

NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
Radiological Environmental Monitoring Program
2019 Annual Report
January 1, 2019 to December 31, 2019

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Preface

This report covers the period of January 1 through December 31, 2019. Personnel of Nebraska Public Power District made all sample collections. Analyses were performed and reports of analyses were prepared by Teledyne Brown Engineering – Environmental Services and forwarded to Nebraska Public Power District. Environmental Thermoluminescent Dosimeter (TLD) analyses were performed and reports of analyses were prepared by Mirion Technologies.

SECTION I. INTRODUCTION

I. INTRODUCTION

This report contains a complete tabulation of data collected during the period January 1 through December 31 2019, for the operational Radiological Environmental Monitoring Program (REMP) performed for Cooper Nuclear Station (CNS) of Nebraska Public Power District (NPPD) by Teledyne Brown Engineering - Environmental Services.

Cooper Nuclear Station is located in Nemaha County in the southeast corner of Nebraska on the Missouri River. A portion of the site extends into Missouri. The reactor is an 830-megawatt (net electrical) boiling water reactor. Initial criticality was attained on February 21, 1974.

Radiological environmental monitoring began in 1971 before the plant became operational and has continued to the present. The program monitors radiation levels in air, terrestrial and aquatic environments. All samples are collected by NPPD personnel. All samples are shipped for analysis to a contractor's laboratory where there exists special facilities required for measurements of extremely low levels of radioactivity. Teledyne Brown Engineering - Environmental Services has the responsibility for the analyses for Cooper Nuclear Station.

The United States Nuclear Regulatory Commission (USNRC) regulations (10CFR50.34a) require that nuclear power plants be designed, constructed, and operated to keep levels of radioactive material in effluents to unrestricted areas as low as is reasonably achievable (ALARA). Inplant monitoring is used to ensure that release limits are not exceeded. As a precaution against unexpected or undefined environmental processes, which might allow undue accumulation of radioactivity in the environment, a program for monitoring the plant environs is included in NPPD's CNS Offsite Dose Assessment Manual (ODAM).

A. Atmospheric Nuclear Tests and Nuclear Incidents

Three atmospheric nuclear detonations in the People's Republic of China influenced program results significantly in late 1976 and in 1977. Two of these detonations occurred in late 1976 (September 26 and November 17) and one in late 1977 (September 17). As a consequence of these tests elevated activities of gross beta in air particulate filters and iodine-131 in milk were observed throughout most of the United States. No atmospheric nuclear tests have been conducted since 1980, thus no short-lived fission products were detected in air particulate samples.

On April 26, 1986 the fire and explosion of Chernobyl Reactor No. 4 in the Soviet Union resulted in the release of fission products to the atmosphere and worldwide fallout. Following the explosion, elevated levels of gross beta activities in air particulates and iodine-131 in charcoal filters and milk samples were measured. Additionally, in 1986, cesium-137 and the short-lived radionuclides iodine-131, ruthenium-106, and cesium-134 were detected in broadleaf vegetation. Similar results occurred in other areas of the United States and the entire Northern Hemisphere.

B. Monitoring Program Objectives and Data Interpretation

The objective of the monitoring program is to detect and assess the impact of possible releases to the environs of radionuclides from the operations of Cooper Nuclear Station. This objective requires measurements of low levels of radioactivity equal to or lower than pre-determined limits of detection. In addition the source of the environmental radiation must be established. Sources of environmental radiation include:

- (1) Natural background radiation from cosmic rays (beryllium-7).
- (2) Terrestrial, primordial radionuclides from the environment (potassium-40, radium-226, thorium-228).
- (3) Fallout from atmospheric nuclear tests such as the September 1977 detonation by the Peoples' Republic of China and the atmospheric weapons test of October 16, 1980 (fission products and fusion products).
- (4) Releases from nuclear power plants such as CNS (fission products and neutron activation products).
- (5) Fallout from the Chernobyl nuclear reactor accident.

Radiation levels measured in the vicinity of an operating power station are compared with preoperational measurements at the same locations to distinguish power plant effects from other sources. Also, results of the monitoring program are related to events known to cause elevated levels of radiation in the environment, e.g., atmospheric nuclear detonations or abnormal plant releases.

SECTION II. SUMMARY

II. SUMMARY

Presented in this report are summaries and discussions of the data generated for the Radiological Environmental Monitoring Program (REMP) for Cooper Nuclear Station (CNS) of Nebraska Public Power District (NPPD) for 2019.

The sampling and analyses program is described in Section III. It contains the sampling schedule and required analyses in Table 1 and Table 2 and the site map.

A discussion of each type of sample analyzed and its impact, if any, on the environment is presented in Section IV. Included are graphs of the radionuclides of interest for the past several years and the statistical results for each quarter of the year.

Section V presents the yearly conclusions of the program.

Section VI is the Radiological Environmental Monitoring Program Summary. It contains the yearly summary of the program with the total number of samples of each type analyzed. It lists the yearly average and range for the control locations versus the indicator locations and the number of detections per total number of samples. It identifies the station with the highest yearly average, the distance and location of that station and provides the range of detection.

Section VII contains the complete data tables for the period.

References are presented in Section VIII.

SECTION III. SAMPLING AND ANALYSIS PROGRAM

III. SAMPLING AND ANALYSES PROGRAM

The 2019 sampling and analyses program is described in Table 1 and Table 2. Teledyne Brown Engineering - Environmental Services has a comprehensive quality assurance/quality control program designed to assure the reliability of data obtained. The results for the 2019 Interlaboratory Comparison Program conducted by Analytics, Inc., the Department of Energy's (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) and Environmental Resource Associates (ERA) are contained in Appendix B.

Sampling locations are indicated in the map labeled Figure 1 and Figure 2. The sample types collected at each location and the approximate distance and direction from the reactor elevated release point are specified.

The annual land use census for 2019 is described in Appendix A. There were no milk animals found within three miles of CNS in 2019 and no evidence of potable water use from the river. The nearest garden to CNS is in sector P, 1.9 miles from CNS. From year to year there is a slight variation in the number of gardens tended. The nearest resident to CNS is in sector Q, 0.9 miles from CNS.

All of the required 2019 environmental monitoring, including sampling and analyses, were conducted as specified in Table D4.1-1 of the CNS Offsite Dose Assessment Manual (ODAM), except as noted in Appendix E, REMP Sampling and Analytical Exceptions table.

NEBRASKA PUBLIC POWER DISTRICT**COOPER NUCLEAR STATION*****Environmental Radiation Surveillance Program Sampling Schedule and Analyses*****TABLE 1: Sampling Frequencies and Minimum Numbers**

SAMPLE MEDIUM	ODAM SAMPLE STATIONS	NON-ODAM SAMPLE STATIONS	MINIMUM SAMPLES PER ODA M (PER SAMPLE PERIOD)	SAMPLE COLLECTION FREQUENCY (AT LEAST ONCE PER)	MAXIMUM INTERVAL
Radioiodine	1-10	111	5	7 Days	8.75 Days
Particulates	1-10	111	5	7 Days	8.75 Days
Milk (nearest producer)	99	-	1	15 Days in Peak Pasture (June 1 - Sep 30)	18.75 Days
				31 Days in Non-Peak Pasture (Oct 1 - May 31)	38.75 Days
River Water	12 or 35, 28	-	2	31 Days	38.75 Days
Food Products ¹ (Broadleaf Vegetation)	35, 96, 101	-	3	Monthly when available ²	N/A
Direct Radiation	1-10, 20, 44, 56, 58, 59, 66, 67, 71, 79-91, 94	111, N01-N25	32 ³	92 Days	115 Days
Ground Water	11, 47	-	2	92 Days	115 Days
Sediment from Shoreline	28	35	1	Once in Spring (March 1 - May 31), Once in Fall (Sep 1 - Nov 30)	
Fish	28, 35	-	2	Once in Summer (June 1 - Aug 31), Once in Fall (Sep 1 - Nov 30)	

¹ Broadleaf vegetation required (when available) due to absence of "Milk (other producers)" (LBDCR 2018-001).

² Don't need to physically go to Sample Station in attempt to obtain sample if based on season/weather its obvious vegetation is unavailable (e.g., January).

³ TLD is single phosphore. ≥ 2 phosphores in one package are considered ≥ 2 dosimeters.

TABLE 2: Analysis Frequencies

MEDIUM	ODAM STATIONS	NON-ODAM STATIONS	ANALYSIS TYPE	ANALYSIS FREQUENCY (AT LEAST ONCE PER)	MAXIMUM INTERVAL
Radioiodine	1-10	111	I-131	7 Days	8.75 Days
Particulate	1-10	111	Gross Beta ^a	-	-
			Gamma Isotopic	Only each sample in which gross beta > 10 times yearly mean of control samples	-
			Gamma Isotopic of Composite (by location)	92 Days	115 Days
Milk ¹ (nearest producer)	99	-	Gamma Isotopic, I-131	-	-
River Water	12 or 35, 28	-	Gamma Isotopic	-	-
			Tritium on Composite	92 Days	115 Days
Food Products (broadleaf vegetation)	35, 96, 101	-	Gamma Isotopic, I-131	-	-
Direct Radiation	1-10, 20, 44, 56, 58, 59, 66, 67, 71, 79-91, 94	111, N01-N25	Gamma	92 Days	115 Days
Ground Water	11, 47	-	Gamma Isotopic, Tritium	-	-
Sediment from Shoreline	28	35	Gamma Isotopic	-	-
Fish (edible portions)	28, 35	-	Gamma Isotopic	-	-

^a Analyze for gross beta radioactivity ≥ 24 hours following filter change.

Figure 1

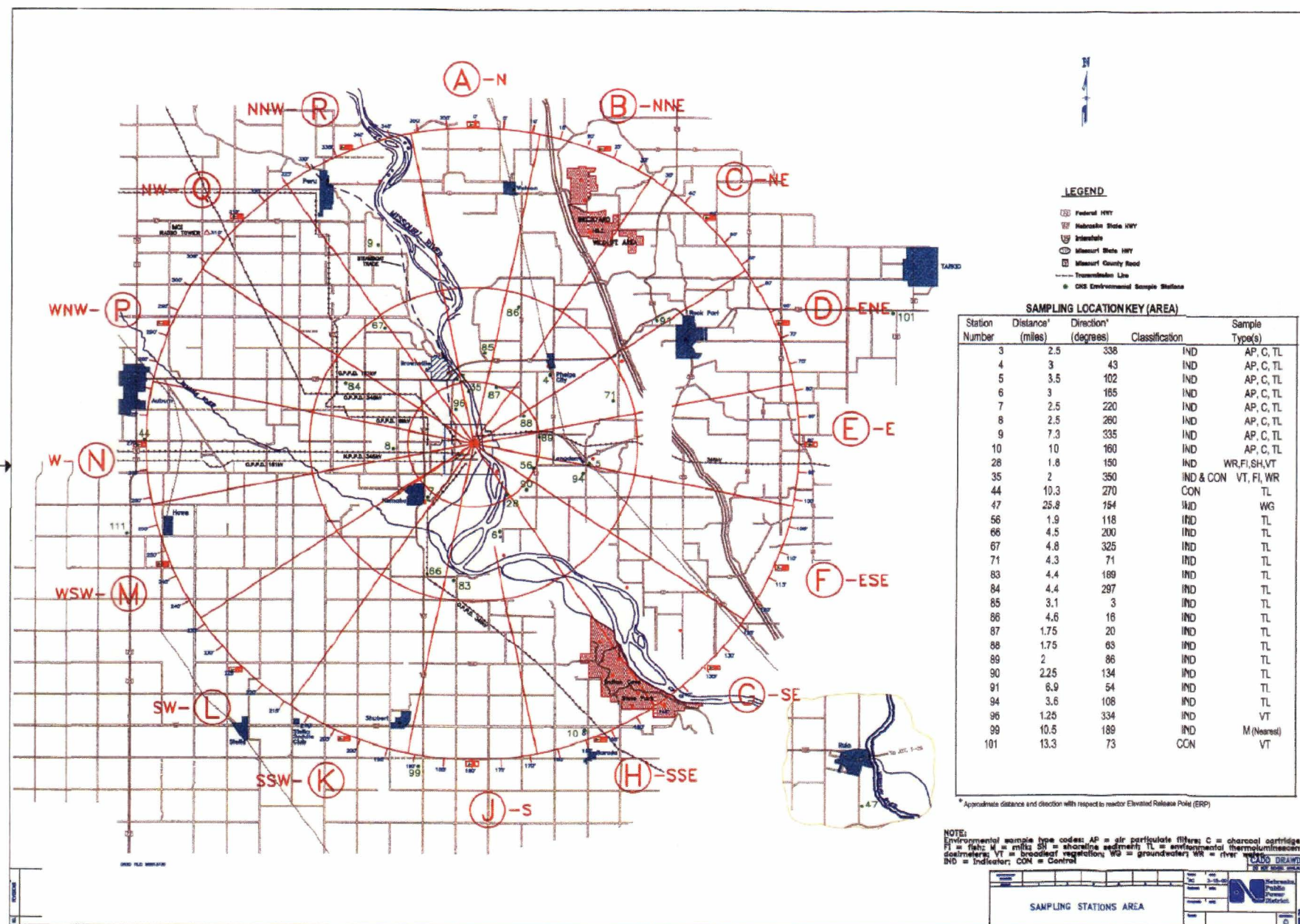
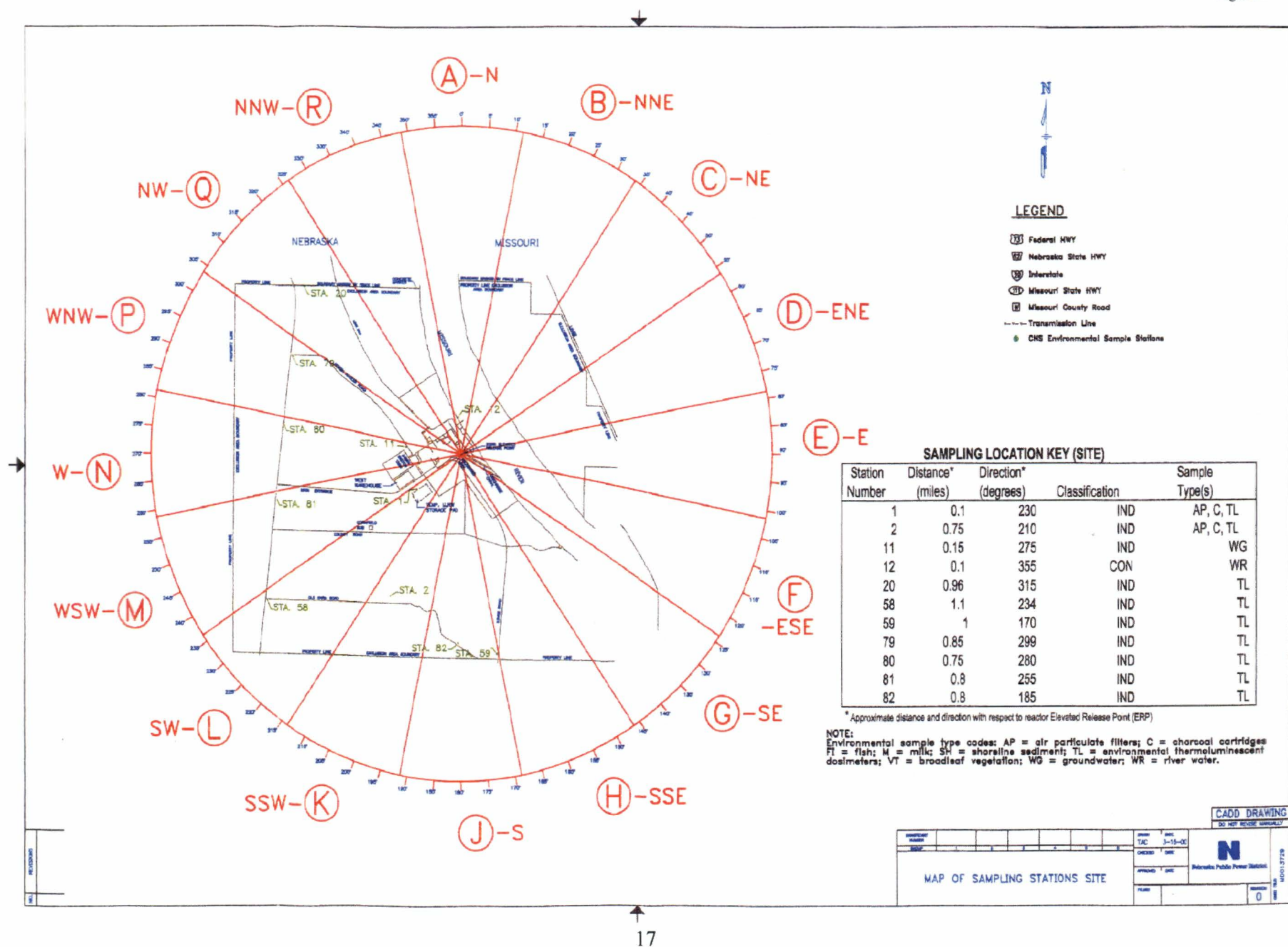


Figure 2



SECTION IV. SUMMARY AND DISCUSSION OF 2019 ANALYTICAL RESULTS

IV. SUMMARY AND DISCUSSION OF 2019 ANALYTICAL RESULTS

Data from the radiological analyses of environmental media collected during 2019 are tabulated and discussed in section A through H. The procedures and specifications followed in the laboratory for these analyses are as required in the Teledyne Brown Engineering Quality Assurance manual and are explained in the Teledyne Brown Engineering Analytical Procedures. A synopsis of analytical procedures used for the environmental samples is provided in Appendix C. In addition to internal quality control measures performed by Teledyne Brown Engineering, the laboratory also participates in an Interlaboratory Comparison Program. Participation in this program ensures that independent checks on the precision and accuracy of the measurements of radioactive material in environmental samples are performed. The results of the Interlaboratory Comparison are provided in Appendix B.

Radiological analyses of environmental media characteristically approach and frequently fall below the detection limits of state-of-the-art measurement methods. The "less than" values in the data tables were calculated from each specific analysis and are dependent on sample size, detector efficiency, length of counting time, chemical yield (when appropriate) and the radioactive decay factor from time of counting to time of collection. Teledyne Brown Engineering's analytical methods meet or are below the Lower Limit of Detection (LLD) requirements given in Table 2 of the USNRC Branch Technical Position, Radiological Monitoring Acceptable Program (November 1979, Revision 1). Appendix C contains a discussion of the LLD formulas.

The following is a discussion and summary of the results of the environmental measurements taken during the 2019 reporting period:

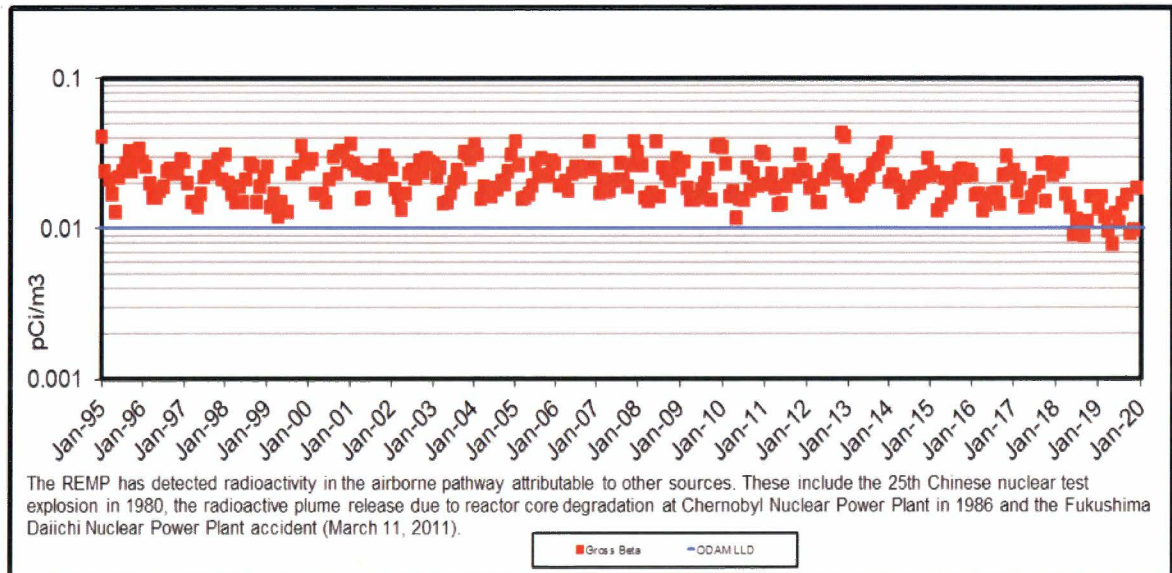
A. Airborne Particulates

Gross beta activity was observed in 308 of the 333 indicator samples collected during 2019. The average concentration was 0.014 pCi/m³ with a range of 0.003 to 0.038 pCi/m³. The results of the gross beta activities are presented in Section VII-1 and Trending Graph 1. The gross beta activities for 2019 were comparable to levels measured in the previous several years. Prior to that period the gross beta activities were higher due to atmospheric nuclear weapons testing performed in other countries. The preoperational period of 1971 through 1974 averaged 0.098 pCi/m³ gross beta.

Air particulate filters were collected weekly and composited by locations on a quarterly basis, unless otherwise specified in Section VII-2. They were analyzed by gamma ray spectroscopy. The results are presented in Section VII-2. Beryllium-7, which is produced continuously in the upper atmosphere by cosmic radiation, was measured in 28 of the 28 composite samples. The indicator locations had an average concentration of 0.101 pCi/m³ with a range of 0.044 to 0.186 pCi/m³. During the preoperational period, beryllium-7 was measured at comparable levels. Naturally occurring Potassium-40 was detected in one indicator station at a concentration of 0.032 pCi/L. All other gamma emitters were below the detection limits. The operation of Cooper Nuclear Station has no discernable impact on Airborne Particulate samples.

TRENDING GRAPH 1

GROSS BETA IN AIR PARTICULATES MONTHLY AVERAGE – ALL LOCATIONS

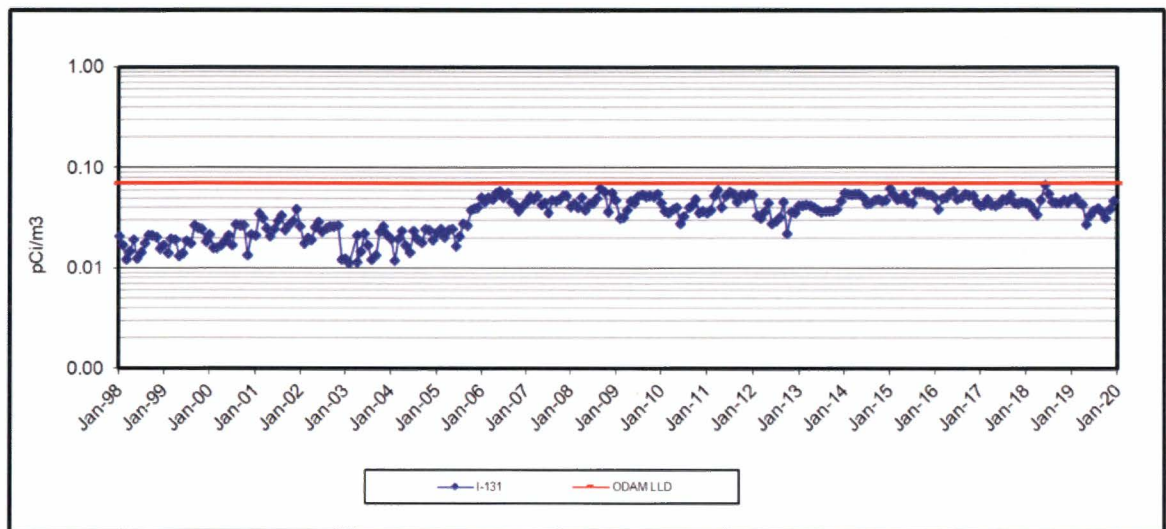


B. Airborne Iodine

Charcoal cartridges used to collect airborne iodine were collected weekly and analyzed by gamma spectrometry for iodine-131, unless otherwise specified in Section VII-1. The results are presented in Section VII-1 and Trending Graph 2. Iodine-131 was below the lower limit of detection in all 334 samples. The operation of Cooper Nuclear has no discernable impact on charcoal cartridge samples.

TRENDING GRAPH 2

IODINE-131 IN CHARCOAL FILTERS
MONTHLY AVERAGE – ALL LOCATIONS



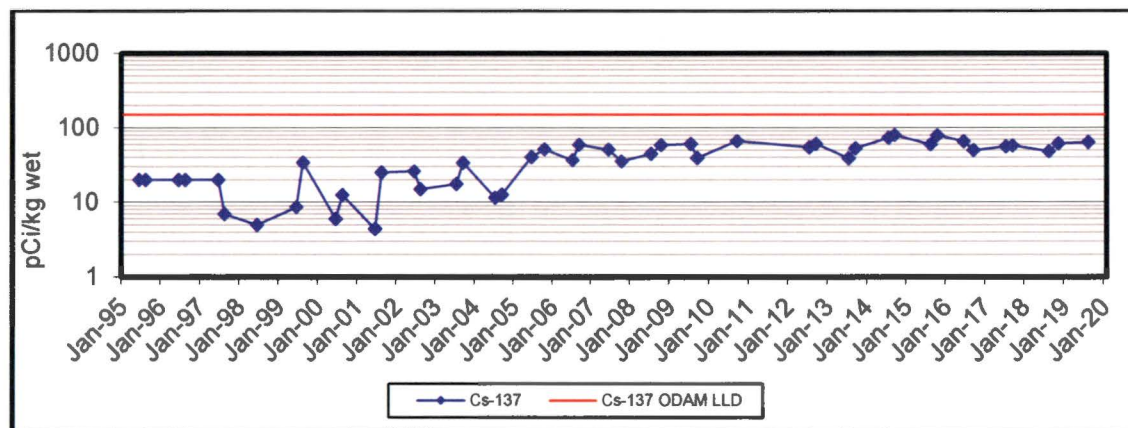
Trending Graph 2 represents minimum detectable concentration (MDC) results. This graph has the ODAM LLD trend line, showing the MDC results as below the ODAM required LLDs. The upward trend indicates shortened detector count time in order to maximize the number of samples counted each day, and is not an indication that the trend will continue to increase above the LLD limit.

C. Fish

Aquatic biota can be sensitive indicators of radionuclide accumulation in the environment because of their ability to concentrate certain chemical elements, which have radioisotopes. The results are presented in Table VII-3 and Trending Graph 3. Two samples of fish were collected during the summer of 2019. Middle-top feeding fish (carp) and bottom feeding fish (catfish) were collected in August. Due to flooding of the Missouri River, fish sampling was not able to be performed in Fall 2019. These samples were analyzed by gamma ray spectroscopy. Naturally occurring potassium-40 was detected in all samples. The average concentration at the upstream control location was 3,205 pCi/kg (wet weight) with a range of 3,061 to 3,349 pCi/kg (wet weight). The average concentration for the indicator samples was 3,422 pCi/kg (wet weight) with a range of 3,110 to 3,734 pCi/kg (wet weight). The preoperational period of 1971 through 1974 averaged 2,400 pCi/kg potassium-40. All other gamma emitters were below the lower limit of detection. The operation of Cooper Nuclear Station has had no discernable impact on fish samples.

TRENDING GRAPH 3

CESIUM-137 IN FISH ALL LOCATIONS



Trending Graph 3 represents minimum detectable concentration (MDC) results. This graph has the ODAM LLD trend line, showing the MDC results as below the ODAM required LLDs. The upward LLD trend indicates that detector count times were gradually shortened to maximize the number of samples counted each day, and is not an indication that the trend will continue to increase above the LLD limit.

Samples were not collected in Summer 2010.

Flooding of the Missouri River prevented collection of fish in Summer or Fall 2011.

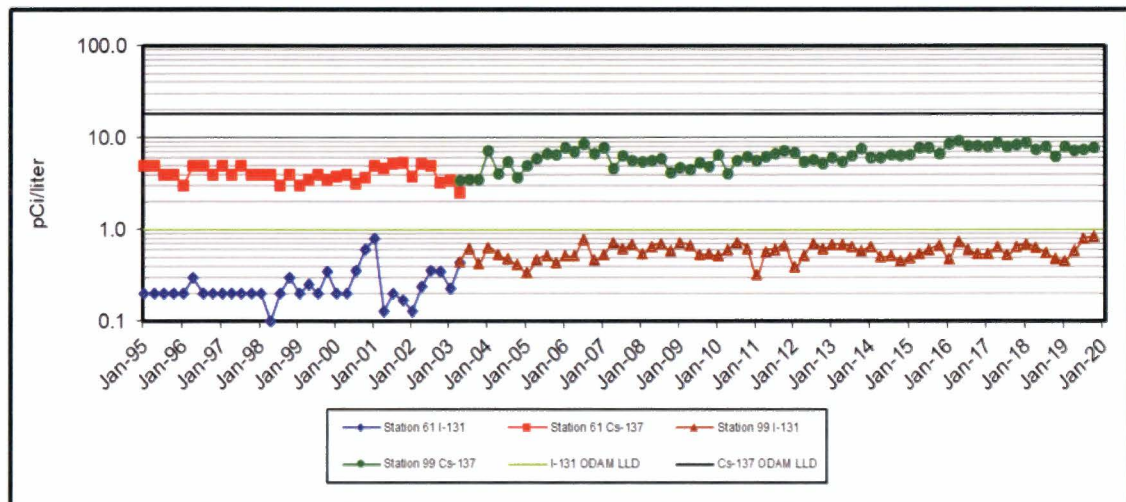
Flooding of the Missouri River prevented collection of fish in Fall 2019.

D. Milk – Nearest Producer

Milk samples are collected once every 15 days in peak pasture season and once every 31 days the rest of the year from Station 99. The results are presented in Table VII-4 and Trending Graph 4. Twenty three samples were analyzed by gamma ray spectroscopy and for low-level iodine-131 by radiochemical separation. All iodine-131 results were below the lower limit of detection. Naturally occurring potassium-40 was measured in all samples with an average concentration of 1,200 pCi/L and a range of 1,006 to 1,402 pCi/L. Naturally occurring Radium-226 was detected in one indicator sample at a concentration of 138 pCi/L. All other gamma emitters were below the lower limit of detection. The operation of Cooper Nuclear Station has no discernable impact on milk samples.

TRENDING GRAPH 4

IODINE-131 AND CESIUM-137 IN MILK – NEAREST PRODUCER STATIONS 61 & 99



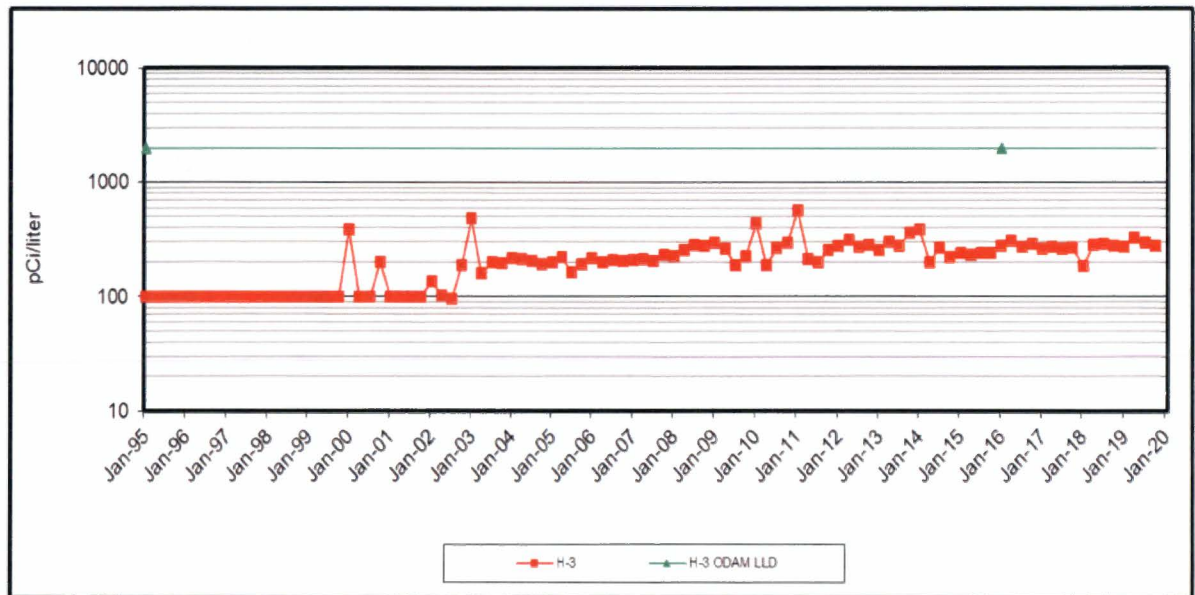
Station 61 went out of business in May of 2003. Station 99 replaced station 61 in May of 2003. Trending Graph 4 represents minimum detectable concentration (MDC) results. This graph has the ODA M LLD trend line, showing the MDC results as below the ODA M required LLDs. The upward trend indicates shortened detector count time in order to maximize the number of samples counted each day, and is not an indication that the trend will continue to increase above the LLD limit.

E. Ground Water

Groundwater was collected from two stations quarterly and analyzed for tritium, low level iodine-131 and for gamma emitting radionuclides. Station 11 is located 0.15 miles from the plant and station 47 is 25.8 miles from the plant. The results are presented in Table VII-5 and Trending Graph 5. All tritium and low level iodine results were below the lower limit of detection. Naturally occurring potassium-40 was measured in one indicator sample with a concentration of 74.8 pCi/L. Naturally occurring Thorium-228 was also measured in one indicator sample with a concentration of 12.1 pCi/L. The operation of Cooper Nuclear Station has no discernable impact on groundwater samples.

TRENDING GRAPH 5

TRITIUM IN GROUND WATER QUARTERLY AVERAGE - ALL LOCATIONS



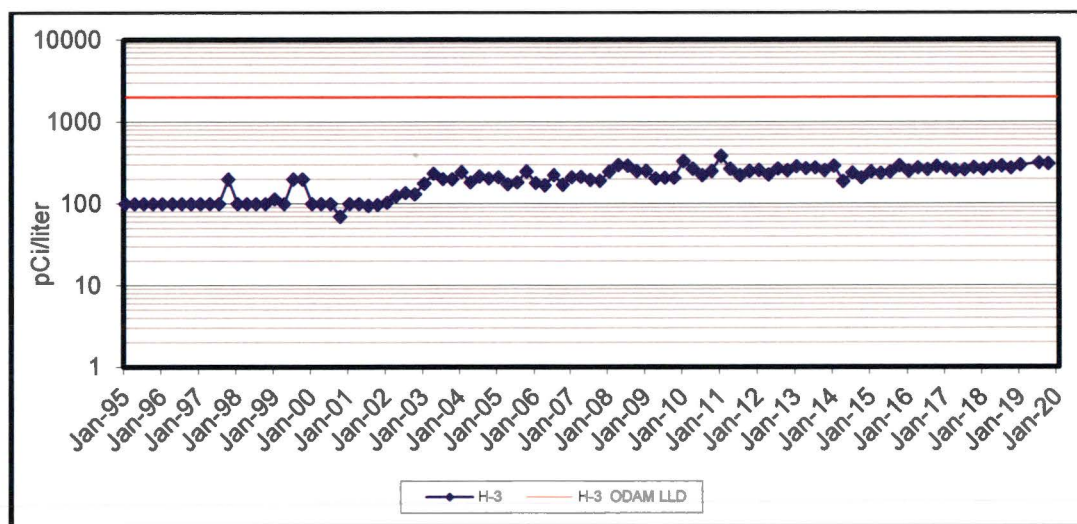
Trending Graph 5 represents minimum detectable concentration (MDC) results. This graph has the ODAM LLD trend line, showing the MDC results as below the ODAM required LLDs. The upward LLD trend indicates that detector count times were gradually shortened to maximize the number of samples counted each day, and is not an indication that the trend will continue to increase above the LLD limit.

F. River Water

River water was collected monthly and monitored for gamma emitting radionuclides and tritium. The monthly samples are composited quarterly and analyzed for tritium. The results are presented in Table VII-6 and Trending Graph 6. All tritium results were below the lower limit of detection. All other the gamma emitters were below the lower limit of detection. The operation of Cooper Nuclear Station has no discernable impact on river water samples.

TRENDING GRAPH 6

TRITIUM IN RIVER WATER QUARTERLY AVERAGE – ALL LOCATIONS



Trending Graph 6 represents minimum detectable concentration (MDC) results. This graph has the ODAM LLD trend line, showing the MDC results as below the ODAM required LLDs. The upward LLD trend indicates that detector count times were gradually shortened to maximize the number of samples counted each day, and is not an indication that the trend will continue to increase above the LLD limit.

