Omaha Public Power District

April 11, 2018
LIC-18-0015

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

Fort Calhoun Station, Unit No. 1
Renewed Facility Operating License No. DPR-40
NRC Docket No. 50-285

Subject: Fort Calhoun Station (FCS) Radiological Effluent Release Report and Radiological Environmental Operating Report

References: FCS Technical Specifications (TS) 5.9.4a and 5.9.4b

Pursuant to Fort Calhoun Station (FCS), Unit No. 1, Technical Specifications (TS) 5.9.4a, and 5.9.4b, the Omaha Public Power District (OPPD) provides the Annual Radiological Effluent Release Report and the Annual Radiological Environmental Operating Report.

The Annual Radiological Effluent Release Report is submitted in accordance with TS 5.9.4a and encompasses the period of January 1, 2017 through December 31, 2017. The report is presented in the format outlined in Regulatory Guide 1.21, Revision 1. In addition, the report provides the results of quarterly dose calculations performed in accordance with the Offsite Dose Calculation Manual (ODCM). In accordance with TS 5.17d, Section VII of the Annual Radiological Effluent Release Report includes the revisions to the ODCM made during this period. Section VII of the Annual Radiological Effluent Release Report also includes Process Control Program (PCP) changes made during this period.

The Annual Radiological Environmental Operating Report is submitted in accordance with TS 5.9.4b and encompasses the period of January 1, 2017 through December 31, 2017.

No commitments to the NRC are contained in this letter.

IE48
NRR

Please contact Mr. Bradley H. Blome at (402) 533-6041 if you should have any questions.

Respectfully,

Bradley H. Blome
Director, Licensing and Regulatory Assurance

BHB/epm

Enclosures:

1. Annual Radiological Effluent Release Report
2. Annual Radiological Environmental Operating Report

c: K. M. Kennedy, NRC Regional Administrator, Region IV
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Omaha Public Power District
Fort Calhoun Station Unit No. 1

Annual Report
For
Technical Specifications,
Section 5.9.4.a

January 1, 2017 to December 31, 2017

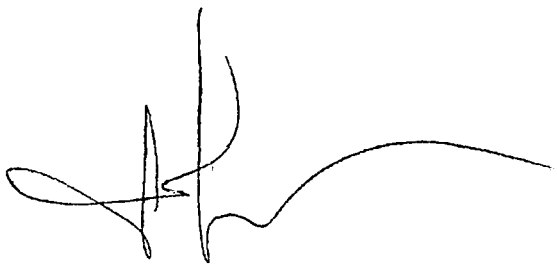
DOCKET NO. 50-285 OPERATING LICENSE DPR-40

Annual Radiological Effluent Release Report

This report is submitted in accordance with Section 5.9.4.a of the Technical Specifications of Fort Calhoun Station Unit No. 1, Facility Operating License DPR-40 for the period January 1, 2017 through December 31, 2017. The Effluent Report is presented in the format outlined in Regulatory Guide 1.21, Revision 2.

In addition, this report provides the results of quarterly dose calculations performed in accordance with the Offsite Dose Calculation Manual. Results are presented by quarter for the period January 1, 2017 through December 31, 2017.

Descriptions of any changes made during the preceding twelve months to the Offsite Dose Calculation Manual and/or the Process Control Program for the Fort Calhoun Station are presented.



Plant Manager

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1.0 INTRODUCTION

This Annual Radiological Effluent Release Report, for Fort Calhoun Station Unit No. 1, is submitted as required by Technical Specification 5.9.4.a for the period January 1, 2017 through December 31, 2017.

1.1 Executive Summary

The Radioactive Effluent Monitoring program for the year 2017 was conducted as described in the following report. Major efforts were made to maintain the release of radioactive effluents to the environment as low as reasonably achievable.

The total airborne activity released from noble gas was 1.88 E-4 curies. This was a decrease from the 2016 activity of 1.04 curies. This decrease was due to decrease in RCS source from plant shutdown.

The total airborne activity from I-131, I-133, and particulates with half-lives > 8 days in 2017 was 0.00 curies. This is a continuation from the 2016 activity of 0.00 curies. This remained constant from 2016.

The total airborne activity from Tritium was 0.393 curies. This was a decrease from the 2016 activity of 2.99 curies. This decrease was due to not performing containment purges for defueling activities.

The total airborne activity from C-14 was 0.00 curies. This was the decrease from 2016 levels of 1.97 curies. Airborne activity from C-14 is included in the 2017 annual report, per Regulatory Guide 1.21, Revision 2. This is a calculated value based on power generation and days of operation. Critical organ doses from C-14 were calculated using a ratio of 15% as CO_2. This ratio was determined during an NRC in-plant source term study conducted at the Fort Calhoun Station between 1976 and 1977, NUREG/CR-0140. Since Fort Calhoun Station ceased power operations, C-14 is no longer being produced. Any C-14 released from gas tanks or decommissioning activities was previously accounted for in reports which had power history.

Dose contributions from airborne effluents at the unrestricted area boundary were; 1.13E-09 mRad gamma air dose, 1.28E-07 mRad beta air dose, 5.47E-04 mRem total body dose, and 5.47E-04 mRem critical organ dose. Gamma and beta dose showed a decrease from 2016 levels of 1.28 E-03 mRad gamma air dose and 5.70-04 mRad beta air dose, from not releasing iodines and a

reduction in gas source term due to plant shutdown. Whole body and critical organ doses decreased from 2016 levels of 8.68E-02 mRem total body dose and 4.20E-01 mRem critical organ dose. This decrease is attributed to the gas source term reduction previously mentioned.

Total water activity (excluding tritium, dissolved gases, and alpha) released in 2017 in liquid effluents was 2.23E-03 curies. This was a decrease from the 2016 activity of 4.34E-02 curies. This decrease was due to a substantial decrease in liquid waste generated and reduced source term from cessation of operations.

The total water tritium activity released in 2017 in liquid effluents was 2.2 curies. This was a decrease from the 2016 activity of 149 curies. This decrease was due to a substantial decrease in liquid waste generated and reduced source term from cessation of operations.

The calculated whole body dose due to liquid effluents at the site discharge from all sources in 2017 was 2.80E-01 mRem which was 9.33% of the annual dose limit. This was an increase from the 2016 dose of 2.11-01 mRem, which was 7.03% of the annual dose limit. Dose increased despite a significant decrease in volume and activity released. Since cessation of operations, dilution flow has decreased from a range 120,000-360,000 gpm to 7200 gpm. Station procedures limit release flow rates at these lower dilution levels. The combination of lower flow and decreased dilution represents an increase in concentrations being released offsite.

The calculated critical organ dose due to liquid effluents at the site discharge from all sources in 2017 was 4.39E-01 mRem. This was an increase from the 2016 dose of 3.26E-01 mRem. This increase was previously described.

The Fort Calhoun Station meteorological system had a cumulative recovery rate of 96.47% from the station meteorological tower with the remaining 3.53% provided by the National Weather Service, for the joint frequency parameters required by Regulatory Guide 1.23 for wind speed, wind direction, and delta temperature.

There were no abnormal releases during 2017.

During 2017 there were two changes to the Off-site Dose Calculations Manual (ODCM), CH-ODCM-0001 and one change to the Process Control Program, RP-5101.

For 2017, the total volume of solid radwaste released from the unit was 260.24 cubic meters. This was a increase from the 69.04 cubic meters of solid waste released from the unit in 2016. The increase was attributed to thirteen shipments made in 2017 and two shipments in 2016.

The total activity released from the unit for 2017 was 212.18 curies, 212.09 curies from spent resin, 7.93E-02 curies from dry compressables, and 8.11E-03 curies from other. This was an increase from the 2016 value of 2.16E-02 curies. Overall, the effluent monitoring program was conducted in a manner to ensure the activity released and dose to the public were maintained as low as reasonably achievable.

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

The ODCM Radiological Effluent Control Specifications applicable to the release of radioactive material in liquid and gaseous effluents are described in the following sections.

2.1.1 Fission and Activation Gases (Noble Gases)

The release rate of radioactive material in airborne effluents shall be controlled such that the instantaneous concentrations of radionuclides do not exceed the values specified in 10 CFR 20 for airborne effluents at the unrestricted area boundary. To support plant operations, Supervisor - System Chemistry may increase this limit up to the limits specified in Technical Specification 5.16.1.g.

Technical Specification 5.16.1.g establishes the administrative control limit on the concentration resulting from radioactive material, other than noble gases, released in gaseous effluents to unrestricted areas conforming to ten times 10 CFR 20.1001-20.2401, Appendix B, Table 2, Column 1. For noble gases, the concentration shall be limited to five times 10 CFR 20.1001-20.2401, Appendix B, Table 2, Column 1.

The air dose due to noble gases released in gaseous effluents to areas at or beyond the unrestricted area boundary shall be limited to the following:

a. During any calendar quarter: Less than or equal to 5 mRad for gamma radiation and less than or equal to 10 mRad for beta radiation, and

b. During any calendar year: Less than or equal to 10 mRad for gamma radiation and less than or equal to 20 mRad for beta radiation.

2.1.2 Doses from I-131, I-133, C-14, Tritium, and Radioactive Material in Particulate Form with Half Lives Greater than 8 Days (Other than Noble Gases).

a. The dose to an individual or dose commitment to any organ of an individual in unrestricted areas due to the release of I-131, I-133, C-14, H-3, and radioactive material in particulate form with half-lives greater than eight days (other than noble gases) in airborne effluents shall not exceed 7.5 millirem from all exposure pathways during any calendar quarter.

b. The dose to an individual or dose commitment to any organ of an individual in unrestricted areas due to the release of I-131, I-133, C-14, H-3, and radioactive materials in particulate form with half-lives greater than eight days (other than noble gases) in airborne effluents shall not exceed 15 millirem from all exposure pathways during any calendar year.

2.1.3 Liquid Effluents

The release rate of radioactive material in liquid effluents shall be controlled such that the instantaneous concentrations for radionuclides, other than dissolved or entrained noble gases, do not exceed the values specified in 10 CFR 20 for liquid effluents at site discharge. To support plant operations, the Supervisor - System Chemistry may increase this limit up to the limit specified in Technical Specifications 5.16.1.b.

Technical Specification 5.16.1.b establishes the administrative control limit on concentration of radioactive material, other than dissolved or entrained noble gases, released in liquid effluents to unrestricted areas conforming to ten times 10 CFR 20.1001-20.2401, Appendix B, Table 2, Column 2. For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-04 µCi/mL total activity.

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to unrestricted areas shall be limited to:

a. During any calendar quarter: Less than or equal to 1.5 mRem to the whole body and less than or equal to 5 mRem to any organ, and

b. During any calendar year: Less than or equal to 3 mRem to the whole body and less than or equal to 10 mRem to any organ.

2.1.4 Total Dose-Uranium Fuel Cycle

The dose to any individual from uranium fuel cycle sources shall be limited to ≤ 25 mRem to the total body or any organ (except the thyroid, which shall be limited to ≤ 75 mRem) during each calendar year.

2.2 Effluent Concentration Limits (ECL)

2.2.1 Liquid Effluents

The values specified in 10 CFR Part 20, Appendix B, Column 2 are used as the ECL for liquid radioactive effluents released to unrestricted areas. A value of 2.0E-04 µCi/mL is used as the ECL for dissolved and entrained noble gases in liquid effluents.

2.2.2 Gaseous Effluents

The values specified in 10 CFR Part 20, Appendix B, Column 1 are used as the ECL for gaseous radioactive effluents released to unrestricted areas.

2.3 Measurements and Approximations of Total Radioactivity

Measurements of total radioactivity in liquid and gaseous radioactive effluents were accomplished in accordance with the sampling and analysis requirements of Tables 3.1 and 3.2 of Part I of the ODCM.

2.3.1 Liquid Radioactive Effluents

Each batch was sampled and analyzed for gamma emitting radionuclides using gamma spectroscopy, prior to release. Composite samples were analyzed monthly and quarterly for the Monitor Tanks. Composite samples were analyzed monthly in the onsite laboratory for tritium and gross alpha radioactivity, using liquid scintillation and proportional counting techniques respectively. Composite samples were analyzed quarterly for Sr-89, Sr-90, Fe-55, Ni-63, and Gross Alpha by a contract laboratory (Teledyne Brown Engineering, Inc.). A software program was used to project the total body and critical organ dose contribution at the unrestricted area boundary for each release and the percent contribution to the annual objective dose.

There were no releases from the Steam Generator blowdown during the reporting period.

2.3.2 Gaseous Radioactive Effluents

Each gaseous batch release was sampled and analyzed for radioactivity prior to release. For release of Waste Gas Decay Tanks, noble gas grab samples were analyzed for gamma emitting radionuclides using gamma spectroscopy. The results of the analysis and the total volume of effluent released were used to determine the total amount of radioactivity released in the batch mode. A software program was developed and installed that can project the total body and critical organ dose contribution at the unrestricted area boundary for each release and the percent contribution to the annual objective dose. This program also adds the projected dose to the current actual dose totals in a temporary file, until it is updated with actual release data at the completion of a purge.

Continuous release effluent pathways were continuously sampled using charcoal and particulate filters and analyzed weekly for gamma emitting radionuclides using gamma spectroscopy. Weekly particulate filters were analyzed for gross alpha radioactivity in the onsite laboratory using proportional counting techniques. Quarterly composites of particulate filters were analyzed for Sr-89, Sr-90, and Gross Alpha by a contract laboratory (Teledyne Brown Engineering, Inc.).

2.4 Estimation of Total Percent Error

The estimated total percent error is calculated as follows:

Total Percent Error = $(E_1^2 + E_2^2 + E_3^2 + ... + E_n^2)^{0.5}$
Where E_n = percent error associated with each contributing parameter.

Sample counting error is estimated by the Canberra Genie System Software for samples analyzed by gamma spectroscopy. This calculation can include the error associated with peak area determination, gamma ray abundance, efficiency and half-life. Systematic error is estimated for gaseous and liquid effluent analyses and dilution and wastewater volume.

2.5 Batch Releases

A summary of information for liquid and gaseous batch releases is included in Table III.1.

2.6 Abnormal Releases

Abnormal Releases are defined as unplanned and unmonitored releases of radioactive material from the site.

A summary of information for liquid and gaseous abnormal releases is included in Table III.2.

3.0 GASEOUS EFFLUENTS

The quantities of radioactive material released in gaseous effluents are summarized in Tables III.3, III.4 and III.5. All radioactive materials released in gaseous form are considered to be ground level releases.

4.0 LIQUID EFFLUENTS

The quantities of radioactive material released in liquid effluents are summarized in Tables III.6, III.7 and III.8.

5.0 SOLID WASTES

The quantities of radioactive material released as solid effluents are summarized in Section VI.

6.0 RELATED INFORMATION

6.1 Operability of Liquid and Gaseous Monitoring Instrumentation

During the reporting period there was 1 instrument used to monitor radioactive effluent releases that failed to meet the minimum reportable instrument operability requirements listed in the ODCM during the reporting period.

RM-063, Post Accident Radiation Monitor, was inoperable for 100 days (9/22/2017-12/31/2017) due to a failure of a circuit board. Multiple attempts to obtain new and modified boards did not address the issue. The ability to perform grab sampling per CH-SMP-PA-0005 in the event of an emergency was the required compensatory action during the monitor's unavailability.

6.2 Changes to the Offsite Dose Calculation Manual (ODCM) and/or Process Control Program (PCP)

During 2017, two revisions were made to the ODCM and one change made to the PCP.

- The following changes were made to the ODCM:
  - Added annual reporting methodology for the total dose as required by 10 CFR 72.104.
  - Revised the vegetation sampling location as determined by the 2016 Land Use Survey.
  - Removed reference to Technical Specifications 5.18 to ODCM Implementing Step 6.2.1D, since Technical Specification was deleted.
  - Added twelve new TLD locations to allow for better tracking of dose to members of the general public to ensure compliance with 40 CFR 190.

- The following change was made to the PCP:
  - The document number was revised from RW-AA-100, Process Control Program for Radioactive Wastes, to RP-5101, Process Control Program for Radioactive Wastes.
  - The format was revised, but the content remained unchanged.

6.3 New Locations or Modifications for Dose Calculations or Environmental Monitoring

- Sample Station #77, River N-1
- Sample Station #78, River S-1
- Sample Station #79, Lagoon S-1
- Sample Station #80, Parking S-1
- Sample Station #81, Training W-1
- Sample Station #82, Switchyard S-1
- Sample Station #83, Switchyard SE-1
- Sample Station #84, Switchyard NE-1
- Sample Station #85, Switchyard W-1
- Sample Station #86, Switchyard N-1
- Sample Station #87, Range S-1
- Sample Station #88, Mausoleum E-1

6.4 Noncompliance with Radiological Effluent Control Requirements

This section provides a list of any event that did not comply with the applicable requirements of the Radiological Effluent Controls given in the Offsite Dose Calculation Manual (ODCM). Detailed documentation concerning the evaluations and corrective actions is maintained onsite.

6.4.1 Abnormal Gaseous and Liquid Releases

No abnormal releases were made during the calendar year of 2017.

6.4.2 Failure to Meet Specified Sampling Requirements

During 2017, there were no instances in which specified sampling requirements were not met.

6.5 Modifications to Liquid and Gaseous Waste Treatment and Ventilation Exhaust Systems

During the reporting period no design modifications were approved nor implemented involving major changes to the Liquid and Gaseous Waste Treatment Systems.

6.6 Meteorological Monitoring Program

A summary of hourly meteorological data, collected during 2017, is retained onsite and is maintained as documentation as required by Regulatory Guide 1.21 Rev 2. This data is available for review by the Nuclear Regulatory Commission upon request. Joint Frequency tables are included in Section VII, Attachment 2

Real time hourly meteorological data is used to calculate the annual air effluent dose to individuals. For quarterly estimates during the year an annual average X/Q is used, which is an average of the highest X/Q's calculated for each of the previous two years.

6.7 Assessment of Doses

6.7.1 Doses Due to Liquid Effluents

Total body, skin, and organ dose for liquid releases were calculated in mRem for all significant liquid pathways using the annual configuration of the LADTAP II program. The site discharge location was chosen to present a most conservative estimate of dose for an average adult, teenager, child, and infant. A conservative approach is also presented by the assumption that Omaha and Council Bluffs receive all drinking water from the Missouri River.

The LADTAP II program in its annual configuration was also used to calculate the total body and organ doses for the population of 950,006 within a 50-mile radius of the plant (based on the 2010 census). The results of the calculations are listed in Section V.

The doses due to liquid effluents for total body and critical organ are also calculated quarterly using the methods in the ODCM. The results are listed in Section II.

6.7.2 Doses Due to Gaseous Effluents

Total body, skin and organ doses from ground releases were calculated in mRem to an average adult, teenager, child, and infant in each receptor using the annual configuration of the GASPAR II program. Also, the doses to the same groups, in units of mRad due to gamma and beta radiation carried by air, were computed using GASPAR II.

The GASPAR II program in its annual configuration was also used to calculate the ALARA integrated population dose

summary for the total body, skin and organ doses in person-rem for all individuals within a 50-mile radius. The results of the calculations are shown in Section IV.

The doses due to gaseous effluents for total body gamma and beta noble gas air dose are calculated quarterly using the methods in the ODCM with an annual average X/Q. The results are listed in Section II.

6.7.3 Doses Due to I-131, I-133, C-14, H-3, and Particulates with Half Lives Greater than 8 days.

The doses due to I-131, I-133, C-14, H-3, and Particulates with half-lives greater than 8 days for total body and critical organ dose are calculated quarterly using the highest of infant or child dose factors and an annual average X/Q. The results are listed in Section II for inhalation, ground and food.

6.7.4 Direct Radiation Dose to Individuals and Populations

Direct radiation doses attributed to the gamma radiation emitted from the containment structure were not observed above local background at any TLD sample locations for this annual period.

6.7.5 40 CFR 190 Dose Evaluation

ODCM Radiological Effluent Controls require dose evaluations and a special report to demonstrate compliance with 40 CFR Part 190 only if calculated yearly doses exceed two times the annual design objectives for liquid and/or gaseous effluents. At no time during 2017 were any of these limits exceeded; therefore, no special report per Tech Specification 5.16 was required.

The external Total Body Dose is comprised of:

1) Total Body Dose due to noble gas radionuclides in gaseous effluents
2) Dose due to radioactive waste and the ISFSI
3) Total Body Dose due to radioactivity deposited on the ground (this dose is accounted for in the determination of the non-noble gas dose and is not considered here)

The Total Body Dose, external is given by:
Dext = Dtb + Dosf

Where Dext is the external dose
Dtb is the total body dose
Dosf is the dose from on-site storage

The Total Dose is then given by:
Dtot = Dext + Dliq + Dnng

Where Dtot is the total dose
Dext is the external dose
Dliq is the dose from liquid effluents
Dnng is the dose from non-noble gases

Dose Limits

Total Body, annual	25 mrem
Thyroid, annual	75 mrem
Other Organs, annual	25 mrem

Calculation using REMP TLD Comparison

Indicating TLD station {OTD-B-(I)}, closest to on site storage, in mrem/week minus REMP environmental control {OTD-L-(C)}, in mrem/week

Dext = (1.40 – 1.30) * 52 weeks = 5.2 mrem

Maximum offsite doses from report

Dtbwb = 0.000547 mrem, Dtbco = 0.000547 mrem

D liqwb = 0.280 mrem Dliqco = 0.439 mrem

Dtot wholebody = 5.2 + 0.000547 + 0.280 = 5.48 mrem

Dtot critical organ = 5.2 + 0.000547 + 0.439 = 5.64 mrem

For cases when the general public accesses the site, see Table 18 of the ODCM, the calculated dose would be:

Dtot wholebody = 5.2 + 5.08 + 0.280 = 10.56 mrem

Dtot critical organ = 5.2 + 1.20 + 0.439 = 6.84 mrem

These reported doses are bounding cases demonstrating compliance. Actual REMP TLD readings do not show any deviation from historical averages for this location, both pre and post construction of the SG storage mausoleum and ISFSI. On-site TLD's used for dose monitoring at onsite rad storage facilities do not have identical counterparts at the site boundary or actual offsite receptors. Additionally the liquid dose pathway, since it is downstream of the indicator location and is not hydro-geologically connected, would produce very conservative results compared to calculating actual dose.

6.8 Groundwater Monitoring Program and Observations

- OPPD conducted groundwater sampling from 19 wells, 2 surface water sites, and 4 storm water headers within the site property per NEI 07-07. Additionally Nebraska requirements regarding avoidance of snow runoff were deleted, so storm water sampling is now performed quarterly, if available.

- No new monitoring wells were added to the sampling program during 2017. Additional radiological surveys were performed during decommissioning characterization, no plant related nuclides were discovered in soil. The sampling program consists of 2 affected sectors per rain event and an upwind background test. Three rain sampling events were conducted. No tritium activity in excess of the vendor's Minimum Detectable Activity (MDA) was reported. Fourth quarter had no rain or snow events significant enough to collect storm water or rain samples. No tritium activity in excess of the vendor's Minimum Detectable Activity (MDA) was reported in collected storm water or rain sampling.

- One monitoring well (MW-3A) had tritium in excess of the vendor's Minimum Detectable Activity (MDA < 295 pCi/L) was reported in Table III.9 at 326 pCi/L +/- 205 pCi/L. MW-3A detection was below any reporting thresholds. This well is sampled quarterly for the entire HTD suite of analyses. No other analyses had detected activity. No other detections were present in this well on follow up sampling. MW-6 had tritium identified with activity > 2 sigma but <MDA (291 pCi/L) at 195 pCi/L +/- 192. This result was included based on detections near MDA from station trends for this location. This well is hydrogeology connected to the Missouri River downstream of the plant discharge and is influenced by high river levels and station discharge. All listed Sr-90 results identified < MDA, but were retained during statistical data review based on historical station shallow well trends. Some hard to detect nuclides, were reduced to an annual sample frequency (Ni-63, Fe-55, Sr-90 in deep wells) based on 2 years of quarterly sampling with no detections above MDA.

- The Fort Calhoun REMP sampling did not detect tritium in samples within the Missouri River downstream at the site boundary or at the nearest municipal drinking water facility. No groundwater drinking pathway exists on site. Groundwater monitoring of neighboring drinking wells is performed to have data, if a plume were identified on site. No state or federal drinking water limits, and no site groundwater protection program administrative limits were exceeded.

SECTION II

QUARTERLY DOSES FROM EFFLUENTS

Offsite Dose Calculation Manual

January 1, 2017 - December 31, 2017

Quarterly Dose Calculation Results

January 1, 2017 through December 31, 2017

With the implementation of the Fort Calhoun Station Radiological Effluent Technical Specifications (RETS) on October 1, 1985, radiation doses in the unrestricted area from liquid and gaseous effluents must be calculated on a quarterly basis in accordance with the Offsite Dose Calculation Manual (ODCM). These calculations are performed to ensure the annual dose limits delineated in Appendix I of 10 CFR 50 and implemented by RETS are not exceeded. If the results of the quarterly calculations exceed fifty percent (50%) of the annual limits of Appendix I, actions are taken to reduce effluents so that the resultant doses do not exceed the annual limits during the remainder of the year and a special report is submitted to the Nuclear Regulatory Commission. No special reports were required for 2017 calculated doses.

This section presents the results of the quarterly dose calculations performed during the period January 1, 2017 through December 31, 2017. Details are shown as to the types, sources and resultant doses from the effluents, the annual limits and a comparison to the annual limits.

QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
FORT CALHOUN FIRST QUARTER 2017 DOSE PROJECTIONS

I. Liquid Effluents:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Batch:	2.41E-02	3.48E-02
Continuous:	0.00E+00	0.00E+00
Totals:	2.41E-02	3.48E-02
ODCM Quarterly Objective:	1.50E+00	5.00E+00
Percent of Quarterly Obj:	1.61 %	0.70 %
ODCM Annual Objective:	3.00E+00	1.00E+01
YTD Percent of Annual Obj:	0.80 %	0.35 %

II. Gaseous Effluents:	Total Body Gamma Dose (mrad)	Total Body Beta Dose (mrad)
A. Noble Gas Air Dose:	8.73E-10	9.90E-08
ODCM Quarterly Objective:	5.00E+00	1.00E+01
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.00E+01	2.00E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

B. I-131, I-133, Tritium, C-14, and Particulates with Half-Lives > 8 Days:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Inhalation:	2.43E-05	2.43E-05
Ground and Food:	1.12E-04	1.12E-04
Totals:	1.37E-04	1.37E-04
ODCM Quarterly Objective:	7.50E+00	7.50E+00
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.50E+01	1.50E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

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QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
FORT CALHOUN SECOND QUARTER 2017 DOSE PROJECTIONS

I. Liquid Effluents:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Batch:	1.15E-01	1.80E-01
Continuous:	0.00E+00	0.00E+00
Totals:	1.15E-01	1.80E-01
ODCM Quarterly Objective:	1.50E+00	5.00E+00
Percent of Quarterly Obj:	7.67 %	3.60 %
ODCM Annual Objective:	3.00E+00	1.00E+01
YTD Percent of Annual Obj:	4.63 %	2.14 %

II. Gaseous Effluents:	Total Body Gamma Dose (mrad)	Total Body Beta Dose (mrad)
A. Noble Gas Air Dose:	5.89E-10	6.68E-08
ODCM Quarterly Objective:	5.00E+00	1.00E+01
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.00E+01	2.00E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

B. I-131, I-133, Tritium, C-14, and Particulates with Half-Lives > 8 Days:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Inhalation:	2.83E-05	2.83E-05
Ground and Food:	1.31E-04	1.31E-04
Totals:	1.59E-04	1.59E-04
ODCM Quarterly Objective:	7.50E+00	7.50E+00
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.50E+01	1.50E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

Reviewed by

QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
FORT CALHOUN THIRD QUARTER 2017 DOSE PROJECTIONS

I. Liquid Effluents:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Batch:	2.49E-01	3.96E-01
Continuous:	0.00E+00	0.00E+00
Totals:	2.49E-01	3.96E-01
ODCM Quarterly Objective:	1.50E+00	5.00E+00
Percent of Quarterly Obj:	16.60 %	7.92 %
ODCM Annual Objective:	3.00E+00	1.00E+01
YTD Percent of Annual Obj:	12.97 %	6.10 %

II. Gaseous Effluents:	Total Body Gamma Dose (mrad)	Total Body Beta Dose (mrad)
A. Noble Gas Air Dose:	0.00E+00	0.00E+00
ODCM Quarterly Objective:	5.00E+00	1.00E+01
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.00E+01	2.00E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

B. I-131, I-133, Tritium, C-14, and Particulates with Half-Lives > 8 Days:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Inhalation:	5.72E-05	5.72E-05
Ground and Food:	2.64E-04	2.64E-04
Totals:	3.21E-04	3.21E-04
ODCM Quarterly Objective:	7.50E+00	7.50E+00
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.50E+01	1.50E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

Reviewed by: _____

QUARTERLY CUMULATIVE DOSE CONTRIBUTION FROM RADIOACTIVE EFFLUENTS
FORT CALHOUN FOURTH QUARTER 2017 DOSE PROJECTIONS

I. Liquid Effluents:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Batch:	3.91E-02	6.10E-02
Continuous:	0.00E+00	0.00E+00
Totals:	3.91E-02	6.10E-02
ODCM Quarterly Objective:	1.50E+00	5.00E+00
Percent of Quarterly Obj:	2.61 %	1.22 %
ODCM Annual Objective:	3.00E+00	1.00E+01
YTD Percent of Annual Obj:	14.27 %	6.72 %

II. Gaseous Effluents:	Total Body Gamma Dose (mrad)	Total Body Beta Dose (mrad)
A. Noble Gas Air Dose:	0.00E+00	0.00E+00
ODCM Quarterly Objective:	5.00E+00	1.00E+01
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.00E+01	2.00E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

B. I-131, I-133, Tritium, C-14, and Particulates with Half-Lives > 8 Days:	Total Body Dose (mrem)	Critical Organ Dose (mrem)
Inhalation:	1.94E-05	1.94E-05
Ground and Food:	8.96E-05	8.96E-05
Totals:	1.09E-04	1.09E-04
ODCM Quarterly Objective:	7.50E+00	7.50E+00
Percent of Quarterly Obj:	0.00 %	0.00 %
ODCM Annual Objective:	1.50E+01	1.50E+01
YTD Percent of Annual Obj:	0.00 %	0.00 %

Reviewed by:

SECTION III

RADIOLOGICAL EFFLUENT RELEASES

Technical Specification (5.9.4.a)

January 1, 2017 - December 31, 2017

TABLE III.1

BATCH LIQUID AND GASEOUS RELEASE SUMMARY

JANUARY THROUGH DECEMBER 2017

A. Liquid Releases All Sources	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Year
1. Number of Batch Releases:	13	7	6	5	31
2. Total Time Period for Batch Releases(min):	5,104	3,101	2,950	2,560	13,715
3. Maximum Time Period for Batch Releases(min):	633	526	545	553	633
4. Average Time Period for Batch Releases(min):	393	443	492	512	442
5. Minimum Time Period for Batch Releases(min):	70	235	462	480	70
6. Average Dilution Stream Flow During Periods of Release into the Missouri River(mls/min):	2.401E+07	2.730E+07	2.730E+07	2.730E+07	2.592E+07

B. Gaseous Releases All Sources	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Year
1. Number of Batch Releases:	1	2	1		4
2. Total Time Period for Batch Releases(min):	384	737	245		1,366
3. Maximum Time Period for Batch Releases(min):	384	400	245		400
4. Average Time Period for Batch Releases(min):	384	369	245		342
5. Minimum Time Period for Batch Releases(min):	384	337	245		245

TABLE III.2

ABNORMAL BATCH LIQUID AND GASEOUS RELEASE SUMMARY

JANUARY THROUGH DECEMBER 2017

A. Liquid Releases All Sources	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Year
Number of Releases:	0	0	0	0	0
Total Activity Releases(Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

B. Gaseous Releases All Sources	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	Year
Number of Releases:	0	0	0	0	0
Total Activity Releases (Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TABLE III.3

GASEOUS EFFLUENTS--SUMMATION OF ALL RELEASES

JANUARY THROUGH DECEMBER 2017

		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year
A.	Fission & Activation Gases					
	Total Release (Ci):	1.12E-04	7.56E-05	0.00E+00	0.00E+00	1.88E-04
	Average Release Rate (uCi/sec):	1.46E-05	9.72E-06	0.00E+00	0.00E+00	1.19E-05
	Total Error (%): 52.03					
B.	Iodines					
	Total Release (Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Average Release Rate (uCi/sec):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total Error (%): 21.2					
C.	Particulates					
	Total Release (Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Average Release Rate (uCi/sec):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total Error (%): 20.62					
	Gross Alpha:					
	Total Error (%): 20.62	1.68E-06	2.81E-06	2.56E-06	2.65E-06	9.69E-06
D.	Tritium					
	Total Release (Ci):	7.39E-02	8.61E-02	1.74E-01	5.90E-02	3.93E-01
	Average Release Rate (uCi/sec):	7.39E-04	8.51E-04	1.70E-03	5.77E-04	9.61E-04
	Total Error (%): 25.08					
E.	Carbon-14					
	Total Release (Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Average Release Rate (uCi/sec):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total Error (%): 20.62					

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.4
GASEOUS EFFLUENTS--GROUND LEVEL RELEASES
JANUARY THROUGH DECEMBER 2017
Batch Mode

Nuclides(Ci)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	YEAR
Fission & Activation Gases					
KR-85	1.12E-04	7.56E-05	0.00E+00	0.00E+00	1.88E-04
Totals for Period:	1.12E-04	7.56E-05	0.00E+00	0.00E+00	1.88E-04
Iodines					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Particulates					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium and Gross Alpha					

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.5

GASEOUS EFFLUENTS--GROUND LEVEL RELEASES

JANUARY THROUGH DECEMBER 2017

Continuous Mode

Nuclides(Ci)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year
Fission & Activation Gases					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Iodines					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Particulates					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium and Gross Alpha					
ALPHA	1.68E-06	2.81E-06	2.56E-06	2.65E-06	9.69E-06
H-3	7.39E-02	8.61E-02	1.74E-01	5.90E-02	3.93E-01

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.6

LIQUID EFFLUENTS--SUMMATION OF ALL RELEASES

JANUARY THROUGH DECEMBER 2017

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year
A. Fission & Activiation Products					
Total Release (No H-3,Gas,Alpha) (Ci):	6.55E-05	1.11E-03	9.33E-04	1.22E-04	2.23E-03
Average Diluted Concentration (uCi/mL):	6.40E-09	9.18E-08	6.95E-08	8.74E-09	1.88E-07
10 CFR 20, App. B Limit 1.00E-06 (uCi/mL) Percent of Limit (%):	6.40E-01	9.18E+00	6.95E+00	8.74E-01	1.88E+01
Total Error (%): 22.31					
B. Tritium					
Total Release (Ci):	8.61E-01	8.90E-01	1.35E-01	3.14E-01	2.20E+00
Average Diluted Concentration (uCi/mL):	8.41E-05	7.36E-05	1.00E-05	2.25E-05	1.85E-04
10 CFR 20, App. B Limit 1.00E-03(uCi/mL) Percent of Limit (%):	8.41E+00	7.36E+00	1.00E+00	2.25E+00	1.85E+01
Total Error (%): 25.08					
C. Dissolved & Entrained Gases					
Total Release (Ci):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Average Diluted Concentration (uCi/mL):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ODCM Limit 2.00E-04 (uCi/mL): Percent of Limit (%):	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total Error (%): 18.14					
D. Gross Alpha Radioactivity					
Total Release (Ci):	0.00E+00	5.38E-05	6.44E-06	0.00E+00	6.03E-05
Total Error (%): 25.08					
E. Volume of Waste Released Prior to Dilution (Liters):	2.37E+05	1.32E+05	1.26E+05	1.06E+05	6.01E+05
F. Volume of Dilution Water During Releases (Liters):	1.25E+08	8.45E+07	8.04E+07	6.98E+07	3.60E+08

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.7

LIQUID EFFLUENTS

JANUARY THROUGH DECEMBER 2017

Batch Mode

Nuclides(Ci)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year
Fission & Activation Gases					
FE-55	0.00E+00	7.38E-04	0.00E+00	0.00E+00	7.38E-04
MN-54	0.00E+00	2.04E-06	0.00E+00	0.00E+00	2.04E-06
SE-75	0.00E+00	2.90E-06	5.37E-07	0.00E+00	3.44E-06
CS-137	5.79E-05	3.21E-04	7.22E-04	1.10E-04	1.21E-03
CS-134	0.00E+00	1.85E-06	2.88E-06	0.00E+00	4.73E-06
CO-58	0.00E+00	7.08E-06	2.58E-06	0.00E+00	9.66E-06
AG-110M	0.00E+00	3.47E-07	0.00E+00	0.00E+00	3.47E-07
SB-125	0.00E+00	1.03E-05	0.00E+00	0.00E+00	1.03E-05
SB-124	0.00E+00	1.02E-05	0.00E+00	0.00E+00	1.02E-05
NI-63	0.00E+00	0.00E+00	1.76E-04	0.00E+00	1.76E-04
CO-60	7.61E-06	1.67E-05	2.85E-05	1.23E-05	6.51E-05
CO-57	0.00E+00	7.68E-08	0.00E+00	0.00E+00	7.68E-08
Totals for Period:	6.55E-05	1.11E-03	9.33E-04	1.22E-04	2.23E-03
Dissolved & Entrained Gases					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium and Gross Alpha					
ALPHA	0.00E+00	5.38E-05	6.44E-06	0.00E+00	6.03E-05
H-3	8.61E-01	8.90E-01	1.35E-01	3.14E-01	2.20E+00

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD) values.
Reported Alpha activity was attributed to natural short-lived radionuclides. This was confirmed by quarterly offside vendor analysis.

