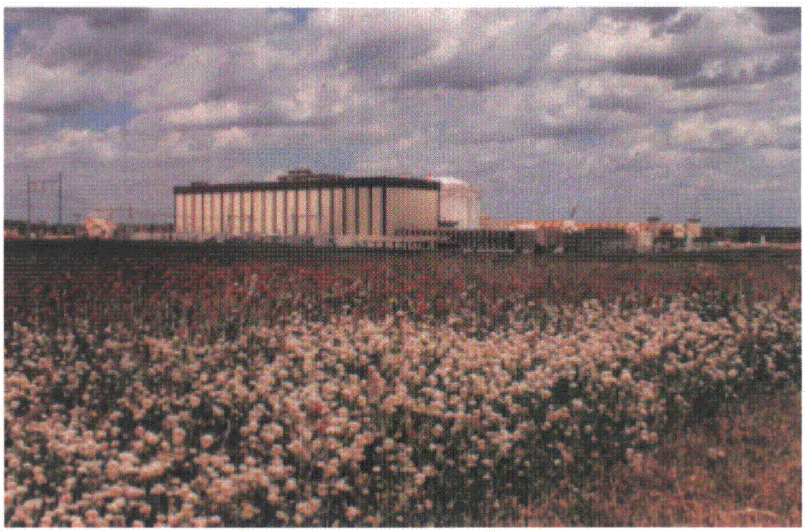
Edwin I. Hatch Nuclear Plant
Joseph M. Farley Nuclear Plant
Vogtle Electric Generating Plant
Annual Radiological Environmental Operating Reports for 2009

Enclosure 2

Farley Annual Radiological Environmental Operating Report for 2009

JOSEPH M. FARLEY NUCLEAR PLANT ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 2009



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LIST OF ACRONYMS

Acronyms presented in alphabetical order

Acronym	Definition
APCo	Alabama Power Company
ASTM	American Society for Testing and Materials
CL	Confidence Level
EL	Georgia Power Company Environmental Laboratory
EPA	Environmental Protection Agency
FNP	Joseph M. Farley Nuclear Plant
ICP	Interlaboratory Comparison Program
MDC	Minimum Detectable Concentration
MDD	Minimum Detectable Difference
MWe	MegaWatts Electric
NA	Not Applicable
NDM	No Detectable Measurement(s)
NRC	Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
Po	Preoperation
PWR	Pressurized Water Reactor
REMP	Radiological Environmental Monitoring Program
RL	Reporting Level
RM	River Mile
TLD	Thermoluminescent Dosimeter
TS	Technical Specification

1.0 INTRODUCTION

The Radiological Environmental Monitoring Program (REMP) for 2009 was conducted in accordance with Chapter 4 of the Offsite Dose Calculation Manual (ODCM). The REMP activities for 2009 are reported herein in accordance with Technical Specification (TS) 5.6.2 and ODCM 7.1.

The objectives of the REMP are to:

1) Determine the levels of radiation and the concentrations of radioactivity in the environs and;

2) Assess the radiological impact (if any) to the environment due to the operation of the Joseph M. Farley Nuclear Plant (FNP).

The assessments include comparisons between results of analyses of samples obtained at locations where radiological levels are not expected to be affected by plant operation (control stations) and at locations where radiological levels are more likely to be affected by plant operation (indicator stations), as well as comparisons between preoperational and operational sample results.

FNP is owned by Alabama Power Company (APCo) and operated by Southern Nuclear Operating Company. It is located in Houston County, Alabama approximately fifteen miles east of Dothan, Alabama on the west bank of the Chattahoochee River. Unit 1, a Westinghouse Electric Corporation Pressurized Water Reactor (PWR) with a licensed core thermal power output of 2775 MegaWatts thermal (MWt), achieved initial criticality on August 9, 1977 and was declared "commercial" on December 1, 1977. Unit 2, also a 2775 MWt Westinghouse PWR, achieved initial criticality on May 8, 1981 and was declared "commercial" on July 30, 1981.

The preoperational stage of the REMP began with initial sample collections in January of 1975. The transition from the preoperational to the operational stage of the REMP was marked by Unit 1 initial criticality.

A description of the REMP is provided in Section 2 of this report. An annual summary of the results of the analyses of REMP samples is provided in Section 3. A discussion of the results, including assessments of any radiological impacts upon the environment and the results of the land use census are provided in Section 4. The results of the Interlaboratory Comparison Program (ICP) are provided in Section 5. Conclusions are provided in Section 6.

2.0 REMP DESCRIPTION

A summary description of the REMP is provided in Table 2-1. This table summarizes the program as it meets the requirements outlined in ODCM Table 4-1. It details the sample types to be collected and the analyses to be performed in order to monitor the airborne, direct radiation, waterborne and ingestion pathways, and also delineates the collection and analysis frequencies. In addition, Table 2-1 describes the locations of the indicator, community and control stations as described in ODCM Table 4-4 and the identification of each sample according to station location and analysis type. The stations are also depicted on maps in Figures 2-1 through 2-3.

The location of each REMP station for gaseous releases is described by its direction and distance from a point midway between the Unit 1 and Unit 2 plant vent stacks. The surrounding area is divided into 16 azimuthal sectors which are centered on the major compass points; each sector is numbered sequentially clockwise and oriented so that the centerline of sector 16 is due north. Each sampling station is identified by a four digit number. The first two digits indicate the sector number, and the last two digits indicate the distance from the origin to the nearest mile. For example, air monitoring station 0215 is located approximately 15 miles northeast of the origin. The locations for the sampling stations along the river are identified by the nearest River Mile (RM) which is the distance along the navigable portion of the Chattahoochee River upstream of the Jim Woodruff Dam near Chattahoochee, Florida. The approximate locations of the plant discharge and intake structures are at RM 43.5 and 43.8, respectively.

The samples are collected by the plant's technical staff, except for fish and river sediment samples which are collected by APCo Environmental Field Services personnel.

All laboratory analyses were performed by Georgia Power Company's Environmental Laboratory (EL) in Smyrna, Georgia.

TABLE 2-1 (SHEET 1 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
AIRBORNE <u>Particulates</u>		Continuous sampler operation with sample collection weekly.	Particulate sampler: Analyze for gross beta radioactivity ≥ 24 hours following filter change. Perform gamma isotopic analysis on each sample when gross beta activity is > 10 times the yearly mean of control samples. Perform gamma isotopic analysis on composite sample (by location) quarterly.
Indicator Stations: River Intake Structure (ESE-0.8) South Perimeter (SSE-1.0) Plant Entrance (WSW-0.9) North Perimeter (N-0.8)	 PI-0501 PI-0701 PI-1101 PI-1601		
Control Stations: Blakely GA (NE-15) Neals Landing, FL (SSE-18) Dothan, AL (W-18)	 PB-0215 PB-0718 (spare station, not in service) PB-1218		
Community Stations: GA Pacific Paper Co. (SSE-3) Ashford, AL (WSW-8) Columbia, AL (N-5)	 PC-0703 PC-1108 PC-1605		

TABLE 2-1 (SHEET 2 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	**Sample Identification**	**Sampling and Collection Frequency**	**Type and Frequency of Analysis**
<u>Iodine</u>		Continuous sampler operation with sample collection weekly	Radioiodine canister: Analyze each sample for I-131 weekly.
Indicator Stations: River Intake Structure (ESE-0.8) South Perimeter (SSE-1.0) Plant Entrance (WSW-0.9) North Perimeter (N-0.8)	 II-0501 II-0701 II-1101 II-1601		
Control Station: Blakely, GA (NE-15) Neals Landing, FL (SSE-18) Dothan, AL (W-18)	 IB-0215 IB-0718 (spare station, not in service) IB-1218		
Community Station: GA Pacific Paper Co. (SSE-3)	 IC-0703		
DIRECT RADIATION <u>TLD</u>		Quarterly	Gamma dose: Read each badge quarterly
Indicator Stations: Plant Perimeter (NNE-0.9) (NE-1.0) (ENE-0.9) (E-0.8) (ESE-0.8)	 RI-0101 RI-0201 RI-0301 RI-0401 RI-0501		

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
(SE-1.1)	RI-0601		
(SSE-1.0)	RI-0701		
(S-1.0)	RI-0801		
(SSW-1.0)	RI-0901		
(SW-0.9)	RI-1001		
(WSW-0.9)	RI-1101		
(W-0.8)	RI-1201		
(WNW-0.8)	RI-1301		
(NW-1.1)	RI-1401		
(NNW-0.9)	RI-1501		
(N-0.8)	RI-1601		
Control Stations:			
Blakely, GA (NE-15)	RB-0215		
Neals Landing, FL (SSE-18)	RB-0718		
Dothan, AL (W-15)	RB-1215		
Dothan, AL (W-18)	RB-1218		
Webb, AL (WNW-11)	RB-1311		
Haleburg, AL (N-12)	RB-1612		
Community Station By sector			
(NNE-4)	RC-0104		
(NE-4)	RC-0204		
(ENE-4)	RC-0304		
(E-5)	RC-0405		
(ESE-5)	RC-0505		
(SE-5)	RC-0605		
(SSE-3)	RC-0703		

TABLE 2-1 (SHEET 4 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
(S-5) (SSW-4) (SW-5) (WSW-4) (W-4) (WNW-4) (NW-4) (NNW-4) (N-5) Of Special Interest: Nearest Residence (SW-1.2) City of Ashford, AL (WSW-8.0)	RC-0805 RC-0904 RC-1005 RC-1104 RC-1204 RC-1304 RC-1404 RC-1504 RC-1605 RC-1001 RC-1108		
WATERBORNE Surface Water		Aliquots taken with proportional semi-continuous sampler, having a minimum sampling frequency not exceeding two hours, collected weekly for 4 week composites and quarterly composites	Gamma isotopic analysis of each 4 week composite sample. Tritium analysis for each quarterly composite.
Indicator Station: Paper Mill, (~3 miles downstream of plant discharge, RM 40)	WRI		
Control Station: Upstream of Andrews Lock and dam (~3 miles upstream of the plant intake, RM 47)	WRB		

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
Offsite Ground Water		Grab sample quarterly	Gamma isotopic, I-131, and tritium analyses of each sample quarterly
Indicator Station: Paper Mill Well (SSE-4)	WGI-07		
Control Station: Whatley Residence Well (SW-1.2)	WGB-10		
Onsite Ground Water	See Table 2-2	Quarterly sample; pump used to sample GW wells; grab sample from yard drains and ponds	Tritium, gamma isotopic, and field parameters (pH, temperature, conductivity, dissolved oxygen, oxidation/reduction potential, and turbidity) of each sample quarterly; Hard to detect radionuclides as necessary based on results of tritium and gamma
River Sediment		Grab sample semiannually	Gamma isotopic analysis of each sample semiannually
Indicator Station: Downstream of plant discharge at Smith's Bend (RM 41)[a]	RSI		
Control Station: Upstream of plant discharge at Andrews Lock & Dam Reservoir (RM 48)[a]	RSB		

TABLE 2-1 (SHEET 6 of 7)

SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway with Sample Types and Locations (sector-miles)	Sample Identification	Sampling and Collection Frequency	Type and Frequency of Analysis
INGESTION Milk		Grab sample biweekly	Gamma isotopic and I-131 analyses of each sample biweekly
Control Station: Robert Weir Dairy Donaldsonville, GA (SSE - 14)	MB-0714		
Fish		Grab sample semiannually for Game Fish and Bottom Feeding Fish	Gamma isotopic analysis on the edible portions of each sample semiannually
Indicator Stations: Downstream of plant discharge in vicinity of Smith's Bend (RM 41)[b]	FGI & FBI		
Control Station: Upstream of plant discharge in Andrews Lock & Dam Reservoir (RM 48)[b]	FGB & FBB		
Forage		Grab sample from forage every 4 weeks.	Gamma isotopic analysis of each sample every 4 weeks.
Indicator Station: South Southeast Perimeter (SSE-1.0) North Perimeter (N-0.8)	FI-0701 FI-1601		
Control Station: Dothan, AL (W-18)	FB-1218		

TABLE 2-1 (SHEET 7 of 7)

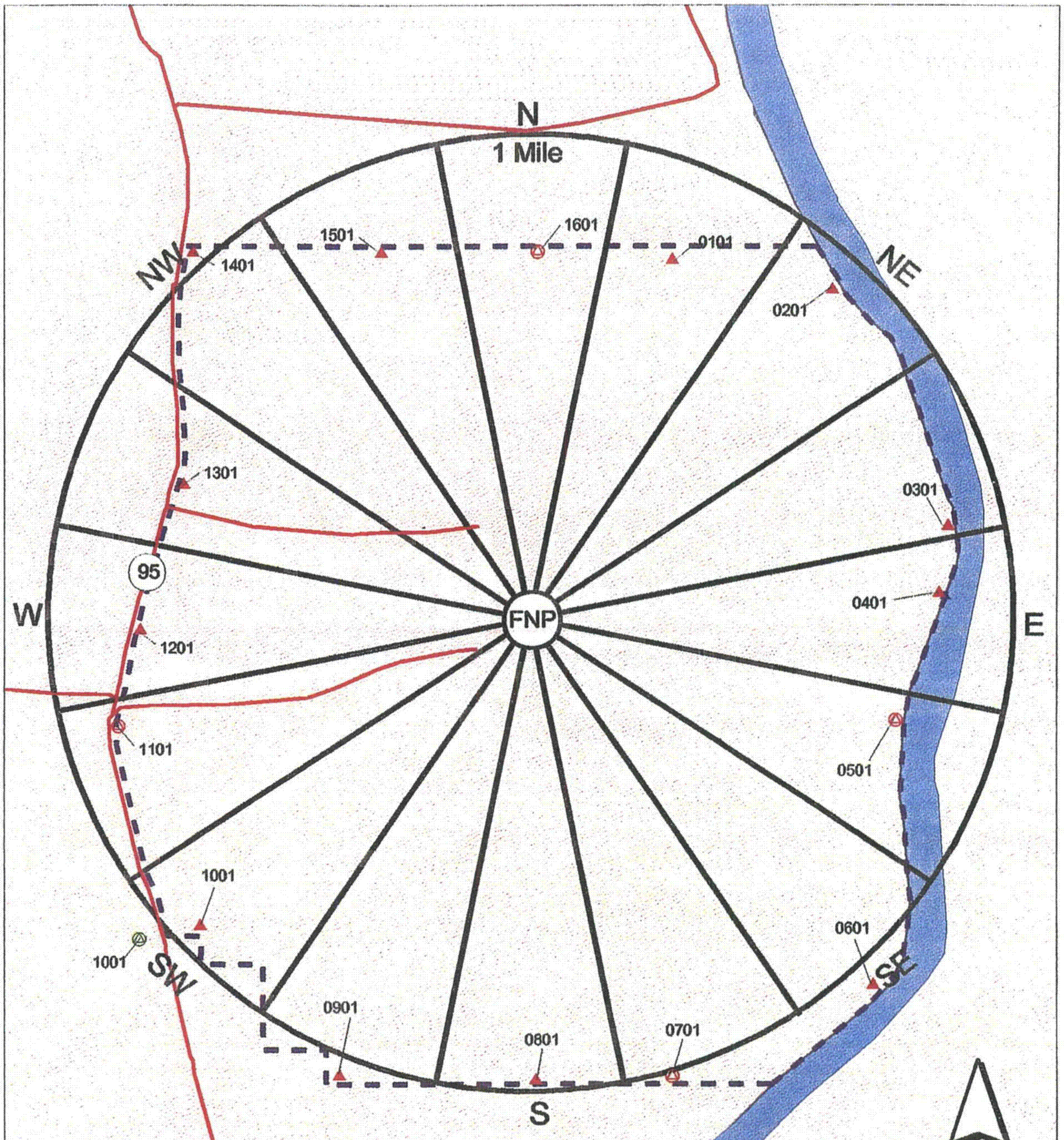
SUMMARY DESCRIPTION OF RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

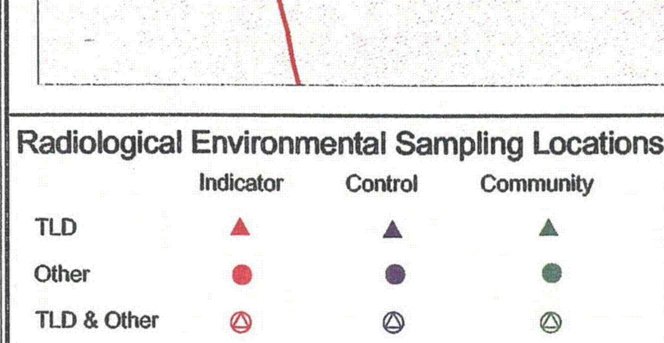
NOTATIONS

a. These collections are normally made at river mile 41.3 for the indicator station and river mile 47.8 for the control station; however, due to river bottom sediment shifting caused by high flows, dredging, etc., collections may be made from river mile 40 to 42 for the indicator station and from river mile 47 to 49 for the control station.

b. Since a few miles of river water may be needed to obtain adequate fish samples, these river mile positions represent the approximate locations about which the catches are taken. Collections for the indicator station should be from river mile 37.5 to 42.5 and for the control station from river mile 47 to 52.

