



Entergy Operations, Inc.  
1448 S.R. 333  
Russellville, AR 72802  
Tel: 501 858 5000

May 11, 2000

0CAN050001

U. S. Nuclear Regulatory Commission  
Document Control Desk  
Mail Station OP1-17  
Washington, DC 20555

Subject: Arkansas Nuclear One - Units 1 and 2  
Docket Nos. 50-313 and 50-368  
License Nos. DPR-51 and NPF-6  
1999 Annual Radiological Environmental Operating Report

Gentlemen:

Arkansas Nuclear One (ANO), Units 1 and 2, Technical Specifications 6.12.2.5 and 6.9.4, respectively, require the submittal of an annual radiological environmental operating report for the previous calendar year by May 15 of each year. Attached is the annual radiological environmental operating report for ANO for the year 1999. The radionuclides detected by the radiological environmental monitoring program during 1999 were significantly below regulatory limits; therefore, ANO plant operations during 1999 had no harmful effects nor resulted in any irreversible damage to the environment. This report fulfills the reporting requirements referenced above. Should you have any questions regarding this submittal, please contact me.

Very truly yours,

A handwritten signature in black ink, appearing to read "Jimmy D. Vandergrift".

for  
Jimmy D. Vandergrift  
Director, Nuclear Safety Assurance

JDV/nbm  
Attachment

JK25

cc: Mr. Ellis W. Merschoff  
Regional Administrator  
U. S. Nuclear Regulatory Commission  
Region IV  
611 Ryan Plaza Drive, Suite 400  
Arlington, TX 76011-8064

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

Mr. Christopher Nolan  
NRR Project Manager Region IV/ANO-1  
U. S. Nuclear Regulatory Commission  
NRR Mail Stop 04-D-03  
One White Flint North  
11555 Rockville Pike  
Rockville, MD 20852

Mr. Thomas W. Alexion  
NRR Project Manager Region IV/ANO-2  
U. S. Nuclear Regulatory Commission  
NRR Mail Stop 04-D-03  
One White Flint North  
11555 Rockville Pike  
Rockville, MD 20852

**ARKANSAS NUCLEAR ONE - UNITS 1 AND 2**

**ANNUAL RADIOLOGICAL ENVIRONMENTAL  
OPERATING REPORT FOR 1999**

**TABLE OF CONTENTS**

<b>SUMMARY</b>	<b>7</b>
<b>1.0 INTRODUCTION</b>	<b>11</b>
<b>1.1 Radiological Environmental Monitoring Program Purpose</b>	<b>11</b>
<b>1.2 Pathways Monitored</b>	<b>11</b>
<b>1.3 Program Description</b>	<b>11</b>
<b>1.3.1 Air Particulate and Radioiodine</b>	<b>11</b>
<b>1.3.2 Thermoluminescent Dosimetry</b>	<b>12</b>
<b>1.3.3 Drinking Water, Surface Water and Groundwater</b>	<b>12</b>
<b>1.3.4 Sediment</b>	<b>14</b>
<b>1.3.5 Milk</b>	<b>14</b>
<b>1.3.6 Vegetation and Food Products</b>	<b>14</b>
<b>1.3.7 Fish</b>	<b>15</b>
<b>1.3.8 Land Use Census</b>	<b>15</b>
<b>2.0 INTERPRETATION AND TRENDS OF RESULTS</b>	<b>30</b>
<b>2.1 Air Particulate and Radioiodine Sample Results</b>	<b>30</b>
<b>2.2 Thermoluminescent Dosimetry Sample Results</b>	<b>30</b>
<b>2.3 Milk Sample Results</b>	<b>31</b>
<b>2.4 Water Sample Results</b>	<b>31</b>
<b>2.5 Vegetation and Food Product Sample Results</b>	<b>32</b>
<b>2.6 Sediment Sample Results</b>	<b>32</b>
<b>2.7 Fish Sample Results</b>	<b>33</b>
<b>2.8 Land Use Census Results</b>	<b>33</b>
<b>2.9 Interlaboratory Comparison Results</b>	<b>33</b>

<b>3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY</b>	<b>38</b>
<b>3.1 1999 Program Results Summary</b>	<b>38</b>

## LIST OF TABLES

TABLE 1.1	SAMPLING STATIONS	17
TABLE 2.1	1999 LAND USE CENSUS	34
TABLE 3.1	RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY	39

**LIST OF FIGURES**

<b>FIGURE 1-1</b>	<b>EXPOSURE PATHWAYS</b>	<b>27</b>
<b>FIGURE 1-2</b>	<b>SAMPLE COLLECTION SITES – NEAR FIELD</b>	<b>28</b>
<b>FIGURE 1-3</b>	<b>SAMPLE COLLECTION SITES – FAR FIELD</b>	<b>29</b>
<b>FIGURE 2-1</b>	<b>TLD RADIATION DOSE</b>	<b>35</b>
<b>FIGURE 2-2</b>	<b>DISCHARGE TRITIUM CONCENTRATIONS</b>	<b>36</b>
<b>FIGURE 2-3</b>	<b>DISCHARGE SEDIMENT</b>	<b>37</b>

**LIST OF ATTACHMENTS**

<b>ATTACHMENT 1</b>	<b>1999 RADIOLOGICAL MONITORING REPORT SUMMARY OF MONITORING RESULTS</b>	<b>44</b>
<b>ATTACHMENT 2</b>	<b>SEDIMENT DOSE CALCULATIONS</b>	<b>84</b>

## Summary

The Annual Radiological Environmental Operating Report 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, 1999 through December 31, 1999. This report fulfills the requirements of ANO Unit 1 Technical Specification 6.12.2.5 and Unit 2 Technical Specification 6.9.4. During 1999, as in previous years, ANO detected radionuclides attributable to plant operations at the discharge location (Station 8). ANO personnel routinely monitor results from this area in order to note any trends. Their review of results from this area indicates the following:

- Tritium levels in the surface water media continue to be well below regulatory limits.
- Cobalt-60 and Cesium-137 levels in the sediment media are not demonstrating any increase in comparison to previous years. Review indicates that 1999 levels are less than that of the historical average and also well below regulatory limits.

Gross beta concentrations at the Station 14 (City of Russellville) indicator drinking water location continues to remain at previous operational background measurements.

Tritium was detected in the Station 10 intake surface water control location and the Ouita (Station 33) control groundwater locations. Levels detected were similar to previous measurements.

Cesium-137, attributable to fallout from previous atmospheric weapons testing, was detected at the intake indicator (Station 10) and Piney Creek control (Station 16) sediment sample locations. However, the levels detected were well below the historic average.

### **Radiological Environmental Monitoring Program**

Radiation and radioactivity are monitored around ANO within an approximately 20-mile radius. The REMP was established prior to the station becoming operational (1974). This preoperational program provided data on background radiation and radioactivity that is normally present in the area. ANO has continued to monitor the environment by sampling air, milk, water, food products, vegetation, sediment and fish, as well as measuring radiation directly. Samples are collected from both indicator and control locations. Indicator locations are expected to show any increases or buildup of radioactivity that might occur due to station operation. Control locations are further from the station and are expected to indicate the presence of only naturally occurring radioactivity.

The results obtained from indicator locations are compared with control locations and with concentrations present in the environment before the station became operational. This allows for assessment of any impact the operation of ANO might have had on the surrounding environment.

In 1999, radiological environmental samples were collected and analyzed for radioactivity. Radionuclide concentrations measured at indicator locations were compared to control locations, as well as to concentrations in previous years. ANO personnel assessed this data and concluded that no significant impact occurred on the environs surrounding the plant. Radiation levels in the environment were undetectable in many cases and at or near previous levels in significant pathways associated with ANO.

### **Harmful Effects or Irreversible Damage**

No harmful effects or evidence of irreversible damage were detected by ANO monitoring. Therefore, no analysis or planned course of action to alleviate problems was necessary.

### **Reporting Levels**

No reporting levels for radioactivity concentration in environmental samples, as outlined in the Offsite Dose Calculation Manual (ODCM) Table 2.6-3, when averaged over any calendar quarter, were equaled or exceeded due to ANO effluents during 1999. Therefore, no Radiological Monitoring Special Reports were required.

### **Radioactivity Not Attributable to ANO**

Prior to 1981, the ANO REMP detected radioactivity resulting from nuclear weapons testing, with Cesium-137 continuing to be periodically detected in certain pathways. In addition to the weapons testing, the ANO REMP detected radioactivity in May 1986 as a result of the reactor core degradation at the Chernobyl Nuclear Power Plant.

### **Comparison to State Program**

Data from the ANO REMP was compared to the Arkansas Department of Health (ADH) state program as results became available. Radiological monitoring by the ADH entails similar sampling requirements to the ANO REMP. In many cases air samples and thermoluminescent dosimeters (TLDs) are collocated, while sample media such as water, milk, fish and sediment are shared or split. When comparing 1999 results from ADH and ANO collocated air sample and TLD locations, both programs are in agreement with each other when comparing indicator and control locations. The only common location where radioactivity attributable to ANO has been detected by both programs is the ANO discharge.

### **Missed Samples**

During 1999, ANO personnel noted the following deviations:

#### ◆ Air Samples

- One gross beta particulate and Iodine-131 sample was missed at air sample station AS-2 for the sampling period of June 1 – June 8, 1999 and air sample station AS-6 for the sampling period of May 4 – May 11, 1999 due to loss of power.
- One Iodine-131 sample was missed at air sample station AS-3 for the sampling period of August 24 – August 31 due to loss of power.

These deviations were isolated instances that did not recur during the year and were corrected by ANO personnel once discovered.

#### ◆ TLDs

- Two first quarter TLDs (Stations 133 & 135), two second quarter TLDs (Stations 126 & 131), and one third quarter TLD (Station 130) were missing in the field due to vandalism.

These losses were isolated instances that did not recur during the year and were replaced with new TLDs by ANO personnel once discovered. The 1999 TLD recovery rate was 97% (171 of 176 TLDs).

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

The gross beta lower limit of detection (LLD) value of 0.01 pCi/m<sup>3</sup> was not met at air sample station AS-3 during the sampling period of June 29 – July 6, 1999 due to low sample volume caused by an interruption in the power supply.

All other LLDs during this reporting period were within the acceptable limits required by the technical specifications.

### **Unavailable Results**

Analytical contractor results were received in adequate time for inclusion in this report. No missing results were identified during ANO personnel's review.

### **Program Modifications**

During 1999, ANO reduced REMP sampling frequencies. In addition, the following sample locations were deleted from the REMP:

- Air Sample Station AS-3 (indicator location).
- Air Sample Station AS-4 (indicator location).
- Broadleaf Vegetation Sample Station 45 (indicator location).
- Groundwater Sample Station 32 (indicator location).
- Groundwater Sample Station 33 (control location).
- Food-Product Sample Station 48 (indicator location).
- Food-Product Sample Station 51 (indicator location).
- Food-Product Sample Station 108 (indicator location).
- Milk Sample Station 37 (control location).
- Milk Sample Station 52 (control location).
- Milk Sample Station 53 (control location).
- Milk Sample Station 54 (control location).
- Fish and Sediment Sample Station 10 (control location).

Also during 1999, the following sample locations were added to the ANO REMP:

- Air Sample Station AS-56 (indicator location).
- Drinking Water Sample Station 57 (control location).
- Vegetation Sample Station 55 (control location).
- Fish Sample Station 16 (control location).

These changes were evaluated per ANO's 10CFR50.59 evaluation program and were incorporated into Revision 13 PC-3 of the Offsite Dose Calculation Manual (ODCM).

### **Attachments**

Attachment 1 contains results of air, milk, water, fish, sediment, vegetation, food products, and TLD samples collected in 1999. TLDs were analyzed by Waterford-3 Dosimetry while the remaining samples were analyzed by River Bend Station's (RBS) environmental laboratory. Attachment 1 also contains RBS' participation in the interlaboratory comparison program during 1999. Attachment 2 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 Purpose**

The radiological environmental monitoring program (REMP) was established to ensure that plant operating controls properly function to minimize any associated radiation endangerment to human health or the environment. The purpose of the REMP is:

- to measure radiation levels and their variations in environmental media in the area surrounding the plant,
- to determine average levels of radiation and radioactive material in various environmental media,
- to detect effects, if any, of ANO operation on the environmental radiation levels and concentrations.

### **1.2 Pathways Monitored**

The airborne, waterborne, ingestion and direct radiation pathways, as seen in Figure 1-1, are monitored as required by ANO Technical Specifications and the ODCM. The REMP includes the sampling program required to meet the above intent. Sample locations used to monitor exposure pathways are described in Table 1.1 and shown in Figures 1-2 and 1-3.

Table 1.1 and Figures 1-2 and 1-3, reflect only those sampling locations that were active at the end of 1999. Section 2.0 of this report provides a discussion of 1999 sampling results with Section 3.0 providing a summary of results for the monitored exposure pathways.

### **1.3 Program Description**

#### **1.3.1 Air Particulate and Radioiodine**

The ANO REMP utilized five continuous air samplers at the beginning of 1999. ANO modifications to the REMP during the year reduced the number of air sampling locations to four and reduced sampling frequency from weekly to biweekly. These air samplers were placed as follows to meet the ANO Units 1 and 2 ODCM Table 2.6-1 requirements:

- Two samples (Stations 2 and 56) close to the Site Boundary in (or near) different sectors with the highest calculated annual average groundlevel D/Q.

- One sample (Station 6) from a community having the highest calculated annual average groundlevel D/Q.
- One sample (Station 7) from a control location 15-30 km (10 – 20 miles) distance.

ANO also elected to maintain an additional air sampler near the Site Boundary (Station 1). These air samplers were placed approximately one meter above the ground in weatherproof houses. A 47-millimeter glass fiber filter was installed in the intake line by the vacuum pump with a charcoal cartridge located directly downstream. Flows were adjusted to  $30 \pm 3$  liters per minute. Filters and cartridges were changed weekly (biweekly effective November 2, 1999) and analyzed for gross beta radionuclides and radioiodine activity, respectively. In addition, filters were composited quarterly and analyzed for gamma radionuclides.

### **1.3.2 Thermoluminescent Dosimetry**

The ANO REMP measured ambient radiation in the environment surrounding the plant with 44 TLD (one lithium borate and three calcium sulfate elements) locations at the beginning of 1999. However, effective January 2000, ANO modifications to the REMP reduced the number of locations to twenty-four. These locations were placed as follows to meet the ANO Units 1 and 2 ODCM Table 2.6-1 requirements:

- 16 inner ring stations with two or more dosimeters in each meteorological sector in the general area of the Site Boundary
- 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.

Each dosimeter was sealed in a plastic protective holder and suspended above the ground. The dosimeters were collected and analyzed quarterly.

### **1.3.3 Drinking Water, Surface Water and Groundwater**

ANO sampled one drinking water, two surface water and two groundwater locations for the measurement of radioactivity by the waterborne exposure pathway at the beginning of 1999. Modifications to the REMP during 1999 changed the ANO Units 1 and 2 ODCM Table 2.6-1 requirements as follows:

### Surface Water

- 1 indicator surface water location (influenced by plant discharge)
- 1 control surface water location (uninfluenced by plant discharge)

### Drinking Water

- 1 indicator drinking water location (influenced by plant discharge)
- 1 control drinking water location (uninfluenced by plant discharge)

In 1999, the groundwater locations were deleted from the REMP. In addition, the sampling frequency for surface water and drinking water was changed from monthly to quarterly.

**Drinking water** was sampled from an indicator location (Station 14 - Russellville City Water System from Illinois Bayou) and control location (Station 57 - Danville Public Water Supply). Water was collected in two one-gallon labeled containers for the gross beta radionuclide, Iodine-131 and gamma radionuclide analyses, and one 250-milliliter (ml) labeled glass container for the tritium analysis. Upon return from the field, the one-gallon samples were acidified with hydrochloric acid. ANO personnel also collected backup samples that remained on-site as a precautionary measure to replace samples lost during shipment or to verify analytical results.

**Surface water** was sampled from two locations, an indicator location influenced by plant discharge (Station 8) and a control location uninfluenced by plant discharge (Station 10). Water was collected in two one-gallon labeled containers for the gamma radionuclide analysis, and one 250-milliliter (ml) labeled glass container for the tritium analysis. Upon return from the field, the one-gallon samples were acidified with hydrochloric acid. ANO personnel also collected backup samples that remained on-site as a precautionary measure to replace samples lost during shipment or to verify analytical results. Surface water samples were split with the ADH.

**Groundwater** was sampled quarterly from two locations, the C. Stewart Residence (indicator) and Ouita Lake Recreation Area (control), at the beginning of 1999. Water was collected in two one-gallon labeled containers for the gamma radionuclide analysis, and one 250-milliliter (ml) labeled glass container for the tritium analysis. Upon return from the field, the one-gallon samples were acidified with hydrochloric acid. ANO personnel also collected backup samples at each location that remained on-site as a precautionary measure to replace samples lost during shipment or to verify analytical results.

