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W3F1-2009-0015

April 30, 2009

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

Subject: Annual Radiological Environmental Operating Report -2008
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, 2008. This report is submitted pursuant to the requirements of Waterford 3 Technical Specification Section 6.9.1.7.

Please contact me at (504) 739-6715 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 "Robert J. Murillo".

RJM/JBW/ssf

Attachment: Annual Radiological Environmental Operating Report - 2008

IEAS
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Attachment 1

W3F1-2009-0015

Annual Radiological Environmental Operating Report - 2008



**Annual
Radiological Environmental Operating
Report**

January 1, 2008 - December 31, 2008



**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, 2008. This report fulfills the requirements of W3 Technical Specification 6.9.1.7.

During 2008, 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.

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 38-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 2008, 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 2008 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 2008. 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, 2008 results did not trigger any radiological monitoring program special reports.

Radioactivity Not Attributable to W3

The W3 REMP detected radioactivity attributable to other sources twice. These include the 25th Chinese nuclear test explosion in 1980, and the radioactivity plume release due to reactor core degradation at the Chernobyl Nuclear Power Plant in 1986.

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**

Milk samples were unavailable from indicator location MKE-3 for all quarters of 2008 due to cows not producing enough milk. With the absence of milk samples at this location, broad leaf vegetation sampling was performed as required by TRM Table 3.12-1.

◆ **Air Samples**

The air sample locations listed below failed to meet the requirement for sample continuity. As described in footnote (1) of TRM Table 3.12-1, deviations are permitted from the required sampling schedule due to malfunction of sampling equipment and other legitimate reasons.

Location	Sample period	Explanation of Deviation
APP-1	09/08/08 - 12/31/08	Loss of power due to Hurricane Gustav
APE-30	02/12/08 - 02/26/08	Sample pump trip
APE-30	08/25/08 - 09/08/08	Loss of power during sample period due to Hurricane Gustav

◆ **Missed Samples**

TLDs located at stations A-2, D-2, G-4 and H-8 were missing at the time of the first quarter exchange. TLDs located at stations A-2, G-4, K-1 and P-1 were missing at the time of the third quarter exchange. TLDs located at stations G-4, J-15, L-1 and Q-5 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 2008.

Attachments

Attachment 1 contains results of air, TLD, water, sediment, milk, fish and broad leaf vegetation collected in 2008. TLDs were analyzed by Areva NP – Dosimetry Services. 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 2008.

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 2008 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>Radioiodine 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>Radioiodine 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>Radioiodine 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>Radioiodine 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 Zephirin 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.</p> <p>Q-1 (NW, 0.81 Miles) – (West bank) Located on fence enclosing air sample station APQ-1.</p> <p>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.</p> <p>D-5 (ENE, 4.09 Miles) – (East bank) Located on gate on shell road north of US61/LA48 intersection.</p> <p>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>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>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.</p> <p>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</p> <p>One sample downstream</p>	<p>SWP-7 (WNW, 7.37 Miles) - (West bank) Located at St. John Parish Waterworks in Edgard. (Control)</p> <p>SWF-2 (ESE, 1.51 Miles) - (West bank) Located at Dow Chemical Plant drinking water canal.</p> <p>SWE-5 (E, 4.59 Miles) - (East bank) Located at St. Charles Parish Waterworks in New Sarpy.</p> <p>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>Drinking Water 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>	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.
	<p>Sediment from Shoreline 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>	Annually	Gamma isotopic analysis annually.
Ingestion	<p>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.</p>	<p>MKE-3 (E, 2.35 Miles) - (West bank) Located at the Zeringue's house on LA 18 in Taft.</p>	Quarterly	Gamma isotopic and I-131 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
Ingestion	<p>Milk 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)</p>	<p>Quarterly</p>	<p>Gamma isotopic and I-131 analysis quarterly.</p>
	<p>Fish and Invertebrates One sample of each commercially and recreational important species in vicinity of plant discharge area.</p> <p>One sample of same species in area not influenced by plant discharge.</p>	<p>- FH-2 (Distance/Direction Not Applicable) – Downstream of the plant discharge structure.</p> <p>FH-3 (Distance/Direction Not Applicable)– (Westbank) Waterways downstream of plant discharge directed to 40 Arpent Canal.</p> <p>FH-1 (Distance/Direction Not Applicable) – Upstream of the plant intake structure. (Control)</p>	<p>Sample in season, or annually if they are not seasonal</p>	<p>Gamma isotopic analysis on edible portion.</p>
	<p>Broadleaf 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.</p> <p>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.</p> <p>BLB-1 (NNE, 0.81 Miles) – (East bank) Located west of Little Gypsy on LA 628.</p> <p>BLE-20 (E, 19.7 Miles) – (West bank) Located on property of Nine Mile Point in Westwego. (Control)</p>	<p>Quarterly</p>	<p>Gamma isotopic and I-131 analysis.</p>

