Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-4704

Stephenie L. Pyle
Manager, Regulatory Assurance
Arkansas Nuclear One

0CAN041702

April 28, 2017

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

SUBJECT: Annual Radioactive Effluent Release Report for 2016
Arkansas Nuclear One, Units 1 and 2
Docket No. 50-313 and 50-368
License No. DPR-51 and NPF-6

Dear Sir or Madam:

Arkansas Nuclear One, Units 1 and 2 (ANO-1 and ANO-2) Technical Specifications (TSs) 5.6.3 and 6.6.3, respectively, require the submittal of an Annual Radioactive Effluent Release Report. The information which fulfills this reporting requirement for ANO-1 and ANO-2 for the 2016 calendar year is enclosed.

ANO-1 TS 5.6.3 and ANO-2 TS 6.6.3 require this report to be submitted prior to May 1 of each year in accordance with 10 CFR 50.36a. 10 CFR 50.36a(a)(2) states that the interval between submittals for this report must not exceed 12 months.

Liquid and gaseous release data show that the dose from both ANO-1 and ANO-2 was considerably below the Offsite Dose Calculation Manual limits. The data reveals that radioactive effluents had an overall minimal dose contribution to the surrounding environment.

No new commitments have been identified in this letter.

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

Sincerely,

ORIGINAL SIGNED BY STEPHENIE L. PYLE

SLP/rwc

Enclosure: Annual Radioactive Effluent Release Report for 2016

cc: Mr. Kriss Kennedy
Regional Administrator
U. S. Nuclear Regulatory Commission, Region IV
1600 East Lamar Boulevard
Arlington, TX 76011-4511

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

U. S. Nuclear Regulatory Commission
Attn: Mr. Thomas Wengert
MS O-08B1A
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

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

ENCLOSURE TO

0CAN041702

ARKANSAS NUCLER ONE

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT FOR 2016

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This report is published to provide information regarding radioactive effluent monitoring at Arkansas Nuclear One (ANO) nuclear power plant. The 2016 Annual Radioactive Effluent Release Report (ARERR) covers the period from January 1, 2016, through December 31, 2016.

The ARERR is produced annually, to document plant releases and offsite dose resulting from these releases. The data presented indicate that the operation of ANO-1 and ANO-2 results in offsite radiation exposures that are well below the applicable allowable levels set by the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA).

Data on releases of radioactive isotopes in liquid and gaseous effluents, as well as regulatory limits and sampling methods for these releases, are contained in the body of the report and in Appendix A.

Regulatory limits for radioactive effluents pertain to allowable offsite doses rather than to quantities of radioactivity released. The highest potential single organ dose to a person living offsite due to iodines, particulates, tritium, and carbon-14 released from the plant was calculated to be 0.51 mrem, which is 2.1% of the applicable limit found in 10 CFR Part 50, Appendix I.

During 2016, no direct radiation dose to members of the public beyond the site boundary was attributed to the operation of ANO-1&2, based on analysis of readings of thermoluminescent dosimeters (TLD) placed at various locations near the ANO site. The offsite dose due to effluents is a small fraction of the 40 CFR 190 limits. Therefore, the combined direct radiation and effluent dose due to ANO-1&2 was in compliance with 40 CFR 190 in 2016.

Data on radioactivity contained in radioactive waste shipments from ANO-1&2 to offsite locations are contained in the body of the report and in Appendix A. Appendix B of this report describes the ANO Ground Water Protection Program. This program was established as part of the site's commitment to conformance with an industry-wide ground water protection initiative. This appendix also contains the results of 2016 quarterly/semi-annual ground water sampling, from approximately 20 monitor wells around ANO. One well of these monitor wells, MW-17; has yielded sporadic trace quantities of tritium that have been attributed to the recapture of tritium in precipitation from the plant's monitored gaseous effluent. Appendix C of this report contains the meteorological joint frequency distribution tables for 2016. The Offsite Dose Calculation Manual (ODCM) was revised in 2016, and the revised ODCM is shown as Appendix D. Additional sections of the report address ODCM required monitors which were out of service for more than 30 days in 2016, major changes in radioactive waste processing, and the contents of outside temporary tanks, abnormal releases, and errata to previous years' reports.

2. INTRODUCTION

ANO is a two unit site consisting of a Babcock & Wilcox (Unit 1) and a Combustion Engineering (Unit 2) nuclear steam supply system. Both liquid and gaseous effluents are released in accordance with the ODCM. This report is a summary of the effluent data in accordance with ANO-1 Technical Specification (TS) 5.6.3 and Unit 2 TS 6.6.3.

Noble Gases:

Some of the fission products released in airborne effluents are radioactive isotopes of noble gases, such as xenon and krypton. These noble gases are released continuously at low levels while the reactor is operating. Noble gas releases to the environment are reduced by plant systems which delay release of these gases from the plant, which allows a portion of the noble gas activity to decay within plant systems prior to release. Noble gases are biologically and chemically nonreactive and are readily dispersed in the atmosphere. They do not concentrate in humans or other organisms; however, they contribute to human radiation dose by being an external source of radiation exposure to the body.

Iodines and Particulates:

ANO-1&2 is required to calculate offsite dose due to releases of iodine-131 and iodine-133, which are radioisotopes of iodine with half-lives of 8 days and 1 day, respectively, and particulates with half-lives greater than 8 days in gaseous and liquid effluents, and tritium. The principal radioactive particulates released are fission products (e.g., yttrium-91m and barium-139) and activation products (e.g., cobalt-58 and cobalt-60). Annual releases of these radionuclides are well within industry norms. Factors such as their high chemical reactivity and solubility in water, combined with the high efficiency of gaseous and liquid processing and radioactive waste systems, minimize their discharge. The main contribution of radioactive iodine to human radiation dose is to the thyroid gland, where the body concentrates iodine. This exposure results from inhalation or ingestion of these iodines. Radioactive cesiums and cobalts, when ingested or inhaled, contribute to radiation exposure of tissues such as the muscle, liver, and intestines. These iodines and particulates are also a source of external radiation exposure if deposited on the ground.

Tritium:

Tritium, a radioactive isotope of hydrogen, is the predominant radionuclide in radioactive liquid and gaseous effluents.

Carbon-14:

U.S. nuclear power plants are expected to report releases of carbon-14 (C-14). The releases reported are based on calculations involving the thermal power rating of the unit and 2016 Year-To-Date (YTD) capacity factors. The calculation performed for this report estimated a total 2016 C-14 releases of 6.62 curies for ANO-1 and 10.36 curies for ANO-2.

Plant Effluent Monitoring:

Effluents are strictly monitored to ensure that radioactivity released to the environment is as low as reasonably achievable and does not exceed regulatory limits. Effluent control includes the operation of monitoring systems, in-plant and environmental sampling and analyses programs, quality assurance programs for effluent and environmental programs, and procedures covering all aspects of effluent and environmental monitoring. The radioactive waste treatment systems at ANO-1&2 are designed to collect, process, and/or delay the release of liquid and gaseous wastes that contain radioactivity

The waste gas decay system provides additional delay for such gases. Radioactivity monitoring systems are used to verify that all releases are below regulatory limits. These instruments provide a continuous indication of radioactivity present at the release points. Each instrument is equipped with alarms and indicators in the control room. The alarm setpoints are low enough to ensure that applicable limits will not be exceeded. In some cases, these alarms restrict the release.

All liquid and gaseous radioactive effluents are evaluated to identify the specific concentrations of radionuclides being released. Sampling and analysis provide a more sensitive and precise method of determining effluent composition than monitoring instruments.

A meteorological tower is located on the ANO site. It is linked to computers that record the meteorological data. This data is used in calculating dispersion and deposition factors, which are essentially dilution factors between plant release points and locations offsite. Coupled with the effluent release data, these factors are used to calculate dose to the public. Beyond the plant, devices maintained in conjunction with the Radiological Environmental Monitoring Program constantly sample the air in the surrounding environment. Also, frequent samples of other environmental media, such as water and vegetation, are collected to verify that the station radiological effluent program is being appropriately implemented without adverse impact to the surrounding environment.

Exposure Pathways to People

Radiological exposure pathways define the methods by which people may become exposed to radioactive material. The major pathways of concern are those that could cause the highest calculated radiation dose. These projected pathways are determined from the type and amount of radioactive material released the environmental transport mechanism, and the use of the environment. The environmental transport mechanism includes consideration of physical factors, such as the hydrological and meteorological characteristics of the area. An important factor in evaluating the exposure pathways is the use of the environment. This is evaluated in the Biennial Land Use Census. Many factors are considered, such as the locations of homes, gardens, and milk or meat animals in the area. The release of radioactive gaseous effluents involves pathways such as external whole body exposure, deposition of radioactive material on plants, deposition on soil, inhalation and ingestion by animals raised for human consumption, and inhalation by humans. The release of radioactive material in liquid effluents involves pathways such as drinking water and fish consumption. Although radionuclides can reach humans by many different pathways, some result in greater dose than others. The most significant pathway is the exposure pathway that will provide the greatest dose to a population, or to a specific individual. Identification of the most significant pathway depends on the radionuclides involved, the age and diet of the individual, and the location of the individual's residence. Doses delivered to the total body and to specific organs are calculated. The organ receiving the greatest dose is important in determining compliance with dose limits. The standard assumptions used in dose calculation result in conservative dose estimates.

Dose Assessment

Dose is energy deposited by radiation in an exposed individual. Whole body exposure to radiation involves the exposure of all organs. Most exposures due to external sources of radiation are of this type. Both non-radioactive and radioactive elements can enter the body through inhalation or ingestion. When they do, they are usually not distributed evenly. For example, iodine concentrates in the thyroid gland, cesium collects in muscle and liver tissue, and strontium collects in bone tissue. The total dose to organs from a given radionuclide depends on the amount of radioactive material present in the organ and the amount of time that the radionuclide remains in the organ. Some radionuclides remain for very short times due to their rapid radioactive decay and/or elimination rate from the body, while other radionuclides may remain in the body for longer periods of time. The form of the radionuclide (soluble vs. insoluble) and the method of uptake also influence residence times in the body.

The maximum dose to the general public in the area surrounding ANO-1&2 is calculated for periods of gaseous release and for each liquid release. The dose due to radioactive material released in gaseous effluents is calculated using factors such as the amount of radioactive material released, the concentration beyond the site boundary, the locations of exposure pathways (for example cow milk, goat milk, vegetable gardens and residences), and usage factors (inhalation and food consumption). The dose due to radioactive material released in liquid effluents is calculated using factors such as radionuclide concentrations, the total volume of liquid released, the total volume of dilution water, near field dilution, and usage factors (water and fish consumption). These calculations produce a conservative estimation of the dose.

3. RADIOACTIVE EFFLUENT MONITORING RESULTS

This section summarizes the results of effluent monitoring and offsite dose calculation for the year 2016. Calculated offsite doses are compared with Nuclear Regulatory Commission limits, and these limits are summarized in Appendix A. Appendix A also contains a detailed discussion of the methods used to determine quantities of radioactivity released in effluents, the types of solid radioactive waste shipped offsite, as well as tables of individual radionuclides released in effluents and shipped as solid radioactive waste.

Data in the following liquid effluent tables represent continuous and batch releases for ANO-1&2.

Table 1 – Fission and Activation Products Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	5.07E-02	1.38E-02	4.13E-02	4.53E-02
Avg. Concentration (uCi/ml)	1.54E-10	3.75E-11	1.09E-10	2.70E-10
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	2.17E-03	4.26E-03	3.74E-03	8.16E-03
Avg. Concentration (uCi/ml)	6.60E-12	1.16E-11	9.86E-12	4.86E-11

Table 2 –Tritium Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	1.52E+02	1.57E+02	2.07E+02	3.87E+01
Avg. Concentration (uCi/ml)	4.62E-07	4.25E-07	5.46E-07	2.30E-07
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	6.76E+01	1.07E+02	6.72E+01	2.87E+02
Avg. Concentration (uCi/ml)	2.06E-07	2.91E-07	1.77E-07	1.71E-06

Table 3 – Dissolved and Entrained Gases Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	1.35E-02	1.75E-02	1.00E-01	1.05E-02
Avg. Concentration (uCi/ml)	4.13E-11	4.73E-11	2.64E-10	6.26E-11
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	7.43E-04	1.24E-04	6.75E-04	2.08E-03
Avg. Concentration (uCi/ml)	2.26E-12	3.36E-13	1.78E-12	1.24E-11

Table 4 – Liquid Effluents Dose Receptor with Highest Single Organ Dose

ANO-1	Dose to Organ (mrem)
Bone	3.57E-02
Liver	6.80E-02
Thyroid	1.43E-03
Kidney	2.29E-02
Lung	8.26E-03
GI-Li	4.11E-03
Total Body	5.19E-02
ANO-2	**Dose to Organ (mrem)**
Bone	7.76E-03
Liver	1.26E-02
Thyroid	1.60E-03
Kidney	5.29E-03
Lung	2.85E-03
GI-Li	1.87E-03
Total Body	8.90E-03

The highest single organ dose is 6.80E-02 mrem to the liver on ANO-1. This is 0.68% of the federal limit of 10 mrem specified in 10 CFR 50, Appendix I.

The highest total body dose for any given unit was 5.19E-02 mrem on ANO-1. This is 1.73% of the federal limit of 3 mrem specified in 10 CFR 50, Appendix I. Dose estimates are conservative in nature and are well below the federal limits for organ and total body dose.

Data in the following gaseous effluent tables represent continuous and batch releases for ANO 1&2.

Table 5 – Fission and Activation Gases Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	0.00E+00	1.71E-01	1.25E+01	2.49E+00
Average Release Rate for Period (uCi/sec)	0.00E+00	2.17E-02	1.57E+00	3.13E-01
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	1.07E+00	1.21E-05	1.08E-01	1.20E+01
Average Release Rate for Period (uCi/sec)	1.36E-01	1.54E-06	1.36E-02	1.50E+00

Table 6 – Radioiodines and Halogens Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	0.00E+00	0.00E+00	1.25E-05	1.87E-04
Average Release Rate for Period (uCi/sec)	0.00E+00	0.00E+00	1.58EE-06	2.35E-05
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	0.00E+00	0.00E+00	8.71E-06	1.99E-06
Average Release Rate for Period (uCi/sec)	0.00E+00	0.00E+00	1.10E-06	2.50E-07

Table 7 – Particulates Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	0.00E+00	0.00E+00	0.00E+00	2.30E-04
Average Release Rate for Period (uCi/sec)	0.00E+00	0.00E+00	0.00E+00	2.89E-05
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Average Release Rate for Period (uCi/sec)	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 8 - Tritium Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	2.77E+00	2.60E+00	4.63E+00	4.99E+00
Average Release Rate for Period (uCi/sec)	3.53E-01	3.31E-01	5.83E-01	6.28E-01
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	3.85E+00	5.68E+00	5.06E+00	2.71E+00
Average Release Rate for Period (uCi/sec)	4.90E-01	7.23E-01	6.37E-01	3.41E-01

Table 9 - Carbon-14 Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Release (Curies)	2.11E+00	2.13E+00	1.99E+00	3.99E-01
Average Release Rate for Period (uCi/sec)	2.68E-01	2.71E-01	2.50E-01	5.02E-02
ANO-2	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**
Release (Curies)	2.54E+00	2.88E+00	2.85E+00	2.09E+00
Average Release Rate for Period (uCi/sec)	3.23E-01	3.66E-01	3.59E-01	2.63E-01

Table 10 – Gaseous Effluents Dose Receptor with Highest Single Organ Dose

ANO-1	Dose to Organ (mrem)
Bone	1.83E-01
Liver	1.03E-01
Thyroid	1.81E-01
Kidney	1.03E-01
Lung	1.03E-01
GI-Li	1.03E-01
Skin	2.57E-05
Total Body	1.03E-01
ANO-2	**Dose to Organ (mrem)**
Bone	2.86E-01
Liver	1.33E-01
Thyroid	1.36E-01
Kidney	1.33E-01
Lung	1.33E-01
GI-Li	1.33E-01
Skin	1.60E-07
Total Body	1.33E-01

The highest single organ dose is 2.86E-01 mrem to the bone between ANO-1&2. This is 1.91% of the federal limit of 15 mrem specified in 10 CFR 50, Appendix I. (The ANO 1&2 ODCM requires maximum receptor dose calculation for releases of I-131, I-133, H-3, and particulates with half-lives greater than 8 days; for these isotopes, the thyroid is the highest dose organ. When C-14 is added, bone becomes the highest dose organ.)

In addition, gamma and beta air dose at the site boundary due to noble gases was calculated. In 2016, the highest gamma air dose was 7.73E-02 mrad, 0.77% of the 10 mrad annual limit; highest beta air dose in 2016 was 2.73E-02 mrad, 0.14% of the 20 mrad annual limit.

Summary Discussion:

The highest single organ dose is 2.86E-01 mrem to the bone. This is 1.91% of the federal limit of 15 mrem specified in 10 CFR 50, Appendix I. (The ANO-1&2 ODCM requires maximum receptor dose calculation for releases of I-131, I-133, H-3, and particulates with half-lives greater than 8 days; for these isotopes, the thyroid is the highest dose organ. When C-14 is added, bone becomes the highest dose organ. In 2016, the highest gamma air dose was 7.73E-02 mrad, 0.77% of the 10 mrad annual limit; highest beta air dose in 2016 was 2.73E-02 mrad, 0.14% of the 20 mrad annual limit.

Title 40, Part 190 of the Code of Federal Regulations (CFR) requires that dose to an individual in the unrestricted area from the uranium fuel cycle, including direct radiation dose, be limited to 25 mrem/year to the total body/other organs and 75 mrem/year to the thyroid. During 2016, there was no direct radiation dose attributed to the operation of ANO 1&2 beyond the site boundary, based on analysis of offsite TLD readings. Based on Dose Summary Table (Page 42) located in Appendix A, the offsite dose due to effluents for ANO-1&2 is 1.14% and 0.43% of 40 CFR 190 limits for the total body and thyroid, respectively. Therefore, ANO-1&2 was in compliance with 40 CFR 190 in 2016. Potential dose to visitors at ANO-1&2 due to all radioactive effluents, including noble gases, was also calculated. The ODCM considers persons visiting the ANO-1&2 Training Center (8 hours a day for 52 weeks). Using ODCM assumptions about these categories of visitors, the maximum potential dose to a visitor to ANO-1&2 in 2016 was 7.68E-02 mrem to the maximally exposed organ (thyroid) and 6.72E-02 mrem to the total body. These doses are below the annual maximum offsite doses due to gaseous effluents shown in Dose Summary Table (Page 42), and are very small fractions of the 100 mrem/year limit for individual members of the public due to licensed operation of the plant provided in 10 CFR 20.1301.

4. SUMMARY OF RADIOACTIVE WASTE SHIPMENTS:

The radioactivity and volume of ANO solid waste shipped offsite is summarized in the following table:

Table 10 – ANO-1 Waste Shipped Offsite

Type of Waste	Units	12 Month Period	Est. activity error, %
Resins, Filters, and Evaporator Bottoms	Cubic meters	4.67E+01	± 25
	Curies	8.28E+01	
Dry compressible waste, contaminated equipment	Cubic meters	4.42E+02	± 25
	Curies	1.65E+00	
Irradiated components	Cubic meters	0.00E+00	± 25
	Curies	0.00E+00	
Other	Cubic meters	0.00E+00	± 25
	Curies	0.00E+00	

Table 11 – ANO-2 Waste Shipped Offsite

Type of Waste	Units	12 Month Period	Est. activity error, %
Resins, Filters, and Evaporator Bottoms	Cubic meters Curies	4.78E+01 2.30E+01	± 25
Dry compressible waste, contaminated equipment	Cubic meters Curies	0.00E+00 0.00E+00	± 25
Irradiated components	Cubic meters Curies	0.00E+00 0.00E+00	± 25
Other	Cubic meters Curies	0.00E+00 0.00E+00	± 25

Table 12 – ANO-Common Waste Shipped Offsite

Type of Waste	Units	12 Month Period	Est. activity error, %
Resins, Filters, and Evaporator Bottoms	Cubic meters Curies	2.55E+00 2.19E-03	± 25
Dry compressible waste, contaminated equipment	Cubic meters Curies	4.94E+02 1.34E+00	± 25
Irradiated components	Cubic meters Curies	0.00E+00 0.00E+00	± 25
Other	Cubic meters Curies	1.43E+01 2.30E-01	± 25

Table 13 - ANO 1 Total Waste Shipped

Number of Shipments	Mode of Transportation	Destination
11	Hittman Transport	Bear Creek Operations
5 (2 shared with ANO-2)	Hittman Transport	Gallaher Road Operations
1	Hittman Transport	Erwin Resin Solutions
1	Landstar Ranger	Bear Creek Operations

Total ANO-1 Shipments	**18**

Table 14 - ANO 2 Total Waste Shipped

Number of Shipments	Mode of Transportation	Destination
3 (2 shared with ANO-1)	Hittman Transport	Gallaher Road Operations

Total ANO-2 Shipments	**3**

Table 15 - ANO 1 & 2 (Common) Total Waste Shipped

Number of Shipments	Mode of Transportation	Destination
19	Hittman Transport	Bear Creek Operations
1	CAST	Bear Creek Operations
1	Landstar Ranger	Bear Creek Operations

Total ANO-Common Shipments	**21**

Total Offsite Shipments	**40**

5. ADDITIONAL REQUIRED INFORMATION

APPENDICES

Appendix A, Effluent and Radioactive Waste Data, provides more detailed data on radiological effluents and radioactive waste shipments. Appendix B contains a description of the ANO-1&2 Integrated Groundwater Protection Program, 2016 sampling data for this program, and a discussion of sampling results. Appendix C contains meteorological joint frequency distributions of wind speed and wind direction by atmospheric stability class, for all of 2016. Appendix D contains the revised ODCM.

ODCM REVISION

In accordance with ANO-1&2 TSs, changes to the ODCM shall be included in the ARERR for the period in which the change(s) was made effective.

The ODCM was revised two times during 2016 to include the following:

Rev 026 (June 27, 2016)

Changed location of control broadleaf vegetation sample site from current location at intersection of AR Highways 27 and 154 to within the Ozark National Forest at the intersection of Forest Service Roads 36 and 1618A. The change was performed due to forest and broadleaf eradication of previous control location.

Rev 027 (November 29, 2016)

Basis (B) 2.5.1, Radiological Environmental Monitoring, background data is updated to include explanation for sample location choice associated with air station #2. Revised explanation for air station samples in highest D/Q and also in the vicinity of a community. Defined community as it relates to this location.

PROCESS CONTROL PROGRAM REVISIONS

As required by ODCM Section 5.0, a description of changes made to the Entergy fleet Process Control Program (EN-RW-105) shall be included in the ARERR for the period in which the change was made effective.

There were no changes to EN-RW-105, Process Control Program, for the year 2016.

ODCM MONITORS OUT OF SERVICE

There was one radiation monitor (radmonitor) out-of-service for greater than 30 days which requires reporting with the ARERR. See below for details.

On December 26, 2015, SPING-4 (ANO-1 Emergency Piping Penetration Room Ventilation Radmonitor) noble gas channels (Channels 5, 7, and 9) were declared out-of-service due to spurious alarms (reference CR-ANO-C-05096). Parts for repair of SPING-4 are obsolete and require refurbishment to repair Channel 5. In this instance, the SPING was thoroughly checked and returned to Chemistry to place back in-service. SPING-4 is considered an applicable radiation monitor due to the auto-start function of the ventilation fans in the event pressure within the room gets too high. SPING-4 was returned to service on February 2, 2016. During the out-of-service time from December 26, 2015, to February 2, 2016, the SPING-4 ventilation fan ran for ~5.50 hours for maintenance run of the fan. This time period is the only time gaseous effluents were being released via this pathway. Alternate sampling apparatus was installed during release via this pathway to ensure effluents being released were within federal limits. There were no samples during this period that indicated release of any radioactive effluents. Currently, ANO is upgrading the ventilation stack monitors, which is scheduled to be completed by the end of 2018 to reduce out-of-service time for all stack monitors. (reference CR-ANO-1-2016-00363, for monitors out-of-service > 30 days.)

OUTSIDE TEMPORARY TANKS

There were no temporary tanks utilized in 2016 for the purpose of storing liquid radwaste.

MAJOR CHANGES TO RADIOACIVE WASTE SYSTEMS

There were no major changes to radioactive waste systems in 2016.

ABNORMAL RADIOLOGICAL RELEASES

There were no abnormal (e.g. unplanned) releases for ANO-1 or ANO-2 in 2016.

ERRATA/CORRECTIONS TO PREVIOUS ARERRs

No prior corrections are required.

LLD LEVELS

In accordance with ODCM, Appendix 1, lower limits of detection (LLDs) higher than required shall be documented in the ARERR:

During 2016, there were no LLDs higher than required by the ODCM.

Appendix A

Effluent and Radioactive Waste Data

REGULATORY LIMITS FOR RADIOACTIVE EFFLUENTS

The ODCM contains the limits to which ANO must adhere. Because of the "as low as reasonably achievable" (ALARA) philosophy at ANO, actions are taken to reduce the amount of radiation released to the environment. Liquid and gaseous release data show that the dose from both ANO-1&2 is considerably below the ODCM limits. This data reveals that the radioactive effluents have an overall minimal dose contribution to the surrounding environment. The following are the limits required by the ODCM:

A. Gaseous Effluents

1. Dose rate due to radioactive materials released in gaseous effluent to unrestricted areas shall be limited to the following:

   a. Noble gases

      - Less than or equal to 500 mrem/year to the total body
      - Less than or equal to 3000 mrem/year to the skin

   b. Iodine-131, tritium, and for all radionuclides in particulate form with half-lives greater than 8 days

      - Less than or equal to 1500 mrem/yr to any organ

2. Dose - Noble Gases

   Quarterly

   - Less than or equal to 5 mrads gamma
   - Less than or equal to 10 mrads beta

   Yearly

   - Less than or equal to 10 mrads gamma
   - Less than or equal to 20 mrads beta

3. Dose - Iodine-131, Tritium, and Radionuclides in Particulate Form

   Quarterly

   - Less than or equal to 7.5 mrem to any organ

   Yearly

   - Less than or equal to 15 mrem to any organ

B. Liquid Effluents

1. Concentration

The concentration of radioactive material released to the discharge canal shall be limited to the concentration specified in 10 CFR 20, Appendix B, Table II, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the total concentration released shall be limited to 2.0E-4 microcuries/ml.

2. Dose

Quarterly

- Less than or equal to 1.5 mrem total body
- Less than or equal to 5 mrem critical organ

Yearly

- Less than or equal to 3 mrem total body
- Less than or equal to 10 mrem critical organ

MEASUREMENTS APPROXIMATIONS OF TOTAL ACTIVITY IN RADIOACTIVE EFFLUENTS

As required by NRC Regulatory Guide 1.21, this section describes the methods used to measure the total radioactivity in effluent releases and to estimate the overall errors associated with these measurements.

A. GASEUOUS EFFLUENTS

ANO continuously releases gases and other activation products through a total of ten ventilation pathways. There are additional Waste Gas tanks that allow for further decay of high activity short-lived gases. Weekly a release permit is generated for the prior week's release through the ventilation pathways as a batch release. This is done due to a known volume of gases. Primarily tritium is released continuously, while the remaining contributors, (i.e. fission gases, radioiodines, particulates) are normally only released for such activities as a refueling outage or plant transients.

I. FISSION AND ACTIVATION GASES

Samples are obtained from each of the ten plant radiation monitors (SPINGs) which continuously monitor the ventilation exhaust points. The fission and activation gases are quantified by gamma spectroscopy analysis of periodic samples. The summary values reported are the sums of all fission and activation gases quantified at all monitored release points.

II. RADIOIODINES

Samples are obtained from each of the ten plant radiation monitors (SPINGs) which continuously monitor the ten ventilation exhaust points. The radioiodines are entrained on charcoal and then quantified by gamma spectroscopy analysis. For each sample, the duration of sampling and continuous flow rate through the charcoal are used in determining the concentration of radioiodines. From the flow rate of the ventilation system, a rate of release can be determined. The summary values reported are the sums of all radioiodines quantified at all monitored release points.

III. PARTICULATES

Samples are obtained from each of the ten plant effluent radiation monitors (SPINGs) which continuously monitor the ten ventilation exhaust points. The particulates are collected on a filter and then quantified by gamma spectroscopy analysis. For each sample, the duration of sampling and the continuous flow rate through the filter are used in determining the concentration of particulates. From the flow rate of the ventilation system, a rate of release can be determined. Quarterly, the filters from each ventilation release point are composited and then radiochemically separated and analyzed for strontium (Sr)-89/90 and iron (Fe)-55. The summary values reported are the sums of all particulates quantified at all monitored release points.

IV. TRITIUM

Samples are obtained from each of the ten plant effluent radiation monitors (SPINGs) which continuously monitor the ten ventilation exhaust points. The sample is passed a calcium chloride desiccant. The sample is then distilled and the water collected is analyzed for tritium using liquid scintillation counting techniques. For each sample, the duration of sample and sample flow rate is used to determine the concentration. From the flow rate of the ventilation system, a release rate can be determined. The summary values reported are the sums of all tritium quantified at all monitored release points.

V. GROSS ALPHA

The gaseous particulate samples are collected and sent to Teledyne for gross alpha analysis. Permits are updated accordingly in the presence of gross alpha.

VI. CARBON-14

Carbon-14 releases are calculated using a method published by the Electric Power Research Institute in December 2010. Plant rated thermal power and monthly capacity factors were used in the calculation of quarterly releases. Release rates are calculated using the total curies divided by total seconds in each applicable quarter.

B. LIQUID EFFLUENTS

The liquid radwaste processing system and the liquid effluent monitoring system are described in ANO-1&2 Safety Analysis Report (SAR). Most liquid releases are performed as batch release. Gamma spec and tritium samples are analyzed prior to the release to quantify the release.

There are two continuous release streams, Unit 1&2 Turbine Building Sump are sampled daily for gamma spec and tritium daily. A weekly release is performed for these release streams.

C. STATISTICAL MEASURMENT UNCERTAINTIES

The statistical uncertainty of the measurements in this section have been estimated, calculated using the square root of the sum of the squares for estimates in each area and summarized in the following table:

Measurement Type	Sample Type	One Sigma Uncertainty
Fission and Activation Gases	Gaseous	24%
Radioiodines	Gaseous	20%
Particulates	Gaseous	22%
Tritium	Gaseous	21%
Gross Alpha	Gaseous	31%
Fission and Activation Products	Liquid	21%
Tritium	Liquid	12%
Gross Alpha	Liquid	27%
Volume of Waste Release	Liquid	8%
Volume of Dilution Water	Liquid	10%

LIQUID RELEASES

As required by Regulatory Guide 1.21, Revision 1, "Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," a summary of data for liquid and gas releases is provided in the ARERR. Calculated offsite doses are compared with Nuclear Regulatory Commission limits, and these limits are summarized in Appendix A. Appendix A also contains a detailed discussion of the methods used to determine quantities of radioactivity released in effluents, the types of solid radioactive waste shipped offsite, as well as tables of individual radionuclides released in effluents and shipped as solid radioactive waste.

The summary of liquid and gaseous effluents for both ANO-1&2 is as follows.

REPORT CATEGORY: LIQUID CONTINUOUS AND BATCH RELEASES
TABLE 5A

ANO-1		
	Batch	**Continuous**
Number of releases	124	35
Total time for all releases (minutes)	2.32E+04	2.43E+05
Maximum time for a release (minutes)	8.65E+02	1.03E+04
Average time for a release (minutes)	1.87E+02	6.94E+03
Minimum time for a release (minutes)	7.00E+00	1.23E+03

ANO-1

REPORT CATEGORY: ANNUAL LIQUID CONTINUOUS AND BATCH RELEASES REG. GUIDE 1.21 TABLE 2A

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

A. Fission and Activation Products

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	5.07E-02	1.38E-02	4.13E-02	4.53E-02	21
Avg. Concentration (uCi/ml)	1.54E-10	3.75E-11	1.09E-10	2.70E-10	
Percent of Limit	5.15E-01	1.25E-01	3.63E-01	8.98E-01	

B. Tritium

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	1.52E+02	1.57E+02	2.07E+02	3.87E+01	12
Avg. Concentration (uCi/ml)	4.62E-07	4.25E-07	5.46E-07	2.30E-07	
Percent of Limit	1.54E-02	1.42E-02	1.82E-02	7.68E-03	

C. Dissolved and Entrained Gases Summary

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	1.35E-02	1.75E-02	1.00E-01	1.05E-02	22
Avg. Concentration (uCi/ml)	4.13E-11	4.73E-11	2.64E-10	6.26E-11	
Percent of Limit	2.06E-05	2.36E-05	1.32E-04	3.13E-05	

D. Gross Alpha Activity

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	27
Avg. Concentration (uCi/ml)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

E. Volumes

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Primary Liquid Release Volume (liters)	1.53E+07	1.26E+07	5.72E+06	3.54E+06	8
Dilution Volume (liters)	3.28E+11	3.69E+11	3.79E+11	1.68E+11	10

ANO-1

REPORT CATEGORY: ANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 2B

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

NUCLIDE	UNIT	BATCH RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Products					
Na-24	CURIES	3.453E-04	5.393E-04	6.079E-04	0.000E+00
Cr-51	CURIES	4.575E-05	0.000E+00	2.486E-04	6.391E-03
Mn-54	CURIES	2.061E-04	1.287E-05	2.766E-04	3.586E-04
Fe-55	CURIES	3.583E-03	3.304E-03	1.477E-03	4.744E-03
Fe-59	CURIES	0.000E+00	0.000E+00	0.000E+00	7.050E-04
Co-58	CURIES	2.332E-03	4.532E-04	3.884E-03	6.747E-03
Co-60	CURIES	1.972E-03	1.611E-03	7.251E-03	8.577E-03
Sr-85	CURIES	1.011E-05	1.866E-05	5.966E-05	0.000E+00
Sr-92	CURIES	0.000E+00	0.000E+00	7.465E-06	1.092E-05
Y-91m	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Zr-95	CURIES	1.784E-04	4.184E-05	4.314E-04	1.826E-03
Nb-95	CURIES	3.396E-04	1.503E-04	9.842E-04	3.697E-03
Nb-97	CURIES	0.000E+00	0.000E+00	0.000E+00	5.224E-06
Mo-99	CURIES	0.000E+00	3.987E-05	2.219E-05	0.000E+00
Tc-99m	CURIES	0.000E+00	0.000E+00	2.259E-05	0.000E+00
Ru-105	CURIES	1.991E-05	2.466E-05	2.297E-05	0.000E+00
Ag-110m	CURIES	6.687E-04	4.623E-04	1.030E-03	2.571E-03
Sb-122	CURIES	0.000E+00	0.000E+00	0.000E+00	2.441E-05
Sb-124	CURIES	8.859E-05	1.947E-04	6.514E-05	3.975E-03
Sb-125	CURIES	0.000E+00	5.124E-04	2.137E-04	1.066E-03
I-131	CURIES	5.851E-05	0.000E+00	4.128E-04	2.652E-04
I-133	CURIES	0.000E+00	0.000E+00	1.704E-04	0.000E+00
I-134	CURIES	0.000E+00	0.000E+00	0.000E+00	8.483E-05
Cs-134	CURIES	2.413E-02	9.008E-04	1.322E-02	2.180E-03
Cs-136	CURIES	1.949E-06	2.679E-06	0.000E+00	1.001E-05
Cs-137	CURIES	1.611E-02	1.824E-03	1.078E-02	1.918E-03
Cs-138	CURIES	0.000E+00	0.000E+00	2.096E-05	0.000E+00
W-187	CURIES	0.000E+00	0.000E+00	0.000E+00	5.362E-05
Total	**CURIES**	**5.009E-02**	**1.009E-02**	**4.121E-02**	**4.521E-02**
Tritium					
H-3	CURIES	1.514E+02	1.556E+02	2.070E+02	3.870E+01
Dissolved and Entrained Gases					
Kr-85	CURIES	2.328E-03	6.888E-03	1.377E-02	0.000E+00
Xe-131m	CURIES	2.265E-04	1.579E-04	0.000E+00	0.000E+00
Xe-133	CURIES	1.099E-02	1.002E-02	8.646E-02	1.051E-02
Total	**CURIES**	**1.355E-02**	**1.706E-02**	**1.002E-01**	**1.051E-02**

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents < Minimum Detectable Activity

ANO-1

REPORT CATEGORY: ANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 2B

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 12-31-2016

NUCLIDE	UNIT	CONTINUOUS RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Products					
Na-24	CURIES	0.000E+00	8.872E-05	0.000E+00	0.000E+00
Mn-54	CURIES	0.000E+00	1.952E-05	0.000E+00	0.000E+00
Co-58	CURIES	0.000E+00	1.141E-05	0.000E+00	0.000E+00
Co-60	CURIES	0.000E+00	5.518E-05	0.000E+00	0.000E+00
Cs-134	CURIES	3.390E-04	2.091E-03	6.052E-05	3.857E-05
Cs-137	CURIES	2.332E-04	1.469E-03	5.893E-05	3.739E-05
Total	CURIES	**5.721E-04**	**3.735E-03**	**1.194E-04**	**7.596E-05**
Tritium					
H-3	CURIES	2.488E-01	1.225E+00	1.206E-02	5.374E-03
Dissolved and Entrained Gases					
Kr-88	CURIES	0.000E+00	1.633E-04	0.000E+00	0.000E+00
Xe-133	CURIES	0.000E+00	2.251E-04	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**3.884E-04**	**0.000E+00**	**0.000E+00**

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents < Minimum Detectable Activity

REPORT CATEGORY: LIQUID CONTINUOUS AND BATCH RELEASES
TABLE 5A

ANO-2		
	Batch	**Continuous**
Number of releases	26	0
Total time for all releases (minutes)	1.00E+04	0
Maximum time for a release (minutes)	9.84E+02	0
Average time for a release (minutes)	3.84E+02	0
Minimum time for a release (minutes)	1.84E+02	0

