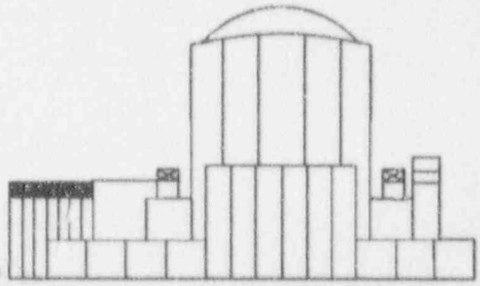
ENTERGY



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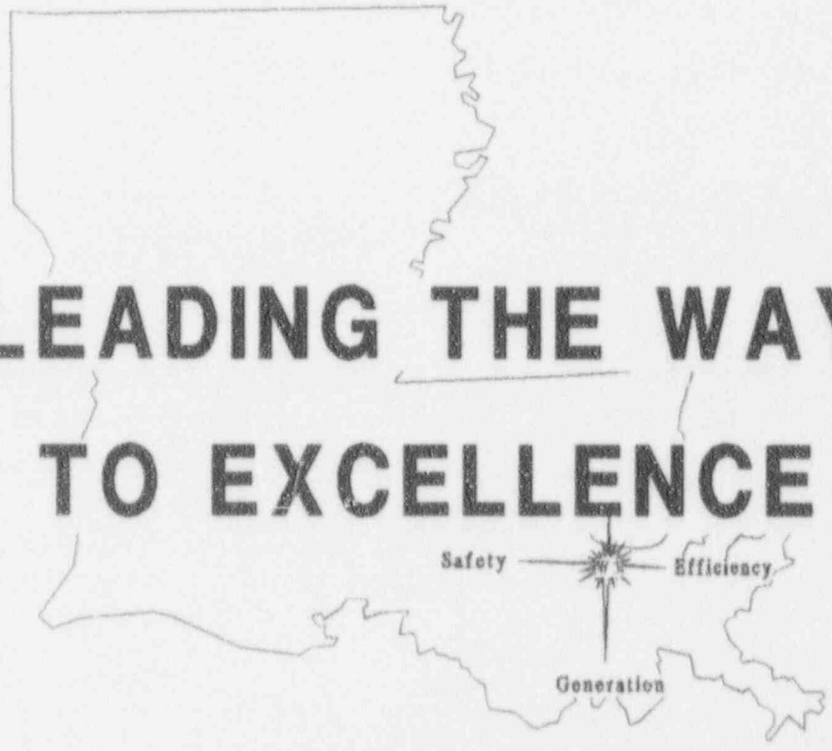

LEADING THE WAY TO EXCELLENCE

1993 Annual Radiological Environmental Operating Report

Entergy Operations, Inc.

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

FOR WATERFORD 3 STEAM ELECTRIC STATION

JANUARY 1 THROUGH DECEMBER 31, 1993

Docket Number: 50-382

License Number: NPF-38

ABSTRACT

This report is issued pursuant to Waterford 3 Technical Specification 6.9.1.7. Its purpose is to discuss the Waterford 3 Radiological Environmental Monitoring Program (REMP), present the results of the program for the year of 1993, and evaluate the radiological impact on the environment resulting from plant operation.

The Waterford 3 REMP collected data on environmental radioactivity levels around the Waterford 3 nuclear power plant. These levels were determined by analyzing samples of air, water, shoreline soil, fish, vegetation, and milk from various locations around the facility. Based on the evaluation of the environmental data collected, the operation of Waterford 3 exhibited no discernable impact on the levels of radioactivity in the environment during 1993.

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1.0 INTRODUCTION

This report describes the Radiological Environmental Monitoring Program (REMP) for the Waterford 3 Steam Electric Station and discusses the results obtained during the calendar year 1993. The results discussed in this report were used to evaluate the radiological environmental impact resulting from the operation of Waterford 3. The submission of this report to the Nuclear Regulatory Commission (NRC) fulfills the requirements pursuant to Waterford 3 Technical Specification 6.9.1.7.

1.1 Program and Report Objectives

The objective of the monitoring program is to evaluate the radiological environmental impact of the plant. In order to conduct this evaluation, the data analyses and interpretations contained in this report fulfill the following specific objectives:

a. to identify any radioactive materials or radiation in the environment associated with plant operation,

b. to compare the results obtained during the reporting period with past operational and pre-operational data and identify any trends associated with accumulation of radioactivity in the environment; and

c. to verify compliance with federal regulatory requirements.

1.2 Plant and Site Description

Waterford 3 employs a pressurized water reactor for the production of approximately 1153 gross (1104 net) megawatts of electricity. The station uses a flow of water obtained from and discharged to the Mississippi River for condenser cooling. On March 4, 1985, the unit achieved initial criticality.

The plant is located on the west bank of the Mississippi River at River Mile 129.6 between Baton Rouge and New Orleans, Louisiana. The site is in the northwestern section of St. Charles Parish approximately 3 miles southeast of the St. John the Baptist Parish boundary between the towns of Killona and Taft. The Mississippi River is the closest prominent natural feature; other features include Lac des Allemands, about 5.5 miles southwest of the site, and Lake Ponchartrain, about 7 miles northeast of the site.

Most of the man-made features are located on the narrow strip of land between the Mississippi River and the wetlands. Specifically, several industrial facilities including Waterford 1 and 2 Steam Electric Stations (0.4 miles northwest), Little Gypsy Steam Electric Station (0.8 miles northeast), IMC Agrico, a fertilizer manufacturer (0.6 miles east southeast), Occidental Chemical Company (0.8 miles east southeast), and Union Carbide, a chemical manufacturer (1.2 miles east southeast) are operating in the area.

Major urban centers in the region include New Orleans (approximately 25 miles east) and Baton Rouge (approximately 50 miles west northwest). Communities near the site in St. Charles Parish include Killona (0.9 miles west northwest), Montz (1.0 miles north), Norco (2.5 miles east), Hahnville (3.7 miles east southeast), and Destrehan (6.3 miles east southeast). Laplace (4.7 miles north) is located in St. John the Baptist Parish.

2.0 PROGRAM DESCRIPTION

A general summary of the REMP is given in Table 2.1; brief descriptions and locations of the sampling stations are presented in Table 2.2. In addition, station locations are illustrated in Figures 2.1 through 2.3. A more detailed description of the REMP is provided below.

2.1 History and Development

The Waterford 3 REMP evolved from the Pre-operational Environmental Radiological Surveillance (PERS) program (1978-1982) and was initiated in April of 1983. Equipment, procedures, techniques, and sampling locations used during the pre-operational survey were incorporated into the operational program. Further, the environmental data collected during the first two years of the REMP (1983 and 1984), prior to initial criticality, were used to supplement the baseline established during the PERS Program.

2.2 Responsibilities

Waterford 3 personnel are responsible for implementing and insuring that the REMP complies with federal regulatory, Technical Specification, and Offsite Dose Calculation Manual (ODCM) requirements. Responsibilities of Waterford 3 personnel include collecting (with the exception of fish samples), preparing, and shipping of environmental samples; conducting environmental dosimetry measurements; reviewing analytical results reports; and preparing and submitting the annual Radiological Environmental Monitoring and other relevant reports to the Nuclear Regulatory Commission.

The primary contractor, Entergy Services, Inc. (ESI) System Chemistry located in Little Rock, Arkansas, is responsible for performing radiological analyses; conducting initial data review; preparing results reports; and overseeing laboratory quality assurance and control. Additionally, a separate contractor, the Fisheries Co-operative Extension Service of Louisiana State University, is responsible for the collection of fish samples.

2.3 Sample Collection and Handling Procedures

Sample types, location, collection frequency, and the analyses performed are summarized in Tables 2.1 and 2.2. The information contained in these tables is based on requirements specified in Table 5.8-1 of the Waterford 3 ODCM. Location maps of the sampling are illustrated in Figures 2.1 through 2.3. Any stations deviations (i.e., unavailable samples and missed lower limits of detection) or changes made to the REMP during 1993 are discussed in Section 3.6.

The environmental samples collected are classified into four general categories according to exposure pathways: direct radiation, airborne, waterborne, and ingestion. Sample collection and handling procedures are described in the following sections. The descriptions are intended to provide a concise procedural overview rather than a step-by-step description.

2.3.1 Direct Radiation Exposure Pathway Samples

Integrated external gamma exposure, determined using Panasonic Multi-element thermoluminescent dosimeters (TLDs), was measured at thirty-one locations as follows:

a. an inner ring of stations, one in each of the sixteen meteorological sectors, in the general area of the site boundary;

b. an outer ring of stations, one in ten of the sixteen meteorological sectors, in the six to eight kilometer range from the site; and

c. the balance placed in areas of special interest (e.g., population centers, schools, etc.) with one area serving as a control.

The TLDs were exchanged and analyzed quarterly by Waterford 3 personnel.

2.3.2 Airborne Exposure Pathway Samples

Samples of airborne particulates and radioiodines were collected at four indicator stations (APP-1, APQ-1, APG-1, APC-1) and one control station (APE-30). Low-volume air pumps and flow totalizers in weather proof shelters provided continuous air sampling.

Using the sampling device described above, airborne particulate samples were obtained on a filter and collected weekly by Waterford 3 personnel for shipment to the contract laboratory for gross beta analysis. The filters were composited quarterly by the contract laboratory for isotopic analysis by gamma spectroscopy.

Airborne iodine sampling was done in conjunction with air particulate sampling using a charcoal cartridge to collect iodine. The cartridges were collected weekly by Waterford 3 personnel and sent to the contract laboratory for iodine-131 analysis by gamma spectroscopy.

2.3.3 Waterborne Exposure Pathway Samples

Because the plant discharges into the Mississippi River, the major source of drinking water in the vicinity of Waterford 3, water samples taken from the Mississippi River were designated as both drinking and surface water samples.

Composite drinking/surface water samples were obtained biweekly from the Mississippi River using automatic composite samplers placed at one upstream (DWP-7/SWP-7) and two downstream (DWG-2/SWG-2, DWE-5/SWE-5) locations. Hydrochloric acid was added to each sample prior to shipment. The contract laboratory analyzed the biweekly samples for iodine-131, composited them monthly for gross beta and gamma spectroscopy, and composited them quarterly for tritium analysis.

Due to the high water table resulting from shallow aquifers in the vicinity of the site, drainage canal sampling represents groundwater discharge. Groundwater was obtained quarterly by grab sampling from one sampling location (GWK-1). Again, hydrochloric acid was added to the sample prior to shipment to the contract laboratory for tritium and gamma spectroscopy analyses.

Shoreline sediment samples were obtained semi-annually from a sampling station at each plant discharge point. Station SHWE-3 is located downstream on the shoreline of the Mississippi River; station SHWK-1 is on the shoreline of the 40-Arpent canal. The samples were shipped without further processing.

2.3.4 Ingestion Exposure Pathway Samples

Milk samples were collected semi-monthly from one indicator location (MKQ-5) and one control location (MKQ-45). Sampling of the control station was performed by Louisiana Radiation Protection Division personnel. Although one additional indicator location was identified (MKQ-1), no samples were available from this location during 1993 (see Section 3.6). Finally, formaldehyde was added as a preservative to all samples prior to shipment. Upon arrival at the laboratory, iodine-131 and gamma spectroscopy analyses were performed.

Fish samples were collected bi-annually from the Mississippi River upstream (FH-1) and downstream (FH-2) from the plant. A contractor performed the sampling by netting. Subsequently, the fish were segregated by species and location prior to delivery to Waterford 3. The samples were shipped frozen for analysis by gamma spectroscopy.

The Waterford 3 ODCM, Section 5.8.1, requires broad leaf vegetation to be sampled from 3 locations within 5 miles of the plant in the event milk samples are unavailable. Since milk samples were collected from only one sampling location within five miles of Waterford 3, broad leaf vegetation was sampled monthly at two indicator locations (BLQ-1 and BLB-1) and one control location (BLK-15). The samples were shipped without further processing.

Food product sampling was not required because no areas surrounding the plant were irrigated with water in which plant wastes are discharged. However, food products grown within the site boundary were collected to demonstrate the absence of radionuclide accumulation.

These food product samples (sugarcane) were collected at the time of harvest from two locations (FPP-1 and FPP-1) by normal harvesting techniques and shipped without further processing. Iodine-131 and gamma spectroscopy analyses were performed.

2.4 Analytical Procedures

A brief synopsis of the analytical procedures used by ESI System Chemistry and Waterford 3 are given in Appendix D to provide an overview of the program.

The minimum sensitivities for the analytical procedures are reflected by the Lower Limits of Detection (LLD) values presented in Table 2.3 from Table 5.8-3 of Waterford 3 ODCM. The LLD's are *a priori* estimates based on assumed sample volumes, counting times, detector efficiencies, etc. Analyses that could not achieve these lower limits of detection are discussed in Section 3.6.

2.5 Laboratory Quality Assurance

During 199', the ESI System Chemistry laboratory performed between 5% and 10% of all analyses for quality assurance purposes. Spiked and blank samples were prepared in-house. In addition, the laboratory participated in the EPA Radiological Interlaboratory Comparison (cross-check) Program.

This quality assurance program satisfies the requirements of the Waterford 3 ODCM, Section 5.8.2, for participation in an interlaboratory comparison program. The program involved analyses on various sample media typically found in the REMP. As a result of participation in the program, an objective measure of analytical precision and accuracy was obtained. In the event that results obtained by ESI System Chemistry were not within control limits (3 standard deviations), an investigation was conducted to determine the cause, and corrective action was taken to prevent a recurrence. Appendix C lists the 1993 results of the laboratory's participation in the cross-check program.

TABLE 2.1
RADIOLOGICAL ENVIRONEMNTAL MONITORING
PROGRAM (REMP) SUMMARY[a]

SAMPLE TYPE	LOCATION	ANALYSIS	FREQUENCY
Direct Radiation	A-2, B-1, C-1, D-2, E-1, F-2, G-2, H-2, J-2, K-1, L-1, M-1, N-1, P-1, Q-1, R-1, A-5, B-4, D-5, E-5, F-4, G-4, H-6, P-6, Q-5, R-6, G-9, E-15, J-15, E-30	TLD gamma	Quarterly
Radioiodine and Particulates	APP-1, APQ-1, APG-1, APC-1, APE-30	Gross beta, I-131 gamma isotopic	Weekly Qrtly composite
Drinking Water[b]	DWG-2, DWE-5, DWP-7	H-3 Gross beta, gamma isotopic, I-131	Qrtly composite Monthly composite Bi-wkly composite
Surface Water[b]	SWG-2, SWE-5, SWP-7	H-3 gamma isotopic	Qrtly composite Monthly composite
Ground Water	GWK-1	gamma isotopic, H-3	Qrtly
Shoreline Sediment	SHWE-3, SHWK-1	gamma isotopic	Semi-annually
Milk	MKE-4, MKQ-5, MKQ-1, MKQ-45	gamma isotopic, I-131	Semi-mntly/mntly
Fish	FH-1, FH-2	gamma isotopic	In season or semi-annually
Food Products	FPG-1, FPP-1, FPQ-1	gamma isotopic	At harvest time
Broad Leaf	BLQ-1, BLB-1, BLK-15	gamma isotopic, I-131	Monthly When milk samples not collected

a. Based on requirements in Table 5.8-1 of Waterford 3 SES Offsite Dose Calculational Manual, Section 5.8-1.
b. Drinking and surface water samples are identical.