### **1.3.4 Sediment**

ANO Units 1 and 2 ODCM Table 2.6-1 requires two sediment locations for measurement of radioactivity by the waterborne exposure pathway as follows:

- 1 indicator location (influenced by plant discharge)
- 1 control location (uninfluenced by plant discharge)

Contract personnel collected sediment semiannually from three locations, an indicator (discharge) and two control locations (intake and Piney Creek), at the beginning of 1999. A minimum of 1.5 liters of sample was collected with a dredge from the top layer of sediment at each location. After foreign objects were discarded, the samples were transferred to labeled containers and then analyzed for gamma radionuclides. Sediment samples were split with the ADH. Modifications to the REMP during 1999 changed the sampling frequency from semiannually to annually and deleted the intake location.

### **1.3.5 Milk**

ANO sampled four control milk locations (Steuber, Collins, Harms and Cole) for measurement of radioactivity by the ingestion exposure pathway at the beginning of 1999. Milk was collected from each location in two one-gallon labeled containers. Samples were preserved with formaldehyde and then analyzed for Iodine-131 and gamma radionuclides. When available, ANO personnel also collected backup samples at each location that remained on-site as a precautionary measure to replace samples lost during shipment or to verify analytical results.

Modifications to the ANO REMP during the year changed the ANO Units 1 and 2 ODCM Table 2.6-1 sampling requirements as follows:

- 1 indicator sample location within 8 km distant if commercially available.
- 1 control sample location at a distant of >8 km, when an indicator exists.

Since no indicator locations exist within a 8-km distant of ANO, no milk samples were collected after the ANO REMP was modified.

### **1.3.6 Vegetation and Food Products**

ANO personnel collected, when available, from two vegetation indicator locations (Flatwood Road and Intake Canal) and three food product indicator locations (Cochran, Rye and Shivers) at the beginning of 1999. The source of

food products was fruits, flowering vegetables, and tubular vegetables. The source of non-food products was any vegetation with relatively broad leaves on which airborne radioactive particulate material might be deposited. Normally, when available, a one-gallon food product and a two-gallon vegetation sample were collected. The samples were then analyzed for gamma radionuclides and Iodine-131.

Modifications to the REMP during 1999 deleted the food product locations and changed the ANO Units 1 and 2 ODCM Table 2.6-1 vegetation sampling requirements as follows:

- 1 sample of broadleaf (edible or non-edible) near the Site Boundary from one of the highest anticipated annual average groundlevel D/Q sectors, if milk sampling is not performed.
- 1 sample location of broadleaf vegetation (edible or non-edible) from a control location 15 – 30 km distant, if milk sampling is not performed.

### **1.3.7 Fish**

Fish were collected semiannually by a contractor from two locations, an indicator and a control, for measurement of radioactivity by the ingestion exposure pathway. A sufficient amount was collected from each location to provide a minimum of 1000 grams (wet weight) of eviscerated fish sample. The samples were then analyzed for gamma radionuclides. Fish samples were split with the ADH.

Modifications to the ANO REMP during 1999 changed the sampling frequency from semiannually to annually and changed the ANO Units 1 and 2 ODCM Table 2.6-1 sampling requirements as follows:

- 1 sample of commercially and/or recreationally important species in vicinity of plant discharge (Station 8).
- 1 sample of same species in area not influenced by plant discharge (Station 16).

### **1.3.8 Land Use Census**

ANO personnel conducted a land use census, as required by ANO Units 1 and Unit 2 ODCM Section 2.6.2. The purpose of the census was 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 the census were to determine location in each sector of the nearest:

- 1) Residence
- 2) Animal milked for human consumption
- 3) Garden of greater than 50 m<sup>2</sup> (500 ft<sup>2</sup>) producing broadleaf vegetation \*

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

- ANO personnel conducted door-to-door field surveys and/or aerial surveys in each meteorological sector out to five miles in order to locate the nearest resident and milk animal.
- Consultation with local agricultural authorities was used in instances when personal contact could not be made.
- As a result of these surveys, the following information was obtained in each meteorological sector:
  - 1) Nearest permanent residence
  - 2) Nearest milking animal
- ANO personnel identified locations on the map, measured distances to ANO and recorded results.
- Locations, if any, were identified which yielded a calculated dose or dose commitments greater than those currently calculated in the ODCM.
- ANO personnel compared results to previous census.

Modifications to the ANO REMP during 1999 changed the land use census frequency from annually to biannually.

\* ANO personnel chose not to perform a garden census in 1999. This is allowed by ODCM Section 2.6.2, (broadleaf vegetation sampling may be performed at the site boundary in the direction sector with the highest "D/Q" in lieu of the garden census).

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>1</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	90° - 0.6 miles
<b>Sample Types:</b>	1) Airborne radioiodines 2) Airborne particulates 3) Direct radiation
<b>Sample Station Location:</b>	
The TLD is on a pole near the meteorology tower approximately 0.6 miles east of ANO.	

<b>Sample Station Number:</b>	<b>2</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	240° - 0.5 miles
<b>Sample Types:</b>	1) Airborne radioiodines 2) Airborne particulates 3) Direct radiation
<b>Sample Station Location:</b>	
<u>IF</u> traveling from ANO, <u>THEN</u> go approximately 0.2 miles west toward Gate 4. Turn left (at the east end of the sewage treatment plant) and go approximately 0.1 miles. Turn right and go approximately 0.1 miles. The sample station is on the right.	

<b>Sample Station Number:</b>	<b>3</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	6° - 0.7 miles
<b>Sample Types:</b>	1) Direct radiation
<b>Sample Station Location:</b>	
<u>IF</u> traveling west on Highway 333, <u>THEN</u> go approximately 0.35 miles from Gate 2 at ANO. Turn left onto gravel road and go approximately 0.05 miles.	
<u>IF</u> traveling east on Highway 333, <u>THEN</u> go approximately 0.9 miles from junction of Highway 333 and Flatwood Road. Turn right onto gravel road and go approximately 0.05 miles.	

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>4</b>
Approximate Direction & Distance from Plant:	176° - 0.5 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>  Go approximately 0.25 miles south from bridge over intake canal. Turn right onto gravel road. Proceed approximately 0.1 miles west of May Cemetery entrance. The sample station is on the left approximately 50 feet south of the road.	

---

<b>Sample Station Number:</b>	<b>6</b>
Approximate Direction & Distance from Plant:	111° - 7.0 miles
Sample Types:	1) Airborne radioiodines 2) Airborne particulates 3) Direct radiation
<u>Sample Station Location:</u>  Go to the Entergy local office which is located off Highway 7T in Russellville, AR (305 South Knoxville Avenue). The sample station is in the southeast corner of the back lot.	

---

<b>Sample Station Number:</b>	<b>7</b>
Approximate Direction & Distance from Plant:	209° - 19.3 miles
Sample Types:	1) Airborne radioiodines 2) Airborne particulates 3) Direct radiation
<u>Sample Station Location:</u>  Turn west at junction of Highway 7 and Highway 27 in Dardanelle, AR. Proceed to junction of Highway 27 and Highway 10 in Danville, AR. Turn right onto Highway 10 and proceed a short distance to the Entergy supply yard, which is on the right adjacent to an Entergy substation. The sample station is in the southwest corner of the supply yard.	

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>8</b>
Approximate Direction & Distance from Plant:	1) 180° - 0.1 miles 2) 245° - 0.7 miles 3) 230° - 0.6 miles
Sample Types:	1) Surface water (composite) 2) Shoreline sediment 3) Fish
<u>Sample Station Location:</u>  Plant discharge canal.	

<b>Sample Station Number:</b>	<b>10</b>
Approximate Direction & Distance from Plant:	90° - 0.5 miles (intake canal)
Sample Types:	Surface water (grab)
<u>Sample Station Location:</u>  Surface water (grab) is collected at plant intake canal.	

<b>Sample Station Number:</b>	<b>13</b>
Approximate Direction & Distance from Plant:	278° - 0.5 miles
Sample Types:	1) Broadleaf vegetation
<u>Sample Station Location:</u>  <u>IF</u> traveling west from ANO toward Gate 4, <u>THEN</u> go approximately 0.4 miles from ANO. Turn right onto Flatwood Road. Go a short distance. The sample may be collected from either side of Flatwood Road.	

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>14</b>
Approximate Direction & Distance from Plant:	70° - 5.3 miles
Sample Types:	1) Drinking water
<u>Sample Station Location:</u>	
From junction of Highway 7 and Water Works Road, go approximately 0.8 miles west on Water Works Road. The sample station is on the left at the intake to the Russellville city water system from the Illinois Bayou.	

---

<b>Sample Station Number:</b>	<b>16</b>
Approximate Direction & Distance from Plant:	290° - 5.9 miles
Sample Types:	1) Shoreline sediment 2) Fish
<u>Sample Station Location:</u>	
Panther Bay, located on the south side of the Arkansas River across from the mouth of Piney Creek.	

---

<b>Sample Station Number:</b>	<b>36</b>
Approximate Direction & Distance from Plant:	140° - 0.05 miles
Sample Types:	1) Pond water 2) Pond sediment
<u>Sample Station Location:</u>	
The sample station is at the Wastewater Holding Pond on the ANO site east of the discharge canal.	

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>55</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	209° - 16.6 miles
<b>Sample Types:</b>	1) Broadleaf Vegetation
<b>Sample Station Location:</b>	
From Dardanelle, travel south on Highway 27. Go approximately 15.5 miles to the intersection of Highways 27 and 154. The sample station is located at this intersection.	

---

<b>Sample Station Number:</b>	<b>56</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	273° - 0.4 miles
<b>Sample Types:</b>	1) Airborne radioiodines 2) Airborne particulates 3) Direct Radiation
<b>Sample Station Location:</b>	
If traveling west from ANO, the sample station is located at the west end of the sewage treatment plant near the facility blower building.	

---

<b>Sample Station Number:</b>	<b>57</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	208° - 19.5 miles
<b>Sample Types:</b>	1) Drinking Water
<b>Sample Station Location:</b>	
Go to Danville and turn left on Fifth Street. Go approximately three blocks. The Danville public water supply treatment facility is located on the left.	

**Table 1.1**

**Sampling Stations**

<b>Sample Station Number:</b>	<b>108</b>
Approximate Direction & Distance from Plant:	313° - 0.9 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
<p><u>IF</u> traveling from Highway 333, <u>THEN</u> turn south onto Flatwood Road and go approximately 0.4 miles. The TLD is on a utility pole on the right.</p> <p><u>IF</u> traveling north on Flatwood Road, <u>THEN</u> go approximately 0.4 miles from sample station 109. The TLD is on a utility pole on the left.</p>	

<b>Sample Station Number:</b>	<b>109</b>
Approximate Direction & Distance from Plant:	290° - 0.6 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
<p><u>IF</u> traveling west from ANO toward Gate 4, <u>THEN</u> go approximately 0.4 miles and turn right onto Flatwood Road. Go approximately 0.2 miles. The TLD is on a utility pole on the right across from the junction of Flatwood Road and Round Mountain Road.</p>	

<b>Sample Station Number:</b>	<b>110</b>
Approximate Direction & Distance from Plant:	140° - 0.7 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
<p>From bridge over intake canal, go south approximately 0.25 miles. Turn left and go approximately 0.25 miles. Turn right on Bunker Hill Lane. The sample station is on the first utility pole on the left.</p>	

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>111</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	117° - 2.0 miles
<b>Sample Types:</b>	1) Direct radiation
<b>Sample Station Location:</b>  From junction of Highway 64 and Highway 326 (Marina Road), go approximately 2.1 miles on Marina Road. The TLD is on a utility pole on the left just prior to curve.	

---

<b>Sample Station Number:</b>	<b>116</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	320° - 1.9 miles
<b>Sample Types:</b>	1) Direct radiation
<b>Sample Station Location:</b>  Go one block south of the west junction of Highway 333 and Highway 64 in London, AR. The TLD is on a utility pole north of the railroad tracks.	

---

<b>Sample Station Number:</b>	<b>125</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	46° - 9.0 miles
<b>Sample Types:</b>	1) Direct radiation
<b>Sample Station Location:</b>  While traveling north on Highway 7, turn left onto Water Street in Dover, AR. Go one block and turn left onto South Elizabeth Street. Go one block and turn right onto College Street. The TLD is on a utility pole at the southeast corner of the red brick school building, which is located on top of hill.	

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>127</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	102° - 5.6 miles
<b>Sample Types:</b>	1) Direct radiation
<b><u>Sample Station Location:</u></b>  The TLD is located on Arkansas Tech Campus on West O Street. The TLD is on a security light pole in front of Bryan Hall, which is the first building on the left when traveling from North Arkansas on West O Street.	

---

<b>Sample Station Number:</b>	<b>137</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	150° - 8.1 miles
<b>Sample Types:</b>	1) Direct radiation
<b><u>Sample Station Location:</u></b>  At junction of Highway 7 and Highway 28 in Dardanelle, AR, go approximately 0.2 miles on Highway 28. The TLD is on a speed limit sign on the right in front of the Morris R. Moore Arkansas National Guard Armory.	

---

<b>Sample Station Number:</b>	<b>145</b>
<b>Approximate Direction &amp; Distance from Plant:</b>	30° - 0.6 miles
<b>Sample Types:</b>	1) Direct radiation
<b><u>Sample Station Location:</u></b>  The TLD is located near the west entrance to the RERTC on a utility pole on the north side of State Highway 333.	

**Table 1.1**  
**Sampling Stations**

<b>Sample Station Number:</b>	<b>146</b>
Approximate Direction & Distance from Plant:	50° - 0.6 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
The TLD is located on the south end of the east parking lot at the RERTC. The TLD is located on a utility pole.	

---

<b>Sample Station Number:</b>	<b>147</b>
Approximate Direction & Distance from Plant:	63° - 0.6 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
The TLD is located on the west side of Bunker Hill Road, approximately 100 yards from the intersection with State Highway 333.	

---

<b>Sample Station Number:</b>	<b>148</b>
Approximate Direction & Distance from Plant:	122° - 0.5 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
If traveling east from ANO, turn right on Bunker Hill Road. Travel south for approximately 0.25 miles to the intersection with Scott Lane. The TLD is located on the county road sign post.	

---

<b>Sample Station Number:</b>	<b>149</b>
Approximate Direction & Distance from Plant:	150° - 0.6 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
If traveling south on Bunker Hill Road, turn right on May Road. Travel approximately 0.3 miles. The TLD is located on a utility pole on the south side of May Road.	