TABLE III.8
LIQUID EFFLUENTS
JANUARY THROUGH DECEMBER 2017
Continuous Mode

Nuclides (Ci)	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Year
Fission & Activation Products					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dissolved & Entrained Gases					
Totals for Period:	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tritium and Gross Alpha					
ALPHA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).

TABLE III.9

GROUNDWATER ANALYSIS RESULTS

pCi/L

JANUARY THROUGH DECEMBER 2017

		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
MW-1A					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-1B					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-2					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-2A					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		3.92E-01		
	Total Gamma		0.00E+00		
MW-2B					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		5.55E-01		
	Total Gamma		0.00E+00		
MW-3					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-3A					
	Tritium	3.26E+02	0.00E+00	0.00E+00	0.00E+00
	FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Sr-90	0.00E+00	0.00E+00	2.76E-01	5.76E-01
	Total Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MW-3B					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Sr-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MW-4A					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		2.50E-01		
	Total Gamma		0.00E+00		

TABLE III.9

GROUNDWATER ANALYSIS RESULTS

pCi/L

JANUARY THROUGH DECEMBER 2017

		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
MW-4B					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-5A					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-6					
	Tritium	0.00E+00	0.00E+00	0.00E+00	1.95E+02
	FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Sr-90	0.00E+00	5.50E-01	3.71E-01	0.00E+00
	Total Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MW-5B					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-7					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-9					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-10					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-11					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		
MW-12A					
	Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	FE-55		0.00E+00		
	NI-63		0.00E+00		
	Sr-90		0.00E+00		
	Total Gamma		0.00E+00		

TABLE III.9

GROUNDWATER ANALYSIS RESULTS

pCi/L

JANUARY THROUGH DECEMBER 2017

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
MW-12B				
Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55		0.00E+00		
NI-63		0.00E+00		
Sr-90		0.00E+00		
Total Gamma		0.00E+00		
EAST LAGOON				
Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55				
NI-63				
Sr-90				
Total Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00
WEST LAGOON				
Tritium	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55				
NI-63				
Sr-90				
Total Gamma	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NORTH STORMWATER HDR				
Tritium	0.00E+00	0.00E+00	0.00E+00	
FE-55				
NI-63				
Sr-90				
Total Gamma			0.00E+00	
SOUTH STORMWATER HDR				
Tritium		0.00E+00	0.00E+00	
FE-55				
NI-63				
Sr-90				
Total Gamma			0.00E+00	
SW-8 NORTH PA				
Tritium	0.00E+00	0.00E+00	0.00E+00	
FE-55				
NI-63				
Sr-90				
Total Gamma			0.00E+00	
SW-6 ISFSI				
Tritium	0.00E+00		0.00E+00	
FE-55				
NI-63				
Sr-90				
Total Gamma			0.00E+00	

NOTE: Values reported as zero are determined to be below the Lower Limit of Detection (LLD).
Only Tritium and Gamma are required for each sampling event.
Hard to detect (HTD) nuclide sampling frequency is per station procedures.
Missed sampling events are covered in the executive summary.

SECTION IV
DOSE FROM GASEOUS EFFLUENTS

Technical Specification 5.9.4.a

GASPAR II OUTPUT

January 1, 2017 - December 31, 2017

Radioactive Effluent Releases - First, Second, Third and Fourth Quarters 2017

GASEOUS EFFLUENTS

Radioactive gaseous releases for the reporting period totaled 1.88E-04 curies of inert gas. The gross gaseous activity release rates were 1.46E-05 µCi/sec for the first quarter, 9.72E-06 µCi/sec for the second quarter, 0.00E+00 µCi/sec for the third quarter, and 0.00E+00 µCi/sec for the fourth quarter.

No radioactive halogens releases were released during the reporting period from gaseous effluent discharges.

No radioactive particulates with half-lives greater that eight days were released during the reporting period from gaseous effluent discharges.

Radioactive tritium released during the reporting period totaled 3.93E-01 curies.

Carbon-14 released for the reporting period totaled 0.00 curies, this is a calculated value based on reactor power and days of operation. The Fort Calhoun estimate of 0.00 curies Carbon-14 with a normalized C-14 production rate and 15% carbon dioxide fraction.

Off-site vendor analysis of weekly composite samples indicated that no gross alpha radioactivity was released during the reporting period.

POTENTIAL DOSES TO INDIVIDUALS AND POPULATIONS

A. Potential Annual Doses to Individuals from Gaseous Releases

Total body, skin, and organ doses from ground releases were calculated in mRem to an average adult, teenager, child, and infant using the annual configuration of the GASPAR II program. Results to each receptor are shown in Tables IV-A-1 through IV-A-40. Also, the doses to the same groups, Table IV-B-1, in units of mRad, due to gamma and beta radiation carried by air, was computed using GASPAR II. In its annual configuration, GASPAR II assumes that all release rates are entered in curies per year (Ci/yr).

The inputs to GASPAR II for the annual period from January 1, 2017 through December 31, 2017 were as follows:

(1) All gaseous effluents

(2) Entrained gases (Ar-41, Xe-131M, Xe-133M, Xe-133, Xe-135M, Xe-135, Kr-85M, Kr-87, and Kr-88) from liquid effluents.

(3) Annual X/Q at the actual receptor locations, which are corrected for open terrain and plume depletion, are calculated according to Regulatory Guide 1.111. Also included are annual deposition rates corrected for the open terrain factor.

(4) The production, intake and grazing fractions were as follows: 1.0 for leafy vegetables grown in garden of interest, 0.76 for produce grown in garden of interest, 0.5 for the pasture grazing season of the milk animal, 1.0 for pasture grazing season of the meat animal, and 8 g/m^3 for the air water (humidity) concentrations.

(5) All dose factors, transport times from receptor to individual, and usage factors are defined by Regulatory Guide 1.109 and NUREG-0172.

(6) Site specific information, within a five-mile radius of the plant, on types of receptors located in each sector was used. That is, if a cow was not present in a sector, then the milk pathway for that sector was not considered. If it was present, then the actual sector distance was used.

(7) Using approved methodologies the C-14 doses to the site specific pathways (e.g. inhalation, milk, meat, and vegetation pathways) age group and organs are based upon airborne composition rather than ground deposition. For this reason, X/Q is utilized to calculate doses from Carbon-14 effluent releases

These inputs introduce a most conservative approach for the following reasons:

(1) The open terrain and deposition corrections increase annual X/Q by a factor ranging between 1.0 and 4.0

(2) The production, intake, and grazing fractions, as defined in the input definition statement, represent the environment in an extremely conservative manner.

B. Potential Semiannual Doses to Population from Gaseous Releases

The GASPAR II program in its annual configuration was also used to calculate the ALARA integrated population dose summary for the total body, skin, and organ doses in man-rem for all individuals within a 50-mile radius. The population-integrated dose is the summation of the dose received by all individuals and has units of man-thyroid-rem when applied to the summation of thyroid doses. The same inputs were used as in the individual case with the addition of the following:

(1) A total population of 950,006 (based on the 2010 census) was used to define the sector segments within a 50-mile radius of the plant.

(2) Production of milk, meat, and vegetation is based on 1973 annual data for Nebraska as recommended by the Nuclear Regulatory Commission for use in GASPAR II.

TABLE IV-A- 1

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 1 RES
AT 4.36 MILES N

ANNUAL_BETA_AIR_DOSE = 1.39E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.23E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	8.04E-12	8.04E-12	8.04E-12	8.04E-12	8.04E-12	8.04E-12	2.14E-11	9.66E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	1.07E-06	1.07E-06	0.00E+00	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06
TEEN	1.08E-06	1.08E-06	0.00E+00	1.08E-06	1.08E-06	1.08E-06	1.08E-06	1.08E-06
CHILD	9.57E-07	9.57E-07	0.00E+00	9.57E-07	9.57E-07	9.57E-07	9.57E-07	9.57E-07
INFANT	5.50E-07	5.50E-07	0.00E+00	5.50E-07	5.50E-07	5.50E-07	5.50E-07	5.50E-07

TABLE IV-A- 2

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 2 RES
AT 1.93 MILES NNE

ANNUAL_BETA_AIR_DOSE = 6.73E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 5.93E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.89E-11	3.89E-11	3.89E-11	3.89E-11	3.89E-11	3.89E-11	1.03E-10	4.67E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	5.19E-06	5.19E-06	0.00E+00	5.19E-06	5.19E-06	5.19E-06	5.19E-06	5.19E-06
TEEN	5.24E-06	5.24E-06	0.00E+00	5.24E-06	5.24E-06	5.24E-06	5.24E-06	5.24E-06
CHILD	4.63E-06	4.63E-06	0.00E+00	4.63E-06	4.63E-06	4.63E-06	4.63E-06	4.63E-06
INFANT	2.66E-06	2.66E-06	0.00E+00	2.66E-06	2.66E-06	2.66E-06	2.66E-06	2.66E-06

TABLE IV-A- 3

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 3 RES
AT 1.52 MILES NE

ANNUAL_BETA_AIR_DOSE = 1.09E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 9.61E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.30E-11	6.30E-11	6.30E-11	6.30E-11	6.30E-11	6.30E-11	1.68E-10	7.57E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	8.41E-06	8.41E-06	0.00E+00	8.41E-06	8.41E-06	8.41E-06	8.41E-06	8.41E-06
TEEN	8.49E-06	8.49E-06	0.00E+00	8.49E-06	8.49E-06	8.49E-06	8.49E-06	8.49E-06
CHILD	7.50E-06	7.50E-06	0.00E+00	7.50E-06	7.50E-06	7.50E-06	7.50E-06	7.50E-06
INFANT	4.31E-06	4.31E-06	0.00E+00	4.31E-06	4.31E-06	4.31E-06	4.31E-06	4.31E-06

TABLE IV-A- 4

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 4 RES
AT 4.79 MILES ENE

ANNUAL_BETA_AIR_DOSE = 7.89E-10 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 6.96E-12 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.56E-12	4.56E-12	4.56E-12	4.56E-12	4.56E-12	4.56E-12	1.21E-11	5.47E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	6.09E-07	6.09E-07	0.00E+00	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
TEEN	6.14E-07	6.14E-07	0.00E+00	6.14E-07	6.14E-07	6.14E-07	6.14E-07	6.14E-07
CHILD	5.42E-07	5.42E-07	0.00E+00	5.42E-07	5.42E-07	5.42E-07	5.42E-07	5.42E-07
INFANT	3.12E-07	3.12E-07	0.00E+00	3.12E-07	3.12E-07	3.12E-07	3.12E-07	3.12E-07

TABLE IV-A- 5

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 5 RES
AT 4.67 MILES E

ANNUAL_BETA_AIR_DOSE = 1.14E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.00E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.57E-12	6.57E-12	6.57E-12	6.57E-12	6.57E-12	6.57E-12	1.75E-11	7.89E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	8.77E-07	8.77E-07	0.00E+00	8.77E-07	8.77E-07	8.77E-07	8.77E-07	8.77E-07
TEEN	8.85E-07	8.85E-07	0.00E+00	8.85E-07	8.85E-07	8.85E-07	8.85E-07	8.85E-07
CHILD	7.81E-07	7.81E-07	0.00E+00	7.81E-07	7.81E-07	7.81E-07	7.81E-07	7.81E-07
INFANT	4.50E-07	4.50E-07	0.00E+00	4.50E-07	4.50E-07	4.50E-07	4.50E-07	4.50E-07

TABLE IV-A- 6

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 6 RES
AT 4.22 MILES ESE

ANNUAL_BETA_AIR_DOSE = 1.28E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.13E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.37E-12	7.37E-12	7.37E-12	7.37E-12	7.37E-12	7.37E-12	1.96E-11	8.85E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	9.84E-07	9.84E-07	0.00E+00	9.84E-07	9.84E-07	9.84E-07	9.84E-07	9.84E-07
TEEN	9.93E-07	9.93E-07	0.00E+00	9.93E-07	9.93E-07	9.93E-07	9.93E-07	9.93E-07
CHILD	8.77E-07	8.77E-07	0.00E+00	8.77E-07	8.77E-07	8.77E-07	8.77E-07	8.77E-07
INFANT	5.05E-07	5.05E-07	0.00E+00	5.05E-07	5.05E-07	5.05E-07	5.05E-07	5.05E-07

TABLE IV-A- 7

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 7 RES
AT 1.67 MILES SE

ANNUAL_BETA_AIR_DOSE = 9.63E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 8.49E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	5.56E-11	5.56E-11	5.56E-11	5.56E-11	5.56E-11	5.56E-11	1.48E-10	6.68E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	7.43E-06	7.43E-06	0.00E+00	7.43E-06	7.43E-06	7.43E-06	7.43E-06	7.43E-06
TEEN	7.49E-06	7.49E-06	0.00E+00	7.49E-06	7.49E-06	7.49E-06	7.49E-06	7.49E-06
CHILD	6.62E-06	6.62E-06	0.00E+00	6.62E-06	6.62E-06	6.62E-06	6.62E-06	6.62E-06
INFANT	3.81E-06	3.81E-06	0.00E+00	3.81E-06	3.81E-06	3.81E-06	3.81E-06	3.81E-06

TABLE IV-A- 8

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 8 RES
AT 0.65 MILES SSE

ANNUAL_BETA_AIR_DOSE = 8.00E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 7.06E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.62E-10	4.62E-10	4.62E-10	4.62E-10	4.62E-10	4.62E-10	1.23E-09	5.55E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	6.18E-05	6.18E-05	0.00E+00	6.18E-05	6.18E-05	6.18E-05	6.18E-05	6.18E-05
TEEN	6.23E-05	6.23E-05	0.00E+00	6.23E-05	6.23E-05	6.23E-05	6.23E-05	6.23E-05
CHILD	5.50E-05	5.50E-05	0.00E+00	5.50E-05	5.50E-05	5.50E-05	5.50E-05	5.50E-05
INFANT	3.17E-05	3.17E-05	0.00E+00	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05

TABLE IV-A- 9

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 9 RES
AT 0.73 MILES S

ANNUAL_BETA_AIR_DOSE = 4.52E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 3.99E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.61E-10	2.61E-10	2.61E-10	2.61E-10	2.61E-10	2.61E-10	6.95E-10	3.14E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	3.49E-05	3.49E-05	0.00E+00	3.49E-05	3.49E-05	3.49E-05	3.49E-05	3.49E-05
TEEN	3.52E-05	3.52E-05	0.00E+00	3.52E-05	3.52E-05	3.52E-05	3.52E-05	3.52E-05
CHILD	3.11E-05	3.11E-05	0.00E+00	3.11E-05	3.11E-05	3.11E-05	3.11E-05	3.11E-05
INFANT	1.79E-05	1.79E-05	0.00E+00	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05

TABLE IV-A-10

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 10 RES
AT 0.65 MILES SSW

ANNUAL_BETA_AIR_DOSE = 4.75E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 4.19E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.75E-10	2.75E-10	2.75E-10	2.75E-10	2.75E-10	2.75E-10	7.31E-10	3.30E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	3.67E-05	3.67E-05	0.00E+00	3.67E-05	3.67E-05	3.67E-05	3.67E-05	3.67E-05
TEEN	3.70E-05	3.70E-05	0.00E+00	3.70E-05	3.70E-05	3.70E-05	3.70E-05	3.70E-05
CHILD	3.27E-05	3.27E-05	0.00E+00	3.27E-05	3.27E-05	3.27E-05	3.27E-05	3.27E-05
INFANT	1.88E-05	1.88E-05	0.00E+00	1.88E-05	1.88E-05	1.88E-05	1.88E-05	1.88E-05

TABLE IV-A-11

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 11 RES
AT 0.73 MILES SW

ANNUAL_BETA_AIR_DOSE = 3.48E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 3.07E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.01E-10	2.01E-10	2.01E-10	2.01E-10	2.01E-10	2.01E-10	5.35E-10	2.41E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	2.68E-05	2.68E-05	0.00E+00	2.68E-05	2.68E-05	2.68E-05	2.68E-05	2.68E-05
TEEN	2.71E-05	2.71E-05	0.00E+00	2.71E-05	2.71E-05	2.71E-05	2.71E-05	2.71E-05
CHILD	2.39E-05	2.39E-05	0.00E+00	2.39E-05	2.39E-05	2.39E-05	2.39E-05	2.39E-05
INFANT	1.38E-05	1.38E-05	0.00E+00	1.38E-05	1.38E-05	1.38E-05	1.38E-05	1.38E-05

TABLE IV-A-12

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 12 RES
AT 1.06 MILES WSW

ANNUAL_BETA_AIR_DOSE = 1.97E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.74E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.14E-10	1.14E-10	1.14E-10	1.14E-10	1.14E-10	1.14E-10	3.03E-10	1.37E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	1.52E-05	1.52E-05	0.00E+00	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05
TEEN	1.54E-05	1.54E-05	0.00E+00	1.54E-05	1.54E-05	1.54E-05	1.54E-05	1.54E-05
CHILD	1.36E-05	1.36E-05	0.00E+00	1.36E-05	1.36E-05	1.36E-05	1.36E-05	1.36E-05
INFANT	7.80E-06	7.80E-06	0.00E+00	7.80E-06	7.80E-06	7.80E-06	7.80E-06	7.80E-06

TABLE IV-A-13

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 13 RES
AT 1.20 MILES W

ANNUAL_BETA_AIR_DOSE = 1.62E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.43E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	9.38E-11	9.38E-11	9.38E-11	9.38E-11	9.38E-11	9.38E-11	2.50E-10	1.13E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	1.25E-05	1.25E-05	0.00E+00	1.25E-05	1.25E-05	1.25E-05	1.25E-05	1.25E-05
TEEN	1.26E-05	1.26E-05	0.00E+00	1.26E-05	1.26E-05	1.26E-05	1.26E-05	1.26E-05
CHILD	1.12E-05	1.12E-05	0.00E+00	1.12E-05	1.12E-05	1.12E-05	1.12E-05	1.12E-05
INFANT	6.42E-06	6.42E-06	0.00E+00	6.42E-06	6.42E-06	6.42E-06	6.42E-06	6.42E-06

TABLE IV-A-14

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 14 RES
AT 2.60 MILES WNW

ANNUAL_BETA_AIR_DOSE = 5.22E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 4.60E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.02E-11	3.02E-11	3.02E-11	3.02E-11	3.02E-11	3.02E-11	8.02E-11	3.62E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	4.03E-06	4.03E-06	0.00E+00	4.03E-06	4.03E-06	4.03E-06	4.03E-06	4.03E-06
TEEN	4.06E-06	4.06E-06	0.00E+00	4.06E-06	4.06E-06	4.06E-06	4.06E-06	4.06E-06
CHILD	3.59E-06	3.59E-06	0.00E+00	3.59E-06	3.59E-06	3.59E-06	3.59E-06	3.59E-06
INFANT	2.06E-06	2.06E-06	0.00E+00	2.06E-06	2.06E-06	2.06E-06	2.06E-06	2.06E-06

TABLE IV-A-15

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 15 RES
AT 2.40 MILES NW

ANNUAL_BETA_AIR_DOSE = 5.22E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 4.60E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.02E-11	3.02E-11	3.02E-11	3.02E-11	3.02E-11	3.02E-11	8.02E-11	3.62E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	4.03E-06	4.03E-06	0.00E+00	4.03E-06	4.03E-06	4.03E-06	4.03E-06	4.03E-06
TEEN	4.06E-06	4.06E-06	0.00E+00	4.06E-06	4.06E-06	4.06E-06	4.06E-06	4.06E-06
CHILD	3.59E-06	3.59E-06	0.00E+00	3.59E-06	3.59E-06	3.59E-06	3.59E-06	3.59E-06
INFANT	2.06E-06	2.06E-06	0.00E+00	2.06E-06	2.06E-06	2.06E-06	2.06E-06	2.06E-06

TABLE IV-A-16

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 16 RES
AT 2.08 MILES NNW

ANNUAL_BETA_AIR_DOSE = 7.89E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 6.96E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.56E-11	4.56E-11	4.56E-11	4.56E-11	4.56E-11	4.56E-11	1.21E-10	5.47E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
INHAL								
ADULT	6.09E-06	6.09E-06	0.00E+00	6.09E-06	6.09E-06	6.09E-06	6.09E-06	6.09E-06
TEEN	6.14E-06	6.14E-06	0.00E+00	6.14E-06	6.14E-06	6.14E-06	6.14E-06	6.14E-06
CHILD	5.42E-06	5.42E-06	0.00E+00	5.42E-06	5.42E-06	5.42E-06	5.42E-06	5.42E-06
INFANT	3.12E-06	3.12E-06	0.00E+00	3.12E-06	3.12E-06	3.12E-06	3.12E-06	3.12E-06

TABLE IV-A-17

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 17 VEG
AT 2.23 MILES NNE

ANNUAL_BETA_AIR_DOSE = 4.41E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 3.89E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.55E-11	2.55E-11	2.55E-11	2.55E-11	2.55E-11	2.55E-11	6.77E-11	3.06E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	6.16E-06	6.16E-06	0.00E+00	6.16E-06	6.16E-06	6.16E-06	6.16E-06	6.16E-06
TEEN	7.05E-06	7.05E-06	0.00E+00	7.05E-06	7.05E-06	7.05E-06	7.05E-06	7.05E-06
CHILD	1.09E-05	1.09E-05	0.00E+00	1.09E-05	1.09E-05	1.09E-05	1.09E-05	1.09E-05

TABLE IV-A-18

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 18 VEG
AT 1.52 MILES NE

ANNUAL_BETA_AIR_DOSE = 1.09E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 9.61E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.30E-11	6.30E-11	6.30E-11	6.30E-11	6.30E-11	6.30E-11	1.68E-10	7.57E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	1.52E-05	1.52E-05	0.00E+00	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05
TEEN	1.74E-05	1.74E-05	0.00E+00	1.74E-05	1.74E-05	1.74E-05	1.74E-05	1.74E-05
CHILD	2.71E-05	2.71E-05	0.00E+00	2.71E-05	2.71E-05	2.71E-05	2.71E-05	2.71E-05

TABLE IV-A-19

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 19 VEG
AT 4.79 MILES ENE

ANNUAL_BETA_AIR_DOSE = 7.89E-10 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 6.96E-12 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.56E-12	4.56E-12	4.56E-12	4.56E-12	4.56E-12	4.56E-12	1.21E-11	5.47E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	1.10E-06	1.10E-06	0.00E+00	1.10E-06	1.10E-06	1.10E-06	1.10E-06	1.10E-06
TEEN	1.26E-06	1.26E-06	0.00E+00	1.26E-06	1.26E-06	1.26E-06	1.26E-06	1.26E-06
CHILD	1.96E-06	1.96E-06	0.00E+00	1.96E-06	1.96E-06	1.96E-06	1.96E-06	1.96E-06

TABLE IV-A-20

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 20 VEG
AT 4.67 MILES E

ANNUAL_BETA_AIR_DOSE = 1.14E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.00E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.57E-12	6.57E-12	6.57E-12	6.57E-12	6.57E-12	6.57E-12	1.75E-11	7.89E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	1.59E-06	1.59E-06	0.00E+00	1.59E-06	1.59E-06	1.59E-06	1.59E-06	1.59E-06
TEEN	1.82E-06	1.82E-06	0.00E+00	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
CHILD	2.82E-06	2.82E-06	0.00E+00	2.82E-06	2.82E-06	2.82E-06	2.82E-06	2.82E-06

TABLE IV-A-21

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 21 VEG
AT 4.22 MILES ESE

ANNUAL_BETA_AIR_DOSE = 1.28E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.13E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.37E-12	7.37E-12	7.37E-12	7.37E-12	7.37E-12	7.37E-12	1.96E-11	8.85E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	1.78E-06	1.78E-06	0.00E+00	1.78E-06	1.78E-06	1.78E-06	1.78E-06	1.78E-06
TEEN	2.04E-06	2.04E-06	0.00E+00	2.04E-06	2.04E-06	2.04E-06	2.04E-06	2.04E-06
CHILD	3.17E-06	3.17E-06	0.00E+00	3.17E-06	3.17E-06	3.17E-06	3.17E-06	3.17E-06

TABLE IV-A-22

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 22 VEG
AT 1.74 MILES SE

ANNUAL_BETA_AIR_DOSE = 9.05E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 7.98E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	5.23E-11	5.23E-11	5.23E-11	5.23E-11	5.23E-11	5.23E-11	1.39E-10	6.28E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	1.26E-05	1.26E-05	0.00E+00	1.26E-05	1.26E-05	1.26E-05	1.26E-05	1.26E-05
TEEN	1.45E-05	1.45E-05	0.00E+00	1.45E-05	1.45E-05	1.45E-05	1.45E-05	1.45E-05
CHILD	2.25E-05	2.25E-05	0.00E+00	2.25E-05	2.25E-05	2.25E-05	2.25E-05	2.25E-05

TABLE IV-A-23

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 23 VEG
AT 0.65 MILES SSE

ANNUAL_BETA_AIR_DOSE = 8.00E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 7.06E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.62E-10	4.62E-10	4.62E-10	4.62E-10	4.62E-10	4.62E-10	1.23E-09	5.55E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	1.12E-04	1.12E-04	0.00E+00	1.12E-04	1.12E-04	1.12E-04	1.12E-04	1.12E-04
TEEN	1.28E-04	1.28E-04	0.00E+00	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04
CHILD	1.99E-04	1.99E-04	0.00E+00	1.99E-04	1.99E-04	1.99E-04	1.99E-04	1.99E-04

TABLE IV-A-24

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 24 VEG
AT 0.73 MILES S

ANNUAL_BETA_AIR_DOSE = 4.52E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 3.99E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.61E-10	2.61E-10	2.61E-10	2.61E-10	2.61E-10	2.61E-10	6.95E-10	3.14E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	6.32E-05	6.32E-05	0.00E+00	6.32E-05	6.32E-05	6.32E-05	6.32E-05	6.32E-05
TEEN	7.23E-05	7.23E-05	0.00E+00	7.23E-05	7.23E-05	7.23E-05	7.23E-05	7.23E-05
CHILD	1.12E-04	1.12E-04	0.00E+00	1.12E-04	1.12E-04	1.12E-04	1.12E-04	1.12E-04

TABLE IV-A-25

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 25 VEG
AT 2.00 MILES SSW

ANNUAL_BETA_AIR_DOSE = 3.36E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 2.97E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.94E-11	1.94E-11	1.94E-11	1.94E-11	1.94E-11	1.94E-11	5.17E-11	2.33E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	4.70E-06	4.70E-06	0.00E+00	4.70E-06	4.70E-06	4.70E-06	4.70E-06	4.70E-06
TEEN	5.38E-06	5.38E-06	0.00E+00	5.38E-06	5.38E-06	5.38E-06	5.38E-06	5.38E-06
CHILD	8.35E-06	8.35E-06	0.00E+00	8.35E-06	8.35E-06	8.35E-06	8.35E-06	8.35E-06

TABLE IV-A-26

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 26 VEG
AT 1.43 MILES SW

ANNUAL_BETA_AIR_DOSE = 6.61E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 5.83E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.82E-11	3.82E-11	3.82E-11	3.82E-11	3.82E-11	3.82E-11	1.02E-10	4.59E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	9.24E-06	9.24E-06	0.00E+00	9.24E-06	9.24E-06	9.24E-06	9.24E-06	9.24E-06
TEEN	1.06E-05	1.06E-05	0.00E+00	1.06E-05	1.06E-05	1.06E-05	1.06E-05	1.06E-05
CHILD	1.64E-05	1.64E-05	0.00E+00	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05

TABLE IV-A-27

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 27 VEG
AT 1.13 MILES WSW

ANNUAL_BETA_AIR_DOSE = 1.74E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.53E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.01E-10	1.01E-10	1.01E-10	1.01E-10	1.01E-10	1.01E-10	2.67E-10	1.21E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	2.43E-05	2.43E-05	0.00E+00	2.43E-05	2.43E-05	2.43E-05	2.43E-05	2.43E-05
TEEN	2.78E-05	2.78E-05	0.00E+00	2.78E-05	2.78E-05	2.78E-05	2.78E-05	2.78E-05
CHILD	4.32E-05	4.32E-05	0.00E+00	4.32E-05	4.32E-05	4.32E-05	4.32E-05	4.32E-05

TABLE IV-A-28

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 28 VEG
AT 1.30 MILES W

ANNUAL_BETA_AIR_DOSE = 1.28E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.13E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.37E-11	7.37E-11	7.37E-11	7.37E-11	7.37E-11	7.37E-11	1.96E-10	8.85E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	1.78E-05	1.78E-05	0.00E+00	1.78E-05	1.78E-05	1.78E-05	1.78E-05	1.78E-05
TEEN	2.04E-05	2.04E-05	0.00E+00	2.04E-05	2.04E-05	2.04E-05	2.04E-05	2.04E-05
CHILD	3.17E-05	3.17E-05	0.00E+00	3.17E-05	3.17E-05	3.17E-05	3.17E-05	3.17E-05

TABLE IV-A-29

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 29 VEG
AT 2.65 MILES WNW

ANNUAL_BETA_AIR_DOSE = 4.87E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 4.30E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.81E-11	2.81E-11	2.81E-11	2.81E-11	2.81E-11	2.81E-11	7.49E-11	3.38E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	6.81E-06	6.81E-06	0.00E+00	6.81E-06	6.81E-06	6.81E-06	6.81E-06	6.81E-06
TEEN	7.79E-06	7.79E-06	0.00E+00	7.79E-06	7.79E-06	7.79E-06	7.79E-06	7.79E-06
CHILD	1.21E-05	1.21E-05	0.00E+00	1.21E-05	1.21E-05	1.21E-05	1.21E-05	1.21E-05

TABLE IV-A-30

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 30 VEG
AT 2.40 MILES NW

ANNUAL_BETA_AIR_DOSE = 5.22E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 4.60E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.02E-11	3.02E-11	3.02E-11	3.02E-11	3.02E-11	3.02E-11	8.02E-11	3.62E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	7.30E-06	7.30E-06	0.00E+00	7.30E-06	7.30E-06	7.30E-06	7.30E-06	7.30E-06
TEEN	8.34E-06	8.34E-06	0.00E+00	8.34E-06	8.34E-06	8.34E-06	8.34E-06	8.34E-06
CHILD	1.30E-05	1.30E-05	0.00E+00	1.30E-05	1.30E-05	1.30E-05	1.30E-05	1.30E-05

TABLE IV-A-31

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 31 VEG
AT 3.73 MILES NNW

ANNUAL_BETA_AIR_DOSE = 2.20E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.94E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.27E-11	1.27E-11	1.27E-11	1.27E-11	1.27E-11	1.27E-11	3.39E-11	1.53E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VEGET								
ADULT	3.08E-06	3.08E-06	0.00E+00	3.08E-06	3.08E-06	3.08E-06	3.08E-06	3.08E-06
TEEN	3.52E-06	3.52E-06	0.00E+00	3.52E-06	3.52E-06	3.52E-06	3.52E-06	3.52E-06
CHILD	5.47E-06	5.47E-06	0.00E+00	5.47E-06	5.47E-06	5.47E-06	5.47E-06	5.47E-06

TABLE IV-A-32

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 32 BEEF
AT 4.91 MILES E

ANNUAL_BETA_AIR_DOSE = 1.07E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 9.41E-12 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.17E-12	6.17E-12	6.17E-12	6.17E-12	6.17E-12	6.17E-12	1.64E-11	7.40E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	2.14E-07	2.14E-07	0.00E+00	2.14E-07	2.14E-07	2.14E-07	2.14E-07	2.14E-07
TEEN	1.28E-07	1.28E-07	0.00E+00	1.28E-07	1.28E-07	1.28E-07	1.28E-07	1.28E-07
CHILD	1.55E-07	1.55E-07	0.00E+00	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07

TABLE IV-A-33

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 33 BEEF
AT 1.82 MILES SSE

ANNUAL_BETA_AIR_DOSE = 7.42E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 6.55E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.29E-11	4.29E-11	4.29E-11	4.29E-11	4.29E-11	4.29E-11	1.14E-10	5.15E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	1.49E-06	1.49E-06	0.00E+00	1.49E-06	1.49E-06	1.49E-06	1.49E-06	1.49E-06
TEEN	8.89E-07	8.89E-07	0.00E+00	8.89E-07	8.89E-07	8.89E-07	8.89E-07	8.89E-07
CHILD	1.08E-06	1.08E-06	0.00E+00	1.08E-06	1.08E-06	1.08E-06	1.08E-06	1.08E-06

TABLE IV-A-34

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 34 BEEF
AT 2.48 MILES S

ANNUAL_BETA_AIR_DOSE = 2.20E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.94E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.27E-11	1.27E-11	1.27E-11	1.27E-11	1.27E-11	1.27E-11	3.39E-11	1.53E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	4.43E-07	4.43E-07	0.00E+00	4.43E-07	4.43E-07	4.43E-07	4.43E-07	4.43E-07
TEEN	2.64E-07	2.64E-07	0.00E+00	2.64E-07	2.64E-07	2.64E-07	2.64E-07	2.64E-07
CHILD	3.20E-07	3.20E-07	0.00E+00	3.20E-07	3.20E-07	3.20E-07	3.20E-07	3.20E-07

TABLE IV-A-35

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 35 BEEF
AT 0.65 MILES SSW

ANNUAL_BETA_AIR_DOSE = 4.75E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 4.19E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.75E-10	2.75E-10	2.75E-10	2.75E-10	2.75E-10	2.75E-10	7.31E-10	3.30E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	9.56E-06	9.56E-06	0.00E+00	9.56E-06	9.56E-06	9.56E-06	9.56E-06	9.56E-06
TEEN	5.69E-06	5.69E-06	0.00E+00	5.69E-06	5.69E-06	5.69E-06	5.69E-06	5.69E-06
CHILD	6.90E-06	6.90E-06	0.00E+00	6.90E-06	6.90E-06	6.90E-06	6.90E-06	6.90E-06