TABLE 2.2

DESCRIPTION OF REMP SAMPLING STATION LOCATIONS

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
DIRECT RADIATION (TLD)			
A-2	(Eastbank) Located on a utility pole on River Road (LA 628) at the south corner of the Zephrin L. Perriloux Fire Station (Station 5) in Montz, La.	1.1	N
B-1	(Eastbank) On fence enclosing the transmission tower 0.3 miles west (up-river) from Little Gypsy. Access from River Road (LA 628). TLDs are located at SW corner of fence enclosure.	0.8	NNE
C-1	(Eastbank) On fence enclosing the Little Gypsy Cooling Water Intake. Access is from River Road (LA 628) across from Little Gypsy Steam Electric Station entrance. TLDs are on the south side (inside) of the Cooling Water Intake fence enclosure, directly opposite the entrance gate.	0.8	NE

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
D-2	(Eastbank) Located approximately 0.3 miles east of Little Gypsy Power Station. Access from River Road (LA 628) near the west end of the Bonne Carre Spillway. TLDs are on the fence at the west entrance to the Spillway (located on levee).	1.1	ENE
E-1	(Westbank) Located on utility pole along River Road (LA 18) approximately 0.3 miles east of Waterford 3 plant entrance. Access from LA 18. TLDs are on the third utility pole east of the construction entrance road.	0.2	E
F-2	(Westbank) Located on fence enclosure surrounding the LP&L substation on LA 3142. Access from LA 3142 approximately 0.2 miles south of LA 18. TLDs are on the southeast corner of the fence enclosure.	1.1	ESE
G-2	(Westbank) Located on utility pole on east side of LA 3142 (Next to Union Carbide Star Plant Gate 3). Access from LA 3142 approximately 0.2 miles north of railroad overpass.	1.2	SE

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
H-2	(Westbank) Located on fence enclosure to shell road off of LA 3142. Access from LA 3142 south of railroad overpass on east side of LA 3142. TLDs are on the south side of the gate for shell road (just south of Texaco pipeline station).	1.2	SSE
J-2	(Westbank) Located on northeast corner of fence enclosing Texaco valve station south of LA 3127. Access from LA 3127, approximately 0.6 miles west of LA 3127/3142 intersection.	1.3	S
K-1	(Westbank) Located on fence at Gate 92 entrance off of LA 3127. Access from LA 3127, approximately 1.3 miles west of LA 3127/3142 intersection. (Gate 92 is the access to the Waterford 3 switch-yard station and training center.)	1.0	SSW
L-1	(Westbank) Located next to "Private Road" sign at LP&L Gate 97 entrance off of LA 3127, approximately 1.6 miles west of LA 3127/3142 inter-section. (Gate 97 is an access road for Waterford 3.)	1.0	SW

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
M-1	(Westbank) Located on south gate into the Waterford 1 and 2 SES fuel oil storage tank enclosure. Access is either thru LP&L Gate 92, Gate 97 off of LA 3127, the shell access road from LA 18 between Waterford 3, or through the Waterford 1 and 2 SES access road.	0.7	WSW
N-1	(Westbank) Located behind the "No Trespassing" sign off of Short Street, in Killona, just south of the entrance to Killona Elementary School.	0.9	W
P-1	(Westbank) Located on Short Street, in Killona. TLD is inside fence at air sample station APP-1.	0.8	WNW
Q-1	(Westbank) Located on fence enclosing air sample station approximately 0.5 miles west of Waterford 1 and 2 on River Road (LA 18).	0.8	NW
R-1	(Westbank) Located on fence enclosure for Waterford 1 and 2 Cooling Water Intake Structure. Access is from River Road (LA 18) opposite Waterford 1 and 2. TLDs are on the southwest corner of fence.	0.5	NNW

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
A-5	(Eastbank) Located on utility pole just east of the Shady Nook Trailer Park on Hwy 61 in LaPlace. TLDs are on second utility pole east of trailer park on north side of Hwy 61 (eastern end of LaPlace).	4.5	N
B-4	(Eastbank) Located on utility pole just east of shell access road to South Central Bell transmission tower on south side of Hwy 61. Transmission tower is just east of weigh station at St. John/St. Charles Parish line. TLDs are on the first utility pole east of access road.	3.8	NNE
D-5	(Eastbank) Located on fence gate on shell access road to Big 3 Chemical Plant. Shell access road is approximately 0.1 miles west of Hwy 61/48 intersection (at black and yellow gate). TLD's are on fence gate 0.1 miles north on shell access road from Hwy 61.	4.2	ENE
E-5	(Eastbank) Located on the Norco Substation fence enclosure. Access from River Road (LA 48) onto Wesco St. (adjacent to Norco Shell Chemical Plant), take Wesco St. to the dead end. TLDs are located on sixth fence post south of the north substation gate.	4.2	E

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
F-4	(Westbank) Located on utility pole behind blonde brick house on Aquarius St. in Hahnville. Access from River Road (LA 18) and turn onto Oak St. Follow Oak St. to Hickory St., turn right on Hickory St. and follow to Aquarius St. and turn left. Blonde brick house is second house on right (west) side of Aquarius St. heading south.	3.5	ESE
G-4	(Westbank) Located on railroad sign northwest side of LA 3160/railroad track intersection. Access from either LA 3127 or River Road (LA 18) onto LA 3160.	3.2	SE
H-6	(Westbank) Located on a road sign on the northwest side of the second canal bridge east of LA 3160 along LA 3127.	5.7	SSE
P-6	(Westbank) Located on a fence surrounding the Union Pacific communications tower at the LA 640/railroad intersection approximately 500 ft. from LA 640.	5.5	WNW
Q-5	(Westbank) Located on fence post surrounding (green) river marker on levee just east of Edgard. Fence post is located along River Road (LA 18) across from the Webre's house.	5.0	NW

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
R-6	(Eastbank) Located on fence enclosing LP&L laydown yard on LA 3223 in LaPlace. Access from Hwy 61 onto Elm St. (LA 3223), take Elm St. to the northeast corner of LA 3223/railroad intersection. TLDs are located on the southeast corner of fence enclosure.	5.3	NNW
F-9	(Eastbank) Located on entrance gate to Destrehan Substation. Access from River Road (LA 48), approximately 1.5 miles east of Luling-Destrehan Ferry, onto Jonathan Street (west of Bunge Corp. Grain Elevator), and proceed to substation gate.	8.2	ESE
G-9	(Westbank) Located on back fence of LP&L District Office in Luling. Access via Ellington St. from either River Road (LA 18); or Second or Third St. from Paul Mallaird Rd. (LA 52) to Ellington St.	8.1	SE
E-15	(Eastbank) Located on Kenner Substation fence enclosure. Access from either River Road (LA 48) or Hwy 61, turn onto Alliance Ave. TLDs are located on the north side of the fence enclosure, near a light pole.	11.8	E

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
J-15	(Westbank) Located on fence enclosure surrounding LP&L switchyard at LA 631/Hwy 90 intersection in Des Allemands. TLDs are on the northwest corner of fence. Access from LA 631 via shell road.	12.0	S
E-30*	(Westbank) at LP&L General Office on Delaronde St. in Algiers. TLDs are in the courtyard at the south entrance to the building.	27.0	E
AIRBORNE			
APP-1	(Westbank) Located in soybean/ sugarcane field at northwest corner of Short St. in Killona.	0.8	WNW
APQ-1	(Westbank) Located at northwest corner of soybean/sugarcane field on east side of Killona. Access from River Road (LA 18) approximately 0.6 miles east of LA 18/3141 intersection.	0.8	NW
APG-1	(Westbank) Located at the north side of the Secondary Meteorological Tower.	0.5	SE

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
APC-1	(Eastbank) Located inside the Little Gypsy Cooling Water Intake Structure fence enclosure.	0.8	NE
APE-30*	(Westbank) Located on the roof of the LP&L General Office building on Delaronde St. in Algiers.	27.0	E
WATERBORNE			
DWG-2 SWG-2	(Westbank) Located at the Union Carbide drinking water canal. Access from LA 3142 through Gate 28.	2.0	SE
DWE-5 SWE-5	(Eastbank) Located at the St. Charles Parish Waterworks off of River Road (LA 48) near New Sarpy.	4.5	E
DWP-7* SWP-7*	(Westbank) Located at the St. John Parish Waterworks off of LA 18 in Edgard.	6.5	WNW
SHWE-3	(Westbank) Located at the Foot Ferry Landing off of LA 18 in Taft.	3.0	E
SHWK-1	(Westbank) Located at the 40 Arpent Canal south of the Plant. Access from LA 3127 through Gate 92.	0.5	SSW

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
GWK-1	(Westbank) Located at 40 Arpent Canal south of the plant. Access from LA 3127 through LP&L Gate 92 which is at the Waterford 3 Training Center. The canal is northwest of the shell access road/railroad track intersection.	0.5	SSW
INGESTION			
MILK			
MKQ-1	(Westbank) 1.0 miles west of Waterford 3 SES at the corner of River Road and Post Street in Killona.	1.0	NW
MKQ-5	(Westbank) Located at the Webre's house, just across LA 18 from river marker, at the eastern end of Edgard.	4.9	NW
MKQ-45*	(Eastbank) Located off of I-12 in Denham Springs, take LA 3002 south to LA 1034, then right to LA 1032, then left. Farm is 1 mile on the right.	42	NW

TABLE 2.2

(CONTINUED)

LOCATION NUMBER	LOCATION DESCRIPTION	MILES FROM PLANT	SECTOR DIRECTION
FISH			
FH-1*	Upstream of the plant intake structure.	NA**	NA**
FH-2	Downstream of the plant discharge structure.	NA**	NA**
BROAD LEAF			
BLQ-1	(Westbank) Located between LA 18 and soybean field on eastern edge of Killona, near air sample station APQ-1.	0.8	NW
BLB-1	(Eastbank) Located at wooded area at the southwestern corner of the LP&L Little Gypsy plant along River Road.	0.8	NNE
BLK-15*	(Westbank) Located 3.5 miles SSW of Des Allemands on Hwy. 90.	15	SSW
FOOD PRODUCTS***			
FPP-1	(Westbank) Located in sugarcane/ soybean field on eastern edge of Killona, between air sample stations APP-1 and APQ-1.	0.8	WNW
FPG-1	(Westbank) Located in a sugarcane/ soybean field east of Waterford 3 near the back-up meteorological tower and air sample station APG-1.	0.4	SE

TABLE 2.2

(CONTINUED)

* DENOTES CONTROL LOCATION

** NA - NOT APPLICABLE

*** Food products are not required since no areas surrounding the plant are irrigated with water into which plant wastes are discharged. Food products grown within the site boundary were collected however, in order to demonstrate the absence of man-made radionuclides.

TABLE 2.3

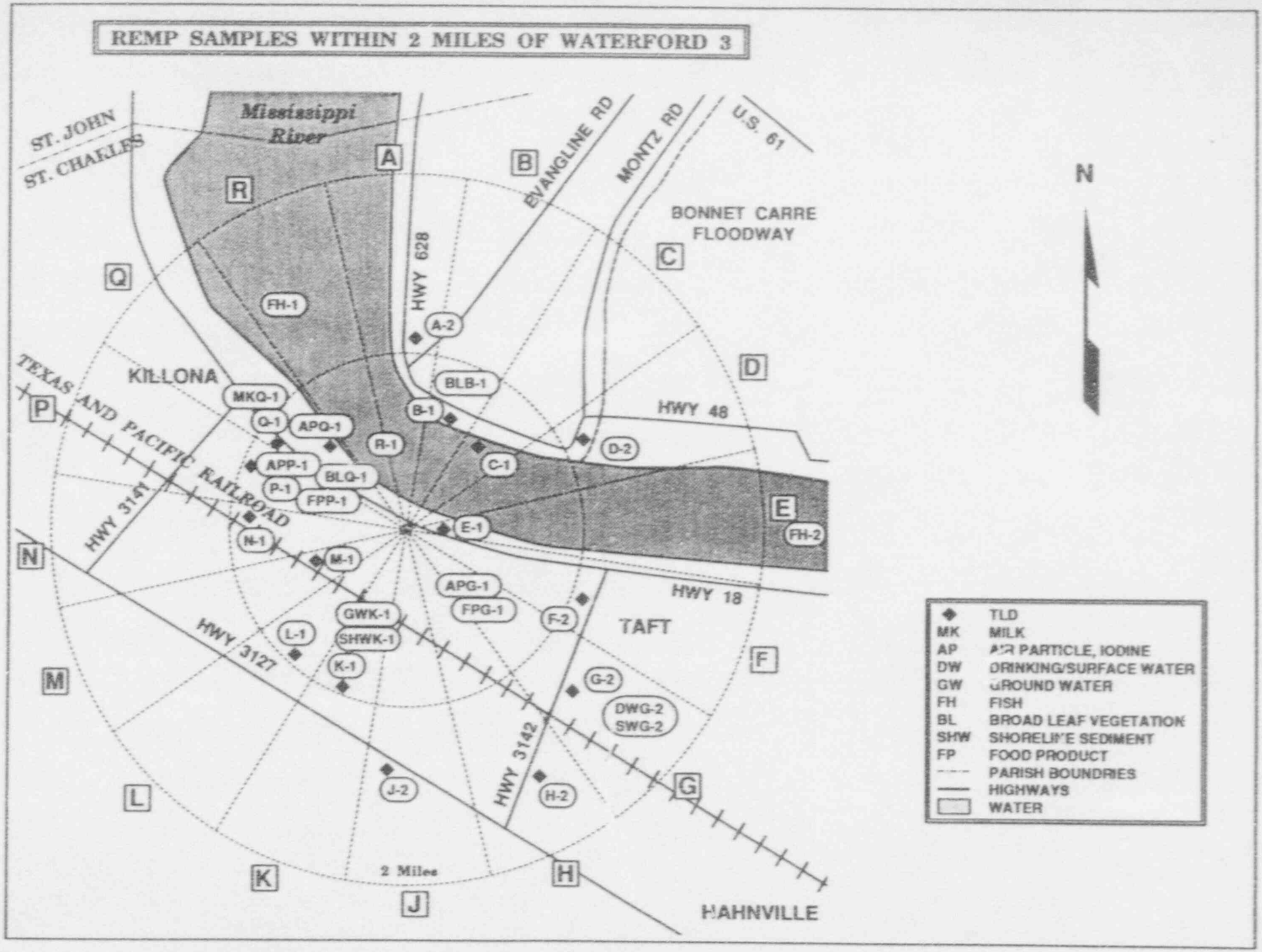
DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS

LOWER LIMIT OF DETECTION (LLD) [a]

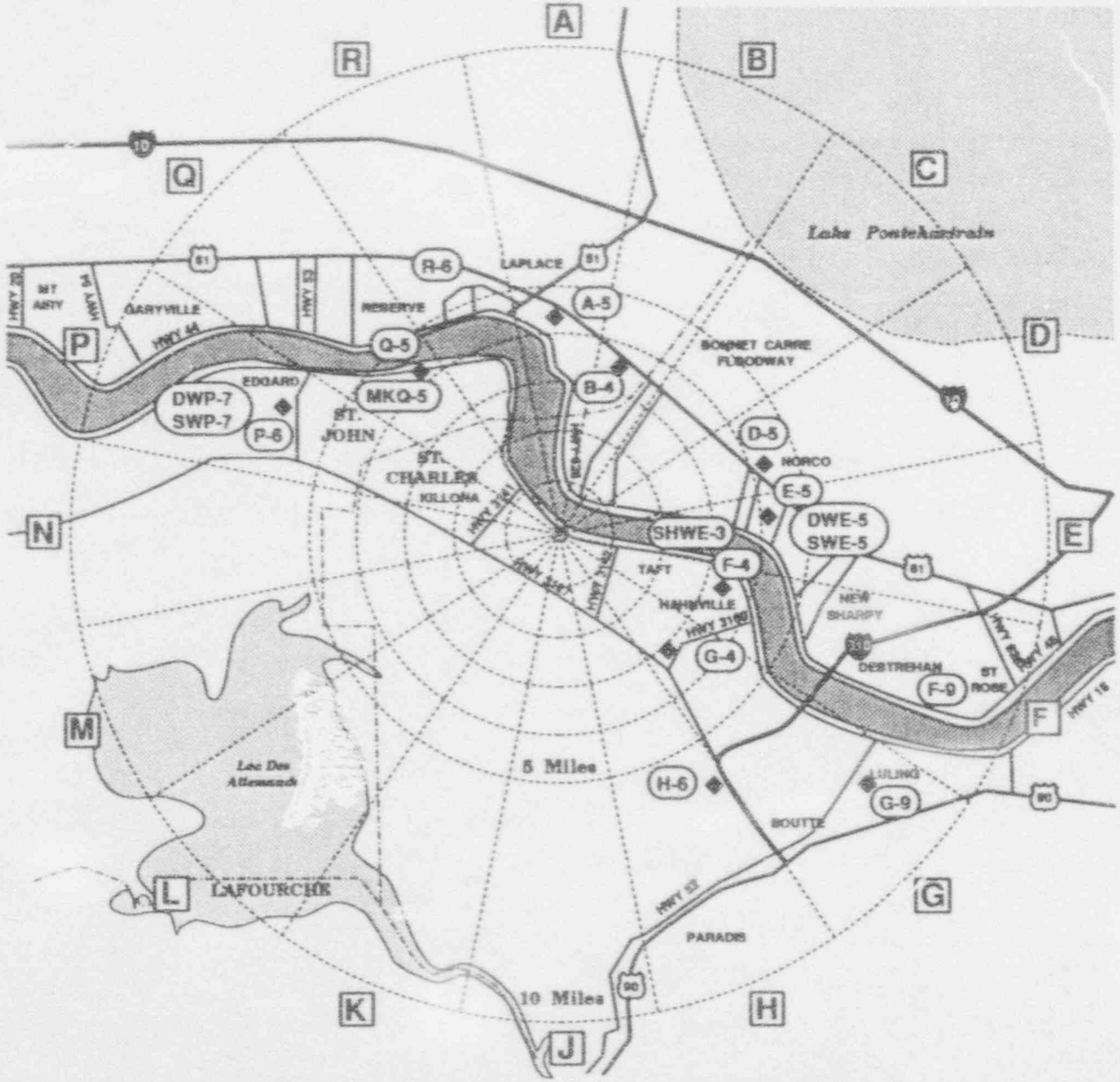
ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GAS (pCi/m^3)	FISH (pCi/kg-wet)	MILK (pCi/l)	FOOD PRODUCTS[b] (pCi/kg-wet)	SEDIMENT (pCi/kg-dry)
gross beta	4	0.01				
H-3	2000					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

a. From Table 5.8-3 of Waterford 3 SES Offsite Dose Calculation Manual.

