< 3.65	< 1.77	< 3.10	< 2.09	< 2.03	< 7.44	< 2.43
DWE/SWE-5 (Indicator)	09/01/2021	4.91	< 2.12	< 2.06	< 4.27	< 2.09	< 4.25	< 2.24	< 3.60	< 2.65	< 2.36	< 8.19	< 2.84
DWP/SWP-7 (Control)	09/01/2021	4.55	< 2.11	< 1.82	< 3.90	< 2.21	< 4.28	< 1.91	< 3.53	< 2.34	< 2.21	< 8.07	< 2.85
DWF/SWF-2[(1)] (Indicator)	11/23/2021	3.59	< 1.16	< 1.20	< 2.58	< 1.37	< 2.61	< 1.26	< 2.20	< 1.35	< 1.34	< 6.26	< 2.29
DWE/SWE-5 (Indicator)	11/23/2021	3.04	< 1.71	< 1.79	< 4.13	< 2.02	< 3.98	< 1.77	< 3.32	< 2.17	< 1.86	< 9.13	< 3.16
DWP/SWP-7 (Control)	11/23/2021	3.41	< 1.56	< 1.82	< 3.68	< 1.66	< 3.44	< 1.80	< 3.16	< 1.92	< 1.62	< 9.50	< 3.01

[(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)	12/22/2020	01/18/2021	< 0.647
DWF/SWF-2 (Indicator) Dup.	12/22/2020	01/18/2021	< 0.716
DWE/SWE-5 (Indicator)	12/22/2020	01/18/2021	< 0.742
DWP/SWP-7 (Control)	12/22/2020	01/18/2021	< 0.802
DWF/SWF-2 (Indicator)	01/18/2021	02/15/2021	< 0.912
DWE/SWE-5 (Indicator)	01/18/2021	02/15/2021	< 0.811
DWP/SWP-7 (Control)	01/18/2021	02/15/2021	< 0.883
DWF/SWF-2 (Indicator)	02/15/2021	03/15/2021	< 0.757
DWE/SWE-5 (Indicator)	02/15/2021	03/15/2021	< 0.871
DWP/SWP-7 (Control)	02/15/2021	03/15/2021	< 0.809
DWF/SWF-2 (Indicator)	03/15/2021	04/13/2021	< 0.886
DWE/SWE-5 (Indicator)	03/15/2021	04/13/2021	< 0.860
DWP/SWP-7 (Control)	03/15/2021	04/13/2021	< 0.741
DWF/SWF-2 (Indicator)	04/13/2021	05/11/2021	< 0.660
DWE/SWE-5 (Indicator)	04/13/2021	05/11/2021	< 0.630
DWP/SWP-7 (Control)	04/13/2021	05/11/2021	< 0.648
DWF/SWF-2 (Indicator)	05/11/2021	06/07/2021	< 0.848
DWE/SWE-5 (Indicator)	05/11/2021	06/07/2021	< 0.646
DWP/SWP-7 (Control)	05/11/2021	06/07/2021	< 0.862
DWF/SWF-2 (Indicator)	06/07/2021	07/06/2021	< 0.676
DWE/SWE-5 (Indicator)	06/07/2021	07/06/2021	< 0.772
DWP/SWP-7 (Control)	06/07/2021	07/06/2021	< 0.850
DWF/SWF-2 (Indicator)	07/06/2021	08/03/2021	< 0.650
DWE/SWE-5 (Indicator)	07/06/2021	08/03/2021	< 0.731
DWP/SWP-7 (Control)	07/06/2021	08/03/2021	< 0.822
DWF/SWF-2 (Indicator)	08/03/2021	09/01/2021	< 0.742
DWE/SWE-5 (Indicator)	08/03/2021	09/01/2021	< 0.686
DWP/SWP-7 (Control)	08/03/2021	09/01/2021	< 0.771
DWF/SWF-2 (Indicator)	09/01/2021	09/28/2021	< 0.684
DWE/SWE-5 (Indicator)	09/01/2021	09/28/2021	< 0.793
DWP/SWP-7 (Control)	09/01/2021	09/28/2021	< 0.504
DWF/SWF-2 (Indicator)	09/28/2021	10/26/2021	< 0.903
DWE/SWE-5 (Indicator)	09/28/2021	10/25/2021	< 0.812
DWP/SWP-7 (Control)	09/28/2021	10/25/2021	< 0.787
DWF/SWF-2 (Indicator)	10/26/2021	11/23/2021	< 0.871
DWE/SWE-5 (Indicator)	10/25/2021	11/23/2021	< 0.850
DWP/SWP-7 (Control)	10/25/2021	11/23/2021	< 0.826
DWF/SWF-2 (Indicator)	11/23/2021	12/21/2021	< 0.743
DWE/SWE-5 (Indicator)	11/23/2021	12/21/2021	< 0.677
DWP/SWP-7 (Control)	11/23/2021	12/21/2021	< 0.859