FIGURE 1-1

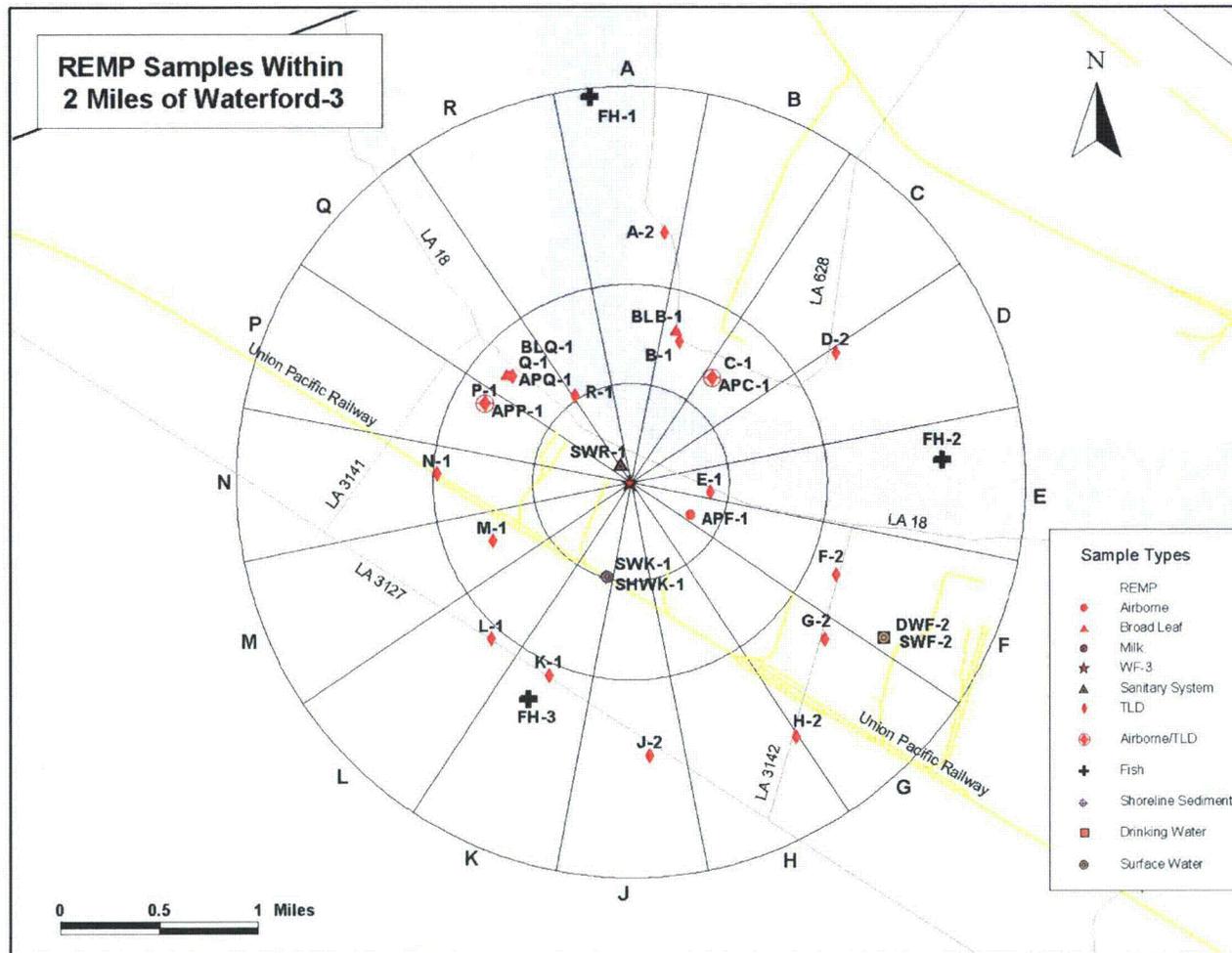


FIGURE 1-2