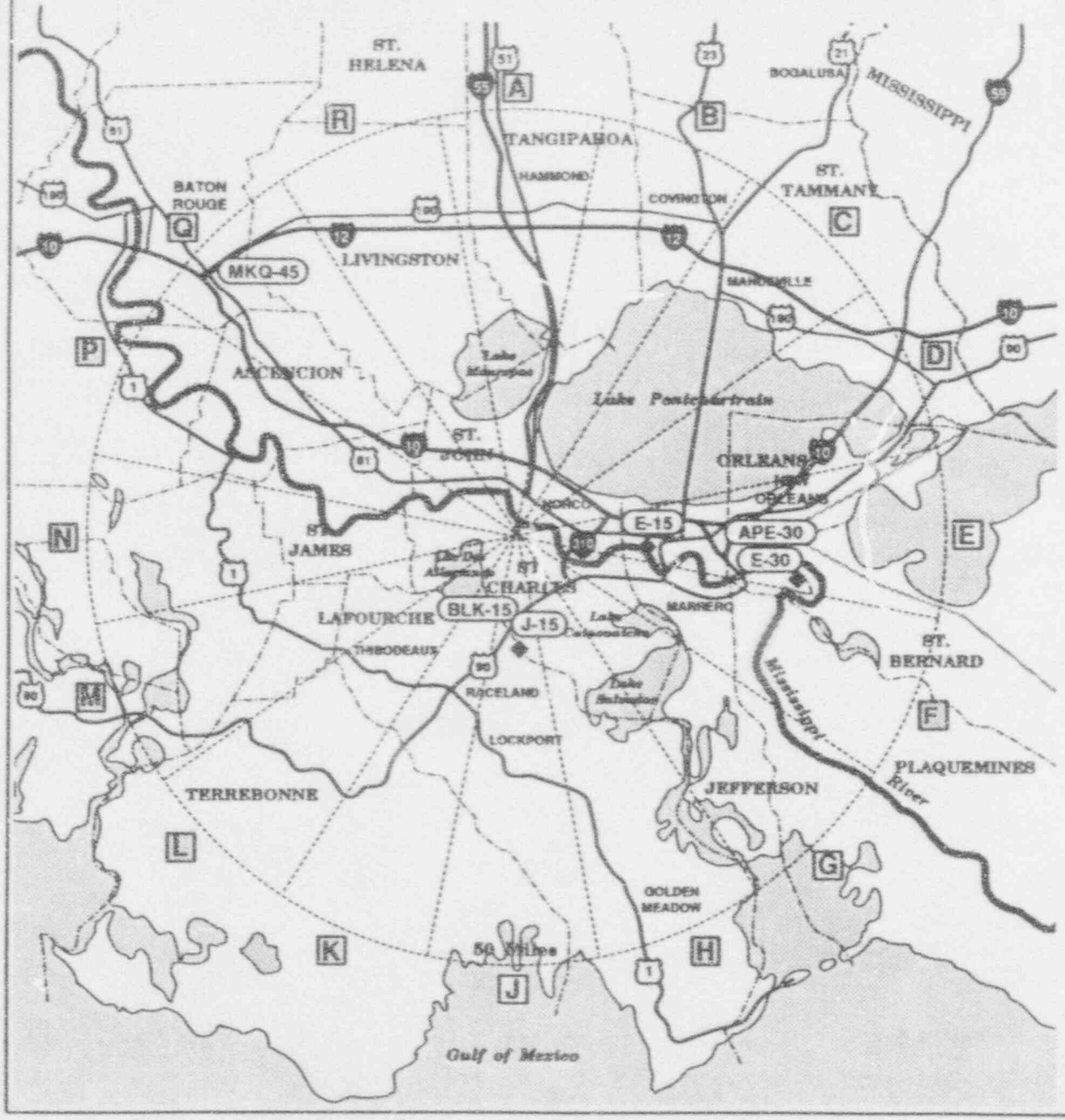
b. Applicable to broad leaf vegetation.


REMP SAMPLES WITHIN 2 MILES OF WATERFORD 3
Mississippi River
ST. JOHN
ST. CHARLES
EVANGLINE RD
MONTZ RD
U.S. 61
BONNET CARRE FLOODWAY
HWY 628
HWY 48
HWY 18
KILLONA
TEXAS AND PACIFIC RAILROAD
HWY 3141
HWY 3127
HWY 3142
TAFT
HAHNVILLE
2 Miles
A
B
C
D
E
F
G
H
J
K
L
M
N
P
Q
R
FH-1
A-2
BLB-1
B-1
D-2
C-1
MKQ-1
Q-1
APQ-1
R-1
APP-1
BLQ-1
P-1
FPP-1
N-1
M-1
E-1
FH-2
APG-1
FPG-1
F-2
GWK-1
SHWK-1
L-1
K-1
G-2
DWG-2
SWG-2
J-2
H-2
N
TLD
MK MILK
AP AIR PARTICLE, IODINE
DW DRINKING/SURFACE WATER
GW GROUND WATER
FH FISH
BL BROAD LEAF VEGETATION
SHW SHORELINE SEDIMENT
FP FOOD PRODUCT
PARISH BOUNDRIES
HIGHWAYS
WATER

REMP SAMPLES WITHIN 10 MILES OF WATERFORD 3



REMP SAMPLES WITHIN 50 MILES OF WATERFORD 3



N

◆ TLD
MK MILK
AP AIR PARTICLE, IODINE
BL BROAD LEAF VEGETATION
PARISH BOUNDRIES
HIGHWAYS
WATER

3.0 DISCUSSION OF RESULTS

Analytical results for the year 1993 are discussed in this section by exposure pathway, sample type, and analysis performed. Further, analytical results focusing only on man-made radioactivity are summarized in Appendix A; data for the individual analyses are presented in the tables of Appendix B.

3.1 Direct Radiation Exposure Pathway

The average exposure rates measured by thermoluminscent dosimeters (TLDs) at both control and indicator stations were 12, 12, 11, and 16 mrem/standard quarter for the first, second, third, and fourth quarters of 1993 respectively. The average exposure rate of the 123 indicator TLD locations was 13 mrem/standard quarter compared to 11 mrem/standard quarter average exposure rate at the control location. The lowest and highest individual exposure rates were 8 mrem/standard quarter (D-2, 2nd quarter; C-1 and E-15, 3rd quarter) and 23 mrem/standard quarter (R-6, 4th quarter), respectively, for all locations. Table 3.1 compares the indicator TLD results by directional sector and distance from the facility. A comparison of directional sectors indicates the highest average exposure rate in 1993 to be 14 mrem/standard quarter in Sectors A,B, N, and P.

The average exposure rates during 1993 are consistent with those from the pre-operational program and the previous five years of operation (Figure 3.1). In particular, the pre-operational survey indicates that exposure rates ranged between 11 and 33 mrem/standard quarter with an average of 20 mrem/standard quarter. Similarly, the range indicated during the previous five years of operation was from 7 to 24 mrem/standard quarter with an average exposure rate of 13 mrem/standard quarter.

3.2 Airborne Exposure Pathway

3.2.1 Airborne Particulates

Gross beta activity ranged from 0.004 pCi/m^3 (APG-1, 8/2-8/10 and APE-30, 8/31-9/7) to 0.032 pCi/m^3 (APQ-1, 7/20-7/27) with an average of 0.014 pCi/m^3 for 257 measurements from all five locations. The average gross beta activity for the indicator (APG-1, APQ-1, APP-1, APC-1) locations was 0.014 pCi/m^3 compared to 0.015 pCi/m^3 at the control (APE-30) location.

The gross beta activity results obtained during 1993 are consistent with those from the pre-operational program and the previous five years of operation (Figure 3.2). Specifically, the pre-operational survey indicates that in periods not significantly influenced by nuclear weapons testing the gross beta activity ranged between 0.007 and 0.48 pCi/m^3 with an average of .08 pCi/m^3. Similarly, the range indicated during the previous five years of operation was from 0.003 to 0.046 pCi/m^3 with an average activity of 0.016 pCi/m^3.

3.2.2 Airborne Iodine

All of the 257 airborne iodine-131 results were below the calculated lower limit of detection (LLD). The sample LLD variability (0.010 to 0.035 pCi/m^3) was due primarily to the difference in air sample volumes.

3.2.3 Gamma Isotopic Analysis

Gamma spectroscopy results of the twenty air sample quarterly composites indicate that no man-made radionuclides were detected above their respective lower limits of detection.

3.3 Waterborne Exposure Pathway

3.3.1 Drinking/Surface Water

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

Seventy-seven composite drinking/surface water samples were analyzed by a radiochemical procedure for iodine-131 (Table B-4). Iodine was detected in one indicator sample (DWG-2, 6/15-6/29) and in one control sample (DWP-7, 11/2-11/16) at an average concentration of 0.2 pCi/l. Iodine-131 was detected in several preoperational samples at an average concentration of 0.4 pCi/l. The levels detected in the 1993 samples were well below reporting levels and the LLD required by the Waterford 3 ODCM and has a high degree of uncertainty associated with it.

Gross beta activity was detected in twenty-seven of the thirty-nine composites with a range of 2.2 (DWE-5, 6/29-7/27) to 11.7 (DWG-2, 9/21-10/19) pCi/l and an average activity of 5.8 pCi/l. The average activity for the control location, DWP-7, was 4.9 pCi/l compared to the averages of 6.3 and 5.8 pCi/l for indicator stations DWG-2 and DWE-5 respectively.

Analyses for gross beta in drinking/surface water were not performed during the pre-operational survey. However, in order to fulfill comparison requirements, 1993 data will be compared to data from the 1983 report and the previous five years of operation.

The gross beta activity results obtained during 1993 are consistent with those from the 1983 reporting period and the previous five years of operation (Figure 3.3). In particular, the 1983 survey indicates that in periods not significantly influenced by nuclear weapons testing the gross beta activity ranged between 2.9 and 14.0 pCi/l with an average of 7.0 pCi/l. Similarly, the range indicated during the previous five years of operation was from 1.1 to 11 pCi/l with an average activity of 4.3 pCi/l.

Tritium analysis of drinking/surface water samples indicate that all of the twelve measurements were below the calculated LLD.

3.3.2 Groundwater

Four groundwater samples were collected from one sampling location, GWK-1, and analyzed for tritium and gamma emitters. Gamma emitters were not detected; however, tritium was detected in two of the four samples at concentrations of 270 +/- 260 and 440 +/-260 pCi/l.

The tritium concentrations detected in 1993 are consistent with those from the pre-operational program and the previous five years of operation. In particular, the pre-operational survey indicates that tritium concentrations in groundwater samples ranged between 50 and 180 pCi/l with an average of 121 pCi/l. Similarly, the range indicated in the previous five years of operation was from 270 to 650 pCi/l. Tritium levels detected in 1993 are well below the reporting levels and the LLD required by the Waterford 3 ODCM, and have a high degree of uncertainty associated with it.

3.3.3 Shoreline Sediment

Four shoreline soil samples were collected f[illegible]e following sampling locations: two samples fr[illegible] the Mississippi River shoreline downriver of the plant (SHWE-3) and two samples from the shoreline of a drainage canal (SHWK-1).

Naturally occurring radionuclides including potassium-40, radium-226, and actinium-228 were detected in all of the samples. Cesium-137, a man-made nuclide was detected in samples from station SHWK-1 at concentrations of 37 and 35 pCi/kg(dry). No other man-made radionuclides were detected in any of the samples.

The cesium-137 results obtained during 1993 are consistent with those from the pre-operational program and the previous five years of operation. In particular, the pre-operational survey indicates that cesium-137 was detected in 9 of 14 soil samples at concentrations ranging between 30 and 890 pCi/kg(dry) with an average concentration of 164 pCi/kg (dry). Similarly, the range indicated during the previous five years of operation was from 18 to 142 pCi/kg (dry) with an average activity of 53 pCi/kg (dry) respectively. Further, studies in Louisiana indicate that cesium-137 is commonly found in soils and sediments as a result of atmospheric weapon testing. Because the cesium-137 levels are consistent with pre-operational values and cesium-137 has been shown to be present in most Louisiana soils, these cesium-137 levels are more than likely attributable to weapon testing fallout.

3.4 Ingestion Exposure Pathway

3.4.1 Milk

Forty-eight milk samples were collected from two sampling locations and analyzed by gamma spectroscopy and a radiochemical procedure for iodine-131. Naturally occurring potassium-40 was detected in all samples. Additional results from these analyses indicate that iodine-131 was detected in one indicator (MKQ-5, 11/17) and one control (MKQ-45, 11/30) location at concentrations of 0.3 +/- 0.2 and 0.2 +/- 0.2 pCi/liter, respectively. Iodine-131 was detected in preoperational samples at an average concentration of 1.3 pCi/liter and a range of 0.7 to 2.5 pCi/liter. The levels detected in 1993 are below both reporting levels and the LLD required by the Waterford 3 ODCM and have a high degree of uncertainty associated with them.

3.4.2 Fish

Sixteen fish samples, eight upstream and eight downstream of the plant were collected and the edible portions analyzed by gamma spectroscopy. Only naturally occurring potassium-40 was detected above the lower limits of detection in any samples.

3.4.3 Broad Leaf Vegetation

Thirty-six broad leaf vegetation samples were collected and analyzed by gamma spectroscopy and a radiochemical procedure for iodine-131. Naturally occurring radionuclides were detected in all of the samples; however, no man-made radionuclides were detected above their calculated LLDs.

3.4.4 Food Products

Two food products samples were collected and analyzed by gamma spectroscopy and a radiochemical procedure for iodine-131. Naturally occurring potassium-40 was detected in all the samples; however, no man-made radionulides were detected above their calculated LLDs.

3.5 Statistical Analyses

3.5.1 Calculation of the Mean and Standard Deviation

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

(F-1)

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

(F-2)

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

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.

3.5.2 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)):

(F-3)

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

where:

t = calculated "t" value,
x = mean of first data set,
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.

If the data from both sample populations are treated as correlated pairs, the difference between individual measurements can be examined using the statistical "t" test. In this case, if the true means and true standard deviations for the sample populations are equal, the difference between the correlated data points should be normally distributed about a mean of zero. The "t" value can be calculated from the following equation (obtained from the CRC Standard Mathematical Tables, 26th Edition (1981)):

(F-4)

$$t = \frac{\bar{d}\,(n)^{0.5}}{s_d}$$

where:

$\bar{d}$ = the average of the difference between the correlated data points from the two sample populations:

$$\bar{d} = \sum_{i=1}^{n} \frac{(x_i - y_i)}{n}$$

x_i = the i'th data point from population x,
y_i = the i'th data point from population y,
N = the number of correlated pairs of data points,
n = degrees of freedom, for equation F-4, n=N-1, and
s_d = the standard deviation of the difference between the correlated data points.

The calculated "t" value in both cases is used to test the hypothesis that the true mean of the first population (μ_x) is equal to the true mean of the second population (μ_y) assuming that the true standard deviations of both populations are equal ($\mu_x = \mu_y$). The calculated "t" value is compared to a tabular "t" value such that:

a. if $t > t_{\alpha,n}$ then reject the hypothesis when $\mu_x > \mu_y$,

b. if $t < -t_{\alpha,n}$ then reject the hypothesis when $\mu_x < \mu_y$,

c. if $t > t_{\alpha/2,n}$ then reject the hypothesis when $\mu_x = \mu_y$,

where $t_{\alpha/2,n}$ and $t_{\alpha,n}$ are the tabular "t" values, with a preselected error (5 percent in this case), confidence level $(1 - \alpha)$ or $(1 - \alpha/2)$, and degrees of freedom n ($n=n_x+n_y-2$ for Equation F-3 and n=N-1 for F-4, respectively). Tabular values of the "t" were obtained from the CRC Standard Mathematical Tables, 26th Edition (1981).

3.5.3 TLD Measurements

TLD stations were categorized by distance into three groups: 0-2 miles, 2-5 miles, and >5 miles from the plant. A statistical analysis using the standard "t" test (described above) was performed comparing the average exposure rates from 0-2 miles and 2-5 miles to the average exposure rate at >5 miles. In short, the results of the analyses indicate that the average exposure rate at 0-2 miles and 2-5 miles to be statistically the same as at >5 miles. Table 3.2 summarizes the results of this analysis.

3.5.4 Gross Beta Activity on Air Particulate Filters

Additionally, 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. While the results from this test show average activity detected at indicator stations APG-1, APQ-1, and APC-1 to be statistically the same as the activity detected at the control station, activity at indicator station APP-1 was statistically lower than activity detected at the control station. Table 3.3 summarizes the result of this analysis.

3.5.5 Gross Beta Activity in Monthly Drinking Water Composites

Finally, the standard "t" test was used to compare average gross beta activity from the two indicator stations to the average gross beta activity from the control station. The results from this test show average activity at indicator stations (DWG-2 and DWE-5) to be statistically the same as the average activity detected at the control station. Table 3.4 summarizes the result of this analysis.