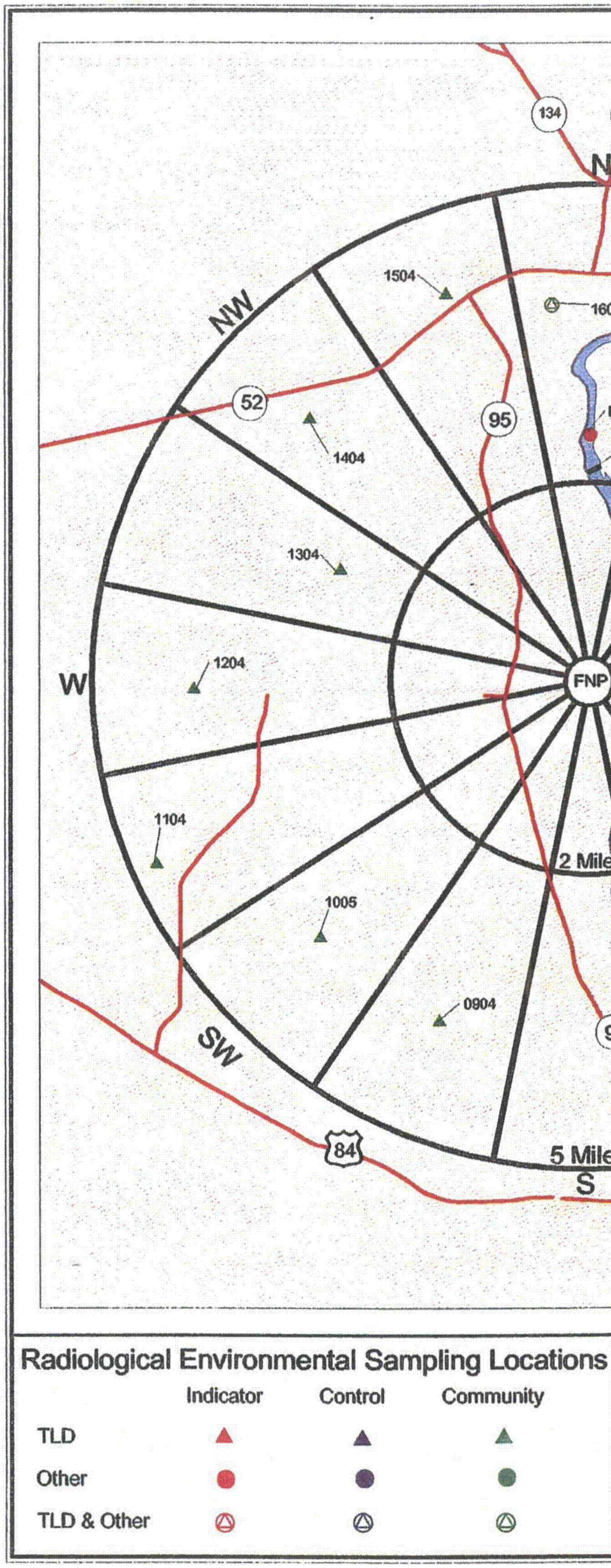
TABLE 2-2 **Onsite Groundwater Monitoring Locations**		
WELL	**ACQUIFER**	**MONITORING PURPOSE**
R1	Major Shallow aquifer	Dilution line
R2	Major Shallow aquifer	Dilution line
R3	Major Shallow aquifer	Unit 2 RWST
R4	Major Shallow aquifer	Unit 1 RWST
R5	Major Shallow aquifer	Dilution line
R6	Major Shallow aquifer	Dilution line
R7	Major Shallow aquifer	Dilution line
R8	Major Shallow aquifer	Dilution line
R9	Major Shallow aquifer	Dilution line
R10	Major Shallow aquifer	Dilution line
R11	Major Shallow aquifer	Background 1
R13	Major Shallow aquifer	Dilution line
R14	Major Shallow aquifer	Background 2
PW#2	Drinking water	Production Well #2 Supply
PW#3	Drinking water	Production Well #3 Supply
CW#1	Drinking water	Construction Well West Supply
CW#2	Drinking water	Construction Well East Supply
FRW	Drinking water	Firing Range Well Supply
SW-1	N/A	Background 3 Service Water Pond
East YD	N/A	Plant outfall East Yard Drain
SE YD	N/A	Plant outfall Southeast Yard Drain





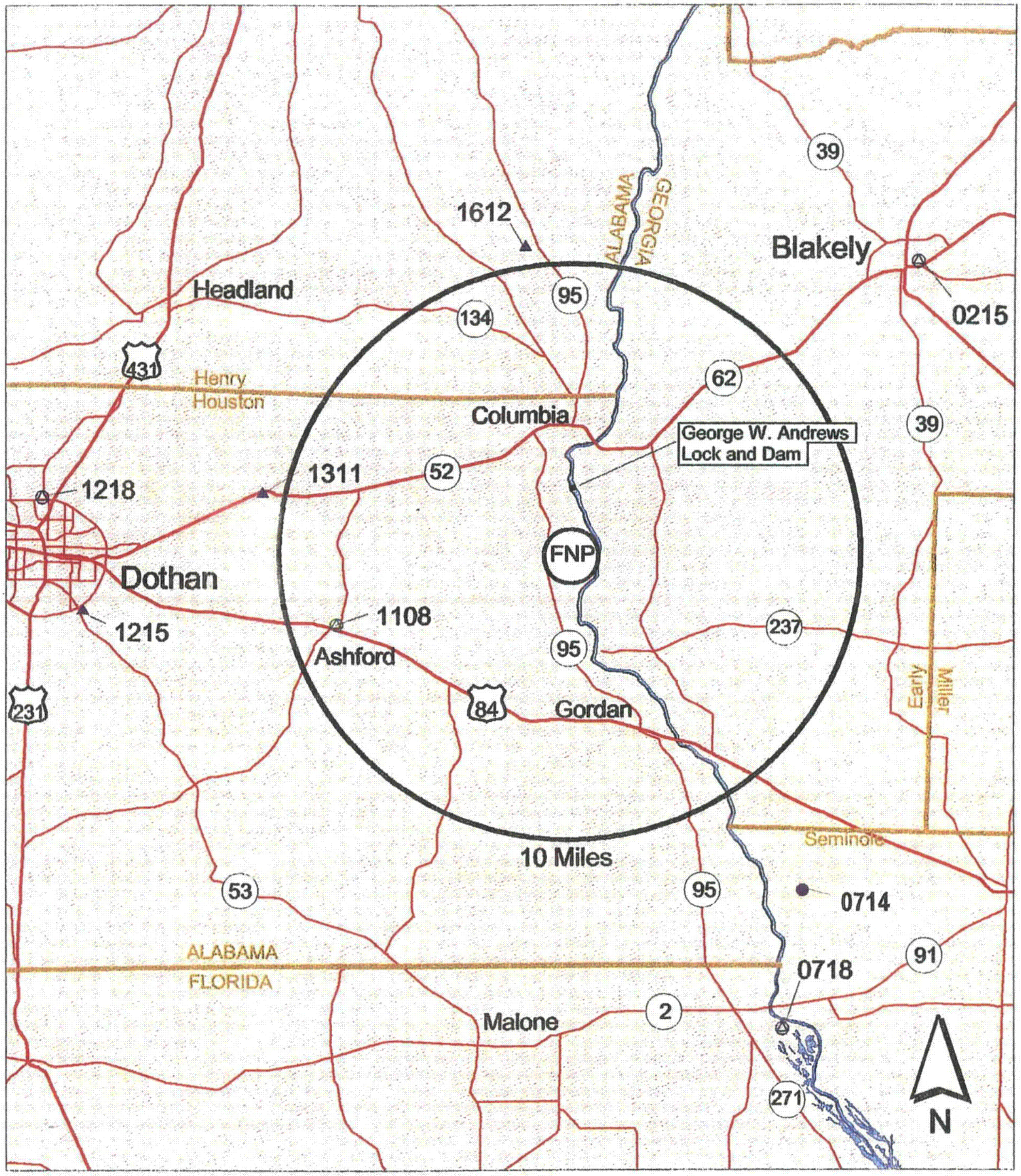
REMP Stations Near the Plant Perimeter

Figure 2-1



REMP Stations 2 to 5 Miles From the Plant

Figure 2-2



Radiological Environmental Sampling Locations

	Indicator	Control	Community
TLD	▲	▲	▲
Other	●	●	●
TLD & Other	◬	◬	◬

REMP Stations Beyond 5 Miles From the Plant

Figure 2-3

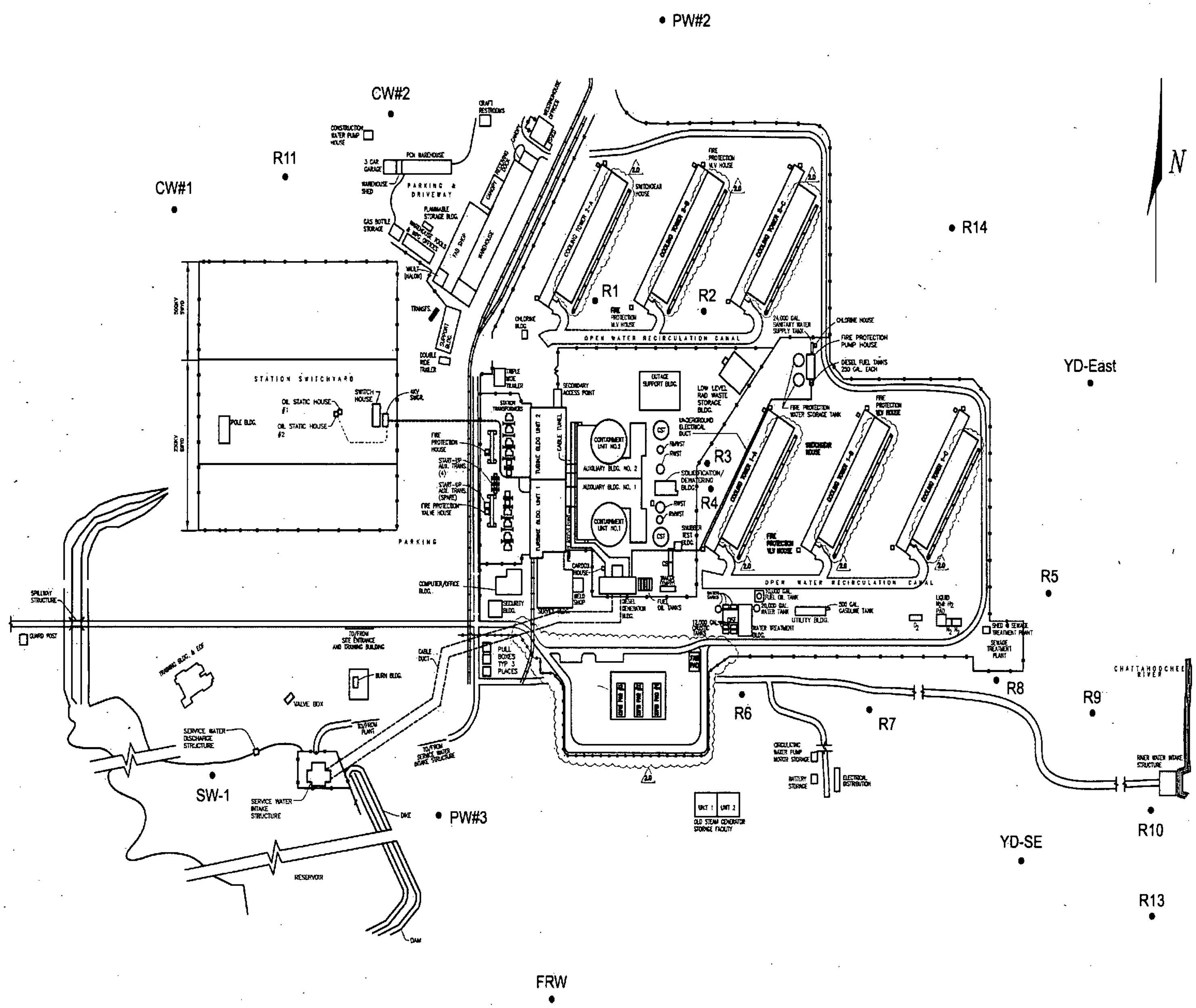


Figure 2-4 Onsite Groundwater Monitoring Location

2-13

3.0 RESULTS SUMMARY

In accordance with ODCM 7.1.2.1, the summarized and tabulated results for all of the regular samples collected for the year at the designated indicator, community and control stations are presented in Table 3-1. The format of Table 3-1 is similar to Table 3 of the Nuclear Regulatory Commission (NRC) Branch Technical Position, "An Acceptable Radiological Environmental Monitoring Program" Revision 1, November 1979. Results for samples collected at locations other than those listed in Table 2-1 are discussed in Section 4 under the particular sample type.

As indicated in ODCM 7.1.2.1, the results for naturally-occurring radionuclides that are also found in plant effluents must be reported along with man-made radionuclides. The radionuclide Be-7, which occurs abundantly in nature, is often detected in REMP samples. It is occasionally detected in the plant's liquid and gaseous effluents. When it is detected in effluents, it is also included in the REMP results. In 2009, Be-7 was detected in Farley's liquid effluents but not in the gaseous effluents.

TABLE 3-1 (SHEET 1 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean Name Distance & Direction	 Mean (b), Range (Fraction)	Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
Airborne Particulates (fCi/m3)	Gross Beta 465	10	16.2 3.0-34.5 (205/205)	PC-0703 Paper Mill 3 miles, SSE	20.1 7.3-37.0 (52/52)	17.3 5.6-37.0 (156/156)	16.3 6.3-36.3 (104/104)
	Gamma Isotopic 36						
	I-131	70	NDM(c) (0/16)	NA(d)		NDM (0/12)	NDM (0/8)
	Cs-134	50	NDM (0/16)	NA		NDM (0/12)	NDM (0/8)
	Cs-137	60	NDM (0/16)	NA		NDM (0/12)	NDM (0/8)
Airborne Radioiodine (fCi/m3)	I-131 361	70	NDM (0/205)	NA		NDM (0/52)	NDM (0/104)
Direct Radiation (mR/91 days)	Gamma Dose 159	NA	15.2 11.5-22.2 (63/63)	RI-0401 Plt. Perimeter 0.8 miles, E	21.9 21.5-22.2 (4/4)	12.8 10.2-16.0 (72/72)	13.6 10.6-17.2 (24/24)
Milk (pCi/l)	Gamma Isotopic 26						
	Cs-134	15	NA	NA		NA	NDM (0/26)
	Cs-137	18	NA	NA		NA	NDM (0/26)
	Ba-140	60	NA	NA		NA	NDM (0/26)
	La-140	15	NA	NA		NA	NDM (0/26)
	I-131 26	1	NA	NA		NA	NDM (0/26)

TABLE 3-1 (SHEET 2 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
Forage (pCi/kg wet)	Gamma Isotopic 39						
	I-131	60	NDM (0/26)	NA		NA	NDM (0/13)
	Cs-134	60	NDM (0/26)	NA		NA	NDM (0/13)
	Cs-137	80	NDM (0/26)	NA		NA	NDM (0/13)
Offsite Ground Water (g) (pCi/l)	H-3 8	2000	474 444-503 (2/4)	WGI-07 Paper Mill 4 miles, SSE	474 444-503 (2/4)	NA	401 255-547 (2/4)
	I-131 8	1	NDM (0/4)	NA		NA	NDM (0/4)
	Gamma Isotopic 8						
	Mn-54	15	NDM (0/4)	NA		NA	NDM (0/4)
	Fe-59	30	NDM (0/4)	NA		NA	NDM (0/4)
	Co-58	15	NDM (0/4)	NA		NA	NDM (0/4)
	Co-60	15	NDM (0/4)	NA		NA	NDM (0/4)
	Zn-65	30	NDM (0/4)	NA		NA	NDM (0/4)
	Zr-95	30	NDM (0/4)	NA		NA	NDM (0/4)
	Nb-95	15	NDM (0/4)	NA		NA	NDM (0/4)

TABLE 3-1 (SHEET 3 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY
Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
	Cs-134	15	NDM (0/4)	NA		NA	NDM (0/4)
	Cs-137	18	NDM (0/4)	NA		NA	NDM (0/4)
	Ba-140	60	NDM (0/4)	NA		NA	NDM (0/4)
	La-140	15	NDM (0/4)	NA		NA	NDM (0/4)
Surface Water (pCi/l)	H-3 8	3000	343 (1/4)	Ga Pacific Paper Mill RM 40	343 (1/4)	NA	NDM (0/4)
	Gamma Isotopic 26						
	Be-7	124 (e)	NDM (0/13)	NA		NA	NDM (0/13)
	Mn-54	15	NDM (0/13)	NA		NA	NDM (0/13)
	Fe-59	30	NDM (0/13)	NA		NA	NDM (0/13)
	Co-58	15	NDM (0/13)	NA		NA	NDM (0/13)
	Co-60	15	NDM (0/13)	NA		NA	NDM (0/13)
	Zn-65	30	NDM (0/13)	NA		NA	NDM (0/13)
	Zr-95	30	NDM (0/13)	NA		NA	NDM (0/13)
	Nb-95	15	NDM (0/13)	NA		NA	NDM (0/13)

