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W3F1-2012-0036

April 30, 2012

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

Subject: Annual Radiological Environmental Operating Report -2011
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

Dear Sir or Madam:

Attached is the Annual Radiological Environmental Operating Report for the period of January 1 through December 31, 2011. This report is submitted pursuant to the requirements of Waterford 3 Technical Specification Section 6.9.1.7.

Please contact William J. Steelman, Licensing Manager, at (504) 739-6685, if you have questions regarding this information.

There are no new commitments contained in this submittal.

Sincerely,

A handwritten signature in black ink, appearing to read "William J. Steelman", with a long horizontal flourish extending to the right.

WJS/JDW

Attachment: Annual Radiological Environmental Operating Report – 2011

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Attachment to

W3F1-2012-0036

Annual Radiological Environmental Operating Report - 2011



**Annual
Radiological Environmental Operating
Report**

January 1, 2011 - December 31, 2011



**Waterford 3 Steam Electric Station
Entergy Operations, Inc.**

Docket Number 50-382

License Number NPF-38

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Summary

The Annual Radiological Environmental Operating Report presents data obtained through analyses of environmental samples collected for Waterford 3's (W3) Radiological Environmental Monitoring Program (REMP) for the period January 1 through December 31, 2011. This report fulfills the requirements of W3 Technical Specification 6.9.1.7.

During 2011, gross beta radioactivity was detected in air and drinking/surface water locations. Results obtained at the indicator locations were similar to those obtained at the control location. Therefore, levels continue to remain at background.

Cesium-137 was detected during 2011 at control milk location MKA-31. This is consistent with results obtained from the preoperational program and previous years of operation. The level of Cesium-137 in the sample was below both the reporting level and the LLD level required by the W3 TRM.

REMP air samples collected on 04-04-11 identified detectable concentrations of Iodine-131. Given the following facts, the detectable concentrations are not a result of W3 operation.

- The quantities of radioactive airborne effluents from W3 during 2011 did not increase significantly compared to year 2010.
- Prior REMP sample results have not detected the presence of this isotope in air samples.
- The concentrations being detected in the indicator samples were also identified in the control samples far from W3.

As such, the atypical detection of these radionuclides in both indicator and control samples is credibly attributed to the trans-Pacific transport of airborne releases from Dai-ichi, Fukushima following the March 11, 2011 Tohoku earthquake and is not related to the operations of W3.

Radiological Environmental Monitoring Program

W3 established the REMP prior to the station becoming operational (1985) to provide data on background radiation and radioactivity normally present in the area. W3 has continued to monitor the environment by sampling air, water, sediment, milk, fish and broad leaf vegetation, as well as measuring radiation directly.

The REMP includes sampling indicator and control locations within a 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. W3 compares indicator results with control, preoperational, and previous years operational results to assess any impact W3 might have on the surrounding environment.

In 2011, W3 collected environmental samples for radiological analysis. Based on the comparison results of indicator locations with control locations and previous studies, it was concluded that overall W3 operations had no significant impact on plant environs. The review of 2011 data, in many cases, showed undetectable radiation levels in the environment and near background levels in significant pathways associated with W3.

Harmful Effects or Irreversible Damage

The REMP did not detect any harmful effects or evidence of irreversible damage in 2011. Therefore, no analysis or planned course of action to alleviate problems was necessary.

Reporting Levels

W3'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 W3 effluents. Therefore, 2011 results did not trigger any radiological monitoring program special reports.

Radioactivity Not Attributable to W3

The W3 REMP detected radioactivity attributable to other sources three times. These include the 25th Chinese nuclear test explosion in 1980, the radioactivity plume release due to reactor core degradation at the Chernobyl Nuclear Power Plant in 1986, and the airborne release from Dai-Ichi, Fukushima following the Tohoku earthquake on March 11, 2011.

Comparison to State Program

W3 compared REMP data to the monitoring program of the Environmental Radiological Laboratory – Department of Environmental Quality Laboratory Services Division (ERL-DEQLSD). The ERL-DEQLSD and the W3 REMP entail similar radiological environmental monitoring program requirements. Both programs have obtained similar results over previous years.

Sample Deviations

◆ Milk Samples

Since milk samples for indicator location MKE-3 were unavailable for all quarters of 2011, broad leaf vegetation sampling was performed as required by TRM Table 3.12-1. Broad leaf vegetation results are in section 2.7. Milk samples were collected from one control location and analyzed for Iodine-131 and gamma radionuclides. Results indicate that all measurements were below the calculated LLDs. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

◆ Missed Samples

TLDs located at stations G-4, G-8 and Q-5 were missing at the time of the first quarter exchange. TLDs located at stations A-2, B-1, B-4, D-2, and G-8 were missing at the time of the second quarter exchange. TLDs located at stations A-5 and E-5 were missing at the time of the third quarter exchange. TLDs located at stations C-1 and G-8 were missing at the time of the fourth quarter exchange.

◆ Required Lower Limit of Detection (LLD) Values

All LLDs during this reporting period were within the acceptable limits required by the W3 TRM.

◆ Unavailable Results

W3 received analytical results in adequate time for inclusion in this report. In addition, W3's review identified no missing results.

◆ Program Modifications

No program modifications were made during 2011.

Attachments

Attachment 1 contains results of air, TLD, water, sediment, milk, fish and broad leaf vegetation collected in 2011. TLDs were analyzed by Stanford Dosimetry. All remaining samples were analyzed by the River Bend (RBS) Environmental Laboratory. Attachment 1 also contains River Bend's participation in the interlaboratory comparison program during 2011.

Attachment 2 contains statistical comparisons of:

- TLD measurements from stations grouped by distance
- TLD radiation dose to historical data by location
- Gross beta activity measurements on air particulate filters
- Gross beta activity measurements in surface/drinking water samples

1.0 Introduction

1.1 Radiological Environmental Monitoring Program

W3 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 important 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 W3.
- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

1.2 Pathways Monitored

The airborne, direct radiation, waterborne and ingestion pathways are monitored as required by W3 TRM Table 3.12-1. A description of the W3 REMP utilized to monitor the exposure pathways is described in Table 1.1 and shown in Figures 1-1, 1-2 and 1-3.

Section 2.0 of this report provides a discussion of 2011 sampling results with Section 3.0 providing a summary of results for the monitored exposure pathways.

1.3 Land Use Census

W3 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 W3 that would require modifications to the REMP and the Offsite Dose Calculation Manual (ODCM). 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.

W3 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 and approximate size
 - Nearest beef cow
 - Nearest food product
 - Nearest milking animal
- Identifying locations on maps, measuring distances to W3 and recording results on data sheets.
- Comparing current census results to previous results.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Airborne	<p><u>Radiiodine and Particulates</u> 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>	<p>APQ-1 (NW, 0.81 Miles) – (West bank) Located in soybean/sugarcane field off LA 18 east of LA 18/3141 intersection.</p> <p>APF-1 (ESE, 0.35 Miles) – (West bank) Located on north side of Secondary Meteorological Tower.</p> <p>APC-1 (NE, 0.67 Miles) – (East bank) Located inside Little Gypsy Cooling Water Intake Structure fence.</p>	Continuous sampler operation with sample collection bi-weekly, or more frequently if required by dust loading.	<p>Radiiodine Canister – I-131 analysis bi-weekly.</p> <p>Particulate Sampler – Gross beta radioactivity analysis following filter change. Gamma isotopic analysis of composite (by location) quarterly.</p>
	<p><u>Radiiodine and Particulates</u> One sample from the vicinity of a community having the highest calculated annual average ground level D/Q.</p>	<p>APP-1 (WNW, 0.84 Miles) – (West bank) Located in soybean/sugarcane field on Short St. in Killona.</p>		
	<p><u>Radiiodine and Particulates</u> One sample from a control location, as for example 15 -30 km distant and in the least prevalent wind direction.</p>	<p>APE-30 (E, 25.2 Miles) – (West bank) Located on roof of Entergy Office building on Delaronde St. in Algiers. (Control)</p>		

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p>TLDs An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<p>A-2 (N, 1.27 Miles) – (East bank) Located on pole on LA 628 at Zephrin L. Perriloux Fire House.</p> <p>B-1 (NNE, 0.75 Miles) – (East bank) Located on fence west of Little Gypsy.</p> <p>C-1 (NE, 0.67 Miles) – (East bank) Located on fence at Little Gypsy Cooling Water Intake structure.</p> <p>D-2 (ENE, 1.24 Miles) – (East bank) Located on pole on levee at west entrance to Bonnet Carre Spillway.</p>	Quarterly	Gamma dose quarterly.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p>TLDs An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<p>E-1 (E, 0.41 Miles) – (West bank) Located on pole on LA 18 east of Waterford 3 plant entrance.</p> <p>F-2 (ESE, 1.15 Miles) – (West bank) Located on fence on LA 3142 south of LA 18.</p> <p>G-2 (SE, 1.26 Miles) – (West bank) Located on fence on LA 3142 north of railroad overpass.</p> <p>H-2 (SSE, 1.54 Miles) – (West bank) Located on fence on LA 3142 north of LA 3127/3142 intersection.</p>	Quarterly	Gamma dose quarterly.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p>TLDs An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<p>J-2 (S, 1.38 Miles) – (West bank) Located on fence south of LA 3127 west of LA 3127/3142 intersection.</p> <p>K-1 (SSW, 1.06 Miles) – (West bank) Located on stop sign at entrance to Entergy Education Center on LA 3127.</p> <p>L-1 (SW, 1.06 Miles) – (West bank) Located on gate on LA 3127 west of LA 3127/3142 intersection.</p> <p>M-1 (WSW, 0.76 Miles) – (West bank) Located on south gate of Waterford 1 and 2.</p> <p>N-1 (W, 0.98 Miles) – (West bank) Located on pole at corner of Railroad Avenue and School House Road.</p>	Quarterly	Gamma dose quarterly.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p><u>TLDs</u> An inner ring of stations, one in each meteorological sector in the general area of the SITE BOUNDARY.</p>	<p>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	Gamma dose quarterly.
	<p><u>TLDs</u> An outer ring of stations, 1 in 10 of the meteorological sectors in the 6 to 8 km ranges from the site.</p>	<p>A-5 (N, 4.59 Miles) – (East bank) Located on pole at intersection of Oswald Avenue and US 61.</p>		