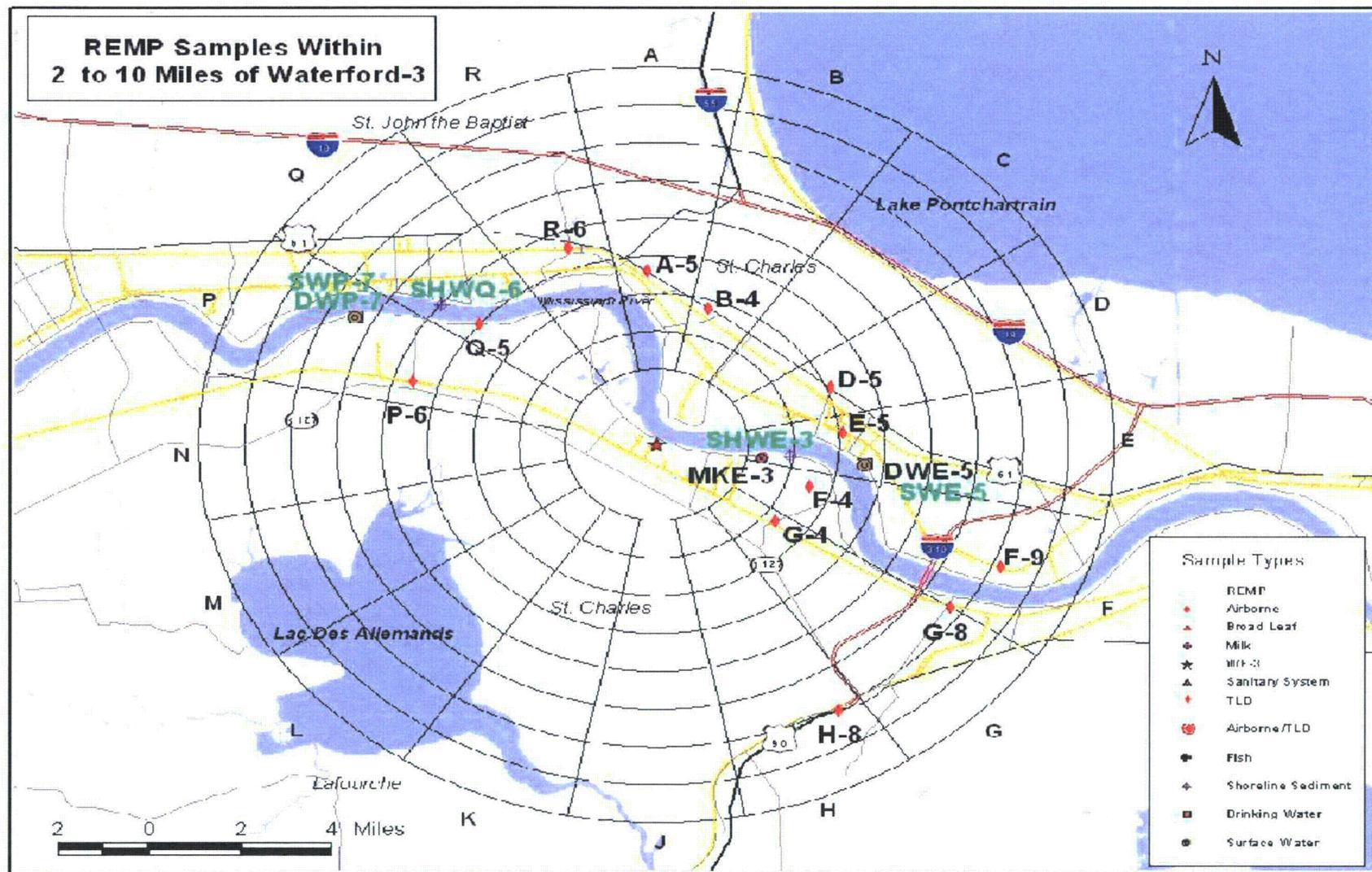
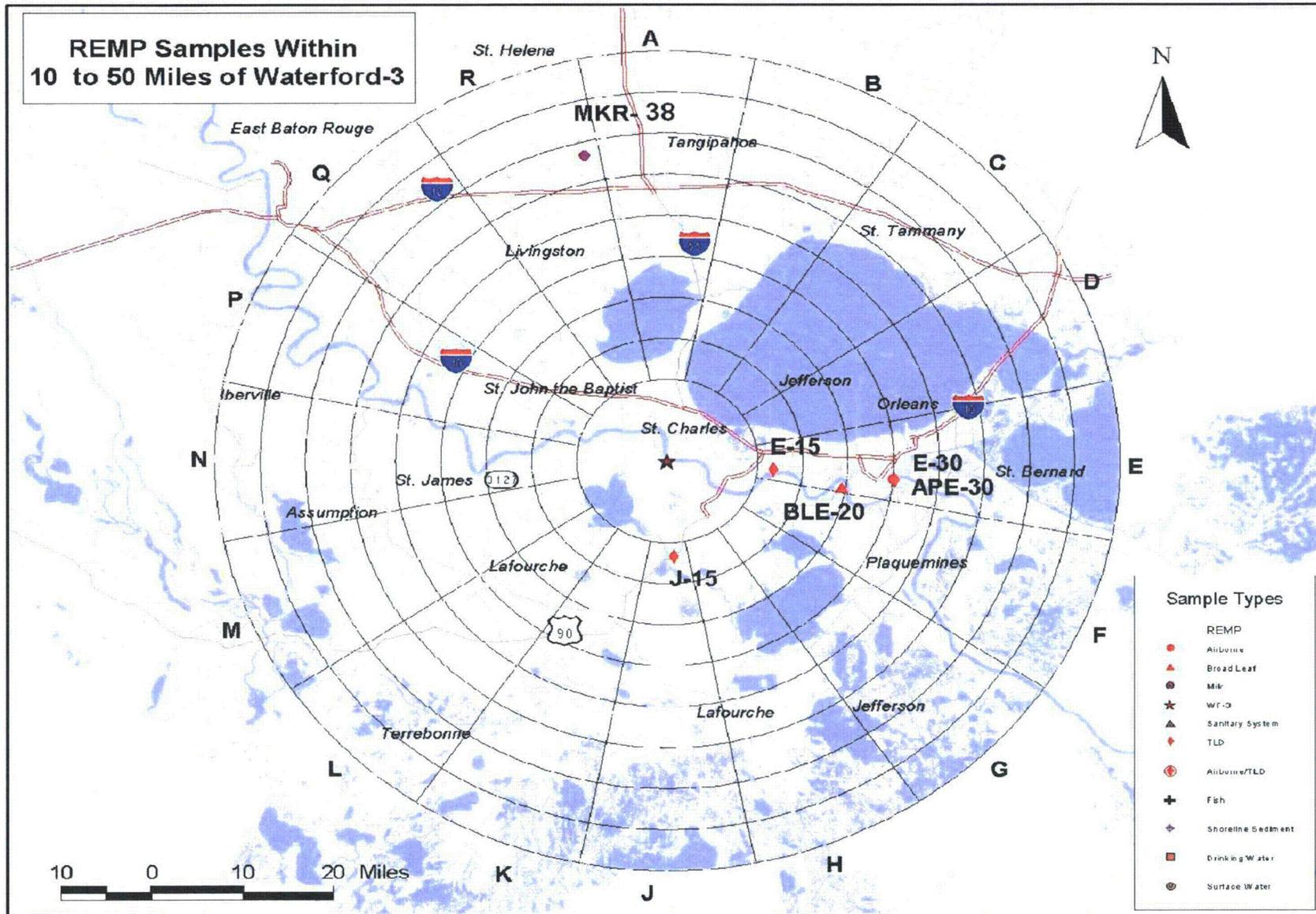