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)	12/22/2020	03/15/2021	< 503
DWE/SWE-5 (Indicator)	12/22/2020	03/15/2021	< 500
DWP/SWP-7 (Control)	12/22/2020	03/15/2021	< 498
DWF/SWF-2 (Indicator)	03/15/2021	06/07/2021	< 467
DWE/SWE-5 (Indicator)	03/15/2021	06/07/2021	< 509
DWP/SWP-7 (Control)	03/15/2021	06/07/2021	< 495
DWF/SWF-2 (Indicator)	06/07/2021	09/01/2021	< 550
DWE/SWE-5 (Indicator)	06/07/2021	09/01/2021	< 542
DWP/SWP-7 (Control)	06/07/2021	09/01/2021	< 537
DWF/SWF-2 (Indicator)	09/01/2021	11/23/2021	< 504
DWE/SWE-5 (Indicator)	09/01/2021	11/23/2021	< 485
DWP/SWP-7 (Control)	09/01/2021	11/23/2021	< 480

Monitoring Results Tables

Table 20: Sediment - Gamma

Analysis: Gamma Isotopic		Units: pCi/kg (dry)	
Location	**Collection Date**	**Cs-134**	**Cs-137**
	REQUIRED LLD ➔	**150**	**180**
SHWK-1 (Indicator)	09/07/2021	< 81.47	< 75.65
SHWE-3 (Indicator)	09/07/2021	< 88.67	< 84.79
SHWQ-6 (Control)	09/07/2021	< 67.24	< 56.71

Monitoring Results Tables

Table 21: Fish - Gamma

Analysis: Gamma Isotopic								Units: pCi/kg (wet)	
Location	**Collection Date**	**Species**	**Mn-54**	**Co-58**	**Fe-59**	**Co-60**	**Zn-65**	**Cs-134**	**Cs-137**
REQUIRED LLD ➔			**130**	**130**	**260**	**130**	**260**	**130**	**150**
FH-1 (Control)	10/31/2021	Catfish	< 45.32	< 80.59	< 103.2	< 66.05	< 117.2	< 68.82	< 70.44
FH-2 (Indicator)	10/31/2021	Catfish	< 62.29	< 54.80	< 96.33	< 67.81	< 159.9	< 70.02	< 62.05
FH-3 (Indicator)	10/12/2021	Catfish	< 60.43	< 90.30	< 194.3	< 65.75	< 164.6	< 77.84	< 59.53
FH-1 (Control)	10/31/2021	Buffalo	< 54.19	< 57.89	< 102.9	< 46.21	< 103.8	< 63.93	< 50.19
FH-2 (Indicator)	10/31/2021	Buffalo	< 49.29	< 51.46	< 132.0	< 63.45	< 118.7	< 57.56	< 56.28
FH-3 (Indicator)	10/12/2021	Buffalo	< 79.32	< 89.59	< 229.1	< 59.57	< 169.1	< 66.02	< 78.93
FH-1 (Control)	10/31/2021	Mullet	< 52.99	< 59.53	< 84.96	< 57.63	< 105.4	< 50.74	< 48.49
FH-2 (Indicator)	10/31/2021	Mullet	< 61.17	< 80.12	< 188.8	< 55.66	< 161.0	< 65.92	< 64.30
FH-3 (Indicator)	10/12/2021	Mullet	< 47.34	< 78.63	< 216.5	< 52.01	< 106.4	< 79.16	< 50.90
FH-1 (Control)	10/31/2021	Carp	< 74.18	< 88.04	< 157.1	< 69.24	< 130.6	< 75.22	< 66.55
FH-2 (Indicator)	10/31/2021	Carp	< 65.14	< 72.68	< 142.9	< 76.57	< 179.3	< 71.82	< 62.02
FH-3 (Indicator)	10/12/2021	Carp	< 72.99	< 98.06	< 203.4	< 69.04	< 154.3	< 75.22	< 55.13