ANO-2

REPORT CATEGORY: ANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 2A

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

A. Fission and Activation Products

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	2.17E-03	4.26E-03	3.74E-03	8.16E-03	21
Avg. Concentration (uCi/ml)	6.60E-12	1.16E-11	9.86E-12	4.86E-11	
Percent of Limit	2.20E-02	3.85E-02	3.29E-02	1.62E-01	

B. Tritium

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	6.76E+01	1.07E+02	6.72E+01	2.87E+02	12
Avg. Concentration (uCi/ml)	2.06E-07	2.91E-07	1.77E-07	1.71E-06	
Percent of Limit	6.87E-03	9.71E-03	5.91E-03	5.69E-02	

C. Dissolved and Entrained Gases Summary

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	7.43E-04	1.24E-04	6.75E-04	2.08E-03	22
Avg. Concentration (uCi/ml)	2.26E-12	3.36E-013	1.78E-12	1.24E-11	
Percent of Limit	1.13E-06	1.68E-07	8.90E-07	6.20E-06	

D. Gross Alpha Activity

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	27
Avg. Concentration (uCi/ml)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

E. Volumes

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Primary Liquid Release Volume (liters)	4.97E+05	5.15E+05	2.48E+05	7.54E+05	8
Dilution Volume (liters)	3.28E+11	3.69E+11	3.79E+11	1.68E+11	10

ANO-2

REPORT CATEGORY: ANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 2B

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

NUCLIDE	UNIT	BATCH RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Products					
Mn-54	CURIES	6.957E-05	3.886E-05	0.000E+00	0.000E+00
Fe-55	CURIES	0.000E+00	1.494E-03	2.041E-03	2.197E-03
Fe-59	CURIES	2.727E-05	0.000E+00	0.000E+00	1.368E-04
Co-58	CURIES	1.504E-04	1.256E-04	1.348E-05	4.759E-05
Co-60	CURIES	6.746E-04	3.415E-04	3.375E-05	4.328E-05
Zr-95	CURIES	0.000E+00	4.013E-06	0.000E+00	0.000E+00
Nb-94	CURIES	0.000E+00	0.000E+00	0.000E+00	1.387E-06
Nb-95	CURIES	0.000E+00	1.251E-05	0.000E+00	0.000E+00
Ag-110m	CURIES	8.469E-06	1.031E-05	0.000E+00	0.000E+00
Sb-124	CURIES	8.936E-05	3.796E-04	5.033E-05	2.770E-05
Sb-125	CURIES	8.073E-04	1.031E-03	4.902E-04	1.069E-03
Cs-134	CURIES	1.264E-05	3.684E-05	7.540E-05	2.704E-04
Cs-137	CURIES	3.267E-04	7.904E-04	1.032E-03	4.368E-03
Total	**CURIES**	**2.166E-03**	**4.264E-03**	**3.736E-03**	**8.162E-03**
Tritium					
H-3	CURIES	6.765E+01	1.075E+02	6.723E+01	2.870E+02
Dissolved and Entrained Gases					
Xe-133	CURIES	7.428E-04	1.239E-04	6.748E-04	2.085E-03
Total	**CURIES**	**7.428E-04**	**1.239E-04**	**6.748E-04**	**2.085E-03**

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents < Minimum Detectable Activity

ANO-2

REPORT CATEGORY: ANNUAL LIQUID CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 2B

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

NUCLIDE	UNIT	CONTINUOUS RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Products					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Tritium					
H-3	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Dissolved and Entrained Gases					
NONE	CURIES	0.000E+00	2.251E-04	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents <Minimum Detectable Activity

4. SUMMARY OF GASEOUS EFFLUENT DATA

As required by Regulatory Guide 1.21, Revision 1, a summary of data for gaseous releases is provided in the ARERR. At ANO only ground level releases are used to maintain a conservative does estimate. The summary of gaseous effluents for both Unit 1 and Unit 2 is as follows:

ANO-1

REPORT CATEGORY: GASEOUS CONTINUOUS AND BATCH RELEASES TABLE 5B

ANO-1		
	Batch	**Continuous**
Number of releases	106	0
Total time for all releases (minutes)	8.43E+05	0
Maximum time for a release (minutes)	4.46E+04	0
Average time for a release (minutes)	7.95E+03	0
Minimum time for a release (minutes)	4.00E+00	0

ANO-1

REPORT CATEGORY: ANNUAL GASEOUS CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 1A

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

A. Fission and Activation Gases

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	1.71E-01	1.25E+01	2.49E+00	24
Avg. Release Rate (uCi/sec)	0.00E+00	2.17E-02	1.57E+00	3.13E-01	
Percent of Limit	0.00E+00	3.05E-04	2.20E-02	4.39E-03	

B. Iodines and Halogens

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	1.25E-05	1.87E-04	20
Avg. Release Rate (uCi/sec)	0.00E+00	0.00E+00	1.58E-06	2.35E-05	
Percent of Limit	0.00E+00	0.00E+00	4.50E-06	6.71E-05	

C. Particulates

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	0.00E+00	2.30E-04	22
Avg. Release Rate (uCi/sec)	0.00E+00	0.00E+00	0.00E+00	2.89E-05	
Percent of Limit	0.00E+00	0.00E+00	0.00E+00	8.27E-05	

D. Tritium

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	2.77E+00	2.60E+00	4.63E+00	4.99E+00	21
Avg. Release Rate (uCi/sec)	3.53E-01	3.31E-01	5.83E-01	6.28E-01	
Percent of Limit	4.94E-04	4.63E-04	8.163E-04	8.795E-04	

E. Carbon-14

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Total Release (Curies)	2.11E+00	2.13E+00	1.99E+00	3.99E-01
Avg. Release Rate (uCi/sec)	2.68E-01	2.71E-01	2.50E-01	5.02E-02

F. Gross Alpha

ANO-1	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	31

ANO-1

REPORT CATEGORY: ANNUAL GASEOUS CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 1B GROUND RELEASE

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

NUCLIDE	UNIT	BATCH RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Gases					
Ar-41	CURIES	0.000E+00	0.000E+00	4.297E-03	0.000E+00
Kr-85	CURIES	0.000E+00	1.710E-01	9.097E-01	1.320E-01
Xe-133	CURIES	0.000E+00	0.000E+00	1.160E+01	2.358E+00
Xe-135	CURIES	0.000E+00	0.000E+00	7.856E-05	0.000E+00
Total	**CURIES**	**0.000E+00**	**1.710E-01**	**1.251E+01**	**2.490E+00**
Iodines and Halogens					
I-131	CURIES	0.000E+00	0.000E+00	1.252E-05	1.866E-04
I-133	CURIES	0.000E+00	0.000E+00	8.174E-09	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**1.253E-05**	**1.866E-04**
Particulates					
Sr-85	CURIES	0.000E+00	0.000E+00	0.000E+00	2.228E-04
Ag-110m	CURIES	0.000E+00	0.000E+00	0.000E+00	7.265E-06
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**2.300E-04**
Tritium					
H-3	CURIES	2.772E+00	2.599E+00	4.635E+00	4.994E+00
Gross Alpha					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents < Minimum Detectable Activity

ANO-1

REPORT CATEGORY: ANNUAL GASEOUS CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 1B GROUND RELEASE

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

NUCLIDE	UNIT	CONTINUOUS RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Products					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Tritium					
H-3	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Dissolved and Entrained Gases					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents < Minimum Detectable Activity

ANO-2

REPORT CATEGORY: GASEOUS CONTINUOUS AND BATCH RELEASES
TABLE 5B

ANO-2		
	Batch	**Continuous**
Number of releases	103	0
Total time for all releases (minutes)	8.19E+05	0
Maximum time for a release (minutes)	1.06E+04	0
Average time for a release (minutes)	7.95E+03	0
Minimum time for a release (minutes)	5.70E+01	0

ANO-2

REPORT CATEGORY: ANNUAL GASEOUS CONTINUOUS AND BATCH RELEASES
REG. GUIDE 1.21 TABLE 1A

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

A. Fission and Activation Gases

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	1.07E+00	1.21E-05	1.08E-01	1.20E+01	24
Avg. Release Rate (uCi/sec)	1.36E-01	1.54E-06	1.36E-02	1.50E+00	
Percent of Limit	1.90E-03	2.15E-08	1.91E-04	2.106E-02	

B. Iodines and Halogens

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	8.71E-06	1.99E-06	20
Avg. Release Rate (uCi/sec)	0.00E+00	0.00E+00	1.10E-06	2.50E-07	
Percent of Limit	0.00E+00	0.00E+00	3.13E-06	7.14E-07	

C. Particulates

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	22
Avg. Release Rate (uCi/sec)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
Percent of Limit	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

D. Tritium

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	3.85E+00	5.68E+00	5.06E+00	2.71E+00	21
Avg. Release Rate (uCi/sec)	4.90E-01	7.23E-01	6.37E-01	3.41E-01	
Percent of Limit	6.86E-04	1.01E-03	8.91E-04	4.78E-04	

E. Carbon-14

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4
Total Release (Curies)	2.54E+00	2.88E+00	2.85E+00	2.09E+00
Avg. Release Rate (uCi/sec)	3.23E-01	3.66E-01	3.59E-01	2.63E-01

E. Gross Alpha

ANO-2	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Uncertainty (%)
Total Release (Curies)	0.00E+00	0.00E+00	0.00E+00	0.00E+00	31

ANO-2

REPORT CATEGORY: ANNUAL GASEOUS CONTINUOUS AND BATCH RELEASES REG. GUIDE 1.21 TABLE 1B GROUND RELEASE

REPORTING PERIOD: STARTING: 1-JAN-2016 ENDING: 31-DEC-2016

NUCLIDE	UNIT	BATCH RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Gases					
Ar-41	CURIES	1.062E+00	0.000E+00	8.939E-02	1.196E+01
Kr-85	CURIES	0.000E+00	0.000E+00	3.262E-03	0.000E+00
Xe-133	CURIES	7.500E-03	1.208E-05	1.584E-02	0.000E+00
Total	**CURIES**	**1.069E+00**	**1.208E-05**	**1.085E-01**	**1.196E+01**
Iodines and Halogens					
I-131	CURIES	0.000E+00	0.000E+00	7.961E-06	1.987E-06
I-133	CURIES	0.000E+00	0.000E+00	7.535E-07	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**8.714E-06**	**1.987E-06**
Particulates					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Tritium					
H-3	CURIES	3.855E+00	5.681E+00	5.060E+00	2.714E+00
Gross Alpha					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents < Minimum Detectable Activity

ANO-2

REPORT CATEGORY: **ANNUAL GASEOUS CONTINUOUS AND BATCH RELEASES**
REG. GUIDE 1.21 TABLE 1B GROUND RELEASE

REPORTING PERIOD: **STARTING: 1-JAN-2016 ENDING: 31-DEC-2016**

NUCLIDE	UNIT	CONTINUOUS RELEASES			
		QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Fission and Activation Products					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**
Tritium					
H-3	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Dissolved and Entrained Gases					
NONE	CURIES	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Total	**CURIES**	**0.000E+00**	**0.000E+00**	**0.000E+00**	**0.000E+00**

*In the above table, 0.00E+00 is used when no radioactivity was detected and represents <Minimum Detectable Activity

RADIATION DOSES

The following is a summary of the annual radiation doses due to radiological effluents during 2016 calculated in accordance with the ODCM.

ANO-1

Liquid Radwaste Effluents

- Dose Limits (mrem): Total Body = 1.5/Qtr 3/Yr, Organs = 5/Qtr 10/Yr

A. Critical Organ Dose

Bone	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrem)	1.84E-02	2.61E-03	9.28E-03	5.39E-03	3.57E-02
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	3.69E-01	5.22E-02	1.86E-01	1.08E-01	3.57E-01
Liver	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	3.55E-02	4.87E-03	1.76E-02	1.01E-02	6.80E-02
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	7.10E-01	9.75E-02	3.51E-01	2.01E-01	6.80E-01
Thyroid	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	2.65E-04	2.24E-04	4.51E-04	4.87E-04	1.43E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	5.31E-03	4.48E-03	9.02E-03	9.74E-03	1.43E-02
Kidney	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.18E-02	1.76E-03	5.96E-03	3.39E-03	2.29E-02
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	2.37E-01	3.52E-02	1.19E-01	6.79E-02	2.29E-01
Lung	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	4.09E-03	7.39E-04	2.16E-03	1.27E-03	8.26E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	8.18E-02	1.48E-02	4.33E-02	2.53E-02	8.26E-02
GI-Li	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	9.71E-04	3.43E-04	7.58E-04	2.04E-03	4.11E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	1.94E-02	6.87E-03	1.52E-02	4.08E-02	4.11E-02

B. Total Body

Total Body	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrem)	2.72E-02	3.69E-03	1.34E-02	7.64E-03	5.19E-02
Limit (mrem)	1.50	1.50	1.50	1.50	3.00
Percent of Limit	1.81E+00	2.46E-01	8.91E-01	5.10E-01	1.73E+00

ANO-1

Gaseous Radwaste Effluents

- Iodine, H-3, and Particulate (ITP) - Dose Limits (mrem) = 7.5/Qtr 15/Yr
- Noble Gas Air Dose Limits (mrad) = Gamma 5/Qtr 10/Yr, Beta 10/Qtr 20/Yr

A. Critical Organ Dose

Bone	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	0.00E+00	0.00E+00	1.88E-05	3.01E-04	3.20E-04
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	0.00E+00	0.00E+00	2.51E-04	4.02E-03	2.14E-03
Liver	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.22E-02	1.14E-02	2.04E-02	2.21E-02	6.62E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	1.63E-01	1.52E-01	2.72E-01	2.95E-01	4.41E-01
Thyroid	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.22E-02	1.14E-02	2.38E-02	1.17E-01	1.44E-01
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	1.63E-01	1.52E-01	3.17E-01	1.564E+00	9.59E-01
Kidney	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.22E-02	1.14E-02	2.04E-02	2.22E-02	6.63E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	1.63E-01	1.52E-01	2.72E-01	2.97E-01	4.42E-01
Lung	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.22E-02	1.14E-02	2.04E-02	2.20E-02	6.60E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	1.63E-01	1.52E-01	2.72E-01	2.94E-01	4.40E-01
GI-Li	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.22E-02	1.14E-02	2.04E-02	2.21E-02	6.61E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	1.63E-01	1.52E-01	2.72E-01	2.94E-01	4.41E-01
Skin	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	0.00E+00	0.00E+00	2.02E-07	2.55E-05	2.57E-05
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	0.00E+00	0.00E+00	2.69E-06	3.40E-04	1.71E-04

B. Total Body

Total Body	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrem)	1.22E-02	1.14E-02	2.04E-02	2.21E-02	6.61E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	1.63E-01	1.52E-01	2.72E-01	2.94E-01	4.41E-01

C. Noble Gas

Gamma Air	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrad)	0.00E+00	1.87E-06	2.63E-03	5.29E-04	3.16E-03
Limit (mrad)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	0.00E+00	3.74E-05	5.26E-02	1.06E-02	3.16E-02
Beta Air	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrad)	0.00E+00	2.11E-04	8.86E-03	1.73E-03	1.08E-02
Limit (mrad)	10.00	10.00	10.00	10.00	20.00
Percent of Limit	0.00E+00	2.11E-03	8.86E-02	1.73E-02	5.40E-02

ANO-2

Liquid Radwaste Effluents

- Dose Limits (mrem): Total Body = 1.5/Qtr 3/Yr, Organs = 5/Qtr 10/Yr

A. Critical Organ Dose

Bone	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrem)	1.78E-04	3.88E-04	5.01E-04	6.69E-03	7.76E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	3.56E-03	7.76E-03	1.00E-02	1.34E-01	7.76E-02
Liver	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	3.58E-04	6.93E-04	7.97E-04	1.07E-02	1.26E-02
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	7.16E-03	1.39E-02	1.594E-02	2.14E-01	1.26E-01
Thyroid	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.06E-04	1.51E-04	9.01E-05	1.25E-03	1.60E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	2.11E-03	3.03E-03	1.80E-03	2.51E-02	1.60E-02
Kidney	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.90E-04	3.33E-04	3.27E-04	4.44E-03	5.29E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	3.81E-03	6.66E-03	6.54E-03	8.88E-02	5.29E-02
Lung	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.34E-04	2.14E-04	1.72E-04	2.33E-03	2.85E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	2.67E-03	4.28E-03	3.44E-03	4.65E-02	2.85E-02
GI-Li	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.23E-04	1.71E-04	1.07E-04	1.47E-03	1.87E-03
Limit (mrem)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	2.45E-03	3.42E-03	2.14E-03	2.94E-02	1.87E-02

B. Total Body

Total Body	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrem)	2.74E-04	5.10E-04	5.61E-04	7.55E-03	8.90E-03
Limit (mrem)	1.50	1.50	1.50	1.50	3.00
Percent of Limit	1.83E-02	3.40E-02	3.74E-02	5.04E-01	2.97E-01

ANO-2

Gaseous Radwaste Effluents

- Iodine, H-3, and Particulate (ITP) - Dose Limits (mrem) = 7.5/Qtr 15/Yr
- Noble Gas Air Dose Limits (mrad) = Gamma 5/Qtr 10/Yr, Beta 10/Qtr 20/Yr

A. Critical Organ Dose

Bone	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	0.00E+00	0.00E+00	1.20E-05	2.99E-06	1.50E-05
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	0.00E+00	0.00E+00	1.60E-04	3.99E-05	9.97E-05
Liver	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.70E-02	2.50E-02	2.23E-02	1.19E-02	7.61E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	2.26E-01	3.33E-01	2.97E-01	1.59E-01	5.08E-01
Thyroid	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.70E-02	2.50E-02	2.44E-02	1.25E-02	7.89E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	2.26E-01	3.33E-01	3.26E-01	1.66E-01	5.26E-01
Kidney	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.70E-02	2.50E-02	2.23E-02	1.19E-02	7.62E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	2.26E-01	3.33E-01	2.97E-01	1.59E-01	5.08E-01
Lung	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.70E-02	2.50E-02	2.23E-02	1.19E-02	7.61E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	2.26E-01	3.33E-01	2.97E-01	1.59E-01	5.08E-01
GI-Li	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	1.70E-02	2.50E-02	2.23E-02	1.19E-02	7.61E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	2.26E-01	3.33E-01	2.97E-01	1.59E-01	5.08E-01
Skin	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrem)	0.00E+00	0.00E+00	1.28E-07	3.20E-08	1.60E-07
Limit (mrem)	7.50	7.50	7.50	7.50	15.00
Percent of Limit	0.00E+00	0.00E+00	1.71E-06	4.26E-07	1.07E-06

B. Total Body

Total Body	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrem)	1.70E-02	2.50E-02	2.23E-02	1.19E-02	7.61E-02
Limit (mrem)	7.50	7.50	7.50	7.50	15.0
Percent of Limit	2.26E-01	3.33E-01	2.97E-01	1.59E-01	5.08E-01

C. Noble Gas

Gamma Air	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Annual
Dose (mrad)	6.26E-03	2.70E-09	5.31E-04	7.05E-02	7.73E-02
Limit (mrad)	5.00	5.00	5.00	5.00	10.00
Percent of Limit	1.25E-01	5.40E-08	1.06E-02	1.41E+00	7.73E-01
Beta Air	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Annual**
Dose (mrad)	2.21E-03	8.04E-09	2.01E-04	2.49E-02	2.73E-02
Limit (mrad)	10.00	10.00	10.00	10.00	20.00
Percent of Limit	2.21E-02	8.04E-08	2.01E-03	2.49E-01	1.37E-01

SUMMARY OF DOSE TO MEMBERS OF THE PUBLIC (40CFR190 Radioactive Effluents Impact)

The following is a summary of the annual radiation dose to members of the public (in mrem) due to activities inside the site boundary.

	BONE	LIVER	TBODY	THYROID	KIDNEY	GI-LLI	LUNG	SKIN
ANO-1								
Gaseous Effluent								
Iodine/Tritium Particulate	3.20E-04	6.62E-02	6.61E-02	1.44E-01	6.63E-02	6.61E-02	6.60E-02	2.57E-05
Noble Gas			1.85E-03					6.20E-03
Carbon-14	1.83E-01	3.65E-02	3.65E-02	3.65E-02	3.65E-02	3.65E-02	3.65E-02	
Liquid Effluent								
Fish	3.57E-02	6.80E-02	5.19E-02	1.43E-03	2.29E-02	4.11E-03	8.26E-03	0.00E+00
Sediment			1.12E-03					1.31E-03
Unit 1 Total	2.19E-01	1.71E-01	1.57E-01	1.82E-01	1.26E-01	1.07E-01	1.11E-01	7.51E-03
ANO-2								
Gaseous Effluent								
Iodine/Tritium Particulate	1.50E-05	7.61E-02	7.61E-02	7.89E-02	7.62E-02	7.61E-02	7.61E-02	1.60E-07
Noble Gas			5.14E-02					8.24E-02
Carbon-14	2.86E-01	5.71E-02	5.71E-02	5.71E-02	5.71E-02	5.71E-02	5.71E-02	
Liquid Effluent								
Fish	7.76E-03	1.26E-02	8.90E-03	1.60E-03	5.29E-03	1.87E-03	2.85E-03	0.00E+00
Sediment			1.02E-04					1.19E-04
Unit 2 Total	2.94E-01	1.46E-01	1.94E-01	1.38E-01	1.39E-01	1.35E-01	1.36E-01	8.25E-02
ANO Site								
Site Total	5.13E-01	3.17E-01	3.51E-01	3.20E-01	2.65E-01	2.42E-01	2.47E-01	9.01E-02
Limit (40CFR190)	25	25	25	75	25	25	25	25
% Limit	2.05E+00	1.27E+00	1.40E+00	4.27E-01	1.06E+00	9.68E-01	9.88E-01	3.60E-01

8. SOLID WASTE SUMMARY

As required by Regulatory Guide 1.21, Revision 1, a summary of data for solid wastes shipped offsite is provided in the ARERR.

ANO-1&2 complies with the extensive federal regulations which govern radioactive waste shipments. Radioactive solid waste shipments from the ANO-1&2 site consist of waste generated during water treatment, radioactive trash, irradiated components, etc. Shipment destinations are either a licensed burial site or intermediate processing facilities. Waste shipped to intermediate processing facilities is shipped directly from these facilities to a licensed burial site after processing. The following tables contain estimates of major nuclide composition, by class of waste, of ANO-1&2 radwaste shipped offsite in 2016. The waste volumes shown in these tables are the volumes shipped, not the final volumes sent for burial after processing.

a. Resins, Filters and Evaporator Bottoms

ANO-1 Waste Characterization

ANO-1 Class A		
Isotope	**Percent Abundance**	**Curies**
H-3	0.37%	8.55E-02
C-14	2.71%	6.25E-01
Mn-54	3.93%	9.07E-01
Fe-55	21.95%	5.06E+00
Co-57	0.09%	2.03E-02
Co-58	0.52%	1.20E-01
Co-60	46.85%	1.08E+01
Ni-59	0.07%	1.71E-02
Ni-63	20.34%	4.69E+00
Zn-65	0.49%	1.12E-01
Sr-89	0.00%	3.84E-05
Sr-90	0.04%	9.46E-03
Nb-95	0.00%	3.31E-05
Tc-99	0.28%	6.34E-02
Sb-125	0.26%	6.00E-02
I-129	0.05%	1.24E-02
Cs-134	0.15%	3.42E-02
Cs-137	1.89%	4.36E-01

Total Curies	**2.31E+01**

ANO-1 Class B		
Isotope	**Percent Abundance**	**Curies**
H-3	0.10%	6.27E-02
Be-7	0.02%	1.27E-02
C-14	2.27%	1.36E+00
Mn-54	3.11%	1.86E+00
Fe-55	20.29%	1.22E+01
Co-57	0.08%	4.58E-02
Co-58	0.83%	4.97E-01
Co-60	41.08%	2.46E+01
Ni-59	0.12%	6.98E-02
Ni-63	22.61%	1.35E+01
Zn-65	0.47%	2.80E-01
Sr-89	0.00%	4.14E-04
Sr-90	0.06%	3.72E-02
Nb-95	0.00%	1.94E-04
Zr-95	0.00%	1.40E-03
Tc-99	0.02%	1.17E-02
Ag-110m	0.13%	7.53E-02
Sn-113	0.00%	6.33E-04
Sb-124	0.00%	2.68E-03
Sb-125	1.37%	8.23E-01
I-129	0.00%	1.66E-03
Cs-134	0.51%	3.08E-01
Cs-137	6.85%	4.10E+00
Ce-144	0.05%	3.02E-02
Pu-238	0.00%	1.87E-04
Am-241	0.00%	2.99E-05
Cm-242	0.00%	1.28E-06
Cm-243	0.00%	1.06E-04
Cm-244	0.00%	1.04E-04

Total Curies	**5.99E+01**

ANO-1 Total		
Isotope	**Percent Abundance**	**Curies**
H-3	0.18%	1.48E-01
Be-7	0.02%	1.27E-02
C-14	2.40%	1.99E+00
Mn-54	3.34%	2.77E+00
Fe-55	20.75%	1.72E+01
Co-57	0.08%	6.61E-02
Co-58	0.74%	6.17E-01
Co-60	42.69%	3.54E+01
Ni-59	0.10%	8.69E-02
Ni-63	21.98%	1.82E+01
Zn-65	0.47%	3.92E-01
Sr-89	0.00%	4.52E-04
Sr-90	0.06%	4.67E-02
Nb-95	0.00%	2.27E-04
Zr-95	0.00%	1.40E-03
Tc-99	0.09%	7.51E-02
Ag-110m	0.09%	7.53E-02
Sn-113	0.00%	6.33E-04
Sb-124	0.00%	2.68E-03
Sb-125	1.06%	8.83E-01
I-129	0.02%	1.41E-02
Cs-134	0.41%	3.42E-01
Cs-137	5.47%	4.54E+00
Ce-144	0.04%	3.02E-02
Pu-238	0.00%	1.87E-04
Am-241	0.00%	2.99E-05
Cm-242	0.00%	1.28E-06
Cm-243	0.00%	1.06E-04
Cm-244	0.00%	1.04E-04

Total Curies	**8.29E+01**

Notes:

There were zero Class C shipments.

The values listed for H-3, C-14, Tc-99 and I-129 in the above table contain LLD values calculated and reported on Manifests.

ANO-2 Waste Characterization

ANO-2 Class A		
Isotope	**Percent Abundance**	**Curies**
H-3	0.34%	1.07E-02
C-14	0.34%	1.09E-02
Co-60	0.00%	3.00E-05
Sr-89	89.79%	2.84E+00
Sr-90	9.01%	2.85E-01
Tc-99	0.34%	1.07E-02
I-129	0.06%	1.82E-03
Cs-137	0.12%	3.91E-03

Total Curies	3.16E+00

ANO-2 Class B		
Isotope	**Percent Abundance**	**Curies**
H-3	0.39%	7.81E-02
C-14	0.40%	8.01E-02
Co-60	0.00%	1.85E-04
Sr-89	85.61%	1.70E+01
Sr-90	13.14%	2.61E+00
Tc-99	0.38%	7.56E-02
I-129	0.04%	7.48E-03
Cs-137	0.04%	7.04E-03

Total Curies	1.99E+01

ANO-2 Total		
Isotope	**Percent Abundance**	**Curies**
H-3	0.39%	8.88E-02
C-14	0.40%	9.10E-02
Co-60	0.00%	2.15E-04
Sr-89	86.18%	1.98E+01
Sr-90	12.58%	2.90E+00
Tc-99	0.38%	8.63E-02
I-129	0.04%	9.30E-03
Cs-137	0.04%	1.09E-02

Total Curies	2.30E+01

Notes:

There were zero Class C shipments.

The values listed for H-3, C-14, Tc-99 and I-129 in the above table contain LLD values calculated and reported on Manifests.

ANO-Common Waste Characterization

ANO-Common Class A/Total		
Isotope	**Percent Abundance**	**Curies**
H-3	24.99%	4.01E-03
C-14	22.25%	3.57E-03
Co-60	0.11%	1.76E-05
Tc-99	32.59%	5.23E-03
I-129	6.54%	1.05E-03
Cs-137	13.52%	2.17E-03

Total Curies	1.60E-02

Notes:

There were zero Class B & C shipments.

The values listed for H-3, C-14, Tc-99 and I-129 in the above table contain LLD values calculated and reported on Manifests.

b. Dry compressible waste, contaminated equipment, etc.

ANO-1 Waste Characterization

ANO-1 Class A/Total		
Isotope	**Percent Abundance**	**Curies**
H-3	2.77%	4.74E-02
C-14	0.64%	1.10E-02
Mn-54	0.25%	4.36E-03
Fe-55	8.41%	1.44E-01
Co-58	1.62%	2.77E-02
Co-60	8.82%	1.51E-01
Ni-63	63.07%	1.08E+00
Nb-95	0.54%	9.27E-03
Tc-99	1.04%	1.78E-02
Sb-125	1.37%	2.34E-02
I-129	0.01%	2.07E-04
Cs-134	1.12%	1.92E-02
Cs-137	10.34%	1.77E-01

Total Curies	**1.71E+00**

Notes:

There were zero Class B & C shipments.

The values listed for H-3, C-14, Tc-99 and I-129 in the above table contain LLD values calculated and reported on Manifests.

ANO-2 Waste Characterization

No waste for this category.

ANO-Common Waste Characterization

ANO-Common Class A/Total		
Isotope	**Percent Abundance**	**Curies**
H-3	9.33%	1.45E-01
C-14	4.13%	6.40E-02
Mn-54	0.75%	1.16E-02
Fe-55	0.86%	1.33E-02
Co-58	5.26%	8.15E-02
Co-60	10.51%	1.63E-01
Ni-63	28.96%	4.49E-01
Sr-90	1.05%	1.63E-02
Zr-95	5.42%	8.40E-02
Nb-95	8.18%	1.27E-01
Tc-99	3.38%	5.25E-02
Sb-125	0.14%	2.16E-03
I-129	0.63%	9.80E-03
Cs-134	0.11%	1.78E-03
Cs-137	21.28%	3.30E-01

Total Curies	1.55E+00

Notes:

There were zero Class B & C shipments.

The values listed for H-3, C-14, Tc-99 and I-129 in the above table contain LLD values calculated and reported on Manifests.

c. Irradiated components, control rods, etc. - No waste for this category

d. Other

ANO-1 Waste Characterization

No waste for this category

ANO-2 Waste Characterization

No waste for this category

ANO-Common Waste Characterization

ANO-Common Class A/Total		
Isotope	**Percent Abundance**	**Curies**
H-3	10.44%	2.79E-02
C-14	80.08%	2.14E-01
Co-60	0.06%	1.59E-04
Tc-99	3.34%	8.93E-03
I-129	0.24%	6.42E-04
Cs-137	5.84%	1.56E-02

Total Curies	**2.67E-01**

Notes:

There were zero Class B & C shipments.

The values listed for H-3, C-14, Tc-99 and I-129 in the above table contain LLD values calculated and reported on Manifests.

e. Shipping Manifests

ANO-1 Waste Shipping Manifest Information

ANO-1 Manifests		
Manifest Number	**Date Shipped**	**Comment**
RSR 2016-012	27-JAN-16	
RSR 2016-014	3-FEB-16	
RSR 2016-031	10-MAR-16	180 ft^3 ANO-1, 540 ft^3 ANO-2
RSR 2016-075	20-JUL-16	
RSR 2016-088	23-AUG-16	341 ft^3 ANO-1, 426 ft^3 ANO-2
RSR 2016-101	5-OCT-16	
RSR 2016-107	18-OCT-16	
RSR 2016-108	19-OCT-16	
RSR 2016-109	24-OCT-16	
RSR 2016-114	25-OCT-16	
RSR 2016-118	2-NOV-16	
RSR 2016-119	26-OCT-16	
RSR 2016-127	9-NOV-16	
RSR 2016-144	6-DEC-16	
RSR 2016-147	5-DEC-16	
RSR 2016-148	6-DEC-16	
RSR 2016-149	7-DEC-16	
RSR 2016-150	8-DEC-16	

ANO-2 Waste Shipping Manifest Information

ANO-2 Manifests		
Manifest Number	**Date Shipped**	**Comment**
RSR 2016-028	8-MAR-16	
RSR 2016-031	10-MAR-16	180 ft^3 ANO-1, 540 ft^3 ANO-2
RSR 2016-088	23-AUG-16	341 ft^3 ANO-1, 426 ft^3 ANO-2

ANO-Common Waste Shipping Manifest Information

ANO-Common Manifests		
Manifest Number	**Date Shipped**	**Comment**
RSR 2016-001	7-JAN-16	
RSR 2016-005	12-JAN-16	
RSR 2016-007	14-JAN-16	
RSR 2016-022	23-FEB-16	
RSR 2016-023	25-FEB-16	
RSR 2016-025	26-FEB-16	
RSR 2016-032	16-MAR-16	
RSR 2016-036	29-MAR-16	
RSR 2016-037	24-MAR-16	
RSR 2016-040	7-APR-16	
RSR 2016-041	12-APR-16	
RSR 2016-045	14-APR-16	
RSR 2016-049	19-APR-16	
RSR 2016-050	21-APR-16	
RSR 2016-051	26-APR-16	
RSR 2016-052	28-APR-16	
RSR 2016-053	5-MAY-16	
RSR 2016-058	17-MAY-16	
RSR 2016-059	19-MAY-16	
RSR 2016-091	30-AUG-16	
RSR 2016-096	16-SEP-16	

Appendix B

Ground Water Protection Program Data and Analysis

RADIOACTIVE GROUND WATER MONITORING PROGRAM (RGWMP) DATA

NEI 07-07, "Industry Ground Water Protection Initiative – Final Guidance Document," Objective 2.4, "Annual Reporting," requires documentation of all on-site ground water sample results and a description of any significant on-site leaks/spills into ground water for each calendar year in the ARERR as contained in the appropriate reporting procedure.

A. NEI 07-07, Objective 2.4, "Annual Reporting," Acceptance Criteria "b.i", requires that ground water sample results that are taken in support of the Ground Water Protection Initiative (GPI) but are not part of the Radiological Environmental Monitoring Program (REMP) (e.g. samples obtained during the investigatory phase of the action plan) are reported in the ARERR. Additionally, Entergy's procedure EN-CY-111, "Radiological Ground Water Monitoring Program", Step 5.15[3] requires that a listing of non-REMP wells and a summary of pertinent sample results from the Radiological Ground Water Monitoring Program (RGWMP) are reported in the ARERR and an estimate of the doses to a member of the public associated with off-site releases of licensed radioactive material via ground water is included in the ARERR.

   In 2016, there were no "non-REMP" designated ground water wells installed at ANO. There were no new "REMP" designated ground water wells installed in 2016. There were four previously installed (prior to 2010) "REMP" designated ground water wells. The results of the samples collected from the "REMP" designated ground water wells are included in the 2016 Annual Radiological Environmental Operating Report (AREOR) as required by NEI 07-07.

   ANO did not show any positive results during storm water sampling activities in 2016.

B. NEI 07-07, Objective 2.4, Acceptance Criteria "c.ii", requires that a description of all spills or leaks that were communicated per NEI 07-07, Objective 2.2, "Voluntary Communication," be included in the ARERR. Additionally, Entergy's procedure EN-RP-113, "Response to Contaminated Spills/Leaks," requires that the following be included in the ARERR:

   1. Spills/leaks documented on Attachment 9.1 that was released to the environment or outside the spent fuel pool enclosure, SHALL be documented in the next ARERR.

   2. The documentation in the ARERR report will contain:
      - Description of event
      - Impact of event
      - Remediation of event
      - Radioactive contamination content and levels of event
      - Discussion of impact on groundwater, if any

C. Program Data Analysis Summary:

- In 2016, there were no spills/leaks that required communication per NEI 07-07 Objective 2.2 or inclusion in the ARERR per EN-RP-113.
- A search of the ANO Corrective Action Program was conducted using radioactive spill(s) as the search criteria. Zero items were found.
- Entergy's procedure EN-CY-108, "Monitoring of Non-Radioactive Systems", requires that verified positive results associated with the sampling of designated nonradioactive or cross-contaminated systems are to be included in the site's ARERR, unless already reported under an existing monitored ODCM release point.

Discussion:

In 2016, there was one ground water sample point, Ground Water Monitoring Well-17 (MW-17), where a positive detection of tritium was found. During routine quarterly sampling of this well a detectable amount of tritium was confirmed by offsite vendor analysis. The increase in tritium in MW-17 is suspected to be atmospheric recapture. There are no indications of underground piping leaks. The levels indicated below, 553 pCi/L and 412 pCi/L are well below the ODCM requirement of 3000 pCi/L for non-drinking water sources. The tritium minimum detectable activity (MDA) imposed by ANO on offsite vendor analysis is 400 pCi/L. This allows ANO chemistry to closely trend ground water tritium and initiate remediation action quicker if a leak is detected.

All other ground water wells were found to be less than MDA for tritium and gamma emitters.

See results below:

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-17	06/02/2016 13:50	H-3 (DIST)	553	553	243	314	pCi/L	+
MW-17	09/14/2016 15:59	H-3 (DIST)	412	412	222	306	pCi/L	+

Legend:

Flag U identifies the samples analysis is less than MDA.

Flag + identifies a positive analysis for radioactivity for a particular nuclide.