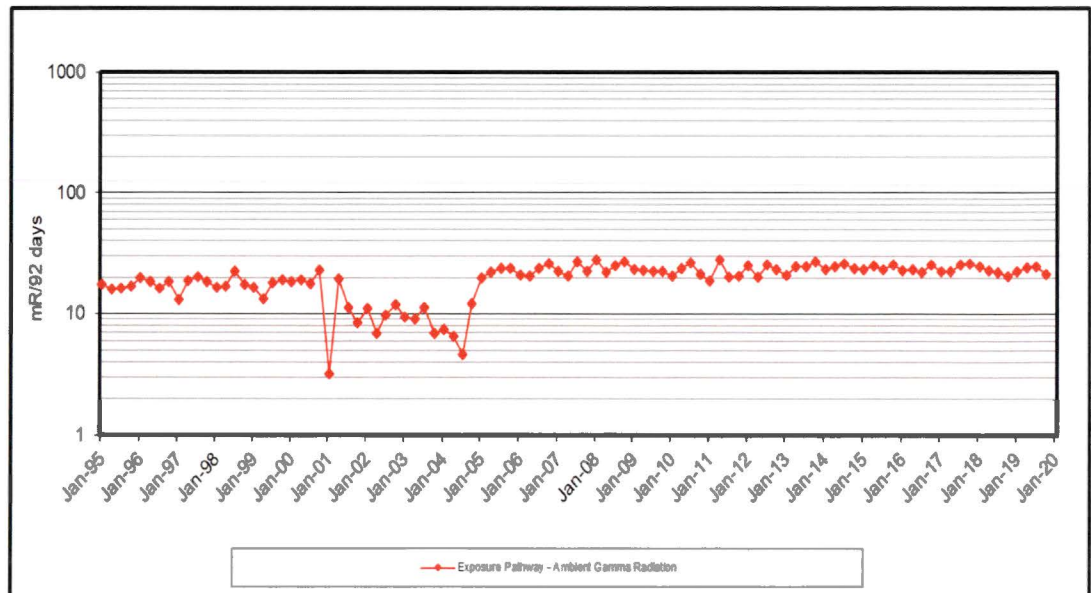
G. Thermoluminescent Dosimeters

Thermoluminescent dosimeters (TLDs) determine environmental radiation doses and the results are presented in Table VII-7 and Trending Graph 7. Ambient radiation was monitored at 32 locations within an 11 mile radius of Cooper Nuclear Station and collected quarterly. The average concentration for the indicator locations was 23.5 millirem/quarter and a range from 18.5 to 29.2 millirem/quarter. The control station 44, which is located 10.3 miles, 270 degrees, had an average of 24.7 millirem/quarter and a range from 21.6 to 27.0 millirem/quarter. The highest station was Station 83 with an average of 25.5 millirem/quarter and a range from 21.8 to 29.2 millirem/quarter. The preoperational period of 1971 through 1974 averaged 37.0 millirem/quarter; which is the preoperational four year average. Current year TLD averages deviate from the preoperational averages due to instrument variations from previous vendors.

The data from year to year is in good agreement and indicates no adverse changes in radiation exposure to the population near Cooper Nuclear Station.

TRENDING GRAPH 7

THERMOLUMINESCENT DOSIMETRY QUARTERLY AVERAGE – ALL LOCATIONS



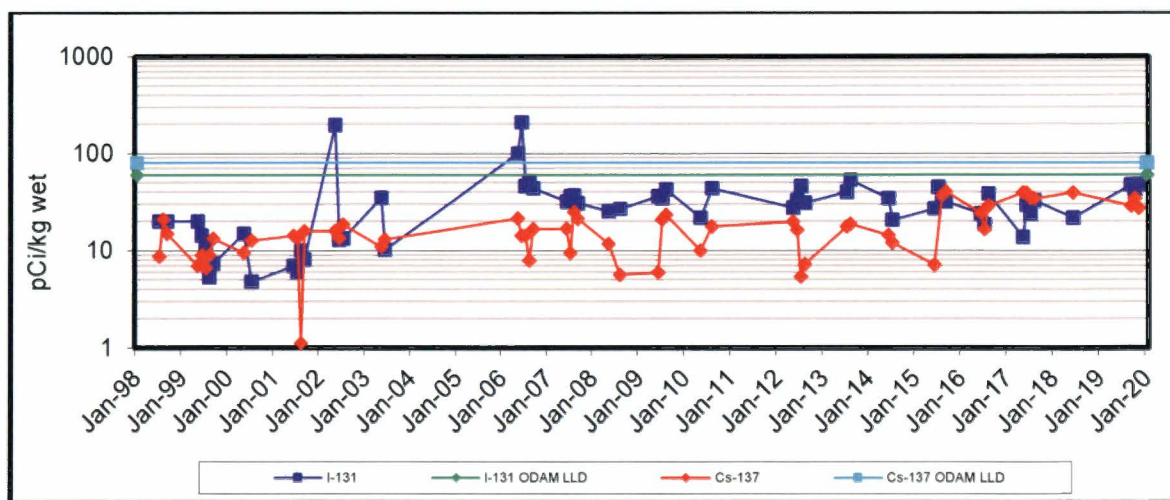
First quarter 2001 TLD data low but still within acceptable limits due to possible dry conditions.

H. Food – Broadleaf Vegetation

Three broadleaf vegetation samples were collected from two indicator locations and one control location in September, October, and November 2019. The samples were analyzed by gamma ray spectroscopy and for low-level iodine-131 by radiochemical separation. The results are presented in Table VII-8 and Trending Graph 8. Beryllium-7, which is produced continuously in the upper atmosphere by cosmic radiation was measured in all nine samples analyzed. The average concentration for the indicator locations was 3,288 pCi/kg (wet weight) with a range of 1,489 to 6,636 pCi/kg wet. The control location had an average concentration of 2,612 pCi/kg (wet weight) with a range of 1,211 to 4,177 pCi/kg (wet). Naturally occurring potassium-40 was measured in all nine samples analyzed. The concentration for the indicator locations was 5,832 pCi/kg (wet weight) with a range of 2,382 to 7,920 pCi/kg (wet). The control location had an average concentration of 4,951 pCi/kg (wet weight) with a range of 4,218 to 6,313 pCi/kg (wet). All other gamma emitters were below the lower limit of detection. The operation of Cooper Nuclear Station has no discernable impact on broadleaf vegetation samples.

TRENDING GRAPH 8

IODINE-131 AND CESIUM-137 IN FOOD – BROADLEAF VEGETATION ALL LOCATIONS



The low Cs-137 value reported in July 2001 was due to the wrong aliquot being entered for the gamma analysis resulted in an invalid analysis and is not reported

Due to delay in sample receipt, the I-131 had decayed away, resulting in an invalid analysis for May 2002 and is not reported. Milk samples were collected in lieu of broadleaf vegetation samples in 2004 and 2005.

Due to delay in counting sample, the I-131 had decayed away, resulting in an invalid analysis for June 2006 and is not reported. The I-131 by chemical separation met required I-131 LLD.

Trending Graph 8 represents minimum detectable concentration (MDC) results. This graph has the ODA M LLD trend line, showing the MDC results as below the ODA M required LLDs. The upward trend indicates shortened detector count time in order to maximize the number of samples counted each day, and is not an indication that the trend will continue to increase above the LLD limit.

Broadleaf vegetation samples were not available for collection in 2011 due to Missouri River flooding.

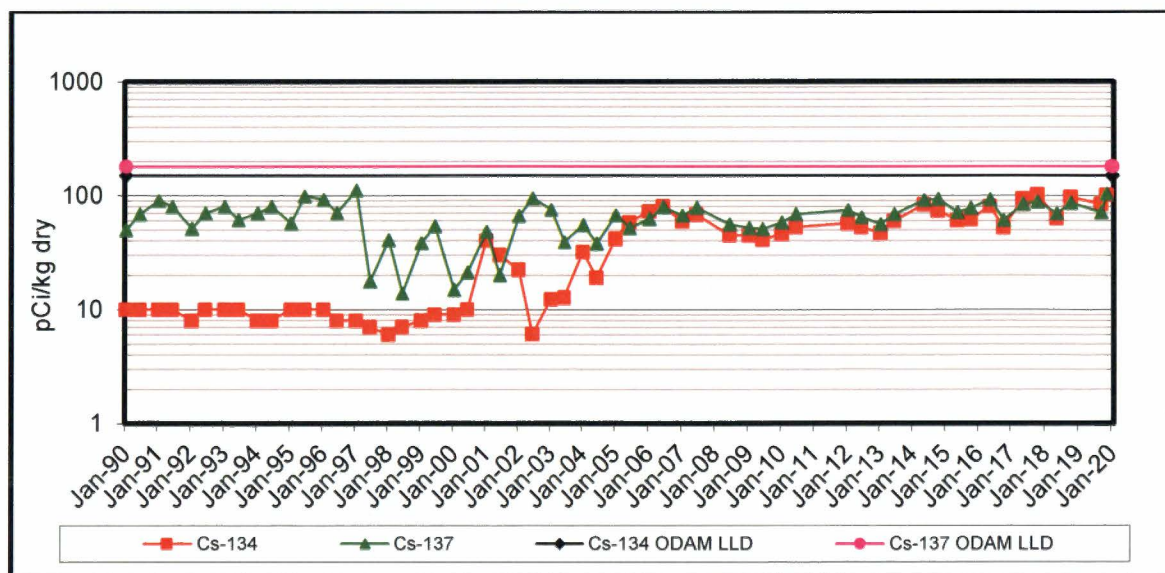
Broadleaf vegetation samples were not available for collection April thru August 2019 due to Missouri River Flooding.

I. Shoreline Sediment

Due to Missouri River flooding, “Once in Spring” and “Once in Fall” sediment samples could not be safely collected from Station 28. A downstream replacement sample was obtained from Indian Caves State Park boat ramp on 11/26/19 in lieu of Station 28. Sediment samples were collected in September and November from control location 35. The samples collected were analyzed by gamma spectrometry. The results are presented in Table VII-9 and Trending Graph 9. A number of naturally occurring radionuclides were detected in these samples. Naturally occurring potassium-40 was observed in all three samples. The average concentration for the control location was 13,820 pCi/kg (dry weight) and a range of 12,570 to 15,070 pCi/kg (dry weight). The average concentration for the indicator location was 16,280 pCi/kg (dry weight). Naturally occurring Radium-226 was observed in one of the indicator samples with an average concentration of 3,762 pCi/kg (dry weight). Naturally occurring Thorium-228 was observed in all three samples. The average concentration for the control location was 1,004 pCi/kg (dry weight) with a range of 417 to 1,591 pCi/kg (dry weight). The average concentration for the indicator location was 942 pCi/kg (dry weight). All other gamma emitters were below the lower limit of detection. The operation of Cooper Nuclear Station has no discernable impact on shoreline sediment samples.

TRENDING GRAPH 9

CESIUM-134 AND CESIUM-137 IN SHORELINE SEDIMENT STATIONS 28 AND 35



Trending Graph 9 represents minimum detectable concentration (MDC) results. Only one sample was collected in 2008. This graph has the ODAM LLD trend line, showing the MDC results as below the ODAM required LLDs. The upward trend indicates shortened detector count time in order to maximize the number of samples counted each day, and is not an indication that the trend will continue to increase above the LLD limit. Graph data extends through October 2019 only. Shoreline sediment samples were not available for collection due to flooding of the Missouri River in 2011. Shoreline sediment samples were not available for collection due to flooding of the Missouri River in September 2019.

2018 REMP Exceptions Table, Revised 3/16/20

Condition Report Number (CR-CNS-)	Requirement	Analyses Impacted	Cause of Exception	Location Where Replacement Samples were Obtained
2017-06091, 2018-04198	"Milk - Other Producers" from at least 2 locations at least once per 92 days (+25% grace).	Gamma Isotopic and I-131	Stations 102 & 103 are only available milk producers besides Station 99 (already being used to meet the Nearest Producer requirement) in area. Owners of Stations 102 & 103 weren't actively in production in 2018 and were removed from the ODAM on 10/13/2018 (LBDCR 2018-013).	Broadleaf vegetation replacement samples were available and obtained from Stations 35, 96 and 101 on 6/12/18. Broadleaf vegetation was unavailable in other calendar months.
2018-00421	River Water from at least 2 locations at least once per 31 days (+25% grace).	Gamma and Tritium	Due to icy weather conditions, it was not safe to collect sample from Station 28 or 35 within 31 days (+25% grace) of previous sample taken 12/6/2017. Samples were able to be safely obtained on 1/24/2018.	N/A
2018-04195	River Water from at least 2 locations at least once per 31 days (+25% grace).	Gamma and Tritium	Due to Missouri River flooding, it was not safe to collect sample from Station 28 or 35 within 31 days (+25% grace) of previous sample taken 6/6/2018. Samples were able to be safely obtained on 8/7/2018.	N/A
2020-00881	"Milk - Nearest Producers" from at least 1 location at least once per 15 days (+25% grace) during Peak Pasture Period.	Gamma Isotopic and I-131	Due to human error, milk sample from Station 99 was not collected within 15 days (+25% grace) of previous sample taken 7/17/18. Sample was obtained on 8/7/18. To address this, the following were performed: personal accountability, revised structure/formality of performing and second checking that REMP sampling requirements met, re-assigned REMP Program ownership role and increased REMP program oversight.	N/A
2018-05226	River Water from at least 2 locations at least once per 31 days (+25% grace).	Gamma and Tritium	Due to Missouri River flooding, it was not safe to collect sample from Station 28 or 35 within 31 days (+25% grace) of previous sample taken 8/7/2018. Samples were able to be safely obtained on 9/17/2018.	N/A
2019-05102	Direct Radiation (TLDs) from at least 32 locations at least once per 92 days.	Gamma	Results were obtained from 29 of 32 ODAM TLD locations in 3rd Quarter 2018. Due to Missouri River flooding, TLDs installed at Station 3 and Station 82 on 7/16/18 and 7/12/18 respectively were lost in Missouri River flood waters. New TLDs could not be installed at these locations until 1/8/19. Station 8 TLD installed from 7/12/18 to 10/16/18 was collected but not successfully analyzed.	TLD replacement samples for 3rd Quarter 2018 were obtained from 23 locations (Stations N02-N14, N16-N25).

2018 REMP Exceptions Table, Revised 3/16/20 (Continued)

Condition Report Number (CR-CNS-)	Requirement	Analyses Impacted	Cause of Exception	Location Where Replacement Samples were Obtained
2019-05102	Direct Radiation (TLDs) from at least 32 locations at least once per 92 days.	Gamma	Results were obtained from 29 of 32 ODAM TLD locations in 3rd Quarter 2018. Due to Missouri River flooding, TLDs installed at Station 3 and Station 82 on 7/16/18 and 7/12/18 respectively were lost in Missouri River flood waters. New TLDs could not be installed at these locations until 1/8/19. Station 8 TLD installed from 7/12/18 to 10/16/18 was collected but not successfully analyzed.	TLD replacement samples for 3rd Quarter 2018 were obtained from 23 locations (Stations N02-N14, N16-N25).
2018-05407	River Water from at least 2 locations at least once per 31 days (+25% grace).	Gamma and Tritium	Due to Missouri River flooding, it was not safe to collect sample from Station 28 or 35 within 31 days (+25% grace) of previous sample taken 9/17/2018. Samples were able to be safely obtained on 11/7/2018.	N/A
2019-05102	Direct Radiation (TLDs) from at least 32 locations at least once per 92 days.	Gamma	Results were obtained from 30 of 32 ODAM TLD locations in 4th Quarter 2018. Due to Missouri River flooding, TLDs installed at Station 3 and Station 82 on 7/16/18 and 7/12/18 respectively were lost in Missouri River flood waters. New TLDs could not be installed at these locations until 1/8/19.	TLD replacement samples for 4th Quarter 2018 were obtained from 24 locations (Stations 111, N01-N14, N16-N17, N19-N25).
2020-00881	Fish from at least 2 locations two times per year (summer & fall). Attempt to include both Bottom and Middle-Top feeding species.	Gamma Isotopic	Attempted for 2 days during fall collection to catch bottom feeding fish from Stations 28 & 35. Attempts were unsuccessful. All other ODAM requirements for fish were met in 2018.	N/A
2019-04960, 2019-04691	In September 2019, CNS self-identified that REMP analysis frequency requirements from 1984 to 2019 have not been met in all cases for Radioiodine (Iodine-131), Particulate Composite by Location (Gamma Isotopic), Direct Radiation (Gamma) and River Water Composite by Location (Tritium). Due to improper interpretation of a 1984 revision to CNS' ODAM, CNS did not recognize that this revision created analysis frequency requirements for 4 of the 9 sample types. For example, the 1984 revision requires that each radioiodine canister <u>analysis</u> date/time be no more than 7 days plus 25% grace (8.75 days) from <u>analysis</u> date/time of the previous radioiodine canister. From 1984 to 2019, CNS minimized the elapsed time between sample <u>collection</u> and offsite vendor <u>analysis</u> to the extent practical and ensured detection capabilities stated in ODAM Table D4.1-2 were achieved. Because CNS did not recognize that the additional analysis frequency requirement described above existed, CNS did not track elapsed time between the analysis dates/times. Additional information is available in CR-CNS-2019-04960. Each specific instance of an analysis frequency being exceeded (or unknown) since 1/1/2019 was determined and documented in the 2019 Exceptions Table. Specific instances between 1984 and 2018 were not determined, primarily due to lack of documentation regarding precise analysis date/time. To address this, the following were performed: REMP analysis frequency tracking mechanism established at CNS, established structure/formality at CNS for verification of analysis frequencies and revised contracts with offsite vendors to require analysis dates/times be documented and specific turnaround times met so that ODAM required analysis frequencies are not exceeded.			

SECTION V. CONCLUSIONS

V. CONCLUSIONS

The results of the 2019 Radiological Environmental Monitoring Program (REMP) for Cooper Nuclear Station (CNS) of Nebraska Public Power District (NPPD) have been presented. The report contains data tables, summaries, and discussions of the data and trending graphs.

Naturally occurring radioactivity and residual traces of fallout were observed in sample media in the expected ranges. They have been discussed individually in the text. Observed radioactivity was at very low concentrations.

The results of the analyses have been presented. Based on the evidence of the Radiological Environmental Monitoring Program, Nebraska Public Power District, Cooper Nuclear Station has had no discernable radiological impact on the environment and is operating within regulatory limits.

SECTION VI. RADIOLOGICAL ENVIRONMENTAL MONITORING
PROGRAM SUMMARY TABLE - 2019

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Cooper Nuclear Station
 Location of Facility Nemaha Nebraska
 (County/State)

Docket No. 50-298
 Reporting Period January 1 2019 to December 31 2019

Medium of Pathway Sampled (Unit of Measurement)	Type & Total No. of Analysis Performed	Lower Limit of Detection(1) (LLD)	All Indicator Locations Mean(2) Range(2)	Location with Highest Annual Mean			Control Location Mean(2) Range(2)	No. of Reportable Occurrences
				Name		Mean(2) Range(2)		
Air Particulate (pCi/m ³)	GR-B	333	0.01	.014(308/333) (.003/.038)	Sta. 5 3.5 mi.	.02(9/10) (.008/.038)	NA(0/0) (NA-NA)	0
	BE-7	28	NA	.101(28/28) (.044/.186)	Sta. 10 10.0 mi.	.124(4/4) (.072/.186)	NA(0/0) (NA-NA)	0
	K-40	28	NA	.032(1/28) (NA-NA)	Sta. 10 10.0 mi.	.032(1/4) (NA-NA)	NA(0/0) (NA-NA)	0
	CO-60	28	NA	ND(0/28) (ND-ND)	NA	NA(0/0) (NA-NA)	NA(0/0) (NA-NA)	0
	TH-228	28	NA	ND(0/28) (ND-ND)	NA	NA(0/0) (NA-NA)	NA(0/0) (NA-NA)	0
Air Iodine (pCi/m ³)	I-131	334	0.07	ND(0/334) (ND-ND)	NA	NA(0/0) (NA-NA)	NA(0/0) (NA-NA)	0
Fish (pCi/kg wet)	K-40	4	NA	3422(2/2) (3110/3734)	Sta. 28 1.8 mi.	3422(2/2) (3110/3734)	3205(2/2) (3061/3349)	0
	CO-60	4	130	ND(0/2) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/2) (ND-ND)	0

(1) Lower Limit of Detection (LLD), as stated in ODAM.

(2) Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location indicated in brackets().

ND = Non Detectable.

NA = Not Applicable.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Cooper Nuclear Station
 Location of Facility Nemaha Nebraska
 (County/State)

Docket No. 50-298
 Reporting Period January 1 2019 to December 31 2019

Medium of Pathway Sampled (Unit of Measurement)	Type & Total No. of Analysis Performed	Lower Limit of Detection(1) (LLD)	All Indicator Locations Mean(2) Range(2)	Location with Highest Annual Mean				Control Location Mean(2) Range(2)	No. of Reportable Occurrences
				Name		Mean(2) Range(2)			
Fish (cont'd) (pCi/kg wet)	CS-137	4	150	ND(0/2) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/2) (ND-ND)		0
	TH-228	4	NA	ND(0/2) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/2) (ND-ND)		0
Milk Nearest (pCi/L)	I-131	23	1	ND(0/23) (ND-ND)	NA	NA(0/0) (NA-NA)	NA(0/0) (NA-NA)		0
	K-40	23	NA	1200(23/23) (1006/1402)	Sta. 99 10.5 mi.	1200(23/23) (1006/1402)	NA(0/0) (NA-NA)		0
	RA-226	23	NA	138(1/23) (NA-NA)	Sta. 99 10.5 mi.	138(1/23) (NA-NA)	NA(0/0) (NA-NA)		0
	TH-228	23	NA	ND(0/23) (ND-ND)	NA	NA(0/0) (NA-NA)	NA(0/0) (NA-NA)		0
Water - Ground (pCi/L)	I-131	8	1	ND(0/8) (ND-ND)	NA	NA(0/0) (NA-NA)	NA(0/0) (NA-NA)		0
	H-3	8	2000	ND(0/8) (ND-ND)	NA	NA(0/0) (NA-NA)	NA(0/0) (NA-NA)		0

(1) Lower Limit of Detection (LLD), as stated in ODAM.

(2) Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location indicated in brackets().

ND = Non Detectable.

NA = Not Applicable.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Cooper Nuclear Station
 Location of Facility Nemaha Nebraska
 (County/State)

Docket No. 50-298
 Reporting Period January 1 2019 to December 31 2019

Medium of Pathway Sampled (Unit of Measurement)	Type & Total No. of Analysis Performed	Lower Limit of Detection(1) (LLD)	All Indicator Locations Mean(2) Range(2)	Location with Highest Annual Mean			Control Location Mean(2) Range(2)	No. of Reportable Occurrences
				Name		Mean(2) Range(2)		
Water - Ground (cont'd) (pCi/L)	K-40	8	NA	75(1/8) (NA-NA)	Sta. 11 0.15 mi.	74(1/4) (NA-NA)	NA(0/0) (NA-NA)	0
	TH-228	8	NA	12(1/8) (NA-NA)	Sta. 11 0.15 mi.	12(1/4) (NA-NA)	NA(0/0) (NA-NA)	0
River Water (pCi/L)	H-3	18	2000	ND(0/7) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/11) (ND-ND)	0
	K-40	13	NA	ND(0/5) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/8) (ND-ND)	0
	TH-228	13	NA	ND(0/5) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/8) (ND-ND)	0
Thermoluminescence Dosimeter (mR/Quarter)	Gamma Dose	63	NA	23.5(59/59) (18.5/29.2)	Sta. 83 4.4 mi.	25.5(4/4) (21.8/29.2)	24.7(4/4) (21.6/27.0)	0
Broadleaf Vegetation (pCi/kg wet)	I-131	9	60	ND(0/6) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/3) (ND-ND)	0
	BE-7	9	NA	3288(6/6) (1489/6636)	Sta. 96 1.3 mi.	3290(3/3) (1545/4965)	2612(3/3) (1211/4177)	0

(1) Lower Limit of Detection (LLD), as stated in ODAM.

(2) Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location indicated in brackets().

ND = Non Detectable.

NA = Not Applicable.

ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM SUMMARY

Name of Facility Cooper Nuclear Station
 Location of Facility Nemaha Nebraska
 (County/State)

Docket No. 50-298
 Reporting Period January 1 2019 to December 31 2019

Medium of Pathway Sampled (Unit of Measurement)	Type & Total No. of Analysis Performed		Lower Limit of Detection(1) (LLD)	All Indicator Locations Mean(2) Range(2)	Location with Highest Annual Mean		Control Location Mean(2) Range(2)	No. of Reportable Occurrences
					Name	Mean(2) Range(2)		
Broadleaf Vegetation (cont'd) (pCi/kg wet)	K-40	9	NA	5832(6/6) (2382/7920)	Sta. 101 13.3 mi.	6176(3/3) (4762/7164)	4951(3/3) (4218/6313)	0
	RA-226	9	NA	ND(0/6) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/3) (ND-ND)	0
	TH-228	9	NA	ND(0/6) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/3) (ND-ND)	0
Shoreline Sediment (pCi/kg dry)	BE-7	3	NA	ND(0/1) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/2) (ND-ND)	0
	K-40	3	NA	16280(1/1) (NA-NA)	Indian Caves 7.4 mi.	16280(1/1) (NA-NA)	13820(2/2) (12570/15070)	0
	CS-137	3	180	ND(0/1) (ND-ND)	NA	NA(0/0) (NA-NA)	ND(0/2) (ND-ND)	0
	RA-226	3	NA	3762(1/1) (NA-NA)	Indian Caves 7.4 mi.	3762(1/1) (NA-NA)	ND(0/2) (ND-ND)	0
	TH-228	3	NA	942(1/1) (NA-NA)	Sta. 35 2.0 mi.	1004(2/2) (417/1591)	1004(2/2) (417/1591)	0

(1) Lower Limit of Detection (LLD), as stated in ODAM.

(2) Mean and Range based upon detectable measurements only. Fraction of detectable measurements at specified location indicated in brackets().

ND = Non Detectable.

NA = Not Applicable.

SECTION VII. COMPLETE DATA TABLES

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 1					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.61E+03	CU.FT.	6.97E-03 ± 3.31E-03	< 6.E-02
01/08/19	01/15/19	1.01E+04	CU.FT.	7.13E-03 ± 3.09E-03	< 4.E-02
01/15/19	01/21/19	8.66E+03	CU.FT.	2.46E-02 ± 4.69E-03	< 5.E-02
01/21/19	01/29/19	1.15E+04	CU.FT.	5.47E-03 ± 2.76E-03	< 3.E-02
01/29/19	02/05/19	1.01E+04	CU.FT.	1.68E-02 ± 3.90E-03	< 4.E-02
02/05/19	02/11/19	8.67E+03	CU.FT.	< 5.20E-03	< 6.E-02
02/11/19	02/18/19	1.00E+04	CU.FT.	3.02E-02 ± 4.87E-03	< 6.E-02
02/18/19	02/27/19	1.31E+04	CU.FT.	2.40E-02 ± 3.74E-03	< 3.E-02
02/27/19	03/04/19	7.04E+03	CU.FT.	1.73E-02 ± 4.95E-03	< 7.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	1.63E-02 ± 3.49E-03	< 4.E-02
03/12/19	03/26/19 (a)	2.02E+04	CU.FT.	1.23E-02 ± 2.09E-03	< 2.E-02
03/26/19	04/02/19	1.01E+04	CU.FT.	1.30E-02 ± 3.82E-03	< 4.E-02
04/02/19	04/09/19	1.00E+04	CU.FT.	1.15E-02 ± 3.40E-03	< 4.E-02
04/09/19	04/16/19	1.01E+04	CU.FT.	< 4.03E-03	< 4.E-02
04/16/19	04/23/19	9.97E+03	CU.FT.	1.51E-02 ± 3.81E-03	< 6.E-02
04/23/19	04/30/19	1.02E+04	CU.FT.	5.69E-03 ± 3.06E-03	< 5.E-02
04/30/19	05/07/19	1.02E+04	CU.FT.	< 3.75E-03	< 1.E-02
05/07/19	05/15/19	1.14E+04	CU.FT.	6.06E-03 ± 2.61E-03	< 4.E-02
05/15/19	05/20/19	7.21E+03	CU.FT.	1.39E-02 ± 5.04E-03	< 5.E-02
05/20/19	05/28/19	1.15E+04	CU.FT.	< 4.92E-03	< 1.E-02
05/28/19	06/04/19	1.01E+04	CU.FT.	1.66E-02 ± 3.82E-03	< 3.E-02
06/04/19	06/11/19	1.01E+04	CU.FT.	1.66E-02 ± 3.75E-03	< 5.E-02
06/11/19	06/18/19	9.97E+03	CU.FT.	1.22E-02 ± 3.87E-03	< 2.E-02
06/18/19	06/25/19	1.02E+04	CU.FT.	1.09E-02 ± 3.27E-03	< 4.E-02
06/25/19	07/02/19	1.01E+04	CU.FT.	1.13E-02 ± 3.11E-03	< 2.E-02
07/02/19	07/08/19	8.56E+03	CU.FT.	1.03E-02 ± 3.69E-03	< 3.E-02

(a) Due to Missouri River flooding, sample was collected over a 14 day period instead of 7 day period.

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 1					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
07/08/19	07/16/19	1.15E+04	CU.FT.	4.11E-03 ± 2.33E-03	< 5.E-02
07/16/19	07/23/19	1.02E+04	CU.FT.	1.56E-02 ± 3.55E-03	< 3.E-02
07/23/19	07/30/19	1.00E+04	CU.FT.	8.72E-03 ± 3.20E-03	< 4.E-02
07/30/19	08/06/19	9.98E+03	CU.FT.	2.94E-02 ± 4.76E-03	< 3.E-02
08/06/19	08/13/19	1.01E+04	CU.FT.	1.38E-02 ± 3.88E-03	< 7.E-02
08/13/19	08/21/19	1.15E+04	CU.FT.	1.52E-02 ± 3.56E-03	< 4.E-02
08/21/19	08/27/19	8.72E+03	CU.FT.	1.40E-02 ± 3.95E-03	< 6.E-02
08/27/19	09/04/19	1.14E+04	CU.FT.	1.59E-02 ± 3.66E-03	< 4.E-02
09/04/19	09/10/19	8.71E+03	CU.FT.	1.96E-02 ± 4.54E-03	< 3.E-02
09/10/19	09/17/19	1.00E+04	CU.FT.	2.04E-02 ± 4.34E-03	< 5.E-02
09/17/19	09/24/19	1.00E+04	CU.FT.	1.81E-02 ± 3.92E-03	< 1.E-02
09/24/19	09/30/19	8.60E+03	CU.FT.	5.93E-03 ± 3.20E-03	< 5.E-02
09/30/19	10/08/19	1.15E+04	CU.FT.	9.38E-03 ± 3.15E-03	< 4.E-02
10/08/19	10/15/19	1.01E+04	CU.FT.	1.37E-02 ± 3.68E-03	< 3.E-02
10/15/19	10/22/19	1.00E+04	CU.FT.	1.17E-02 ± 3.49E-03	< 4.E-02
10/22/19	10/29/19	1.00E+04	CU.FT.	7.65E-03 ± 3.02E-03	< 3.E-02
10/29/19	11/05/19	1.02E+04	CU.FT.	1.37E-02 ± 3.63E-03	< 2.E-02
11/05/19	11/12/19	1.01E+04	CU.FT.	8.27E-03 ± 3.34E-03	< 2.E-02
11/12/19	11/19/19	1.00E+04	CU.FT.	1.67E-02 ± 4.08E-03	< 4.E-02
11/19/19	11/26/19	1.01E+04	CU.FT.	1.34E-02 ± 3.76E-03	< 3.E-02
11/26/19	12/03/19	9.98E+03	CU.FT.	< 3.12E-03	< 5.E-02
12/03/19	12/10/19	1.01E+04	CU.FT.	1.77E-02 ± 4.08E-03	< 5.E-02
12/10/19	12/17/19	1.01E+04	CU.FT.	1.14E-02 ± 3.52E-03	< 4.E-02
12/17/19	12/23/19	8.47E+03	CU.FT.	1.18E-02 ± 3.80E-03	< 3.E-02
12/23/19	12/31/19	1.17E+04	CU.FT.	4.30E-03 ± 2.77E-03	< 5.E-02

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 2					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.60E+03	CU.FT.	4.19E-03 ± 3.00E-03	< 6.E-02
01/08/19	01/15/19	1.02E+04	CU.FT.	1.32E-02 ± 3.60E-03	< 4.E-02
01/15/19	01/21/19	8.77E+03	CU.FT.	3.11E-02 ± 5.10E-03	< 5.E-02
01/21/19	01/29/19	1.11E+04	CU.FT.	2.27E-02 ± 4.16E-03	< 3.E-02
01/29/19	02/05/19	1.02E+04	CU.FT.	1.78E-02 ± 3.95E-03	< 4.E-02
02/05/19	02/11/19	8.53E+03	CU.FT.	1.58E-02 ± 4.68E-03	< 6.E-02
02/11/19	02/18/19	1.01E+04	CU.FT.	7.74E-03 ± 3.10E-03	< 6.E-02
02/18/19	02/26/19	1.15E+04	CU.FT.	9.14E-03 ± 2.91E-03	< 4.E-02
02/26/19	03/04/19	8.72E+03	CU.FT.	1.58E-02 ± 4.16E-03	< 2.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	6.82E-03 ± 2.66E-03	< 4.E-02
03/12/19	03/26/19 (a)	2.01E+04	CU.FT.	2.67E-03 ± 1.24E-03	< 2.E-02
03/26/19	04/23/19 (b)	4.04E+04	CU.FT.	8.00E-03 ± 1.23E-03	< 4.E-02
04/23/19	04/30/19	1.00E+04	CU.FT.	1.46E-02 ± 3.91E-03	< 5.E-02
04/30/19	05/07/19	9.98E+03	CU.FT.	4.27E-03 ± 2.83E-03	< 3.E-02
05/07/19	05/15/19	1.15E+04	CU.FT.	8.19E-03 ± 2.81E-03	< 4.E-02
05/15/19	05/20/19	7.27E+03	CU.FT.	< 6.02E-03	< 5.E-02
05/20/19	05/28/19	1.15E+04	CU.FT.	< 4.88E-03	< 1.E-02
05/28/19	06/04/19	1.00E+04	CU.FT.	1.01E-02 ± 3.29E-03	< 3.E-02
06/04/19	06/11/19	1.01E+04	CU.FT.	1.71E-02 ± 3.79E-03	< 5.E-02
06/11/19	06/18/19	1.00E+04	CU.FT.	1.02E-02 ± 3.70E-03	< 5.E-02

(a) Due to Missouri River flooding, sample was collected over a 14 day period instead of 7 day period.

(b) Due to Missouri River flooding, sample was collected over a 28 day period instead of 7 day period.

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 2					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
06/18/19	07/30/19 (a)	6.07E+04	CU.FT.	1.23E-02 ± 1.15E-03	< 3.E-02
07/30/19	08/06/19	9.78E+03	CU.FT.	2.39E-02 ± 4.44E-03	< 3.E-02
08/06/19	08/13/19	1.01E+04	CU.FT.	9.05E-03 ± 3.50E-03	< 7.E-02
08/13/19	08/21/19	1.14E+04	CU.FT.	1.22E-02 ± 3.35E-03	< 4.E-02
08/21/19	08/27/19	8.73E+03	CU.FT.	1.31E-02 ± 3.87E-03	< 6.E-02
08/27/19	09/04/19	1.15E+04	CU.FT.	1.92E-02 ± 3.87E-03	< 4.E-02
09/04/19	09/10/19	8.66E+03	CU.FT.	2.30E-02 ± 4.82E-03	< 3.E-02
09/10/19	09/17/19	1.01E+04	CU.FT.	2.25E-02 ± 4.45E-03	< 5.E-02
09/17/19	09/24/19	1.00E+04	CU.FT.	1.82E-02 ± 3.94E-03	< 1.E-02
09/24/19	09/30/19	8.47E+03	CU.FT.	1.03E-02 ± 3.97E-03	< 2.E-02
09/30/19	10/08/19	1.15E+04	CU.FT.	5.08E-03 ± 2.77E-03	< 4.E-02
10/08/19	10/15/19	1.01E+04	CU.FT.	5.13E-03 ± 2.87E-03	< 3.E-02
10/15/19	10/22/19	1.01E+04	CU.FT.	1.60E-02 ± 3.81E-03	< 2.E-02
10/22/19	10/29/19	9.98E+03	CU.FT.	6.31E-03 ± 2.88E-03	< 3.E-02
10/29/19	11/05/19	1.01E+04	CU.FT.	1.39E-02 ± 3.67E-03	< 3.E-02
11/05/19	11/12/19	1.03E+04	CU.FT.	1.69E-02 ± 3.98E-03	< 2.E-02
11/12/19	11/19/19	9.93E+03	CU.FT.	1.36E-02 ± 3.87E-03	< 2.E-02
11/19/19	11/22/19	4.65E+03	CU.FT.	< 8.77E-03	< 7.E-02
11/22/19	12/03/19	1.01E+04	CU.FT.	6.50E-03 ± 2.71E-03	< 3.E-02
12/03/19	12/10/19	9.93E+03	CU.FT.	2.60E-02 ± 4.69E-03	< 6.E-02
12/10/19	12/17/19	1.01E+04	CU.FT.	1.62E-02 ± 3.90E-03	< 4.E-02
12/17/19	12/23/19	8.50E+03	CU.FT.	2.46E-02 ± 4.88E-03	< 7.E-02
12/23/19	12/31/19	1.16E+04	CU.FT.	3.35E-02 ± 4.76E-03	< 5.E-02

(a) Due to Missouri River flooding, sample was collected over a 42 day period instead of a 7 day period.

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 3					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.54E+03	CU.FT.	< 4.09E-03	< 6.E-02
01/08/19	01/15/19	1.03E+04	CU.FT.	7.72E-03 ± 3.10E-03	< 4.E-02
01/15/19	01/21/19	8.65E+03	CU.FT.	2.95E-02 ± 5.03E-03	< 5.E-02
01/21/19	01/29/19	1.17E+04	CU.FT.	9.60E-03 ± 3.08E-03	< 3.E-02
01/29/19	02/05/19	9.91E+03	CU.FT.	1.86E-02 ± 4.09E-03	< 4.E-02
02/05/19	02/11/19	8.82E+03	CU.FT.	1.07E-02 ± 4.15E-03	< 5.E-02
02/11/19	02/18/19	9.84E+03	CU.FT.	7.31E-03 ± 3.11E-03	< 6.E-02
02/18/19	02/26/19	1.17E+04	CU.FT.	1.35E-02 ± 3.25E-03	< 4.E-02
02/26/19	03/04/19	8.42E+03	CU.FT.	1.98E-02 ± 4.58E-03	< 6.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	9.09E-03 ± 2.88E-03	< 4.E-02
03/12/19	12/31/19			(a)	(a)

(a) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 4					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.71E+03	CU.FT.	9.99E-03 ± 3.58E-03	< 6.E-02
01/08/19	01/15/19	1.01E+04	CU.FT.	1.25E-02 ± 3.57E-03	< 4.E-02
01/15/19	01/21/19	8.60E+03	CU.FT.	1.53E-02 ± 3.96E-03	< 5.E-02
01/21/19	01/29/19			(a)	< 3.E-02
01/29/19	02/05/19	8.46E+03	CU.FT.	1.49E-02 ± 4.25E-03	< 5.E-02
02/05/19	02/11/19	8.83E+03	CU.FT.	2.08E-02 ± 4.94E-03	< 5.E-02
02/11/19	02/18/19	1.01E+04	CU.FT.	1.90E-02 ± 4.07E-03	< 6.E-02
02/18/19	02/26/19	1.15E+04	CU.FT.	2.85E-02 ± 4.33E-03	< 4.E-02
02/26/19	03/04/19	8.66E+03	CU.FT.	1.75E-02 ± 4.31E-03	< 6.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	2.17E-02 ± 3.87E-03	< 3.E-02
03/12/19	12/31/19			(b)	(b)

(a) Due to sample pump failure, no sample was able to be collected.

