



Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-4710

David B. Bice
Acting Manager, Licensing
Arkansas Nuclear One

OCAN050901

May 13, 2009

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

SUBJECT: Annual Radiological Environmental Operating Report for 2008
Arkansas Nuclear One, Units 1 and 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6

REFERENCES: 1. Arkansas Nuclear One, Unit 1, Technical Specification 5.6.2
2. Arkansas Nuclear One, Unit 2, Technical Specification 6.6.2

Dear Sir or Madam:

The referenced Arkansas Nuclear One (ANO) Technical Specifications (TSs) require the submittal of an annual radiological environmental operating report for the previous year by May 15 of each year. Attached is the subject ANO report for the calendar year 2008.

This report fulfills the reporting requirements of TSs referenced above.

The radionuclides detected by the radiological environmental monitoring program during 2008 were significantly below the regulatory limits. The operation of the ANO station during 2008 had no harmful effects nor resulted in any irreversible damage to the local environment.

Based on Entergy's review, no environmental samples from the monitoring program equated or exceeded the reporting levels for radioactivity concentration due to ANO effluents when averaged over any calendar quarter. Therefore the 2008 results did not require any Radiological Monitoring Program Special Reports.

This letter contains no new commitments.

If you have any questions or require additional information, please contact me.

Sincerely,

Original signed by F. Van Buskirk for D. Bice

DBB/rwc

Attachment: Annual Radiological Environmental Operating Report for 2008

cc: Mr. Elmo E. Collins
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
612 E. Lamar Blvd., Suite 400
Arlington, TX 76011-4125

NRC Senior Resident Inspector
Arkansas Nuclear One
P. O. Box 310
London, AR 72847

U. S. Nuclear Regulatory Commission
Attn: Mr. Kaly Kalyanam
MS O-8B1
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Mr. Bernard R. Bevill
Arkansas Department of Health
Radiation Control Section
4815 West Markham Street
Slot #30
Little Rock, AR 72205

ARKANSAS NUCLEAR ONE - UNITS 1 AND 2

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT FOR 2008

TABLE OF CONTENTS

SUMMARY	6
1.0 INTRODUCTION	10
1.1 Radiological Environmental Monitoring Program	10
1.2 Pathways Monitored	10
1.3 Land Use Census	11
2.0 INTERPRETATION AND TRENDS OF RESULTS	21
2.1 Air Particulate and Radioiodine Sample Results	21
2.2 Thermoluminescent Dosimetry Sample Results	21
2.3 Water Sample Results	22
2.4 Sediment Sample Results	23
2.5 Milk Sample Results	24
2.6 Fish Sample Results	24
2.7 Food Product Sample Results	24
2.8 Land Use Census Results	25
2.9 Interlaboratory Comparison Results	25
3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY	27
3.1 2008 Program Results Summary	27

LIST OF TABLES

TABLE 1.1	RADIOLOGICAL ENVIRONMENTAL SAMPLING PROGRAM	12
TABLE 2.1	2007 LAND USE CENSUS	26
TABLE 3.1	RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY	28

LIST OF FIGURES

FIGURE 1-1	SAMPLE COLLECTION SITES – NEAR FIELD	18
FIGURE 1-2	SAMPLE COLLECTION SITES – FAR FIELD	19
FIGURE 1-3	SAMPLE COLLECTION SITES – SITE MAP	20

LIST OF ATTACHMENTS

ATTACHMENT 1	2008 RADIOLOGICAL MONITORING REPORT SUMMARY OF MONITORING RESULTS	32
ATTACHMENT 2	INTERLABORATORY COMPARISON PROGRAM	48
ATTACHMENT 3	SEDIMENT DOSE CALCULATIONS	52

Summary

The Annual Radiological Environmental Operating Report (AREOR) presents data obtained through analyses of environmental samples collected for Arkansas Nuclear One's (ANO's) Radiological Environmental Monitoring Program (REMP) for the period January 1, through December 31, 2008. This report fulfills the requirements of ANO Unit 1 Technical Specification 5.6.2 and Unit 2 Technical Specification 6.6.2.

During 2008 as in previous years, Entergy detected radionuclides attributable to plant operations at the discharge location (Station 8) where previously monitored liquid radioactive effluent from the plant is periodically discharged in accordance with the regulatory criteria established in the Offsite Dose Calculation Manual (ODCM). ANO personnel routinely monitor results from this area in order to note any trends. The review of results from this area indicates the following:

- Tritium levels in the surface water media continue to be below regulatory reporting limits and are consistent with concentrations that would typically be seen at this location as discussed in Section 2.3 of this AREOR
- Cesium-137 levels in the sediment media are not demonstrating any consistent increase in comparison to previous years. Review indicates that results for 2008 were within the range of previous operational levels as discussed in Section 2.4 of this AREOR.
- Gross beta concentrations at the Station 14 (City of Russellville) indicator drinking water location continue to remain consistent with previous operational measurements and similar to the levels detected at the Station 57 (City of Danville) control drinking water location.

Radiological Environmental Monitoring Program

Entergy established the REMP prior to the station becoming operational (1974) to provide data on background radiation and radioactivity normally present in the area. Entergy has continued to monitor the environment by sampling air, water, sediment, fish and food products, as well as measuring radiation directly. Entergy also samples milk if milk-producing animals are present commercially within five miles of the plant.

The REMP includes sampling indicator and control locations within an approximately 20-mile radius of the plant. The REMP utilizes indicator locations near the site to show any increases or buildup of radioactivity that might occur due to station operation, and control locations farther away from the site to indicate the presence of only naturally occurring radioactivity. ANO personnel compare indicator results with control and pre-operational results to assess any impact ANO operation might have had on the surrounding environment.

In 2008, ANO personnel collected environmental samples for radiological analysis. They compared results of indicator locations with control locations and previous studies and concluded that overall no significant relationship exists between ANO operation and effect on the plant environs. The review of 2008 data, in many cases, showed undetectable radiation levels in the environment and in all instances, no definable trends related to significant pathways associated with ANO.

Harmful Effects or Irreversible Damage

The REMP monitoring did not detect any harmful effects or evidence of irreversible damage in 2008. Therefore, no analysis or planned course of action to alleviate problems was necessary.

Reporting Levels

Entergy's review indicates that no samples equaled or exceeded reporting levels for radioactivity concentration in environmental samples due to ANO effluents, as outlined in Units 1 and 2 ODCM Table 2.6-3, when averaged over any calendar quarter. Therefore, 2008 results did not trigger any Radiological Monitoring Program Special Reports.

Radioactivity Not Attributable to ANO

The ANO REMP has detected radioactivity attributable to other sources. These include the 25th Chinese nuclear test explosion in 1980 and the radioactivity plume release due to reactor core degradation at the Chernobyl Nuclear Power Plant in 1986. Prior to 1981, the ANO REMP detected radioactivity resulting from nuclear weapons testing, with Cesium-137 continuing to be periodically detected.

Comparison to Federal and State Programs

ANO personnel compared REMP data to state monitoring programs as results became available. Historically, the programs used for comparison have included the U.S. Nuclear Regulatory Commission (NRC) Thermoluminescent Dosimeter Direct Radiation Monitoring Network and the Arkansas Department of Health (ADH).

The NRC Thermoluminescent Dosimeter Network Program was discontinued in 1998. Historically these results have compared to those from the ANO REMP. ANO Thermoluminescent Dosimeter results continue to remain similar to the historical average and continue to verify that plant operation is not affecting the ambient radiation levels in the environment.

The ADH and the ANO REMP entail similar radiological environmental monitoring program requirements. These programs include collecting air samples and splitting or sharing sample media such as water, sediment and fish. Both programs have obtained similar results over previous years.

Sample Deviations

◆ **Milk**

The REMP did not include milk sampling within five miles (8 km) of ANO in 2008 due to unavailability. ANO Units 1 and 2 ODCM require collection of milk samples if available commercially within 8 km (5 miles) of the plant. ANO personnel collected vegetation samples to monitor the ingestion pathway, as specified in the ODCM, because of milk unavailability.

◆ **Required Lower Limit of Detection (LLD) Values**

LLDs during this reporting period were within the acceptable limits required by Table 2.6-2 of the ANO Units 1 and 2 ODCM.

◆ **Air Samples**

Listed below are air sampler deviations that occurred during 2008 due to hazardous weather conditions, electrical power outages and equipment failure. These deviations did not result in the exceedance of the LLD values specified in the ODCM. As described in footnote (a) to ANO Units 1 and 2 ODCM Table 2.6-1, deviations are permitted from the required sampling schedule due to malfunction of sampling equipment and other legitimate reasons.

Station	Sampling Period	Comment
ALL	02/19/08 - 03/04/08	Due to hazardous weather conditions the bi-weekly air sample stations were not collected as scheduled. The air samples were collected the following day (03/05/08). CR-ANO-C-2008-00445
7	04/15/08 – 04/29/08	Air sample station totalizer recorded ~ 96 hour run time. Normal run time = 336 hours. This condition is typical of a power failure. CR-ANO-C-2008-00909
7	04/29/08 – 05/13/08	Air sample station totalizer not operating. Totalizer replaced. CR-ANO-C-2008-00985
1	05/13/08 – 05/27/08	Air sample station found not running. Estimated air pump off for 208 hours. Reset Ground Fault Circuit Interrupter. CR-ANO-C-2008-01067
2	11/25/08 – 12/09/08	Air sample station totalizer did not change. Totalizer replaced. CR-ANO-C-2008-02584

◆ **Missed Samples**

There were no missed REMP samples during 2008.