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p>TLDs An outer ring of stations, 1 in 10 of the meteorological sectors in the 6 to 8 km ranges from the site.</p>	<p>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 US61/LA48 intersection. F-4 (ESE, 3.53 Miles) – (West bank) Located on pole behind house at 646 Aquarius St. in Hahnville.</p>	Quarterly	Gamma dose quarterly.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p><u>TLDs</u> An outer ring of stations, 1 in 10 of the meteorological sectors in the 6 to 8 km ranges from the site.</p>	<p>E-5 (E, 4.08 Miles) – (East bank) Located on fence on Wesco Street off LA 48.</p> <p>G-4 (SE, 3.30 Miles) – (West bank) Located on pole on LA 3160 north of railroad track.</p> <p>H-8 (SSE, 8.13 Miles) – (West bank) Located on pole in front of Hahnville High School.</p> <p>P-6 (WNW, 5.58 Miles) – (West bank) Located on fence at LA 640/railroad track intersection.</p> <p>Q-5 (NW, 5.01 Miles) – (West bank) Located on pole on LA 18 across from Mississippi River marker 137.</p>	Quarterly	Gamma dose quarterly.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p>TLDs An outer ring of stations, 1 in 10 of the meteorological sectors in the 6 to 8 km ranges from the site.</p>	<p>R-6 (NNW, 5.52 Miles) – (East bank) Located on fence on LA 3223 near railroad crossing.</p>	Quarterly	Gamma dose quarterly.
	<p>TLDs The balance of the stations to be in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control stations.</p>	<p>F-9 (ESE, 8.18 Miles) – (East bank) Located on fence north of railroad tracks on Jonathan Street.</p>		
		<p>G-8 (SE, 7.74 Miles) – (West bank) Located on back fence of Luling Entergy Office.</p> <p>E-15 (E, 11.7 Miles) – (East bank) Located on fence on Alliance Avenue.</p>		

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p>TLDs The balance of the stations to be in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control stations.</p>	<p>J-15 (S, 11.7 Miles) - (West bank) Located on pole near LA 631/Hwy 90 intersection in Des Allemands. E-30 (E, 25.2 Miles) - (West bank) Located at entrance to Entergy office on Delaronde St. in Algiers. (Control)</p>	Quarterly	Gamma dose quarterly.
Waterborne	<p>Surface Water One sample upstream One sample downstream</p>	<p>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.	Gamma isotopic analysis quarterly. Composite for tritium analysis quarterly.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Waterborne	<p><u>Drinking Water</u> One sample upstream</p> <p>One sample downstream</p>	<p>DWP-7 (WNW, 7.37 Miles) - (West bank) Located at St. John Parish Waterworks in Edgard. (Control)</p> <p>DWF-2 (ESE, 1.51 Miles) - (West bank) Located at Dow Chemical Plant drinking water canal.</p> <p>DWE-5 (E, 4.59 Miles) - (East bank) Located at St. Charles Parish Waterworks in New Sarpy.</p>	<p>Composite sample over one month period when I-131 analysis is performed, quarterly composite otherwise.</p>	<p>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>
	<p><u>Sediment from Shoreline</u> One sample upstream</p> <p>One sample downstream</p>	<p>SHWQ-6 (NW, 5.99 Miles) – (East bank) Located on LA 628 east of Reserve ferry landing. (Control)</p> <p>SHWE-3 (E, 2.99 Miles) – (West bank) Located at Foot Ferry landing on LA 18.</p> <p>SHWK-1 (SSW, 0.49 Miles) – (West bank) Located at 40 Arpent Canal south of plant.</p>	<p>Annually</p>	<p>Gamma isotopic analysis annually.</p>
	<p><u>Milk</u> 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.</p>	<p>MKE-3 (E, 2.35 Miles) - (West bank) Located at the Zeringue's house on LA 18 in Taft.</p>	<p>Quarterly</p>	<p>Gamma isotopic and I-131 analysis quarterly.</p>

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Ingestion	<p><u>Milk</u> One sample from milking animals at a control location 15 – 30 km distant and in the least prevalent wind direction.</p>	<p>MKR-38 (NNW, 38.0 Miles) – (East bank) Located at 30300 Cleveland Road, Albany, La. (Control) MKA-31 (N, 31.2 Miles) – (East bank) Located at 18736 Sisters Road, Ponchatoula, LA.</p>	Quarterly	Gamma isotopic and I-131 analysis quarterly.
	<p><u>Fish and Invertebrates</u> One sample of each commercially and recreational important species in vicinity of plant discharge area.</p>	<p>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	Gamma isotopic analysis on edible portion.
	<p><u>Broadleaf</u> Samples of one to three different kinds of broadleaf vegetation grown nearest each of 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.</p>	<p>BLQ-1 (NW, 0.83 Miles) – (West bank) Located near air sample station APQ-1. 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	Gamma isotopic and I-131 analysis.