ANO-Common

GROUND WATER RAW DATA (CHRONOLOGICAL):

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-03	3/16/2016 11:57	H-3 (DIST)	<360	-97.1	211	360	pCi/L	U
MW-03	3/16/2016 11:57	MN-54	<5.81	2.88	3.02	5.81	pCi/L	U
MW-03	3/16/2016 11:57	CO-58	<6.404	-0.6489	4.008	6.404	pCi/L	U
MW-03	3/16/2016 11:57	FE-59	<11.65	0.9442	6.956	11.65	pCi/L	U
MW-03	3/16/2016 11:57	CO-60	<5.636	-0.7796	3.664	5.636	pCi/L	U
MW-03	3/16/2016 11:57	ZN-65	<12.79	1.447	8.756	12.79	pCi/L	U
MW-03	3/16/2016 11:57	NB-95	<6.869	-1.543	4.4	6.869	pCi/L	U
MW-03	3/16/2016 11:57	ZR-95	<10.82	-3.067	7.069	10.82	pCi/L	U
MW-03	3/16/2016 11:57	I-131	<11.31	0.5482	6.756	11.31	pCi/L	U
MW-03	3/16/2016 11:57	CS-134	<5.93	-1.292	4.433	5.93	pCi/L	U
MW-03	3/16/2016 11:57	CS-137	<7.275	1.796	4.18	7.275	pCi/L	U
MW-03	3/16/2016 11:57	BA-140	<28.02	-15.74	19.1	28.02	pCi/L	U
MW-03	3/16/2016 11:57	LA-140	<10.73	1.315	6.333	10.73	pCi/L	U
MW-10	3/16/2016 12:35	H-3 (DIST)	<351	-187	198	351	pCi/L	U
MW-10	3/16/2016 12:35	MN-54	<7.058	2.787	3.913	7.058	pCi/L	U
MW-10	3/16/2016 12:35	CO-58	<6.054	1.166	3.497	6.054	pCi/L	U
MW-10	3/16/2016 12:35	FE-59	<17.29	11.09	9.015	17.29	pCi/L	U
MW-10	3/16/2016 12:35	CO-60	<6.959	3.491	3.537	6.959	pCi/L	U
MW-10	3/16/2016 12:35	ZN-65	<14.56	0.119	8.923	14.56	pCi/L	U
MW-10	3/16/2016 12:35	NB-95	<7.418	1.353	4.344	7.418	pCi/L	U
MW-10	3/16/2016 12:35	ZR-95	<12.18	-0.6007	7.501	12.18	pCi/L	U
MW-10	3/16/2016 12:35	I-131	<13.46	6.542	7.534	13.46	pCi/L	U
MW-10	3/16/2016 12:35	CS-134	<5.746	-12.68	5.041	5.746	pCi/L	U
MW-10	3/16/2016 12:35	CS-137	<6.023	-0.4854	3.734	6.023	pCi/L	U
MW-10	3/16/2016 12:35	BA-140	<32.6	-4.327	20.26	32.6	pCi/L	U
MW-10	3/16/2016 12:35	LA-140	<8.838	-3.027	6.244	8.838	pCi/L	U
MW-12	3/16/2016 13:22	H-3 (DIST)	<347	74.9	216	347	pCi/L	U
MW-12	3/16/2016 13:22	MN-54	<6.434	-0.6578	4.01	6.434	pCi/L	U
MW-12	3/16/2016 13:22	CO-58	<5.869	-2.167	3.996	5.869	pCi/L	U
MW-12	3/16/2016 13:22	FE-59	<11.73	2.695	6.393	11.73	pCi/L	U
MW-12	3/16/2016 13:22	CO-60	<7.827	1.994	4.311	7.827	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-12	3/16/2016 13:22	ZN-65	<13.85	-5.258	9.653	13.85	pCi/L	U
MW-12	3/16/2016 13:22	NB-95	<7.233	-0.783	4.48	7.233	pCi/L	U
MW-12	3/16/2016 13:22	ZR-95	<11.85	-3.118	7.687	11.85	pCi/L	U
MW-12	3/16/2016 13:22	I-131	<12.18	2.3	7.309	12.18	pCi/L	U
MW-12	3/16/2016 13:22	CS-134	<7.074	3.535	4.023	7.074	pCi/L	U
MW-12	3/16/2016 13:22	CS-137	<7.283	2.34	3.941	7.283	pCi/L	U
MW-12	3/16/2016 13:22	BA-140	<36.31	14.91	19.34	36.31	pCi/L	U
MW-12	3/16/2016 13:22	LA-140	<11.57	0.854	6.962	11.57	pCi/L	U
DUP-MW-12	3/16/2016 13:25	H-3 (DIST)	<347	-146	199	347	pCi/L	U
DUP-MW-12	3/16/2016 13:25	MN-54	<6.441	1.186	3.681	6.441	pCi/L	U
DUP-MW-12	3/16/2016 13:25	CO-58	<7.06	3.828	3.642	7.06	pCi/L	U
DUP-MW-12	3/16/2016 13:25	FE-59	<14.21	3.693	7.993	14.21	pCi/L	U
DUP-MW-12	3/16/2016 13:25	CO-60	<5.323	0.276	3.2	5.323	pCi/L	U
DUP-MW-12	3/16/2016 13:25	ZN-65	<10.69	-0.7629	7.783	10.69	pCi/L	U
DUP-MW-12	3/16/2016 13:25	NB-95	<7.207	3.439	4.232	7.207	pCi/L	U
DUP-MW-12	3/16/2016 13:25	ZR-95	<8.182	-4.694	5.792	8.182	pCi/L	U
DUP-MW-12	3/16/2016 13:25	I-131	<9.956	-6.179	6.819	9.956	pCi/L	U
DUP-MW-12	3/16/2016 13:25	CS-134	<6.229	-1.628	4.777	6.229	pCi/L	U
DUP-MW-12	3/16/2016 13:25	CS-137	<7.451	-1.642	4.622	7.451	pCi/L	U
DUP-MW-12	3/16/2016 13:25	BA-140	<35.01	1.897	21.51	35.01	pCi/L	U
DUP-MW-12	3/16/2016 13:25	LA-140	<11.61	0.02041	7.225	11.61	pCi/L	U
MW-06	3/16/2016 14:03	H-3 (DIST)	<364	-41	218	364	pCi/L	U
MW-06	3/16/2016 14:03	MN-54	<6.188	0.1572	3.698	6.188	pCi/L	U
MW-06	3/16/2016 14:03	CO-58	<7.425	3.354	3.794	7.425	pCi/L	U
MW-06	3/16/2016 14:03	FE-59	<16.22	3.905	9.074	16.22	pCi/L	U
MW-06	3/16/2016 14:03	CO-60	<4.644	-1.469	3.455	4.644	pCi/L	U
MW-06	3/16/2016 14:03	ZN-65	<13.92	1.837	9.059	13.92	pCi/L	U
MW-06	3/16/2016 14:03	NB-95	<7.48	1.427	4.234	7.48	pCi/L	U
MW-06	3/16/2016 14:03	ZR-95	<8.672	-3.144	6.003	8.672	pCi/L	U
MW-06	3/16/2016 14:03	I-131	<13.01	1.67	7.925	13.01	pCi/L	U
MW-06	3/16/2016 14:03	CS-134	<6.533	2.015	3.936	6.533	pCi/L	U
MW-06	3/16/2016 14:03	CS-137	<6.975	1.372	3.908	6.975	pCi/L	U
MW-06	3/16/2016 14:03	BA-140	<34.21	-3.645	20.8	34.21	pCi/L	U
MW-06	3/16/2016 14:03	LA-140	<11.11	4.444	5.286	11.11	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-07	3/16/2016 14:09	H-3 (DIST)	<364	-221	204	364	pCi/L	U
MW-07	3/16/2016 14:09	MN-54	<7.382	0.3701	4.379	7.382	pCi/L	U
MW-07	3/16/2016 14:09	CO-58	<6.612	-0.3367	4.016	6.612	pCi/L	U
MW-07	3/16/2016 14:09	FE-59	<12.32	-0.258	7.554	12.32	pCi/L	U
MW-07	3/16/2016 14:09	CO-60	<4.733	-0.5918	3.103	4.733	pCi/L	U
MW-07	3/16/2016 14:09	ZN-65	<13.17	-2.842	8.578	13.17	pCi/L	U
MW-07	3/16/2016 14:09	NB-95	<7.465	1.933	4.192	7.465	pCi/L	U
MW-07	3/16/2016 14:09	ZR-95	<12.58	4.578	6.831	12.58	pCi/L	U
MW-07	3/16/2016 14:09	I-131	<10.72	-9.751	7.643	10.72	pCi/L	U
MW-07	3/16/2016 14:09	CS-134	<5.49	-0.6674	4.09	5.49	pCi/L	U
MW-07	3/16/2016 14:09	CS-137	<6.784	-1.311	4.209	6.784	pCi/L	U
MW-07	3/16/2016 14:09	BA-140	<31.91	-13.04	21.66	31.91	pCi/L	U
MW-07	3/16/2016 14:09	LA-140	<8.144	-7.249	7.115	8.144	pCi/L	U
MW-104	3/16/2016 15:40	H-3 (DIST)	<362	-97.7	212	362	pCi/L	U
MW-104	3/16/2016 15:40	MN-54	<5.999	0.04011	3.68	5.999	pCi/L	U
MW-104	3/16/2016 15:40	CO-58	<7.85	2.4	4.322	7.85	pCi/L	U
MW-104	3/16/2016 15:40	FE-59	<14.22	1.713	8.057	14.22	pCi/L	U
MW-104	3/16/2016 15:40	CO-60	<6.741	1.388	3.603	6.741	pCi/L	U
MW-104	3/16/2016 15:40	ZN-65	<9.658	-15.68	9.882	9.658	pCi/L	U
MW-104	3/16/2016 15:40	NB-95	<6.077	-1.083	3.978	6.077	pCi/L	U
MW-104	3/16/2016 15:40	ZR-95	<11.85	0.2127	7.211	11.85	pCi/L	U
MW-104	3/16/2016 15:40	I-131	<12.76	0.8971	7.489	12.76	pCi/L	U
MW-104	3/16/2016 15:40	CS-134	<5.533	-1.68	4.344	5.533	pCi/L	U
MW-104	3/16/2016 15:40	CS-137	<8.194	1.297	4.762	8.194	pCi/L	U
MW-104	3/16/2016 15:40	BA-140	<31.28	-7.359	20.19	31.28	pCi/L	U
MW-104	3/16/2016 15:40	LA-140	<11.59	2.154	6.31	11.59	pCi/L	U
MW-19	3/16/2016 15:57	H-3 (DIST)	<348	-41.7	208	348	pCi/L	U
MW-19	3/16/2016 15:57	MN-54	<8.158	0.4885	4.93	8.158	pCi/L	U
MW-19	3/16/2016 15:57	CO-58	<7.847	1.377	4.55	7.847	pCi/L	U
MW-19	3/16/2016 15:57	FE-59	<16.09	0.9586	9.39	16.09	pCi/L	U
MW-19	3/16/2016 15:57	CO-60	<6.498	-2.83	4.689	6.498	pCi/L	U
MW-19	3/16/2016 15:57	ZN-65	<12.28	-10.39	9.735	12.28	pCi/L	U
MW-19	3/16/2016 15:57	NB-95	<9.997	3.061	5.673	9.997	pCi/L	U
MW-19	3/16/2016 15:57	ZR-95	<12.92	-3.034	8.487	12.92	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-19	3/16/2016 15:57	I-131	<12.59	0.4498	7.447	12.59	pCi/L	U
MW-19	3/16/2016 15:57	CS-134	<7.756	0.5334	5.32	7.756	pCi/L	U
MW-19	3/16/2016 15:57	CS-137	<6.366	-0.3857	3.958	6.366	pCi/L	U
MW-19	3/16/2016 15:57	BA-140	<36.02	-5.267	22.55	36.02	pCi/L	U
MW-19	3/16/2016 15:57	LA-140	<12.44	3.31	6.532	12.44	pCi/L	U
MW-102	3/16/2016 17:06	H-3 (DIST)	<370	-93.7	218	370	pCi/L	U
MW-102	3/16/2016 17:06	MN-54	<6.11	-0.7093	3.856	6.11	pCi/L	U
MW-102	3/16/2016 17:06	CO-58	<7.82	1.705	4.337	7.82	pCi/L	U
MW-102	3/16/2016 17:06	FE-59	<17.8	4.158	9.898	17.8	pCi/L	U
MW-102	3/16/2016 17:06	CO-60	<8.263	2.344	4.358	8.263	pCi/L	U
MW-102	3/16/2016 17:06	ZN-65	<10.84	-2.909	7.614	10.84	pCi/L	U
MW-102	3/16/2016 17:06	NB-95	<8.163	2.656	4.37	8.163	pCi/L	U
MW-102	3/16/2016 17:06	ZR-95	<11.44	2.033	6.355	11.44	pCi/L	U
MW-102	3/16/2016 17:06	I-131	<13.68	0.4854	8.382	13.68	pCi/L	U
MW-102	3/16/2016 17:06	CS-134	<6.223	-5.971	4.704	6.223	pCi/L	U
MW-102	3/16/2016 17:06	CS-137	<5.326	-3.355	3.996	5.326	pCi/L	U
MW-102	3/16/2016 17:06	BA-140	<33.79	6.788	19.69	33.79	pCi/L	U
MW-102	3/16/2016 17:06	LA-140	<5.799	-0.0051	3.604	5.799	pCi/L	U
MW-17	3/16/2016 17:07	H-3 (DIST)	<355	202	231	355	pCi/L	U
MW-17	3/16/2016 17:07	MN-54	<6.661	-2.645	3.946	6.661	pCi/L	U
MW-17	3/16/2016 17:07	CO-58	<5.84	-1.136	3.225	5.84	pCi/L	U
MW-17	3/16/2016 17:07	FE-59	<14.34	-0.8361	7.573	14.34	pCi/L	U
MW-17	3/16/2016 17:07	CO-60	<7.378	1.124	3.458	7.378	pCi/L	U
MW-17	3/16/2016 17:07	ZN-65	<14.05	-0.4677	7.289	14.05	pCi/L	U
MW-17	3/16/2016 17:07	NB-95	<7.634	0.382	4.037	7.634	pCi/L	U
MW-17	3/16/2016 17:07	ZR-95	<13.25	6.611	5.948	13.25	pCi/L	U
MW-17	3/16/2016 17:07	I-131	<12.76	-1.946	7.365	12.76	pCi/L	U
MW-17	3/16/2016 17:07	CS-134	<6.724	2.364	3.719	6.724	pCi/L	U
MW-17	3/16/2016 17:07	CS-137	<5.23	-3.303	3.335	5.23	pCi/L	U
MW-17	3/16/2016 17:07	BA-140	<34.37	-4.037	19.27	34.37	pCi/L	U
MW-17	3/16/2016 17:07	LA-140	<8.15	-3.351	4.785	8.15	pCi/L	U
MW-15	3/17/2016 8:53	H-3 (DIST)	<366	-67.9	217	366	pCi/L	U
MW-15	3/17/2016 8:53	MN-54	<1.536	-0.4583	0.9815	1.536	pCi/L	U
MW-15	3/17/2016 8:53	CO-58	<1.553	0.2265	0.9542	1.553	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-15	3/17/2016 8:53	FE-59	<3.295	0.5882	1.92	3.295	pCi/L	U
MW-15	3/17/2016 8:53	CO-60	<1.486	-0.5979	0.9331	1.486	pCi/L	U
MW-15	3/17/2016 8:53	ZN-65	<3.031	-1.358	2.141	3.031	pCi/L	U
MW-15	3/17/2016 8:53	NB-95	<1.707	1.384	0.9921	1.707	pCi/L	U
MW-15	3/17/2016 8:53	ZR-95	<2.746	0.2853	1.686	2.746	pCi/L	U
MW-15	3/17/2016 8:53	I-131	<3.003	1.357	1.742	3.003	pCi/L	U
MW-15	3/17/2016 8:53	CS-134	<1.45	-0.3014	1.007	1.45	pCi/L	U
MW-15	3/17/2016 8:53	CS-137	<1.732	0.8169	1.142	1.732	pCi/L	U
MW-15	3/17/2016 8:53	BA-140	<7.787	-1.102	4.76	7.787	pCi/L	U
MW-15	3/17/2016 8:53	LA-140	<2.723	-0.3021	1.678	2.723	pCi/L	U
DUP-MW-15	3/17/2016 9:15	H-3 (DIST)	<364	-194	206	364	pCi/L	U
DUP-MW-15	3/17/2016 9:15	MN-54	<7.576	2.446	4.258	7.576	pCi/L	U
DUP-MW-15	3/17/2016 9:15	CO-58	<7.439	-2.345	4.878	7.439	pCi/L	U
DUP-MW-15	3/17/2016 9:15	FE-59	<14.39	-0.3079	8.888	14.39	pCi/L	U
DUP-MW-15	3/17/2016 9:15	CO-60	<6.018	0.7664	3.505	6.018	pCi/L	U
DUP-MW-15	3/17/2016 9:15	ZN-65	<14.38	6.229	8.415	14.38	pCi/L	U
DUP-MW-15	3/17/2016 9:15	NB-95	<10.18	5.569	5.585	10.18	pCi/L	U
DUP-MW-15	3/17/2016 9:15	ZR-95	<12.15	-2.328	7.76	12.15	pCi/L	U
DUP-MW-15	3/17/2016 9:15	I-131	<13.9	-0.3818	8.408	13.9	pCi/L	U
DUP-MW-15	3/17/2016 9:15	CS-134	<7.489	-0.1025	5.308	7.489	pCi/L	U
DUP-MW-15	3/17/2016 9:15	CS-137	<7.003	-0.01458	4.258	7.003	pCi/L	U
DUP-MW-15	3/17/2016 9:15	BA-140	<32.96	-9.578	21.17	32.96	pCi/L	U
DUP-MW-15	3/17/2016 9:15	LA-140	<11.87	6.148	5.832	11.87	pCi/L	U
MW-14	3/17/2016 9:34	H-3 (DIST)	<367	-12.4	222	367	pCi/L	U
MW-14	3/17/2016 9:34	MN-54	<5.722	-1.553	3.948	5.722	pCi/L	U
MW-14	3/17/2016 9:34	CO-58	<6.88	-0.9344	4.453	6.88	pCi/L	U
MW-14	3/17/2016 9:34	FE-59	<19.92	-1.983	12.22	19.92	pCi/L	U
MW-14	3/17/2016 9:34	CO-60	<8.2	2.262	4.253	8.2	pCi/L	U
MW-14	3/17/2016 9:34	ZN-65	<14.32	-4.074	11.39	14.32	pCi/L	U
MW-14	3/17/2016 9:34	NB-95	<7.325	0.1425	4.456	7.325	pCi/L	U
MW-14	3/17/2016 9:34	ZR-95	<11.44	-0.1126	7.037	11.44	pCi/L	U
MW-14	3/17/2016 9:34	I-131	<11.92	-2.695	7.461	11.92	pCi/L	U
MW-14	3/17/2016 9:34	CS-134	<5.402	-5.438	5.308	5.402	pCi/L	U
MW-14	3/17/2016 9:34	CS-137	<8.562	1.935	4.848	8.562	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-14	3/17/2016 9:34	BA-140	<39.82	12.69	22.01	39.82	pCi/L	U
MW-14	3/17/2016 9:34	LA-140	<13.75	-1.122	8.655	13.75	pCi/L	U
MW-09	3/17/2016 10:25	H-3 (DIST)	<367	-78.4	217	367	pCi/L	U
MW-09	3/17/2016 10:25	MN-54	<6.455	-1.26	4.175	6.455	pCi/L	U
MW-09	3/17/2016 10:25	CO-58	<7.285	-1.327	4.659	7.285	pCi/L	U
MW-09	3/17/2016 10:25	FE-59	<14.94	1.492	8.758	14.94	pCi/L	U
MW-09	3/17/2016 10:25	CO-60	<8.096	0.4086	4.886	8.096	pCi/L	U
MW-09	3/17/2016 10:25	ZN-65	<12.14	-8.19	9.683	12.14	pCi/L	U
MW-09	3/17/2016 10:25	NB-95	<8.65	0.9665	5.032	8.65	pCi/L	U
MW-09	3/17/2016 10:25	ZR-95	<13.28	0.5496	7.865	13.28	pCi/L	U
MW-09	3/17/2016 10:25	I-131	<11.76	0.6218	7.274	11.76	pCi/L	U
MW-09	3/17/2016 10:25	CS-134	<7.251	2.241	4.368	7.251	pCi/L	U
MW-09	3/17/2016 10:25	CS-137	<6.737	-2.482	4.51	6.737	pCi/L	U
MW-09	3/17/2016 10:25	BA-140	<36.75	-19.48	24.5	36.75	pCi/L	U
MW-09	3/17/2016 10:25	LA-140	<5.057	-10.95	7.918	5.057	pCi/L	U
MW-04	3/17/2016 11:25	H-3 (DIST)	<364	-203	206	364	pCi/L	U
MW-04	3/17/2016 11:25	MN-54	<4.455	-0.6296	2.844	4.455	pCi/L	U
MW-04	3/17/2016 11:25	CO-58	<5.14	0.8473	2.977	5.14	pCi/L	U
MW-04	3/17/2016 11:25	FE-59	<8.094	-0.4027	4.94	8.094	pCi/L	U
MW-04	3/17/2016 11:25	CO-60	<5.118	-0.4234	3.218	5.118	pCi/L	U
MW-04	3/17/2016 11:25	ZN-65	<9.446	-1.005	6.886	9.446	pCi/L	U
MW-04	3/17/2016 11:25	NB-95	<6.035	1.407	3.45	6.035	pCi/L	U
MW-04	3/17/2016 11:25	ZR-95	<8.03	0.2481	4.813	8.03	pCi/L	U
MW-04	3/17/2016 11:25	I-131	<8.744	-0.04429	5.271	8.744	pCi/L	U
MW-04	3/17/2016 11:25	CS-134	<4.306	-1.946	3.344	4.306	pCi/L	U
MW-04	3/17/2016 11:25	CS-137	<5.326	-0.6704	3.289	5.326	pCi/L	U
MW-04	3/17/2016 11:25	BA-140	<25.58	8.171	14.65	25.58	pCi/L	U
MW-04	3/17/2016 11:25	LA-140	<7.794	-0.2856	4.719	7.794	pCi/L	U
MW-08	3/17/2016 12:28	H-3 (DIST)	<364	-170	208	364	pCi/L	U
MW-08	3/17/2016 12:28	MN-54	<6.783	-1.059	4.247	6.783	pCi/L	U
MW-08	3/17/2016 12:28	CO-58	<5.792	-2.216	3.897	5.792	pCi/L	U
MW-08	3/17/2016 12:28	FE-59	<13.8	-0.9114	8.592	13.8	pCi/L	U
MW-08	3/17/2016 12:28	CO-60	<5.821	-2.837	4.352	5.821	pCi/L	U
MW-08	3/17/2016 12:28	ZN-65	<13.58	-13.92	10.9	13.58	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-08	3/17/2016 12:28	NB-95	<7.905	0.6479	4.632	7.905	pCi/L	U
MW-08	3/17/2016 12:28	ZR-95	<11	-6.875	7.722	11	pCi/L	U
MW-08	3/17/2016 12:28	I-131	<11.06	1.574	6.566	11.06	pCi/L	U
MW-08	3/17/2016 12:28	CS-134	<7.115	2.815	4.491	7.115	pCi/L	U
MW-08	3/17/2016 12:28	CS-137	<7.78	-4.554	5.835	7.78	pCi/L	U
MW-08	3/17/2016 12:28	BA-140	<36.31	9.641	21.19	36.31	pCi/L	U
MW-08	3/17/2016 12:28	LA-140	<11.03	-6.173	8.358	11.03	pCi/L	U
MW-02	3/17/2016 12:30	H-3 (DIST)	<368	-126	214	368	pCi/L	U
MW-02	3/17/2016 12:30	MN-54	<7.67	2.457	4.088	7.67	pCi/L	U
MW-02	3/17/2016 12:30	CO-58	<4.877	-0.9058	3.135	4.877	pCi/L	U
MW-02	3/17/2016 12:30	FE-59	<8.718	-6.739	7.376	8.718	pCi/L	U
MW-02	3/17/2016 12:30	CO-60	<6.915	-0.901	4.445	6.915	pCi/L	U
MW-02	3/17/2016 12:30	ZN-65	<13.73	-2.66	8.894	13.73	pCi/L	U
MW-02	3/17/2016 12:30	NB-95	<7.733	-1.946	4.89	7.733	pCi/L	U
MW-02	3/17/2016 12:30	ZR-95	<11.43	0.6763	6.607	11.43	pCi/L	U
MW-02	3/17/2016 12:30	I-131	<11.47	3.441	6.569	11.47	pCi/L	U
MW-02	3/17/2016 12:30	CS-134	<4.748	-2.503	4.165	4.748	pCi/L	U
MW-02	3/17/2016 12:30	CS-137	<7.882	2.633	4.416	7.882	pCi/L	U
MW-02	3/17/2016 12:30	BA-140	<29.55	-3.918	19.31	29.55	pCi/L	U
MW-02	3/17/2016 12:30	LA-140	<9.95	0.0661	6.053	9.95	pCi/L	U
EB-MW-02	3/17/2016 13:30	H-3 (DIST)	<342	65.6	213	342	pCi/L	U
MW-05	3/17/2016 15:25	H-3 (DIST)	<370	87.4	231	370	pCi/L	U
MW-05	3/17/2016 15:25	MN-54	<9.615	1.05	5.634	9.615	pCi/L	U
MW-05	3/17/2016 15:25	CO-58	<7.043	-0.1369	4.25	7.043	pCi/L	U
MW-05	3/17/2016 15:25	FE-59	<19.15	6.523	10.58	19.15	pCi/L	U
MW-05	3/17/2016 15:25	CO-60	<10.18	4.978	5.127	10.18	pCi/L	U
MW-05	3/17/2016 15:25	ZN-65	<17.79	0.02863	12.76	17.79	pCi/L	U
MW-05	3/17/2016 15:25	NB-95	<10.03	3.594	5.52	10.03	pCi/L	U
MW-05	3/17/2016 15:25	ZR-95	<15.15	6.627	7.999	15.15	pCi/L	U
MW-05	3/17/2016 15:25	I-131	<13.16	0.2372	7.812	13.16	pCi/L	U
MW-05	3/17/2016 15:25	CS-134	<7.68	1.999	5.034	7.68	pCi/L	U
MW-05	3/17/2016 15:25	CS-137	<6.91	-5.217	5.22	6.91	pCi/L	U
MW-05	3/17/2016 15:25	BA-140	<38.47	-12.76	25.17	38.47	pCi/L	U
MW-05	3/17/2016 15:25	LA-140	<13.5	-0.5736	8.342	13.5	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
EB-MW-05	3/17/2016 16:06	H-3 (DIST)	<366	-257	202	366	pCi/L	U
MW-13	6/2/2016 9:52	SAMPLE						U
MW-12	6/2/2016 11:10	H-3 (DIST)	<320	71.1	201	320	pCi/L	U
MW-12	6/2/2016 11:10	MN-54	<5.091	0.6182	3.045	5.091	pCi/L	U
MW-12	6/2/2016 11:10	CO-58	<6.088	2.456	3.421	6.088	pCi/L	U
MW-12	6/2/2016 11:10	FE-59	<9.479	-3.836	6.287	9.479	pCi/L	U
MW-12	6/2/2016 11:10	CO-60	<5.285	0.1719	3.144	5.285	pCi/L	U
MW-12	6/2/2016 11:10	ZN-65	<10.71	3.254	6.613	10.71	pCi/L	U
MW-12	6/2/2016 11:10	NB-95	<5.884	1.587	3.406	5.884	pCi/L	U
MW-12	6/2/2016 11:10	ZR-95	<10.42	6.201	5.559	10.42	pCi/L	U
MW-12	6/2/2016 11:10	I-131	<12.65	-1.4	7.673	12.65	pCi/L	U
MW-12	6/2/2016 11:10	CS-134	<5.394	2.195	3.452	5.394	pCi/L	U
MW-12	6/2/2016 11:10	CS-137	<5.189	-2.267	3.44	5.189	pCi/L	U
MW-12	6/2/2016 11:10	BA-140	<29.36	5.354	17.12	29.36	pCi/L	U
MW-12	6/2/2016 11:10	LA-140	<8.096	-4.812	6.074	8.096	pCi/L	U
MW-14	6/2/2016 12:10	H-3 (DIST)	<313	94.1	200	313	pCi/L	U
MW-14	6/2/2016 12:10	MN-54	<3.875	-2.045	2.563	3.875	pCi/L	U
MW-14	6/2/2016 12:10	CO-58	<3.71	-2.052	2.486	3.71	pCi/L	U
MW-14	6/2/2016 12:10	FE-59	<9.87	1.188	5.877	9.87	pCi/L	U
MW-14	6/2/2016 12:10	CO-60	<4.097	-0.3399	2.577	4.097	pCi/L	U
MW-14	6/2/2016 12:10	ZN-65	<9.202	-6.67	6.398	9.202	pCi/L	U
MW-14	6/2/2016 12:10	NB-95	<4.817	0.636	2.831	4.817	pCi/L	U
MW-14	6/2/2016 12:10	ZR-95	<7.959	1.465	4.622	7.959	pCi/L	U
MW-14	6/2/2016 12:10	I-131	<10.7	-7.395	7.095	10.7	pCi/L	U
MW-14	6/2/2016 12:10	CS-134	<4.315	-2.186	3.4	4.315	pCi/L	U
MW-14	6/2/2016 12:10	CS-137	<3.85	-2.79	2.59	3.85	pCi/L	U
MW-14	6/2/2016 12:10	BA-140	<25.17	-1.759	15.79	25.17	pCi/L	U
MW-14	6/2/2016 12:10	LA-140	<8.992	2.417	5.006	8.992	pCi/L	U
DUP-MW-14	6/2/2016 12:25	H-3 (DIST)	<314	138	205	314	pCi/L	U
DUP-MW-14	6/2/2016 12:25	MN-54	<3.794	-1.23	2.468	3.794	pCi/L	U
DUP-MW-14	6/2/2016 12:25	CO-58	<4.52	-1.261	2.895	4.52	pCi/L	U
DUP-MW-14	6/2/2016 12:25	FE-59	<9.283	-0.9743	5.873	9.283	pCi/L	U
DUP-MW-14	6/2/2016 12:25	CO-60	<4.033	-1.146	2.583	4.033	pCi/L	U
DUP-MW-14	6/2/2016 12:25	ZN-65	<9.261	-2.513	6.065	9.261	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
DUP-MW-14	6/2/2016 12:25	NB-95	<4.553	0.2742	2.734	4.553	pCi/L	U
DUP-MW-14	6/2/2016 12:25	ZR-95	<8.007	0.9577	4.75	8.007	pCi/L	U
DUP-MW-14	6/2/2016 12:25	I-131	<11.45	-3.044	7.369	11.45	pCi/L	U
DUP-MW-14	6/2/2016 12:25	CS-134	<4.136	-1.977	3.11	4.136	pCi/L	U
DUP-MW-14	6/2/2016 12:25	CS-137	<4.201	-3.496	2.892	4.201	pCi/L	U
DUP-MW-14	6/2/2016 12:25	BA-140	<29.79	16.13	16.46	29.79	pCi/L	U
DUP-MW-14	6/2/2016 12:25	LA-140	<8.235	-2.532	5.387	8.235	pCi/L	U
MW-17	6/2/2016 13:50	H-3 (DIST)	553	553	243	314	pCi/L	+
MW-17	6/2/2016 13:50	MN-54	<5.958	1.837	3.436	5.958	pCi/L	U
MW-17	6/2/2016 13:50	CO-58	<4.538	-2.142	3.124	4.538	pCi/L	U
MW-17	6/2/2016 13:50	FE-59	<11.23	-2.787	7.177	11.23	pCi/L	U
MW-17	6/2/2016 13:50	CO-60	<6.161	4.076	3.043	6.161	pCi/L	U
MW-17	6/2/2016 13:50	ZN-65	<11.61	0.2274	6.965	11.61	pCi/L	U
MW-17	6/2/2016 13:50	NB-95	<6.174	1.391	3.601	6.174	pCi/L	U
MW-17	6/2/2016 13:50	ZR-95	<8.9	0.2627	5.389	8.9	pCi/L	U
MW-17	6/2/2016 13:50	I-131	<12.77	-3.973	8.143	12.77	pCi/L	U
MW-17	6/2/2016 13:50	CS-134	<4.407	-5.29	3.201	4.407	pCi/L	U
MW-17	6/2/2016 13:50	CS-137	<4.985	0.646	2.921	4.985	pCi/L	U
MW-17	6/2/2016 13:50	BA-140	<32.81	-1.819	19.65	32.81	pCi/L	U
MW-17	6/2/2016 13:50	LA-140	<14.76	6.544	7.843	14.76	pCi/L	U
MW-19	6/2/2016 14:42	H-3 (DIST)	<317	29	195	317	pCi/L	U
MW-19	6/2/2016 14:42	MN-54	<4.419	-0.8692	2.774	4.419	pCi/L	U
MW-19	6/2/2016 14:42	CO-58	<4.753	-2.218	3.092	4.753	pCi/L	U
MW-19	6/2/2016 14:42	FE-59	<10.89	-2.869	7.035	10.89	pCi/L	U
MW-19	6/2/2016 14:42	CO-60	<4.765	0.5402	2.791	4.765	pCi/L	U
MW-19	6/2/2016 14:42	ZN-65	<8.579	-2.953	6.691	8.579	pCi/L	U
MW-19	6/2/2016 14:42	NB-95	<4.849	-1.079	3.035	4.849	pCi/L	U
MW-19	6/2/2016 14:42	ZR-95	<8.558	-0.4413	5.229	8.558	pCi/L	U
MW-19	6/2/2016 14:42	I-131	<12.51	4.987	7.463	12.51	pCi/L	U
MW-19	6/2/2016 14:42	CS-134	<4.713	0.9879	3.16	4.713	pCi/L	U
MW-19	6/2/2016 14:42	CS-137	<4.807	-1.009	2.973	4.807	pCi/L	U
MW-19	6/2/2016 14:42	BA-140	<29.55	-2.318	17.77	29.55	pCi/L	U
MW-19	6/2/2016 14:42	LA-140	<8.389	-3.995	5.677	8.389	pCi/L	U
MW-10	6/2/2016 16:42	H-3 (DIST)	<314	206	212	314	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-10	6/2/2016 16:42	MN-54	<4.34	-2.916	3.146	4.34	pCi/L	U
MW-10	6/2/2016 16:42	CO-58	<5.28	-0.5014	3.365	5.28	pCi/L	U
MW-10	6/2/2016 16:42	FE-59	<10.56	-5.349	7.111	10.56	pCi/L	U
MW-10	6/2/2016 16:42	CO-60	<5.332	0.3156	3.193	5.332	pCi/L	U
MW-10	6/2/2016 16:42	ZN-65	<9.363	-1.866	6.929	9.363	pCi/L	U
MW-10	6/2/2016 16:42	NB-95	<5.618	-1.103	3.629	5.618	pCi/L	U
MW-10	6/2/2016 16:42	ZR-95	<8.359	0.7299	5.082	8.359	pCi/L	U
MW-10	6/2/2016 16:42	I-131	<14.03	-1.127	8.456	14.03	pCi/L	U
MW-10	6/2/2016 16:42	CS-134	<5.297	-0.7942	3.817	5.297	pCi/L	U
MW-10	6/2/2016 16:42	CS-137	<5.648	1.597	3.292	5.648	pCi/L	U
MW-10	6/2/2016 16:42	BA-140	<33.07	12.24	18.86	33.07	pCi/L	U
MW-10	6/2/2016 16:42	LA-140	<8.461	-5.198	6.448	8.461	pCi/L	U
EB-MW-10	6/2/2016 17:00	H-3 (DIST)	<312	-4.09	189	312	pCi/L	U
MW-19	9/14/2016 9:11	H-3 (DIST)	<314	157	205	314	pCi/L	U
MW-19	9/14/2016 9:11	MN-54	<5.544	-2.049	3.617	5.544	pCi/L	U
MW-19	9/14/2016 9:11	CO-58	<5.344	-0.6694	3.361	5.344	pCi/L	U
MW-19	9/14/2016 9:11	FE-59	<13.22	-1.568	8.057	13.22	pCi/L	U
MW-19	9/14/2016 9:11	CO-60	<5.497	-1.899	3.571	5.497	pCi/L	U
MW-19	9/14/2016 9:11	ZN-65	<9.718	-1.165	6.968	9.718	pCi/L	U
MW-19	9/14/2016 9:11	NB-95	<6.186	0.01804	3.792	6.186	pCi/L	U
MW-19	9/14/2016 9:11	ZR-95	<10.02	-1.033	6.248	10.02	pCi/L	U
MW-19	9/14/2016 9:11	I-131	<14.88	-6.674	9.188	14.88	pCi/L	U
MW-19	9/14/2016 9:11	CS-134	<5.332	-0.804	3.818	5.332	pCi/L	U
MW-19	9/14/2016 9:11	CS-137	<5.578	-1.74	3.551	5.578	pCi/L	U
MW-19	9/14/2016 9:11	BA-140	<36.58	13.31	21.03	36.58	pCi/L	U
MW-19	9/14/2016 9:11	LA-140	<10.58	-6.602	7.512	10.58	pCi/L	U
MW-10	9/14/2016 10:16	H-3 (DIST)	<305	-92.4	176	305	pCi/L	U
MW-10	9/14/2016 10:16	MN-54	<4.201	-0.4621	2.583	4.201	pCi/L	U
MW-10	9/14/2016 10:16	CO-58	<5.028	1.706	2.851	5.028	pCi/L	U
MW-10	9/14/2016 10:16	FE-59	<9.474	0.0186	5.833	9.474	pCi/L	U
MW-10	9/14/2016 10:16	CO-60	<3.572	-2.083	2.473	3.572	pCi/L	U
MW-10	9/14/2016 10:16	ZN-65	<10.15	2.132	6.874	10.15	pCi/L	U
MW-10	9/14/2016 10:16	NB-95	<4.735	1.089	2.726	4.735	pCi/L	U
MW-10	9/14/2016 10:16	ZR-95	<7.009	-1.397	4.36	7.009	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-10	9/14/2016 10:16	I-131	<10.78	-1.004	6.567	10.78	pCi/L	U
MW-10	9/14/2016 10:16	CS-134	<3.895	-0.9369	2.914	3.895	pCi/L	U
MW-10	9/14/2016 10:16	CS-137	<4.762	1.658	2.673	4.762	pCi/L	U
MW-10	9/14/2016 10:16	BA-140	<29.28	0.271	18.06	29.28	pCi/L	U
MW-10	9/14/2016 10:16	LA-140	<7.301	-3.282	5.059	7.301	pCi/L	U
MW-12	9/14/2016 11:45	H-3 (DIST)	<304	-12.4	183	304	pCi/L	U
MW-12	9/14/2016 11:45	MN-54	<5.46	-1.359	3.477	5.46	pCi/L	U
MW-12	9/14/2016 11:45	CO-58	<5.932	1.294	3.404	5.932	pCi/L	U
MW-12	9/14/2016 11:45	FE-59	<12.61	5.927	6.793	12.61	pCi/L	U
MW-12	9/14/2016 11:45	CO-60	<6.338	0.5289	3.719	6.338	pCi/L	U
MW-12	9/14/2016 11:45	ZN-65	<10.51	-8.804	7.959	10.51	pCi/L	U
MW-12	9/14/2016 11:45	NB-95	<6.217	0.2621	3.702	6.217	pCi/L	U
MW-12	9/14/2016 11:45	ZR-95	<8.621	-0.9452	5.316	8.621	pCi/L	U
MW-12	9/14/2016 11:45	I-131	<13.91	0.4521	8.334	13.91	pCi/L	U
MW-12	9/14/2016 11:45	CS-134	<5.383	0.9207	3.7	5.383	pCi/L	U
MW-12	9/14/2016 11:45	CS-137	<5.334	0.5902	3.096	5.334	pCi/L	U
MW-12	9/14/2016 11:45	BA-140	<36.85	9.069	21.75	36.85	pCi/L	U
MW-12	9/14/2016 11:45	LA-140	<13.1	0.04611	7.977	13.1	pCi/L	U
MW-14	9/14/2016 14:26	H-3 (DIST)	<309	54.1	193	309	pCi/L	U
MW-14	9/14/2016 14:26	MN-54	<3.705	0.1911	2.172	3.705	pCi/L	U
MW-14	9/14/2016 14:26	CO-58	<4.024	-1.569	2.745	4.024	pCi/L	U
MW-14	9/14/2016 14:26	FE-59	<9.149	-0.2989	5.522	9.149	pCi/L	U
MW-14	9/14/2016 14:26	CO-60	<3.238	-0.3108	2.021	3.238	pCi/L	U
MW-14	9/14/2016 14:26	ZN-65	<7.669	-2.047	4.909	7.669	pCi/L	U
MW-14	9/14/2016 14:26	NB-95	<3.927	-1.194	2.624	3.927	pCi/L	U
MW-14	9/14/2016 14:26	ZR-95	<8.231	1.463	4.955	8.231	pCi/L	U
MW-14	9/14/2016 14:26	I-131	<11.72	-0.7436	7.215	11.72	pCi/L	U
MW-14	9/14/2016 14:26	CS-134	<3.856	1.999	3.227	3.856	pCi/L	U
MW-14	9/14/2016 14:26	CS-137	<4.5	0.2272	2.771	4.5	pCi/L	U
MW-14	9/14/2016 14:26	BA-140	<29.64	13.98	16.84	29.64	pCi/L	U
MW-14	9/14/2016 14:26	LA-140	<7.648	-4.84	5.643	7.648	pCi/L	U
DUP-MW-14	9/14/2016 14:36	H-3 (DIST)	<313	-74.7	182	313	pCi/L	U
DUP-MW-14	9/14/2016 14:36	MN-54	<4.191	-0.1196	2.577	4.191	pCi/L	U
DUP-MW-14	9/14/2016 14:36	CO-58	<4.662	-0.9146	2.934	4.662	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
DUP-MW-14	9/14/2016 14:36	FE-59	<9.12	-0.8256	5.56	9.12	pCi/L	U
DUP-MW-14	9/14/2016 14:36	CO-60	<3.766	-0.8418	2.41	3.766	pCi/L	U
DUP-MW-14	9/14/2016 14:36	ZN-65	<9.32	-1.426	5.739	9.32	pCi/L	U
DUP-MW-14	9/14/2016 14:36	NB-95	<5.074	1.459	2.966	5.074	pCi/L	U
DUP-MW-14	9/14/2016 14:36	ZR-95	<7.537	-4.843	5.045	7.537	pCi/L	U
DUP-MW-14	9/14/2016 14:36	I-131	<13.66	4.463	8.075	13.66	pCi/L	U
DUP-MW-14	9/14/2016 14:36	CS-134	<4.28	0.2045	2.963	4.28	pCi/L	U
DUP-MW-14	9/14/2016 14:36	CS-137	<4.391	-0.3497	2.68	4.391	pCi/L	U
DUP-MW-14	9/14/2016 14:36	BA-140	<28.32	-8.494	17.52	28.32	pCi/L	U
DUP-MW-14	9/14/2016 14:36	LA-140	<10.39	2.493	6.055	10.39	pCi/L	U
MW-17	9/14/2016 15:59	H-3 (DIST)	412	412	222	306	pCi/L	+
MW-17	9/14/2016 15:59	MN-54	<5.747	0.7738	3.454	5.747	pCi/L	U
MW-17	9/14/2016 15:59	CO-58	<6.383	0.7116	3.849	6.383	pCi/L	U
MW-17	9/14/2016 15:59	FE-59	<14.3	0.8887	8.453	14.3	pCi/L	U
MW-17	9/14/2016 15:59	CO-60	<6.807	5.347	3.381	6.807	pCi/L	U
MW-17	9/14/2016 15:59	ZN-65	<10.51	-9.435	7.481	10.51	pCi/L	U
MW-17	9/14/2016 15:59	NB-95	<5.806	-0.9967	3.671	5.806	pCi/L	U
MW-17	9/14/2016 15:59	ZR-95	<10.18	-0.8521	6.335	10.18	pCi/L	U
MW-17	9/14/2016 15:59	I-131	<14.95	-2.409	9.024	14.95	pCi/L	U
MW-17	9/14/2016 15:59	CS-134	<5.916	-2.519	3.778	5.916	pCi/L	U
MW-17	9/14/2016 15:59	CS-137	<5.121	-0.8195	3.208	5.121	pCi/L	U
MW-17	9/14/2016 15:59	BA-140	<39.93	-0.008983	24.06	39.93	pCi/L	U
MW-17	9/14/2016 15:59	LA-140	<10.43	-3.879	7.126	10.43	pCi/L	U
EB-MW-17	9/14/2016 16:10	H-3 (DIST)	<311	-36.2	185	311	pCi/L	U
MW-19	12/15/2016 9:10	H-3 (DIST)	<283	-134	162	283	pCi/L	U
MW-19	12/15/2016 9:10	MN-54	<4.06	-1.588	2.681	4.06	pCi/L	U
MW-19	12/15/2016 9:10	CO-58	<4.363	0.7713	2.625	4.363	pCi/L	U
MW-19	12/15/2016 9:10	FE-59	<7.011	-4.215	4.791	7.011	pCi/L	U
MW-19	12/15/2016 9:10	CO-60	<4.53	3.093	2.38	4.53	pCi/L	U
MW-19	12/15/2016 9:10	ZN-65	<7.946	1.436	5.375	7.946	pCi/L	U
MW-19	12/15/2016 9:10	NB-95	<4.663	2.686	2.626	4.663	pCi/L	U
MW-19	12/15/2016 9:10	ZR-95	<7.101	2.284	4.128	7.101	pCi/L	U
MW-19	12/15/2016 9:10	I-131	<7.075	-0.1218	4.349	7.075	pCi/L	U
MW-19	12/15/2016 9:10	CS-134	<3.621	-1.65	2.721	3.621	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-19	12/15/2016 9:10	CS-137	<4.284	-0.9515	2.692	4.284	pCi/L	U
MW-19	12/15/2016 9:10	BA-140	<19.77	7.136	11.23	19.77	pCi/L	U
MW-19	12/15/2016 9:10	LA-140	<6.931	1.399	4.006	6.931	pCi/L	U
MW-10	12/15/2016 10:56	H-3 (DIST)	<278	-87.1	163	278	pCi/L	U
MW-10	12/15/2016 10:56	MN-54	<4.886	-1.751	3.18	4.886	pCi/L	U
MW-10	12/15/2016 10:56	CO-58	<5.224	-0.8031	3.259	5.224	pCi/L	U
MW-10	12/15/2016 10:56	FE-59	<9.767	-3.625	6.615	9.767	pCi/L	U
MW-10	12/15/2016 10:56	CO-60	<6.067	2.487	3.25	6.067	pCi/L	U
MW-10	12/15/2016 10:56	ZN-65	<11.24	0.8285	7.895	11.24	pCi/L	U
MW-10	12/15/2016 10:56	NB-95	<6.63	3.8	3.624	6.63	pCi/L	U
MW-10	12/15/2016 10:56	ZR-95	<9.529	2.821	5.402	9.529	pCi/L	U
MW-10	12/15/2016 10:56	I-131	<10.59	3.022	6.21	10.59	pCi/L	U
MW-10	12/15/2016 10:56	CS-134	<5.091	0.8006	3.357	5.091	pCi/L	U
MW-10	12/15/2016 10:56	CS-137	<4.654	-2.638	3.094	4.654	pCi/L	U
MW-10	12/15/2016 10:56	BA-140	<26.03	-2.318	16.47	26.03	pCi/L	U
MW-10	12/15/2016 10:56	LA-140	<9.431	0.002815	5.734	9.431	pCi/L	U
MW-12	12/15/2016 12:16	H-3 (DIST)	<284	173	184	284	pCi/L	U
MW-12	12/15/2016 12:16	MN-54	<5.689	2.031	3.248	5.689	pCi/L	U
MW-12	12/15/2016 12:16	CO-58	<5.577	-1.033	3.444	5.577	pCi/L	U
MW-12	12/15/2016 12:16	FE-59	<10.63	1.346	6.357	10.63	pCi/L	U
MW-12	12/15/2016 12:16	CO-60	<5.292	-0.4295	3.229	5.292	pCi/L	U
MW-12	12/15/2016 12:16	ZN-65	<10.72	-2.71	8.186	10.72	pCi/L	U
MW-12	12/15/2016 12:16	NB-95	<6.645	3.582	4.251	6.645	pCi/L	U
MW-12	12/15/2016 12:16	ZR-95	<10.09	2.99	5.786	10.09	pCi/L	U
MW-12	12/15/2016 12:16	I-131	<10.12	0.6402	6.023	10.12	pCi/L	U
MW-12	12/15/2016 12:16	CS-134	<5.736	2.589	3.836	5.736	pCi/L	U
MW-12	12/15/2016 12:16	CS-137	<5.504	0.7189	3.332	5.504	pCi/L	U
MW-12	12/15/2016 12:16	BA-140	<26.11	-6.914	16.48	26.11	pCi/L	U
MW-12	12/15/2016 12:16	LA-140	<8.337	-2.81	5.46	8.337	pCi/L	U
MW-14	12/15/2016 13:27	H-3 (DIST)	<284	-16.4	171	284	pCi/L	U
MW-14	12/15/2016 13:27	MN-54	<4.008	-0.7718	2.485	4.008	pCi/L	U
MW-14	12/15/2016 13:27	CO-58	<4.05	-1.693	2.602	4.05	pCi/L	U
MW-14	12/15/2016 13:27	FE-59	<8.036	-4.262	5.472	8.036	pCi/L	U
MW-14	12/15/2016 13:27	CO-60	<4.283	0.858	2.527	4.283	pCi/L	U