3.6 Deviations from the REMP

3.6.1 Unavailable Samples

Deviations from the REMP associated with missing TLDs resulted from theft of the dosimeters and were beyond the control of Waterford 3. One TLD was discovered missing from location G-4 during dosimeter change-out at the end of the third quarter. Consequently, the missing TLD was replaced and the deviation recorded.

Three air samples were unavailable for analysis during the 1993 reporting period. At indicator location APP-1, a sample pump malfunctioned during the week of 2/16-2/24. Upon discovery, the pump was replaced with a new pump and the calibration was tested. At locations APP-1 during the week of 3/23-3/30 and APE-30 during the week of 7/27-8/3, the technician failed to restart the pump when collecting the previous week's sample. All deviations were recorded and a new sample collection method was implemented which allows sample collection while the sample pump is running to prevent recurrence.

Additionally, seven air samples failed to meet the requirement for sample continuity. While two failures were due to a electrical malfunction at the sample locations, the other five continuity failures were the result of intentional shut downs to accomodate electrical enhancements of the sample equipment.

Milk samples were not available during 1993 from the animal owners at station MKQ-1 since the cows are not currently producing milk for human consumption. With the absence of milk samples at these stations, broad leaf vegetation sampling was performed.

A list of deviations and associated explanations is provided in Table 3.5.

3.6.2 Missed Lower Limits of Detection

All lower limit of detection requirements were met for 1993.

3.7 Annual Land Use Census

In compliance with Waterford 3 ODCM, the annual land use census was conducted on October 19, 20, 21, and 22, 1993. The nearest residence, garden, and milking animal in each sector within a five mile radius of the plant were located by visual inspection and verbal inquiry.

New residence locations and minor changes in garden locations were observed as recorded on Table 3.6. Additionally, large tracts of sugar cane are still being cultivated near the plant and remain classified as food products.

Several new milking animals were identified as a result of this census; however, none of the animals are currently producing milk for human consumption. This information was ascertained by verbal inquiry with the owners of the animals. In addition, the owners at all locations have agreed to sell milk samples to Waterford 3 in the event of a radiological emergency to provide additional data for analysis of environmental impact.

TABLE 3.1

1993 DIRECT RADIATION DATA
ORGANIZED BY COMPASS DIRECTION
AND DISTANCE FROM WATERFORD 3 SES

BY COMPASS DIRECTION

SECTOR	COMPASS DIRECTION	AVERAGE DOSE RATE (mrem/std qtr)	STANDARD DEVIATION (mrem/std qtr)	NUMBER IN GROUP
A	N	14	1.47	8
B	NNE	14	1.68	8
C	NE	10	1.79	4
D	ENE	11	1.98	8
E*	E	12	2.25	12
F	ESE	12	2.03	11
G	SE	13	2.56	12
H	SSE	13	1.97	8
J	S	12	2.47	8
K	SSW	12	1.60	4
L	SW	13	1.06	4
M	WSW	13	1.79	4
N	W	14	1.85	4
P	WNW	14	1.37	8
Q	NW	13	2.32	8
R	NNW	13	1.78	8
CONTROL	E	11	1.79	4

BY DISTANCE FROM PLANT

DISTANCE FROM PLANT (MILES)	AVERAGE DOSE RATE (mrem/std qtr)	STANDARD DEVIATION (mrem/std qtr)	NUMBER IN GROUP
0 - 2	13	1.81	63
2 - 5	13	1.87	27
5(a)	14	2.19	28
CONTROL	11	1.79	4

* Does not include control station data.

TABLE 3.2

STATISTICAL COMPARISON OF 1993 TLD MEASUREMENTS FROM
STATIONS GROUPED BY DISTANCE FROM WATERFORD 3 SES

	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.)	12.45(13)	13.30(13)	13.32(13)
Standard Deviation (mrem/std. qtr.)	2.27	2.21	3.04
Number in Sample	64	27	28
Calculated "t" Value to Comparisons with Stations Located more than 5 miles from the Plant	1.52	0.03	NA*
Tabular "t" Value at 95% Confidence ($t_{0.025,n}$)	1.990(a)	2.008(a)	NA*

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

*Not Applicable

TABLE 3.3

STATISTICAL COMPARISONS OF GROSS BETA ACTIVITY
ON AIR PARTICULATE FILTERS FOR 1993

SAMPLE STATION	APC-1	APG-1	APP-1	APQ-1	APE-30
Mean (10^{-3}pCi/m^3)	15.0	14.8	13.1	14.3	15.4
Standard Deviation (10^{-3}pCi/m^3)	4.28	4.59	4.15	4.82	4.45
Number in Sample	52	52	50	52	51
Calculated "t" Value Comparing Control Station (APE-30) to Indicator Station	0.58	1.15	2.66	0.44	NA*
Tabular "t" Value at 95% Confidence ($t_{0.025,n}$)	1.986	1.986	1.987	1.986	NA*

* Not Applicable

TABLE 3.4

STATISTICAL COMPARISON OF GROSS BETA ACTIVITY
IN MONTHLY DRINKING WATER COMPOSITES FOR 1993

SAMPLE STATION	DWG-2	DWE-5	DWP-7
Mean (pCi/l)	6.3	5.8	4.9
Standard Deviation (pCi/l)	2.8	3.1	2.9
Number in Sample	12	10	5
Calculated "t" Value Comparing Control Station (DWP-7) to Indicator Station	0.87	0.50	NA*
Tabular "t" Value at 95% Confidence ($t_{0.025,n}$)	2.080	2.101	NA*

* Not Applicable

TABLE 3.5

SUMMARY OF 1993 REMP DEVIATIONS

SAMPLE TYPE	ANALYSIS	LOCATION	DATE	EXPLANATION
MISSED SAMPLES				
1. Direct Radiation	N/A*	G-9	First Quarter	TLD Stolen
2. Air	Gr. Beta & I-131	APP-1	02/16/93-02/24/93	Sample pump malfunction
3. Air	Gr. Beta & I-131	APP-1	03/23/93-03/30/93	Technician failed to restart
4. Air	Gr. Beta & I-131	APE-30	07/27/93-08/03/93	Technician failed to restart
LACK OF SAMPLE CONTINUITY				
1. Air	N/A*	APQ-1	12/29/92-01/05/93	Tripped breaker
2. Air	N/A*	APG-1	03/30/93-04/06/93	Electrical enhancement
3. Air	N/A*	APQ-1	04/06/93-04/13/93	Electrical enhancement
4. Air	N/A*	APP-1	05/11/93-05/18/93	Electrical enhancement
5. Air	N/A*	APC-1	05/18/93-05/25/93	Electrical enhancement
6. Air	N/A*	APE-30	06/01/93-06/08/93	Electrical enhancement
7. Air	N/A*	APG-1	08/03/93-08/10/93	Electrical circuit failure
MISSED LLDs				
NONE	N/A*	N/A*	N/A*	N/A*

*Not Applicable.

TABLE 3.6

1993 ANNUAL LAND USE CENSUS RESULTS

SECTOR	DIRECTION	DISTANCE FROM PLANT IN MILES					
		BEEF COW	MILK COW	MILK GOAT	GARDEN	RESIDENCE	FOOD PRODUCTS
A	N	3.5	3.5[c]	3.9[c]	1.7	1.3	4.1
B	NNE	-	-	-	1.4	1.1	-
C	NE	1.3	-	-	0.9	0.9	-
D	ENE	-	-	-	0.9	0.9	-
E	E	2.3	-	-	2.2	2.2	0.3
F	ESE	2.3	3.1[c]	-	2.2	3.1	0.3
G	SE	2.4	-	-	4.1	4.0	0.3
H	SSE	-	-	-	-	-	0.3
J	S	-	-	-	-	-	0.5
K	SSW	-	-	-	-	-	0.5
L	SW	-	-	-	-	-	0.5
M	WSW	1.0	-	-	1.4	-	0.5
N	W	1.0	-	-	1.1	0.9	0.6
P	WNW	0.9	-	-	0.9	0.9	0.5
Q	NW	0.9	4.9[a,b]	-	0.9	0.9	0.5
R	NNW	2.3	4.9[c]	-	3.0	3.0	2.6

- None found in sector within five mile radius of the plant.

a Samples are being taken at 4.9 miles (MKE-5) for the Waterford 3 REMP.

b Cows at Location MKQ-1 are currently not producing milk for human consumption. The owner will be contacted on a periodic basis to determine if milk will be used for human consumption and for the availability of samples.

c Cows located in these locations are currently not producing milk for human consumption. The owners will be contacted on a periodic basis to determine if milk will be used for human consumption and for the availability of samples.

4.0 CONCLUSIONS

The radiological environmental data collected during 1993 are consistent with the data obtained during the previous five years of plant operation (1988-92), the first two years of the REMP prior to Waterford 3 initial criticality (1983-84), and the Pre-operational Environmental Radiological Surveillance (PERS) Program (1978-82). The only man-made radionuclides detected in the environmental samples analyzed during 1993 were cesium-137, iodine-131, and tritium.

Cesium-137 was detected in two shoreline soil samples. Studies in Louisiana indicate that cesium-137 is commonly found in soils and sediments as a result of fallout from nuclear weapons testing. In addition, the detected concentrations were consistent with pre-operational levels and the levels detected in the previous five years of operation. Further, the concentrations detected in both instances were lower than the required LLD and well below levels requiring notification.

Iodine-131 was detected in drinking/surface water at one indicator and one control location in June and November, respectively. In addition, iodine-131 was detected in milk at one indicator and one control location in November. The activity detected in all instances was at levels below the required LLD and well below reporting levels defined in the Waterford 3 ODCM. In addition, iodine-131 concentrations detected in 1993 are consistent with the levels indicated in the pre-operational program and the previous five years of operation. Further, levels detected had a high level of uncertainty associated with them and may be artifacts of counting statistics.

Tritium activity detected in two groundwater samples was consistent with pre-operational levels and the concentrations recorded in the previous five years of operation. Additionally, the concentrations detected in the analyses are below both the required LLD and reporting levels defined in the Waterford 3 ODCM. Further, statistical errors associated with the indicated concentrations are higher than would be expected with true activity.

In conclusion, based on the evaluation of the REMP data collected during 1993 the operation of Waterford 3 had no discernable radiological impact on the environment.

FIGURE 3.1

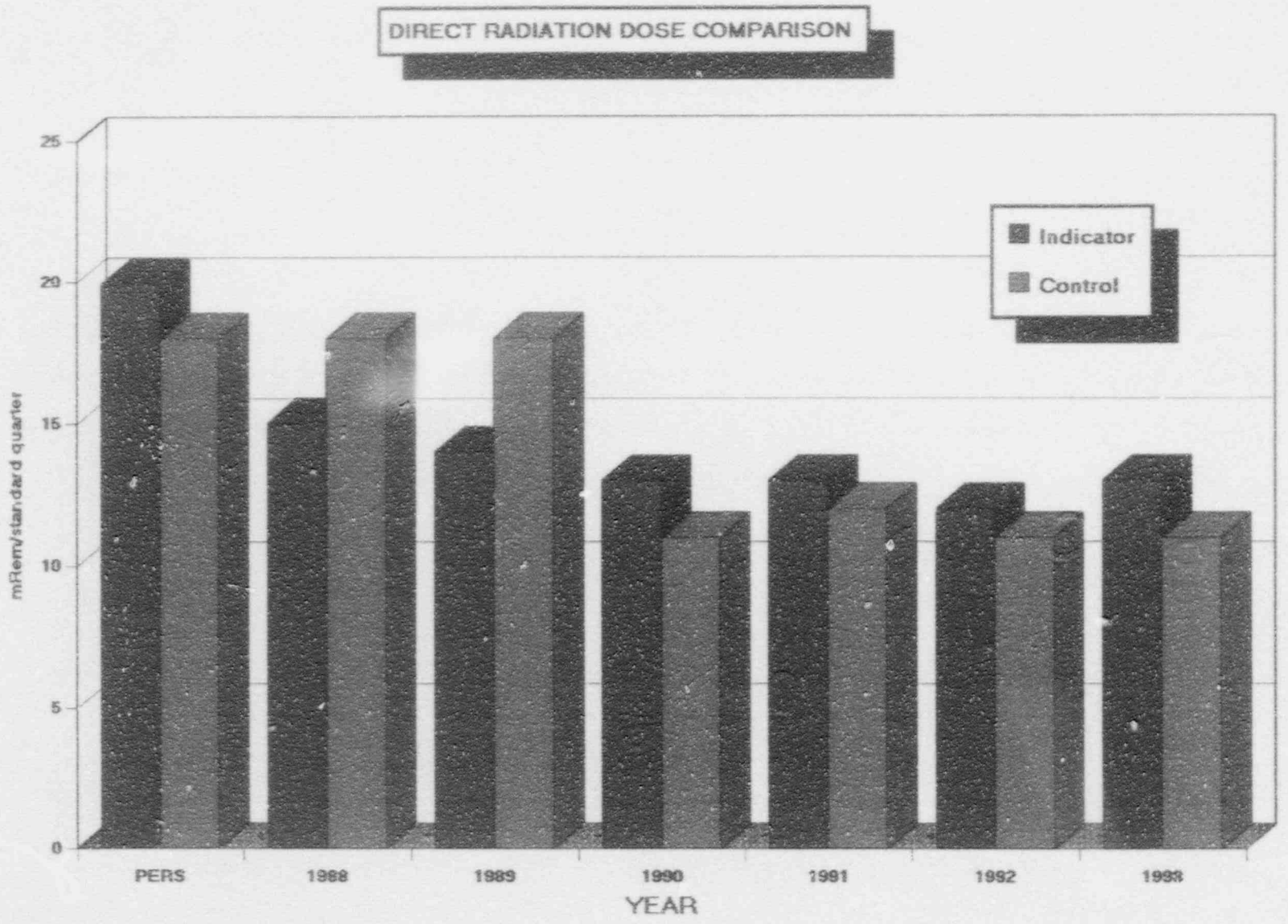

DIRECT RADIATION DOSE COMPARISON
Indicator
Control
mRem/standard quarter
25
20
15
10
5
0
PERS
1988
1989
1990
1991
1992
1993
YEAR