FIGURE 1-1

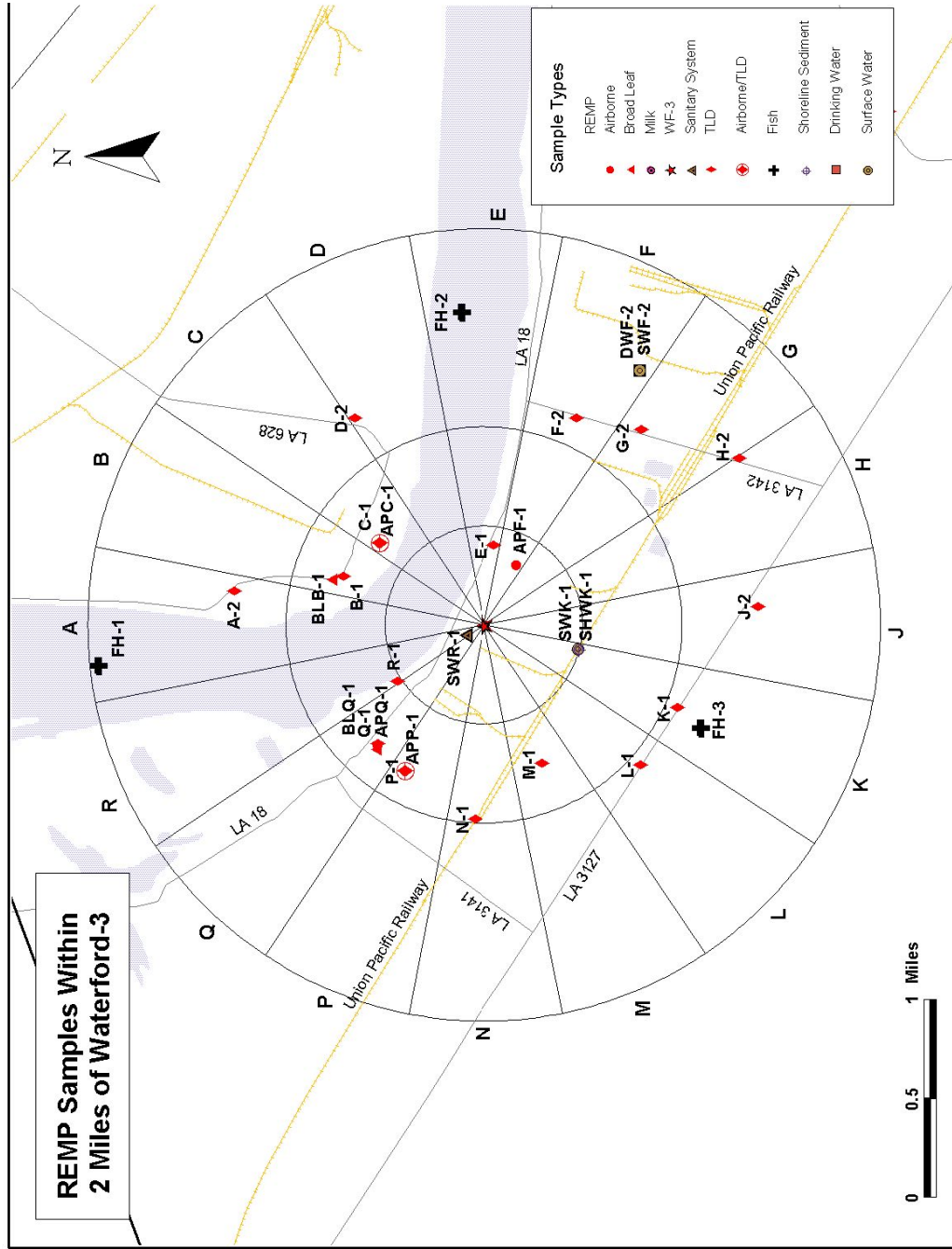


FIGURE 1-2

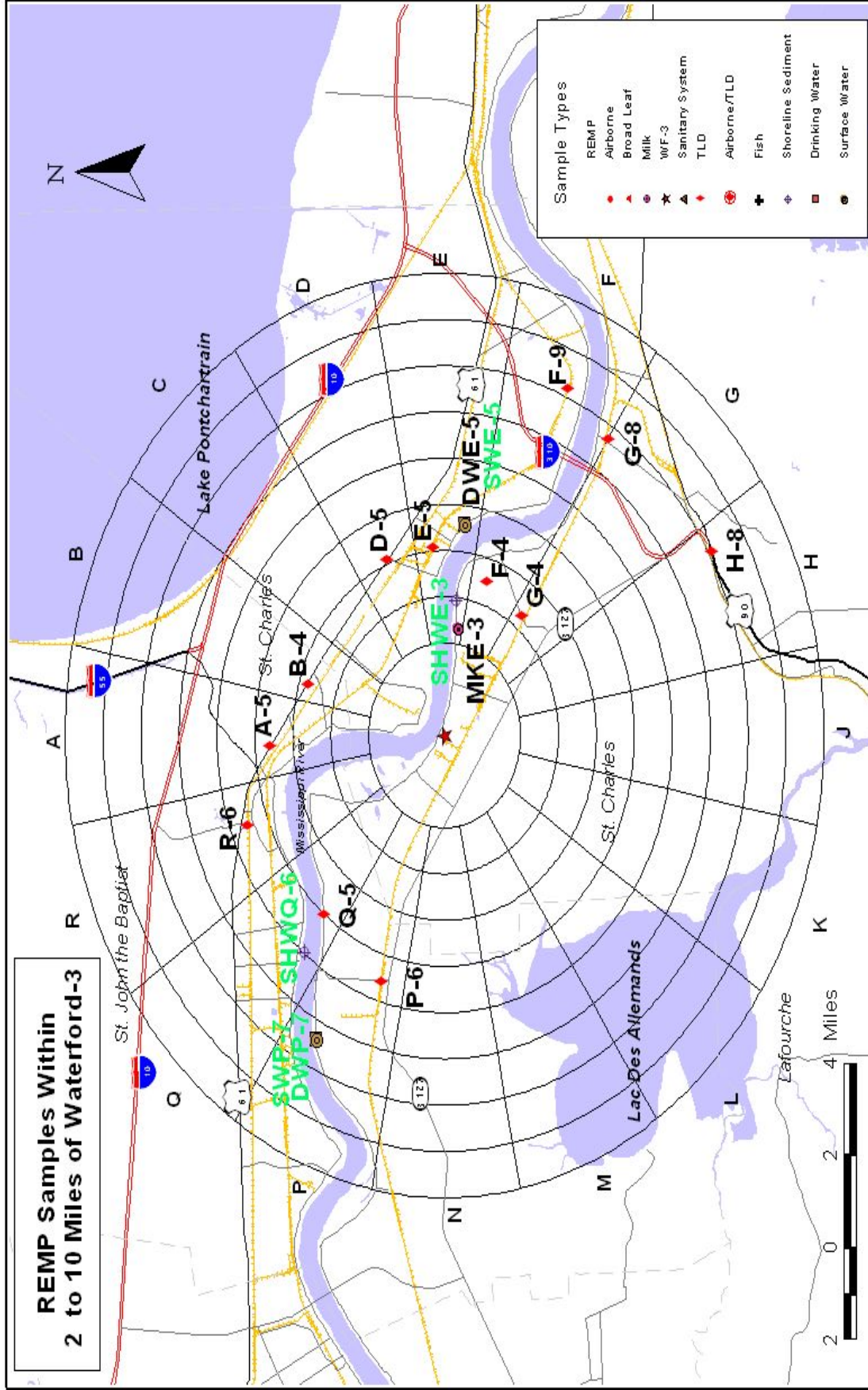
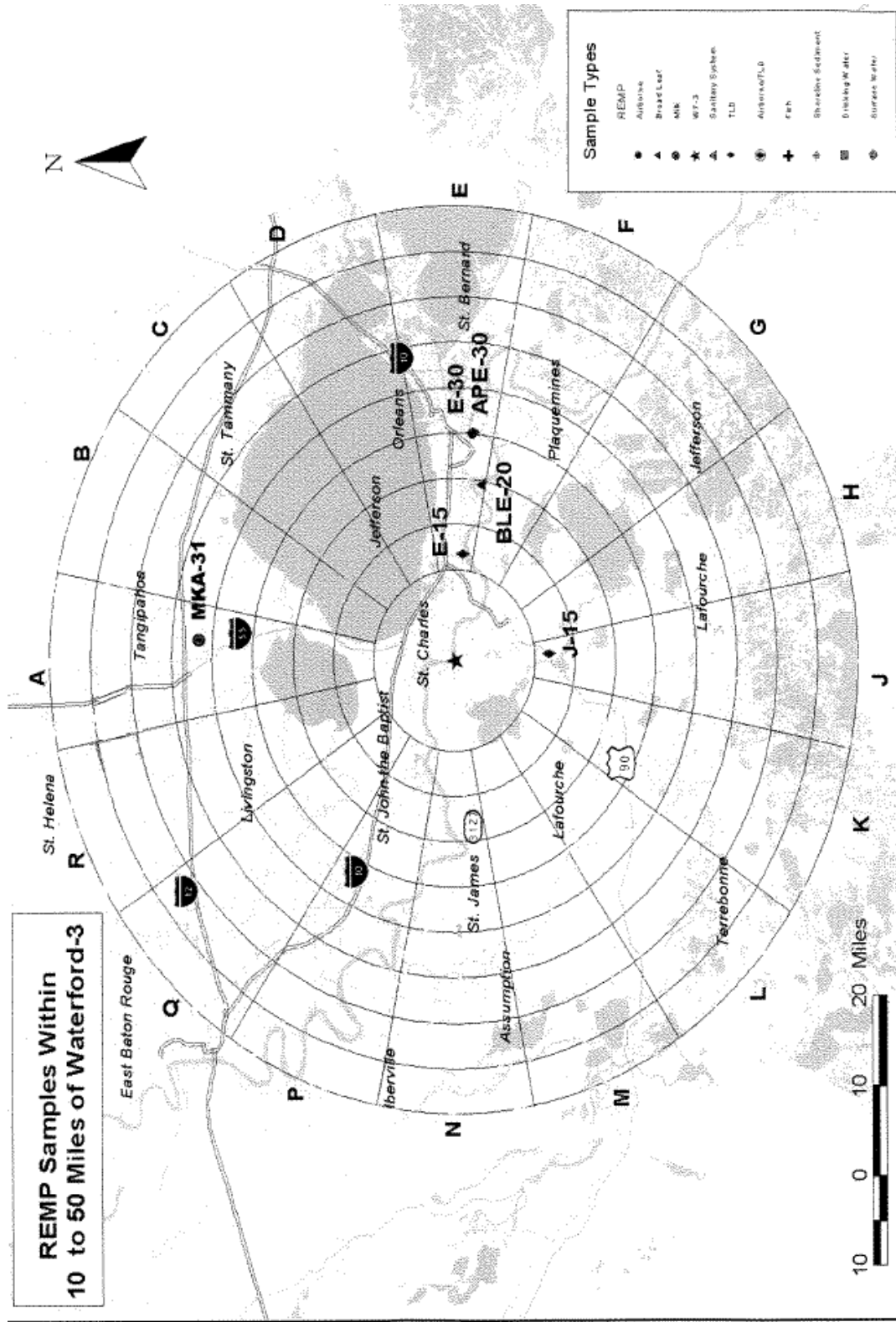


FIGURE 1-3



2.0 Interpretation and Trends of Results

2.1 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). W3 did not detect any gamma radionuclides in the quarterly air particulate composites as has been the case in previous years. Iodine-131 was detected in air samples collected on 04-04-11 due to releases from Dai-Ichi, Fukushima as explained in the summary on page 1. Indicator gross beta air particulate results for 2011 were similar to those background levels obtained in 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>
Preoperational	0.080
1983 – 2010	0.020
2011	0.026

Table 3.1, which includes gross beta concentrations for 2011, provides a comparison of the indicator and control means further emphasizes that the airborne pathway continues to remain at background levels. In addition, as shown in Attachment 2, the standard "t" test was used to compare average gross beta activity from each indicator station to the average gross beta activity at the control station. The results from this test show the average activity detected at all indicator stations is statistically the same as the average activity detected at the control station. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

2.2 Thermoluminescent Dosimetry Sample Results

The average exposure rates during 2011 are consistent with those from the preoperational program and the previous five years of operation as seen in Figure 2-1. 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 8 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 3.1, shows that the average indicator is slightly higher than that of the control. As shown in Attachment 1, Table 2.1, several indicator locations are higher than the control by a few mrem with a maximum difference of six mrem.

As shown in Attachment 2, Table 2.1, the standard "t" test was used to compare average exposure rates for TLD stations located in groups 0-2 miles and 2-5 miles from the plant to those > 5 miles. The results indicate that the average exposure rates 0-2 miles from the plant are statistically the same as >5 miles while those 2-5 miles are statistically higher.

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 W3 plant operations that can affect background radiation in the vicinity of each TLD station. Direct radiation measurements at each TLD station have remained statistically the same in 2011 as previous years of operation as evidenced on Attachment 2, Table 2.2. In addition, Radiological Gaseous Effluents for 2011 were only a small fraction of the limits and are not expected to have any impact on environmental TLD measurements.

2.3 Water Sample Results

Analytical results for 2011 drinking/surface water samples were similar to those reported in previous years.

Drinking/Surface Water

Drinking water samples also serve as surface water samples for W3. Therefore, monthly and quarterly gamma spectroscopy and tritium analyses of drinking water also satisfy the surface water sampling requirement.

Composite drinking/surface water samples were collected from two indicators and one control location and analyzed for Iodine-131, gamma radionuclides and tritium. Results indicate that all measurements were below the calculated LLDs.

Although gross beta was detected in the drinking/surface water samples, results for the indicator locations were below previous operational and preoperational years as seen below. Results are reported as annual average pCi/l.