TABLE 3-1 (SHEET 4 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean: Name Distance & Direction	Location with the Highest Annual Mean: Mean (b), Range (Fraction)	Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
	I-131	15 (f)	NDM (0/13)	NA		NA	NDM (0/13)
	Cs-134	15	NDM (0/13)	NA		NA	NDM (0/13)
	Cs-137	18	NDM (0/13)	NA		NA	NDM (0/13)
	Ba-140	60	NDM (0/13)	NA		NA	NDM (0/13)
	La-140	15	NDM (0/13)	NA		NA	NDM (0/13)
Bottom Feeding Fish (pCi/kg wet)	Gamma Isotopic 4						
	Be-7	655 (e)	NDM (0/2)	NA		NA	NDM (0/2)
	Mn-54	130	NDM (0/2)	NA		NA	NDM (0/2)
	Fe-59	260	NDM (0/2)	NA		NA	NDM (0/2)
	Co-58	130	NDM (0/2)	NA		NA	NDM (0/2)
	Co-60	130	NDM (0/2)	NA		NA	NDM (0/2)
	Zn-65	260	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-134	130	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-137	150	8.4 (1/2)	Upstream, at Andrews Dam (RM 48)	21.9 (1/2)	NA	21.9 (1/2)

TABLE 3-1 (SHEET 5 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Minimum Detectable Concentration (MDC) (a)	Indicator Locations Mean (b), Range (Fraction)	Location with the Highest Annual Mean		Community Locations Mean (b), Range (Fraction)	Control Locations Mean(b), Range (Fraction)
				Name Distance & Direction	Mean (b), Range (Fraction)		
Game Fish (pCi/kg wet)	Gamma Isotopic 4						
	Be-7	655 (e)	NDM (0/2)	NA		NA	NDM (0/2)
	Mn-54	130	NDM (0/2)	NA		NA	NDM (0/2)
	Fe-59	260	NDM (0/2)	NA		NA	NDM (0/2)
	Co-58	130	NDM (0/2)	NA		NA	NDM (0/2)
	Co-60	130	NDM (0/2)	NA		NA	NDM (0/2)
	Zn-65	260	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-134	130	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-137	150	24.9 15.7-34.2 (2/2)	Downstream, near Smith's Bend (RM 41)	24.9 15.7-34.2 (2/2)	NA	12.5 (1/2)
River Shoreline Sediment (pCi/kg dry)	Gamma Isotopic 4						
	Be-7	655 (e)	72.8 (1/2)	Downstream, near Smith's Bend (RM 41)	72.8 (1/2)	NA	NDM (0/2)
	Cs-134	150	NDM (0/2)	NA		NA	NDM (0/2)
	Cs-137	180	NDM (0/2)	Upstream, at Andrews Dam (RM 48)	24.4 (1/2)	NA	24.4 (1/2)

TABLE 3-1 (SHEET 6 of 6)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY

Farley Nuclear Plant, Docket Nos. 50-348 and 50-364
Houston County, Alabama

NOTATIONS

a. The MDC is defined in ODCM 10.1. Except as noted otherwise, the values listed in this column are the detection capabilities required by ODCM Table 4-3 (Table 4-1 of this report). The values listed in this column are a priori (before the fact) MDCs. In practice, the a posteriori (after the fact) MDCs are generally lower than the values listed. Any a posteriori MDC greater than the value listed in this column is discussed in Section 4.

b. Mean and range are based upon detectable measurements only. The fraction of all measurements at a specified location that are detectable is placed in parentheses.

c. No Detectable Measurement(s).

d. Not Applicable.

e. The EL has determined that this value may be routinely attained under normal conditions. No value is provided in Table 4-1 of this report.

f. If a drinking water pathway exists, a value of 1 pCi/l would be used. See note b of Table 4-1 of this report.

g. Onsite groundwater results are discussed in Section 4.6.

4.0 DISCUSSION OF RESULTS

Included in this section are evaluations of the laboratory results for the various sample types. Comparisons were made between the difference in mean values for pairs of station groups (e.g., indicator and control stations, or, community and control stations) and the calculated Minimum Detectable Difference (MDD) between these pairs, at the 99% Confidence Level (CL). The MDD was determined using the standard Student's t-test. A difference in the mean values which was less than the MDD was considered to be statistically indiscernible.

The 2009 results were compared with past results, including those obtained during preoperation. As appropriate, results were compared with their Minimum Detectable Concentrations (MDC) and Reporting Levels (RL) which are listed in Tables 4-1 and 4-2 of this report, respectively. The required MDCs were achieved during laboratory sample analysis. Any anomalous results are explained within this report.

Results of interest are graphed to show historical trends. The data points are tabulated and included in this report. The points plotted and provided in the tables represent mean values of only detectable results. Periods for which no detectable measurements (NDM) were observed, or periods for which values were not applicable (e.g., milk indicator, etc.), are plotted as 0's and listed in the tables as NDM.

Table 4-1

Minimum Detectable Concentrations (MDC)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg) wet	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg) wet	Sediment (pCi/kg) dry
Gross Beta	4	10				
H-3	2000 (a)					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1 (b)	70		1	60	
Cs-134	15	50	130	15	60	150
Cs-137	18	60	150	18	80	180
Ba-140	60			60		
La-140	15			15		

(a) If no drinking water pathway exists, a value of 3000 pCi/l may be used.

(b) If no drinking water pathway exists, a value of 15 pCi/l may be used.

Table 4-2

Reporting Levels (RL)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (fCi/m3)	Fish (pCi/kg) wet	Milk (pCi/l)	Grass or Leafy Vegetation (pCi/kg) wet
H-3	20,000 (a)				
Mn-54	1000		30,000		
Fe-59	400		10,000		
Co-58	1000		30,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-95	400				
Nb-95	700				
I-131	2 (b)	900		3	100
Cs-134	30	10,000	1000	60	1000
Cs-137	50	20,000	2000	70	2000
Ba-140	200			300	
La-140	100			400	

(a) This is the 40 CFR 141 value for drinking water samples. If no drinking water pathway exists, a value of 30,000 may be used.

(b) If no drinking water pathway exists, a value of 20 pCi/l may be used.

Atmospheric nuclear weapons tests from the mid 1940's through 1980 distributed man-made nuclides around the world. The most recent atmospheric tests in the 1970's and in 1980 had a significant impact upon the radiological concentrations found in the environment prior to and during preoperation, and the earlier years of operation. Some long-lived radionuclides, such as Cs-137, continue to have some impact.

Significant upward trends also followed the Chernobyl incident, which began on April 26, 1986.

In accordance with ODCM 4.1.1.2.1, deviations from the required sampling schedule are permitted if samples are unobtainable due to hazardous conditions, unavailability, inclement weather, equipment malfunction or other just reasons. Deviations from conducting the REMP as described in Table 2-1 are summarized in Table 4-3 along with their causes and resolutions.

All results were tested for conformance with Chauvenet's criterion (G. D. Chase and J. L. Rabinowitz, Principles of Radioisotope Methodology, Burgess Publishing Company, 1962, pages 87-90) to identify values which differed from the mean of a set by a statistically significant amount. Identified outliers were investigated to determine the reason(s) for the variation. If equipment malfunction or other valid physical reasons were identified as causing the variation, the anomalous result was excluded from the data set as non-representative. No data were excluded exclusively for failing Chauvenet's criterion. Data exclusions are discussed in this section under the appropriate sample type.

TABLE 4-3 (SHEET 2 of 2)

DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLE(S)	DEVIATION	CAUSE	RESOLUTION
2nd Quarter CR2009108139	Groundwater Monitoring Well R-2	Not sampled	Flooding in area – unable to access well	Will consider modifications to well or relocating well if flooding is a recurring problem
05/19/09-05/26/09 CR2009106938	PB-0215/IB-0215 Blakely, GA	Non-representative sample of airborne particulates	Power loss due to inclement weather; sample time short about 2 hours	Station operation satisfactory after power restored
08/18/09-08/25/09 CR2009110637 EXCLUDED	PI-0701/II-0701 South Perimeter	Non-representative sample of airborne particulates; not enough volume collected to meet MDC	Sample pump found not running; circuit breaker would not reset; work order initiated	Station operation satisfactory after maintenance performed
3rd Quarter CR2009113255 EXCLUDED	TLD Stations RC-1404A and RI-0201A	TLDs rendered suspect by presence of moisture in bag	Moisture / rain water entered holding bag; both TLDs had >1.4 SD and were excluded	Replaced TLDs at beginning of quarter
10/20/09-10/27/09 CR2009112939	PI-1101/II-1101 Plant Entrance	Non-representative sample of airborne particulates	Sample station lost power for approximately 2 hours while work order 1063407901 was performed	Station operation satisfactory after maintenance performed
10/20/09-10/27/09 CR2009112931	PB-0215/IB-0215 Blakely, GA	Non-representative sample of airborne particulates	Damage to filter noted at changeout	Replaced filter at beginning of weekly sampling period
11/10/09-11/17/09 CR2009113842 EXCLUDED	PI-1601/II-1601 North Perimeter	Non-representative sample of airborne particulates; did not meet MDC	Sample pump found not running; when circuit breaker reset, pump ran satisfactorily; potentially weather related	Station operation satisfactory after power restored
12/01/09-12/29/09 CR2009114920	WRB Andrews Dam	Non-representative monthly river water composite	ISCO sampler had to be taken out of service due to high river water level; one weekly sample (12/15-12/21) missed of the monthly composite sample	ISCO continuous river water sampling restored when water level decreased; other 3 weeks of sample used for monthly composite sample

TABLE 4-3 (SHEET 1 of 2)

DEVIATIONS FROM RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

COLLECTION PERIOD	AFFECTED SAMPLE(S)	DEVIATION	CAUSE	RESOLUTION
02/10/09-02/17/09 CR2009101892	PI-0501/II-0501 River Water Intake Structure	Non-representative sample of airborne particulates	Power tagged out @0530 on 02/16/09 for maintenance at river water intake structure; sample time short approximately 30.5 hours	Station operation satisfactory after power restored
02/17/09-02/24/09 CR2009101892	PI-0501/II-0501 River Water Intake Structure	Non-representative sample of airborne particulates	Power tagged out @0530 on 02/16/09 for maintenance at river water intake structure; sample time short approximately 42.5 hours	Station operation satisfactory after power restored
1st Quarter	TLD Station RB-1612 N @ 12 miles	TLDs rendered suspect by presence of water in bag	Moisture / rain water entered holding bag	Replaced TLDs at beginning of quarter
03/24/09-03/31/09 CR2009103480	PI-0701/II-0701 South Perimeter	Non-representative sample of airborne particulates	Sample time short approximately 6 hours; possibly weather related	Station operation satisfactory at sample collection time
03/30/09-04/21/09 CR2009103388	WRB Andrews Dam	Non-representative monthly river water composite	ISCO sampler had to be taken out of service due to high river water level; one weekly sample (03/30-04/07) was a grab rather than a composite sample	ISCO continuous river water sampling restored when water level decreased
03/31/09-04/07/09 CR2009103944 and CR2009105175 EXCLUDED	PI-0701/II-0701 South Perimeter	Non-representative sample of airborne particulates; not enough volume collected to meet MDC	Sample pump found not running; circuit breaker would not reset; work order initiated; sample time short approximately 124 hours	Station operation satisfactory after maintenance performed
2nd Quarter CR2009108199 EXCLUDED	TLD Station RI-1401 NW @ 1.1 mile	Non-representative direct radiation monitoring duration; only 44 days on station	TLD packet was attached to utility pole which was removed by Centurytel; TLDs were recovered and sent for analysis; 1401A was excluded because the results had >1.4 SD (and was wet) and 1401B failed Chauvenet's Criterion	TLDs were placed in service on new pole at beginning of 3rd Quarter

4.1 Land Use Census

In accordance with ODCM 4.1.2, a land use census was conducted during the month of December 2009. The land use census is used to determine the locations of the nearest permanent residence and milk animal in each of the 16 compass sectors within a distance of 5 miles. A milk animal is a cow or goat producing milk for human consumption. The 2009 survey revealed no significant changes from the 2008 survey. No milk animals were found within a 5 mile distance. The census results are tabulated in Table 4.1-1.

Table 4.1-1

LAND USE CENSUS RESULTS

Distance in Miles to the Nearest Location in Each Sector

SECTOR	RESIDENCE	MILK ANIMAL
N	2.6	none
NNE	2.5	none
NE	2.4	none
ENE	2.4	none
E	2.8	none
ESE	3.0	none
SE	3.4	none
SSE	>5	none
S	4.3	none
SSW	2.9	none
SW	1.2	none
WSW	2.4	none
W	1.3	none
WNW	2.1	none
NW	1.5	none
NNW	3.4	none

The Houston County, Alabama and the Early County, Georgia Extension Agents were contacted for assistance in locating commercial dairy farms and privately owned milk animals within 5 miles of the plant. A list of commercial dairy farms in Houston County, AL and Seminole County, GA was provided; there are no commercial dairy farms in Early County. Neither agent knew of privately owned milk animals within 5 miles of FNP. In addition, field surveys were conducted in the plant vicinity along the state and county highways and the interconnecting secondary roads. No milk animals were found within 5 miles of the plant.

ODCM 4.1.2.2.1 requires a new controlling receptor to be determined, if the land use census identifies a location that yields a calculated receptor dose greater than the one in current use. Neither current sampling locations nor the controlling receptor were affected by the 2009 land use census results. The current controlling receptor as described in ODCM Table 3-7 remains a child in the SW Sector at 1.2 miles.

4.2 Airborne

As specified in Table 2-1 and shown in Figures 4.2-1 and 4.2-2, airborne particulate filters and charcoal canisters are collected weekly at 4 indicator, 3 control and 3 community stations. Particulate filters are collected at all of the stations while the charcoal canisters are collected at all but 2 of the community stations. At each location, air is continuously drawn through a glass fiber filter to retain airborne particulates and, as appropriate, an activated charcoal canister is placed in series to adsorb radioiodine.

Each particulate filter is counted for gross beta activity. A quarterly gamma isotopic analysis is performed on a composite of the air particulate filters for each station. Each charcoal canister is analyzed for I-131.

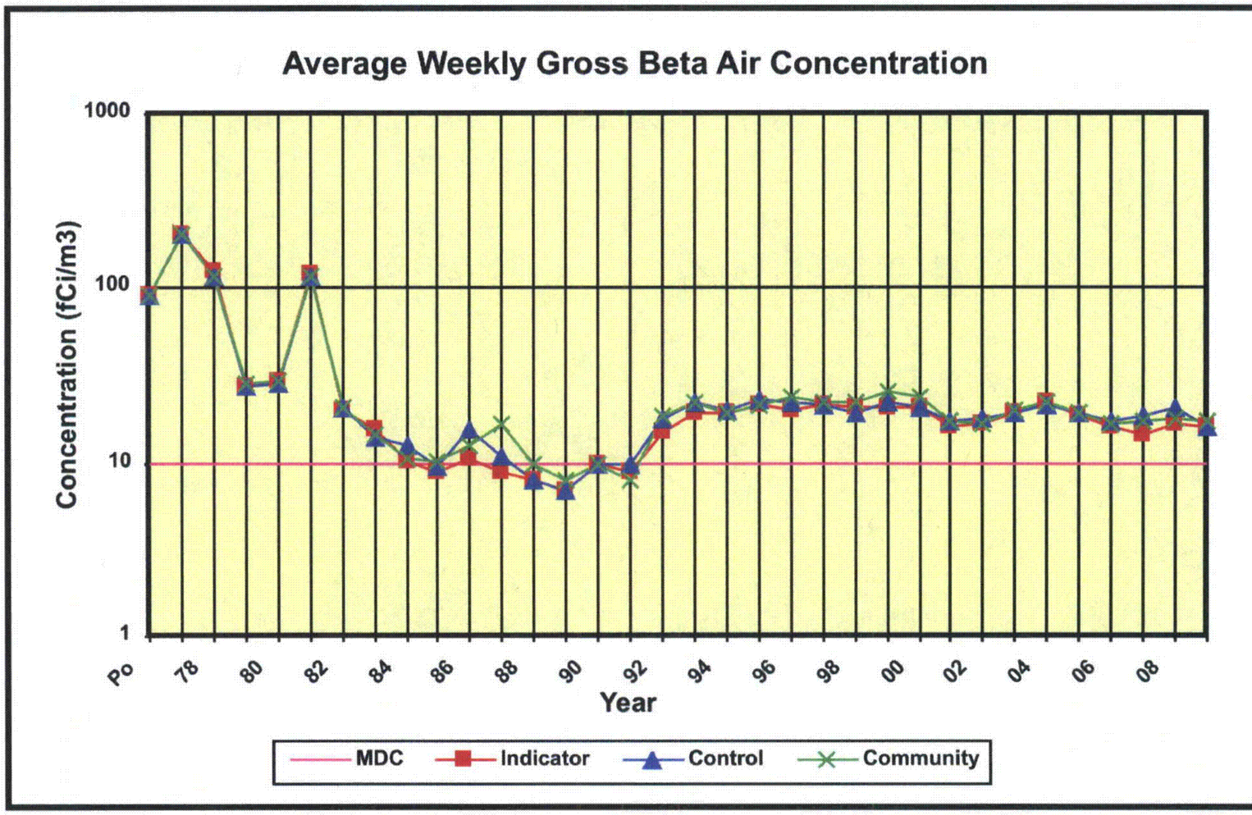
As provided in Table 3-1, the 2009 annual average weekly gross beta activity was 16.2 fCi/m^3 at the indicator stations and 16.3 fCi/m^3 at the control stations. The difference of 0.1 fCi/m^3 between the two averages is not statistically discernible since the MDD for these two average values is 1.6 fCi/m^3. The trend over the years has shown close agreement between the control, community, and indicator stations, and in most years (including pre-op), the indicator station gross beta average activity was lower than the control and community annual averages.