FIGURE 1-3



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 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 2008 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 – 2007	0.019
2008	0.027

Table 3.1, which includes gross beta concentrations for 2008, 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 2008.

2.2 Thermoluminescent Dosimetry Sample Results

The average exposure rates during 2008 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 14 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 four 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 and 2-5 miles from the plant are statistically the same as those > 5 miles.

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 2008 as previous years of operation as evidenced on Attachment 2, Table 2.2. In addition, Radiological Gaseous Effluents for 2008 were only a small fraction of the limits as is typical in previous years of operation and are not expected to have any impact on environmental TLD measurements.

2.3 Water Sample Results

Analytical results for 2008 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 indicator 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 – 2007	4.8
2008	3.0

Table 3.1, which includes gross beta concentrations for 2008, 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 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 2008.

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 2008.

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 2008.

2.5 Milk Sample Results

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 2008.

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 2008.

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 2008.

2.8 Land Use Census Results

In compliance with the Waterford 3 ODCM and TRM, the land use census was conducted September 30 – October 2, 2008. 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.

While residence, milk cow, beef cow and food product locations remained unchanged for 2008, two goat locations (sector A and F) and two garden locations (sector B and D) were removed. Two new garden locations (sector B and D) were identified in 2008. 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 2008 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

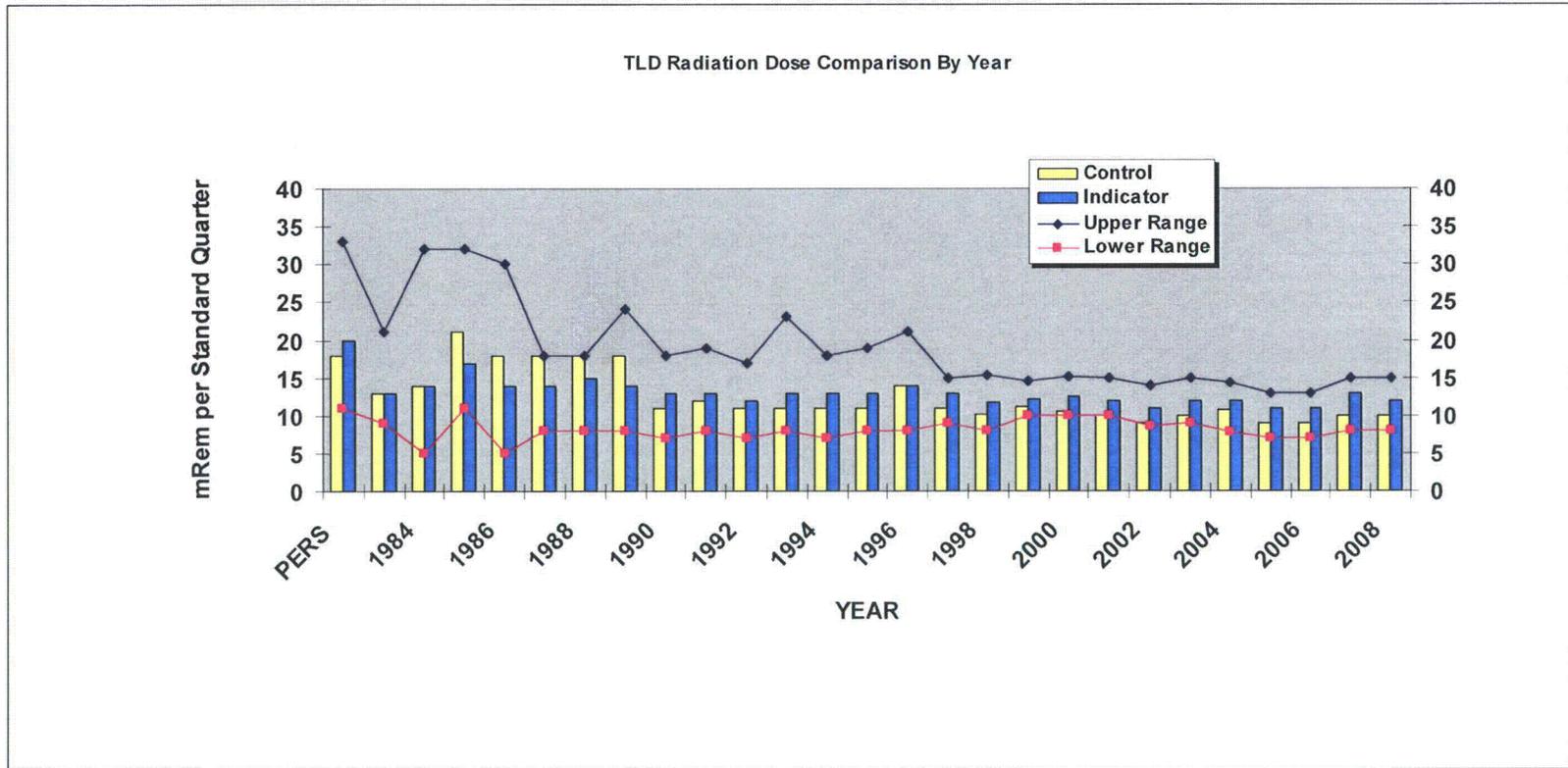
Sector	Direction	Distance from Plant in Miles					
		Residence	Garden	Milk Cows	Beef Cows	Goats	Food Products
A	N	1.3	1.7	* 4.6	4.6	^	4.1
B	NNE	1.1	1.3	^	^	^	1.3
C	NE	0.9	1.0	^	^	^	^
D	ENE	0.9	0.9	^	^	^	^
E	E	2.2	2.2	**2.3	2.3	* 3.2	0.3
F	ESE	3.1	2.2	^	2.3	^	0.3
G	SE	4.0	4.1	^	2.4	^	0.3
H	SSE	^	^	^	^	^	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	^	0.9	^	0.6
Q	NW	0.9	1.0	^	0.9	* 4.9	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
TLD RADIATION DOSE COMPARISON (BY YEAR)



3.0 Radiological Environmental Monitoring Program Summary

3.1 2008 Program Results Summary

Table 3.1 summarizes the 2008 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 2008

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 122	0.01	0.027 (96 / 96) [0.010 - 0.092]	APP-1 (WNW, 0.84 mi.)	0.030 (27 / 27) [0.012 - 0.092]	0.023 (26 / 26) [0.012 - 0.051]	0
	GS 19						
	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-131 122	0.07	<LLD	N/A	N/A	<LLD	0
Indicator TLDs (mrem/Std. Qtr)	Gamma 124	(f)	12 (108 / 120) [7.2 - 15.0]	F-4 (ESE, 3.53 mi.)	15 (4 / 4) [14.7 - 15.0]	N/A	0
Control TLDs (mrem/Std. Qtr)	Gamma 4	(f)	N/A	N/A	N/A	10 (4 / 4) [9.7 - 11.0]	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 2008

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 12	4	3.00 (8 / 8) [0.71 – 5.60]	DWF/SWF-2 (ESE, 1.51 mi.)	3.14 (4 / 4) [1.93 – 5.60]	2.11 (4 / 4) [1.51 – 2.85]	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
	Fe-59 30		<LLD	N/A	N/A	<LLD	0
	Co-58 15		<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
	Zr-95 15		<LLD	N/A	N/A	<LLD	0
	Nb-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	

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 2008

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	N/A	0
	GS 13						
	Mn-54 15	15	<LLD	N/A	N/A	N/A	0
	Fe-59 30	30	<LLD	N/A	N/A	N/A	0
	Co-58 15	15	<LLD	N/A	N/A	N/A	0
	Co-60 15	15	<LLD	N/A	N/A	N/A	0
	Zn-65 30	30	<LLD	N/A	N/A	N/A	0
	Zr-95 15	15	<LLD	N/A	N/A	N/A	0
	Nb-95 15	15	<LLD	N/A	N/A	N/A	0
	Cs-134 15	15	<LLD	N/A	N/A	N/A	0
	Cs-137 18	18	<LLD	N/A	N/A	N/A	0
	Ba-140 15	15	<LLD	N/A	N/A	N/A	0
	La-140 15	15	<LLD	N/A	N/A	N/A	0
Shoreline Sediment (pCi/kg dry)	GS 3						
	Cs-134 150	150	<LLD	N/A	N/A	<LLD	0
	Cs-137 180	180	<LLD	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 2008

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 4	1	< LLD	N/A	N/A	<LLD	0
	GS 4						
	Cs-134 15	15	< LLD	N/A	N/A	<LLD	0
	Cs-137 18	18	< LLD	N/A	N/A	<LLD	0
	Ba-140 15 La-140 15	15 15	< LLD < LLD	N/A N/A	N/A N/A	<LLD <LLD	0 0
Fish (pCi/kg wet)	GS 12						
	Mn-54 130	130	<LLD	N/A	N/A	<LLD	0
	Fe-59 260	260	<LLD	N/A	N/A	<LLD	0
	Co-58 130	130	<LLD	N/A	N/A	<LLD	0
	Co-60 130	130	<LLD	N/A	N/A	<LLD	0
	Zn-65 260	260	<LLD	N/A	N/A	<LLD	0
	Cs-134 130	130	<LLD	N/A	N/A	<LLD	0
	Cs-137 150	150	<LLD	N/A	N/A	<LLD	0
Broadleaf Vegetation (pCi/kg wet)	I-131 12	60	<LLD	N/A	N/A	<LLD	0
	GS 12						
	Cs-134 60 Cs-137 80	60 80	<LLD <LLD	N/A N/A	N/A N/A	<LLD <LLD	0 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