<u>Monitoring Period</u>	<u>Result</u>
Preoperational	7.0
1983 – 2010	4.6
2011	4.7

Table 3.1, which includes gross beta concentrations for 2011, provides a comparison of the indicator and control means shows that the waterborne pathway continues to remain at background levels. In addition, as shown in Attachment 2, the standard "t" test was used to compare average gross beta activity from indicator stations to the average gross beta activity from the control station. The results from the test show the average activity detected at one indicator station is statistically the same as the average activity detected at the control station and one indicator station is statistically higher than the mean for the control location. Results obtained are consistent with historical data stated above. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

Surface Water

Surface water samples were collected from one indicator location and analyzed for gamma radionuclides and tritium. Results indicate that all measurements were below the calculated LLDs. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

2.4 Sediment Sample Results

Sediment samples were collected from two indicator locations and one control location and analyzed for gamma radionuclides. Results indicate that all measurements were below the calculated LLDs. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

2.5 Milk Sample Results

Since milk samples for indicator location MKE-3 were unavailable for all quarters of 2011, broad leaf vegetation sampling was performed as required by TRM Table 3.12-1. Broad leaf vegetation results are in section 2.7. Milk samples were collected from one control location and analyzed for Iodine-131 and gamma radionuclides. Results from Iodine-131 analyses indicate that all measurements were below the calculated LLDs. Cesium-137 was detected in one control sample MKA-31 on 06-16-11 at a concentration of 6.05 pCi/l. The sample was recounted on 06-16-11 with results of 5.88 pCi/l. Another sample was collected on 06-23-11 and analyzed. Cesium-137 was detected at a concentration of 4.03 pCi/l. The levels of Cesium-137 in these samples are below both the reporting level and the LLD level required by Waterford 3 TRM. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

2.6 Fish Sample Results

Fish samples were collected from two indicators and one control location and analyzed for gamma radionuclides. Results indicate that all measurements were below the calculated LLDs. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

2.7 Broadleaf Vegetation Sample Results

Broadleaf vegetation samples were collected from two indicators and one control location and analyzed for Iodine-131 and gamma radionuclides. Results indicate that all measurements were below the calculated LLDs. Therefore, W3 concluded that plant operations had no significant impact on this pathway during 2011.

2.8 Land Use Census Results

In compliance with the Waterford 3 ODCM and TRM, the land use census was conducted September 28 – September 30, 2010. 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.

One new residence location (sector P) and four new garden locations (sectors C, N, P, and Q) were identified in 2010. One milk cow location (sector A), one goat location (sector Q) and four beef cow locations (sectors P and Q) were removed. Food product locations remained unchanged for 2010. 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 W3, no REMP sampling location changes are necessary. Results of the 2010 biennial census are shown in Table 2.1.

2.9 Interlaboratory Comparison Results

The River Bend Station Environmental Laboratory analyzed interlaboratory comparison samples for W3 to fulfill the requirements of Section 5.7.2 of the ODCM. Attachment 1 contains these results.

TABLE 2.1
Biennial Land Use Census Results

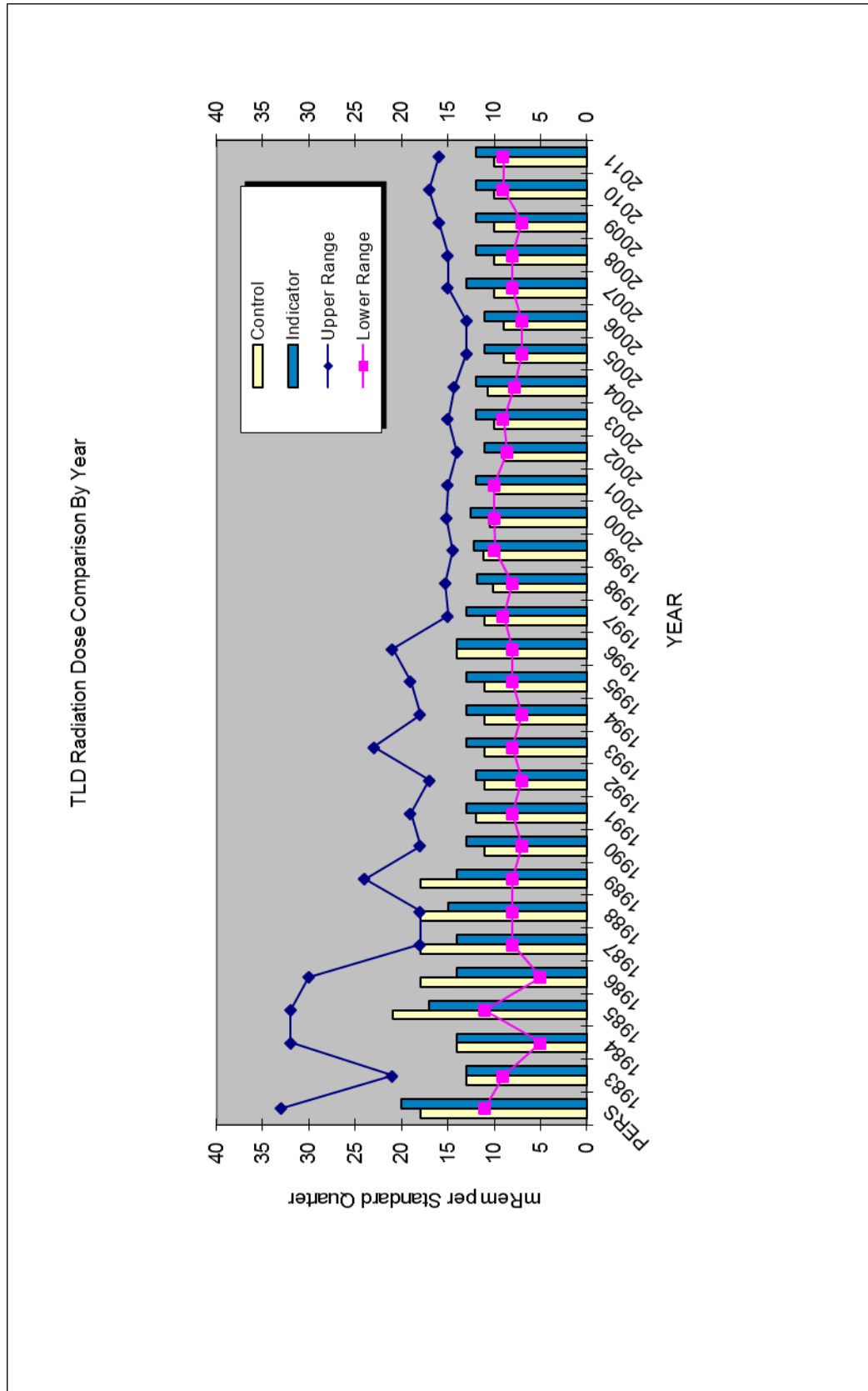
Sector	Direction	Distance from Plant in Miles					
		Residence	Garden	Milk Cows	Beef Cows	Goats	Food Products
A	N	1.3	1.7	^	4.8	^	4.1
B	NNE	1.1	1.3	^	^	^	1.3
C	NE	0.9	1.0	^	^	^	^
D	ENE	0.9	0.9	^	^	^	^
E	E	2.2	2.2	**2.3	2.3	* 3.2	0.3
F	ESE	3.1	2.2	^	2.3	^	0.3
G	SE	4.0	4.1	^	2.4	^	0.3
H	SSE	^	^	^	^	^	0.3
J	S	^	^	^	^	^	0.5
K	SSW	^	^	^	^	^	0.5
L	SW	^	^	^	^	^	0.5
M	WSW	^	1.4	^	1.2	^	0.5
N	W	1.0	1.1	^	1.0	^	0.6
P	WNW	0.9	0.9	^	^	^	0.6
Q	NW	0.9	1.0	^	^	^	0.6
R	NNW	3.0	3.0	^	4.9	^	2.6

^ Indicates that nothing was found in the sector within a five mile radius of Waterford 3

* Animals were located at this distance from Waterford 3, but the milk is not currently used for human consumption

** Samples are being obtained from animals at this location (MKE-3) for REMP

FIGURE 2-1



3.0 Radiological Environmental Monitoring Program Summary

3.1 2011 Program Results Summary

Table 3.1 summarizes the 2011 REMP results. W3 did not use values reported as less than the lower limit of detection (< LLD) when determining ranges and means for indicator and control locations.