**Table 1.1**  
**Sampling Stations**

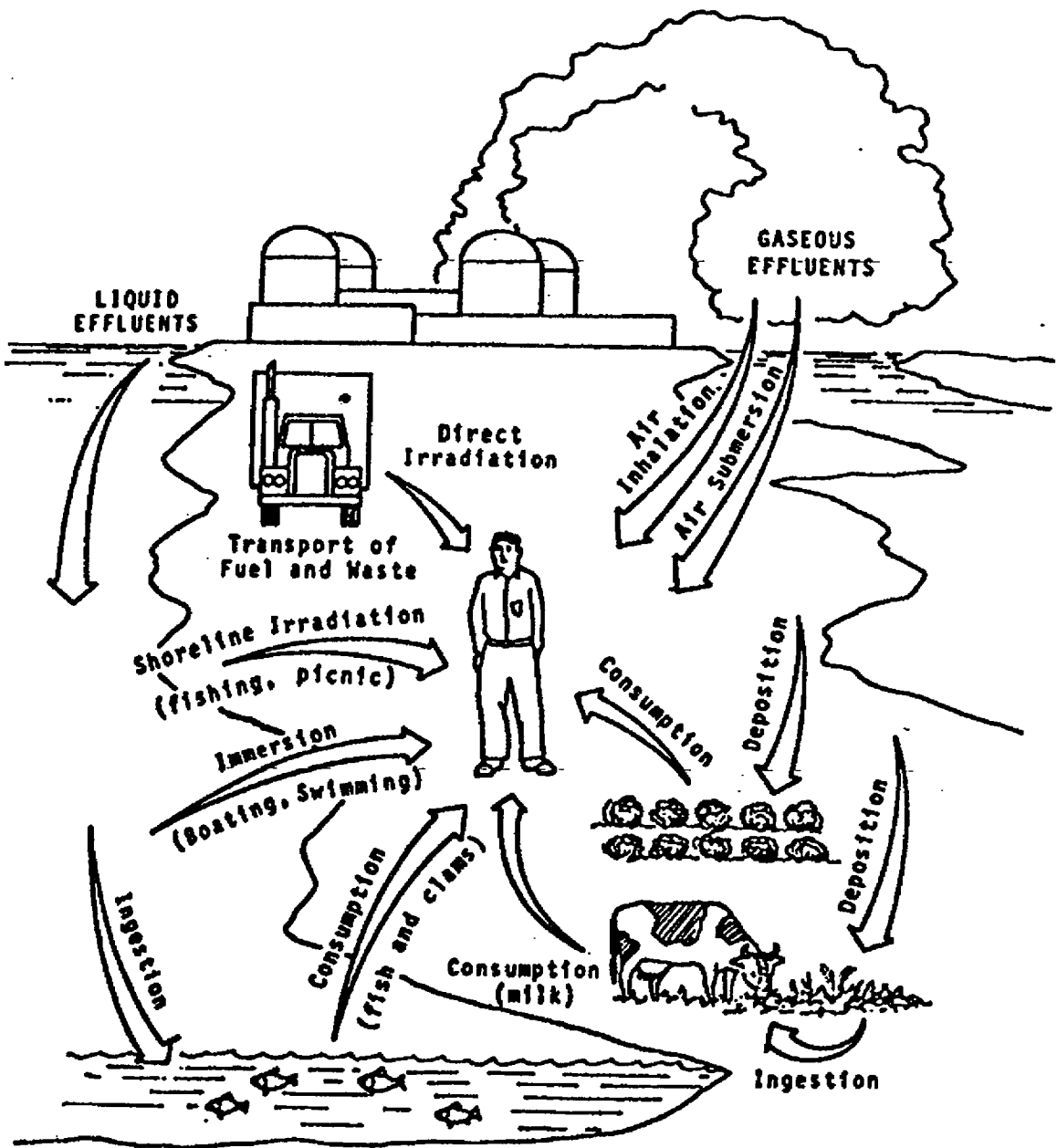
<b>Sample Station Number:</b>	<b>150</b>
Approximate Direction & Distance from Plant:	201° - 0.6 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
<p>If traveling south on Bunker Hill Road, turn right on May Road. Travel approximately 0.8 miles. The TLD is located just past the McCurley Place turn off on the north side of May Road on a utility pole.</p>	

<b>Sample Station Number:</b>	<b>151</b>
Approximate Direction & Distance from Plant:	220° - 0.4 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
<p>If traveling west from ANO, turn south on plant road along the west side of the sewage treatment plant. The TLD is located at the end of this road, near the lake on a metal post.</p>	

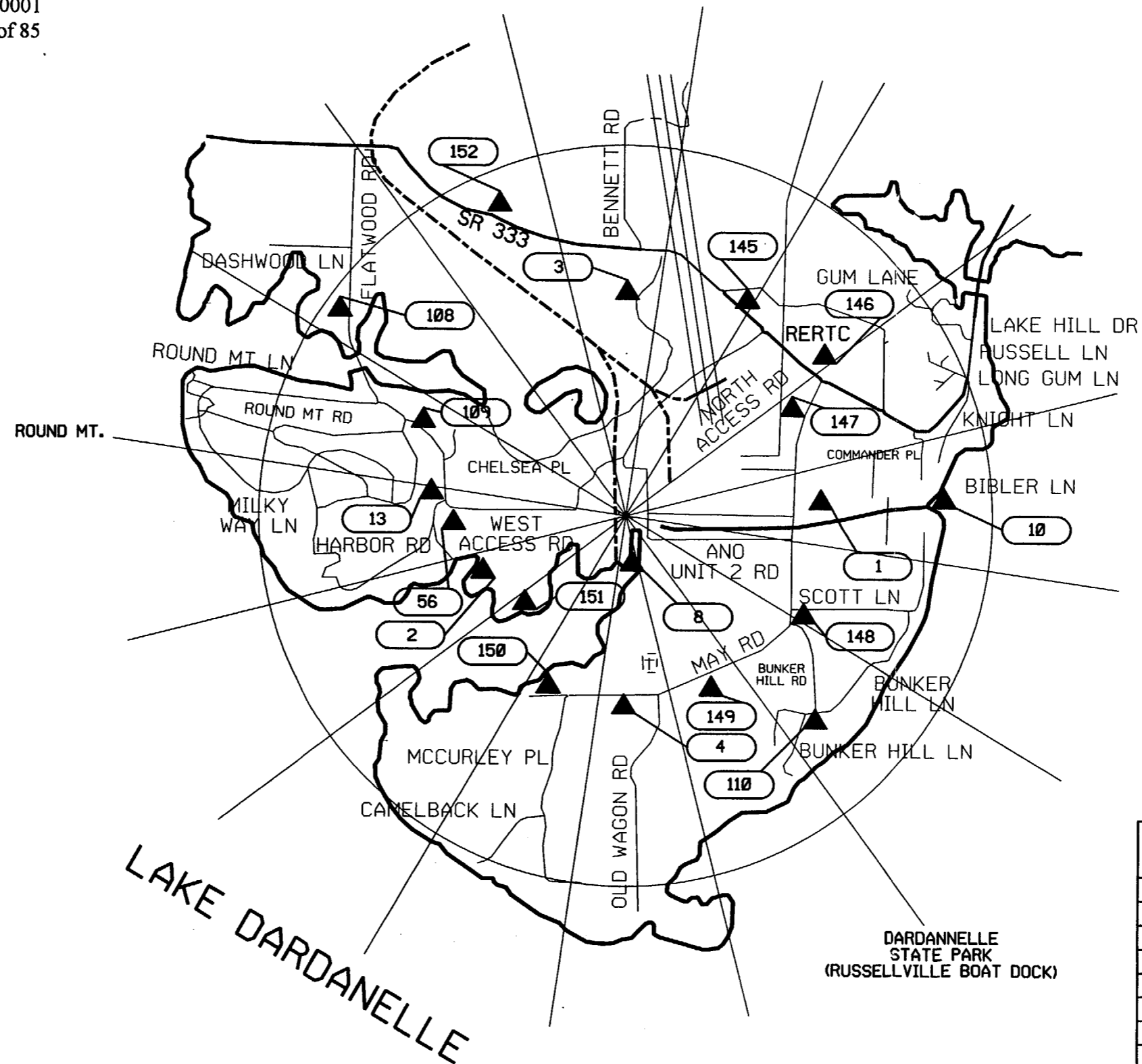
<b>Sample Station Number:</b>	<b>152</b>
Approximate Direction & Distance from Plant:	338° - 0.8 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
<p>If traveling west on State Highway 333 from the RERTC, travel approximately 0.7 miles. The TLD is located on the north side of State Highway 333 on a London City limit sign post.</p>	

<b>Sample Station Number:</b>	<b>153</b>
Approximate Direction & Distance from Plant:	305° - 9.2 miles
Sample Types:	1) Direct radiation
<u>Sample Station Location:</u>	
<p>Travel State Highway 64 West to Knoxville Elementary School. The TLD is located near the school entrance gate on a utility pole.</p>	

**FIGURE 1-1**  
**Exposure Pathways**



H  
G  
F  
E  
D  
C  
B  
A

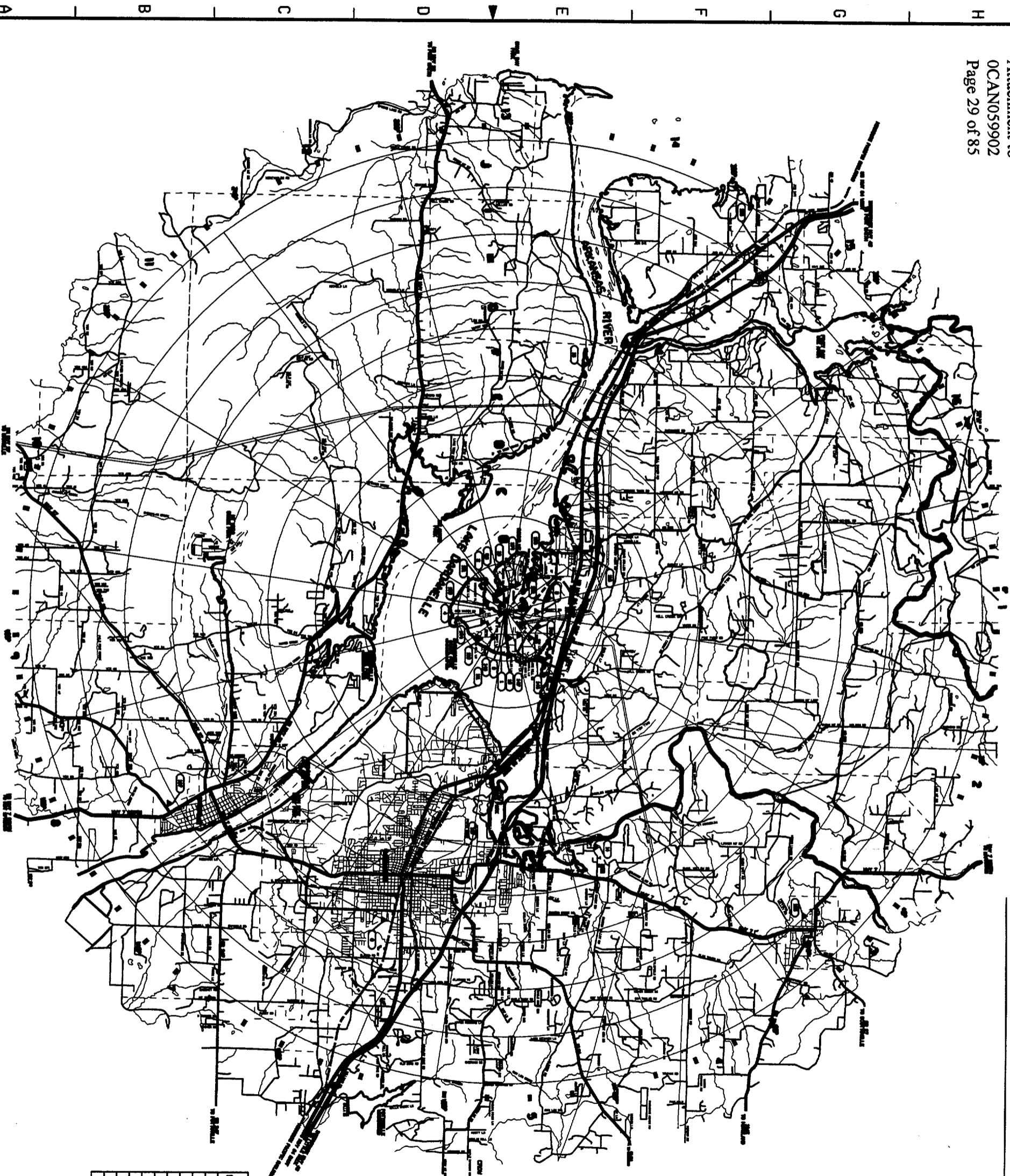


LETTER DESIGNATION	MILES	ENVIRONMENTAL SAMPLING STATIONS
A	0-1	
B	1-2	
C	2-3	7 DANVILLE - 19.3 MILES SSW OF PLANT (TLD), (AIR)
D	3-4	55 DANVILLE - 16.6 MILES SSE OF PLANT (VEG.)
E	4-5	57 DANVILLE - 19.5 MILES SSE OF PLANT (DRINKING WATER)
F	5-6	
G	6-7	
H	7-8	
I	8-9	
J	9-10	

REV	DATE	REVISION DESCRIPTION	BY	CHKD	APP'D
SCALE	1:1000	SECTION	EMERGENCY OPS	DRAWN	J. S. MILLER
<b>ARKANSAS NUCLEAR ONE</b> UNIT # RUSSELLVILLE, ARKANSAS					
<b>1 MILE ENVIRONMENTAL RADILOGICAL SAMPLE STATIONS MAP</b>					
DRAWING NO	DATE	REVISION			
FIGURE 1-2	1	N			

SAMPLE COLLECTION SITES - FAR FIELD

FIGURE 1-3



LETTER DESIGNATION	MILES	ENVIRONMENTAL SAMPLE TYPE TO BE COLLECTED
A	0-1	☐ PLANT - 100 MILES SSE
B	1-2	☐ PLANT - 100 MILES SSE
C	2-3	☐ PLANT - 100 MILES SSE
D	3-4	☐ PLANT - 100 MILES SSE
E	4-5	☐ PLANT - 100 MILES SSE
F	5-6	☐ PLANT - 100 MILES SSE
G	6-7	☐ PLANT - 100 MILES SSE
H	7-8	☐ PLANT - 100 MILES SSE
I	8-9	☐ PLANT - 100 MILES SSE
J	9-10	☐ PLANT - 100 MILES SSE

**ARKANSAS NUCLEAR ONE**  
 UNIT 9  
 RUSSELLVILLE, ARKANSAS

**10 MILE ENVIRONMENTAL RADIOLOGICAL SAMPLE STATIONS MAP**

FIGURE 1-3

DATE: 11/1/85

SCALE: 1:50,000

PROJECT NO. 1

REVISION

## 2.0 Interpretation and Trends of Results

### 2.1 Air Particulate and Radioiodine Sample Results

Since gamma radionuclides were not detected in the air particulate composites and Iodine-131 was not detected in the radioiodine cartridges during 1999, as has been the case in previous years, the airborne exposure pathway has been unaffected by the operation of ANO. Indicator gross beta air particulate results for 1999 were similar to those background levels obtained in previous years of the operational REMP and well below preoperational levels as seen below. Results are reported as annual average pCi/m<sup>3</sup>.

<u>Monitoring Period</u>	<u>Result</u>
Preoperational	0.047
1990 – 1998	0.017
1999	0.023

Gross beta results for indicator locations during 1999 ranged from 0.009 - 0.052 pCi/m<sup>3</sup> with a mean of 0.023 pCi/m<sup>3</sup> as compared to control locations that ranged from 0.012 - 0.042 pCi/m<sup>3</sup> with a mean of 0.023 pCi/m<sup>3</sup>. This further emphasizes that the airborne pathway has been unaffected by the operation of ANO.

### 2.2 Thermoluminescent Dosimetry Sample Results

Quarterly doses recorded by TLDs during 1999 were as follows:

- 0 - 2 miles, mean of 7.8 mrem and range of 6.0 - 10.0 mrem
- 2 - 5 miles, mean of 6.3 mrem and range of 4.0 - 10.0 mrem
- > 5 miles, mean of 6.9 mrem and range of 3.0 - 10.0 mrem

ANO reported measured doses in 1999 as net exposure (field reading - transit reading) normalized to 92 days and relies on comparison of indicator locations to the controls as a measure of plant impact. This comparison, as shown in Figure 2-1, indicates that the ambient radiation levels are unaffected by plant operations. Therefore, levels continue to remain at or near background.

### 2.3 Milk Sample Results

Milk samples were collected from four control locations in 1999 and analyzed for Iodine-131 and gamma radionuclides. As expected, Iodine-131 and gamma radionuclides were below detectable limits in all control locations. Since there are no dairies within five miles of the ANO site and the control locations do not indicate any unusual concentrations of radioisotopes, it is concluded ANO's operation had no impact on this pathway in 1999, as has been the case in previous years.

### 2.4 Water Sample Results

Analytical results for 1999 drinking water, surface water and groundwater samples were similar to those reported in previous years.

**Drinking water** samples were collected from two locations (indicator and control) and analyzed for gross beta radionuclides, Iodine-131, gamma radionuclides and tritium. Gamma radionuclides, Iodine-131 and tritium at the indicator location were below detectable limits, which is consistent with preoperational and operational years. Gross beta concentrations ranged from 1.87 – 4.99 pCi/l with a mean of 3.24 pCi/l, which are consistent with the preoperational and operational levels. Listed below is a comparison of 1999 results to preoperational and operational years. Results are reported as annual average pCi/l.

<b><u>Radionuclide</u></b>	<b><u>1999</u></b>	<b><u>1990 – 1998</u></b>	<b><u>Preoperational</u></b>
Gross Beta	3.24	3.41	2.0
Iodine-131	<LLD	0.3	<LLD
Gammas	<LLD	<LLD	<LLD
Tritium	<LLD	457.5	200.0

Based on this comparison, the operation of ANO had no impact on this pathway during 1999 and radionuclides monitored for this pathway continue to remain at background levels.

**Surface water** samples were collected and analyzed for gamma radionuclides and tritium. Gamma radionuclides were below detectable limits with tritium continuing to be detected at the indicator location. Listed below is a comparison of 1999 results from the indicator location as compared to the preoperational and operational years. Results are reported as annual average pCi/l.

<u>Radionuclide</u>	<u>1999</u>	<u>1990 – 1998</u>	<u>Preoperational</u>
Cobalt-58	<LLD	7.5	<LLD
Cesium-137	<LLD	<LLD	17.8
Other Gammas	<LLD	<LLD	<LLD
Tritium	1847.5	871.1	200.0

Although tritium levels showed an increase as compared to previous years, ANO personnel have noted no definable trends. Since the indicator sample is collected at the point where liquid radwaste effluents are discharged to the bay prior to mixing with Lake Dardanelle, the potential for the presence of tritium exists. However, levels detected during 1999 and previous operational years have been below regulatory reporting limits. Therefore, the operation of ANO is having little or no impact on this pathway. Figure 2-2 presents 1999 tritium concentrations in comparison to previous years.