◆ **Unavailable Results**

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

Program Modifications

ANO made no modifications to the REMP during 2008.

Attachments

Attachment 1 contains results of air, TLD, water, sediment, fish, and food product samples collected in 2008. TLDs were analyzed by vendor (AREVA). All remaining samples were analyzed by River Bend Station's (RBS's) Environmental Laboratory.

Attachment 2 also contains RBS's participation in the interlaboratory comparison program during 2008.

Attachment 3 contains dose calculations performed for sediment using a generalized equation from Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I."

1.0 Introduction

1.1 Radiological Environmental Monitoring Program

Entergy established the REMP to ensure that plant operating controls properly function to minimize any associated radiation endangerment to human health or the environment. The REMP is designed for:

- Analyzing applicable pathways for anticipated types and quantities of radionuclides released into the environment.
- Considering the possibility of a buildup of long-lived radionuclides in the environment and identifying physical and biological accumulations that may contribute to human exposures.
- Considering the potential radiation exposure to plant and animal life in the environment surrounding ANO.
- Correlating levels of radiation and radioactivity in the environment with radioactive releases from station operation.

1.2 Pathways Monitored

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

Section 2.0 of this report provides a discussion of 2008 sampling results and Section 3.0 provides a summary of results for the monitored exposure pathways.

1.3 Land Use Census

ANO personnel conducts land use census biannually (once every two years) as required by ANO Units 1 and Unit 2 ODCM Section 2.6.2. The latest land use census was conducted in 2007. The purpose of this census is to identify changes in uses of land within five miles of ANO that would require modifications to the REMP or ODCM. The most important criteria during this census are to determine location in each sector of the nearest:

- 1) Residence
- 2) Animal milked for human consumption
- 3) Garden of greater than 500 square feet producing fresh leafy (broadleaf) vegetables *

* ANO personnel do not perform a garden census since ODCM Section 2.6.2 allows the routine sampling of broadleaf vegetation in the highest D/Q sector near the site boundary in lieu of the garden census.

The method used by ANO personnel for conducting the land use census is as follows:

- ANO personnel conducted door-to-door (drive by) field surveys in order to locate the nearest resident in each meteorological sector.
- Consultation with local agricultural authorities is used for the identification of commercial milk providers within five-miles of the Unit-1 reactor building.
- As a result of these surveys, the following information is obtained in each meteorological sector:
 - 1) Nearest permanent residence
 - 2) Nearest milking animal
- ANO personnel identify locations on the map, measure distances to ANO (or use a global positioning system) and record results.
- Locations, if any, are identified which yield a calculated dose or dose commitments greater than those currently calculated in the ODCM.
- ANO personnel compare results to previous census.

Table 1.1

Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Airborne	<p><u>Radioiodine and Particulates</u> 2 samples close to the Site Boundary, in (or near) different sectors with the highest calculated annual average ground level D/Q.</p>	<p>Station 2 (243° - 0.5 miles) - South of the sewage treatment plant.</p> <p>Station 56 (264° - 0.4 miles) – West end of the sewage treatment plant.</p>	Continuous operation of sampler with sample collection as required by dust loading but at least once per 14 days.	<p>Radioiodine Canister – Analyze at least once per 14 days for I-131.</p> <p>Particulate Sampler – Analyze for gross beta radioactivity following filter change.</p>
	<p><u>Radioiodine and Particulates</u> 1 sample from the vicinity of a community having the highest calculated annual average ground level D/Q.</p>	<p>Station 6 (111° - 6.8 miles) - Entergy local office in Russellville (305 South Knoxville Avenue).</p>		
	<p><u>Radioiodine and Particulates</u> 1 sample from a control location 15-30 km (10 – 20 miles) distance.</p>	<p>Station 7 (210° - 19.0 miles) – Entergy Supply Yard on Highway 10 in Danville.</p>		
	<p><u>Radioiodine and Particulates</u> 1 location sampled voluntarily by ANO.</p>	<p>Station 1 (88° - 0.5 miles) - Near the meteorology tower.</p>		
Direct Radiation	<p><u>Thermoluminescent dosimetry (TLDs)</u> 16 inner ring stations with two or more dosimeters in each meteorological sector in the general area of the Site Boundary</p>	<p>Station 1 (88° - 0.5 miles) - On a pole near the meteorology tower.</p> <p>Station 2 (243° - 0.5 miles) - South of the sewage treatment plant.</p> <p>Station 3 (5° - 0.7 miles) – West of ANO Gate #2 on Highway 333 (approximately 0.35 miles)</p>	Once per 92 days.	Gamma Dose – Once per 92 days.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p>TLDs 16 inner ring stations with two or more dosimeters in each meteorological sector in the general area of the Site Boundary.</p>	<p>Station 4 (181° - 0.5 miles) – West of May Cemetery entrance on south side of the road.</p> <p>Station 56 (264° - 0.4 miles) - West end of the sewage treatment plant.</p> <p>Station 108 (306° - 0.9 miles) - South on Flatwood Road on a utility pole.</p> <p>Station 109 (291° - 0.6 miles) - Utility pole across from the junction of Flatwood Road and Round Mountain Road.</p> <p>Station 110 (138° - 0.8 miles) - Bunker Hill Lane on the first utility pole on the left.</p> <p>Station 145 (28° - 0.6 miles) - Near west entrance to the RERTC on a utility pole.</p> <p>Station 146 (45° - 0.6 miles) - South end of east parking lot at RERTC on a utility pole.</p> <p>Station 147 (61° - 0.6 miles) - West side of Bunker Hill Road, approximately 100 yards from intersection with State Highway 333.</p> <p>Station 148 (122° - 0.6 miles) - Intersection of Bunker Hill Road with Scott Lane on county road sign post.</p>	Once per 92 days.	Gamma Dose – Once per 92 days.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p><u>TLDs</u> 16 inner ring stations with two or more dosimeters in each meteorological sector in the general area of the Site Boundary.</p>	<p>Station 149 (156° - 0.5 miles) – On a utility pole on the south side of May Road.</p> <p>Station 150 (205° - 0.6 miles) – North side of May Road on a utility pole past the McCurley Place turn.</p> <p>Station 151 (225° - 0.4 miles) – West side of sewage treatment plant near the lake on a metal post.</p> <p>Station 152 (338° - 0.8 miles) – South side of State Highway 333 on a road sign post.</p>	Once per 92 days.	Gamma Dose – Once per 92 days.
	<p><u>TLDs</u> 8 stations with two or more dosimeters in special interest areas such as population centers, nearby residences, schools, and in 1 – 2 areas to serve as control locations.</p>	<p>Station 6 (111° - 6.8 miles) - Entergy local office in Russellville (305 South Knoxville Avenue).</p> <p>Station 7 (210° - 19.0 miles) – Entergy Supply Yard on Highway 10 in Danville.</p> <p>Station 111 (120° - 2.0 miles) – Marina Road on a utility pole on the left just prior to curve.</p> <p>Station 116 (318° - 1.8 miles) - Highway 333 and Highway 64 in London on a utility pole north of the railroad tracks.</p>		

Table 1.1

Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Direct Radiation	<p><u>TLDs</u> 8 stations with two or more dosimeters in special interest areas such as population centers, nearby residences, schools, and in 1 – 2 areas to serve as control locations.</p>	<p>Station 125 (46° - 8.7 miles) - College Street on a utility pole at the southeast corner of the red brick school building.</p> <p>Station 127 (100° - 5.2 miles) - Arkansas Tech Campus on a utility pole across from Paine Hall.</p> <p>Station 137 (151° - 8.2 miles) – On a speed limit sign on the right in front of the Morris R. Moore Arkansas National Guard Armory.</p> <p>Station 153 (304° - 9.2 miles) - Knoxville Elementary School near the school entrance gate on a utility pole.</p>	Once per 92 days.	Gamma Dose – Once per 92 days.
Waterborne	<p><u>Surface Water</u> 1 indicator location (influenced by plant discharge) 1 control location (uninfluenced by plant discharge)</p>	<p>Station 8 (166° - 0.2 miles) - Plant discharge canal.</p> <p>Station 10 (95° - 0.5 miles) – Plant intake canal.</p>	Once per 92 days.	Gamma isotopic and tritium analyses once per 92 days.
	<p><u>Drinking Water</u> 1 indicator location (influenced by plant discharge) 1 control location (uninfluenced by plant discharge)</p>	<p>Station 14 (70° - 5.1 miles) - Russellville city water system from the Illinois Bayou.</p> <p>Station 57 (208° - 19.5 miles) - Danville public water supply treatment on Fifth Street.</p>	Once per 92 days.	I-131, gross beta, gamma isotopic and tritium analyses once per 92 days.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Waterborne	<p><u>Sediment</u> 1 indicator location (influenced by plant discharge)</p> <p>1 control location (uninfluenced by plant discharge)</p>	<p>Station 8 (243° - 0.9 miles) - Plant discharge canal.</p> <p>Station 16 (287° - 5.5 miles) - Panther Bay on south side of Arkansas River across from mouth of Piney Creek.</p>	Once per 365 days.	Gamma isotopic analysis once per 365 days.
Ingestion	<p><u>Milk</u> 1 indicator sample location within 8 km (five-miles) distance if commercially available.</p> <p>1 control sample location at a distance of > 8 km, (five-miles) when an indicator exists.</p>	Currently, no available milking animals within 8 km of ANO.	Once per 92 days.	Gamma isotopic and I-131 analyses once per 92 days.
	<p><u>Fish</u> 1 sample of commercially and/or recreationally important species in vicinity of plant discharge.</p> <p>1 sample of same species in area not influenced by plant discharge.</p>	<p>Station 8 (212° - 0.5 miles) – Plant discharge canal.</p> <p>Station 16 (287° - 5.5 miles) - Panther Bay on south side of Arkansas River across from mouth of Piney Creek.</p>	Once per 365 days.	Gamma isotopic on edible portions once per 365 days.