Station	Collection Date	Analysis	Result	Activity	Error	MDC	Units	Flag
MW-14	12/15/2016 13:27	ZN-65	<8.709	2.317	5.729	8.709	pCi/L	U
MW-14	12/15/2016 13:27	NB-95	<4.426	0.8629	2.554	4.426	pCi/L	U
MW-14	12/15/2016 13:27	ZR-95	<6.733	-0.8121	4.099	6.733	pCi/L	U
MW-14	12/15/2016 13:27	I-131	<8.154	5.114	4.546	8.154	pCi/L	U
MW-14	12/15/2016 13:27	CS-134	<4.057	-1.91	3.117	4.057	pCi/L	U
MW-14	12/15/2016 13:27	CS-137	<4.799	0.4857	2.944	4.799	pCi/L	U
MW-14	12/15/2016 13:27	BA-140	<21.21	5.968	12.47	21.21	pCi/L	U
MW-14	12/15/2016 13:27	LA-140	<6.874	1.45	3.917	6.874	pCi/L	U
DUP-MW-14	12/15/2016 13:33	H-3 (DIST)	<279	-39.2	166	279	pCi/L	U
DUP-MW-14	12/15/2016 13:33	MN-54	<5.264	1.153	3.136	5.264	pCi/L	U
DUP-MW-14	12/15/2016 13:33	CO-58	<5.098	-0.7163	3.249	5.098	pCi/L	U
DUP-MW-14	12/15/2016 13:33	FE-59	<10.28	-4.061	6.665	10.28	pCi/L	U
DUP-MW-14	12/15/2016 13:33	CO-60	<4.654	0.5765	2.72	4.654	pCi/L	U
DUP-MW-14	12/15/2016 13:33	ZN-65	<10.82	-16.61	8.308	10.82	pCi/L	U
DUP-MW-14	12/15/2016 13:33	NB-95	<6.344	4.89	3.443	6.344	pCi/L	U
DUP-MW-14	12/15/2016 13:33	ZR-95	<8.65	0.2613	5.32	8.65	pCi/L	U
DUP-MW-14	12/15/2016 13:33	I-131	<9.727	-2.564	6.034	9.727	pCi/L	U
DUP-MW-14	12/15/2016 13:33	CS-134	<5.052	-34.67	5.396	5.052	pCi/L	U
DUP-MW-14	12/15/2016 13:33	CS-137	<6.091	0.7584	3.677	6.091	pCi/L	U
DUP-MW-14	12/15/2016 13:33	BA-140	<24.53	-3.152	15.28	24.53	pCi/L	U
DUP-MW-14	12/15/2016 13:33	LA-140	<8.623	0.9452	5.114	8.623	pCi/L	U
MW-17	12/15/2016 14:53	H-3 (DIST)	<280	250	186	280	pCi/L	U
MW-17	12/15/2016 14:53	MN-54	<5.231	-1.919	3.508	5.231	pCi/L	U
MW-17	12/15/2016 14:53	CO-58	<5.183	-0.3249	3.265	5.183	pCi/L	U
MW-17	12/15/2016 14:53	FE-59	<12.83	-0.4999	7.771	12.83	pCi/L	U
MW-17	12/15/2016 14:53	CO-60	<4.476	-0.2929	2.773	4.476	pCi/L	U
MW-17	12/15/2016 14:53	ZN-65	<9.903	-6.077	6.886	9.903	pCi/L	U
MW-17	12/15/2016 14:53	NB-95	<6.08	0.1819	3.741	6.08	pCi/L	U
MW-17	12/15/2016 14:53	ZR-95	<10.62	3.027	6.176	10.62	pCi/L	U
MW-17	12/15/2016 14:53	I-131	<14.92	0.6499	8.947	14.92	pCi/L	U
MW-17	12/15/2016 14:53	CS-134	<5.135	-7.839	3.909	5.135	pCi/L	U
MW-17	12/15/2016 14:53	CS-137	<5.773	3.25	3.144	5.773	pCi/L	U
MW-17	12/15/2016 14:53	BA-140	<34.56	8.445	20.19	34.56	pCi/L	U
MW-17	12/15/2016 14:53	LA-140	<7.909	-6.368	6.362	7.909	pCi/L	U

Appendix C

METEOROLOGICAL JOINT FREQUENCY DISTRIBUTIONS

REPORT CATEGORY: **METEOROLOGICAL JOINT FREQUENCY DISTRIBUTIONS**
REG. GUIDE 1.21 TABLE 4A

WS/WD Joint Frequency Distribution (percent)

WS (MPH), WD (Sect), JFD (%)

57 Meter

Period 01/01/2016 – 12/31/2016

WS Lim/Dir.	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Freq
2	1.19	0.87	1.42	2.11	1.68	1.35	1.06	0.73	0.56	0.60	0.48	0.68	0.73	0.94	0.56	0.38	**15.34**
4	0.27	0.60	1.09	1.76	1.76	1.53	1.18	0.62	0.53	0.31	0.26	0.37	0.62	0.71	0.23	0.27	**12.11**
6	0.38	0.66	1.48	3.83	3.02	2.08	1.43	1.28	0.72	0.43	0.21	0.34	0.82	1.03	0.52	0.31	**18.56**
8	0.32	0.56	1.21	2.51	3.03	1.98	1.61	1.50	1.12	0.60	0.22	0.25	0.47	1.43	0.45	0.29	**17.55**
10	0.31	0.41	0.55	0.81	2.37	1.32	1.05	1.59	1.21	0.68	0.18	0.08	0.33	1.79	0.60	0.27	**13.55**
15	0.30	0.21	0.08	0.18	1.85	1.71	0.60	1.08	0.81	0.34	0.27	0.16	0.42	2.27	1.04	0.85	**12.17**
20	0.00	0.00	0.01	0.02	0.09	0.52	0.06	0.03	0.01	0.00	0.06	0.07	0.16	0.66	0.63	0.08	**2.40**
>20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.45	0.21	0.00	**0.70**
Freq	**2.77**	**3.31**	**5.84**	**11.23**	**13.82**	**10.49**	**6.99**	**6.85**	**4.97**	**2.95**	**1.68**	**1.95**	**3.59**	**9.27**	**4.22**	**2.45**	**92.38**

REPORT CATEGORY: **METEOROLOGICAL JOINT FREQUENCY DISTRIBUTIONS**
REG. GUIDE 1.21 TABLE 4B

			57 Meter			10 Meter			
	Sigma Theta (Deg)	Delta Temp (Deg C)	Wind Direction (Deg)	Wind Speed (MPH)	Dew Point (Deg C)	Wind Direction (Deg)	Wind Speed (MPH)	Dew Point (Deg C)	Temperature (Deg C)
Maximum	34.57	4.90	359.49	26.11	23.83	359.92	23.60	25.18	43.91
Minimum	0.00	-5.00	0.00	0.00	-50.00	0.00	0.00	-50.00	-50.00
Sigma	3.52	1.65	95.52	4.20	10.49	93.14	2.90	11.51	10.67
Average	4.59	-0.47	154.36	6.49	6.13	144.81	3.85	7.81	18.18
Percent	**92.40%**	**92.40%**	**92.40%**	**92.40%**	**92.40%**	**99.76%**	**94.08%**	**99.76%**	**99.76%**

Sigma Theta Stability Class	Percent
A	10.17
B	0.74
C	0.79
D	34.67
E	36.73
F	8.78
G	0.50
Total	**92.38**

Delta T Stability Class	Percent
A	10.17
B	0.74
C	0.79
D	34.67
E	36.73
F	8.78
G	0.50
Total	**92.38**

Appendix D

REVISED OFFSITE DOSE CALCULATION MANUAL

ARKANSAS NUCLEAR ONE

OFFSITE DOSE CALCULATION MANUAL

REVISION 27

Changes are indicated by beginning the affected information with a revision bar on the right side of the page which stops at the end of the change. Deletions of entire paragraphs or sections have a revision bar to the right of the page where text was deleted. The amendment number is indicated at the bottom of the affected page near the left margin and indicates the latest revision to the information contained on that page. Absence of a revision bar on a replacement page means the page was reprinted for word processing purposes only. However, general formatting changes may have been made to all pages.

TABLE OF CONTENTS

TABLE OF CONTENTS *(continued)*

APPENDIX 1 RADIOLOGICAL EFFLUENT CONTROLS BASES

1.0 INTRODUCTION

The Offsite Dose Calculation Manual (ODCM) provides guidance for making release rate and dose calculations for radioactive liquid and gaseous effluents from Arkansas Nuclear One - Units 1 and 2 (ANO-1 and ANO-2). The methodology is drawn from NUREG-0133, Rev. 0. Parameters contained within this manual were taken from NUREG-0133 and Regulatory Guide (RG) 1.109 except as noted for site specific values. These numbers and the calculational method may be changed as provided for in the Technical Specifications (TSs).

The following references are utilized in conjunction with the limitations included in this manual concerning the indicated subjects:

Subject	ANO-1	ANO-2
Process Control Program (PCP)	EN RW-105	EN RW-105
Radioactive Effluent Controls Program	TS 5.5.4	TS 6.5.4
Annual Radiological Environmental Monitoring Report	TS 5.6.2	TS 6.6.2
Radioactive Effluent Release Report	TS 5.6.3	TS 6.6.3
ODCM	TS 5.5.1	TS 6.5.1

2.0 LIQUID EFFLUENTS

2.1 Radioactive Liquid Effluent Monitor Setpoint

ODCM Limitation L 2.1.1, “Radioactive Liquid Effluent Instrumentation,” requires that the radioactive liquid effluents be monitored with the alarm/trip setpoints adjusted to ensure that the limits of the radioactive liquid effluent concentration limitations are not exceeded. These concentrations are for the site. The alarm/trip setpoint on the liquid effluent monitor is dependent upon the dilution water flow rate, radwaste tank flow rate, isotopic composition of the radioactive liquid to be discharged, a gross gamma count of the liquid to be discharged, background count rate of the monitor, and the efficiency of the monitor. Due to the fact that these are variables, an adjustable setpoint is used. The setpoint must be calculated and the monitor setpoint set prior to the release of each batch of radioactive liquid effluents. The following methodology is used for the setpoint determination for the following monitors.

ANO-1: RE-4642 – Liquid Radwaste Monitor

ANO-2: 2RE-2330 – Liquid Radwaste Monitor
2RE-4423 – Liquid Radwaste Monitor

1) A sample from each tank (batch) to be discharged is obtained and counted for gross gamma (Cs-137 equivalent) and a gamma isotopic analysis is performed.

2) A dilution factor (DF) for the tank is calculated based upon the results of the gamma isotopic analysis and the Maximum Permissible Concentration (MPC) of each detected radionuclide.

DF is calculated as follows:

$$DF = \Sigma_i(C_i/MPC_i) + C_{TNG}/MPC_{TNG}$$

where:

DF = dilution factor;

C_i = concentration of isotope "i", (µCi/ml);

MPC_i = maximum permissible concentration of isotope "i", (from 10 CFR 20, Appendix B, Table II, Column 2 in µCi/ml);

C_{TNG} = total concentration of noble gases (µCi/ml); and

MPC_{TNG} = 2×10^{-4} (µCi/ml) per Limitation L 2.3.1.a

3) The dilution water flowrate is normally the number of ANO-1 circulating water pumps in operation at the time of release. Each circulating water pump has an approximate flowrate of 191,500 gallons per minute (gpm) (this flowrate may be reduced due to throttling of circulating water pump flow and/or circulating water bay configuration). However, under specific conditions and under strict controls, lower dilution water flowrates utilizing service water and cooling tower blowdown flowrates may be used.

4) The theoretical release rate, F_m, of the tank (batch) to be released is expressed in terms of the dilution water flowrate, such that for each volume of dilution water released, a given volume of liquid radwaste may be combined. This may be expressed as follows:

$$F_m = DV/DF$$

where:

F_m = theoretical release rate (gpm);

DV = Dilution volume (gpm). When ANO-1 circulating water pumps are running, DV is the number of ANO-1 circulating water pumps in operation multiplied by the approximate flowrate of an ANO-1 circulating water pump (normally 191,500 gpm) or an indicated flow rate. The minimum total flow rate shall be greater than or equal to 100,000 gpm. Otherwise DV is dilution volume provided by service water and cooling tower blowdown flowrate; and

DF = dilution factor as calculated in Step 2 above.

Note: In the above equation, the theoretical release rate (F_m) approaches zero as the dilution factor increases. The actual flowrate (F_A) will normally be equal to the theoretical release rate for high activity releases. For low activity releases, the theoretical release rate becomes large and may exceed the capacity of the pump discharging the tank. In these cases, the actual release rate may be set to the maximum flowrate of the discharge pump.

5) The monitor setpoint is calculated by incorporating the monitor reading prior to starting the release (i.e., background countrate), and a factor which is the amount of increase in the release concentration that would be needed to exceed the radioactive liquid concentration limitation. The monitor setpoint is expressed as follows:

$$M_L = A*(K*F_M/F_A) + B$$

where:

- M_L = monitor setpoint (counts per minute or "cpm");
- A = allocation fraction for the specific unit. (Typically, these values are set at 0.45, but may be adjusted up or down as needed. However, the total site allocation can not exceed 1.0.)
- K = monitor countrate (cpm) expected based on the gross activity of the release (this value is obtained from a graph of activity (µCi/ml) versus output countrate for the monitor (cpm));
- F_M/F_A = number of times the activity would have to increase to exceed the radioactive liquid effluent-concentration limitation; and
- B = background countrate (cpm) prior to the release.

To permit the computer to calculate the setpoint, an equation for the expected countrate (K) is expressed as follows:

$$K = \text{Offset} * S_A^{\text{Slope}}$$

where:

$$\text{Slope} = \frac{\text{Log of the detector response in cpm}}{\text{Log of activity concentration in } \mu\text{Ci/ml}}$$

- S_A = Gross gamma (Cs-137 equivalent) activity for the tank (µCi/ml); and
- Offset = detector response (cpm) for the minimum detectable sample activity calculated from the calibration data.

Note: I&C personnel use varying concentrations of Cs-137 to determine the response curve; therefore, a Cs-137 equivalent activity must be used to accurately predict the countrate.

Combining terms, the equation for determining the monitor setpoint may be expressed as follows:

$$M_L = A[(\text{Offset} * S_A^{\text{Slope}})F_M/F_A] + B$$

2.2 Liquid Dose Calculation

The "dose" or "dose commitment" to an individual in the unrestricted area shall be less than or equal to the limits specified in 'Radioactive Liquid Effluents – Dose' Limitations. The dose limits are on a per reactor basis. This value is calculated using the adult as the maximum exposed individual via the aquatic foods (Sport Freshwater Fish) and the potable water pathways.

2.2.1 Dose Calculations for Aquatic Foods

The concentrations of radionuclides in aquatic foods are assumed to be directly related to the concentrations in water. The equilibrium ratios between the two concentrations are called "bioaccumulation factors."

Two different pathways are calculated for aquatic foods: sport and commercial freshwater fish.

The internal dose "d" from the consumption of aquatic foods in pathway "p" to organ "j" of individuals of age group "a" from all nuclides "i" is computed as follows (see Chapter 4 of NUREG-0133 and RG 1.109-12, equation A-3):

$$d_p\,(r,\theta,a,j) = \Sigma_i[\{(1100)(e^{-\lambda_i t_p})(B_i)\}(M)(U_a)(F)^{-1}(Q_i)(D_{aij})]$$

The total dose from both aquatic food pathways is then:

$$D(r,\theta,a,j) = \sum_P d_p\,(r,\theta,a,j)$$

where:

- r = user-selected distance from the release point to the receptor location, in kilometers. It may be different from the controlling distance specified for the potable water pathway (0.4 km);
- θ = user-selected sector (one of sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc.). This sector may be different from the controlling sector specified for the potable water pathway (S);
- A = user-selected age group: infant, child, teen, adult. It is the same controlling age group used in the potable water pathway (adult);
- J = user-selected organ: bone, liver, total body, thyroid, kidney, lung, GI-LLI. It is the same controlling organ used in the potable water pathway (liver);
- { } = represents the concentration factor stored in the database;

  Note: Only one concentration factor is needed to represent the two pathways since sport and commercial use the same bioaccumulation factor for a given pathway.

- 1100 = factor to convert from (Ci/yr)/(ft^3/sec) to ρCi/liter;
- λ_i = decay constant of nuclide "i" in hr^{-1};
- t_p = environmental transit time, release to receptor;

  Note: This value should be set to 0 hours (i.e., no decay correction) for the above equation in order to be consistent with the equation presented in Chapter 4 of NUREG-0133. For maximum individual dose calculations, this value is set to 24 hours, which is the minimum transit time recommended by RG 1.109, Appendix A, 2.b.

- B_i = bioaccumulation factor for nuclide "i", in ρCi/kg per ρCi/liter. Cesium has a site specific number based on carnivorous and bottom feeder sport fish of 400 ρCi/kg per ρCi/liter (0CAN048408, dated April 13, 1984); Niobium has a site specific number based upon freshwater fish of 300 ρCi/kg per ρCi/liter.
- M = dimensionless mixing ratio (reciprocal of the dilution factor) at the point of exposure;

U_a = annual usage factor that specifies the intake rate for an individual of age group "a", in kilograms/year. The program selects this usage factor in accordance with the controlling age group "a" as specified previously by the user;

F = average flow rate in ft^3/sec. This value is based on total dilution volume for the quarter divided by time into the quarter;

Q_i = number of curies of nuclide "i" released; and

D_{aij} = ingestion dose factor for age group "a", nuclide "i", and organ "j", in mrem per ρCi ingested. The program selects the ingestion dose factor according to the user-specified controlling age group "a" and controlling organ "j".

2.2.2 Dose Calculations for Potable Water

The dose "D" from ingestion of water to organ "j" of individuals of age group "a" due to all nuclides "i" is calculated as follows (See Chapter 4 of NUREG-0133 and NRC RG 1.109-12, equation A-2):

Note: The potable water pathway is used only during the time that the Russellville Water System is using the Arkansas River as a water source. The Russellville Water Works will notify ANO when they are using the Arkansas River as a water source.

$$D(r,\theta,a,j) = \Sigma_i [\{(1100)(e^{-\lambda_i t_p})\}(M)(U_a)(F^{-1})(Q_i)(D_{aij})]$$

where:

r = user-selected distance (0.4 km) from the release point to the receptor location, in kilometers. It may be different from the controlling distance selected for the aquatic food pathway;

θ = user-selected sector; (one of the sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc.). It may be different from the controlling sector for the aquatic food pathway;

a = user-selected age group (infant, child, teen, adult). The same controlling age group is used for all liquid pathways (adult);

j = user-selected organ (bone, liver, total body, thyroid, kidney, lung, GI-LLI). The same controlling organ is used for all liquid pathways (liver).

{ } = the expression in brackets represents the concentration factor stored in the database;

1100 = factor to convert from (Ci/yr)/(ft^3/sec) to ρCi/liter;

M = dimensionless mixing ratio (reciprocal of the dilution factor) at the point of exposure;

λ_i = decay constant of nuclide "i" in hr^{-1}; and

t_p = environmental transit time, release to receptor.

Note: This value is set to 0 hours (i.e., no decay correction) for the above equation to be consistent with the equation presented in Chapter 4 of NUREG-0133.

U_a = annual usage factor that specifies the intake rate for an individual of age group "a", in liters/year. The program selects this usage factor according to the user-specified controlling age group "a";

F = average flow rate in ft^3/sec; this value is based on total dilution volume for one quarter divided by time into the quarter;

Q_i = number of curies of nuclide "i" in the release; and

D_{aij} = ingestion dose factor, for age group "a", nuclide "i", and organ "j", in mrem per ρCi ingested. The program selects the ingestion dose factor according to the user-specified controlling age group "a" and controlling organ "j".

2.3 Liquid Projected Dose Calculation

The quarterly projected dose is based upon the methodology of Section 2.2 and is expressed as follows:

$$D_{QP} = 92(D_{QC} + D_{RP})/T$$

where:

D_{QP} = quarterly projected dose (mrem);

92 = number of days per quarter;

D_{QC} = cumulative dose for the quarter (mrem);

D_{RP} = dose for current release (mrem); and

T = current days into quarter;

3.0 GASEOUS EFFLUENTS

3.1 Gaseous Monitor Setpoints

Note: Sections 3.1.1 and 3.1.2 below detail two methods of calculating setpoints at ANO. These methods cover two different sets of monitors of which only one will be in-service at any one time.

3.1.1 Batch Release Setpoint Calculations

3.1.1.a This section applies to the following gaseous radiation monitors (these releases are also monitored by the SPING monitors in Section 3.1.2):

ANO-1: RE-4830 – Waste Gas Holdup System Monitor*

RX-9820 – Reactor Building Purge and Ventilation SPING

ANO-2: 2RE-8233 – Containment Building Purge Monitor*

2RE-2429 – Waste Gas Holdup System Monitor*

2RX-9820 – Containment Building Purge and Ventilation SPING

* These monitors provide automatic isolation.

The setpoints to be used during a batch type of release (i.e., Reactor Building [Containment] Purge, release from the Waste Gas Holdup System or any other non-routine release) will be calculated for each release before it occurs.

3.1.1.b The basic methodology for determining a monitor setpoint is based upon the expected concentration at the monitor (C_M). This is in turn based upon the fraction of an MPC assigned to this release point. Batch releases are maintained below the assigned MPC fraction by controlling the release rate. The calculated value of S may not exceed the equivalent of 1 MPC at site boundary. If value of S for RX (2RX) -9820 is less than SPING Channel 5 high alarm setpoint, then the high alarm setpoint may be used as a default value. If the value of S for RE-4830 and 2RE-2429 is less than 50,000 cpm, then 50,000 cpm may be used as a minimum setpoint. If the value of S for 2RE-8233 is less than 1,000 cpm, then 1,000 cpm may be used as a minimum setpoint.

$$S = 1.2(C_M)(K) + (2.0)(B)$$

where:

S = monitor setpoint (cpm);

C_M = Xe-133 equivalent concentration at the monitor (μCi/ml);

K = conversion factor determined from response curve of monitor (cpm per μCi/ml). This value is 1.0 when calculating S for RX (2RX) -9820.

2.0 = factor to accommodate random count rate fluctuations;

B = background count rate at the monitor (cpm).

1.2 = Safety Factor to correct for instrument uncertainties.

3.1.2 Eberline SPING (Final Effluent) Monitor Setpoint Calculations

3.1.2.a This section applies to the following gaseous radiation monitors:

ANO-1:
- RX-9820 – Reactor Building Purge and Ventilation SPING
- RX-9825 – Auxiliary Building Ventilation SPING
- RX-9830 – Spent Fuel Pool Area Ventilation SPING
- RX-9835 – Emergency Penetration Room Ventilation SPING

ANO-2:
- 2RX-9820 – Containment Building Purge and Ventilation SPING
- 2RX-9825 – Auxiliary Building Ventilation SPING
- 2RX-9830 – Spent Fuel Pool Area Ventilation SPING
- 2RX-9835 – Emergency Penetration Room Ventilation SPING
- 2RX-9845 – Auxiliary Building Extension Ventilation SPING
- 2RX-9850 – Radwaste Storage Building Ventilation SPING

The determination of setpoints for the above monitors is based on an assigned fraction of the MPC of noble gas activity at the site boundary (Xe-133 equivalent) released from the above release points. The total of these fractions is always less than 1.00. The assigned fractions are based on the vent flow rates, atmospheric dilution rate, and the ventilation system(s) in operation.

Note: The fact that an effluent monitor is in alarm does not necessarily mean that radioactive gases are being released at such a rate that the MPC limit is being exceeded. The alarm would indicate that radioactive gases are being released at a rate that is exceeding the fractional allocation of an MPC allotted to that particular release point. Consideration must be given to the release rate of radioactive gases via all of the release pathways.

The initial fractions of an MPC allocated to the release points are given below. The allocations may be changed as needed, to allow for operational transients, but may not exceed a site total of 1.00.

Monitor Number	Monitor Name	Fractional Allocation
RX-9820	Reactor Building Purge and Ventilation	0.1000
RX-9825	Auxiliary Building Ventilation	0.2000
RX-9830	Spent Fuel Pool Area Ventilation	0.1500
RX-9835	Emergency Penetration Room Ventilation	0.0001

Monitor Number	Monitor Name	Fractional Allocation
2RX-9820	Containment Building Purge and Ventilation	0.1000
2RX-9825	Auxiliary Building Ventilation	0.2000
2RX-9830	Spent Fuel Pool Area Ventilation	0.1500
2RX-9835	Emergency Penetration Room Ventilation	0.0001
2RX-9840	PASS Building Ventilation	0.0100
2RX-9845	Auxiliary Building Extension Ventilation	0.0100
2RX-9850	Radwaste Storage Building Ventilation	0.0100

Note: The setpoints to be used during a batch release (i.e., Reactor Building [Containment] Purge or Waste Gas Holdup System) will be calculated for each release before it occurs.

3.1.2.b SPING monitor setpoints may be calculated as follows:

$$\text{Setpoint } (\mu\text{Ci/cc}) = A\left(\frac{\text{Xe-133 eq } (\mu\text{Ci/cc})}{F(9.4390\text{E-}9)(\text{TMPC})}\right)$$

where:

A = allocation fraction (the fraction of an MPC at the site boundary (of noble gas Xe-133 eq activity) assigned to the particular release point);

Xe-133 eq = Xenon-133 equivalent concentration;

F = discharge flow of the particular release point in cubic feet per minute (cfm)

$$9.4390\text{E-}9 = 2.8317\text{E-}2(\text{cm/cf})\left(\frac{2.0\text{E-}5(\text{sec/m}^3)}{60(\text{sec/min})}\right)$$

where:

2.0E-5 = the annual average gaseous dispersion factor (corrected for radioactive decay) as defined in Section 2.3 of the ANO-1/ANO-2 Safety Analysis Report (SAR); and

TMPC = total MPCs at site boundary.

3.2 Airborne Release Dose Rate Effects

3.2.1 Noble Gas Release Rate

3.2.1.a To calculate the noble gas release dose rate, the average ground-level concentration of radionuclide "i" at the receptor location must first be determined from the following equation (see RG 1.109-20 equation B-4).

$$x_i\,(\theta) = (3.17 \times 10^4)(Q_i)[D1X/Q(\theta)]$$

where:

$x_i\,(\theta)$ = average ground level concentration in ρCi/m^3 of nuclide "i" at the user-specified controlling distance in sector θ (1.05 km);

(θ) = one of the sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc. (WNW);

3.17×10^4 = number of ρCi per Ci divided by the number of seconds/year;

Q_i = release rate of nuclide "i" in curies/yr and

$D1X/Q(\theta)$ = annual average gaseous dispersion factor (corrected for radioactive decay) in the sector at angle "θ" at the receptor location in sec/m^3. This value is 2.0E-5 sec/m^3 for short term releases.