As shown in Table 3-1, the 2009 annual average weekly gross beta concentration was 17.3 fCi/m^3 at community stations. The community stations average was 1.0 fCi/m^3 less than the average for the control stations. The difference is not statistically discernible since it is less than the MDD of 1.8 fCi/m^3 between the two averages.

Due to the weapons tests during preoperation and the early years of operation, the average gross beta concentrations were 5 to 10 times greater than those currently being measured. By the mid 1980s, the readings had diminished to about half the current levels. These annual averages approximately doubled as a consequence of the Chernobyl incident in 1986; this impact faded away in approximately 2 years. The installation of new air monitoring equipment in 1992 yielded an approximate factor of 2 increase in the readings. Since then, the levels have been fairly flat.

The historical trending of the average weekly gross beta air concentrations for each year of operation and the preoperational period at the indicator, control and community stations is plotted in Figure 4.2-1 and listed in Table 4.2-1. In general, there is close agreement between the results for the indicator, control and community stations. This close agreement supports the position that the plant's contribution to gross beta concentration in air is insignificant.

Figure 4.2-1



Average Weekly Gross Beta Air Concentration
1000
100
10
1
Concentration (fCi/m3)
Po
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Year
MDC
Indicator
Control
Community

Table 4.2-1

Average Weekly Gross Beta Air Concentration

Period	Indicator (fCi/m3)	Control (fCi/m3)	Community (fCi/m3)
Pre-op	90	92	91
1977	205	206	206
1978	125	115	115
1979	27.3	27.3	28.7
1980	29.7	28.1	29.2
1981	121	115	115
1982	20.0	20.4	21.0
1983	15.5	14.1	14.5
1984	10.2	12.6	10.5
1985	9.0	9.6	10.3
1986	10.5	15.8	12.5
1987	9.0	11.0	17.0
1988	8.0	8.0	10.0
1989	7.0	7.0	8.0
1990	10.0	10.0	10.0
1991	9.0	10.0	8.0
1992	15.0	17.9	18.5
1993	19.1	22.3	22.4
1994	19.0	20.0	19.0
1995	21.7	22.9	21.6
1996	20.3	22.3	23.5
1997	21.1	21.6	22.4
1998	20.6	19.3	22.0
1999	20.5	22.1	25.2
2000	20.9	20.8	23.6
2001	16.3	17.2	17.3
2002	16.8	18.0	16.8
2003	19.1	19.3	19.9
2004	22.0	21.3	22.4
2005	18.4	19.3	19.0
2006	16.1	17.5	16.8
2007	14.5	18.9	17.3
2008	16.7	20.6	18.0
2009	16.2	16.3	17.3

During 2009, no man-made radionuclides were detected from the gamma isotopic analysis of the quarterly composites of the air particulate filters. This has generally been the case since the impact of the weapons tests and the Chernobyl incident have faded. During preoperation and the early years of operation, a number of fission and activation products were detected. During preoperation, the average levels for Cs-134 and Cs-137 were 22 and 9 fCi/m^3, respectively. In 1986, as a consequence of the Chernobyl incident, Cs-134 and Cs-137 levels of 3 to 4 fCi/m^3 were found. The MDC and RL for Cs-134 are 50 and 10,000 fCi/m^3 and the MDC and RL for Cs-137 are 60 and 20,000 fCi/m^3 respectively.

The historical trending of the annual detectable Cs-137 concentrations for the indicator, control and community stations is provided in Figure 4.2-2 and Table 4.2-2. The trend has been generally downward since preoperation and no positive results have been observed since 1988.

Figure 4.2-2

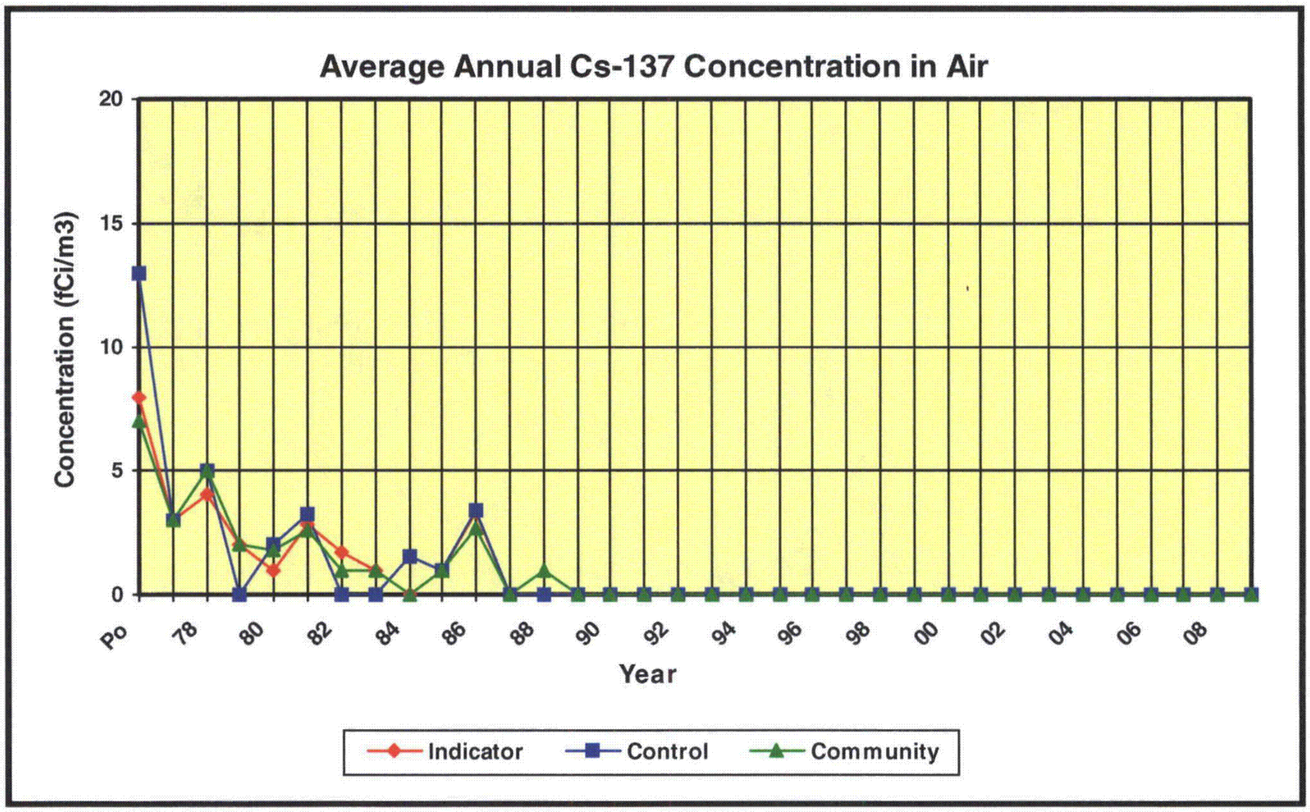


Table 4.2-2

Average Annual Cs-137 Concentration in Air

Period	Indicator (fCi/m3)	Control (fCi/m3)	Community (fCi/m3)
Pre-op	8	13	7
1977	3.0	3.0	3.0
1978	4.0	5.0	5.0
1979	2.0	NDM	2.0
1980	1.0	2.0	1.8
1981	2.8	3.2	2.6
1982	1.7	NDM	1.0
1983	1.0	NDM	1.0
1984	NDM	1.5	NDM
1985	1.0	1.0	1.0
1986	3.3	3.4	2.7
1987	NDM	NDM	NDM
1988	NDM	NDM	1
1989	NDM	NDM	NDM
1990	NDM	NDM	NDM
1991	NDM	NDM	NDM
1992	NDM	NDM	NDM
1993	NDM	NDM	NDM
1994	NDM	NDM	NDM
1995	NDM	NDM	NDM
1996	NDM	NDM	NDM
1997	NDM	NDM	NDM
1998	NDM	NDM	NDM
1999	NDM	NDM	NDM
2000	NDM	NDM	NDM
2001	NDM	NDM	NDM
2002	NDM	NDM	NDM
2003	NDM	NDM	NDM
2004	NDM	NDM	NDM
2005	NDM	NDM	NDM
2006	NDM	NDM	NDM
2007	NDM	NDM	NDM
2008	NDM	NDM	NDM
2009	NDM	NDM	NDM

Airborne I-131 was not detected in the charcoal canisters during 2009. In 1978, levels between 40 and 50 fCi/m^3 were found in a few samples and attributed to the Chinese weapons tests; then after the Chernobyl incident, levels up to a few hundred fCi/m^3 were found in some samples. At no other times has airborne I-131 been detected in the environmental samples. The MDC and RL for airborne I-131 are 70 and 900 fCi/m3 respectively.

Table 4-3 lists REMP deviations that occurred during 2009. There were nine air sampling deviations listed in Table 4-3, six results passed Chauvenet's Criterion and the data was retained in the calculation of the mean values. Three air sample results were excluded because they failed to meet the MDC. Low sample volumes were collected during those three weeks due to equipment malfunctions.

4.3 Direct Radiation

Direct (external) radiation is measured with thermoluminescent dosimeters (TLDs). Two Panasonic UD-814 TLD badges are placed at each station. Each badge contains three phosphors composed of calcium sulfate crystals (with thulium impurity). The gamma dose at each station is based upon the average readings of the phosphors from the two badges. The two badges for each station are placed in thin plastic bags for protection from moisture while in the field. The badges are nominally exposed for periods of a quarter of a year (91 days). An inspection is performed near mid-quarter for offsite badges to assure that the badges are on-station and to replace any missing or damaged badges.

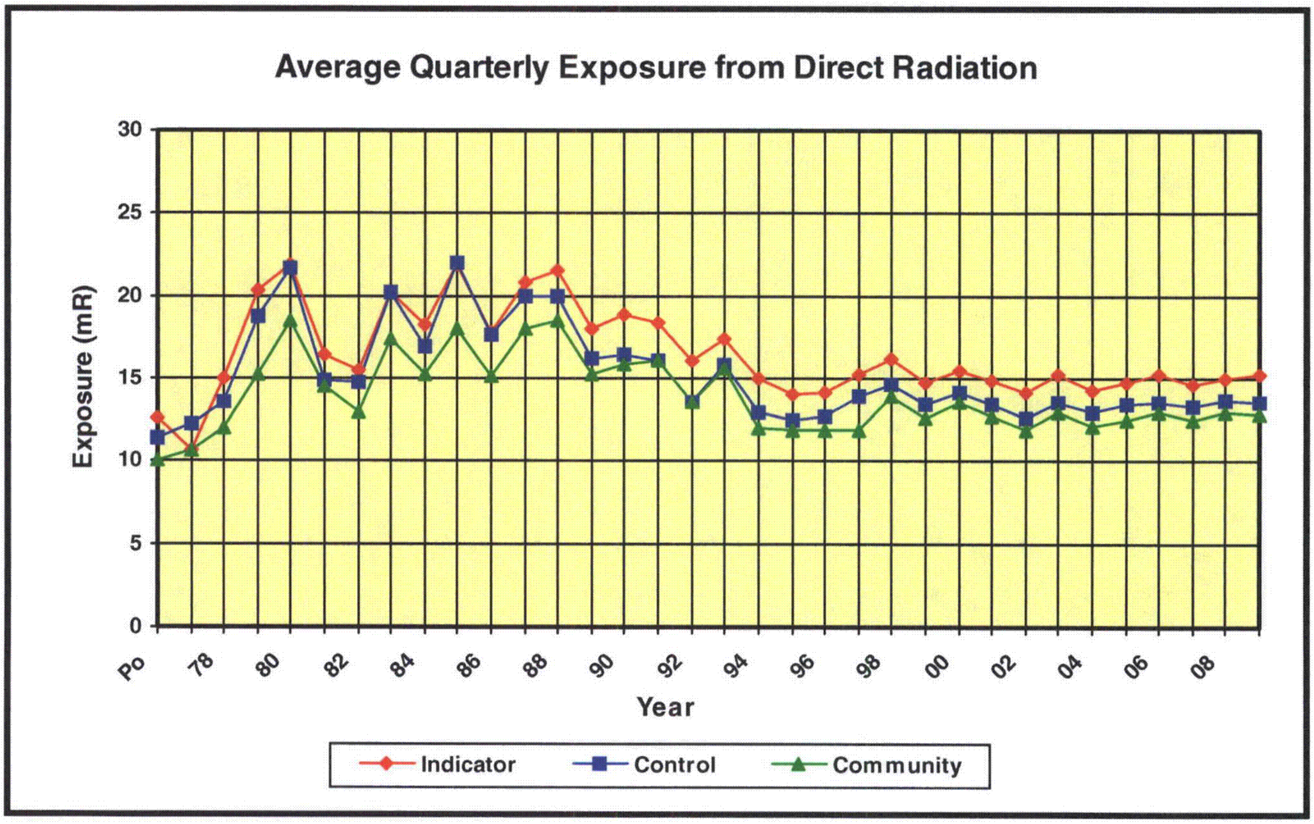
Two TLD stations are established in each of the 16 sectors, to form 2 concentric rings. The inner ring stations are located near the plant perimeter, as shown in Figure 2-1, and the outer ring stations are located at distances of approximately 3 to 5 miles from the plant, as shown in Figure 2-2. The stations forming the inner ring are designated as the indicator stations. The 6 control stations are located at distances greater than 10 miles from the plant, as shown in Figure 2-3. Stations are also provided which monitor special interest areas: the nearest occupied residence (SW at 1.2 miles), as shown in Figure 2-1, and the city of Ashford (WSW at 8 miles), as shown in Figure 2-3. The 16 outer ring stations and the 2 special interest stations are designated as community stations.

As provided in Table 3-1, the average quarterly exposure measured at the indicator stations (inner ring) during 2009 was 15.2 mR which was 1.6 mR greater than the 13.6 mR which was acquired at the control stations. This difference is statistically discernible since it is greater than the MDD of 1.4 mR. The difference of 0.82 mR found between the control stations (12.8 mR) and community stations (13.6 mR) is not statistically discernible since the difference is less than the MDD of 0.84 mR. The difference between the indicator and control and between the control and community stations is consistent with what has been seen in previous years.

The historical trending of the average quarterly exposures in units of mR at the indicator, control, and community locations are plotted in Figure 4.3-1 and listed in Table 4.3-1. During preoperation the average exposure at the indicator stations was 1.2 mR greater than that for the control stations, but the average over the entire period of operation was only 1.1 mR greater. During preoperation, the average exposure at the control stations was 1.3 mR greater than that at the community stations and the average over the period of operation is 1.5 mR greater. This supports the position that the plant is not contributing significantly to direct radiation in the environment.

Table 4-3 lists the REMP program deviations that occurred in 2009. There were three deviations involving TLD badges. In first quarter, RB-1612 TLDs had moisture in the holding bags, but the results passed Chauvenet's Criterion and were retained in the data set. In second quarter, RI-1401A TLD was wet in the holding bag. The results from the "A" badge failed Chauvenet's Criterion and RI-1401B had >1.4 SD; therefore both badges from 1401 were excluded. In third quarter, RC-1401A and RI-0201A were wet in the holding bag. The results from both of these TLDs were >1.4 SD therefore both were excluded from the data set.