2008 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 →	0.01	0.01	0.01	0.01	0.01
01-15-08	0.0228	0.0215	0.0230	0.0210	0.0220
01-29-08	0.0260	0.0250	0.0250	0.0250	0.0280
02-12-08	0.0236	0.0238	0.0229	0.0233	0.0251
02-26-08	0.0189	0.0205	0.0218	0.0210	0.0239
03-11-08	0.0217	0.0215	0.0227	0.0212	0.0200
03-24-08	0.0179	0.0209	0.0221	0.0219	0.0225
04-08-08	0.0167	0.0166	0.0146	0.0146	0.0149
04-22-08	0.0187	0.0195	0.0202	0.0203	0.0190
05-06-08	0.0230	0.0210	0.0240	0.0200	0.0230
05-19-08	0.0170	0.0190	0.0200	0.0200	0.0190
06-03-08	0.0220	0.0210	0.0220	0.0170	0.0210
06-17-08	0.0100	0.0120	0.0120	0.0120	0.0120
07-01-08	0.0220	0.0180	0.0230	0.0220	0.0240
07-14-08	0.0510	0.0820	0.0920	0.0440	0.0290
07-28-08	0.0650	0.0870	0.0730	0.0410	0.0280
08-11-08	0.0560	0.0820	0.0490	0.0280	0.0190
08-25-08	0.0137	0.0178	0.0175	0.0171	0.0166
09-08-08	0.0160	0.0220	0.0290	0.0210	0.0240
09-22-08	0.0110	0.0220	(1)	0.0220	0.0220
10-06-08	0.0314	0.0343	(1)	0.0345	0.0359
10-20-08	0.0217	0.0210	(1)	0.0217	0.0205
11-03-08	0.0260	0.0290	(1)	0.0270	0.0230
11-17-08	0.0210	0.0210	(1)	0.0220	0.0170
12-01-08	0.0540	0.0500	(1)	0.0400	0.0510
12-15-08	0.0200	0.0200	(1)	0.0200	0.0200
12-29-08	0.0170	0.0170	(1)	0.0190	0.0180

(1) Damage due to Hurricane Gustav

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
01-15-08	< 0.018	< 0.011	< 0.014	< 0.011	< 0.024
01-29-08	< 0.018	< 0.015	< 0.018	< 0.012	< 0.019
02-12-08	< 0.012	< 0.009	< 0.015	< 0.012	< 0.013
02-26-08	< 0.013	< 0.016	< 0.011	< 0.010	< 0.044
03-11-08	< 0.015	< 0.014	< 0.016	< 0.014	< 0.015
03-24-08	< 0.013	< 0.016	< 0.015	< 0.012	< 0.014
04-08-08	< 0.014	< 0.013	< 0.020	< 0.013	< 0.016
04-22-08	< 0.019	< 0.014	< 0.014	< 0.014	< 0.013
05-06-08	< 0.022	< 0.021	< 0.021	< 0.021	< 0.021
05-19-08	< 0.015	< 0.014	< 0.015	< 0.012	< 0.014
06-03-08	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
06-17-08	< 0.020	< 0.018	< 0.023	< 0.021	< 0.016
07-01-08	< 0.013	< 0.014	< 0.014	< 0.012	< 0.010
07-14-08	< 0.014	< 0.015	< 0.015	< 0.011	< 0.009
07-28-08	< 0.018	< 0.015	< 0.014	< 0.011	< 0.012
08-11-08	< 0.013	< 0.017	< 0.011	< 0.013	< 0.012
08-25-08	< 0.015	< 0.016	< 0.014	< 0.011	< 0.012
09-08-08	< 0.015	< 0.023	< 0.030	< 0.011	< 0.029
09-22-08	< 0.017	< 0.013	(1)	< 0.013	< 0.017
10-06-08	< 0.019	< 0.013	(1)	< 0.013	< 0.011
10-20-08	< 0.017	< 0.013	(1)	< 0.011	< 0.010
11-03-08	< 0.019	< 0.014	(1)	< 0.012	< 0.013
11-17-08	< 0.014	< 0.016	(1)	< 0.009	< 0.016
12-01-08	< 0.017	< 0.014	(1)	< 0.015	< 0.011
12-15-08	< 0.018	< 0.014	(1)	< 0.012	< 0.012
12-29-08	< 0.016	< 0.012	(1)	< 0.011	< 0.010

(1) Damage due to Hurricane Gustav

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	< 0.002	< 0.003
APQ-1 (Indicator)	1st	< 0.002	< 0.002
APP-1 (Indicator)	1st	< 0.003	< 0.002
APC-1 (Indicator)	1st	< 0.002	< 0.002
APE-30 (Control)	1st	< 0.003	< 0.003
APF-1 (Indicator)	2nd	< 0.003	< 0.001
APQ-1 (Indicator)	2nd	< 0.003	< 0.002
APP-1 (Indicator)	2nd	< 0.002	< 0.002
APC-1 (Indicator)	2nd	< 0.003	< 0.001
APE-30 (Control)	2nd	< 0.002	< 0.002
APF-1 (Indicator)	3rd	< 0.002	< 0.002
APQ-1 (Indicator)	3rd	< 0.002	< 0.001
APP-1 (Indicator)	3rd	< 0.005	< 0.005
APC-1 (Indicator)	3rd	< 0.002	< 0.002
APE-30 (Control)	3rd	< 0.003	< 0.002
APF-1 (Indicator)	4th	< 0.003	< 0.003
APQ-1 (Indicator)	4th	< 0.003	< 0.002
APP-1 (Indicator)	4th	(1)	(1)
APC-1 (Indicator)	4th	< 0.001	< 0.002
APE-30 (Control)	4th	< 0.001	< 0.001

(1) Damage due to Hurricane Gustav

Table 2.1

Sample Type: Thermoluminescent Dosimeters

Analysis: Gamma Dose.

Units: mrem/Std. Qtr.

Indicator Locations					
Station	1st Qtr '08	2nd Qtr '08	3rd Qtr '08	4th Qtr '08	Annual Mean '08
A-2	(2)	12	(2)	14	13
A-5	14	12	13	13	13
B-1	14	12	14	13	13
B-4	13	13	13	14	13
C-1	11	9	11	11	10
D-2	(2)	13	14	14	14
D-5	12	11	13	12	12
E-1	12	11	12	12	12
E-5	10	14	9	10	11
E-15	11	10	10	10	10
F-2	13	12	13	13	13
⁽¹⁾ F-4	15	14	15	15	15
F-9	12	11	13	13	12
G-2	14	13	14	14	14
G-4	(2)	10	(2)	(2)	10
G-8	12	10	11	11	11
H-2	13	12	13	14	13
H-8	(2)	12	12	13	12
J-2	13	12	12	12	12
J-15	15	13	14	(2)	14
K-1	11	10	(2)	11	11
L-1	15	14	14	(2)	14
M-1	12	12	13	13	12
N-1	13	13	14	13	13
P-1	10	9	(2)	10	10
P-6	14	13	14	14	14
Q-1	13	12	12	13	12
Q-5	12	11	12	(2)	12
R-1	8	7	8	8	8
R-6	11	10	10	11	10
Control Location					
Station	1st Qtr '08	2nd Qtr '08	3rd Qtr '08	4th Qtr '08	Annual Mean '08
E-30	11	10	10	11	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	1.93	3.88	1.97
2 nd	3.04	2.31	2.85
3 rd	2.00	0.71	2.12
4 th	5.60	4.50	1.51