FIGURE 3.2

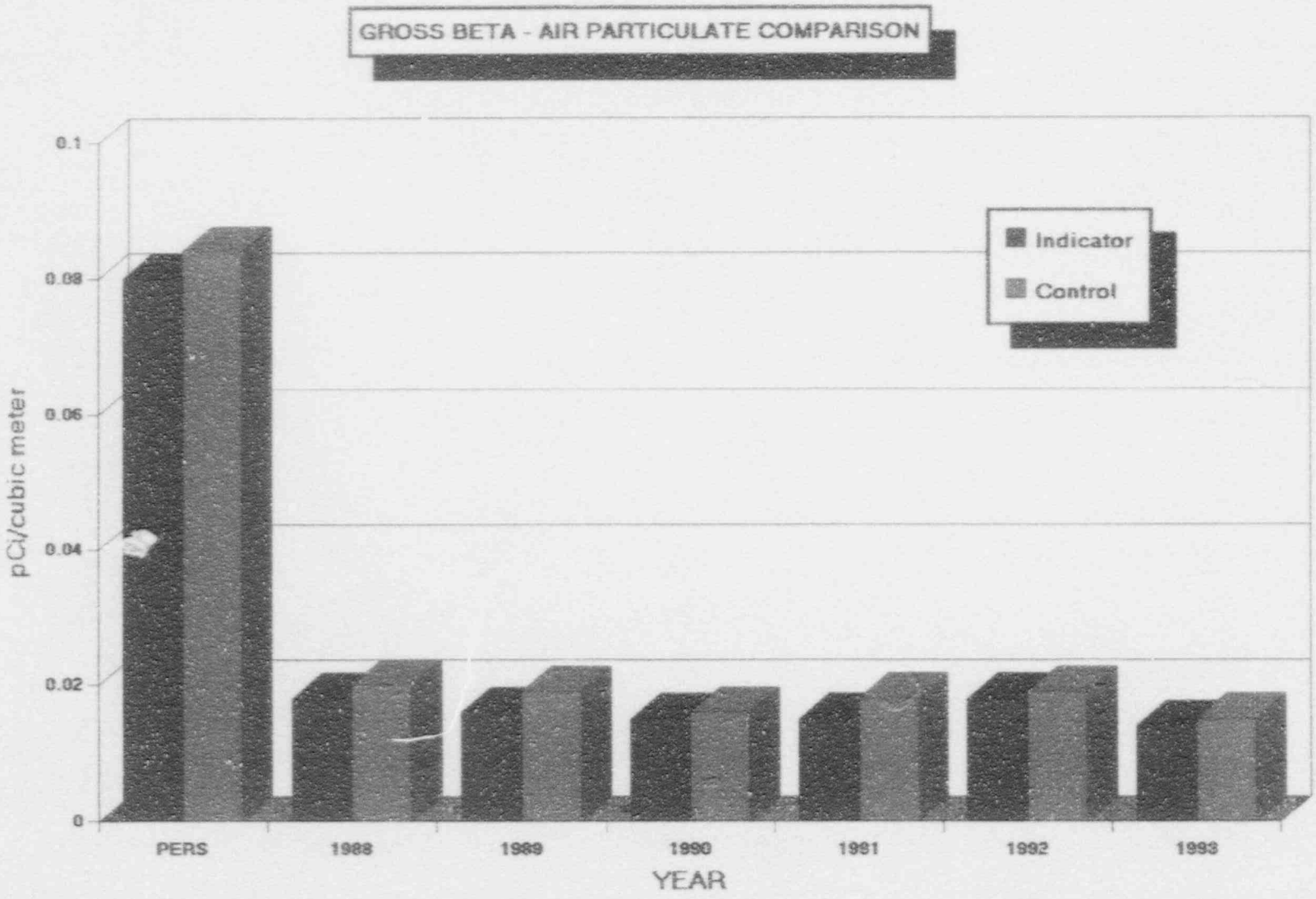
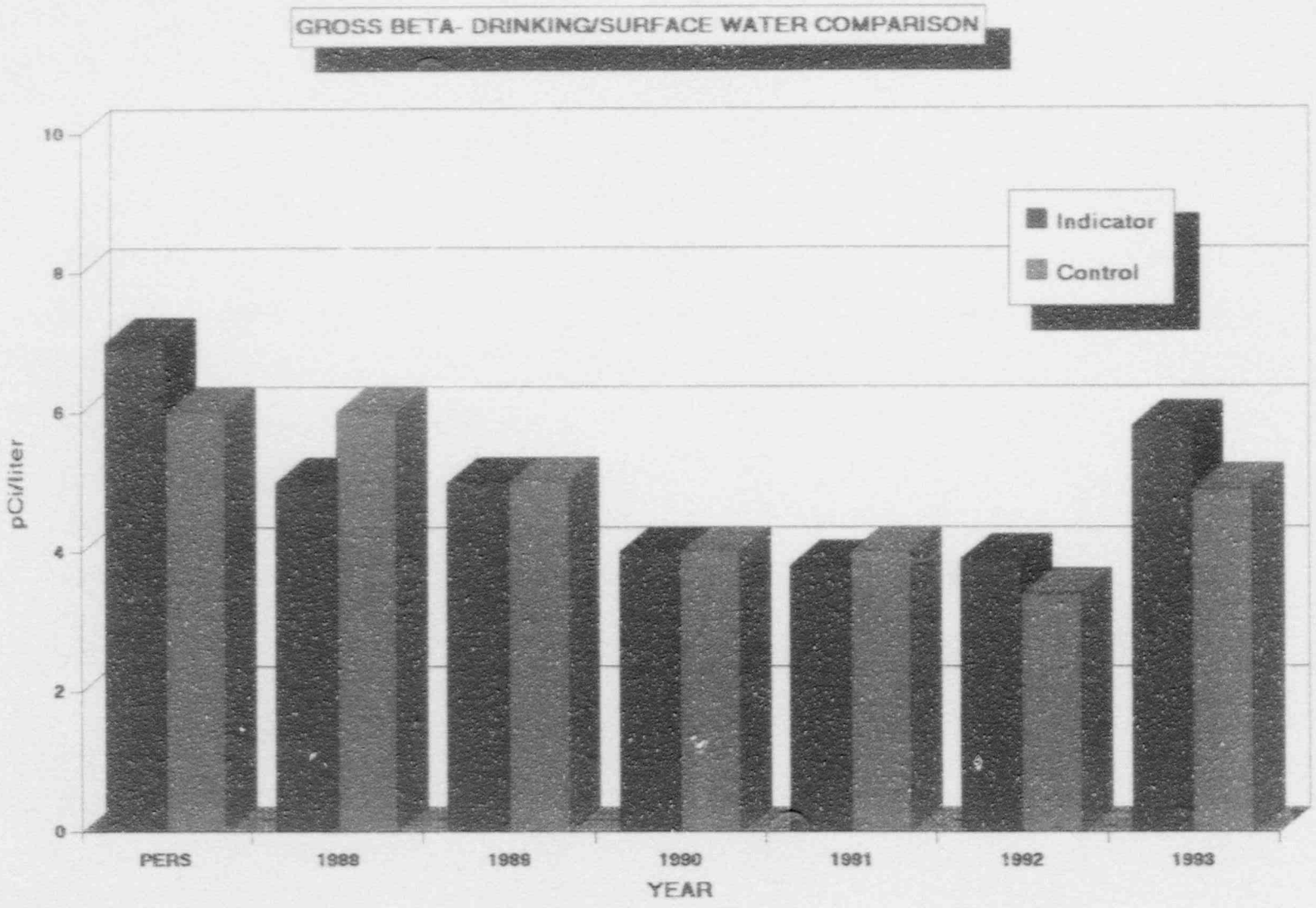

GROSS BETA - AIR PARTICULATE COMPARISON
Indicator
Control
pCi/cubic meter
0.1
0.08
0.06
0.04
0.02
0
PERS
1988
1989
1990
1991
1992
1993
YEAR

FIGURE 3.3


GROSS BETA- DRINKING/SURFACE WATER COMPARISON
Indicator
Control
10
8
6
4
2
0
pCi/liter
PERS
1988
1989
1990
1991
1992
1993
YEAR

APPENDIX A
REMP DATA SUMMARY

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility Waterford 3 SES Docket No. 50-382

Location of Facility St. Charles, Louisiana (Parish, State) Reporting Period January 1 to December 31, 1993

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES		LOWER LIMIT OF DETECTION[a] PERFORMED	ALL INDICATOR LOCATIONS MEAN[b] (RANGE)[b] (LLD)	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN[b] (RANGE)[b]	CONTROL LOCATION MEAN[b] (RANGE)[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
1. Direct Radiation (mrem/Std. Qtr.)	TLD	123	(c)	12(119/119) (8-23)	R-6 5.3 miles NNW	18(4/4) (15-23)	E-30 11(4/4) (11-13)	0
2. Airborne Particulates (10^{-3}pCi/m^3)	Gross Beta	257	10	14(205/205) (4-32)	APE-30 27 miles E	15(51/51) (4-26)	APE-30 15(51/51) (4-26)	0
	Gamma	20	(d)	<LLD (0/16) (-)	N/A	N/A	APE-30 <LLD (0/4) (-)	0
3. Airborne Iodine (10^{-3}pCi/m^3)	I-131	257	70	<LLD (0/205) (-)	N/A	N/A	APE-30 <LLD (0/51) (-)	0

NOTE: Footnotes at end of table.

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility Waterford 3 SES Docket No. 50-382

Location of Facility St. Charles, Louisiana (Parish, State) Reporting Period January 1 to December 31, 1993

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES	LOWER LIMIT OF DETECTION[a] PERFORMED	ALL INDICATOR LOCATIONS MEAN[b] (RANGE)[b] (LLD)	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN[b] (RANGE)[b]	CONTROL LOCATION MEAN[b] (RANGE)[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
4. Drinking/Surface Water (pCi/l)	Gross Beta 39	4	6.1(22/26) (2.2-11.7)	DWG-2 2.0 miles ESE	6.3(12/13) (2.3-11.7)	DWP-7 4.9(5/13) (2.3-10.4)	0
	I-131 78	1	0.3 (1/52) (0.2-0.3)	DWG-2/DWP-7 2.0 miles ESE 6.5 miles WNW	0.2(2/52) (-)	DWP-7 0.2(1/26) (-)	0
	Gamma 39	(d)	<LLD (0/26) (-)	N/A	N/A	DWP-7 <LLD (0/13) (-)	0
	Tritium 12	2000	<LLD (0/8) (-)	N/A	N/A	DWP-7 <LLD (0/4) (-)	0

NOTE: Footnotes at end of table.

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility Waterford 3 SES Docket No. 50-382

Location of Facility St. Charles, Louisiana (Parish, State) Reporting Period January 1 to December 31, 1993

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES	LOWER LIMIT OF DETECTION[a] PERFORMED	ALL INDICATOR LOCATIONS MEAN[b] (RANGE)[b] (LLD)	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION MEAN[b] (RANGE)[b]		CONTROL LOCATION MEAN[b] (RANGE)[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
5. Groundwater (pCi/l)	Gamma 4	(d)	<LLD(0/4) (-)	N/A	N/A	NONE	0
	Tritium 4	2000	355(2/4) (270-440)	N/A	N/A	NONE	0
6. Shoreline Sediment (pCi/kg-dry)	Gamma 4 Cs-137	180	36(2/4) (35-37)	SHWK-1 1.0 miles S	36(2/2) (35-37)	NONE	0

NOTE: Footnotes at end of table.

TABLE A-I

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility Waterford 3 SES Docket No. 50-382

Location of Facility St. Charles, Louisiana (Parish, State) Reporting Period January 1 to December 31, 1993

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES		LOWER LIMIT OF DETECTION[a] PERFORMED	ALL INDICATOR LOCATIONS MEAN[b] (RANGE)[b] (LLD)	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN[b] (RANGE)[b]	CONTROL LOCATION MEAN[b] (RANGE)[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
7. Milk (pCi/l)	I-131	48	1	LLD (0/24) (-)	N/A	N/A	MKQ-45 <LLD (0/24) (-)	0
	Gamma Cs-137	48	18	<LLD (0/24) (-)	N/A	N/A	MKQ-45 (0/24) (-)	0
8. Fish (pCi/kg-wet)	Gamma	16	(d)	<LLD (0/8) (-)	N/A	N/A (-)	FH-1 <LLD (0/8)	0

NOTE: Footnotes at end of table.

TABLE A-1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

Name of Facility Waterford 3 SES Docket No. 50-382

Location of Facility St. Charles, Louisiana (Parish, State) Reporting Period January 1 to December 31, 1993

MEDIUM OR PATHWAY SAMPLED (UNIT OF MEASUREMENT)	ANALYSIS AND TOTAL NUMBER OF ANALYSES		LOWER LIMIT OF DETECTION[a] PERFORMED	ALL INDICATOR LOCATIONS MEAN[b] (RANGE)[b] (LLD)	LOCATION WITH HIGHEST ANNUAL MEAN NAME DISTANCE AND DIRECTION	MEAN[b] (RANGE)[b]	CONTROL LOCATION MEAN[b] (RANGE)[b]	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
9. Broad Leaf Vegetation (pCi/kg-wet)	I-131	36	60	<LLD (0/24) (-)	N/A	N/A	BLK-15 <LLD (0/12) (-)	0
	Gamma	36	(d)	<LLD (0/24) (-)	N/A	N/A	BLK-15 <LLD (0/12) (-)	0
10. Food/Garden Crop (pCi/kg-wet)	Gamma	4	(d)	<LLD (0/2) (-)	N/A	N/A	NONE	0

NOTE: Footnotes at end of table.

TABLE A-1 (Cont.)

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

FOOTNOTES

[a]Nominal Lower Limit of Detection (LLD) as defined in the Waterford 3 Offsite Dose Calculation Manual.

[b]Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parenthesis.

[c]Lower Limit of Detection (LLD) not defined in Waterford 3 Offsite Dose Calculation Manual.

[d]Lower Limit of Detection (LLD) for individual radionuclides using gamma spectroscopy are given in Waterford 3 Offsite Dose Calculation Manual.

APPENDIX B
REMP DATA

TABLE B-1

QUARTERLY TLD DOSE RATES

LOCATION	1ST QUARTER DOSE RATE (mrem/std qtr)	2ND QUARTER DOSE RATE (mrem/std qtr)	3RD QUARTER DOSE RATE (mrem/std qtr)	4TH QUARTER DOSE RATE (mrem std qtr)	AVERAGE DOSE RATE (mrem/std qtr)
A-2	14	12	13	16	14
A-5	13	12	13	16	14
B-1	13	12	13	18	14
B-4	13	12	14	15	14
C-1	10	10	08	13	10
D-2	09	08	10	11	13
D-5	12	12	09	18	13
E-1	12	12	11	16	13
E-5	13	12	09	15	12
E-15	11	12	08	16	12
E-30	11	11	08	13	11
F-2	12	13	12	13	13
F-4	13	14	12	16	14
F-9	13	12	10	16	[illegible]
G-2	14	17	13	17	[illegible]
G-4	N/A*	11	11	14	
G-9	11	12	09	17	[illegible]
H-2	13	14	13	15	[illegible]
H-6	12	11	11	13	12
J-2	12	12	12	15	13
J-15	12	12	12	17	13
K-1	12	10	10	12	11
L-1	12	12	12	16	13
M-1	13	11	10	13	12
N-1	13	13	12	18	14
P-1	10	10	09	15	11
P-6	15	13	12	15	14
Q-1	12	11	11	16	13
Q-5	18	13	13	16	15
R-1	11	10	10	15	12
R-6	16	15	17	23	18
Average	12	12	11	16	

* - TLD missing, replaced - See Table C-5

TABLE B-2

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APC-1

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
930020	12/29/92	01/05/93	0.016 +/-0.002	< 0.017
930057	01/05/93	01/12/93	0.019 +/-0.002	< 0.034
930112	01/12/93	01/19/93	0.027 +/-0.003	< 0.011
930177	01/19/93	01/26/93	0.018 +/-0.002	< 0.012
930209	01/26/93	02/02/93	0.022 +/-0.003	< 0.014
930245	02/02/93	02/09/93	0.018 +/-0.002	< 0.035
930277	02/09/93	02/16/93	0.020 +/-0.002	< 0.024
930312	02/16/93	02/24/93	0.025 +/-0.002	< 0.010
930348	02/24/93	03/02/93	0.019 +/-0.003	< 0.027
930374	03/02/93	03/09/93	0.015 +/-0.003	< 0.027
930423	03/09/93	03/16/93	0.017 +/-0.002	< 0.027
930452	03/16/93	03/23/93	0.013 +/-0.002	< 0.014
930489	03/23/93	03/30/93	0.011 +/-0.002	< 0.014
930577	03/30/93	04/06/93	0.015 +/-0.002	< 0.025
930622	04/06/93	04/13/93	0.014 +/-0.002	< 0.032
930660	04/13/93	04/20/93	0.019 +/-0.002	< 0.014
930712	04/20/93	04/27/93	0.016 +/-0.002	< 0.025
930738	04/27/93	05/04/93	0.016 +/-0.002	< 0.024
930786	05/04/93	05/11/93	0.014 +/-0.002	< 0.024
930833	05/11/93	05/18/93	0.017 +/-0.002	< 0.020
930895	05/18/93	05/25/93	0.017 +/-0.002	< 0.015
930910	05/25/93	06/01/93	0.014 +/-0.002	< 0.020
930980	06/01/93	06/08/93	0.016 +/-0.002	< 0.022
931011	06/08/93	06/15/93	0.018 +/-0.002	< 0.033
931045	06/15/93	06/22/93	0.012 +/-0.002	< 0.015
931079	06/22/93	06/29/93	0.013 +/-0.002	< 0.021

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APC-1

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
931134	06/29/93	07/06/93	0.021 +/-0.002	< 0.016
931207	07/06/93	07/13/93	0.007 +/-0.002	< 0.023
931263	07/13/93	07/20/93	0.007 +/-0.002	< 0.020
931286	07/20/93	07/27/93	0.014 +/-0.002	< 0.021
931344	07/27/93	08/03/93	0.014 +/-0.002	< 0.040
931368	08/03/93	08/10/93	0.009 +/-0.002	< 0.014
931398	08/10/93	08/17/93	0.010 +/-0.002	< 0.017
931425	08/17/93	08/24/93	0.017 +/-0.002	< 0.027
931462	08/24/93	08/31/93	0.010 +/-0.002	< 0.026
931495	08/31/93	09/07/93	0.007 +/-0.002	< 0.021
931538	09/07/93	09/14/93	0.009 +/-0.002	< 0.019
931580	09/14/93	09/21/93	0.009 +/-0.002	< 0.034
931611	09/21/93	09/28/93	0.011 +/-0.002	< 0.014
931686	09/28/93	10/05/93	0.021 +/-0.003	<0.019
931748	10/05/93	10/12/93	0.014 +/-0.002	< 0.022
931782	10/12/93	10/19/93	0.014 +/-0.002	< 0.032
931810	10/19/93	10/25/93	0.016 +/-0.003	< 0.032
931855	10/25/93	11/02/93	0.016 +/-0.002	< 0.020
931899	11/02/93	11/09/93	0.015 +/-0.002	< 0.015
931947	11/09/93	11/16/93	0.016 +/-0.002	< 0.027
931991	11/16/93	11/23/93	0.013 +/-0.002	< 0.027
932024	11/23/93	11/30/93	0.015 +/-0.002	< 0.021
932064	11/30/93	12/07/93	0.015 +/-0.003	< 0.026
932096	12/07/93	12/14/93	0.009 +/-0.002	< 0.020
932143	12/14/93	12/21/93	0.014 +/-0.003	< 0.018
932155	12/21/93	12/28/93	0.007 +/-0.002	< 0.014