Figure 4.3-1



Average Quarterly Exposure from Direct Radiation
30
25
20
15
10
5
0
Exposure (mR)
Po
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Year
Indicator
Control
Community

Table 4.3-1

Average Quarterly Exposure from Direct Radiation

Period	Indicator (mR)	Control (mR)	Community (mR)
Pre-op	12.6	11.4	10.1
1977	10.6	12.2	10.6
1978	15.0	13.5	12.0
1979	20.3	18.7	15.2
1980	21.9	21.6	18.5
1981	16.5	14.9	14.5
1982	15.5	14.7	13.0
1983	20.2	20.2	17.4
1984	18.3	16.9	15.3
1985	21.9	22.0	18.0
1986	17.8	17.7	15.1
1987	20.8	20.0	18.0
1988	21.5	19.9	18.5
1989	18.0	16.2	15.3
1990	18.9	16.4	15.8
1991	18.4	16.1	16.1
1992	16.1	13.6	13.5
1993	17.4	15.9	15.6
1994	15.0	13.0	12.0
1995	14.0	12.5	11.8
1996	14.2	12.7	11.9
1997	15.3	13.9	11.9
1998	16.2	14.6	13.9
1999	14.7	13.4	12.6
2000	15.5	14.1	13.5
2001	14.9	13.4	12.7
2002	14.1	12.6	11.9
2003	15.2	13.6	12.9
2004	14.3	12.9	12.1
2005	14.7	13.4	12.5
2006	15.2	13.6	12.9
2007	14.6	13.3	12.5
2008	15.0	13.7	12.9
2009	15.2	13.6	12.8

The standard deviation for the quarterly result for each badge was subjected to a self imposed limit of 1.4. This limit is calculated using a method developed by the American Society for Testing and Materials (ASTM) (ASTM Special Technical Publication 15D, ASTM Manual on Presentation of Data and Control Chart Analysis, Fourth Revision, Philadelphia, PA, October 1976). The calculation is based upon the standard deviations obtained by the EL with the Panasonic UD-814 badges during 1992. This limit serves as a flag to initiate an investigation. To be conservative, readings with a standard deviation greater than 1.4 are excluded since the high standard deviation is interpreted as an indication of unacceptable variation in TLD response.

The TLD results from the following stations were excluded from the data set because their standard deviations were greater than 1.4:

Quarter 1 – RB-0718A
Quarter 2 – RI-1401A
Quarter 3 – RC-1404A, RI-0101A, RI-0201A
Quarter 4 – None

For the TLD stations where these badges were located, only the reading of the companion badge was used to determine the quarterly exposure for the station with the exception of 2nd Qtr RI-1401. One badge was greater than 1.4 standard deviation and the other badge was excluded for failing Chauvenet's Criterion. These badges were only on station for 44 days due to the change out of a utility pole.

The badges (with >1.4 SD) were visually inspected under a microscope and the glow curve and test results for the anneal data and the element correction factors were reviewed. No reason was found for the high standard deviations.

4.4 Milk

In accordance with Table 2-1, milk samples are collected biweekly from a control location. No indicator station (a location within five miles of the plant) has been available for milk sampling since 1987. As discussed in Section 4.0, no milk animals were found within five miles of the plant during the 2009 land use census.

Gamma isotopic analyses were performed on each sample as specified in Table 2-1. No man-made radionuclides were identified from the gamma isotopic analysis of the milk samples during 2009. The MDC and RL for Cs-137 in milk are 18 and 70 pCi/l, respectively. The historical trending of the average annual detectable Cs-137 concentration in milk samples is shown in Figure 4.4-1 and Table 4.4-1. Cs-137 has not been detected in milk since 1986. Its presence at that time is attributed to the Chernobyl incident. The earlier detectable results were attributed to the weapons tests.

Figure 4.4-1

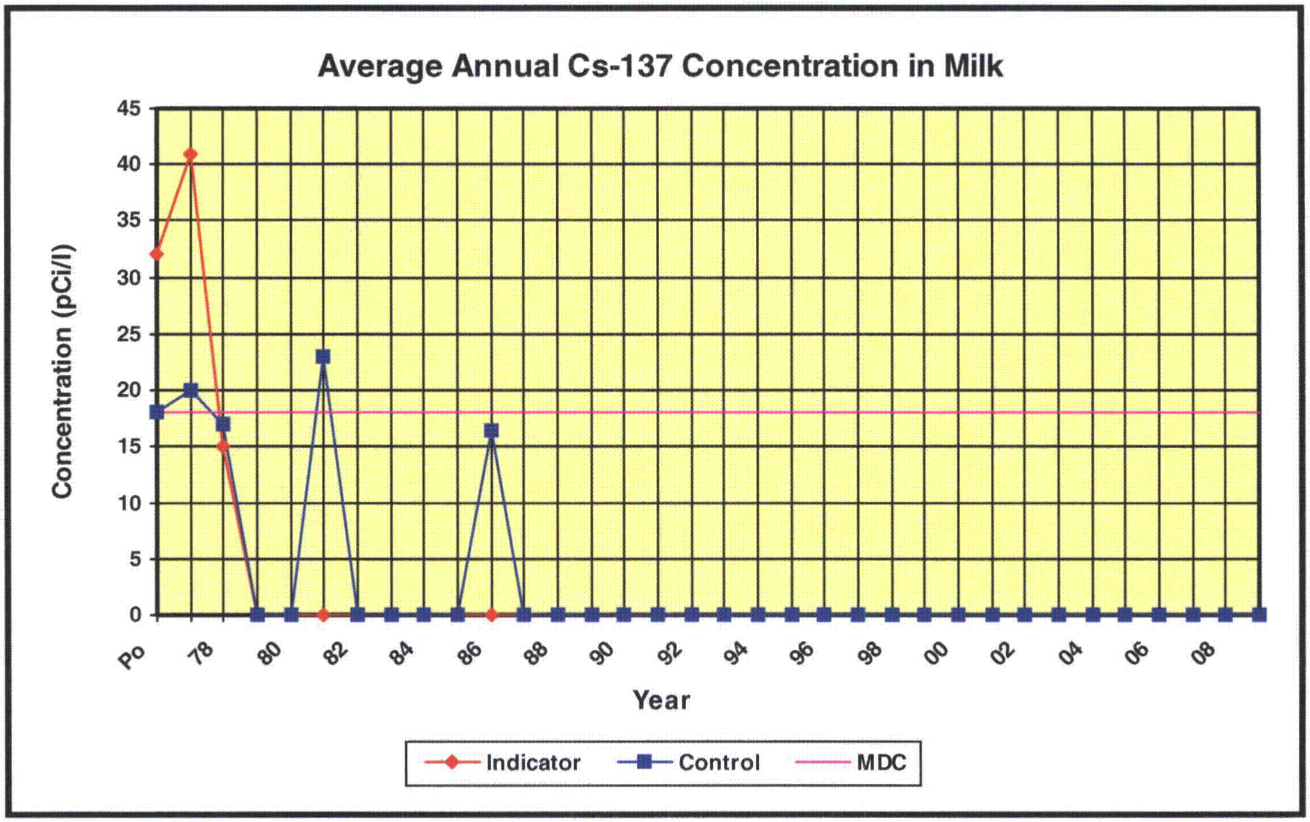


Table 4.4-1

Average Annual Cs-137 Concentration in Milk

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	32	18
1977	41	20
1978	15	17
1979	NDM	NDM
1980	NDM	NDM
1981	NDM	23.0
1982	NDM	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	NDM	16.5
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM

As specified in Table 2-1, each sample was analyzed for I-131, which has not been detected in milk since 1986. The presence of I-131 at that time is attributed to the Chernobyl incident. The earlier detectable results were attributed to the weapons tests. The MDC and RL for I-131 are 1 and 3 pCi/l, respectively. Figure 4.4-2 and Table 4.4-2 show the historical trending of the average annual detectable I-131 concentration in milk samples.

Figure 4.4-2

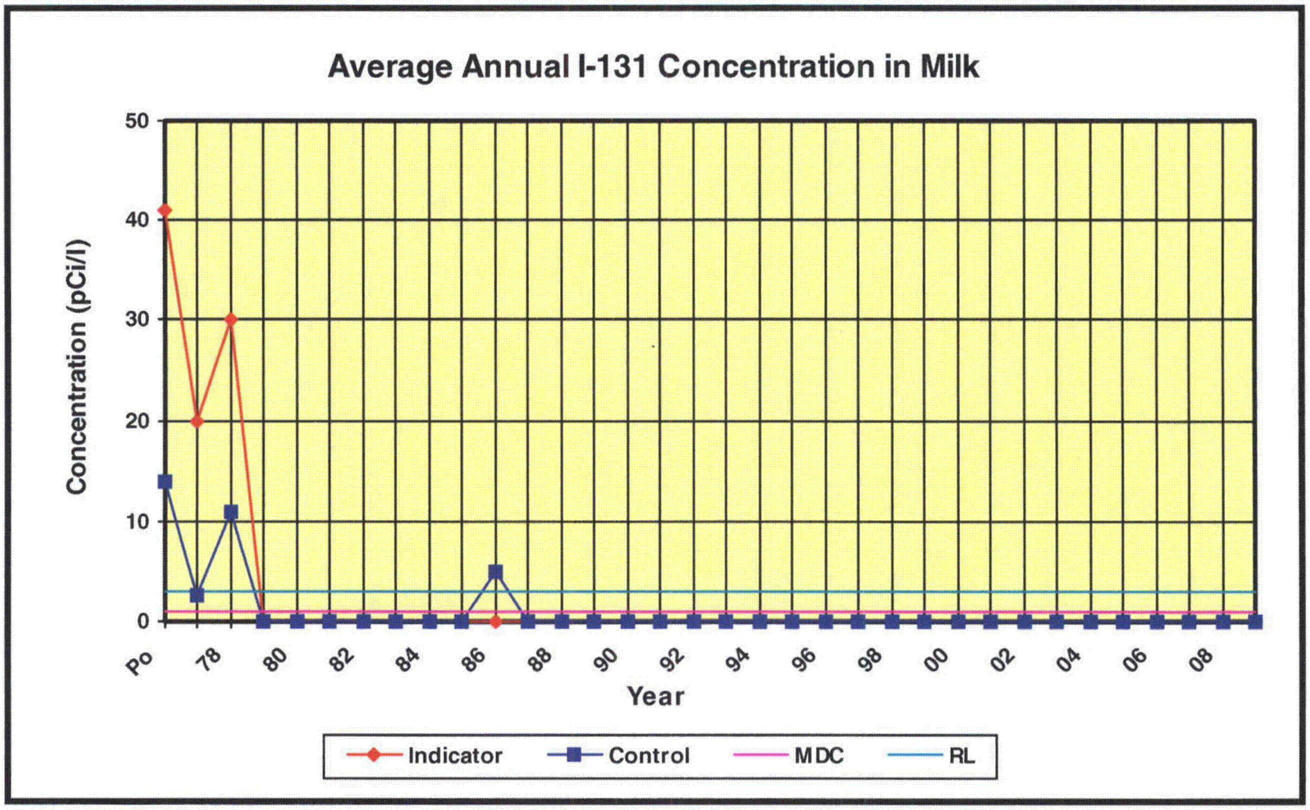


Table 4.4-2

Average Annual I-131 Concentration in Milk

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	41	14
1977	20	2.6
1978	30	11
1979	NDM	NDM
1980	NDM	NDM
1981	NDM	NDM
1982	NDM	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	NDM	5.0
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM

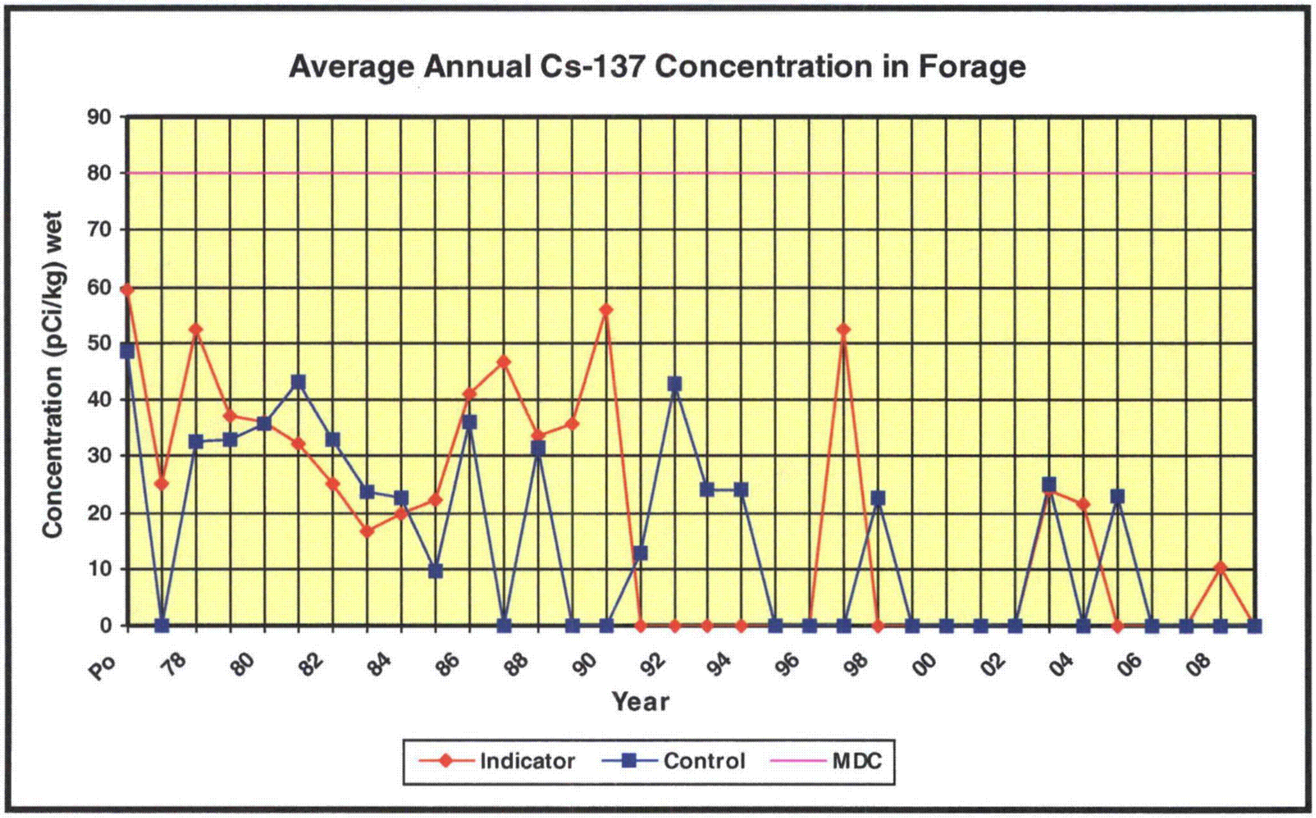
4.5 Forage

In accordance with Table 2-1, forage samples are collected every 4 weeks at two indicator stations on the plant perimeter, and at one control station located approximately 18 miles west of the plant, in Dothan. Gamma isotopic analyses are performed on each sample.

During preoperation and the years of operation through 1986 (the year of the Chernobyl incident), Cs-137 was typically found in about a third of the 35 to 40 forage samples collected per year. In 1987 and 1988 the number dropped to about a seventh of the total samples and from 1989 through 1994, it was only found in one or two samples every year. From 1994 to 2006, Cs-137 was detected in only a few samples, three indicator samples and three control samples.

In 2009, Cs-137 was not detected in any of the 13 control samples or in any of the 26 indicator samples. The occasional presence of Cs-137 in vegetation samples is attributed primarily to fallout from nuclear weapons tests and from the Chernobyl incident. The MDC and RL for Cs-137 in forage are 80 and 2000 pCi/kg wet, respectively. Table 4.5-1 presents the average detectable results of Cs-137 found in forage over the life of the plant and Figure 4.5-1 shows the historical trending of this data.

Figure 4.5-1



Average Annual Cs-137 Concentration in Forage
Concentration (pCi/kg) wet
90
80
70
60
50
40
30
20
10
0
Po
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Year
Indicator
Control
MDC

Table 4.5-1

Average Annual Cs-137 Concentration in Forage

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	59.4	48.6
1977	25.0	NDM
1978	52.5	32.5
1979	37.2	32.8
1980	36.2	35.9
1981	32.1	43.1
1982	25.0	33.1
1983	16.8	23.6
1984	19.9	22.8
1985	22.2	9.5
1986	41.2	36.2
1987	46.8	NDM
1988	33.6	31.7
1989	35.7	NDM
1990	56.0	NDM
1991	NDM	12.9
1992	NDM	43.0
1993	NDM	24.0
1994	NDM	24
1995	NDM	NDM
1996	NDM	NDM
1997	52.6	NDM
1998	NDM	22.7
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	24.1	25.2
2004	21.6	NDM
2005	NDM	23.1
2006	NDM	NDM
2007	NDM	NDM
2008	10.1	NDM
2009	NDM	NDM

During preoperation and in the early years of operation, I-131 was found in 10% to 25% of the forage samples at very high levels which ranged from around 100 to 1,000 pCi/kg wet. In 1986 (Chernobyl incident), I-131 reappeared after not having been detected for 3 years. The MDC and RL for I-131 are 60 and 100 pCi/kg wet, respectively. Table 4.5-2 lists the average detectable results of I-131 found in forage over the life of the plant and Figure 4.5-2 plots the historical trending of this data.