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>
01-14-08	< 5.42	< 0.89	<0.86	<0.86
⁽¹⁾ 01-14-08				<1.00
02-11-08	< 5.09		<0.89	<0.88
02-13-08		< 0.80		
03-10-08	< 5.08	< 0.88	<0.90	<0.89
04-07-08	< 5.14	< 0.87	<0.90	<0.86
05-05-08	< 4.59	< 0.88	<0.88	<0.89
06-02-08	< 6.53	< 0.89	<0.85	<0.88
06-30-08	< 4.25	< 0.88	<0.87	<0.89
07-23-08	< 5.44	< 0.84	<0.88	<0.90
08-20-08	< 4.56	< 0.89	<0.70	<0.87
09-17-08	< 6.00	< 0.90	<0.91	<0.88
10-15-08	< 5.11	< 0.87	<0.83	<0.80
11-12-08	< 5.77	< 0.82	<0.90	<0.90
12-09-08	< 4.27	< 0.89	<0.80	<0.89

⁽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
<u>Required LLD</u>	→	<u>15</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>18</u>	<u>15</u>	<u>15</u>
DWF/SWF-2 (Indicator)	03-10-08	< 3.47	< 3.24	< 7.67	< 4.37	< 6.03	< 3.15	< 5.34	< 3.89	< 3.86	< 14.19	< 5.25
DWE/SWE-5 (Indicator)	03-10-08	< 4.87	< 4.86	< 7.77	< 5.08	< 8.58	< 6.04	< 7.70	< 4.80	< 4.89	< 14.44	< 5.91
DWP/SWP-7 (Control)	03-10-08	< 3.63	< 3.59	< 8.23	< 3.53	< 8.86	< 3.93	< 6.01	< 3.92	< 4.26	< 14.90	< 6.26
DWF/SWF-2 (Indicator)	06-02-08	< 3.04	< 3.31	< 6.78	< 2.92	< 6.98	< 3.23	< 5.44	< 3.34	< 3.89	< 14.96	< 4.04
DWE/SWE-5 (Indicator)	06-02-08	< 4.55	< 4.75	< 8.99	< 3.82	< 9.26	< 3.80	< 7.18	< 4.90	< 4.77	< 14.99	< 5.28
DWP/SWP-7 (Control)	06-02-08	< 4.20	< 4.52	< 7.54	< 2.99	< 8.97	< 3.80	< 6.22	< 4.42	< 3.80	< 14.86	< 6.32
DWF/SWF-2 (Indicator)	09-17-08	< 3.05	< 3.08	< 5.93	< 2.63	< 6.54	< 4.22	< 6.05	< 3.36	< 3.54	< 14.30	< 5.89
DWE/SWE-5 (Indicator)	09-17-08	< 3.58	< 3.22	< 7.21	< 3.47	< 7.08	< 4.39	< 5.92	< 4.19	< 3.39	< 12.45	< 7.02
DWP/SWP-7 (Control)	09-17-08	< 2.94	< 2.87	< 5.87	< 2.94	< 5.96	< 4.22	< 4.83	< 3.29	< 2.98	< 14.15	< 4.81
DWF/SWF-2 (Indicator)	12-09-08	< 2.72	< 2.86	< 6.04	< 2.88	< 5.91	< 3.70	< 5.03	< 3.07	< 3.00	< 14.91	< 6.02
DWE/SWE-5 (Indicator)	12-09-08	< 2.93	< 2.93	< 6.28	< 2.97	< 6.29	< 4.37	< 6.16	< 3.29	< 2.64	< 14.19	< 5.05
DWP/SWP-7 (Control)	12-09-08	< 2.86	< 2.76	< 5.47	< 2.66	< 5.61	< 3.51	< 4.56	< 2.94	< 2.53	< 14.93	< 4.48

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	< 592.47	< 574.39	< 573.03	< 572.46
2 nd	< 565.13	< 562.52	< 558.43	< 562.82
3 rd	< 585.68	< 565.49	< 583.30	< 568.42
4 th	< 577.70	< 573.89	< 577.84	< 572.71

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
Required LLD	→	15	15	30	15	30	15	15	15	18	15	15
SWK-1 (Indicator)	01-14-08	< 3.97	< 3.29	< 7.60	< 3.44	< 9.50	< 4.48	< 7.35	< 3.93	< 4.18	< 14.29	< 5.14
	02-11-08	< 3.46	< 3.97	< 7.48	< 3.61	< 7.95	< 4.17	< 7.04	< 4.96	< 4.54	< 14.64	< 2.17
	03-10-08	< 4.12	< 4.68	< 8.78	< 4.06	< 9.71	< 4.87	< 7.81	< 5.30	< 4.49	< 14.41	< 6.19
	04-07-08	< 4.21	< 3.98	< 8.00	< 3.49	< 8.92	< 4.94	< 7.38	< 4.35	< 4.39	< 14.90	< 6.85
	05-05-08	< 2.98	< 3.53	< 7.06	< 2.58	< 9.72	< 4.36	< 6.53	< 4.27	< 4.52	< 14.95	< 5.79
	06-02-08	< 4.40	< 4.19	< 9.91	< 3.80	< 7.72	< 3.84	< 6.00	< 4.66	< 4.02	< 14.98	< 3.32
	06-30-08	< 4.55	< 4.16	< 4.88	< 3.57	< 8.74	< 4.50	< 5.46	< 5.36	< 3.80	< 14.11	< 5.23
	07-23-08	< 5.19	< 4.94	< 9.91	< 5.15	< 10.33	< 4.74	< 8.41	< 6.10	< 3.99	< 14.65	< 7.03
	08-20-08	< 4.01	< 3.78	< 6.05	< 3.93	< 6.99	< 4.38	< 6.73	< 3.67	< 3.87	< 13.73	< 5.94
	09-17-08	< 4.21	< 4.92	< 9.03	< 4.05	< 9.36	< 5.76	< 8.65	< 5.32	< 4.36	< 14.80	< 5.20
	10-15-08	< 3.70	< 4.00	< 7.74	< 3.37	< 7.99	< 3.90	< 7.11	< 4.30	< 3.78	< 14.49	< 5.37
	11-12-08	< 4.08	< 4.48	< 10.16	< 4.31	< 9.69	< 5.02	< 8.05	< 4.81	< 4.34	< 14.67	< 6.74
	12-09-08	< 3.41	< 2.96	< 5.67	< 3.52	< 6.69	< 4.00	< 6.68	< 3.66	< 3.68	< 13.47	< 5.26