Groundwater samples were collected from two locations and analyzed for gamma radionuclides and tritium. As in preoperational and previous operational years, gamma radionuclides remained undetectable. Tritium was detected once in the control location at a concentration of 216.0 pCi/l. This concentration is well below the required LLD value and is considered background. Therefore, it can be concluded that plant operations is not impacting this pathway.

## **2.5 Vegetation and Food Product Sample Results**

Vegetation and food product samples were collected when available from five locations in 1999 and analyzed for Iodine-131 and gamma radionuclides. The 1999 levels remained undetectable, as has been the case since 1989. Therefore, since levels continue to remain at background, it can be concluded that plant operations is not impacting this pathway.

## **2.6 Sediment Sample Results**

Sediment samples were collected from three locations in 1999 and analyzed for gamma radionuclides. As in previous years, radionuclides attributable to ANO were detected in the discharge sediment. However, Figure 2-3 shows that 1999 levels are below those of previous operational years. 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 all radionuclides to the skin and total body was <0.01 millirem.

Design objectives given in 10CFR50, Appendix I for liquid effluents are annual doses of  $\leq 3$  millirem total body and  $\leq 10$  millirem any organ. The values of  $< 0.01$  millirem for the skin and total body are well within the design objective criteria. Therefore, the level of radionuclides detected in 1999 had no significant impact on the environment or public.

## **2.7 Fish Sample Results**

Fish samples were collected from two locations and analyzed for gamma radionuclides. In 1999, gamma radionuclides were below detectable limits which is 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 pathway.

## **2.8 Land Use Census Results**

The land use census did not identify any new locations during 1999 which yielded a calculated dose or dose commitment greater than those currently calculated, even though some minor adjustments (see Table 2.1) were made to the nearest residence mileage distances, as a result of improved technology.

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 1999, 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' environmental laboratory analyzed interlaboratory comparison samples for ANO to fulfill the requirements of ANO Units 1 and 2 ODCM Section 2.6.3. Attachment 1, 1999 Radiological Environmental Monitoring Report, contains these results. ANO's review of RBS' interlaboratory comparison indicated that 92% of the sample results for accuracy and precision were within the acceptable control limits of the three normalized deviations. For those sample results outside the acceptable control limits, ANO's and RBS's review indicated no impact on previously reported data. Attachment 1 also provides additional discussion regarding sample results outside the acceptable control limits.

**TABLE 2.1**

**1999 Land Use Census**

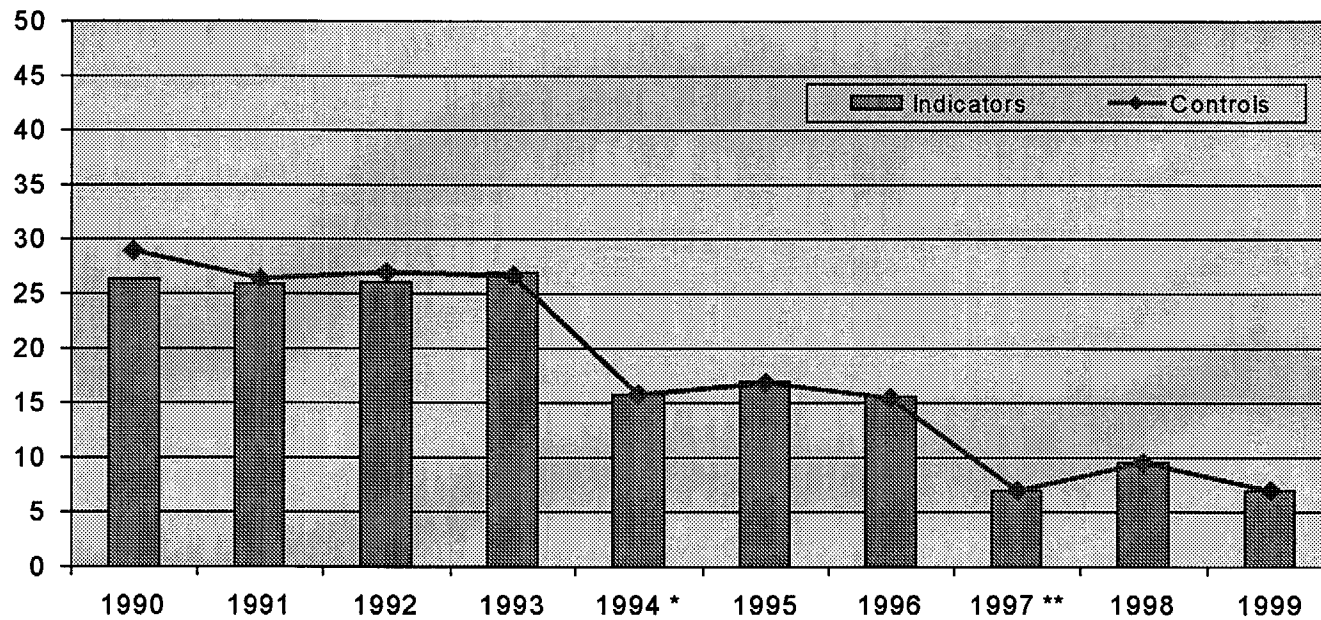
**NEAREST RESIDENCE WITHIN FIVE MILES**

<b>Sector</b>	<b>Distance (miles)</b>
1	0.7
2	1.2
3	0.9
4	0.9
5	0.8
6	0.8
7	0.8
8	0.8
9	1.0
10	0.8
11	2.9
12	0.7
13	1.0
14	0.8
15	0.8
16	0.8

**Figure 2-1**  
**TLD Radiation Dose**

1990 - 1999 TLD Results  
Indicators Versus Controls

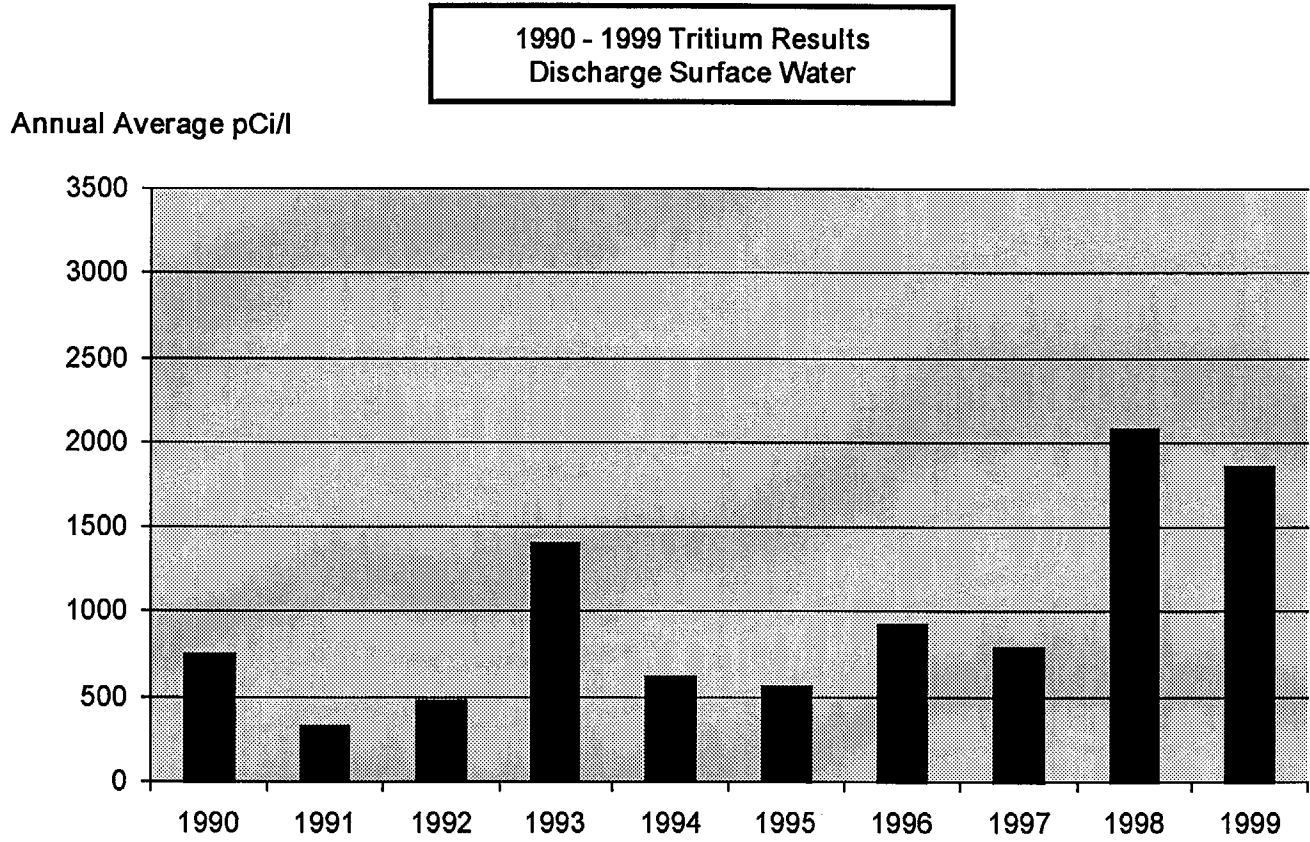
Annual Average mR/Qtr



\* Dose based on deep working dose (1000 mg/cm<sup>2</sup>). Previous doses based on lens of eye (300 mg/cm<sup>2</sup>).

\*\* Dose based on actual net field dose (gross field dose - gross transit dose).

**Figure 2-2**  
**Discharge Tritium Concentrations**

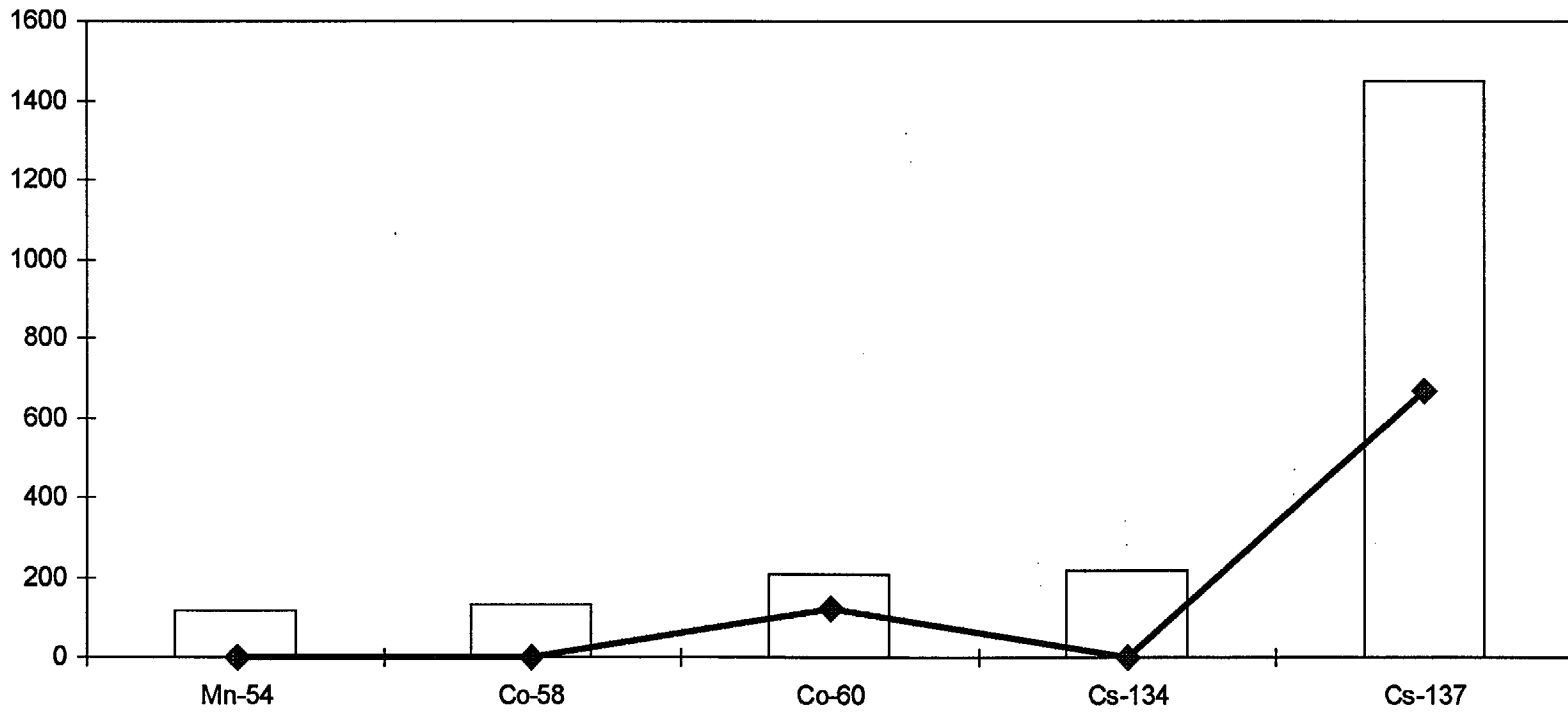


**Figure 2-3**  
**Discharge Sediment**

1990 - 1999 Gamma Radionuclide Results  
Discharge Sediment

Annual Average pCi/kg

□ 1990 - 1998 Operational Average      ◆ 1999 Operational Average



### **3.0 Radiological Environmental Monitoring Program Summary**

#### **3.1 1999 Program Results Summary**

Table 3.1 summarizes the 1999 REMP results. ANO personnel did not use values reported as less than the lower limit of detection (<LLD) when determining ranges and means for indicator and control locations.

TABLE 3.1

**Radiological Environmental Monitoring Program Summary**

Name of Facility ANO - Units 1 and 2 Docket No. 50-313 and 50-368  
 Location of Facility Pope, Arkansas Reporting Period January - December 1999  
 (County, State)

Sample Type (Units)	Type & Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Locations Mean (F) <sup>c</sup> [ Range ]	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> [ Range ]	Number of Nonroutine Results <sup>e</sup>
				Location <sup>d</sup>	Mean (F) <sup>c</sup> [ Range ]		
Air Particulates (pCi/m <sup>3</sup> )	GB 282	0.01	0.023 (186 / 187) [ 0.009 - 0.052 ]	Station 56 (273°, 0.4 mi)	0.026 (4 / 4) [ 0.009 - 0.037 ]	0.023 (95 / 95) [ 0.012 - 0.042 ]	0
	GS 25						
	Cs-134 Cs-137	0.05 0.06	<LLD <LLD	N/A N/A	N/A N/A	<LLD <LLD	0 0
Airborne Iodine (pCi/m <sup>3</sup> )	I-131 281	0.07	<LLD	N/A	N/A	<LLD	0
0 - 2 Mile TLDs (mR/Qtr)	Gamma 44	(f)	7.8 (44 / 44) [ 6.0 - 10.0 ]	Station 2 (240°, 0.5 mi)	9.0 (4 / 4) [ 7.0 - 10.0 ]	N/A	0
				Station 109 (290°, 0.6 mi)	9.0 (4 / 4) [ 7.0 - 10.0 ]	N/A	
2 - 5 Mile TLDs (mR/Qtr)	Gamma 56	(f)	6.3 (56 / 56) [ 4.0 - 10.0 ]	Station 124 (60°, 3.2 mi)	9.0 (4 / 4) [ 7.0 - 10.0 ]		0
>5 Mile TLDs (mR/Qtr)	Gamma 71	(f)	N/A	N/A	N/A	6.9 (71 / 71) [ 3.0 - 10.0 ]	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, Arkansas Reporting Period January - December 1999  
 (County, State)

Sample Type (Units)	Type & Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Locations Mean (F) <sup>c</sup> [ Range ]	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> [ Range ]	Number of Nonroutine Results <sup>e</sup>
				Location <sup>d</sup>	Mean (F) <sup>c</sup> [ Range ]		
Drinking Water (pCi/l)	GB 13	4	3.24 (6 / 12) [ 1.87 - 4.99 ]	Station 14 ( 70°, 5.3 mi )	3.24 (6 / 12) [ 1.87 - 4.99 ]	<LLD	0
	I-131 13	1.0	<LLD	N/A	N/A	<LLD	0
	H-3 5	2000	<LLD	N/A	N/A	<LLD	0
	GS 13						
	Mn-54 15	15	<LLD	N/A	N/A	<LLD	0
	Fe-59 30	30	<LLD	N/A	N/A	<LLD	0
	Co-58 15	15	<LLD	N/A	N/A	<LLD	0
	Co-60 15	15	<LLD	N/A	N/A	<LLD	0
	Zn-65 30	30	<LLD	N/A	N/A	<LLD	0
	Zr-95 30	30	<LLD	N/A	N/A	<LLD	0
	Nb-95 15	15	<LLD	N/A	N/A	<LLD	0
	Cs-134 15	15	<LLD	N/A	N/A	<LLD	0
	Cs-137 18	18	<LLD	N/A	N/A	<LLD	0
Ba-140 60	60	<LLD	N/A	N/A	<LLD	0	
La-140 15	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, Arkansas Reporting Period January - December 1999  
 (County, State)