Figure 4.5-2

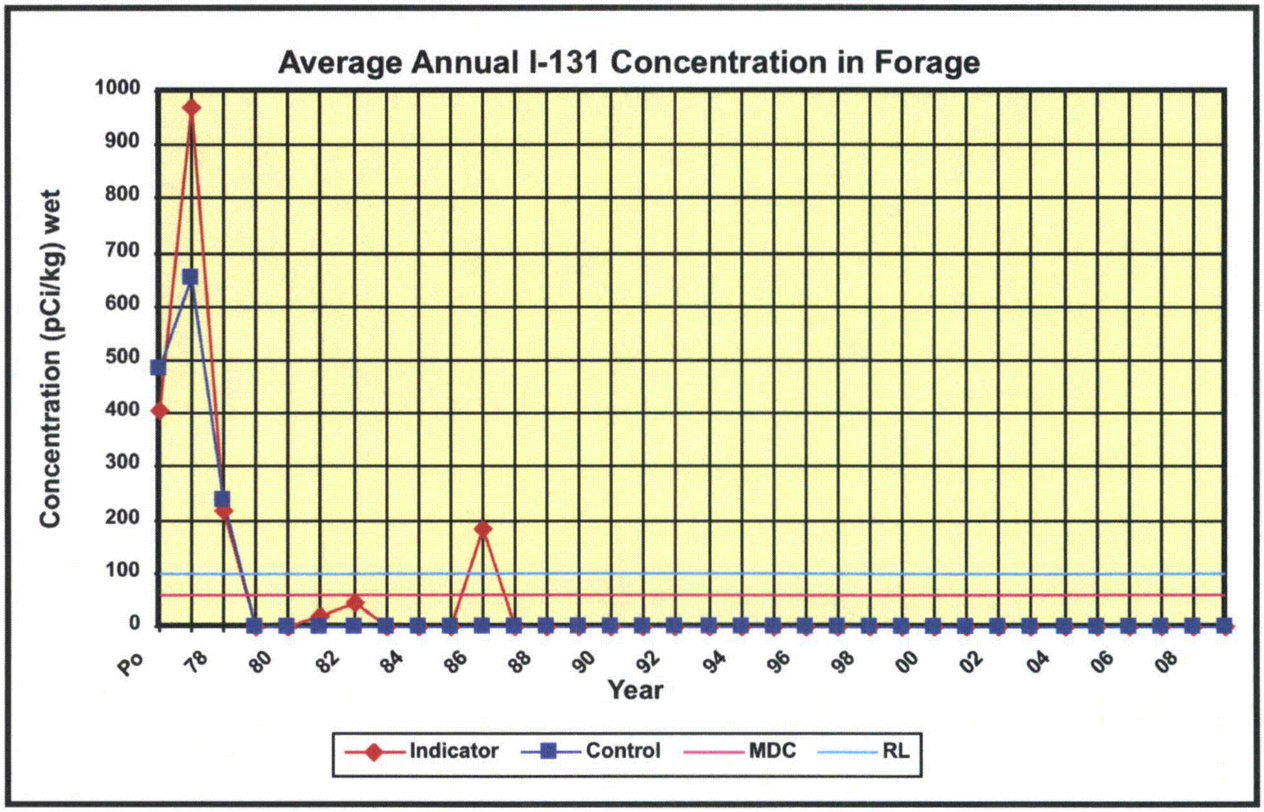


Table 4.5-2

Average Annual I-131 Concentration in Forage

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	405	486
1977	971	654
1978	220	240
1979	NDM	NDM
1980	NDM	NDM
1981	21.4	NDM
1982	46.4	NDM
1983	NDM	NDM
1984	NDM	NDM
1985	NDM	NDM
1986	184	NDM
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	NDM	NDM
2005	NDM	NDM
2006	NDM	NDM
2007	NDM	NDM
2008	NDM	NDM
2009	NDM	NDM

These forage analyses results show the impact of the weapons tests during preoperation and the early years of operation and of the Chernobyl incident in 1986 and for a few years afterwards. The impact is reflected by the number of different radionuclides detected, the fraction of samples with detectable results, as well as the magnitude of the results. During preoperation and for the first few years of operation, 11 different radionuclides from fission and activation products were detected. By 1985, only 2 different radionuclides were detected and the fraction of samples with detectable results had diminished. In 1986, the same two nuclides as seen in 1985 appeared at a significantly higher magnitude and I-131 reappeared. In the years following 1986, only Cs-137 has been found in forage and it has been found in a decreasing fraction of the samples.

4.6 Ground Water

In the FNP offsite environs, there are no true indicator sources of ground water. A well, located about four miles south-southeast of the plant on the east bank of the Chattahoochee River, serves Georgia Pacific Paper Company as a source of potable water and is designated as the indicator station. A deep well located about 1.2 miles southwest of the plant, which supplies water to the Whatley residence, is designated as the control station. Samples are collected quarterly and analyzed for gamma isotopic, I-131 and tritium as specified in Table 2-1. In 2009, two indicator samples and two control samples were positive for tritium. No other radionuclides were detected.

In 1983, 1985, and 1986, Cs-134 was detected in single samples at levels ranging from 3 to 13 pCi/l. The MDC and RL for Cs-134 in water are 15 and 30 pCi/l, respectively.

During preoperation, Cs-137 was detected in two of the samples at levels of 15 and 17 pCi/l. Then in 1984 and 1985, Cs-137 was again detected in a few samples with levels ranging from 4 to 5 pCi/l. The MDC and RL for Cs-137 in water are 18 and 50 pCi/l, respectively.

Iodine-131 has never been detected in ground water samples. From 1986-2003, no radionuclides were detected. In 2004, 2005, 2007, 2008, and 2009 tritium was detected at very low concentrations (near the instrument detection level) and close to environmental background concentration which is approximately 350 pCi/l (+/- 250 pCi/l) in the area around Farley. The positive results seen in these years were less than 3% of the reporting level for tritium. In 2009, the difference (73pCi/L) between the average of the 2 positive values seen at the indicator station (474 pCi/L) and the average of the 2 positive values seen at the control station (401 pCi/L) was not statistically discernible because it was less than the MDD of 1035 pCi/L. The MDC and RL for tritium in drinking water are 2,000 and 20,000 pCi/l, respectively. Figure 4.6-1 and Table 4.6-1 show the historical trending of the average annual detectable tritium concentration in offsite ground water.

Figure 4.6-1

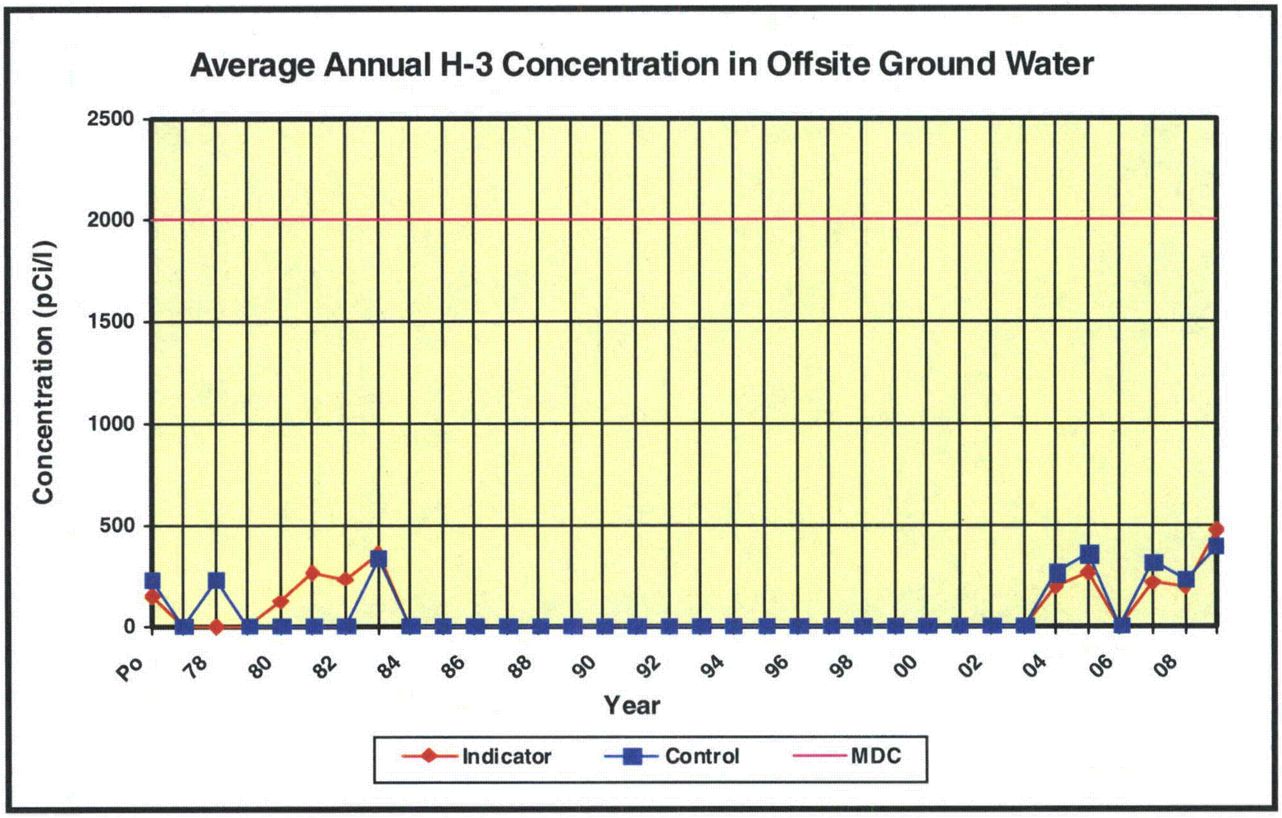

Average Annual H-3 Concentration in Offsite Ground Water
Concentration (pCi/l)
2500
2000
1500
1000
500
0
Po
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Year
Indicator
Control
MDC

Table 4.6-1

Average Annual H-3 Concentration in Offsite Ground Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	150	240
1977	NDM	NDM
1978	NDM	240
1979	NDM	NDM
1980	124	NDM
1981	264	NDM
1982	240	NDM
1983	360	341
1984	NDM	NDM
1985	NDM	NDM
1986	NDM	NDM
1987	NDM	NDM
1988	NDM	NDM
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	NDM	NDM
1994	NDM	NDM
1995	NDM	NDM
1996	NDM	NDM
1997	NDM	NDM
1998	NDM	NDM
1999	NDM	NDM
2000	NDM	NDM
2001	NDM	NDM
2002	NDM	NDM
2003	NDM	NDM
2004	194	271
2005	264	360
2006	NDM	NDM
2007	218	321
2008	196	237
2009	474	401

As nuclear plants began to undergo decommissioning in the late 1990's to early 2000s, instances of subsurface and/or groundwater contamination were identified. In addition, several operating facilities also identified groundwater contamination resulting from spills and leaks or equipment failure. In one instance, low levels of licensed material were detected in a private well located on property adjacent to a nuclear power plant.

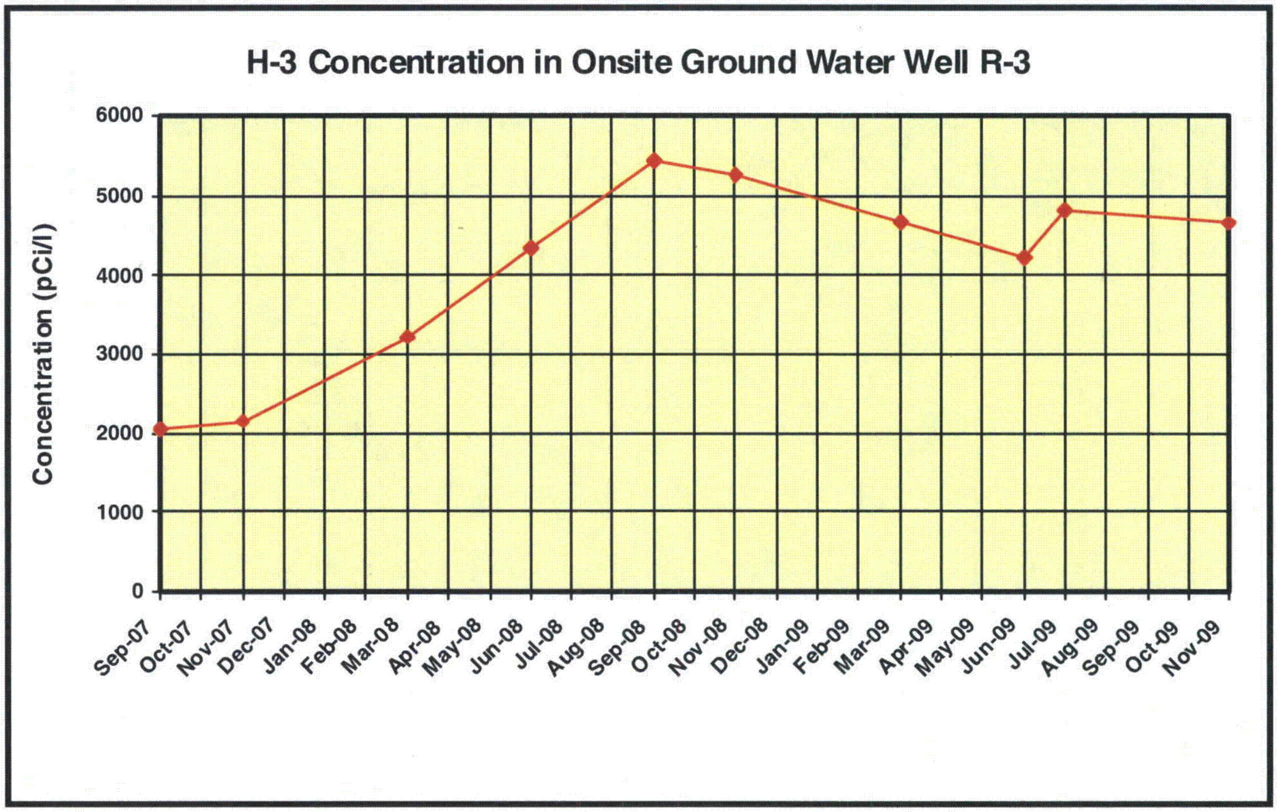
In 2006, NEI (Nuclear Energy Institute) formed a task force to address monitoring onsite groundwater for radionuclides at nuclear facilities. A Groundwater Protection Initiative was developed which was adopted by all U.S. commercial operating nuclear plants.

The NRC also formed a task force to study the groundwater issues and released Information Notice 2006-13 "Ground-water Contamination due to Undetected Leakage of Radioactive Water" which summarized its review of radioactive contamination of ground water at multiple facilities as a result of undetected leakage from structures, systems, or components that contain or transport radioactive fluids. Licensees were instructed to review the information for applicability and to consider appropriate actions to avoid similar problems.

The NEI task force felt it was prudent for the industry to update site hydrology information and to develop radiological groundwater monitoring plans at each site. These groundwater protection plans would ensure that underground leaks and spills would be addressed promptly. Additionally, the task force recommended developing a communications protocol to report radioactive leaks or spills that entered groundwater (or might eventually enter groundwater) to the NRC and State / Local government officials as needed. For guidance regarding monitoring wells with unexpected results, Southern Nuclear developed a company-wide communications protocol which is contained in the Nuclear Management Procedure, *Actions for Potential Groundwater Contamination Events*, to ensure radioactive leaks and spills are addressed and communicated appropriately. In an effort to prevent future leaks of radioactive material to groundwater, SNC plants have established detailed buried piping and tanks inspection programs.

In 2006, Farley located several old onsite piezometer wells and sampled these and the onsite drinking water wells for tritium and gamma isotopic activity. None of these wells contained detectable amounts of radioactivity. In 2007, after the site hydrology was evaluated, Farley implemented a more extensive radiological groundwater monitoring program which included drilling twelve new onsite monitoring wells (see Table 2-2). The twelve new wells along with one of the existing piezometer wells, the onsite drinking water wells, and several surface water / discharge locations comprise the monitoring program. These locations were sampled twice in the latter portion of 2007 and sampled quarterly in 2008. Of the numerous samples taken from 2007 through 2009 (from the locations described above), only one location (groundwater well R-3) showed low levels of radiological contamination (see Figure 4.6-2). Tritium was the only nuclide identified. R-3 was also analyzed for gamma emitters (quarterly) and strontium (initially and after increase was noted) and these were not detected. This well is located near the Protected Area and in the vicinity of the site where the Unit-2 radioactive effluent discharge line ruptured several years ago. In 2009, the level of tritium in R-3 remained fairly constant for all 4 quarterly sample events at an average of 4585 pCi/L.