The annual dose to the total body and skin due to noble gas can be calculated according to Sections 3.1.2.b and 3.2.1.c.

3.2.1.b Annual Total Body Dose Rate

The annual average total body dose rate to the maximally exposed individual is calculated as follows:

$$D^T(\theta) = (RBPF)(S_F)(\Sigma_i\,[x_i(\theta) * DFB_i]$$

where:

$D^T(\theta)$ = total body dose rate due to immersion in a semi-infinite cloud of gas at the controlling distance in sector "θ", in mrem/yr. The program computes one total body dose rate value for each sector in which the user has specified a controlling distance and reports only the maximum value;

θ = one of sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc. (WNW);

RBPF = Reactor Building (Containment) Purge Factor – This factor is used to calculate the length of time (fractional duty cycle) that the purge fans will be in operation. It is calculated by comparing the highest dose rate (DOSER) to its applicable release limit, taking into account the allocation factor for the release point (RBPF = Allocation * Limit/DOSER). This factor is calculated only for ANO-1 and ANO-2 Reactor Building (Containment) purges. For all other releases, this factor is set to 1.0;

S_F = dimensionless attenuation factor accounting for the dose reduction due to shielding by residential structures. The NRC recommended value is 0.7 (for maximum individual)

$x_i(\theta)$ = average ground-level concentration of nuclide "i" at the receptor location in the sector at angle "θ" from the release point, as defined in Section 3.2.1.a; and

DFB_i = total body dose factor for a semi-infinite cloud of radionuclide "i", which includes the attenuation of 5 g/cm² of tissue, in mrem-m^3/ρCi-yr

3.2.1.c Annual Skin Dose Rate

The annual dose rate to the skin of the maximally exposed individual due to noble gases is calculated as follows (see RG 1.109-20 equation B-9):

$$D^S(\theta) = RBPF[(1.11)(S_F)(\Sigma_i(x_i(\theta))(DF_i^\gamma) + \Sigma_i(x_i(\theta))(DFS_i)]$$

where:

$D^S(\theta)$ = skin dose due to immersion in a semi-infinite cloud of gas at the user-specified controlling distance in sector "θ", in mrem;

Note: The program computes a skin dose value for each sector in which the user as specified a controlling distance, but prints out only the maximum value.

RBPF = Reactor Building [Containment] Purge Factor as defined in Section 3.2.1.b.

1.11 = average ratio of tissue to air energy absorption coefficient;

S_F = dimensionless attenuation factor accounting for the dose reduction due to shielding by residential structures. The value is 0.7 (for maximum individual);

$x_i(\theta)$ = is the average ground-level concentration of nuclide "i" at the receptor location in the sector at angle "θ" from the release point, as defined in Section 3.2.1;

θ = one of sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc. (WNW);

DF^γ = gamma air dose factor for a semi-infinite cloud of radionuclide "i", in mrad-m^3/ρCi-yr; and

DFS_i = beta skin dose factor for a semi-infinite cloud of radionuclide "i", which includes the attenuation by the outer "dead" layer of skin, in mrem-m^3/ρCi-yr.

3.2.2 I-131, Tritium and Particulate Release Dose Rate Effects

The annual dose rate to the maximally exposed individual for I-131, tritium and radionuclides in particulate form with half-lives greater than eight days is calculated as follows:

$$DR^{TOT} = (RBPF)(DR^{I} + DR^{G} + DR^{M})$$

where:

RBPF = Reactor Building (Containment) Purge Factor as defined in Section 3.2.1.b;

DR^{I} = dose rate to the controlling age group (infant) associated with the inhalation of radioiodines and particulates, as calculated in Section 3.4.1.b;

DR^{G} = dose rate from direct exposure to activity deposited on the ground plane, as calculated in Section 3.4.1.a; and

DR^{M} = dose rate to the controlling age group (infant) and the controlling organ for ingestion of food (milk), as calculated in Section 3.4.1.d.

Calculation of the annual dose rate considers the infant as the most restrictive age group. The organs that are considered as contributing to the dose rate are: skin, bone, liver, total body, thyroid, kidney, lung, and GI-LLI. The food pathway for the infant is considered to be from milk only. All three pathways will contribute to the total body dose, while the skin will be affected by only the ground plane pathway. The other organs are affected only by the inhalation and food pathways.

3.3 <u>Dose Due to Noble Gases</u>

The air dose in unrestricted areas due to noble gases released in gaseous effluents shall be less than or equal to 5 mrad for gamma radiation and 10 mrad for beta radiation for any calendar quarter for each unit. The objective of less than or equal to 10 mrad of gamma radiation and 20 mrad of beta radiation for a calendar year per unit (2.5 mrad and 5 mrad respectively per quarter) should be used for planning releases.

Note: The following equations have been simplified from equations in NUREG-0133, Revision 0, in that there are no free-standing stacks at ANO. The equations were further simplified in that there are no long term (i.e., continuous) releases. The individual stack vents are sampled weekly, or are assigned a release period of 168 hours per sample (i.e., considered as short term (batch) releases). Individual samples are to be taken for each waste gas release and Reactor (Containment) Building purge.

3.3.1 Beta and Gamma Air Doses from Noble Gas Releases

Using the average ground level concentration of radionuclide “i” at the receptor location calculated in Section 3.2.1.a, the associated annual gamma or beta air dose may be calculated by the following equation (see RG 1.109-20 equation B-5).

$$D^{\gamma}(\theta) \ \underline{or} \ D^{\beta}(\theta) = \Sigma_i \, [(x_i(\theta))(DF_i^{\gamma} \ \underline{or} \ DF_i^{\beta})]$$

where:

$D^{\gamma}(\theta)$ <u>or</u> $D^{\beta}(\theta)$ = the gamma or beta air dose for the controlling distance in sector “θ” (only the maximum value is reported), and

DF_i^{γ} <u>or</u> DF_i^{β} = gamma or beta air dose factors for a uniform semi-annual infinite cloud of nuclide “i”, in mrad-m^3/ρCi-yr.

3.4 Dose Due to I-131, Tritium, and Particulates in Gaseous Effluents

The calculational methodology for determining the dose to an individual from I-131, tritium, and radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released to unrestricted areas as specified in the Limitations is in this section.

The child is the controlling age group unless stated otherwise.

The inhalation and ground plane pathways are considered to exist at all locations. The grass-cow-milk, grass-cow-meat, and vegetation pathways are used where applicable.

It is assumed that iodines are in the elemental form.

A dispersion parameter of 2.0E-5 sec/m^3 (per ANO-1/ANO-2 SAR, Section 2.3) is used for “w” in the inhalation pathway since the majority of gaseous activity released from the site is within the 8 to 24 hours time frame (i.e., Reactor Building [Containment] purges and Waste Gas Decay tanks).

The equation is:

$$D^{TOT} = D^{G} + D^{I} + D^{V} + D^{L} + D^{M} + D^{F}$$

where:

D^{TOT} = total dose;

D^{G} = dose contribution from ground plane deposition as calculated in Section 3.4.1.a;

D^{I} = dose contribution from inhalation of radioiodines, tritium, and particulates (> 8 days) as calculated in Section 3.4.1.b;

D^{V} = dose contributions from consumption of vegetation (defined as produce) for humans and stored feed for cattle. See Section 3.4.1.c for calculations;

D^{L} dose contributions from consumption of fresh leafy vegetables (defined as garden products) for humans and pasture grass for cattle. See Section 3.4.1.c for calculations;

D^{M} = dose contribution from consumption of cow's milk; and

Note: Consumption by the cow of both stored feeds and pasture grasses is taken into account when calculating this dose contribution. Concentration factors for both food sources are calculated.

D^{F} = dose contribution from consumption of meat.

Note: Consumption by the cow of both stored feeds and pasture grasses is taken into account when calculating this dose contribution. Concentration factors for both types of animal are calculated.

3.4.1 Total Dose from Atmospherically Released Radionuclide

After the calculation of the concentration factors from the applicable parts of Section 3.4.1, the maximum individual dose as calculated for controlling age group "a" and controlling organ "j", in sector θ at the controlling distance "r" is given from:

$D^G(r,\theta,j,a)$		(Section 3.4.1.a)	for ground plane deposition
$D^I(r,\theta,j,a)$		(Section 3.4.1.b)	for inhalation
$D^V(r,\theta,j,a)$	=	$\sum_i DFI_{ija} U_a^V C_i^V(r,\theta)$	for produce
$D^L(r,\theta,j,a)$	=	$\sum_i DFI_{ija} U_a^L C_i^L(r,\theta)$	for leafy vegetables
$D^M(r,\theta,j,a)$	=	$\sum_i DFI_{ija} U_a^M C_i^M(r,\theta)$	for cow's milk
$D^F(r,\theta,j,a)$	=	$\sum_i DFI_{ija} U_a^F C_i^F(r,\theta)$	for meat

where:

a = controlling age group (infant, child, teen, or adult);

j = controlling organ (bone, liver, total body, thyroid, kidney, lung, or GI-LLI);

r = user-selected distance from the release point to the receptor location in a particular sector, in kilometers (the controlling distance is the same for all airborne pathways, 1.05 km);

θ = one of sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc. (WNW);

DFI_{ija} = dose conversion factor for ingestion of nuclide "i", organ "j", and age group "a", in mrem/ρCi;

Note: Values used in these tables are taken from Tables E-11 through E-14 of RG 1.109. DFI_{ija} is selected according to the controlling organ and age group as specified in the database.

U_a^V, U_a^L, U_a^M, U_a^F = ingestion rates for produce, leafy vegetables, cow's milk, and meat, respectively, for individuals in age group "a". Values used are taken from Table E-5 of RG 1.109.);

C_i^V, D_i^L, C_i^M D_i^F = concentration of nuclide "i" for produce, leafy vegetables, cow's milk, and meat, respectively, in ρCi/kg or ρCi/liter.

The program calculates that maximum individual dose for each sector surrounding the plant in which the user has specified a controlling distance for each of the following pathways: A) ground plane deposition; B) inhalation and the ingestion of; C) produce; D) leafy vegetables; E) cow's milk; and F) meat. Only the receptor point receiving the maximum dose value is printed.

3.4.1.a Dose from Ground Plane Deposition

The dose D^G from direct exposure to activity deposited on the ground plane is calculated as follows (see RG 1.109-24, equations C-1 and C-2):

$$D^G(R,\theta,j,a) = \{(S_F)(1.0 \times 10^{12})(\Sigma_i[(\lambda_i^{-1})(1 - e^{-\lambda_i t_b})]\}(DOQ(r,\theta))(Q_i)(DFG_{ij})$$

where:

r = user-selected distance from the release point to the receptor location in a particular sector, in kilometers. The controlling distance is the same for all airborne pathways (1.05 km);

θ = one of sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc. (WNW);

a = user-selected age group (infant, child, teen, adult) which is the same controlling age group used for all airborne pathways (child);

j = user-selected organ (bone, liver, total body, thyroid, kidney, lung, GI-LLI) which is the same controlling organ used for all airborne pathways;

{ } = represents the concentration factor stored in the database;

S_F = dimensionless attenuation factor accounting for the dose reduction due to shielding by residential structures. The value is 0.7 (for maximum individual);

1.0×10^{12} = number of ρCi per Ci;

λ_i = decay constant of nuclide "i" in hr^{-1};

t_b = length of time over which the accumulation is evaluated (nominally 15 years which is the approximate midpoint of facility operating life or 1.31×10^5 hours);

DOQ(r,θ) = average relative deposition of the effluent at the receptor location "r" in sector "θ", considering depletion of the plume during transport, in m^2 (1.7E-8/m^2);

Qi = release of nuclide "i" in curies, and

DFG_{ij} = open field ground plane dose conversion factor for organ "j" (total body or skin) from radionuclide "i", in mrem-m^2/ρCi-hr. The dose factor is selected according to the user-specified controlling age group "a" and controlling organ "j".

3.4.1.b Dose from Inhalation of Radionuclides in Air

The dose DI to organ "j" of age group "a" associated via inhalation of radioiodines and particulates is (see RG 1.109-25, Equations C-3 and C-4):

$$D^I(r,\theta,j,a) = (3.17 \times 10^4)(R_a)(\Sigma_i[(Q_i)(D2DPX/Q(r,\theta))(DFA_{ija})]$$

where:

r = user-selected distance from the release point to the receptor location in a particular sector, in kilometers. The controlling distance is the same for all airborne pathways (1.05 km);

θ = one of sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc. (WNW);

j = user-selected organ (bone, liver, total body, thyroid, kidney, lung, GI-LLI) and is the same controlling organ as that used for all airborne pathways;

a = user-selected age group (infant, child, teen, adult) and is the same controlling age group as that used for all airborne pathways;

3.17×10^4 = number of ρCi/Ci divided by the number of seconds/year;

R_a = annual air intake for individuals in age group “a” (in m^3/year). The air intake factor is selected in accordance with the user-specified controlling age group;

Q_i = release of nuclide “i” in curies;

D2DPX/Q(r,θ) = annual average atmospheric dispersion factor of the radionuclide at the receptor location “r” in sector “θ“ (in sec/m^3) as calculated; and

Note: This includes depletion (for radioiodines and particulates) and radioactive decay of the plume.

DFA_{ija} = inhalation dose factor for radionuclide “i”, organ “j”, and age group “a”. The inhalation dose factor is selected in accordance with the user-specified controlling age group “a” and controlling organ “j”.

3.4.1.c Dose from Nuclide Concentrations in Vegetation

Note: To reduce the computational overhead of the computer, the calculations for dose resulting from nuclide concentrations in forage, produce and leafy vegetables is performed in three steps.

First, the concentration factors (CF) are computed and stored in the database. The concentration factor includes all the parameters that are considered constant for each nuclide and agricultural activity, such as the radioactive decay constant, removal rate constant, exposure time, etc.

Second, the deposition rate from the plume is multiplied by the concentration factor and the nuclide activity to produce the nuclide concentration as follows:

$$C_i^V(r,\theta) = (CF_i)(DOQ(r,\theta))(Q_i)$$

where:

$C_i^V(r,\theta)$ = concentration of nuclide “i” at the receptor location (r,θ);

CF_i = concentration factor of nuclide “i”;

DOQ(r,θ) = relative deposition of nuclide “i”. For the short term dispersion option, DOQ is replaced by (F x DOQ), where F is the short term dispersion correction factor;

Q_i = quantity of nuclide “i” released in curies.

For carbon-14 and tritium, the nuclide concentration is calculated from the concentration factor times the decayed and depleted X/Q for radioiodines and particulates (D2DPX/Q), times the quantity of nuclide “i” released in curies. For the short term dispersion option, D2DPX/Q is replaced by F x D2DPX/Q, where F is the short term dispersion correction factor.

$$C^V_T(r,\theta) = (CF_T)(D2DPX/Q(r,\theta))(Q_T) \text{ for tritium, and}$$

$$CF^V{}_{14}(r,\theta) = (CF_{14})(D2DPX/Q(r,\theta))(Q_{14}) \text{ for carbon-14}$$

Third, the nuclide concentrations for a particular pathway (produce, leafy vegetables, cow's milk, and meat) are summed and multiplied by: 1) the ingestion rate for a particular age group and 2) the dose conversion factor:

$$D(r,\theta,j,a) = \Sigma_i [(DFI_{ija})(U_a)(C^V_i(r,\theta))]$$

where:

- r = user-selected distance from the release point to the receptor location in a particular sector, in kilometers (1.05 km);
- θ = one of sixteen 22.5° sectors surrounding the reactor site, designated N, NNE, NE, etc. (WNW);
- j = user-selected organ (bone, liver, total body, thyroid, kidney, lung, GI-LLI), and is the same controlling organ as that used for all airborne pathways;
- a = user-selected age group (infant, child, teen, adult), and is the same controlling age group as that used for all airborne pathways;
- DFI_{ija} = dose conversion factor for ingestion of nuclide "i", organ "j", and age group "a", in mrem/ρCi, according to the controlling organ and age group;
- Ua = annual ingestion rate of food in a particular pathway (kilograms/year or liters/year) for individuals in age group "a", according to the controlling age group; and
- $C^V_i(r,\theta)$ = concentration of nuclide "i" at the receptor location (r,θ).

3.4.1.c.1 Calculating Vegetation Concentration Factors

NUREG-0133 calculations for radioiodines and particulate radionuclides (except tritium and carbon-14), the concentration factor of nuclide "i" in and on vegetation is estimated as follows:

$$CF^V_i = (CONST)\left(\frac{r}{(Y_v)(\lambda_i)}\right)(e^{-\lambda_i t_h})(f)$$

where:

- CF^V_i = concentration factor of radionuclide "i" in vegetation (forage, produce, or leafy vegetables), in m^2-hr/kg;
- CONST = 1.14×10^8 number of ρCi per Ci (10^{12}) divided by the number of hours per year (8760);
- r = is the fraction of deposited activity retained on crops, leafy vegetables, or pasture grass, from airborne radioiodine and particulate deposition:
  - r = 1.00 for radioiodines
  - r = 0.20 for particulates
- Y_v = agricultural productivity (yield or vegetation area density), in kg (wet weight)/m^2:
  - Y_s = 2.0 kg/m^2 for stored animal feed for grass-animal-man pathways
  - Y_ρ = 0.7 kg/m^2 for pasture grass for grass-animal-man pathways

Y_1 = 2.0 kg/m^2 for leafy vegetation (fresh) for crop/vegetation-man pathways

Y_g = 2.0 kg/m^2 for garden produce (stored vegetables) for crop/vegetation-man pathways

λ_i = is the decay constant of nuclide "i" in hr^{-1};

t_h = is a holdup time that represents the time interval between harvest and consumption of the food, in hours:

t_h = 0 hours for pasture grass consumed by animals

t_h = 2160 hours for stored feed consumed by animals

t_h = 24 hours for leafy vegetables consumed by humans

t_h = 1440 hours for produce consumed by humans

f = is the fraction of leafy vegetables or produce grown in garden of interest:

f = 0.76 for the fraction of produce ingested, grown in garden of interest (this is f_g in equation C-13 of RG 1.109)

f = 1.00 for the fraction of leafy vegetables grown in garden of interest (this is f_1 in equation C-13 of RG 1.109)

f = 1.00 for all other pathways

3.4.1.c.2 Concentration Factor for Carbon-14

For carbon-14, the concentration factor in and on vegetation is estimated as follows (see RG 1.109-26, equation C-8):

$$CF^V{}_{14} = (2.2 \times 10^7)(\rho)$$

where:

$CF^V{}_{14}$ = concentration factor of carbon-14 in and on vegetation, in m^2-hr/kg; and

ρ = is defined as the ratio of total annual release time (for C-14 atmospheric releases) to the total annual time during which photosynthesis occurs (taken to be 4400 hours), under the condition that the value of "ρ" should never exceed unity. For continuous C-14 releases, "ρ" is taken to be unity (thus, the value of 2.2×10^7 is stored for $CF^V{}_{14}$ in lieu of a site specific value for "ρ").

3.4.1.c.3 Concentration Factor for Tritium

The concentration factor for tritium in vegetation is calculated from the tritium concentration in air surrounding the vegetation (see RG 1.109-27, equation C-9):

$$CF_T^V = \frac{1.2 \times 10^7}{H}$$

where:

CF_T^V = concentration factor for tritium in vegetation (in m^2-hr/kg); and

H = absolute humidity at the location of the vegetation, in g/m^3 (the regulatory default value for "H" is 8.0 grams/m^3).

Thus, the value 1.5×10^6 is stored for CF_T^V in lieu of a site specific value for "H".

3.4.1.c.4 Nuclide Concentrations in Produce and Leafy Vegetables

The concentrations in and on produce and leafy vegetables of all radioiodine and particulate nulcides "i" (except carbon-14 and tritium) are calculated as follows:

$$C_i^V(r,\theta) = (CF_i^V)(DOQ(r,\theta))(Q_i) \text{ for produce; and}$$

$$C_i^L(r,\theta) = (CF_i^L)(DOQ(r,\theta))(Q_i) \text{ for leafy vegetables}$$

where:

CF_i^V = concentration factor of nuclide "i" in produce;

CF_i^L = concentration factor of nuclide "i" in leafy vegetables;

Note that the difference between CF_i^V and CF_i^L are the values for t_h and f_1.

$DOQ(r,\theta)$ = relative deposition of the radionuclide "i" at the receptor (r,θ); and

Q_i = release of nuclide "i" (in curies).

The C-14 and H-3 nuclide concentrations are calculated from the concentration factors times the decayed and depleted radioiodine relative deposition D2DPX/Q times the fraction grown in the garden of interest (f_g = 0.76, f_1 = 1.0):

$$C_T^V(r,\theta) = (CF_T^V)(D2DPX/Q(r,\theta))(Q_T)(f_g)$$

$$C_T^L(r,\theta) = (CF_T^L)(D2DPX/Q(r,\theta))(Q_T)(f_1) \text{ for tritium}$$

$$C_{14}^V(r,\theta) = (CF_{14}^V)(D2DPX/Q(r,\theta))(Q_{14})(f_g)$$

$$C_{14}^L(r,\theta) = (CF_{14}^L)(D2DPX/Q(r,\theta))(Q_{14})(f_1) \text{ for carbon-14}$$

3.4.1.d Nuclide Concentration in Cow's Milk

The radionuclide concentration in cow's milk is dependent upon the quantity and contamination level of feed consumed by the animal. The concentration is estimated (see RG 1.109-27, equations C-10 and C-11) as follows:

$$C_i^m(r,\theta) = \{(F_m)(Q_F)(e^{-\lambda_i t_f})[(f_p)(f_s)(CF_i^v) + (1 - f_p)(CF_i^{v1}) + (f_p)(1 - f_s)(CF_i^{v1})]\}(D(r,\theta)(Q_i)$$

where:

$C_i^m(r,\theta)$ = is the concentration of nuclide "i" in cow's milk at the receptor location (r,θ), in ρCi/liter;

{ } = the expression in brackets represents the concentration factor (note that the concentration factor for cow's milk involves two different vegetation concentration factors (see below));

F_m = average fraction of the cow's daily intake of radionuclide "i" (which appears in each liter of milk), in days/liter;

Q_F = amount of feed consumed by the cow per day, in kg/day (wet weight);

λ_i = decay constant of nuclide "i" in hr^{-1};

t_f = average transport time of the activity from the feed into the milk and to the receptor (a value of 2 days is assumed);

fp = fraction of the year that cows graze on pasture;

fs = fraction of daily feed that is pasture grass when the cow grazes on pasture;

CF_i^v = vegetation concentration factor of nuclide "i" on pasture grass with the holdup time t_h = 0 days, in ρCi/kg (refer to the explanation of the vegetation concentration factor calculation);

CF_i^{v1} = vegetation concentration factor of nuclide "i" in stored feeds with the holdup time t_h = 90 days, in ρCi/kg (refer to the explanation of the vegetation concentration factor calculations);

D(r,θ) = relative deposition DOQ(r,θ) of the radionuclides, except carbon-14 and tritium. For carbon-14 and tritium, the decayed and depleted dispersion factor D2DPX/Q(r,θ) for radioiodines and particulates (in sec/m^3) is used; and

Q_i = is the release of nuclide "i" in curies.

3.4.1.e Nuclide Concentration in Meat

The radionuclide concentration in meat is dependent upon the quantity and contamination level of feed consumed by the animal. The concentration is estimated (see RG 1.109-27, equations C-11 and C-12) as follows:

$$C_i^f(r,\theta) = \{(F_f)(Q_F)(e^{-\lambda_i t_s})[(f_p)(f_s)(CF_i^v) + (1- f_p)(CF_i^{v1}) +(f_p)(1 - f_s)(CF_i^{v1})]\}(D(r,\theta)(Q_i)$$

where:

Note: All parameters used in this pathway are for beef cattle.

$C_i^f(r,\theta)$ = concentration of nuclide "i" in animal flesh at the receptor location (r,θ) in ρCi/liter;

{ } = the expression in brackets represents the concentration factor (note that the concentration factor for meat involves two different vegetation concentration factors);

F_f = average fraction of the animal's daily intake of radionuclide "i" which appears in each kilogram of flesh (in days/kg);

Q_f = amount of feed consumed by the animal per day in kg/day (wet weight);

λ_i = decay constant of nuclide "i" in hr^{-1};

t_s = average time from slaughter of the animal to consumption by humans (20 days);

f_p = fraction of the year that animals graze on pasture;

f_s = fraction of daily feed that is pasture grass when the animal grazes on pasture;

CF_i^{v1} = vegetation concentration factor of nuclide "i" on pasture grass with the holdup time t_h = 0 days in ρCi/kg (refer to the explanation of the vegetation concentration factor calculation);

CF_i^{v1} = vegetation concentration factor of nuclide "i" in stored feeds with the holdup time t_h = 90 days, in ρCi/kg (refer to the explanation of the vegetation concentration factor calculation);

$D(r,\theta)$ = relative deposition $DOQ(r,\theta)$ of the radionuclides, except carbon-14 and tritium. For carbon-14 and tritium, the decayed and depleted dispersion factor $D2DPX/Q(r,\theta)$ for radioiodines and particulates (in sec/m^3) is used;

Q_i = is the release of nuclide "i" (in curies).

3.5 Gaseous Effluent Projected Dose Calculation

3.5.1 The quarterly projected dose is based upon the methodology of Sections 3.3 and 3.4, and is expressed as follows:

$$D_{QP} = \left(\frac{D_{QC} + D_{RP}}{T}\right)(92)$$

where:

D_{QP} = Quarterly projected dose (mrem);

D_{QC} = cumulative dose for the quarter (mrem);

D_{RP} = dose for current release (mrem);

T = current days into quarter; and

92 = number of days per quarter.

3.6 Dose to the Public Inside the Site Boundary

3.6.1 Liquid Releases

Dose to the public inside the site boundary due to liquid releases will be due to ingestion of fish caught from the discharge canal and exposure to sediment along the discharge canal bank while fishing.

3.6.1.a Dose Due to Ingestion of Fish

Dose due to ingestion of fish is calculated using the methodology given in Section 2.2, Liquid Dose Calculation.

3.6.1.b Dose Due to Exposure to Shoreline Sediments

Dose from external exposure to shoreline sediments is calculated from equation A-7 of RG 1.109, Rev. 1, 10/77.

$$R_{apj} = 110{,}000\left(\frac{(U_{ap})(M_p)(W)}{F}\right)(\Sigma_i\ [(Q_i)(T_i)(D_{aipj})(e^{-\lambda i\ tp})(1-e^{-\lambda i\ tb})]$$

where:

R_{apj} = is the total annual dose to organ "j" of individuals of age group "a" from all of the nuclides "i" in pathway in mrem/yr;

U_{ap} = is the usage factor that specifies exposure time for the maximum individual of age group "a" in hours from Table E-5 of RG 1.109. Sixty-seven hours for shoreline recreation for a teen was chosen. Adult is the controlling age group for ingestion but the maximum usage factor (teen) was used rather than the adult factor to ensure a conservative dose estimate;

M_p = is the mixing ratio (reciprocal of dilution factor);

W = is the shoreline width factor from Table A-2 of RG 1.109. The discharge canal value of 0.1 was chosen;

F = is the flow rate of the liquid effluent in ft^3/sec. This was determined by:

$$F(ft^3/sec) = \text{waste volume (gal/yr)} * \frac{.134\ ft^3}{1\ gal} * \frac{1\ yr}{8760\ hr} * \frac{1\ hr}{3600\ sec}$$

where:

Q_i = is the release of nuclide "i" in Ci/yr;

T_i = is the radioactive half-life of nuclide "i", in days, from Radioactive Decay Data Tables, Technical Information Center, U. S. Dept. of Energy, 1981;

D_{aipj} = is the dose factor specific to age group "a", nuclide "i", and organ "j" from Table E-6 of RG 1.109;

λ_i = is the radioactive decay constant of nuclide "i" in hr^{-1};

t_p = is the average transit time for nuclides to reach the point of exposure. A value of 0 hours was chosen due to the proximity of the discharge canal to the plant; and

t_b = is the period of time for which sediment is exposed to the contaminated water in hours. The mid-point of plant operating life, 15 years was chosen per RG 1.109.

3.6.2 Airborne Release

3.6.2.a Dose Due to Noble Gases

Dose to fisherman at the discharge canal can be calculated by the ratio of dispersion factor for the discharge canal (1.6E-4 sec/m^3 from Table 2-45 SAR, Unit 1, 100 meters downwind in a southerly direction) and the usage factor of 67 hours of shoreline recreation to the values used in Section 3.3 of this manual.

$$\text{Dose at discharge canal} = D^T(\theta) * \frac{1.6E\text{-}4}{2.0E\text{-}5} * \frac{67\ hr}{8760\ hr}$$

where $D^T(\theta)$ is the noble gas dose calculated by Section 3.3.

3.6.2.b Dose Due to Iodine, Tritium and Particulates from Gaseous Effluents

Section 3.4 calculates total dose for iodine, tritium and particulates as the sum of:

$$D^{TOT} = D^G + D^I + D^V + D^L + D^M + D^F$$

where:

D^G = ground plane deposition;

D^I = inhalation;

D^v = consumption of vegetation;

D^L = consumption of fresh leafy vegetables;

D^m = consumption of milk; and

D^F = consumption of meat and poultry

The only contributions relevant to fishing activities at the discharge canal are ground plane deposition and inhalation. As D^G and D^I are not independently available, a conservative estimate can be obtained by using the same correction factor developed for noble gas dose to the total dose calculated in Section 3.4 for iodine, tritium and particulates. Depletion of the plume as it travels downwind can be ignored since the fraction remaining in the plume at 100 meters (discharge canal) and 1046 meters (site boundary) are both greater than 90% according to Figure 3 of RG 1.111.

The only activity inside the plant site by members of the public that might contribute a significant dose is fishing along the banks of the discharge canal. Travel along public roads would involve short exposure time and tours of the facility are conducted according to radiological control procedures enforced at the plant to control exposure. Fishing is the only uncontrolled activity.

4.0 ENVIRONMENTAL SAMPLING STATIONS - RADIOLOGICAL

Section 1.0 of the ODCM provides reference to the Radioactivty Effluent Controls Program governed by ANO-1 TS 5.5.4 and ANO-2 TS 6.5.4. However, a Radiological Environmental Monitoring Program is also necessary to meet the intent of the purpose of the ODCM.

The Radiological Environmental Monitoring Program is established to provide radiation and radionuclide monitoring in the environs surrounding the site. The program provides a method for representative measurements of radioactivity in the highest potential exposure pathways. In addition, the program provides for verification of the accuracy of the effluent monitoring program and modeling of envronmental exposure pathways.

The Radiological Environmental Monitoring Program is established by the ODCM and conforms to the guidance contained in 10 CFR 50, Appendix I. The program also provides for:

1. Monitoring, sampling, analysis, and reporting of radiation and radionuclides in the environment in accordance with the methodology and parameters of the ODCM,

2. A land use census to ensure that changes in the use of areas at and beyond the site boundary are identified and that modifications to the monitoring program are made, if required by the results of the census, and

3. Participation in an Interlaboratory Comparison Program to ensure that independent checks on the precision and accuracy of the measurements of radioactive materials in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring.

Environmental samples are collected as specified in the Limitations. The approximate locations of selected sample sites are shown on Figures 4-1, 4-1A, and 4-1B for illustrative purposes.

Table 4-1 lists the approximate distances and directions of the sample stations from the plant.

5.0 REPORTING REQUIREMENTS

5.1 Annual Radiological Environmental Operating Report

The Annual Radiological Environmental Operating Report is submitted by May 15 of each year and contains a summary of the Radiological Environmental Monitoring Program for the reporting period. This report meets the requirements of TS 5.6.2 (ANO-1) and TS 6.6.2 (ANO-2), and is consistent with the objectives outlined in the ODCM and 10 CFR 50, Appendix I, Sections IV.B.2, IV.B.3, and IV.C. The report is formatted consistent with RG 1.21, Revision 1, to the extent possible. A single submittal is normally prepared incorporating the data for both ANO units (common information is combined).

The Annual Radiological Environmental Operating Report includes the following:

1. Summarized and tabulated results of all radiological environmental samples and environmental radiation measurements required by the ODCM.

2. A summary description of the Radiological Environmental Monitoring Program.

3. A map of the sampling locations with concurrent table providing distances and directions from the Reactor (Containment) Building. Because the ODCM contains this information and the ODCM is submitted as part of the Radioactive Effluent Release Report, reference to the Radioactive Effluent Release Report submittal date and letter number may be included in the Annual Radiological Environmental Operating Report in lieu of submitting the sample location map and table.

4. A summary of the land use census results in accordance with Surveillance S 2.5.2.2.

5. A summary of the Interlaboratory Comparison Program in accordance with, Surveillance S 2.5.3.1.

As required by the Limitations, the report shall include the following for the conditions listed below:

1. A description of the condition or event and, if applicable, equipment involved.

2. The cause of the condition or event.

3. Actions taken to restore the condition and prevent/minimize recurrence.

4. The consequences of the condition or event.

Limitation	Required Action	Description
2.5.1	A.2	• Sample not taken at required location* • Sample equipment out-of-service (OOS) • Sample frequency not met • Monitoring/analysis lower limit of detection (LLD) not met • Concentration limits not met • Dose from other radionuclides exceed concentration limits
2.5.1	B.1	New sample location identified
2.5.2	A.1	New sample location identified
2.5.3	A.1	Interlaboratory Comparison Program requirements not met
NA	NA	Other harmful effects or evidence of irreversible damage detected

* The report shall include a summary of information not available for reporting at the time of submittal. Such missing information shall be submitted in a supplemental letter when data becomes available.

5.2 Radioactive Effluent Release Report

The Radioactive Effluent Release Report is submitted prior to May 1 of each year, but not more than 12 months from the previous year's submittal, and includes a summary of the quantities of radioactive liquid effluents, gaseous effluents, and solid waste released from the site. This report meets the requirements of TS 5.6.3 (ANO-1), TS 6.6.3 (ANO-2), 10 CFR 50.36a, and 10 CFR 50, Appendix I, Section IV.B.1. The report is formatted consistent with RG 1.21, Revision 1. A single submittal is normally prepared incorporating the data from both ANO units (common information is combined).

In general, the Radioactive Effluent Release Report includes the following:

1. A description of changes to the ODCM and PCP implemented during the reporting period. TS 5.6.3 (ANO-1) and TS 6.6.3 (ANO-2) contain a description of the ODCM change process.

2. A summary of the hourly meteorological data collected over the previous calendar year. In lieu of including this information in the report, it is permissible to retain this summary available for NRC review, if so noted in the report.

3. A summary of radiation doses due to radiological effluents during the previous calendar year, calculated in accordance with the methodology specified in the ODCM.

4. The radiation dose to members of the public while performing activities inside the site boundary. The calculated dose includes only contributions directly attributed to operation of the units.

5. A description of major changes to the radioactive waste systems (liquid/gaseous/solid) during the previous calendar year, if not included in the cycle SAR update.

As required by the Limitations, the report shall include the following for the conditions listed below:

1. A description of the condition or event and, if applicable, equipment involved.
2. The cause of the condition or event.
3. Actions taken to restore the condition and prevent/minimize recurrence.
4. The consequences of the condition or event.