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APG-1

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
930017	12/29/92	01/05/93	0.014 +/-0.002	< 0.017
930054	01/05/93	01/12/93	0.017 +/-0.002	< 0.034
930109	01/12/93	01/19/93	0.027 +/-0.003	< 0.011
930174	01/19/93	01/26/93	0.012 +/-0.002	< 0.012
930206	01/26/93	02/02/93	0.023 +/-0.003	< 0.014
930242	02/02/93	02/09/93	0.023 +/-0.003	< 0.035
930274	02/09/93	02/16/93	0.021 +/-0.002	< 0.024
930310	02/16/93	02/24/93	0.027 +/-0.002	< 0.010
930345	02/24/93	03/02/93	0.020 +/-0.003	< 0.027
930371	03/02/93	03/09/93	0.016 +/-0.003	< 0.027
930420	03/09/93	03/16/93	0.020 +/-0.002	< 0.027
930449	03/16/93	03/23/93	0.014 +/-0.002	< 0.014
930487	03/23/93	03/30/93	0.014 +/-0.002	< 0.014
930574	03/30/93	04/06/93	0.016 +/-0.002	< 0.025
930619	04/06/93	04/13/93	0.012 +/-0.002	< 0.032
930657	04/13/93	04/20/93	0.016 +/-0.002	< 0.014
930709	04/20/93	04/27/93	0.018 +/-0.002	< 0.025
930735	04/27/93	05/04/93	0.012 +/-0.002	< 0.024
930783	05/04/93	05/11/93	0.015 +/-0.002	< 0.024
930830	05/11/93	05/18/93	0.015 +/-0.002	< 0.020
930892	05/18/93	05/25/93	0.019 +/-0.002	< 0.015
930907	05/25/93	06/01/93	0.018 +/-0.002	< 0.020
930977	06/01/93	06/08/93	0.017 +/-0.002	< 0.022
931008	06/08/93	06/15/93	0.016 +/-0.002	< 0.033
931042	06/15/93	06/22/93	0.010 +/-0.002	< 0.015
931076	06/22/93	06/29/93	0.011 +/-0.002	< 0.021

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APG-1

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
931131	06/29/93	07/06/93	0.019 +/-0.002	< 0.016
931204	07/06/93	07/13/93	0.012 +/-0.002	< 0.023
931260	07/13/93	07/20/93	0.007 +/-0.002	< 0.020
931283	07/20/93	07/27/93	0.013 +/-0.002	< 0.021
931341	07/27/93	08/02/93	0.014 +/-0.002	< 0.040
931365	08/07/93	08/10/93	< 0.007	< 0.032
931395	08/10/93	08/17/93	0.010 +/-0.002	< 0.017
931422	08/17/93	08/24/93	0.011 +/-0.002	< 0.027
931459	08/24/93	08/31/93	0.008 +/-0.002	< 0.026
931492	08/31/93	09/07/93	0.007 +/-0.002	< 0.021
931535	09/07/93	09/14/93	0.011 +/-0.002	< 0.019
931577	09/14/93	09/21/93	0.014 +/-0.002	< 0.034
931608	09/21/93	09/28/93	0.008 +/-0.002	< 0.014
931683	09/28/93	10/05/93	0.017 +/-0.002	<0.019
931745	10/05/93	10/12/93	0.015 +/-0.002	< 0.022
931779	10/12/93	10/19/93	0.014 +/-0.002	< 0.032
931807	10/19/93	10/25/93	0.014 +/-0.003	< 0.032
931852	10/25/93	11/02/93	0.013 +/-0.002	< 0.020
931896	11/02/93	11/09/93	0.011 +/-0.002	< 0.015
931944	11/09/93	11/16/93	0.013 +/-0.002	< 0.027
931988	11/16/93	11/23/93	0.010 +/-0.002	< 0.027
932021	11/23/93	11/30/93	0.021 +/-0.002	< 0.021
932061	11/30/93	12/07/93	0.013 +/-0.002	< 0.026
932093	12/07/93	12/14/93	0.010 +/-0.002	< 0.020
932140	12/14/93	12/21/93	0.014 +/-0.002	< 0.018
932152	12/21/93	12/28/93	0.009 +/-0.002	< 0.014

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APP-1

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
930019	12/29/92	01/05/93	0.014 +/-0.002	< 0.017
930056	01/05/93	01/12/93	0.018 +/-0.002	< 0.034
930111	01/12/93	01/19/93	0.024 +/-0.003	< 0.011
930176	01/19/93	01/26/93	0.014 +/-0.002	< 0.012
930208	01/26/93	02/02/93	0.021 +/-0.003	< 0.014
930244	02/02/93	02/09/93	0.014 +/-0.002	< 0.035
930276	02/09/93	02/16/93	0.017 +/-0.002	< 0.024
N/A	02/16/93	02/24/93	NO SAMPLE	N/A
930347	02/24/93	03/02/93	0.023 +/-0.003	< 0.027
930373	03/02/93	03/09/93	0.012 +/-0.002	< 0.027
930422	03/09/93	03/16/93	0.017 +/-0.002	< 0.027
930451	03/16/93	03/23/93	0.010 +/-0.002	< 0.014
N/A	03/23/93	03/30/93	NO SAMPLE	N/A
930576	03/30/93	04/06/93	0.014 +/-0.002	< 0.025
930621	04/06/93	04/13/93	0.011 +/-0.002	< 0.032
930659	04/13/93	04/20/93	0.015 +/-0.002	< 0.014
930711	04/20/93	04/27/93	0.016 +/-0.002	< 0.025
930737	04/27/93	05/04/93	0.013 +/-0.002	< 0.024
930785	05/04/93	05/11/93	0.014 +/-0.002	< 0.024
930832	05/11/93	05/18/93	0.016 +/-0.002	< 0.020
930894	05/18/93	05/25/93	0.018 +/-0.002	< 0.015
930909	05/25/93	06/01/93	0.009 +/-0.002	< 0.020
930979	06/01/93	06/08/93	0.018 +/-0.002	< 0.022
931010	06/08/93	06/15/93	0.014 +/-0.002	< 0.033
931044	06/15/93	06/22/93	0.012 +/-0.002	< 0.015
931078	06/22/93	06/29/93	0.010 +/-0.002	< 0.021

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APP-1

UNITS: pCi/CUBIC METER

LAB NO	BEGIN DATE	END DATE	GROSS BETA	I-131
931133	06/29/93	07/06/93	0.020 +/-0.002	< 0.016
931206	07/06/93	07/13/93	0.006 +/-0.002	< 0.023
931262	07/13/93	07/20/93	0.008 +/-0.002	< 0.020
931285	07/20/93	07/27/93	0.010 +/-0.002	< 0.021
931343	07/27/93	08/03/93	0.010 +/-0.002	< 0.040
931367	08/03/93	08/10/93	0.007 +/-0.002	< 0.014
931397	08/10/93	08/17/93	0.009 +/-0.002	< 0.017
931424	08/17/93	08/24/93	0.011 +/-0.002	< 0.027
931461	08/24/93	08/31/93	0.009 +/-0.002	< 0.026
931494	08/31/93	09/07/93	0.005 +/-0.002	< 0.021
931537	09/07/93	09/14/93	0.011 +/-0.002	< 0.019
931579	09/14/93	09/21/93	0.009 +/-0.002	< 0.034
931610	09/21/93	09/28/93	0.011 +/-0.002	< 0.014
931685	09/28/93	10/05/93	0.016 +/-0.002	<0.019
931747	10/05/93	10/12/93	0.016 +/-0.002	< 0.022
931781	10/12/93	10/19/93	0.014 +/-0.002	< 0.032
931809	10/19/93	10/25/93	0.015 +/-0.003	< 0.032
931854	10/25/93	11/02/93	0.011 +/-0.002	< 0.020
931898	11/02/93	11/09/93	0.013 +/-0.002	< 0.015
931946	11/09/93	11/16/93	0.012 +/-0.002	< 0.027
931990	11/16/93	11/23/93	0.011 +/-0.002	< 0.027
932023	11/23/93	11/30/93	0.013 +/-0.002	< 0.021
932063	11/30/93	12/07/93	0.012 +/-0.002	< 0.026
932095	12/07/93	12/14/93	0.00[illegible] +/-0.002	< 0.020
932142	12/14/93	12/21/93	0.012 +/-0.003	< 0.018
932154	12/21/93	12/28/93	0.009 +/-0.002	< 0.014

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APQ-1

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
930018	12/29/92	01/05/93	0.010 +/-0.003	< 0.017
930055	01/05/93	01/12/93	0.013 +/-0.002	< 0.034
930110	01/12/93	01/19/93	0.018 +/-0.002	< 0.011
930175	01/19/93	01/26/93	0.015 +/-0.002	< 0.012
930207	01/26/93	02/02/93	0.020 +/-0.002	< 0.014
930243	02/02/93	02/09/93	0.022 +/-0.002	< 0.035
930275	02/09/93	02/16/93	0.019 +/-0.002	< 0.024
930311	02/16/93	02/24/93	0.024 +/-0.002	< 0.010
930346	02/24/93	03/02/93	0.021 +/-0.003	< 0.027
930372	03/02/93	03/09/93	0.016 +/-0.002	< 0.027
930421	03/09/93	03/16/93	0.018 +/-0.002	< 0.027
930450	03/16/93	03/23/93	0.013 +/-0.002	< 0.014
930488	03/23/93	03/30/93	0.013 +/-0.002	< 0.014
930575	03/30/93	04/06/93	0.014 +/-0.002	< 0.025
930620	04/06/93	04/13/93	0.014 +/-0.002	< 0.032
930658	04/13/93	04/20/93	0.016 +/-0.002	< 0.014
930710	04/20/93	04/27/93	0.019 +/-0.002	< 0.025
930736	04/27/93	05/04/93	0.015 +/-0.002	< 0.024
930784	05/04/93	05/11/93	0.015 +/-0.002	< 0.024
930831	05/11/93	05/18/93	0.014 +/-0.002	< 0.020
930893	05/18/93	05/25/93	0.019 +/-0.002	< 0.015
930908	05/25/93	06/01/93	0.015 +/-0.002	< 0.020
930978	06/01/93	06/08/93	0.015 +/-0.002	< 0.022
931009	06/08/93	06/15/93	0.015 +/-0.002	< 0.033
931043	06/15/93	06/22/93	0.011 +/-0.002	< 0.015
931077	06/22/93	06/29/93	0.011 +/-0.002	< 0.021

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APQ-1

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
931132	06/29/93	07/06/93	0.019 +/-0.002	< 0.016
931205	07/06/93	07/13/93	0.009 +/-0.002	< 0.023
931261	07/13/93	07/20/93	0.004 +/-0.002	< 0.020
931284	07/20/93	07/27/93	0.032 +/-0.002	< 0.021
931342	07/27/93	08/03/93	0.010 +/-0.002	< 0.040
931366	08/03/93	08/10/93	0.010 +/-0.002	< 0.014
931396	08/10/93	08/17/93	0.010 +/-0.002	< 0.017
931423	08/17/93	08/24/93	0.014 +/-0.002	< 0.027
931460	08/24/93	08/31/93	0.008 +/-0.002	< 0.026
931493	08/31/93	09/07/93	0.006 +/-0.002	< 0.021
931536	09/07/93	09/14/93	0.009 +/-0.002	< 0.019
931578	09/14/93	09/21/93	0.010 +/-0.002	< 0.034
931609	09/21/93	09/28/93	0.009 +/-0.002	< 0.014
931684	09/28/93	10/05/93	0.017 +/-0.002	<0.019
931746	10/05/93	10/12/93	0.016 +/-0.002	< 0.022
931780	10/12/93	10/19/93	0.015 +/-0.002	< 0.032
931808	10/19/93	10/25/93	0.013 +/-0.003	< 0.032
931853	10/25/93	11/02/93	0.014 +/-0.002	< 0.020
931897	11/02/93	11/09/93	0.014 +/-0.002	< 0.015
931945	11/09/93	11/16/93	0.016 +/-0.002	< 0.027
931989	11/16/93	11/23/93	0.008 +/-0.002	< 0.027
932022	11/23/93	11/30/93	0.018 +/-0.002	< 0.021
932062	11/30/93	12/07/93	0.012 +/-0.003	< 0.026
932094	12/07/93	12/14/93	0.010 +/-0.002	< 0.020
932141	12/14/93	12/21/93	0.012 +/-0.003	< 0.018
932153	12/21/93	12/28/93	0.007 +/-0.002	< 0.014

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APE-30*

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-131
930021	12/29/92	01/05/93	0.016 +/-0.002	< 0.017
930058	01/05/93	01/12/93	0.017 +/-0.002	< 0.034
930113	01/12/93	01/19/93	0.026 +/-0.003	< 0.011
930178	01/19/93	01/26/93	0.018 +/-0.002	< 0.012
930210	01/26/93	02/02/93	0.023 +/-0.003	< 0.014
930246	02/02/93	02/09/93	0.020 +/-0.003	< 0.035
930278	02/09/93	02/16/93	0.020 +/-0.002	< 0.024
930313	02/16/93	02/24/93	0.025 +/-0.002	< 0.010
930349	02/24/93	03/02/93	0.019 +/-0.003	< 0.027
930375	03/02/93	03/09/93	0.017 +/-0.003	< 0.027
930424	03/09/93	03/16/93	0.018 +/-0.002	< 0.027
930453	03/16/93	03/23/93	0.014 +/-0.002	< 0.014
930490	03/23/93	03/30/93	0.015 +/-0.002	< 0.014
930578	03/30/93	04/06/93	0.015 +/-0.002	< 0.025
930623	04/06/93	04/13/93	0.019 +/-0.002	< 0.032
930661	04/13/93	04/20/93	0.015 +/-0.002	< 0.014
930713	04/20/93	04/27/93	0.018 +/-0.002	< 0.025
930739	04/27/93	05/04/93	0.015 +/-0.002	< 0.024
930787	05/04/93	05/11/93	0.013 +/-0.002	< 0.024
930834	05/11/93	05/18/93	0.017 +/-0.002	< 0.020
930896	05/18/93	05/25/93	0.018 +/-0.002	< 0.015
930911	05/25/93	06/01/93	0.018 +/-0.002	< 0.020
930981	06/01/93	06/08/93	0.015 +/-0.002	< 0.022
931012	06/08/93	06/15/93	0.017 +/-0.002	< 0.033
931046	06/15/93	06/22/93	0.014 +/-0.002	< 0.015
931080	06/22/93	06/29/93	0.011 +/-0.002	< 0.021

* Control Location

TABLE B-2 (continued)

AIR PARTICULATE FILTERS AND CHARCOAL CARTRIDGES
GROSS BETA AND IODINE-131 ANALYSES

SAMPLE LOCATION: APE-30*

UNITS: pCi/CUBIC METER

LAB NO.	BEGIN DATE	END DATE	GROSS BETA	I-
931135	06/29/93	07/06/93	0.022 +/-0.002	< 0.016
931208	07/06/93	07/13/93	0.005 +/-0.002	< 0.023
931264	07/13/93	07/20/93	0.006 +/-0.002	< 0.020
931287	07/20/93	07/27/93	0.012 +/-0.002	< 0.021
931345	07/27/93	08/03/93	NO SAMPLE	N/A
931369	08/03/93	08/10/93	0.011 +/-0.002	< 0.014
931399	08/10/93	08/17/93	0.010 +/-0.002	< 0.017
931426	08/17/93	08/24/93	0.017 +/-0.002	< 0.027
931463	08/24/93	08/31/93	0.010 +/-0.002	< 0.026
931496	08/31/93	09/07/93	0.004 +/-0.002	< 0.021
931539	09/07/93	09/14/93	0.009 +/-0.002	< 0.019
931581	09/14/93	09/21/93	0.011 +/-0.002	< 0.034
931612	09/21/93	09/28/93	0.013 +/-0.002	< 0.014
931687	09/28/93	10/05/93	0.020 +/-0.003	<0.019
931749	10/05/93	10/12/93	0.015 +/-0.002	< 0.022
931783	10/12/93	10/19/93	0.014 +/-0.002	< 0.032
931811	10/19/93	10/25/93	0.015 +/-0.003	< 0.032
931856	10/25/93	11/02/93	0.018 +/-0.002	< 0.020
931900	11/02/93	11/09/93	0.014 +/-0.002	< 0.015
931948	11/09/93	11/16/93	0.017 +/-0.003	< 0.027
931992	11/16/93	11/23/93	0.014 +/-0.002	< 0.027
932025	11/23/93	11/30/93	0.016 +/-0.002	< 0.021
932065	11/30/93	12/07/93	0.016 +/-0.003	< 0.026
932097	12/07/93	12/14/93	0.011 +/-0.002	< 0.020
932144	12/14/93	12/21/93	0.015 +/-0.003	< 0.018
932156	12/21/93	12/28/93	0.009 +/-0.002	< 0.014