Table 1.1
Radiological Environmental Sampling Program

Exposure Pathway	Requirement	Sample Point Description, Distance and Direction	Sampling and Collection Frequency	Type and Frequency Of Analyses
Ingestion	<p>Food Products 1 sample of broadleaf (edible or non-edible) near the Site Boundary from one of the highest anticipated annual average ground level D/Q sectors, if milk sampling is not performed.</p> <p>1 sample location of broadleaf vegetation (edible or non-edible) from a control location 15 – 30 km (10 – 20 miles) distant, if milk sampling is not performed.</p>	<p>Station 13 (273° - 0.5 miles) - West from ANO toward Gate 4 onto Flatwood Road.</p> <p>Station 55 (208° - 16.5 miles) – Intersection of Highway 27 and 154.</p>	Three per 365 days.	Gamma isotopic and I-131 analyses three times per 365 days.
Groundwater	<p>1 sample location of Groundwater from a control location up gradient from the protected area</p> <p>3 sample locations of Groundwater from indicator locations down gradient from the protected area</p>	<p>Station 58 (GWM-1, 22° - 0.3 miles) – North of Protected Area on ACA. South of Outside Fab-Shop, west side of access road</p> <p>Station 59 (GWM-2, 185° - 0.1 miles) – South of Protected Area on OCA. Near Security barriers and discharge canal.</p> <p>Station 60 (GWM-3, 206° - 0.1 miles) – South of Protected area on OCA. West of Station number 59 near wood line.</p> <p>Station 61 (GWM-4, 245° - 0.1 miles) – West of Protected Area no OCA. Edge of parking lot, east of equipment laydown area</p>	<p>Once per 92 days</p> <p>Once per 92 days</p> <p>Once per 92 days</p> <p>Once per 92 days</p>	<p>Control, Tritium and Gamma Isotopic, once per 92 days.</p> <p>Indicator, Tritium and Gamma Isotopic, once per 92 days.</p> <p>Indicator, Tritium and Gamma Isotopic, once per 92 days.</p> <p>Indicator, Tritium and Gamma Isotopic, once per 92 days.</p>

FIGURE 1-1

SAMPLE COLLECTION SITES – NEAR FIELD

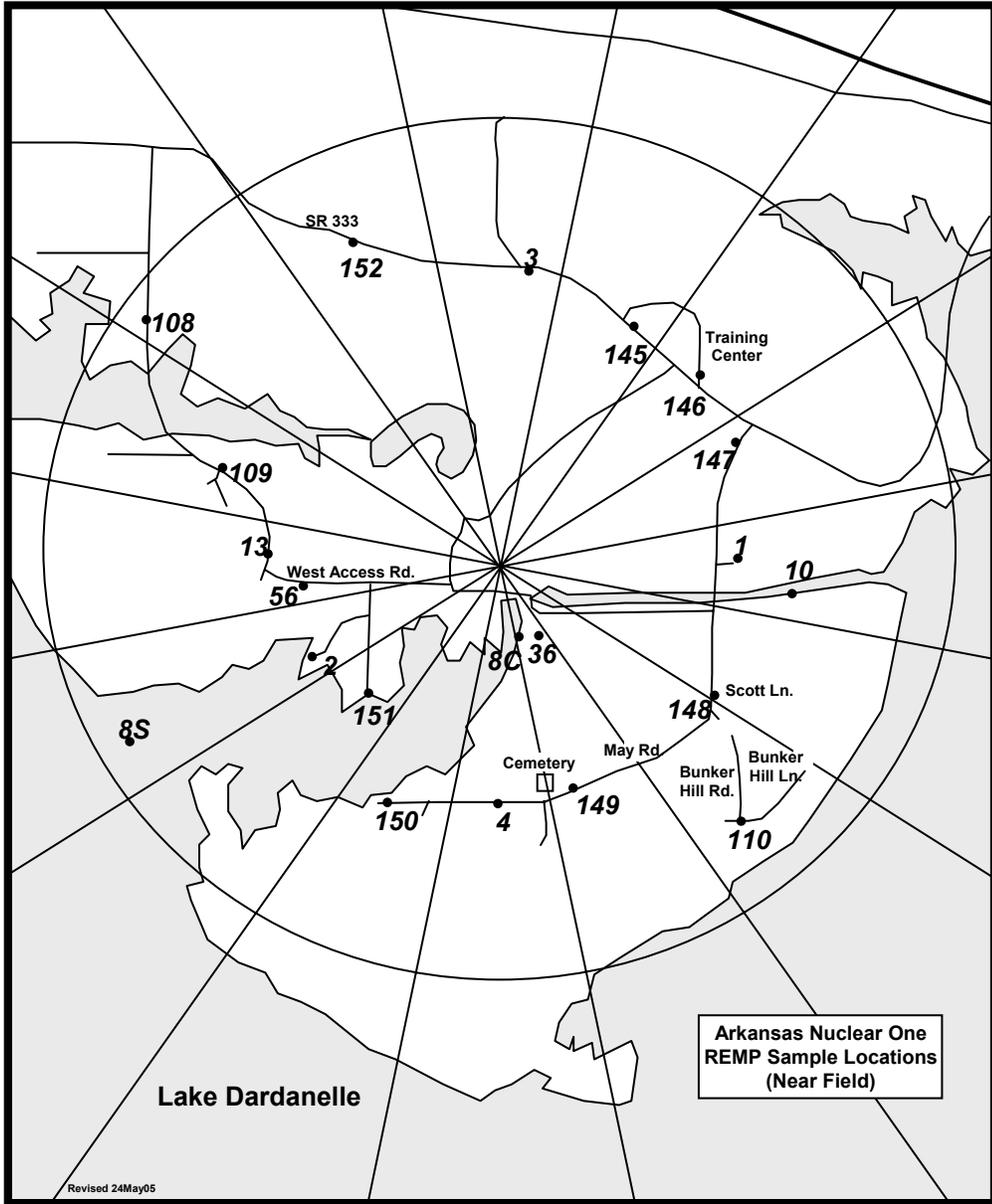
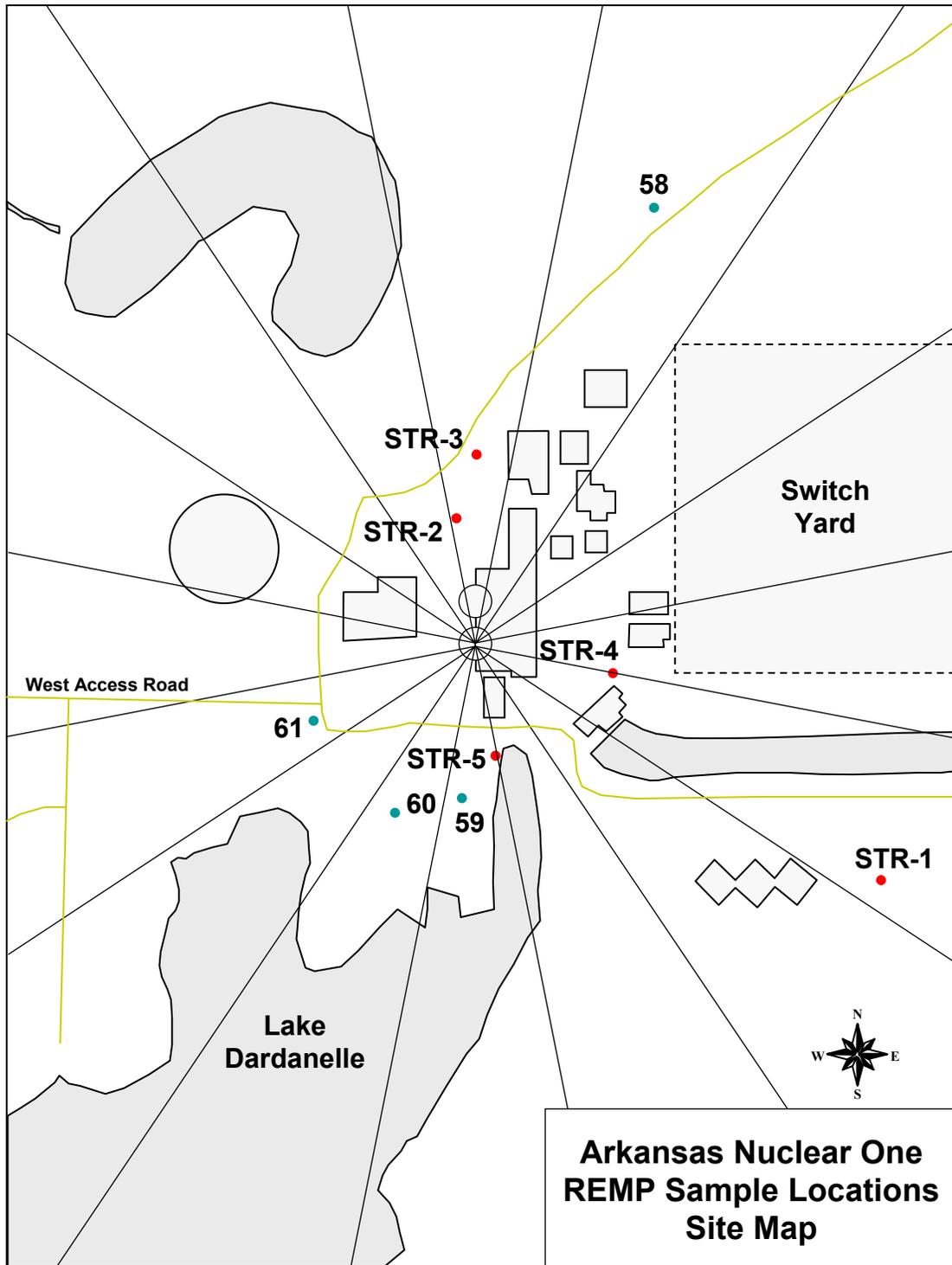


FIGURE 1-3
SAMPLE COLLECTION SITES – SITE MAP



2.0 Interpretation and Trends of Results

2.1 Air Particulate and Radioiodine Sample Results

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

During 2008, Iodine-131 was not detected in the radioiodine cartridges, as has been the case in previous years. In addition, indicator gross beta air particulate results for 2008 were within the range of levels obtained in previous years of the operational REMP and well below preoperational levels as seen below. Results are reported as annual average pCi/m³.