Monitoring Results Tables

Table 22: Broad Leaf Vegatation - 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)	03/09/2021	< 25.19	< 23.64	< 25.36
BLB-1 (Indicator)	03/09/2021	< 18.97	< 20.91	< 24.08
BLE-20 (Control)	03/09/2021	< 21.26	< 24.52	< 23.22
BLQ-1 (Indicator)	06/08/2021	< 57.07	< 57.48	< 51.41
BLB-1 (Indicator)	06/08/2021	< 35.22	< 31.70	< 29.06
BLE-20 (Control)	06/08/2021	< 32.54	< 23.81	< 31.13
BLQ-1 (Indicator)	09/07/2021	< 53.43	< 57.58	< 50.04
BLB-1 (Indicator)	09/07/2021	< 41.22	< 43.34	< 35.99
BLE-20 (Control)	09/07/2021	< 44.34	< 39.40	< 45.45
BLQ-1 (Indicator)	12/07/2021	< 33.46	< 37.04	< 32.74
BLB-1 (Indicator)	12/07/2021	< 33.29	< 40.53	< 38.08
BLE-20 (Control)	12/07/2021	< 36.63	< 45.35	< 47.02

Monitoring Results Tables

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 ➔		**1**	**15**	**18**	**15**	**15**
MKE-3 (Indicator)	03/09/2021	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	03/09/2021	< 0.836	< 2.73	< 3.37	< 10.3	< 2.94
MKE-3 (Indicator)	06/08/2021	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	06/08/2021	< 0.797	< 4.28	< 4.00	< 14.8	< 3.93
MKE-3 (Indicator)	09/01/2021	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	09/01/2021	(2)	(2)	(2)	(2)	(2)
MKE-3 (Indicator)	12/01/2021	(1)	(1)	(1)	(1)	(1)
MKA-31 (Control)	12/01/2021	(2)	(2)	(2)	(2)	(2)

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

(2) See Attachment 1, Table 7, Samples Deviations Table, Comment 2

Attachment 3 **Page 1 of 8**

Interlaboratory Comparison Program Results

1.0 Summary of Teledyne Brown Engineering Quality Assurance

For the Teledyne Brown Engineering (TBE) laboratory, 146 out of 154 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.* A summary is found below:

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)

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)

Interlaboratory Comparison Program Results

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.

Attachment 3

Table 24: 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
	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
			Zn-65	pCi	166	173	0.96	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
			Zn-65	pCi/g	0.448	0.441	1.02	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 24: 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
	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
			Zn-65	pCi	202	180	1.12	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
			Zn-65	pCi/g	0.312	0.293	1.06	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

Table 25: 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 26: 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	76.2 - 99.6	A
			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	63.7	43.7 - 81.5	A
			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	A
			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***

2.0 Environmental TLD Quality Assurance

Environmental dosimetry services for the reporting period of January – December, 2021 were provided by the Environmental Dosimetry Company (EDC), Sterling, Massachusetts. The TLD systems at the Environmental Dosimetry Company (EDC) are calibrated and operated to ensure consistent and accurate evaluation of TLDs. The quality of the dosimetric results reported to EDC clients is ensured by in house performance testing and independent performance testing by EDC clients.