Sample Type (Units)	Type & Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Location Mean (F) <sup>c</sup> [ Range ]	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> [ Range ]	Number of Nonroutine Results <sup>e</sup>
				Location <sup>d</sup>	Mean (F) <sup>c</sup> [ Range ]		
Surface Water (pCi/l)	H-3 8	2000	1847.5 (4 / 4) [ 393.0 - 5588.0 ]	Station 8 (180°, 0.1 mi)	1847.5 (4 / 4) [ 393.0 - 5588.0 ]	642.0 (2 / 4) [ 350.0 - 934.0 ]	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
	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
Groundwater (pCi/l)	H-3 6	2000	<LLD	N/A	N/A	216.0 (1 / 3) [ N/A ]	0
	GS 6						
	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

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, Arkansas Reporting Period January - December 1999  
 (County, State)

Sample Type (Units)	Type & Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Locations Mean ( F ) <sup>c</sup> [ Range ]	Location with Highest Annual Mean		Control Locations Mean ( F ) <sup>c</sup> [ Range ]	Number of Nonroutine Results <sup>e</sup>
				Location <sup>d</sup>	Mean ( F ) <sup>c</sup> [ Range ]		
Milk ( pCi/l )	I-131 41	1.0	N/A	N/A	N/A	<LLD	0
	GS 41						
	Cs-134	15	N/A	N/A	N/A	<LLD	0
	Cs-137	18	N/A	N/A	N/A	<LLD	0
	Ba-140	60	N/A	N/A	N/A	<LLD	0
	La-140	15	N/A	N/A	N/A	<LLD	0
Vegetation ( 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
Food Product ( pCi/kg )	I-131 10	60	<LLD	N/A	N/A	N/A	0
	GS 10						
	Cs-134	60	<LLD	N/A	N/A	N/A	0
	Cs-137	80	<LLD	N/A	N/A	N/A	0
Fish ( pCi/kg )	GS 8						
	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

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, Arkansas Reporting Period January - December 1999  
 (County, State)

Sample Type (Units)	Type & Number of Analyses <sup>a</sup>	LLD <sup>b</sup>	Indicator Locations Mean (F) <sup>c</sup> [ Range ]	Location with Highest Annual Mean		Control Locations Mean (F) <sup>c</sup> [ Range ]	Number of Nonroutine Results <sup>e</sup>
				Location <sup>d</sup>	Mean (F) <sup>c</sup> [ Range ]		
Bottom Sediment (pCi/kg)	GS <sup>6</sup>						
	Mn-54	(f)	<LLD	N/A	<LLD	<LLD	0
	Co-58	(f)	<LLD)	N/A	<LLD)	<LLD	0
	Co-60	(f)	124.0 ( 2 / 2 ) [ 103.0 - 145.0 ]	Station 8 ( 245°, 0.7 mi )	124.0 ( 2 / 2 ) [ 103.0 - 145.0 ]	<LLD	0
	Cs-134	150	<LLD	N/A	<LLD	<LLD	0
Cs-137	180		666.0 ( 2 / 2 ) [ 569.0 - 763.0 ]	Station 8 ( 245°, 0.7 mi )	666.0 ( 2 / 2 ) [ 569.0 - 763.0 ]	286.0 ( 4 / 4 ) [ 110.0 - 562.0 ]	0

<sup>a</sup> GB = Gross beta; I-131 = Iodine-131; H-3 = Tritium; GS = Gamma scan.

<sup>b</sup> LLD = Required lower limit of detection based on ANO Units 1 and 2 ODCM Tables 2.6-2.

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

<sup>d</sup> Locations are specified (1) by name and (2) degrees relative to reactor site.

<sup>e</sup> 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.

<sup>f</sup> LLD is not defined in ANO Units 1 and 2 ODCM Tables.

**Attachment 1**  
**1999 Radiological Monitoring Report**  
**Summary of Monitoring Results**

TABLE OF CONTENTS

TABLE 1.1	AIR PARTICULATE & RADIOIODINE	47
TABLE 1.2	AIR PARTICULATE & RADIOIODINE	49
TABLE 1.3	AIR PARTICULATE & RADIOIODINE	51
TABLE 1.4	AIR PARTICULATE & RADIOIODINE	53
TABLE 1.5	AIR PARTICULATE & RADIOIODINE	55
TABLE 1.6	AIR PARTICULATE & RADIOIODINE	57
TABLE 1.7	AIR PARTICULATE & RADIOIODINE	59
TABLE 1.8	AIR PARTICULATE	60
TABLE 2.1	MILK	61
TABLE 2.2	MILK	62
TABLE 2.3	MILK	63
TABLE 2.4	MILK (ADH SPLIT)	64
TABLE 3.1	DRINKING WATER	65
TABLE 3.2	DRINKING WATER	66
TABLE 3.3	DRINKING WATER	67
TABLE 4.1	SURFACE WATER	68
TABLE 4.2	SURFACE WATER	69
TABLE 4.3	SURFACE WATER	70
TABLE 5.1	GROUNDWATER	71
TABLE 5.2	GROUNDWATER	72
TABLE 6.1	FISH	73
TABLE 7.1	SEDIMENT	74
TABLE 8.1	VEGETATION	75
TABLE 9.1	FOOD PRODUCTS	76

TABLE 10.1	THERMOLUMINESCENT DOSIMETERS	77
TABLE 10.2	THERMOLUMINESCENT DOSIMETERS	78
TABLE 10.3	THERMOLUMINESCENT DOSIMETERS	79
TABLE 11.1	INTERLABORATORY COMPARISON	80

Table 1.1

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 01, Met Tower (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990024	12/29/98	01/05/99	0.032 ± 0.003	<0.017
990050	01/05/99	01/12/99	0.027 ± 0.003	<0.016
990072	01/12/99	01/19/99	0.033 ± 0.003	<0.028
990086	01/19/99	01/26/99	0.024 ± 0.003	<0.023
990113	01/26/99	02/02/99	0.020 ± 0.002	<0.016
990137	02/02/99	02/09/99	0.024 ± 0.002	<0.021
990157	02/09/99	02/16/99	0.020 ± 0.002	<0.017
990176	02/16/99	02/23/99	0.026 ± 0.003	<0.017
990187	02/23/99	03/02/99	0.026 ± 0.003	<0.018
990218	03/02/99	03/09/99	0.017 ± 0.002	<0.019
990240	03/09/99	03/16/99	0.018 ± 0.002	<0.023
990266	03/16/99	03/23/99	0.026 ± 0.002	<0.018
990295	03/23/99	03/30/99	0.024 ± 0.002	<0.020
990321	03/30/99	04/06/99	0.020 ± 0.002	<0.024
990369	04/06/99	04/13/99	0.021 ± 0.002	<0.020
990384	04/13/99	04/20/99	0.019 ± 0.002	<0.019
990411	04/20/99	04/27/99	0.020 ± 0.002	<0.018
990432	04/27/99	05/04/99	0.016 ± 0.002	<0.020
990447	05/04/99	05/11/99	0.021 ± 0.002	<0.017
990481	05/11/99	05/18/99	0.018 ± 0.002	<0.020
990497	05/18/99	05/25/99	0.015 ± 0.002	<0.012
990538	05/25/99	06/01/99	0.018 ± 0.002	<0.020
990544	06/01/99	06/08/99	0.016 ± 0.002	<0.024
990571	06/08/99	06/15/99	0.016 ± 0.002	<0.019
990605	06/15/99	06/22/99	0.024 ± 0.002	<0.014
990639	06/22/99	06/29/99	0.014 ± 0.002	<0.019

Table 1.1

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 01, Met Tower (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990659	06/29/99	07/06/99	0.017 ± 0.002	<0.019
990700	07/06/99	07/13/99	0.017 ± 0.002	<0.020
990730	07/13/99	07/20/99	0.022 ± 0.002	<0.013
990750	07/20/99	07/27/99	0.020 ± 0.002	<0.016
990767	07/27/99	08/03/99	0.020 ± 0.002	<0.018
990789	08/03/99	08/10/99	0.038 ± 0.003	<0.017
990812	08/10/99	08/17/99	0.021 ± 0.002	<0.015
990835	08/17/99	08/24/99	0.036 ± 0.003	<0.018
990858	08/24/99	08/31/99	0.040 ± 0.003	<0.019
990875	08/31/99	09/07/99	0.032 ± 0.003	<0.020
990899	09/07/99	09/14/99	0.021 ± 0.002	<0.017
990925	09/14/99	09/21/99	0.032 ± 0.003	<0.017
990969	09/21/99	09/28/99	0.027 ± 0.003	<0.016
990998	09/28/99	10/05/99	0.030 ± 0.003	<0.022
991046	10/05/99	10/12/99	0.031 ± 0.004	<0.043
991070	10/12/99	10/19/99	0.041 ± 0.003	<0.018
991086	10/19/99	10/26/99	0.025 ± 0.002	<0.019
991113	10/26/99	11/02/99	0.039 ± 0.003	<0.016
991158	11/02/99	11/16/99	0.033 ± 0.002	<0.010
991183	11/16/99	11/30/99	0.039 ± 0.002	<0.017
991254	11/30/99	12/14/99	0.032 ± 0.002	<0.011
991279	12/14/99	12/28/99	0.025 ± 0.002	<0.027

Table 1.2

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 02, Southwest of Site (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990025	12/29/98	01/05/99	0.041 ± 0.003	<0.023
990051	01/05/99	01/12/99	0.033 ± 0.003	<0.020
990073	01/12/99	01/19/99	0.034 ± 0.003	<0.019
990087	01/19/99	01/26/99	0.024 ± 0.002	<0.017
990114	01/26/99	02/02/99	0.017 ± 0.002	<0.016
990138	02/02/99	02/09/99	0.020 ± 0.002	<0.014
990158	02/09/99	02/16/99	0.021 ± 0.003	<0.024
990177	02/16/99	02/23/99	0.026 ± 0.002	<0.014
990188	02/23/99	03/02/99	0.021 ± 0.002	<0.018
990219	03/02/99	03/09/99	0.018 ± 0.002	<0.020
990241	03/09/99	03/16/99	0.018 ± 0.002	<0.020
990267	03/16/99	03/23/99	0.024 ± 0.002	<0.019
990296	03/23/99	03/30/99	0.016 ± 0.002	<0.019
990322	03/30/99	04/06/99	0.020 ± 0.002	<0.019
990367	04/06/99	04/13/99	0.019 ± 0.002	<0.020
990383	04/13/99	04/20/99	0.021 ± 0.002	<0.021
990412	04/20/99	04/27/99	0.019 ± 0.002	<0.013
990433	04/27/99	05/04/99	0.015 ± 0.002	<0.018
990448	05/04/99	05/11/99	0.021 ± 0.002	<0.016
990482	05/11/99	05/18/99	0.017 ± 0.002	<0.019
990498	05/18/99	05/25/99	0.017 ± 0.002	<0.019
990539	05/25/99	06/01/99	0.018 ± 0.002	<0.016
<b>990555</b>	<b>06/01/99</b>	<b>06/08/99</b>	*	*
990572	06/08/99	06/15/99	0.012 ± 0.002	<0.018
990607	06/15/99	06/22/99	0.024 ± 0.002	<0.014
990640	06/22/99	06/29/99	0.012 ± 0.002	<0.014

\* Missed sample due to power loss.

Table 1.2

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 02, Southwest of Site (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990660	06/29/99	07/06/99	0.018 ± 0.002	<0.020
990701	07/06/99	07/13/99	0.017 ± 0.002	<0.019
990731	07/13/99	07/20/99	0.028 ± 0.003	<0.018
990751	07/20/99	07/27/99	0.022 ± 0.002	<0.017
990768	07/27/99	08/03/99	0.023 ± 0.002	<0.018
990790	08/03/99	08/10/99	0.037 ± 0.003	<0.019
990813	08/10/99	08/17/99	0.018 ± 0.002	<0.021
990836	08/17/99	08/24/99	0.034 ± 0.003	<0.016
990859	08/24/99	08/31/99	0.032 ± 0.005	<0.059
990876	08/31/99	09/07/99	0.028 ± 0.003	<0.018
990900	09/07/99	09/14/99	0.021 ± 0.002	<0.019
990926	09/14/99	09/21/99	0.032 ± 0.003	<0.021
990970	09/21/99	09/28/99	0.027 ± 0.002	<0.021
990999	09/28/99	10/05/99	0.028 ± 0.003	<0.017
991047	10/05/99	10/12/99	0.025 ± 0.004	<0.041
991071	10/12/99	10/19/99	0.039 ± 0.007	<0.065
991087	10/19/99	10/26/99	0.025 ± 0.002	<0.021
991114	10/26/99	11/02/99	0.052 ± 0.005	<0.046
991159	11/02/99	11/16/99	0.033 ± 0.002	<0.015
991184	11/16/99	11/30/99	0.036 ± 0.002	<0.011
991255	11/30/99	12/14/99	0.029 ± 0.002	<0.010
991280	12/14/99	12/28/99	0.047 ± 0.018	<0.060

Table 1.3

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 03, North of Site (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<b>Required LLD →</b>		<b><u>0.01</u></b>	<b><u>0.07</u></b>
990026	12/29/98	01/05/99	0.028 ± 0.003	<0.017
990052	01/05/99	01/12/99	0.032 ± 0.003	<0.015
990074	01/12/99	01/19/99	0.029 ± 0.002	<0.018
990088	01/19/99	01/26/99	0.023 ± 0.002	<0.015
990115	01/26/99	02/02/99	0.015 ± 0.002	<0.018
990139	02/02/99	02/09/99	0.019 ± 0.002	<0.015
990159	02/09/99	02/16/99	0.019 ± 0.002	<0.021
990178	02/16/99	02/23/99	0.026 ± 0.002	<0.020
990189	02/23/99	03/02/99	0.022 ± 0.002	<0.015
990220	03/02/99	03/09/99	0.018 ± 0.002	<0.017
990242	03/09/99	03/16/99	0.018 ± 0.002	<0.022
990268	03/16/99	03/23/99	0.022 ± 0.002	<0.017
990297	03/23/99	03/30/99	0.024 ± 0.002	<0.016
990323	03/30/99	04/06/99	0.020 ± 0.002	<0.022
990366	04/06/99	04/13/99	0.015 ± 0.002	<0.015
990385	04/13/99	04/20/99	0.024 ± 0.002	<0.021
990413	04/20/99	04/27/99	0.019 ± 0.002	<0.020
990434	04/27/99	05/04/99	0.014 ± 0.002	<0.018
990449	05/04/99	05/11/99	0.020 ± 0.002	<0.019
990483	05/11/99	05/18/99	0.016 ± 0.003	<0.033
990499	05/18/99	05/25/99	0.016 ± 0.002	<0.019
990540	05/25/99	06/01/99	0.018 ± 0.002	<0.019
990556	06/01/99	06/08/99	0.014 ± 0.002	<0.020
990573	06/08/99	06/15/99	0.015 ± 0.003	<0.024
990604	06/15/99	06/22/99	0.023 ± 0.002	<0.017
990641	06/22/99	06/29/99	0.013 ± 0.002	<0.018

Table 1.3

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 03, North of Site (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<b>Required LLD →</b>		<b><u>0.01</u></b>	<b><u>0.07</u></b>
990661	06/29/99	07/06/99	<0.021 *	<0.065
990702	07/06/99	07/13/99	0.014 ± 0.007	<0.066
990732	07/13/99	07/20/99	0.024 ± 0.002	<0.020
990752	07/20/99	07/27/99	0.020 ± 0.009	<0.054
990769	07/27/99	08/03/99	0.020 ± 0.002	<0.017
990791	08/03/99	08/10/99	0.036 ± 0.003	<0.017
990814	08/10/99	08/17/99	0.021 ± 0.004	<0.035
990837	08/17/99	08/24/99	0.034 ± 0.003	<0.016
990860	08/24/99	08/31/99	0.042 ± 0.007	**
990877	08/31/99	09/07/99	0.031 ± 0.003	<0.017
990901	09/07/99	09/14/99	0.021 ± 0.004	<0.033
990927	09/14/99	09/21/99	0.031 ± 0.003	<0.020
990971	09/21/99	09/28/99	0.028 ± 0.003	<0.017
991000	09/28/99	10/05/99	0.034 ± 0.004	<0.025
991048	10/05/99	10/12/99	0.030 ± 0.003	<0.021
991072	10/12/99	10/19/99	0.034 ± 0.003	<0.021
991088	10/19/99	10/26/99	0.024 ± 0.003	<0.029
991115	10/26/99	11/02/99	0.049 ± 0.004	<0.025
***				

\* Exceeded allowable LLD value due to low sample volume from short run time.