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Waterford 3 SES Docket No: 50-382
 Location of Facility: St. Charles, Louisiana Reporting Period: January - December 2011

Sample Type (Units)	Type & Number Of Analyses a	LLD b	Indicator Locations Mean (F) c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) c [Range]	Number of Nonroutine Results e
				Location d	Mean (F) c [Range]		
Airborne Particulates (pCi/m ³)	GB 130	0.01	0.026 (104 / 104) [0.013 - 0.039]	APQ-1 (NW, 0.81 mi.)	0.026 (26 / 26) [0.013 - 0.039]	0.027 (26 / 26) [0.015 - 0.038]	0
	GS 20 Cs-134 Cs-137	0.05 0.06	<LLD <LLD	N/A N/A	N/A N/A	<LLD <LLD	0 0
Airborne Iodine (pCi/m ³)	I-131 130	0.07	0.092 (4/104) [0.087 - 0.101]	APF-1 (ESE, 0.35 mi.)	0.101 (1/26)	0.1165 (1/26)	0
Indicator TLDs (mrem/Std. Qtr)	Gamma 120	(f)	12 (108 / 120) [9.2 - 16.3]	F-4 (ESE, 3.53 mi.)	15 (4 / 4) [14.0 - 15.6]	N/A	0
	Gamma 4	(f)	N/A	N/A	N/A	10 (4 / 4) [10.1 - 10.7]	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Waterford 3 SES Docket No: 50-382
 Location of Facility: St. Charles, Louisiana Reporting Period: January - December 2011

Sample Type (Units)	Type & Number of Analyses a	LLD b	Indicator Location Mean (F) c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) c [Range]	Number of Nonroutine Results e	
				Location d	Mean (F) c [Range]			
Surface Water & Drinking Water (pCi/l)	Gross Beta	4	4.7 (7 / 8) [1.8 – 8.6]	DWF/SWF-2 (ESE, 1.51 mi.)	6.4 (4 / 4) [4.9 – 8.6]	2.9 (3 / 4) [1.7 – 3.5]	0	
	I-131	40	<LLD	N/A	N/A	<LLD	0	
	H-3	12	<LLD	N/A	N/A	<LLD	0	
	GS	12	15	<LLD	N/A	N/A	<LLD	0
				Mn-54	N/A	N/A	<LLD	0
				Fe-59	N/A	N/A	<LLD	0
				Co-58	N/A	N/A	<LLD	0
				Co-60	N/A	N/A	<LLD	0
				Zn-65	N/A	N/A	<LLD	0
				Zr-95	N/A	N/A	<LLD	0
				Nb-95	N/A	N/A	<LLD	0
				Cs-134	N/A	N/A	<LLD	0
				Cs-137	N/A	N/A	<LLD	0
				Ba-140	N/A	N/A	<LLD	0
				La-140	N/A	N/A	<LLD	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: Waterford 3 SES Docket No: 50-382
 Location of Facility: St. Charles, Louisiana Reporting Period: January - December 2011

Sample Type (Units)	Type & Number of Analyses a	LLD b	Indicator Locations Mean (F) c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) c [Range]	Number of Nonroutine Results e	
				Location d	Mean (F) c [Range]			
Surface Water (pCi/l)	H-3	4	3000	<LLD	N/A	N/A	0	
	GS Mn-54 Fe-59 Co-58 Co-60 Zn-65 Zr-95 Nb-95 Cs-134 Cs-137 Ba-140 La-140 I-131	13	15	<LLD	N/A	N/A	N/A	0
		30	30	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
		30	30	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
		18	18	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
		15	15	<LLD	N/A	N/A	N/A	0
Shoreline Sediment (pCi/kg dry)	GS	3	150	<LLD	N/A	<LLD	0	
	Cs-134 Cs-137	180	<LLD	N/A	<LLD	<LLD	0	

TABLE 3.1
Radiological Environmental Monitoring Program Summary

Name of Facility: **Waterford 3 SES** Docket No: **50-382**
 Location of Facility: **St. Charles, Louisiana** Reporting Period: **January - December 2011**

Sample Type (Units)	Type & Number of Analyses ^a	LLD ^b	Indicator Location Mean (F) ^c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) ^c [Range]	Number of Nonroutine Results ^e
				Location ^d	Mean (F) ^c [Range]		
Milk (pCi/l)	I-131	5	< LLD	N/A	N/A	<LLD	0
	GS	5	< LLD	N/A	N/A	<LLD	0
		Cs-134	15	< LLD	N/A	N/A	5.04 (2/5)
	Cs-137	18	< LLD	N/A	N/A	[4.03 – 6.05]	0
	Ba-140	15	< LLD	N/A	N/A	<LLD	0
La-140	15	< LLD	N/A	N/A	<LLD	0	
Fish (pCi/kg wet)	GS	12	<LLD	N/A	N/A	<LLD	0
	Mn-54	130	<LLD	N/A	N/A	<LLD	0
	Fe-59	260	<LLD	N/A	N/A	<LLD	0
	Co-58	130	<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
Broadleaf Vegetation (pCi/kg wet)	I-131	12	<LLD	N/A	N/A	<LLD	0
	GS	12	<LLD	N/A	N/A	<LLD	0
		Cs-134	60	<LLD	N/A	N/A	<LLD
	Cs-137	80	<LLD	N/A	N/A	<LLD	0

^a GB = Gross beta; I-131 = Iodine-131; H-3 = Tritium; GS = Gamma scan.

^b LLD = required lower limit of detection based on Waterford 3 TRM.

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

^d Locations are specified (1) by name and (2) degrees relative to reactor site.

^e 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.

^f LLD is not defined in Waterford 3 TRM.

Attachment 1
2011 Radiological Monitoring Report
Summary of Monitoring Results

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Table 1.1
Sample Type: **Air Particulate Filter**
Analysis: Gross Beta
Units: pCi/m³

End Date	APF-1 (Indicator)	APQ-1 (Indicator)	APP-1 (Indicator)	APC-1 (Indicator)	APE-30 (Control)
Required LLD →	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>
01-10-11	0.031	0.033	0.032	0.031	0.034
01-24-11	0.034	0.034	0.034	0.032	0.035
02-07-11	0.028	0.028	0.029	0.027	0.029
02-21-11	0.026	0.026	0.025	0.024	0.024
03-07-11	0.020	0.022	0.022	0.021	0.022
03-21-11	0.023	0.024	0.023	0.023	0.024
04-04-11	0.032	0.033	0.036	0.035	0.037
04-19-11	0.021	0.021	0.023	0.021	0.023
05-03-11	0.020	0.020	0.019	0.018	0.020
05-17-11	0.024	0.022	0.023	0.023	0.024
05-31-11	0.022	0.023	0.025	0.021	0.024
06-13-11	0.029	0.032	0.030	0.030	0.031
06-27-11	0.019	0.020	0.020	0.016	0.023
07-11-11	0.020	0.020	0.021	0.020	0.022
07-25-11	0.014	0.013	0.013	0.014	0.015
08-08-11	0.015	0.015	0.016	0.016	0.018
08-22-11	0.026	0.027	0.029	0.028	0.029
09-06-11	0.029	0.031	0.029	0.030	0.029
09-19-11	0.033	0.034	0.034	0.033	0.034
10-03-11	0.025	0.027	0.026	0.027	0.026
10-17-11	0.033	0.032	0.032	0.032	0.034
11-01-11	0.035	0.039	0.035	0.035	0.038
11-14-11	0.027	0.029	0.027	0.026	0.026
11-28-11	0.022	0.020	0.020	0.021	0.020
12-12-11	0.030	0.030	0.028	0.030	0.034
12-28-11	0.025	0.027	0.026	0.025	0.026

Table 1.2

Sample Type: **Radioiodine Cartridge**

Analysis: Iodine-131

Units: pCi/m³

End Date	APF-1 (Indicator)	APQ-1 (Indicator)	APP-1 (Indicator)	APC-1 (Indicator)	APE-30 (Control)
Required LLD	→ 0.07	0.07	0.07	0.07	0.07
01-10-11	< 0.014	< 0.017	< 0.015	< 0.013	< 0.014
01-24-11	< 0.019	< 0.017	< 0.017	< 0.011	< 0.012
02-07-11	< 0.015	< 0.013	< 0.013	< 0.013	< 0.019
02-21-11	< 0.014	< 0.026	< 0.026	< 0.009	< 0.014
03-07-11	< 0.018	< 0.014	< 0.014	< 0.012	< 0.028
03-21-11	< 0.016	< 0.016	< 0.016	< 0.016	< 0.019
*04-04-11	0.1010	0.0898	0.0898	0.0867	0.1165
04-19-11	< 0.018	< 0.016	< 0.016	< 0.018	< 0.017
05-03-11	< 0.017	< 0.017	< 0.017	< 0.014	< 0.017
05-17-11	< 0.015	< 0.015	< 0.015	< 0.013	< 0.012
05-31-11	< 0.018	< 0.013	< 0.013	< 0.014	< 0.012
06-13-11	< 0.020	< 0.015	< 0.015	< 0.011	< 0.016
06-27-11	< 0.016	< 0.012	< 0.012	< 0.011	< 0.009
07-11-11	< 0.012	< 0.018	< 0.018	< 0.015	< 0.014
07-25-11	< 0.014	< 0.010	< 0.010	< 0.014	< 0.014
08-08-11	< 0.017	< 0.012	< 0.012	< 0.014	< 0.015
08-22-11	< 0.014	< 0.013	< 0.013	< 0.011	< 0.015
09-06-11	< 0.013	< 0.012	< 0.012	< 0.012	< 0.014
09-19-11	< 0.012	< 0.013	< 0.013	< 0.011	< 0.018
10-03-11	< 0.015	< 0.011	< 0.011	< 0.012	< 0.013
10-17-11	< 0.013	< 0.012	< 0.012	< 0.011	< 0.014
11-01-11	< 0.012	< 0.010	< 0.010	< 0.010	< 0.013
11-14-11	< 0.016	< 0.014	< 0.014	< 0.015	< 0.017
11-28-11	< 0.016	< 0.012	< 0.012	< 0.014	< 0.015
12-12-11	< 0.011	< 0.015	< 0.015	< 0.015	< 0.013
12-28-11	< 0.013	< 0.012	< 0.012	< 0.013	< 0.015

* Dai-Ichi, Fukushima (see page 1)

Table 1.3

Sample Type: **Air Particulate Filter**

Analysis: Gamma Isotopic

Units: pCi/m³

Location	Quarterly Composite		Cs-134	Cs-137
	<u>Required LLD</u>	→	<u>0.05</u>	<u>0.06</u>
APF-1 (Indicator)	1st		< 0.003	< 0.002
APQ-1 (Indicator)	1st		< 0.002	< 0.002
APP-1 (Indicator)	1st		< 0.002	< 0.003
APC-1 (Indicator)	1st		< 0.003	< 0.002
APE-30 (Control)	1st		< 0.002	< 0.003
APF-1 (Indicator)	2nd		< 0.003	< 0.002
APQ-1 (Indicator)	2nd		< 0.002	< 0.002
APP-1 (Indicator)	2nd		< 0.003	< 0.002
APC-1 (Indicator)	2nd		< 0.003	< 0.002
APE-30 (Control)	2nd		< 0.003	< 0.003
APF-1 (Indicator)	3rd		< 0.001	< 0.002
APQ-1 (Indicator)	3rd		< 0.002	< 0.002
APP-1 (Indicator)	3rd		< 0.001	< 0.002
APC-1 (Indicator)	3rd		< 0.001	< 0.001
APE-30 (Control)	3rd		< 0.001	< 0.001
APF-1 (Indicator)	4th		< 0.002	< 0.002
APQ-1 (Indicator)	4th		< 0.001	< 0.002
APP-1 (Indicator)	4th		< 0.001	< 0.002
APC-1 (Indicator)	4th		< 0.002	< 0.002
APE-30 (Control)	4th		< 0.001	< 0.002

Table 2.1

Sample Type: **Thermoluminescent Dosimeters**

Analysis: Gamma Dose

Units: mrem/Std. Qtr.