<u>Monitoring Period</u>	<u>Result</u>
2000 – 2007 (Minimum Value)	0.020
2008 Value	0.032
2000 – 2007 (Maximum Value)	0.030
Preoperational	0.050

In the absence of plant-related gamma radionuclides, gross beta activity is attributed to naturally occurring radionuclides. Table 3.1, which includes gross beta concentrations and provides a comparison of the indicator and control means and ranges, emphasizes the consistent trends seen in this pathway to support the presence of naturally occurring activity. Therefore, it can be concluded that the airborne pathway continues to be unaffected by ANO operations.

2.2 Thermoluminescent Dosimetry (TLD) Sample Results

Entergy reports measured dose as net exposure (field reading less transit reading) normalized to 92 days and relies on comparison of the indicator locations to the control as a measure of plant impact. Entergy's comparison of the inner ring and special interest area TLD results to the control, as seen in Table 3.1, identified no noticeable trend that would indicate that the ambient radiation levels are being affected by plant operations. In addition, the inner ring value of 7.51 mrem shown in Table 3.1 is within the historical bounds of 2000 – 2006 annual average results, which have ranged from 6.7 to 8.8 mrem.

Gamma radiation dose in the reporting period was further compared to historical control location readings for previous years as shown in Figure 2-1. Entergy's comparison of the results to the control indicates that the ambient radiation levels are unaffected by plant operations. Although the third quarter readings for TLD Stations 1, 2, 56, 108, 109, and 151 shown in Figure 2-1 was above the upper (+) three standard deviation range value of 9.7 mrem for the historical maximum control location, Entergy considers the difference to be insignificant since the dose rates remain well below the limitations of 10 CFR 20.1301(a)(1) and 10CFR 20.1302(b)(2)(ii), and since there has been no identifiable trends associated with these stations. In addition, Entergy utilized a different vendor for TLD processing in 2008. Therefore, these increases can also be attributed to differences in dosimeter processing.

Overall, Entergy concluded that the ambient radiation levels are not being affected by plant operations.

2.3 Water Sample Results

Analytical results for 2008 surface water and drinking water samples were similar to those reported in previous years.

Surface water samples were collected and analyzed for gamma radionuclides and tritium. Gamma radionuclides were below detectable limits which is consistent with results seen in previous operational years. Tritium continues to be detected at the indicator location (Station 8) where previously monitored radioactive effluent from the plant is periodically discharged in accordance with the regulatory criteria established in the ODCM. However, the levels detected are consistent with concentrations that would typically be seen at this location as shown below. Results are reported as annual average pCi/l.

<u>Monitoring Period</u>	<u>Concentration</u>
2000 – 2007 (Minimum Value)	272.0
2008 Value	1023.3
2000 – 2007 (Maximum Value)	876.3
Preoperational Value	200.0

ANO personnel have noted no definable increasing trends associated with the tritium levels at the discharge location. Levels detected during 2008 and previous operational years have been well below regulatory reporting limits. Therefore, the operation of ANO had no definable impact on this waterborne pathway during 2008 and levels of radionuclides remain similar to those obtained in previous operational years.

Drinking water samples were collected from two locations (indicator and control). Although ANO personnel utilize Station 14 (City of Russellville) as an indicator location due to the potential for the drinking water pathway to exist, the City of Russellville has not withdrawn water from Lake Dardanelle in the past several years.

Drinking water samples were analyzed for gross beta radionuclides, Iodine-131, gamma radionuclides and tritium. Gamma radionuclides, Iodine-131 and tritium concentrations were below the LLD limits at the indicator and control locations, which is consistent with preoperational and operational years. Gross beta concentrations at the indicator and control locations are similar as shown in Table 3.1. Listed below is a comparison of 2008 indicator results to preoperational and operational years. Results are reported as annual average pCi/l.

<u>Radionuclide</u>	<u>2008</u>	<u>2000 – 2007</u>	<u>Preoperational</u>
Gross Beta	1.64	3.24	2.0
Iodine-131	< LLD	< LLD	< LLD
Gammas	< LLD	< LLD	< LLD
Tritium	< LLD	< LLD	200.0

ANO personnel have noted no definable trends associated with drinking water results at the indicator location. Therefore, the operation of ANO had no definable impact on this waterborne pathway during 2008 and levels of radionuclides remain similar to those obtained in previous operational years.

Groundwater samples were collected from four locations (1 – control, and 3 – indicator locations).

Groundwater samples were analyzed for Tritium and Gamma radionuclides. Tritium and Gamma concentrations were below the LLD limits at the indicator and control locations. Listed below is a comparison of 2008 indicator results to past operational years. Results are reported as annual average pCi/l. Groundwater data is captured in Tables 8.1 and 8.2.

<u>Radionuclide</u>	<u>2008</u>	<u>2006 – 2007</u>
Tritium	< LLD	< LLD
Gammas	< LLD	< LLD

2.4 Sediment Sample Results

Sediment samples were collected from two locations in 2008 and analyzed for gamma radionuclides. As in previous years, Cesium-137 attributable to ANO was detected in the discharge sediment indicator location (Station 8) where previously monitored liquid radioactive effluent from the plant is periodically discharged in accordance with the regulatory criteria established in the ODCM. Although it is anticipated that radionuclides would be detected at this location since sediment particles provide a natural binding mechanism, ANO personnel have noted no definable consistent trends associated with this radionuclide at the discharge location. Cesium-137 results for 2008 were actually below the minimum range of previous operational levels as seen below. Results are reported as annual average pCi/kg.

<u>Monitoring Period</u>	<u>Concentration</u>
2000 – 2007 (Minimum Value)	97.78
2008 Value	41.79
2000 – 2007 (Maximum Value)	1170.0

Since reporting levels for radionuclides in sediment have not been established, an evaluation of potential dose to the public from this media was performed as shown in Attachment 2. The annual maximum dose from Cesium-137 to the skin and total body was calculated to be < 0.01 mrem.

Design objectives given in 10CFR50, Appendix I for liquid effluents are annual doses of ≤ 3 mrem total body and ≤ 10 mrem any organ. The values of < 0.01 mrem for the skin and total body are well within the design objective criteria. Therefore, the level of Cesium-137 detected in 2008 had no significant impact on the environment or public by this waterborne pathway.

2.5 Milk Sample Results

Milk samples were not collected during 2008 due to the unavailability of indicator locations within five-miles of ANO.

2.6 Fish Sample Results

Fish samples were collected from two locations and analyzed for gamma radionuclides. In 2007, gamma radionuclides were below detectable limits which are consistent with the preoperational monitoring period and operational results since 1997. Therefore, based on these measurements, ANO operations had no significant radiological impact upon the environment or public by this ingestion pathway.

2.7 Food Product Sample Results

The REMP has detected radionuclides prior to 1990 that are attributable to other sources. These include the radioactive plume release due to reactor core degradation at Chernobyl Nuclear Power Plant in 1986 and atmospheric weapons testing.

In 2008, food product samples were collected when available from two locations and analyzed for Iodine-131 and gamma radionuclides. The 2008 levels remained undetectable, as has been the case in previous years. Therefore, based on these measurements, ANO operations had no significant radiological impact upon the environment or public by this ingestion pathway.

2.8 Land Use Census Results

The latest land use census (performed in 2007) did not identify any new locations that yielded a calculated dose or dose commitment greater than those currently calculated. (see Table 2.1)

Also, the land use census identified no milk-producing animals within a five-mile radius of the plant site. ANO personnel chose not to perform a garden census in 2007, which is allowed by ANO Units 1 and 2 ODCM Section 2.6.2, in lieu of broadleaf vegetation sampling in the meteorological sector (Sector 13) with the highest D/Q.

2.9 Interlaboratory Comparison Results

RBS's Environmental Laboratory analyzed interlaboratory comparison samples for ANO to fulfill the requirements of ANO Units 1 and 2 ODCM Section 2.6.3. Attachment 2 contains these results. Entergy's review of RBS's interlaboratory comparison indicated that 100% of the sample results (40 of 40) were within the acceptable control limits of the three normalized deviations.