(b) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 5					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.71E+03	CU.FT.	1.45E-02 ± 3.99E-03	< 5.E-02
01/08/19	01/15/19	1.01E+04	CU.FT.	1.54E-02 ± 3.80E-03	< 6.E-02
01/15/19	01/21/19	8.59E+03	CU.FT.	3.79E-02 ± 5.60E-03	< 6.E-02
01/21/19	01/29/19	1.15E+04	CU.FT.	7.56E-03 ± 2.95E-03	< 4.E-02
01/29/19	02/05/19	9.90E+03	CU.FT.	2.03E-02 ± 4.22E-03	< 5.E-02
02/05/19	02/11/19	8.83E+03	CU.FT.	< 5.11E-03	< 5.E-02
02/11/19	02/18/19	1.01E+04	CU.FT.	3.25E-02 ± 4.99E-03	< 6.E-02
02/18/19	02/26/19	1.15E+04	CU.FT.	1.58E-02 ± 3.47E-03	< 5.E-02
02/26/19	03/04/19	8.66E+03	CU.FT.	2.06E-02 ± 4.56E-03	< 6.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	1.47E-02 ± 3.36E-03	< 4.E-02
03/12/19	12/31/19			(a)	(a)

(a) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 6					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.72E+03	CU.FT.	7.40E-03 ± 3.32E-03	< 5.E-02
01/08/19	01/15/19	1.01E+04	CU.FT.	1.22E-02 ± 3.54E-03	< 6.E-02
01/15/19	01/21/19	8.60E+03	CU.FT.	1.79E-02 ± 4.18E-03	< 6.E-02
01/21/19	01/29/19	1.15E+04	CU.FT.	1.54E-02 ± 3.57E-03	< 4.E-02
01/29/19	02/05/19	9.90E+03	CU.FT.	1.83E-02 ± 4.07E-03	< 5.E-02
02/05/19	02/11/19	8.83E+03	CU.FT.	8.89E-03 ± 3.99E-03	< 5.E-02
02/11/19	02/18/19	1.01E+04	CU.FT.	1.41E-02 ± 3.68E-03	< 6.E-02
02/18/19	02/26/19	1.15E+04	CU.FT.	2.32E-02 ± 3.99E-03	< 5.E-02
02/26/19	03/04/19	8.67E+03	CU.FT.	2.08E-02 ± 4.57E-03	< 6.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	6.15E-03 ± 2.59E-03	< 3.E-02
03/12/19	12/31/19			(a)	(a)

(a) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 7					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.60E+03	CU.FT.	1.10E-02 ± 3.71E-03	< 5.E-02
01/08/19	01/15/19	1.02E+04	CU.FT.	8.83E-03 ± 3.22E-03	< 6.E-02
01/15/19	01/21/19	8.64E+03	CU.FT.	2.30E-02 ± 4.57E-03	< 6.E-02
01/21/19	01/29/19	1.14E+04	CU.FT.	1.87E-02 ± 3.83E-03	< 5.E-02
01/29/19	02/05/19	1.02E+04	CU.FT.	2.06E-02 ± 4.15E-03	< 5.E-02
02/05/19	02/11/19	8.54E+03	CU.FT.	1.76E-02 ± 4.82E-03	< 5.E-02
02/11/19	02/18/19	1.01E+04	CU.FT.	2.35E-02 ± 4.40E-03	< 6.E-02
02/18/19	02/26/19	1.15E+04	CU.FT.	2.98E-02 ± 4.41E-03	< 5.E-02
02/26/19	03/04/19	8.72E+03	CU.FT.	9.81E-03 ± 3.63E-03	< 6.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	1.03E-02 ± 2.99E-03	< 6.E-02
03/12/19	03/26/19 (a)	2.03E+04	CU.FT.	1.54E-02 ± 2.30E-03	< 2.E-02
03/26/19	04/02/19	9.87E+03	CU.FT.	1.82E-02 ± 4.28E-03	< 4.E-02
04/02/19	04/09/19	1.01E+04	CU.FT.	5.93E-03 ± 2.85E-03	< 4.E-02
04/09/19	04/16/19	1.01E+04	CU.FT.	8.31E-03 ± 3.30E-03	< 4.E-02
04/16/19	04/23/19	1.01E+04	CU.FT.	1.72E-02 ± 3.93E-03	< 6.E-02
04/23/19	04/30/19	1.00E+04	CU.FT.	< 4.07E-03	< 5.E-02
04/30/19	05/07/19	9.98E+03	CU.FT.	5.19E-03 ± 2.93E-03	< 3.E-02
05/07/19	05/15/19	1.15E+04	CU.FT.	1.45E-02 ± 3.37E-03	< 4.E-02
05/15/19	05/20/19	7.27E+03	CU.FT.	< 6.02E-03	< 5.E-02
05/20/19	05/28/19	1.14E+04	CU.FT.	1.07E-02 ± 4.19E-03	< 1.E-02
05/28/19	06/04/19	1.00E+04	CU.FT.	1.36E-02 ± 3.60E-03	< 3.E-02
06/04/19	06/11/19	1.01E+04	CU.FT.	9.36E-03 ± 3.11E-03	< 2.E-02
06/11/19	06/18/19	1.00E+04	CU.FT.	8.24E-03 ± 3.53E-03	< 5.E-02
06/18/19	06/25/19	1.01E+04	CU.FT.	1.43E-02 ± 3.60E-03	< 4.E-02
06/25/19	07/02/19	1.00E+04	CU.FT.	9.29E-03 ± 2.94E-03	< 6.E-02
07/02/19	07/08/19	8.60E+03	CU.FT.	7.68E-03 ± 3.42E-03	< 6.E-02

(a) Due to Missouri River flooding, sample was collected over a 14 day period instead of a 7 day period.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 7					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
07/08/19	07/16/19	1.15E+04	CU.FT.	8.23E-03 ± 2.75E-03	< 5.E-02
07/16/19	07/23/19	1.02E+04	CU.FT.	1.22E-02 ± 3.26E-03	< 3.E-02
07/23/19	07/30/19	1.02E+04	CU.FT.	1.62E-02 ± 3.78E-03	< 3.E-02
07/30/19	08/06/19	9.79E+03	CU.FT.	2.42E-02 ± 4.45E-03	< 5.E-02
08/06/19	08/13/19	1.01E+04	CU.FT.	1.17E-02 ± 3.72E-03	< 4.E-02
08/13/19	08/21/19	1.14E+04	CU.FT.	1.44E-02 ± 3.52E-03	< 4.E-02
08/21/19	08/27/19	8.73E+03	CU.FT.	8.55E-03 ± 3.44E-03	< 4.E-02
08/27/19	09/04/19	1.15E+04	CU.FT.	1.71E-02 ± 3.73E-03	< 4.E-02
09/04/19	09/10/19	8.66E+03	CU.FT.	1.56E-02 ± 4.23E-03	< 4.E-02
09/10/19	09/17/19	1.01E+04	CU.FT.	2.05E-02 ± 4.31E-03	< 2.E-02
09/17/19	09/24/19	1.00E+04	CU.FT.	1.06E-02 ± 3.31E-03	< 4.E-02
09/24/19	09/30/19	8.60E+03	CU.FT.	8.08E-03 ± 3.72E-03	< 4.E-02
09/30/19	10/08/19	1.15E+04	CU.FT.	8.21E-03 ± 3.05E-03	< 4.E-02
10/08/19	10/15/19	1.01E+04	CU.FT.	1.15E-02 ± 3.49E-03	< 4.E-02
10/15/19	10/22/19	1.01E+04	CU.FT.	1.77E-02 ± 3.94E-03	< 4.E-02
10/22/19	10/29/19	9.98E+03	CU.FT.	5.86E-03 ± 2.84E-03	< 3.E-02
10/29/19	11/05/19	1.01E+04	CU.FT.	1.33E-02 ± 3.62E-03	< 3.E-02
11/05/19	11/07/19	3.01E+03	CU.FT.	< 1.39E-02 (a)	< 8.E-02
11/12/19	11/19/19	9.97E+03	CU.FT.	1.60E-02 ± 4.04E-03	< 4.E-02
11/19/19	11/26/19	1.01E+04	CU.FT.	8.75E-03 ± 3.36E-03	< 6.E-02
11/26/19	12/03/19	1.01E+04	CU.FT.	3.55E-03 ± 2.36E-03	< 4.E-02
12/03/19	12/10/19	9.98E+03	CU.FT.	8.26E-03 ± 3.36E-03	< 5.E-02
12/10/19	12/17/19	1.00E+04	CU.FT.	1.39E-02 ± 3.75E-03	< 4.E-02
12/17/19	12/23/19	8.49E+03	CU.FT.	2.89E-02 ± 5.19E-03	< 5.E-02
12/23/19	12/31/19	1.16E+04	CU.FT.	2.49E-02 ± 4.27E-03	< 5.E-02

(a) Due to sample pump failure on 11/7/19, sample volume was low and ODAM required LLD could not be achieved.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 8					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.64E+03	CU.FT.	1.06E-02 ± 3.66E-03	< 5.E-02
01/08/19	01/16/19	1.17E+04	CU.FT.	1.63E-02 ± 3.51E-03	< 3.E-02
01/16/19	01/21/19	7.20E+03	CU.FT.	2.67E-02 ± 5.42E-03	< 6.E-02
01/21/19	01/29/19	1.13E+04	CU.FT.	4.38E-03 ± 2.69E-03	< 5.E-02
01/29/19	02/05/19	1.03E+04	CU.FT.	5.53E-03 ± 2.88E-03	< 5.E-02
02/05/19	02/11/19	8.40E+03	CU.FT.	1.61E-02 ± 4.76E-03	< 5.E-02
02/11/19	02/19/19	1.14E+04	CU.FT.	9.32E-03 ± 2.98E-03	< 5.E-02
02/19/19	02/27/19	1.16E+04	CU.FT.	7.88E-03 ± 2.78E-03	< 4.E-02
02/27/19	03/04/19	7.27E+03	CU.FT.	1.42E-02 ± 4.58E-03	< 7.E-02
03/04/19	03/26/19 (a)	3.17E+04	CU.FT.	7.15E-03 ± 1.28E-03	< 1.E-02
03/26/19	04/02/19	9.91E+03	CU.FT.	7.54E-03 ± 3.41E-03	< 4.E-02
04/02/19	04/09/19	1.01E+04	CU.FT.	1.11E-02 ± 3.34E-03	< 4.E-02
04/09/19	04/16/19	1.01E+04	CU.FT.	5.04E-03 ± 3.00E-03	< 4.E-02
04/16/19	04/23/19	1.01E+04	CU.FT.	1.18E-02 ± 3.49E-03	< 6.E-02
04/23/19	04/30/19	1.01E+04	CU.FT.	7.46E-03 ± 3.26E-03	< 3.E-02
04/30/19	05/15/19 (b)	2.15E+04	CU.FT.	8.54E-03 ± 1.86E-03	< 1.E-02
05/15/19	05/20/19	7.27E+03	CU.FT.	< 6.02E-03	< 5.E-02
05/20/19	06/11/19 (c)	3.16E+04	CU.FT.	7.72E-03 ± 1.38E-03	< 8.E-03
06/11/19	06/18/19	1.00E+04	CU.FT.	8.85E-03 ± 3.58E-03	< 5.E-02
06/18/19	06/25/19	1.01E+04	CU.FT.	1.62E-02 ± 3.76E-03	< 4.E-02
06/25/19	07/02/19	1.00E+04	CU.FT.	1.83E-02 ± 3.74E-03	< 6.E-02
07/02/19	07/08/19	8.60E+03	CU.FT.	< 4.15E-03	< 6.E-02

(a) Due to Missouri River flooding and impassible road conditions, sample was collected over a 22 day period instead of 7 day period.

(b) Due to impassible road conditions, sample was collected over a 15 day period instead of 7 day period.

(c) Due to impassible road conditions, sample was collected over a 22 day period instead of 7 day period.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 8					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
07/08/19	07/16/19	1.15E+04	CU.FT.	1.08E-02 ± 2.98E-03	< 5.E-02
07/16/19	07/23/19	1.04E+04	CU.FT.	1.21E-02 ± 3.21E-03	< 2.E-02
07/23/19	07/30/19	9.99E+03	CU.FT.	1.85E-02 ± 4.00E-03	< 4.E-02
07/30/19	08/06/19	9.98E+03	CU.FT.	2.12E-02 ± 4.18E-03	< 5.E-02
08/06/19	08/13/19	9.97E+03	CU.FT.	1.17E-02 ± 3.75E-03	< 4.E-02
08/13/19	08/21/19	1.17E+04	CU.FT.	6.41E-03 ± 2.78E-03	< 4.E-02
08/21/19	08/27/19	8.43E+03	CU.FT.	1.63E-02 ± 4.25E-03	< 4.E-02
08/27/19	09/04/19	1.17E+04	CU.FT.	1.46E-02 ± 3.49E-03	< 4.E-02
09/04/19	09/10/19	8.71E+03	CU.FT.	2.13E-02 ± 4.67E-03	< 4.E-02
09/10/19	09/17/19	9.81E+03	CU.FT.	2.29E-02 ± 4.56E-03	< 5.E-02
09/17/19	09/24/19	1.03E+04	CU.FT.	1.91E-02 ± 3.93E-03	< 2.E-02
09/24/19	09/30/19	8.52E+03	CU.FT.	9.55E-03 ± 3.88E-03	< 4.E-02
09/30/19	10/08/19	1.13E+04	CU.FT.	8.35E-03 ± 3.10E-03	< 2.E-02
10/08/19	10/15/19	1.04E+04	CU.FT.	5.73E-03 ± 2.86E-03	< 4.E-02
10/15/19	10/22/19	9.97E+03	CU.FT.	1.26E-02 ± 3.57E-03	< 4.E-02
10/22/19	10/29/19	9.98E+03	CU.FT.	< 3.50E-03	< 3.E-02
10/29/19	11/05/19	1.02E+04	CU.FT.	5.12E-03 ± 2.85E-03	< 3.E-02
11/05/19	11/12/19	1.00E+04	CU.FT.	5.52E-03 ± 3.12E-03	< 2.E-02
11/12/19	11/19/19	1.00E+04	CU.FT.	< 4.25E-03	< 4.E-02
11/19/19	11/26/19	1.01E+04	CU.FT.	6.64E-03 ± 3.16E-03	< 6.E-02
11/26/19	12/03/19	9.92E+03	CU.FT.	5.11E-03 ± 2.59E-03	< 4.E-02
12/03/19	12/10/19	1.01E+04	CU.FT.	1.10E-02 ± 3.56E-03	< 5.E-02
12/10/19	12/17/19	1.02E+04	CU.FT.	2.83E-02 ± 4.71E-03	< 4.E-02
12/17/19	12/23/19	8.34E+03	CU.FT.	1.74E-02 ± 4.36E-03	< 5.E-02
12/23/19	12/31/19	1.16E+04	CU.FT.	1.73E-02 ± 3.80E-03	< 5.E-02

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 9					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.72E+03	CU.FT.	4.47E-03 ± 3.00E-03	< 5.E-02
01/08/19	01/15/19	9.98E+03	CU.FT.	4.51E-03 ± 2.85E-03	< 6.E-02
01/15/19	01/21/19	8.66E+03	CU.FT.	9.82E-03 ± 3.43E-03	< 4.E-02
01/21/19	01/29/19	1.15E+04	CU.FT.	< 3.59E-03	< 4.E-02
01/29/19	02/05/19	1.03E+04	CU.FT.	5.67E-03 ± 2.89E-03	< 5.E-02
02/05/19	02/11/19	8.48E+03	CU.FT.	1.37E-02 ± 4.53E-03	< 6.E-02
02/11/19	02/18/19	9.97E+03	CU.FT.	7.52E-03 ± 3.10E-03	< 6.E-02
02/18/19	02/26/19	1.17E+04	CU.FT.	1.85E-02 ± 3.63E-03	< 3.E-02
02/26/19	03/04/19	8.49E+03	CU.FT.	1.59E-02 ± 4.24E-03	< 7.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	4.01E-03 ± 2.36E-03	< 6.E-02
03/12/19	03/26/19 (a)	2.04E+04	CU.FT.	3.88E-03 ± 1.36E-03	< 2.E-02
03/26/19	04/02/19	1.01E+04	CU.FT.	< 4.28E-03	< 4.E-02
04/02/19	04/09/19	1.01E+04	CU.FT.	1.35E-02 ± 3.55E-03	< 4.E-02
04/09/19	04/16/19	9.97E+03	CU.FT.	5.41E-03 ± 3.06E-03	< 2.E-02
04/16/19	04/23/19	9.92E+03	CU.FT.	< 3.79E-03	< 6.E-02
04/23/19	04/30/19	1.02E+04	CU.FT.	1.15E-02 ± 3.60E-03	< 3.E-02
04/30/19	05/07/19	9.91E+03	CU.FT.	< 3.86E-03	< 3.E-02
05/07/19	05/15/19	1.15E+04	CU.FT.	8.60E-03 ± 2.85E-03	< 2.E-02
05/15/19	05/20/19	7.21E+03	CU.FT.	1.54E-02 ± 5.16E-03	< 3.E-02
05/20/19	05/28/19	1.11E+04	CU.FT.	6.62E-03 ± 3.79E-03	< 1.E-02
05/28/19	06/04/19	1.02E+04	CU.FT.	8.97E-03 ± 3.14E-03	< 2.E-02
06/04/19	06/11/19	9.98E+03	CU.FT.	1.79E-02 ± 3.88E-03	< 2.E-02
06/11/19	06/18/19	9.97E+03	CU.FT.	1.47E-02 ± 4.06E-03	< 5.E-02
06/18/19	06/25/19	1.02E+04	CU.FT.	1.66E-02 ± 3.77E-03	< 2.E-02
06/25/19	07/02/19	9.98E+03	CU.FT.	1.01E-02 ± 3.02E-03	< 6.E-02
07/02/19	07/08/19	8.58E+03	CU.FT.	< 4.16E-03	< 6.E-02

(a) Due to Missouri River flooding, sample was collected over a 14 day period instead of a 7 day period.

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 9

COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
07/08/19	07/16/19	1.16E+04	CU.FT.	1.70E-02 ± 3.45E-03	< 5.E-02
07/16/19	07/23/19	1.03E+04	CU.FT.	1.59E-02 ± 3.55E-03	< 2.E-02
07/23/19	07/30/19	8.00E+03	CU.FT.	2.40E-02 ± 5.07E-03	< 5.E-02
07/30/19	08/06/19	9.97E+03	CU.FT.	1.34E-02 ± 3.55E-03	< 5.E-02
08/06/19	08/13/19	9.93E+03	CU.FT.	1.57E-02 ± 4.07E-03	< 4.E-02
08/13/19	08/21/19	1.18E+04	CU.FT.	1.64E-02 ± 3.59E-03	< 2.E-02
08/21/19	08/27/19	8.65E+03	CU.FT.	2.01E-02 ± 4.48E-03	< 3.E-02
08/27/19	09/04/19	1.15E+04	CU.FT.	1.98E-02 ± 3.92E-03	< 2.E-02
09/04/19	09/10/19	8.48E+03	CU.FT.	1.17E-02 ± 3.94E-03	< 4.E-02
09/10/19	09/17/19	9.81E+03	CU.FT.	2.86E-02 ± 4.94E-03	< 5.E-02
09/17/19	09/24/19	1.00E+04	CU.FT.	2.28E-02 ± 4.27E-03	< 4.E-02
09/24/19	09/30/19	8.65E+03	CU.FT.	9.74E-03 ± 3.85E-03	< 4.E-02
09/30/19	10/08/19	1.15E+04	CU.FT.	5.08E-03 ± 2.77E-03	< 4.E-02
10/08/19	10/15/19	1.04E+04	CU.FT.	5.43E-03 ± 2.83E-03	< 4.E-02
10/15/19	10/22/19	9.81E+03	CU.FT.	1.16E-02 ± 3.53E-03	< 4.E-02
10/22/19	10/29/19	1.02E+04	CU.FT.	< 3.43E-03	< 3.E-02
10/29/19	11/05/19	1.02E+04	CU.FT.	1.42E-02 ± 3.67E-03	< 2.E-02
11/05/19	11/12/19	1.00E+04	CU.FT.	9.40E-03 ± 3.47E-03	< 2.E-02
11/12/19	11/19/19	1.01E+04	CU.FT.	8.47E-03 ± 3.40E-03	< 4.E-02
11/19/19	11/26/19	1.01E+04	CU.FT.	5.58E-03 ± 3.06E-03	< 6.E-02
11/26/19	12/03/19	9.92E+03	CU.FT.	4.36E-03 ± 2.50E-03	< 4.E-02
12/03/19	12/10/19	1.02E+04	CU.FT.	2.01E-02 ± 4.23E-03	< 4.E-02
12/10/19	12/17/19	1.02E+04	CU.FT.	1.82E-02 ± 4.03E-03	< 3.E-02
12/17/19	12/23/19	8.36E+03	CU.FT.	2.99E-02 ± 5.31E-03	< 5.E-02
12/23/19	12/31/19	1.16E+04	CU.FT.	2.46E-02 ± 4.26E-03	< 2.E-02

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 10					
COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.61E+03	CU.FT.	8.54E-03 ± 3.47E-03	< 5.E-02
01/08/19	01/15/19	1.02E+04	CU.FT.	7.21E-03 ± 3.07E-03	< 6.E-02
01/15/19	01/21/19	8.61E+03	CU.FT.	1.75E-02 ± 4.14E-03	< 4.E-02
01/21/19	01/29/19	1.12E+04	CU.FT.	7.49E-03 ± 3.00E-03	< 4.E-02
01/29/19	02/05/19	1.02E+04	CU.FT.	2.09E-02 ± 4.18E-03	< 5.E-02
02/05/19	02/11/19	8.55E+03	CU.FT.	1.05E-02 ± 4.23E-03	< 6.E-02
02/11/19	02/18/19	1.01E+04	CU.FT.	2.88E-02 ± 4.75E-03	< 5.E-02
02/18/19	02/26/19	1.15E+04	CU.FT.	9.27E-03 ± 2.93E-03	< 3.E-02
02/26/19	03/04/19	8.71E+03	CU.FT.	1.98E-02 ± 4.48E-03	< 7.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	3.61E-03 ± 2.32E-03	< 6.E-02
03/12/19	03/26/19 (a)	2.02E+04	CU.FT.	5.54E-03 ± 1.54E-03	< 3.E-02
03/26/19	04/02/19	1.00E+04	CU.FT.	5.95E-03 ± 3.24E-03	< 4.E-02
04/02/19	04/09/19	1.00E+04	CU.FT.	1.63E-02 ± 3.80E-03	< 4.E-02
04/09/19	04/16/19	1.02E+04	CU.FT.	9.40E-03 ± 3.38E-03	< 2.E-02
04/16/19	04/23/19	9.93E+03	CU.FT.	1.40E-02 ± 3.72E-03	< 6.E-02
04/23/19	04/30/19	1.02E+04	CU.FT.	1.26E-02 ± 3.69E-03	< 3.E-02
04/30/19	05/07/19	9.85E+03	CU.FT.	4.18E-03 ± 2.85E-03	< 3.E-02
05/07/19	05/15/19	1.16E+04	CU.FT.	1.12E-02 ± 3.07E-03	< 2.E-02
05/15/19	05/20/19	7.17E+03	CU.FT.	9.56E-03 ± 4.68E-03	< 3.E-02
05/20/19	05/28/19	1.15E+04	CU.FT.	7.70E-03 ± 3.93E-03	< 1.E-02
05/28/19	06/04/19	1.00E+04	CU.FT.	1.40E-02 ± 3.64E-03	< 3.E-02
06/04/19	06/11/19	1.03E+04	CU.FT.	1.30E-02 ± 3.40E-03	< 2.E-02
06/11/19	06/18/19	9.90E+03	CU.FT.	1.14E-02 ± 3.82E-03	< 1.E-02
06/18/19	06/25/19	1.02E+04	CU.FT.	9.69E-03 ± 3.15E-03	< 4.E-02
06/25/19	07/02/19	1.00E+04	CU.FT.	2.10E-02 ± 3.95E-03	< 6.E-02
07/02/19	07/08/19	8.49E+03	CU.FT.	8.66E-03 ± 3.55E-03	< 2.E-02

(a) Due to Missouri River flooding, sample was collected over a 14 day period instead of a 7 day period.

VII-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 10

COLL START DATE	COLL STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
07/08/19	07/16/19	1.16E+04	CU.FT.	1.50E-02 ± 3.30E-03	< 2.E-02
07/16/19	07/23/19	1.01E+04	CU.FT.	9.49E-03 ± 3.03E-03	< 3.E-02
07/23/19	07/30/19	1.02E+04	CU.FT.	1.16E-02 ± 3.41E-03	< 5.E-02
07/30/19	08/06/19	9.74E+03	CU.FT.	7.90E-03 ± 3.07E-03	< 5.E-02
08/06/19	08/13/19	1.02E+04	CU.FT.	7.20E-03 ± 3.31E-03	< 4.E-02
08/13/19	08/21/19	1.15E+04	CU.FT.	1.59E-02 ± 3.62E-03	< 5.E-02
08/21/19	08/27/19	8.88E+03	CU.FT.	1.27E-02 ± 3.79E-03	< 4.E-02
08/27/19	09/04/19	1.13E+04	CU.FT.	2.12E-02 ± 4.06E-03	< 2.E-02
09/04/19	09/10/19	8.71E+03	CU.FT.	2.27E-02 ± 4.78E-03	< 2.E-02
09/10/19	09/17/19	9.99E+03	CU.FT.	3.15E-02 ± 5.06E-03	< 3.E-02
09/17/19	09/24/19	1.01E+04	CU.FT.	1.80E-02 ± 3.90E-03	< 4.E-02
09/24/19	09/30/19	8.62E+03	CU.FT.	< 4.73E-03	< 3.E-02
09/30/19	10/08/19	1.17E+04	CU.FT.	1.09E-02 ± 3.23E-03	< 1.E-02
10/08/19	10/15/19	9.86E+03	CU.FT.	9.71E-03 ± 3.38E-03	< 2.E-02
10/15/19	10/22/19	1.01E+04	CU.FT.	1.82E-02 ± 3.97E-03	< 2.E-02
10/22/19	10/29/19	9.97E+03	CU.FT.	1.19E-02 ± 3.42E-03	< 4.E-02
10/29/19	11/05/19	1.01E+04	CU.FT.	1.39E-02 ± 3.67E-03	< 5.E-02
11/05/19	11/12/19	1.03E+04	CU.FT.	1.27E-02 ± 3.66E-03	< 4.E-02
11/12/19	11/19/19	1.00E+04	CU.FT.	1.98E-02 ± 4.31E-03	< 4.E-02
11/19/19	11/26/19	1.01E+04	CU.FT.	1.09E-02 ± 3.54E-03	< 6.E-02
11/26/19	12/03/19	9.93E+03	CU.FT.	< 3.13E-03	< 4.E-02
12/03/19	12/10/19	9.92E+03	CU.FT.	1.68E-02 ± 4.06E-03	< 3.E-02
12/10/19	12/17/19	1.00E+04	CU.FT.	2.49E-02 ± 4.54E-03	< 6.E-02
12/17/19	12/23/19	8.55E+03	CU.FT.	1.77E-02 ± 4.31E-03	< 4.E-02
12/23/19	12/31/19	1.17E+04	CU.FT.	6.32E-03 ± 2.95E-03	< 3.E-02

VII-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PCI/CU.M.)

STATION NUMBER 1

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:				
BE-7	1.31E-01 ± 4.09E-02	1.05E-01 ± 4.73E-02	1.37E-01 ± 5.31E-02	6.44E-02 ± 2.89E-02
K-40	< 4.E-02	< 5.E-02	< 6.E-02	< 3.E-02
MN-54	< 3.E-03	< 2.E-03	< 4.E-03	< 2.E-03
CO-58	< 5.E-03	< 6.E-03	< 5.E-03	< 3.E-03
FE-59	< 2.E-02	< 2.E-02	< 2.E-02	< 8.E-03
CO-60	< 3.E-03	< 3.E-03	< 4.E-03	< 2.E-03
ZN-65	< 6.E-03	< 9.E-03	< 7.E-03	< 6.E-03
ZR-95	< 8.E-03	< 1.E-02	< 1.E-02	< 5.E-03
RU-103	< 1.E-02	< 8.E-03	< 9.E-03	< 5.E-03
RU-106	< 2.E-02	< 3.E-02	< 3.E-02	< 2.E-02
I-131	< 1.E+00	< 7.E-01	< 8.E-01	< 4.E-01
CS-134	< 2.E-03	< 3.E-03	< 4.E-03	< 2.E-03
CS-137	< 2.E-03	< 2.E-03	< 3.E-03	< 2.E-03
BA-140	< 4.E-01	< 3.E-01	< 4.E-01	< 2.E-01
LA-140	< 2.E-01	< 8.E-02	< 1.E-01	< 7.E-02
CE-141	< 1.E-02	< 1.E-02	< 1.E-02	< 7.E-03
CE-144	< 1.E-02	< 1.E-02	< 2.E-02	< 9.E-03
RA-226	< 4.E-02	< 4.E-02	< 5.E-02	< 3.E-02
TH-228	< 4.E-03	< 5.E-03	< 5.E-03	< 2.E-03

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PCI/CU.M.)

STATION NUMBER 2

DATE COLLECTED	01/02-03/26/2019	03/26-06/18/2019	06/18-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:				
BE-7	7.63E-02 ± 3.24E-02	9.50E-02 ± 4.67E-02	1.18E-01 ± 3.45E-02	7.05E-02 ± 2.64E-02
K-40	< 3.E-02	< 5.E-02	< 2.E-02	< 3.E-02
MN-54	< 3.E-03	< 3.E-03	< 2.E-03	< 2.E-03
CO-58	< 4.E-03	< 5.E-03	< 3.E-03	< 4.E-03
FE-59	< 1.E-02	< 2.E-02	< 1.E-02	< 1.E-02
CO-60	< 2.E-03	< 3.E-03	< 2.E-03	< 1.E-03
ZN-65	< 6.E-03	< 6.E-03	< 7.E-03	< 5.E-03
ZR-95	< 8.E-03	< 9.E-03	< 7.E-03	< 7.E-03
RU-103	< 7.E-03	< 6.E-03	< 5.E-03	< 5.E-03
RU-106	< 3.E-02	< 2.E-02	< 2.E-02	< 2.E-02
I-131	< 1.E+00	< 1.E+00	< 9.E-01	< 5.E-01
CS-134	< 3.E-03	< 3.E-03	< 2.E-03	< 2.E-03
CS-137	< 2.E-03	< 2.E-03	< 2.E-03	< 2.E-03
BA-140	< 5.E-01	< 5.E-01	< 3.E-01	< 2.E-01
LA-140	< 2.E-01	< 2.E-01	< 6.E-02	< 1.E-01
CE-141	< 1.E-02	< 1.E-02	< 8.E-03	< 7.E-03
CE-144	< 9.E-03	< 1.E-02	< 8.E-03	< 9.E-03
RA-226	< 4.E-02	< 3.E-02	< 3.E-02	< 3.E-02
TH-228	< 3.E-03	< 4.E-03	< 3.E-03	< 3.E-03

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
 (PCI/CU.M.)

STATION NUMBER 3

DATE COLLECTED	01/02-03/12/2019	03/12-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:		(a)	(a)	(a)
BE-7	1.02E-01 ± 4.90E-02			
K-40	< 5.E-02			
MN-54	< 3.E-03			
CO-58	< 7.E-03			
FE-59	< 2.E-02			
CO-60	< 3.E-03			
ZN-65	< 7.E-03			
ZR-95	< 1.E-02			
RU-103	< 9.E-03			
RU-106	< 2.E-02			
I-131	< 4.E+00			
CS-134	< 3.E-03			
CS-137	< 3.E-03			
BA-140	< 9.E-01			
LA-140	< 3.E-01			
CE-141	< 2.E-02			
CE-144	< 1.E-02			
RA-226	< 5.E-02			
TH-228	< 4.E-03			

(a) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

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NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
 (PCI/CU.M.)

STATION NUMBER 4

DATE COLLECTED	01/02-03/12/2019	03/12-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:		(a)	(a)	(a)
BE-7	9.24E-02 ± 5.00E-02			
K-40	< 5.E-02			
MN-54	< 3.E-03			
CO-58	< 5.E-03			
FE-59	< 2.E-02			
CO-60	< 3.E-03			
ZN-65	< 9.E-03			
ZR-95	< 1.E-02			
RU-103	< 1.E-02			
RU-106	< 3.E-02			
I-131	< 3.E+00			
CS-134	< 4.E-03			
CS-137	< 3.E-03			
BA-140	< 9.E-01			
LA-140	< 4.E-01			
CE-141	< 2.E-02			
CE-144	< 1.E-02			
RA-226	< 5.E-02			
TH-228	< 4.E-03			

(a) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

VII-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PCU/CU.M.)

STATION NUMBER 5

DATE COLLECTED	01/02-03/12/2019	03/12-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:		(a)	(a)	(a)
BE-7	1.06E-01 ± 6.19E-02			
K-40	< 4.E-02			
MN-54	< 4.E-03			
CO-58	< 7.E-03			
FE-59	< 3.E-02			
CO-60	< 5.E-03			
ZN-65	< 9.E-03			
ZR-95	< 1.E-02			
RU-103	< 1.E-02			
RU-106	< 4.E-02			
I-131	< 4.E+00			
CS-134	< 4.E-03			
CS-137	< 4.E-03			
BA-140	< 1.E+00			
LA-140	< 4.E-01			
CE-141	< 2.E-02			
CE-144	< 2.E-02			
RA-226	< 6.E-02			
TH-228	< 4.E-03			

(a) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

VII-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
 (PCI/CU.M.)

STATION NUMBER 6

DATE COLLECTED	01/02-03/12/2019	03/12-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:		(a)	(a)	(a)
BE-7	1.24E-01 ± 4.64E-02			
K-40	< 5.E-02			
MN-54	< 4.E-03			
CO-58	< 5.E-03			
FE-59	< 2.E-02			
CO-60	< 4.E-03			
ZN-65	< 9.E-03			
ZR-95	< 9.E-03			
RU-103	< 1.E-02			
RU-106	< 2.E-02			
I-131	< 3.E+00			
CS-134	< 2.E-03			
CS-137	< 3.E-03			
BA-140	< 7.E-01			
LA-140	< 4.E-01			
CE-141	< 1.E-02			
CE-144	< 1.E-02			
RA-226	< 4.E-02			
TH-228	< 4.E-03			

(a) Due to Missouri River flooding submerging and destroying station, sampling was not able to be conducted during this time period.

VII-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PC/CU.M.)

STATION NUMBER 7

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:				
BE-7	1.21E-01 ± 3.39E-02	9.33E-02 ± 3.95E-02	1.04E-01 ± 3.27E-02	7.17E-02 ± 3.15E-02
K-40	< 3.E-02	< 4.E-02	< 4.E-02	< 4.E-02
MN-54	< 2.E-03	< 2.E-03	< 2.E-03	< 2.E-03
CO-58	< 2.E-03	< 4.E-03	< 3.E-03	< 4.E-03
FE-59	< 1.E-02	< 2.E-02	< 1.E-02	< 6.E-03
CO-60	< 3.E-03	< 2.E-03	< 3.E-03	< 2.E-03
ZN-65	< 6.E-03	< 6.E-03	< 5.E-03	< 9.E-03
ZR-95	< 8.E-03	< 9.E-03	< 7.E-03	< 6.E-03
RU-103	< 6.E-03	< 6.E-03	< 5.E-03	< 7.E-03
RU-106	< 2.E-02	< 3.E-02	< 2.E-02	< 2.E-02
I-131	< 8.E-01	< 7.E-01	< 6.E-01	< 7.E-01
CS-134	< 3.E-03	< 3.E-03	< 3.E-03	< 3.E-03
CS-137	< 2.E-03	< 2.E-03	< 2.E-03	< 2.E-03
BA-140	< 3.E-01	< 3.E-01	< 2.E-01	< 3.E-01
LA-140	< 2.E-01	< 1.E-01	< 8.E-02	< 1.E-01
CE-141	< 9.E-03	< 1.E-02	< 7.E-03	< 1.E-02
CE-144	< 1.E-02	< 1.E-02	< 9.E-03	< 1.E-02
RA-226	< 3.E-02	< 5.E-02	< 3.E-02	< 4.E-02
TH-228	< 3.E-03	< 4.E-03	< 3.E-03	< 4.E-03

VII-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PCI/CU.M.)