TABLE IV-A-36

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 36 BEEF
AT 0.76 MILES SW

ANNUAL_BETA_AIR_DOSE = 3.13E-08 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 2.76E-10 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.81E-10	1.81E-10	1.81E-10	1.81E-10	1.81E-10	1.81E-10	4.81E-10	2.17E-08
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	6.29E-06	6.29E-06	0.00E+00	6.29E-06	6.29E-06	6.29E-06	6.29E-06	6.29E-06
TEEN	3.75E-06	3.75E-06	0.00E+00	3.75E-06	3.75E-06	3.75E-06	3.75E-06	3.75E-06
CHILD	4.54E-06	4.54E-06	0.00E+00	4.54E-06	4.54E-06	4.54E-06	4.54E-06	4.54E-06

TABLE IV-A-37

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 37 BEEF
AT 2.18 MILES WSW

ANNUAL_BETA_AIR_DOSE = 3.59E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 3.17E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.08E-11	2.08E-11	2.08E-11	2.08E-11	2.08E-11	2.08E-11	5.53E-11	2.49E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	7.22E-07	7.22E-07	0.00E+00	7.22E-07	7.22E-07	7.22E-07	7.22E-07	7.22E-07
TEEN	4.30E-07	4.30E-07	0.00E+00	4.30E-07	4.30E-07	4.30E-07	4.30E-07	4.30E-07
CHILD	5.21E-07	5.21E-07	0.00E+00	5.21E-07	5.21E-07	5.21E-07	5.21E-07	5.21E-07

TABLE IV-A-38

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

SPECIAL LOCATION NO. 38 BEEF
AT 2.28 MILES W

ANNUAL_BETA_AIR_DOSE = 3.71E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 3.27E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.14E-11	2.14E-11	2.14E-11	2.14E-11	2.14E-11	2.14E-11	5.70E-11	2.58E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	7.46E-07	7.46E-07	0.00E+00	7.46E-07	7.46E-07	7.46E-07	7.46E-07	7.46E-07
TEEN	4.44E-07	4.44E-07	0.00E+00	4.44E-07	4.44E-07	4.44E-07	4.44E-07	4.44E-07
CHILD	5.38E-07	5.38E-07	0.00E+00	5.38E-07	5.38E-07	5.38E-07	5.38E-07	5.38E-07

TABLE IV-A-39

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 39 BEEF
AT 4.59 MILES WNW

ANNUAL_BETA_AIR_DOSE = 1.97E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 1.74E-11 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11	1.14E-11	3.03E-11	1.37E-09
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MEAT								
ADULT	3.96E-07	3.96E-07	0.00E+00	3.96E-07	3.96E-07	3.96E-07	3.96E-07	3.96E-07
TEEN	2.36E-07	2.36E-07	0.00E+00	2.36E-07	2.36E-07	2.36E-07	2.36E-07	2.36E-07
CHILD	2.86E-07	2.86E-07	0.00E+00	2.86E-07	2.86E-07	2.86E-07	2.86E-07	2.86E-07

TABLE IV-A-40

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
SPECIAL LOCATION NO. 40 GOAT
AT 3.44 MILES S

ANNUAL_BETA_AIR_DOSE = 1.10E-09 MILLRADS
ANNUAL_GAMMA_AIR_DOSE = 9.72E-12 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.37E-12	6.37E-12	6.37E-12	6.37E-12	6.37E-12	6.37E-12	1.69E-11	7.65E-10
GROUND	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
GOATMILK								
ADULT	1.06E-06	1.06E-06	0.00E+00	1.06E-06	1.06E-06	1.06E-06	1.06E-06	1.06E-06
TEEN	1.38E-06	1.38E-06	0.00E+00	1.38E-06	1.38E-06	1.38E-06	1.38E-06	1.38E-06
CHILD	2.19E-06	2.19E-06	0.00E+00	2.19E-06	2.19E-06	2.19E-06	2.19E-06	2.19E-06
INFANT	3.32E-06	3.32E-06	0.00E+00	3.32E-06	3.32E-06	3.32E-06	3.32E-06	3.32E-06

FORT CALHOUN 1 DOSE CONTRIBUTIONS FROM GASEOUS EFFLUENTS
UNRESTRICTED AREA BOUNDARY
REQUIRED BY TECHNICAL SPECIFICATION 5.9.4.a.
JANUARY 1, 2017 TO DECEMBER 31, 2017

MAXIMUM SITE BOUNDARY GAMMA AIR DOSE - 1.13E-09 MILLRADS

MAXIMUM SITE BOUNDARY BETA AIR DOSE - 1.28E-07 MILLRADS

TABLE IV-C-1

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS
ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.16E-10	6.16E-10	6.16E-10	6.16E-10	6.16E-10	6.16E-10	2.05E-09	1.03E-07
	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.04%
INHAL	1.13E-04	1.13E-04	0.00E+00	1.13E-04	1.13E-04	1.13E-04	1.13E-04	1.13E-04
	40.65%	40.65%	0.00%	40.65%	40.65%	40.65%	40.65%	40.63%
VEGET	1.16E-04	1.16E-04	0.00E+00	1.16E-04	1.16E-04	1.16E-04	1.16E-04	1.16E-04
	41.66%	41.66%	0.00%	41.66%	41.66%	41.66%	41.66%	41.65%
COW MILK	2.31E-05	2.31E-05	0.00E+00	2.31E-05	2.31E-05	2.31E-05	2.31E-05	2.31E-05
	8.30%	8.30%	0.00%	8.30%	8.30%	8.30%	8.30%	8.30%
MEAT	2.61E-05	2.61E-05	0.00E+00	2.61E-05	2.61E-05	2.61E-05	2.61E-05	2.61E-05
	9.39%	9.39%	0.00%	9.39%	9.39%	9.39%	9.39%	9.39%
TOTAL	2.78E-04	2.78E-04	6.16E-10	2.78E-04	2.78E-04	2.78E-04	2.78E-04	2.78E-04

SECTION V

DOSE FROM LIQUID EFFLUENTS

LADTAP II OUTPUT

Technical Specification 5.9.4.a

January 1, 2017 - December 31, 2017

Radioactive Effluent Releases - First, Second, Third, and Fourth Quarters 2017

LIQUID EFFLUENTS

During the reporting period, a total of 2.23E-03 curies of radioactive liquid materials less tritium, dissolved noble gases, and alpha were released to the Missouri River at an average concentration of 1.88E-07 µCi/mL. This represents 1.88E+01 percent of the limits specified in Appendix B to 10 CFR 20 (1.0E-06 µCi/mL for unrestricted areas), 2.2 curies of tritium were discharged at an average diluted concentration of 1.85E-04 µCi/mL or 1.85E+01 percent of ECL (1.0E-03 µCi/mL).

No gross alpha radioactivity was identified by Off-site vendor analysis of quarterly liquid composites for the reporting period. Ni-63 was identified in the third quarterly composite, and Fe-55 was identified in the second quarterly composite. These Hard to detect nuclides represented 4.1% of the total activity released.

Dilution water during the period amounted to 3.60E+08 liters, while liquid waste discharges consisted of 6.01E+05 liters of radioactive liquid waste.

A. Potential Annual Doses to Individuals from Liquid Releases

Total body, skin, and organ mRem for liquid releases were calculated for all significant liquid pathways using the annual configuration of the LADTAP II program.

The inputs to LADTAP II for the annual period from January 1, 2017 through December 31, 2017 were as follows:

(1) All liquid effluents were as described in Section IV except for entrained noble gases (Ar-41, Xe-131M, Xe-133M, Xe-133, Xe-135M, Xe-135, Kr-85M, Kr-87, and Kr-88).

(2) An average dilution stream flow during periods of release was 16.04 cubic feet per second (CFS) was utilized for 2017. The average discharge rate during releases was 16.08 cubic feet per second (CFS).

(3) Dilution factors (inverse of the mixing ratios) were computed based on Regulatory Guide 1.113 (equation 7 in Section 2.a.1 of Appendix A) for a one dimensional transport model.

(4) Drinking water transport times of 6.6 hours to the Omaha intake and 7.0 hours to the Council Bluffs intake were used for dose calculations.

(5) A shorewidth factor of 0.2 was used.

(6) All dose factors, transport times from receptor to individual, and usage factors are defined by Regulatory Guide 1.109 and NUREG-0172.

The discharge site was chosen to present the most conservative estimate of mRem dose for an average adult, teenager, child, and infant. A conservative approach is also presented by the assumption that Omaha and Council Bluffs receive all drinking water from the Missouri River.

B. Potential Annual Doses to Population from Liquid Releases

The LADTAP II program in its annual configuration was also used to calculate to total body and organ doses for the population of 950,006 within a 50-mile radius of the plant (based on the 2010 census). The same input was used as in the individual cases with the addition of the following:

(1) Dilution factors and transport times for the pathways of sport fish, commercial fish, recreation and biota were calculated based on a distance of two miles downstream as approximately the distance to the nearest recreation facility - DeSoto National Wildlife Preserve.

(2) The total fish harvest for both sport and commercial purposes was calculated using an average commercial fish catch for Nebraska.