Table 4.1

Sample Type: **Sediment**

Analysis: Gamma Isotopic

Units: pCi/kg (dry)

Location	Collection Date	Cs-134	Cs-137
<u>Required LLD</u>	→	<u>150</u>	<u>180</u>
SHWK-1 (Indicator)	06-02-08	< 24.9	< 25.1
SHWE-3 (Indicator)	06-02-08	< 23.7	< 27.6
SHWQ-6 (Control)	06-02-08	< 28.0	< 36.3

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⁾ 03-25-08	n/a	n/a	n/a	n/a	n/a
	⁽¹⁾ 06-19-08	n/a	n/a	n/a	n/a	n/a
	⁽¹⁾ 09-18-08	n/a	n/a	n/a	n/a	n/a
	⁽¹⁾ 12-18-08	n/a	n/a	n/a	n/a	n/a
MKR-38 (Control)	03-25-08	< 0.86	< 4.96	< 5.16	< 14.19	< 4.91
	06-19-08	< 0.90	< 4.54	< 5.10	< 14.55	< 4.55
	09-18-08	< 0.89	< 4.10	< 5.54	< 14.96	< 4.74
	12-18-08	< 0.85	< 5.29	< 7.72	< 14.89	< 5.33

⁽¹⁾ Sample not available. Cows not producing enough milk.

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)	10-22-08	Buffalo	< 16.37	< 16.58	< 40.18	< 23.34	< 41.11	< 14.79	< 15.14
FH-1 (Control)	10-22-08	Catfish	< 10.82	< 11.56	< 37.00	< 13.53	< 28.46	< 6.73	< 12.00
FH-1 (Control)	10-22-08	Mullet	< 9.27	< 15.22	< 50.35	< 20.09	< 35.56	< 14.02	< 14.60
FH-1 (Control)	10-22-08	Shad	< 20.14	< 22.46	< 66.68	< 21.70	< 70.04	< 22.81	< 18.22
FH-2 (Indicator)	10-27-08	Buffalo	< 16.73	< 11.39	< 42.25	< 18.09	< 43.71	< 16.40	< 13.01
FH-2 (Indicator)	10-27-08	Catfish	< 17.00	< 13.05	< 47.56	< 17.38	< 42.11	< 15.11	< 13.54
FH-2 (Indicator)	10-27-08	Shad	< 18.56	< 19.12	< 62.61	< 27.15	< 55.86	< 19.16	< 12.50
FH-2 (Indicator)	10-27-08	Mullet	< 10.53	< 14.87	< 40.05	< 16.43	< 38.11	< 13.08	< 11.64
FH-3 (Indicator)	10-28-08	Buffalo	< 18.18	< 12.09	< 45.57	< 19.24	< 36.29	< 16.67	< 17.21
FH-3 (Indicator)	10-28-08	Catfish	< 17.53	< 19.50	< 41.19	< 17.80	< 52.26	< 17.54	< 15.29
FH-3 (Indicator)	10-28-08	Shad	< 16.08	< 18.67	< 45.04	< 20.01	< 43.79	< 11.45	< 15.09
FH-3 (Indicator)	10-28-08	Mullet	< 10.61	< 18.12	< 37.30	< 21.75	< 46.08	< 15.75	< 15.95

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)	03-04-08	< 54.06	< 48.26	< 46.97
BLQ-1 (Indicator)	06-11-08	< 57.62	< 40.38	< 55.63
BLQ-1 (Indicator)	09-16-08	< 31.88	< 56.23	< 64.16
BLQ-1 (Indicator)	12-17-08	< 53.77	< 57.79	< 61.40
BLB-1 (Indicator)	03-04-08	< 59.27	< 47.86	< 38.16
BLB-1 (Indicator)	06-11-08	< 59.44	< 55.94	< 63.20
BLB-1 (Indicator)	09-16-08	< 56.53	< 40.43	< 64.20
BLB-1 (Indicator)	12-17-08	< 47.46	< 57.38	< 42.43
BLE-20 (Control)	03-04-08	< 43.27	< 30.21	< 32.84
BLE-20 (Control)	06-11-08	< 44.85	< 59.96	< 61.28
BLE-20 (Control)	09-16-08	< 56.17	< 32.24	< 50.98
BLE-20 (Control)	12-17-08	< 55.70	< 53.91	< 57.09

Table 8.1
Sample Type: Interlaboratory Comparison
Analysis: Gross Beta, Iodine-131, Tritium and Gamma Isotopic

Sample Type (units)	Analytics #	Date	Analysis	Known value (a)	RBS Value	RBS N-DEV (b)	RBS N-RANGE (c)
Face Loaded F&J Charcoal Cartridge	E5943-125	6/19/2008	I-131	8.45E+01	8.23E+01	-0.60	0.22
Gross Beta in 1 Liter Water	E5942-125	6/19/2008	BETA	1.49E+02	1.55E+02	0.45	0.25
(pCi/liter) Gamma in Water Sample	E5941-125	6/19/2008	Cr-51	1.88E+02	1.70E+02	-2.22	2.16
			Mn-54	1.84E+02	2.04E+02	2.50	0.21
			Co-58	8.42E+01	8.55E+01	0.34	0.42
			Fe-59	1.25E+02	1.40E+02	2.69	0.71
			Co-60	1.42E+02	1.47E+02	0.77	0.19
			Zn-65	1.72E+02	1.76E+02	0.60	0.49
			I-131	4.53E+01	4.86E+01	1.68	1.87
			Cs-134	1.04E+02	1.04E+02	-0.08	0.30
			Cs-137	1.58E+02	1.63E+02	0.77	0.41
Ce-141	2.37E+02	2.36E+02	-0.14	0.24			
Tritium in Water	E6263-125	9/18/2008	H-3	1.14E+04	1.18E+04	0.49	0.09
Gross Beta on 47mm Air Particulate Filter	E6264-125	9/18/2008	BETA	9.51E+01	8.52E+01	-1.39	0.01
Gamma Emitters on 47 mm (pCi/filter)	E6265-125	9/18/08	Cr-51	2.49E+02	2.50E+02	0.07	0.79
			Mn-54	9.84E+01	1.07E+02	2.11	0.23
			Co-58	1.06E+02	1.05E+02	-0.12	0.28
			Fe-59	8.56E+01	9.52E+01	2.59	0.44
			Co-60	1.39E+02	1.40E+02	0.16	0.19
			Zn-65	1.89E+02	1.90E+02	0.14	0.44
			Cs-134	1.37E+02	1.33E+02	-0.76	0.16
			Cs-137	9.60E+01	9.66E+01	0.14	0.38
Ce-141	9.55E+01	9.77E+01	0.54	0.25			
Gamma Emitters in 1 Liter Soil (pCi/gram)	E6266-125	9/18/2008	Cr-51	8.33E-01	8.66E-01	0.95	0.42
			Mn-54	3.29E-01	3.69E-01	2.92	0.17
			Co-58	3.53E-01	3.66E-01	0.88	0.25
			Fe-59	2.86E-01	3.15E-01	2.40	0.47
			Co-60	4.64E-01	4.78E-01	0.75	0.21
			Zn-65	6.32E-01	6.79E-01	1.78	0.16
			Cs-134	4.59E-01	4.61E-01	0.09	0.14
			Cs-137	4.16E-01	4.47E-01	1.82	0.21
Ce-141	3.19E-01	3.43E-01	1.81	0.18			