Limitation	Required Action	Description
2.1.1	D.1	Liquid radioactive monitoring equipment OOS > 30 days
2.2.1	G.1	Gaseous radioactive monitoring equipment OOS > 30 days
2.3.1	A.2	Liquid radioactive release limits exceeded
2.3.1	F.1	Liquid radioactive monitor LLD exceeded
2.4.1	A.2	Gaseous radioactive release limits exceeded
2.4.1	E.1	Gaseous radioactive monitor LLD exceeded

FIGURE 4-1

RADIOLOGICAL SAMPLE STATIONS

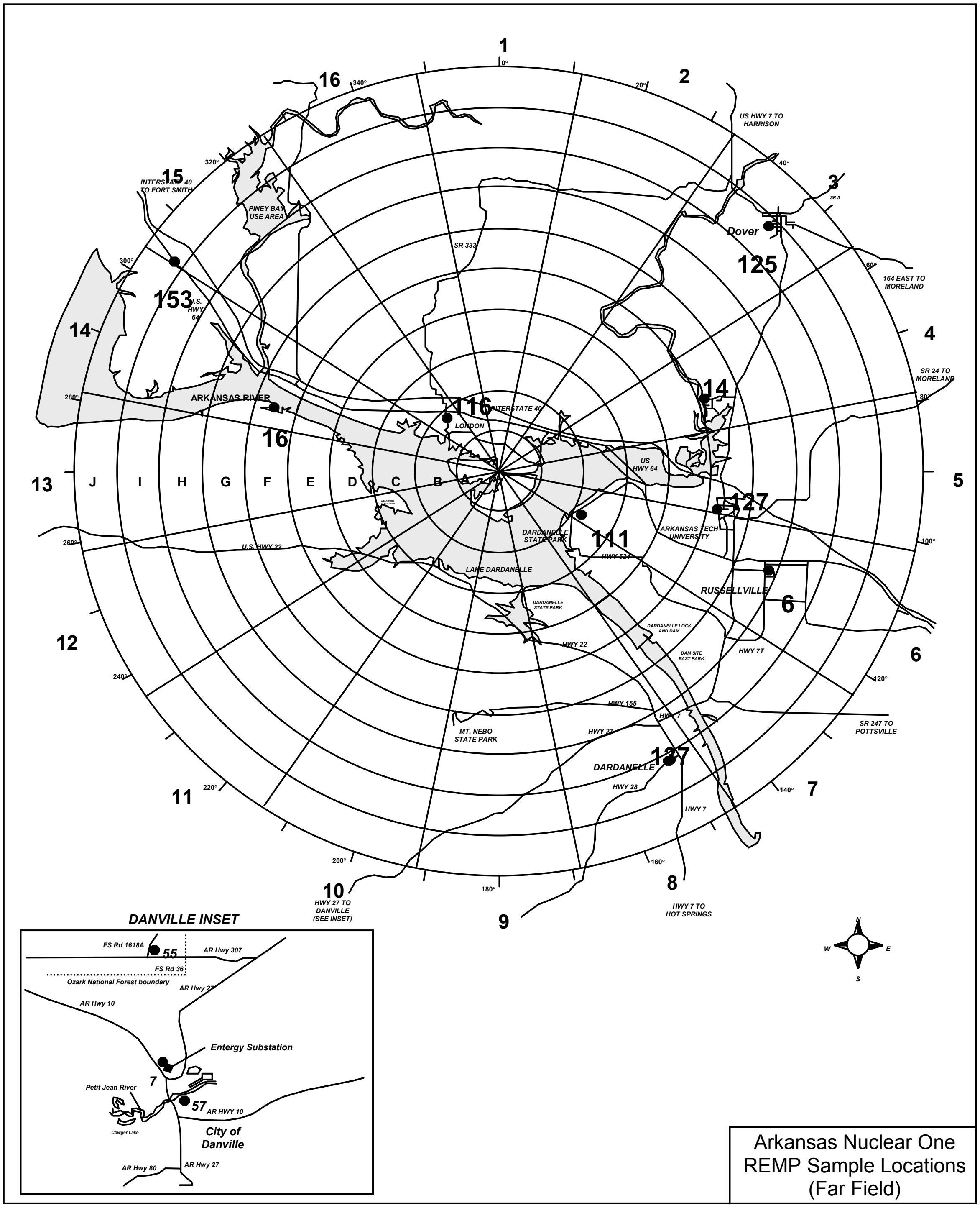

FIGURE 4-1A

RADIOLOGICAL SAMPLE STATIONS

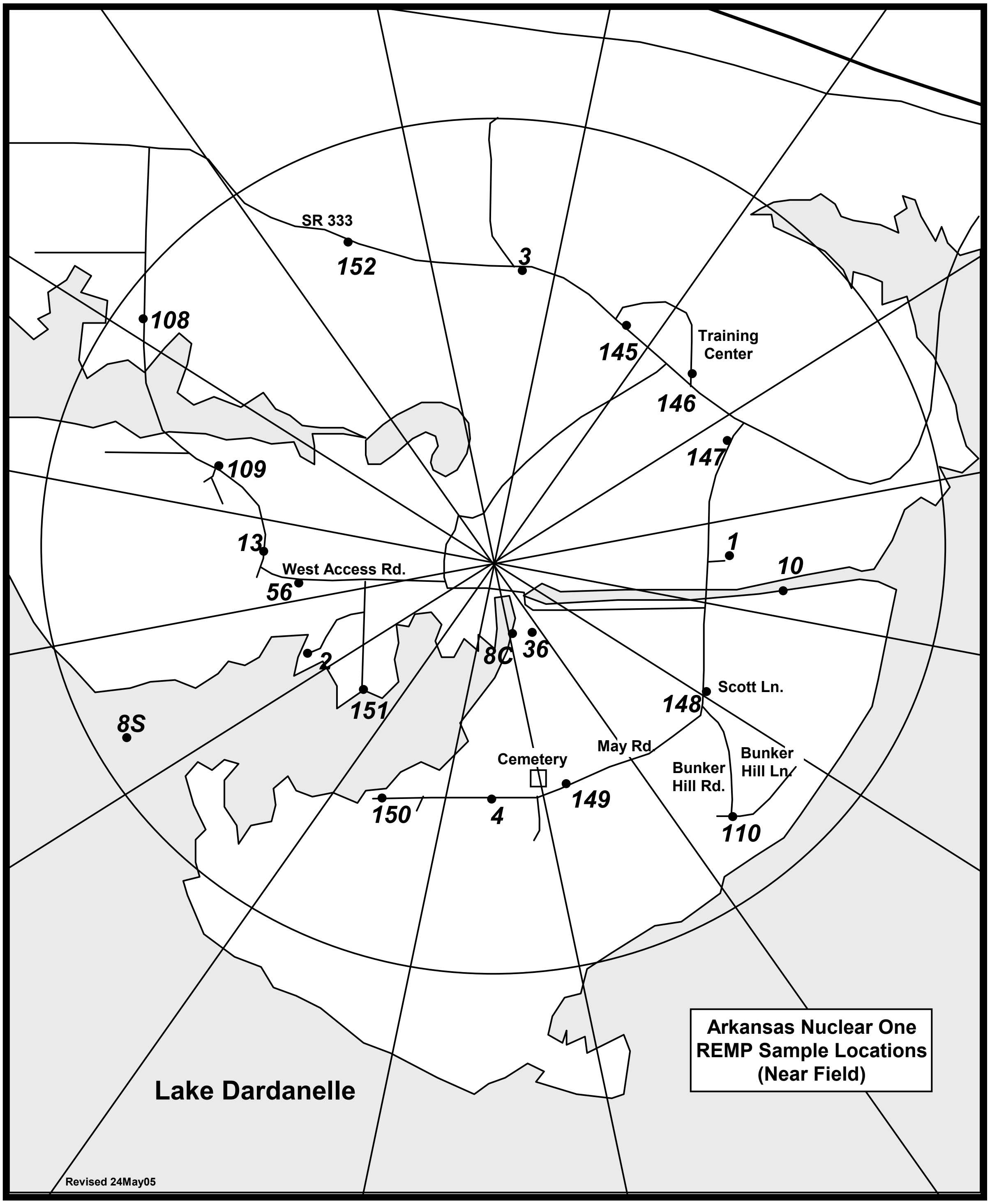

FIGURE 4-1B

RADIOLOGICAL SAMPLE STATIONS

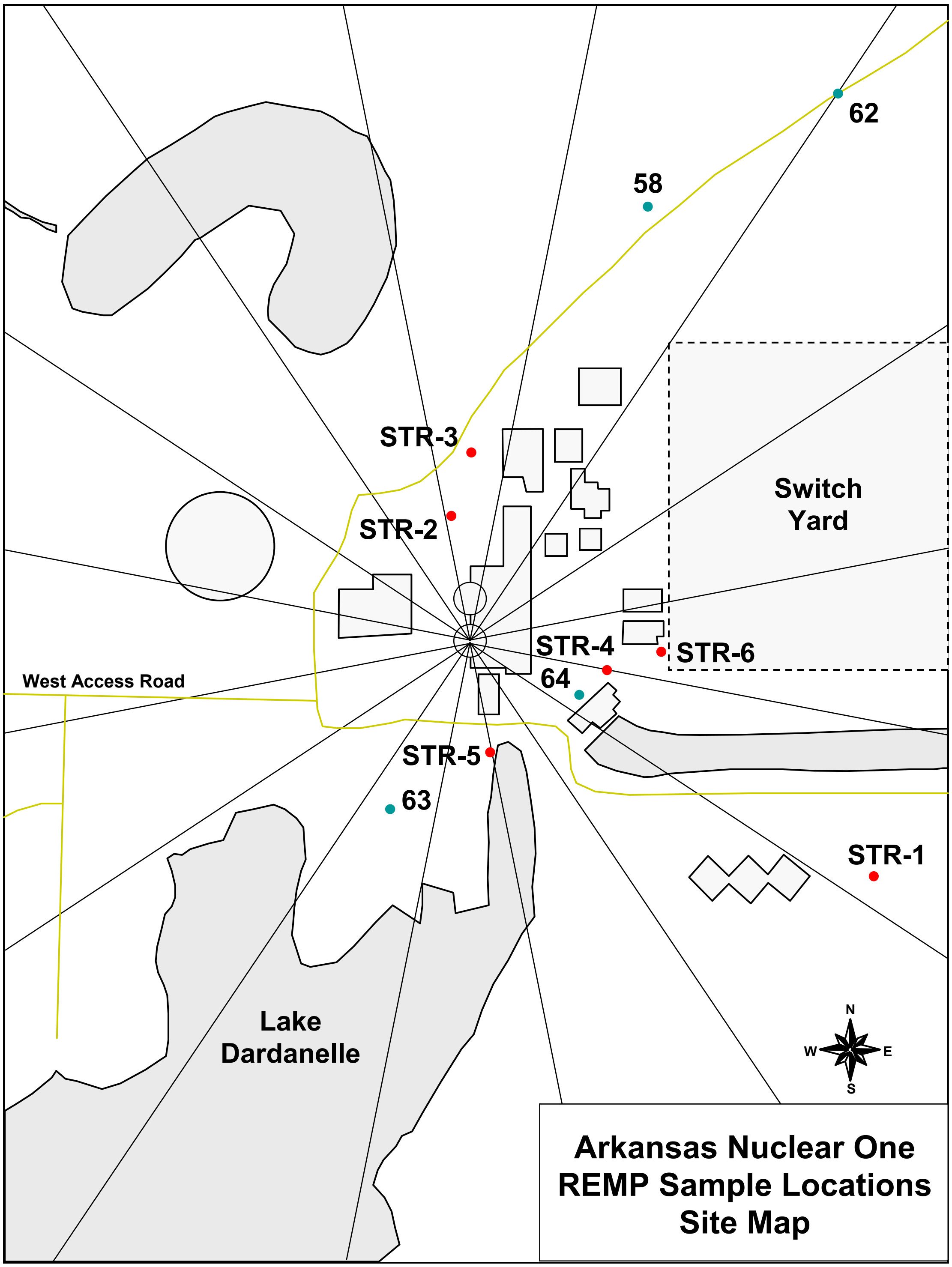

FIGURE 4-2

MAXIMUM AREA BOUNDARY FOR RADIOACTIVE RELEASE CALCULATION
(Exclusion Areas)

GASES – 1046 METER RADIUS
LIQUIDS – END OF DISCHARGE CANAL (POINT A)

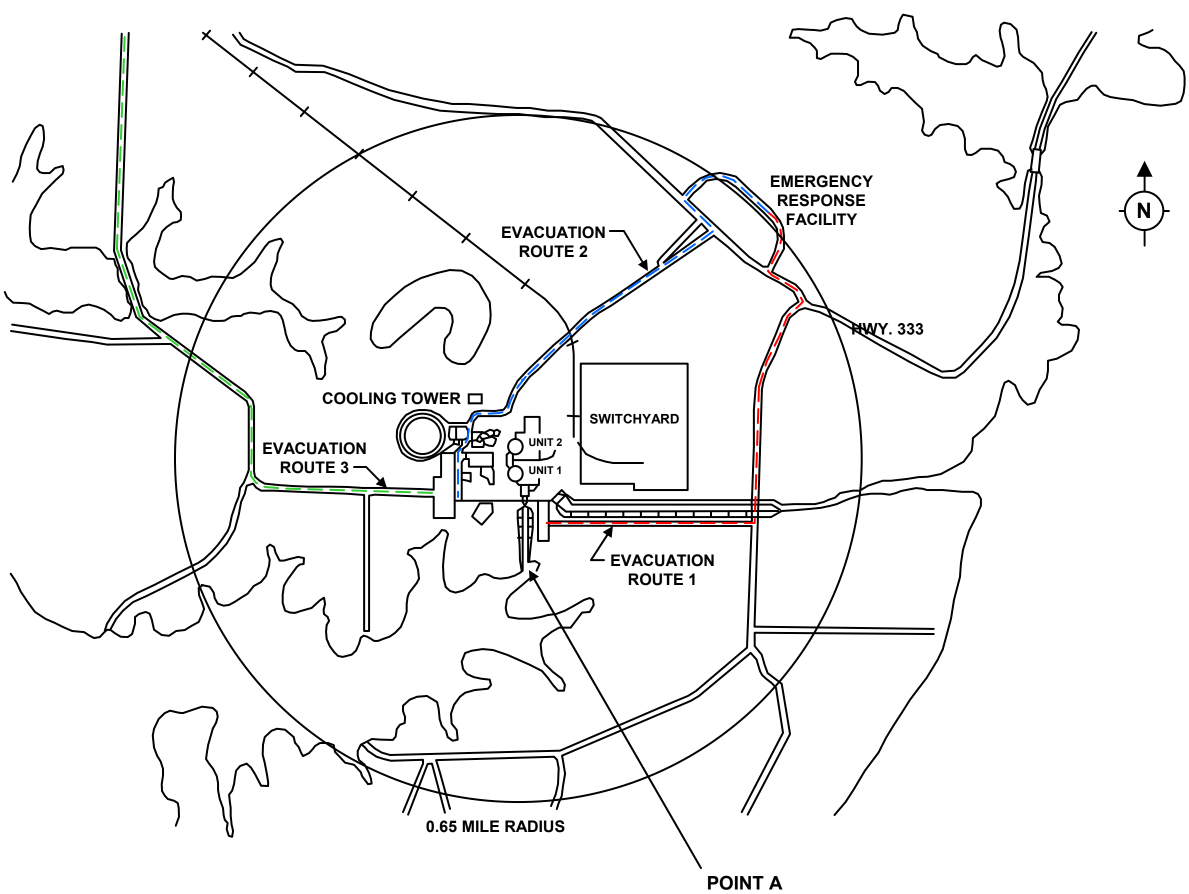

TABLE 4-1

Environmental Sampling Stations - Radiological

Sample Station #	Approximate Direction and Distance from Plant	Sample Types	Sample Station Location
1	88° - 0.5 miles	Airborne radioiodines Airborne particulates Direct radiation	The thermoluminescent dosimeter (TLD) is on a pole near the meteorology tower approx. 0.6 miles east of ANO.
2	243° - 0.5 miles	Airborne radioiodines Airborne particulates Direct radiation	Traveling from ANO, go approx. 0.2 miles west toward Gate 4. Turn left (at the east end of the sewage treatment plant) and go approx. 0.1 miles. Turn right and go approx. 0.1 miles. The sample station is on the right.
3	5° - 0.7 miles	Direct radiation	If traveling west on Highway (Hwy) 333, go approx. 0.35 miles from Gate 2 at ANO. TLD is located on utility pole on south side of Hwy 333 S. If traveling east on Highway 333, go approx. 0.9 miles from junction of Hwy 333 and Flatwood Road. TLD is located on utility pole on south side of Hwy 333 S.
4	181° - 0.5 miles	Direct radiation	Go approx. 0.25 miles south from bridge over intake canal. Turn right onto May Road. Proceed approx. 0.1 miles west of May Cemetery entrance. The TLD is located on a utility pole on the south side of May Road.
6	111° - 6.8 miles	Airborne radioiodines Airborne particulates Direct radiation	Go to the Entergy local office which is located off Hwy 7T in Russellville, Arkansas (AR) (305 South Knoxville Avenue). The sample station is against the east wall of the back lot.
7	210° - 19.0 miles	Airborne radioiodines Airborne particulates Direct radiation	Turn west at junction of Hwy 7 and Hwy 27 in Dardanelle, AR. Proceed to junction of Hwy 27 and Hwy 10 in Danville, AR. Turn right onto Hwy 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.
8	166° - 0.2 miles 243° - 0.9 miles 212° - 0.5 miles	Surface water (composite) Shoreline sediment Fish	Plant discharge canal

TABLE 4-1

Environmental Sampling Stations – Radiological (continued)

Sample Station #	Approximate Direction and Distance from Plant	Sample Types	Sample Station Location
10	95° - 0.5 miles (intake canal)	Surface water (grab)	Surface water (grab) is collected at plant intake canal.
13	273° - 0.5 miles	Broad leaf vegetation	Traveling from Hwy 333, turn south onto Flatwood Road. Go approx. 1.0 miles. The sample may be collected from either side of Flatwood Road.
14	70° - 5.1 miles	Drinking water	From junction of Hwy 7 and Water Works Road, go approx. 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.
16	287° - 5.5 miles	Shoreline sediment Fish	Panther Bay, located on the south side of the AR River across from the mouth of Piney Creek.
36	153° - 0.02 miles	Pond water Pond sediment	The sample station is at the Wastewater Holding Pond on the ANO site east of the discharge canal.
55	217° - 13.1 miles	Broad leaf vegetation	Travel south on Hwy 27 and west on Hwy 307 to the western edge of the Ozark National Forest. Hwy 307 becomes Forest Service (FS) Rd 36; proceed ~ 3/4 mile on FS Rd 36 to its intersection with FS Rd 1618A. The sample station is located at this intersection.
56	264° - 0.4 miles	Airborne radioiodines Airborne particulates Direct radiation	Traveling west from ANO, the sample station is located at the west end of the sewage treatment plant near the facility blower building.
57	208° - 19.5 miles	Drinking water	Go to Danville and turn left on Fifth Street. Go approx. three blocks. The Danville public water supply treatment facility is located on the left.
58	22° - 0.3 miles	Groundwater	GWM – 1; North of Protected Area on owner controlled area (OCA), west of north Security Check Point, east side of access road.
62	34° - 0.5 miles	Groundwater	GWM – 101; North of Protected Area on OCA, east of outside receiving building.

TABLE 4-1

Environmental Sampling Stations – Radiological (continued)

Sample Station #	Approximate Direction and Distance from Plant	Sample Types	Sample Station Location
63	206° - 0.1 miles	Groundwater	GWM – 103; South of Protected Area on OCA, northeast of Stator Rewind Building near woodline.
64	112° - 0.1 miles	Groundwater	GWM – 13; South of Oily Water Separator, northwest corner of ANO-2 Intake Structure, inside the Protected Area.
108	306° - 0.9 miles	Direct radiation	If traveling from Hwy 333, turn south onto Flatwood Road and go approx. 0.4 miles. The TLD is on a utility pole on the right. If traveling north on Flatwood Road, go approx. 0.4 miles from sample station 109. The TLD is on a utility pole on the left.
109	291° - 0.6 miles	Direct radiation	Traveling from Hwy 333, turn south onto Flatwood Road. Go approx. 0.8 miles. The TLD is on a utility pole on the left across from the junction of Flatwood Road and Round Mountain Road.
110	138° - 0.8 miles	Direct radiation	From bridge over intake canal, go south approx. 0.25 miles. Turn left and go approx. 0.25 miles. Turn right on Bunker Hill Lane. The TLD is on the first utility pole on the left.
111	120° - 2.0 miles	Direct radiation	From junction of Hwy 64 and Hwy 326 (Marina Road), go approx. 2.1 miles on Marina Road. The TLD is on a utility pole on the left just prior to curve.
116	318° - 1.8 miles	Direct radiation	Go one block south of the west junction of Hwy 333 and Hwy 64 in London, AR. The TLD is on a utility pole north of the railroad tracks.
125	46° - 8.7 miles	Direct radiation	Traveling north on Hwy 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 4-1

Environmental Sampling Stations – Radiological (continued)

Sample Station #	Approximate Direction and Distance from Plant	Sample Types	Sample Station Location
127	100° - 5.2 miles	Direct radiation	The TLD is located on Arkansas Tech Campus on N. Glenwood Street. If traveling south on Hwy 7 from I- 40, turn right on N. Glenwood. Follow N. Glenwood for approx. 0.6 miles. The TLD is located on a utility pole (with a No Parking sign on it) across from the northeast corner of Paine Hall.
137	151° - 8.2 miles	Direct radiation	At junction of Hwy 7 and Hwy 28 in Dardanelle, AR, go approx. 0.2 miles on Hwy 28. The TLD is on a speed limit sign on the right in front of the Morris R. Moore Arkansas National Guard Armory.
145	28° - 0.6 miles	Direct radiation	The TLD is located near the west entrance to the Reeves E. Ritchie Training Center (RERTC) on a utility pole on the north side of Hwy 333.
146	45° - 0.6 miles	Direct radiation	The TLD is located on the south end of the east parking lot at the RERTC. The TLD is located on a utility pole.
147	61° - 0.6 miles	Direct radiation	The TLD is located on the west side of Bunker Hill Road, approx. 100 yards from the intersection with Hwy 333.
148	122° - 0.6 miles	Direct radiation	Traveling east from ANO, turn right on Bunker Hill Road. Travel south for approx. 0.25 miles to the intersection with Scott Lane. The TLD is located on the county road sign post.
149	156° - 0.5 miles	Direct radiation	Traveling south on Bunker Hill Road, turn right on May Road. Travel approx. 0.4 miles. The TLD is located on a “Notice” sign on the north side of May Road.
150	205° - 0.6 miles	Direct radiation	Traveling south on Bunker Hill Road, turn right on May Road. Travel approx. 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.

TABLE 4-1

Environmental Sampling Stations – Radiological (continued)

Sample Station #	Approximate Direction and Distance from Plant	Sample Types	Sample Station Location
151	225° - 0.4 miles	Direct radiation	Traveling west from ANO, turn south on plant road along the east side of the sewage treatment plant. The TLD is located at the end of this road, near the lake on a metal post.
152	338° - 0.8 miles	Direct radiation	Traveling west on Hwy 333 from the RERTC, travel approx. 0.7 miles. The TLD is located on the south side of Hwy 333 on a utility pole.
153	304° - 9.2 miles	Direct radiation	Travel Hwy 64 west to Knoxville Elementary School. The TLD is located near the school entrance gate on a utility pole.
STR - 1	120° - 0.33 miles	Storm water runoff	East side of GSB drainage ditch near lift station.
STR – 2	351° - < 0.10 miles	Storm water runoff	Inside protected area near Sally Port from drainage ditch along fence.
STR – 3	0.2° - 0.13 miles	Storm water runoff	Outside Protected Area near Sally Port from drainage ditch along fence.
STR - 4	102° - 0.10 miles	Storm water runoff	East side of Oily Water Separator from storm drain.
STR - 5	170° - < 0.10 miles	Storm water runoff	West side of discharge canal from storm drain.
STR - 6	90° - < 0.10 miles	Storm water runoff	East side of chemistry chemical storage area storm drain.

APPENDIX 1

RADIOLOGICAL EFFLUENT CONTROLS

1.0 DEFINITIONS

---NOTE---
The defined terms of this section appear in capitalized type and are applicable throughout these Limitations and Bases.

Term	Definition
ACTION(S)	ACTIONS shall be that part of a Limitation that prescribes Required Actions to be taken under designated Conditions within specified Completion Times.
BATCH RELEASE	A BATCH RELEASE is the discharge of liquid or gaseous wastes of a discrete volume.
CHANNEL CALIBRATION	A CHANNEL CALIBRATION shall be the adjustment, as necessary, of the channel output such that it responds within the necessary range and accuracy to known values of the parameter that the channel monitors. The CHANNEL CALIBRATION shall encompass all devices in the channel required for channel FUNCTIONALITY and the CHANNEL TEST. The CHANNEL CALIBRATION may be performed by means of any series of sequential, overlapping, or total channel steps.
CHANNEL CHECK	A CHANNEL CHECK shall be the qualitative assessment, by observation, of channel behavior during operation. This determination shall include, where possible, comparison of the channel indication and status to other indications or status derived from independent instrument channels measuring the same parameter.
CHANNEL TEST	A CHANNEL TEST shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify FUNCTIONALITY of all devices in the channel required for channel FUNCTIONALITY. The CHANNEL TEST may be performed by means of any series of sequential, overlapping, or total steps.
CONTINUOUS RELEASE	A CONTINUOUS RELEASE is the discharge of liquid waste of a non-discrete volume, e.g. from a volume of a system that has an input flow during the continuous release.
EXCLUSION AREA	The EXCLUSION AREA is that area surrounding ANO within a minimum radius of 0.65 miles of the Reactor (Containment) Buildings and controlled to the extent necessary by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials.

1.0 DEFINITIONS (continued)

Term	Definition
FUNCTIONAL-FUNCTIONALITY	A system, subsystem, train, component, or device shall be FUNCTIONAL or have FUNCTIONALITY when it is capable of performing its specified function(s), as set forth in the current license basis (CLB) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its specified function(s) are also capable of performing their related support function(s).
GASEOUS RADWASTE TREATMENT SYSTEM	A GASEOUS RADWASTE TREATMENT SYSTEM is any system designed and installed to reduce radioactive gaseous effluents by collecting gases from radioactive systems and providing for decay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.
LIQUID RADWASTE TREATMENT SYSTEM	A LIQUID RADWASTE TREATMENT SYSTEM is a system designed and used for holdup, filtration, and/or demineralization of radioactive liquid effluents prior to their release to the environment.
MEMBER(S) OF THE PUBLIC	MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the utility, its contractors or vendors. Also excluded from the category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational or other purposes not associated with the plant.
MODE(S)	Refer to Definitions section of ANO-1 and ANO-2 TSs.
PURGE – PURGING	PURGE or PURGING is the controlled process of discharging air or gas from a confinement to reduce the airborne radioactivity concentration in such a manner that replacement air or gas is required to purify the confinement.
SOURCE CHECK	A SOURCE CHECK shall be the qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.

1.0 DEFINITIONS (continued)

Term	Definition
VENTILATION EXHAUST TREATMENT SYSTEM	A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal adsorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEMS.
UNRESTRICTED AREA	An UNRESTRICTED AREA shall be any area beyond the EXCLUSION AREA boundary.

2.0 LIMITITATION (L) APPLICABILITY

L 2.0.1 Limitations shall be met during the specified conditions in the Applicability, except as provided in L 2.0.2.

L 2.0.2 Upon discovery of a failure to meet a Limitation, the applicable ACTIONS of the associated Limitation shall be met, except as provided in L 3.0.5. If the Limitation is met or is no longer applicable prior to expiration of the specified Completion Time(s), completion of the ACTIONS is not required, unless otherwise stated.

L 2.0.3 When a Limitation is not met and the associated ACTIONS are not met, an associated ACTION is not provided, or if directed by the associated ACTIONS, immediately initiate a condition report to document the condition and determine any limitations for continued operation of the plant.

Exceptions to this Limitation are stated in the individual Limitations.

L 2.0.4 When a Limitation is not met, entry into a MODE or other specified condition in the Applicability shall only be made when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time.

L 2.0.5 Equipment removed from service or declared non-functional to comply with ACTIONS may be returned to service under administrative control solely to perform testing required to demonstrate its FUNCTIONALITY or the FUNCTIONALITY of other equipment. This is an exception to L 2.0.2 for the system returned to service under administrative control to perform the testing required to demonstrate FUNCTIONALITY.

2.0 SURVEILLANCE (S) APPLICABILITY

S 2.0.1 Surveillances shall be met during the specified conditions in the Applicability for individual Limitations, unless otherwise stated in the Surveillance. Failure to meet a Surveillance, whether such failure is experienced during the performance of the Surveillance or between performances of the Surveillance, shall be failure to meet the Limitation. Failure to perform a Surveillance within the specified Frequency shall be failure to meet the Limitation except as provided in S 2.0.3. Surveillances are not required to be performed on non-functional equipment or variables outside specified limits.

S 2.0.2 The specified Frequency for each Surveillance is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met. For Frequencies specified as "once," the above interval extension does not apply. If an Action completion time requires periodic performance on a "once per . . ." basis, the above Frequency extension applies to each performance after the initial performance.

S 2.0.3 If it is discovered that a Surveillance was not performed within its specified Frequency, then compliance with the requirement to declare the Limitation not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified Frequency, whichever is greater. This delay period is permitted to allow performance of the Surveillance.

If the Surveillance is not performed within the delay period, the Limitation must immediately be declared not met, and the applicable ACTIONS must be entered.

When the Surveillance is performed within the delay period and the Surveillance is not met, the Limitation must immediately be declared not met, and the applicable ACTIONS must be entered.

S 2.0.4 Entry into a specified condition in the Applicability of a Limitation shall only be made when the Limitation's Surveillances have been met within their specified Frequency, except as provided by S 2.0.3. When a Limitation is not met due to Surveillances not having been met, entry into a specified condition in the Applicability shall only be made in accordance with L 2.0.4.

L 2.1 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

L 2.1.1 The following Radioactive Liquid Effluent Monitoring Instrumentation shall be FUNCTIONAL:

a. Liquid Radwaste Effluent Radiation Monitor with alarm/trip function

b. Liquid Radwaste Effluent Flow Monitor

c. One Main Steam Line Radiation Monitor per Steam Generator (ANO-1 only)

APPLICABILITY: Liquid Radwaste Effluent Monitor – during releases via the associated pathway

Main Steam Line Radiation Monitors – MODES 1, 2, 3, and 4

ACTIONS

--NOTE--
Separate Condition entry is allowed for each instrument.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Required Liquid Radwaste Effluent Radiation Monitor non-functional.	A.1 Suspend the release of radioactive effluents monitored by the affected channel.	Immediately
	AND	
	A.2.1 Restore the monitor to a FUNCTIONAL status.	Prior to release of radioactive effluents monitored by the affected channel
	OR	
	A.2.2.1 Analyze two independent samples of the associated tank contents.	Prior to release of radioactive effluents monitored by the affected channel
	AND	
	A.2.2.2 Computer input data verified by two qualified individuals.	Prior to release of radioactive effluents monitored by the affected channel
	AND	

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. (continued)	A.2.2.3 Correct discharge valve lineup independently verified by two qualified individuals.	Prior to release of radioactive effluents monitored by the affected channel
B. Required Liquid Radwaste Effluent Flow Monitor non-functional.	B.1 Estimate flow. OR B.2 Suspend the release of radioactive effluents monitored by the affected channel.	4 hours Immediately
C. One or more required Main Steam Line Radiation Monitor non-functional.	C.1 Establish pre-planned alternate monitoring method of monitoring. AND C.2 Restore the affected Main Steam Line Radiation Monitor(s) to a FUNCTIONAL status.	72 hours 7 days
D. Required Action(s) and/or Completion Time(s) of Conditions A, B, and/or C not met.	D.1 Initiate a condition report to document the condition and determine any limitations for the continued effluent release operations.	Immediately
E. Required Radioactive Liquid Effluent Monitoring Instrument non-functional for > 30 days.	E.1 Initiate a condition report to document and track the condition for inclusion in the Radioactive Effluent Release Report pursuant to TS 5.6.3 (ANO-1) / TS 6.6.3 (ANO-2).	Immediately

SURVEILLANCES

SURVEILLANCE		FREQUENCY
S 2.1.1.1	Perform a CHANNEL CHECK of required instrumentation.	24 hours
S 2.1.1.2	-----NOTE----- Not applicable to Liquid Radwaste Effluent Flow Monitor. ---------- Perform a CHANNEL TEST of the required instrumentation.	92 days
S 2.1.1.3	Perform a CHANNEL CALIBRATION on the required instrumentation.	18 months
S 2.1.1.4	-----NOTES----- 1. SOURCE CHECK not required when background radioactivity is greater than the check source. 2. Not applicable to Liquid Radwaste Effluent Flow Monitor or Main Steam Line Radiation Monitors. ---------- Perform a SOURCE CHECK on the required instrumentation.	Within 8 hours prior to release of radioactive effluents monitored by the channel

L 2.2 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

L 2.2.1 The following Radioactive Gaseous Effluent Monitoring Instrumentation shall be FUNCTIONAL:

--NOTE--

Refer to ANO-2 Technical Specification (TS) 3.3.3.1 for ANO-2 Containment Building Purge System Process Monitor operability requirements and associated ACTIONS.

----

a. Waste Gas Holdup Systems

   1. Gas Activity Process Monitor with alarm/trip function
   2. Effluent Flow Process Monitor

b. Reactor (Containment) Building Purge and Ventilation, Auxiliary Building Ventilation, Spent Fuel Pool Area Ventilation, Emergency Penetration Room Ventilation, Low Level Radwaste Building Ventilation, and ANO-2 Auxiliary Building Extension Ventilation SPING Monitors

   1. Noble Gas Activity Monitor
   2. Iodine Sampler
   3. Particulate Sampler
   4. Effluent Flow Monitor
   5. Sampler Flow Monitor

APPLICABILITY:

1. SPINGS 4 and 8 – when Emergency Penetration Room Ventilation is capable of auto-start
2. All Radioactive Gaseous Effluent Monitoring Instrumentation – during releases via the associated pathway

ACTIONS

--NOTE--
Separate Condition entry is allowed for each instrument.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. -------------NOTE-------------- Applicable to releases associated with Waste Gas Holdup Systems and PURGE of the ANO-1 Reactor Building. ----------------------------------- Required Waste Gas Holdup and/or Reactor Building Purge System Gas Activity Process and/or Noble Gas Activity Monitor non-functional.	A.1 Suspend the release of radioactive effluents monitored by the affected channel.	Immediately
	AND	
	A.2.1 Restore the monitor to a FUNCTIONAL status.	Prior to release of radioactive effluents monitored by the affected channel
	OR	
	A.2.2.1 Analyze two independent samples of the Waste Gas Holdup Tank and/or Reactor Building contents.	Prior to release of radioactive effluents monitored by the affected channel
	AND	
	A.2.2.2 Computer input data verified by two qualified individuals.	Prior to release of radioactive effluents monitored by the affected channel
	AND	
	A.2.2.3 -------------NOTE------------- Not applicable to Reactor Building Purge System. --------------------------------- Correct discharge valve lineup independently verified by two qualified individuals.	Prior to release of radioactive effluents monitored by the affected channel

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required Effluent or Sampler Flow Monitor non-functional.	B.1 Estimate flow. OR B.2 Suspend the release of radioactive effluents monitored by the affected channel.	Once per 4 hours Immediately
C. --------------NOTE-------------- 1. Applicable to releases other than those described in Condition A above. 2. Applicable to SPINGS 4 and 8 only when pathway is in service. ----------------------------------- Required Noble Gas Activity Monitor non-functional.	--------------------NOTE------------------ If ANO-1 Reactor Building Purge and Ventilation required Noble Gas Activity Monitor inoperable and moving irradiated fuel within the ANO-1 Reactor Building, refer to ANO-1 TS 3.9.3. -- C.1 Obtain sample of effluent. AND C.2 Analyze sample of effluent.	 12 hours Within 24 hours following completion of Required Action C.1
D. --------------NOTE-------------- Applicable to SPINGS 4 and 8 only when pathway is in service. ----------------------------------- Required Iodine and/or Particulate Sampler non-functional.	D.1 Verify effluent samples are continuously collected by auxiliary sampling equipment. AND D.2 Replace Iodine and/or Particulate cartridges (as applicable). AND D.3 Analyze Iodine and/or Particulate cartridges (as applicable).	4 hours 7 days Within 48 hours following replacement

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. Required Action(s) and/or Completion Time(s) of Condition C and/or Condition D not met.	E.1 Suspend the release of radioactive effluents monitored by the affected channel.	Immediately
F. Required Action(s) and/or Completion Time(s) Condition A, B, and/or E not met.	F.1 Initiate a condition report to document the condition and determine any limitations for the continued effluent release operations.	Immediately
G. Required Radioactive Gaseous Effluent Monitoring Instrument non-functional for > 30 days.	G.1 Initiate a condition report to document and track the condition for inclusion in the Radioactive Effluent Release Report pursuant to TS 5.6.3 (ANO-1) / TS 6.6.3 (ANO-2).	Immediately

SURVEILLANCES

SURVEILLANCE		FREQUENCY
S 2.2.1.1	----------------------------------NOTE------------------------------------ Not applicable to Iodine and Particulate Samplers --- Perform a CHANNEL CHECK of required instrumentation.	24 hours
S 2.2.1.2	Verify presence of required Iodine Sampler Cartridge and required Particulate Sample Filter.	7 days
S 2.2.1.3	Perform a CHANNEL TEST of the required Reactor Building Purge and Ventilation System Gas Activity Process and Noble Gas Activity Monitors.	31 days prior to initiating Reactor Building Purge and/or Ventilation activities

SURVEILLANCES (continued)

SURVEILLANCE		FREQUENCY
S 2.2.1.4	----------------------------------NOTES---------------------------------- SOURCE CHECK not required when background radioactivity is greater than the check source. --- Perform a SOURCE CHECK on the required Noble Gas Activity Monitors.	31 days
S 2.2.1.5	----------------------------------NOTES---------------------------------- 1. SOURCE CHECK not required when background radioactivity is greater than the check source. 2. Only applicable to Waste Gas Holdup and Reactor Building Purge Systems. --- Perform a SOURCE CHECK on the required Gas Activity Process and Noble Gas Activity Monitors.	Within 14 days prior to release of radioactive effluents monitored by the channel
S 2.2.1.6	Perform a CHANNEL TEST of the required Noble Gas Activity Monitors.	92 days
S 2.2.1.7	----------------------------------NOTE----------------------------------- Not applicable to Iodine and Particulate Samplers --- Perform a CHANNEL CALIBRATION on the required instrumentation.	18 months

L 2.3 RADIOACTIVE LIQUID EFFLUENTS

L 2.3.1 Radioactive material released to the discharge canal shall:

a. For dissolved or entrained noble gases, be limited to a total concentration of ≤ 2 x 10^{-4} µCi/ml.

b. For radioactive nuclides other than dissolved or entrained noble gases, be limited to the concentration specified in 10 CFR 20, Appendix B, Table II, Column 2.

c. During any calendar quarter, result in a dose commitment to a MEMBER OF THE PUBLIC of ≤ 1.5 mrem to the total body and ≤ 5 mrem to any organ.

d. During any calendar year, result in a dose commitment to a MEMBER OF THE PUBLIC of ≤ 3 mrem to the total body and ≤ 10 mrem to any organ.

e. Be processed by a LIQUID RADWASTE TREATMENT SYSTEM when accumulative dose during a calendar quarter is projected to exceed 0.18 mrem to the total body and/or 0.625 mrem to any organ.