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L       AAA   DDDD   TTTTT   AAA   PPPP     IIIII IIIII
L      A   A  D   D    T    A   A  P   P      I     I
L      A   A  D   D    T    A   A  P   P      I     I
L      AAAAA  D   D    T    AAAAA  PPPP       I     I
L      A   A  D   D    T    A   A  P          I     I
LLLLL  A   A  DDDD     T    A   A  P        IIIII IIIII
```

EVALUATION OF RADIATION DOSES FROM RELEASES OF RADIACTIVITY

IN NUCLEAR POWER PLANTS LIQUID EFFLUENTS

REVISION DATE: PNL VAX - OCTOBER 1985

FORT CALHOUN ANNUAL 2017, DOSE PROJECTIONS

RADIOLOGICAL ASSESSMENT BRANCH

DIVISION OF SYSTEMS INTEGRATION

U. S. NUCLEAR REGULATORY COMMISSION

WASHINGTON, D. C.

DATE OF RUN: 201802051

LOCATION IS FRESHWATER INTAKE

A D U L T D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		4.13E-02	5.59E-02	3.67E-02	2.49E-05	1.90E-02	6.34E-03	1.16E-03
DRINKING		2.11E-04	4.64E-04	3.82E-04	2.28E-04	3.07E-04	2.56E-04	2.41E-04
SHORELINE	6.37E-05	5.46E-05	5.46E-05	5.46E-05	5.46E-05	5.46E-05	5.46E-05	5.46E-05
SWIMMING		1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07	1.91E-07
BOATING		9.56E-08	9.56E-08	9.56E-08	9.56E-08	9.56E-08	9.56E-08	9.56E-08
TOTAL	6.37E-05	4.15E-02	5.64E-02	3.71E-02	3.08E-04	1.93E-02	6.65E-03	1.46E-03

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	21.0	7.3	24.00	
DRINKING	730.0	30.8	18.60	
SHORELINE	12.0	7.3	0.00	
SWIMMING	12.0	7.3	0.00	
BOATING	12.0	7.3	0.00	

T E E N A G E R D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		4.42E-02	5.82E-02	2.03E-02	1.92E-05	1.98E-02	7.72E-03	8.87E-04
DRINKING		2.06E-04	3.86E-04	2.40E-04	1.61E-04	2.36E-04	1.92E-04	1.70E-04
SHORELINE	3.56E-04	3.05E-04	3.05E-04	3.05E-04	3.05E-04	3.05E-04	3.05E-04	3.05E-04
SWIMMING		1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06
BOATING		5.34E-07	5.34E-07	5.34E-07	5.34E-07	5.34E-07	5.34E-07	5.34E-07
TOTAL	3.56E-04	4.47E-02	5.89E-02	2.09E-02	4.86E-04	2.03E-02	8.22E-03	1.36E-03

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	16.0	7.3	24.00	
DRINKING	510.0	30.8	18.60	
SHORELINE	67.0	7.3	0.00	
SWIMMING	67.0	7.3	0.00	
BOATING	67.0	7.3	0.00	

C H I L D D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		5.56E-02	5.27E-02	7.84E-03	1.59E-05	1.72E-02	6.21E-03	3.61E-04
DRINKING		6.06E-04	7.82E-04	3.84E-04	3.09E-04	4.59E-04	3.66E-04	3.17E-04
SHORELINE	7.43E-05	6.37E-05	6.37E-05	6.37E-05	6.37E-05	6.37E-05	6.37E-05	6.37E-05
SWIMMING		2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07	2.23E-07
BOATING		1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07	1.12E-07
TOTAL	7.43E-05	5.63E-02	5.36E-02	8.29E-03	3.89E-04	1.77E-02	6.64E-03	7.42E-04

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	6.9	7.3	24.00	
DRINKING	510.0	30.8	18.60	
SHORELINE	14.0	7.3	0.00	
SWIMMING	14.0	7.3	0.00	
BOATING	14.0	7.3	0.00	

I N F A N T D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
DRINKING		5.92E-04	8.97E-04	3.51E-04	3.03E-04	4.60E-04	3.69E-04	3.08E-04
SHORELINE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	0.00E+00	5.92E-04	8.97E-04	3.51E-04	3.03E-04	4.60E-04	3.69E-04	3.08E-04

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	0.0	7.3	24.00	
DRINKING	330.0	30.8	18.60	

LOCATION IS SITE DISCHG.

A D U L T D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		3.01E-01	4.08E-01	2.68E-01	1.82E-04	1.39E-01	4.63E-02	8.47E-03
DRINKING		6.50E-03	1.43E-02	1.18E-02	7.04E-03	9.44E-03	7.88E-03	7.44E-03
SHORELINE	4.65E-04	3.98E-04	3.98E-04	3.98E-04	3.98E-04	3.98E-04	3.98E-04	3.98E-04
SWIMMING		1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06	1.40E-06
BOATING		6.98E-07	6.98E-07	6.98E-07	6.98E-07	6.98E-07	6.98E-07	6.98E-07
TOTAL	4.65E-04	3.08E-01	4.23E-01	2.80E-01	7.62E-03	1.48E-01	5.46E-02	1.63E-02

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	21.0	1.0	24.00	
DRINKING	730.0	1.0	12.00	
SHORELINE	12.0	1.0	0.00	
SWIMMING	12.0	1.0	0.00	
BOATING	12.0	1.0	0.00	

T E E N A G E R D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		3.22E-01	4.25E-01	1.48E-01	1.40E-04	1.45E-01	5.64E-02	6.48E-03
DRINKING		6.34E-03	1.19E-02	7.39E-03	4.96E-03	7.26E-03	5.90E-03	5.23E-03
SHORELINE	2.60E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03	2.22E-03
SWIMMING		7.80E-06	7.80E-06	7.80E-06	7.80E-06	7.80E-06	7.80E-06	7.80E-06
BOATING		3.90E-06	3.90E-06	3.90E-06	3.90E-06	3.90E-06	3.90E-06	3.90E-06
TOTAL	2.60E-03	3.31E-01	4.39E-01	1.58E-01	7.33E-03	1.54E-01	6.45E-02	1.39E-02

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	16.0	1.0	24.00	
DRINKING	510.0	1.0	12.00	
SHORELINE	67.0	1.0	0.00	
SWIMMING	67.0	1.0	0.00	
BOATING	67.0	1.0	0.00	

C H I L D D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		4.06E-01	3.85E-01	5.72E-02	1.16E-04	1.25E-01	4.53E-02	2.64E-03
DRINKING		1.87E-02	2.41E-02	1.18E-02	9.52E-03	1.41E-02	1.13E-02	9.76E-03
SHORELINE	5.42E-04	4.65E-04	4.65E-04	4.65E-04	4.65E-04	4.65E-04	4.65E-04	4.65E-04
SWIMMING		1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06	1.63E-06
BOATING		8.15E-07	8.15E-07	8.15E-07	8.15E-07	8.15E-07	8.15E-07	8.15E-07
TOTAL	5.42E-04	4.25E-01	4.10E-01	6.95E-02	1.01E-02	1.40E-01	5.71E-02	1.29E-02

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	6.9	1.0	24.00	
DRINKING	510.0	1.0	12.00	
SHORELINE	14.0	1.0	0.00	
SWIMMING	14.0	1.0	0.00	
BOATING	14.0	1.0	0.00	

I N F A N T D O S E S

	DOSE (MREM PER YEAR INTAKE)						
PATHWAY	SKIN	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
DRINKING		1.82E-02	2.76E-02	1.08E-02	9.34E-03	1.42E-02	1.14E-02	9.49E-03
SHORELINE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	0.00E+00	1.82E-02	2.76E-02	1.08E-02	9.34E-03	1.42E-02	1.14E-02	9.49E-03

	USAGE (KG/YR,HR/YR)	DILUTION	TIME(HR)	SHOREWIDTH FACTOR=0.2
FISH	0.0	1.0	24.00	
DRINKING	330.0	1.0	12.00	

* * * FISH CONSUMPTION POPULATION DOSES * * *
PERSON-REM

SPORT HARVEST

PATHWAY	AGE GROUP	USAGE	DOSE (PERSON-REM) BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	6.10E+04	1.20E-01	1.62E-01	1.06E-01	7.24E-05	5.51E-02	1.84E-02	3.37E-03
FISH	TEENAGER	7.12E+03	1.96E-02	2.59E-02	9.04E-03	8.52E-06	8.80E-03	3.43E-03	3.94E-04
FISH	CHILD	4.93E+03	3.97E-02	3.76E-02	5.60E-03	1.13E-05	1.23E-02	4.43E-03	2.58E-04
FISH	TOTAL	7.30E+04	1.79E-01	2.26E-01	1.21E-01	9.22E-05	7.61E-02	2.63E-02	4.02E-03

LOCATION	DILUTION	CATCH	TIME(HR)-INCLUDES FOOD PROCESSING TIME OF 1.68E+02 HR	POPULATION=1.24E+04
	7.30E+00	7.30E+04	1.69E+02	

AVERAGE INDIVIDUAL CONSUMPTION (KG/YR) ADULT=6.90E+00 TEEN=5.20E+00 CHILD=2.20E+00

* * * FISH CONSUMPTION POPULATION DOSES * * *
PERSON-REM

COMMERCIAL HARVEST

PATHWAY	AGE GROUP	USAGE	DOSE (PERSON-REM) BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	4.18E+06	1.36E-02	1.85E-02	1.21E-02	8.23E-06	6.26E-03	2.09E-03	3.83E-04
FISH	TEENAGER	4.88E+05	2.23E-03	2.95E-03	1.03E-03	9.69E-07	1.00E-03	3.91E-04	4.49E-05
FISH	CHILD	3.38E+05	4.52E-03	4.28E-03	6.37E-04	1.29E-06	1.39E-03	5.04E-04	2.93E-05
FISH	TOTAL	5.01E+06	2.04E-02	2.57E-02	1.38E-02	1.05E-05	8.66E-03	2.99E-03	4.57E-04

LOCATION	DILUTION	CATCH	TIME(HR)-INCLUDES FOOD PROCESSING TIME OF 2.40E+02 HR	POPULATION=8.53E+05
	7.30E+00	7.30E+04	2.41E+02	

AVERAGE INDIVIDUAL CONSUMPTION (KG/YR) ADULT=6.90E+00 TEEN=5.20E+00 CHILD=2.20E+00

NEPA DOSES
NOTE--TOTAL NEPA DOSE INCLUDES SPORT CATCH

PATHWAY	AGE GROUP	USAGE	DOSE (PERSON-REM) BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
FISH	ADULT	1.22E+05	2.39E-01	3.24E-01	2.13E-01	1.45E-04	1.10E-01	3.68E-02	6.73E-03
FISH	TEENAGER	1.42E+04	3.93E-02	5.18E-02	1.81E-02	1.70E-05	1.76E-02	6.87E-03	7.89E-04
FISH	CHILD	9.85E+03	7.94E-02	7.53E-02	1.12E-02	2.26E-05	2.45E-02	8.86E-03	5.15E-04
FISH	TOTAL	1.46E+05	3.58E-01	4.52E-01	2.42E-01	1.84E-04	1.52E-01	5.25E-02	8.04E-03

* * * POPULATION WATER CONSUMPTION DOSES * * *

SUPPLIER-OMAHA

			DOSE (PERSON-REM)						
PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING	ADULT	1.39E+08	4.02E-02	8.83E-02	7.27E-02	4.35E-02	5.83E-02	4.87E-02	4.60E-02
DRINKING	TEENAGER	1.51E+07	6.11E-03	1.14E-02	7.12E-03	4.77E-03	6.99E-03	5.68E-03	5.04E-03
DRINKING	CHILD	2.48E+07	2.94E-02	3.80E-02	1.87E-02	1.50E-02	2.23E-02	1.78E-02	1.54E-02
DRINKING	TOTAL	1.79E+08	7.57E-02	1.38E-01	9.84E-02	6.33E-02	8.76E-02	7.21E-02	6.64E-02

POPULATION=5.29E+05 DILUTION=3.08E+01 TRANSIT TIME=3.06E+01 HR (INCLUDING 24 HR FOR TREATMENT FACILITY)

AVERAGE INDIVIDUAL CONSUMPTION (L/YR) ADULT=3.70E+02 TEEN=2.60E+02 CHILD=2.60E+02

SUPPLIER-COUNCIL BLUFFS

			DOSE (PERSON-REM)						
PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING	ADULT	2.29E+07	6.50E-03	1.43E-02	1.18E-02	7.04E-03	9.44E-03	7.88E-03	7.44E-03
DRINKING	TEENAGER	2.49E+06	9.88E-04	1.85E-03	1.15E-03	7.72E-04	1.13E-03	9.19E-04	8.15E-04
DRINKING	CHILD	4.07E+06	4.76E-03	6.15E-03	3.02E-03	2.43E-03	3.61E-03	2.88E-03	2.49E-03
DRINKING	TOTAL	2.94E+07	1.22E-02	2.23E-02	1.59E-02	1.02E-02	1.42E-02	1.17E-02	1.07E-02

POPULATION=8.70E+04 DILUTION=3.13E+01 TRANSIT TIME=3.10E+01 HR (INCLUDING 24 HR FOR TREATMENT FACILITY)

AVERAGE INDIVIDUAL CONSUMPTION (L/YR) ADULT=3.70E+02 TEEN=2.60E+02 CHILD=2.60E+02

-----CUMULATIVE TOTAL-----

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
DRINKING	CUMUL TOTAL	2.08E+08	8.79E-02	1.60E-01	1.14E-01	7.35E-02	1.02E-01	8.38E-02	7.71E-02

HYDROSPHERE TRITIUM DOSE

AVERAGE INDIVIDUAL WATER CONSUMPTION = 3.0 L/DAY

PATHWAY	AGE GROUP	USAGE	BONE	LIVER	TOTAL BODY	THYROID	KIDNEY	LUNG	GI-LLI
WATER	TOTAL	2.86E+11	0.00E+00	1.68E-05	1.68E-05	1.68E-05	1.68E-05	1.68E-05	1.68E-05

* * * RECREATION POPULATION DOSES * * *

LOCATION- DOWN STREAM SWIMMING

DILUTION= 7.30E+00 TRANSIT TIME= 6.70E-01 HR SWF= 0.2

			DOSE (PERSON-REM)		
PATHWAY	AGE GROUP	USAGE	SKIN	TOTAL BODY	THYROID
SHORELINE	TOTAL POPUL	4.10E+07	2.18E-01	1.86E-01	1.86E-01

LOCATION- DOWN STREAM SWIMMING

DILUTION= 7.30E+00 TRANSIT TIME= 6.70E-01 HR

			DOSE (PERSON-REM)		
PATHWAY	AGE GROUP	USAGE	SKIN	TOTAL BODY	THYROID
SWIMMING	TOTAL POPUL	4.10E+07		6.54E-04	6.54E-04

LOCATION- DOWN STREAM BOATING

DILUTION= 7.30E+00 TRANSIT TIME= 6.70E-01 HR

			DOSE (PERSON-REM)		
PATHWAY	AGE GROUP	USAGE	SKIN	TOTAL BODY	THYROID
BOATING	TOTAL POPUL	4.10E+07		3.27E-04	3.27E-04

* * * DOSE TO BIOTA * * *
MRADS PER YEAR

BIOTA DILUTION= 1.00E+00 TRANSIT TIME= 0.00E+00 HR

	INTERNAL	EXTERNAL	TOTAL
FISH	8.96E-01	1.45E+00	2.35E+00
INVERTEBRATE	4.89E-01	2.91E+00	3.40E+00
ALGAE	2.51E-01	1.02E-03	2.52E-01
MUSKRAT	4.92E+00	9.70E-01	5.90E+00
RACCOON	1.85E+00	7.27E-01	2.57E+00
HERON	2.83E+01	9.70E-01	2.93E+01
DUCK	4.50E+00	1.45E+00	5.96E+00

SECTION VI

RADIOACTIVE EFFLUENT RELEASES - SOLID RADIOACTIVE WASTE
Technical Specifications 5.9.4.a

January 1, 2017 - December 31, 2017

VI. RADIOACTIVE EFFLUENT RELEASE – SOLID RADIOACTIVE WASTE EFFLUENT AND WASTE DISPOSAL REPORT

January 1, 2017 through December 31, 2017

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (NOT IRRADIATED)

1.	Type of Waste	Month Shipped	Number of Shipments	Volume Cu. Meter	Curie Content	Est. Total % Error
a.	Spent resins, filter sludges, evaporator bottoms, etc.	January	0	0	0	N/A
		February	0	0	0	N/A
		March	0	0	0	N/A
		April	0	0	0	N/A
		May	0	0	0	N/A
		June	0	0	0	N/A
		July	0	0	0	N/A
		August	0	0	0	N/A
		September	0	0	0	N/A
		October	4	11.32	94.09	20
		November	1	2.83	118	20
		December	0	0	0	N/A
Total		(Type a)	5	14.15	212.09	20
b.	Dry compressible, contaminated equipment, etc.	January	0	0	0	N/A
		February	1	19.74	2.79E-03	20
		March	1	54.99	1.46E-02	20
		April	1	31.80	3.23E-02	20
		May	0	0	0	N/A
		June	0	0	0	N/A
		July	1	5.26	2.95E-03	20
		August	2	91.37	1.54E-02	20
		September	0	0	0	N/A
		October	0	0	0	N/A
		November	0	0	0	N/A
		December	1	36.25	1.13E-02	20
Total		(Type b)	7	239.41	7.93E-02	20

VI. RADIOACTIVE EFFLUENT RELEASE – SOLID RADIOACTIVE WASTE EFFLUENT AND WASTE DISPOSAL REPORT

(Continued)

1.	Type of Waste	Month Shipped	Number of Shipments	Volume Cu. Meter	Curie Content	Est. Total % Error
c.	Irradiated components and other categories.	January	0	0	0	N/A
		February	0	0	0	N/A
		March	0	0	0	N/A
		April	0	0	0	N/A
		May	0	0	0	N/A
		June	0	0	0	N/A
		July	0	0	0	N/A
		August	0	0	0	N/A
		September	0	0	0	N/A
		October	0	0	0	N/A
		November	0	0	0	N/A
		December	0	0	0	N/A
Total		(Type c)	0	0	0	N/A
d.	Other	January	0	0	0	N/A
		February	0	0	0	N/A
		March	0	0	0	N/A
		April	0	0	0	N/A
		May	0	0	0	N/A
		June	0	0	0	N/A
		July	1	6.68	8.11E-03	20
		August	0	0	0	N/A
		September	0	0	0	N/A
		October	0	0	0	N/A
		November	0	0	0	N/A
		December	0	0	0	N/A
Total		(Type d)	1	6.68	8.11E-03	20

III. RADIOACTIVE EFFLUENT RELEASES–SOLID RADIOACTIVE

(Continued)

B. ESTIMATE OF MAJOR NUCLIDE COMPOSITION (By Type of Waste)

1. Percentage of Curies from Represented Isotopes

	Isotope	Percent	Curies
a.	Cs-137	29	6.05E+01
	Ni-63	26	5.61E+01
	Co-58	26	5.42E+01
	Co-60	12	2.43E+01
	Fe-55	5	1.08E+01
	All Other Nuclides Constitute Less than 1% Each for Type a		
b.	Cs-137	92	7.29E+01
	Co-60	5	4.23E+00
	Cs-134	1	6.58E-01
	Fe-55	1	6.27E-01
	All Other Nuclides Constitute Less than 1% Each for Type b		
c.	N/A	N/A	N/A
d.	Cs-137	92	7.45E+00
	Co-60	5	4.32E-01
	Cs-134	1	6.72E-02
	Fe-55	1	6.40E-02
	All Other Nuclides Constitute Less than 1% Each for Type d		

C. SOLID WASTE (DISPOSITION)

Number of Shipments	Transportation Mode	Destination
10	Sole Use Vehicle	Energy Solutions, Bear Creek, TN
2	Sole Use Vehicle	Erwin Resin Solutions, Erwin, TN

D. IRRADIATED FUEL SHIPMENTS (DISPOSITION)

Number of Shipments	Transportation Mode	Destination
N/A	N/A	N/A

SECTION VII

ATTACHMENT 1

ODCM and PCP revisions for the period January 1, 2017 through December 31, 2017 in accordance with Technical Specification 5.17.d and 5.18.d, the radioactive effluent release report shall include any revisions to the Offsite Dose Calculation Manual (ODCM) and the Process Control Program (PCP).

__2__ revisions were made to the Offsite Dose Calculation Manual (ODCM).

__1__ revision was made to the Process Control Program (PCP).

January 1, 2017 - December 31, 2017

RP-5101
Revision 0
PROCESS CONTROL PROGRAM FOR RADIOACTIVE WASTES

1.0 PURPOSE AND SCOPE

1.1 The purpose of the Process Control Program (PCP) is to:

1.1.1 Establish the process and boundary conditions for the preparation of specific procedures for processing, sampling, analysis, packaging, storage, and shipment of solid radwaste in accordance with local, state, and federal requirements.

1.1.2 Establish parameters which will provide reasonable assurance that all Low Level Radioactive Wastes (LLRW), processed by the in-plant waste process systems on-site OR by on-site vendor supplied waste processing systems, meet the acceptance criteria to a Licensed Burial Facility, as required by 10CFR Part 20, 10CFR Part 61, 10CFR Part 71, 49CFR Parts 171-172, "Technical Position on Waste Form (Revision 1)" [1/91], "Low-Level Waste Licensing Branch Technical Position on Radioactive Waste Classification" [5/83], and the Station Technical Specifications, as applicable.

1.1.3 Provide reasonable assurance that waste placed in "on-site storage" meets the requirements as addressed within the Safety Analysis Reports for the low level radwaste storage facilities for dry and/or processed wet waste.

2.0 DEFINITIONS

2.1 Blending: The mixing of LLRW with different concentrations of radionuclides, typically in an effort to create a relatively homogeneous mixture for disposal.

2.2 Classification Controlling Nuclides: One or more nuclides, listed in Table 1 or Table 2 of 10CFR61.55, whose concentration is the specific basis for the classification of the waste container. This could be a single nuclide or multiple nuclides that make up >50% of the sum of the fractions.

2.3 Compaction: When dry wastes such as paper, wood, plastic, cardboard, incinerator ash, and etc. are volume reduced through the use of a compactor.

2.4 Concentration Averaging: The averaging of the radionuclide concentrations for specific wastes or mixture of waste over the volume or weight of the waste.

2.5 Dewatering: The process of removing fluids from liquid waste streams to produce a waste form that meets the requirements of 10CFR Part 61 and applicable burial site criteria, $\leq$0.5% by volume when the waste is packaged to an "unstable" state, or $\leq$1% by volume when the waste is packaged to a "stable" form.

2.6 Encapsulation: Encapsulation is the surrounding of a radioactive source or component with a nonradioactive material. Encapsulation involves a radioactive core surrounded by a non-radioactive matrix.

2.7 High Integrity Container (HIC): A disposable container that is approved to the Requirements of 10CFR61. The use of HIC's is an alternative to solidification or encapsulation in a steel container to meet burial stability. HIC's are used to package dewatered liquid wastes, (e.g. filter cartridges, filter media, resin, sludges, etc), or dry active waste.

2.8 Homogeneous Waste: Waste in which concentrations of radionuclides of concern are likely to approach uniformity in the context of reasonable foreseeable intruder scenarios (This is because hot spots are a concern with respect to protection of an individual who may inadvertently intrude into the burial site).

2.9 Incineration, RVR, and/or Glass Vitrification of Liquid or Solid: Dry or wet waste processed via incineration and/or thermal processing where the volume is reduced by thermal means meets 10CFR61 requirements.

2.10 Liquid Waste Processing Systems: In-plant or vendor supplied processing systems consisting of equipment utilized for evaporation, filtration, demineralization, dewatering, compression dewatering, solidification, or reverse osmosis (RO) for the treatment of liquid wastes (such as Floor Drains, Chemical Drains and Equipment Drain inputs).

2.11 Mixable Waste: Waste that is amenable to physical mixing to create relatively uniform radionuclide concentrations.

2.12 Nuclides of Concern: A nuclide in the waste in concentrations greater than 1% of the concentration of that nuclide listed in Table 1 of 10CFR61.55 or 1% of the applicable class-dependent concentration of that nuclide in Table 2 of 10CFR61.55, Column 2 or 3.

2.13 Process Control Program (PCP): The program which contains the current formulas, sampling, analysis, tests, and determinations to be made to ensure that processing and packaging of solid radioactive waste based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure the waste meets the stabilization criteria specified in 10CFR Parts 20, 61 and 71, state regulations, and burial site requirements.

2.14 Solidification: Liquid waste processed to either an unstable or stable form per 10CFR61 requirements. Waste solidified does not have to meet the 300-year free standing monolith criteria. Approved formulas, samples and tests do not have to meet NRC approval for wastes solidified in a container meeting stability criteria (e.g. High Integrity Container).

2.15 Solidification Media: An approved media (e.g. Barnwell - vinyl ester styrene, cement, bitumen) when waste containing nuclides with greater than 5-year half-lives is solidified in a container with activity greater than 1 micro curie/cc. Waste solidified in a HIC is approved by the commission meeting the 10CFR61 stabilization criteria, including 1% free standing liquids by volume when the waste is packaged to a "stable" form and ≤ 0.5% when waste is packaged to an "unstable" form. The formulas, sampling, analysis, and test do not require NRC approval, because the HIC meets the stability criteria.

2.15.1 Solidification to an unstable or stable state is performed by vendors, when applicable. Liquid waste solidified to meet stabilization criteria (10CFR61 and 01-91 Branch Technical Requirements) shall have documentation available that demonstrates that the process is approved by the NRC or disposal facility.

2.16 Stabilization: Liquid waste processed to a "stable state" per 10CFR61 Requirements. Established formulas, samples, and tests shall be approved by the NRC in order to meet solidification "stabilization" criteria. This processing method is currently not available, because the NRC recognizes that waste packed in a High Integrity Container meets the 300-year stabilization criteria. In the event that this processing method becomes an acceptable method, then the NRC shall approve the stabilization formulas, samples, tests, etc.

2.17 Waste Streams: Consist of but are not limited to

2.17.1 Filter media (powdered, bead resin and fiber),

2.17.2 Filter cartridges,

2.17.3 Contaminated charcoal,

2.17.4 Fuel pool activated hardware,

2.17.5 Oil Dry absorbent material added to a container to absorb liquids

2.17.6 Sump and tank sludges,

2.17.7 High activity filter cartridges,

2.17.8 Concentrated liquids,

2.17.9 Contaminated waste oil,

2.17.10 Dried sewage or wastewater plant waste,

2.17.11 Dry Active Waste (DAW): Waste such as filters, air filters, low activity cartridge filters, paper, wood, glass, plastic, cardboard, hoses, cloth, and metals, etc, which have become contaminated as a consequence of normal operating, housekeeping and maintenance activities.

2.17.12 Other radioactive waste generated from cleanup of inadvertent contamination.

3.0 RESPONSIBILITIES

3.1 Implementation of this Process Control Program (PCP) is described in procedures and is the responsibility of the Radiation Protection and Chemistry Departments to implement.

4.0 TOOLS AND EQUIPMENT - NONE

5.0 PRECAUTIONS, PREREQUISITES AND INITIAL CONDITIONS - NONE

6.0 PROCEDURE

6.1 Process Control Program Requirements

6.1.1 A change to this PCP (Radioactive Waste Treatment Systems) may be made provided that the change is reported as part of the annual radioactive effluent release report, Regulatory Guide 1.21, and is approved by the Plant Operations Review Committee (PORC).

6.1.2 Changes become effective upon acceptance per station requirements.

6.1.3 A solidification media, approved by the burial site, may be **REQUIRED when** liquid radwaste is solidified to a stable/unstable state.

6.1.4 **When** processing liquid radwaste to meet solidification stability using a vendor supplied solidification system:

A. **If** the vendor has its own Quality Assurance (QA) Program, **then** the vendor shall **ADHERE** to its own QA Program and shall have **SUBMITTED** its process system topical report to the NRC or agreement state.

B. **If** the vendor does **not HAVE** its own Quality Assurance Program, **then** the vendor shall **ADHERE** to an approved Quality Assurance Topical Report standard belonging to the Station or to another approved vendor.

6.1.5 The vendor processing system(s) is/are controlled per the following:

A. A commercial vendor supplied processing system(s) may be **USED** for the processing of LLRW streams.

B. Vendors that process liquid LLRW at the sites shall **MEET** applicable Quality Assurance Topical Report and Augmented Quality Requirements.

6.1.6 Vendor processing system(s) operated at the site shall be **OPERATED and CONTROLLED** in accordance with vendor approved procedures or station procedures based upon vendor approved documents.

6.1.7 All waste streams processed for burial or long term on-site storage shall **MEET** the waste classification and characteristics specified in 10CFR Part 61.55, Part 61.56, the 5-83 Branch Technical Position for waste classification, and the applicable burial site acceptance criteria (for any burial site operating at the time the waste was processed).

6.2 General Waste Processing Requirements

	NOTE	
i	On-site resin processing involves tank mixing and settling, transferring to the station or vendor processing system via resin water slurry or vacuuming into approved waste containers, and, when applicable, dewatering for burial.	i

6.2.1 Vendor resin beds may be **USED** for decontamination of plant systems, such as, SFP (Spent Fuel Pool), and SDC (Shut Down Cooling). These resins are **then PROCESSED** via the station or vendor processing system.

6.2.2 Various drains and sump discharges will be **COLLECTED** in tanks or suitable containers for processing treatment. Water from these tanks may be **SENT** through a filter, demineralizer, concentrator or vendor supplied processing systems.

6.2.3 Process waste (e.g. filter media, sludges, resin, etc) will be periodically **DISCHARGED** to the station or vendor processing system for onsite waste treatment **or PACKAGED** in containers for shipment to offsite vendor for volume reduction processing.

6.2.4 Process water (e.g. chemical, floor drain, equipment drain, etc.) may be **SENT** to either the site waste processing systems or vendor waste processing systems for further filtration, demineralization for plant re-use, or discharge.

6.2.5 All dewatering and solidification/stabilization will be **PERFORMED** by either utility site personnel or by on-site vendors **or** will be **PACKAGED and SHIPPED** to an off-site vendor low-level radwaste processing facility.

6.2.6 Dry Active Waste (DAW) will be **HANDLED and PROCESSED** per the following:

A. DAW will be **COLLECTED and SURVEYED and** may be **SORTED** for compactable and non-compactable wastes.

B. DAW may be packaged in containers to facilitate on-site pre-compaction and/or off-site vendor contract requirements.

C. DAW items may be **SURVEYED** for release onsite or offsite when applicable.

D. Contaminated filter cartridges will be **PLACED** into a HIC **or** will be **ENCAPSULATED** in an in-situ liner for disposal **or SHIPPED** to an offsite waste processor in drums, boxes or steel liners per the vendor site criteria for processing and disposal.

6.2.7 Filtering devices using pre-coat media may be **USED** for the removal of suspended solids from liquid waste streams. The pre-coat material or cartridges from these devices may be routinely **REMOVED** from the filter vessel and discharged to a Filter Sludge Tank or Liner/HIC. Periodically, the filter sludge may be **DISCHARGED** to the vendor processing system for waste treatment onsite **or PACKAGED** in containers for shipment to offsite vendor for volume reduction processing.

6.2.8 Activated hardware stored in the Spent Fuel Pools will be **PROCESSED** periodically using remote handling equipment **and** may then be **PUT** into a container for shipment or storage in the pool or loading the processed activated hardware into the Dry Cask storage system.

6.2.9 High Integrity Containers (HIC):

A. For disposal at Barnwell, vendors supplying HIC's to the station shall **PROVIDE** a copy of the HIC Certificate of Compliance, which details specific limitations on use of the HIC.

B. For disposal at Clive or WCS, vendors supplying HIC's to the station shall **PROVIDE** a copy of the HIC Certificate of Conformance, which details specific limitations on use of the HIC.

C. Vendors supplying HIC's to the station shall **PROVIDE** a handling procedure which establishes guidelines for the utilization of the HIC. These guidelines serve to protect the integrity of the HIC and ensure the HIC is handled in accordance with the requirements of the Certificate of Compliance or Certificate of Conformance.

6.2.10 Lubricants and oils contaminated as a consequence of normal operating and maintenance activities may be **PROCESSED** on-site (by incineration, for oils meeting 10CFR20.2004 and applicable state requirements, or by an approved vendor process) or **SHIPPED** offsite (for incineration or other acceptable processing method).

6.2.11 Certain waste, including flowable solids from holding pond or oily waste separator, may be disposed of onsite under the provisions of a 10CFR20.2002 permit. Specific requirements associated with the disposal shall be incorporated into station implementing procedures.

6.2.12 Concentration averaging may be **PERFORMED** to combine LLRW having different concentrations of radionuclides to form a homogeneous mixture in accordance with the guidance in the NRC's Branch Technical Position on Concentration Averaging and Encapsulation-1995, NRC-2011-0022:

A. For homogeneous waste types such as resins and filter media, the concentration of the mixture for classification purposes may be based on either the highest radionuclide concentration in any of the individual waste types contributing to the mixture or the volumetric or weight-averaged nuclide concentrations in the mixture provided that the concentrations of the individual waste type contributors to the mixture are within a factor of 10 of the average concentration of the resulting mixture. (A designed collection of homogeneous waste types (from different sources within a facility) is not considered 'mixing' and the concentration for classification purposes may be the average concentration of the combination).

B. For non-homogeneous waste types such as activated metals, cartridge filters or components incorporating radioactivity in their design, the concentration should be determined from the total weight or displaced volume (excluding major void spaces) of the component. Mixtures of components in a disposal container is permissible. Concentration averaging of a mixture of components of similar types can be performed in accordance with the NRC's Branch Technical Position on Concentration Averaging and Encapsulation and any State or Disposal Site specific requirements.

6.2.13 Blending may be **PERFORMED** for routine LLRW such as resins and filter media in accordance with the guidance in the NRC's Branch Technical Position on Concentration Averaging and Encapsulation as further clarified in SECY 2010-0043. The concentration of the mixture may be determined based on the total activity of all components in the mixture divided by the total volume or mass of the mixture. Reasonable effort should be made to mix blended LLRW so that activity is evenly distributed.

6.2.14 Encapsulation may be **PERFORMED** for routine wastes such as filters, filter cartridges, or sealed sources centered in an encapsulated mass, in accordance with the guidance in the NRC's Branch Technical Position on Concentration Averaging and Encapsulation. Classification may be based on the overall volume of the final solidified mass provided that;