Indicator Locations					
Station	1st Qtr '11	2nd Qtr '11	3rd Qtr '11	4th Qtr '11	Annual Mean '11
A-2	13	(2)	14	16	14
A-5	12	15	(2)	12	13
B-1	13	(2)	13	14	13
B-4	13	(2)	15	15	14
C-1	10	9	10	(2)	10
D-2	10	(2)	10	10	10
D-5	12	13	13	12	13
E-1	11	12	13	11	12
E-5	13	13	(2)	13	13
E-15	10	11	11	11	11
F-2	12	13	13	13	13
(1) F-4	14	16	15	15	15
F-9	12	13	13	12	13
G-2	13	15	14	14	14
G-4	(2)	12	12	12	12
G-8	(2)	(2)	11	(2)	11
H-2	13	14	12	12	13
H-8	12	12	12	12	12
J-2	12	13	12	11	12
J-15	12	14	13	12	13
K-1	10	11	12	11	11
L-1	14	14	15	14	14
M-1	11	11	11	10	11
N-1	13	15	14	13	14
P-1	10	11	10	10	10
P-6	14	15	14	14	14
Q-1	13	14	14	13	13
Q-5	(2)	13	13	13	13
R-1	10	10	9	10	10
R-6	10	11	11	10	10
Control Location					
Station	1st Qtr '11	2nd Qtr '11	3rd Qtr '11	4th Qtr '11	Annual Mean '11
E-30	10	11	11	10	10

(1) Location with highest annual mean

(2) No data - TLDs missing at time of exchange

Table 3.1

Sample Type: **Drinking/Surface Water**

Analysis: Gross Beta

Units: pCi/l

Quarterly Composite	DWF/SWF-2 (Indicator)	DWE/SWE-5 (Indicator)	DWP/SWP-7 (Control)
Required LLD →	<u>4</u>	<u>4</u>	<u>4</u>
1 st	8.57	2.83	3.52
2 nd	6.01	<1.75	<1.75
3 rd	6.00	2.95	3.46
4 th	4.93	1.75	< 0.99

Table 3.2

Sample Type: **Drinking/Surface Water**

Analysis: Iodine-131

Units: pCi/l

Collection Date	SWK-1 (Indicator)	DWF/SWF-2 (Indicator)	DWE/SWE-5 (Indicator)	DWP/SWP-7 (Control)
LLD	<u>15</u>	<u>1</u>	<u>1</u>	<u>1</u>
⁽¹⁾ 01-05-11				< 0.78
02-02-11	< 4.70	< 0.90	< 0.73	< 0.90
03-01-11	< 4.59	< 0.90	< 0.82	< 0.90
03-29-11	< 5.33	< 0.84	< 0.89	< 0.89
04-26-11	< 5.15	< 0.81	< 0.89	< 0.89
05-25-11	< 4.85	< 0.84	< 0.78	< 0.86
06-22-11	< 5.13	< 0.90	< 0.89	< 0.81
07-20-11	< 5.46	< 0.83	< 0.90	< 0.81
08-17-11	< 4.80	< 0.84	< 0.86	< 0.83
09-14-11	< 5.02	< 0.89	< 0.97	< 0.99
10-12-11	< 4.79	< 0.75	< 0.75	< 0.67
11-09-11	< 5.09	< 0.99	< 0.96	< 0.99
12-06-11	< 4.75	< 0.85	< 0.71	< 0.93
01-04-12	< 3.50	< 0.46	< 0.57	< 0.55

⁽¹⁾ Duplicate sample

Table 3.3

Sample Type: Drinking/Surface Water

Analysis: Gamma Isotopic

Units: pCi/l

Location	Collection Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140	Required LLD	
													15	15
DWF/SWF-2 (Indicator)	1st	< 2.64	< 2.42	< 5.60	< 2.18	< 4.84	< 3.26	< 4.55	< 2.56	< 2.45	< 14.95	< 6.17	15	15
DWE/SWE-5 (Indicator)	1st	< 1.97	< 2.06	< 5.09	< 1.93	< 3.90	< 2.52	< 3.60	< 2.10	< 2.05	< 14.04	< 4.78	15	15
DWP/SWP-7 (Control)	1st	< 2.80	< 2.59	< 6.04	< 2.50	< 4.35	< 3.19	< 4.79	< 2.79	< 2.55	< 14.96	< 6.64	15	15
DWF/SWF-2 (Indicator)	2nd	< 4.46	< 4.18	< 8.95	< 5.31	< 9.27	< 5.81	< 6.41	< 3.87	< 3.89	< 14.88	< 8.55	15	15
DWE/SWE-5 (Indicator)	2nd	< 2.57	< 2.35	< 5.31	< 2.57	< 5.79	< 3.25	< 4.77	< 2.82	< 2.71	< 12.75	< 4.34	15	15
DWP/SWP-7 (Control)	2nd	< 3.22	< 2.88	< 5.39	< 3.37	< 5.37	< 4.30	< 6.11	< 3.34	< 3.05	< 14.60	< 5.76	15	15
DWF/SWF-2 (Indicator)	3rd	< 2.82	< 2.95	< 5.20	< 2.74	< 6.12	< 3.41	< 5.07	< 2.63	< 3.24	< 14.70	< 5.57	15	15
DWE/SWE-5 (Indicator)	3rd	< 4.75	< 3.93	< 7.30	< 4.61	< 9.95	< 4.89	< 9.30	< 5.47	< 4.80	< 14.97	< 5.26	15	15
DWP/SWP-7 (Control)	3rd	< 3.53	< 3.43	< 9.05	< 3.70	< 8.64	< 4.52	< 6.97	< 2.98	< 4.77	< 14.96	< 6.70	15	15
DWF/SWF-2 (Indicator)	4th	< 3.26	< 3.02	< 6.12	< 3.39	< 6.51	< 3.69	< 5.27	< 3.23	< 3.46	< 13.20	< 5.88	15	15
DWE/SWE-5 (Indicator)	4th	< 2.22	< 2.70	< 5.38	< 2.35	< 5.20	< 3.52	< 5.01	< 2.63	< 2.65	< 13.74	< 5.15	15	15
DWP/SWP-7 (Control)	4th	< 2.73	< 2.79	< 3.95	< 1.97	< 5.79	< 2.87	< 4.72	< 2.91	< 2.99	< 13.00	< 4.29	15	15

Table 3.4
Sample Type: **Drinking/Surface Water**
Analysis: Tritium
Units: pCi/l

Quarter	DWF/SWF-2 (Indicator)	DWE/SWE-5 (Indicator)	SWK-1 (Indicator)	DWP/SWP-7 (Control)
<u>Required LLD</u> →	<u>2000</u>	<u>2000</u>	<u>3000</u>	<u>2000</u>
1 st	< 441.26	< 407.59	< 425.70	< 456.77
2 nd	< 415.74	< 431.00	< 446.73	< 395.55
3 rd	< 629.71	< 634.91	< 634.37	< 668.46
4 th	< 647.28	< 655.76	< 652.44	< 692.83

Table 3.5

Sample Type: **Surface Water**

Analysis: Gamma Isotopic

Units: pCi/l

Location	Collection Date	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
		15	15	30	15	30	15	15	15	15	18	15
<u>Required LLD</u> →		15	15	30	15	30	15	15	15	18	15	15
SWK-1 (Indicator)	02-02-11	< 2.67	< 2.69	< 5.50	< 2.73	< 7.17	< 3.95	< 5.64	< 2.69	< 3.33	< 13.89	< 5.50
	03-01-11	< 3.25	< 2.85	< 7.80	< 3.58	< 7.52	< 3.09	< 4.44	< 3.60	< 3.33	< 13.60	< 4.60
	03-29-11	< 4.71	< 3.74	< 6.59	< 5.01	< 9.49	< 4.58	< 6.22	< 4.18	< 4.56	< 14.57	< 6.19
	04-26-11	< 5.52	< 4.35	< 9.53	< 4.78	< 11.34	< 5.36	< 6.86	< 4.35	< 4.19	< 14.65	< 3.98
	05-25-11	< 3.45	< 4.14	< 5.79	< 4.00	< 7.58	< 4.35	< 6.14	< 3.76	< 4.34	< 14.91	< 5.06
	06-22-11	< 2.98	< 2.90	< 5.25	< 3.02	< 6.31	< 3.74	< 5.45	< 3.09	< 3.20	< 13.89	< 5.95
	07-20-11	< 2.87	< 3.46	< 6.64	< 3.13	< 8.41	< 4.30	< 6.02	< 3.51	< 3.71	< 14.59	< 5.21
	08-17-11	< 4.02	< 3.92	< 7.76	< 4.37	< 11.18	< 4.24	< 6.93	< 4.02	< 5.45	< 14.36	< 4.38
	09-14-11	< 3.84	< 4.01	< 8.88	< 4.07	< 7.76	< 4.23	< 7.31	< 3.26	< 4.35	< 13.40	< 4.08
	10-12-11	< 3.18	< 2.69	< 5.38	< 4.34	< 9.60	< 3.44	< 7.08	< 3.67	< 3.54	< 14.40	< 4.39
	11-09-11	< 4.70	< 4.95	< 12.40	< 5.16	< 8.90	< 5.04	< 9.08	< 4.99	< 4.99	< 14.50	< 5.65
	12-06-11	< 3.74	< 3.62	< 4.60	< 3.24	< 7.45	< 3.89	< 6.52	< 3.57	< 3.57	< 14.97	< 5.45
	01-04-12	< 3.72	< 2.94	< 5.76	< 4.28	< 6.41	< 4.55	< 5.94	< 3.76	< 3.93	< 14.10	< 6.12