APPLICABILITY: At all times.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each Limitation L 2.3.1.a through L 2.3.1.e above and for each BATCH RELEASE and CONTINUOUS RELEASE Surveillance requirement not met.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Any limit listed in L 2.3.1.a through L 2.3.1.e not met.	A.1 Initiate action to restore to within limit.	Immediately
	<u>AND</u>	
	A.2 Initiate a condition report to document the condition, determine any limitations for the continued effluent release operations, and track the condition for inclusion in the Radioactive Effluent Release Report pursuant to TS 5.6.3 (ANO-1) / TS 6.6.3 (ANO-2).	Immediately

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. --------------NOTE-------------- Only applicable to BATCH RELEASE. ------------------------------------ Sampling and/or analysis requirements not met.	B.1 Verify associated effluent release suspended. AND B.2 Initiate a condition report to document the condition and determine any limitations for the continued effluent release operations.	Immediately Immediately
C. --------------NOTE-------------- Only applicable to CONTINUOUS RELEASE of secondary coolant. ------------------------------------ Secondary coolant dose equivalent I-131 (DEI) > 0.01 μCi/ml.	C.1 Obtain a grab sample of the associated secondary coolant. AND C.2 Perform gamma isotopic and I-131 analysis of sample.	12 hours 12 hours following sample acquisition
D. Annual dose limits of L 2.3.1.d projected to exceed 40 CFR 190 limits.	D.1 Apply for a variance from the NRC to permit releases in excess of 40 CFR 190 limits.	Prior to exceed 40 CFR 190 limits Immediately
E. Required Action(s) and/or Completion Time(s) of Conditions C and/or D not met. OR Sampling and/or analysis requirements not met.	E.1 Initiate a condition report to document the condition and determine any limitations for the continued effluent release operations.	Immediately

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
F. Lower Limit(s) of Detection (LLD) not met.	F.1 Initiate a condition report to document and track the condition for inclusion in the Radioactive Effluent Release Report pursuant to TS 5.6.3 (ANO-1) / TS 6.6.3 (ANO-2).	Immediately

SURVEILLANCES

SURVEILLANCE		FREQUENCY
S 2.3.1.1	----------------------------------NOTE---------------------------------- Only applicable to BATCH RELEASE. --	
	Obtain representative sample of each batch.	Prior to release
	<u>AND</u>	
	Perform gamma isotopic and I-131 analysis of sample.	Prior to release
	<u>AND</u>	
	Perform dissolved and entrained gas analysis of sample.	31 days following sample acquisition
	<u>AND</u>	
	Perform gross alpha composite and H-3 analysis of sample.	31 days following sample acquisition
	<u>AND</u>	
	Perform Sr-89, Sr-90, and Fe-55 composite analysis of sample.	92 days following sample acquisition

SURVEILLANCES (continued)

SURVEILLANCE		FREQUENCY
S 2.3.1.2	----------NOTE---------- Only applicable to CONTINUOUS RELEASE. ---------- Obtain representative sample of effluent. <u>AND</u> Perform gamma isotopic and I-131 analysis. <u>AND</u> Perform dissolved and entrained gas analysis. <u>AND</u> Perform gross alpha composite and H-3 analysis. <u>AND</u> Perform Sr-89, Sr-90, and Fe-55 composite analysis.	 24 hours 24 hours following sample acquisition 31 days following sample acquisition 31 days following sample acquisition 92 days following sample acquisition
S 2.3.1.3	Using data acquired by performance of S 2.3.1.1 and S.2.3.1.2, verify Limitations L 2.3.1.a through L 2.3.1.e continue to be met.	Within 7 days following completion of each required analysis
S 2.3.1.4	Using data acquired by performance of S 2.3.1.1 and S.2.3.1.2, verify the limits of 40 CFR 190 are not projected to be exceeded.	31 days
S 2.3.1.5	Verify the following LLDs are met: Gamma isotopic 5×10^{-7} µCi/ml I-131 and Fe-55 1×10^{-6} µCi/ml Dissolved/entrained gases (gamma emitters) 1×10^{-5} µCi/ml H-3 1×10^{-5} µCi/ml Gross alpha 1×10^{-7} µCi/ml Sr-89 and Sr-90 5×10^{-8} µCi/ml	12 months

L 2.4 RADIOACTIVE GASEOUS EFFLUENTS

L 2.4.1 Radioactive Gaseous Effluent releases to unrestricted areas shall:

---NOTE---
Dose rates associated with Reactor (Containment) Building Purge operations may be averaged over a one hour interval.
----

a. For noble gases, be limited to:

   1. A total body dose rate of ≤ 500 mrem/yr.

   2. A skin dose rate of ≤ 3000 mrem/yr.

   3. A dose commitment to a MEMBER OF THE PUBLIC in any calendar quarter of ≤ 5 mrads gamma and ≤ 10 mrads beta radiation.

   4. A dose commitment to a MEMBER OF THE PUBLIC in any calendar year of ≤ 10 mrads gamma and ≤ 20 mrads beta radiation.

b. For I-131, H-3, and for all radionuclides in particulate form having a half life of > 8 days, be limited to:

   1. An organ dose rate of ≤ 1500 mrem/yr.

   2. A dose commitment to a MEMBER OF THE PUBLIC in any calendar quarter of ≤ 7.5 mrem to any organ.

   3. A dose commitment to a MEMBER OF THE PUBLIC in any calendar year of ≤ 15 mrem to any organ.

c. Be processed by a VENTILATION EXHAUST TREATMENT SYSTEM when:

   1. For noble gases, the dose over a calendar quarter is project to exceed 0.625 mrads gamma and/or 1.25 mrads beta radiation.

   2. For I-131, H-3, and for all radionuclides in particulate form having a half life of > 8 days, the dose over a calendar quarter is project to exceed 1.0 mrem to any organ.

d. Be processed by the GASEOUS RADWASTE TREATMENT SYSTEM when degasifying the Reactor Coolant System (RCS), if projected dose would exceed 0.625 mrads gamma and/or 1.25 mrads beta radiation over a calendar quarter.

APPLICABILITY: At all times.

ACTIONS

--NOTE--
Separate Condition entry is allowed for each Limitation L 2.4.1.a through L 2.4.1.d above and for each Surveillance requirement not met.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Any limit listed in L 2.4.1.a through L 2.4.1.d not met.	A.1 Initiate action to restore to within limit. AND A.2 Initiate a condition report to document the condition, determine any limitations for the continued effluent release operations, and track the condition for inclusion in the Radioactive Effluent Release Report pursuant to TS 5.6.3 (ANO-1) / TS 6.6.3 (ANO-2).	Immediately Immediately
B. Sampling and/or analysis requirements of S 2.4.1.1 not met.	B.1 Verify associated effluent release suspended. AND B.2 Initiate a condition report to document the condition and determine any limitations for the continued effluent release operations.	Immediately Immediately
C. Annual dose limits of L 2.4.1.a.4 and/or L 2.4.1.b.4 projected to exceed 40 CFR 190 limits.	C.1 Apply for a variance from the NRC to permit releases in excess of 40 CFR 190 limits.	Prior to exceed 40 CFR 190 limits Immediately

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action(s) and/or Completion Time(s) of Condition C not met. <u>OR</u> Sampling and/or analysis requirements of S 2.4.1.2 not met.	D.1 Initiate a condition report to document the condition and determine any limitations for the continued effluent release operations.	Immediately
E. Lower Limit(s) of Detection (LLD) not met.	E.1 Initiate a condition report to document and track the condition for inclusion in the Radioactive Effluent Release Report pursuant to TS 5.6.3 (ANO-1) / TS 6.6.3 (ANO-2).	Immediately

SURVEILLANCES

SURVEILLANCE		FREQUENCY
S 2.4.1.1	----------------------------------NOTE----------------------------------- Only applicable to Waste Gas Storage Tank and Reactor Building Purge release. --	
	Obtain representative sample of gas to be released.	Prior to release
	<u>AND</u>	
	Analyze sample for principal gamma emitters.	Prior to release
	<u>AND</u>	
	----------------------------------NOTE----------------------------------- Only applicable to Reactor Building Purge release. --	
	Perform H-3 analysis of sample.	Prior to release

SURVEILLANCES (continued)

SURVEILLANCE		FREQUENCY
S 2.4.1.2	----------------------------------NOTE---------------------------------- Only applicable to Auxiliary Building, Spent Fuel Pool Area, Auxiliary Building Extension Area (ANO-2), Low Level Radwaste Building, Emergency Penetration Room, and Reactor (Containment) Building Ventilation systems. --	
	The following effluent samples shall be obtained to support the radioactive analysis specified:	
	a. ----------------------------------NOTE------------------------------ Only applicable to Reactor Building Ventilation when Reactor Vessel Head is removed. --	
	Representative sample for H-3 analysis.	24 hours
	b. ----------------------------------NOTE------------------------------ Only applicable to Spent Fuel Pool Area Ventilation. --	
	Representative sample for H-3 analysis.	7 days
	c. Charcoal sample for I-131 analysis.	7 days
	d. Particulate sample for principal gamma emmiters analysis.	7 days
	e. Particulate sample for composite gross alpha analysis.	31 days
	f. Representative sample for principal gamma emmiters analysis.	31 days
	g. Representative sample for H-3 analysis.	31 days
	h. Particulate sample of for Sr-89 and Sr-90 composite analysis.	92 days
	AND	
	(continued)	*(continued)*

S 2.4.1.2	*(continued)* Complete analysis of above samples: i. Samples a, b, c, and d j. Samples e, f, and g k. Sample h	 48 hours following sample acquisition 31 days following sample acquisition 60 days following sample acquisition
S 2.4.1.3	Record SPING Noble Gas activity.	24 hours
S 2.4.1.4	Using data acquired by performance of S 2.4.1.1 and S.2.4.1.2, verify Limitations L 2.4.1.a through L 2.4.1.d continue to be met.	31 days
S 2.4.1.5	Using data acquired by performance of S 2.4.1.1 and S.2.4.1.2, verify the limits of 40 CFR 190 are not projected to be exceeded.	31 days
S 2.4.1.6	Verify the following LLDs are met: Principal gamma emitters (gaseous) — 1×10^{-4} µCi/ml Principal gamma emitters (particulate) — 1×10^{-11} µCi/ml I-131 — 1×10^{-12} µCi/ml H-3 — 1×10^{-6} µCi/ml Gross alpha — 1×10^{-11} µCi/ml Sr-89 and Sr-90 — 1×10^{-11} µCi/ml Noble gas (dose equivalent Xe-133) — 1×10^{-6} µCi/ml	12 months

L 2.5 RADIOLOGICAL ENVIRONMENTAL MONITORING

L 2.5.1 The following environmental sample locations shall be designated and maintained:

---NOTE---
Other instruments may be used in place of, or in addition to, integrating dosimeters.

<table>
<tr><th colspan="2">Pathway / Sample Type</th><th>#</th><th>Location</th></tr>
<tr><td colspan="2" rowspan="3">Airborne Radionuclide and Particulate</td><td>3</td><td>Samples close to site boundary in or near different sectors having the highest calculated annual average ground-level D/Q</td></tr>
<tr><td>1</td><td>Sample from the vicinity of a community having the highest calculated annual average ground-level D/Q</td></tr>
<tr><td>1</td><td>Background information sample from a control location 10-20 miles from one reactor building</td></tr>
<tr><td colspan="2" rowspan="2">Direct Radiation</td><td>16</td><td>Inner ring stations with 2 or more dosimeters in each meteorological sector in the general area of the site boundary</td></tr>
<tr><td>8</td><td>Stations with 2 or more dosimeters in special interest areas such as population centers, nearby residences, schools, and in 1-2 areas to serve as control locations.</td></tr>
<tr><td rowspan="8">Waterborne</td><td rowspan="2">Surface Water</td><td>1</td><td>Indicator location influenced by plant discharge</td></tr>
<tr><td>1</td><td>Control location uninfluenced by plant discharge</td></tr>
<tr><td rowspan="2">Drinking Water</td><td>1</td><td>Indicator location influenced by plant discharge</td></tr>
<tr><td>1</td><td>Control location uninfluenced by plant discharge</td></tr>
<tr><td rowspan="2">Shoreline Sediment</td><td>1</td><td>Indicator location influenced by plant discharge</td></tr>
<tr><td>1</td><td>Control location uninfluenced by plant discharge</td></tr>
<tr><td rowspan="2">Ground Water</td><td>1</td><td>Indicator location influenced by plant discharge</td></tr>
<tr><td>1</td><td>Control location uninfluenced by plant discharge</td></tr>
<tr><td rowspan="6">Ingestion</td><td rowspan="2">Milk</td><td>1</td><td>Indicator location within 5 miles of one reactor, if commercially available</td></tr>
<tr><td>1</td><td>Control location > 5 miles from one reactor when an indicator exists</td></tr>
<tr><td rowspan="2">Fish</td><td>1</td><td>Sample of commercially and/or recreationally important species in vicinity of plant discharge</td></tr>
<tr><td>1</td><td>Sample of same species in area not influenced by plant discharge</td></tr>
<tr><td rowspan="2">Food Products</td><td>1</td><td>Sample of broadleaf (edible or inedible) near the site boundary from one of the highest anticipated annual average ground-level D/Q sectors</td></tr>
<tr><td>1</td><td>Sample location of broadleaf vegetation (edible or inedible) from a control location 10-20 miles from one reactor</td></tr>
</table>

APPLICABILITY: At all times.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each sample location and Surveillance requirement.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Sample location requirement not met. OR Required sample equipment non-functional. OR Sample Frequency not met. OR Sample analysis Frequency not met. OR One or more Lower Limit(s) of Detection (LLD) listed in Table 2.5-1 not met. OR One or more limits listed in Table 2.5-2 not met. OR Dose to a MEMBER OF THE PUBLIC from radionuclides other than those listed in Table 2.5-2 projected to exceed calendar year limits of L 2.3.1 and/or L 2.4.1.	A.1 Initiate action to restore to within limits. AND A.2 Initiate a condition report to document and track the condition for inclusion in the Annual Radiological Environmental Operating Report pursuant to TS 5.6.2 (ANO-1) / TS 6.6.2 (ANO-2).	Immediately Immediately

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Sample(s) from required sample location(s) unavailable.	B.1 Identify and add to the Radiological Environment Monitoring Program, locations for obtaining replacement samples.	30 days

SURVEILLANCES

SURVEILLANCE		FREQUENCY
S 2.5.1.1	-----------------------------------NOTE----------------------------------- Only applicable to Airborne Radionuclide and Particulate. --	
	Collect sample from continuous sampler.	14 days
	AND	
	Perform I-131 analysis of radioiodine canister.	14 days following sample acquisition
	AND	
	Perform gross beta analysis of particulate sampler.	≥ 24 hours and ≤ 14 days following filter change
S 2.5.1.2	-----------------------------------NOTE----------------------------------- Only applicable to Direct Radiation locations. --	
	Collect sample from required location.	92 days
	AND	
	Perform gamma dose analysis of sample.	60 days following sample acquisition

SURVEILLANCES (continued)

SURVEILLANCE		FREQUENCY
S 2.5.1.3	----------------------------------NOTE---------------------------------- Only applicable to Surface Water samples. --	
	Collect sample from required location.	92 days
	AND	
	Perform gamma isotopic analysis of sample.	21 days following sample acquisition
	AND	
	Perform H-3 analysis of sample.	31 days following sample acquisition
S 2.5.1.4	----------------------------------NOTE---------------------------------- Only applicable to Drinking and Ground Water samples. --	
	Collect sample from required location.	92 days
	AND	
	Perform gamma isotopic analysis of sample.	21 days following sample acquisition
	AND	
	Perform H-3 analysis of sample.	31 days following sample acquisition
	AND	
	Perform I-131 analysis of sample.	21 days following sample acquisition
	AND	
	Perform gross beta analysis of sample.	31 days following sample acquisition

SURVEILLANCES (continued)

SURVEILLANCE		FREQUENCY
S 2.5.1.5	----------------------------------NOTE---------------------------------- Only applicable to Waterborne Shoreline Sediment samples. --	
	Collect sample from required location.	12 months
	AND	
	Perform gamma isotopic analysis of sample.	60 days following sample acquisition
S 2.5.1.6	----------------------------------NOTE---------------------------------- Only applicable to Milk samples. --	
	Collect sample from required location.	92 days
	AND	
	Perform gamma isotopic analysis of sample.	21 days following sample acquisition
	AND	
	Perform I-131 analysis of sample.	21 days following sample acquisition
S 2.5.1.7	----------------------------------NOTE---------------------------------- Only applicable to edible portions of Fish samples. --	
	Collect sample from required location.	12 months
	AND	
	Perform gamma isotopic analysis of sample.	60 days following sample acquisition

SURVEILLANCES (continued)

	SURVEILLANCE	FREQUENCY
S 2.5.1.8	----------------------------------NOTES---------------------------------- 1. Only applicable to Food Product samples. 2. Only applicable if Milk sampling not performed. --	
	Collect sample from required location.	12 months
	AND	
	Perform gamma isotopic analysis of sample.	21 days following sample acquisition
	AND	
	Perform I-131 analysis of sample.	21 days following sample acquisition
S 2.5.1.9	Verify the LLDs listed in Table 2.5-1 are met.	12 months
S 2.5.1.10	Verify radioactivity concentrations are less than or equal to the limits listed in Table 2.5-2, when averaged over a calendar quarter.	92 days

TABLE 2.5-1

MAXIMUM VALUES OF THE LOWER LIMITS OF DETECTION (LLD)

Analyses	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)	Sediment (pCi/kg, dry)
Gross Beta	4[(a)]	1×10^{-2}[(b)]				
H-3	2000[(c)]					
Mn-54	15		130			
Fe-59	30		260			
Co-58, 60	15		130			
Zn-65	30		260			
Zr-95	30					
Nb-95	15					
I-131	1[(d)]	7×10^{-2}[(e)]		1	60	
Cs-134	15	5×10^{-2}[(f)]	130	15	60	150
Cs-137	18	6×10^{-2}[(f)]	150	18	80	180
Ba-140	60			60		
La-140	15			15		

(a) LLD for drinking water.

(b) Only applicable to particulate.

(c) LLD for drinking water. When no drinking water pathway exists, a value of 3000 pCi/l may be used.

(d) LLD for drinking water. When no drinking water pathway exists, a gamma isotopic analysis LLD value of 15 pCi/l may be used.

(e) Only applicable to gas.

(f) Only applicable to particulate gamma isotopic analysis.

L 2.5.1

TABLE 2.5-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Analyses	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	2×10^4 [(a)]				
Mn-54	1×10^3		3×10^4		
Fe-59	4×10^2		1×10^4		
Co-58	1×10^3		3×10^4		
Co-60	3×10^2		1×10^4		
Zn-65	3×10^2		2×10^4		
Zr-95, Nb-95	4×10^2 [(b)]				
I-131	2 [(c)]	0.9		3	1×10^2
Cs-134	30	10 [(d)]	1×10^3	60	1×10^3
Cs-137	50	20 [(d)]	2×10^3	70	2×10^3
Ba-140, La-140	2×10^2 [(b)]			3×10^2 [(b)]	

(a) Drinking water samples.

(b) Total for parent and daughter.

(c) LLD for drinking water. When no drinking water pathway exists, a value of 20 pCi/l may be used.

(d) Applicable when performing a gamma isotopic analysis of individual particulate samples with gross beta activity more than 10 times the yearly mean of control samples.

L 2.5 RADIOLOGICAL ENVIRONMENTAL MONITORING

L 2.5.2 ---NOTE---
Broad leaf vegetation sampling may be performed at the site boundary in the directional sector with the highest D/Q in lieu of the garden census.

The location of the nearest milk animal, the nearest residence, and the nearest garden of greater than 500 ft^2 producing fresh leafy vegetables in each of the 16 meteorological sectors within a 5 mile distance from one reactor (containment) building shall be identified.

APPLICABILITY: At all times.

ACTIONS

---NOTE---
Separate Condition entry is allowed for each sample location.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. New sample location identified which yields a calculated dose due to I-131, H-3, and/or particulates projected to exceed 40 CFR 190 limits. OR New sample location identified which yields a calculated dose via the same exposure pathway in excess of values calculated at sample locations of Limitation L 2.51.	A.1 Initiate a condition report to document and track the condition for inclusion in the Annual Radiological Environmental Operating Report pursuant to TS 5.6.2 (ANO-1) / TS 6.6.2 (ANO-2).	Immediately
	AND	
	A.2.1 Identify and add the new sample location to the Radiological Environment Monitoring Program.	30 days
	AND	
	A.2.2 Delete the previous sample location via the associated exposure pathway from the Radiological Environment Monitoring Program.	Within 90 days following October 31 of the year in which the new sample location was identified.

SURVEILLANCES

--NOTE--
S 2.0.2 is not applicable to the Surveillances of this Limitation.

SURVEILLANCE		FREQUENCY
S 2.5.2.1	A land use census to identify the locations described in Limitation L 2.5.2 shall be performed by door-to-door survey, aerial survey, or by consulting local agricultural authorities.	24 months between June 1 and October 1
S 2.5.2.2	Include the results of S 2.5.2.1 in the Annual Radiological Environmental Operating Report pursuant to TS 5.6.2 (ANO-1) / TS 6.6.2 (ANO-2).	12 months

L 2.5 RADIOLOGICAL ENVIRONMENTAL MONITORING

L 2.5.3 Radioactive materials supplied as part of the Interlaboratory Comparison Program shall be analyzed.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Limitation not met.	A.1 Initiate a condition report to document and track the condition for inclusion in the Annual Radiological Environmental Operating Report pursuant to TS 5.6.2 (ANO-1) / TS 6.6.2 (ANO-2).	Immediately

SURVEILLANCES

--NOTE--
S 2.0.2 is not applicable to the Surveillances of this Limitation.

SURVEILLANCE	FREQUENCY
S 2.5.3.1 Include the results of analyses performed as part of the Interlaboratory Comparison Program in the next Annual Radiological Environmental Operating Report pursuant to TS 5.6.2 (ANO-1) / TS 6.6.2 (ANO-2).	12 months

B 2.0 LIMITITATION (L) APPLICABILITY

BASES

Limitations	L 2.0.1 through L 2.0.5 establish the general requirements applicable to all Limitations and apply at all times, unless otherwise stated.
B 2.0.1	L 2.0.1 establishes the Applicability statement within each individual Limitation as the requirement for when the Limitation is required to be met (i.e., when the unit is in the MODES or other specified conditions of the Applicability statement of each Limitation).
B 2.0.2	L 2.0.2 establishes that upon discovery of a failure to meet a Limitation, the associated ACTIONS shall be met. The Completion Time of each Required Action for an ACTIONS Condition is applicable from the point in time that an ACTIONS Condition is entered. The Required Actions establish those remedial measures that must be taken within specified Completion Times when the requirements of a Limitation are not met. This Limitation establishes that: a. Completion of the Required Actions within the specified Completion Times constitutes compliance with a Limitation; and b. Completion of the Required Actions is not required when a Limitation is met within the specified Completion Time, unless otherwise specified. Completing the Required Actions is not required when a Limitation is no longer applicable, unless otherwise stated in the individual Specification.
B 2.0.3	L 2.0.3 establishes the Required Actions that must be implemented when a Limitation is not met and the condition is not specifically addressed by the associated Conditions. It is not intended to be used as an operational convenience that permits routine voluntary removal of redundant systems or components from service in lieu of other alternatives that would not result in redundant systems or components being inoperable. This requirement is intended to provide assurance that plant management is aware of the condition and to ensure that the condition is evaluated for its affect on continued operation of the plant.
B 2.0.4	L 2.0.4 establishes Limitations on changes in MODES or other specified conditions in the Applicability when a Limitation is not met. It allows placing the unit in a MODE or other specified condition stated in that Applicability (e.g., the Applicability desired to be entered) when unit conditions are such that the requirements of the Limitation would not be met, in accordance with Limitation L 2.0.4.a, L 2.0.4.b, or L 2.0.4.c.

BASES

LIMITATION APPLICABILITY (continued)

B 2.0.4 (continued)

L 2.0.4 allows entry into a MODE or other specified condition in the Applicability with the Limitation not met when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. Compliance with Required Actions that permit continued operation of the unit for an unlimited period of time in a MODE or other specified condition provides an acceptable level of safety for continued operation. This is without regard to the status of the unit before or after the MODE change. Therefore, in such cases, entry into a MODE or other specified condition in the Applicability may be made in accordance with the provisions of the Required Actions. The provisions of this Limitation should not be interpreted as endorsing the failure to exercise the good practice of restoring systems or components to FUNCTIONAL status before entering an associated MODE or other specified condition in the Applicability.

Upon entry into a MODE or other specified condition in the Applicability with the Limitation not met, L 2.0.1 and L 2.0.2 require entry into the applicable Conditions and Required Actions until the Condition is resolved, until the Limitation is met, or until the unit is not within the Applicability of the Limitation.

Surveillances do not have to be performed on the associated inoperable equipment (or on variables outside the specified limits), as permitted by S 2.0.1. Therefore, utilizing L 2.0.4 is not a violation of S 2.0.1 or S 2.0.4 for any Surveillances that have not been performed on equipment. However, Surveillances must be met to ensure FUNCTIONALITY prior to declaring the associated equipment FUNCTIONAL (or variable within limits) and restoring compliance with the affected Limitation.

B 2.0.5

L 2.0.5 establishes the allowance for restoring equipment to service under administrative controls when it has been removed from service or declared non-functional to comply with ACTIONS. The sole purpose of this Limitation is to provide an exception to L 2.0.2 (e.g., to not comply with the applicable Required Actions) to allow the performance of required testing to demonstrate:

a. The FUNCTIONALITY of the equipment being returned to service; or

b. The FUNCTIONALITY of other equipment.

The administrative controls ensure the time the equipment is returned to service in conflict with the requirements of the ACTIONS is limited to the time absolutely necessary to perform the required testing to demonstrate FUNCTIONALITY. This Limitation does not provide time to perform any other preventive or corrective maintenance.

An example of demonstrating the FUNCTIONALITY of the equipment being returned to service is restarting a ventilation system that has been secured to comply with Required Actions and must be restarted to perform the required testing.

B 2.0 SURVEILLANCE (S) APPLICABILITY

BASES

S 2.0.1	SRs shall be met during the MODES or other specified conditions in the Applicability for individual Limitations, unless otherwise stated in the individual Surveillance. Failure to meet a Surveillance, whether such failure is experienced during the performance of the Surveillance or between performances of the Surveillance, shall be failure to meet the Limitation. Failure to perform a Surveillance within the specified Frequency shall be failure to meet the Limitation except as provided in S 2.0.3. Surveillances are not required to be performed on non-functional equipment or variables outside specified limits.
S 2.0.2	The specified Frequency for each Surveillance is met if the Surveillance is performed within 1.25 times the interval specified in the Frequency, as measured from the previous performance or as measured from the time a specified condition of the Frequency is met. For Frequencies specified as "once," the above interval extension does not apply. If a Completion Time requires periodic performance on a "once per . . ." basis, the above Frequency extension applies to each performance after the initial performance. Exceptions to this Limitation are stated in the individual Limitations.
S 2.0.3	If it is discovered that a Surveillance was not performed within its specified Frequency, then compliance with the requirement to declare the Limitation not met may be delayed, from the time of discovery, up to 24 hours or up to the limit of the specified Frequency, whichever is greater. This delay period is permitted to allow performance of the Surveillance. If the Surveillance is not performed within the delay period, the Limitation must immediately be declared not met, and the applicable Condition(s) must be entered. When the Surveillance is performed within the delay period and the Surveillance is not met, the Limitation must immediately be declared not met, and the applicable Condition(s) must be entered.
S 2.0.4	Entry into a MODE or other specified condition in the Applicability of a Limitation shall only be made when the Limitation's Surveillances have been met within their specified Frequency, except as provided by S 2.0.3. When a Limitation is not met due to Surveillances not having been met, entry into a MODE or other specified condition in the Applicability shall only be made in accordance with L 2.0.4.

B 2.1 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

BASES

BACKGROUND

The Radioactive Liquid Effluent Monitoring Instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases.

LIMITATION

The following Radioactive Liquid Effluent Monitoring Instrumentation is required to be FUNCTIONAL:

ANO-1: RE-4642 – Liquid Radwaste Monitor
RE-2682 – “A” Main Steam Line Radiation Monitor
RE-2681 – “B” Main Steam Line Radiation Monitor

ANO-2: 2RE-2330 – Liquid Radwaste Monitor
2RE-4423 – Liquid Radwaste Monitor

Both radiation monitoring and flow monitoring capability are required to be FUNCTIONAL for each Liquid Radwaste Monitor. With regard to Liquid Radwaste radiation monitoring, the alarm/trip function must also be FUNCTIONAL. The alarm/trip setpoints for these instruments are calculated in accordance with the methods contained in ODCM Section 2.1 to ensure that the alarm/trip will occur prior to potentially exceeding the limits of 10 CFR Part 20.

With regard to the Main Steam Line Radiation Monitors, these monitors must have a measurement range capability from 10^{-1} mR/hr to 10^{4} mR/hr.

APPLICABILITY

The Liquid Radwaste Monitors are required to be FUNCTIONAL during any release via the pathway in which the monitor is installed. The Main Steam Line Radiation Monitors are required to be FUNCTIONAL in MODES 1, 2, 3, and 4.

ACTIONS

The following ACTIONS are generally applicable to the pathway in which a radioactive liquid release is in progress. Because more than one release could occur simultaneously, the ACTIONS are modified by a Note that permits separate Condition entry for each non-functional Radioactive Liquid Effluent Monitoring Instrument.

ACTIONS (continued)

A.1

If the radiation monitoring feature of the Radioactive Liquid Effluent Monitoring Instrument is non-functional, any release via the associated pathway must be suspended immediately. This prevents the release of unmonitored effluents to the environment.

A.2.1

In addition to Required Action A.1, a non-functional radiation monitoring feature of a Radioactive Liquid Effluent Monitoring Instrument must be returned to a FUNCTIONAL status prior to the restart or subsequent release of effluents via the associated pathway. This prevents the release of unmonitored effluents to the environment. Exceptions to this requirement are included in Required Actions A.2.2.1 through A.2.2.3 below.

A.2.2.1 through A.2.2.3

In lieu of performing Required Action A.2.1 above, grab samples may be obtained and analyzed to provide a backup monitoring method for the effluent release. Because of the importance of monitoring radioactive liquid releases, two independent samples of the effluent must be obtained and analyzed. The independency required is with regard to obtaining and analyzing each sample separately. Two independent personnel are not required to obtain and analyze the two samples.

Notwithstanding the above, computer input data and the discharge valve lineup associated with the effluent release path must be verified by two independent, qualified individuals. Integrity of independence is maintained by preventing interaction between personnel during the verification process. With regard to valve lineups, independent verification is conducted such that each check constitutes actual identification of the valve and a determination of both “required” and “actual” valve position.

B.1 and B.2

If the flow monitoring feature of the Radioactive Liquid Effluent Monitoring Instrument is non-functional, the flow rate may be estimated within 4 hours of initial loss of the instrument and every 4 hours thereafter, for the duration of the effluent release. Flow rate data is necessary to calculate the amount of radioactive released via the effluent discharge. The 4-hour Completion Time is reasonable because a significant change in flow rate over the course of an effluent release is unlikely.

S 2.0.2 is not applicable to the initial flow estimation, but may be applied to the flow estimations thereafter. Pump curves may be used to estimate flow.

ACTIONS (continued)

C.1

If one or more Main Steam Line Radiation Monitors is non-functional, the pre-planned alternate monitoring method of monitoring must be established within 72 hours. The alternate method chosen should ensure continued monitoring of the Main Steam system for radiation while operating in MODES 1, 2, 3, or 4. In addition, the affected monitor(s) must be restored to a FUNCTIONAL status within 7 days.

D.1

If the Required Actions and associated Completion Times of Conditions A, B, and/or C cannot be met, then additional measures may be necessary to ensure continued safe operation or to reduce overall station risk. Therefore, a condition report must be initiated immediately to assess the impact on continued effluent release operations given the degraded condition.

E.1

Instrumentation installed to ensure radiological monitoring of effluent releases is expected to be normally available in accordance with the design function or purpose of the equipment. During releases via a respective pathway, instrumentation that remains non-functional for greater than 30 days may indicate inappropriate importance placed on the equipment or over-reliance on the backup sampling method for effluent release monitoring. As an incentive to avoid either of these conditions, Radioactive Liquid Effluent Monitoring Instrumentation that remains non-functional for more than 30 days must be included in the Radioactive Effluent Release Report submitted pursuant to TS 5.6.3 (ANO-1) or TS 6.6.3 (ANO-2). In order to ensure inclusion, Required Action E.1 requires the condition to be tracked via a condition report.

Information to be provided in the respective Radioactive Effluent Release Report should include 1) the component number and noun name, 2) the failure mode, 3) the reason for continued inoperability, and 4) the expected return to service date.

SURVEILLANCES

S 2.1.1.1

Performance of the CHANNEL CHECK every 24 hours provides reasonable assurance for prompt identification of a gross failure of instrumentation. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. Where parameter comparison is not possible, the CHANNEL CHECK will continue to identify gross instrument failure such as loss of power, unexpected upscale readings, failed-low indications, etc. The CHANNEL CHECK is key in verifying that the instrumentation continues to operate properly between CHANNEL CALIBRATIONs. The Frequency is based on unit operating experience that demonstrates channel failure is rare.

SURVEILLANCES (continued)

S 2.1.1.2

A CHANNEL TEST is performed on the radiation monitoring portion of each required instrument channel to ensure the entire channel will perform the intended functions. The CHANNEL TEST demonstrates that automatic isolation of the associated pathway and Control Room alarm occur should the instrument indicate measured levels above the trip setpoint. The channel test also demonstrates that alarm occurs when any of the following conditions exist:

A. Power to the detector is lost.

B. The instrument indicates a downscale failure.

C. Instrument controls are not set in the operate mode.

Any setpoint adjustment shall be consistent with Section 2.1 of the ODCM.

The Surveillance is modified by a Note clarifying that the CHANNEL TEST is applicable only to the radiation detection portion of the monitor function and is not applicable to the flow monitoring function. The Frequency of 92 days is based on unit operating experience, with regard to channel FUNCTIONALITY and drift, which demonstrates that failure of a channel in any 92-day interval is a rare event, especially in light of the infrequency of radioactive liquid releases.

S 2.1.1.3

CHANNEL CALIBRATION is a complete check of the instrument channel, including the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drift (as required) to ensure that the instrument channel remains FUNCTIONAL between successive tests. CHANNEL CALIBRATION shall find that measurement errors and setpoint errors are within the assumptions of the setpoint calculations. CHANNEL CALIBRATIONS must be performed consistent with the assumptions of the setpoint calculations. This Frequency is justified by the assumption of at least an 18 month calibration interval to determine the magnitude of equipment drift or deviation in the setpoint calculations.

Initial CHANNEL CALIBRATION is performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration are used.

SURVEILLANCES (continued)

S 2.1.1.4

A SOURCE CHECK provides a qualitative assessment of channel response when the channel sensor is exposed to the radioactive source. This check is performed within 8 hours prior to release of effluent via the associated flow path. When a SOURCE CHECK can be performed, it provides verification that the sensor will respond to an increase in radiation level. Note 1, however, does not require a SOURCE CHECK when the background radiation at the sensor is greater than the check source. This is acceptable because of the other required tests above (CHANNEL CHECK, CHANNEL TEST, CHANNEL CALIBRATION). The 8-hour restriction is reasonable because it is unlikely that the sensor will unexpectedly fail in any 8-hour period.

Note 2 provides clarification that the SOURCE CHECK applies only to the radiation detection portion of the Liquid Radwaste Monitor and is not applicable to the flow monitor portion or to the Main Steam Line Radiation Monitors.

B 2.2 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

BASES

BACKGROUND

The Radioactive Gaseous Effluent Monitoring Instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases.

LIMITATION

The following Radioactive Gaseous Effluent Monitoring Instrumentation is required to be FUNCTIONAL:

--NOTE--
Refer to ANO-2 Technical Specification (TS) 3.3.3.1 for ANO-2 Containment Building Purge System Process Monitor (2RE-8233) operability requirements and associated ACTIONS.

ANO-1: RE-4830 – Waste Gas Holdup System Process Monitor*
RX-9820 – Reactor Building Purge and Ventilation SPING
RX-9825 – Auxiliary Building Ventilation SPING
RX-9830 – Spent Fuel Pool Area Ventilation SPING
RX-9835 – Emergency Penetration Room Ventilation SPING

ANO-2: 2RE-2429 – Waste Gas Holdup System Process Monitor*
2RX-9820 – Containment Building Purge and Ventilation SPING
2RX-9825 – Auxiliary Building Ventilation SPING
2RX-9830 – Spent Fuel Pool Area Ventilation SPING
2RX-9835 – Emergency Penetration Room Ventilation SPING
2RX-9845 – Auxiliary Building Extension Ventilation SPING
2RX-9850 – Radwaste Storage Building Ventilation SPING

* These monitors provide automatic isolation.

The radiation monitoring (process gas and SPING noble gas) and effluent flow monitoring capability are required to be FUNCTIONAL for each monitor. For SPING monitors the sample flow monitoring, the iodine sample, and the particulate sampler must also be FUNCTIONAL. With regard to Waste Gas Holdup System radiation monitoring, the alarm/trip function must also be FUNCTIONAL. The alarm/trip setpoints for specified instruments are calculated in accordance with the methods contained in ODCM Section 3.1 to ensure that the alarm/trip will occur prior to potentially exceeding the limits of 10 CFR Part 20.105. Note that the PURGE function of the ANO-1 and ANO-2 Reactor (Containment) Building is treated separately from the ventilation function.

Performance of a SOURCE CHECK on a given radiation monitor does not require the monitor to be declared non-functional due to the short period of time required to perform this test.

APPLICABILITY

The above monitors are required to be FUNCTIONAL during any release via the pathway in which the monitor is installed. Because SPINGs 4 and 8 monitor the Emergency Penetration Room Ventilation of ANO-1 and ANO-2, respectively, and because these ventilation systems are normally aligned for auto-start capability to aid in accident mitigation, these SPINGs must be FUNCTIONAL whenever the associated ventilation system is available for auto-start.