A. The minimum solidified volume or mass should be reasonably difficult to move by hand.

B. The maximum solidified volume or mass used for determining concentration for any single discrete source should be no more than 0.2 m^3 or 500Kg (typically 55-gallon drum).

C. The maximum amount of gamma-emitting radioactivity or radioactive material is <0.02 mrem/hr on the surface of the encapsulation over a 500-year decay period.

D. The maximum amount of any radionuclide in a single encapsulation, when averaged over the waste and encapsulating media, does not exceed the maximum concentration limits for Class C waste.

E. Written procedures should be established to ensure that the radiation source(s) is reasonably centered (or distributed) within the encapsulating media.

F. All other disposal facility requirements for encapsulated material are met.

6.3 Burial Site Requirements

6.3.1 Waste sent directly to burial shall **COMPLY** with the applicable parts of 49CFR171-172, 10CFR61, 10CFR71, and the acceptance criteria for the applicable burial site.

6.4 Shipping and Inspection Requirements

6.4.1 All shipping/storage containers shall be **INSPECTED**, as required by station procedures, for compliance with applicable requirements (Department of Transportation (DOT), Nuclear Regulatory Commission (NRC), station, on-site storage, and/or burial site requirements) prior to use.

6.4.2 Containers of solidified liquid waste shall be **INSPECTED** for solidification quality and/or dewatering requirements per the burial site, offsite vendor acceptance, or station acceptance criteria, as applicable.

6.4.3 Shipments sent to an off-site processor shall be **INSPECTED** to ensure that the applicable processor's waste acceptance criteria are being met.

6.4.4 Shipments sent for off-site storage shall **MEET** the storage site's waste acceptance criteria.

6.5 Inspection and Corrective Action

6.5.1 Inspection results that indicate non-compliance with applicable NRC, State, vendor, or site requirements shall be **IDENTIFIED** and **TRACKED** through the Corrective Action Program.

6.5.2 Administrative controls for preventing unsatisfactory waste forms from being released for shipment are described in applicable station procedures. **If** the provisions of the Process Control Program are not satisfied, **then SUSPEND** shipments of defectively packaged radioactive waste from the site.

6.5.3 **If** freestanding water or solidification **not** meeting program requirements is observed, **then** samples of the particular series of batches shall be **TAKEN** to determine the cause. Additional samples shall be **TAKEN**, as warranted, to ensure that **no** freestanding water is present and solidification requirements are maintained.

6.6 Procedure and Process Reviews

6.6.1 The FCS Process Control Program and subsequent changes (other than editorial/minor changes) shall be **REVIEWED and APPROVED** in accordance with the station procedures and manuals (as applicable), the Technical Specifications (Tech Spec), and LS-FC-106. Changes to Controlled Documents, DSAR, Tech Spec and applicable procedures and manuals are controlled by the provisions of 10CFR 50.59.

6.6.2 Any changes to the PCP shall be reviewed to determine if reportability is required in the Annual Radiological Effluent Release Report (ARERR). RP Supervision and Chemistry Supervision shall ensure correct information is **SUBMITTED** to the ODCM program owner prior to submittal of the ARERR.

6.6.3 Procedures shall be **IMPLEMENTED** as follows:

A. Station processes or other vendor waste processing/operating procedures shall be technically reviewed and approved per CC-FC-204, Control of Vendor Equipment Manuals and CC-FC-204-1001, Control of Vendor Equipment Manuals Guideline.

B. Procedures related to waste manifests, shipment inspections, and container activity determinations are **CONTROLLED** by Radiation Protection Standard Procedures (RP-6000 Series).

C. Site waste processing program **IS CONTROLLED** by Radiation Protection and Chemistry procedures.

D. Liquid processed by vendor equipment shall be **PERFORMED** in accordance with vendor procedures.

E. The dewatering procedures implemented by Vendor for the purpose of compliance to the Process Control Program **SHALL BE REVIEWED and APPROVED** in accordance with LS-FC-106, Plant Operations Review Committee (PORC).

6.7 Waste Types, Point of Generation, and Processing Method

6.7.1 Methods of processing and individual vendors may **CHANGE** due to changing financial and regulatory options. The table below is a representative sample. It is **not** intended be all encompassing.

WASTE STREAM	POINTS OF GENERATION	AVAILABLE WASTE PROCESSING METHODS
Bead Resin	Systems - Fuel Pool, Equipment Drain, Chemical and Volume Control Systems, Floor Drain, Vendor Supplied Processing Systems, and Portable Demin System	Dewatering, solidification to an unstable/stable state Free Release to a Land Fill
Powdered Resin	Systems - (Condensate System, Floor Drain/Equipment Drain filtration, Fuel Pool)	Dewatering, solidification to an unstable/stable state
Concentrated Waste	Waste generated from Site Evaporators resulting typically from the Floor Drain and Equipment Drain Systems	Solidification to an unstable/stable state
Sludge	Sedimentation resulting from various sumps, condensers and tanks	Dewatering, solidification to an unstable/stable state On-site disposal per 10CFR20.2002 permit
Filter cartridges	Systems - Floor/Equipment Drains, Fuel Pool; cartridge filters are typically generated from clean up activities within the fuel pool	Dewatering, solidification to an unstable/stable state Processed by a vendor for volume reduction
Dry Active Waste	Paper, wood, plastic, rubber, glass, metal, and etc. resulting from daily plant activities	Decon Compaction/Super-compaction Thermal Processing by Incineration or glass vitrification Sorting for Free Release Metal melting to an ingot
Contaminated Oil	Oil contaminated with radioactive materials from any in-plant system.	Solidification unstable state Thermal Processing by Incineration Free Release for recycling
Drying Bed Sludge	Sewage Treatment and Waste Water Treatment Facilities	Free release to a landfill or burial
Metals	See DAW	See DAW
Irradiated Hardware	Fuel Pool, Reactor Components	Volume Reduction for packaging efficiencies

7.0 RETENTION AND RECORDS

7.1 Records of reviews performed shall be retained in accordance with the Station Records Retention Schedule (SRRS). This documentation shall contain:

7.1.1 Sufficient information to support the change together with the appropriate analyses or evaluations justifying the change, and

7.1.2 A determination which documents that the change will maintain the overall conformance of waste products to Federal (10CFR61 and the Branch Technical Position), State, or other applicable requirements, including applicable burial site criteria.

8.0 REFERENCES

8.1 Technical Specifications

8.2 DSAR-11.3, Radiological Effluent Requirements

8.3 Code of Federal Regulations: 10 CFR Part 20, Part 61, Part 71, 49 CFR Parts171-172

8.4 I.E. Circular 80.18, 10CFR 50.59 Safety Evaluation for Changes to Radioactive Waste Treatment Systems

8.5 Low Level Waste Licensing Branch Technical Position on Radioactive Waste Classification, May 1983

8.6 NRC Branch Technical Position on Blending of Low-Level Radioactive Waste, SECY-10-0043

8.7 NRC Concentration Averaging and Encapsulation Branch Technical Position, NRC-2011-0022

8.8 Regulatory Guide 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

8.9 Technical Position on Waste Form (Revision 1), January 1991

8.10 LS-FC-106, Plant Operations Review Committee

8.11 NO-FC-10, Quality Assurance Topical Report (QATR)

8.12 RM-FC-101, Records Management Program

8.13 CC-FC-204, Control of Vendor Equipment Manuals

8.14 CC-FC-204-1001, Control of Vendor Equipment Manuals Guideline

9.0 ATTACHMENTS - NONE

SECTION VII

ATTACHMENT 2

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED
BY STABILITY CLASS AND METEOROLOGICAL DATA

(Regulatory Guide 1.21)

January 1, 2017 - December 31, 2017

JOINT FREQUENCY DISTRIBUTION WIND DIRECTION VS. WIND SPEED BY STABILITY CLASS AND METEOROLOGICAL DATA

A. Meteorological Data Recovery

Data availability from the on-site weather tower for the period January 1, 2017 through December 31, 2017 had a cumulative recovery rate of 96.47% from the meteorological tower with the remaining 3.53% provided by Eppley Airfield Weather Station, a branch of the National Weather Service. The data provided by Eppley Airfield Weather Station. The following table is a summary of the parameters and their respective recovery rates for the period.

The tabulations of the Weather Tower Data for the period January 1, 2017 through December 31, 2017 look appropriate for the season indicated. The Pasquill Classes observed for the twelve-month period are detailed below.

Pasquill Class	A	B	C	D	E	F	G	Total
% Obs.	5.11	2.88	4.77	46.59	25.60	8.40	6.65	100

On the basis of the data and its cross-checks, the weather data as amended is completely valid for use in tabulating atmospheric releases.

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY EVENTS
EXTREMELY UNSTABLE (delta T/ delta z <= -1.9)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL A
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0	0	1	1	22	26	15	2	0	0	0	67
NNE	0	0	2	0	9	6	0	0	0	0	0	17
NE	0	0	1	1	4	5	2	0	0	0	0	13
ENE	0	0	0	1	5	9	0	0	0	0	0	15
E	0	0	1	2	3	2	0	0	0	0	0	8
ESE	0	0	0	0	4	1	0	1	0	0	0	6
SE	0	0	1	0	1	0	4	3	0	0	0	9
SSE	0	0	0	0	3	1	3	3	15	2	0	27
S	0	0	0	0	1	1	0	4	8	5	0	19
SSW	0	0	0	0	2	2	5	5	9	1	0	24
SW	0	0	1	0	1	1	5	1	0	0	0	9
WSW	0	0	0	0	1	0	0	0	0	0	0	1
W	0	0	0	0	1	1	2	0	0	0	0	4
WNW	0	1	2	4	8	11	6	1	1	0	0	34
NW	0	0	1	2	15	26	31	10	10	1	0	96
NNW	0	0	0	3	19	32	21	12	8	2	0	97
Total	0	1	10	14	99	124	94	42	51	11	0	446

Number of Calms 0
Number of Invalid Hours 0
Number of Valid Hours 446

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY EVENTS
MODERATELY UNSTABLE (-1.9 < delta T/ delta z <= -1.7)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL B
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0	0	0	2	13	7	4	0	0	0	0	26
NNE	0	0	2	2	5	2	0	0	0	0	0	11
NE	0	1	2	2	3	4	1	2	0	0	0	15
ENE	0	0	1	2	4	2	1	1	0	0	0	11
E	0	0	0	0	3	5	1	0	0	0	0	9
ESE	0	0	0	1	1	0	1	1	0	0	0	4
SE	0	1	1	2	0	5	6	8	6	0	0	29
SSE	0	0	0	1	0	0	1	3	2	0	0	7
S	0	0	0	0	0	0	0	1	1	0	0	2
SSW	0	0	0	0	2	0	1	3	2	0	0	8
SW	0	0	0	0	2	0	0	0	0	0	0	2
WSW	0	0	0	0	0	2	1	0	0	0	0	3
W	0	0	0	0	0	1	2	1	1	0	0	5
WNW	0	0	2	2	1	1	0	0	4	0	0	10
NW	0	0	1	2	7	7	9	4	6	1	0	37
NNW	0	0	0	6	20	12	11	16	7	1	0	73
Total	0	2	9	22	61	48	39	40	29	2	0	252

Number of Calms 0
Number of Invalid Hours 0
Number of Valid Hours 252

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY EVENTS
SLIGHTLY UNSTABLE (-1.7 < delta T/ delta z <= -1.5)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL C
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	> 10.0	Total
N	0	1	4	5	15	15	7	3	1	0	0	53
NNE	0	0	0	3	7	2	0	1	0	0	0	13
NE	0	0	0	2	6	6	0	0	0	0	0	14
ENE	0	0	3	4	11	7	3	0	0	0	0	28
E	0	1	2	3	4	3	1	0	0	0	0	14
ESE	0	0	1	1	5	1	2	1	2	0	0	13
SE	0	2	0	0	2	1	5	2	5	0	0	17
SSE	0	0	0	3	0	1	3	4	7	1	0	19
S	0	0	3	2	3	1	0	3	1	1	0	15
SSW	0	1	1	2	1	0	1	2	2	0	0	10
SW	0	0	2	1	0	3	1	3	1	0	0	11
WSW	0	0	0	2	1	1	1	1	1	0	0	7
W	0	0	4	2	4	4	2	2	0	1	0	19
WNW	0	1	3	3	7	2	2	0	1	0	0	19
NW	0	0	4	4	5	15	7	8	17	1	0	61
NNW	0	1	1	14	22	20	18	9	12	4	3	104
Total	0	7	28	51	93	82	53	39	50	8	3	414

Number of Calms 3
Number of Invalid Hours 0
Number of Valid Hours 417

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY EVENTS
NEUTRAL (-1.5 < delta T/ delta z <= -0.5)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL D
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	> 10.0	Total
N	0	16	47	63	136	80	31	11	6	0	0	390
NNE	0	18	27	36	49	31	12	1	2	0	0	176
NE	0	18	18	22	31	16	25	9	2	0	0	141
ENE	0	11	26	26	28	27	9	2	4	0	0	133
E	0	12	22	21	45	18	7	3	0	0	0	128
ESE	0	11	18	28	46	29	12	3	1	0	0	148
SE	0	6	10	10	68	79	43	36	26	0	3	281
SSE	0	1	10	11	56	85	106	95	103	11	0	478
S	0	1	5	15	36	69	91	70	104	20	5	416
SSW	0	1	5	8	37	43	37	43	33	5	3	215
SW	0	1	8	9	43	43	24	13	14	1	0	156
WSW	0	3	7	8	25	21	14	8	3	0	0	89
W	0	3	11	18	25	20	14	4	3	2	0	100
WNW	0	6	14	16	44	27	16	6	8	1	0	138
NW	0	7	20	21	64	91	79	60	59	12	3	416
NNW	0	6	28	54	203	173	105	54	36	6	0	665
Total	0	121	276	366	936	852	625	418	404	58	14	4070

Number of Calms 0
Number of Invalid Hours 0
Number of Valid Hours 4070

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY EVENTS
SLIGHTLY STABLE (-0.5 < delta T/ delta z <= 1.5)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL E
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	3	17	22	10	17	5	2	0	0	0	0	76
NNE	1	20	13	8	8	2	3	0	0	0	0	55
NE	3	13	18	7	2	0	0	0	0	0	0	43
ENE	0	19	14	9	5	2	0	0	0	0	0	49
E	2	21	11	11	14	1	0	0	0	0	0	60
ESE	0	10	29	32	27	3	0	0	0	0	0	101
SE	2	18	28	38	90	61	17	2	3	1	0	260
SSE	1	9	9	21	90	82	58	19	12	0	0	301
S	0	10	11	12	43	51	37	20	11	2	0	197
SSW	1	12	9	7	21	14	25	26	37	14	0	166
SW	3	8	10	8	9	14	12	13	22	8	1	108
WSW	1	15	7	9	15	13	12	5	5	0	0	82
W	4	20	14	23	22	17	6	6	4	0	0	116
WNW	1	49	36	22	55	26	13	6	2	0	0	210
NW	1	35	51	36	47	28	11	3	2	0	1	215
NNW	1	20	29	52	64	25	4	2	0	0	0	197
Total	24	296	311	305	529	344	200	102	98	25	2	2236

Number of Calms 0
Number of Invalid Hours 0
Number of Valid Hours 2236

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY EVENTS
MODERATELY STABLE (1.5 < delta T/ delta z <= 4.0)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL F
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	> 10.0	Total
N	2	2	3	2	5	0	0	0	0	0	0	15
NNE	1	7	5	0	0	0	0	0	0	0	0	13
NE	0	9	0	0	0	0	0	0	0	0	0	9
ENE	1	15	7	3	2	0	0	0	0	0	0	28
E	1	17	14	5	4	0	0	0	0	0	0	41
ESE	3	12	16	12	9	2	0	0	0	0	0	54
SE	6	17	21	19	45	11	0	0	0	0	0	119
SSE	1	23	12	8	22	3	1	0	0	0	0	70
S	6	23	6	6	15	5	6	1	0	0	0	68
SSW	10	12	2	2	7	7	8	0	0	0	0	48
SW	11	23	2	4	2	0	3	3	0	0	0	48
WSW	9	15	7	1	2	6	5	0	1	0	0	46
W	7	33	7	5	0	0	0	0	0	0	0	52
WNW	7	49	14	3	7	0	0	0	0	0	0	80
NW	8	11	7	2	2	0	0	0	0	0	0	30
NNW	3	4	2	4	0	0	0	0	0	0	0	13
Total	76	272	125	76	122	34	23	4	1	0	0	733

Number of Calms 1
Number of Invalid Hours 0
Number of Valid Hours 734

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY EVENTS
EXTREMELY STABLE (delta T/ delta z > 4.0)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL G
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5-1.0	1.1-1.5	1.6-2.0	2.1-3.0	3.1-4.0	4.1-5.0	5.1-6.0	6.1-8.0	8.1-10.0	> 10.0	Total
N	3	2	1	0	0	0	0	0	0	0	0	6
NNE	5	4	0	0	0	0	0	0	0	0	0	9
NE	4	11	1	0	0	0	0	0	0	0	0	16
ENE	4	22	6	2	1	0	0	0	0	0	0	35
E	8	16	11	2	0	0	0	0	0	0	0	37
ESE	9	37	121	8	0	0	0	0	0	0	0	175
SE	3	32	16	5	5	1	0	0	0	0	0	62
SSE	14	30	8	3	2	1	0	0	0	0	0	58
S	8	22	5	0	4	2	0	0	0	0	0	41
SSW	10	23	1	0	1	1	0	0	0	0	0	36
SW	6	28	1	0	1	0	0	0	0	0	0	36
WSW	6	13	1	0	0	0	0	0	0	0	0	20
W	10	16	0	1	1	0	0	0	0	0	0	28
WNW	1	6	3	0	0	0	0	0	0	0	0	10
NW	3	4	2	0	0	0	0	0	0	0	0	9
NNW	1	2	0	0	0	0	0	0	0	0	0	3
Total	95	268	177	21	15	5	0	0	0	0	0	581

Number of Calms 0
Number of Invalid Hours 0
Number of Valid Hours 581

Hours Accounted For: 8736

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY PERCENT
EXTREMELY UNSTABLE (delta T/ delta z <= -1.9)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL A
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0.00	0.00	0.01	0.01	0.25	0.30	0.17	0.02	0.00	0.00	0.00	0.77
NNE	0.00	0.00	0.02	0.00	0.10	0.07	0.00	0.00	0.00	0.00	0.00	0.19
NE	0.00	0.00	0.01	0.01	0.05	0.06	0.02	0.00	0.00	0.00	0.00	0.15
ENE	0.00	0.00	0.00	0.01	0.06	0.10	0.00	0.00	0.00	0.00	0.00	0.17
E	0.00	0.00	0.01	0.02	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.09
ESE	0.00	0.00	0.00	0.00	0.05	0.01	0.00	0.01	0.00	0.00	0.00	0.07
SE	0.00	0.00	0.01	0.00	0.01	0.00	0.05	0.03	0.00	0.00	0.00	0.10
SSE	0.00	0.00	0.00	0.00	0.03	0.01	0.03	0.03	0.17	0.02	0.00	0.31
S	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.05	0.09	0.06	0.00	0.22
SSW	0.00	0.00	0.00	0.00	0.02	0.02	0.06	0.06	0.10	0.01	0.00	0.27
SW	0.00	0.00	0.01	0.00	0.01	0.01	0.06	0.01	0.00	0.00	0.00	0.10
WSW	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
W	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.05
WNW	0.00	0.01	0.02	0.05	0.09	0.13	0.07	0.01	0.01	0.00	0.00	0.39
NW	0.00	0.00	0.01	0.02	0.17	0.30	0.35	0.11	0.11	0.01	0.00	1.10
NNW	0.00	0.00	0.00	0.03	0.22	0.37	0.24	0.14	0.09	0.02	0.00	1.11
Total	0.00	0.01	0.11	0.16	1.13	1.42	1.08	0.48	0.58	0.13	0.00	5.11

Percent of Calms 0.00
Percent of Invalid Hours 0.00
Percent of Valid Hours 5.11

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY PERCENT
MODERATELY UNSTABLE (-1.9 < delta T/ delta z <= -1.7)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL B
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0.00	0.00	0.00	0.02	0.15	0.08	0.05	0.00	0.00	0.00	0.00	0.30
NNE	0.00	0.00	0.02	0.02	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.13
NE	0.00	0.01	0.02	0.02	0.03	0.05	0.01	0.02	0.00	0.00	0.00	0.17
ENE	0.00	0.00	0.01	0.02	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.13
E	0.00	0.00	0.00	0.00	0.03	0.06	0.01	0.00	0.00	0.00	0.00	0.10
ESE	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.05
SE	0.00	0.01	0.01	0.02	0.00	0.06	0.07	0.09	0.07	0.00	0.00	0.33
SSE	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.03	0.02	0.00	0.00	0.08
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02
SSW	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.03	0.02	0.00	0.00	0.09
SW	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02
WSW	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.03
W	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.00	0.00	0.06
WNW	0.00	0.00	0.02	0.02	0.01	0.01	0.00	0.00	0.05	0.00	0.00	0.11
NW	0.00	0.00	0.01	0.02	0.08	0.08	0.10	0.05	0.07	0.01	0.00	0.42
NNW	0.00	0.00	0.00	0.07	0.23	0.14	0.13	0.18	0.08	0.01	0.00	0.84
Total	0.00	0.02	0.10	0.25	0.70	0.55	0.45	0.46	0.33	0.02	0.00	2.88

Percent of Calms 0.00
Percent of Invalid Hours 0.00
Percent of Valid Hours 2.88

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY PERCENT
SLIGHTLY UNSTABLE (-1.7 < delta T/ delta z <= -1.5)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL C
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0.00	0.01	0.05	0.06	0.17	0.17	0.08	0.03	0.01	0.00	0.00	0.61
NNE	0.00	0.00	0.00	0.03	0.08	0.02	0.00	0.01	0.00	0.00	0.00	0.15
NE	0.00	0.00	0.00	0.02	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.16
ENE	0.00	0.00	0.03	0.05	0.13	0.08	0.03	0.00	0.00	0.00	0.00	0.32
E	0.00	0.01	0.02	0.03	0.05	0.03	0.01	0.00	0.00	0.00	0.00	0.16
ESE	0.00	0.00	0.01	0.01	0.06	0.01	0.02	0.01	0.02	0.00	0.00	0.15
SE	0.00	0.02	0.00	0.00	0.02	0.01	0.06	0.02	0.06	0.00	0.00	0.19
SSE	0.00	0.00	0.00	0.03	0.00	0.01	0.03	0.05	0.08	0.01	0.00	0.22
S	0.00	0.00	0.03	0.02	0.03	0.01	0.00	0.03	0.01	0.01	0.00	0.17
SSW	0.00	0.01	0.01	0.02	0.01	0.00	0.01	0.02	0.02	0.00	0.00	0.11
SW	0.00	0.00	0.02	0.01	0.00	0.03	0.01	0.03	0.01	0.00	0.00	0.13
WSW	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.08
W	0.00	0.00	0.05	0.02	0.05	0.05	0.02	0.02	0.00	0.01	0.00	0.22
WNW	0.00	0.01	0.03	0.03	0.08	0.02	0.02	0.00	0.01	0.00	0.00	0.22
NW	0.00	0.00	0.05	0.05	0.06	0.17	0.08	0.09	0.19	0.01	0.00	0.70
NNW	0.00	0.01	0.01	0.16	0.25	0.23	0.21	0.10	0.14	0.05	0.03	1.19
Total	0.00	0.08	0.32	0.58	1.06	0.94	0.61	0.45	0.57	0.09	0.03	4.74

Percent of Calms 0.03
Percent of Invalid Hours 0.00
Percent of Valid Hours 4.77

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY PERCENT
NEUTRAL (-1.5 < delta T/ delta z <= -0.5)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL D
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0.00	0.18	0.54	0.72	1.56	0.92	0.35	0.13	0.07	0.00	0.00	4.46
NNE	0.00	0.21	0.31	0.41	0.56	0.35	0.14	0.01	0.02	0.00	0.00	2.01
NE	0.00	0.21	0.21	0.25	0.35	0.18	0.29	0.10	0.02	0.00	0.00	1.61
ENE	0.00	0.13	0.30	0.30	0.32	0.31	0.10	0.02	0.05	0.00	0.00	1.52
E	0.00	0.14	0.25	0.24	0.52	0.21	0.08	0.03	0.00	0.00	0.00	1.47
ESE	0.00	0.13	0.21	0.32	0.53	0.33	0.14	0.03	0.01	0.00	0.00	1.69
SE	0.00	0.07	0.11	0.11	0.78	0.90	0.49	0.41	0.30	0.00	0.03	3.22
SSE	0.00	0.01	0.11	0.13	0.64	0.97	1.21	1.09	1.18	0.13	0.00	5.47
S	0.00	0.01	0.06	0.17	0.41	0.79	1.04	0.80	1.19	0.23	0.06	4.76
SSW	0.00	0.01	0.06	0.09	0.42	0.49	0.42	0.49	0.38	0.06	0.03	2.46
SW	0.00	0.01	0.09	0.10	0.49	0.49	0.27	0.15	0.16	0.01	0.00	1.79
WSW	0.00	0.03	0.08	0.09	0.29	0.24	0.16	0.09	0.03	0.00	0.00	1.02
W	0.00	0.03	0.13	0.21	0.29	0.23	0.16	0.05	0.03	0.02	0.00	1.14
WNW	0.00	0.07	0.16	0.18	0.50	0.31	0.18	0.07	0.09	0.01	0.00	1.58
NW	0.00	0.08	0.23	0.24	0.73	1.04	0.90	0.69	0.68	0.14	0.03	4.76
NNW	0.00	0.07	0.32	0.62	2.32	1.98	1.20	0.62	0.41	0.07	0.00	7.61
Total	0.00	1.39	3.16	4.19	10.71	9.75	7.15	4.78	4.62	0.66	0.16	46.59

Percent of Calms 0.00
Percent of Invalid Hours 0.00
Percent of Valid Hours 46.59

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY PERCENT
SLIGHTLY STABLE (-0.5 < delta T/ delta z <= 1.5)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL E
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0.03	0.19	0.25	0.11	0.19	0.06	0.02	0.00	0.00	0.00	0.00	0.87
NNE	0.01	0.23	0.15	0.09	0.09	0.02	0.03	0.00	0.00	0.00	0.00	0.63
NE	0.03	0.15	0.21	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.49
ENE	0.00	0.22	0.16	0.10	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.56
E	0.02	0.24	0.13	0.13	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.69
ESE	0.00	0.11	0.33	0.37	0.31	0.03	0.00	0.00	0.00	0.00	0.00	1.16
SE	0.02	0.21	0.32	0.43	1.03	0.70	0.19	0.02	0.03	0.01	0.00	2.98
SSE	0.01	0.10	0.10	0.24	1.03	0.94	0.66	0.22	0.14	0.00	0.00	3.45
S	0.00	0.11	0.13	0.14	0.49	0.58	0.42	0.23	0.13	0.02	0.00	2.26
SSW	0.01	0.14	0.10	0.08	0.24	0.16	0.29	0.30	0.42	0.16	0.00	1.90
SW	0.03	0.09	0.11	0.09	0.10	0.16	0.14	0.15	0.25	0.09	0.01	1.24
WSW	0.01	0.17	0.08	0.10	0.17	0.15	0.14	0.06	0.06	0.00	0.00	0.94
W	0.05	0.23	0.16	0.26	0.25	0.19	0.07	0.07	0.05	0.00	0.00	1.33
WNW	0.01	0.56	0.41	0.25	0.63	0.30	0.15	0.07	0.02	0.00	0.00	2.40
NW	0.01	0.40	0.58	0.41	0.54	0.32	0.13	0.03	0.02	0.00	0.01	2.46
NNW	0.01	0.23	0.33	0.60	0.73	0.29	0.05	0.02	0.00	0.00	0.00	2.26
Total	0.27	3.39	3.56	3.49	6.06	3.94	2.29	1.17	1.12	0.29	0.02	25.60

Percent of Calms 0.00
Percent of Invalid Hours 0.00
Percent of Valid Hours 25.60

Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY PERCENT
MODERATELY STABLE (1.5 < delta T/ delta z <= 4.0)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL F
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0.02	0.02	0.03	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.17
NNE	0.01	0.08	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
NE	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
ENE	0.01	0.17	0.08	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.32
E	0.01	0.19	0.16	0.06	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.47
ESE	0.03	0.14	0.18	0.14	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.62
SE	0.07	0.19	0.24	0.22	0.52	0.13	0.00	0.00	0.00	0.00	0.00	1.36
SSE	0.01	0.26	0.14	0.09	0.25	0.03	0.01	0.00	0.00	0.00	0.00	0.80
S	0.07	0.26	0.07	0.07	0.17	0.06	0.07	0.01	0.00	0.00	0.00	0.78
SSW	0.11	0.14	0.02	0.02	0.08	0.08	0.09	0.00	0.00	0.00	0.00	0.55
SW	0.13	0.26	0.02	0.05	0.02	0.00	0.03	0.03	0.00	0.00	0.00	0.55
WSW	0.10	0.17	0.08	0.01	0.02	0.07	0.06	0.00	0.01	0.00	0.00	0.53
W	0.08	0.38	0.08	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60
WNW	0.08	0.56	0.16	0.03	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.92
NW	0.09	0.13	0.08	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.34
NNW	0.03	0.05	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Total	0.87	3.11	1.43	0.87	1.40	0.39	0.26	0.05	0.01	0.00	0.00	8.39

Percent of Calms 0.01
Percent of Invalid Hours 0.00
Percent of Valid Hours 8.40

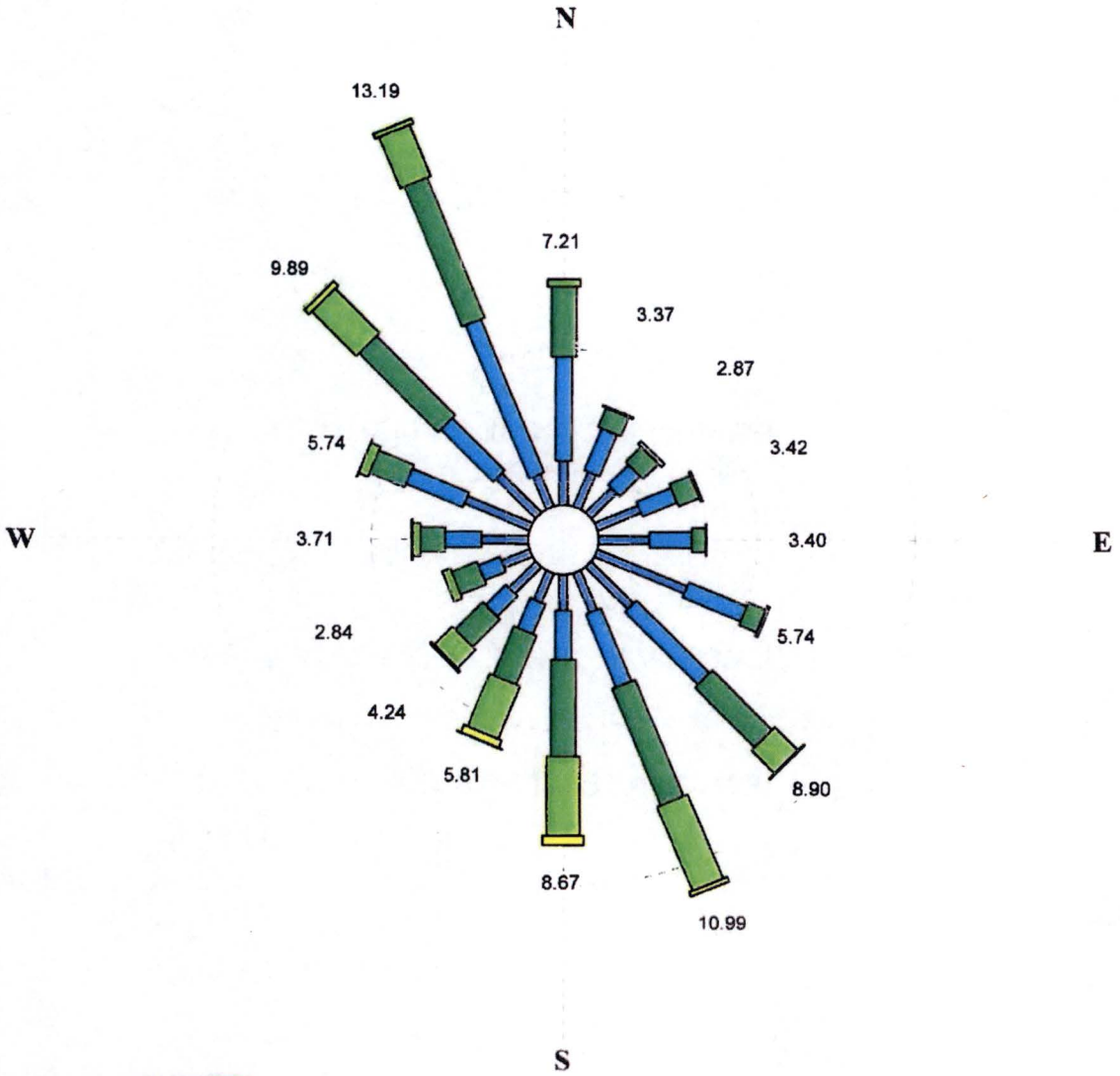
Omaha Public Power District
Fort Calhoun Nuclear Station
JOINT FREQUENCY DISTRIBUTION BY PERCENT
EXTREMELY STABLE (delta T/ delta z > 4.0)
PERIOD OF RECORD: JAN 2017 - DEC 2017
PASQUILL G
WIND SPEED (m/s) AT 10-m LEVEL

Wind Direct	< 0.5	0.5- 1.0	1.1- 1.5	1.6- 2.0	2.1- 3.0	3.1- 4.0	4.1- 5.0	5.1- 6.0	6.1- 8.0	8.1- 10.0	> 10.0	Total
N	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
NNE	0.06	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
NE	0.05	0.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
ENE	0.05	0.25	0.07	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.40
E	0.09	0.18	0.13	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42
ESE	0.10	0.42	1.39	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00
SE	0.03	0.37	0.18	0.06	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.71
SSE	0.16	0.34	0.09	0.03	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.66
S	0.09	0.25	0.06	0.00	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.47
SSW	0.11	0.26	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.41
SW	0.07	0.32	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.41
WSW	0.07	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23
W	0.11	0.18	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.32
WNW	0.01	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
NW	0.03	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10
NNW	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Total	1.09	3.07	2.03	0.24	0.17	0.06	0.00	0.00	0.00	0.00	0.00	6.65

Percent of Calms 0.00
Percent of Invalid Hours 0.00
Percent of Valid Hours 6.65

Percent of Hours Accounted For: 100.00

Joint Frequency Distribution
2017 FCS Meteorological Tower



Calms excluded.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.
No observations were missing.

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION

RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

TECHNICAL SPECIFICATION 5.9.4.b

January 01, 2017 – December 31, 2017

Annual Radiological Environmental Operating Report

This report is submitted in accordance with Section 5.9.4.b of the Technical Specifications of Fort Calhoun Station Unit No. 1, Facility Operating License DPR-40 for the period January 01, 2017 through December 31, 2017.

In addition, this report provides any observations and anomalies that occurred during the monitoring period.

Reviewed by:

RP/Chem Supervisor

Approved by:

Manager-Chemistry

FCS Plant Manager

Senior Director of Nuclear Decommissioning

Annual Radiological Environmental Operating Report

In accordance with Technical Specification 5.9.4.b, herein is the Fort Calhoun Station (FCS) Annual Radiological Environmental Operating Report for year 2017. The data provided is consistent with the objectives as specified in Section 5.2.2 of the Offsite Dose Calculation Manual (ODCM), "Annual Radiological Environmental Operating Report." The report is presented as follows:

1) An introductory discussion of the implementation of the Radiological Environmental Monitoring Program (REMP), including program observations and environmental impact relevant to the operation of FCS.

2) The sample class, sample collection frequency, number of sample locations, and the number of samples collected this reporting period for each parameter is delineated in Table 1.0.

3) A statistical evaluation of REMP data is summarized in Table 2.0, in accordance with Regulatory Guide 4.8, Table 1. For each type of sample media and analysis, Table 2.0 presents data separately for all **indicator** locations, all **control** (background) locations, and the location having the highest annual mean result. For each of these classes, Table 2.0 specifies the following:

   a. The total number of analyses,

   b. The fraction of analyses yielding detectable results (i.e., results above the highest Lower Limit of Detection (LLD) for this period),

   c. The maximum, minimum, and average results,

   d. Locations with the highest annual mean are specified by code, name, and by distance and direction from the center of plant reactor containment building.

4) Table 3.0 is a listing of missed samples and explanations

5) Table 4.0 is the 2016 Land Use Survey

6) Review of Environmental Inc. Quality Assurance Program

7) Appendix A describes the Interlaboratory Comparison Program

8) Appendix B describes the vendor Data Reporting Conventions utilized

9) Appendix C reports the information required when primary coolant specific activity has exceeded the limits of Technical Specification 2.1.3

10) Appendix D is the Sample Location Maps

INTRODUCTION

Radiological Environmental Monitoring Program (REMP) – 2017

This report gives the results of the Radiological Environmental Monitoring Program (REMP) for the year 2017. The REMP is a requirement of the Fort Calhoun Station (FCS) operating license. It was initiated prior to plant operation in 1973.

The main purpose of the REMP is to ensure public safety by monitoring plant discharges and assessing the effect, if any, of plant operations on the environment. Samples are collected that would account for various exposure pathways such as ingestion, inhalation, adsorption and direct exposure. Samples collected on a regular basis include: air, surface water, ground water, milk, vegetation, fish, sediment, and food crops. Direct radiation is measured by thermoluminescent dosimeters (TLDs). These samples and TLDs are sent to an independent vendor laboratory for analysis. The vendor uses analytical methods that are sensitive enough to detect a level of activity far below that which would be considered harmful. Locations for sample collection are based on radiological and meteorological data from the Annual Effluent Release Report and information obtained from the Environmental Land Use Survey.

Most samples, particularly indicator samples, are collected in a circular area within a five-mile radius of plant containment. (However, control locations are usually outside of five miles.) This circle is divided into sixteen equal sectors, each assigned an identification letter "A" through "R" (note: letters "I" and "O" are not used, as they may be mistaken for the numbers "1" and "0"). Sector "A" is centered on North or zero degrees. Sectors are also given directional labels such as "West-Southwest" ("WSW"). Sample locations are listed by number along with their respective distances and direction from plant containment, in the Offsite Dose Calculation Manual (ODCM).