Figure 4.6-2


H-3 Concentration in Onsite Ground Water Well R-3
Concentration (pCi/l)
6000
5000
4000
3000
2000
1000
0
Sep-07
Oct-07
Nov-07
Dec-07
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Mar-09
Apr-09
May-09
Jun-09
Jul-09
Aug-09
Sep-09
Oct-09
Nov-09

4.7 Surface Water

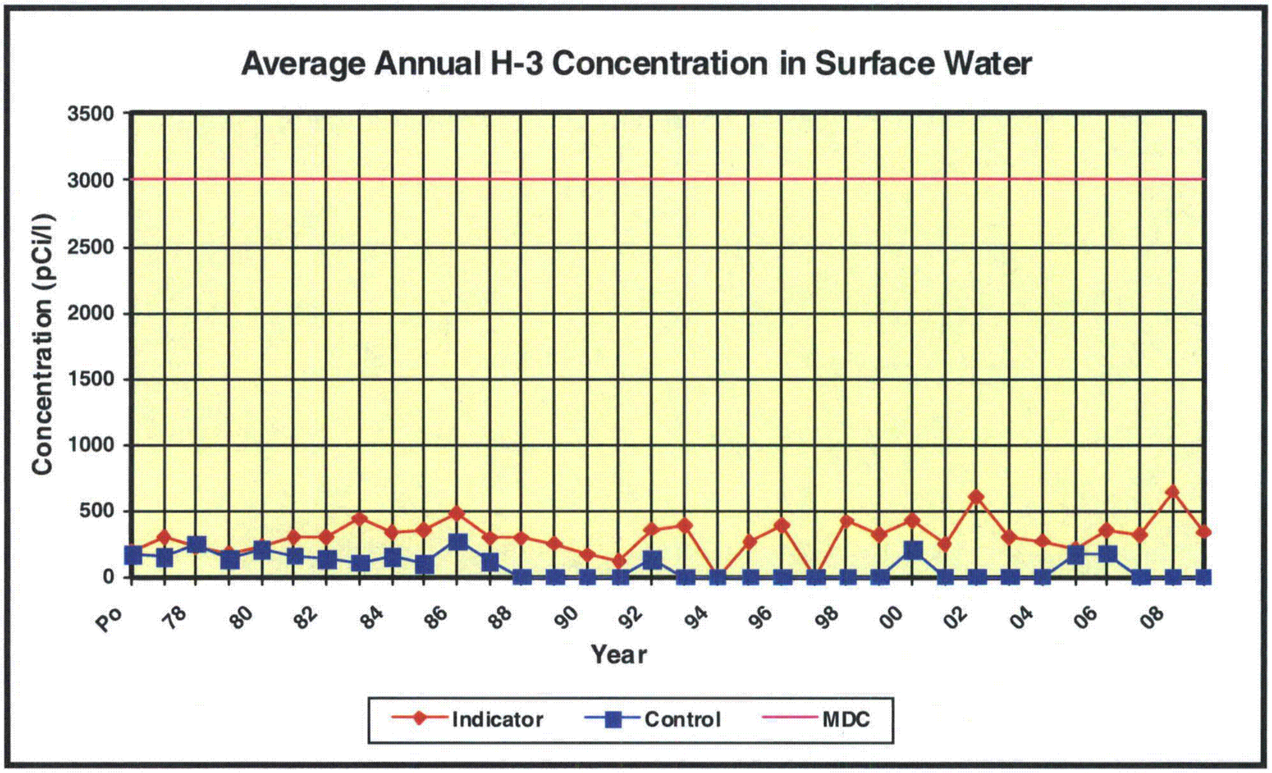
As specified in Table 2-1 and shown in Figure 2-2, water samples are collected from the Chattahoochee River at a control station approximately 3 miles upstream of the intake structure and at an indicator station approximately 4 miles downstream of the discharge structure. Small quantities are collected during the week at periodic intervals using automatic samplers. For each station, one liter from each of four consecutive weekly samples is combined into a composite sample which is analyzed for gamma emitters. In addition, 0.075 liters is collected from 13 consecutive weekly samples for each station to form composite quarterly samples which are analyzed for tritium.

No detectable results have been found from these gamma isotopic analyses since 1988. During preoperation and in every year of operation through 1988 (except 1979 and 1980), a few samples showed at least one of nine different activation or fission products at levels less than or on the order of their MDCs. During preoperation, Cs-137 was found in about 3% of the samples. From 1981 through 1988, it was found in about 15% of the samples. Cs-134 was found in about 15% of the samples from 1981 to 1986. All of these gamma emitters are attributed to the weapons tests and the Chernobyl incident.

In 2009, as shown in Table 3-1, tritium was detected in one of the 4 quarterly composites at the indicator station (343 pCi/L) and in none of the 4 quarterly composite samples collected at the control station. Although tritium was detectable in one quarterly sample, the value was at the environmental background level which is approximately 350 pCi/l (+/- 250 pCi/l) in the area around Farley.

Historical trending of the detectable concentrations of tritium in surface water is provided in Figure 4.7-1 and Table 4.7-1. The slightly elevated plot of the indicator stations is indicative of plant tritium contributions to surface water. However, it is noteworthy that the annual average levels are less than 10% of the MDC and less than 1% of the RL. The MDC and RL for tritium in surface water are 3,000 and 30,000, respectively.

Figure 4.7-1



Average Annual H-3 Concentration in Surface Water
Concentration (pCi/l)
3500
3000
2500
2000
1500
1000
500
0
Po
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Year
Indicator
Control
MDC

Table 4.7-1

Average Annual H-3 Concentration in Surface Water

Period	Indicator (pCi/l)	Control (pCi/l)
Pre-op	200	170
1977	300	160
1978	230	250
1979	169	135
1980	221	206
1981	294	162
1982	300	132
1983	434	111
1984	333	152
1985	351	105
1986	478	272
1987	291.8	116.5
1988	293.3	NDM
1989	253.8	NDM
1990	166	NDM
1991	122	NDM
1992	360.5	134
1993	388.8	NDM
1994	NDM	NDM
1995	257	NDM
1996	386	NDM
1997	NDM	NDM
1998	415	NDM
1999	314	NDM
2000	424	212
2001	252	NDM
2002	598	NDM
2003	296	NDM
2004	270	NDM
2005	215	173
2006	348	179
2007	321	NDM
2008	644	NDM
2009	343	NDM

4.8 Fish

Two types of fish (bottom feeding and game) are collected semiannually from the Chattahoochee River at a control station several miles upstream of the plant intake structure and at an indicator station a few miles downstream of the plant discharge structure. These locations are shown in Figure 2-2. Gamma isotopic analysis is performed on the edible portions of each sample as specified in Table 2-1.

As provided in Table 3-1, Cs-137 was the only radionuclide of interest that was found from the gamma isotopic analysis of fish samples in 2009. Cs-137 was detected in both the fall and spring collection of game fish samples at the indicator station. The average was 24.9 pCi/kg wet. Cs-137 was detected in one game fish sample at the control station (12.5 pCi/kg-wet). Using the modified Student's t-test, the difference between the indicator and control station was not statistically discernible. The average of the samples at the indicator station was less than 2% of the reporting level. The MDC for Cs-137 in fish is 150 pCi/kg wet and the RL is 2000 pCi/kg wet.

Cesium-137 was detected in one bottom feeding fish sample at the indicator location (spring collection) at 8.4 pCi/kg-wet and one bottom feeding fish at the control station (fall collection) at 21.9 pCi/kg-wet. The positive values seen at both stations were less than 2% of the reporting level. The MDC for Cs-137 in fish is 150 pCi/kg wet and the RL is 2000 pCi/kg wet.

Historically, Cs-137 has been found in approximately 30% of the bottom feeding fish samples and in 80% of the game fish samples. Figures 4.8-1 and 4.8-2 and Tables 4.8-1 and 4.8-2 provide the historical trending of the average annual detectable concentrations of Cs-137 in pCi/kg wet in bottom feeding and game fish, respectively. Since the early 1980s, values have generally decreased for both indicator and control groups, with the exception of the bottom feeding fish collected at the indicator station in 1993. While some contribution from the plant cannot be ruled out, most of the Cs-137 in these samples may be attributed to the nuclear weapons tests and the Chernobyl incident, as evidenced by the normally close agreement between the control and indicator station results.

Figure 4.8-1

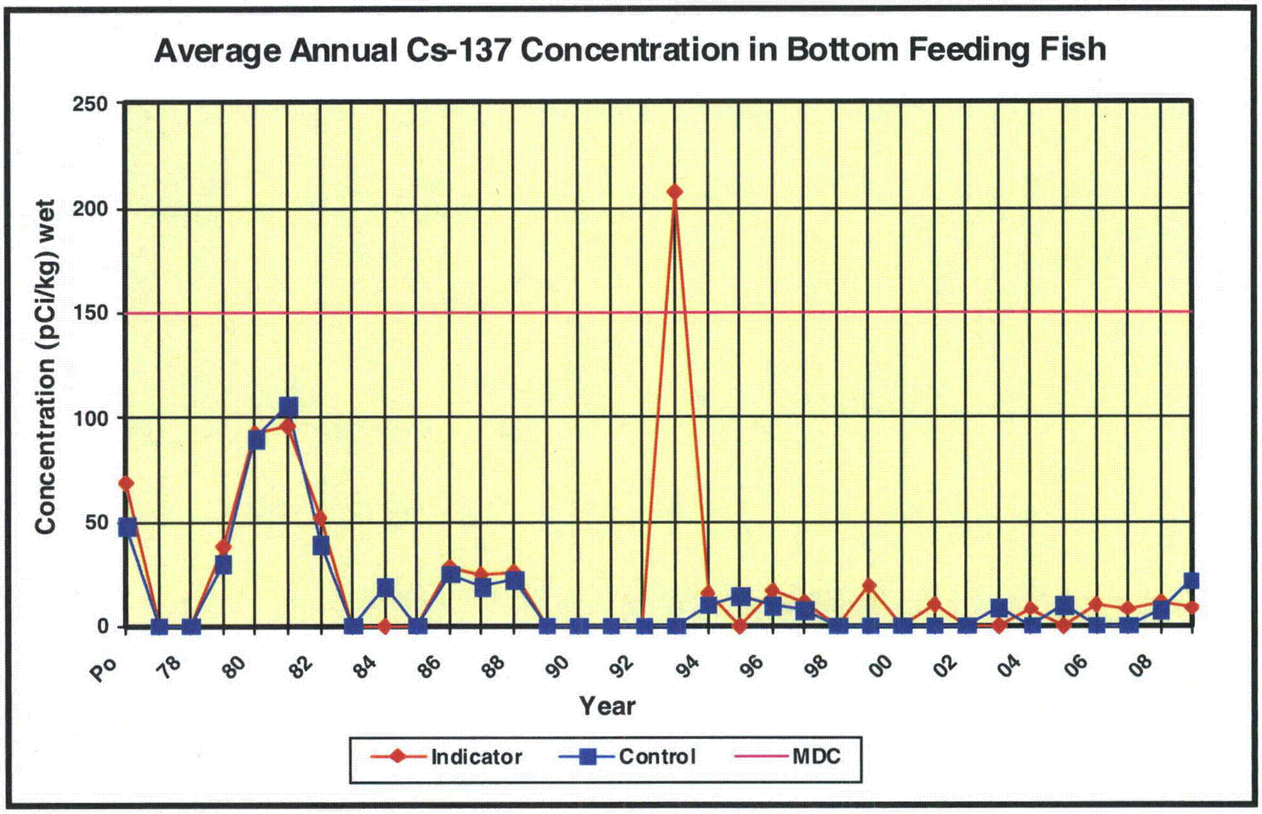

Average Annual Cs-137 Concentration in Bottom Feeding Fish
Concentration (pCi/kg) wet
250
200
150
100
50
0
Po
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Year
Indicator
Control
MDC

Table 4.8-1

Average Annual Cs-137 Concentration in Bottom Feeding Fish

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	69	48
1977	NDM	NDM
1978	NDM	NDM
1979	38	30
1980	92	90
1981	96	106
1982	51.5	39.0
1983	NDM	NDM
1984	NDM	19
1985	NDM	NDM
1986	28	25
1987	25	19
1988	25.5	22.0
1989	NDM	NDM
1990	NDM	NDM
1991	NDM	NDM
1992	NDM	NDM
1993	208	NDM
1994	15.9	10.3
1995	NDM	14.2
1996	16.4	9.9
1997	10.9	7.7
1998	NDM	NDM
1999	19.2	NDM
2000	NDM	NDM
2001	9.8	NDM
2002	NDM	NDM
2003	NDM	8.5
2004	8.1	NDM
2005	NDM	9.6
2006	9.7	NDM
2007	8.1	NDM
2008	11.4	7.7
2009	8.4	21.9

Figure 4.8-2

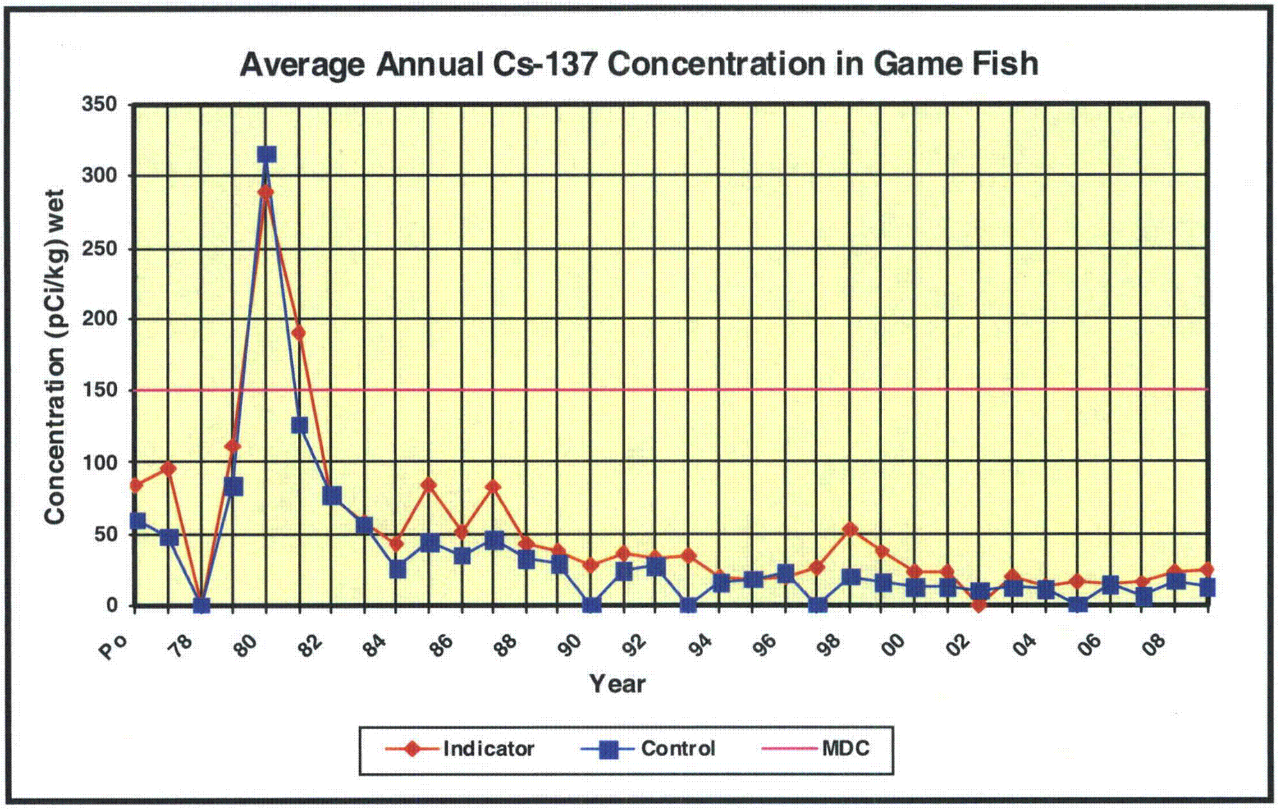

Average Annual Cs-137 Concentration in Game Fish
Concentration (pCi/kg) wet
350
300
250
200
150
100
50
0
Po
78
80
82
84
86
88
90
92
94
96
98
00
02
04
06
08
Year
Indicator
Control
MDC

Table 4.8-2

Average Annual Cs-137 Concentration in Game Fish

Period	Indicator (pCi/kg) wet	Control (pCi/kg) wet
Pre-op	84	60
1977	95	48
1978	NDM	NDM
1979	111	83.5
1980	289	316
1981	189	126
1982	76	77
1983	57	56.5
1984	42	26
1985	84	44
1986	51	35
1987	83	46
1988	42	33
1989	38	29
1990	28	NDM
1991	36	24
1992	32.5	28
1993	34	NDM
1994	19	16
1995	17.9	18.2
1996	19.6	23.1
1997	25.9	NDM
1998	52	20
1999	36.9	15.9
2000	22.9	12.5
2001	22.4	12.3
2002	NDM	10.1
2003	19.3	12.0
2004	12.7	10.8
2005	15.7	NDM
2006	15.0	14.7
2007	15.4	6.5
2008	16.6	23.2
2009	24.9	12.5

Radionuclides of interest other than Cs-137 have been found in only a few samples in the past. The following table provides a summary of the results in pCi/kg wet compared with the applicable MDCs.