TABLE 2.1

2007 Land Use Census

Nearest Residence Within Five Miles

Direction	Sector	Distance (miles)
N	1	0.9
NNE	2	1.3
NE	3	0.9
ENE	4	0.8
E	5	0.8
ESE	6	0.8
SE	7	0.8
SSE	8	0.8
S	9	0.8
SSW	10	0.7
SW	11	2.8
WSW	12	0.7
W	13	0.8
WNW	14	0.8
NW	15	1.0
NNW	16	0.9

3.0 Radiological Environmental Monitoring Program Summary

3.1 2008 Program Results Summary

Table 3.1 summarizes the 2008 REMP results. ANO personnel did not use values reported as less than the LLD when determining ranges and means for indicator and control locations.

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: **ANO - Units 1 and 2** Docket No: **50-313 and 50-368**
 Location of Facility: **Pope County, Arkansas** Reporting Period: **January - December 2008**

Sample Type (Units)	Type & Number of Analyses ^a	LLD ^b	Indicator Locations Mean (F) ^c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) ^c [Range]	Number of Nonroutine Results ^e
				Location ^d	Mean (F) ^c [Range]		
Air Particulates (pCi/m³)	GB 140	0.01	0.032 (81 / 81) [0.017 – 0.065]	Station 1 (88°, 0.5 mi)	0.032 (27 / 27) [0.018 - 0.045]	0.030 (54 / 54) [0.015 - 0.0924]	0
Airborne Iodine (pCi/m³)	I-131 140	0.07	< LLD	N/A	N/A	< LLD	0
Inner Ring TLDs (mR/Qtr)	Gamma 64	(f)	8.1 (64 / 64) [4.9 – 10.6]	Station 56 (264°, 0.4 mi)	9.7 (4 / 4) [9.1 – 10.6]	N/A	0
Special Interest TLDs (mR/Qtr)	Gamma 28	(f)	7.1 (28 / 28) [4.6 – 9.6]	Station 127 (100°, 5.2 mi)	8.7 (4 / 4) [8.0 – 9.6]	N/A	0
Control TLD (mR/Qtr)	Gamma 4	(f)	N/A	N/A	N/A	7.3 (4 / 4) [7.1 – 7.6]	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: ANO - Units 1 and 2 Docket No: 50-313 and 50-368
 Location of Facility: Pope County, Arkansas Reporting Period: January - December 2008

Sample Type (Units)	Type & Number of Analyses ^a	LLD ^b	Indicator Location Mean (F) ^c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) ^c [Range]	Number of Nonroutine Results ^e
				Location ^d	Mean (F) ^c [Range]		
Surface Water (pCi/l)	H-3 8	3000	1023.3 (4 / 4) [521.0 – 1548.0]	Station 8 (166°, 0.2 mi)	1023.3 (3 / 4) [521.0 – 1548.0]	< LLD	0
	GS 24						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	N/A	N/A	< LLD	0
	Co-58	15	< LLD	N/A	N/A	< LLD	0
	Co-60	15	< LLD	N/A	N/A	< LLD	0
	Zn-65	30	< LLD	N/A	N/A	< LLD	0
	Zr-95	30	< LLD	N/A	N/A	< LLD	0
	Nb-95	15	< LLD	N/A	N/A	< LLD	0
	I-131	15	< LLD	N/A	N/A	< LLD	0
	Cs-134	15	< LLD	N/A	N/A	< LLD	0
	Cs-137	18	< LLD	N/A	N/A	< LLD	0
	Ba-140	60	< LLD	N/A	N/A	< LLD	0
	La-140	15	< LLD	N/A	N/A	< LLD	0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: ANO - Units 1 and 2 Docket No: 50-313 and 50-368
Location of Facility: Pope County, Arkansas Reporting Period: January - December 2008

Sample Type (Units)	Type & Number of Analyses ^a	LLD ^b	Indicator Locations Mean (F) ^c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) ^c [Range]	Number of Nonroutine Results ^e
				Location ^d	Mean (F) ^c [Range]		
Drinking Water (pCi/1)	GB 8	4	1.64 (3 / 4) [0.92 – 3.44]	Station 14 (70°, 5.1 mi)	1.64 (3 / 4) [0.92 – 3.44]	1.77 (4 / 4) [0.92 – 3.53]	0
	I-131 8	1.0	< LLD	N/A	N/A	< LLD	0
	H-3 8	2000	< LLD	N/A	N/A	< LLD	0
	GS 8						
	Mn-54	15	< LLD	N/A	N/A	< LLD	0
	Fe-59	30	< LLD	N/A	N/A	< LLD	0
	Co-58	15	< LLD	N/A	N/A	< LLD	0
	Co-60	15	< LLD	N/A	N/A	< LLD	0
	Zn-65	30	< LLD	N/A	N/A	< LLD	0
	Zr-95	30	< LLD	N/A	N/A	< LLD	0
	Nb-95	15	< LLD	N/A	N/A	< LLD	0
	Cs-134	15	< LLD	N/A	N/A	< LLD	0
	Cs-137	18	< LLD	N/A	N/A	< LLD	0
	Ba-140	60	< LLD	N/A	N/A	< LLD	0
La-140	15	< LLD	N/A	N/A	< LLD	0	
Bottom Sediment (pCi/kg)	GS 2 Cs-134 Cs-137	150 180	< LLD 41.79 (1 / 1) [N/A]	N/A Station 8 (243°, 0.9 mi)	N/A 41.79 (1 / 1) [N/A]	< LLD < LLD	0 0

TABLE 3.1

Radiological Environmental Monitoring Program Summary

Name of Facility: ANO - Units 1 and 2 Docket No: 50-313 and 50-368
Location of Facility: Pope County, Arkansas Reporting Period: January - December 2008

Sample Type (Units)	Type & Number of Analyses ^a	LLD ^b	Indicator Location Mean (F) ^c [Range]	Location with Highest Annual Mean		Control Locations Mean (F) ^c [Range]	Number of Nonroutine Results ^e
				Location ^d	Mean (F) ^c [Range]		
Fish (pCi/kg)	GS 2						
	Mn-54	130	< LLD	N/A	N/A	< LLD	0
	Fe-59	260	< LLD	N/A	N/A	< LLD	0
	Co-58	130	< LLD	N/A	N/A	< LLD	0
	Co-60	130	< LLD	N/A	N/A	< LLD	0
	Zn-65	260	< LLD	N/A	N/A	< LLD	0
	Cs-134	130	< LLD	N/A	N/A	< LLD	0
	Cs-137	150	< LLD	N/A	N/A	< LLD	0
Food Products (pCi/kg)	I-131 6	60	< LLD	N/A	N/A	N/A	0
	GS 6						
	Cs-134	60	< LLD	N/A	N/A	N/A	0
	Cs-137	80	< LLD	N/A	N/A	N/A	0

- a GB = Gross beta; I-131 = Iodine-131; H-3 = Tritium; GS = Gamma scan.
- b LLD = Required lower limit of detection based on ANO Units 1 and 2 ODCM Tables 2.6-2.
- c Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parenthesis (F).
- d Locations are specified (1) by name and (2) degrees relative to reactor site.
- e Non-routine results are those which exceed ten times the control station value. If no control station value is available, the result is considered non-routine if it exceeds ten times the preoperational value for the location.
- f LLD is not defined in ANO Units 1 and 2 ODCM Tables 2.6-2.

ATTACHMENT 1

2008 Radiological Monitoring Report

Summary of Monitoring Results

TABLE OF CONTENTS

TABLE 1.1	AIR PARTICULATE	34
TABLE 1.2	RADIOIODINE CARTRIDGE	35
TABLE 2.1	THERMOLUMINESCENT DOSIMETERS (INNER RING)	36
TABLE 2.2	THERMOLUMINESCENT DOSIMETERS (SPECIAL INTEREST AREAS)	37
TABLE 3.1	SURFACE WATER (GAMMA ISOTOPIC)	38
TABLE 3.2	SURFACE WATER (TRITIUM)	40
TABLE 4.1	DRINKING WATER (GROSS BETA, I-131 AND GAMMA ISOTOPIC)	41
TABLE 4.2	DRINKING WATER (TRITIUM)	42
TABLE 5.1	SEDIMENT	43
TABLE 6.1	FISH	44
TABLE 7.1	FOOD PRODUCTS	45
TABLE 8.1	GROUNDWATER DATA (I-131 AND GAMMA ISOTOPIC)	46
TABLE 8.2	GROUNDWATER DATA (TRITIUM)	47

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

Start Date	End Date	Station 1 * (Indicator)	Station 2 (Indicator)	Station 56 (Indicator)	Station 6 (Control)	Station 7 (Control)
	<u>Required LLD</u> →	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>	<u>0.01</u>
12/20/2007	01/02/2008	0.032	0.033	0.031	0.028	0.027
01/02/2008	01/08/2008	0.028	0.032	0.033	0.027	0.028
01/08/2008	01/22/2008	0.038	0.040	0.036	0.034	0.034
01/22/2008	02/05/2008	0.038	0.039	0.040	0.031	0.035
02/05/2008	02/19/2008	0.035	0.033	0.031	0.027	0.030
02/19/2008	03/05/2008	0.026	0.025	0.026	0.022	0.024
03/05/2008	03/18/2008	0.031	0.032	0.031	0.022	0.026
03/18/2008	04/01/2008	0.020	0.023	0.023	0.018	0.021
04/01/2008	04/15/2008	0.021	0.022	0.023	0.020	0.023
04/15/2008	04/29/2008	0.027	0.026	0.027	0.023	0.092
04/29/2008	05/13/2008	0.024	0.024	0.023	0.020	0.023
05/13/2008	05/27/2008	0.032	0.025	0.025	0.021	0.023
05/27/2008	06/10/2008	0.018	0.017	0.017	0.015	0.016
06/10/2008	06/24/2008	0.023	0.024	0.024	0.021	0.022
06/24/2008	07/08/2008	0.029	0.026	0.027	0.022	0.026
07/08/2008	07/22/2008	0.033	0.033	0.033	0.028	0.031
07/22/2008	08/05/2008	0.036	0.036	0.036	0.030	0.034
08/05/2008	08/19/2008	0.038	0.037	0.036	0.030	0.033
08/19/2008	09/02/2008	0.037	0.034	0.035	0.035	0.032
09/02/2008	09/16/2008	0.025	0.023	0.023	0.023	0.023
09/16/2008	09/30/2008	0.045	0.045	0.041	0.041	0.038
09/30/2008	10/14/2008	0.031	0.031	0.029	0.029	0.027
10/14/2008	10/28/2008	0.032	0.034	0.031	0.031	0.029
10/28/2008	11/11/2008	0.037	0.035	0.034	0.034	0.034
11/11/2008	11/25/2008	0.034	0.040	0.031	0.031	0.032
11/25/2008	12/09/2008	0.045	0.043	0.042	0.042	0.041
12/09/2008	12/17/2008	0.035	0.034	0.037	0.037	0.033
12/17/2008	12/29/2008	0.045	0.046	0.065	0.065	0.040

* Station with highest annual mean.