STATION NUMBER 8

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:				
BE-7	7.16E-02 ± 2.55E-02	9.13E-02 ± 3.51E-02	1.09E-01 ± 3.16E-02	6.99E-02 ± 2.45E-02
K-40	< 3.E-02	< 5.E-02	< 5.E-02	< 5.E-02
MN-54	< 3.E-03	< 2.E-03	< 2.E-03	< 3.E-03
CO-58	< 5.E-03	< 4.E-03	< 4.E-03	< 4.E-03
FE-59	< 2.E-02	< 1.E-02	< 9.E-03	< 1.E-02
CO-60	< 3.E-03	< 2.E-03	< 2.E-03	< 2.E-03
ZN-65	< 9.E-03	< 7.E-03	< 8.E-03	< 8.E-03
ZR-95	< 1.E-02	< 5.E-03	< 7.E-03	< 9.E-03
RU-103	< 8.E-03	< 5.E-03	< 6.E-03	< 7.E-03
RU-106	< 3.E-02	< 2.E-02	< 3.E-02	< 2.E-02
I-131	< 1.E+00	< 4.E-01	< 8.E-01	< 5.E-01
CS-134	< 3.E-03	< 2.E-03	< 3.E-03	< 3.E-03
CS-137	< 3.E-03	< 2.E-03	< 2.E-03	< 2.E-03
BA-140	< 5.E-01	< 2.E-01	< 4.E-01	< 2.E-01
LA-140	< 2.E-01	< 9.E-02	< 1.E-01	< 1.E-01
CE-141	< 2.E-02	< 7.E-03	< 1.E-02	< 9.E-03
CE-144	< 2.E-02	< 7.E-03	< 1.E-02	< 1.E-02
RA-226	< 5.E-02	< 3.E-02	< 4.E-02	< 3.E-02
TH-228	< 5.E-03	< 3.E-03	< 4.E-03	< 3.E-03

VII-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PC/CU.M.)

STATION NUMBER 9

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:				
BE-7	7.18E-02 ± 2.43E-02	1.17E-01 ± 3.01E-02	1.55E-01 ± 4.56E-02	4.37E-02 ± 2.59E-02
K-40	< 5.E-02	< 3.E-02	< 6.E-02	< 3.E-02
MN-54	< 3.E-03	< 3.E-03	< 4.E-03	< 2.E-03
CO-58	< 3.E-03	< 4.E-03	< 6.E-03	< 3.E-03
FE-59	< 1.E-02	< 9.E-03	< 1.E-02	< 8.E-03
CO-60	< 4.E-03	< 2.E-03	< 4.E-03	< 2.E-03
ZN-65	< 8.E-03	< 6.E-03	< 8.E-03	< 6.E-03
ZR-95	< 1.E-02	< 8.E-03	< 1.E-02	< 6.E-03
RU-103	< 6.E-03	< 6.E-03	< 1.E-02	< 4.E-03
RU-106	< 2.E-02	< 2.E-02	< 3.E-02	< 2.E-02
I-131	< 1.E+00	< 4.E-01	< 9.E-01	< 4.E-01
CS-134	< 2.E-03	< 2.E-03	< 3.E-03	< 2.E-03
CS-137	< 2.E-03	< 2.E-03	< 4.E-03	< 2.E-03
BA-140	< 3.E-01	< 2.E-01	< 5.E-01	< 2.E-01
LA-140	< 8.E-02	< 9.E-02	< 9.E-02	< 6.E-02
CE-141	< 1.E-02	< 7.E-03	< 1.E-02	< 6.E-03
CE-144	< 1.E-02	< 1.E-02	< 2.E-02	< 7.E-03
RA-226	< 4.E-02	< 3.E-02	< 5.E-02	< 3.E-02
TH-228	< 4.E-03	< 3.E-03	< 5.E-03	< 2.E-03

VII-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PCI/CU.M.)

STATION NUMBER 10

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:				
BE-7	7.16E-02 ± 3.42E-02	1.86E-01 ± 4.19E-02	1.50E-01 ± 4.32E-02	8.97E-02 ± 3.34E-02
K-40	< 3.E-02	3.17E-02 ± 2.76E-02	< 4.E-02	< 4.E-02
MN-54	< 2.E-03	< 3.E-03	< 3.E-03	< 3.E-03
CO-58	< 5.E-03	< 5.E-03	< 5.E-03	< 4.E-03
FE-59	< 1.E-02	< 1.E-02	< 1.E-02	< 1.E-02
CO-60	< 3.E-03	< 3.E-03	< 3.E-03	< 3.E-03
ZN-65	< 6.E-03	< 6.E-03	< 1.E-02	< 7.E-03
ZR-95	< 8.E-03	< 9.E-03	< 1.E-02	< 8.E-03
RU-103	< 6.E-03	< 8.E-03	< 7.E-03	< 6.E-03
RU-106	< 2.E-02	< 3.E-02	< 3.E-02	< 3.E-02
I-131	< 8.E-01	< 6.E-01	< 7.E-01	< 6.E-01
CS-134	< 2.E-03	< 3.E-03	< 3.E-03	< 3.E-03
CS-137	< 2.E-03	< 3.E-03	< 3.E-03	< 2.E-03
BA-140	< 3.E-01	< 2.E-01	< 3.E-01	< 3.E-01
LA-140	< 1.E-01	< 1.E-01	< 1.E-01	< 1.E-01
CE-141	< 9.E-03	< 1.E-02	< 1.E-02	< 9.E-03
CE-144	< 1.E-02	< 1.E-02	< 1.E-02	< 1.E-02
RA-226	< 3.E-02	< 4.E-02	< 4.E-02	< 4.E-02
TH-228	< 3.E-03	< 4.E-03	< 4.E-03	< 3.E-03

VII-3
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
FISH
(PCI/KG WET)

STATION NUMBER 28

DATE COLLECTED	8/13/2019 CATFISH	8/13/2019 CARP	11/1/2019	11/1/2019
GAMMA SPECTRUM ANALYSIS:			(a)	(a)
BE-7	< 6.E+02	< 4.E+02		
K-40	3.73E+03 ± 1.12E+03	3.11E+03 ± 7.99E+02		
MN-54	< 8.E+01	< 4.E+01		
CO-58	< 5.E+01	< 4.E+01		
FE-59	< 1.E+02	< 1.E+02		
CO-60	< 5.E+01	< 4.E+01		
ZN-65	< 1.E+02	< 1.E+02		
ZR-95	< 1.E+02	< 5.E+01		
RU-103	< 7.E+01	< 5.E+01		
RU-106	< 6.E+02	< 4.E+02		
I-131	< 1.E+02	< 9.E+01		
CS-134	< 7.E+01	< 5.E+01		
CS-137	< 7.E+01	< 5.E+01		
BA-140	< 4.E+02	< 2.E+02		
CE-141	< 1.E+02	< 7.E+01		
CE-144	< 3.E+02	< 3.E+02		
RA-226	< 2.E+03	< 1.E+03		
TH-228	< 1.E+02	< 8.E+01		

(a) Due to Missouri River flooding, it was not safe to perform boating to obtain fish samples.

VII-3
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
FISH
(PCI/KG WET)

STATION NUMBER 35

DATE COLLECTED	8/12/2019 CATFISH	8/12/2019 CARP	11/1/2019	11/1/2019
GAMMA SPECTRUM ANALYSIS:			(a)	(a)
BE-7	< 6.E+02	< 5.E+02		
K-40	3.06E+03 ± 9.63E+02	3.35E+03 ± 8.82E+02		
MN-54	< 6.E+01	< 6.E+01		
CO-58	< 6.E+01	< 7.E+01		
FE-59	< 1.E+02	< 1.E+02		
CO-60	< 8.E+01	< 7.E+01		
ZN-65	< 2.E+02	< 2.E+02		
ZR-95	< 1.E+02	< 1.E+02		
RU-103	< 7.E+01	< 6.E+01		
RU-106	< 6.E+02	< 6.E+02		
I-131	< 1.E+02	< 1.E+02		
CS-134	< 7.E+01	< 7.E+01		
CS-137	< 6.E+01	< 7.E+01		
BA-140	< 4.E+02	< 4.E+02		
CE-141	< 8.E+01	< 1.E+02		
CE-144	< 3.E+02	< 4.E+02		
RA-226	< 1.E+03	< 1.E+03		
TH-228	< 1.E+02	< 1.E+02		

(a) Due to Missouri River flooding, it was not safe to perform boating to obtain fish samples.

VII-4
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
MILK NEAREST PRODUCER
(PCI/LITER)

STATION NUMBER 99

DATE COLLECTED	1/2/2019	2/5/2019	3/5/2019	4/2/2019
RADIOCHEMICAL ANALYSIS:				
I-131	< 6.E-01	< 4.E-01	< 4.E-01	< 9.E-01
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 5.E+01	< 6.E+01	< 6.E+01	< 6.E+01
K-40	1.29E+03 ± 2.07E+02	1.19E+03 ± 1.76E+02	1.01E+03 ± 1.66E+02	1.19E+03 ± 1.40E+02
MN-54	< 8.E+00	< 7.E+00	< 8.E+00	< 5.E+00
CO-58	< 1.E+01	< 8.E+00	< 8.E+00	< 6.E+00
FE-59	< 2.E+01	< 2.E+01	< 2.E+01	< 1.E+01
CO-60	< 8.E+00	< 8.E+00	< 1.E+01	< 7.E+00
ZN-65	< 2.E+01	< 2.E+01	< 1.E+01	< 1.E+01
ZR-95	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
RU-103	< 8.E+00	< 7.E+00	< 8.E+00	< 6.E+00
RU-106	< 8.E+01	< 7.E+01	< 8.E+01	< 6.E+01
I-131	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
CS-134	< 8.E+00	< 8.E+00	< 9.E+00	< 5.E+00
CS-137	< 9.E+00	< 8.E+00	< 7.E+00	< 5.E+00
BA-140	< 4.E+01	< 4.E+01	< 4.E+01	< 3.E+01
LA-140	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
CE-141	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
CE-144	< 5.E+01	< 5.E+01	< 5.E+01	< 4.E+01
RA-226	< 2.E+02	< 2.E+02	< 2.E+02	< 2.E+02
TH-228	< 1.E+01	< 1.E+01	< 2.E+01	< 1.E+01

VII-4
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
MILK NEAREST PRODUCER
(PCI/LITER)

STATION NUMBER 99

DATE COLLECTED	5/7/2019	6/4/2019	6/4/2019	6/18/2019
RADIOCHEMICAL ANALYSIS:				
I-131	< 4.E-01	< 4.E-01	< 5.E-01	< 7.E-01
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 8.E+01	< 6.E+01	< 6.E+01	< 7.E+01
K-40	1.27E+03 ± 1.80E+02	1.15E+03 ± 1.86E+02	1.16E+03 ± 1.85E+02	1.25E+03 ± 1.97E+02
MN-54	< 8.E+00	< 7.E+00	< 8.E+00	< 9.E+00
CO-58	< 1.E+01	< 7.E+00	< 7.E+00	< 8.E+00
FE-59	< 2.E+01	< 2.E+01	< 2.E+01	< 2.E+01
CO-60	< 1.E+01	< 7.E+00	< 9.E+00	< 1.E+01
ZN-65	< 2.E+01	< 2.E+01	< 2.E+01	< 2.E+01
ZR-95	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
RU-103	< 8.E+00	< 8.E+00	< 9.E+00	< 8.E+00
RU-106	< 7.E+01	< 5.E+01	< 7.E+01	< 8.E+01
I-131	< 1.E+01	< 9.E+00	< 1.E+01	< 1.E+01
CS-134	< 8.E+00	< 1.E+01	< 8.E+00	< 9.E+00
CS-137	< 8.E+00	< 5.E+00	< 8.E+00	< 9.E+00
BA-140	< 3.E+01	< 2.E+01	< 2.E+01	< 3.E+01
LA-140	< 1.E+01	< 6.E+00	< 1.E+01	< 9.E+00
CE-141	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
CE-144	< 6.E+01	< 5.E+01	< 6.E+01	< 7.E+01
RA-226	< 2.E+02	< 2.E+02	< 2.E+02	< 2.E+02
TH-228	< 2.E+01	< 2.E+01	< 2.E+01	< 2.E+01

VII-4
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
MILK NEAREST PRODUCER
(PCI/LITER)

STATION NUMBER 99

DATE COLLECTED	7/2/2019	7/2/2019	7/16/2019	7/30/2019
RADIOCHEMICAL ANALYSIS:				
I-131	< 1.E+00	< 8.E-01	< 7.E-01	< 8.E-01
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 3.E+01	< 5.E+01	< 8.E+01	< 6.E+01
K-40	1.20E+03 ± 9.84E+01	1.07E+03 ± 1.89E+02	1.26E+03 ± 1.70E+02	1.40E+03 ± 1.95E+02
MN-54	< 4.E+00	< 7.E+00	< 6.E+00	< 7.E+00
CO-58	< 4.E+00	< 7.E+00	< 8.E+00	< 6.E+00
FE-59	< 9.E+00	< 2.E+01	< 2.E+01	< 1.E+01
CO-60	< 4.E+00	< 9.E+00	< 1.E+01	< 9.E+00
ZN-65	< 1.E+01	< 2.E+01	< 2.E+01	< 2.E+01
ZR-95	< 7.E+00	< 1.E+01	< 1.E+01	< 1.E+01
RU-103	< 4.E+00	< 6.E+00	< 1.E+01	< 7.E+00
RU-106	< 4.E+01	< 7.E+01	< 7.E+01	< 6.E+01
I-131	< 6.E+00	< 1.E+01	< 1.E+01	< 1.E+01
CS-134	< 5.E+00	< 9.E+00	< 9.E+00	< 7.E+00
CS-137	< 4.E+00	< 7.E+00	< 8.E+00	< 7.E+00
BA-140	< 2.E+01	< 3.E+01	< 4.E+01	< 3.E+01
LA-140	< 4.E+00	< 1.E+01	< 1.E+01	< 1.E+01
CE-141	< 7.E+00	< 1.E+01	< 2.E+01	< 1.E+01
CE-144	< 3.E+01	< 4.E+01	< 6.E+01	< 5.E+01
RA-226	< 1.E+02	< 1.E+02	< 2.E+02	< 1.E+02
TH-228	< 9.E+00	< 1.E+01	< 2.E+01	< 1.E+01

VII-4
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
MILK NEAREST PRODUCER
(PCI/LITER)

STATION NUMBER 99

DATE COLLECTED	8/6/2019	8/6/2019	8/27/2019	9/4/2019
RADIOCHEMICAL ANALYSIS:				
I-131	< 9.E-01	< 5.E-01	< 8.E-01	< 7.E-01
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 7.E+01	< 5.E+01	< 7.E+01	< 7.E+01
K-40	1.24E+03 ± 1.79E+02	1.16E+03 ± 1.64E+02	1.09E+03 ± 1.55E+02	1.31E+03 ± 1.91E+02
MN-54	< 9.E+00	< 6.E+00	< 7.E+00	< 8.E+00
CO-58	< 7.E+00	< 7.E+00	< 7.E+00	< 1.E+01
FE-59	< 2.E+01	< 2.E+01	< 2.E+01	< 2.E+01
CO-60	< 9.E+00	< 7.E+00	< 9.E+00	< 1.E+01
ZN-65	< 2.E+01	< 1.E+01	< 2.E+01	< 2.E+01
ZR-95	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
RU-103	< 9.E+00	< 7.E+00	< 8.E+00	< 1.E+01
RU-106	< 6.E+01	< 6.E+01	< 8.E+01	< 8.E+01
I-131	< 1.E+01	< 8.E+00	< 1.E+01	< 1.E+01
CS-134	< 1.E+01	< 6.E+00	< 8.E+00	< 9.E+00
CS-137	< 8.E+00	< 6.E+00	< 1.E+01	< 8.E+00
BA-140	< 3.E+01	< 2.E+01	< 3.E+01	< 4.E+01
LA-140	< 1.E+01	< 6.E+00	< 1.E+01	< 1.E+01
CE-141	< 2.E+01	< 1.E+01	< 1.E+01	< 2.E+01
CE-144	< 6.E+01	< 5.E+01	< 6.E+01	< 6.E+01
RA-226	< 2.E+02	< 2.E+02	< 2.E+02	< 2.E+02
TH-228	< 2.E+01	< 1.E+01	< 2.E+01	< 2.E+01

VII-4
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
MILK NEAREST PRODUCER
(PCI/LITER)

STATION NUMBER 99

DATE COLLECTED	9/4/2019	9/10/2019	9/24/2019	10/1/2019
RADIOCHEMICAL ANALYSIS:				
I-131	< 7.E-01	< 1.E+00	< 7.E-01	< 9.E-01
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 6.E+01	< 6.E+01	< 8.E+01	< 6.E+01
K-40	1.35E+03 ± 1.61E+02	1.31E+03 ± 1.76E+02	1.03E+03 ± 1.53E+02	1.23E+03 ± 1.45E+02
MN-54	< 6.E+00	< 8.E+00	< 9.E+00	< 7.E+00
CO-58	< 6.E+00	< 9.E+00	< 7.E+00	< 7.E+00
FE-59	< 1.E+01	< 2.E+01	< 2.E+01	< 1.E+01
CO-60	< 6.E+00	< 9.E+00	< 8.E+00	< 7.E+00
ZN-65	< 2.E+01	< 1.E+01	< 2.E+01	< 2.E+01
ZR-95	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
RU-103	< 6.E+00	< 8.E+00	< 8.E+00	< 7.E+00
RU-106	< 5.E+01	< 7.E+01	< 7.E+01	< 7.E+01
I-131	< 7.E+00	< 9.E+00	< 1.E+01	< 8.E+00
CS-134	< 7.E+00	< 1.E+01	< 1.E+01	< 8.E+00
CS-137	< 6.E+00	< 9.E+00	< 9.E+00	< 9.E+00
BA-140	< 3.E+01	< 3.E+01	< 3.E+01	< 3.E+01
LA-140	< 1.E+01	< 1.E+01	< 1.E+01	< 8.E+00
CE-141	< 9.E+00	< 1.E+01	< 1.E+01	< 1.E+01
CE-144	< 4.E+01	< 6.E+01	< 6.E+01	< 6.E+01
RA-226	1.38E+02 ± 1.24E+02	< 2.E+02	< 2.E+02	< 2.E+02
TH-228	< 1.E+01	< 2.E+01	< 2.E+01	< 1.E+01

VII-4
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
MILK NEAREST PRODUCER
(PCI/LITER)

STATION NUMBER 99

DATE COLLECTED	10/8/2019	11/5/2019	12/3/2019
RADIOCHEMICAL ANALYSIS:			
I-131	< 8.E-01	< 9.E-01	< 8.E-01
GAMMA SPECTRUM ANALYSIS:			
BE-7	< 7.E+01	< 6.E+01	< 7.E+01
K-40	1.17E+03 ± 1.61E+02	1.19E+03 ± 1.75E+02	1.07E+03 ± 1.85E+02
MN-54	< 8.E+00	< 7.E+00	< 7.E+00
CO-58	< 8.E+00	< 7.E+00	< 9.E+00
FE-59	< 2.E+01	< 2.E+01	< 2.E+01
CO-60	< 1.E+01	< 7.E+00	< 9.E+00
ZN-65	< 2.E+01	< 2.E+01	< 2.E+01
ZR-95	< 2.E+01	< 1.E+01	< 1.E+01
RU-103	< 8.E+00	< 7.E+00	< 9.E+00
RU-106	< 8.E+01	< 7.E+01	< 7.E+01
I-131	< 1.E+01	< 9.E+00	< 1.E+01
CS-134	< 9.E+00	< 8.E+00	< 8.E+00
CS-137	< 9.E+00	< 7.E+00	< 6.E+00
BA-140	< 3.E+01	< 2.E+01	< 3.E+01
LA-140	< 1.E+01	< 8.E+00	< 1.E+01
CE-141	< 2.E+01	< 1.E+01	< 1.E+01
CE-144	< 6.E+01	< 5.E+01	< 5.E+01
RA-226	< 2.E+02	< 2.E+02	< 2.E+02
TH-228	< 2.E+01	< 1.E+01	< 1.E+01

VII-5
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
WATER - GROUND
(PCI/LITER)

STATION NUMBER 11

DATE COLLECTED	1/14/2019	4/10/2019	7/17/2019	10/16/2019
RADIOCHEMICAL ANALYSIS:				
I-131	< 7.E-01	< 5.E-01	< 9.E-01	< 9.E-01
H-3	< 3.E+02	< 3.E+02	< 3.E+02	< 3.E+02
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 7.E+01	< 5.E+01	< 5.E+01	< 5.E+01
K-40	< 7.E+01	< 1.E+02	< 1.E+02	7.48E+01 ± 4.64E+01
MN-54	< 6.E+00	< 4.E+00	< 6.E+00	< 5.E+00
CO-58	< 6.E+00	< 5.E+00	< 6.E+00	< 5.E+00
FE-59	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
CO-60	< 1.E+01	< 6.E+00	< 7.E+00	< 6.E+00
ZN-65	< 1.E+01	< 1.E+01	< 1.E+01	< 1.E+01
ZR-95	< 1.E+01	< 9.E+00	< 1.E+01	< 9.E+00
RU-103	< 6.E+00	< 5.E+00	< 6.E+00	< 6.E+00
RU-106	< 6.E+01	< 6.E+01	< 6.E+01	< 4.E+01
I-131	< 8.E+00	< 8.E+00	< 9.E+00	< 6.E+00
CS-134	< 9.E+00	< 6.E+00	< 8.E+00	< 6.E+00
CS-137	< 8.E+00	< 5.E+00	< 6.E+00	< 5.E+00
BA-140	< 3.E+01	< 2.E+01	< 3.E+01	< 2.E+01
LA-140	< 8.E+00	< 6.E+00	< 1.E+01	< 6.E+00
CE-141	< 9.E+00	< 1.E+01	< 1.E+01	< 9.E+00
CE-144	< 4.E+01	< 5.E+01	< 4.E+01	< 4.E+01
RA-226	< 2.E+02	< 2.E+02	< 1.E+02	< 1.E+02
TH-228	< 1.E+01	< 1.E+01	< 1.E+01	1.21E+01 ± 9.28E+00

VII-5
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
WATER - GROUND
(PCI/LITER)

STATION NUMBER 47

DATE COLLECTED	1/14/2019	4/9/2019	7/17/2019	10/15/2019
RADIOCHEMICAL ANALYSIS:				
I-131	< 6.E-01	< 5.E-01	< 6.E-01	< 9.E-01
H-3	< 3.E+02	< 3.E+02	< 3.E+02	< 3.E+02
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 4.E+01	< 4.E+01	< 5.E+01	< 5.E+01
K-40	< 3.E+01	< 8.E+01	< 7.E+01	< 2.E+02
MN-54	< 4.E+00	< 5.E+00	< 7.E+00	< 8.E+00
CO-58	< 4.E+00	< 5.E+00	< 6.E+00	< 6.E+00
FE-59	< 8.E+00	< 1.E+01	< 1.E+01	< 1.E+01
CO-60	< 5.E+00	< 5.E+00	< 7.E+00	< 7.E+00
ZN-65	< 1.E+01	< 9.E+00	< 2.E+01	< 1.E+01
ZR-95	< 8.E+00	< 8.E+00	< 6.E+00	< 1.E+01
RU-103	< 5.E+00	< 5.E+00	< 6.E+00	< 6.E+00
RU-106	< 4.E+01	< 4.E+01	< 5.E+01	< 8.E+01
I-131	< 5.E+00	< 6.E+00	< 9.E+00	< 9.E+00
CS-134	< 5.E+00	< 5.E+00	< 6.E+00	< 8.E+00
CS-137	< 4.E+00	< 5.E+00	< 7.E+00	< 5.E+00
BA-140	< 2.E+01	< 2.E+01	< 2.E+01	< 3.E+01
LA-140	< 5.E+00	< 7.E+00	< 7.E+00	< 1.E+01
CE-141	< 9.E+00	< 8.E+00	< 1.E+01	< 1.E+01
CE-144	< 4.E+01	< 3.E+01	< 3.E+01	< 4.E+01
RA-226	< 1.E+02	< 1.E+02	< 1.E+02	< 2.E+02
TH-228	< 1.E+01	< 9.E+00	< 1.E+01	< 1.E+01

VII-6
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
WATER - RIVER
(PCI/LITER)

STATION NUMBER 28

DATE COLLECTED	1/7/2019	2/5/2019	3/11/2019	4/1/2019-10/1/2019
RADIOCHEMICAL ANALYSIS:				(a)
H-3	< 3.E+02	< 3.E+02	< 3.E+02	
H-3 Qtrly			< 3.E+02	
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 5.E+01	< 3.E+01	< 4.E+01	
K-40	< 1.E+02	< 6.E+01	< 4.E+01	
MN-54	< 5.E+00	< 4.E+00	< 5.E+00	
CO-58	< 6.E+00	< 4.E+00	< 4.E+00	
FE-59	< 1.E+01	< 9.E+00	< 9.E+00	
CO-60	< 7.E+00	< 5.E+00	< 6.E+00	
ZN-65	< 1.E+01	< 8.E+00	< 8.E+00	
ZR-95	< 1.E+01	< 6.E+00	< 7.E+00	
RU-103	< 7.E+00	< 4.E+00	< 4.E+00	
RU-106	< 5.E+01	< 3.E+01	< 4.E+01	
I-131	< 8.E+00	< 5.E+00	< 6.E+00	
CS-134	< 8.E+00	< 4.E+00	< 4.E+00	
CS-137	< 7.E+00	< 3.E+00	< 4.E+00	
BA-140	< 2.E+01	< 2.E+01	< 1.E+01	
LA-140	< 8.E+00	< 7.E+00	< 6.E+00	
CE-141	< 1.E+01	< 6.E+00	< 7.E+00	
CE-144	< 5.E+01	< 2.E+01	< 3.E+01	
RA-226	< 2.E+02	< 1.E+02	< 1.E+02	
TH-228	< 1.E+01	< 6.E+00	< 8.E+00	

(a) Due to Missouri River flooding, samples could not be safely collected.

VII-6
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
WATER - RIVER
(PCI/LITER)

STATION NUMBER 28

DATE COLLECTED	11/19/2019	12/3/2019
RADIOCHEMICAL ANALYSIS:	(a)	(a)
H-3	< 3.E+02	< 3.E+02
H-3 Qtrly		< 3.E+02
GAMMA SPECTRUM ANALYSIS:		
BE-7	< 5.E+01	< 5.E+01
K-40	< 1.E+02	< 1.E+02
MN-54	< 5.E+00	< 7.E+00
CO-58	< 7.E+00	< 6.E+00
FE-59	< 1.E+01	< 1.E+01
CO-60	< 6.E+00	< 4.E+00
ZN-65	< 1.E+01	< 2.E+01
ZR-95	< 9.E+00	< 1.E+01
RU-103	< 6.E+00	< 6.E+00
RU-106	< 5.E+01	< 6.E+01
I-131	< 1.E+01	< 6.E+00
CS-134	< 6.E+00	< 7.E+00
CS-137	< 6.E+00	< 6.E+00
BA-140	< 3.E+01	< 2.E+01
LA-140	< 1.E+01	< 1.E+01
CE-141	< 1.E+01	< 1.E+01
CE-144	< 4.E+01	< 5.E+01
RA-226	< 1.E+02	< 2.E+02
TH-228	< 1.E+01	< 1.E+01

(a) Due to Missouri River flooding, Station 28 remained inaccessible. Samples obtained downstream of plant at Indian Caves State Park boat ramp in lieu of Station 28.

VII-6
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
WATER - RIVER
(PCI/LITER)

STATION NUMBER 35

DATE COLLECTED	1/7/2019	2/5/2019	3/11/2019	4/1/2019
RADIOCHEMICAL ANALYSIS:				(a)
H-3	< 3.E+02	< 3.E+02	< 3.E+02	
H-3 Qtrly			< 3.E+02	
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 5.E+01	< 5.E+01	< 4.E+01	
K-40	< 6.E+01	< 1.E+02	< 4.E+01	
MN-54	< 6.E+00	< 6.E+00	< 4.E+00	
CO-58	< 5.E+00	< 6.E+00	< 5.E+00	
FE-59	< 1.E+01	< 1.E+01	< 8.E+00	
CO-60	< 6.E+00	< 6.E+00	< 4.E+00	
ZN-65	< 1.E+01	< 1.E+01	< 1.E+01	
ZR-95	< 1.E+01	< 9.E+00	< 9.E+00	
RU-103	< 6.E+00	< 6.E+00	< 5.E+00	
RU-106	< 5.E+01	< 5.E+01	< 4.E+01	
I-131	< 8.E+00	< 8.E+00	< 6.E+00	
CS-134	< 6.E+00	< 6.E+00	< 5.E+00	
CS-137	< 7.E+00	< 7.E+00	< 6.E+00	
BA-140	< 3.E+01	< 2.E+01	< 2.E+01	
LA-140	< 7.E+00	< 6.E+00	< 4.E+00	
CE-141	< 1.E+01	< 1.E+01	< 9.E+00	
CE-144	< 5.E+01	< 4.E+01	< 4.E+01	
RA-226	< 2.E+02	< 1.E+02	< 1.E+02	
TH-228	< 1.E+01	< 1.E+01	< 1.E+01	

(a) Due to Missouri River flooding, samples could not be safely collected.

VII-6
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
WATER - RIVER
(PCI/LITER)

STATION NUMBER 35

DATE COLLECTED	5/1/2019	6/1/2019	7/23/2019	8/22/2019
RADIOCHEMICAL ANALYSIS:	(a)	(a)		
H-3			< 3.E+02	< 3.E+02
H-3 Qtrly				
GAMMA SPECTRUM ANALYSIS:				
BE-7			< 5.E+01	< 6.E+01
K-40			< 9.E+01	< 2.E+02
MN-54			< 5.E+00	< 6.E+00
CO-58			< 5.E+00	< 7.E+00
FE-59			< 1.E+01	< 1.E+01
CO-60			< 8.E+00	< 8.E+00
ZN-65			< 1.E+01	< 2.E+01
ZR-95			< 8.E+00	< 1.E+01
RU-103			< 6.E+00	< 8.E+00
RU-106			< 4.E+01	< 6.E+01
I-131			< 6.E+00	< 1.E+01
CS-134			< 6.E+00	< 8.E+00
CS-137			< 5.E+00	< 1.E+01
BA-140			< 2.E+01	< 3.E+01
LA-140			< 8.E+00	< 1.E+01
CE-141			< 8.E+00	< 1.E+01
CE-144			< 4.E+01	< 6.E+01
RA-226			< 1.E+02	< 2.E+02
TH-228			< 1.E+01	< 2.E+01

(a) Due to Missouri River flooding, samples could not be safely collected.

VII-6
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
WATER - RIVER
(PCI/LITER)

STATION NUMBER 35

DATE COLLECTED	9/5/2019	10/1/2019	11/18/2019	12/3/2019
RADIOCHEMICAL ANALYSIS:		(a)		
H-3	< 3.E+02		< 3.E+02	< 3.E+02
H-3 Qtrly	< 3.E+02			< 3.E+02
GAMMA SPECTRUM ANALYSIS:				
BE-7	< 4.E+01		< 5.E+01	< 5.E+01
K-40	< 1.E+02		< 1.E+02	< 7.E+01
MN-54	< 5.E+00		< 6.E+00	< 7.E+00
CO-58	< 4.E+00		< 6.E+00	< 6.E+00
FE-59	< 1.E+01		< 1.E+01	< 1.E+01
CO-60	< 4.E+00		< 8.E+00	< 1.E+01
ZN-65	< 1.E+01		< 1.E+01	< 2.E+01
ZR-95	< 8.E+00		< 1.E+01	< 1.E+01
RU-103	< 6.E+00		< 6.E+00	< 6.E+00
RU-106	< 5.E+01		< 6.E+01	< 7.E+01
I-131	< 7.E+00		< 9.E+00	< 8.E+00
CS-134	< 5.E+00		< 7.E+00	< 6.E+00
CS-137	< 6.E+00		< 8.E+00	< 6.E+00
BA-140	< 2.E+01		< 3.E+01	< 3.E+01
LA-140	< 7.E+00		< 7.E+00	< 7.E+00
CE-141	< 8.E+00		< 1.E+01	< 9.E+00
CE-144	< 4.E+01		< 4.E+01	< 4.E+01
RA-226	< 1.E+02		< 1.E+02	< 2.E+02
TH-228	< 9.E+00		< 1.E+01	< 1.E+01

(a) Due to Missouri River flooding, samples could not be safely collected.

VII-7
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - THERMOLUMINESCENT DOSIMETRY - TLD
MILLIREM/QUARTER

Sample Nuclide	Station Number	First Quarter 01/01-03/31	Second Quarter 04/01-06/30	Third Quarter 07/01-09/30	Fourth Quarter 10/01-01/01	Quarter Average - 1 S.D.
TLD	1	22.9 ± 0.2	25.6 ± 1.4	26.1 ± 0.4	21.0 ± 1.0	23.9 ± 2.4
	2	(a)	(a)	(a)	22.5 ± 0.6	22.5 ± 0.0
	3	(a)	(a)	(a)	(a)	(b)
	4	(a)	(a)	(a)	(a)	(b)
	5	(a)	(a)	(a)	(a)	(b)
	6	(a)	(a)	(a)	(a)	(b)
	7	22.1 ± 0.1	25.1 ± 0.3	25.4 ± 0.3	22.9 ± 0.8	23.9 ± 1.6
	8	23.3 ± 0.5	25.4 ± 0.7	24.9 ± 1.4	21.3 ± 0.7	23.7 ± 1.8
	9	22.0 ± 0.7	24.4 ± 0.5	24.8 ± 0.3	22.3 ± 0.8	23.4 ± 1.4
	10	20.9 ± 1.4	23.7 ± 0.2	(a)	22.7 ± 0.7	22.5 ± 1.4
	20	22.1 ± 0.1	25.4 ± 0.1	25.1 ± 0.6	20.1 ± 1.2	23.2 ± 2.6
	44	23.4 ± 0.3	26.7 ± 0.5	27.0 ± 0.7	21.6 ± 0.6	24.7 ± 2.6
	56	(a)	(a)	(a)	(a)	(b)
	58	21.8 ± 0.2	23.4 ± 0.7	24.8 ± 0.5	18.5 ± 0.3	22.1 ± 2.7
	59	(a)	(a)	(a)	(a)	(b)
	66	21.6 ± 0.9	26.1 ± 0.6	25.7 ± 0.3	23.3 ± 0.2	24.2 ± 2.1
	67	23.6 ± 0.5	26.0 ± 0.9	26.5 ± 0.4	19.5 ± 0.3	23.9 ± 3.2
	71	(a)	(a)	(a)	21.9 ± 0.5	21.9 ± 0.0
	79	(a)	23.9 ± 2.2	(a)	(a)	23.9 ± 0.0
	80	23.0 ± 0.3	24.4 ± 0.6	24.6 ± 0.5	18.7 ± 0.2	22.7 ± 2.7
	81	22.2 ± 0.4	25.2 ± 0.8	24.3 ± 0.3	21.8 ± 0.7	23.4 ± 1.6
	82	(a)	(a)	(a)	(a)	(b)
	83	24.2 ± 1.0	26.6 ± 1.3	29.2 ± 0.3	21.8 ± 1.8	25.5 ± 3.2
	84	23.0 ± 0.3	26.6 ± 0.3	25.8 ± 1.0	23.2 ± 0.7	24.7 ± 1.8
	85	(a)	(a)	(a)	(a)	(b)

(a) Due to Missouri River flooding, sample station was either inaccessible or TLD was lost/damaged in flood waters.

(b) Quarterly average and standard deviation unable to be calculated.

VII-7
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - THERMOLUMINESCENT DOSIMETRY - TLD
MILLIREM/QUARTER

Sample Nuclide	Station Number	First Quarter 01/01-03/31	Second Quarter 04/01-06/30	Third Quarter 07/01-09/30	Fourth Quarter 10/01-01/01	Quarter Average - 1 S.D.
TLD	86	(a)	(a)	(a)	(a)	(b)
	87	(a)	(a)	(a)	(a)	(b)
	88	(a)	(a)	(a)	(a)	(b)
	89	(a)	(a)	(a)	(a)	(b)
	90	(a)	(a)	(a)	(a)	(b)
	91	23.6 ± 0.3	24.3 ± 1.4	23.9 ± 0.3	19.2 ± 0.1	22.8 ± 2.4
	94	(a)	(a)	(a)	22.6 ± 0.6	22.6 ± 0.0
Average/Quarter		22.7 ± 0.9	25.2 ± 1.0	25.6 ± 1.4	21.4 ± 1.5	
Range		(20.9-24.2)	(23.4-26.7)	(23.9-29.2)	(18.5-23.3)	
Detection/Total		15/15	17/17	14/14	18/18	

(a) Due to Missouri River flooding, sample station was either inaccessible or TLD was lost/damaged in flood waters.

(b) Quarterly average and standard deviation unable to be calculated.

VII-8
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
VEGETATION - TERRESTRIAL, BROADLEAF
(PCI/KG WET)

STATION NUMBER 35

DATE COLLECTED	4/1/2019-8/31/2019	9/16/2019	10/30/2019	11/6/2019
RADIOCHEMICAL ANALYSIS:	(a)			
I-131		< 5.E+01	< 5.E+01	< 4.E+01
GAMMA SPECTRUM ANALYSIS:				
BE-7		1.21E+03 ± 3.75E+02	4.18E+03 ± 5.30E+02	2.45E+03 ± 3.49E+02
K-40		6.31E+03 ± 8.32E+02	4.22E+03 ± 6.56E+02	4.32E+03 ± 5.54E+02
MN-54		< 3.E+01	< 3.E+01	< 3.E+01
CO-58		< 3.E+01	< 3.E+01	< 3.E+01
FE-59		< 7.E+01	< 8.E+01	< 6.E+01
CO-60		< 4.E+01	< 4.E+01	< 3.E+01
ZN-65		< 7.E+01	< 8.E+01	< 6.E+01
ZR-95		< 6.E+01	< 4.E+01	< 5.E+01
RU-103		< 4.E+01	< 3.E+01	< 3.E+01
RU-106		< 3.E+02	< 3.E+02	< 3.E+02
I-131		< 4.E+01	< 4.E+01	< 5.E+01
CS-134		< 4.E+01	< 4.E+01	< 3.E+01
CS-137		< 3.E+01	< 4.E+01	< 3.E+01
BA-140		< 1.E+02	< 1.E+02	< 2.E+02
CE-141		< 5.E+01	< 6.E+01	< 5.E+01
CE-144		< 2.E+02	< 2.E+02	< 2.E+02
RA-226		< 7.E+02	< 9.E+02	< 6.E+02
TH-228		< 7.E+01	< 8.E+01	< 5.E+01

(a) Due to Missouri River flooding, sample could not be obtained.