Table 4.1

Sample Type: **Sediment**

Analysis: Gamma Isotopic

Units: pCi/kg (dry)

Location	Collection Date	Cs-134	Cs-137
Required LLD	→	150	180
SHWK-1 (Indicator)	03-07-11	< 21.1	< 22.0
SHWE-3 (Indicator)	03-07-11	< 27.1	< 34.4
SHWQ-6 (Control)	03-07-11	< 21.0	< 19.6

Table 5.1
Sample Type: **Milk**
Analysis: Iodine-131 and Gamma Isotopic
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)	⁽¹⁾ 03-17-11	n/a	n/a	n/a	n/a	n/a
	⁽¹⁾ 06-16-11	n/a	n/a	n/a	n/a	n/a
	⁽¹⁾ 09-15-11	n/a	n/a	n/a	n/a	n/a
	⁽¹⁾ 12-15-11	n/a	n/a	n/a	n/a	n/a
MKA-31 (Control)	03-17-11	< 0.79	< 3.56	<4.00	< 13.89	< 4.96
	06-16-11	< 0.89	< 3.69	6.05	< 14.90	< 4.14
	⁽²⁾ 06-16-11		< 2.86	5.88	< 11.55	< 3.19
	⁽³⁾ 06-23-11	<0.90	< 2.74	4.03	< 13.91	< 4.01
	09-15-11	< 0.92	< 3.42	< 4.23	< 14.80	< 5.06
	12-15-11	< 0.81	< 3.78	< 5.14	< 14.10	< 4.12

⁽¹⁾ Sample not available. Cows not producing enough milk. See page 2 for details.
⁽²⁾ Recount of sample taken on 06-16-11 to verify Cs-137 result.
⁽³⁾ Resample of location to verify Cs-137 result.

Table 6.1
Sample Type: **Fish**
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)	12-07-11	Buffalo	< 10.60	< 11.60	< 38.30	< 13.60	< 24.80	< 9.68	< 6.11
		Carp	< 11.50	< 13.50	< 34.30	< 12.90	< 24.10	< 7.70	< 5.97
		Catfish	< 7.06	< 8.98	< 23.70	< 9.58	< 22.60	< 5.96	< 7.77
		Drum	< 9.47	< 9.66	< 32.10	< 8.62	< 28.60	< 7.73	< 6.38
FH-2 (Indicator)	11-22-11	Buffalo	< 10.20	< 13.40	< 36.30	< 9.41	< 26.90	< 8.90	< 8.49
		Carp	< 10.60	< 13.50	< 34.90	< 11.30	< 21.40	< 8.12	< 8.23
		Catfish	< 7.87	< 9.61	< 25.70	< 8.24	< 15.70	< 4.70	< 6.42
		Shad	< 10.90	< 14.30	< 40.90	< 9.64	< 27.50	< 9.45	< 7.56
FH-3 (Indicator)	12-05-11	Buffalo	< 9.14	< 11.70	< 28.50	< 8.36	< 28.40	< 7.52	< 9.85
		Carp	< 10.20	< 12.90	< 38.30	< 11.30	< 20.90	< 9.49	< 10.50
		Catfish	< 8.50	< 10.20	< 34.30	< 7.42	< 24.30	< 4.57	< 7.59
		Mullet	< 9.07	< 14.20	< 40.10	< 10.40	< 25.60	< 7.16	< 10.10

Table 7.1
Sample Type: **Broad Leaf Vegetation**
Analysis: Iodine-131 and Gamma Isotopic
Units: pCi/kg (wet)

Location	Collection Date	I-131	Cs-134	Cs-137
Required LLD	→	60	60	80
BLQ-1 (Indicator)	03-16-11	< 57.28	< 36.11	< 41.65
BLQ-1 (Indicator)	06-15-11	< 54.04	< 41.87	< 41.15
BLQ-1 (Indicator)	09-12-11	< 41.00	< 25.30	< 32.90
BLQ-1 (Indicator)	12-14-11	< 26.50	< 30.20	< 32.40
BLB-1 (Indicator)	03-16-11	< 58.17	< 50.83	< 40.53
BLB-1 (Indicator)	06-15-11	< 55.08	< 58.12	< 62.16
BLB-1 (Indicator)	09-12-11	< 56.90	< 26.00	< 36.50
BLB-1 (Indicator)	12-14-11	< 29.00	< 36.40	< 33.60
BLE-20 (Control)	03-16-11	< 59.46	< 44.03	< 49.84
BLE-20 (Control)	06-15-11	< 59.43	< 59.08	< 31.48
BLE-20 (Control)	09-12-11	< 36.50	< 22.40	< 34.10
BLE-20 (Control)	12-14-11	< 22.90	< 17.00	< 21.00

Table 8.1

Sample Type: **Interlaboratory Comparison**

Analysis: Gross Beta, Iodine-131, Tritium and Gamma Isotopic

Units: pCi/kg (wet)

Calendar Year: 2011

1st Quarter dated Mar 17, 2011

Analytics E7481-125	Gross Beta in Water					Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/L	RBS 1-s pCi/L	Ref Lab Value pCi/L	Ref Lab uncertainty pCi/L	Resolution	RBS/Ref Lab Ratio	Pass/Fail
Cs-137	199	19	247	4.13	59.8	0.80	Pass

3rd Quarter dated Sept. 15, 2011

Analytics E8137-125	Gross Beta filter					Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/filter	RBS 1-s pCi/filter	Ref Lab Value pCi/filter	Ref Lab uncertainty pCi/filter	Resolution	RBS/Ref Lab Ratio	Pass/Fail
Cs-137	84.2	1.41	82.1	1.37	59.9	1.03	Pass

Analytics E8136-125	H-3 in water					Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/L	RBS 1-s pCi/L	Ref Lab Value pCi/L	Ref Lab uncertainty pCi/L	Resolution	RBS/Ref Lab Ratio	Pass/Fail
H-3	9060	419	9010	151	59.7	1.01	Pass

Analytics E8138-125	Gamma Filter					Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/filter	RBS 1-s pCi/filter	Ref Lab Value pCi/filter	Ref Lab Uncertainty pCi/filter	Resolution	RBS/Ref Lab Ratio	Pass/Fail
Ce-141	58.2	2.80	59.6	0.995	59.7	0.98	Pass
Cr-51	188	11.9	202	3.38	59.8	0.93	Pass
Cs-134	94.3	4.20	115	1.91	60.2	0.82	Pass
Cs-137	101	4.20	102	1.70	60	0.99	Pass
Co-58	83.9	3.90	87.1	1.45	60.1	0.96	Pass
Mn-54	134	4.00	135	2.25	60	0.99	Pass
Fe-59	52.1	2.60	49.0	0.818	59.9	1.06	Pass
Zn-65	157	6.40	161	2.69	59.9	0.97	Pass
Co-60	134	4.50	140	2.34	59.8	0.95	Pass

Analytics E8139-125	Gamma Soil					Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/g	RBS 1-s pCi/g	Ref Lab Value pCi/g	Ref Lab Uncertainty pCi/g	Resolution	RBS/Ref Lab Ratio	Pass/Fail
Ce-141	0.174	.0110	0.168	.00280	60	1.04	Pass
Cr-51	0.556	.0450	0.569	.00950	59.9	0.98	Pass
Cs-134	0.271	.0110	0.322	.00580	55.5	0.84	Pass
Cs-137	0.347	.0170	0.375	.00625	60	0.93	Pass
Co-58	0.221	.0110	0.245	.00409	59.9	0.90	Pass
Mn-54	0.357	.0100	0.379	.00633	59.9	0.94	Pass
Fe-59	0.142	.00100	0.138	.00230	60	1.03	Pass
Zn-65	0.423	.0350	0.454	.00758	59.9	0.93	Pass
Co-60	0.361	.0180	0.395	.00659	59.9	0.91	Pass

Table 8.1

Sample Type: **Interlaboratory Comparison**

Analysis: Gross Beta, Iodine-131, Tritium and Gamma Isotopic

Units: pCi/kg (wet)