\*\* Missed sample due to power loss.

\*\*\* Sample station deleted.

Table 1.4

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 04, May Cemetery (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990027	12/29/98	01/05/99	0.025 ± 0.003	<0.022
990053	01/05/99	01/12/99	0.022 ± 0.003	<0.020
990075	01/12/99	01/19/99	0.024 ± 0.002	<0.020
990089	01/19/99	01/26/99	0.020 ± 0.003	<0.021
990116	01/26/99	02/02/99	0.014 ± 0.002	<0.019
990140	02/02/99	02/09/99	0.016 ± 0.002	<0.023
990160	02/09/99	02/16/99	0.016 ± 0.002	<0.017
990179	02/16/99	02/23/99	0.023 ± 0.002	<0.015
990190	02/23/99	03/02/99	0.018 ± 0.002	<0.024
990221	03/02/99	03/09/99	0.014 ± 0.002	<0.022
990243	03/09/99	03/16/99	0.014 ± 0.002	<0.015
990269	03/16/99	03/23/99	0.021 ± 0.002	<0.018
990298	03/23/99	03/30/99	0.021 ± 0.002	<0.017
990324	03/30/99	04/06/99	0.019 ± 0.003	<0.030
990368	04/06/99	04/13/99	0.015 ± 0.002	<0.020
990386	04/13/99	04/20/99	0.015 ± 0.002	<0.019
990414	04/20/99	04/27/99	0.016 ± 0.002	<0.020
990435	04/27/99	05/04/99	0.013 ± 0.002	<0.020
990450	05/04/99	05/11/99	0.016 ± 0.002	<0.017
990484	05/11/99	05/18/99	0.014 ± 0.002	<0.022
990500	05/18/99	05/25/99	0.016 ± 0.003	<0.018
990541	05/25/99	06/01/99	0.014 ± 0.002	<0.019
990557	06/01/99	06/08/99	0.014 ± 0.002	<0.017
990574	06/08/99	06/15/99	0.012 ± 0.002	<0.017
990606	06/15/99	06/22/99	0.020 ± 0.002	<0.017
990642	06/22/99	06/29/99	0.010 ± 0.002	<0.018

Table 1.4

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 04, May Cemetery (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990662	06/29/99	07/06/99	0.014 ± 0.002	<0.022
990703	07/06/99	07/13/99	0.014 ± 0.002	<0.015
990733	07/13/99	07/20/99	0.021 ± 0.002	<0.016
990753	07/20/99	07/27/99	0.018 ± 0.002	<0.015
990770	07/27/99	08/03/99	0.017 ± 0.002	<0.016
990792	08/03/99	08/10/99	0.035 ± 0.003	<0.019
990815	08/10/99	08/17/99	0.016 ± 0.002	<0.016
990838	08/17/99	08/24/99	0.029 ± 0.003	<0.016
990861	08/24/99	08/31/99	0.028 ± 0.003	<0.023
990878	08/31/99	09/07/99	0.026 ± 0.002	<0.017
990902	09/07/99	09/14/99	0.018 ± 0.002	<0.016
990928	09/14/99	09/21/99	0.028 ± 0.003	<0.018
990972	09/21/99	09/28/99	0.023 ± 0.003	<0.015
991001	09/28/99	10/05/99	0.024 ± 0.002	<0.019
991049	10/05/99	10/12/99	0.034 ± 0.006	<0.042
991073	10/12/99	10/19/99	0.030 ± 0.003	<0.016
991089	10/19/99	10/26/99	0.021 ± 0.002	<0.024
991116	10/26/99	11/02/99	0.031 ± 0.003	<0.017
*				

\* Sample station deleted.

Table 1.5

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 06, Local Office (Control)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990028	12/29/98	01/05/99	0.035 ± 0.003	<0.026
990054	01/05/99	01/12/99	0.029 ± 0.003	<0.018
990076	01/12/99	01/19/99	0.033 ± 0.003	<0.020
990090	01/19/99	01/26/99	0.022 ± 0.002	<0.019
990117	01/26/99	02/02/99	0.018 ± 0.002	<0.012
990141	02/02/99	02/09/99	0.021 ± 0.002	<0.020
990161	02/09/99	02/16/99	0.018 ± 0.002	<0.016
990180	02/16/99	02/23/99	0.023 ± 0.002	<0.020
990191	02/23/99	03/02/99	0.019 ± 0.002	<0.018
990222	03/02/99	03/09/99	0.017 ± 0.002	<0.018
990244	03/09/99	03/16/99	0.016 ± 0.002	<0.023
990270	03/16/99	03/23/99	0.023 ± 0.002	<0.018
990299	03/23/99	03/30/99	0.020 ± 0.002	<0.017
990325	03/30/99	04/06/99	0.020 ± 0.002	<0.023
990365	04/06/99	04/13/99	0.019 ± 0.003	<0.025
990387	04/13/99	04/20/99	0.017 ± 0.004	<0.052
990415	04/20/99	04/27/99	0.022 ± 0.002	<0.020
990436	04/27/99	05/04/99	0.013 ± 0.002	<0.016
<b>990451</b>	<b>05/04/99</b>	<b>05/11/99</b>	*	*
990485	05/11/99	05/18/99	0.015 ± 0.002	<0.026
990501	05/18/99	05/25/99	0.015 ± 0.002	<0.018
990542	05/25/99	06/01/99	0.017 ± 0.002	<0.015
990558	06/01/99	06/08/99	0.014 ± 0.002	<0.022
990575	06/08/99	06/15/99	0.012 ± 0.003	<0.024
990603	06/15/99	06/22/99	0.022 ± 0.003	<0.021
990643	06/22/99	06/29/99	0.013 ± 0.003	<0.032

\* Missed sample due to power loss.

Table 1.5

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 06, Local Office (Control)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990663	06/29/99	07/06/99	0.012 ± 0.011	<0.065
990704	07/06/99	07/13/99	0.017 ± 0.002	<0.022
990734	07/13/99	07/20/99	0.024 ± 0.002	<0.014
990754	07/20/99	07/27/99	0.020 ± 0.002	<0.019
990771	07/27/99	08/03/99	0.018 ± 0.002	<0.020
990793	08/03/99	08/10/99	0.026 ± 0.002	<0.022
990816	08/10/99	08/17/99	0.019 ± 0.002	<0.022
990839	08/17/99	08/24/99	0.033 ± 0.003	<0.017
990862	08/24/99	08/31/99	0.034 ± 0.003	<0.017
990879	08/31/99	09/07/99	0.028 ± 0.003	<0.018
990903	09/07/99	09/14/99	0.019 ± 0.003	<0.024
990929	09/14/99	09/21/99	0.028 ± 0.003	<0.017
990973	09/21/99	09/28/99	0.024 ± 0.003	<0.024
991002	09/28/99	10/05/99	0.026 ± 0.002	<0.021
991050	10/05/99	10/12/99	0.029 ± 0.003	<0.022
991074	10/12/99	10/19/99	0.033 ± 0.003	<0.020
991090	10/19/99	10/26/99	0.027 ± 0.003	<0.025
991117	10/26/99	11/02/99	0.035 ± 0.003	<0.019
991160	11/02/99	11/16/99	0.032 ± 0.002	<0.013
991185	11/16/99	11/30/99	0.035 ± 0.002	<0.011
991256	11/30/99	12/14/99	0.040 ± 0.002	<0.017
991281	12/14/99	12/28/99	0.023 ± 0.002	<0.018

Table 1.6

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 07, Danville (Control)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990029	12/29/98	01/05/99	0.042 ± 0.003	<0.024
990055	01/05/99	01/12/99	0.033 ± 0.003	<0.018
990077	01/12/99	01/19/99	0.041 ± 0.003	<0.019
990091	01/19/99	01/26/99	0.032 ± 0.003	<0.020
990118	01/26/99	02/02/99	0.021 ± 0.002	<0.016
990142	02/02/99	02/09/99	0.021 ± 0.002	<0.016
990162	02/09/99	02/16/99	0.019 ± 0.002	<0.017
990181	02/16/99	02/23/99	0.028 ± 0.003	<0.016
990192	02/23/99	03/02/99	0.023 ± 0.002	<0.018
990223	03/02/99	03/09/99	0.019 ± 0.002	<0.019
990245	03/09/99	03/16/99	0.017 ± 0.002	<0.017
990271	03/16/99	03/23/99	0.023 ± 0.002	<0.016
990300	03/23/99	03/30/99	0.018 ± 0.002	<0.020
990326	03/30/99	04/06/99	0.020 ± 0.002	<0.022
990364	04/06/99	04/13/99	0.015 ± 0.002	<0.018
990388	04/13/99	04/20/99	0.021 ± 0.002	<0.018
990416	04/20/99	04/27/99	0.018 ± 0.002	<0.020
990437	04/27/99	05/04/99	0.014 ± 0.002	<0.020
990452	05/04/99	05/11/99	0.016 ± 0.002	<0.018
990486	05/11/99	05/18/99	0.021 ± 0.003	<0.025
990502	05/18/99	05/25/99	0.016 ± 0.002	<0.016
990543	05/25/99	06/01/99	0.017 ± 0.002	<0.019
990559	06/01/99	06/08/99	0.015 ± 0.002	<0.022
990576	06/08/99	06/15/99	0.014 ± 0.002	<0.019
990602	06/15/99	06/22/99	0.021 ± 0.002	<0.018
990644	06/22/99	06/29/99	0.013 ± 0.002	<0.019

Table 1.6

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Weekly Exchange (Biweekly change effective 11/02/99)

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 07, Danville (Control)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
990664	06/29/99	07/06/99	0.018 ± 0.002	<0.017
990705	07/06/99	07/13/99	0.015 ± 0.002	<0.023
990735	07/13/99	07/20/99	0.025 ± 0.002	<0.015
990755	07/20/99	07/27/99	0.020 ± 0.002	<0.015
990772	07/27/99	08/03/99	0.020 ± 0.002	<0.017
990794	08/03/99	08/10/99	0.035 ± 0.003	<0.019
990817	08/10/99	08/17/99	0.019 ± 0.002	<0.013
990840	08/17/99	08/24/99	0.035 ± 0.003	<0.017
990863	08/24/99	08/31/99	0.035 ± 0.003	<0.021
990880	08/31/99	09/07/99	0.029 ± 0.003	<0.017
990904	09/07/99	09/14/99	0.022 ± 0.002	<0.023
990930	09/14/99	09/21/99	0.032 ± 0.003	<0.017
990974	09/21/99	09/28/99	0.028 ± 0.003	<0.021
991003	09/28/99	10/05/99	0.028 ± 0.003	<0.017
990151	10/05/99	10/12/99	0.029 ± 0.003	<0.017
991075	10/12/99	10/19/99	0.034 ± 0.003	<0.020
991091	10/19/99	10/26/99	0.025 ± 0.003	<0.023
991118	10/26/99	11/02/99	0.035 ± 0.003	<0.018
991161	11/02/99	11/16/99	0.032 ± 0.002	<0.008
991186	11/16/99	11/30/99	0.039 ± 0.002	<0.013
991257	11/30/99	12/14/99	0.018 ± 0.001	<0.012
991282	12/14/99	12/28/99	0.024 ± 0.002	<0.013

Table 1.7

Sample Type: Air Particulate and Radioiodine

Collection: Continuous with Biweekly Exchange

Analysis: Gross Beta (Particulate) and Iodine-131 (Radioiodine Cartridge)

Units: pCi/m<sup>3</sup>

Location: 56, Sewage Treatment Plant (Indicator)

Lab Number	Start Date	End Date	Gross Beta	I-131
	<u>Required LLD</u> →		<u>0.01</u>	<u>0.07</u>
991162	11/02/99	11/16/99	0.032 ± 0.002	<0.011
991187	11/16/99	11/30/99	0.037 ± 0.002	<0.011
991258	11/30/99	12/14/99	0.027 ± 0.002	<0.011
991283	12/14/99	12/28/99	0.009 ± 0.003	<0.056

Table 1.8  
 Sample Type: Air Particulate  
 Collection: Quarterly Composites of Weekly and Biweekly Samples  
 Analysis: Gamma  
 Units: pCi/m<sup>3</sup>

Location	Lab Number	Quarterly Composite	Cs-134	Cs-137
		<b>Required LLD →</b>	<b><u>0.05</u></b>	<b><u>0.06</u></b>
01, Met Tower (Indicator)	990335	1ST	<0.002	<0.003
01, Met Tower (Indicator)	990683	2ND	<0.002	<0.002
01, Met Tower (Indicator)	991022	3RD	<0.001	<0.002
01, Met Tower (Indicator)	991296	4TH	<0.002	<0.001
02, Southwest of Site (Indicator)	990336	1ST	<0.003	<0.002
02, Southwest of Site (Indicator)	990684	2ND	<0.002	<0.002
02, Southwest of Site (Indicator)	991023	3RD	<0.002	<0.002
02, Southwest of Site (Indicator)	991297	4TH	<0.003	<0.002
03, North of Site (Indicator)	990337	1ST	<0.003	<0.001
03, North of Site (Indicator)	990685	2ND	<0.002	<0.002
03, North of Site (Indicator)	991024	3RD	<0.003	<0.002
03, North of Site (Indicator) *	991290	4TH	<0.007	<0.004
04, May Cemetery (Indicator)	990338	1ST	<0.002	<0.001
04, May Cemetery (Indicator)	990686	2ND	<0.002	<0.002
04, May Cemetery (Indicator)	991025	3RD	<0.002	<0.001
04, May Cemetery (Indicator) *	991291	4TH	<0.006	<0.005
06, Local Office (Control)	990339	1ST	<0.002	<0.002
06, Local Office (Control)	990687	2ND	<0.002	<0.003
06, Local Office (Control)	991026	3RD	<0.003	<0.002
06, Local Office (Control)	991298	4TH	<0.002	<0.002
07, Danville (Control)	990340	1ST	<0.002	<0.002
07, Danville (Control)	990688	2ND	<0.002	<0.002
07, Danville (Control)	991027	3RD	<0.002	<0.002
07, Danville (Control)	991299	4TH	<0.002	<0.002
56, S.T.P. (Indicator) *	991300	4TH	<0.003	<0.003

\* Incomplete 4th quarter samples stations 3 and 4 were deleted on November 2, 1999.  
 Station 56 was added to the REMP on November 2, 1999.

Table 2.1  
 Sample Type: Milk  
 Collection: Monthly Grab  
 Analysis: Iodine-131 and Gamma  
 Units: pCi/l

Location: 37, Steuber Dairy (Control)

Lab Number	Collection Date	I-131	Cs-134	Cs-137	Ba-140	La-140
	<b>Required LLD →</b>	<b><u>1.0</u></b>	<b><u>15</u></b>	<b><u>18</u></b>	<b><u>60</u></b>	<b><u>15</u></b>
990094	01/28/99	<0.90	<3.79	<3.44	<14.4	<4.05
990173	02/24/99	<0.78	<3.77	<4.04	<12.5	<3.44
990278	03/25/99	<0.85	<3.38	<3.73	<14.4	<4.88
990390	04/22/99	<0.76	<5.62	<6.57	<14.5	<6.35
990478	05/19/99	<0.86	<5.16	<5.83	<14.9	<5.91
990587	06/16/99	<0.90	<3.87	<4.36	<14.9	<4.69
990707	07/14/99	<0.79	<4.28	<5.14	<13.4	<5.22
990796	08/12/99	<0.89	<4.54	<3.93	<14.3	<5.67
990833	09/09/99	<0.84	<3.47	<3.99	<13.8	<3.82
991005	10/06/99	<0.88	<4.00	<3.58	<14.4	<5.34
*						

\* Sample station deleted.

Table 2.2  
 Sample Type: Milk  
 Collection: Monthly Grab  
 Analysis: Iodine-131 and Gamma  
 Units: pCi/l

Location: 52, Collins Dairy (Control)

Lab Number	Collection Date	I-131	Cs-134	Cs-137	Ba-140	La-140
	<b>Required LLD →</b>	<b><u>1.0</u></b>	<b><u>15</u></b>	<b><u>18</u></b>	<b><u>60</u></b>	<b><u>15</u></b>
990095	01/28/99	<0.89	<3.89	<4.51	<14.6	<4.64
990174	02/24/99	<0.88	<4.07	<4.97	<14.9	<5.29
990277	03/25/99	<0.90	<4.16	<4.26	<14.3	<5.44
990393	04/26/99	<0.87	<3.89	<4.51	<14.0	<4.65
990479	05/19/99	<0.76	<4.00	<5.08	<13.8	<3.92
990589	06/17/99	<0.72	<3.81	<4.20	<12.7	<2.01
990708	07/14/99	<0.84	<5.01	<6.55	<14.8	<4.42
990797	08/12/99	<0.88	<3.51	<4.37	<13.1	<3.92
990885	09/10/99	<0.88	<4.07	<4.57	<14.9	<4.39
991007	10/06/99	<0.88	<4.34	<4.47	<14.7	<3.81
*						

\* Sample station deleted.