VII-8
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
VEGETATION - TERRESTRIAL, BROADLEAF
(PCI/KG WET)

STATION NUMBER 96

DATE COLLECTED	4/1/2019-8/31/2019	9/16/2019	10/30/2019	11/6/2019
RADIOCHEMICAL ANALYSIS:	(a)			
I-131		< 4.E+01	< 6.E+01	< 5.E+01
GAMMA SPECTRUM ANALYSIS:				
BE-7	1.55E+03 ± 3.85E+02	4.97E+03 ± 5.44E+02	3.36E+03 ± 3.39E+02	
K-40	7.92E+03 ± 8.76E+02	2.38E+03 ± 5.65E+02	6.16E+03 ± 6.51E+02	
MN-54	< 3.E+01	< 3.E+01	< 3.E+01	
CO-58	< 3.E+01	< 2.E+01	< 3.E+01	
FE-59	< 6.E+01	< 6.E+01	< 7.E+01	
CO-60	< 3.E+01	< 3.E+01	< 3.E+01	
ZN-65	< 8.E+01	< 6.E+01	< 5.E+01	
ZR-95	< 5.E+01	< 5.E+01	< 4.E+01	
RU-103	< 3.E+01	< 4.E+01	< 2.E+01	
RU-106	< 3.E+02	< 3.E+02	< 2.E+02	
I-131	< 4.E+01	< 5.E+01	< 6.E+01	
CS-134	< 3.E+01	< 4.E+01	< 3.E+01	
CS-137	< 3.E+01	< 4.E+01	< 2.E+01	
BA-140	< 1.E+02	< 1.E+02	< 1.E+02	
CE-141	< 4.E+01	< 5.E+01	< 5.E+01	
CE-144	< 2.E+02	< 2.E+02	< 2.E+02	
RA-226	< 8.E+02	< 9.E+02	< 7.E+02	
TH-228	< 6.E+01	< 8.E+01	< 6.E+01	

(a) Due to Missouri River flooding, sample could not be obtained.

VII-8
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - INGESTION
VEGETATION - TERRESTRIAL, BROADLEAF
(PCI/KG WET)

STATION NUMBER 101

DATE COLLECTED	4/1/2019-8/31/2019	9/16/2019	10/30/2019	11/7/2019
RADIOCHEMICAL ANALYSIS:	(a)			
I-131		< 5.E+01	< 3.E+01	< 5.E+01
GAMMA SPECTRUM ANALYSIS:				
BE-7	1.73E+03 ± 3.24E+02	6.64E+03 ± 4.81E+02	1.49E+03 ± 3.23E+02	
K-40	4.76E+03 ± 6.99E+02	6.60E+03 ± 6.73E+02	7.16E+03 ± 8.90E+02	
MN-54	< 2.E+01	< 3.E+01	< 2.E+01	
CO-58	< 2.E+01	< 3.E+01	< 4.E+01	
FE-59	< 6.E+01	< 5.E+01	< 9.E+01	
CO-60	< 2.E+01	< 3.E+01	< 4.E+01	
ZN-65	< 5.E+01	< 7.E+01	< 8.E+01	
ZR-95	< 4.E+01	< 5.E+01	< 5.E+01	
RU-103	< 2.E+01	< 3.E+01	< 3.E+01	
RU-106	< 2.E+02	< 3.E+02	< 3.E+02	
I-131	< 3.E+01	< 5.E+01	< 5.E+01	
CS-134	< 3.E+01	< 3.E+01	< 4.E+01	
CS-137	< 3.E+01	< 3.E+01	< 3.E+01	
BA-140	< 1.E+02	< 1.E+02	< 1.E+02	
CE-141	< 3.E+01	< 5.E+01	< 4.E+01	
CE-144	< 1.E+02	< 2.E+02	< 1.E+02	
RA-226	< 5.E+02	< 8.E+02	< 7.E+02	
TH-228	< 5.E+01	< 6.E+01	< 5.E+01	

(a) Due to Missouri River flooding, sample could not be obtained.

VII-9
NEBRASKA PUBLIC POWER DISTRICT
 COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
SHORELINE SEDIMENT
 (PCI/KG DRY)

STATION NUMBER 28

DATE COLLECTED	5/29/2019	9/1/2019	11/26/2019
GAMMA SPECTRUM ANALYSIS:	(a)	(a)	(b)
BE-7			< 9.E+02
K-40			1.63E+04 ± 2.03E+03
MN-54			< 9.E+01
CO-58			< 7.E+01
FE-59			< 2.E+02
CO-60			< 1.E+02
ZN-65			< 2.E+02
ZR-95			< 1.E+02
RU-103			< 8.E+01
RU-106			< 8.E+02
I-131			< 1.E+02
CS-134			< 1.E+02
CS-137			< 1.E+02
BA-140			< 4.E+02
CE-141			< 1.E+02
CE-144			< 4.E+02
RA-226			3.76E+03 ± 1.75E+03
TH-228			9.42E+02 ± 1.60E+02

(a) Due to Missouri River flooding, sample could not safely be collected in Spring 2019. Attempt to obtain sample in late Summer 2019 was also unsuccessful.

(b) Due to Missouri River flooding, Station 28 remained inaccessible. Samples obtained downstream of plant at Indian Caves State Park boat ramp in lieu of Station 28.

VII-9
NEBRASKA PUBLIC POWER DISTRICT
 COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
SHORELINE SEDIMENT
 (PCI/KG DRY)

STATION NUMBER 35

DATE COLLECTED	5/29/2019	9/10/2019	11/19/2019
GAMMA SPECTRUM ANALYSIS:	(a)		
BE-7		< 6.E+02	< 6.E+02
K-40		1.26E+04 ± 1.64E+03	1.51E+04 ± 1.46E+03
MN-54		< 6.E+01	< 8.E+01
CO-58		< 7.E+01	< 7.E+01
FE-59		< 2.E+02	< 2.E+02
CO-60		< 6.E+01	< 8.E+01
ZN-65		< 2.E+02	< 2.E+02
ZR-95		< 1.E+02	< 1.E+02
RU-103		< 7.E+01	< 7.E+01
RU-106		< 5.E+02	< 6.E+02
I-131		< 1.E+02	< 1.E+02
CS-134		< 8.E+01	< 9.E+01
CS-137		< 7.E+01	< 8.E+01
BA-140		< 3.E+02	< 3.E+02
CE-141		< 1.E+02	< 1.E+02
CE-144		< 4.E+02	< 4.E+02
RA-226		< 2.E+03	< 2.E+03
TH-228		4.17E+02 ± 1.39E+02	1.59E+03 ± 1.18E+02

(a) Due to Missouri River flooding, sample could not safely be collected. While outside the ODAM specified timeframe, this Spring 2019 sample was obtained at the earliest possible opportunity, which was 9/10/19.

SECTION VIII. REFERENCES

VIII. REFERENCES

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5. U.S. Environmental Protection Agency; Environmental Radiation Data, Report 35, July -- September 1983, Report 39, July -- September 1985; Report 40, October -- December 1984; Report 41, January -- March 1985. Report 42, April -- June 1985; Report 43, July-September 1985, Report 44-45, October-March 1986; Report 46, April-June 1986; Report 47, July-September 1986; Report 48, October-December 1986; Report 49, January-March 1987. Environmental Radiation Facility, Montgomery, Alabama.
6. U.S. Department of Energy; EML 460, October 1, 1986; Environmental Measurements Laboratory, US Department of Energy, New York, New York 10014.
7. U.S. Nuclear Regulatory Commission, 1975, Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants.
8. U.S. Regulatory Commission, Branch Technical Position, Radiological Monitoring Acceptable Program (November, 1979, Revision 1).

APPENDIX A
2019 LAND USE CENSUS

ANNUAL CNS LAND USE CENSUS / POTABLE **WATER USE**

Conducted July 15-16, 2019
0-3 miles

Cooper Nuclear Station (CNS) Offsite Dose Assessment Manual (ODAM) requires an annual land use census. This census identifies the location of the nearest garden that is greater than 500 square feet in area and yields leafy green vegetables, the nearest milk animal, and the location of the nearest resident in each of the 16 meteorological sectors within 3 miles of CNS.

A land use census was performed July 15-16, 2019, in accordance with the CNS ODAM. The nearest residence was found in sector Q, 0.9 miles from CNS, and the nearest garden was found in sector P, 1.9 miles from CNS.

No milk animals were found within 3 miles of CNS and there was no evidence of potable water use from the Missouri River within three miles of CNS.

ANNUAL CNS LAND USE CENSUS

July 15-16, 2019
0-3 Miles

SECTOR	NEAREST RESIDENT	Direction in Degrees	NEAREST GARDEN	Direction in Degrees	NEAREST MILK ANIMAL
	Distance		Distance		
A/N	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
B/NNE	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
C/NE	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
D/ENE	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
E/E	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
F/ESE	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
G/SE	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
H/SSE	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
J/S	NONE ⁽¹⁾	NA	NONE ⁽¹⁾	NA	NONE
K/SSW	NONE	NA	NONE	NA	NONE
L/SW	1.3 Miles	221.0°	2.2 Miles	230.0°	NONE
M/WSW	1.8 Miles	251.0°	1.8 Miles	251.0°	NONE
N/W	NONE	NA	NONE	NA	NONE
P/WWNW	1.9 Miles	290.0°	1.9 Miles	290.0°	NONE
Q/NW	0.9 Miles	307.0°	NONE	NA	NONE
R/NNW	1.9 Miles	335.0°	3 Miles	330.0°	NONE

(1) signifies flooded areas with no residences nor gardens for 2019.

APPENDIX B
SUMMARY OF INTRALABORATORY COMPARISONS

INTERLABORATORY COMPARISION PROGRAM

The purpose of the Interlaboratory Comparison Program (ICP) is to confirm the accuracy of results produced by Teledyne Brown Engineering. Samples of various matrices (i.e. soil, water, vegetation, air filters, and milk) are spiked with known amounts of radioactivity by commercial vendors of this service and by departments within the government. TBE participates in three programs. Two are commercial, Analytics Inc. and Environmental Resource Associates (ERA) and one is a government sponsored program, the Department of Energy's (DOE) Mixed Analyte Performance Evaluation Program (MAPEP). The DOE's MAPEP was created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities. All three programs are blind performance evaluation studies in which samples with known activities are sent to TBE for analysis. Once analyzed, TBE submits the results to the respective agency for evaluation. The results of these evaluations are published in TBE's quarterly and annual QA reports.

The National Institute of Standards and Technology (NIST) is the approval authority for laboratory providers participating in Intercomparison Study Programs; however, at this time, there are no approved laboratories for environmental and/or radiochemical isotope analyses.

For the TBE laboratory, 119 out of 129 analyses performed met the specified acceptance criteria. Ten analyses did not meet the specified acceptance criteria and were addressed through the TBE Corrective Action Program. A summary of the NCR dispositions is provided.

**A.1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services**

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Ratio of TBE to Analytics Result	Evaluation ^(b)
March 2019	E12468A	Milk	Sr-89	pCi/L	87.1	96	0.91	A
			Sr-90	pCi/L	12.6	12.6	1.00	A
	E12469A	Milk	Ce-141	pCi/L	113	117	0.97	A
			Co-58	pCi/L	153	143	1.07	A
			Co-60	pCi/L	289	299	0.97	A
			Cr-51	pCi/L	233	293	0.80	A
			Cs-134	pCi/L	147	160	0.92	A
			Cs-137	pCi/L	193	196	0.98	A
			Fe-59	pCi/L	153	159	0.96	A
			I-131	pCi/L	91.5	89.5	1.02	A
			Mn-54	pCi/L	149	143	1.04	A
			Zn-65	pCi/L	209	220	0.95	A
	E12470	Charcoal	I-131	pCi	77.5	75.2	1.03	A
	E12471	AP	Ce-141	pCi	60.7	70.2	0.87	A
			Co-58	pCi	87.9	85.8	1.02	A
			Co-60	pCi	175	179	0.98	A
			Cr-51	pCi	165	176	0.94	A
			Cs-134	pCi	91.2	95.9	0.95	A
			Cs-137	pCi	120	118	1.02	A
			Fe-59	pCi	108	95.3	1.13	A
			Mn-54	pCi	94.2	85.7	1.10	A
			Zn-65	pCi	102	132	0.77	W
	E12472	Water	Fe-55	pCi/L	2230	1920	1.16	A
	E12473	Soil	Ce-141	pCi/g	0.189	0.183	1.03	A
			Co-58	pCi/g	0.209	0.224	0.93	A
			Co-60	pCi/g	0.481	0.466	1.03	A
			Cr-51	pCi/g	0.522	0.457	1.14	A
			Cs-134	pCi/g	0.218	0.250	0.87	A
			Cs-137	pCi/g	0.370	0.381	0.97	A
			Fe-59	pCi/g	0.263	0.248	1.06	A
			Mn-54	pCi/g	0.248	0.223	1.11	A
			Zn-65	pCi/g	0.371	0.344	1.08	A
	E12474	AP	Sr-89	pCi	88.3	95.2	0.93	A
			Sr-90	pCi	11.7	12.5	0.94	A
August 2019	E12562	Soil	Sr-90	pCi/g	4.710	6.710	0.70	W

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

A.1 Analytics Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Ratio of TBE to Analytics Result	Evaluation ^(b)
September 2019	E12475	Milk	Sr-89	pCi/L	70.0	93.9	0.75	W
			Sr-90	pCi/L	12.0	12.9	0.93	A
	E12476	Milk	Ce-141	pCi/L	150	167	0.90	A
			Co-58	pCi/L	170	175	0.97	A
			Co-60	pCi/L	211	211	1.00	A
			Cr-51	pCi/L	323	331	0.98	A
			Cs-134	pCi/L	180	207	0.87	A
			Cs-137	pCi/L	147	151	0.97	A
			Fe-59	pCi/L	156	148	1.05	A
			I-131	pCi/L	81.1	92.1	0.88	A
			Mn-54	pCi/L	160	154	1.04	A
			Zn-65	pCi/L	303	293	1.03	A
	E12477	Charcoal	I-131	pCi	95.9	95.1	1.01	A
	E12478	AP	Ce-141	pCi	129	138	0.93	A
			Co-58	pCi	128	145	0.88	A
			Co-60	pCi	181	174	1.04	A
			Cr-51	pCi	292	274	1.07	A
			Cs-134	pCi	166	171	0.97	A
			Cs-137	pCi	115	125	0.92	A
			Fe-59	pCi	119	123	0.97	A
			Mn-54	pCi	129	128	1.01	A
			Zn-65	pCi	230	242	0.95	A
	E12479	Water	Fe-55	pCi/L	1810	1850	0.98	A
	E12480	Soil	Ce-141	pCi/g	0.305	0.276	1.10	A
			Co-58	pCi/g	0.270	0.289	0.93	A
			Co-60	pCi/g	0.358	0.348	1.03	A
			Cr-51	pCi/g	0.765	0.547	1.40	N ⁽¹⁾
			Cs-134	pCi/g	0.327	0.343	0.95	A
			Cs-137	pCi/g	0.308	0.321	0.96	A
			Fe-59	pCi/g	0.257	0.245	1.05	A
			Mn-54	pCi/g	0.274	0.255	1.07	A
			Zn-65	pCi/g	0.536	0.485	1.11	A
	E12481	AP	Sr-89	pCi	95.9	91.9	1.04	A
			Sr-90	pCi	12.3	12.6	0.97	A
	E12563	Soil	Sr-90	pCi/g	0.392	0.360	1.09	A

(a) The Analytics known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) Analytics evaluation based on TBE internal QC limits:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

(1) See **NCR 19-27**

(Page 2 of 4)

A.2 DOE's Mixed Analyte Performance Evaluation Program (MAPEP)
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Acceptance Range	Evaluation ^(b)
February 2019	19-GrF40	AP	Gross Alpha	Bq/sample	0.184	0.528	0.158 - 0.898	A
			Gross Beta	Bq/sample	0.785	0.948	0.474 - 1.422	A
	19-MaS40	Soil	Ni-63	Bq/kg	420	519.0	363 - 675	A
			Sr-90	Bq/kg			(1)	NR ⁽³⁾
	19-MaW40	Water	Am-241	Bq/L	0.764	0.582	0.407 - 0.757	N ⁽⁴⁾
			Ni-63	Bq/L	4.72	5.8	4.1 - 7.5	A
			Pu-238	Bq/L	0.443	0.451	0.316 - 0.586	A
			Pu-239/240	Bq/L	-0.00161	0.0045	(2)	A
	19-RdF40	AP	U-234/233	Bq/sample	0.1138	0.106	0.074 - 0.138	A
			U-238	Bq/sample	0.107	0.110	0.077 - 0.143	A
	19-RdV40	Vegetation	Cs-134	Bq/sample	2.14	2.44	1.71 - 3.17	A
			Cs-137	Bq/sample	2.22	2.30	1.61 - 2.99	A
			Co-57	Bq/sample	2.16	2.07	1.45 - 2.69	A
			Co-60	Bq/sample	0.02382		(1)	A
			Mn-54	Bq/sample	-0.03607		(1)	A
			Sr-90	Bq/sample	-0.1060		(1)	N ⁽⁵⁾
			Zn-65	Bq/sample	1.35	1.71	1.20 - 2.22	W
August 2019	19-GrF41	AP	Gross Alpha	Bq/sample	0.192	0.528	0.158 - 0.898	W
			Gross Beta	Bq/sample	0.722	0.937	0.469 - 1.406	A
	19-MaS41	Soil	Ni-63	Bq/kg	436	629	440 - 818	N ⁽⁶⁾
			Sr-90	Bq/kg	444	572	400 - 744	W
	19-MaW41	Water	Am-241	Bq/L				NR ⁽⁷⁾
			Ni-63	Bq/L	7.28	9.7	6.8 - 12.6	W
			Pu-238	Bq/L	0.0207	0.0063	(2)	A
			Pu-239/240	Bq/L	0.741	0.727	0.509 - 0.945	A
	19-RdF41	AP	U-234/233	Bq/sample	0.0966	0.093	0.065 - 0.121	A
			U-238	Bq/sample	0.0852	0.096	0.067-0.125	A
	19-RdV41	Vegetation	Cs-134	Bq/sample	0.0197		(1)	A
			Cs-137	Bq/sample	3.21	3.28	2.30 - 4.26	A
			Co-57	Bq/sample	4.62	4.57	3.20 - 5.94	A
			Co-60	Bq/sample	4.88	5.30	3.71 - 6.89	A
			Mn-54	Bq/sample	4.54	4.49	3.14 - 5.84	A
			Sr-90	Bq/sample	0.889	1.00	0.70 - 1.30	A
			Zn-65	Bq/sample	2.78	2.85	2.00 - 3.71	A

(a) The MAPEP known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation

(b) DOE/MAPEP evaluation:

A = Acceptable - reported result falls within ratio limits of 0.80-1.20

W = Acceptable with warning - reported result falls within 0.70-0.80 or 1.20-1.30

N = Not Acceptable - reported result falls outside the ratio limits of < 0.70 and > 1.30

NR = Not Reported.

(1) False positive test

(2) Sensitivity evaluation

(3) See **NCR 19-12**

(4) See **NCR 19-13**

(5) See **NCR 19-14**

(6) See **NCR 19-25**

(7) See **NCR 19-26**

A.3 ERA Environmental Radioactivity Cross Check Program
Teledyne Brown Engineering Environmental Services

Month/Year	Identification Number	Matrix	Nuclide	Units	TBE Reported Value	Known Value ^(a)	Acceptance Limits	Evaluation ^(b)
April 2019	Rad-117	Water	Ba-133	pCi/L	26.3	24.1	18.6 - 27.8	A
			Cs-134	pCi/L	15.2	12.1	8.39 - 14.4	N ⁽¹⁾
			Cs-137	pCi/L	33.6	33.1	28.8 - 39.4	A
			Co-60	pCi/L	11.9	11.5	8.67 - 15.5	A
			Zn-65	pCi/L	87.1	89.2	80.3 - 107	A
			GR-A	pCi/L	19	19.3	9.56 - 26.5	A
			GR-B	pCi/L	20.2	29.9	19.1 - 37.7	A
			U-Nat	pCi/L	55.5	55.9	45.6 - 61.5	A
			H-3	pCi/L	21500	21400	18700 - 23500	A
			Sr-89	pCi/L	44.9	33.3	24.5 - 40.1	N ⁽²⁾
			Sr-90	pCi/L	24.5	26.3	19.0 - 30.7	A
			I-131	pCi/L	28.9	28.4	23.6 - 33.3	A
October 2019	Rad-119	Water	Ba-133	pCi/L	42.7	43.8	35.7 - 48.8	A
			Cs-134	pCi/L	53.5	55.9	45.2 - 61.5	A
			Cs-137	pCi/L	77.7	78.7	70.8 - 89.2	A
			Co-60	pCi/L	51.5	53.4	48.1 - 61.3	A
			Zn-65	pCi/L	36.6	34.0	28.5 - 43.1	A
			GR-A	pCi/L	40.5	27.6	14.0 - 36.3	N ⁽³⁾
			GR-B	pCi/L	36.3	39.8	26.4 - 47.3	A
			U-Nat	pCi/L	27.66	28.0	22.6 - 31.1	A
			H-3	pCi/L	22800	23400	20500 - 25700	A
			Sr-89	pCi/L	47.1	45.5	35.4 - 52.7	A
			Sr-90	pCi/L	32.5	26.5	19.2 - 30.9	N ⁽⁴⁾
			I-131	pCi/L	26.0	23.9	19.8 - 28.4	A
December 2019	QR 120419D	Water	Sr-90	pCi/L	20.1	18.6	13.2 - 22.1	A

(a) The ERA known value is equal to 100% of the parameter present in the standard as determined by gravimetric and/or volumetric measurements made during standard preparation.

(b) ERA evaluation:

A = Acceptable - Reported value falls within the Acceptance Limits

N = Not Acceptable - Reported value falls outside of the Acceptance Limits

(1) See NCR 19-10

(2) See NCR 19-11

(3) See NCR 19-23

(4) See NCR 19-24

- NCR 19-10: The ERA April 2019 water Cs-134 result was evaluated as Not Acceptable. The reported value was 15.2 pCi/L (error 2.82 pCi/L) and the known result was 12.1 pCi/L (acceptance range of 8.39 - 14.4 pCi/L). With the error, the reported result overlaps the acceptable range. This sample was run as the workgroup duplicate on a different detector with a result of 10.7 pCi/L (within acceptable range).
- NCR 19-11: The ERA April 2019 water Sr-89 result was evaluated as Not Acceptable. The reported value was 44.9 pCi/L and the known result was 33.3 pCi/L (acceptance range of 24.5 - 40.1 pCi/L). The sample was only counted for 15 minutes instead of 200 minutes. The sample was re-prepped in duplicate and counted for 200 minutes with results of 30.7 ± 5.37 pCi/L and 33.0 ± 8.71 pCi/L. This was the 1st “high” failure for Sr-89 in 5 years.
- NCR 19-12: The MAPEP February 2019 soil Sr-90 result was not submitted and therefore evaluated as Not Acceptable. The sample was run in duplicate, with results of -1.32 ± 4.09 Bq/kg (<6.87) and -1.030 ± 3.55 Bq/kg (<5.97). The known result was a false positive test (no significant activity). TBE did not submit a result because it appeared that the results may not be accurate. TBE analyzed a substitute soil Sr-90 sample from another vendor, with a result within the acceptable range.
- NCR 19-13: The MAPEP February 2019 water Am-241 result was evaluated as Not Acceptable. The reported value was 0.764 ± 0.00725 Bq/L with a known result of 0.582 Bq/L (acceptable range 0.407 - 0.757 Bq/L). TBE’s result falls within the upper acceptable range with the error. It appeared that a non-radiological interference was added and lead to an increased mass and higher result.
- NCR 19-14: The MAPEP February 2019 vegetation Sr-90 result was evaluated as Not Acceptable. The reported result was -0.1060 ± 0.0328 Bq/kg and the known result was a false positive test (no significant activity). TBE’s result was correct in that there was no activity. MAPEP’s evaluation was a “statistical failure” at 3 standard deviations.
- NCR 19-23: The ERA October 2019 water Gross Alpha result was evaluated as Not Acceptable. TBE’s reported result was 40.5 ± 10.3 pCi/L and the known result was 27.6 pCi/L (ratio of TBE to known result at 135%). With the associated error, the result falls within the acceptable range (14.0 - 36.3 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 30.8 ± 9.17 pCi/L (within the acceptable range). This was the first failure for drinking water Gr-A since 2012.

- NCR 19-24: The ERA October 2019 water Sr-90 result was evaluated as Not Acceptable. TBE's reported result was 32.5 ± 2.12 pCi/L and the known result was 26.5 pCi/L (ratio of TBE to known result at 123%). With the associated error, the result falls within the acceptable range (19.2 - 30.9 pCi/L). The sample was run as the workgroup duplicate on a different detector with a result of 20.0 ± 1.91 pCi/L (within the acceptable range). Both TBE results are within internal QC limits. A substitute "quick response" sample was analyzed with an acceptable result of 18.6 pCi/L (known range of 13.2 - 22.1 pCi/L).
- NCR 19-25: The MAPEP August 2019 soil Ni-63 result of 436 ± 22.8 Bq/kg was evaluated as Not Acceptable. The known result was 629 Bq/kg (acceptable range 440 - 818 Bq/sample). With the associated error, the TBE result falls within the lower acceptance range. All associated QC was acceptable. No reason for failure could be found. This is the first failure for soil Ni-63 since 2012.
- NCR 19-26: The MAPEP August 2019 water Am-241 result was not reported and therefore evaluated as Not Acceptable. Initial review of the results showed a large peak where Am-241 should be (same as the February, 2019 sample results). It is believed that Th-228 was intentionally added as an interference. The sample was re-prepped and analyzed using a smaller sample aliquot. The unusual large peak (Th-228) was seen again and also this time a smaller peak (Am-241). The result was 436 ± 22.8 Bq/L (acceptable range 0.365 ± 0.679 Bq/L). Th-228 is not a typical nuclide requested by clients, so there is no analytical purpose to take samples through an additional separation step. TBE will pursue using another vendor for Am-241 water cross-checks that more closely reflects actual customer samples.
- NCR 19-27: The Analytics September 2019 soil Cr-51 sample was evaluated as Not Acceptable. TBE's reported result of 0.765 ± 0.135 pCi/g exceeded the upper acceptance range (140% of the known result of 0.547 pCi/g). The TBE result was within the acceptable range (0.63 - 0.90 pCi/g) with the associated error. The Cr-51 result is very close to TBE's normal detection limit. In order to get a reportable result, the sample must be counted for 15 hours (10x longer than client samples). There is no client or regulatory requirement for this nuclide and TBE will remove Cr-51 from the reported gamma nuclides going forward.

APPENDIX C
SYNOPSIS OF ANALYTICAL PROCEDURES

SYNOPSIS OF ANALYTICAL PROCEDURES

Appendix C is a synopsis of the analytical procedures performed during this reporting period on samples collected for the Nebraska Public Power Nuclear Plant's Radiological Environmental Monitoring Program. All analyses have been mutually agreed upon by Nebraska Public Power District and Teledyne Brown Engineering and include those recommended by the USNRC Branch Technical Position, Rev. 1, November 1979.

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GROSS BETA ANALYSIS OF AIR PARTICULATE SAMPLES

Air Particulates

After a delay of five or more days, allowing for the radon-222 and radon-220 (thoron) daughter products to decay, the filters are counted in a gas-flow proportional counter.

Calculations of the results, the two sigma error and the lower limit of detection (LLD):

$$\text{RESULT (pCi/m}^3\text{)} = ((S/T) - (B/t))/(2.22 \text{ V E})$$

$$\text{TWO SIGMA ERROR (pCi/m}^3\text{)} = 2((S/T)^2 + (B/t^2))^{1/2}/(2.22 \text{ V E})$$

$$\text{LLD (pCi/m}^3\text{)} = 4.66(B^{1/2})/(2.22 \text{ V E t})$$

where:

S	=	Gross counts of sample including blank
B	=	Counts of blank
E	=	Counting efficiency
T	=	Number of minutes sample was counted
t	=	Number of minutes blank was counted
V	=	Sample aliquot size (cubic meters)

DETERMINATION OF GROSS BETA ACTIVITY IN WATER SAMPLES

Introduction

The procedures described in this section are used to measure the overall radioactivity of water samples without identifying the radioactive species present. No chemical separation techniques are involved.

One liter of the sample is evaporated on a hot plate. A smaller volume may be used if the sample has a significant salt content as measured gravimetrically. If requested by the customer, the sample is filtered through No. 54 filter paper before evaporation, removing particles greater than 30 microns in size.

After evaporating to a small volume in a beaker, the sample is rinsed into a 2-inch diameter stainless steel planchette, which is stamped with a concentric ring pattern to distribute residue evenly. Final evaporation to dryness takes place under heat lamps.

Residue mass is determined by weighing the planchette before and after mounting the sample. The planchette is counted for beta activity on an automatic proportional counter. Results are calculated using empirical self-absorption curves which allow for the change in effective counting efficiency caused by the residue mass.

Detection Capability

Detection capability depends upon the sample volume actually represented on the planchette, the background and the efficiency of the counting instrument, and upon self-absorption of beta particles by the mounted sample. Because the radioactive species are not identified, no decay corrections are made and the reported activity refers to the counting time.

The minimum detectable level (MDL) for water samples is nominally 1.6 picoCuries per liter for gross beta at the 4.66 sigma level (1.0 pCi/L at the 2.83 sigma level), assuming that 1 liter of sample is used and that 0.5 gram of sample residue is mounted on the planchette. These figures are based upon a counting time of 50 minutes and upon representative values of counting efficiency and background of 0.2 and 1.2 cpm, respectively

The MDL becomes significantly lower as the mount weight decreases because of reduced self-absorption. At a zero mount weight, the 4.66 sigma MDL for gross beta is 0.9 pCi/L. These values reflect a beta counting efficiency of 0.38.

ANALYSIS OF SAMPLES FOR TRITIUM
(Liquid Scintillation)

Water

Ten milliliters of water are mixed with 10 ml of a liquid scintillation "cocktail" and then the mixture is counted in an automatic liquid scintillator.

Calculation of the results, the two sigma error and the lower limit detection (LLD) in pCi/L:

$$\text{RESULT} = (N-B)/(2.22 \text{ V E})$$

$$\text{TWO SIGMA ERROR} = 2((N + B)/\Delta t)^{1/2} / (2.22 \text{ V E})$$

$$\text{LLD} = 4.66(B/\Delta t)^{1/2} / (2.22 \text{ V E})$$

where:

N	=	the gross cpm of the sample
B	=	the background of the detector in cpm
2.22	=	conversion factor changing dpm to pCi
V	=	volume of the sample in ml
E	=	efficiency of the detector
Δt	=	counting time for the sample

ANALYSIS OF SAMPLES FOR IODINE-131

Milk or Water

Two or more liters of sample are first equilibrated with stable iodide carrier. A batch treatment with anion exchange resin is used to remove iodine from the sample. The iodine is then stripped from the resin with sodium hypochlorite solution, is reduced with hydroxylamine hydrochloride and is extracted into carbon tetrachloride as free iodine. It is then back-extracted as iodide into sodium bisulfite solution and is precipitated as palladium iodide. The precipitate is weighed for chemical yield and is mounted on a nylon planchette for low-level beta counting.

Calculations of results, two sigma error and the lower limit of detection (LLD) in pCi/L:

$$\begin{aligned}\text{RESULT} &= (N/\Delta t - B)/(2.22 E V Y DF) \\ \text{TWO SIGMA ERROR} &= 2((N/\Delta t + B)/\Delta t)^{1/2}/(2.22 E V Y DF) \\ \text{LLD} &= 4.66(B/\Delta t)^{1/2}/(2.22 E V Y DF)\end{aligned}$$

where:	N	=	total counts from sample (counts)
	Δt	=	counting time for sample (min)
	B	=	background rate of counter (cpm)
	2.22	=	dpm/pCi
	V	=	volume or weight of sample analyzed
	Y	=	chemical yield of the mount or sample counted
	DF	=	decay factor from the collection to the counting date
	E	=	efficiency of the counter for I-131, corrected for self absorption effects by the formula
	E	=	$E_s(\exp-0.0061M)/(\exp-0.0061M_s)$
	E_s	=	efficiency of the counter determined from an I-131 standard mount
	M_s	=	mass of PdI_2 on the standard mount, mg
	M	=	mass of PdI_2 on the sample mount, mg

GAMMA SPECTROMETRY OF SAMPLES

Milk or Water

A 1.0 or 4.0 liter Marinelli beaker is filled with a representative aliquot of the sample. The sample is then counted until detection limits are met with a shielded high purity germanium (HPGe) detector coupled to a VAX-based data acquisition system, which performs pulse height analysis.

Dried Solids other than Soils and Sediments

A large quantity of the sample is dried at a low temperature, less than 100°C. As much as possible (up to the total sample) is loaded into a tare, standard 240 cc container and weighed. The sample is then counted until detection limits are met with a shielded HPGe detector coupled to a VAX-based data acquisition system, which performs pulse height analysis.

Fish

As much as possible (up to the total sample) of the edible portion of the sample is loaded into a tared Marinelli and weighed. The sample is then counted until detection limits are met with a shielded HPGe detector coupled to a VAX-based data acquisition system, which performs pulse height analysis.

Soils and Sediments

Soils and sediments are dried at a low temperature, less than 100°C. The soil or sediment is loaded fully into a tared, standard 240 cc container and weighed. The sample is then counted until detection limits are met with a shielded HPGe detector coupled to a VAX-based data acquisition system, which performs pulse height and analysis.

Charcoal Cartridges (Air Iodine)

Charcoal cartridges are counted up to five at a time, with one positioned on the face of an HPGe detector and up to four on the side of the HPGe detector. Each HPGe detector is calibrated for both positions. The detection limit for iodine-131 of each charcoal cartridge can be determined (assuming no positive iodine-131) uniquely from the volume of air, which passed through it. In the event iodine-131 is observed in the initial counting of a set, each charcoal cartridge is then counted separately, positioned on the face of the detector.

Air Particulates

The thirteen airborne particulate filters for a quarterly composite for each field station are aligned one in front of another and then counted until detection limits are met with a shielded HPGe detector coupled to a VAX-based data acquisition system which performs pulse height analysis.

A VAX software program defines peaks by certain changes in the slope of the spectrum. The program also compares the energy of each peak with a library of peaks for isotope identification and then performs the radioactivity calculation using the appropriate fractional gamma ray abundance, half-life, detector efficiency, and net counts in the peak region.

The calculation of results, two sigma error and the lower limit of detection (LLD) in pCi/volume or pCi/mass:

$$\text{RESULT} = (S-B)/(2.22 \, t \, E \, V \, F \, DF)$$

$$\text{TWO SIGMA ERROR} = 2(S+B)^{1/2}/(2.22 \, t \, E \, V \, F \, DF)$$

$$\text{LLD} = 4.66(B)^{1/2}/(2.22 \, t \, E \, V \, F \, DF)$$

where:	S	=	Area, in counts, of sample peak and background (region of spectrum of interest)
	B	=	Background area, in counts, under sample peak, determined by a linear interpolation of the representative backgrounds on either side of the peak
	t	=	length of time in minutes the sample was counted
	2.22	=	dpm/pCi
	E	=	detector efficiency for energy of interest and geometry of sample
	V	=	sample aliquot size (liters, cubic meters, kilograms, or grams)
	F	=	fractional gamma abundance (specific for each emitted gamma)
	DF	=	decay factor from the mid-collection date to the counting date

ADDENDUM TO GAMMA SPECTROMETRY PROCEDURE

Ba-140 (half-life = ~12.8d) decays to La-140 (half-life ~40 hrs) and the daughter radionuclide, La-140 approaches ~ 90 % of the Ba-140 activity within ~ 6 days. The La-140 photon energy at 1596 keV is used to quantify the Ba-140 activity due to its high photon emission probability yield (96%) producing a higher count rate when present and therefore, a smaller associated counting error.

Zr-95 (half-life = ~65d) decays to Nb-95 (half-life = ~35d). The photon energy of Nb-95 (~765 keV) is used to quantify Zr-95 because of the high photon emission probability yield (~100%) yielding a higher count rate and an associated lower counting error. The daughter radionuclide, Nb-95 approaches the Zr-95 activity after a time period of ~65 days, an estimated time interval occurring between sample exposure, collection and shipping, and analysis.

ENVIRONMENTAL DOSIMETRY

Environmental Dosimetry services are provided by Mirion Technologies. Mirion Technologies uses a thermoluminescent dosimeter (TLD) manufactured by Panasonic, Inc. Panasonic identifies it as an UD-814A1 TLD. The TLD has four elements, numbered 1-4. Elements and their filtration are composed of:

ELEMENT	MATERIAL	FILTRATION
1	${}^n\text{Li}_2{}^n\text{B}_4\text{O}_7\text{-Cu}$	Thin plastic
2	$\text{CaSO}_4\text{-Tm}$	Lead
3	$\text{CaSO}_4\text{-Tm}$	Lead
4	$\text{CaSO}_4\text{-Tm}$	Lead

This material has a high light output, negligible thermally induced signal loss (fading) and negligible self-dosing. The energy response curve (as well as other features) satisfies NRC Regulatory Guide 4.13. Transit doses are accounted for by use of separate TLDs.

Prior to being sent to Cooper Nuclear Station, the Mirion badges are exposed to Cs-137, to a known dose and read in the Panasonic UD-710 reader, with reference badges to establish an element response level for each badge. Badges are then re-annealed for assignment and distribution to Cooper Nuclear Station.

Following the field exposure the badges are returned to Mirion Technologies for processing in a Panasonic UD-710 reader. Each element is heated and the measured light emission is recorded. The transit controls are read in the same manner. Total exposure for each badge is the average of Elements 2, 3, and 4.