When assessing sample results, data from indicator locations (those most likely to be affected by plant operations) are compared to those from control locations (those least or not likely to be affected). Results from an indicator location which were significantly higher than those from a control location could indicate a plant-attributable effect and could require additional investigation.

The results of the sample analyses, as required by the FCS Offsite Dose Calculation Manual (ODCM), are presented in the attached statistical tables in accordance with Table 1 of Regulatory Guide 4.8, "Environmental Technical Specifications for Nuclear Power Plants." Sample collection was conducted by plant chemistry/environmental staff. A contract vendor (Environmental Inc., Northbrook, Illinois) performed sample analyses, preparation of monthly reports and the statistical evaluation of sample results. All vendor analysis techniques met the sensitivity requirements as stated in the ODCM.

Results for 2017 were within expected ranges and compared closely with historical results. The result details and exceptions are listed in the following sections.

1) Ambient Gamma Radiation

Ambient gamma radiation is measured by thermoluminescent dosimeters (TLDs) provided by the vendor laboratory. These dosimeters contain calcium sulfate phosphors and are processed quarterly.

One incident condition report was documented in the Corrective Action Program in 2017 related to TLD sampling. Multiple TLD locations could not be accessed safely due to structural concerns with the site met tower. Repairs to the tower could not be made due to the presence of an active raptor nest on the tower. Once the nesting season had ended, the TLD's in question were obtained and counted. The reading period was extended and quality data was returned for the two quarters the TLD's were in the field. The samples were added to Table 3.0 to help reviewers of this report since the vendor attachments show that not all TLD's were collected/read.

TLD OTD-1C was not recovered due to a local county road worker replacing the road sign/pole. (Condition Report 2017-01839). This sample was added to Table 3.0

All sample results are within the range of historical data and displayed less than 17% difference when compared to historical averages. All results were less than 3 sigma standard deviations from historical means. No discrepancy between released effluents and resultant radiation dose measured was observed. No changes in plant operation/procedures are required based upon observed impacts to the environment to date.

Twelve TLD's were added to the station's ODCM. These TLD's were placed within the owner controlled area to assist with determination of 40 CFR 190 doses. These locations are not included in Table 1.0, but are being described to assist reviewers of vendor analysis records.

10-Year Trend Comparison of TLD Locations

Location	Avg. Dose (mr/week)	2017 Avg. Dose (mr/week)
A	1.33	1.50
B	1.41	1.40
C	1.37	1.38
D	1.22	1.18
F	1.35	1.40
G	1.33	1.40
H	1.38	1.35
I	1.47	1.45
J	1.53	1.63
K	1.45	1.58
N	1.44	1.60
O	1.43	1.55
P	1.48	1.53
S	1.51	1.58
L (Control)	1.26	1.30

2) **Milk/Pasture**

Milk samples or pasture grasses, if milk is temporarily unavailable, are collected every two weeks during the pasture season from the beginning of May through September, and monthly the rest of the calendar year. Indicator samples are collected from a herd of milk goats at a family farm located approximately 3.4 miles from the plant in Sector J (South). The control samples are collected from a commercial dairy cow herd located approximately 9.9 miles from the plant in Sector J (South). The indicator station and control location are unchanged from last year. No indicator milk samples were available until spring (May) due to the dairy owners suspending operations. Late fall samples were not performed due to the does drying up before birthing. Pasture grass in lieu of milk was collected at the indicator location due to unavailability.

All sample results for Cesium-134, Cesium-137 and other gammas were at the LLD for both indicator and control locations. No plant-related effects were observed.

3) **Fish**

Fish are collected on an annual basis. Control samples are collected at a location approximately twenty miles upstream of the plant (river miles 665 – 667). Indicator samples are collected in the immediate vicinity of the power plant (river miles 644 – 646). Several species of fish, important to commercial and recreational interest, representing all levels of the aquatic food chain are collected at both locations.

All sample results are within the range of historical data. Results from both control and indicator locations were less than LLD for all gamma emitters, indicating no plant-related effects.

4) **Food Crop**

Based on the results of the biennial Land Use Survey, the nearest high deposition pathway for food crops is the Alvin Pechnik Farm in Sector H (0.94 miles, 163°). Accordingly, vegetable samples were collected at Alvin Pechnik Farm for the purposes of the 2017 REMP.

Samples were comparable with historical results and within the range of results reported from the control location garden at Mohr Dairy. Additional special interest samples were obtained from on-site farm fields per plant Technical Specifications.

All results were at the LLD for all non-naturally occurring radionuclides. No plant-related effects were observed.

5) **Sediment**

River sediment samples are collected twice a year at an upstream control location and a downstream indicator location. All results were at the LLD for all non-naturally occurring radionuclides. No plant-related effects were observed.

6) **Air Monitoring**

Air sample results for 2017 were well within historical limits for all locations. Additionally, all indicator locations showed results very similar to the control locations.

One incident was documented in the Corrective Action Program in 2017 related to air sampling. CR 2017-01904 Air Iodine (AI) sample did not meet the LLD due to less than adequate air sample volume after a sample pump failure. Since identified activity was identified on the pre-filter the Gross Beta sample was not impacted. This sample is documented in Table 3.0.

All sample results are within the range of historical data. All indicator locations displayed less than 15% difference when compared to historical average. All 2017 results when compared to historical averages are within the stated vendor error acceptance tolerance.

Results from both control and indicator locations were less than LLD for gamma emitters and iodine. No changes in plant operation/procedures are required based upon observed impacts to the environment to date.

10-Year Trend Comparison of Air Sampling Locations

Location	Avg. Beta (pCi/m^3)	2017 Avg. Beta (pCi/m^3)
Sector B	0.028	0.024
Sector D	0.028	0.025
Sector I	0.025	0.025
Sector J	0.026	0.023
Sector K	0.027	0.024
Sector F (Control)	0.029	0.026

7) **Surface Water**

Water samples are collected upstream of the plant (control location) as well as half-mile downstream and at a municipal water treatment plant on the north edge of Omaha.

Results for Cs-134, Cs-137, and other gammas were all less than LLD. All tritium results were less than LLD. No plant-related effects were detected.

8) **Ground Water**

Quarterly residential well water samples are collected at the following four locations: Station No. 15: Smith Farm, Station No. 20: Mohr Dairy, Station No. 74: D. Miller Farm and Station No. 75: Lomp Acreage. All sample results to date have been at the LLD except gross beta due to naturally occurring radionuclides. Gross beta results have ranged from a low of 2.2 pCi/liter to a high of 7.4 pCi/liter, with an average gross beta for the year of 4.2 pCi/liter for indicator locations. Strontium-90 analysis is being conducted on wells as part of the station's groundwater protection program. No plant-related effects were detected.

Table 1.0

Sample Collection Program

Sample Class	Collection Frequency	Number of Sample Locations	Samples Collected this Period
Background Radiation (TLDs)	Quarterly	47[4]	185[5]
Air Particulates	Weekly	6	312
Airborne Iodine	Weekly	6	311[5]
Milk	Biweekly May thru Sept	2	36[1]
Surface Water	Monthly	3	36
Ground Water	Quarterly	4	16
Fish	Annually	2	5[2]
Sediment	Semi-annually	2	4
Food Crops	Annually	3	9[3]
		TOTAL	**914**

Note 1: Milk sample collection total includes 9 vegetation samples performed for milk unavailability. Milk samples are collected every two weeks May-Sept. and monthly the rest of the year. Three milk samples were performed in August.
Note 2: Includes one background sample.
Note 3: Variety of samples collected during period
Note 4: Twelve sample locations were added for assessing 40 CFR 190 doses. The results are not included in REMP program totals.
Note 5: See table of missed samples for explanations.

Table 2: Radiological Environmental Monitoring Program Summary — Reporting Period: January-December, 2017

Name of Facility: Fort Calhoun Nuclear Power Station - Unit 1 — Docket No.: 50-285

Location of Facility: Washington, Nebraska
(County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean Location[d]	Location with Highest Annual Mean Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Background Radiation (TLD) (mR/week)	Gamma 185	0.5	1.6 (185/185) (1.0-2.1)	OTD-15-(I) 0.61 mi. @205°	1.7 (4/4) 1.4-1.9	1.3 (4/4) (1.2-1.4)	0
Airborne Particulates (pCi/m³)	GB 312	0.005	0.025 (256/256) (0.007-0.056)	DAP-H-(I) 1.57 mi SE	0.025 (52/52) (0.009-0.052)	0.026 (52/52) (0.005-0.053)	0
	GS 24						
	Cs-134	0.001	< LLD	-	-	< LLD	0
	Cs-137	0.001	< LLD	-	-	< LLD	0
	Other Gammas	0.001	< LLD	-	-	< LLD	0
Airborne Iodine (pCi/m3)	I-131 311	0.07	< LLD	-	-	< LLD	0
Milk (pCi/L)	I-131 27	0.5	< LLD	-	-	< LLD	0
	GS 27						
	K-40	150	1735 (9/9) (1531-2050)	Stangl Farm 3.4 mi. @ 159°	1739 (9/9) (1531-2050)	1343 (18/18) (1246-1457)	0
	Cs-134	15	< LLD	-	-	< LLD	0
	Cs-137	15	< LLD	-	-	< LLD	0
	Other Gammas	15	< LLD	-	-	< LLD	0
Ground Water (pCi/L)	GB 16		3.7 (12/12) (2.3-7.4)	Lomp Acreage 0.55 mi.@153°	5.6 (4/4) (2.9-7.4)	4.0 (4/4) (2.1-5.1)	0
	H-3 16	300	< LLD	-	-	< LLD	0
	Sr-90 16	0.7	< LLD	-	-	< LLD	0
	GS 16						
(pCi/L)	Cs-134	15	< LLD	-	-	< LLD	0
	Cs-137	18	< LLD	-	-	< LLD	0
	Other Gammas	15	< LLD	-	-	< LLD	0
Surface Water (pCi/L)	GS 36						
	Cs-134	15	< LLD	-	-	< LLD	0
	Cs-137	18	< LLD	-	-	< LLD	0
	Other Gammas	15	< LLD	-	-	< LLD	0
	H-3 12	300	< LLD	-	-	< LLD	0

Table 2: Radiological Environmental Monitoring Program Summary — Reporting Period: January-December, 2017

Name of Facility: Fort Calhoun Nuclear Power Station - Unit 1 — Docket No.: 50-285

Location of Facility: Washington, Nebraska (County, State)

Sample Type (Units)	Type and Number of Analyses[a]	LLD[b]	Indicator Locations Mean (F)[c] Range[c]	Location with Highest Annual Mean: Location[d]	Location with Highest Annual Mean: Mean (F)[c] Range[c]	Control Locations Mean (F)[c] Range[c]	Number Non-Routine Results[e]
Fish (pCi/g wet)	GS 5						
	Mn-54	0.023	< LLD	-	-	< LLD	0
	Co-58	0.030	< LLD	-	-	< LLD	0
	Co-60	0.021	< LLD	-	-	< LLD	0
	Fe-59	0.056	< LLD	-	-	< LLD	0
	Zn-65	0.051	< LLD	-	-	< LLD	0
	Ru-103	0.043	< LLD	-	-	< LLD	0
	Cs-134	0.021	< LLD	-	-	< LLD	0
	Cs-137	0.020	< LLD	-	-	< LLD	0
Sediment pCi/g dry	GS 4						
	Mn-54	0.021	< LLD	-	-	< LLD	0
	Co-58	0.024	< LLD	-	-	< LLD	0
	Co-60	0.015	< LLD	-	-	< LLD	0
	Fe-59	0.053	< LLD	-	-	< LLD	0
	Zn-65	0.043	< LLD	-	-	< LLD	0
	Cs-134	0.016	< LLD	-	-	< LLD	0
	Cs-137	0.013	< LLD	-	-	< LLD	0
Food Crops (pCi/g wet)	GS 9						
	Mn-54	0.044	< LLD	-	-	< LLD	0
	Co-58	0.043	< LLD	-	-	< LLD	0
	Co-60	0.042	< LLD	-	-	< LLD	0
	Fe-59	0.073	< LLD	-	-	< LLD	0
	Zn-65	0.057	< LLD	-	-	< LLD	0
	Zr-Nb-95	0.041	< LLD	-	-	< LLD	0
	Cs-134	0.035	< LLD	-	-	< LLD	0
	Cs-137	0.035	< LLD	-	-	< LLD	0
	Ba-La-140	0.051	< LLD	-	-	< LLD	0
Vegetation (pCi/g wet) Pasture grass in lieu of Milk	GS 9						
	Mn-54	0.044	< LLD	-	-	< LLD	0
	Co-58	0.043	< LLD	-	-	< LLD	0
	Co-60	0.042	< LLD	-	-	< LLD	0
	Fe-59	0.073	< LLD	-	-	< LLD	0
	Zn-65	0.057	< LLD	-	-	< LLD	0
	Zr-Nb-95	0.041	< LLD	-	-	< LLD	0
	Cs-134	0.035	< LLD	-	-	< LLD	0
	Cs-137	0.035	< LLD	-	-	< LLD	0
	Ba-La-140	0.051	< LLD	-	-	< LLD	0

[a] GB = gross beta, GS = gamma scan.

[b] LLD = nominal lower limit of detection based on a 95% confidence level.

[c] Mean and range are based on detectable measurements only (i.e., >LLD). Fraction of detectable measurements at specified locations is indicated in parentheses (F).

Table 3.0 Listing of Missed Samples (samples scheduled but not collected)

Sample Type	Date	Location	Reason
TLD	06-30-17	OTD-A	Sample was not recovered due to potentially unsafe condition around the weather tower. (Condition Report 2017-01839)
TLD	06-30-17	OTD-A Duplicate	Sample was not recovered due to potentially unsafe condition around the weather tower. (Condition Report 2017-01839)
TLD	06-30-17	OTD-1P	Sample was not recovered due to potentially unsafe condition around the weather tower. (Condition Report 2017-01839)
TLD	06-30-17	OTD-1C	Sample was not recovered due to a local county road worker replacing the road sign/pole. (Condition Report 2017-01839)
AI	07-12-17	OAP-K	Air Iodine (AI) sample did not meet the LLD due to less than adequate air sample volume after a sample pump failure. (Condition Report 2017-01904)

2016
Environmental Land Use Survey Report

Sector	Dir	Land Use	Owner	Miles	Meters	Deg	Survey Technique	Age Group				XOQ	DOQ	Remarks
								Adult	Teen	Child	Infant			
A	N	RESIDENCE	WRIGHT	4.36	7016.74	351	INTERVIEW	X		X		1.10E-07	4.50E-10	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION												
		GROUNDWATER	WRIGHT	4.36	7016.74	351	INTERVIEW	X		X				
B	NNE	RESIDENCE	RAND,J	1.93	3106.03	12	MAIL SURVEY	X				5.60E-07	2.20E-09	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION	SHEPARD	2.23	3588.84	16	INTERVIEW	X		X		3.70E-07	1.49E-09	
		GROUNDWATER	RAND,J	1.93	3106.03	12	MAIL SURVEY	X						
C	NE	RESIDENCE	HANSEN,M	1.52	2446.20	42	MAIL SURVEY	X		X		1.00E-06	2.90E-09	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION	HANSEN,M	1.52	2446.20	42	MAIL SURVEY	X		X		1.00E-06	2.90E-09	
		GROUNDWATER	HANSEN,M	1.52	2446.20	42	MAIL SURVEY	X		X				
D	ENE	RESIDENCE	MEADE,G	4.79	7708.76	63	MAIL SURVEY	X				8.70E-08	1.30E-10	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION	MEADE,G	4.79	7708.76	63	MAIL SURVEY	X				8.70E-08	1.30E-10	
		GROUNDWATER	MEADE,G	4.79	7708.76	63	MAIL SURVEY	X						
E	E	RESIDENCE	LOVE	4.67	7515.64	89	MAIL SURVEY	X	X			9.80E-08	1.80E-10	
		MILK ANIMAL												
		MEAT ANIMAL	BROTHERS,D	4.91	7901.88	90	INTERVIEW	X				9.20E-08	1.60E-10	
		VEGETATION	LOVE	4.67	7515.64	89	MAIL SURVEY	X	X			9.80E-08	1.80E-10	
		GROUNDWATER	LOVE	4.67	7515.64	89	MAIL SURVEY	X	X					
F	ESE	RESIDENCE	WILSON ISLAND	4.22	6791.43	121	MAIL SURVEY	X		X		1.30E-07	2.90E-10	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION	WILSON ISLAND	4.22	6791.43	121	MAIL SURVEY	X		X		1.30E-07	2.90E-10	
		GROUNDWATER	WILSON ISLAND	4.22	6791.43	121	MAIL SURVEY	X		X				

2016
Environmental Land Use Survey Report

Sector	Dir	Land Use	Owner	Miles	Meters	Deg	Survey Technique	Age Group				X/Q	D/Q	Remarks
								Adult	Teen	Child	Infant			
G	SE	RESIDENCE	CARTER,T	1.67	2687.60	145	INTERVIEW	X				6.20E-07	3.60E-09	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION	KALIN,W	1.74	2800.26	145	MAIL SURVEY	X				5.80E-07	3.30E-09	
		GROUNDWATER	KALIN,W	1.74	2800.26	145	MAIL SURVEY	X						OGW-A-(I) SMITH FARM RETAINED TO MAINTAIN HISTORICAL DATA FROM PRE-OP TO PRESENT
H	SSE	RESIDENCE	LOMP	.65	1046.07	163	MAIL SURVEY	X				6.60E-06	6.10E-08	
		MILK ANIMAL												
		MEAT ANIMAL	HINELINE,R	1.82	2929.01	148	INTERVIEW	X				6.20E-07	5.30E-09	
		VEGETATION	LOMP	.65	1046.07	163	MAIL SURVEY	X				6.60E-06	6.10E-08	
		GROUNDWATER	LOMP	.65	1046.07	163	MAIL SURVEY	X						
J	S	RESIDENCE	DOWLER	.73	1174.82	175	MAIL SURVEY	X				2.90E-06	1.90E-08	
		MILK ANIMAL	STANGL	3.44	5536.14	169	INTERVIEW	X	X	X		7.10E-08	3.80E-10	
		MEAT ANIMAL	PRATT	2.48	3991.17	170	INTERVIEW	X		X		1.41E-07	8.40E-10	
		VEGETATION	DOWLER	.73	1174.82	175	MAIL SURVEY	X				2.90E-06	1.90E-08	
		GROUNDWATER	DOWLER	.73	1174.82	175	MAIL SURVEY	X						
K	SSW	RESIDENCE	D.MILLER	.65	1046.07	203	INTERVIEW	X				2.70E-06	1.10E-08	
		MILK ANIMAL												
		MEAT ANIMAL	D.MILLER	.65	1046.07	203	INTERVIEW	X				2.70E-06	1.10E-08	
		VEGETATION	T. DEIN	2.00	3218.69	193	INTERVIEW	X		X		1.90E-07	7.30E-10	
		GROUNDWATER	D.MILLER	.65	1046.07	203	INTERVIEW	X						
L	SW	RESIDENCE	ROBERTSON,D	.73	1174.82	224	MAIL SURVEY	X				2.60E-06	8.40E-09	
		MILK ANIMAL												
		MEAT ANIMAL	RYDER	.76	1223.10	227	MAIL SURVEY	X				2.40E-06	7.70E-09	
		VEGETATION	BURGIN	1.43	2301.36	223	MAIL SURVEY	X				5.00E-07	1.50E-09	
		GROUNDWATER	ROBERTSON,D	.73	1174.82	224	MAIL SURVEY	X						
M	WSW	RESIDENCE	BENSEN,M	1.06	1705.90	257	INTERVIEW	X				1.40E-06	4.20E-09	
		MILK ANIMAL												
		MEAT ANIMAL	FREDERICK	2.18	3508.37	258	MAIL SURVEY	X				2.40E-07	6.40E-10	
		VEGETATION	THOMAS	1.13	1818.56	259	INTERVIEW	X				1.10E-06	3.40E-09	
		GROUNDWATER	BENSEN,M	1.06	1705.90	257	INTERVIEW	X						

2016
Environmental Land Use Survey Report

Sector	Dir	Land Use	Owner	Miles	Meters	Deg	Survey Technique	Age Group				XOQ	DOQ	Remarks
								Adult	Teen	Child	Infant			
N	W	RESIDENCE	NIELSEN	1.20	1931.21	263	INTERVIEW	X				1.30E-06	4.20E-09	
		MILK ANIMAL												
		MEAT ANIMAL	BREITHAUPT	2.28	3669.30	261	INTERVIEW	X				2.80E-07	8.10E-10	
		VEGETATION	ASMUSSEN,G	1.30	2092.15	270	MAIL SURVEY	X				1.00E-06	3.30E-09	
		GROUNDWATER	ASMUSSEN,G	1.30	2092.15	270	MAIL SURVEY	X						
P	WNW	RESIDENCE	STONE	2.60	4184.29	283	INTERVIEW	X				2.50E-07	8.50E-10	
		MILK ANIMAL												
		MEAT ANIMAL	BROWN	4.59	7386.89	288	MAIL SURVEY	X				9.60E-08	2.60E-10	
		VEGETATION	TABOR	2.65	4264.76	285	MAIL SURVEY	X	X	X		2.40E-07	8.00E-10	
		GROUNDWATER	STONE	2.60	4184.29	283	INTERVIEW	X						
Q	NW	RESIDENCE	HANSEN,R	2.40	3862.43	318	INTERVIEW	X				5.00E-07	1.90E-09	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION	HANSEN,R	2.40	3862.43	318	INTERVIEW	X				5.00E-07	1.90E-09	
		GROUNDWATER	HANSEN,R	2.40	3862.43	318	INTERVIEW	X						
R	NNW	RESIDENCE	BATTIATO	2.08	3347.44	330	CITY REGISTER	X				6.40E-07	3.50E-09	
		MILK ANIMAL												
		MEAT ANIMAL												
		VEGETATION	SONDERUP	3.73	6002.85	328	INTERVIEW	X				1.70E-07	7.90E-10	
		GROUNDWATER	SONDERUP	3.73	6002.85	328	INTERVIEW	X						

Performed by_____ Reviewed by_____

Review of Environmental Inc., Quality Assurance Program

Fort Calhoun Station contracts with Environmental Inc., Midwest Laboratory (vendor lab) to perform radioanalysis of environmental samples. Environmental Inc. participates in inter-laboratory comparison (cross-check) programs as part of its quality control program. These programs are operated by such agencies as the Department of Energy, which supply blind-spike samples such as milk or water containing concentrations of radionuclides unknown to the testing laboratory. This type of program provides an independent check of the analytical laboratory's procedures and processes, and provides indication of possible weaknesses. In addition, Environmental Inc. has its own in-house QA program of blind-spike and duplicate analyses.

Vendor in-house spike sampling was performed without a failure and in-house blank analyses were performed within acceptable ranges. Routine FCS REMP duplicates samples were performed by the vendor to verify reproducibility of results. All duplicates were within acceptance criteria.

Three DOE MAPEP cross check samples failed in 2017. DOE water sample MAW-847 dated 2/1/2017, failed for Co-57. The laboratory report had a decimal point misplaced during unit conversion. The result was within control limits when the proper unit conversion was performed. Third quarter MAW testing for C0-57 was performed within acceptable limits. DOE air particulate sample, MAAP 907 failed high on its Am-241 results due to plating issues. Sample was reanalyzed in duplicate with acceptable results. The MAAP sample failed low during 3rd quarter Am-241 testing, however the DOE is no longer offering Am-241 testing for air particulates, so this failure was not addressed. Testing on ERA air particulate for Am-241 ERAP-1112 was successfully completed by the vendor. Am-241 is currently not performed in the REMP program but performed in house as part of the REMP program. No Am-241 was detected in effluent releases, and FCS personnel passed its Analytics cross checks for Am-241.

Environmental Resource Associates cross checks had four failures during 2017. ERA air particulate sample, ERAP-1112, failed high for Fe-55 on 3/20/2017. Insufficient sample existed to re-perform the analysis, so the sample was re-counted for an extended count and successful results were obtained. ERAP-1114 failed Gross Beta analysis high outside limits. The ERA samples appear to have been deposited in a pattern closer to the center of the filter changing the efficiency calculation (low) causing the report activity to be high. In house spiked samples had a test ratio 0.94 for sample prepared by Environmental Inc. Soil sample ERSO-1116 (low) on the following isotopes Pu-29, Pu-240, U-233 and U-234. These analytes passed after re-analysis. Poor electroplating was listed as a potential cause. Water sample, ERW-11120, failed high for Fe-55. Sample was recounted and acceptable resulted were generated. Insufficient sample was left after water testing to re-perform the entire analysis. The FCS REMP program does not perform Fe-55 or Transuranic analyses on its samples. Gross Beta results obtained were within historical means and did not show a high bias,

No test results failed both the ERA and DOE methodologies for a given sample type. Reanalysis produced acceptable results. The ordering of additional tests and successful testing after corrections were applied, visibly demonstrates the vendor's commitment to reporting and resolving deficiencies.

These results indicate the vendor's ability to self-identify and correct any deviations from acceptable or expected results. The test results had no impact on Fort Calhoun samples and were documented as such by the vendor. No changes are deemed necessary to the FCS REMP program due to vendor performance.

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APPENDIX A

INTERLABORATORY COMPARISON PROGRAM RESULTS
AND INTRALABORATORY COMPARISON PROGRAM RESULTS

NOTE: Appendix A is updated four times a year. The complete appendix is included in March, June, September and December monthly progress reports only.

January, 2017 through December, 2017

Appendix A

Interlaboratory/ Intralaboratory Comparison Program Results

Environmental, Inc., Midwest Laboratory has participated in interlaboratory comparison (crosscheck) programs since the formulation of it's quality control program in December 1971. These programs are operated by agencies which supply environmental type samples containing concentrations of radionuclides known to the issuing agency but not to participant laboratories. The purpose of such a program is to provide an independent check on a laboratory's analytical procedures and to alert it of any possible problems.

Participant laboratories measure the concentration of specified radionuclides and report them to the issuing agency. Several months later, the agency reports the known values to the participant laboratories and specifies control limits. Results consistently higher or lower than the known values or outside the control limits indicate a need to check the instruments or procedures used.

Results in Table A-1 were obtained through participation in the RAD PT Study Proficiency Testing Program administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the U.S. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada.

Table A-2 lists results for thermoluminescent dosimeters (TLDs), via irradiation and evaluation by the University of Wisconsin-Madison Radiation Calibration Laboratory at the University of Wisconsin Medical Radiation Research Center.

Table A-3 lists results of the analyses on in-house "spiked" samples for the past twelve months. All samples are prepared using NIST traceable sources. Data for previous years available upon request.

Table A-4 lists results of the analyses on in-house "blank" samples for the past twelve months. Data for previous years available upon request.

Table A-5 lists analytical results from the in-house "duplicate" program for the past twelve months. Acceptance is based on the difference of the results being less than the sum of the errors. Complete analytical data for duplicate analyses is available upon request.

The results in Table A-6 were obtained through participation in the Mixed Analyte Performance Evaluation Program.

Results in Table A-7 were obtained through participation in the MRAD PT Study Proficiency Testing Program administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the Environmental Measurement Laboratory Quality Assessment Program (EML).

Attachment A lists the laboratory precision at the 1 sigma level for various analyses. The acceptance criteria in Table A-3 is set at ± 2 sigma.

Out-of-limit results are explained directly below the result.

Attachment A

ACCEPTANCE CRITERIA FOR "SPIKED" SAMPLES

LABORATORY PRECISION: ONE STANDARD DEVIATION VALUES FOR VARIOUS ANALYSES[a]

Analysis	Level	One standard deviation for single determination
Gamma Emitters	5 to 100 pCi/liter or kg > 100 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-89[b]	5 to 50 pCi/liter or kg > 50 pCi/liter or kg	5.0 pCi/liter 10% of known value
Strontium-90[b]	2 to 30 pCi/liter or kg > 30 pCi/liter or kg	5.0 pCi/liter 10% of known value
Potassium-40	≥ 0.1 g/liter or kg	10% of known value
Gross alpha	≤ 20 pCi/liter > 20 pCi/liter	5.0 pCi/liter 25% of known value
Gross beta	≤ 100 pCi/liter > 100 pCi/liter	5.0 pCi/liter 10% of known value
Tritium	≤ 4,000 pCi/liter > 4,000 pCi/liter	$\pm 1\sigma$ = 169.85 x (known)$^{0.0933}$ 10% of known value
Radium-226,-228	≥ 0.1 pCi/liter	15% of known value
Plutonium	≥ 0.1 pCi/liter, gram, or sample	10% of known value
Iodine-131, Iodine-129[b]	≤ 55 pCi/liter > 55 pCi/liter	6 pCi/liter 10% of known value
Uranium-238, Nickel-63[b] Technetium-99[b]	≤ 35 pCi/liter > 35 pCi/liter	6 pCi/liter 15% of known value
Iron-55[b]	50 to 100 pCi/liter > 100 pCi/liter	10 pCi/liter 10% of known value
Other Analyses [b]	—	20% of known value

[a] From EPA publication, "Environmental Radioactivity Laboratory Intercomparison Studies Program", Fiscal Year, 1981-1982, EPA-600/4-81-004.

[b] Laboratory limit.

TABLE A-1. Interlaboratory Comparison Crosscheck program, Environmental Resource Associates (ERA)[a]. RAD study

Lab Code	Date	Analysis	Concentration (pCi/L) Laboratory Result	ERA Result	Control Limits	Acceptance
ERW-95	1/9/2017	Sr-89	51.9 ± 4.6	55.5	44.3 - 63.2	Pass
ERW-95	1/9/2017	Sr-90	43.6 ± 2.4	43.1	31.8 - 49.5	Pass
ERW-97	1/9/2017	Ba-133	78.2 ± 4.1	85.6	72.0 - 94.2	Pass
ERW-97	1/9/2017	Cs-134	53.9 ± 3.8	52.6	42.4 - 57.9	Pass
ERW-97	1/9/2017	Cs-137	122 ± 6	112	101 - 126	Pass
ERW-97	1/9/2017	Co-60	117 ± 4	113	102 - 126	Pass
ERW-97	1/9/2017	Zn-65	208 ± 13	189	170 - 222	Pass
ERW-99	1/9/2017	Gr. Alpha	48.9 ± 2.4	52.3	27.3 - 65.5	Pass
ERW-99	1/9/2017	Gr. Beta	37.1 ± 1.3	41.6	27.7 - 49.0	Pass
ERW-101	1/9/2017	I-131	22.3 ± 0.6	24.3	20.2 - 28.8	Pass
ERW-103	1/9/2017	Ra-226	11.3 ± 0.4	12.7	9.5 - 14.7	Pass
ERW-103	1/9/2017	Ra-228	6.10 ± 0.90	6.20	3.8 - 8.1	Pass
ERW-103	1/9/2017	Uranium	11.8 ± 0.8	12.6	9.9 - 14.4	Pass
ERW-106	1/9/2017	H-3	12,600 ± 300	12,500	10,900 - 13,800	Pass
ERW-3344	7/10/2017	Sr-89	29.0 ± 10.0	26.4	18.4 - 32.9	Pass
ERW-3344	7/10/2017	Sr-90	33.8 ± 3.3	36.0	26.4 - 41.5	Pass
ERW-3346	7/10/2017	Ba-133	66.4 ± 4.1	66.3	55.2 - 72.9	Pass
ERW-3346	7/10/2017	Cs-134	27.0 ± 4.3	24.4	18.7 - 27.2	Pass
ERW-3346	7/10/2017	Cs-137	57.4 ± 4.5	51.6	46.4 - 59.6	Pass
ERW-3346	7/10/2017	Co-60	92.6 ± 4.4	88.6	79.7 - 99.8	Pass
ERW-3346	7/10/2017	Zn-65	32.4 ± 6.0	32.7	27.3 - 41.6	Pass
ERW-3348	7/10/2017	Gr. Alpha	23.7 ± 1.9	25.7	13.0 - 34.1	Pass
ERW-3348	7/10/2017	Gr. Beta	54.6 ± 1.6	63.0	43.5 - 69.6	Pass
ERW-3350	7/10/2017	I-131	25.4 ± 1.3	25.5	21.2 - 30.1	Pass
ERW-3352	7/10/2017	Ra-226	1.38 ± 0.15	1.29	1.07 - 1.95	Pass
ERW-3352	7/10/2017	Ra-228	6.70 ± 0.93	5.66	3.45 - 7.47	Pass
ERW-3352	7/10/2017	Uranium	58.4 ± 0.9	66.7	54.3 - 73.9	Pass
ERW-3354	7/10/2017	H-3	5,254 ± 224	5,060	4,340 - 5,570	Pass

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing in drinking water conducted by Environmental Resources Associates (ERA).

TABLE A-2. Thermoluminescent Dosimetry, (TLD, $CaSO_4$: Dy Cards). [a b]

Lab Code	Irradiation Date	Description	Delivered Dose (mrem)	Reported Dose (mrem)	Performance Quotient (P) [c]	
Environmental, Inc.		Group 1				
2017-1	10/16/2017	Spike 1	59.0	46.9	-0.21	
2017-1	10/16/2017	Spike 2	59.0	50.6	-0.14	
2017-1	10/16/2017	Spike 3	59.0	50.2	-0.15	
2017-1	10/16/2017	Spike 4	59.0	50.8	-0.14	
2017-1	10/16/2017	Spike 5	59.0	49.2	-0.17	
2017-1	10/16/2017	Spike 6	59.0	51.4	-0.13	
2017-1	10/16/2017	Spike 7	59.0	49.4	-0.16	
2017-1	10/16/2017	Spike 8	59.0	50.1	-0.15	
2017-1	10/16/2017	Spike 9	59.0	51.9	-0.12	
2017-1	10/16/2017	Spike 10	59.0	48.0	-0.19	
2017-1	10/16/2017	Spike 11	59.0	51.3	-0.13	
2017-1	10/16/2017	Spike 12	59.0	53.0	-0.10	
2017-1	10/16/2017	Spike 13	59.0	47.8	-0.19	
2017-1	10/16/2017	Spike 14	59.0	49.8	-0.16	
2017-1	10/16/2017	Spike 15	59.0	51.7	-0.12	
2017-1	10/16/2017	Spike 16	59.0	50.6	-0.14	
2017-1	10/16/2017	Spike 17	59.0	47.6	-0.19	