* Control Location

TABLE B-3

AIR PARTICULATE FILTERS
GAMMA ISOTOPIC ANALYSIS ON QUARTERLY COMPOSITES

SAMPLE LOCATION: ALL SAMPLE SITES

UNITS: pCi/CUBIC METER

LOCATION	LAB NO.	BEGIN DATE	END DATE	Cs-134	Cs-137
APG-1	930950	12/29/92	03/30/93	< 0.0016	< 0.0014
APG-1	931124	03/30/93	06/29/93	< 0.0009	< 0.0007
APG-1	931630	06/29/93	09/28/93	< 0.0007	< 0.0006
APG-1	932188	09/28/93	12/28/93	< 0.0011	< 0.0009
APQ-1	930951	12/29/92	03/30/93	< 0.0014	< 0.0012
APQ-1	931125	03/30/93	06/29/93	< 0.0013	< 0.0012
APQ-1	931631	06/29/93	09/28/93	< 0.0010	< 0.0009
APQ-1	932189	09/28/93	12/28/93	< 0.0010	< 0.0006
APP-1	930952	12/29/92	03/30/93	< 0.0011	< 0.0010
APP-1	931126	03/30/93	06/29/93	< 0.0006	< 0.0005
APP-1	931632	06/29/93	09/28/93	< 0.0007	< 0.0008
APP-1	932190	09/28/93	12/28/93	< 0.0011	< 0.0009
APC-1	930953	12/29/92	03/30/93	< 0.0015	< 0.0013
APC-1	931127	03/30/93	06/29/93	< 0.0011	< 0.0012
APC-1	931633	06/29/93	09/28/93	< 0.0011	< 0.0009
APC-1	932191	09/28/93	12/28/93	< 0.0009	< 0.0008
APE-30	930954	12/29/92	03/30/93	< 0.0016	< 0.0013
APE-30	931128	03/30/93	06/29/93	< 0.0008	< 0.0007
APE-30	931634	06/29/93	09/28/93	< 0.0008	< 0.0008
APE-30	932192	09/28/93	12/28/93	< 0.0010	< 0.0011

TABLE B-4

DRINKING/SURFACE WATER
IODINE-131 ANALYSIS

SAMPLE LOCATION: DWG/SWG-2

UNITS: pCi/LITER

LAB NO.	BEGIN DATE	END DATE	I-131*
930060	12/29/92	01/12/93	< 0.3
930180	01/12/93	01/26/93	< 0.4
930248	01/26/93	02/09/93	< 0.3
930315	02/09/93	02/24/93	< 0.4
930377	02/24/93	03/09/93	< 0.3
930455	03/09/93	03/23/93	< 0.4
930580	03/23/93	04/06/93	< 0.3
930663	04/06/93	04/20/93	< 0.3
930741	04/20/93	05/04/93	< 0.2
930836	05/04/93	05/18/93	< 0.3
930912	05/18/93	06/01/93	< 0.3
931013	06/01/93	06/15/93	< 0.2
931081	06/15/93	06/29/93	0.2 +/-0.2
931209	06/29/93	07/13/93	< 0.3
931288	07/13/93	07/27/93	< 0.3
931370	07/27/93	08/10/93	< 0.3
931427	08/10/93	08/24/93	< 0.3
931497	08/24/93	09/07/93	< 0.5
931582	09/07/93	09/21/93	< 0.4
931688	09/21/93	10/05/93	< 0.3
931784	10/05/93	10/19/93	< 0.2
931857	10/19/93	11/02/93	< 0.3
931949	11/02/93	11/16/93	< 0.3
932026	11/16/93	11/30/93	< 0.3
932099	11/30/93	12/14/93	< 0.3
932157	12/14/93	12/28/93	< 0.5

TABLE B-4 (continued)

DRINKING/SURFACE WATER
IODINE-131 ANALYSIS

SAMPLE LOCATION: DWE/SWE-5

UNITS: pCi/LITER

LAB NO.	BEGIN DATE	END DATE	I-131*
930061	12/29/92	01/12/93	< 0.2
930181	01/12/93	01/26/93	< 0.4
930249	01/26/93	02/09/93	< 0.3
930316	02/09/93	02/24/93	< 0.3
930378	02/24/93	03/09/93	< 0.3
930456	03/09/93	03/23/93	< 0.4
930581	03/23/93	04/06/93	< 0.3
930664	04/06/93	04/20/93	< 0.3
930742	04/20/93	05/04/93	< 0.2
930837	05/04/93	05/18/93	< 0.3
930913	05/18/93	06/01/93	< 0.2
931014	06/01/93	06/15/93	< 0.3
931082	06/15/93	06/29/93	< 0.3
931210	06/29/93	07/13/93	< 0.3
931289	07/13/93	07/27/93	< 0.2
931371	07/27/93	08/10/93	< 0.3
931428	08/10/93	08/24/93	< 0.3
931498	08/24/93	09/07/93	< 0.5
931583	09/07/93	09/21/93	< 0.4
931689	09/21/93	10/05/93	< 0.3
931785	10/05/93	10/19/93	< 0.3
931858	10/19/93	11/02/93	< 0.3
931950	11/02/93	11/16/93	< 0.3
932027	11/16/93	11/30/93	< 0.4
932100	11/30/93	12/14/93	< 0.4
932158	12/14/93	12/28/93	< 0.5

TABLE B-4 (continued)

DRINKING/SURFACE WATER
IODINE-131 ANALYSIS

SAMPLE LOCATION: DWP/SWP-7*

UNITS: pCi/LITER

LAB NO	BEGIN DATE	END DATE	I-131*
930059	12/29/92	01/12/93	< 0.3
930177	01/12/93	01/26/93	< 0.4
930247	01/26/93	02/09/93	< 0.3
930314	02/09/93	02/24/93	< 0.4
930376	02/24/93	03/09/93	< 0.3
930454	03/09/93	03/23/93	< 0.4
930579	03/23/93	04/06/93	< 0.3
930662	04/06/93	04/20/93	< 0.4
930740	04/20/93	05/04/93	< 0.2
930835	05/04/93	05/18/93	< 0.3
930914	05/18/93	06/01/93	< 0.3
931015	06/01/93	06/15/93	< 0.3
931083	06/15/93	06/29/93	< 0.3
931211	06/29/93	07/13/93	< 0.3
931290	07/13/93	07/27/93	< 0.2
931372	07/27/93	08/10/93	< 0.3
931429	08/10/93	08/24/93	< 0.3
931499	08/24/93	09/07/93	< 0.5
931584	09/07/93	09/21/93	< 0.4
931690	09/21/93	10/05/93	< 0.3
931786	10/05/93	10/19/93	< 0.3
931859	10/19/93	11/02/93	< 0.3
931951	11/02/93	11/16/93	0.2 +/-0.2
932028	11/16/93	11/30/93	< 0.5
932101	11/30/93	12/14/93	< 0.3
932159	12/14/93	12/28/93	< 0.5

* Control Location

TABLE B-5

DRINKING/SURFACE WATER
GROSS BETA ANALYSIS
ON MONTHLY COMPOSITES

SAMPLE LOCATION: DWG/SWG-2

UNITS: pCi/LITER

LAB NO.	BEGIN DATE	END DATE	BETA
930063	12/15/92	01/12/93	8.3 +/-1.9
930251	01/12/93	02/09/93	5.6 +/-1.6
930380	02/09/93	03/09/93	9.6 +/-3.0
930583	03/09/93	04/06/93	3.0 +/-2.3
930744	04/06/93	05/04/93	2.3 +/-2.2
930915	05/04/93	06/01/93	3.8 +/-2.8
931084	06/01/93	06/29/93	2.8 +/-2.1
931291	06/29/93	07/27/93	8.7 +/-2.1
931430	07/27/93	08/24/93	6.4 +/-1.7
931585	08/24/93	09/21/93	< 3.3
931787	09/21/93	10/19/93	11.7 +/-1.9
931952	10/19/93	11/16/93	6.7 +/-4.4
932102	11/16/93	12/14/93	6.6 +/-2.8

TABLE B-5 (continued)

DRINKING/SURFACE WATER
GROSS BETA ANALYSIS
ON MONTHLY COMPOSITES

SAMPLE LOCATION: DWE/SWE-5

UNITS: pCi/LITER

LAB NO.	BEGIN DATE	END DATE	BETA
930064	12/29/92	01/15/93	4.7 +/-1.5
930252	01/12/93	02/09/93	2.9 +/-1.4
930381	02/09/93	03/09/93	8.2 +/-2.6
930584	03/09/93	04/06/93	6.0 +/-2.4
930745	04/06/93	05/04/93	3.4 +/-2.6
930916	05/04/93	06/01/93	< 3.5
931085	06/01/93	06/29/93	< 3.7
931292	06/29/93	07/27/93	2.2 +/-1.8
931431	07/27/93	08/24/93	2.5 +/-1.4
931586	08/24/93	09/21/93	< 3.9
931788	09/21/93	10/19/93	10.5 +/-1.9
931953	10/19/93	11/16/93	6.1 +/-4.4
932103	11/16/93	12/14/93	11.1 +/-2.9

TABLE B-5 (continued)

DRINKING/SURFACE WATER
GROSS BETA ANALYSIS
ON MONTHLY COMPOSITES

SAMPLE LOCATION: DWP/SWP-7*

UNITS: pCi/LITER

LAB NO	BEGIN DATE	END DATE	BETA
930062	12/15/92	01/12/93	5.5 +/-1.6
930250	01/12/93	02/09/93	3.8 +/-1.4
930379	02/09/93	03/09/93	< 3.8
930582	03/09/93	04/06/93	< 4.0
930743	04/06/93	05/04/93	< 3.5
930917	05/04/93	06/01/93	2.3 +/-2.1
931086	06/01/93	06/29/93	< 3.7
931293	06/29/93	07/27/93	< 2.9
931432	07/27/93	08/24/93	2.7 +/-1.4
931587	08/24/93	09/21/93	< 3.9
931789	09/21/93	10/19/93	10.4 +/-1.9
931954	10/19/93	11/16/93	< 3.7
932104	11/16/93	12/14/93	< 3.6

* Control Location

TABLE B-5 (continued)

DRINKING/SURFACE WATER
GAMMA ISOTOPIC ANALYSIS
ON MONTHLY COMPOSITES

SAMPLE LOCATION: DWG/SWG-2 UNITS: pCi/LITER

LAB NO.	BEGIN DATE	END DATE	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	Cs-134	Cs-137	Ba-140	La-140
930063	12/15/92	01/12/93	< 2	< 2	< 2	< 2	< 8	< 4	< 2	< 2	< 2	< 7	< 2
930251	01/12/93	02/09/93	< 1	< 2	< 1	< 2	< 3	< 3	< 2	< 2	< 2	< 6	< 2
930380	02/09/93	03/09/93	< 2	< 3	< 2	< 3	< 5	< 6	< 3	< 3	< 3	< 9	< 3
930583	03/09/93	04/06/93	< 3	< 4	< 3	< 3	< 5	< 6	< 3	< 3	< 3	< 12	< 5
930744	04/06/93	05/04/93	< 2	< 3	< 2	< 3	< 5	< 6	< 3	< 3	< 3	< 11	< 4
930915	05/04/93	06/01/93	< 2	< 4	< 2	< 3	< 5	< 6	< 3	< 3	< 3	< 11	< 3
931084	06/01/93	06/29/93	< 2	< 2	< 2	< 2	< 4	< 4	< 2	< 2	< 2	< 7	< 2
931291	06/29/93	07/27/93	< 2	< 2	< 2	< 2	< 4	< 4	< 2	< 2	< 2	< 8	< 3
931430	07/27/93	08/24/93	< 2	< 3	< 2	< 2	< 5	< 5	< 2	< 2	< 2	< 9	< 3
931585	08/24/93	09/21/93	< 2	< 3	< 2	< 2	< 5	< 5	< 2	< 3	< 2	< 10	< 3
931787	09/21/93	10/19/93	< 2	< 3	< 2	< 2	< 5	< 5	< 2	< 3	< 2	< 10	< 3
931952	10/19/93	11/16/93	< 3	< 4	< 3	< 3	< 5	< 6	< 3	< 3	< 3	< 14	< 4
932102	11/16/93	12/14/93	< 2	< 3	< 3	< 3	< 5	< 6	< 3	< 3	< 3	< 11	< 4

TABLE B-5 (continued)

DRINKING/SURFACE WATER
GAMMA ISOTOPIC ANALYSIS
ON MONTHLY COMPOSITES

SAMPLE LOCATION: DWE/SWE-5

UNITS: pCi/LITER

LAB NO.	BEGIN DATE	END DATE	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	Cs-134	Cs-137	Ba-140	La-140
930064	12/29/92	01/12/93	< 2	< 3	< 2	< 2	< 5	< 5	< 2	< 2	< 2	< 9	< 3
930252	01/12/93	02/09/93	< 2	< 3	< 2	< 2	< 5	< 5	< 2	< 2	< 2	< 9	< 3
930381	02/09/93	03/09/93	< 3	< 4	< 2	< 3	< 5	< 6	< 3	< 2	< 3	< 10	< 3
930584	03/09/93	04/06/93	< 2	< 3	< 2	< 2	< 4	< 4	< 2	< 2	< 2	< 9	< 3
930745	04/06/93	05/04/93	< 2	< 2	< 2	< 2	< 3	< 4	< 2	< 2	< 2	< 8	< 3
930916	05/04/93	06/01/93	< 2	< 4	< 3	< 3	< 5	< 6	< 2	< 3	< 3	< 10	< 3
931085	06/01/93	06/29/93	< 3	< 3	< 2	< 3	< 6	< 6	< 3	< 3	< 3	< 10	< 3
931292	06/29/93	07/27/93	< 3	< 3	< 2	< 3	< 6	< 6	< 3	< 3	< 3	< 10	< 3
931431	07/27/93	08/24/93	< 2	< 2	< 2	< 2	< 3	< 3	< 2	< 2	< 2	< 7	< 2
931586	08/24/93	09/21/93	< 2	< 3	< 2	< 2	< 4	< 4	< 2	< 2	< 2	< 7	< 3
931788	09/21/93	10/19/93	< 2	< 2	< 2	< 2	< 3	< 4	< 2	< 2	< 2	< 8	< 3
931953	10/19/93	11/16/93	< 2	< 2	< 2	< 2	< 4	< 5	< 2	< 2	< 2	< 11	< 3
932103	11/16/93	12/14/93	< 2	< 4	< 3	< 3	< 6	< 6	< 3	< 3	< 3	< 11	< 4

TABLE B-5 (continued)

DRINKING/SURFACE WATER
GAMMA ISOTOPIC ANALYSIS
ON MONTHLY COMPOSITES

SAMPLE LOCATION: DWP/SWP-7*

UNITS: pCi/LITER

LAB NO	BEGIN DATE	END DATE	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	Cs-134	Cs-137	Ba-140	La-140
930062	12/15/92	01/12/93	< 2	< 2	< 2	< 2	< 3	< 3	< 2	< 2	< 2	< 7	< 2
930250	01/12/93	02/09/93	< 3	< 4	< 3	< 3	< 7	< 7	< 3	< 2	< 3	< 13	< 4
930379	02/09/93	03/09/93	< 1	< 2	< 1	< 2	< 3	< 4	< 2	< 2	< 2	< 7	< 2
930582	03/09/93	04/06/93	< 2	< 3	< 2	< 3	< 5	< 6	< 3	< 2	< 3	< 13	< 5
930743	04/06/93	05/04/93	< 2	< 3	< 2	< 3	< 5	< 6	< 2	< 3	< 3	< 9	< 4
930917	05/04/93	06/01/93	< 3	< 5	< 4	< 4	< 8	< 8	< 4	< 4	< 4	< 17	< 5
931086	06/01/93	06/29/93	< 2	< 3	< 2	< 2	< 5	< 5	< 2	< 2	< 2	< 9	< 3
931293	06/29/93	07/27/93	< 2	< 3	< 2	< 2	< 5	< 5	< 2	< 3	< 2	< 9	< 3
931432	07/27/93	08/24/93	< 2	< 3	< 2	< 3	< 5	< 6	< 3	< 3	< 3	< 11	< 3
931587	08/24/93	09/21/93	< 2	< 3	< 3	< 2	< 5	< 5	< 3	< 2	< 2	< 12	< 4
931789	09/21/93	10/19/93	< 2	< 3	< 3	< 2	< 5	< 6	< 3	< 3	< 3	< 14	< 4
931954	10/19/93	11/16/93	< 2	< 2	< 2	< 2	< 3	< 4	< 2	< 2	< 2	< 9	< 3
932104	11/16/93	12/14/93	< 2	< 2	< 2	< 2	< 4	< 5	< 2	< 3	< 2	< 10	< 6