Transit Controls are calculated using the following equation:

$$\text{TRANSDOSE} = \frac{(E3_1 + E4_1 + E3_2 + E4_2)}{4} - \frac{(E3_{\text{trans}} + E4_{\text{trans}})}{2}$$

LOWER LIMIT of DETECTION FORMULAS

The LLD formulas in Appendix C are consistent with the LLD discussion in the ODAM. The term s_b in the ODAM equals $\sqrt{B}/t$ by Poisson statistics, where B = blank counts and t = blank counting intervals. The decay factor term $e^{-\lambda \Delta t}$ in the ODAM is the same as the DF terms in Appendix C, but does not appear in certain analyses such as gross beta because decay does not apply. In the tritium analysis, decay is not considered because of the relatively long half-life.

Efficiencies and volumes are consistent between the two documents. Chemical yields appear in Appendix C where applicable but do not apply to other analyses such as tritium and gross beta.

APPENDIX D
DETECTION LIMITS AND REPORTING LEVELS

NEBRASKA PUBLIC POWER - COOPER NUCLEAR STATION
DETECTION LIMITS AND REPORTING LEVELS

Isotope	ODAM LLD	NRC Rept. Level
<u>Water - pCi/liter</u>		
Gross beta	4	N/A
H-3	2000	20000 ^(a) / 30000 ^(b)
Mn-54	15	1000
Fe-59	30	400
Co-58	15	1000
Co-60	15	300
Zn-65	30	300
Zr-95	30	400 - [Nb-95]
Nb-95	15	400 - [Zr-95]
I-131	1 ^(c)	2
Cs-134	15	30
Cs-137	18	50
Ba-140	60	200 - [La-140]
La-140	15	200 - [Ba-140]
<u>Air Filter - pCi/m³</u>		
Gross Beta	0.01	N/A
I-131	0.07	0.9
Cs-134	0.05	10
Cs-137	0.06	20
<u>Fish - pCi/kg-wet</u>		
Mn-54	130	30000
Fe-59	260	10000
Co-58	130	30000
Co-60	130	10000
Zn-65	260	20000
Cs-134	130	1000
Cs-137	150	2000
<u>Milk - pCi/liter</u>		
I-131	1	3
Cs-134	15	60
Cs-137	18	70
Ba-140	60	300 - [La-140]
La-140	15	300 - [Ba-140]

(a) For drinking water samples

(b) For samples of water not used as a source of drinking water

(c) LLD for drinking water

NEBRASKA PUBLIC POWER - COOPER NUCLEAR STATION
DETECTION LIMITS AND REPORTING LEVELS

Isotope	ODAM LLD	NRC Rept. Level
<u>Vegetation - pCi/kg-wet</u>		
I-131	60	100
Cs-134	60	1000
Cs-137	80	2000
<u>Sediment - pCi/kg-dry</u>		
Cs-134	150	N/A
Cs-137	180	N/A

APPENDIX E
REMP SAMPLING AND ANALYTICAL EXCEPTIONS

EXCEPTIONS

Appendix E contains the exceptions to the 2019 REMP Program. Where possible, causes of the deviation have been corrected to prevent recurrence.

Any deviations from the sampling schedule are documented on the data tables. Data Tables are in Section VII.

2019 REMP Exceptions Table

Condition Report Number (CR-CNS-)	Requirement	Analyses Impacted	Cause of Exception	Location Where Replacement Samples were Obtained
2019-02054, 2019-02693, 2019-03245, 2019-03829, 2019-04538, 2019-04728, 2019-05218, 2019-05746, 2019-05749, 2019-06252, 2020-00357	River Water from at least 2 locations at least once per 31 days (+25% grace).	Gamma Isotopic	Due to Missouri River flooding and impassable road conditions, it was not safe to collect sample from Station 28 within 31 days (+25% grace) of sample taken 3/11/2019. Samples could not be obtained from Station 28 for the remainder of 2019 calendar year.	On 11/19/19 and 12/3/19, replacement river water samples were collected downstream of plant at Indian Caves State Park boat ramp (~8 miles from CNS).
	Composite River Water grab samples for analysis at least once per 92 days (+25% grace).	Tritium	Because samples could not be safely collected from Station 28, Station 28 composite analysis was not able to be performed 2nd and 3rd Quarter 2019. 4th quarter composite analysis was performed but it utilized replacement samples obtained at Indian Caves State Park boat ramp in lieu of Station 28.	
2019-02054, 2019-02693, 2019-03245, 2019-03829, 2019-05218, 2019-05746, 2019-05749	River Water from at least 2 locations at least once per 31 days (+25% grace).	Gamma Isotopic	Due to Missouri River flooding, it was not safe to collect sample from Station 35 within 31 days (+25% grace) of sample taken 3/11/2019. Samples were able to be safely obtained on 7/23/19. It was not safe to collect sample from Station 35 within 31 days (+25% grace) of sample taken 9/5/2019. Samples were able to be safely obtained on 11/18/19.	None
	Composite River Water grab samples for analysis at least once per 92 days (+25% grace).	Tritium	Because samples could not be safely collected from Station 35, Station 35 composite analysis was not able to be performed 2nd Quarter 2019.	
2019-06135	Fish from at least 2 locations two times per year (Summer & Fall).	Gamma Isotopic	Due to Missouri River flooding preventing boating activities, it was not safe to conduct Fall sampling from Stations 28 or 35.	None
2019-02967, 2019-04848	Sediment from Shoreline from at least 1 location two times per year (Spring & Fall).	Gamma Isotopic	Due to Missouri River flooding, "Once in Spring" and "Once in Fall" sediment samples could not be safely collected from Station 28.	Replacement sample obtained in Fall (on 11/26/19) from Indian Caves State Park boat ramp.
2019-01684	Radioiodine and Particulate from at least 5 locations at least once per 7 days (+25% grace).	I-131, Gross Beta, Gamma Isotopic	Due to Missouri River flooding, samples were not able to be collected within 7 days (+25% grace) of samples taken on 3/12/19 (3/4/19 for Station 8). Samples were able to be safely collected on 3/26/19 from Stations 1, 2, 7, 8, 9 & 10 and required analysis was performed.	N/A
2019-04836	"Milk - Nearest Producers" from at least 1 location at least once per 15 days (+25% grace) during Peak Pasture Period.	Gamma Isotopic, I-131	Due to human error, milk sample from Station 99 was not collected within 15 days (+25% grace) of previous sample taken 8/6/19. Sample was obtained on 8/27/19. To address this, the following were performed: personal accountability, revised structure/formality of performing and second checking that REMP sampling requirements met, re-assigned REMP Program ownership role and increased REMP program oversight.	N/A
2019-05102, 2020-00250	Direct Radiation (TLDs) from at least 32 locations at least once per 92 days.	Gamma	Due to Missouri River flooding, samples were only able to be collected and analyzed from 15 of 32 ODAM TLD locations in 1st, 2nd and 3rd Quarter 2019. Due to Missouri River flooding, samples were only able to be collected and analyzed from 18 of 32 ODAM TLD locations in 4th Quarter 2019. To minimize future risk of not being able to collect sufficient TLDs to meet ODAM requirements, CNS added an additional 26 TLDs to the ODAM in 2020 (LBDCR 2020-018).	TLD replacement samples were obtained from 18 locations in 1st and 2nd Quarter, 20 locations in 3rd Quarter and 13 locations in 4th Quarter per Table B-3.
2019-02966, 2019-03596, 2019-04173, 2019-04680	"Milk - Other Producers" from at least 2 locations at least once per 92 days (+25% grace).	Gamma Isotopic, I-131	Due to no milk producers currently in production in the area (besides Station 99 already being used to meet the Nearest Producer requirement), it is not possible to collect milk samples to meet this requirement.	Broadleaf samples were able to be collected at Stations 35, 96 and 101 on 9/16/19, 10/30/19 and 11/6/19.

2019 REMP Exceptions Table (Continued)

Condition Report Number (CR-CNS-)	Requirement	Analyses Impacted	Cause of Exception	Location Where Replacement Samples were Obtained
2019-04960, 2019-04691	In September 2019, CNS self-identified that REMP analysis frequency requirements from 1984 to 2019 have not been met in all cases for Radioiodine (Iodine-131), Particulate Composite by Location (Gamma Isotopic), Direct Radiation (Gamma) and River Water Composite by Location (Tritium). Due to improper interpretation of a 1984 revision to CNS' ODAM, CNS did not recognize that this revision created analysis frequency requirements for 4 of the 9 sample types. For example, the 1984 revision requires that each radioiodine canister analysis date/time be no more than 7 days plus 25% grace (8.75 days) from analysis date/time of the previous radioiodine canister. From 1984 to 2019, CNS minimized the elapsed time between sample collection and offsite vendor analysis to the extent practical and ensured detection capabilities stated in ODAM Table D4.1-2 were achieved. Because CNS did not recognize that the additional analysis frequency requirement described above existed, CNS did not track elapsed time between the analysis dates/times. Additional information is available in CR-CNS-2019-04960. Each specific instance of an analysis frequency being exceeded (or unknown) since in 2019 is documented below. Specific instances between 1984 and 2018 were not determined, primarily due to lack of documentation regarding precise analysis date/time. To address this condition, the following were performed: REMP analysis frequency tracking mechanism established at CNS, established structure/formality at CNS for verification of analysis frequencies and revised contracts with offsite vendors to require analysis dates/times be documented and specific turnaround times met so that ODAM required analysis frequencies are not exceeded.			
2019-05748	Due to the analysis frequency condition described above, nine instances occurred in 2019 where the radioiodine (I-131) analysis maximum interval of 8.75 days was exceeded. No instances occurred after the interpretation error was realized. 1) Analysis was performed on 2/11/19 which was 10 days following previous analysis. 2) Analysis was performed on 2/26/19 which was 12 days following previous analysis. 3) Analysis was performed on 4/9/19 which was 11 days following previous analysis. 4) Analysis was performed on 4/28/19 which was 9 days following previous analysis. 5) Analysis was performed on 7/8/19 which was 11 days following previous analysis. 6) Analysis was performed on 7/22/19 which was 12 days following previous analysis. 7) Analysis was performed on 8/5/19 which was 10 days following previous analysis. 8) Analysis was performed on 8/19/19 which was 12 days following previous analysis. 9) Analysis was performed on 9/9/19 which was 10 days following previous analysis.			
2019-05763	Direct Radiation (TLD) analysis frequencies could not be determined because prior the analysis frequency condition being identified, Vendor's analysis documentation did not contain the date/time the TLD analysis was performed. (This condition was corrected per CR-CNS-2019-04960-CA-11.)			

APPENDIX F

SUMMARY OF DOSES TO A MEMBER OF THE PUBLIC OFFSITE

LIQUID EFFLUENT DOSE CALCULATIONS

Doses to the maximum individual and 0 to 50 - mile population resulting from the release of radioactive material in liquid effluents from Cooper Nuclear Station were calculated using the latest version of the LADTAP II computer program included as part of NRC Dose 2.3.20 (ORNL 2015). The LADTAP II program implements the radiological dose models of Regulatory Guide 1.109 for determining the radiation exposure to man from three principal exposure pathways in the aquatic environment -- potable water, aquatic foods, and recreational water use. Doses to both the maximum individual and 0 to 50 mile population are calculated as a function of age group and pathway for significant body organs, and are presented in Tables 1 - 6.

Assumptions and data sources used for input to the LADTAP II code are described in a separate section of this appendix (see page F-67).

TABLE 1. Doses to Maximum Individual at the Site Boundary, Resulting From Exposure to Radioactivity Discharged in Liquid Effluents, January-June 2019 Cooper Nuclear Station

Period and Pathway	Dose to Individual, mrem							
	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
<u>1st Quarter</u>								
Drinking Water		1.51 E-03	4.43 E-03	3.72 E-03	2.05 E-03	2.88 E-03	2.27 E-03	4.73 E-03
Shoreline	7.99 E-04	6.80 E-04	6.80 E-04	6.80 E-04	6.80 E-04	6.80 E-04	6.80 E-04	6.80 E-04
Totals	7.99 E-04	8.90 E-02	1.32 E-01	8.49 E-02	2.78 E-03	5.06 E-02	1.58 E-02	2.12 E-02
<u>2nd Quarter</u>								
Eating Fish		2.60 E-02	3.56 E-02	2.34 E-02	2.69 E-05	1.21 E-02	4.04 E-03	1.08 E-03
Drinking Water		4.52 E-04	1.67 E-03	1.47 E-03	1.04 E-03	1.25 E-03	1.11 E-03	1.29 E-03
Shoreline	1.07 E-04	9.10 E-05	9.10 E-05	9.10 E-05	9.10 E-05	9.10 E-05	9.10 E-05	9.10 E-05
Totals	1.07 E-04	2.65 E-02	3.74 E-02	2.49 E-02	1.16 E-03	1.34 E-02	5.24 E-03	2.46 E-03
Totals for 1st & 2nd Quarters	9.06 E-04	1.16 E-01	1.69 E-01	1.10 E-01	3.94 E-03	6.40 E-02	2.10 E-02	2.37 E-02

Calculated doses are based on the following periods of exposures: Fishing: April - November;
Drinking water and shoreline: January - December

TABLE 2. Doses to Maximum Individual at the Site Boundary, Resulting From Exposure to Radioactivity Discharged in Liquid Effluents, July-December 2019, Cooper Nuclear Station

Period and Pathway	Dose to Individual, mrem							
	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
<u>3rd Quarter</u>								
Eating Fish		1.79 E-02	2.46 E-02	1.61 E-02	2.74 E-05	8.36 E-03	2.80 E-03	7.71 E-04
Drinking Water		3.12 E-04	1.50 E-03	1.36 E-03	1.06 E-03	1.20 E-03	1.11 E-03	1.24 E-03
Shoreline	7.59 E-05	6.47 E-05	6.47 E-05	6.47 E-05	6.47 E-05	6.47 E-05	6.47 E-05	6.47 E-05
Totals	7.59 E-05	1.83 E-02	2.61 E-02	1.76 E-02	1.15 E-03	9.63 E-03	3.97 E-03	2.08 E-03
<u>4th Quarter</u>								
Eating Fish		2.49 E-02	3.42 E-02	2.24 E-02	3.56 E-04	1.16 E-02	3.88 E-03	1.19 E-03
Drinking Water		4.35 E-04	2.06 E-03	1.88 E-03	2.22 E-03	1.65 E-03	1.52 E-03	1.80 E-03
Shoreline	1.34 E-04	1.14 E-04	1.14 E-04	1.14 E-04	1.14 E-04	1.14 E-04	1.14 E-04	1.14 E-04
Totals	1.34 E-04	2.55 E-02	3.63 E-02	2.44 E-02	2.69 E-03	1.34 E-02	5.51 E-03	3.10 E-03
Totals for 3rd & 4th Quarters	2.10 E-04	4.38 E-02	6.24 E-02	4.20 E-02	3.84 E-03	2.30 E-02	9.48 E-03	5.18 E-03

Calculated doses are based on the following periods of exposures: Fishing: April - November; Drinking water and shoreline: January - December

TABLE 3. Summary of Doses to Maximum Individual at the Site Boundary, Resulting from Exposure to Radioactivity Discharged in Liquid Effluents, January-December 2019, Cooper Nuclear Station

Period and Pathway	Dose to Individual, mrem							
	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
1st <u>Quarter</u>	7.99 E-04	8.90 E-02	1.32 E-01	8.49 E-02	2.78 E-03	5.06 E-02	1.58 E-02	2.12 E-02
2nd <u>Quarter</u>	1.07 E-04	2.65 E-02	3.74 E-02	2.49 E-02	1.16 E-03	1.34 E-02	5.24 E-03	2.46 E-03
3rd <u>Quarter</u>	7.59 E-05	1.83 E-02	2.61 E-02	1.76 E-02	1.15 E-03	9.63 E-03	3.97 E-03	2.08 E-03
4th <u>Quarter</u>	1.34 E-04	2.55 E-02	3.63 E-02	2.44 E-02	2.69 E-03	1.34 E-02	5.51 E-03	3.10 E-03
Totals for 2019	1.12 E-03	1.59 E-01	2.32 E-01	1.52 E-01	7.78 E-03	8.70 E-02	3.05 E-02	2.88 E-02

TABLE 4. Doses to Population Within a 50-Mile Radius, Resulting From Exposure to Radioactivity Discharged in Liquid Effluents, January-June 2019, Cooper Nuclear Station

Period and Pathway	Dose to Population, manrem							
	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
<u>1st Quarter</u>								
Drinking Water		3.50 E-02	8.53 E-02	6.41 E-02	3.69 E-02	5.36 E-02	4.16 E-02	7.76 E-02
Shoreline	1.90 E-02	0.00 E+00	0.00 E+00	1.62 E-02	1.62 E-02	0.00 E+00	0.00 E+00	0.00 E+00
Totals	1.90 E-02	3.50 E-02	8.53 E-02	8.03 E-02	5.31 E-02	5.36 E-02	4.16 E-02	7.76 E-02
<u>2nd Quarter</u>								
Eating Fish		1.87 E-02	2.38 E-02	1.28 E-02	1.64 E-05	8.03 E-03	2.77 E-03	6.14 E-04
Drinking Water		6.81 E-03	2.05 E-02	1.63 E-02	1.21 E-02	1.48 E-02	1.30 E-02	1.46 E-02
Shoreline	1.64 E-03	0.00 E+00	0.00 E+00	1.40 E-03	1.40 E-03	0.00 E+00	0.00 E+00	0.00 E+00
Swimming	0.00 E+00	0.00 E+00	0.00 E+00	6.07 E-06	6.07 E-06	0.00 E+00	0.00 E+00	0.00 E+00
Boating	0.00 E+00	0.00 E+00	0.00 E+00	2.22 E-05	2.22 E-05	0.00 E+00	0.00 E+00	0.00 E+00
Totals	1.64 E-03	2.55 E-02	4.43 E-02	3.05 E-02	1.35 E-02	2.28 E-02	1.58 E-02	1.52 E-02
Totals for 1st & 2nd Quarters	2.06 E-02	6.05 E-02	1.30 E-01	1.11 E-01	6.66 E-02	7.64 E-02	5.74 E-02	9.28 E-02

Calculated doses are based on the following periods of exposures: Fishing and Boating: April - November; Drinking water and shoreline: January - December; Swimming: June - September. Exposure from drinking water is calculated for the city of St. Joseph, Missouri, nearest public water intake from the Missouri River, 84 miles downstream.

TABLE 5. Doses to Population Within a 50-Mile Radius, Resulting From Exposure to Radioactivity Discharged in Liquid Effluents, July-December 2019, Cooper Nuclear Station

Period and Pathway	Dose to Population, manrem							
	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-ILLI
<u>3rd Quarter</u>								
Eating Fish		1.76 E-02	2.24 E-02	1.20 E-02	2.28 E-05	7.57 E-03	2.61 E-03	5.97 E-04
Drinking Water		6.41 E-03	2.47 E-02	2.08 E-02	1.68 E-02	1.94 E-02	1.77 E-02	1.93 E-02
Shoreline	1.59 E-03	0.00 E+00	0.00 E+00	1.36 E-03	1.36 E-03	0.00 E+00	0.00 E+00	0.00 E+00
Swimming	0.00 E+00	0.00 E+00	0.00 E+00	5.94 E-06	5.94 E-06	0.00 E+00	0.00 E+00	0.00 E+00
Boating	0.00 E+00	0.00 E+00	0.00 E+00	2.17 E-05	2.17 E-05	0.00 E+00	0.00 E+00	0.00 E+00
Totals	1.59 E-03	2.40 E-02	4.71 E-02	3.42 E-02	1.82 E-02	2.70 E-02	2.03 E-02	1.99 E-02
<u>4th Quarter</u>								
Eating Fish		3.15 E-02	4.02 E-02	2.16 E-02	1.34 E-04	1.36 E-02	4.68 E-03	1.19 E-03
Drinking Water		1.15 E-02	4.40 E-02	3.72 E-02	4.55 E-02	3.44 E-02	3.13 E-02	3.58 E-02
Shoreline	3.63 E-03	0.00 E+00	0.00 E+00	3.09 E-03	3.09 E-03	0.00 E+00	0.00 E+00	0.00 E+00
Boating	0.00 E+00	0.00 E+00	0.00 E+00	5.24 E-05	5.24 E-05	0.00 E+00	0.00 E+00	0.00 E+00
Totals	3.63 E-03	4.30 E-02	8.42 E-02	6.19 E-02	4.88 E-02	4.80 E-02	3.60 E-02	3.70 E-02
Totals for 3rd & 4th Quarters	5.22 E-03	6.70 E-02	1.31 E-01	9.61 E-02	6.70 E-02	7.50 E-02	5.63 E-02	5.69 E-02

Calculated doses are based on the following periods of exposures: Fishing and Boating: April - November; Drinking water and shoreline: January - December; Swimming: June - September. Exposure from drinking water is calculated for the city of St. Joseph, Missouri, nearest public water intake from the Missouri River, 84 miles downstream.

TABLE 6. Summary of Doses to Population Within a 50-Mile Radius, Resulting from Exposure to Radioactivity Discharged in Liquid Effluents, January-December 2019 Cooper Nuclear Station

Period and Pathway	Dose to Population, manrem							
	Skin	Bone	Liver	Total Body	Thyroid	Kidney	Lung	GI-LLI
1st <u>Quarter</u>	1.90 E-02	3.50 E-02	8.53 E-02	8.03 E-02	5.31 E-02	5.36 E-02	4.16 E-02	7.76 E-02
2nd <u>Quarter</u>	1.64 E-03	2.55 E-02	4.43 E-02	3.05 E-02	1.35 E-02	2.28 E-02	1.58 E-02	1.52 E-02
3rd <u>Quarter</u>	1.59 E-03	2.40 E-02	4.71 E-02	3.42 E-02	1.82 E-02	2.70 E-02	2.03 E-02	1.99 E-02
4th <u>Quarter</u>	3.63 E-03	4.30 E-02	8.42 E-02	6.19 E-02	4.88 E-02	4.80 E-02	3.60 E-02	3.70 E-02
Totals for 2019	2.59 E-02	1.28 E-01	2.61 E-01	2.07 E-01	1.34 E-01	1.51 E-01	1.14 E-01	1.50 E-01

GASEOUS EFFLUENT DOSE CALCULATIONS (EXCEPT CARBON-14)

Doses to the maximum individual and 0 to 50 mile population resulting from the release of radioactive material in gaseous effluents from the Cooper Nuclear Station were calculated using the latest version of the GASPAR computer code included as part of NRC Dose 2.3.20 (ORNL 2015). Four sites were selected for individual dose calculations: the site boundary, the nearest residence, the nearest garden and the nearest cow. GASPAR implements the radiological dose models of Regulatory Guide 1.109 for determining the radiation exposure to man from four principal atmospheric exposure pathways: plume, ground, inhalation, and ingestion. Doses to the maximum individual and the population are calculated as a function of age group and pathway for significant body organs.

Tables 1 through 7 present maximum individual doses. Population doses are given in Tables 8 through 14.

Assumptions and data used for input to the GASPAR code are described in a separate section of this appendix (see page F-67).

TABLE 1. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-MARCH 2019

SPECIAL LOCATION NO. 1A Site Boundary
AT .67 MILES N

ANNUAL BETA AIR DOSE = 2.58E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.06E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.36E-05	1.36E-05	1.36E-05	1.36E-05	1.36E-05	1.36E-05	1.39E-05	3.56E-05
GROUND	8.97E-05	8.97E-05	8.97E-05	8.97E-05	8.97E-05	8.97E-05	8.97E-05	1.06E-04
VEGET								
ADULT	1.85E-06	1.16E-05	6.34E-07	1.41E-06	4.20E-07	3.52E-05	7.56E-08	0.00E+00
TEEN	2.58E-06	1.24E-05	1.03E-06	2.20E-06	6.54E-07	4.72E-05	1.42E-07	0.00E+00
CHILD	4.70E-06	8.11E-06	2.46E-06	3.60E-06	1.06E-06	9.04E-05	2.16E-07	0.00E+00
MEAT								
ADULT	4.00E-07	3.10E-06	4.32E-08	2.22E-07	2.36E-08	9.35E-07	6.18E-09	0.00E+00
TEEN	3.04E-07	1.67E-06	3.59E-08	1.74E-07	1.91E-08	6.77E-07	5.85E-09	0.00E+00
CHILD	4.58E-07	8.41E-07	6.62E-08	2.13E-07	2.42E-08	1.02E-06	6.87E-09	0.00E+00
COW MILK								
ADULT	4.30E-07	7.15E-07	4.01E-07	5.85E-07	3.04E-07	2.68E-05	5.23E-08	0.00E+00
TEEN	5.01E-07	8.46E-07	7.27E-07	1.03E-06	5.40E-07	4.25E-05	1.08E-07	0.00E+00
CHILD	6.35E-07	5.66E-07	1.75E-06	1.78E-06	8.98E-07	8.46E-05	1.66E-07	0.00E+00
INFANT	9.31E-07	5.01E-07	2.93E-06	3.61E-06	1.50E-06	2.06E-04	3.00E-07	0.00E+00
GOATMILK								
ADULT	9.77E-07	1.41E-07	1.09E-06	1.50E-06	6.48E-07	3.22E-05	1.57E-07	0.00E+00
TEEN	9.65E-07	1.76E-07	1.98E-06	2.64E-06	1.15E-06	5.10E-05	3.24E-07	0.00E+00
CHILD	8.37E-07	1.27E-07	4.77E-06	4.58E-06	1.91E-06	1.02E-04	4.98E-07	0.00E+00
INFANT	9.77E-07	1.19E-07	7.78E-06	9.10E-06	3.14E-06	2.47E-04	9.01E-07	0.00E+00
INHAL								
ADULT	3.97E-08	3.75E-07	2.89E-08	5.79E-08	5.36E-08	5.56E-06	7.45E-06	0.00E+00
TEEN	4.67E-08	3.45E-07	4.06E-08	7.87E-08	7.41E-08	7.19E-06	1.09E-05	0.00E+00
CHILD	4.78E-08	1.32E-07	5.52E-08	7.51E-08	6.95E-08	8.78E-06	8.82E-06	0.00E+00
INFANT	2.77E-08	4.47E-08	3.96E-08	6.08E-08	4.56E-08	8.07E-06	5.63E-06	0.00E+00

TABLE 1. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-MARCH 2019 (Continued)

SPECIAL LOCATION NO. 2A Site Boundary
AT .54 MILES ESE

ANNUAL BETA AIR DOSE = 2.63E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.55E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.69E-05	1.69E-05	1.69E-05	1.69E-05	1.69E-05	1.69E-05	1.72E-05	4.04E-05
GROUND	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.10E-04	1.29E-04
VEGET								
ADULT	2.29E-06	1.43E-05	9.07E-07	1.76E-06	5.51E-07	4.90E-05	9.41E-08	0.00E+00
TEEN	3.19E-06	1.53E-05	1.48E-06	2.74E-06	8.55E-07	6.57E-05	1.76E-07	0.00E+00
CHILD	5.81E-06	1.00E-05	3.53E-06	4.49E-06	1.39E-06	1.26E-04	2.68E-07	0.00E+00
MEAT								
ADULT	4.92E-07	3.80E-06	5.60E-08	2.74E-07	3.00E-08	1.30E-06	7.69E-09	0.00E+00
TEEN	3.74E-07	2.04E-06	4.65E-08	2.15E-07	2.44E-08	9.44E-07	7.27E-09	0.00E+00
CHILD	5.61E-07	1.03E-06	8.58E-08	2.63E-07	3.09E-08	1.42E-06	8.55E-09	0.00E+00
COW MILK								
ADULT	5.41E-07	8.83E-07	5.12E-07	7.40E-07	4.00E-07	3.73E-05	6.51E-08	0.00E+00
TEEN	6.33E-07	1.05E-06	9.28E-07	1.30E-06	7.10E-07	5.91E-05	1.34E-07	0.00E+00
CHILD	8.08E-07	7.02E-07	2.24E-06	2.25E-06	1.18E-06	1.18E-04	2.07E-07	0.00E+00
INFANT	1.19E-06	6.22E-07	3.77E-06	4.58E-06	1.98E-06	2.86E-04	3.74E-07	0.00E+00
GOATMILK								
ADULT	1.22E-06	1.80E-07	1.38E-06	1.88E-06	8.32E-07	4.48E-05	1.95E-07	0.00E+00
TEEN	1.21E-06	2.25E-07	2.50E-06	3.31E-06	1.47E-06	7.10E-05	4.03E-07	0.00E+00
CHILD	1.07E-06	1.64E-07	6.02E-06	5.74E-06	2.45E-06	1.41E-04	6.20E-07	0.00E+00
INFANT	1.27E-06	1.53E-07	9.84E-06	1.14E-05	4.04E-06	3.43E-04	1.12E-06	0.00E+00
INHAL								
ADULT	3.18E-08	3.01E-07	2.32E-08	4.64E-08	4.30E-08	4.47E-06	5.96E-06	0.00E+00
TEEN	3.74E-08	2.78E-07	3.27E-08	6.31E-08	5.95E-08	5.78E-06	8.71E-06	0.00E+00
CHILD	3.83E-08	1.11E-07	4.43E-08	6.02E-08	5.58E-08	7.05E-06	7.06E-06	0.00E+00
INFANT	2.22E-08	4.05E-08	3.19E-08	4.88E-08	3.66E-08	6.49E-06	4.51E-06	0.00E+00

TABLE 1. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-MARCH 2019 (Continued)

SPECIAL LOCATION NO. 3A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 1.95E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 3.05E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.05E-04	2.05E-04	2.05E-04	2.05E-04	2.05E-04	2.05E-04	2.07E-04	4.08E-04
GROUND	5.23E-05	5.23E-05	5.23E-05	5.23E-05	5.23E-05	5.23E-05	5.23E-05	6.16E-05
VEGET								
ADULT	1.31E-06	7.65E-06	1.71E-06	1.13E-06	6.06E-07	8.06E-05	5.85E-08	0.00E+00
TEEN	1.79E-06	8.24E-06	2.79E-06	1.76E-06	9.30E-07	1.08E-04	1.10E-07	0.00E+00
CHILD	3.21E-06	5.52E-06	6.71E-06	2.91E-06	1.50E-06	2.07E-04	1.67E-07	0.00E+00
MEAT								
ADULT	2.43E-07	1.83E-06	5.63E-08	1.44E-07	2.56E-08	2.15E-06	4.77E-09	0.00E+00
TEEN	1.83E-07	9.85E-07	4.68E-08	1.14E-07	2.08E-08	1.56E-06	4.51E-09	0.00E+00
CHILD	2.72E-07	4.99E-07	8.66E-08	1.40E-07	2.64E-08	2.35E-06	5.30E-09	0.00E+00
COW MILK								
ADULT	3.89E-07	4.90E-07	4.45E-07	5.71E-07	4.52E-07	6.11E-05	4.03E-08	0.00E+00
TEEN	4.82E-07	5.92E-07	8.07E-07	1.01E-06	8.04E-07	9.67E-05	8.32E-08	0.00E+00
CHILD	6.64E-07	4.10E-07	1.95E-06	1.74E-06	1.34E-06	1.92E-04	1.28E-07	0.00E+00
INFANT	1.06E-06	3.72E-07	3.49E-06	3.70E-06	2.28E-06	4.67E-04	2.32E-07	0.00E+00
GOATMILK								
ADULT	8.38E-07	1.54E-07	1.02E-06	1.30E-06	7.60E-07	7.33E-05	1.21E-07	0.00E+00
TEEN	8.87E-07	2.00E-07	1.86E-06	2.30E-06	1.35E-06	1.16E-04	2.50E-07	0.00E+00
CHILD	9.12E-07	1.53E-07	4.50E-06	4.00E-06	2.24E-06	2.31E-04	3.84E-07	0.00E+00
INFANT	1.26E-06	1.48E-07	7.64E-06	8.16E-06	3.76E-06	5.60E-04	6.94E-07	0.00E+00
INHAL								
ADULT	1.42E-08	1.88E-07	1.40E-08	2.25E-08	2.44E-08	2.71E-06	2.31E-06	0.00E+00
TEEN	1.70E-08	2.14E-07	1.98E-08	3.07E-08	3.37E-08	3.49E-06	3.38E-06	0.00E+00
CHILD	1.76E-08	2.58E-07	2.68E-08	2.95E-08	3.16E-08	4.22E-06	2.75E-06	0.00E+00
INFANT	1.06E-08	1.79E-07	1.97E-08	2.46E-08	2.08E-08	3.88E-06	1.79E-06	0.00E+00

TABLE 1. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-MARCH 2019 (Continued)

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 6.20E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 9.86E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.61E-05	6.61E-05	6.61E-05	6.61E-05	6.61E-05	6.61E-05	6.67E-05	1.31E-04
GROUND	1.37E-06	1.37E-06	1.37E-06	1.37E-06	1.37E-06	1.37E-06	1.37E-06	1.61E-06
VEGET								
ADULT	3.57E-08	2.06E-07	5.37E-08	3.16E-08	1.82E-08	2.50E-06	1.63E-09	0.00E+00
TEEN	4.87E-08	2.22E-07	8.75E-08	4.92E-08	2.79E-08	3.37E-06	3.05E-09	0.00E+00
CHILD	8.71E-08	1.50E-07	2.11E-07	8.14E-08	4.52E-08	6.45E-06	4.63E-09	0.00E+00
MEAT								
ADULT	6.42E-09	4.79E-08	1.68E-09	3.87E-09	7.49E-10	6.69E-08	1.32E-10	0.00E+00
TEEN	4.81E-09	2.58E-08	1.40E-09	3.05E-09	6.09E-10	4.85E-08	1.25E-10	0.00E+00
CHILD	7.14E-09	1.31E-08	2.59E-09	3.78E-09	7.73E-10	7.32E-08	1.47E-10	0.00E+00
COW MILK								
ADULT	1.11E-08	1.33E-08	1.30E-08	1.64E-08	1.36E-08	1.90E-06	1.12E-09	0.00E+00
TEEN	1.38E-08	1.61E-08	2.37E-08	2.90E-08	2.42E-08	3.00E-06	2.31E-09	0.00E+00
CHILD	1.93E-08	1.12E-08	5.73E-08	5.02E-08	4.03E-08	5.96E-06	3.55E-09	0.00E+00
INFANT	3.11E-08	1.03E-08	1.03E-07	1.07E-07	6.88E-08	1.45E-05	6.43E-09	0.00E+00
GOATMILK								
ADULT	2.37E-08	4.50E-09	2.94E-08	3.70E-08	2.24E-08	2.27E-06	3.35E-09	0.00E+00
TEEN	2.53E-08	5.87E-09	5.33E-08	6.53E-08	3.98E-08	3.60E-06	6.93E-09	0.00E+00
CHILD	2.66E-08	4.52E-09	1.29E-07	1.13E-07	6.61E-08	7.15E-06	1.07E-08	0.00E+00
INFANT	3.75E-08	4.39E-09	2.20E-07	2.32E-07	1.11E-07	1.74E-05	1.93E-08	0.00E+00
INHAL								
ADULT	1.67E-09	3.32E-08	2.40E-09	2.99E-09	3.91E-09	4.65E-07	1.96E-07	0.00E+00
TEEN	2.04E-09	4.38E-08	3.38E-09	4.09E-09	5.41E-09	5.96E-07	2.91E-07	0.00E+00
CHILD	2.14E-09	7.35E-08	4.59E-09	3.97E-09	5.07E-09	7.15E-07	2.38E-07	0.00E+00
INFANT	1.38E-09	5.46E-08	3.43E-09	3.46E-09	3.34E-09	6.57E-07	1.62E-07	0.00E+00

TABLE 1. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-MARCH 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 2.51E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 4.00E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.68E-04	2.68E-04	2.68E-04	2.68E-04	2.68E-04	2.68E-04	2.71E-04	5.32E-04
GROUND	7.60E-06	7.60E-06	7.60E-06	7.60E-06	7.60E-06	7.60E-06	7.60E-06	8.94E-06
VEGET								
ADULT	2.28E-07	1.25E-06	4.69E-07	2.15E-07	1.47E-07	2.16E-05	1.09E-08	0.00E+00
TEEN	3.07E-07	1.36E-06	7.65E-07	3.34E-07	2.25E-07	2.90E-05	2.04E-08	0.00E+00
CHILD	5.44E-07	9.32E-07	1.84E-06	5.56E-07	3.64E-07	5.56E-05	3.10E-08	0.00E+00
MEAT								
ADULT	3.69E-08	2.69E-07	1.33E-08	2.34E-08	5.68E-09	5.77E-07	8.84E-10	0.00E+00
TEEN	2.74E-08	1.45E-07	1.11E-08	1.85E-08	4.62E-09	4.18E-07	8.37E-10	0.00E+00
CHILD	4.03E-08	7.39E-08	2.05E-08	2.30E-08	5.86E-09	6.31E-07	9.83E-10	0.00E+00
COW MILK								
ADULT	7.92E-08	8.30E-08	9.92E-08	1.21E-07	1.11E-07	1.63E-05	7.46E-09	0.00E+00
TEEN	1.01E-07	1.02E-07	1.80E-07	2.13E-07	1.97E-07	2.59E-05	1.54E-08	0.00E+00
CHILD	1.45E-07	7.27E-08	4.37E-07	3.69E-07	3.28E-07	5.14E-05	2.37E-08	0.00E+00
INFANT	2.39E-07	6.72E-08	7.98E-07	8.01E-07	5.61E-07	1.25E-04	4.29E-08	0.00E+00
GOATMILK								
ADULT	1.66E-07	3.42E-08	2.13E-07	2.60E-07	1.73E-07	1.96E-05	2.24E-08	0.00E+00
TEEN	1.82E-07	4.50E-08	3.86E-07	4.60E-07	3.08E-07	3.11E-05	4.62E-08	0.00E+00
CHILD	2.02E-07	3.52E-08	9.35E-07	7.98E-07	5.12E-07	6.16E-05	7.11E-08	0.00E+00
INFANT	2.97E-07	3.45E-08	1.62E-06	1.65E-06	8.64E-07	1.50E-04	1.29E-07	0.00E+00
INHAL								
ADULT	4.87E-09	1.15E-07	8.25E-09	9.28E-09	1.32E-08	1.60E-06	4.45E-07	0.00E+00
TEEN	6.00E-09	1.58E-07	1.16E-08	1.27E-08	1.82E-08	2.05E-06	6.66E-07	0.00E+00
CHILD	6.38E-09	2.85E-07	1.58E-08	1.24E-08	1.71E-08	2.45E-06	5.48E-07	0.00E+00
INFANT	4.23E-09	2.14E-07	1.19E-08	1.10E-08	1.13E-08	2.25E-06	3.90E-07	0.00E+00