Table 2.3  
 Sample Type: Milk  
 Collection: Monthly Grab  
 Analysis: Iodine-131 and Gamma  
 Units: pCi/l

Location: 53, Harms Dairy (Control)

Lab Number	Collection Date	I-131	Cs-134	Cs-137	Ba-140	La-140
	<b>Required LLD →</b>	<b><u>1.0</u></b>	<b><u>15</u></b>	<b><u>18</u></b>	<b><u>60</u></b>	<b><u>15</u></b>
990096	01/28/99	<0.81	<3.86	<3.76	<13.6	<3.47
990175	02/24/99	<0.87	<3.47	<3.96	<13.2	<3.91
990279	03/25/99	<0.90	<4.31	<3.53	<14.9	<5.56
990391	04/22/99	<0.82	<4.39	<4.39	<15.0	<4.61
990480	05/19/99	<0.75	<4.11	<4.67	<13.7	<4.55
990588	06/16/99	<0.88	<4.28	<3.95	<14.8	<3.79
990709	07/14/99	<0.85	<4.58	<4.70	<14.3	<3.37
990798	08/12/99	<0.84	<3.70	<3.96	<14.8	<5.62
990884	09/09/99	<0.90	<3.29	<3.59	<14.3	<5.38
991006	10/06/99	<0.90	<3.79	<4.82	<14.7	<6.46
*						

\* Sample station deleted.

Table 2.4  
 Sample Type: Milk  
 Collection: Monthly Grab  
 Analysis: Iodine-131 and Gamma  
 Units: pCi/l

Location: 54, Cole Dairy (Control) \*

Lab Number	Collection Date	I-131	Cs-134	Cs-137	Ba-140	La-140
	<b>Required LLD →</b>	<b><u>1.0</u></b>	<b><u>15</u></b>	<b><u>18</u></b>	<b><u>60</u></b>	<b><u>15</u></b>
990030	01/05/99	<0.79	<3.58	<3.99	<14.9	<4.24
990119	02/02/99	<0.90	<3.56	<3.97	<13.7	<4.76
990195	03/02/99	<0.78	<4.32	<4.60	<14.9	<5.59
990272	03/23/99	<0.87	<4.48	<4.95	<14.8	<5.41
990389	04/20/99	<0.89	<3.75	<4.18	<14.1	<4.99
990487	05/18/99	<0.89	<4.04	<3.83	<14.8	<3.91
990590	06/15/99	<0.88	<4.32	<5.17	<14.8	<5.66
990706	07/13/99	<0.90	<3.66	<3.79	<13.2	<4.49
990795	08/10/99	<0.89	<4.09	<4.83	<14.0	<4.57
990881	09/07/99	<0.86	<4.12	<4.87	<14.6	<5.50
991004	10/04/99	<0.85	<4.34	<4.18	<14.8	<4.51
**						

\* Arkansas Department of Health collects and splits sample with ANO.  
 \*\* Sample station deleted.

Table 3.1  
 Sample Type: Drinking Water  
 Collection: Monthly Grab (Quarterly effective 11/10/99)  
 Analysis: Gross Beta, Iodine-131 and Gamma  
 Units: pCi/l

Location: 14, City of Russellville (Indicator)

Lab Number	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
<b>Required LLD →</b>		<b>4.0</b>	<b>1.0</b>	<b>15</b>	<b>30</b>	<b>15</b>	<b>15</b>	<b>30</b>	<b>30</b>	<b>15</b>	<b>15</b>	<b>18</b>	<b>60</b>	<b>15</b>
990023	01/07/99	<3.15	<0.87	<3.75	<7.15	<3.53	<4.76	<8.83	<7.37	<4.31	<4.02	<3.73	<13.6	<4.19
990121	02/03/99	2.36 ± 1.86	<0.85	<2.74	<5.48	<2.66	<2.66	<8.35	<4.43	<3.14	<3.64	<3.29	<11.90	<4.20
990208	03/03/99	1.87 ± 1.69	<0.89	<3.40	<6.81	<2.94	<2.85	<6.67	<5.17	<3.43	<3.54	<3.13	<14.0	<5.32
990306	04/01/99	2.06 ± 1.78	<0.88	<3.35	<6.74	<4.06	<3.19	<7.40	<5.40	<3.20	<4.03	<2.73	<14.8	<5.50
990410	04/28/99	<3.44	<0.76	<2.94	<4.95	<2.77	<3.25	<6.16	<4.09	<2.28	<3.39	<2.99	<9.57	<3.14
990512	05/26/99	<3.74	<0.80	<3.19	<5.20	<3.99	<3.63	<6.85	<6.39	<3.72	<3.61	<4.04	<11.7	<3.64
990625	06/23/99	<4.03	<0.78	<2.70	<6.78	<3.29	<2.70	<5.77	<5.72	<3.47	<3.91	<3.27	<14.7	<4.30
990737	07/22/99	3.54 ± 2.00	<0.72	<3.22	<6.71	<3.59	<3.91	<7.55	<5.79	<3.56	<3.66	<3.74	<13.1	<3.89
990821	08/18/99	<3.88	<0.74	<3.83	<7.33	<2.91	<3.32	<6.73	<5.86	<3.38	<3.27	<3.53	<14.4	<4.56
990912	09/16/99	4.63 ± 0.71	<0.90	<2.98	<5.20	<3.00	<2.84	<6.15	<4.70	<3.48	<3.24	<3.98	<11.7	<3.84
991052	10/13/99	4.99 ± 0.74	<0.75	<3.21	<6.95	<3.23	<3.39	<6.68	<6.48	<3.36	<3.68	<3.83	<13.9	<4.83
991134	11/10/99	<3.39	<0.86	<2.04	<4.45	<2.10	<2.04	<4.30	<3.91	<2.46	<2.37	<2.67	<8.96	<3.14

Table 3.2

Sample Type: Drinking Water

Collection: Quarterly Grab

Analysis: Gross Beta, Iodine-131 and Gamma

Units: pCi/l

Location: 57, City of Danville (Control)

Lab Number	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
<b>Required LLD →</b>		<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>
991135	11/10/99	<3.45	<0.78	<1.95	<4.10	<1.97	<1.78	<3.15	<3.44	<2.21	<1.98	<2.39	<7.06	<3.15

Table 3.3

Sample Type: Drinking Water

Collection: Quarterly Composite of Monthly Samples and Quarterly Grabs

Analysis: Tritium

Units: pCi/l

Location	Lab Number	Start Date	End Date	H-3
			<u>Required LLD</u> →	<u>2000</u>
14, City of Russellville (Indicator)	990209	01/07/99	03/03/99	<472
14, City of Russellville (Indicator)	990626	04/01/99	06/23/99	<480
14, City of Russellville (Indicator)	990913	07/22/99	09/16/99	<537
14, City of Russellville (Indicator)	991136	11/10/99	11/10/99	<530
57, City of Danville (Control)	991137	11/10/99	11/10/99	<526

Table 4.1  
 Sample Type: Surface Water  
 Collection: Monthly Composite  
 Analysis: Gamma  
 Units: pCi/l

**Location: 08, Discharge Bay (Indicator)**

Lab Number	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
<b>Required LLD →</b>			<b>15</b>	<b>30</b>	<b>15</b>	<b>15</b>	<b>30</b>	<b>30</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>18</b>	<b>60</b>	<b>15</b>
990111	12/31/98	01/31/99	<3.47	<8.44	<3.41	<3.11	<8.50	<6.45	<3.07	<4.86	<4.25	<3.69	<14.50	<4.06
990196	01/31/99	02/28/99	<3.07	<5.48	<2.95	<2.71	<5.47	<3.72	<3.21	<3.70	<3.30	<3.29	<11.80	<4.54
990302	02/28/99	03/31/99	<3.45	<8.68	<3.63	<2.42	<6.47	<4.02	<3.94	<4.32	<3.48	<3.68	<12.4	<5.53
990418	03/31/99	04/30/99	<5.07	<4.71	<2.69	<5.36	<6.94	<5.11	<3.85	<4.77	<4.26	<3.38	<13.3	<5.46
990531	04/30/99	05/31/99	<2.70	<6.25	<2.99	<3.70	<6.54	<5.00	<3.16	<3.37	<2.82	<2.83	<7.47	<3.83
990645	05/31/99	06/30/99	<3.79	<6.69	<3.64	<4.68	<9.08	<4.99	<2.64	<4.29	<3.72	<4.01	<9.78	<4.96
990773	06/30/99	07/31/99	<4.15	<6.49	<3.43	<3.55	<8.39	<7.02	<4.40	<6.18	<3.96	<3.77	<14.2	<6.76
990864	07/31/99	08/31/99	<3.87	<5.36	<3.48	<3.55	<7.18	<5.74	<3.93	<5.67	<4.02	<2.97	<13.7	<4.55
990980	08/31/99	09/30/99	<3.73	<7.43	<3.23	<3.21	<8.27	<5.28	<3.52	<4.59	<3.67	<3.95	<13.8	<5.06
991111	09/30/99	10/31/99	<3.59	<7.87	<3.80	<1.99	<8.57	<5.85	<3.59	<4.95	<3.79	<4.26	<11.8	<5.48
991188	10/31/99	11/30/99	<4.31	<6.86	<3.85	<3.55	<9.24	<7.04	<4.52	<5.23	<4.17	<4.37	<16.7	<4.86
991292	11/30/99	12/31/99	<2.89	<5.84	<3.36	<2.81	<7.46	<5.99	<3.78	<5.91	<2.88	<3.05	<16.8	<6.05

Table 4.2

Sample Type: Surface Water

Collection: Monthly Composite (Quarterly grab effective 11/01/99)

Analysis: Gamma

Units: pCi/l

Location: 10, Intake Canal (Control)

Lab Number	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
<b>Required LLD →</b>			<b>15</b>	<b>30</b>	<b>15</b>	<b>15</b>	<b>30</b>	<b>30</b>	<b>15</b>	<b>15</b>	<b>15</b>	<b>18</b>	<b>60</b>	<b>15</b>
990112	12/31/98	01/31/99	<3.54	<5.99	<3.09	<3.18	<7.95	<4.64	<3.71	<4.71	<4.03	<3.42	<14.90	<4.60
990197	01/31/99	02/28/99	<2.30	<5.57	<2.53	<2.48	<5.70	<4.99	<3.64	<3.95	<3.11	<3.09	<12.60	<3.67
990303	02/28/99	03/31/99	<3.25	<5.93	<3.11	<3.40	<7.57	<4.92	<3.56	<4.61	<4.30	<2.70	<11.5	<4.65
990419	03/31/99	04/30/99	<3.51	<6.37	<2.81	<3.77	<7.71	<5.79	<3.39	<4.11	<3.36	<4.22	<15.0	<3.76
990532	04/30/99	05/31/99	<3.92	<6.52	<3.16	<3.85	<6.27	<5.46	<3.50	<4.42	<3.59	<4.15	<14.0	<4.41
990646	05/31/99	06/30/99	<3.03	<6.25	<3.39	<2.40	<7.57	<5.12	<3.07	<4.60	<3.27	<3.37	<12.7	<3.53
990774	06/30/99	07/31/99	<3.12	<6.15	<2.97	<3.24	<7.07	<5.40	<3.72	<3.99	<3.29	<3.28	<14.7	<4.55
990865	07/31/99	08/31/99	<2.83	<7.15	<4.02	<2.83	<8.33	<6.68	<4.10	<4.68	<3.58	<2.91	<13.4	<6.34
990981	08/31/99	09/30/99	<3.36	<5.24	<2.47	<3.21	<5.80	<5.36	<2.70	<3.90	<2.82	<2.60	<13.3	<4.36
991112	09/30/99	10/31/99	<3.45	<6.32	<3.32	<3.64	<7.27	<5.19	<3.49	<4.75	<3.87	<3.21	<14.5	<5.28
991189	11/30/99	11/30/99	<3.41	<7.40	<3.61	<4.09	<7.80	<6.05	<3.83	<5.21	<4.01	<4.28	<16.5	<5.68
991293	12/31/99	12/31/99	<4.28	<11.0	<5.86	<4.61	<6.59	<9.16	<6.16	<7.03	<4.77	<6.18	<21.6	<9.54

Table 4.3  
 Sample Type: Surface Water  
 Collection: Quarterly Composite of Monthly Samples  
 Analysis: Tritium  
 Units: pCi/l

Location	Lab Number	Begin Date	End Date	H-3
			<u>Required LLD</u> →	<u>2000</u>
08, Discharge Bay (Indicator)	990304	12/31/98	03/31/99	662 ± 223
08, Discharge Bay (Indicator)	990647	03/31/99	06/30/99	5588 ± 332
08, Discharge Bay (Indicator)	990982	06/30/99	09/30/99	747 ± 263
08, Discharge Bay (Indicator)	991294	09/30/99	12/31/99	393 ± 237
10, Intake Canal (Control)	990305	12/31/98	03/31/99	< 485
10, Intake Canal (Control)	990648	03/31/99	06/30/99	350 ± 213
10, Intake Canal (Control)	990983	06/30/99	09/30/99	<537
10, Intake Canal (Control)	991295	09/30/99	12/31/99	934 ± 252

Table 5.1  
 Sample Type: Groundwater  
 Collection: Quarterly Grab  
 Analysis: Tritium and Gamma  
 Units: pCi/l

Location: 32, Stewart Residence (Indicator)

Lab Number	Collection Date	H-3	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140	La-140
<b>Required LLD →</b>		<b><u>2000</u></b>	<b><u>15</u></b>	<b><u>30</u></b>	<b><u>15</u></b>	<b><u>15</u></b>	<b><u>30</u></b>	<b><u>30</u></b>	<b><u>15</u></b>	<b><u>15</u></b>	<b><u>15</u></b>	<b><u>18</u></b>	<b><u>60</u></b>	<b><u>15</u></b>
990194	03/02/99	<472	<4.25	<5.84	<3.68	<4.36	<8.01	<6.47	<3.09	<4.09	<3.84	<3.44	<14.2	<3.18
990513	05/26/99	<495	<3.92	<7.47	<3.01	<3.55	<6.57	<6.55	<4.13	<4.49	<4.07	<4.43	<12.9	<6.04
990822	08/18/99	<536	<2.03	<3.82	<2.06	<2.05	<4.10	<3.56	<1.96	<7.37	<2.37	<2.24	<8.78	<3.26
*														

\* Sample station deleted.

Table 5.2  
 Sample Type: Groundwater  
 Collection: Quarterly Grab  
 Analysis: Tritium and Gamma  
 Units: pCi/l

Location: 33, Ouita Recreation Area (Control)

Lab Number	Collection Date	H-3	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Zr-95	Nb-95	I-131	Cs-134	Cs-137	Ba-140	La-140
<b>Required LLD →</b>		<b><u>2000</u></b>	<b><u>15</u></b>	<b><u>30</u></b>	<b><u>15</u></b>	<b><u>15</u></b>	<b><u>30</u></b>	<b><u>30</u></b>	<b><u>15</u></b>	<b><u>15</u></b>	<b><u>15</u></b>	<b><u>18</u></b>	<b><u>60</u></b>	<b><u>15</u></b>
990193	03/02/99	216 ± 207	<4.10	<8.02	<3.56	<4.57	<8.82	<6.20	<3.25	<4.23	<4.13	<4.58	<11.5	<2.37
990514	05/26/99	<495	<2.82	<5.47	<3.68	<3.78	<4.88	<5.09	<3.52	<3.95	<3.42	<4.01	<13.9	<5.80
990823	08/18/99	<493	<1.40	<3.16	<1.44	<1.29	<3.38	<2.76	<1.73	<7.37	<1.76	<1.78	<7.18	<2.56
*														

\* Sample station deleted.