Table 1.2
 Sample Type: **Radioiodine Cartridge**
 Analysis: Iodine-131
 Units: pCi/m³

Start Date	End Date	Station 1 (Indicator)	Station 2 (Indicator)	Station 56 (Indicator)	Station 6 (Control)	Station 7 (Control)
	Required LLD	→	0.07	0.07	0.07	0.07
12/20/2007	01/02/2008	< 0.020	< 0.023	< 0.018	< 0.018	< 0.019
01/02/2008	01/08/2008	< 0.021	< 0.022	< 0.023	< 0.023	< 0.022
01/08/2008	01/22/2008	< 0.012	< 0.012	< 0.012	< 0.012	< 0.016
01/22/2008	02/05/2008	< 0.017	< 0.014	< 0.015	< 0.015	< 0.013
02/05/2008	02/19/2008	< 0.015	< 0.022	< 0.015	< 0.015	< 0.013
02/19/2008	03/05/2008	< 0.017	< 0.013	< 0.013	< 0.013	< 0.018
03/05/2008	03/18/2008	< 0.018	< 0.021	< 0.018	< 0.018	< 0.018
03/18/2008	04/01/2008	< 0.018	< 0.018	< 0.015	< 0.015	< 0.018
04/01/2008	04/15/2008	< 0.018	< 0.023	< 0.020	< 0.020	< 0.015
04/15/2008	04/29/2008	< 0.014	< 0.017	< 0.019	< 0.019	< 0.056
04/29/2008	05/13/2008	< 0.018	< 0.018	< 0.022	< 0.022	< 0.017
05/13/2008	05/27/2008	< 0.005	< 0.020	< 0.023	< 0.023	< 0.016
05/27/2008	06/10/2008	< 0.019	< 0.026	< 0.018	< 0.018	< 0.016
06/10/2008	06/24/2008	< 0.023	< 0.019	< 0.020	< 0.020	< 0.018
06/24/2008	07/08/2008	< 0.019	< 0.019	< 0.022	< 0.022	< 0.021
07/08/2008	07/24/2008	< 0.022	< 0.019	< 0.019	< 0.019	< 0.021
07/24/2008	08/05/2008	< 0.019	< 0.020	< 0.019	< 0.019	< 0.017
08/05/2008	08/19/2008	< 0.017	< 0.020	< 0.019	< 0.019	< 0.019
08/19/2008	09/02/2008	< 0.020	< 0.018	< 0.018	< 0.018	< 0.019
09/02/2008	09/16/2008	< 0.021	< 0.018	< 0.017	< 0.017	< 0.016
09/16/2008	09/30/2008	< 0.020	< 0.023	< 0.025	< 0.025	< 0.021
09/30/2008	10/14/2008	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
10/14/2008	10/28/2008	< 0.022	< 0.021	< 0.016	< 0.016	< 0.014
10/28/2008	11/11/2008	< 0.019	< 0.019	< 0.019	< 0.019	< 0.014
11/11/2008	11/25/2008	< 0.022	< 0.025	< 0.016	< 0.016	< 0.019
11/25/2008	12/09/2008	< 0.022	< 0.028	< 0.020	< 0.020	< 0.020
12/09/2008	12/17/2008	< 0.040	< 0.056	< 0.048	< 0.048	< 0.042
12/17/2008	12/29/2008	< 0.047	< 0.036	< 0.051	< 0.051	< 0.039

Table 2.1
 Sample Type: Thermoluminescent Dosimeters
 Analysis: Gamma Dose
 Units: mrem/Qtr

Inner Ring (Indicators)					
Station	1st Qtr '08 (mrem)	2nd Qtr '08 (mrem)	3rd Qtr '08 (mrem)	4th Qtr '08 (mrem)	Annual Mean '08 (mrem)
3	5.6	6.5	4.9	6.2	5.8
145	8.5	7.6	8.1	7.9	8.0
146	9.8	7.9	8.2	7.8	8.4
147	7.4	6.5	7.1	7.1	7.0
1	9.1	8.5	8.3	9.6	8.9
148	8.8	7.3	8.4	7.4	8.0
110	8.0	7.8	8.8	8.9	8.4
149	7.8	6.7	8.1	7.4	7.5
4	7.2	7.5	7.4	8.2	7.6
150	8.7	7.5	8.8	8.8	8.5
151	9.0	7.3	9.2	8.9	8.6
2	8.7	8.3	7.8	8.8	8.4
56 *	9.8	9.1	9.2	10.6	9.7
109	8.8	8.4	9.6	8.9	8.9
108	8.8	7.7	7.9	9.3	8.4
152	7.9	7.4	7.9	8.6	8.0

* Station with highest annual mean.

Table 2.2
 Sample Type: Thermoluminescent Dosimeters
 Analysis: Gamma Dose
 Units: mrem/Qtr

Special Interest Areas - (Population Centers & Schools)					
Station	1st Qtr '08 (mrem)	2nd Qtr '08 (mrem)	3rd Qtr '08 (mrem)	4th Qtr '08 (mrem)	Annual Mean '08 (mrem)
6	7.6	6.3	6.3	7.3	6.9
111	5.4	4.6	6.7	6.4	5.8
116	8.1	7.3	8.1	7.6	7.8
125	4.9	4.7	5.1	5.9	5.2
127*	9.2	8.0	8.1	9.6	8.7
137	8.7	7.5	7.7	8.1	8.0
153	7.8	7.1	7.7	8.0	7.8

* Stations with highest annual mean.

Special Interest Areas – (Control)					
Station	1st Qtr '08 (mrem)	2nd Qtr '08 (mrem)	3rd Qtr '08 (mrem)	4th Qtr '08 (mrem)	Annual Mean '08 (mrem)
7	7.1	7.6	7.1	7.3	7.3

Table 3.1
 Sample Type: **Surface Water**
 Analysis: Gamma Isotopic
 Units: pCi/l

Location	Start Date	End Date	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140	La-140
	<u>Required LLD</u> →		<u>15</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>30</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>15</u>	<u>18</u>	<u>60</u>	<u>15</u>
Station 8 (Indicator)	12/31/2007	01/31/2008	<4.20	<6.78	<3.76	<3.27	<7.15	<6.15	<4.23	<6.37	<4.19	<3.63	<18.31	<5.42
Station 10 (Control)	12/31/2007	01/31/2008	<2.76	<6.68	<3.15	<3.88	<7.01	<4.91	<4.21	<5.29	<3.63	<2.95	<16.13	<5.13
Station 8 (Indicator)	01/31/2008	02/29/2008	<4.01	<5.52	<3.63	<4.19	<8.70	<5.91	<4.26	<9.89	<3.38	<3.73	<23.09	<7.45
Station 10 (Control)	01/31/2008	02/29/2008	<3.03	<7.29	<3.01	<2.88	<6.36	<5.93	<3.75	<7.21	<3.32	<3.13	<16.75	<6.54
Station 8 (Indicator)	02/28/2008	03/31/2008	<3.01	<6.60	<3.33	<3.15	<5.73	<5.16	<3.85	<4.07	<3.56	<3.34	<13.91	<4.37
Station 10 (Control)	02/28/2008	03/31/2008	<4.39	<8.10	<3.95	<3.88	<7.88	<6.60	<4.09	<6.13	<4.13	<3.61	<15.78	<6.67
Station 8 (Indicator)	03/31/2008	04/30/2008	<5.23	<13.54	<6.21	<4.68	<10.39	<10.46	<5.59	<8.73	<7.67	<7.46	<25.98	<4.37
Station 10 (Control)	03/31/2008	04/30/2008	<3.66	<12.36	<6.49	<4.38	<12.95	<9.07	<7.69	<8.56	<5.16	<5.82	<23.78	<6.34
Station 8 (Indicator)	04/30/2008	05/31/2008	<3.56	<8.79	<5.34	<4.59	<11.36	<6.94	<5.11	<9.45	<4.96	<5.35	<23.63	<7.96
Station 10 (Control)	04/30/2008	05/31/2008	<4.17	<9.37	<3.78	<4.29	<9.59	<8.68	<4.94	<8.67	<4.72	<3.30	<20.33	<8.77
Station 8 (Indicator)	05/31/2008	06/30/2008	<6.82	<14.43	<4.80	<3.89	<13.99	<11.87	<7.84	<8.76	<7.17	<5.82	<29.79	<9.13
Station 10 (Control)	05/31/2008	06/30/2008	<4.85	<9.20	<6.39	<6.29	<7.82	<7.48	<7.49	<9.64	<5.63	<4.53	<23.70	<10.33