TABLE 2. DOSES TO MAXIMUM INDIVIDUAL (MREM), APRIL-JUNE 2019

SPECIAL LOCATION NO. 1A Site Boundary
AT .60 MILES NNE

ANNUAL BETA AIR DOSE = 3.14E-07 MILLRADS
ANNUAL GAMMA AIR DOSE = 6.47E-07 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	4.33E-07	4.33E-07	4.33E-07	4.33E-07	4.33E-07	4.33E-07	4.36E-07	7.74E-07
GROUND	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	4.87E-04	5.73E-04
VEGET								
ADULT	1.34E-05	6.11E-05	7.08E-06	1.29E-05	3.53E-06	5.54E-05	1.06E-06	0.00E+00
TEEN	1.66E-05	6.51E-05	1.16E-05	2.04E-05	5.62E-06	7.39E-05	1.99E-06	0.00E+00
CHILD	2.66E-05	4.26E-05	2.77E-05	3.41E-05	9.20E-06	1.42E-04	3.02E-06	0.00E+00
MEAT								
ADULT	2.42E-06	1.63E-05	5.65E-07	1.64E-06	2.69E-07	1.45E-06	8.66E-08	0.00E+00
TEEN	1.74E-06	8.79E-06	4.69E-07	1.30E-06	2.18E-07	1.05E-06	8.20E-08	0.00E+00
CHILD	2.48E-06	4.44E-06	8.64E-07	1.63E-06	2.76E-07	1.59E-06	9.63E-08	0.00E+00
COW MILK								
ADULT	4.75E-06	3.74E-06	4.85E-06	6.83E-06	2.45E-06	4.31E-05	7.33E-07	0.00E+00
TEEN	4.84E-06	4.42E-06	8.80E-06	1.20E-05	4.34E-06	6.85E-05	1.51E-06	0.00E+00
CHILD	4.64E-06	2.95E-06	2.12E-05	2.08E-05	7.20E-06	1.37E-04	2.33E-06	0.00E+00
INFANT	5.61E-06	2.61E-06	3.40E-05	4.09E-05	1.17E-05	3.33E-04	4.21E-06	0.00E+00
GOATMILK								
ADULT	1.29E-05	8.67E-07	1.44E-05	1.97E-05	6.91E-06	5.17E-05	2.20E-06	0.00E+00
TEEN	1.22E-05	1.08E-06	2.61E-05	3.47E-05	1.22E-05	8.21E-05	4.54E-06	0.00E+00
CHILD	9.26E-06	7.78E-07	6.28E-05	6.02E-05	2.03E-05	1.65E-04	6.98E-06	0.00E+00
INFANT	9.08E-06	7.29E-07	1.00E-04	1.18E-04	3.27E-05	4.00E-04	1.26E-05	0.00E+00
INHAL								
ADULT	1.46E-07	1.03E-06	1.12E-07	1.97E-07	1.07E-07	6.65E-06	2.11E-05	0.00E+00
TEEN	1.46E-07	9.43E-07	1.57E-07	2.67E-07	1.48E-07	8.75E-06	3.09E-05	0.00E+00
CHILD	1.25E-07	3.63E-07	2.13E-07	2.55E-07	1.38E-07	1.10E-05	2.50E-05	0.00E+00
INFANT	6.56E-08	1.27E-07	1.37E-07	1.93E-07	8.87E-08	1.01E-05	1.60E-05	0.00E+00

TABLE 2. DOSES TO MAXIMUM INDIVIDUAL (MREM), APRIL-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 2A Site Boundary
AT .54 MILES ESE

ANNUAL BETA AIR DOSE = 5.30E-08 MILLRADS
ANNUAL GAMMA AIR DOSE = 1.09E-07 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.30E-08	7.35E-08	1.31E-07
GROUND	2.44E-04	2.44E-04	2.44E-04	2.44E-04	2.44E-04	2.44E-04	2.44E-04	2.87E-04
VEGET								
ADULT	6.69E-06	3.06E-05	3.52E-06	6.46E-06	1.76E-06	2.59E-05	5.30E-07	0.00E+00
TEEN	8.27E-06	3.26E-05	5.77E-06	1.02E-05	2.80E-06	3.46E-05	9.93E-07	0.00E+00
CHILD	1.33E-05	2.13E-05	1.38E-05	1.71E-05	4.58E-06	6.62E-05	1.51E-06	0.00E+00
MEAT								
ADULT	1.21E-06	8.17E-06	2.82E-07	8.21E-07	1.34E-07	6.79E-07	4.33E-08	0.00E+00
TEEN	8.68E-07	4.40E-06	2.34E-07	6.50E-07	1.09E-07	4.92E-07	4.10E-08	0.00E+00
CHILD	1.24E-06	2.22E-06	4.32E-07	8.14E-07	1.38E-07	7.43E-07	4.82E-08	0.00E+00
COW MILK								
ADULT	2.37E-06	1.87E-06	2.42E-06	3.41E-06	1.22E-06	2.02E-05	3.67E-07	0.00E+00
TEEN	2.42E-06	2.21E-06	4.39E-06	6.01E-06	2.16E-06	3.21E-05	7.57E-07	0.00E+00
CHILD	2.31E-06	1.47E-06	1.06E-05	1.04E-05	3.58E-06	6.44E-05	1.16E-06	0.00E+00
INFANT	2.79E-06	1.30E-06	1.70E-05	2.04E-05	5.80E-06	1.56E-04	2.11E-06	0.00E+00
GOATMILK								
ADULT	6.45E-06	4.32E-07	7.18E-06	9.84E-06	3.45E-06	2.42E-05	1.10E-06	0.00E+00
TEEN	6.10E-06	5.37E-07	1.30E-05	1.73E-05	6.10E-06	3.85E-05	2.27E-06	0.00E+00
CHILD	4.62E-06	3.87E-07	3.14E-05	3.01E-05	1.01E-05	7.73E-05	3.49E-06	0.00E+00
INFANT	4.52E-06	3.62E-07	5.02E-05	5.88E-05	1.63E-05	1.88E-04	6.32E-06	0.00E+00
INHAL								
ADULT	1.25E-07	8.86E-07	9.63E-08	1.69E-07	9.24E-08	5.72E-06	1.82E-05	0.00E+00
TEEN	1.26E-07	8.10E-07	1.35E-07	2.30E-07	1.27E-07	7.52E-06	2.65E-05	0.00E+00
CHILD	1.08E-07	3.05E-07	1.83E-07	2.19E-07	1.19E-07	9.44E-06	2.15E-05	0.00E+00
INFANT	5.64E-08	1.03E-07	1.18E-07	1.66E-07	7.63E-08	8.70E-06	1.37E-05	0.00E+00

TABLE 2. DOSES TO MAXIMUM INDIVIDUAL (MREM), APRIL-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 3A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 1.34E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.77E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.85E-05	1.85E-05	1.85E-05	1.85E-05	1.85E-05	1.85E-05	1.87E-05	3.32E-05
GROUND	1.51E-04	1.51E-04	1.51E-04	1.51E-04	1.51E-04	1.51E-04	1.51E-04	1.78E-04
VEGET								
ADULT	4.25E-06	1.91E-05	2.76E-06	4.16E-06	1.34E-06	6.37E-05	3.29E-07	0.00E+00
TEEN	5.27E-06	2.04E-05	4.53E-06	6.56E-06	2.12E-06	8.55E-05	6.17E-07	0.00E+00
CHILD	8.50E-06	1.33E-05	1.08E-05	1.10E-05	3.45E-06	1.64E-04	9.38E-07	0.00E+00
MEAT								
ADULT	7.54E-07	5.07E-06	1.83E-07	5.14E-07	8.99E-08	1.69E-06	2.69E-08	0.00E+00
TEEN	5.41E-07	2.73E-06	1.52E-07	4.06E-07	7.29E-08	1.23E-06	2.54E-08	0.00E+00
CHILD	7.74E-07	1.38E-06	2.80E-07	5.10E-07	9.24E-08	1.85E-06	2.99E-08	0.00E+00
COW MILK								
ADULT	1.54E-06	1.20E-06	1.60E-06	2.23E-06	9.50E-07	4.85E-05	2.27E-07	0.00E+00
TEEN	1.61E-06	1.42E-06	2.91E-06	3.93E-06	1.68E-06	7.69E-05	4.70E-07	0.00E+00
CHILD	1.63E-06	9.57E-07	7.01E-06	6.80E-06	2.80E-06	1.53E-04	7.23E-07	0.00E+00
INFANT	2.11E-06	8.50E-07	1.15E-05	1.35E-05	4.60E-06	3.72E-04	1.31E-06	0.00E+00
GOATMILK								
ADULT	4.08E-06	3.16E-07	4.60E-06	6.24E-06	2.37E-06	5.82E-05	6.82E-07	0.00E+00
TEEN	3.92E-06	3.98E-07	8.34E-06	1.10E-05	4.20E-06	9.23E-05	1.41E-06	0.00E+00
CHILD	3.11E-06	2.93E-07	2.01E-05	1.91E-05	6.97E-06	1.84E-04	2.17E-06	0.00E+00
INFANT	3.26E-06	2.77E-07	3.24E-05	3.75E-05	1.13E-05	4.46E-04	3.92E-06	0.00E+00
INHAL								
ADULT	3.28E-08	2.31E-07	2.69E-08	4.63E-08	2.99E-08	2.22E-06	4.47E-06	0.00E+00
TEEN	3.37E-08	2.55E-07	3.78E-08	6.29E-08	4.12E-08	2.89E-06	6.54E-06	0.00E+00
CHILD	2.97E-08	5.06E-07	5.12E-08	6.02E-08	3.86E-08	3.56E-06	5.30E-06	0.00E+00
INFANT	1.62E-08	4.04E-07	3.39E-08	4.66E-08	2.49E-08	3.28E-06	3.40E-06	0.00E+00

TABLE 2. DOSES TO MAXIMUM INDIVIDUAL (MREM), APRIL-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 4.89E-06 MILLRADS
ANNUAL GAMMA AIR DOSE = 1.01E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.79E-06	1.21E-05
GROUND	5.97E-06	5.97E-06	5.97E-06	5.97E-06	5.97E-06	5.97E-06	5.97E-06	7.02E-06
VEGET								
ADULT	1.68E-07	7.54E-07	1.10E-07	1.64E-07	5.36E-08	2.64E-06	1.30E-08	0.00E+00
TEEN	2.08E-07	8.04E-07	1.81E-07	2.59E-07	8.45E-08	3.54E-06	2.43E-08	0.00E+00
CHILD	3.36E-07	5.26E-07	4.33E-07	4.33E-07	1.38E-07	6.78E-06	3.70E-08	0.00E+00
MEAT								
ADULT	2.97E-08	2.00E-07	7.23E-09	2.03E-08	3.56E-09	7.02E-08	1.06E-09	0.00E+00
TEEN	2.13E-08	1.08E-07	6.00E-09	1.60E-08	2.89E-09	5.08E-08	1.00E-09	0.00E+00
CHILD	3.05E-08	5.44E-08	1.11E-08	2.01E-08	3.66E-09	7.67E-08	1.18E-09	0.00E+00
COW MILK								
ADULT	6.08E-08	4.74E-08	6.35E-08	8.83E-08	3.80E-08	2.01E-06	8.97E-09	0.00E+00
TEEN	6.37E-08	5.63E-08	1.15E-07	1.56E-07	6.73E-08	3.18E-06	1.85E-08	0.00E+00
CHILD	6.50E-08	3.78E-08	2.78E-07	2.69E-07	1.12E-07	6.33E-06	2.85E-08	0.00E+00
INFANT	8.41E-08	3.36E-08	4.54E-07	5.36E-07	1.84E-07	1.54E-05	5.16E-08	0.00E+00
GOATMILK								
ADULT	1.61E-07	1.26E-08	1.82E-07	2.47E-07	9.42E-08	2.41E-06	2.69E-08	0.00E+00
TEEN	1.55E-07	1.59E-08	3.30E-07	4.35E-07	1.67E-07	3.82E-06	5.56E-08	0.00E+00
CHILD	1.23E-07	1.17E-08	7.94E-07	7.54E-07	2.77E-07	7.60E-06	8.55E-08	0.00E+00
INFANT	1.30E-07	1.11E-08	1.28E-06	1.48E-06	4.50E-07	1.85E-05	1.55E-07	0.00E+00
INHAL								
ADULT	2.81E-09	1.92E-08	2.78E-09	4.50E-09	4.14E-09	3.92E-07	3.06E-07	0.00E+00
TEEN	3.08E-09	3.23E-08	3.91E-09	6.15E-09	5.72E-09	5.04E-07	4.50E-07	0.00E+00
CHILD	2.95E-09	1.49E-07	5.30E-09	5.94E-09	5.36E-09	6.10E-07	3.66E-07	0.00E+00
INFANT	1.78E-09	1.28E-07	3.73E-09	4.91E-09	3.50E-09	5.60E-07	2.40E-07	0.00E+00

TABLE 2. DOSES TO MAXIMUM INDIVIDUAL (MREM), APRIL-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 1.10E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.27E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.52E-05	1.53E-05	2.71E-05
GROUND	2.52E-05	2.52E-05	2.52E-05	2.52E-05	2.52E-05	2.52E-05	2.52E-05	2.97E-05
VEGET								
ADULT	7.15E-07	3.19E-06	5.00E-07	7.03E-07	2.41E-07	1.39E-05	5.48E-08	0.00E+00
TEEN	8.89E-07	3.40E-06	8.21E-07	1.11E-06	3.79E-07	1.87E-05	1.03E-07	0.00E+00
CHILD	1.44E-06	2.23E-06	1.97E-06	1.85E-06	6.18E-07	3.58E-05	1.56E-07	0.00E+00
MEAT								
ADULT	1.26E-07	8.46E-07	3.10E-08	8.59E-08	1.55E-08	3.71E-07	4.48E-09	0.00E+00
TEEN	9.02E-08	4.55E-07	2.57E-08	6.79E-08	1.25E-08	2.69E-07	4.24E-09	0.00E+00
CHILD	1.29E-07	2.30E-07	4.75E-08	8.52E-08	1.59E-08	4.06E-07	4.98E-09	0.00E+00
COW MILK								
ADULT	2.61E-07	2.02E-07	2.74E-07	3.80E-07	1.72E-07	1.06E-05	3.79E-08	0.00E+00
TEEN	2.75E-07	2.41E-07	4.97E-07	6.69E-07	3.05E-07	1.68E-05	7.84E-08	0.00E+00
CHILD	2.86E-07	1.62E-07	1.20E-06	1.16E-06	5.06E-07	3.34E-05	1.20E-07	0.00E+00
INFANT	3.77E-07	1.45E-07	1.97E-06	2.31E-06	8.36E-07	8.11E-05	2.18E-07	0.00E+00
GOATMILK								
ADULT	6.86E-07	5.59E-08	7.76E-07	1.05E-06	4.11E-07	1.27E-05	1.14E-07	0.00E+00
TEEN	6.62E-07	7.08E-08	1.41E-06	1.85E-06	7.29E-07	2.01E-05	2.35E-07	0.00E+00
CHILD	5.35E-07	5.25E-08	3.39E-06	3.21E-06	1.21E-06	4.01E-05	3.61E-07	0.00E+00
INFANT	5.75E-07	4.98E-08	5.49E-06	6.33E-06	1.97E-06	9.73E-05	6.54E-07	0.00E+00
INHAL								
ADULT	7.46E-09	5.17E-08	7.14E-09	1.17E-08	1.01E-08	9.31E-07	8.54E-07	0.00E+00
TEEN	8.09E-09	8.21E-08	1.00E-08	1.59E-08	1.40E-08	1.20E-06	1.25E-06	0.00E+00
CHILD	7.64E-09	3.54E-07	1.36E-08	1.53E-08	1.31E-08	1.45E-06	1.02E-06	0.00E+00
INFANT	4.53E-09	3.04E-07	9.49E-09	1.25E-08	8.55E-09	1.33E-06	6.65E-07	0.00E+00

TABLE 3. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-JUNE 2019

SPECIAL LOCATION NO. 1A Site Boundary
AT .67 MILES N

ANNUAL BETA AIR DOSE = 3.29E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 3.41E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.27E-05	2.27E-05	2.27E-05	2.27E-05	2.27E-05	2.27E-05	2.30E-05	5.26E-05
GROUND	4.86E-04	4.86E-04	4.86E-04	4.86E-04	4.86E-04	4.86E-04	4.86E-04	5.72E-04
VEGET								
ADULT	1.25E-05	6.16E-05	6.31E-06	1.16E-05	3.25E-06	9.78E-05	8.93E-07	0.00E+00
TEEN	1.59E-05	6.56E-05	1.03E-05	1.83E-05	5.15E-06	1.31E-04	1.67E-06	0.00E+00
CHILD	2.63E-05	4.29E-05	2.47E-05	3.04E-05	8.42E-06	2.51E-04	2.55E-06	0.00E+00
MEAT								
ADULT	2.35E-06	1.64E-05	4.83E-07	1.53E-06	2.34E-07	2.59E-06	7.30E-08	0.00E+00
TEEN	1.71E-06	8.84E-06	4.01E-07	1.21E-06	1.89E-07	1.87E-06	6.91E-08	0.00E+00
CHILD	2.48E-06	4.46E-06	7.39E-07	1.51E-06	2.40E-07	2.83E-06	8.11E-08	0.00E+00
COW MILK								
ADULT	4.14E-06	3.78E-06	4.18E-06	5.91E-06	2.28E-06	7.52E-05	6.18E-07	0.00E+00
TEEN	4.31E-06	4.47E-06	7.58E-06	1.04E-05	4.03E-06	1.19E-04	1.28E-06	0.00E+00
CHILD	4.37E-06	2.99E-06	1.83E-05	1.80E-05	6.70E-06	2.38E-04	1.96E-06	0.00E+00
INFANT	5.52E-06	2.64E-06	2.96E-05	3.55E-05	1.09E-05	5.78E-04	3.55E-06	0.00E+00
GOATMILK								
ADULT	1.10E-05	8.49E-07	1.22E-05	1.67E-05	6.08E-06	9.02E-05	1.85E-06	0.00E+00
TEEN	1.04E-05	1.06E-06	2.22E-05	2.95E-05	1.08E-05	1.43E-04	3.83E-06	0.00E+00
CHILD	8.09E-06	7.65E-07	5.34E-05	5.12E-05	1.78E-05	2.86E-04	5.88E-06	0.00E+00
INFANT	8.18E-06	7.16E-07	8.57E-05	1.00E-04	2.89E-05	6.94E-04	1.06E-05	0.00E+00
INHAL								
ADULT	1.72E-07	1.31E-06	1.31E-07	2.37E-07	1.49E-07	1.13E-05	2.66E-05	0.00E+00
TEEN	1.79E-07	1.20E-06	1.84E-07	3.21E-07	2.06E-07	1.47E-05	3.89E-05	0.00E+00
CHILD	1.61E-07	4.73E-07	2.49E-07	3.06E-07	1.92E-07	1.82E-05	3.15E-05	0.00E+00
INFANT	8.66E-08	1.70E-07	1.64E-07	2.35E-07	1.24E-07	1.68E-05	2.01E-05	0.00E+00

TABLE 3. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 2A Site Boundary
AT .54 MILES ESE

ANNUAL BETA AIR DOSE = 2.45E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.23E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.51E-05	3.63E-05
GROUND	3.73E-04	3.73E-04	3.73E-04	3.73E-04	3.73E-04	3.73E-04	3.73E-04	4.39E-04
VEGET								
ADULT	9.60E-06	4.73E-05	4.78E-06	8.88E-06	2.48E-06	7.17E-05	6.85E-07	0.00E+00
TEEN	1.22E-05	5.03E-05	7.83E-06	1.40E-05	3.92E-06	9.60E-05	1.28E-06	0.00E+00
CHILD	2.01E-05	3.29E-05	1.87E-05	2.33E-05	6.41E-06	1.84E-04	1.95E-06	0.00E+00
MEAT								
ADULT	1.81E-06	1.26E-05	3.70E-07	1.17E-06	1.79E-07	1.90E-06	5.60E-08	0.00E+00
TEEN	1.31E-06	6.78E-06	3.07E-07	9.26E-07	1.45E-07	1.37E-06	5.30E-08	0.00E+00
CHILD	1.90E-06	3.42E-06	5.65E-07	1.16E-06	1.84E-07	2.07E-06	6.22E-08	0.00E+00
COW MILK								
ADULT	3.17E-06	2.90E-06	3.20E-06	4.52E-06	1.73E-06	5.51E-05	4.74E-07	0.00E+00
TEEN	3.30E-06	3.43E-06	5.80E-06	7.97E-06	3.07E-06	8.75E-05	9.79E-07	0.00E+00
CHILD	3.33E-06	2.29E-06	1.40E-05	1.38E-05	5.09E-06	1.75E-04	1.50E-06	0.00E+00
INFANT	4.21E-06	2.02E-06	2.26E-05	2.72E-05	8.31E-06	4.24E-04	2.72E-06	0.00E+00
GOATMILK								
ADULT	8.40E-06	6.48E-07	9.37E-06	1.28E-05	4.64E-06	6.62E-05	1.42E-06	0.00E+00
TEEN	8.00E-06	8.06E-07	1.70E-05	2.26E-05	8.21E-06	1.05E-04	2.94E-06	0.00E+00
CHILD	6.18E-06	5.82E-07	4.09E-05	3.92E-05	1.36E-05	2.10E-04	4.51E-06	0.00E+00
INFANT	6.24E-06	5.45E-07	6.57E-05	7.69E-05	2.21E-05	5.09E-04	8.16E-06	0.00E+00
INHAL								
ADULT	1.52E-07	1.15E-06	1.16E-07	2.09E-07	1.32E-07	1.00E-05	2.34E-05	0.00E+00
TEEN	1.58E-07	1.06E-06	1.62E-07	2.84E-07	1.82E-07	1.31E-05	3.43E-05	0.00E+00
CHILD	1.42E-07	4.06E-07	2.20E-07	2.71E-07	1.70E-07	1.62E-05	2.78E-05	0.00E+00
INFANT	7.65E-08	1.40E-07	1.45E-07	2.08E-07	1.10E-07	1.49E-05	1.77E-05	0.00E+00

TABLE 3. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 3A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 2.77E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 4.42E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.97E-04	2.97E-04	2.97E-04	2.97E-04	2.97E-04	2.97E-04	2.99E-04	5.87E-04
GROUND	2.04E-04	2.04E-04	2.04E-04	2.04E-04	2.04E-04	2.04E-04	2.04E-04	2.40E-04
VEGET								
ADULT	5.63E-06	2.71E-05	4.89E-06	5.39E-06	2.04E-06	1.59E-04	3.94E-07	0.00E+00
TEEN	7.16E-06	2.90E-05	8.00E-06	8.47E-06	3.19E-06	2.13E-04	7.37E-07	0.00E+00
CHILD	1.19E-05	1.92E-05	1.92E-05	1.41E-05	5.19E-06	4.08E-04	1.12E-06	0.00E+00
MEAT								
ADULT	1.00E-06	6.92E-06	2.50E-07	6.64E-07	1.19E-07	4.23E-06	3.21E-08	0.00E+00
TEEN	7.26E-07	3.72E-06	2.08E-07	5.25E-07	9.65E-08	3.06E-06	3.04E-08	0.00E+00
CHILD	1.05E-06	1.88E-06	3.84E-07	6.56E-07	1.22E-07	4.62E-06	3.57E-08	0.00E+00
COW MILK								
ADULT	1.97E-06	1.71E-06	2.11E-06	2.87E-06	1.47E-06	1.20E-04	2.72E-07	0.00E+00
TEEN	2.14E-06	2.05E-06	3.83E-06	5.06E-06	2.61E-06	1.91E-04	5.62E-07	0.00E+00
CHILD	2.38E-06	1.39E-06	9.25E-06	8.76E-06	4.34E-06	3.79E-04	8.64E-07	0.00E+00
INFANT	3.30E-06	1.25E-06	1.55E-05	1.77E-05	7.24E-06	9.21E-04	1.56E-06	0.00E+00
GOATMILK								
ADULT	5.01E-06	4.89E-07	5.75E-06	7.70E-06	3.24E-06	1.44E-04	8.16E-07	0.00E+00
TEEN	4.91E-06	6.24E-07	1.04E-05	1.36E-05	5.74E-06	2.29E-04	1.69E-06	0.00E+00
CHILD	4.14E-06	4.68E-07	2.52E-05	2.35E-05	9.53E-06	4.55E-04	2.59E-06	0.00E+00
INFANT	4.71E-06	4.47E-07	4.11E-05	4.67E-05	1.56E-05	1.11E-03	4.69E-06	0.00E+00
INHAL								
ADULT	5.14E-08	4.68E-07	4.55E-08	7.49E-08	5.79E-08	5.18E-06	7.27E-06	0.00E+00
TEEN	5.48E-08	5.20E-07	6.39E-08	1.02E-07	8.00E-08	6.71E-06	1.06E-05	0.00E+00
CHILD	5.05E-08	7.50E-07	8.66E-08	9.76E-08	7.49E-08	8.19E-06	8.64E-06	0.00E+00
INFANT	2.85E-08	5.57E-07	5.92E-08	7.74E-08	4.87E-08	7.53E-06	5.57E-06	0.00E+00

TABLE 3. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 4.12E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 5.80E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.90E-05	3.90E-05	3.90E-05	3.90E-05	3.90E-05	3.90E-05	3.94E-05	8.09E-05
GROUND	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	7.86E-06
VEGET								
ADULT	1.87E-07	8.95E-07	1.72E-07	1.79E-07	7.02E-08	5.76E-06	1.30E-08	0.00E+00
TEEN	2.37E-07	9.58E-07	2.81E-07	2.82E-07	1.10E-07	7.74E-06	2.44E-08	0.00E+00
CHILD	3.93E-07	6.34E-07	6.73E-07	4.70E-07	1.78E-07	1.48E-05	3.71E-08	0.00E+00
MEAT								
ADULT	3.29E-08	2.27E-07	8.44E-09	2.19E-08	4.00E-09	1.54E-07	1.06E-09	0.00E+00
TEEN	2.38E-08	1.22E-07	7.01E-09	1.73E-08	3.25E-09	1.11E-07	1.00E-09	0.00E+00
CHILD	3.44E-08	6.18E-08	1.29E-08	2.16E-08	4.12E-09	1.68E-07	1.18E-09	0.00E+00
COW MILK								
ADULT	6.57E-08	5.67E-08	7.10E-08	9.60E-08	5.07E-08	4.37E-06	8.98E-09	0.00E+00
TEEN	7.19E-08	6.79E-08	1.29E-07	1.69E-07	9.00E-08	6.92E-06	1.86E-08	0.00E+00
CHILD	8.05E-08	4.63E-08	3.11E-07	2.93E-07	1.50E-07	1.37E-05	2.85E-08	0.00E+00
INFANT	1.13E-07	4.15E-08	5.22E-07	5.94E-07	2.50E-07	3.34E-05	5.16E-08	0.00E+00
GOATMILK								
ADULT	1.66E-07	1.66E-08	1.92E-07	2.56E-07	1.09E-07	5.24E-06	2.69E-08	0.00E+00
TEEN	1.64E-07	2.13E-08	3.48E-07	4.51E-07	1.94E-07	8.30E-06	5.57E-08	0.00E+00
CHILD	1.39E-07	1.60E-08	8.39E-07	7.82E-07	3.22E-07	1.65E-05	8.56E-08	0.00E+00
INFANT	1.60E-07	1.53E-08	1.37E-06	1.55E-06	5.29E-07	4.01E-05	1.55E-07	0.00E+00
INHAL								
ADULT	5.14E-09	6.50E-08	6.05E-09	8.37E-09	8.74E-09	9.46E-07	5.89E-07	0.00E+00
TEEN	5.73E-09	8.38E-08	8.51E-09	1.14E-08	1.21E-08	1.21E-06	8.67E-07	0.00E+00
CHILD	5.55E-09	1.59E-07	1.16E-08	1.10E-08	1.13E-08	1.46E-06	7.06E-07	0.00E+00
INFANT	3.37E-09	1.22E-07	8.27E-09	9.21E-09	7.41E-09	1.34E-06	4.68E-07	0.00E+00

TABLE 3. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 2.72E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 4.38E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.94E-04	2.94E-04	2.94E-04	2.94E-04	2.94E-04	2.94E-04	2.96E-04	5.79E-04
GROUND	3.18E-05	3.18E-05	3.18E-05	3.18E-05	3.18E-05	3.18E-05	3.18E-05	3.74E-05
VEGET								
ADULT	9.22E-07	4.37E-06	1.03E-06	9.01E-07	3.98E-07	3.85E-05	6.35E-08	0.00E+00
TEEN	1.17E-06	4.69E-06	1.68E-06	1.41E-06	6.18E-07	5.17E-05	1.19E-07	0.00E+00
CHILD	1.94E-06	3.12E-06	4.03E-06	2.36E-06	1.00E-06	9.91E-05	1.81E-07	0.00E+00
MEAT								
ADULT	1.58E-07	1.08E-06	4.45E-08	1.06E-07	2.10E-08	1.03E-06	5.19E-09	0.00E+00
TEEN	1.14E-07	5.82E-07	3.70E-08	8.39E-08	1.70E-08	7.45E-07	4.91E-09	0.00E+00
CHILD	1.64E-07	2.95E-07	6.84E-08	1.05E-07	2.16E-08	1.12E-06	5.77E-09	0.00E+00
COW MILK								
ADULT	3.34E-07	2.81E-07	3.71E-07	4.93E-07	2.90E-07	2.92E-05	4.39E-08	0.00E+00
TEEN	3.73E-07	3.39E-07	6.74E-07	8.71E-07	5.15E-07	4.62E-05	9.07E-08	0.00E+00
CHILD	4.34E-07	2.33E-07	1.63E-06	1.51E-06	8.57E-07	9.18E-05	1.39E-07	0.00E+00
INFANT	6.30E-07	2.11E-07	2.77E-06	3.09E-06	1.44E-06	2.23E-04	2.52E-07	0.00E+00
GOATMILK								
ADULT	8.30E-07	9.18E-08	9.69E-07	1.28E-06	5.86E-07	3.50E-05	1.32E-07	0.00E+00
TEEN	8.27E-07	1.18E-07	1.76E-06	2.26E-06	1.04E-06	5.55E-05	2.72E-07	0.00E+00
CHILD	7.34E-07	9.01E-08	4.24E-06	3.91E-06	1.72E-06	1.10E-04	4.18E-07	0.00E+00
INFANT	8.83E-07	8.68E-08	7.00E-06	7.81E-06	2.85E-06	2.68E-04	7.56E-07	0.00E+00
INHAL								
ADULT	1.27E-08	1.73E-07	1.58E-08	2.15E-08	2.37E-08	2.55E-06	1.35E-06	0.00E+00
TEEN	1.45E-08	2.45E-07	2.23E-08	2.94E-08	3.27E-08	3.28E-06	1.99E-06	0.00E+00
CHILD	1.43E-08	6.25E-07	3.03E-08	2.85E-08	3.07E-08	3.94E-06	1.63E-06	0.00E+00
INFANT	8.91E-09	5.03E-07	2.19E-08	2.42E-08	2.01E-08	3.62E-06	1.09E-06	0.00E+00

TABLE 4. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-SEPTEMBER 2019

SPECIAL LOCATION NO. 1A Site Boundary
AT .67 MILES N

ANNUAL BETA AIR DOSE = 1.13E-06 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.32E-06 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.55E-06	1.55E-06	1.55E-06	1.55E-06	1.55E-06	1.55E-06	1.56E-06	2.78E-06
GROUND	1.92E-03	1.92E-03	1.92E-03	1.92E-03	1.92E-03	1.92E-03	1.92E-03	2.26E-03
VEGET								
ADULT	4.48E-05	2.43E-04	1.90E-05	3.84E-05	1.23E-05	8.51E-04	2.58E-06	0.00E+00
TEEN	5.93E-05	2.58E-04	3.10E-05	6.03E-05	1.93E-05	1.14E-03	4.84E-06	0.00E+00
CHILD	1.03E-04	1.69E-04	7.38E-05	9.98E-05	3.14E-05	2.19E-03	7.37E-06	0.00E+00
MEAT								
ADULT	8.92E-06	6.52E-05	1.42E-06	5.41E-06	7.54E-07	2.28E-05	2.11E-07	0.00E+00
TEEN	6.62E-06	3.51E-05	1.18E-06	4.26E-06	6.11E-07	1.65E-05	2.00E-07	0.00E+00
CHILD	9.76E-06	1.77E-05	2.17E-06	5.27E-06	7.76E-07	2.49E-05	2.35E-07	0.00E+00
COW MILK								
ADULT	1.32E-05	1.51E-05	1.30E-05	1.86E-05	8.86E-06	6.44E-04	1.79E-06	0.00E+00
TEEN	1.45E-05	1.79E-05	2.36E-05	3.28E-05	1.57E-05	1.02E-03	3.69E-06	0.00E+00
CHILD	1.65E-05	1.20E-05	5.68E-05	5.67E-05	2.61E-05	2.03E-03	5.67E-06	0.00E+00
INFANT	2.29E-05	1.06E-05	9.38E-05	1.14E-04	4.33E-05	4.93E-03	1.03E-05	0.00E+00
GOATMILK								
ADULT	3.27E-05	3.36E-06	3.65E-05	5.00E-05	2.03E-05	7.73E-04	5.36E-06	0.00E+00
TEEN	3.18E-05	4.20E-06	6.61E-05	8.83E-05	3.60E-05	1.23E-03	1.11E-05	0.00E+00
CHILD	2.63E-05	3.05E-06	1.59E-04	1.53E-04	5.97E-05	2.43E-03	1.70E-05	0.00E+00
INFANT	2.92E-05	2.86E-06	2.58E-04	3.02E-04	9.76E-05	5.91E-03	3.08E-05	0.00E+00
INHAL								
ADULT	4.35E-07	3.46E-06	3.33E-07	6.10E-07	4.99E-07	5.26E-05	7.02E-05	0.00E+00
TEEN	4.82E-07	3.18E-06	4.67E-07	8.30E-07	6.88E-07	6.72E-05	1.03E-04	0.00E+00
CHILD	4.62E-07	1.26E-06	6.34E-07	7.94E-07	6.45E-07	8.05E-05	8.32E-05	0.00E+00
INFANT	2.62E-07	4.57E-07	4.38E-07	6.31E-07	4.21E-07	7.40E-05	5.31E-05	0.00E+00

TABLE 4. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-SEPTEMBER 2019 (Continued)

SPECIAL LOCATION NO. 2A Site Boundary
AT .54 MILES ESE

ANNUAL BETA AIR DOSE = 1.33E-08 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.74E-08 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.83E-08	1.83E-08	1.83E-08	1.83E-08	1.83E-08	1.83E-08	1.84E-08	3.29E-08
GROUND	4.95E-04	4.95E-04	4.95E-04	4.95E-04	4.95E-04	4.95E-04	4.95E-04	5.82E-04
VEGET								
ADULT	1.15E-05	6.25E-05	4.78E-06	9.86E-06	3.13E-06	2.12E-04	6.65E-07	0.00E+00
TEEN	1.53E-05	6.66E-05	7.81E-06	1.55E-05	4.90E-06	2.85E-04	1.25E-06	0.00E+00
CHILD	2.64E-05	4.36E-05	1.86E-05	2.57E-05	8.00E-06	5.47E-04	1.90E-06	0.00E+00
MEAT								
ADULT	2.30E-06	1.68E-05	3.64E-07	1.39E-06	1.93E-07	5.68E-06	5.43E-08	0.00E+00
TEEN	1.71E-06	9.04E-06	3.02E-07	1.10E-06	1.57E-07	4.11E-06	5.14E-08	0.00E+00
CHILD	2.52E-06	4.57E-06	5.57E-07	1.36E-06	1.99E-07	6.21E-06	6.04E-08	0.00E+00
COW MILK								
ADULT	3.38E-06	3.89E-06	3.33E-06	4.78E-06	2.25E-06	1.61E-04	4.60E-07	0.00E+00
TEEN	3.72E-06	4.61E-06	6.04E-06	8.42E-06	3.99E-06	2.55E-04	9.50E-07	0.00E+00
CHILD	4.23E-06	3.09E-06	1.46E-05	1.45E-05	6.63E-06	5.05E-04	1.46E-06	0.00E+00
INFANT	5.85E-06	2.74E-06	2.40E-05	2.92E-05	1.10E-05	1.23E-03	2.64E-06	0.00E+00
GOATMILK								
ADULT	8.40E-06	8.58E-07	9.36E-06	1.29E-05	5.19E-06	1.93E-04	1.38E-06	0.00E+00
TEEN	8.17E-06	1.07E-06	1.70E-05	2.27E-05	9.20E-06	3.05E-04	2.85E-06	0.00E+00
CHILD	6.75E-06	7.77E-07	4.09E-05	3.93E-05	1.53E-05	6.06E-04	4.38E-06	0.00E+00
INFANT	7.45E-06	7.27E-07	6.62E-05	7.77E-05	2.50E-05	1.47E-03	7.93E-06	0.00E+00
INHAL								
ADULT	4.07E-07	3.21E-06	3.14E-07	5.75E-07	4.77E-07	5.06E-05	6.52E-05	0.00E+00
TEEN	4.52E-07	2.95E-06	4.41E-07	7.82E-07	6.58E-07	6.48E-05	9.53E-05	0.00E+00
CHILD	4.34E-07	1.11E-06	5.98E-07	7.48E-07	6.18E-07	7.76E-05	7.72E-05	0.00E+00
INFANT	2.47E-07	3.73E-07	4.15E-07	5.97E-07	4.03E-07	7.12E-05	4.93E-05	0.00E+00