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

Location	Lab Number	Collection Date	Sample Type	Mn-54	Fe-59	Co-58	Co-60	Zn-65	Cs-134	Cs-137
			<b>Required LLD →</b>	<b>130</b>	<b>260</b>	<b>130</b>	<b>130</b>	<b>260</b>	<b>130</b>	<b>150</b>
<b>08, Discharge (Indicator)</b>	990327	03/16/99	GAME-FISH	<12.8	<36.7	<12.2	<13.3	<37.2	<10.2	<11.5
<b>08, Discharge (Indicator)</b>	990333	03/16/99	CATFISH	<7.93	<58.2	<15.6	<16.9	<40.4	<13.8	<13.9
<b>08, Discharge (Indicator)</b>	990933	09/14/99	GAME-FISH	<15.3	<33.0	<12.6	<16.1	<42.8	<13.7	<17.0
<b>08, Discharge (Indicator)</b>	990931	09/14/99	CATFISH	<13.4	<39.5	<14.2	<15.4	<39.5	<17.0	<16.2
<b>10, Intake (Control) *</b>	990328	03/15/99	GAME-FISH	<15.8	<71.3	<21.8	<20.3	<51.5	<14.9	<22.5
<b>10, Intake (Control) *</b>	990334	03/15/99	CATFISH	<14.8	<50.2	<18.0	<13.9	<46.4	<14.0	<17.0
<b>10, Intake (Control) *</b>	990934	09/18/99	GAME-FISH	<13.5	<33.4	<12.2	<13.2	<24.5	<10.2	<13.8
<b>10, Intake (Control) *</b>	990932	09/18/99	CATFISH	<15.0	<34.4	<16.0	<10.5	<37.7	<14.0	<15.6

\* Sample station deleted.

Table 7.1  
 Sample Type: Sediment  
 Collection: Semiannually  
 Analysis: Gamma  
 Units: pCi/kg

Location	Lab Number	Collection Date	Mn-54	Co-58	Co-60	Cs-134	Cs-137
		<u>Required LLD</u> →	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>150</u>	<u>180</u>
<b>08, Discharge (Indicator)</b>	990329	03/18/99	<56.2	<56.2	103 ± 27.5	<56.8	569 ± 48.8
<b>08, Discharge (Indicator)</b>	991304	09/28/99			145 ± 26.5	<149.9	763 ± 54.5
<b>10, Intake (Control) *</b>	990330	03/18/99	<48.4	<40.6	<45.4	<40.0	562 ± 46.5
<b>10, Intake (Control) *</b>	991305	09/28/99				<149.70	305 ± 27.0
<b>16, Piney Creek (Control)</b>	990331	03/18/99	<48.4	<45.8	<46.6	<44.8	167 ± 22
<b>16, Piney Creek (Control)</b>	991307	09/28/99				<149	110 ± 23.8

\* Sample station deleted.

Table 8.1  
 Sample Type: Vegetation  
 Collection: At Time of Harvest  
 Analysis: Iodine-131 and Gamma  
 Units: pCi/kg

Location	Lab Number	Collection Date	I-131	Cs-134	Cs-137
		<b><u>Required LLD</u> →</b>	<b><u>60</u></b>	<b><u>60</u></b>	<b><u>80</u></b>
13, Flatwood Road (Indicator)	990544	06/03/99	<58.5	<39.2	<40.3
13, Flatwood Road (Indicator)	990665	07/07/99	<59.7	<39.4	<54.5
13, Flatwood Road (Indicator)	990783	08/06/99	<48.8	<42.8	<63.3
45, Intake Canal (Indicator) *	990545	06/03/99	<51.0	<54.7	<42.6
45, Intake Canal (Indicator) *	990666	07/07/99	<58.6	<45.5	<39.0
45, Intake Canal (Indicator) *	990784	08/06/99	<57.1	<59.5	<54.5

\* Sample station deleted.

Table 9.1  
 Sample Type: Food Products  
 Collection: At Time of Harvest  
 Analysis: Iodine-131 and Gamma  
 Units: pCi/kg

Location	Lab Number	Sample Type	Collection Date	I-131	Cs-134	Cs-137
			<b>Required LLD →</b>	<b>60</b>	<b>60</b>	<b>80</b>
48, Cochran Residence (Indicator)	990593	Tubular	06/16/99	<21.6	<18.7	<26.0
48, Cochran Residence (Indicator)	990592	Flowering	06/16/99	<11.5	<13.9	<15.5
48, Cochran Residence (Indicator)	990651	Fruit	06/29/99	<21.9	<22.7	<15.6
48, Cochran Residence (Indicator)	990586	Broadleaf	06/16/99	<38.0	<16.5	<34.1
	*	*	*	*	*	*
51, Rye Residence (Indicator)	990585	Tubular	06/16/99	<14.3	<18.8	<22.1
51, Rye Residence (Indicator)	990584	Flowering	06/16/99	<14.1	<17.1	<14.2
51, Rye Residence (Indicator)	990652	Fruit	06/29/99	<22.3	<17.7	<13.5
	*	*	*	*	*	*
108, Shivers Residence (Indicator)	990712	Tubular	06/22/99	<43.2	<4.63	<4.85
108, Shivers Residence (Indicator)	990713	Flowering	06/22/99	<59.6	<7.50	<7.33
108, Shivers Residence (Indicator)	990653	Fruit	06/29/99	<26.4	<18.0	<15.5
	*	*	*	*	*	*

\* Sample station deleted.

Table 10.1

Sample Type: Thermoluminescent Dosimeters

Collection: Quarterly

Analysis: Direct Dose

Units: mrem/Qtr

Location: 0 - 2 MILE TLDs (Indicators)

Station	1st Qtr '99 (mrem)	2nd Qtr '99 (mrem)	3rd Qtr '99 (mrem)	4th Qtr '99 (mrem)	Annual Mean '99 (mrem)
1	7.0	9.0	9.0	8.0	8.0
2 *	8.0	10.0	9.0	7.0	9.0
3	6.0	8.0	7.0	7.0	7.0
4	6.0	7.0	8.0	7.0	7.0
108	7.0	9.0	9.0	7.0	8.0
109 *	7.0	10.0	10.0	7.0	9.0
110	7.0	9.0	9.0	7.0	8.0
113	6.0	8.0	7.0	6.0	7.0
114	6.0	9.0	9.0	7.0	8.0
115	7.0	10.0	9.0	7.0	8.0
116	7.0	9.0	9.0	7.0	8.0
MEAN	7.0	9.0	9.0	7.0	

\* Location with annual highest annual mean.

Table 10.2

Sample Type: Thermoluminescent Dosimeters

Collection: Quarterly

Analysis: Direct Dose

Units: mrem/Qtr

Location: 2 - 5 MILE TLDs (Indicators)

Station	1st Qtr '99 (mrem)	2nd Qtr '99 (mrem)	3rd Qtr '99 (mrem)	4th Qtr '99 (mrem)	Annual Mean '99 (mrem)
111	5.0	7.0	7.0	5.0	6.0
112	7.0	9.0	9.0	7.0	8.0
119	5.0	8.0	8.0	7.0	7.0
120	5.0	7.0	6.0	5.0	6.0
121	6.0	8.0	8.0	6.0	7.0
122	5.0	7.0	6.0	5.0	6.0
123	4.0	7.0	7.0	6.0	6.0
124 *	8.0	10.0	9.0	7.0	9.0
130	5.0	6.0	Lost	5.0	5.0
131	4.0	Lost	6.0	5.0	5.0
133	Lost	4.0	4.0	4.0	4.0
134	6.0	7.0	7.0	6.0	7.0
135	Lost	7.0	7.0	6.0	7.0
136	7.0	8.0	8.0	7.0	8.0
141	4.0	6.0	5.0	5.0	5.0
MEAN	5.0	7.0	7.0	6.0	

\* Location with annual highest annual mean. As a note, this station was eliminated from the ANO REMP at the end of 1999. Therefore, it is not identified on AREOR Table 1.1 and Figure 1.3.

Table 10.3

Sample Type: Thermoluminescent Dosimeters

Collection: Quarterly

Analysis: Direct Dose

Units: mrem/Qtr

Location: >5 MILE TLDs (Controls)

Station	1st Qtr '99 (mrem)	2nd Qtr '99 (mrem)	3rd Qtr '99 (mrem)	4th Qtr '99 (mrem)
5	6.0	9.0	8.0	7.0
6	6.0	8.0	7.0	6.0
7	5.0	7.0	7.0	6.0
117	4.0	6.0	5.0	5.0
118	3.0	8.0	7.0	6.0
125	4.0	6.0	6.0	4.0
126	6.0	<b>Lost</b>	7.0	6.0
127	6.0	9.0	8.0	7.0
128	7.0	9.0	8.0	7.0
129	6.0	9.0	9.0	7.0
132	6.0	8.0	7.0	7.0
137	8.0	9.0	10.0	8.7
138	5.0	6.0	5.0	4.7
139	6.0	8.0	8.0	6.0
140	8.0	9.0	8.0	7.0
142	6.0	9.0	7.0	6.0
143	7.0	9.0	8.0	6.0
144	7.0	9.0	7.0	7.0
<b>MEAN</b>	<b>6.0</b>	<b>8.0</b>	<b>7.0</b>	<b>6.0</b>

Table 11.1  
 Sample Type: Interlaboratory Comparison  
 Frequency: Varies  
 Analysis: Varies

Sample Type (units)	Study	Date	Analysis	Known Value <sup>a</sup>	RBS Value	RBS N-Dev <sup>b</sup>	RBS N-Range <sup>c</sup>			
Air Filter (pCi/filter)	E1885-125	09/23/99	Beta	49.0 ± 8.66	48.7	-0.09	0.071			
Charcoal Cartridge (pCi/cartridge)	E1759-125	06/24/99	I-131	76 ± 13.2	76.8	0.17	0.155			
	E2001-125	12/09/99	I-131	86.0 ± 14.9	87.9	0.38	0.192			
Water (pCi/liter)	E1662-125	03/18/99	Beta	201 ± 52.2	179	-1.24	0.059			
			CR-51	398 ± 34.5	381	-1.48	1.929			
				MN-54	152 ± 13.2	162	2.35	0.233		
				FE-59	79 ± 8.66	87.8	3.06 <sup>d</sup>	0.307		
				CO-60	181 ± 15.7	182	0.19	0.653		
				ZN-65	195 ± 33.8	196	0.06	0.424		
				I-131	91 ± 15.8	84.3	-1.28	0.591		
				CS-134	114 ± 9.87	107	-2.13	0.725		
				CS-137	240 ± 20.8	240	0.00	0.345		
				CE-141	177 ± 15.3	186	1.83	0.734		
		E1661-125 (Duplicate)	03/18/99	CR-51	398 ± 34.5	377	-1.86	0.416		
						MN-54	152 ± 13.2	165	3.04 <sup>d</sup>	0.311
						FE-59	79 ± 8.66	93.9	5.15 <sup>d</sup>	1.890
						CO-60	181 ± 15.7	184	0.64	0.457
						ZN-65	195 ± 33.8	212	1.54	0.091
						I-131	91 ± 15.8	86.0	-0.95	0.149
						CS-134	114 ± 9.87	106	-2.43	0.207
						CS-137	240 ± 20.8	242	0.24	0.098
				CE-141	177 ± 15.3	187	1.96	0.601		

Table 11.1  
 Sample Type: Interlaboratory Comparison  
 Frequency: Varies  
 Analysis: Varies

Sample Type (units)	Study	Date	Analysis	Known Value <sup>a</sup>	RBS Value	RBS N-Dev <sup>b</sup>	RBS N-Range <sup>c</sup>
Water (pCi/liter)	E1760-125	06/24/99	H-3	9349 ± 1619	9427	0.15	0.028
	E1883-125	09/23/99	CR-51	184 ± 15.9	200	3.07 <sup>d</sup>	2.311
			MN-54	210 ± 18.2	224	2.31	0.113
			FE-59	94.0 ± 8.66	106	4.16 <sup>d</sup>	0.591
			CO-60	159 ± 13.8	166	1.60	0.371
			ZN-65	202 ± 35	205	0.26	0.439
			I-131	77.0 ± 13.3	79.3	0.52	0.061
			CS-134	119 ± 10.3	116	-0.78	0.397
			CS-137	268 ± 23.2	281	1.68	0.309
			CE-141	244 ± 21.1	248	0.52	0.290
	E1884-125 (Duplicate)	09/23/99	CR-51	184 ± 15.9	204	3.77 <sup>d</sup>	0.642
			MN-54	210 ± 18.2	223	2.20	0.169
			FE-59	94.0 ± 8.66	107	4.62 <sup>d</sup>	0.709
			CO-60	159 ± 13.8	163	0.94	0.669
			ZN-65	202 ± 35	199	-0.23	0.175
			I-131	77.0 ± 13.3	76.7	-0.07	0.453
			CS-134	119 ± 10.3	117	-0.49	0.397
			CS-137	268 ± 23.2	280	1.59	0.485
	CE-141	244 ± 21.1	249	0.71	0.726		

Table 11.1  
 Sample Type: Interlaboratory Comparison  
 Frequency: Varies  
 Analysis: Varies

Sample Type (units)	Study	Date	Analysis	Known Value <sup>a</sup>	RBS Value	RBS N-Dev <sup>b</sup>	RBS N-Range <sup>c</sup>
Sediment (pCi/gram)	E2002-125	12/09/99	CR-51	0.845± 0.027	0.864	0.79	1.097
			MN-54	0.292± 0.025	0.314	2.61	0.129
			Co-58	0.319± 0.028	0.313	-0.63	0.448
			FE-59	0.274± 0.024	0.300	3.24 <sup>d</sup>	0.172
			CO-60	0.383± 0.033	0.410	2.46	0.154
			ZN-65	0.541± 0.094	0.558	0.55	0.158
			CS-134	0.363± 0.031	0.345	-1.69	0.260
			CS-137	0.407± 0.035	0.391	-1.34	0.360
			CE-141	0.306± 0.027	0.322	1.77	0.954

**NOTES:**

- (a) The "known" values are listed with a range reflecting control (3 sigma) limits.
- (b) The normalized deviation from the "known" value is computed from the deviation and the standard error of the mean; ±2.000 is the warning limit and ±3.000 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) The results reported were out of the control limits.

### **Environmental (CROSS-CHECK) Program Exceptions**

There were eight results out of control limits (3 sigma) for accuracy in the 1999 cross check program. Of these eight results, all were analyzed by gamma spectroscopy (8 nuclides in two matrices). Seven of the results in question were in liquid cross check samples; one in a sediment sample. All eight results in question were bias high.

There was one nuclide, Fe-59, slightly bias high (+3.24) in sediment. It had a low bias with a slight upward trend indicated by previous results of sediment analysis. Prior to 1999, all Fe-59 results in sediments have been within warning limits. Fe-59 was also bias high (+3.06, +5.15, +4.16, +4.62) in four water analyses. Trending of past Fe-59 cross check results in waters indicates a high bias, upward trend. Cr-51 was bias high (+3.07 & +3.77) in the last two water analyses this year; in spite of the fact, that trending of past Cr-51 results in water indicates a low bias with a slight downward trend. Mn-54 was bias high (+3.04) in one water sample. Past results for Mn-54 indicate bias high with a slight upward trend.

The third quarter water samples (sample and duplicate) were analyzed three times each, per detector, to note any statistical variation between detectors. This resulted in twelve analyses each for the sample and duplicate. No obvious variations were noted in the average nuclide results between detectors.

Investigation of high bias results in the past indicated it was due to coincidence summing effects of Y-88 and Co-60 on the efficiency curve in the effected regions. To minimize the coincidence summing effects on the efficiency curve, RBS committed to adding two additional nuclide lines (Mn-54 and Zn-65) to the calibration source mix for waters. This was only a step to the fix of the summing effects. A multiplicative correction factor to convert a measured gamma-ray efficiency with summing effects to an efficiency with no summing effects had to be established. This correction factor is the ratio of the calculated non-summing efficiency of the 1173 keV (Co-60) gamma ray to the measured efficiency of the 1173 keV gamma ray. An efficiency curve (equation) is generated with no summing effects by deleting the Y-88 and Co-60 peaks and using only the gamma ray efficiencies with no summing effects, including Mn-54 and Zn-65, in the calibration. This approach for correcting the measured efficiencies of gamma rays from Y-88 and Co-60 for cascade summing effects is now in progress.

There is no impact assessed on past data indicated by these cross check program results; considered to be conservative. Environmental samples are analyzed and reported with a ninety-five percent confidence level that the analytical result with its associated error encompasses the "true" value. Ninety-two percent of RBS environmental cross check results were within control limits for accuracy and precision during 1999.

**ATTACHMENT 2**

**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:

$$R = (40) \times (C) \times (U) \times (D) \times (W)$$

**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/m<sup>2</sup>;

**C** = 1999 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/m<sup>2</sup>, and

**W** = Shore-width factor (0.1) given in Table A-2 of Regulatory Guide 1.109.

**(Dose from Sediment in Millirem/Year)**

Radionuclide	1999 Maximum Concentration	Conversion Factor For Skin	Total Skin Dose	Conversion Factor For Total Body	Total Body Dose
Co-60	145.0	2.00 E-08	7.77 E-04	1.70 E-08	6.61 E-04
Cs-137	763.0	4.90 E-09	1.00 E-03	4.20 E-09	8.59 E-04
<b>TOTAL</b>			<b>1.78 E-03</b>		<b>1.52 E-03</b>