YEAR	Nuclide	Fish Type	Indicator (pCi/kg)	Control (pCi/kg)	MDC (pCi/kg)
1978	Ce-144	Bottom Feeding	NDM	200	
1981	Nb-95	Bottom Feeding	38	NDM	50 (a)
1982	Nb-95	Game	31	NDM	50 (a)
1986	Co-60	Game	25	NDM	130

(a) Determined by the EL. Not defined in ODCM Table 4-3 (Table 4-1 of this report)

4.9 Sediment

River sediment samples are collected semiannually on the Chattahoochee River at a control station which is approximately 4 miles upstream of the intake structure and at an indicator station which is approximately 2 miles downstream of the discharge structure as shown in Figure 2-2. A gamma isotopic analysis is performed on each sample as specified in Table 2-1. During 2009, Be-7 was detected in one of the semiannual samples at the indicator station (72.8 pCi/kg-dry). Be-7 is naturally occurring but has been identified in Farley's liquid effluents so it is a radionuclide of interest. Cs-137 was the only other nuclide detected in river sediment during 2009. One of the semiannual samples at the control station had 24.4 pCi/kg-dry of Cs-137.

Historically, Be-7, Cs-134, Cs-137, and Nb-95 have been detected in some samples. These positive results were generally for samples collected at the control station. A summary of the positive historical results for these nuclides along with their applicable MDCs in units of pCi/kg dry is provided in Table 4.9. Cs-134 and Cs-137 data are plotted in Figures 4.9-1 and 4.9-2, respectively.

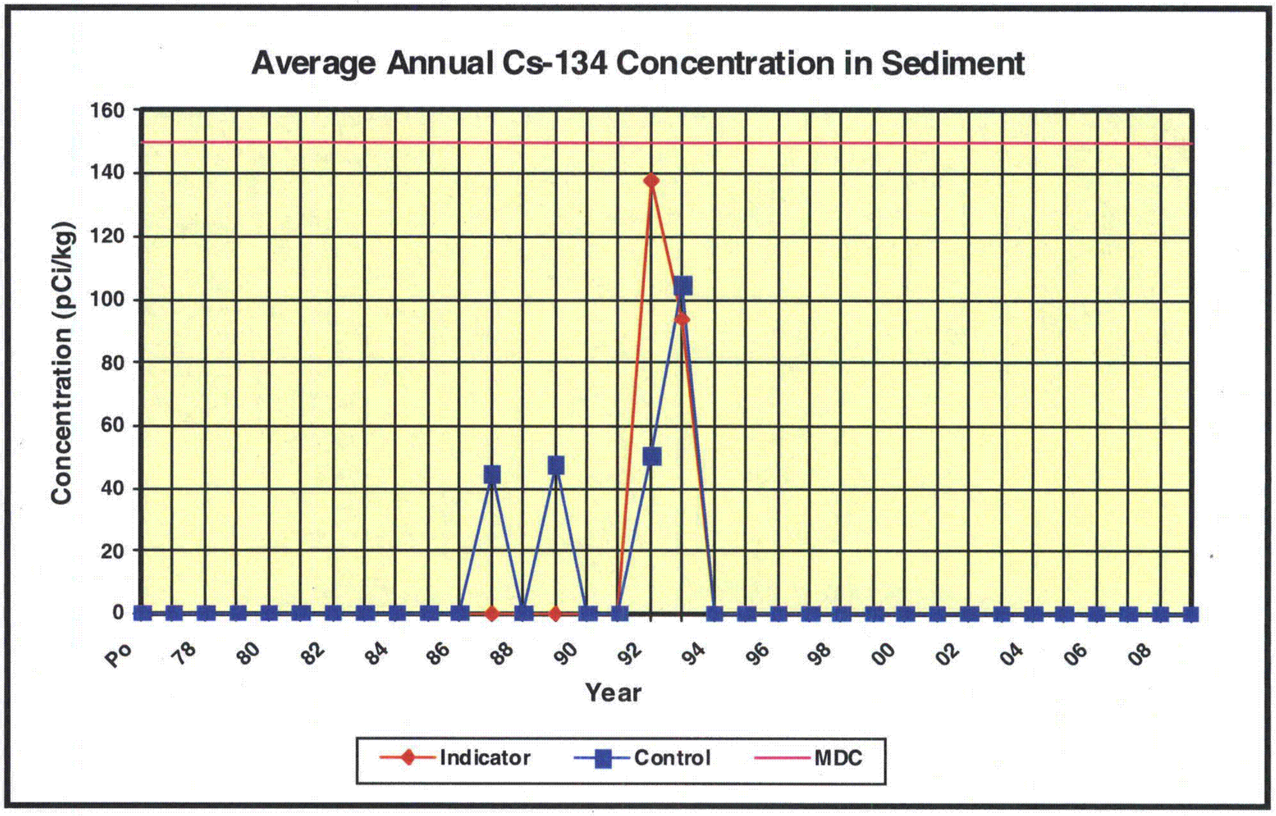
Table 4.9

Sediment Nuclide Concentrations

Nuclide	YEAR	Indicator (pCi/kg)	Control (pCi/kg)	MDC (pCi/kg)
Be-7	**1985**	535	945	655 (a)
	2003	199	NDM	
	2009	72.8	NDM	
Cs-134	**1987**	NDM	45	150
	1989	NDM	48	
	1992	138	51	
	1993	94	105	
Cs-137	**1981**	NDM	185	180
	1985	NDM	97	
	1989	NDM	39	
	1994	29	11	
	1996	11.8	NDM	
	2005	14.5	NDM	
	2009	NDM	24.4	
Nb-95	**1981**	52	113	50 (a)

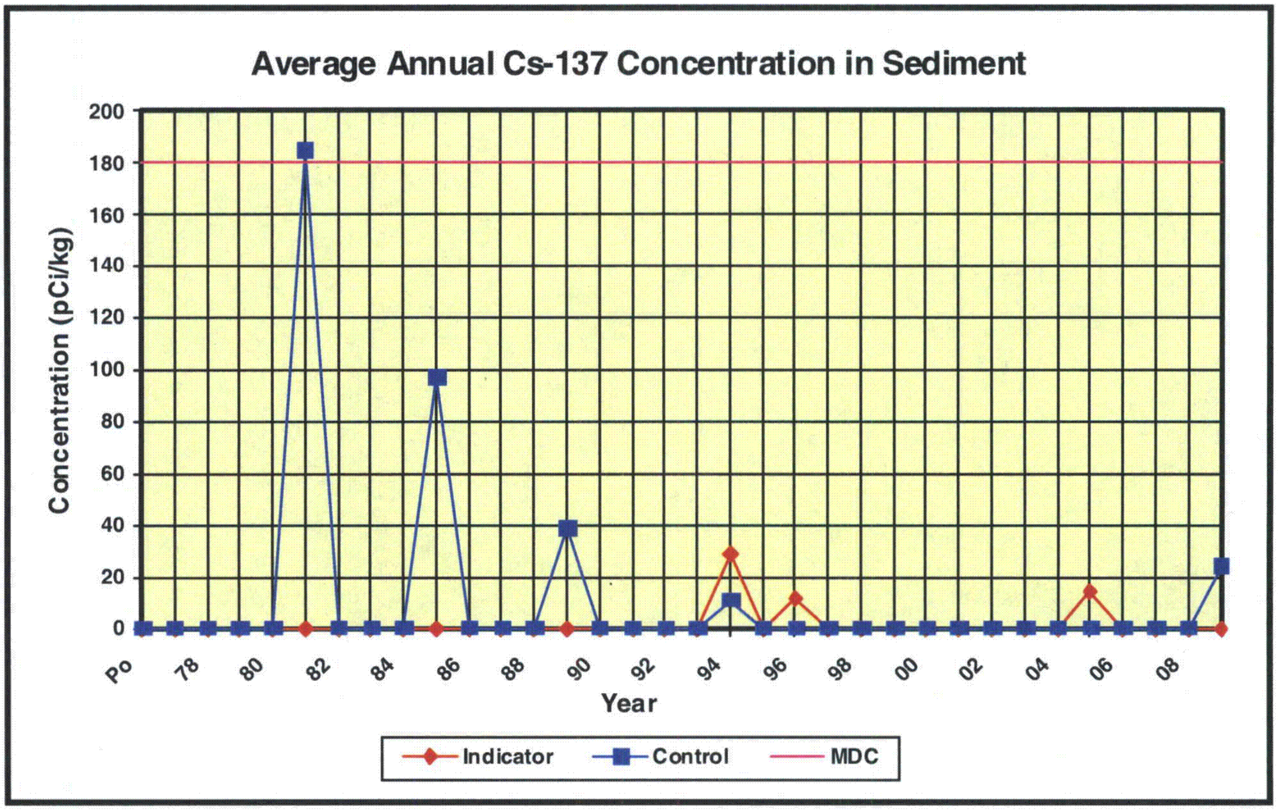
(a) Determined by the EL. Not defined in ODCM Table 4-3 (Table 4-1 of this report).

Figure 4.9-1



The positive results for Cs-134 appear mostly at the control station. Due to its relatively short half-life of approximately 2 years, the positive results may be attributed to the Chernobyl incident. The overall plotting of the positive results does not show any discernible trends.

Figure 4.9-2



Cs-137 appears to be trending down since the ceasing of above ground weapons testing and the majority of the positive results appear at the control stations. Therefore in general, the positive results can be attributed to the weapons tests and the Chernobyl incident.

5.0 INTERLABORATORY COMPARISON PROGRAM

In accordance with ODCM 4.1.3, the EL participates in an ICP that satisfies the requirements of Regulatory Guide 4.15, Revision 1, "Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment", February 1979. The guide indicates the ICP is to be conducted with the Environmental Protection Agency (EPA) Environmental Radioactivity Laboratory Intercomparison Studies (Cross-check) Program or an equivalent program, and the ICP should include all of the determinations (sample medium/radionuclide combinations) that are offered by the EPA and included in the REMP.

The ICP is conducted by Analytics, Inc. of Atlanta, Georgia. Analytics has a documented Quality Assurance (QA) program and the capability to prepare Quality Control (QC) materials traceable to the National Institute of Standards and Technology. The ICP is a third party blind testing program which provides a means to ensure independent checks are performed on the accuracy and precision of the measurements of radioactive materials in environmental sample matrices. Analytics supplies the crosscheck samples to the EL which performs the laboratory analyses in a normal manner. Each of the specified analyses is performed three times. The results are then sent to Analytics who performs an evaluation which may be helpful to the EL in the identification of instrument or procedural problems.

The samples offered by Analytics and included in the EL analyses are gross beta and gamma isotopic analyses of an air filter; gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples.

The accuracy of each result is measured by the normalized deviation, which is the ratio of the reported average less the known value to the total error. The total error is the square root of the sum of the squares of the uncertainties of the known value and of the reported average. The uncertainty of the known value includes all analytical uncertainties as reported by Analytics. The uncertainty of the reported average is the propagated error of the values in the reported average by the EL. The precision of each result is measured by the coefficient of variation, which is defined as the standard deviation of the reported result divided by the reported average. An investigation is undertaken whenever the absolute value of the normalized deviation is greater than three or whenever the coefficient of variation is greater than 15% for all radionuclides other than Cr-51 and Fe-59. For Cr-51 and Fe-59, an investigation is undertaken when the coefficient of variation exceeds the values shown as follows:

Nuclide	**Concentration ***	**Total Sample Activity (pCi)**	**Percent Coefficient of Variation**
Cr-51	<300	NA	25
Cr-51	NA	>1000	25
Cr-51	>300	<1000	15
Fe-59	<80	NA	25
Fe-59	>80	NA	15

* For air filters, concentration units are pCi/filter. For all other media, concentration units are pCi/liter (pCi/l).

As required by ODCM 4.1.3.3 and 7.1.2.3, a summary of the results of the EL's participation in the ICP is provided in Table 5-1 for: the gross beta and gamma isotopic analyses of an air filter; gamma isotopic analyses of milk samples; and gross beta, tritium and gamma isotopic analyses of water samples. Delineated in this table for each of the media/analysis combinations, are: the specific radionuclides; Analytics' preparation dates; the known values with their uncertainties supplied by Analytics; the reported averages with their standard deviations; and the resultant normalized deviations and coefficients of variation expressed as a percentage.

The EL analyzed 9 samples for 35 parameters in 2009. These analyses included tritium, gross beta and gamma emitting radio-nuclides in different matrices. The attached results indicate all analyses are acceptable for precision and one analysis outside the acceptance limits for accuracy. The activity recovery of Fe-59 in air filter was above the upper acceptance limit for accuracy.

The analysis of Fe-59 is performed by gamma spectroscopy, with the value determined by a weighted average of the three germanium detectors. In a 2005 investigation a positive bias was determined to exist in the analysis based on summing of nuclides in the calibration standard. The detectors are calibrated on a three year geometry rotation. The air filter geometry calibration is scheduled and will be completed in 2010. The 2009 sample will be reanalyzed with the new calibration to verify calibration accuracy.

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GROSS BETA ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	09/17/09	85.00	85.80	1.68	0.48	5.21	-0.19

GAMMA ISOTOPIC ANALYSIS OF AN AIR FILTER (pCi/filter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	09/17/09	204.10	193.00	8.07	1.08	5.02	1.08
Co-58	09/17/09	75.60	69.90	3.81	0.39	7.23	1.05
Co-60	09/17/09	117.10	113.00	2.15	0.63	3.78	0.92
Cr-51	09/17/09	194.50	155.00	2.1	0.86	13.61	1.49
Cs-134	09/17/09	83.90	86.50	1.48	0.48	3.99	-0.77
Cs-137	09/17/09	142.40	130.00	4.01	0.72	4.46	1.95
Fe-59	09/17/09	131.30	103.00	6.51	0.58	6.86	3.14
Mn-54	09/17/09	160.10	145.00	0.86	0.81	3.44	2.74
Zn-65	09/17/09	176.20	143.00	7.22	0.80	6.35	2.97

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	06/18/09	286.50	284.00	22.86	1.58	8.94	0.10
Co-58	06/18/09	97.40	91.90	3.44	0.51	8.17	0.69
Co-60	06/18/09	326.50	312.00	9.4	1.74	4.73	0.94
Cr-51	06/18/09	415.30	400.00	48.83	2.23	15.87	0.23
Cs-134	06/18/09	178.10	166.00	6.63	0.92	5.65	1.20
Cs-137	06/18/09	205.20	192.00	15.72	1.07	9.03	0.71

TABLE 5-1 (SHEET 2 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF A MILK SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Fe-59	06/18/09	144.10	122.00	3.6	0.68	7.69	1.99
I-131	06/18/09	116.00	102.00	7.01	0.57	9.34	1.29
Mn-54	06/18/09	138.80	137.00	17.49	0.76	13.97	0.09
Zn-65	06/18/09	194.90	175.00	3.54	0.98	8.45	1.21

GROSS BETA ANALYSIS OF WATER SAMPLE (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Gross Beta	03/19/09	201.70	203.00	2.72	1.13	5.28	-0.12
	06/18/09	134.40	141.00	4.6	0.79	10.03	-0.49

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Ce-141	03/19/09	119.10	120.00	9	0.67	9.54	-0.08
Co-58	03/19/09	145.30	151.00	9.04	0.84	8.18	-0.48
Co-60	03/19/09	193.70	180.00	4.54	1.00	4.44	1.60
Cr-51	03/19/09	406.90	387.00	12.63	2.15	9.69	0.50
Cs-134	03/19/09	122.20	119.00	6.96	0.66	7.42	0.35

TABLE 5-1 (SHEET 3 of 3)

INTERLABORATORY COMPARISON PROGRAM RESULTS

GAMMA ISOTOPIC ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
Cs-137	03/19/09	152.00	141.00	9.57	0.79	8.05	0.90
Fe-59	03/19/09	142.00	127.00	2.78	0.70	6.68	1.58
I-131	03/19/09	76.10	69.00	3.21	0.38	7.95	1.18
Mn-54	03/19/09	179.10	162.00	3.05	0.90	4.90	1.95
Zn-65	03/19/09	210.40	197.00	4.72	1.10	6.91	0.92

TRITIUM ANALYSIS OF WATER SAMPLES (pCi/liter)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
H-3	03/19/09	4470.00	4480.00	106.90	24.93	4.32	-0.05
	06/18/09	12933.90	13000	267.3	74.3	2.98	-0.17

I-131 ANALYSIS OF AN AIR CARTRIDGE (pCi/cartridge)

Analysis or Radionuclide	Date Prepared	Reported Average	Known Value	Standard Deviation EL	Uncertainty Analytics (3S)	Percent Coef of Variation	Normalized Deviation
I-131	06/18/09	96.40	99.10	10.4	0.55	11.94	-0.24

6.0 CONCLUSIONS

This report confirms the licensee's conformance with the requirements of Chapter 4 of the ODCM. It provides a summary and discussion of the results of the laboratory analyses for each type of sample.

In 2009, there one instance where the indicator station results were statistically discernible from the control station results. The direct radiation average of the indicator stations was slightly higher than the average at the control stations. Figure 4.3-1 trend shows that the difference between the indicator, control, and community stations has been very consistent over the years of plant operation and therefore supports the position that the plant is not contributing significantly to direct radiation in the environment. No discernible radiological impact upon the environment or the public as a consequence of plant discharges to the atmosphere and to the river was established for any other REMP samples.

The radiological levels reported in 2009 were low and are generally trending downward. The REMP trends over the course of time from preoperation to the present are generally decreasing or have remained fairly constant. This supports the conclusion that there is no adverse radiological impact on the environment or to the public as a result of the operation of Farley Nuclear Plant.