Table 8.1

Sample Type: **Interlaboratory Comparison**

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

Sample Type (units)	Analytics #	Date	Analysis	Known Value (a)	RBS Value	RBS N-DEV (b)	RBS N-RANGE (c)
Gamma Emitters in Milk (pCi/liter)	E5944-125	6/19/2008	Cr-51	1.38E+02	1.42E+02	0.61	2.74
			Mn-54	1.35E+02	1.49E+02	2.45	0.31
			Co-58	6.19E+01	6.21E+01	0.09	0.84
			Fe-59	9.17E+01	9.87E+01	1.75	0.67
			Co-60	1.04E+02	1.07E+02	0.68	0.46
			Zn-65	1.27E+02	1.34E+02	1.30	0.34
			I-131	7.14E+01	7.12E+01	-0.07	0.58
			Cs-134	7.67E+01	7.80E+01	0.40	0.45
			Cs-137	1.16E+02	1.19E+02	0.67	0.21
Ce-141	1.74E+02	1.77E+02	0.34	0.41			

NOTES:

(a) The known value as determined by Analytics.

(b) The normalized deviation from the "known" value is computed from the deviation and

the standard error of the mean; ± 2.00 is the warning limit and ± 3.00 is the control limit. This is a measure of accuracy of the analytical methods.

(c) The normalized range is computed from the mean range, the control limit, and the standard error of the

range; +2.000 is the warning limit and +3.000 is the control limit. This is a measure of precision of the analytical methods.

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:

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

and

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

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:

- 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 $m_x \neq m_y$,

where $t_{\mu/2, n}$ and $t_{\mu, n}$ are the tabular "t" values, with a preselected error (5%), confidence level $(1 - \mu)$ 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 2008 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.)	1.80	1.60	1.56
Number in Sample	58	24	26
Calculated "t" Value (comparison of stations 0-2 and 2-5 miles from the plant to stations >5 miles from the plant)	0.43	1.39	NA*
Tabular "t" Value at 95% Confidence ($t_{0.025,n}$)	1.993(a)	2.013(a)	NA*

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

* Not Applicable

TABLE 2.2

STATISTICAL COMPARISON OF 2008 TLD RADIATION DOSE TO HISTORICAL DATA BY LOCATION							Units: mrem/Std. Qtr.	
Station	1990 - 2007 Avg**	1990 - 2007 Std.Dev**	1990 - 2007 Range**		2008 Avg**	2008 Std Dev**	2008 Range**	
A-2	13	1.5	10	18	13	1.0	12	14
A-5	13	1.4	10	17	13	0.7	12	14
B-1	13	1.5	10	19	13	0.8	12	14
B-4	13	1.2	11	17	13	0.4	13	14
C-1	9	1.3	7	13	11	0.9	9	11
D-2	12	2.0	8	19	14	0.5	13	14
D-5	12	1.5	9	18	12	0.7	11	13
E-1	11	1.3	9	16	12	0.4	11	12
E-5	12	1.7	9	17	11	1.9	9	14
E-15	11	1.8	8	16	10	0.4	10	11
E-30*	11	1.7	8	17	11	0.5	10	11
F-2	12	1.2	10	17	13	0.4	12	13
F-4	14	1.5	11	19	15	0.4	14	15
F-9	12	1.5	7	17	12	0.8	11	13
G-2	15	1.5	11	19	14	0.4	13	14
G-4	11	1.4	9	16	10	0.0	10	10
G-8	12	2.1	8	19	11	0.7	10	12
H-2	13	1.3	10	18	13	0.7	12	14
H-8	12	1.3	9	17	12	0.5	12	13
J-2	13	1.5	10	17	12	0.4	12	13
J-15	13	1.3	11	17	14	0.8	13	15
K-1	12	1.3	9	16	11	0.5	10	11
L-1	13	1.3	10	16	14	0.5	14	15
M-1	12	1.5	9	18	13	0.5	12	13
N-1	13	1.6	8	18	13	0.4	13	14
P-1	10	1.4	7	15	10	0.5	9	10
P-6	13	1.5	10	19	14	0.4	13	14
Q-1	12	1.2	10	16	13	0.5	12	13
Q-5	13	2.3	9	18	12	0.5	11	12
R-1	10	2.1	6	15	8	0.4	7	8
R-6	12	2.6	8	18	11	0.5	10	11

* 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 2008 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	29	30	24	23
Standard Deviation (10^{-3} pCi/m ³)	14.09	20.75	20.31	7.73	7.37
Number in Sample	26	26	18	26	26
Calculated "t" Value (comparison of the indicator stations to the control station)	0.81	1.49	1.32	0.33	NA*
Tabular "t" Value at 95% Confidence ($t_{0.025,n}$)	2.011(a)	2.011(a)	2.019(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 2008 GROSS BETA ACTIVITY MEASUREMENTS IN DRINKING/SURFACE WATER SAMPLES			
	DWF/SWF-2	DWE/SWE-5	DWP/SWP-7
Mean (pCi/liter)	3.1	2.9	2.1
Standard Deviation (pCi/liter)	1.49	1.47	0.48
Number in Sample	4	4	4
Calculated "t" Value (comparison of the indicator stations to the control station)	1.32	0.95	NA*
Tabular "t" Value at 95% Confidence ($t_{0.025,n}$)	2.447(a)	2.447(a)	NA*

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

* Not Applicable