Table 3.1
 Sample Type: **Surface Water**
 Analysis: Gamma Isotopic
 Units: pCi/l

Location	Start Date	End Date	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140	La-140
	Required LLD	→	15	30	15	15	30	30	15	15	15	18	60	15
Station 8 (Indicator)	06/30/2008	07/31/2008	<4.64	<8.27	<4.15	<4.33	<6.36	<9.26	<5.24	<8.30	<5.32	<4.99	<21.07	<9.58
Station 10 (Control)	06/30/2008	07/31/2008	<3.06	<7.64	<4.17	<3.38	<7.24	<7.79	<5.49	<6.56	<4.01	<3.87	<19.32	<5.73
Station 8 (Indicator)	07/31/2008	08/31/2008	<0.60	<2.19	<0.83	<0.59	<1.33	<1.60	<1.31	<12.79	<0.65	<0.63	<22.44	<7.77
Station 10 (Control)	07/31/2008	08/31/2008	<0.68	<2.34	<0.90	<0.65	<1.41	<1.63	<1.48	<14.88	<0.69	<0.68	<22.61	<7.98
Station 8 (Indicator)	08/31/2008	09/30/2008	<3.55	<6.90	<4.00	<4.82	<6.62	<6.95	<4.37	<6.43	<3.97	<3.60	<22.14	<7.12
Station 10 (Control)	08/31/2008	09/30/2008	<4.64	<9.00	<4.12	<4.11	<8.29	<7.61	<5.49	<9.31	<5.25	<5.08	<22.93	<8.21
Station 8 (Indicator)	09/30/2008	10/31/2008	<3.64	<9.49	<4.48	<3.06	<8.69	<5.69	<3.90	<7.65	<3.71	<3.93	<19.80	<5.87
Station 10 (Control)	09/30/2008	10/31/2008	<3.67	<7.92	<3.85	<2.99	<7.69	<6.43	<3.92	<6.03	<3.62	<3.73	<17.37	<5.10
Station 8 (Indicator)	10/31/2008	11/30/2008	<2.79	<6.14	<3.14	<3.92	<8.05	<6.58	<4.86	<7.59	<3.61	<3.39	<16.07	<5.95
Station 10 (Control)	10/31/2008	11/30/2008	<2.83	<7.17	<3.55	<2.94	<6.12	<4.63	<3.95	<6.46	<3.03	<3.35	<14.40	<5.81
Station 8 (Indicator)	11/30/2008	12/31/2008	<3.52	<10.69	<4.51	<3.24	<7.14	<6.17	<6.14	<11.24	<4.39	<3.39	<26.26	<9.77
Station 10 (Control)	11/30/2008	12/31/2008	<5.63	<9.87	<5.94	<5.19	<7.60	<11.36	<6.72	<13.66	<5.32	<5.31	<36.65	<11.53

Table 3.2
 Sample Type: **Surface Water**
 Analysis: Tritium
 Units: pCi/l

Location	Begin Date	End Date	H-3
		<u>Required LLD</u> →	<u>3000</u>
Station 8 (Indicator)	12/31/2007	03/31/2008	1548
Station 10 (Control)	12/31/2007	03/31/2008	< 585
Station 8 (Indicator)	03/31/2008	06/30/2008	1213
Station 10 (Control)	03/31/2008	06/30/2008	< 560
Station 8 (Indicator)	06/30/2008	09/30/2008	811
Station 10 (Control)	06/30/2008	09/30/2008	< 567
Station 8 (Indicator)	09/30/2008	12/31/2008	521
Station 10 (Control)	09/30/2008	12/31/2008	< 589

Table 4.1
 Sample Type: **Drinking Water**
 Analysis: Gross Beta, Iodine-131 and Gamma Isotopic
 Units: pCi/l

Location	Collection Date	Gross Beta	I-131	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	Cs-134	Cs-137	Ba-140	La-140
	<u>Required LLD →</u>	<u>4.0</u>	<u>1.0</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>30</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>18</u>	<u>60</u>	<u>15</u>
Station 14 (Indicator)	03/25/2008	< 1.14	<0.89	<3.67	<7.96	<3.04	<2.75	<10.52	<6.71	<4.63	<4.53	<3.72	<19.76	<6.84
Station 57 (Control)	03/25/2008	1.31	<0.85	<3.56	<7.41	<4.34	<3.94	<8.49	<6.96	<4.25	<3.64	<3.92	<15.11	<6.32
Station 14 (Indicator)	06/24/2008	1.39	<0.81	<4.19	<5.92	<3.38	<3.51	<6.62	<6.30	<4.31	<3.81	<3.47	<16.49	<5.83
Station 57 (Control)	06/24/2008	0.92	<0.84	<3.19	<7.46	<4.20	<3.68	<8.57	<6.30	<3.61	<3.89	<4.17	<18.88	<6.91
Station 14 (Indicator)	09/30/2008	0.92	<0.88	<3.34	<6.57	<3.23	<2.88	<7.86	<6.47	<4.39	<2.72	<3.45	<16.07	<7.54
Station 57 (Control)	09/30/2008	2.13	<0.90	<2.68	<7.84	<2.83	<2.96	<5.62	<5.51	<3.78	<2.98	<2.62	<16.87	<5.96
Station 14 (Indicator)	12/17/2008	3.44	<0.90	<4.13	<8.06	<6.68	<4.86	<13.52	<9.23	<8.65	<4.94	<5.73	<46.67	<14.34
Station 57 (Control)	12/17/2008	3.53	<0.90	<6.33	<11.87	<5.63	<5.80	<8.21	<10.71	<5.91	<4.44	<6.25	<3.90	<11.23

Table 4.2
Sample Type: **Drinking Water**
Analysis: Tritium
Units: pCi/l

Location	Collection Date	H-3
	<u>Required LLD</u> →	<u>2000</u>
Station 14 (Indicator)	03/25/2008	< 579
Station 57 (Control)	03/25/2008	< 580
Station 14 (Indicator)	06/24/2008	< 584
Station 57 (Control)	06/24/2008	< 567
Station 14 (Indicator)	09/30/2008	< 567
Station 57 (Control)	09/30/2008	< 580
Station 14 (Indicator)	12/17/2008	< 559
Station 57 (Control)	12/17/2008	< 557

Table 5.1
Sample Type: **Sediment**
Analysis: Gamma Isotopic
Units: pCi/kg

Location	Collection Date	Cs-134	Cs-137
	Required LLD →	<u>150</u>	<u>180</u>
Station 8 (Indicator)	10/30/2008	< 120.20	41.79
Station 16 (Control)	09/28/2008	< 85.30	< 72.76

Table 6.1
Sample Type: **Fish**
Analysis: Gamma Isotopic
Units: pCi/kg

Location	Collection Date	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Cs-134	Cs-137
	Required LLD →	<u>130</u>	<u>260</u>	<u>130</u>	<u>130</u>	<u>260</u>	<u>130</u>	<u>150</u>
Station 8 (Indicator)	10/28/2008	< 9.96	< 45.00	< 12.63	< 11.66	< 28.29	< 10.45	< 13.70
Station 16 (Control)	10/23/2008	< 8.19	< 35.34	< 11.02	< 12.92	< 27.51	< 7.55	< 10.08

Table 7.1
 Sample Type: **Food Products**
 Analysis: Iodine-131 and Gamma Isotopic
 Units: pCi/kg

Location	Collection Date	<u>I-131</u>	<u>Cs-134</u>	<u>Cs-137</u>
	<u>Required LLD</u> →	<u>60</u>	<u>60</u>	<u>80</u>
Station 13 (Indicator)	06/24/2008	< 56.76	< 44.56	< 48.69
Station 55 (Control)	06/24/2008	< 52.27	< 41.65	< 42.20
Station 13 (Indicator)	07/22/2008	< 57.30	< 42.20	< 38.30
Station 55 (Control)	07/22/2008	< 58.05	< 42.92	< 54.99
Station 13 (Indicator)	08/19/2008	< 58.59	< 52.14	< 43.55
Station 55 (Control)	08/19/2008	< 55.13	< 36.76	< 33.58