2017-1	10/16/2017	Spike 18	59.0	49.7	-0.16	
2017-1	10/16/2017	Spike 19	59.0	47.9	-0.19	
2017-1	10/16/2017	Spike 20	59.0	48.2	-0.18	
2017-1	10/16/2017	Spike 21	59.0	50.5	-0.14	
2017-1	10/16/2017	Spike 22	59.0	49.0	-0.17	
2017-1	10/16/2017	Spike 23	59.0	51.7	-0.12	
2017-1	10/16/2017	Spike 24	59.0	50.7	-0.14	
2017-1	10/16/2017	Spike 25	59.0	51.1	-0.13	
2017-1	10/16/2017	Spike 26	59.0	49.1	-0.17	
2017-1	10/16/2017	Spike 27	59.0	49.0	-0.17	
2017-1	10/16/2017	Spike 28	59.0	49.1	-0.17	
2017-1	10/16/2017	Spike 29	59.0	47.5	-0.19	
2017-1	10/16/2017	Spike 30	59.0	52.6	-0.11	
Mean (Spike 1-30)				49.9	-0.15	Pass[d]
Standard Deviation (Spike 1-30)				1.6	0.03	Pass[d]

[a] Table A-2 assumes 1 roentgen = 1 rem (NRC -Health Physics Questions and Answers 10 CFR Part 20 - Question 96 - Page Last Reviewed/Updated Thursday, October 01, 2015).

[b] TLD's were irradiated by the University of Wisconsin-Madison Radiation Calibration Laboratory following ANSI N13.37 protocol from a known air kerma rate. TLD's were read and the results were submitted by Environmental Inc. to the University of Wisconsin-Madison Radiation Calibration Laboratory for comparison to the delivered dose.

[c] Performance Quotient (P) is calculated as ((reported dose - conventially true value) ÷ conventially true value) where the conventially true value is the delivered dose.

[d] Acceptance is achieved when neither the absolute value of mean of the P values, nor the standard deviation of the P values exceed 0.15.

TABLE A-2 Thermoluminescent Dosimetry, (TLD, $CaSO_4$: Dy Cards). [a b]

Lab Code	Irradiation Date	Description	Delivered Dose (mrem)	Reported Dose (mrem)	Performance Quotient (P) [c]	
Environmental, Inc.		Group 2				
2017-2	10/16/2017	Spike 31	186.0	156.7	-0.16	
2017-2	10/16/2017	Spike 32	186.0	163.6	-0.12	
2017-2	10/16/2017	Spike 33	186.0	159.2	-0.14	
2017-2	10/16/2017	Spike 34	186.0	152.8	-0.18	
2017-2	10/16/2017	Spike 35	186.0	163.3	-0.12	
2017-2	10/16/2017	Spike 36	186.0	168.4	-0.09	
2017-2	10/16/2017	Spike 37	186.0	168.1	-0.10	
2017-2	10/16/2017	Spike 38	186.0	157.4	-0.15	
2017-2	10/16/2017	Spike 39	186.0	166.1	-0.11	
2017-2	10/16/2017	Spike 40	186.0	164.3	-0.12	
2017-2	10/16/2017	Spike 41	186.0	159.6	-0.14	
2017-2	10/16/2017	Spike 42	186.0	153.2	-0.18	
2017-2	10/16/2017	Spike 43	186.0	158.2	-0.15	
2017-2	10/16/2017	Spike 44	186.0	164.0	-0.12	
2017-2	10/16/2017	Spike 45	186.0	164.5	-0.12	
2017-2	10/16/2017	Spike 46	186.0	161.2	-0.13	
2017-2	10/16/2017	Spike 47	186.0	160.8	-0.14	
2017-2	10/16/2017	Spike 48	186.0	158.8	-0.15	
2017-2	10/16/2017	Spike 49	186.0	157.9	-0.15	
2017-2	10/16/2017	Spike 50	186.0	158.6	-0.15	
2017-2	10/16/2017	Spike 51	186.0	153.3	-0.18	
2017-2	10/16/2017	Spike 52	186.0	165.0	-0.11	
2017-2	10/16/2017	Spike 53	186.0	164.7	-0.11	
2017-2	10/16/2017	Spike 54	186.0	152.2	-0.18	
2017-2	10/16/2017	Spike 55	186.0	158.0	-0.15	
2017-2	10/16/2017	Spike 56	186.0	156.5	-0.16	
2017-2	10/16/2017	Spike 57	186.0	155.9	-0.16	
2017-2	10/16/2017	Spike 58	186.0	152.1	-0.18	
2017-2	10/16/2017	Spike 59	186.0	157.6	-0.15	
2017-2	10/16/2017	Spike 60	186.0	157.0	-0.16	
Mean (Spike 31-60)				159.6	-0.14	Pass[d]
Standard Deviation (Spike 31-60)				4.7	0.03	Pass[d]

[a] Table A-2 assumes 1 roentgen = 1 rem (NRC -Health Physics Questions and Answers 10 CFR Part 20 - Question 96 - Page Last Reviewed/Updated Thursday, October 01, 2015).

[b] TLD's were irradiated by the University of Wisconsin-Madison Radiation Calibration Laboratory following ANSI N13.37 protocol from a known air kerma rate. TLD's were read and the results were submitted by Environmental Inc. to the University of Wisconsin-Madison Radiation Calibration Laboratory for comparison to the delivered dose.

[c] Performance Quotient (P) is calculated as ((reported dose - conventially true value) + conventially true value) where the conventially true value is the delivered dose.

[d] Acceptance is achieved when neither the absolute value of mean of the P values, nor the standard deviation of the P values exceed 0.15.

TABLE A-3. In-House "Spiked" Samples

Lab Code [b]	Date	Concentration [a]				
		Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
W-010417	4/29/2016	Cs-134	38.2 ± 8.1	36.2	29.0 - 43.4	Pass
W-010417	4/29/2016	Cs-137	78.0 ± 8.8	71.9	57.5 - 86.3	Pass
SPW-306	1/4/2017	Ra-226	18.1 ± 0.4	16.7	13.4 - 20.1	Pass
SPW-32	1/6/2017	H-3	17,849 ± 393	17,243	10,346 - 24,140	Pass
SPW-46	1/9/2017	Gr. Alpha	20.0 ± 0.4	20.1	16.1 - 24.1	Pass
SPW-46	1/9/2017	Gr. Beta	29.0 ± 0.3	28.9	23.1 - 34.6	Pass
SPW-92	1/11/2017	H-3	18,095 ± 397	17,243	10,346 - 24,140	Pass
SPW-142	1/12/2017	Sr-90	39.4 ± 2.3	36.6	29.3 - 43.9	Pass
SPW-155	1/19/2017	H-3	17,974 ± 400	17,243	10,346 - 24,140	Pass
SPW-186	1/23/2017	H-3	17,383 ± 366	17,243	10,346 - 24,140	Pass
SPW-232	1/19/2017	H-3	17,542 ± 368	17,243	10,346 - 24,140	Pass
SPW-304	1/26/2017	H-3	17,782 ± 400	17,243	10,346 - 24,140	Pass
SPW-333	1/30/2017	H-3	17,910 ± 406	17,243	10,346 - 24,140	Pass
SPW-353	2/2/2017	U-234	47.8 ± 2.3	41.7	33.4 - 50.0	Pass
SPW-353	2/2/2017	U-238	50.4 ± 2.4	41.7	33.4 - 50.0	Pass
W-020217	4/29/2016	Cs-134	33.7 ± 6.1	36.2	29.0 - 43.4	Pass
W-020217	4/29/2016	Cs-137	78.4 ± 7.3	71.9	57.5 - 86.3	Pass
SPW-412	2/6/2017	Sr-90	36.2 ± 2.4	36.6	29.3 - 43.9	Pass
SPW-465	2/8/2017	H-3	17,573 ± 396	17,243	10,346 - 24,140	Pass
SPW-561	2/15/2017	H-3	17,358 ± 395	17,243	10,346 - 24,140	Pass
SPW-605	2/16/2017	H-3	17,820 ± 401	17,243	10,346 - 24,140	Pass
SPW-657	2/17/2017	H-3	17,614 ± 376	17,243	10,346 - 24,140	Pass
SPW-714	2/23/2017	H-3	17,662 ± 400	17,243	10,346 - 24,140	Pass
SPW-737	2/28/2017	H-3	17,196 ± 395	17,243	10,346 - 24,140	Pass
SPAP-740	2/28/2017	Gr. Beta	38.9 ± 0.1	41.5	33.2 - 49.8	Pass
SPAP-742	2/24/2017	Cs-134	1.05 ± 0.60	0.98	0.78 - 1.18	Pass
SPAP-742	2/24/2017	Cs-137	90.4 ± 2.5	92.9	74.3 - 111.5	Pass
SPW-746	2/28/2017	Sr-90	42.8 ± 2.5	36.6	29.3 - 43.9	Pass
SPW-748	2/28/2017	C-14	4270 ± 17	4735	3788 - 5682	Pass
SPW-750	2/28/2017	Ni-63	463 ± 4	400	240 - 560	Pass
SPF-752	2/28/2017	Cs-134	1033 ± 38	1090	870 - 1300	Pass
SPF-752	2/28/2017	Cs-137	3071 ± 61	2820	2250 - 3380	Pass
SPW-781	3/1/2017	Ra-226	18.1 ± 0.4	16.7	13.4 - 20.1	Pass
SPW-783	3/1/2017	H-3	17,653 ± 400	17,243	13,794 - 20,692	Pass
W-030517	4/29/2016	Cs-134	38.0 ± 9.0	36.2	29.0 - 43.4	Pass
W-030517	4/29/2016	Cs-137	80.9 ± 9.2	71.9	57.5 - 86.3	Pass
SPW-1010	3/14/2017	H-3	17,312 ± 395	17,243	13,794 - 20,692	Pass
SPW-1026	3/16/2017	Gr. Alpha	22.4 ± 0.5	20.1	12.0 - 28.1	Pass
SPW-1026	3/16/2017	Gr. Beta	29.2 ± 0.3	28.9	17.3 - 40.4	Pass
SPW-1092	3/21/2017	H-3	17,252 ± 390	17,243	13,794 - 20,692	Pass
SPW-1151	3/24/2017	H-3	17,009 ± 388	17,243	13,794 - 20,692	Pass
SPW-1163	3/28/2017	Sr-90	39.0 ± 2.3	36.3	29.0 - 43.5	Pass
SPW-1178	3/29/2017	Ra-228	15.1 ± 1.9	16.0	9.6 - 22.4	Pass

TABLE A-3. In-House "Spiked" Samples

Lab Code [b]	Date	Concentration [a] Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
SPW-1232	3/30/2017	H-3	17,150 ± 390	17,243	13,794 - 20,692	Pass
SPW-1246	3/31/2017	I-131(G)	33.0 ± 7.3	36.6	29.3 - 43.9	Pass
SPW-1246	3/31/2017	Cs-134	28.9 ± 4.6	26.6	21.3 - 31.9	Pass
SPW-1246	3/31/2017	Cs-137	80.6 ± 8.2	70.4	56.3 - 84.5	Pass
SPMI-1248	3/31/2017	I-131(G)	39.8 ± 7.0	36.6	29.3 - 43.9	Pass
SPMI-1248	3/31/2017	Cs-134	26.9 ± 5.9	26.6	21.3 - 31.9	Pass
SPMI-1248	3/31/2017	Cs-137	70.4 ± 6.9	70.4	56.3 - 84.5	Pass
SPMI-1248	3/31/2017	I-131	36.2 ± 0.6	36.6	29.3 - 43.9	Pass
SPW-1295	3/31/2017	Ra-226	17.9 ± 0.4	16.7	13.4 - 20.1	Pass
SPW-1304	4/4/2017	H-3	17,741 ± 398	17,243	13,794 - 20,692	Pass
SPW-1359	4/5/2017	I-131	44.3 ± 0.5	47.6	38.1 - 57.1	Pass
SPW-1378	4/7/2017	H-3	17,528 ± 395	17,243	13,794 - 20,692	Pass
SPW-1391	4/7/2017	Gr. Alpha	21.1 ± 0.4	20.1	12.0 - 28.1	Pass
SPW-1391	4/7/2017	Gr. Beta	27.8 ± 0.3	28.2	17.3 - 40.4	Pass
SPW-1480	4/12/2017	H-3	17,399 ± 392	17,243	13,794 - 20,692	Pass
W-041317	4/29/2016	Cs-134	34.6 ± 5.6	36.2	29.0 - 43.4	Pass
W-041317	4/29/2016	Cs-137	81.9 ± 8.0	71.9	57.5 - 86.3	Pass
SPW-1480	4/12/2017	H-3	17,399 ± 392	17,243	13,794 - 20,692	Pass
SPW-1575	4/18/2017	H-3	17,419 ± 393	17,243	13,794 - 20,692	Pass
SPW-1626	4/20/2017	Sr-90	37.2 ± 2.4	36.3	29.0 - 43.5	Pass
SPW-1658	4/21/2017	H-3	17,194 ± 391	17,243	13,794 - 20,692	Pass
SPW-1776	4/26/2017	H-3	16,609 ± 386	17,243	13,794 - 20,692	Pass
SPW-1806	4/27/2017	H-3	17,203 ± 390	17,243	13,794 - 20,692	Pass
SPW-1937	5/3/2017	H-3	16,690 ± 385	17,243	13,794 - 20,692	Pass
SPW-1971	5/5/2017	Sr-90	41.5 ± 2.2	36.3	29.0 - 43.5	Pass
SPW-2033	5/8/2017	H-3	16,780 ± 386	17,243	13,794 - 20,692	Pass
SPW-2420	5/9/2017	Ra-226	16.3 ± 0.5	16.7	13.4 - 20.1	Pass
W-051517	4/29/2016	Cs-134	36.3 ± 5.0	36.2	29.0 - 43.4	Pass
W-051517	4/29/2016	Cs-137	68.9 ± 6.6	71.9	57.5 - 86.3	Pass
SPW-2284	5/22/2017	H-3	16,935 ± 389	16,703	13,362 - 20,043	Pass
SPW-2354	5/23/2017	H-3	17,006 ± 390	16,700	13,360 - 20,040	Pass
SPW-2891	5/23/2017	Ra-226	17.5 ± 0.4	16.7	13.4 - 20.1	Pass
SPW-2418	5/23/2017	Ra-228	14.0 ± 1.8	16.0	11.2 - 20.8	Pass
SPW-2439	5/25/2017	Ra-228	13.0 ± 1.8	16.0	11.2 - 20.8	Pass
SPMI-2378	5/24/2017	Sr-89	83.7 ± 4.9	98.4	78.7 - 118.1	Pass
SPMI-2378	5/24/2017	Sr-90	39.5 ± 1.5	36.1	28.9 - 43.4	Pass
SPW-2468	5/26/2017	H-3	17,065 ± 391	16,692	13,354 - 20,031	Pass
SPW-2848	5/26/2017	I-131	56.4 ± 0.6	58.3	46.6 - 70.0	Pass
SPW-2502	6/1/2017	H-3	17,596 ± 396	16,677	13,342 - 20,012	Pass
SPW-2659	6/5/2017	H-3	17,027 ± 390	16,677	13,342 - 20,012	Pass
SPW-2790	6/9/2017	H-3	17,101 ± 392	17,101	13,325 - 19,988	Pass

TABLE A-3. In-House "Spiked" Samples

Lab Code [b]	Date	Concentration [a] Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
SPW-2798	6/12/2017	H-3	16,683 ± 364	16,649	13,319 - 19,978	Pass
SPW-2943	6/19/2017	Sr-90	39.2 ± 2.3	36.1	28.9 - 43.4	Pass
SPW-3509	6/15/2017	Ra-226	17.6 ± 0.5	16.7	13.4 - 20.1	Pass
W-061317	4/29/2016	Cs-134	35.0 ± 6.2	36.2	29.0 - 43.4	Pass
W-061317	4/29/2016	Cs-137	77.4 ± 7.8	71.9	57.5 - 86.3	Pass
SPW-3041	6/23/2017	H-3	16,419 ± 378	16,620	13,296 - 19,945	Pass
SPW-3511	6/23/2017	Ra-226	15.5 ± 0.6	16.7	13.4 - 20.1	Pass
SPW-3103	6/28/2017	H-3	16,507 ± 380	16,507	13,286 - 19,929	Pass
SPW-3117	6/29/2017	Tc-99	112.7 ± 1.9	107.8	86.2 - 129.4	Pass
SPW-3513	6/29/2017	Ra-226	17.8 ± 0.5	16.7	13.4 - 20.1	Pass
SPW-3188	7/3/2017	Sr-90	38.1 ± 2.2	36.1	28.9 - 43.4	Pass
SPW-3283	7/11/2017	H-3	16,057 ± 347	16,649	13,319 - 19,978	Pass
SPW-4054	7/11/2017	Ra-226	17.7 ± 0.4	16.0	11.2 - 20.8	Pass
SPW-3467	7/14/2017	Gr. Alpha	22.3 ± 0.5	20.1	12.0 - 28.1	Pass
SPW-3467	7/14/2017	Gr. Beta	29.1 ± 0.3	28.2	17.3 - 40.4	Pass
SPW-3449	7/15/2017	H-3	17,196 ± 393	16,507	13,286 - 19,929	Pass
SPW-3548	7/19/2017	H-3	16,764 ± 386	16,507	13,286 - 19,929	Pass
SPW-3728	7/24/2017	H-3	16,117 ± 354	16,507	13,286 - 19,929	Pass
SPW-3794	7/28/2017	H-3	16,645 ± 384	16,507	13,286 - 19,929	Pass
W-072817	4/29/2016	Cs-134	38.6 ± 5.6	36.2	29.0 - 43.4	Pass
W-072817	4/29/2016	Cs-137	76.5 ± 7.6	71.9	57.5 - 86.3	Pass
SPW-3905	8/3/2017	Gr. Alpha	22.3 ± 0.5	20.1	12.0 - 28.1	Pass
SPW-3905	8/3/2017	Gr. Beta	27.6 ± 0.3	28.2	17.3 - 40.4	Pass
SPW-4030	8/9/2017	H-3	17,636 ± 403	16,507	13,286 - 19,929	Pass
SPW-4086	8/14/2017	H-3	17,472 ± 401	16,507	13,286 - 19,929	Pass
SPW-4207	8/17/2017	H-3	17,013 ± 393	16,507	13,286 - 19,929	Pass
W-083017	4/29/2016	Cs-134	34.7 ± 6.4	36.2	29.0 - 43.4	Pass
W-083017	4/29/2016	Cs-137	78.2 ± 6.7	71.9	57.5 - 86.3	Pass
SPW-4241	8/19/2017	H-3	17,222 ± 371	16,507	13,286 - 19,929	Pass
SPW-4458	9/1/2017	Ra-226	14.1 ± 1.8	16.7	13.4 - 20.1	Pass
SPW-4466	9/6/2017	Sr-89	22.8 ± 8.5	26.4	21.1 - 31.7	Pass
SPW-4466	9/6/2017	Sr-90	32.5 ± 2.1	33.8	27.0 - 40.6	Pass
SPW-4512	9/8/2017	Gr. Alpha	19.2 ± 0.4	20.1	10.1 - 30.2	Pass
SPW-4512	9/8/2017	Gr. Beta	27.8 ± 0.3	27.9	22.3 - 33.5	Pass
SPW-4586	9/9/2017	H-3	16,586 ± 362	16,507	13,286 - 19,929	Pass
SPW-4720	9/16/2017	H-3	16,439 ± 362	16,507	13,286 - 19,929	Pass
SPW-4834	9/22/2017	H-3	16,238 ± 376	16,507	13,286 - 19,929	Pass
SPW-4935	9/27/2017	H-3	16,595 ± 381	16,507	13,286 - 19,929	Pass
SPW-4937	9/27/2017	Ra-228	5.7 ± 0.9	5.8	4.1 - 7.5	Pass
W-092717	4/29/2016	Cs-134	36.0 ± 5.9	36.2	29.0 - 43.4	Pass
W-092717	4/29/2016	Cs-137	82.6 ± 6.5	71.9	57.5 - 86.3	Pass
SPW-5001	9/29/2017	H-3	16,446 ± 358	16,507	13,286 - 19,929	Pass

TABLE A-3. In-House "Spiked" Samples

Lab Code [b]	Date	Concentration [a] Analysis	Laboratory results 2s, n=1 [c]	Known Activity	Control Limits [d]	Acceptance
SPW-5134	10/6/2017	H-3	16,128 ± 373	16,507	13,286 - 19,929	Pass
SPW-5274	10/12/2017	H-3	16,108 ± 374	16,507	13,286 - 19,929	Pass
W-101217S	10/12/2017	Fe-55	1,491 ± 77	1,482	1,186 - 01,778	Pass
SPW-5408	10/18/2017	Ni-63	203 ± 3	199	159 - 238	Pass
SPW-5430	10/19/2017	H-3	16,453 ± 380	16,507	13,286 - 19,929	Pass
W-102017	4/29/2016	Cs-134	31.3 ± 4.9	36.2	29.0 - 43.4	Pass
W-102017	4/29/2016	Cs-137	80.4 ± 6.9	71.9	57.5 - 86.3	Pass
SPW-5674	10/25/2017	H-3	16,313 ± 380	16,507	13,286 - 19,929	Pass
SPW-5719	10/27/2017	H-3	16,113 ± 350	16,507	13,286 - 19,929	Pass
SPW-5730	10/31/2017	H-3	16,776 ± 387	16,507	13,286 - 19,929	Pass
SPW-5944	10/27/2017	Ra-226	16.4 ± 0.5	16.7	13.4 - 20.1	Pass
SPW-5915	11/9/2017	H-3	16,930 ± 390	16,507	13,286 - 19,929	Pass
SPW-5989	11/11/2017	H-3	16,084 ± 352	16,507	13,286 - 19,929	Pass
W-111417	4/29/2016	Cs-134	38.1 ± 6.2	36.2	29.0 - 43.4	Pass
W-111417	4/29/2016	Cs-137	74.0 ± 7.5	71.9	57.5 - 86.3	Pass
SPW-6121	11/16/2017	H-3	16,276 ± 378	16,507	13,286 - 19,929	Pass
SPW-6132	11/20/2017	H-3	15,897 ± 374	16,507	13,286 - 19,929	Pass
SPW-6249	11/30/2017	Ra-226	12.2 ± 0.4	12.3	9.8 - 14.8	Pass
SPW-6226	12/1/2017	H-3	16,164 ± 378	16,507	13,286 - 19,929	Pass
SPW-6318	12/7/2017	H-3	15,779 ± 372	16,507	13,286 - 19,929	Pass
W-120817	4/29/2016	Cs-134	29.5 ± 5.6	36.2	29.0 - 43.4	Pass
W-120817	4/29/2016	Cs-137	78.8 ± 9.6	71.9	57.5 - 86.3	Pass
SPW-65	12/11/2017	Ra-226	12.5 ± 0.4	12.3	9.8 - 14.8	Pass
SPW-6437	12/13/2017	Gr. Alpha	19.6 ± 0.4	20.1	10.1 - 30.2	Pass
SPW-6437	12/13/2017	Gr. Beta	28.2 ± 0.3	27.9	22.3 - 33.5	Pass
SPW-6463	12/15/2017	H-3	15,560 ± 372	16,507	13,286 - 19,929	Pass

[a] Liquid sample results are reported in pCi/Liter, air filters (pCi/m3), charcoal (pCi/charcoal canister), and solid samples (pCi/kg).

[b] Laboratory codes : W (Water), MI (milk), AP (air filter), SO (soil), VE (vegetation), CH (charcoal canister), F (fish), U (urine).

[c] Results are based on single determinations.

[d] Control limits are established from the precision values listed in Attachment A of this report, adjusted to ± 2s.

NOTE: For fish, gelatin is used for the spike matrix. For vegetation, cabbage is used for the spike matrix.

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis[b]	Concentration [a]		
				Laboratory results (4.66σ)		Acceptance
				LLD	Activity[c]	Criteria (4.66 σ)
SPW-31	Water	1/6/2017	H-3	143	71 ± 75	200
SPW-45	Water	1/9/2017	Gr. Alpha	0.41	0.09 ± 0.30	2
SPW-45	Water	1/9/2017	Gr. Beta	0.74	-0.56 ± 0.50	4
SPW-91	Water	1/11/2017	H-3	151	-23 ± 71	200
SPW-141	Water	1/12/2017	Sr-89	0.55	0.29 ± 0.47	5
SPW-141	Water	1/12/2017	Sr-90	0.67	-0.02 ± 0.31	1
SPW-154	Water	1/19/2017	H-3	155	-17 ± 73	200
SPW-185	Water	1/23/2017	H-3	176	44 ± 94	200
SPW-231	Water	1/19/2017	H-3	179	26 ± 87	200
SPW-303	Water	1/26/2017	H-3	160	8 ± 77	200
SPW-305	Water	1/4/2017	Ra-226	0.02	0.02 ± 0.01	2
SPW-307	Water	1/27/2017	I-131	0.21	0.01 ± 0.11	1.00
SPW-332	Water	1/30/2017	H-3	169	-52 ± 86	200
SPW-352	Water	2/2/2017	U-234	0.14	0.00 ± 0.08	1
SPW-352	Water	2/2/2017	U-238	0.14	0.12 ± 0.15	1
SPW-411	Water	2/6/2017	Sr-89	0.49	0.30 ± 0.35	5
SPW-411	Water	2/6/2017	Sr-90	0.52	-0.22 ± 0.21	1
SPW-464	Water	2/8/2017	H-3	155	2 ± 74	200
SPW-560	Water	2/15/2017	H-3	156	38 ± 77	200
SPW-604	Water	2/16/2017	H-3	154	59 ± 77	200
SPW-656	Water	2/17/2017	H-3	187	28 ± 94	200
SPW-713	Water	2/23/2017	H-3	161	20 ± 81	200
SPW-736	Water	2/28/2017	H-3	161	-75 ± 76	200
SPAP-739	AP	2/28/2017	Gr. Beta	0.002	0.004 ± 0.001	0.01
SPAP-741	AP	2/24/2017	Cs-134	2.27	-0.95 ± 1.29	100
SPAP-741	AP	2/24/2017	Cs-137	2.65	0.17 ± 1.67	100
SPW-747	Water	2/28/2017	C-14	161	-28 ± 97	200
SPW-749	Water	2/28/2017	Ni-63	17	-3 ± 10	200
SPF-751	Fish	2/28/2017	Cs-134	0.008	0.002 ± 0.004	100
SPF-751	Fish	2/28/2017	Cs-137	0.008	0.000 ± 0.005	100
SPW-780	Water	3/1/2017	Ra-226	0.02	0.02 ± 0.01	2
SPW-782	Water	3/1/2017	H-3	154	35 ± 78	200
SPW-3506	Water	3/1/2017	Ra-226	0.03	0.02 ± 0.02	2
SPW-836	Water	3/3/2017	I-131	0.38	0.04 ± 0.18	1
SPW-1009	Water	3/14/2017	H-3	154	-31 ± 72	200
SPW-1025	Water	3/16/2017	Gr. Alpha	0.43	-0.16 ± 0.28	2
SPW-1025	Water	3/16/2017	Gr. Beta	0.75	-0.24 ± 0.52	4
SPW-1091	Water	3/21/2017	H-3	145	60 ± 73	200
SPW-1150	Water	3/24/2017	H-3	152	-31 ± 71	200
SPW-1162	Water	3/28/2017	Sr-89	0.61	-0.39 ± 0.45	5
SPW-1162	Water	3/28/2017	Sr-90	0.52	0.18 ± 0.27	1

[a] Liquid sample results are reported in pCi/Liter, air filters (pCi/m^3), charcoal (pCi/charcoal canister), and solid samples (pCi/g).

[b] I-131(G); iodine-131 as analyzed by gamma spectroscopy.

[c] Activity reported is a net activity result.

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis[b]	Concentration [a]		
				Laboratory results (4.66σ)		Acceptance
				LLD	Activity[c]	Criteria (4.66 σ)
SPW-1177	Water	3/29/2017	Ra-228	0.83	-0.14 ± 0.36	2
SPW-1231	Water	3/30/2017	H-3	150	24 ± 73	200
SPW-1245	Water	3/31/2017	Cs-134	3.73	0.43 ± 2.18	100
SPW-1245	Water	3/31/2017	Cs-137	3.01	-1.23 ± 2.12	100
SPW-1245	Water	3/31/2017	I-131(G)	5.39	0.92 ± 2.15	100
SPW-1245	Water	3/31/2017	I-131	0.32	0.03 ± 0.18	1
SPMI-1247	Milk	3/31/2017	Cs-134	3.70	1.23 ± 1.96	100
SPMI-1247	Milk	3/31/2017	Cs-137	3.62	-0.84 ± 2.15	100
SPMI-1247	Milk	3/31/2017	I-131(G)	4.42	0.39 ± 2.14	100
SPW-1294	Water	3/31/2017	Ra-226	0.02	0.18 ± 0.02	2
SPW-1303	Water	4/4/2017	H-3	151	8 ± 75	200
SPW-1377	Water	4/7/2017	H-3	150	29 ± 72	200
SPW-1390	Water	4/7/2017	Gr. Alpha	0.42	0.15 ± 0.31	2
SPW-1390	Water	4/7/2017	Gr. Beta	0.73	-0.17 ± 0.51	4
SPW-1479	Water	4/12/2017	H-3	151	89 ± 77	200
SPW-1574	Water	4/18/2017	H-3	144	55 ± 79	200
SPW-1625	Water	4/20/2017	Sr-89	0.59	-0.01 ± 0.50	5
SPW-1625	Water	4/20/2017	Sr-90	0.71	0.16 ± 0.35	1
SPW-1657	Water	4/21/2017	H-3	147	34 ± 73	200
SPW-1775	Water	4/26/2017	H-3	155	67 ± 80	200
SPW-1805	Water	4/27/2017	H-3	153	15 ± 74	200
SPW-1936	Water	5/3/2017	H-3	148	33 ± 71	200
SPW-1970	Water	5/5/2017	Sr-89	0.66	0.34 ± 0.54	5
SPW-1970	Water	5/5/2017	Sr-90	0.62	-0.08 ± 0.28	1
SPW-2032	Water	5/8/2017	H-3	147	66 ± 73	200
SPW-2419	Water	5/9/2017	Ra-226	0.03	0.01 ± 0.03	2
SPW-2283	Water	5/22/2017	H-3	155	24 ± 78	200
SPW-2353	Water	5/23/2017	H-3	151	56 ± 76	200
SPW-2890	Water	5/23/2017	Ra-226	0.03	-0.01 ± 0.02	2
SPMI-2377	Milk	5/24/2017	Sr-89	0.78	0.86 ± 0.93	5
SPMI-2377	Milk	5/24/2017	Sr-90	0.49	0.95 ± 0.33	1
SPW-2438	Water	5/25/2017	Ra-228	0.90	-0.28 ± 0.38	2
SPW-2467	Water	5/26/2017	H-3	152	27 ± 77	200
SPW-2417	Water	5/26/2017	Ra-228	0.80	1.58 ± 0.54	2
SPW-2447	Water	5/26/2017	I-131	0.21	-0.05 ± 0.12	1
SPW-2501	Water	6/1/2017	H-3	151	-23 ± 70	200
SPW-2658	Water	6/5/2017	H-3	152	107 ± 78	200
SPW-2789	Water	6/9/2017	H-3	150	52 ± 77	200
SPW-2797	Water	6/12/2017	H-3	177	7 ± 93	200
SPW-2847	Water	6/14/2017	I-131	0.18	0.03 ± 0.10	1

[a] Liquid sample results are reported in pCi/Liter, air filters (pCi/m^3), charcoal (pCi/charcoal canister), and solid samples (pCi/g).

[b] I-131(G); Iodine-131 as analyzed by gamma spectroscopy.

[c] Activity reported is a net activity result.

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis[b]	Concentration[a] Laboratory results (4.66σ) LLD	Activity[c]	Acceptance Criteria (4.66 σ)
SPW-3508	Water	6/15/2017	Ra-226	0.03	0.00 ± 0.02	2
SPW-2942	Water	6/19/2017	Sr-89	0.58	0.80 ± 0.53	5
SPW-2942	Water	6/19/2017	Sr-90	0.50	0.15 ± 0.25	1
SPW-3042	Water	6/23/2017	H-3	146	25 ± 74	200
SPW-3510	Water	6/23/2017	Ra-226	0.02	0.03 ± 0.02	2
SPW-3102	Water	6/28/2017	H-3	148	-7 ± 73	200
SPW-3116	Water	6/29/2017	Tc-99	5.91	-0.39 ± 3.58	10
SPW-3512	Water	6/29/2017	Ra-226	0.02	-0.01 ± 0.02	2
SPW-3187	Water	7/3/2017	Sr-89	0.62	0.00 ± 0.48	5
SPW-3187	Water	7/3/2017	Sr-90	0.48	0.07 ± 0.23	1
SPW-3282	Water	7/11/2017	H-3	178	-37 ± 84	200
SPW-4053	Water	7/11/2017	Ra-226	0.03	0.02 ± 0.02	2
SPW-3466	Water	7/14/2017	Gr. Alpha	0.42	-0.09 ± 0.28	2
SPW-3466	Water	7/14/2017	Gr. Beta	0.76	-0.18 ± 0.53	4
SPW-3448	Water	7/15/2017	H-3	150	54 ± 77	200
SPW-3727	Water	7/27/2017	Ni-63	90	18 ± 55	200
SPW-3793	Water	7/28/2017	H-3	151	47 ± 82	200
SPW-3904	Water	8/3/2017	Gr. Alpha	0.47	-0.02 ± 0.33	2
SPW-3904	Water	8/3/2017	Gr. Beta	0.75	-0.11 ± 0.52	4
SPW-4029	Water	8/9/2017	H-3	159	11 ± 79	200
SPW-4206	Water	8/17/2017	H-3	157	55 ± 76	200
SPW-4241	Water	8/19/2017	H-3	190	61 ± 96	200
SPW-4085	Water	8/14/2017	H-3	159	-28 ± 77	200
SPW-4206	Water	8/17/2017	H-3	157	55 ± 76	200
SPW-4241	Water	8/19/2017	H-3	190	61 ± 96	200
SPW-4457	Water	9/1/2017	Ra-228	0.78	-0.02 ± 0.36	2
SPW-4465	Water	9/6/2017	Sr-89	0.51	0.30 ± 0.37	5
SPW-4465	Water	9/6/2017	Sr-90	0.46	-0.09 ± 0.20	1
SPW-4585	Water	9/9/2017	H-3	187	-86 ± 83	200
SPW-5720	Water	9/13/2017	Ra-226	0.02	0.13 ± 0.02	2
SPW-4703	Water	9/15/2017	I-131	0.17	0.10 ± 0.10	1
SPW-4719	Water	9/16/2017	H-3	184	-86 ± 93	200
SPW-4833	Water	9/22/2017	H-3	150	5 ± 72	200
SPW-4934	Water	9/27/2017	H-3	148	5 ± 70	200
SPW-4936	Water	9/27/2017	Ra-228	0.80	0.55 ± 0.44	2
SPW-5000	Water	9/29/2017	H-3	183	-13 ± 90	200
SPW-5133	Water	10/6/2017	H-3	144	64 ± 71	200
SPW-5273	Water	10/12/2017	H-3	142	106 ± 72	200

[a] Liquid sample results are reported in pCi/Liter, air filters (pCi/m^3), charcoal (pCi/charcoal canister), and solid samples (pCi/g).

[b] I-131(G); iodine-131 as analyzed by gamma spectroscopy.

[c] Activity reported is a net activity result.

TABLE A-4. In-House "Blank" Samples

Lab Code	Sample Type	Date	Analysis[b]	Concentration [a]		
				Laboratory results (4.66σ)		Acceptance
				LLD	Activity[c]	Criteria (4.66 σ)
SPW-5407	Water	10/18/2017	Ni-63	69	43 ± 43	200
SPW-5429	Water	10/19/2017	H-3	148	54 ± 72	200
SPW-5603	Water	10/23/2017	Sr-89	0.57	0.16 ± 0.47	5
SPW-5603	Water	10/23/2017	Sr-90	0.70	-0.12 ± 0.31	1
SPW-5673	Water	10/25/2017	H-3	156	-36 ± 71	200
SPW-5718	Water	10/27/2017	H-3	182	45 ± 92	200
SPW-5943	Water	10/27/2017	Ra-226	0.02	0.08 ± 0.02	2
SPW-5723	Water	10/30/2017	I-131	0.10	0.03 ± 0.07	1
SPW-5914	Water	11/09/17	H-3	149	-39 ± 68	200
SPW-5988	Water	11/11/2017	H-3	183	-8 ± 88	200
SPW-6120	Water	11/16/2017	H-3	146	83 ± 75	200
SPW-6131	Water	11/20/2017	H-3	151	16 ± 72	200
SPW-6197	Water	11/29/2017	I-131	0.38	0.01 ± 0.18	1
SPW-6248	Water	11/30/2017	Ra-226	0.03	0.15 ± 0.03	2
SPW-6225	Water	12/1/2017	H-3	154	-10 ± 72	200
SPW-6317	Water	12/7/2017	H-3	148	44 ± 74	200
SPW-64	Water	12/11/2017	Ra-226	0.03	0.18 ± 0.03	2
SPW-6436	Water	12/13/2017	Gr. Alpha	0.54	-0.17 ± 0.37	2
SPW-6436	Water	12/13/2017	Gr. Beta	0.74	0.12 ± 0.52	4
SPW-6464	Water	12/15/2017	H-3	148	31 ± 75	200

[a] Liquid sample results are reported in pCi/Liter, air filters (pCi/m^3), charcoal (pCi/charcoal canister), and solid samples (pCi/g).

[b] I-131(G); iodine-131 as analyzed by gamma spectroscopy.

[c] Activity reported is a net activity result.

TABLE A-5. In-House "Duplicate" Samples

			Concentration [a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
AP-7178,7179	1/3/2017	Be-7	0.047 ± 0.015	0.062 ± 0.017	0.054 ± 0.012	Pass
SW-6986,6987	1/3/2017	Gr. Beta	1.39 ± 0.41	0.77 ± 0.41	1.08 ± 0.29	Pass
E-66,67	1/3/2017	Gr. Beta	1.62 ± 0.05	1.45 ± 0.04	1.54 ± 0.11	Pass
E-66,67	1/3/2017	K-40	1.26 ± 0.14	1.39 ± 0.16	1.32 ± 0.11	Pass
CF-87,88	1/3/2017	Be-7	0.25 ± 0.11	0.30 ± 0.12	0.28 ± 0.08	Pass
CF-87,88	1/3/2017	K-40	7.77 ± 0.39	6.84 ± 0.37	7.31 ± 0.27	Pass
AP-011217	1/12/2017	Be-7	0.137 ± 0.078	0.139 ± 0.082	0.138 ± 0.056	Pass
MI-212,213	1/16/2017	K-40	1,515 ± 98	1,347 ± 107	1,431 ± 73	Pass
WW-321,322	1/19/2017	H-3	675 ± 118	506 ± 133	590 ± 89	Pass
WW-674,675	1/20/2017	H-3	7,326 ± 254	7,717 ± 259	7,522 ± 181	Pass
AP-012317	1/23/2017	Gr. Beta	0.034 ± 0.005	0.038 ± 0.005	0.036 ± 0.004	Pass
WW-298,299	1/24/2017	H-3	5,916 ± 239	5764 ± 237	5840 ± 168	Pass
AP-013117	1/30/2017	Gr. Beta	0.027 ± 0.004	0.028 ± 0.004	0.028 ± 0.003	Pass
WW-500,501	1/31/2017	H-3	1,058 ± 122	1,054 ± 121	1,056 ± 86	Pass
SW-391,392	1/31/2017	Gr. Beta	1.40 ± 0.56	1.62 ± 0.61	1.51 ± 0.41	Pass
SPS-370,371	2/1/2017	K-40	23.47 ± 0.66	23.11 ± 0.72	23.29 ± 0.49	Pass
AP-456,457	2/2/2017	Be-7	0.129 ± 0.076	0.167 ± 0.092	0.148 ± 0.060	Pass
AP-020217	2/2/2017	Gr. Beta	0.021 ± 0.004	0.027 ± 0.004	0.024 ± 0.003	Pass
SPS-414,415	2/3/2017	K-40	19.45 ± 1.85	21.58 ± 1.99	20.52 ± 1.36	Pass
AP-020617	2/6/2017	Gr. Beta	0.023 ± 0.004	0.023 ± 0.004	0.023 ± 0.003	Pass
AP-021417A	2/14/2017	Gr. Beta	0.031 ± 0.004	0.030 ± 0.004	0.030 ± 0.003	Pass
SPW-543	2/14/2017	Gr. Beta	7.99 ± 0.82	9.45 ± 0.88	8.72 ± 0.60	Pass
AP-021417B	2/14/2017	Gr. Beta	0.024 ± 0.004	0.028 ± 0.004	0.026 ± 0.003	Pass
WW-718,719	2/14/2017	H-3	737 ± 113	643 ± 110	690 ± 79	Pass
AP-022017	2/20/2017	Gr. Beta	0.018 ± 0.005	0.021 ± 0.005	0.020 ± 0.004	Pass
WW-755,756	2/22/2017	H-3	3,709 ± 196	3,823 ± 198	3,766 ± 139	Pass
AP-022717	2/27/2017	Gr. Beta	0.021 ± 0.004	0.019 ± 0.004	0.020 ± 0.003	Pass
SPDW-80011,2	3/2/2017	Ra-226	7.29 ± 0.32	6.76 ± 0.30	7.03 ± 0.22	Pass
SPDW-80011,2	3/2/2017	Ra-228	4.68 ± 0.82	6.29 ± 1.03	5.49 ± 0.66	Pass
SPDW-80013,4	3/2/2017	Gr. Alpha	13.57 ± 1.43	12.44 ± 1.37	13.01 ± 0.99	Pass
WW-845,846	3/2/2017	H-3	314 ± 93	249 ± 90	281 ± 65	Pass
AP-030617	3/6/2017	Gr. Beta	0.022 ± 0.004	0.019 ± 0.004	0.020 ± 0.003	Pass
WW-1050,1051	3/8/2017	H-3	14,994 ± 364	14,745 ± 362	14,870 ± 257	Pass
SPS-920,921	3/9/2017	K-40	23.30 ± 1.76	23.13 ± 1.64	23.21 ± 1.20	Pass
WW-1004,1005	3/13/2017	H-3	182 ± 80	158 ± 79	170 ± 56	Pass
SPS-1029,1030	3/15/2017	K-40	11.82 ± 0.68	12.01 ± 0.68	11.92 ± 0.48	Pass
AP-031517	3/15/2017	Gr. Beta	0.020 ± 0.003	0.020 ± 0.003	0.020 ± 0.002	Pass
SPDW-80037,8	3/20/2017	Gr. Alpha	4.54 ± 0.82	5.29 ± 0.91	4.91 ± 0.61	Pass
AP-032017	3/20/2017	Gr. Beta	0.021 ± 0.006	0.021 ± 0.006	0.021 ± 0.005	Pass
WW-1094,1095	3/20/2017	H-3	1,571 ± 137	1,595 ± 138	1,583 ± 175	Pass

TABLE A-5. In-House "Duplicate" Samples

			Concentration[B]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
WW-1175,1176	3/20/2017	H-3	218 ± 84	211 ± 84	214 ± 59	Pass
WW-1129,1130	3/21/2017	Gr. Beta	3.51 ± 1.24	2.99 ± 1.17	3.25 ± 0.85	Pass
WW-1219,1220	3/22/2017	H-3	11,467 ± 322	11,516 ± 323	11,492 ± 200	Pass
SPS-1152,1153	3/27/2017	Ac-228	20.39 ± 0.75	20.43 ± 0.88	20.41 ± 0.58	Pass
SPS-1152,1153	3/27/2017	Pb-214	17.22 ± 0.50	16.44 ± 0.52	16.83 ± 0.36	Pass
SPDW-80047,8	3/28/2017	Ra-226	2.06 ± 0.23	1.60 ± 0.32	1.83 ± 0.20	Pass
SPDW-80047,8	3/28/2017	Ra-228	0.53 ± 0.48	0.78 ± 0.49	0.66 ± 0.34	Pass
SWU-1242,1243	3/28/2017	Gr. Beta	2.04 ± 0.81	2.47 ± 0.69	2.26 ± 0.53	Pass
SPS-1198,1199	3/29/2017	K-40	16.95 ± 1.85	18.33 ± 1.71	17.64 ± 1.26	Pass
SPDW-80050,1	3/29/2017	Gr. Alpha	3.19 ± 0.80	3.39 ± 0.78	3.29 ± 0.56	Pass
SPDW-80050,1	3/29/2017	Gr. Beta	1.58 ± 0.60	2.08 ± 0.63	1.83 ± 0.44	Pass
AP-1706,1707	3/30/2017	Be-7	0.068 ± 0.018	0.072 ± 0.017	0.070 ± 0.012	Pass
SW-1381,1382	4/5/2017	H-3	402 ± 92	309 ± 88	356 ± 64	Pass
WW-1446,1447	4/6/2017	H-3	305 ± 89	358 ± 91	332 ± 64	Pass
WW-1532,1533	4/10/2017	H-3	19,124 ± 412	18,991 ± 410	19,058 ± 291	Pass
WW-1618,1619	4/12/2017	H-3	4,187 ± 203	4,305 ± 205	4,246 ± 144	Pass
SS-1553,1554	4/13/2017	Gr. Beta	7.16 ± 0.99	6.09 ± 0.91	6.63 ± 0.67	Pass
SS-1553,1554	4/13/2017	K-40	4.60 ± 0.32	4.84 ± 0.34	4.72 ± 0.23	Pass
SS-1553,1554	4/13/2017	Tl-208	0.038 ± 0.016	0.032 ± 0.011	0.035 ± 0.010	Pass
SS-1553,1554	4/13/2017	Pb-212	0.101 ± 0.015	0.096 ± 0.015	0.098 ± 0.010	Pass
SS-1553,1554	4/13/2017	Bi-214	0.094 ± 0.032	0.109 ± 0.022	0.101 ± 0.019	Pass
SS-1553,1554	4/13/2017	Ac-228	0.089 ± 0.042	0.111 ± 0.046	0.100 ± 0.031	Pass
P-2015,2016	5/4/2017	H-3	189 ± 80	212 ± 81	200 ± 57	Pass
WW-2336,2337	5/8/2017	H-3	422 ± 97	298 ± 91	360 ± 66	Pass
AP-051117	5/11/2017	Gr. Beta	0.018 ± 0.003	0.025 ± 0.004	0.021 ± 0.002	Pass
WW-2497,2498	5/23/2017	H-3	1,268 ± 127	1,247 ± 126	1,257 ± 89	Pass
WW-2583,2584	5/23/2017	H-3	5,159 ± 224	5,223 ± 126	5,191 ± 129	Pass
WW-2732,2733	5/23/2017	H-3	8,559 ± 282	8,570 ± 283	8,564 ± 200	Pass
XW-1218,1219	5/23/2017	H-3	11,467 ± 282	11,516 ± 283	11,492 ± 200	Pass
MI-2428,2429	5/24/2017	K-40	1,752 ± 137	1,805 ± 132	1,778 ± 95	Pass
SO-2562,2563	5/24/2017	K-40	7.87 ± 0.50	8.64 ± 0.49	8.25 ± 0.35	Pass
WW-3023,3024	5/24/2017	H-3	27,398 ± 486	27,733 ± 489	27,565 ± 344	Pass
SO-2453,2454	5/25/2017	Gr. Beta	14.38 ± 0.93	15.70 ± 1.06	15.04 ± 0.70	Pass
SO-2453,2454	5/25/2017	Cs-137	0.17 ± 0.03	0.18 ± 0.03	0.17 ± 0.02	Pass
SO-2453,2454	5/25/2017	K-40	9.80 ± 0.50	9.19 ± 0.57	9.50 ± 0.38	Pass
SO-2453,2454	5/25/2017	Tl-208	0.09 ± 0.02	0.10 ± 0.03	0.09 ± 0.02	Pass
SO-2453,2454	5/25/2017	Pb-212	0.29 ± 0.03	0.30 ± 0.03	0.29 ± 0.02	Pass
SO-2453,2454	5/25/2017	Bi-214	0.24 ± 0.03	0.18 ± 0.04	0.21 ± 0.03	Pass
SO-2453,2454	5/25/2017	Ra-226	0.82 ± 0.22	0.62 ± 0.27	0.72 ± 0.17	Pass
SO-2453,2454	5/25/2017	Ac-228	0.32 ± 0.07	0.28 ± 0.08	0.30 ± 0.05	Pass

TABLE A-5. In-House "Duplicate" Samples

			Concentration [B]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
SWT-2625,2626	5/30/2017	Gr. Beta	0.64 ± 0.53	1.08 ± 0.55	0.86 ± 0.38	Pass
AP-053117	5/31/2017	Gr. Beta	0.013 ± 0.003	0.011 ± 0.003	0.012 ± 0.002	Pass
G-2646,2647	6/1/2017	Be-7	1.02 ± 0.17	1.06 ± 0.26	1.04 ± 0.15	Pass
G-2646,2647	6/1/2017	K-40	7.51 ± 0.49	6.55 ± 0.51	7.03 ± 0.36	Pass
SL-2669,70	6/1/2017	Be-7	0.34 ± 0.06	0.30 ± 0.06	0.32 ± 0.04	Pass
SL-2669,70	6/1/2017	K-40	4.35 ± 0.14	4.39 ± 0.15	4.37 ± 0.10	Pass
F-2711,2712	6/2/2017	K-40	2.56 ± 0.32	2.77 ± 0.44	2.66 ± 0.27	Pass
AP-060617	6/6/2017	Gr. Beta	0.026 ± 0.005	0.027 ± 0.005	0.027 ± 0.004	Pass
SW-2849,50	6/8/2017	H-3	8,178 ± 273	8,563 ± 279	8,371 ± 195	Pass
AP-061217	6/12/2017	Gr. Beta	0.027 ± 0.005	0.027 ± 0.005	0.027 ± 0.004	Pass
BS-3446,3447	6/12/2017	K-40	8.30 ± 0.47	8.57 ± 0.47	8.44 ± 0.33	Pass
VE-2870,2871	6/13/2017	K-40	3.65 ± 0.25	3.90 ± 0.26	3.77 ± 0.18	Pass
AP-2914,5	6/15/2017	Be-7	0.269 ± 0.146	0.212 ± 0.123	0.240 ± 0.095	Pass
AP-3067,8	6/15/2017	Be-7	0.204 ± 0.113	0.328 ± 0.126	0.266 ± 0.085	Pass
AP-061917	6/19/2017	Gr. Beta	0.020 ± 0.004	0.019 ± 0.004	0.020 ± 0.003	Pass
AP-3610,1	6/26/2017	Be-7	0.107 ± 0.015	0.116 ± 0.021	0.111 ± 0.013	Pass
AP-062617	6/26/2017	Gr. Beta	0.017 ± 0.004	0.021 ± 0.004	0.019 ± 0.003	Pass