* Control Location

TABLE B-6

DRINKING/SURFACE WATER
TRITIUM ANALYSIS ON QUARTERLY COMPOSITES

SAMPLE LOCATION: ALL SAMPLE SITES

UNITS: pCi/LITER

LOCATION	LAB NO.	BEGIN DATE	END DATE	H-3
DWG/SWG - 2	930586	12/29/92	04/06/93	< 610
DWG/SWG - 2	931233	04/06/93	06/29/93	< 440
DWG/SWG - 2	931691	06/29/93	10/05/93	< 400
DWG/SWG - 2	932196	10/05/93	12/28/93	< 410
DWE/SWE - 5	930587	12/29/92	04/06/93	< 610
DWE/SWE - 5	931234	04/06/93	06/29/93	< 440
DWE/SWE - 5	931692	06/29/93	10/05/93	< 400
DWE/SWE - 5	932197	10/05/93	12/28/93	< 410
DWP/SWP - 7	930585	12/29/92	04/06/93	< 610
DWP/SWP - 7	931235	04/06/93	06/29/93	< 440
DWP/SWP - 7	931693	06/29/93	10/05/93	< 400
DWP/SWP - 7	932198	10/05/93	12/28/93	< 410

TABLE B-7

GROUNDWATER
TRITIUM AND GAMMA ISOTOPIC ANALYSES

SAMPLE LOCATION: GWK-1

UNITS: pCi/LITER

LAB NO.	COLLECTION DATE	H-3	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	Cs-134	Cs-137	Ba-140	La-140
930065	01/12/93	< 520	< 3	< 4	< 3	< 3	< 5	< 6	< 3	< 3	< 3	< 10	< 3
930626	04/13/93	< 520	< 2	< 2	< 2	< 2	< 4	< 4	< 2	< 2	< 2	< 9	< 3
931212	07/13/93	270 +/-260	< 3	< 3	< 2	< 3	< 6	< 5	< 3	< 3	< 3	< 9	< 3
931750	10/12/93	440 +/-260	< 3	< 4	< 3	< 3	< 6	< 6	< 3	< 3	< 3	< 12	< 4

TABLE B-8

SHORELINE SOIL
GAMMA ISOTOPIC ANALYSIS

SAMPLE LOCATIONS: ALL SAMPLE SITES

UNITS: pCi/Kg

LOCATION	LAB NO.	COLLECTION DATE	Mn-54	Co-58	Co-60	Cs-134	Cs-137
SHWE-3	930624	04/13/93	< 10	< 10	< 10	< 12	< 10
SHWE-3	931752	10/12/93	< 11	< 11	< 11	< 14	< 10
SHWK-1	930625	04/13/93	< 13	< 12	< 13	< 17	37 +/-11
SHWK-1	931751	10/12/93	< 18	< 20	< 20	< 23	35 +/-15

TABLE B-9

MILK
IODINE-131 AND GAMMA ISOTOPIC ANALYSES

SAMPLE LOCATION: MKQ-5

UNITS: pCi/LITER

LAB NO	COLLECTION DATE	I-131*	Cs-134	Cs-137	Ba-140	La-140
930015	01/06/93	< 0.5	< 2	< 2	< 7	< 2
930114	01/20/93	< 0.4	< 2	< 2	< 7	< 2
930211	02/03/93	< 0.3	< 3	< 3	< 9	< 2
930289	02/17/93	< 0.5	< 2	< 2	< 7	< 2
930353	03/03/93	< 0.4	< 3	< 3	< 11	< 3
930425	03/17/93	< 0.4	< 3	< 3	< 10	< 3
930594	04/07/93	< 0.3	< 3	< 3	< 15	< 4
930666	04/21/93	< 0.3	< 3	< 3	< 10	< 3
930748	05/05/93	< 0.3	< 2	< 2	< 8	< 2
930865	05/19/93	< 0.4	< 2	< 2	< 8	< 2
930934	06/02/93	< 0.4	< 2	< 2	< 7	< 2
931017	06/16/93	< 0.4	< 2	< 2	< 8	< 2
931159	07/07/93	< 0.3	< 3	< 2	< 9	< 3
921258	07/21/93	< 0.3	< 3	< 3	< 14	< 4
931323	08/04/93	< 0.3	< 2	< 2	< 7	< 2
931393	08/17/93	< 0.3	< 3	< 2	< 9	< 2
931464	09/01/93	< 0.3	< 2	< 2	< 7	< 2
931544	09/15/93	< 0.3	< 5	< 4	< 17	< 6
931701	10/06/93	< 0.3	< 3	< 3	< 10	< 3
931797	10/20/93	< 0.5	< 3	< 2	< 12	< 3
931878	11/03/93	< 0.7	< 2	< 2	< 9	< 2
931955	11/17/93	0.3 +/-0.2	< 3	< 2	< 9	< 3
932030	12/01/93	< 0.3	< 4	< 4	< 15	< 3
932117	12/15/93	< 0.3	< 4	< 3	< 15	< 7

TABLE B-9 (continued)

MILK
IODINE-131 AND GAMMA ISOTOPIC ANALYSES

SAMPLE LOCATION: MKQ-45*

UNITS: pCi/LITER

LAB NO.	COLLECTION DATE	I-131*	Cs-134	Cs-137	Ba-140	La-140
930016	01/05/93	< 0.5	< 3	< 3	< 10	< 3
930115	01/19/93	< 0.5	< 3	< 3	< 9	< 3
930212	02/03/93	< 0.5	< 2	< 2	< 7	< 2
930290	02/17/93	< 0.5	< 3	< 3	< 9	< 3
930354	03/02/93	< 0.5	< 2	< 2	< 10	< 3
930426	03/16/93	< 0.4	< 2	< 2	< 9	< 3
930595	04/03/93	< 0.3	< 3	< 3	< 13	< 4
930667	04/20/93	< 0.4	< 2	< 2	< 8	< 2
930749	05/04/93	< 0.3	< 3	< 3	< 9	< 3
930866	05/18/93	< 0.4	< 3	< 3	< 9	< 3
930935	06/01/93	< 0.5	< 3	< 3	< 9	< 3
931018	06/15/93	< 0.4	< 3	< 3	< 10	< 3
931160	07/06/93	< 0.5	< 2	< 2	< 11	< 3
931259	07/20/93	< 0.3	< 2	< 2	< 10	< 3
931324	08/03/93	< 0.3	< 3	< 2	< 9	< 3
931394	08/17/93	< 0.3	< 3	< 3	< 10	< 3
931465	08/31/93	< 0.3	< 3	< 3	< 9	< 3
931545	09/14/93	< 0.4	< 2	< 2	< 11	< 3
931702	10/05/93	< 0.3	< 3	< 3	< 10	< 4
931798	10/19/93	< 0.6	< 3	< 3	< 15	< 4
931879	11/02/93	< 0.7	< 3	< 2	< 12	< 3
931956	11/16/93	< 0.3	< 3	< 3	< 11	< 3
932031	11/30/93	0.2 +/-0.2	< 3	< 3	< 13	< 3
932118	12/14/93	< 0.3	< 3	< 3	< 14	< 4

* Control Location

TABLE B-10

FISH
GAMMA ISOTOPIC ANALYSIS

SAMPLE LOCATION: FH-1*

UNITS: pCi/Kg

LAB NO	COLLECTION DATE	SAMPLE TYPE	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Cs-134	Cs-137
930867	05/19/93	CATFISH	< 9	< 14	< 10	< 11	< 23	< 11	< 10
930868	05/19/93	SHAD	< 12	< 18	< 12	< 12	< 30	< 13	< 13
930869	05/19/93	DRUM	< 9	< 13	< 9	< 11	< 23	< 11	< 10
930870	05/19/93	STRIPED BASS	< 7	< 11	< 7	< 7	< 16	< 8	< 7
931924	11/03/93	CATFISH	< 9	< 14	< 10	< 10	< 21	< 10	< 9
931926	11/03/93	SHAD	< 16	< 28	< 19	< 15	< 35	< 16	< 14
931928	11/03/93	DRUM	< 6	< 11	< 8	< 7	< 15	< 8	< 6
931930	11/03/93	MULLET	< 16	< 23	< 17	< 15	< 33	< 18	< 14

* Control Location

TABLE B-10 (continued)

FISH
GAMMA ISOTOPIC ANALYSIS

SAMPLE LOCATION: FH-2

UNITS: pCi/Kg

LAB NO	COLLECTION DATE	SAMPLE TYPE	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Cs-134	Cs-137
930871	5/19/93	CATFISH	< 13	< 19	< 14	< 15	< 33	< 16	< 14
930872	5/19/93	SHAD	< 16	< 21	< 17	< 16	< 38	< 18	< 16
930873	5/19/93	DRUM	< 11	< 16	< 12	< 13	< 28	< 13	< 12
930874	5/19/93	STRIPED BASS	< 11	< 19	< 12	< 13	< 29	< 14	< 13
931925	11/03/93	CATFISH	< 15	< 28	< 19	< 14	< 35	< 16	< 14
931927	11/03/93	SHAD	< 17	< 29	< 19	< 19	< 35	< 19	< 18
931929	11/03/93	DRUM	< 11	< 1	< 1	< 10	< 23	< 11	< 10
931931	11/03/93	MULLET	< 10	< 1	< 2	< 12	< 26	< 12	< 11

TABLE B-11

BROAD LEAF VEGETATION
IODINE-131 AND GAMMA ISOTOPIC ANALYSES

SAMPLE LOCATION: BLQ-1

UNITS: pCi/Kg

LAB NO.	COLLECTION DATE	I-131	Cs-134	Cs-137
930171	01/27/93	< 18	< 16	< 15
930317	02/24/93	< 14	< 10	< 9
930446	03/24/93	< 13	< 15	< 12
930706	04/28/93	< 24	< 23	< 21
930904	05/26/93	< 20	< 13	< 13
931050	06/23/93	< 18	< 12	< 13
931298	07/28/93	< 23	< 23	< 23
931434	08/25/93	< 22	< 20	< 19
931574	09/22/93	< 27	< 26	< 24
931823	10/27/93	< 19	< 19	< 16
931972	11/22/93	< 21	< 19	< 21
932137	12/20/93	< 10	< 9	< 8

TABLE B-11 (continued)

BROAD LEAF VEGETATION
IODINE-131 AND GAMMA ISOTOPIC ANALYSES

SAMPLE LOCATION: BLB-1

UNITS: pCi/Kg

LAB NO.	COLLECTION DATE	I-131	Cs-134	Cs-137
930172	01/27/93	< 10	< 12	< 10
930318	02/24/93	< 11	< 10	< 9
930447	03/24/93	< 14	< 17	< 12
930707	04/28/93	< 8	< 8	< 8
930905	05/26/93	< 25	< 15	< 14
931051	06/23/93	< 11	< 9	< 8
931299	07/28/93	< 21	< 17	< 22
931435	08/25/93	< 22	< 24	< 20
931575	9/22/93	< 23	< 22	< 20
931824	10/27/93	< 20	< 23	< 20
931973	11/22/93	< 15	< 17	< 15
932138	12/20/93	< 23	< 24	< 21

TABLE B-11 (continued)

BROAD LEAF VEGETATION
IODINE-131 AND GAMMA ISOTOPIC ANALYSES

SAMPLE LOCATION: BLK-15*

UNITS: pCi/Kg

LAB NO.	COLLECTION DATE	I-131	Cs-134	Cs-137
930173	01/27/93	< 15	< 15	< 14
930319	02/24/93	< 12	< 12	< 11
930448	03/24/93	< 17	< 15	< 15
930708	04/28/93	< 14	< 14	< 12
930906	5/26/93	< 17	< 13	< 11
931052	06/23/93	< 21	< 17	< 16
931300	07/28/93	< 24	< 21	< 18
931436	08/25/93	< 26	< 27	< 25
931576	09/22/93	< 23	< 20	< 19
931825	10/27/93	< 11	< 12	< 10
931974	11/22/93	< 20	< 20	< 21
932139	12/20/93	< 29	< 30	< 28

* Control Location

TABLE B-12

VEGETATION - FOOD PRODUCTS
IODINE-131 AND GAMMA ISOTOPIC ANALYSES

SAMPLE LOCATION: ALL SAMPLE SITES

UNITS: pCi/Kg

LAB NO.	LOCATION	COLLECTION DATE	I-131	Cs-134	Cs-137
931753	FPG-1	10/08/93	< 27	< 12	< 11
931754	FPP-1	10/08/93	< 27	< 13	< 12

APPENDIX C
SUMMARY OF INTERLABORATORY COMPARISONS

EPA CROSS CHECK RESULTS

EPA PREP DATE	DATE RESULTS ISSUED	MEDIA	NUCLIDE	EPA RESULTS	ESI, SYSTEM CHEMISTRY RESULTS	NORM DEV. KNOWN
10/20/92	02/26/93	WATER	Beta	53.0	34.67	-3.18**1
		BLIND B	Co-60	15.0	15.00	0.00
		(pCi/L)	Cs-134	5.0	5.33	0.12
			Cs-137	8.0	9.33	0.46
02/05/93	04/20/93	WATER	I-131	100.0	100.00	0.00
		(pCi/L)				
04/20/93	08/19/93	WATER	Beta	177.0	154.33	-1.45
		BLIND B	Co-60	39.0	41.67	0.92
		(pCi/L)	Cs-134	27.0	26.00	-0.35
			Cs-137	32.0	34.33	0.81
06/04/93	08/19/93	WATER	H-3	9844.0	10453.33	1.07
		(pCi/L)				
06/11/93	08/27/93	WATER	Co-60	15.0	15.33	0.12
		GAMMA	Zn-65	103.0	103.33	0.06
		(pCi/L)	Ru-106	119.0	107.00	-1.73
			Cs-134	5.0	6.00	0.35
			Cs-137	5.0	6.00	0.35
			Ba-133	99.0	102.00	0.52
10/08/93	12/30/93	WATER	I-131	117.0	117.67	0.10
		(pCi/L)				
08/27/93	12/30/93	AIR FILTER	Beta	47.0	47.67	0.23
		(pCi/F)	Cs-137	9.0	8.67	-0.12
09/24/93	01/07/94	MILK	I-131	120.0	118.00	-0.29
		GAMMA	Cs-137	49.0	48.00	-0.35
		(pCi/L)	K (Total)	1679.0	1636.00	-0.89
11/05/93	01/14/94	WATER	H-3	7398.0	5762.67	-1.49
		(pCi/L)				

**1 A new efficiency curve was determined for the beta counter. Recalculation of the beta in water sample using the new efficiency curve gives results within the control limits.

APPENDIX D
SYNOPSES OF ANALYTICAL PROCEDURES

D-1.0 ANALYSIS OF SAMPLES FOR GROSS BETA ACTIVITY

D-1.1 Air Particulates

After allowing for the radon-222 and radon-220 daughter products to decay, the particulate filters were counted in a gas-flow proportional counter.

D-1.2 Water

A known volume of water, usually 200 milliliters, was reduced by evaporation, transferred to a two inch diameter planchet, and evaporated to dryness. The planchet was counted for 100 minutes in an automatic alpha-beta counter.

D-2.0 ANALYSIS OF WATER SAMPLES FOR TRITIUM

A known volume of water, 5 milliliters, was added to 15 milliliters of liquid scintillation solution in a 25 milliliter vial. The sample was counted for 500 minutes in a liquid scintillation counter.

D-3.0 ANALYSIS OF SAMPLES FOR IODINE-131

D-3.1 Milk and Water

Up to four liters of sample were mixed with a stable iodine carrier solution and eluded through an anion exchange resin column to remove iodine from the sample. The iodine was stripped from the resin with sodium hypochlorite solution, reduced with hydroxylamine hydrochloride, and extracted into carbon tetrachloride as free iodine. It was back-extracted as iodide into sodium bisulfite solution and precipitated as palladium iodide. The precipitate, palladium iodide, was weighed for chemical yield and mounted on a nylon planchet level beta analysis. The chemical yield was corrected by measuring the stable iodide content of the milk or water with a specific ion electrode.

D-3.2 Broad Leaf Vegetation

Iodine analysis was performed using gamma spectroscopy. The time between sample receipt and analysis, the sample size and count times were adjusted in order to attain the required lower limit of detection. Refer to Section E-4.2 for a description of gamma spectroscopy procedure.

D-4.0 GAMMA SPECTROSCOPY ANALYSIS

Air particulate filters and iodine cartridges, water, milk, broadleaf vegetation, sediment, food products and fish samples are analyzed by gamma spectroscopy. Initially, the samples are prepared in containers, using the appropriate geometry for its sample type. Secondly, the sample is counted in a shielded high purity germanium (HPGE) or germanium lithium (GeLi) detector coupled to a computer based data acquisition system that performs pulse height analysis.

The computer software program defines peaks by changes in the slope of the spectrum. Additionally, after comparing each specific peak energy with a library of peaks for isotopic identification the program performs the radioactivity calculation using the appropriate fractional gamma ray abundance, half life, detector efficiency, and net counts in the peak region.

D-5.0 ENVIRONMENTAL DOSIMETRY

Thermoluminescent Dosimeters (TLDs) manufactured by Panasonic (model UD-814) were used for environmental dosimetry. Although the Panasonic TLDs contain one lithium borate and three calcium sulfate phosphor elements, only the calcium sulfate phosphor elements were used. For placement in field, two annealed dosimeters are placed inside a plastic bag and mounted in an aluminum frame. The dosimeters are checked monthly and exchanged for analysis each quarter using an automatic TLD reader manufactured by Panasonic (Model UD-710).