The purpose of the dosimetry quality assurance program is to provide performance documentation of the routine processing of EDC dosimeters. Performance testing provides a statistical measure of the bias and precision of dosimetry processing against a reliable standard, which in turn points out any trends or performance changes. Dosimetry quality control tests are performed on EDC Panasonic 814 Environmental dosimeters. These tests include: (1) the in house testing program conducted by the EDC QA Officer and (2) independent test perform by EDC clients.

Excluded from this report are instrumentation checks. Although instrumentation checks represent an important aspect of the quality assurance program, they are not included as process checks in this report. Instrumentation checks represent between 5-10% of the TLDs processed.

Table 27 provides a summary of individual dosimeter results evaluated against the EDC internal acceptance criteria for high-energy photons (Cs-137) only. The internal acceptance (tolerance) criteria for the Panasonic Environmental dosimeters are: ± 15% for bias and ± 12.8% for precision. During this period, 100% (72/72) of the individual dosimeters, evaluated against these criteria met the tolerance limits for accuracy and 100% (72/72) met the criterion for precision.

Table 28 provides the Bias + Standard deviation results for each group (N=6) of dosimeters evaluated against the internal tolerance criteria. Overall, 100% (12/12) of the dosimeter sets evaluated against the internal tolerance performance criteria met these criteria.

Table 29 presents the independent blind spike results for irradiated dosimeters provided by client utilities during this annual period. All results passed the performance acceptance criterion.

Table 27
PERCENTAGE OF INDIVIDUAL DOSIMETERS THAT PASSED EDC INTERNAL CRITERIA
JANUARY – DECEMBER 2021 [(1), (2)]

Dosimeter Type	Number Tested	% Passed Bias Criteria	% Passed Precision Criteria
Panasonic Environmental	72	100	100

[(1)]This table summarizes results of tests conducted by EDC.
[(2)]Environmental dosimeter results are free in air.

Interlaboratory Comparison Program Results

Table 28
MEAN DOSIMETER ANALYSES (N=6)
JANUARY – DECEMBER 2021 (1), (2)

Process Date	Mean Bias %	Standard Deviation %	Tolerance Limit +/-15%
5/04/2021	0.6	0.9	Pass
5/06/2021	-0.2	1.4	Pass
5/26/2021	-3.8	1.6	Pass
7/27/2021	2.8	1.4	Pass
8/04/2021	-1.8	2.3	Pass
9/14/2021	-0.2	2.3	Pass
11/01/2021	3.7	0.6	Pass
11/03/2021	1.9	1.9	Pass
11/09/2021	1.1	1.1	Pass
01/26/2022	2.6	1.9	Pass
01/30/2022	-4.2	1.1	Pass
02/06/2022	2.9	1.2	Pass

(1)This table summarizes results of tests conducted by EDC for TLDs issued in 2021.
(2)Environmental dosimeter results are free in air.

Table 29
SUMMARY OF INDEPENDENT DOSIMETER TESTING
JANUARY – DECEMBER 2021 (1), (2)

Issuance Period	Client	Mean Bias %	Standard Deviation %	Pass / Fail
1st Qtr. 2021	SONGS	-3.8	1.4	Pass
1st Qtr. 2021	SONGS	-4.7	1.1	Pass
2nd Qtr.2021	Seabrook	3.1	1.0	Pass
3rd Qtr. 2021	Millstone	-4.7	1.4	Pass
4th Qtr.2021	PSEG(PNNL) 50mR	1.3	0.8	Pass
4th Qtr.2021	PSEG(PNNL) 100mR	1.8	0.8	Pass
4th Qtr.2021	PSEG(PNNL) 150mR	-0.6	0.5	Pass
4th Qtr.2021	PSEG(PNNL) 200mR	-2.6	2.0	Pass
4th Qtr.2021	Seabrook	2.6	1.4	Pass

(1)Performance criteria are +/- 30%.
(2)Blind spike irradiations using Cs-137