Table 8.1

Sample Type: **Groundwater**

Analysis: Iodine-131 and Gamma Isotopic

Units: pCi/l

Sample #	Collection Date	I-131	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	Cs-134	Cs-137	Ba-140	La-140
<u>Required LLD</u> □		<u>15</u>	<u>15</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>30</u>	<u>30</u>	<u>15</u>	<u>15</u>	<u>18</u>	<u>60</u>	<u>15</u>
58*	3/12/2008	<13.96	< 4.21	< 9.85	< 4.47	< 3.66	< 7.5	< 8.37	< 5.83	< 3.99	< 5.04	< 27.12	< 9.46
59	3/12/2008	< 14.60	< 3.52	< 10.46	< 5.19	< 3.65	< 7.68	< 5.50	< 6.74	< 4.81	< 4.61	< 24.50	< 10.53
60	3/12/2008	< 14.49	< 4.18	< 9.48	< 5.57	< 4.38	< 11.39	< 9.00	< 7.38	< 5.17	< 3.80	< 28.34	< 10.12
61	3/12/2008	< 14.87	< 4.48	< 7.19	< 3.98	< 4.48	< 6.36	< 8.04	< 6.17	< 5.57	< 4.65	< 27.16	< 12.14
58*	6/17/2008	< 13.54	< 11.2	< 17.3	< 11.6	< 11.5	< 21.3	< 20.8	< 11.4	< 12.0	< 12.7	< 53.5	< 9.9
59	6/17/2008	< 13.54	< 11.2	< 17.3	< 11.6	< 11.5	< 21.3	< 20.8	< 11.4	< 12.0	< 12.7	< 53.5	< 9.9
60	6/17/2008	< 13.54	< 11.2	< 17.3	< 11.6	< 11.5	< 21.3	< 20.8	< 11.4	< 12.0	< 12.7	< 53.5	< 9.9
61	6/17/2008	< 13.54	< 11.2	< 17.3	< 11.6	< 11.5	< 21.3	< 20.8	< 11.4	< 12.0	< 12.7	< 53.5	< 9.9
58*	8/18/2008	< 14.82	< 0.70	< 2.86	< 1.00	< 0.64	< 1.45	< 1.97	< 1.87	< 0.69	< 0.67	< 46.29	< 12.00
59	8/18/2008	< 14.99	< 0.67	< 2.72	< 0.98	< 0.64	< 1.34	< 1.76	< 1.82	< 0.66	< 0.63	< 45.38	< 14.55
60	8/18/2008	< 13.99	< 0.58	< 2.58	< 0.89	< 0.53	< 1.20	< 1.67	< 1.64	< 0.57	< 0.54	< 50.67	< 14.52
61	8/18/2008	< 14.51	< 0.57	< 2.40	< 0.86	< 0.51	< 1.21	< 1.62	< 1.67	< 0.56	< 0.51	< 48.63	< 12.02
58*	11/19/2008	< 14.49	< 4.28	< 12.47	< 6.26	< 5.29	< 14.20	< 9.67	< 8.23	< 4.87	< 6.40	< 33.23	< 12.16
59	11/19/2008	< 12.30	< 5.44	< 9.87	< 4.57	< 2.86	< 9.16	< 7.83	< 6.12	< 4.96	< 5.80	< 26.33	< 10.86
60	11/19/2008	< 14.97	<4.84	< 7.92	< 5.67	< 4.41	< 13.32	< 8.50	< 6.45	< 5.44	< 5.35	< 36.47	< 7.39
61	11/19/2008	< 14.62	< 5.28	< 12.04	< 6.37	< 2.03	< 9.17	< 10.6	< 7.49	< 5.18	< 5.46	< 28.30	< 9.22

* Identifies Control Locations

Table 8.2
 Sample Type: Groundwater
 Analysis: Tritium
 Units: pCi/l

Location	Collection Date	H-3
	<u>Required LLD</u> →	<u>3000</u>
Station 58 (Control)	03/12/2008	< 583
Station 59 ((Indicator	03/12/2008	< 582
Station 60 (Indicator)	03/12/2008	< 581
Station 61 (Indicator)	03/12/2008	< 583
Station 58 (Control)	06/17/2008	< 569
Station 59 ((Indicator	06/17/2008	< 563
Station 60 (Indicator)	06/17/2008	< 579
Station 61 (Indicator)	06/17/2008	< 572
Station 58 (Control)	08/18/2008	< 567
Station 59 ((Indicator	08/18/2008	< 565
Station 60 (Indicator)	08/18/2008	< 581
Station 61 (Indicator)	08/18/2008	< 566
Station 58 (Control)	11/19/2008	< 566
Station 59 ((Indicator	11/19/2008	< 585
Station 60 (Indicator)	11/19/2008	< 581
Station 61 (Indicator)	11/19/2008	< 591

ATTACHMENT 2

INTERLABORATORY COMPARISON PROGRAM

Table 9.1
 Sample Type: Interlaboratory Comparison
 Analysis: Gross Beta, Iodine-131 and Gamma Isotopic

Sample Type (units)	Study	Date	Analysis	Known Value ^a	RBS Value	RBS N-Dev ^b	RBS N-Range ^c
Charcoal Cartridge (pCi/cartridge)	E5390-125	6/14/2007	I-131	7.91E+01	7.97E+01	0.13	0.01
Water (pCi/liter)	E5389-125	6/14/2007	BETA	1.99E+02	2.25E+02	1.49	0.06
	E5388-125	6/14/2007	Cr-51	4.11E+02	4.20E+02	0.75	0.20
			Mn-54	1.33E+02	1.48E+02	3.89^(d)	0.04
			Co-58	1.59E+02	1.64E+02	1.01	0.06
			Fe-59	1.34E+02	1.45E+02	2.83	0.16
			Co-60	1.91E+02	1.95E+02	0.75	0.09
			Zn-65	2.68E+02	2.82E+02	0.87	0.13
			I-131	1.02E+02	1.02E+02	-0.02	0.16
			Cs-134	1.94E+02	1.93E+02	-0.11	0.24
	Cs-137	1.35E+02	1.40E+02	1.21	0.32		
Ce-141	1.60E+02	1.63E+02	0.57	0.38			
E5467-125	9/13/2007	H-3	1.20E+04	1.11E+04	-1.26	0.06	
Milk (pCi/liter)	E5391-125	6/12/2007	Cr-51	5.12E+02	5.17E+02	0.12	0.06
			Mn-54	1.66E+02	1.82E+02	1.14	0.11
			Co-58	1.98E+02	2.02E+02	0.24	0.05
			Fe-59	1.67E+02	1.85E+02	1.23	0.09
			Co-60	2.38E+02	2.37E+02	-0.03	0.02
			Zn-65	3.34E+02	3.72E+02	1.98	0.07
			I-131	7.01E+01	7.03E+01	0.05	0.20
			Cs-134	2.42E+02	2.42E+02	0.02	0.07
			Cs-137	1.69E+02	1.70E+02	0.06	0.03
Ce-141	2.00E+02	2.03E+02	0.16	0.05			

Table 9.1
 Sample Type: **Interlaboratory Comparison**
 Analysis: Tritium and Gamma Isotopic

Sample Type (units)	Study	Date	Analysis	Known Value ^a	RBS Value	RBS N-Dev ^b	RBS N-Range ^c
Air Filter (pCi/Filter)	E5468-125	9/13/2007	BETA	3.23E+01	2.81E+01	-1.46	0.03
	E5469-125	9/13/2007	Cr-51	1.25E+02	1.22E+02	-0.09	0.03
			Mn-54	7.26E+01	7.82E+01	1.93	0.14
			Co-58	4.94E+01	4.87E+01	-0.23	0.19
			Fe-59	4.79E+01	5.17E+01	1.33	0.04
			Co-60	6.41E+01	6.48E+01	0.26	0.03
			Zn-65	8.76E+01	9.96E+01	2.38	0.09
			Cs-134	6.38E+01	6.12E+01	-0.89	0.08
			Cs-137	5.65E+01	5.85E+01	0.69	0.11
			Ce-141	9.14E+01	9.12E+01	-0.06	0.12
Sediment (pCi/gram)	E5470-125	9/13/2007	Cr-51	3.91E-01	3.83E-01	-0.07	0.03
			Mn-54	2.27E-01	2.43E-01	0.24	0.01
			Co-58	1.54E-01	1.38E-01	-0.36	0.04
			Fe-59	1.49E-01	1.48E-01	-0.03	0.02
			Co-60	2.00E-01	1.94E-01	-0.11	0.01
			Zn-65	2.73E-01	3.00E-01	1.74	0.09
			Cs-134	1.99E-01	2.03E-01	0.07	0.02
			Cs-137	2.73E-01	2.99E-01	0.33	0.02
		Ce-141	2.85E-01	2.81E-01	-0.05	0.03	

NOTES:

(a) The known value as determined by Analytics.

(b) The normalized deviation from the "known" value is computed from the deviation and the standard error of the mean; ± 2.00 is the warning limit and ± 3.00 is the control limit. This is a measure of accuracy of the analytical methods.

(c) The normalized range is computed from the mean range, the control limit, and the standard error of the range; $+2.000$ is the warning limit and $+3.000$ is the control limit. This is a measure of precision of the analytical methods.

(d) Results reported were outside Control Limits.

Interlaboratory Comparison Program Exceptions

RBS Environmental Laboratory analyzed interlaboratory comparison samples to fulfill the requirements of Technical Requirements Manual 3.12.3. The interlaboratory comparison results indicated that 100% of the sample results for accuracy and precision were within the acceptable control limits.

ATTACHMENT 3

SEDIMENT DOSE CALCULATIONS

Sediment Dose Calculations

Dose calculation for the discharge sediment was performed using generalized equation found in Regulatory Guide 1.109, Appendix A as follows:

R = (40) × (C) × (U) × (D) × (W)

- R** = Annual dose to skin or total body in mrem/year;
- 40** = Area-mass conversion factor given in Appendix A of Regulatory Guide 1.109 in Kg/m²;
- C** = 2008 maximum radionuclide concentration in pCi/kg;
- U** = Maximum exposure time given in Table E-5 of Regulatory Guide 1.109 (67 hours for teenager);
- D** = External dose conversion factor for standing on contaminated ground given in Table E-6 of Regulatory Guide 1.109 in mrem/hr per pCi/m², and
- W** = Shore-width factor (0.1) given in Table A-2 of Regulatory Guide 1.109.

(Dose from Sediment in mrem/Year)

Radionuclide	2008 Maximum Concentration	Conversion Factor For Skin	Total Skin Dose	Conversion Factor For Total Body	Total Body Dose
Cs-137	41.79	4.90 E-09	5.49 E-05	4.20 E-09	4.70 E-05
TOTAL			5.49 E-05		4.70 E-05