ACTIONS

The following ACTIONS are applicable to the pathway in which a radioactive gaseous release is in progress. Because more than one release could occur simultaneously, the ACTIONS are modified by a Note that permits separate Condition entry for each non-functional Radioactive Gaseous Effluent Monitoring Instrument.

A.1

If the radiation monitoring feature, including the alarm/trip function for monitors having an automatic isolation feature, of the Waste Gas Holdup or ANO-1 Reactor Building Purge and Ventilation System Gas Activity Process or Noble Gas Activity Monitor(s) is non-functional, any release via the associated pathway must be suspended immediately. This prevents the release of unmonitored effluents to the environment.

A.2.1

In addition to Required Action A.1, a non-functional Waste Gas Holdup or ANO-1 Reactor Building Purge and Ventilation System Gas Activity Process or Noble Gas Activity Monitor, including the alarm/trip function for monitors having an automatic isolation feature, must be returned to a FUNCTIONAL status prior to the restart or subsequent release of effluents via the associated pathway. This prevents the release of unmonitored effluents to the environment. Exceptions to this requirement are included in Required Actions A.2.2.1 through A.2.2.3 below.

A.2.2.1 through A.2.2.3

In lieu of performing Required Action A.2.1 above, grab samples may be obtained and analyzed to provide a backup monitoring method for the effluent release. Because of the importance of monitoring radioactive gaseous releases, two independent samples of the effluent must be obtained and analyzed. The independency required is with regard to obtaining and analyzing each sample separately. Two independent personnel are not required to obtain and analyze the two samples.

ACTIONS (continued)

A.2.2.1 through A.2.2.3 (continued)

Notwithstanding the above, computer input data and the discharge valve lineup associated with the effluent release path must be verified by two independent, qualified individuals. Integrity of independence is maintained by preventing interaction between personnel during the verification process. With regard to valve lineups, independent verification is conducted such that each check constitutes actual identification of the valve and a determination of both “required” and “actual” valve position. Required Action A.2.2.3 is modified by a Note that excepts the valve lineup requirement from the ANO-1 Reactor Building Purge and Ventilation System since no manual valves are manipulated for this release path.

B.1 and B.2

If the flow monitoring features of the Radioactive Gaseous Effluent Monitoring Instrumentation is non-functional, the flow rate may be estimated within 4 hours of initial loss of the instrument and every 4 hours thereafter, for the duration of the effluent release. Flow rate data is necessary to calculate the amount of radioactive released via the effluent discharge. Therefore, if flow cannot be estimated, it is necessary to suspend the release of radioactive effluents monitored by the affected channel. The 4-hour Completion Time is reasonable because a significant change in flow rate over the course of an effluent release is unlikely.

A Control Room RDACS trouble alarm is received when sample flows are not within predetermined limits (among other SPING conditions). With regard to SPINGs 4 or 8, procedures require a temporary sample pump to be installed when the sample flow channel is non-functional, which may be used to meet Required Action B.1, even if the flow path is in auto-standby status. With the temporary sample pump installed, Required Action D.1 will be met should the flow path auto start. Therefore, as indicated below, Condition D is not required to be considered while the SPING 4 and 8 flow paths are idle.

S 2.0.2 is not applicable to the initial flow estimation, but may be applied to the flow estimations thereafter. Pump curves may be used to estimate flow.

C.1 and C.2

Condition C is modified by two notes. Note 1 omits this Condition from being applicable to the Waste Gas Holdup or ANO-1 Reactor Building Purge and Ventilation System Gas Activity Process or Noble Gas Activity Monitors. These monitors are addressed in Condition A. Note 2 requires the associated Required Actions and Completion Times of Condition C be applied to SPINGS 4 and 8 (Emergency Penetration Room Ventilation of ANO-1 and ANO-2, respectively) only when the pathway is in service, since noble gas activity sampling and analysis cannot be performed when the pathway is idle.

ACTIONS (continued)

C.1 and C.2 (continued)

With the exception of Waste Gas Holdup System releases or during a PURGE of the ANO-1 Reactor Building, releases may continue via an associated pathway when the Noble Gas Activity Monitor(s) is non-functional, provided a sample of the effluent is obtained once every 12 hours and analyzed within the following 24 hours. This prevents the release of unmonitored effluents to the environment. ACTIONS C.1 and C.2 are modified by a note, referring to ANO-1 TS 3.9.3 for additional ACTIONS that may be necessary if the required ANO-1 Reactor Building Purge and Ventilation System Noble Gas Activity Monitor is inoperable.

S 2.0.2 is not applicable to the initial sample and analysis, but may be applied to the sample and analysis thereafter.

D.1, D.2, and D.2

Condition D is modified by a Note which requires the associated Required Actions and Completion Times of Condition D be applied to SPINGS 4 and 8 (Emergency Penetration Room Ventilation of ANO-1 and ANO-2, respectively) only when the pathway is in service, since iodine and particulate sampling and analysis cannot be performed when the pathway is idle.

If one or more required Iodine and/or Particulate Samplers are non-functional, auxiliary sampling equipment must be established within 4 hours. The backup Iodine and Particulate cartridges must be replaced every 7 days. Following replacement, the respective cartridge must be analyzed within 48 hours. This prevents the release of unmonitored effluents to the environment.

E.1

If the Required Actions and associated Completion Times of Condition C and/or D cannot be met, then releases via the associated pathway must be suspended. This prevents the release of unmonitored effluents to the environment.

F.1

If the Required Actions and associated Completion Times of Condition A, B, and/or E cannot be met, then additional measures may be necessary to ensure continued safe operation or to reduce overall station risk. Therefore, a condition report must be initiated immediately to assess the impact on continued effluent release operations given the degraded condition.

ACTIONS (continued)

G.1

Instrumentation installed to ensure radiological monitoring of effluent releases is expected to be normally available in accordance with the design function or purpose of the equipment. Instrumentation that remains non-functional for greater than 30 days may indicate inappropriate importance placed on the equipment or over-reliance on the backup sampling method for effluent release monitoring. As an incentive to avoid either of these conditions, Radioactive Gaseous Effluent Monitoring Instrumentation that remains non-functional for more than 30 days must be included in the Radioactive Effluent Release Report submitted pursuant to TS 5.6.3 (ANO-1) or TS 6.6.3 (ANO-2). In order to ensure inclusion, Required Action G.1 requires the condition to be tracked via a condition report.

Information to be provided in the respective Radioactive Effluent Release Report should include 1) the component number and noun name, 2) the failure mode, 3) the reason for continued inoperability, and 4) the expected return to service date.

SURVEILLANCES

S 2.2.1.1

Performance of the CHANNEL CHECK every 24 hours provides reasonable assurance for prompt identification of a gross failure of instrumentation. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. Where parameter comparison is not possible, the CHANNEL CHECK will continue to identify gross instrument failure such as loss of power, unexpected upscale readings, failed-low indications, etc. The CHANNEL CHECK is key in verifying that the instrumentation continues to operate properly between CHANNEL CALIBRATIONs. The Frequency is based on unit operating experience that demonstrates channel failure is rare.

This Surveillance is modified by a Note the exempts the Iodine and Particulate Samplers from a CHANNEL CHECK since these components do not have electronic features or indications.

S 2.2.1.2

A local check must be made every 7 days to verify that required Iodine Sampler cartridges and Particulate Sample filters are in place. The 7-day Frequency is reasonable because it is unlikely a cartridge or filter could be inadvertently removed from the system.

SURVEILLANCES (continued)

S 2.2.1.3 and S 2.2.1.6

A CHANNEL TEST is performed on required Gas Activity Process and Noble Gas Activity Monitors to ensure the entire channel will perform the intended functions. For the Waste Gas Holdup and ANO-2 Containment Building Purge Systems, the CHANNEL TEST demonstrates that automatic isolation of the associated pathway and Control Room alarm occur should the instrument indicate measured levels above the trip setpoint. The channel test also demonstrates that alarm occurs when any of the following conditions exist:

A. Power to the detector is lost.

B. The instrument indicates a downscale failure.

C. Instrument controls are not set in the operate mode.

Any setpoint adjustment shall be consistent with Section 3.1 of the ODCM.

Because the alarm/trip function and/or the importance of the release path, a CHANNEL TEST of the associated Gas Activity Process and Noble Gas Activity Monitors is required within 31 days prior to release via the Waste Gas Holdup or ANO-1 Reactor Building Purge and Ventilation Systems. This ensures the monitors are FUNCTIONAL within a reasonable period of time before such a release is commenced. All active pathway Gas Activity Process and Noble Gas Activity Monitors undergo a CHANNEL TEST once every 92 days. This Frequency is reasonable because each has a Control Room alarm function.

S 2.2.1.4 and S 2.2.1.5

A SOURCE CHECK provides a qualitative assessment of channel response when the channel sensor is exposed to the radioactive source. This check is performed within 14 days prior to release of effluent via the Waste Gas Holdup or ANO-1 Reactor Building Purge Systems. The 14-day restriction is reasonable because it is unlikely that the sensor will unexpectedly fail in any 14-day period. All active pathway Gas Activity Process and Noble Gas Activity Monitors must undergo a SOURCE CHECK every 31 days. This Frequency is reasonable because each has a Control Room alarm function.

When a SOURCE CHECK can be performed, it provides verification that the sensor will respond to an increase in radiation level. Note 1 of S 2.2.1.5 and the Note associated with S 2.2.1.4 does not require a SOURCE CHECK when the background radiation at the sensor is greater than the check source. This is acceptable because of the other required tests above (CHANNEL CHECK, CHANNEL TEST, and CHANNEL CALIBRATION).

SURVEILLANCES (continued)

S 2.2.1.7

CHANNEL CALIBRATION is a complete check of the instrument channel, including the sensor. The test verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drift (as required) to ensure that the instrument channel remains FUNCTIONAL between successive tests. CHANNEL CALIBRATION shall find that measurement errors and setpoint errors are within the assumptions of the setpoint calculations. CHANNEL CALIBRATIONS must be performed consistent with the assumptions of the setpoint calculations. This Frequency is justified by the assumption of at least an 18 month calibration interval to determine the magnitude of equipment drift or deviation in the setpoint calculations.

Initial CHANNEL CALIBRATION is performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration are used.

This Surveillance is modified by a Note the exempts the Iodine and Particulate Samplers from a CHANNEL CALIBRATION since these components do not have electronic features or indications.

B 2.3 RADIOACTIVE LIQUID EFFLUENTS

BASES

BACKGROUND

This Limitation is provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site to unrestricted areas will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table II. This limit provides additional assurance that the levels of radioactive materials in bodies of water outside the site will not result in exposures greater than the Section II.A design objectives of 10 CFR 50, Appendix I, to a MEMBER OF THE PUBLIC.

LIMITATION

The concentration limit for noble gases is based upon the assumption that Xe-133 is the controlling radioisotope and its maximum permissible concentration (MPC) in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

Radioactive nuclides other than dissolved or entrained noble gases must be maintained within the limits of 10 CFR 20, Appendix B, Table II, Column 2 values. The various dose limitations are conservative with regard to 10 CFR 20 requirements in order to provide a margin of safety through the use of “as low as reasonably achievable” (ALARA) practices.

Necessary portions of the LIQUID RADWASTE TREATMENT SYSTEM shall be used to reduce the radioactive materials in liquid waste prior to discharge when it is projected that the cumulative dose during a calendar quarter due to liquid effluent releases would exceed 0.18 mrem to the total body or 0.625 mrem to any organ. The provisions of this Limitation do not apply to the laundry tanks due to their incompatibility with the radwaste system.

The specified limits governing the use of appropriate portions of the LIQUID RADWASTE TREATMENT SYSTEM are a suitable fraction of the guide set forth in Section II.A of 10 CFR 50, Appendix I, for liquid effluents. The values of 0.18 mrem and 0.625 mrem are approximately 25% of the yearly design objectives on a quarterly basis. The yearly design objectives are provided in 10 CFR 50, Appendix I, Section II.

APPLICABILITY

The Limitations are required to be met at all times.

ACTIONS

Because more than one Limitation or Surveillance requirement may not be met at a given time, the ACTIONS are modified by a Note that permits separate Condition entry for each Limitation and/or Surveillance requirement that is not met.

ACTIONS (continued)

A.1 and A.2

If any Limitation L 2.3.1.a through L 2.3.1.e is not met, action must be initiated immediately to restore the parameter within limits. This could require a reduction in offsite releases scheduled for the near future or further processing of effluents prior to release. In any event, a condition report must be initiated to determine whether additional actions are necessary to permit continued operations involving radioactive liquid effluent releases given the current circumstances. In addition, corrective action must be issued to identify and track the Limitation that was exceeded for inclusion in the annual Radioactive Effluent Release Report. However, the condition need not be reported in the annual Radioactive Effluent Release Report if reported otherwise (i.e., in accordance with reporting requirements of 10 CFR 20, 10 CFR 50.72, 10 CFR 50.73, or 40 CFR 190).

B.1 and B.2

If the sampling and/or analysis requirements of S 2.3.1.1 are not met, the release must be terminated. This action prevents or minimizes the potential for an unmonitored offsite radioactive liquid release. Such release may commence or be re-initiated once the sampling and analysis requirements of S 2.3.1.1 are met. Regardless, a condition report must be initiated to determine whether additional actions are necessary to permit continued operations involving radioactive liquid effluent releases given the current circumstances. If a condition report has already been initiated relevant to this Condition, then this assessment may be performed in conjunction with that condition report; a second condition report is not required.

C.1 and C.2

This ACTION is modified a Note, limiting its applicability to only a CONTINUOUS RELEASE of secondary coolant.

With elevated dose equivalent I-131 (DEI) activity in the secondary coolant, it is prudent to modify the frequencies for obtaining and analyzing grab samples. Therefore, with secondary coolant DEI > 0.01 μCi/ml, sample frequency is modified from once every 24 hours to once every 12 hours. The analysis of the sample must be completed with 12 hours of sample acquisition. More frequent monitoring of the secondary coolant will assist in detecting further increases in activity and provide personnel better opportunity for in developing corrective action plans, as necessary.

ACTIONS (continued)

D.1

In accordance with 40 CFR 190, a variance must be received from the regulatory authority (NRC) if offsite dose to a member of the public will, or has exceeded, limits established in 40 CFR 190. Because Surveillance S 2.3.1.3 tracks the accumulated dose to members of the public over specified time periods (calendar quarter or calendar year), the dose may be projected and a determination made with regard to whether it is likely 40 CFR 190 limits will be exceeded. If 40 CFR 190 limits are projected to be exceeded, an application for a variance from the NRC must be submitted prior to the estimated date in which any 40 CFR 190 limit will be exceeded. The variance will allow continued offsite liquid and gaseous releases in excess of 40 CFR 190 limits. Note that the variance is normally expected to remain in effect until the end of the current calendar year since 40 CFR 190 limits only apply to the calculated annual dose to members of the public.

If application for variance cannot be made prior to exceeding any 40 CFR 190 limit, it may be prudent to notify the NRC by phone as soon as possible of the need for a variance, providing the expected date in which the application will be submitted. Note that the NRC may provide verbal approval for variance in situations where time is a factor.

E.1

If the Required Actions and associated Completion Times of Conditions C and/or D cannot be met or if the sampling and/or analysis requirements denoted in Surveillances S 2.3.1.1 and/or S 2.3.1.2 are not met, then additional measures may be necessary to ensure continued safe operation or to reduce overall station risk. Therefore, a condition report must be initiated immediately to assess the impact on continued effluent release operations given the requirements that are not being met.

F.1

Surveillance S 2.3.1.5 establishes required capability of various sample analyses. A given analysis must be capable of detecting respective radioactivity at a reasonably low threshold in order to ensure radioactive liquid releases to the public are carefully and accurately monitored. If the stated thresholds can not be met, a condition report must be initiated and corrective action issued to ensure the condition is included and described in the annual Radioactive Effluent Release Report.

SURVEILLANCES

S 2.3.1.1 and S 2.3.1.2

All radioactive liquid effluent releases are required to be monitored. Because a BATCH RELEASE is of a known quantity and of finite duration, sampling of batch effluents must be performed prior to release. In addition, the sample must undergo a gamma isotopic and DEI analysis prior to the release to provide high confidence that radioactive release limits will not be exceeded. Remaining analyses may then be completed at the designated Frequency during or following the release.

For a BATCH RELEASE, a composite sample, one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released, is performed. In order to ensure a representative sample, the batch shall be thoroughly mixed before the sample is obtained.

Unlike the BATCH RELEASE, a CONTINUOUS RELEASE must be monitored at a set Frequency. While gross activity monitoring is available for various release paths as is recommended by Regulatory Guide (RG) 1.21, “Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants,” such monitoring does not provide the necessary breakdown and quantification of radioactivities being discharged. Therefore, the ODCM requires grab samples and analyses of these effluents at a specified Frequency.

To be representative of the quantities and concentrations of radioactive materials in liquid effluents, a CONTINUOUS RELEASE sample must be proportional to the rate of flow of the effluent stream.

S 2.3.1.3

Limitation L 2.3.1 establishes limits on radioactive liquid concentrations discharged from the plant and the accumulative dose that may be received by a MEMBER OF THE PUBLIC as a result of such releases. In order to determine that these limits are met and being maintained, the results of analyses required by Surveillances S 2.3.1.1 and S 2.3.1.2 must be compared to the Limitation requirements on a specified Frequency. Therefore, analysis results obtained within a given 7-day period must be considered, in some cases along with previous analysis results of all liquid release over a specified period of time (calendar quarter or calendar year), to ensure limits are not exceeded.

S 2.3.1.4

In accordance with 40 CFR 190, a variance must be received from the regulatory authority (NRC) is offsite dose to a member of the public will, or has exceeded, limits established in 40 CFR 190. Because Surveillance S 2.3.1.3 tracks the accumulated dose to members of the public over specified time periods (calendar quarter or calendar year), the dose may be projected and a determination made with regard to whether it is likely 40 CFR 190 limits will be exceeded. The 31-day Frequency is acceptable because associated ODCM limits for these releases are significantly less than those described in 40 CFR 190 and, therefore, it is unlikely any 40 CFR 190 limit would be exceeded in any 31-day period.

SURVEILLANCES (continued)

S 2.3.1.5

The Lower Limit of Detection (LLD) is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a “real” signal. This Surveillance contains a list of isotopes and required LLD for each. Sample analysis sensitivity must be such that radioactivities can be detected and measured at the LLD value.

It should be recognized that the LLD is an “a Priori” (before the fact) limit representing the capability of measurement system and not an “a Posteriori” (after the fact) limit for a particular measurement.

For a particular measurement system (which may include radio-chemical separation):

$$LLD = \frac{4.66S_b}{E \bullet V \bullet T \bullet 2.22 \bullet Y \bullet e^{-\lambda \Delta t}}$$

where:

LLD	=	lower limit of detection as defined above (as pCi per unit mass or volume)
S_b	=	standard deviation of the background or blank sample counts
	=	square root of either the background or the blank sample counts
E	=	counting efficiency (as counts per transformation)
V	=	sample size (in units of mass or volume)
T	=	elapsed count time
2.22	=	number of transformations per minute per picocurie
Y	=	fractional radiochemical yield (when applicable)
λ	=	radioactive decay constant for the particular radionuclide
Δt	=	elapsed time between sample collection (or end of the sample collection period) and time of counting

Typical values of E, V, Y and Δt should be used in the calculation.

For certain mixtures of gamma emitters, it may not be possible to measure radionuclides in concentrations near their sensitivity limits when other nuclides are present in the sample in much greater concentrations. Under these circumstances, it will be more appropriate to calculate the concentration of such radionuclides using observed ratios with those radionuclides which are measurable.

SURVEILLANCES (continued)

S 2.3.1.5 (continued)

The principal gamma emitters for which the LLD limitation will apply are exclusively the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level. When unusual circumstances result in LLD requirements not being met, the reasons shall be documented in the Radioactive Effluent Release Report as stated in Required Action F.1 of this Limitation, or the Annual Radiological Environmental Operating Report as stated in L 2.5.1, Required Action A.2.

B 2.4 RADIOACTIVE GASEOUS EFFLUENTS

BASES

BACKGROUND

This Limitation is provided to ensure that radioactive materials released in gaseous effluents from the site to unrestricted areas will be less than the limits specified in 10 CFR Part 20. This Limitation also implements the requirements of Sections II.C, III.A, and IV.A of 10 CFR 50, Appendix I.

Figure 4-2 illustrates the maximum area boundary for radioactive release calculations. For individuals who may at times be within the exclusion area boundary, the occupancy of the individual will be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the exclusion area boundary.

LIMITATION

Radioactive nuclides must be maintained within the limits of 10 CFR 20. The various dose rate and dose limitations are conservative with regard to 10 CFR 20 requirements in order to provide a margin of safety through the use of “as low as reasonably achievable” (ALARA) practices.

The necessary VENTILATION EXHAUST TREATMENT SYSTEMs shall be used to reduce the radioactive materials in gases prior to discharge when it is projected that the cumulative dose during a calendar quarter due to gaseous effluent releases would exceed values specified in this Limitation. The specified limits governing the use of the VENTILATION EXHAUST TREATMENT SYSTEMs are a suitable fraction of the dose design objectives set forth in Sections II.B and II.C of 10 CFR Part 50, Appendix I, for gaseous effluents.

APPLICABILITY

The Limitations are required to be met at all times.

ACTIONS

Because more than one Limitation or Surveillance requirement may not be met at a given time, the ACTIONS are modified by a Note that permits separate Condition entry for each Limitation and/or Surveillance requirement that is not met.

ACTIONS (continued)

A.1 and A.2

If any Limitation L 2.4.1.a through L 2.4.1.d is not met, action must be initiated immediately to restore the parameter within limits. This could require a reduction in offsite releases scheduled for the near future or further processing of effluents prior to release. In any event, a condition report must be initiated to determine whether additional actions are necessary to permit continued operations involving radioactive gaseous effluent releases given the current circumstances. In addition, corrective action must be issued to identify and track the Limitation that was exceeded for inclusion in the annual Radioactive Effluent Release Report. However, the condition need not be reported in the annual Radioactive Effluent Release Report if reported otherwise (i.e., in accordance with reporting requirements of 10 CFR 20, 10 CFR 50.72, 10 CFR 50.73, or 40 CFR 190).

B.1 and B.2

If the sampling and/or analysis requirements of S 2.4.1.1 are not met, the release must be terminated. This action prevents or minimizes the potential for an unmonitored offsite radioactive liquid release. Such release may commence or be re-initiated once the sampling and analysis requirements of S 2.4.1.1 are met. Regardless, a condition report must be initiated to determine whether additional actions are necessary to permit continued operations involving radioactive liquid effluent releases given the current circumstances. If a condition report has already been initiated relevant to this Condition, then this assessment may be performed in conjunction with that condition report; a second Condition Report is not required.

C.1

In accordance with 40 CFR 190, a variance must be received from the regulatory authority (NRC) if offsite dose to a member of the public will, or has exceeded, limits established in 40 CFR 190. Because Surveillance S 2.4.1.3 tracks the accumulated dose to members of the public over specified time periods (calendar quarter or calendar year), the dose may be projected and a determination made with regard to whether it is likely 40 CFR 190 limits will be exceeded. If 40 CFR 190 limits are projected to be exceeded, an application for a variance from the NRC must be submitted prior to the estimated date in which any 40 CFR 190 limit will be exceeded. The variance will allow continued offsite liquid and gaseous releases in excess of 40 CFR 190 limits. Note that the variance is normally expected to remain in effect until the end of the current calendar year since 40 CFR 190 limits only apply to the calculated annual dose to members of the public.

If application for variance cannot be made prior to exceeding any 40 CFR 190 limit, it may be prudent to notify the NRC by phone as soon as possible of the need for a variance, providing the expected date in which the application will be submitted. Note that the NRC may provide verbal approval for variance in situations where time is a factor.

ACTIONS (continued)

D.1

If the Required Actions and associated Completion Times of Condition C cannot be met or if the sampling and/or analysis requirements denoted in Surveillances S 2.4.1.2 are not met, then additional measures may be necessary to ensure continued safe operation or to reduce overall station risk. Therefore, a condition report must be initiated immediately to assess the impact on continued effluent release operations given the requirements that are not being met.

E.1

Surveillance S 2.4.1.5 establishes required capability of various sample analyses. A given analysis must be capable of detecting respective radioactivity at a reasonably low threshold in order to ensure radioactive gaseous releases to the public are carefully and accurately monitored. If the stated thresholds can not be met, a condition report must be initiated and corrective action issued to ensure the condition is included and described in the annual Radioactive Effluent Release Report.

SURVEILLANCES

Continuous gaseous release paths are monitored by instrumentation denoted in Limitation L 2.2.1. Limitation L 2.2.1 provides Required Actions and Completion Times for circumstances when required instrumentation is out of service. Therefore, the Surveillances associated with this Limitation (L 2.4.1) envelop only required grab, charcoal, and particulate samples necessary to verify 10 CFR 20 limits will be met.

The Surveillance Limitations implement the requirements in 10 CFR 50, Appendix I, Section III.A, that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a member of the public through appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in this manual for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in RG 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,” Revision 1, October 1977, and RG 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors,” Revision 1, July 1977. The equations in this manual provided for determining the air doses at and beyond the site boundary are based upon the historical average atmospheric conditions.

The release rate limitations for iodine-131, tritium, and radionuclides in particulate form with half-lives greater than 8 days are dependent on the existing radionuclide pathways to man in the areas at or beyond the site boundary. The pathways that were examined in the development of these calculations were: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

SURVEILLANCES (continued)

S 2.4.1.1 and S 2.4.1.2

All radioactive gaseous effluent releases are required to be monitored. Because a Waste Gas Holdup Tank or Reactor (Containment) Building Purge release is of a known (or estimated) quantity and of finite duration, sampling of these effluents must be performed prior to release. In addition, the sample must be analyzed for principal gamma emitters and tritium prior to the release in order to provide high confidence that radioactive release limits will not be exceeded.

S 2.4.1.3

To meet the intent of the continuous monitoring requirement for noble gases, the noble gas activity from each SPING operating on an activity flow path must be recorded at least once every 24 hours. The current, highest, and average activity recorded from a particular SPING over the required grab sample period designated in other Surveillances associated with this Limitation are used to scale the noble gas and tritium activity obtained from the associated grab sample. The final resulting activity is used, in part, to support completion of S 2.4.1.4 and S 2.4.1.5 below.

S 2.4.1.4

Limitation L 2.4.1 establishes limits on radioactive gases discharged from the plant and the dose rates and accumulative dose that may be received by a MEMBER OF THE PUBLIC as a result of such releases. In order to determine that these limits are met and being maintained, the results of analyses required by Surveillances S 2.4.1.1 and S 2.4.1.2, as adjusted by readings taken in accordance with S 2.4.1.3 as appropriate must be compared to the Limitation requirements on a specified Frequency. Therefore, analysis results obtained within a given 31-day period must be considered, in some cases along with previous analysis results of all gaseous releases over a specified period of time (calendar quarter or calendar year), to ensure limits are not exceeded.

The ratio of the sample flow rate to the sampled stream flow rate must be known for the time period covered by each dose or dose rate calculation made in accordance with this Limitation.

S 2.4.1.5

In accordance with 40 CFR 190, a variance must be received from the regulatory authority (NRC) is offsite dose to a member of the public will, or has exceeded, limits established in 40 CFR 190. Because Surveillance S 2.4.1.3 tracks the accumulated dose to members of the public over specified time periods (calendar quarter or calendar year), the dose may be projected and a determination made with regard to whether it is likely 40 CFR 190 limits will be exceeded. The 31-day Frequency is acceptable because associated ODCM limits for these releases are significantly less than those described in 40 CFR 190 and, therefore, it is unlikely any 40 CFR 190 limit would be exceeded in any 31-day period.

SURVEILLANCES (continued)

S 2.4.1.6

The Lower Limit of Detection (LLD) is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a “real” signal. This Surveillance contains a list of isotopes and required LLD for each. Sample analysis sensitivity must be such that radioactivies can be detected and measured at the LLD value. The Surveillance also contains the LLD for the Noble Gas Monitors associated with Limitation 2.2.1.

For an explanation of the LLD calculation, refer to the S 2.3.1.5 Bases.

For certain radionuclides with low gamma yield or low energies, or for certain radionuclides mixtures, it may not be possible to measure radionuclides in concentrations near the LLD. Under these circumstances, the LLD may be increased inversely proportional to the magnitude of the gamma yield (i.e., $(1 \times 10^{-4}/I)$), where I is the photon abundance expressed as a decimal fraction), but in no case shall the LLD, as calculated in this manner for a specific radionuclide, be > 10% of the MPC value specified in 10 CFR 20, Appendix B, Table II, Column 1.

The principal gamma emitters for which the LLD limitation will apply are exclusively the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported. Nuclides which are below the LLD for the analyses should not be reported as being present at the LLD level for that nuclide. When unusual circumstances result in LLD's higher than required, the reasons shall be documented in the Radioactive Effluent Release Report.

B 2.5 RADIOLOGICAL ENVIRONMENTAL MONITORING

B 2.5.1 Environmental Sampling

BASES

BACKGROUND

The ODCM includes, in tables and figures, specific parameters of distance and direction from the centerline of one reactor, and additional description where pertinent, for each sample location required by the Radiological Environmental Monitoring Program. NUREG-0133, "Preparation of Radiological Technical Specifications for Nuclear Power Plants," October 1978, and Radiological Assessment Branch Technical Position (BTP), Revision 1, November 1979, provide guidance with regard to environmental sampling.

With regard to the aforementioned BTP, one airborne sample location should be from the vicinity of a community having the highest calculated annual average ground-level D/Q. Community as defined by Webster's dictionary is people with common interests living in a particular area; broadly: the area itself. The local municipalities of London, Russellville, and Dardanelle are all part of the River Valley community located near Dardanelle Lake and the Arkansas River. The grouping of houses that reside within WSW (highest D/Q) sector are located in London which is part of the River Valley community. Air Station #2 per the above mentioned NRC BTP meets the requirements of being located within the highest D/Q and also in the vicinity of a community. Reference CR-ANO-C-2016-2732.

The approximate locations of selected sample sites are shown on ODCM Figures 4-1, 4-1A, and 4-1B for illustrative purposes. ODCM Table 4-1 lists the approximate distances and directions of the sample stations from the plant.

"D/Q" refers to a radiological deposition rate considering prevalent winds around the site and is used to determine natural settling of effluents from the atmosphere.

LIMITATION

This Limitation specifies the sample locations and distances, sample analysis type and frequency, and parameters to be sampled as part of the Radiological Environmental Monitoring Program.

The Limitation is modified by a Note that permits other instrumentation to be used in place of, or in addition to, integrating dosimeters for measuring and recording dose rate continuously. For the purposes of this Limitation, a thermoluminescent dosimeter may be considered to be one phosphor and two or more phosphors in a packet considered as two or more dosimeters. Film badges should not be used for measuring direct radiation.

APPLICABILITY

The Limitations are required to be met at all times.

ACTIONS

Because more than one Limitation or Surveillance requirement may not be met at a given time, the ACTIONS are modified by a Note that permits separate Condition entry for each Limitation and/or Surveillance requirement that is not met.

A.1 and A.2

Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunctions, every effort shall be made to complete corrective action before the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report.

This ACTION lists several items that would result in the intent of the Radiological Environmental Monitoring Program not being met. In addition, this ACTION provides guidance for conditions where radionuclides other than those listed in Table 2.5-2 could result in a noteworthy dose to a MEMBER OF THE PUBLIC. Immediate action is required to restore conditions needed to meet the intent of the Radiological Environmental Monitoring Program. All deviations from the Limitations and Surveillances required to meet the intent of the Radiological Environmental Monitoring Program must be reported in the Annual Radiological Environmental Operating Report. However, the condition need not be reported in the Annual Radiological Environmental Operating Report if reported otherwise (i.e., in accordance with reporting requirements of 10 CFR 20, 10 CFR 50.72, 10 CFR 50.73, or 40 CFR 190).

With the level of radioactivity as the result of plant effluents in an environmental sampling medium at one or more required locations exceeding the limits of Table 2.5-2 when averaged over any calendar quarter, the condition must be reported in accordance with Required Action A.2. The report should include an evaluation of any release conditions, environmental factors or other aspects which caused the limits to be exceeded, and define the actions taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC will remain less than the calendar year limits of Limitations L 2.3.1 and L 2.4.1. When more than one of the radionuclides in Table 2.5-2 is detected in the sampling medium, the information shall be included in the report if:

$$\frac{\text{Concentration 1}}{\text{Reporting Level 1}} + \frac{\text{Concentration 2}}{\text{Reporting Level 2}} + \frac{\textit{etc.}}{\textit{etc.}} \geq 1.0$$

B.1

In addition to the requirements of Required Actions A.1 and A.2, a new location must be identified and added to the Radiological Environmental Monitoring Program within 30 days when required samples cannot be obtained from designated locations. Note that broad leaf samples are only required when milk samples are unavailable, pursuant to S 2.5.1.8.

ACTIONS (continued)

B.1 (continued)

The specific locations from which samples were unavailable may then be deleted from the monitoring program. The cause(s) of the unavailability of samples the new location(s) for obtaining replacement samples shall be identified in next Annual Radiological Environmental Operating Report. The report shall also include a revised Table 4-1 reflecting the new location(s).

SURVEILLANCES

S 2.5.1.1 through S 2.5.1.8

These Surveillances ensure samples are collected and analyzed at specified frequencies of the parameters, and from the locations, designated in Limitation L 2.5.1. The approximate locations of selected sample sites are shown on ODCM Figures 4-1, 4-1A, and 4-1B for illustrative purposes. ODCM Table 4-1 lists the approximate distances and directions of the sample stations from the plant.

Note that the gross beta analysis of required particulate samplers should not be performed within the first 24 hours following particulate filter change. This is to allow for radon and thoron daughter decay. If it is discovered that the particulate gross beta activity is more than 10 times the yearly mean of control samples for any medium, consideration should be given to performing a gamma isotopic analysis of the individual particulate samples. Also note that particulate samples may need to be collected more frequently than the specified 14-day Frequency due to dust or other accumulation of matter.

Gamma isotopic analysis includes the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

S 2.5.1.9

The Lower Limit of Detection (LLD) is the smallest concentration of radioactive material in a sample that will be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a “real” signal. Table 2.5-1 contains a list of isotopes and required LLD for each. Sample analysis sensitivity must be such that radioactivities can be detected and measured at the LLD value.

For an explanation of the LLD calculation, refer to the S 2.3.1.5 Bases.

S 2.5.1.10

With the level of radioactivity as the result of plant effluents in an environmental sampling medium at one or more required locations exceeding the limits of Table 2.5-2 when averaged over any calendar quarter, the condition must be reported in accordance with Required Action A.2.

B 2.5 RADIOLOGICAL ENVIRONMENTAL MONITORING

B 2.5.2 Land Use Census

BASES

BACKGROUND

The surveys required by this Limitation ensure that changes in environmental conditions as they relate to radioactive effluent releases from the site are identified and accounted for in the overall dose commitment to the public.

LIMITATION

This Limitation ensures changes in the use of unrestricted areas are identified and that modifications are subsequently included in the Radiological Environmental Monitoring Program. The census satisfies 10 CFR 50, Appendix I, Section IV.B.3.

Restricting the census to gardens of > 500 ft^2 provides assurance that significant exposure pathway via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in RG 1.109 for consumption by a child. This minimum garden size was determined assuming 1) that 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage) and, 2) a vegetation yield of 2 kg/m^2.

The Limitation is modified by a Note that permits broad leaf vegetation sampling to be performed at the site boundary in the directional sector having the highest D/Q in lieu of performing a garden census. “D/Q” refers to a radiological deposition rate considering prevalent winds around the site and is used to determine natural settling of effluents from the atmosphere.

APPLICABILITY

The Limitations are required to be met at all times.

ACTIONS

Because more than one new sample location may be identified during a given census, the ACTIONS are modified by a Note permit separate Condition entry for each new location identified.

ACTIONS (continued)

A.1, A.2.1, and A.2.2

When new locations are discovered that indicate higher radioactivity levels than current locations being sample pursuant to Limitation L 2.5.1 or if radioactivity levels at a new location are projected to exceed 40 CFR 190 limits (with regard to I-131, H-3, and particulate sources), a condition report must be immediately initiated. Initiating a condition report will ensure reporting criteria is evaluated for the given condition. Regardless of any other report, the new location must be included in the next Annual Radiological Environmental Operating Report.

In addition to the requirements of Required Action A.1, the new location must be added to the Radiological Environmental Monitoring Program within 30 days. Following October 31 of the year in which the census is taken, the old sample location in this same pathway may be deleted from the Radiological Environmental Monitoring Program. This is expected to be performed within 90 days following the October 31 limit.

SURVEILLANCES

S 2.5.2.1 through S 2.5.2.2

The land use census must be performed every 24 months and between the dates of June 1 and October 1 of the given year. The results of the census must be reported in the next Annual Radiological Environmental Operating Report.

The Surveillance requirements are modified by a Note that prevents the use of S 2.0.2. Therefore, the 25% Frequency extension associated with S 2.0.2 cannot be applied to the Surveillances associated with this Limitation. This is because the Frequencies are associated with strict performance and reporting dates which cannot be exceeded.

B 2.5 RADIOLOGICAL ENVIRONMENTAL MONITORING

B 2.5.3 Interlaboratory Comparison Program

BASES

BACKGROUND

This Limitation refers to the off-site radiochemistry laboratory. The Limitation provides independent checks on the accuracy of the measurements of radioactive material in environmental samples.

LIMITATION

The requirement for participation in an Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of a quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

APPLICABILITY

The Limitations are required to be met at all times.

ACTION

A.1

Failure to meet the requirements of the Interlaboratory Comparison Program requires initiating a condition report to ensure the circumstances are included in the next Annual Radiological Environmental Operating Report.

SURVEILLANCE

S 2.5.3.1

The results of the Interlaboratory Comparison Program analyses must be reported in the next Annual Radiological Environmental Operating Report.