4th Quarter dated Dec. 8, 2011

Analytics E7480-125		Gamma in Water				Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/L	RBS 1-s pCi/L	Ref Lab Value pCi/L	Ref Lab Uncertainty pCi/L	Resolution	RBS/Ref Lab Ratio	Pass/Fail
I-131	94.0	17.0	88.7	1.48	59.9	1.06	Pass
Ce-141	n/a	n/a	n/a	n/a	n/a	n/a	n/a (1)
Cr-51	599	91.0	566	9.45	59.9	1.06	Pass
Cs-134	164	11.0	171	2.86	59.8	0.96	Pass
Cs-137	223	17.0	210	3.50	60	1.06	Pass
Co-58	216	15.0	221	3.69	59.9	0.98	Pass
Mn-54	255	13.0	241	4.02	60.0	1.06	Pass
Fe-59	188	20.0	183	3.06	59.8	1.03	Pass
Zn-65	309	29.0	291	4.87	59.8	1.06	Pass
Co-60	284	16.0	270	4.51	59.9	1.05	Pass
Analytics E7483-125		Gamma in Milk				Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/L	RBS 1-s pCi/L	Ref Lab Value pCi/L	Ref Lab uncertainty pCi/L	Resolution	RBS/Ref Lab Ratio	Pass/Fail
I-131	91.0	16.0	90.2	1.51	59.7	1.01	Pass
Ce-141	n/a	n/a	n/a	n/a	n/a	n/a	n/a (1)
Cr-51	532	76.0	566	9.45	59.9	0.94	Pass
Cs-134	160	11.0	171	2.86	59.8	0.93	Pass
Cs-137	216	10.0	210	3.50	60	1.03	Pass
Co-58	206	13.0	221	3.69	59.9	0.93	Pass
Mn-54	237	12.0	241	4.02	60.0	0.98	Pass
Fe-59	192	18.0	183	3.06	59.8	1.05	Pass
Zn-65	304	22.0	291	4.87	59.8	1.04	Pass
Co-60	265	16.0	270	4.51	59.9	0.98	Pass
Analytics E7482-125		I-131 cartridge				Range of 0.80 to 1.25	
Nuclide	RBS Mean pCi/each	RBS 1-s pCi/each	Ref Lab Value pCi/each	Ref Lab uncertainty pCi/each	Resolution	RBS/Ref Lab Ratio	Pass/Fail
I-131	90.0	8.00	89.7	1.50	59.8	1.00	Pass

1) Ce-141 was unavailable at the reference lab for the mixed gamma matrix for the 4th quarter milk and water.

RBS Environmental Laboratory analyzed interlaboratory comparison samples to fulfill the requirements of the ODCM. Environmental samples are analyzed and reported with a 95% confidence level. The interlaboratory comparison results indicated that 100% of the sample results for accuracy and precision were within the acceptable control limits for 2011 following a recount of the gross beta in water (CR-RBS-2012-01845). A known gross beta in water standard is run with each group of samples and falls within 10% of the decay corrected activity.

ATTACHMENT 2

Statistical Comparisons

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Statistical Analyses

◆ Calculation of the Mean and Standard Deviation

The mean and standard deviation for different groups of analyses are calculated using the following equations:

$$\bar{X} = \sum_{i=1}^n \frac{X_i}{n}$$

1

and

$$S = \left(\frac{\sum_{i=1}^n (X_i - \bar{X})^2}{(n-1)} \right)^{0.5}$$

2

where:

\bar{X} = mean of sample population,
S = standard deviation of sample population,
n = number of samples in sample population, and
 X_i = value of the i'th sample.

◆ **Comparing Two Sample Population Means**

The means of two sample populations are compared for statistical difference using the standard "t" test. The use of the test requires the assumption that the data within the populations are normally distributed and that the true standard deviations of the mean are equal for both populations. The standard "t" test tests the hypothesis that the true means of both populations are equal. The "t" value can be calculated from the equation below (obtained from the CRC Standard Mathematical Tables, 26th Edition (1981)):

$$t = \frac{\bar{X} - \bar{Y}}{\left(\frac{(n_x - 1)S_x^2 + (n_y - 1)S_y^2}{n_x + n_y - 2} \right)^{0.5} \left(\frac{1}{n_x} + \frac{1}{n_y} \right)^{0.5}}$$

where:

- $\frac{t}{}$ = calculated "t" value,
- \bar{X} = mean of first data set,
- \bar{Y} = mean of second data set,
- n_x = number of variables in first data set,
- S_x = standard deviation of first data set,
- n_y = number of variables in second data set, and
- S_y = standard deviation of second data set.

The calculated "t" value is used to test the hypothesis that the true mean of the first population (m_x) is equal to the true mean of the second population (m_y) assuming that the true standard deviation of both populations are equal ($m_x = m_y$). The calculated "t" value is compared to a tabular "t" value such that:

- a. if $t > t_{\mu,n}$ then reject the hypothesis when $m_x > m_y$,
- b. if $t < -t_{\mu,n}$ then reject the hypothesis when $m_x < m_y$,
- c. if $t > t_{\mu/2,n}$ then reject the hypothesis when $m_x = m_y$,

where $t_{\mu/2,n}$ and $t_{\mu,n}$ are the tabular "t" values, with a preselected error (5%), confidence level (1 - μ) or (1 - $\mu/2$), and degrees of freedom $n = n_x + n_y - 2$. Tabular values of the "t" were obtained from the CRC Standard Mathematical Tables, 26th Edition (1981).

**TABLE 2.1
STATISTICAL COMPARISON OF 2011 TLD MEASUREMENTS FROM
STATIONS GROUPED BY DISTANCE**

	Stations Located 0-2 Miles from the Plant	Stations Located 2-5 Miles from the Plant	Stations Located more than 5 Miles from the Plant
Mean (mRem/std.qtr.)	12	13	12
Standard Deviation (mRem/std. qtr.)	1.73	1.19	1.32
Number in Sample	60	23	25
Calculated "t" Value (comparison of stations 0-2 and 2-5 miles from the plant to stations >5 miles from the plant)	0.46	3.35	NA*
Tabular "t" Value at 95% Confidence($t_{0.025,n}$)	1.992(a)	2.015(b)	NA*

(a) Results indicate the mean for stations located 0-2 miles from the plant are statistically identical to the mean for stations located more than 5 miles from the plant.

(b) Although the TLD stations located 2-5 miles from the plant are statistically higher than those located more than 5 miles from the plant, the quarterly doses measured in 2011 are consistent with historical data at each location as shown in Table 2.2.

* Not Applicable

TABLE 2.2

STATISTICAL COMPARISON OF 2011 TLD RADIATION DOSE TO HISTORICAL DATA BY LOCATION						
Units: mrem/Std. Qtr.						
Station	1990 - 2010 Avg**	1990 - 2010 Std Dev**	1990 - 2010 Range**	2011 Avg**	2011 Std Dev**	2011 Range**
A-2	13	1.4	10	14	1.2	13
A-5	13	1.4	10	13	1.4	12
B-1	13	1.4	10	13	0.5	13
B-4	13	1.2	11	14	0.9	13
C-1	9	1.3	7	10	0.5	9
D-2	12	2.0	8	10	0.0	10
D-5	12	1.5	9	13	0.5	12
E-1	11	1.2	9	12	0.8	11
E-5	12	1.7	9	13	0.0	13
E-15	11	1.7	8	11	0.4	10
E-30*	11	1.6	8	11	0.5	10
F-2	12	1.2	10	13	0.4	12
F-4	14	1.5	11	15	0.7	14
F-9	12	1.4	7	13	0.5	12
G-2	15	1.5	11	14	0.7	13
G-4	11	1.3	9	12	0.0	12
G-8	12	2.0	8	11	0.0	11
H-2	13	1.3	10	13	0.8	12
H-8	12	1.2	9	12	0.0	12
J-2	13	1.4	10	12	0.7	11
J-15	13	1.3	11	13	0.8	12
K-1	11	1.3	9	11	0.7	10
L-1	13	1.4	10	14	0.4	14
M-1	12	1.5	9	11	0.4	10
N-1	13	1.5	8	14	0.8	13
P-1	10	1.3	7	10	0.4	10
P-6	14	1.4	10	14	0.4	14
Q-1	12	1.2	10	14	0.5	13
Q-5	13	2.2	9	13	0.0	13
R-1	10	2.1	6	10	0.4	9
R-6	12	2.5	8	11	0.5	10

* Control Location

** Significant outliers were removed from data sets.

PERS data indicates an average of 20 mrem for all indicator locations with a range of 11 to 33 and an average control of 18 mrem.

TABLE 2.3

STATISTICAL COMPARISON OF 2011 GROSS BETA ACTIVITY MEASUREMENTS ON AIR PARTICULATE FILTERS					
SAMPLE STATION	APF-1	APQ-1	APP-1	APC-1	APE-30
Mean (10^{-3} pCi/m ³)	26	26	26	25	27
Standard Deviation (10^{-3} pCi/m ³)	5.25	6.28	5.85	5.94	6.05
Number in Sample	26	26	26	26	26
Calculated "t" Value (comparison of the indicator stations to the control station)	0.90	0.43	0.56	0.97	NA*
Tabular "t" Value at 95% Confidence($t_{0.025,n}$)	2.011(a)	2.011(a)	2.011(a)	2.011(a)	NA*

(a) Results indicate the mean for the indicator stations is statistically identical to the mean for the control station.

* Not Applicable

TABLE 2.4

STATISTICAL COMPARISON OF 2011 GROSS BETA ACTIVITY MEASUREMENTS IN DRINKING/SURFACE WATER SAMPLES			
	DWF/SWF-2	DWE/SWE-5	DWP/SWP-7
Mean (pCi/liter)	6.4	2.5	2.9
Standard Deviation (pCi/liter)	1.34	0.54	0.85
Number in Sample	4	3	3
Calculated "t" Value (comparison of the indicator stations to the control station)	4.26	0.65	NA*
Tabular "t" Value at 95% Confidence($t_{0.025,n}$)	2.571(b)	2.776(a)	NA*

(a) Results indicate the mean for the indicator station is statistically identical to the mean for the control station.

(b) Results indicate the mean for the indicator station is statistically higher than the mean for the control location. Results obtained in 2011 are consistent with historical data as stated in section 2.3.

* Not Applicable