AP-3673,3674	7/3/2017	Be-7	0.087 ± 0.008	0.078 ± 0.008	0.083 ± 0.006	Pass
AP-3287,3288	7/6/2017	Be-7	0.207 ± 0.112	0.244 ± 0.096	0.226 ± 0.074	Pass
WW-3308,3309	7/7/2017	H-3	549 ± 108	501 ± 107	525 ± 76	Pass
VE-3362,3363	7/12/2017	K-40	2.32 ± 0.17	2.40 ± 0.16	2.36 ± 0.12	Pass
VE-3589,3590	7/18/2017	K-40	5.25 ± 0.33	4.64 ± 0.33	4.94 ± 0.23	Pass
SG-3631,3632	7/18/2017	Pb-214	3.03 ± 0.11	2.97 ± 0.11	3.00 ± 0.08	Pass
SG-3631,3632	7/18/2017	Ac-228	2.47 ± 0.22	2.56 ± 0.23	2.52 ± 0.16	Pass
WW-3846,3847	7/25/2017	H-3	505 ± 101	446 ± 98	475 ± 70	Pass
F-4509,4510	7/26/2017	K-40	0.85 ± 0.25	1.00 ± 0.25	0.93 ± 0.18	Pass
F-4509,4510	7/26/2017	Gr. Beta	1.19 ± 0.03	1.18 ± 0.03	1.18 ± 0.02	Pass
G-3804,3805	7/27/2017	Be-7	3.72 ± 0.39	3.47 ± 0.40	3.59 ± 0.28	Pass
G-3804,3805	7/27/2017	K-40	4.21 ± 0.52	4.46 ± 0.52	4.34 ± 0.33	Pass
SL-3888,3889	8/1/2017	Be-7	0.77 ± 0.04	0.73 ± 0.07	0.75 ± 0.04	Pass
SL-3888,3889	8/1/2017	K-40	0.94 ± 0.04	0.87 ± 0.08	0.90 ± 0.23	Pass
WW-4158,4159	8/8/2017	H-3	321 ± 90	270 ± 88	295 ± 63	Pass
VE-4179,4180	8/14/2017	K-40	1.84 ± 0.18	1.90 ± 0.21	1.87 ± 0.14	Pass
AP-4289,4290	8/17/2017	Be-7	0.212 ± 0.095	0.162 ± 0.080	0.187 ± 0.062	Pass
F-4333,4334	8/18/2017	K-40	3.22 ± 0.41	3.62 ± 0.42	3.42 ± 0.29	Pass
CF-4310,4311	8/21/2017	K-40	10.94 ± 0.74	11.48 ± 0.50	11.21 ± 0.45	Pass
DW-80161,80162	8/22/2017	Ra-226	1.22 ± 0.15	1.19 ± 0.17	1.21 ± 0.11	Pass
DW-80161,80162	8/22/2017	Ra-228	1.99 ± 0.63	0.70 ± 0.49	1.35 ± 0.40	Pass
VE-4398,4399	8/28/2017	Be-7	0.13 ± 0.07	0.13 ± 0.08	0.13 ± 0.05	Pass

TABLE A-5. In-House "Duplicate" Samples

			Concentration [a]			
Lab Code	Date	Analysis	First Result	Second Result	Averaged Result	Acceptance
VE-4398,4399	8/28/2017	K-40	3.32 ± 0.22	3.48 ± 0.25	3.40 ± 0.17	Pass
SW-4463,4464	8/29/2017	H-3	495 ± 106	491 ± 106	493 ± 75	Pass
LW-4486,4487	8/31/2017	Gr. Beta	0.425 ± 0.471	1.358 ± 0.571	0.892 ± 0.370	Pass
VE-4561,4562	9/6/2017	Be-7	5.89 ± 0.29	5.76 ± 0.25	5.83 ± 0.19	Pass
VE-4561,4562	9/6/2017	K-40	3.73 ± 0.34	3.77 ± 0.29	3.75 ± 0.22	Pass
BO-5122,5123	9/8/2017	K-40	4.50 ± 0.36	4.50 ± 0.36	4.50 ± 0.25	Pass
VE-4692,4693	9/12/2017	K-40	5.16 ± 0.13	5.31 ± 0.36	5.24 ± 0.19	Pass
SS-4650,4651	9/12/2017	K-40	10.55 ± 0.51	10.41 ± 0.54	10.48 ± 0.37	Pass
MI-4671,4672	9/13/2017	K-40	1,347 ± 115	1,283 ± 118	1,315 ± 82	Pass
MI-4671,4672	9/13/2017	Sr-90	0.7 ± 0.3	0.5 ± 0.3	0.6 ± 0.2	Pass
VE-4973,4974	9/17/2017	K-40	1.11 ± 0.15	1.17 ± 0.13	1.14 ± 0.10	Pass
F-4928,4929	9/19/2017	K-40	1.84 ± 0.31	1.68 ± 0.34	1.76 ± 0.23	Pass
S-4865,4866	9/20/2017	K-40	21.07 ± 2.39	19.09 ± 2.51	20.08 ± 1.73	Pass
VE-4907,4908	9/20/2017	K-40	3.83 ± 0.44	4.28 ± 0.31	4.05 ± 0.27	Pass
VE-4844,4845	9/21/2017	K-40	1.81 ± 0.22	1.86 ± 0.21	1.84 ± 0.15	Pass
AP-5572,5573	9/27/2017	Be-7	0.082 ± 0.015	0.075 ± 0.014	0.078 ± 0.010	Pass
LW-5145,5146	9/28/2017	Gr. Beta	0.84 ± 0.49	1.47 ± 0.57	1.16 ± 0.38	Pass
AP-092917	9/29/2017	Gr. Beta	0.038 ± 0.004	0.031 ± 0.004	0.035 ± 0.003	Pass
WW-5080,5081	10/2/2017	H-3	208 ± 79	223 ± 80	215 ± 56	Pass
AP-100217	10/2/2017	Gr. Beta	0.025 ± 0.005	0.028 ± 0.005	0.026 ± 0.003	Pass
AP-100317	10/3/2017	Gr. Beta	0.037 ± 0.004	0.033 ± 0.004	0.035 ± 0.003	Pass
S-5165,5166	10/4/2017	K-40	15.93 ± 2.30	20.34 ± 3.15	18.14 ± 1.95	Pass
VE-5228,5229	10/5/2017	K-40	3.25 ± 0.25	2.82 ± 0.24	3.04 ± 0.17	Pass
AP-100917	10/9/2017	Gr. Beta	0.021 ± 0.004	0.025 ± 0.004	0.023 ± 0.003	Pass
VE-5293,5294	10/10/2017	K-40	3.89 ± 0.30	4.08 ± 0.34	3.99 ± 0.22	Pass
DW-80184,80185	10/11/2017	Gr. Alpha	2.17 ± 0.81	2.50 ± 0.81	2.34 ± 0.57	Pass
DW-80184,80185	10/11/2017	Gr. Beta	9.45 ± 0.79	10.20 ± 0.83	9.83 ± 0.57	Pass
S-5421,5422	10/12/2017	K-40	8.82 ± 1.94	7.97 ± 0.72	8.40 ± 1.03	Pass
AP-101617	10/16/2017	Gr. Beta	0.025 ± 0.005	0.022 ± 0.004	0.024 ± 0.003	Pass
F-5658,5659	10/19/2017	K-40	2.44 ± 0.41	2.57 ± 0.39	2.51 ± 0.28	Pass
SO-5704,5705	10/25/2017	Cs-137	0.05 ± 0.02	0.04 ± 0.02	0.04 ± 0.01	Pass
SO-5704,5705	10/25/2017	K-40	10.08 ± 0.51	9.57 ± 0.56	9.83 ± 0.38	Pass
SO-5704,5705	10/25/2017	Tl-208	0.10 ± 0.02	0.09 ± 0.02	0.10 ± 0.01	Pass
SO-5704,5705	10/25/2017	Bi-214	0.34 ± 0.04	0.27 ± 0.04	0.30 ± 0.03	Pass
SO-5704,5705	10/25/2017	Pb-212	0.28 ± 0.03	0.27 ± 0.03	0.27 ± 0.02	Pass
SO-5704,5705	10/25/2017	Ra-226	1.15 ± 0.52	0.59 ± 0.22	0.87 ± 0.28	Pass
SO-5704,5705	10/25/2017	Ac-228	0.33 ± 0.05	0.31 ± 0.07	0.32 ± 0.04	Pass
SO-5704,5705	10/25/2017	Gr. Beta	18.34 ± 1.80	16.50 ± 1.03	17.42 ± 1.04	Pass
AP-5732,5733	10/26/2017	Be-7	0.139 ± 0.064	0.175 ± 0.075	0.157 ± 0.049	Pass

TABLE A-5. In-House "Duplicate" Samples

Lab Code	Date	Analysis	Concentration [a] First Result	Second Result	Averaged Result	Acceptance
SW-5753,5754	10/31/2017	H-3	220 ± 83	279 ± 86	249 ± 60	Pass
SWU-5816,5817	10/31/2017	Gr. Beta	1.51 ± 1.00	2.02 ± 1.02	1.76 ± 0.71	Pass
AP-103117	10/31/2017	Gr. Beta	0.015 ± 0.004	0.014 ± 0.004	0.015 ± 0.003	Pass
SO-5923,5924	11/1/2017	Cs-137	0.30 ± 0.04	0.31 ± 0.04	0.31 ± 0.03	Pass
SO-5923,5924	11/1/2017	K-40	10.52 ± 0.61	10.56 ± 0.67	10.54 ± 0.45	Pass
AP-5858,5859	11/2/2017	Be-7	0.145 ± 0.075	0.146 ± 0.084	0.145 ± 0.056	Pass
AP-110717	11/7/2017	Be-7	0.026 ± 0.004	0.030 ± 0.004	0.028 ± 0.003	Pass
WW-6032,6033	11/7/2017	H-3	204 ± 86	298 ± 80	251 ± 59	Pass
WW-6074,6075	11/8/2017	H-3	72,247 ± 786	73,062 ± 791	72,655 ± 558	Pass
BS-6053,6054	11/13/2017	K-40	7.99 ± 0.62	9.20 ± 0.68	8.60 ± 0.46	Pass
BS-6053,6054	11/13/2017	Cs-137	0.07 ± 0.03	0.08 ± 0.03	0.07 ± 0.02	Pass
DW-80211,80212	11/14/2017	Gr. Alpha	2.30 ± 0.80	3.60 ± 1.00	2.95 ± 0.64	Pass
DW-80211,80212	11/14/2017	Gr. Beta	9.32 ± 0.81	8.99 ± 0.81	9.16 ± 0.57	Pass
DW-80214,80215	11/14/2017	Ra-226	1.36 ± 0.22	1.35 ± 0.15	1.355 ± 0.13	Pass
DW-80214,80215	11/14/2017	Ra-228	1.41 ± 0.51	0.90 ± 0.45	1.16 ± 0.34	Pass
WW-6152,6153	11/15/2017	H-3	416 ± 94	328 ± 90	372 ± 65	Pass
SWU-6219,6220	11/28/2017	Gr. Beta	1.04 ± 0.54	1.75 ± 0.58	1.39 ± 0.39	Pass
SS-6242,6243	11/29/2017	K-40	24.17 ± 1.05	22.31 ± 1.03	23.24 ± 0.74	Pass
SS-6242,6243	11/29/2017	Cs-137	0.11 ± 0.03	0.08 ± 0.03	0.10 ± 0.02	Pass
SG-6938,6939	11/28/2017	Pb-214	15.28 ± 0.34	14.96 ± 0.43	15.12 ± 0.27	Pass
SG-6938,6939	11/28/2017	Ac-228	18.99 ± 0.59	19.92 ± 0.79	19.46 ± 0.49	Pass
AP-112817	11/28/2017	Gr. Beta	0.026 ± 0.004	0.030 ± 0.004	0.028 ± 0.003	Pass
SQ-6286,6287	12/1/2017	Gr. Alpha	70.6 ± 6.2	60.9 ± 6.0	65.8 ± 4.3	Pass
SQ-6286,6287	12/1/2017	Gr. Beta	48.9 ± 2.7	53.7 ± 2.8	51.3 ± 1.9	Pass
SQ-6286,6287	12/1/2017	Ra-226	11.3 ± 0.4	10.7 ± 0.5	11.0 ± 0.3	Pass
SQ-6286,6287	12/1/2017	Ra-228	13.5 ± 0.9	13.2 ± 1.0	13.4 ± 0.7	Pass
SG-6286,6287	12/1/2017	K-40	5.10 ± 1.82	6.65 ± 1.53	5.88 ± 1.19	Pass
AP-120417	12/4/2017	Gr. Beta	0.037 ± 0.006	0.035 ± 0.005	0.036 ± 0.004	Pass
WW-6548,6549	12/19/2017	H-3	8,428 ± 280	8,604 ± 282	8,516 ± 199	Pass
AP-122717	12/27/2017	Gr. Beta	0.047 ± 0.004	0.043 ± 0.004	0.045 ± 0.003	Pass
XAP-6762,6763	12/31/2017	Co-60	2.43 ± 1.30	2.24 ± 0.82	2.34 ± 0.77	Pass
XAP-6762,6763	12/31/2017	Cs-137	4.21 ± 1.11	4.05 ± 0.96	4.14 ± 0.73	Pass

Note: Duplicate analyses are performed on every twentieth sample received in-house. Results are not listed for those analyses with activities that measure below the LLD.

[a] Results are reported in units of pCi/L, except for air filters (pCi/Filter or pCi/m3), food products, vegetation, soil and sediment (pCi/g).

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration [a]			
Lab Code [b]	Reference Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
MASO-903	2/1/2017	Am-241	60.9 ± 6.9	67.0	46.9 - 87.1	Pass
MASO-903	2/1/2017	Cs-134	1360 ± 14	1550	1085 - 2015	Pass
MASO-903	2/1/2017	Cs-137	678 ± 13	611	428 - 794	Pass
MASO-903	2/1/2017	Co-57	1.63 ± 1.69	0.00	NA [c]	Pass
MASO-903	2/1/2017	Co-60	909 ± 12	891	624 - 1158	Pass
MASO-903	2/1/2017	Mn-54	1052 ± 17	967	677 - 1257	Pass
MASO-903	2/1/2017	K-40	657 ± 68	607	425 - 789	Pass
MASO-903	2/1/2017	Zn-65	-0.52 ± 7.40	0.00	NA [c]	Pass
MASO-903	2/1/2017	Ni-63	3.25 ± 7.17	0.00	NA [c]	Pass
MASO-903	2/1/2017	Pu-238	0.46 ± 0.69	0.41	NA [c]	Pass
MASO-903	2/1/2017	Pu-239/240	56.8 ± 5.9	59.8	41.9 - 77.7	Pass
MASO-903	2/1/2017	Sr-90	501 ± 17	624	437 - 811	Pass
MASO-903	2/1/2017	Tc-99	748 ± 16	656	459 - 853	Pass
MAW-849	2/1/2017	I-129	-0.05 ± 0.12	0.00	NA [c]	Pass
MAVE-905	2/1/2017	Cs-134	6.61 ± 0.16	6.95	4.87 - 9.04	Pass
MAVE-905	2/1/2017	Cs-137	4.97 ± 0.18	4.60	3.22 - 5.98	Pass
MAVE-905	2/1/2017	Co-57	-0.01 ± 0.03	0.00	NA [c]	Pass
MAVE-905	2/1/2017	Co-60	9.51 ± 0.17	8.75	6.13 - 11.38	Pass
MAVE-905	2/1/2017	Mn-54	3.67 ± 0.17	3.28	2.30 - 4.26	Pass
MAVE-905	2/1/2017	Zn-65	6.12 ± 0.44	5.39	3.77 - 7.01	Pass
MAW-847	2/1/2017	Am-241	0.679 ± 0.079	0.846	0.592 - 1.100	Pass
MAW-847	2/1/2017	Cs-134	0.03 ± 0.10	0.00	NA [c]	Pass
MAW-847	2/1/2017	Cs-137	12.7 ± 0.4	11.1	7.8 - 14.4	Pass
MAW-847 [d]	2/1/2017	Co-57	2.7 ± 0.3	28.5	20.0 - 37.1	Fail
MAW-847	2/1/2017	Co-60	13.5 ± 0.3	12.3	8.6 - 16.0	Pass
MAW-847	2/1/2017	Mn-54	16.5 ± 0.4	14.9	10.4 - 19.4	Pass
MAW-847	2/1/2017	K-40	287 ± 6	254	178 - 330	Pass
MAW-847	2/1/2017	Zn-65	-0.15 ± 0.23	0.00	NA [c]	Pass
MAW-847	2/1/2017	H-3	275 ± 10	249	174 - 324	Pass
MAW-847	2/1/2017	Fe-55	2.4 ± 13.6	1.7	NA [c]	Pass
MAW-847	2/1/2017	Ni-63	10.1 ± 2.8	12.2	8.5 - 15.9	Pass
MAW-847	2/1/2017	Pu-238	0.729 ± 0.097	0.703	0.492 - 0.914	Pass
MAW-847	2/1/2017	Pu-239/240	0.866 ± 0.102	0.934	0.654 - 1.214	Pass
MAW-847	2/1/2017	Ra-226	0.506 ± 0.053	0.504	0.353 - 0.655	Pass
MAW-847	2/1/2017	Sr-90	10.0 ± 0.8	10.1	7.1 - 13.1	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration [a]			
Lab Code [b]	Reference Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
MAW-847	2/1/2017	Tc-99	4.77 ± 0.62	6.25	4.38 - 8.13	Pass
MAW-847	2/1/2017	U-234/233	1.19 ± 0.10	1.16	0.81 - 1.51	Pass
MAW-847	2/1/2017	U-238	1.15 ± 0.10	1.20	0.84 - 1.56	Pass
MAAP-907[f]	2/1/2017	Am-241	0.0540 ± 0.0140	0.0376	0.0263 - 0.0489	Fail
MAAP-907	2/1/2017	Cs-134	1.31 ± 0.06	1.42	0.99 - 1.85	Pass
MAAP-907	2/1/2017	Cs-137	0.797 ± 0.080	0.685	0.480 - 0.891	Pass
MAAP-907	2/1/2017	Co-57	1.86 ± 0.06	1.70	1.19 - 2.21	Pass
MAAP-907	2/1/2017	Co-60	0.86 ± 0.05	0.78	0.55 - 1.01	Pass
MAAP-907	2/1/2017	Mn-54	0.01 ± 0.03	0.00	NA [c]	Pass
MAAP-907	2/1/2017	Zn-65	1.62 ± 0.13	1.29	0.90 - 1.68	Pass
MAAP-907	2/1/2017	Pu-238	0.0530 ± 0.0190	0.0598	0.0419 - 0.0777	Pass
MAAP-907	2/1/2017	Pu-239/240	0.0490 ± 0.0160	0.0460	0.0322 - 0.0598	Pass
MAAP-907	2/1/2017	Sr-90	0.648 ± 0.120	0.651	0.456 - 0.846	Pass
MAAP-907	2/1/2017	U-234/233	0.086 ± 0.024	0.104	0.073 - 0.135	Pass
MAAP-907	2/1/2017	U-238	0.097 ± 0.024	0.107	0.075 - 0.139	Pass
MASO-4515	8/1/2017	Am-241	45.9 ± 7.0	58.8	41.2 - 76.4	Pass[g]
MASO-4515	8/1/2017	Cs-134	409 ± 7	448	314 - 582	Pass[g]
MASO-4515	8/1/2017	Cs-137	798 ± 12	722	505 - 939	Pass[g]
MASO-4515	8/1/2017	Co-57	1572 ± 10	1458	1021 - 1895	Pass[g]
MASO-4515	8/1/2017	Co-60	0.2 ± 1.4	0.00	NA [c]	Pass[g]
MASO-4515	8/1/2017	Mn-54	934 ± 13	825	578 - 1073	Pass[g]
MASO-4515	8/1/2017	K-40	704 ± 53	592	414 - 770	Pass[g]
MASO-4515	8/1/2017	Zn-65	667 ± 17	559	391 - 727	Pass[g]
MASO-4515	8/1/2017	Pu-238	101 ± 9	92	64 - 120	Pass[g]
MASO-4515	8/1/2017	Pu-239/240	74.8 ± 7.7	68.8	48.2 - 89.4	Pass[g]
MASO-4515	8/1/2017	Sr-90	252 ± 7	289	202 - 376	Pass[g]
MAW-4494	8/1/2017	I-129	2.31 ± 0.10	2.31	1.62 - 3.00	Pass
MAVE-4517	8/1/2017	Cs-134	2.40 ± 0.10	2.32	1.62 - 3.02	Pass
MAVE-4517	8/1/2017	Cs-137	-0.002 ± 0.048	0.000	NA [c]	Pass
MAVE-4517	8/1/2017	Co-57	3.3 ± 0.1	2.8	2.0 - 3.6	Pass
MAVE-4517	8/1/2017	Co-60	2.10 ± 0.10	2.07	1.45 - 2.69	Pass
MAVE-4517	8/1/2017	Mn-54	3.00 ± 0.20	2.62	1.83 - 3.41	Pass
MAVE-4517	8/1/2017	Zn-65	5.90 ± 0.30	5.37	3.76 - 6.98	Pass

TABLE A-6. Department of Energy's Mixed Analyte Performance Evaluation Program (MAPEP).

			Concentration [a]			
Lab Code [b]	Reference Date	Analysis	Laboratory result	Known Activity	Control Limits [c]	Acceptance
MAW-4513	8/1/2017	Am-241	0.820 ± 0.220	0.892	0.624 - 1.160	Pass
MAW-4513	8/1/2017	Cs-134	10.3 ± 0.3	11.5	8.1 - 15.0	Pass
MAW-4513	8/1/2017	Cs-137	17.2 ± 0.5	16.3	11.4 - 21.2	Pass
MAW-4513	8/1/2017	Co-57	12.7 ± 0.4	12.1	8.5 - 15.7	Pass
MAW-4513	8/1/2017	Co-60	10.6 ± 0.3	10.7	7.5 - 13.9	Pass
MAW-4513	8/1/2017	Mn-54	15.6 ± 0.4	14.9	10.4 - 19.4	Pass
MAW-4513	8/1/2017	Zn-65	15.9 ± 0.7	15.5	10.9 - 20.2	Pass
MAW-4513	8/1/2017	H-3	255 ± 9	258	181 - 335	Pass
MAW-4513	8/1/2017	Fe-55	21.6 ± 6.6	19.4	13.6 - 25.2	Pass
MAW-4513	8/1/2017	Ni-63	-0.1 ± 2.0	0.0	NA [c]	Pass
MAW-4513	8/1/2017	Pu-238	0.590 ± 0.080	0.603	0.422 - 0.784	Pass
MAW-4513	8/1/2017	Pu-239/240	0.740 ± 0.090	0.781	0.547 - 1.015	Pass
MAW-4513	8/1/2017	Ra-226	1.000 ± 0.100	0.858	0.601 - 1.115	Pass
MAW-4513	8/1/2017	Sr-90	7.80 ± 0.60	7.77	5.44 - 10.10	Pass
MAW-4513	8/1/2017	Tc-99	6.70 ± 0.40	6.73	4.71 - 8.75	Pass
MAW-4513	8/1/2017	U-2344/233	0.94 ± 0.06	1.01	0.71 - 1.31	Pass
MAW-4513	8/1/2017	U-238	0.97 ± 0.07	1.04	0.73 - 1.35	Pass
MAAP-4519 [h]	8/1/2017	Am-241	0.0400 ± 0.0100	0.0612	0.0428 - 0.0796	Fail
MAAP-4519	8/1/2017	Cs-134	0.90 ± 0.10	1.00	0.70 - 1.30	Pass
MAAP-4519	8/1/2017	Cs-137	0.90 ± 0.10	0.82	0.57 - 1.07	Pass
MAAP-4519	8/1/2017	Co-57	0.01 ± 0.01	0.00	NA [c]	Pass
MAAP-4519	8/1/2017	Co-60	0.70 ± 0.10	0.68	0.48 - 0.88	Pass
MAAP-4519	8/1/2017	Mn-54	1.50 ± 0.10	1.30	0.91 - 1.69	Pass
MAAP-4519	8/1/2017	Zn-65	1.30 ± 0.10	1.08	0.76 - 1.40	Pass
MAAP-4519	8/1/2017	Pu-238	0.0300 ± 0.0100	0.0298	0.0209 - 0.0387	Pass
MAAP-4519	8/1/2017	Pu-239/240	0.0400 ± 0.0200	0.0468	0.0328 - 0.0608	Pass
MAAP-4519	8/1/2017	Sr-90	0.800 ± 0.100	0.801	0.561 - 1.041	Pass
MAAP-4519	8/1/2017	U-234/233	0.070 ± 0.010	0.084	0.059 - 0.109	Pass
MAAP-4519	8/1/2017	U-238	0.090 ± 0.010	0.087	0.061 - 0.113	Pass

[a] Results are reported in units of Bq/kg (soil), Bq/L (water) or Bq/total sample (filters, vegetation).

[b] Laboratory codes as follows: MAW (water), MAAP (air filter), MASO (soil), MAVE (vegetation).

[c] MAPEP results are presented as the known values and expected laboratory precision (1 sigma, 1 determination) and control limits as defined by the MAPEP. A known value of "zero" indicates an analysis was included in the testing series as a "false positive". MAPEP does not provide control limits.

[d] Decimal point was misplaced while performing a unit conversion. The result is within control limits when the proper unit conversion is performed.

[e] Provided in the series for "sensitivity evaluation". MAPEP does not provide control limits.

[f] Sample was reanalyzed in duplicate with acceptable results. Original plating was inferior to platings obtained during reanalysis. It is believed that isotopic tracer was not accurately quantified due to poor resolution of its peak.

[g] Data were erroneously submitted in units of Bq/g. All results pass MAPEP criteria when evaluated in units of Bq/Kg.

[h] Laboratory is not currently offering analysis for Am-241 in Air Particulate samples.

TABLE A-7. Interlaboratory Comparison Crosscheck Program, Environmental Resource Associates (ERA)[a].

MRAD Study

Lab Code [b]	Date	Analysis	Concentration [a] Laboratory Result	ERA Result	Control Limits [c]	Acceptance
ERAP-1112	3/20/2017	Am-241	55.3 ± 2.8	76.4	47.1 - 103.0	Pass
ERAP-1112	3/20/2017	Co-60	1,230 ± 8	1030	797 - 1290	Pass
ERAP-1112	3/20/2017	Cs-134	1,110 ± 9	1100	700 - 1360	Pass
ERAP-1112	3/20/2017	Cs-137	1,810 ± 12	1,390	1,040 - 1,830	Pass
ERAP-1112 [d]	3/20/2017	Fe-55	590 ± 385	256	79.4 - 500	Fail
ERAP-1112	3/20/2017	Mn-54	< 5.14	< 50.0	0.00 - 50.0	Pass
ERAP-1112	3/20/2017	Pu-238	54.6 ± 2.8	54.3	37.2 - 71.4	Pass
ERAP-1112	3/20/2017	Pu-239/240	63.6 ± 3.0	62.0	44.9 - 81.0	Pass
ERAP-1112	3/20/2017	Sr-90	55.3 ± 8.3	52.4	25.6 - 78.5	Pass
ERAP-1112	3/20/2017	U-233/234	65.7 ± 3.0	73.1	45.3 - 110	Pass
ERAP-1112	3/20/2017	U-238	67.3 ± 3.0	72.4	46.8 - 100	Pass
ERAP-1112	3/20/2017	Zn-65	1,355 ± 16	984	705 - 1,360	Pass
ERAP-1114	3/20/2017	Gr. Alpha	106 ± 5	85.5	28.6 - 133	Pass
ERAP-1114 [e]	3/20/2017	Gr. Beta	67.6 ± 3.0	45.2	28.6 - 65.9	Fail
ERSO-1116	3/20/2017	Am-241	418 ± 98	448	262 - 582	Pass
ERSO-1116	3/20/2017	Ac-228	1,540 ± 260	1,240	795 - 1,720	Pass
ERSO-1116	3/20/2017	Bi-212	1,550 ± 90	1,240	330 - 1,820	Pass
ERSO-1116	3/20/2017	Bi-214	2,560 ± 20	2,750	1,660 - 3,960	Pass
ERSO-1116	3/20/2017	Co-60	4,620 ± 100	4,430	3,000 - 6,100	Pass
ERSO-1116	3/20/2017	Cs-134	8,340 ± 100	8,860	5,790 - 10,600	Pass
ERSO-1116	3/20/2017	Cs-137	8,420 ± 100	7,500	5,750 - 9,650	Pass
ERSO-1116	3/20/2017	K-40	13,600 ± 900	10,600	7,740 - 14,200	Pass
ERSO-1116	3/20/2017	Mn-54	< 68.1	< 1000	0.00 - 1,000	Pass
ERSO-1116	3/20/2017	Pb-212	1,060 ± 70	1,240	812 - 1,730	Pass
ERSO-1116	3/20/2017	Pb-214	2,620 ± 160	2,890	1,690 - 4,310	Pass
ERSO-1116	3/20/2017	Pu-238	424 ± 154	648	390 - 894	Pass
ERSO-1116 [f]	3/20/2017	Pu-239/240	252 ± 112	484	316 - 669	Fail
ERSO-1116 [g]	3/20/2017	Pu-239/240	436 ± 106	484	316 - 669	Pass
ERSO-1116	3/20/2017	Sr-90	7,930 ± 250	9,150	3,490 - 14,500	Pass
ERSO-1116	3/20/2017	Th-234	1,820 ± 200	1,940	614 - 3,650	Pass
ERSO-1116 [h]	3/20/2017	U-233/234	1,030 ± 130	1,950	1,190 - 2,500	Fail
ERSO-1116 [i]	3/20/2017	U-233/234	1,820 ± 200	1,950	1,190 - 2,500	Pass
ERSO-1116	3/20/2017	U-238	1,240 ± 140	1,940	1,200 - 2,460	Pass
ERSO-1116 [i]	3/20/2017	U-238	1,930 ± 200	1,940	1,200 - 2,460	Pass
ERSO-1116	3/20/2017	Zn-65	7,190 ± 240	6,090	4,850 - 8,090	Pass
ERW-1122	3/20/2017	Gr. Alpha	65.3 ± 2.4	89.5	31.8 - 139	Pass
ERW-1122	3/20/2017	Gr. Beta	54.8 ± 1.5	61.0	34.9 - 90.4	Pass
ERW-1124	3/20/2017	H-3	19,000 ± 410	19,400	13,000 - 27,700	Pass

TABLE A-7. Interlaboratory Comparison Crosscheck Program, Environmental Resource Associates (ERA)[a].

MRAD Study

Lab Code [b]	Date	Analysis	Concentration [a] Laboratory Result	ERA Result	Control Limits [c]	Acceptance
ERVE-1118	3/20/2017	Am-241	1,560 ± 140	1,860	1,140 - 2,470	Pass
ERVE-1118	3/20/2017	Cm-244	530 ± 80	734	360 - 1,140	Pass
ERVE-1118	3/20/2017	Co-60	1,400 ± 350	1,390	959 - 1,940	Pass
ERVE-1118	3/20/2017	Cs-134	1,650 ± 460	1,830	1,180 - 2,380	Pass
ERVE-1118	3/20/2017	Cs-137	2,580 ± 540	2,500	1,810 - 3,480	Pass
ERVE-1118	3/20/2017	K-40	32,100 ± 700	30,900	22,300 - 43,400	Pass
ERVE-1118	3/20/2017	Mn-54	< 27.3	< 300	0.00 - 300	Pass
ERVE-1118	3/20/2017	Zn-65	889 ± 64	853	615 - 1,200	Pass
ERVE-1118	3/20/2017	Pu-238	3,250 ± 210	3,250	1,940 - 4,450	Pass
ERVE-1118	3/20/2017	Pu-239/240	2,180 ± 170	2,150	1,320 - 2,960	Pass
ERVE-1118	3/20/2017	Sr-90	665 ± 135	726	414 - 963	Pass
ERVE-1118	3/20/2017	U-233/234	2,840 ± 200	3,090	2,030 - 3,970	Pass
ERVE-1118	3/20/2017	U-238	2,990 ± 200	3,060	2,040 - 3,890	Pass
ERW-1120	3/20/2017	Am-241	108 ± 7	140	94.3 - 188	Pass
ERW-1120	3/20/2017	Co-60	2,600 ± 198	2,540	2,210 - 2,970	Pass
ERW-1120	3/20/2017	Cs-134	2,380 ± 250	2,510	1,840 - 2880	Pass
ERW-1120	3/20/2017	Cs-137	1,470 ± 243	1,400	1,190 - 1,680	Pass
ERW-1120	3/20/2017	Mn-54	< 12.3	< 100	0.00 - 100	Pass
ERW-1120	3/20/2017	Pu-238	117 ± 4	128	94.7 - 159	Pass
ERW-1120	3/20/2017	Pu-239/240	74.8 ± 3.3	85.8	66.6 - 108	Pass
ERW-1120	3/20/2017	U-233/234	75.3 ± 3.2	90.3	67.8 - 116	Pass
ERW-1120	3/20/2017	U-238	76.4 ± 3.2	89.5	68.2 - 110	Pass
ERW-1120	3/20/2017	Zn-65	2,130 ± 378	1,960	1630 - 2,470	Pass
ERW-1120 [j]	3/20/2017	Fe-55	1,400 ± 403	984	587 - 1,340	Fail
ERW-1120 [k]	3/20/2017	Fe-55	1,081 ± 383	984	587 - 1,340	Pass
ERW-1120	3/20/2017	Sr-90	652 ± 12	714	465 - 944	Pass

[a] Results obtained by Environmental, Inc., Midwest Laboratory as a participant in the crosscheck program for proficiency testing administered by Environmental Resources Associates, serving as a replacement for studies conducted previously by the Environmental Measurements Laboratory Quality Assessment Program (EML).

[b] Laboratory codes as follows: ERW (water), ERAP (air filter), ERSO (soil), ERVE (vegetation). Results are reported in units of pCi/L, except for air filters (pCi/Filter), vegetation and soil (pCi/kg).

[c] Results are presented as the known values, expected laboratory precision (2 sigma, 1 determination) and control limits as provided by ERA.

[d] Fe-55 analysis result was outside the acceptable range. Recounting the sample disk for 1000 minutes resulted in 254 ± 364 with an LLD calculation of < 342. Insufficient sample was available after performing other required analyses on the sample to quantify the activity with an uncertainty less than the activity.

[e] ERA appears to have applied the standard material to the filter in a pattern closer to the center of the filter compared to previous studies and different from the filter efficiency utilized by the laboratory. This likely caused the efficency used the calculation to be understated and the result obtained by the laboratory to be overstated. For comparison the in-house spike for gross beta in AP (table A-3 SPAP-740 2/28/17) was acceptable with a ratio of 0.84 of lab result to known.

[f] Analysis result for Plutonium-239/240 was below the lower limit of acceptance.

[g] Samples were reanalyzed in duplicate with acceptable results for each. Original analysis had poor resolution possibly due to a poor elctroplating and is suspected in contributing to poor results.

[h] Analysis result for U-233/234 was below the lower limit of acceptance.

[i] The reanalysis result for U-233/234 was within the acceptance limits and U-238 reanalysis result was closer to the known value. Original analysis had poor resolution possibly due to a poor electroplating and is suspected in contributing to poor results.

[j] Fe-55 analysis result was outside acceptable range.

[k] Result of recounting was acceptable. Using available aliquot after dividing sample for other analyses leaves insufficient sample to reliably determine the activity present in sample.

APPENDIX B

DATA REPORTING CONVENTIONS

Data Reporting Conventions

1.0. All activities, except gross alpha and gross beta, are decay corrected to collection time or the end of the collection period.

2.0. Single Measurements

Each single measurement is reported as follows: $x \pm s$

where: x = value of the measurement;

s = 2s counting uncertainty (corresponding to the 95% confidence level).

In cases where the activity is less than the lower limit of detection L, it is reported as: <L,

where L = the lower limit of detection based on 4.66s uncertainty for a background sample.

3.0. Duplicate analyses

3.1 Individual results: For two analysis results; $x_1 \pm s_1$ and $x_2 \pm s_2$

Reported result: $x \pm s$; where $x = (1/2)(x_1 + x_2)$ and $s = (1/2)\sqrt{s_1^2 + s_2^2}$

3.2. Individual results: $<L_1$, $<L_2$ Reported result: <L, where L = lower of L_1 and L_2

3.3. Individual results: $x \pm s$, <L Reported result: $x \pm s$ if $x \geq L$; <L otherwise.

4.0. Computation of Averages and Standard Deviations

4.1 Averages and standard deviations listed in the tables are computed from all of the individual measurements over the period averaged; for example, an annual standard deviation would not be the average of quarterly standard deviations. The average $\bar{x}$ and standard deviation s of a set of n numbers $x_1, x_2 \ldots x_n$ are defined as follows:

$$\bar{x} = \frac{1}{n} \sum x \qquad s = \sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$$

4.2 Values below the highest lower limit of detection are not included in the average.

4.3 If all values in the averaging group are less than the highest LLD, the highest LLD is reported.

4.4 If all but one of the values are less than the highest LLD, the single value x and associated two sigma error is reported.

4.5 In rounding off, the following rules are followed:

4.5.1. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44.

4.5.2. If the figure following those to be retained is equal to or greater than 5, the figure is dropped and the last retained figure is raised by 1. As an example, 11.445 is rounded off to 11.45.

4.6 Composite samples which overlap the next month or year are reported for the month or year in which most of the sample is collected.

APPENDIX C

TECHNICAL SPECIFICATION 2.1.3

REACTOR COOLANT DOSE EQUIVALENT IODINE ABOVE TECHNICAL SPECIFICATION LIMIT

During the 2017 reporting period, radioactivity of primary coolant did not exceed the limits of Technical Specification 2.1.3.

APPENDIX D

SAMPLE LOCATION MAPS

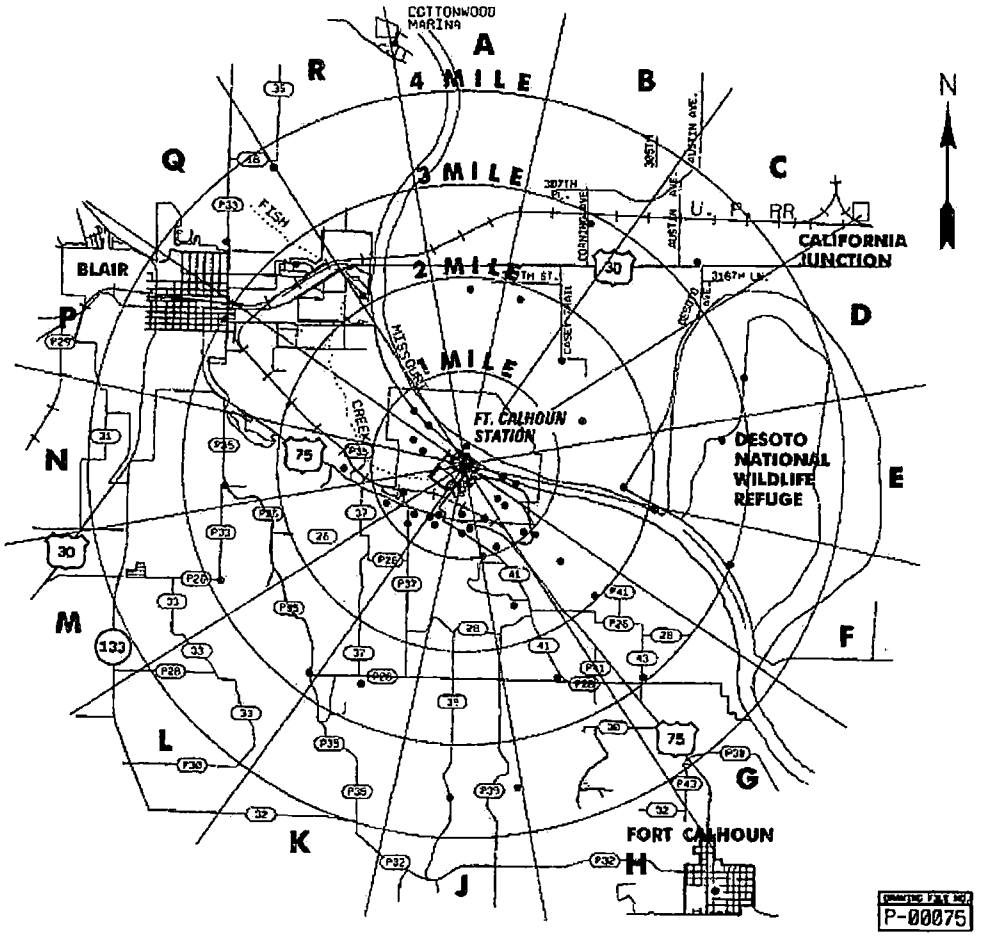
COTTONWOOD MARINA
A
4 MILE
B
C
3 MILE
2 MILE
1 MILE
R
Q
P
N
M
L
K
J
H
G
F
E
D
BLAIR
CALIFORNIA JUNCTION
FT. CALHOUN STATION
DESOTO NATIONAL WILDLIFE REFUGE
FORT CALHOUN
N
P-00075

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
1	Onsite Station, 110-meter weather tower	0.53	293°/WNW	P			X						
2[C,E]	Onsite Station, adjacent to old plant access road	0.59	207°/SSW	K	X	X	X						
3	Offsite Station, Intersection of Hwy. 75 and farm access road	0.94	145°/SE	G			X						
4	Blair OPPD office	2.86	305°/NW	Q	X	X	X						
5[A]													
6	Fort Calhoun, NE City Hall	5.18	150°/SSE	H			X						
7	Fence around intake gate, Desoto Wildlife Refuge	2.07	102°/ESE	F			X						

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
8	Onsite Station, entrance to Plant Site from Hwy. 75	0.55	191°/S	J			X						
9	Onsite Station, NW of Plant	0.68	305°/NW	Q			X						
10	Onsite Station, WSW of Plant	0.61	242°/WSW	M			X						
11	Offsite Station, SE of Plant	1.07	39°/SE	G			X						
12	Metropolitan Utilities Dist., Florence Treatment Plant North Omaha, NE	14.3	154°/SSE	H				X					
13	West bank Missouri River, downstream from Plant discharge	0.45	108°/ESE	F				X		X			
14[D]	Upstream from Intake Bldg, west bank of river	0.09	4°/N	A				X		X			

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
15	Smith Farm	1.99	134°/SE	G									X
16[A]													
17[A]													
18[A]													
19[A]													
20[D]	Mohr Dairy	9.86	186°/S	J					[B]			X	X
21[A]													
22	Fish Sampling Area, Missouri River	0.08 (R.M. 645.0)	6°/N	A							X		
23[D]	Fish Sampling Area, Missouri River	17.9 (R.M. 666.0)	358°/N	A							X		
24[A]													
25[A]													

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
26[A]													
27[A]													
28[A]													
29[A]													
30[A]													
31[A]													
32[D]	Valley Substation #902	19.6	221°/SW	L	X	X	X						
33[A]													
34[A]													
35	Onsite Farm Field	0.52	118°/ESE	F								X	
36	Offsite Station Intersection Hwy 75/Co. Rd. P37	0.75	227°/SW	L			X						

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
37	Offsite Station Desoto Township	1.57	144°/SE	G	X	X	X						
38[A]													
39[A]													
40[A]													
41[C]	Dowler Acreage	0.73	175°/S	J	X	X	X		[B,C]				
42	Sector A-1	1.94	0°/NORTH	A			X						
43	Sector B-1	1.97	16°/NNE	B			X						
44	Sector C-1	1.56	41°/NE	C			X						
45	Sector D-1	1.34	71°/ENE	D			X						
46	Sector E-1	1.54	90°/EAST	E			X						
47	Sector F-1	0.45	108°/ESE	F			X						
48	Sector G-1	1.99	134°/SE	G			X						

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
49	Sector H-1	1.04	159°/SSE	H			X						
50	Sector J-1	0.71	179°/SOUTH	J			X						
51	Sector K-1	0.61	205°/SSW	K			X						
52	Sector L-1	0.74	229°/SW	L			X						
53	Sector M-1	0.93	248°/WSW	M			X						
54	Sector N-1	1.31	266°/WEST	N			X						
55	Sector P-1	0.60	291°/WNW	P			X						
56	Sector Q-1	0.67	307°/NW	Q			X						
57	Sector R-1	2.32	328°/NNW	R			X						
58	Sector A-2	4.54	350°/NORTH	A			X						
59	Sector B-2	2.95	26°/NNE	B			X						
60	Sector C-2	3.32	50°/NE	C			X						

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
61	Sector D-2	3.11	75°/ENE	D			X						
62	Sector E-2	2.51	90°/EAST	E			X						
63	Sector F-2	2.91	110°/ESE	F			X						
64	Sector G-2	3.00	140°/SE	G			X						
65	Sector H-2	2.58	154°/SSE	H			X						
66	Sector J-2	3.53	181°/SOUTH	J			X						
67	Sector K-2	2.52	205°/SSW	K			X						
68	Sector L-2	2.77	214°/SW	L			X						
69	Sector M-2	2.86	243°/WSW	M			X						

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
70	Sector N-2	2.54	263°/WEST	N			X						
71	Sector P-2	2.99	299°/WNW	P			X						
72	Sector Q-2	3.37	311°/NW	Q			X						
73	Sector R-2	3.81	328°/NNW	R			X						
74	D. Miller Farm	0.65	203°/SSW	K									X
75[C]	Lomp Acreage	0.65	163°/SSE	H	X	X	X		[B, C]			X	X
76	Stangl Farm	3.40	169°/S	J					X				
77[G]	River N-1			R			X						
78[G]	River S-1			E			X						
79[G]	Lagoon S-1			G			X						
80[G]	Parking S-1			H			X						
81[G]	Training W-1			K			X						

Table 5.2 - Radiological Environmental Sampling Locations And Media

Sample Station No.	Approximate Collection Sites	Approximate Distance from Center of Containment (miles)	Approximate Direction (degrees from true north)	Sector	Air Monitoring		TLD	Water	Milk	Sedi-ment	Fish	Vegetables and Food Products	Ground-water
					Airborne Particulate	Airborne Iodine							
82[G]	Switchyard S-1			L			X						
83[G]	Switchyard SE-1			L			X						
84[G]	Switchyard NE-1			M			X						
85[G]	Switchyard W-1			L			X						
86[G]	Switchyard N-1			N			X						
87[G]	Range S-1			P			X						
88[G]	Mausoleum E-1			L			X						

NOTES:

A. Location is either not in use or currently discontinued and is documented in the table for reference only.

B. If milk samples are temporarily not available at a sampling site due to mitigating circumstances, then vegetation (broadleaf, pasture grass, etc.) shall be collected as an alternate sample at the site. If there are no milk producers within the entire 5-mile radius of the plant, then vegetation shall be collected monthly, when available, at two offsite locations having the highest calculated annual average ground level D/Q and a background locale. (Reference Off-Site Dose Calculation Manual, Part II, Table 4 "Highest Potential Exposure Pathways for Estimating Dose")

C. Locations represent highest potential exposure pathways as determined by the biennial Land Use Survey, performed in accordance with Part I, Section 7.3.2, of the Off-Site Dose Calculation Manual and are monitored as such.

D. Background location (control). All other locations are indicators.

E. Location for monitoring Sector K High Exposure Pathway Resident Receptor for inhalation.

F. When broad leaf (pasture grasses) are being collected in lieu of milk, background broad leaf samples will be collected at a background locale.

G. Location for special interest monitoring general dose to the public per 40CFR190 (Figure 2)