TABLE 4. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-SEPTEMBER 2019 (Continued)

SPECIAL LOCATION NO. 3A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 1.19E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.46E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.65E-05	2.95E-05
GROUND	4.16E-04	4.16E-04	4.16E-04	4.16E-04	4.16E-04	4.16E-04	4.16E-04	4.90E-04
VEGET								
ADULT	9.93E-06	5.27E-05	5.25E-06	8.64E-06	3.10E-06	2.62E-04	5.70E-07	0.00E+00
TEEN	1.31E-05	5.62E-05	8.58E-06	1.36E-05	4.84E-06	3.53E-04	1.07E-06	0.00E+00
CHILD	2.27E-05	3.68E-05	2.05E-05	2.25E-05	7.88E-06	6.76E-04	1.62E-06	0.00E+00
MEAT								
ADULT	1.94E-06	1.41E-05	3.26E-07	1.18E-06	1.77E-07	7.01E-06	4.65E-08	0.00E+00
TEEN	1.44E-06	7.60E-06	2.71E-07	9.33E-07	1.43E-07	5.08E-06	4.40E-08	0.00E+00
CHILD	2.12E-06	3.84E-06	4.99E-07	1.16E-06	1.82E-07	7.67E-06	5.17E-08	0.00E+00
COW MILK								
ADULT	3.00E-06	3.34E-06	3.03E-06	4.28E-06	2.26E-06	1.99E-04	3.94E-07	0.00E+00
TEEN	3.35E-06	3.97E-06	5.50E-06	7.54E-06	4.01E-06	3.15E-04	8.14E-07	0.00E+00
CHILD	3.93E-06	2.67E-06	1.33E-05	1.30E-05	6.66E-06	6.24E-04	1.25E-06	0.00E+00
INFANT	5.61E-06	2.37E-06	2.22E-05	2.64E-05	1.11E-05	1.52E-03	2.26E-06	0.00E+00
GOATMILK								
ADULT	7.32E-06	8.12E-07	8.27E-06	1.12E-05	4.84E-06	2.38E-04	1.18E-06	0.00E+00
TEEN	7.21E-06	1.02E-06	1.50E-05	1.98E-05	8.58E-06	3.77E-04	2.44E-06	0.00E+00
CHILD	6.18E-06	7.53E-07	3.62E-05	3.44E-05	1.42E-05	7.49E-04	3.75E-06	0.00E+00
INFANT	7.15E-06	7.11E-07	5.90E-05	6.83E-05	2.34E-05	1.82E-03	6.79E-06	0.00E+00
INHAL								
ADULT	7.50E-08	5.96E-07	6.07E-08	1.08E-07	9.52E-08	1.03E-05	1.16E-05	0.00E+00
TEEN	8.38E-08	6.20E-07	8.52E-08	1.48E-07	1.31E-07	1.31E-05	1.69E-05	0.00E+00
CHILD	8.11E-08	8.96E-07	1.16E-07	1.41E-07	1.23E-07	1.57E-05	1.37E-05	0.00E+00
INFANT	4.68E-08	6.77E-07	8.08E-08	1.14E-07	8.05E-08	1.44E-05	8.79E-06	0.00E+00

TABLE 4. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-SEPTEMBER 2019 (Continued)

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 4.78E-06 MILLRADS
ANNUAL GAMMA AIR DOSE = 9.83E-06 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.57E-06	6.57E-06	6.57E-06	6.57E-06	6.57E-06	6.57E-06	6.62E-06	1.18E-05
GROUND	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.63E-05	1.91E-05
VEGET								
ADULT	3.93E-07	2.06E-06	2.32E-07	3.45E-07	1.32E-07	1.21E-05	2.25E-08	0.00E+00
TEEN	5.20E-07	2.20E-06	3.80E-07	5.42E-07	2.05E-07	1.63E-05	4.21E-08	0.00E+00
CHILD	8.98E-07	1.44E-06	9.12E-07	8.98E-07	3.34E-07	3.12E-05	6.41E-08	0.00E+00
MEAT								
ADULT	7.59E-08	5.51E-07	1.32E-08	4.66E-08	7.22E-09	3.24E-07	1.84E-09	0.00E+00
TEEN	5.63E-08	2.97E-07	1.10E-08	3.67E-08	5.86E-09	2.35E-07	1.74E-09	0.00E+00
CHILD	8.29E-08	1.50E-07	2.02E-08	4.55E-08	7.43E-09	3.54E-07	2.04E-09	0.00E+00
COW MILK								
ADULT	1.21E-07	1.32E-07	1.24E-07	1.73E-07	9.63E-08	9.17E-06	1.55E-08	0.00E+00
TEEN	1.36E-07	1.57E-07	2.24E-07	3.05E-07	1.71E-07	1.45E-05	3.21E-08	0.00E+00
CHILD	1.62E-07	1.06E-07	5.41E-07	5.27E-07	2.84E-07	2.88E-05	4.94E-08	0.00E+00
INFANT	2.35E-07	9.44E-08	9.11E-07	1.08E-06	4.76E-07	7.01E-05	8.93E-08	0.00E+00
GOATMILK								
ADULT	2.92E-07	3.37E-08	3.32E-07	4.49E-07	2.00E-07	1.10E-05	4.66E-08	0.00E+00
TEEN	2.89E-07	4.27E-08	6.02E-07	7.92E-07	3.54E-07	1.74E-05	9.64E-08	0.00E+00
CHILD	2.53E-07	3.16E-08	1.45E-06	1.37E-06	5.88E-07	3.46E-05	1.48E-07	0.00E+00
INFANT	2.99E-07	3.00E-08	2.38E-06	2.73E-06	9.69E-07	8.41E-05	2.68E-07	0.00E+00
INHAL								
ADULT	5.65E-09	4.50E-08	5.52E-09	9.10E-09	9.83E-09	1.12E-06	7.21E-07	0.00E+00
TEEN	6.51E-09	6.84E-08	7.76E-09	1.24E-08	1.36E-08	1.43E-06	1.06E-06	0.00E+00
CHILD	6.51E-09	2.72E-07	1.05E-08	1.20E-08	1.27E-08	1.71E-06	8.61E-07	0.00E+00
INFANT	3.98E-09	2.31E-07	7.62E-09	1.01E-08	8.36E-09	1.57E-06	5.60E-07	0.00E+00

TABLE 4. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-SEPTEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 1.19E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.46E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.65E-05	2.95E-05
GROUND	6.35E-05	6.35E-05	6.35E-05	6.35E-05	6.35E-05	6.35E-05	6.35E-05	7.46E-05
VEGET								
ADULT	1.56E-06	8.08E-06	1.03E-06	1.38E-06	5.60E-07	5.53E-05	8.88E-08	0.00E+00
TEEN	2.06E-06	8.62E-06	1.68E-06	2.17E-06	8.70E-07	7.44E-05	1.66E-07	0.00E+00
CHILD	3.55E-06	5.65E-06	4.03E-06	3.59E-06	1.41E-06	1.43E-04	2.53E-07	0.00E+00
MEAT								
ADULT	2.97E-07	2.15E-06	5.34E-08	1.83E-07	2.96E-08	1.48E-06	7.25E-09	0.00E+00
TEEN	2.20E-07	1.16E-06	4.44E-08	1.44E-07	2.40E-08	1.07E-06	6.86E-09	0.00E+00
CHILD	3.24E-07	5.85E-07	8.19E-08	1.79E-07	3.04E-08	1.62E-06	8.06E-09	0.00E+00
COW MILK								
ADULT	4.85E-07	5.21E-07	5.04E-07	7.01E-07	4.11E-07	4.19E-05	6.14E-08	0.00E+00
TEEN	5.53E-07	6.22E-07	9.15E-07	1.24E-06	7.30E-07	6.64E-05	1.27E-07	0.00E+00
CHILD	6.69E-07	4.21E-07	2.21E-06	2.14E-06	1.21E-06	1.32E-04	1.95E-07	0.00E+00
INFANT	9.82E-07	3.75E-07	3.75E-06	4.38E-06	2.04E-06	3.20E-04	3.53E-07	0.00E+00
GOATMILK								
ADULT	1.16E-06	1.40E-07	1.34E-06	1.79E-06	8.25E-07	5.03E-05	1.84E-07	0.00E+00
TEEN	1.16E-06	1.79E-07	2.42E-06	3.16E-06	1.46E-06	7.96E-05	3.81E-07	0.00E+00
CHILD	1.04E-06	1.33E-07	5.84E-06	5.49E-06	2.43E-06	1.58E-04	5.85E-07	0.00E+00
INFANT	1.25E-06	1.27E-07	9.61E-06	1.10E-05	4.01E-06	3.84E-04	1.06E-06	0.00E+00
INHAL								
ADULT	1.75E-08	1.40E-07	1.64E-08	2.75E-08	2.85E-08	3.20E-06	2.36E-06	0.00E+00
TEEN	2.01E-08	1.97E-07	2.31E-08	3.76E-08	3.93E-08	4.10E-06	3.45E-06	0.00E+00
CHILD	1.99E-08	6.99E-07	3.13E-08	3.62E-08	3.69E-08	4.90E-06	2.81E-06	0.00E+00
INFANT	1.20E-08	5.90E-07	2.25E-08	3.02E-08	2.42E-08	4.50E-06	1.82E-06	0.00E+00

TABLE 5. DOSES TO MAXIMUM INDIVIDUAL (MREM), OCTOBER-DECEMBER 2019

SPECIAL LOCATION NO. 1A Site Boundary
AT .67 MILES N

ANNUAL BETA AIR DOSE = 4.84E-07 MILLRADS
ANNUAL GAMMA AIR DOSE = 9.08E-07 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	6.07E-07	6.07E-07	6.07E-07	6.07E-07	6.07E-07	6.07E-07	6.12E-07	1.13E-06
GROUND	2.59E-04	2.59E-04	2.59E-04	2.59E-04	2.59E-04	2.59E-04	2.59E-04	3.04E-04
VEGET								
ADULT	7.28E-06	3.53E-05	2.01E-05	6.41E-06	2.72E-06	2.64E-04	4.37E-07	0.00E+00
TEEN	9.56E-06	3.81E-05	3.33E-05	1.01E-05	4.22E-06	3.55E-04	8.19E-07	0.00E+00
CHILD	1.67E-05	2.54E-05	8.10E-05	1.68E-05	6.86E-06	6.79E-04	1.25E-06	0.00E+00
MEAT								
ADULT	1.25E-06	8.77E-06	4.09E-07	8.03E-07	1.44E-07	7.05E-06	3.57E-08	0.00E+00
TEEN	9.15E-07	4.72E-06	3.42E-07	6.34E-07	1.17E-07	5.10E-06	3.38E-08	0.00E+00
CHILD	1.33E-06	2.39E-06	6.36E-07	7.90E-07	1.49E-07	7.70E-06	3.97E-08	0.00E+00
COW MILK								
ADULT	2.35E-06	2.28E-06	3.18E-06	3.41E-06	2.00E-06	2.00E-04	3.02E-07	0.00E+00
TEEN	2.66E-06	2.74E-06	5.78E-06	6.02E-06	3.54E-06	3.17E-04	6.25E-07	0.00E+00
CHILD	3.19E-06	1.88E-06	1.40E-05	1.04E-05	5.89E-06	6.30E-04	9.60E-07	0.00E+00
INFANT	4.68E-06	1.70E-06	2.44E-05	2.13E-05	9.90E-06	1.53E-03	1.74E-06	0.00E+00
GOATMILK								
ADULT	5.76E-06	8.78E-07	8.04E-06	8.81E-06	4.03E-06	2.40E-04	9.07E-07	0.00E+00
TEEN	5.77E-06	1.14E-06	1.46E-05	1.55E-05	7.15E-06	3.81E-04	1.87E-06	0.00E+00
CHILD	5.24E-06	8.78E-07	3.54E-05	2.69E-05	1.19E-05	7.56E-04	2.88E-06	0.00E+00
INFANT	6.44E-06	8.54E-07	6.00E-05	5.38E-05	1.96E-05	1.84E-03	5.21E-06	0.00E+00
INHAL								
ADULT	1.80E-07	1.14E-06	2.77E-07	2.95E-07	3.30E-07	3.70E-05	2.03E-05	0.00E+00
TEEN	2.05E-07	1.08E-06	3.92E-07	4.04E-07	4.56E-07	4.75E-05	2.98E-05	0.00E+00
CHILD	2.04E-07	4.34E-07	5.35E-07	3.91E-07	4.28E-07	5.72E-05	2.42E-05	0.00E+00
INFANT	1.25E-07	1.56E-07	3.75E-07	3.30E-07	2.81E-07	5.26E-05	1.57E-05	0.00E+00

TABLE 5. DOSES TO MAXIMUM INDIVIDUAL (MREM), OCTOBER-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 2A Site Boundary
AT .60 MILES NNE

ANNUAL BETA AIR DOSE = 1.31E-07 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.45E-07 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.64E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	1.64E-07	1.65E-07	3.05E-07
GROUND	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.28E-04	1.50E-04
VEGET								
ADULT	3.59E-06	1.74E-05	9.91E-06	3.16E-06	1.34E-06	1.29E-04	2.16E-07	0.00E+00
TEEN	4.72E-06	1.88E-05	1.64E-05	4.96E-06	2.07E-06	1.74E-04	4.04E-07	0.00E+00
CHILD	8.22E-06	1.25E-05	3.99E-05	8.26E-06	3.37E-06	3.33E-04	6.15E-07	0.00E+00
MEAT								
ADULT	6.17E-07	4.33E-06	2.02E-07	3.96E-07	7.11E-08	3.45E-06	1.76E-08	0.00E+00
TEEN	4.52E-07	2.33E-06	1.68E-07	3.13E-07	5.77E-08	2.50E-06	1.67E-08	0.00E+00
CHILD	6.58E-07	1.18E-06	3.14E-07	3.90E-07	7.32E-08	3.77E-06	1.96E-08	0.00E+00
COW MILK								
ADULT	1.16E-06	1.12E-06	1.57E-06	1.68E-06	9.81E-07	9.81E-05	1.49E-07	0.00E+00
TEEN	1.31E-06	1.35E-06	2.85E-06	2.97E-06	1.74E-06	1.55E-04	3.08E-07	0.00E+00
CHILD	1.57E-06	9.28E-07	6.92E-06	5.13E-06	2.90E-06	3.09E-04	4.74E-07	0.00E+00
INFANT	2.30E-06	8.38E-07	1.20E-05	1.05E-05	4.86E-06	7.50E-04	8.57E-07	0.00E+00
GOATMILK								
ADULT	2.84E-06	4.32E-07	3.96E-06	4.34E-06	1.98E-06	1.18E-04	4.47E-07	0.00E+00
TEEN	2.85E-06	5.64E-07	7.21E-06	7.66E-06	3.52E-06	1.86E-04	9.25E-07	0.00E+00
CHILD	2.58E-06	4.32E-07	1.75E-05	1.33E-05	5.84E-06	3.70E-04	1.42E-06	0.00E+00
INFANT	3.17E-06	4.20E-07	2.96E-05	2.65E-05	9.65E-06	9.00E-04	2.57E-06	0.00E+00
INHAL								
ADULT	1.27E-07	8.09E-07	1.96E-07	2.09E-07	2.33E-07	2.61E-05	1.44E-05	0.00E+00
TEEN	1.45E-07	7.62E-07	2.77E-07	2.85E-07	3.22E-07	3.35E-05	2.11E-05	0.00E+00
CHILD	1.44E-07	3.02E-07	3.79E-07	2.76E-07	3.02E-07	4.04E-05	1.71E-05	0.00E+00
INFANT	8.85E-08	1.06E-07	2.65E-07	2.33E-07	1.98E-07	3.71E-05	1.11E-05	0.00E+00

TABLE 5. DOSES TO MAXIMUM INDIVIDUAL (MREM), OCTOBER-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 3A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 6.29E-06 MILLRADS
ANNUAL GAMMA AIR DOSE = 1.18E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.95E-06	1.47E-05
GROUND	4.61E-05	4.61E-05	4.61E-05	4.61E-05	4.61E-05	4.61E-05	4.61E-05	5.42E-05
VEGET								
ADULT	1.36E-06	6.38E-06	3.97E-06	1.24E-06	6.35E-07	7.46E-05	7.95E-08	0.00E+00
TEEN	1.79E-06	6.89E-06	6.57E-06	1.94E-06	9.79E-07	1.00E-04	1.49E-07	0.00E+00
CHILD	3.13E-06	4.61E-06	1.60E-05	3.24E-06	1.59E-06	1.92E-04	2.27E-07	0.00E+00
MEAT								
ADULT	2.25E-07	1.56E-06	7.85E-08	1.46E-07	2.99E-08	1.99E-06	6.49E-09	0.00E+00
TEEN	1.64E-07	8.42E-07	6.56E-08	1.16E-07	2.43E-08	1.44E-06	6.14E-09	0.00E+00
CHILD	2.39E-07	4.26E-07	1.22E-07	1.44E-07	3.09E-08	2.18E-06	7.22E-09	0.00E+00
COW MILK								
ADULT	4.63E-07	4.28E-07	6.33E-07	6.83E-07	4.71E-07	5.65E-05	5.49E-08	0.00E+00
TEEN	5.42E-07	5.19E-07	1.15E-06	1.21E-06	8.38E-07	8.96E-05	1.14E-07	0.00E+00
CHILD	6.88E-07	3.60E-07	2.80E-06	2.09E-06	1.39E-06	1.78E-04	1.74E-07	0.00E+00
INFANT	1.06E-06	3.28E-07	4.95E-06	4.36E-06	2.36E-06	4.32E-04	3.16E-07	0.00E+00
GOATMILK								
ADULT	1.09E-06	1.86E-07	1.54E-06	1.68E-06	8.63E-07	6.78E-05	1.65E-07	0.00E+00
TEEN	1.12E-06	2.44E-07	2.80E-06	2.96E-06	1.53E-06	1.07E-04	3.41E-07	0.00E+00
CHILD	1.09E-06	1.89E-07	6.79E-06	5.13E-06	2.55E-06	2.13E-04	5.23E-07	0.00E+00
INFANT	1.42E-06	1.84E-07	1.16E-05	1.04E-05	4.24E-06	5.19E-04	9.47E-07	0.00E+00
INHAL								
ADULT	1.75E-08	1.13E-07	2.72E-08	2.94E-08	3.43E-08	3.91E-06	1.87E-06	0.00E+00
TEEN	2.01E-08	1.23E-07	3.85E-08	4.03E-08	4.74E-08	5.01E-06	2.75E-06	0.00E+00
CHILD	2.01E-08	1.96E-07	5.26E-08	3.91E-08	4.45E-08	6.03E-06	2.24E-06	0.00E+00
INFANT	1.25E-08	1.50E-07	3.71E-08	3.33E-08	2.92E-08	5.54E-06	1.46E-06	0.00E+00

TABLE 5. DOSES TO MAXIMUM INDIVIDUAL (MREM), OCTOBER-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 6.29E-06 MILLRADS
ANNUAL GAMMA AIR DOSE = 1.18E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.89E-06	7.95E-06	1.47E-05
GROUND	1.95E-06	1.95E-06	1.95E-06	1.95E-06	1.95E-06	1.95E-06	1.95E-06	2.29E-06
VEGET								
ADULT	5.86E-08	2.71E-07	1.74E-07	5.40E-08	2.91E-08	3.58E-06	3.38E-09	0.00E+00
TEEN	7.72E-08	2.92E-07	2.88E-07	8.44E-08	4.49E-08	4.81E-06	6.34E-09	0.00E+00
CHILD	1.35E-07	1.96E-07	7.00E-07	1.41E-07	7.28E-08	9.21E-06	9.64E-09	0.00E+00
MEAT								
ADULT	9.52E-09	6.60E-08	3.41E-09	6.23E-09	1.33E-09	9.56E-08	2.76E-10	0.00E+00
TEEN	6.96E-09	3.55E-08	2.85E-09	4.93E-09	1.08E-09	6.93E-08	2.61E-10	0.00E+00
CHILD	1.01E-08	1.80E-08	5.30E-09	6.16E-09	1.37E-09	1.05E-07	3.07E-10	0.00E+00
COW MILK								
ADULT	2.02E-08	1.84E-08	2.78E-08	3.00E-08	2.17E-08	2.71E-06	2.34E-09	0.00E+00
TEEN	2.39E-08	2.23E-08	5.06E-08	5.30E-08	3.86E-08	4.29E-06	4.83E-09	0.00E+00
CHILD	3.09E-08	1.56E-08	1.23E-07	9.18E-08	6.41E-08	8.52E-06	7.43E-09	0.00E+00
INFANT	4.80E-08	1.42E-08	2.18E-07	1.92E-07	1.09E-07	2.07E-05	1.34E-08	0.00E+00
GOATMILK								
ADULT	4.70E-08	8.27E-09	6.67E-08	7.25E-08	3.87E-08	3.25E-06	7.01E-09	0.00E+00
TEEN	4.88E-08	1.09E-08	1.21E-07	1.28E-07	6.87E-08	5.15E-06	1.45E-08	0.00E+00
CHILD	4.83E-08	8.43E-09	2.94E-07	2.22E-07	1.14E-07	1.02E-05	2.23E-08	0.00E+00
INFANT	6.44E-08	8.25E-09	5.05E-07	4.49E-07	1.90E-07	2.48E-05	4.03E-08	0.00E+00
INHAL								
ADULT	2.58E-09	1.80E-08	4.24E-09	4.93E-09	6.85E-09	8.32E-07	1.95E-07	0.00E+00
TEEN	3.11E-09	3.37E-08	5.99E-09	6.77E-09	9.47E-09	1.06E-06	2.89E-07	0.00E+00
CHILD	3.24E-09	1.61E-07	8.17E-09	6.61E-09	8.90E-09	1.28E-06	2.36E-07	0.00E+00
INFANT	2.14E-09	1.38E-07	5.96E-09	5.85E-09	5.86E-09	1.17E-06	1.60E-07	0.00E+00

TABLE 5. DOSES TO MAXIMUM INDIVIDUAL (MREM), OCTOBER-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 3.00 MILES NNW

ANNUAL BETA AIR DOSE = 6.77E-06 MILLRADS
ANNUAL GAMMA AIR DOSE = 1.27E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	8.50E-06	8.50E-06	8.50E-06	8.50E-06	8.50E-06	8.50E-06	8.56E-06	1.58E-05
GROUND	2.77E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06	3.26E-06
VEGET								
ADULT	8.25E-08	3.84E-07	2.42E-07	7.55E-08	3.95E-08	4.74E-06	4.79E-09	0.00E+00
TEEN	1.09E-07	4.15E-07	4.01E-07	1.18E-07	6.10E-08	6.37E-06	8.97E-09	0.00E+00
CHILD	1.90E-07	2.77E-07	9.75E-07	1.97E-07	9.88E-08	1.22E-05	1.37E-08	0.00E+00
MEAT								
ADULT	1.35E-08	9.39E-08	4.77E-09	8.82E-09	1.84E-09	1.27E-07	3.91E-10	0.00E+00
TEEN	9.88E-09	5.05E-08	3.99E-09	6.97E-09	1.49E-09	9.17E-08	3.70E-10	0.00E+00
CHILD	1.44E-08	2.56E-08	7.43E-09	8.71E-09	1.90E-09	1.38E-07	4.35E-10	0.00E+00
COW MILK								
ADULT	2.82E-08	2.59E-08	3.87E-08	4.17E-08	2.94E-08	3.59E-06	3.31E-09	0.00E+00
TEEN	3.32E-08	3.14E-08	7.04E-08	7.37E-08	5.22E-08	5.69E-06	6.84E-09	0.00E+00
CHILD	4.24E-08	2.18E-08	1.71E-07	1.28E-07	8.68E-08	1.13E-05	1.05E-08	0.00E+00
INFANT	6.55E-08	1.99E-08	3.03E-07	2.67E-07	1.47E-07	2.74E-05	1.90E-08	0.00E+00
GOATMILK								
ADULT	6.61E-08	1.14E-08	9.34E-08	1.02E-07	5.32E-08	4.31E-06	9.93E-09	0.00E+00
TEEN	6.82E-08	1.50E-08	1.70E-07	1.80E-07	9.44E-08	6.82E-06	2.05E-08	0.00E+00
CHILD	6.67E-08	1.16E-08	4.12E-07	3.11E-07	1.57E-07	1.35E-05	3.15E-08	0.00E+00
INFANT	8.81E-08	1.13E-08	7.06E-07	6.29E-07	2.61E-07	3.29E-05	5.71E-08	0.00E+00
INHAL								
ADULT	3.20E-09	2.20E-08	5.21E-09	6.00E-09	8.18E-09	9.86E-07	2.55E-07	0.00E+00
TEEN	3.83E-09	3.87E-08	7.36E-09	8.24E-09	1.13E-08	1.26E-06	3.77E-07	0.00E+00
CHILD	3.97E-09	1.74E-07	1.00E-08	8.04E-09	1.06E-08	1.51E-06	3.08E-07	0.00E+00
INFANT	2.60E-09	1.49E-07	7.29E-09	7.09E-09	6.99E-09	1.39E-06	2.07E-07	0.00E+00

TABLE 6. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-DECEMBER 2019

SPECIAL LOCATION NO. 1A Site Boundary
AT .67 MILES N

ANNUAL BETA AIR DOSE = 1.82E-06 MILLRADS
ANNUAL GAMMA AIR DOSE = 3.54E-06 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.37E-06	2.37E-06	2.37E-06	2.37E-06	2.37E-06	2.37E-06	2.39E-06	4.34E-06
GROUND	2.03E-03	2.03E-03	2.03E-03	2.03E-03	2.03E-03	2.03E-03	2.03E-03	2.39E-03
VEGET								
ADULT	4.89E-05	2.60E-04	3.97E-05	4.21E-05	1.42E-05	1.07E-03	2.84E-06	0.00E+00
TEEN	6.46E-05	2.77E-04	6.53E-05	6.61E-05	2.22E-05	1.43E-03	5.33E-06	0.00E+00
CHILD	1.12E-04	1.82E-04	1.58E-04	1.10E-04	3.62E-05	2.75E-03	8.11E-06	0.00E+00
MEAT								
ADULT	9.50E-06	6.90E-05	1.75E-06	5.82E-06	8.48E-07	2.85E-05	2.32E-07	0.00E+00
TEEN	7.04E-06	3.71E-05	1.46E-06	4.58E-06	6.88E-07	2.07E-05	2.20E-07	0.00E+00
CHILD	1.04E-05	1.88E-05	2.69E-06	5.68E-06	8.73E-07	3.12E-05	2.58E-07	0.00E+00
COW MILK								
ADULT	1.46E-05	1.63E-05	1.54E-05	2.08E-05	1.03E-05	8.08E-04	1.97E-06	0.00E+00
TEEN	1.62E-05	1.93E-05	2.79E-05	3.66E-05	1.83E-05	1.28E-03	4.06E-06	0.00E+00
CHILD	1.86E-05	1.30E-05	6.75E-05	6.33E-05	3.03E-05	2.54E-03	6.25E-06	0.00E+00
INFANT	2.61E-05	1.16E-05	1.13E-04	1.28E-04	5.05E-05	6.18E-03	1.13E-05	0.00E+00
GOATMILK								
ADULT	3.62E-05	4.03E-06	4.22E-05	5.54E-05	2.30E-05	9.70E-04	5.90E-06	0.00E+00
TEEN	3.54E-05	5.09E-06	7.66E-05	9.78E-05	4.07E-05	1.54E-03	1.22E-05	0.00E+00
CHILD	2.99E-05	3.75E-06	1.85E-04	1.70E-04	6.76E-05	3.05E-03	1.87E-05	0.00E+00
INFANT	3.38E-05	3.55E-06	3.02E-04	3.36E-04	1.11E-04	7.41E-03	3.39E-05	0.00E+00
INHAL								
ADULT	7.36E-07	5.61E-06	6.75E-07	1.07E-06	9.44E-07	1.01E-04	1.12E-04	0.00E+00
TEEN	8.20E-07	5.17E-06	9.50E-07	1.45E-06	1.30E-06	1.30E-04	1.63E-04	0.00E+00
CHILD	7.92E-07	2.03E-06	1.29E-06	1.39E-06	1.22E-06	1.56E-04	1.32E-04	0.00E+00
INFANT	4.57E-07	7.20E-07	8.97E-07	1.12E-06	7.99E-07	1.43E-04	8.45E-05	0.00E+00

TABLE 6. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 2A Site Boundary
AT .60 MILES NNE

ANNUAL BETA AIR DOSE = 4.13E-07 MILLRADS
ANNUAL GAMMA AIR DOSE = 8.05E-07 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	5.38E-07	5.38E-07	5.38E-07	5.38E-07	5.38E-07	5.38E-07	5.42E-07	9.86E-07
GROUND	1.18E-03	1.18E-03	1.18E-03	1.18E-03	1.18E-03	1.18E-03	1.18E-03	1.39E-03
VEGET								
ADULT	2.83E-05	1.51E-04	2.29E-05	2.44E-05	8.19E-06	6.10E-04	1.65E-06	0.00E+00
TEEN	3.74E-05	1.61E-04	3.77E-05	3.83E-05	1.28E-05	8.20E-04	3.09E-06	0.00E+00
CHILD	6.47E-05	1.05E-04	9.08E-05	6.34E-05	2.09E-05	1.57E-03	4.70E-06	0.00E+00
MEAT								
ADULT	5.50E-06	4.00E-05	1.01E-06	3.37E-06	4.90E-07	1.63E-05	1.35E-07	0.00E+00
TEEN	4.08E-06	2.15E-05	8.42E-07	2.65E-06	3.97E-07	1.18E-05	1.27E-07	0.00E+00
CHILD	6.00E-06	1.09E-05	1.56E-06	3.29E-06	5.05E-07	1.78E-05	1.50E-07	0.00E+00
COW MILK								
ADULT	8.46E-06	9.43E-06	8.90E-06	1.20E-05	5.93E-06	4.62E-04	1.14E-06	0.00E+00
TEEN	9.36E-06	1.12E-05	1.62E-05	2.12E-05	1.05E-05	7.32E-04	2.35E-06	0.00E+00
CHILD	1.07E-05	7.53E-06	3.90E-05	3.66E-05	1.75E-05	1.45E-03	3.62E-06	0.00E+00
INFANT	1.50E-05	6.69E-06	6.51E-05	7.38E-05	2.91E-05	3.53E-03	6.55E-06	0.00E+00
GOATMILK								
ADULT	2.10E-05	2.33E-06	2.44E-05	3.21E-05	1.33E-05	5.55E-04	3.42E-06	0.00E+00
TEEN	2.05E-05	2.94E-06	4.43E-05	5.66E-05	2.35E-05	8.79E-04	7.06E-06	0.00E+00
CHILD	1.73E-05	2.16E-06	1.07E-04	9.81E-05	3.91E-05	1.74E-03	1.09E-05	0.00E+00
INFANT	1.95E-05	2.05E-06	1.75E-04	1.94E-04	6.40E-05	4.24E-03	1.96E-05	0.00E+00
INHAL								
ADULT	5.45E-07	4.13E-06	5.01E-07	7.92E-07	7.06E-07	7.60E-05	8.22E-05	0.00E+00
TEEN	6.07E-07	3.81E-06	7.05E-07	1.08E-06	9.74E-07	9.73E-05	1.20E-04	0.00E+00
CHILD	5.87E-07	1.46E-06	9.58E-07	1.03E-06	9.14E-07	1.17E-04	9.74E-05	0.00E+00
INFANT	3.39E-07	5.00E-07	6.66E-07	8.36E-07	5.97E-07	1.07E-04	6.23E-05	0.00E+00

TABLE 6. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 3A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 1.98E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 3.86E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.60E-05	4.73E-05
GROUND	4.17E-04	4.17E-04	4.17E-04	4.17E-04	4.17E-04	4.17E-04	4.17E-04	4.90E-04
VEGET								
ADULT	1.03E-05	5.35E-05	9.65E-06	9.03E-06	3.49E-06	3.23E-04	5.92E-07	0.00E+00
TEEN	1.36E-05	5.71E-05	1.59E-05	1.42E-05	5.43E-06	4.34E-04	1.11E-06	0.00E+00
CHILD	2.35E-05	3.75E-05	3.83E-05	2.35E-05	8.84E-06	8.31E-04	1.69E-06	0.00E+00
MEAT								
ADULT	1.95E-06	1.41E-05	3.82E-07	1.21E-06	1.91E-07	8.62E-06	4.84E-08	0.00E+00
TEEN	1.45E-06	7.61E-06	3.18E-07	9.51E-07	1.55E-07	6.25E-06	4.58E-08	0.00E+00
CHILD	2.13E-06	3.84E-06	5.88E-07	1.18E-06	1.96E-07	9.43E-06	5.38E-08	0.00E+00
COW MILK								
ADULT	3.17E-06	3.42E-06	3.43E-06	4.56E-06	2.55E-06	2.44E-04	4.10E-07	0.00E+00
TEEN	3.58E-06	4.08E-06	6.22E-06	8.05E-06	4.53E-06	3.87E-04	8.46E-07	0.00E+00
CHILD	4.27E-06	2.76E-06	1.50E-05	1.39E-05	7.53E-06	7.68E-04	1.30E-06	0.00E+00
INFANT	6.19E-06	2.46E-06	2.55E-05	2.84E-05	1.26E-05	1.87E-03	2.35E-06	0.00E+00
GOATMILK								
ADULT	7.70E-06	9.38E-07	9.10E-06	1.18E-05	5.28E-06	2.93E-04	1.23E-06	0.00E+00
TEEN	7.65E-06	1.19E-06	1.65E-05	2.09E-05	9.36E-06	4.64E-04	2.54E-06	0.00E+00
CHILD	6.72E-06	8.91E-07	3.99E-05	3.62E-05	1.55E-05	9.22E-04	3.90E-06	0.00E+00
INFANT	8.00E-06	8.50E-07	6.57E-05	7.21E-05	2.56E-05	2.24E-03	7.06E-06	0.00E+00
INHAL								
ADULT	9.33E-08	7.12E-07	8.90E-08	1.39E-07	1.30E-07	1.43E-05	1.36E-05	0.00E+00
TEEN	1.05E-07	7.37E-07	1.25E-07	1.89E-07	1.80E-07	1.83E-05	1.98E-05	0.00E+00
CHILD	1.02E-07	1.01E-06	1.70E-07	1.82E-07	1.69E-07	2.19E-05	1.61E-05	0.00E+00
INFANT	5.97E-08	7.51E-07	1.19E-07	1.48E-07	1.11E-07	2.01E-05	1.03E-05	0.00E+00

TABLE 6. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 1.07E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.09E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.41E-05	2.56E-05
GROUND	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.64E-05	1.93E-05
VEGET								
ADULT	4.12E-07	2.12E-06	4.15E-07	3.65E-07	1.50E-07	1.50E-05	2.36E-08	0.00E+00
TEEN	5.45E-07	2.26E-06	6.83E-07	5.73E-07	2.34E-07	2.02E-05	4.42E-08	0.00E+00
CHILD	9.43E-07	1.49E-06	1.65E-06	9.51E-07	3.80E-07	3.86E-05	6.73E-08	0.00E+00
MEAT								
ADULT	7.73E-08	5.58E-07	1.56E-08	4.80E-08	7.90E-09	4.01E-07	1.93E-09	0.00E+00
TEEN	5.72E-08	3.00E-07	1.30E-08	3.78E-08	6.41E-09	2.91E-07	1.82E-09	0.00E+00
CHILD	8.41E-08	1.52E-07	2.40E-08	4.69E-08	8.14E-09	4.39E-07	2.14E-09	0.00E+00
COW MILK								
ADULT	1.29E-07	1.37E-07	1.41E-07	1.87E-07	1.10E-07	1.13E-05	1.63E-08	0.00E+00
TEEN	1.47E-07	1.63E-07	2.56E-07	3.29E-07	1.96E-07	1.80E-05	3.37E-08	0.00E+00
CHILD	1.79E-07	1.11E-07	6.20E-07	5.70E-07	3.26E-07	3.57E-05	5.18E-08	0.00E+00
INFANT	2.63E-07	9.90E-08	1.06E-06	1.17E-06	5.48E-07	8.67E-05	9.38E-08	0.00E+00
GOATMILK								
ADULT	3.10E-07	3.94E-08	3.69E-07	4.77E-07	2.21E-07	1.36E-05	4.90E-08	0.00E+00
TEEN	3.11E-07	5.03E-08	6.71E-07	8.43E-07	3.91E-07	2.16E-05	1.01E-07	0.00E+00
CHILD	2.79E-07	3.77E-08	1.62E-06	1.46E-06	6.50E-07	4.28E-05	1.56E-07	0.00E+00
INFANT	3.39E-07	3.61E-08	2.68E-06	2.92E-06	1.07E-06	1.04E-04	2.81E-07	0.00E+00
INHAL								
ADULT	9.23E-09	7.19E-08	1.02E-08	1.52E-08	1.72E-08	2.01E-06	1.10E-06	0.00E+00
TEEN	1.07E-08	1.10E-07	1.44E-08	2.08E-08	2.38E-08	2.57E-06	1.62E-06	0.00E+00
CHILD	1.07E-08	4.35E-07	1.96E-08	2.01E-08	2.24E-08	3.07E-06	1.32E-06	0.00E+00
INFANT	6.64E-09	3.70E-07	1.42E-08	1.71E-08	1.47E-08	2.82E-06	8.62E-07	0.00E+00

TABLE 6. DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 1.98E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 3.86E-05 MILLRADS.

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.58E-05	2.60E-05	4.73E-05
GROUND	5.57E-05	5.57E-05	5.57E-05	5.57E-05	5.57E-05	5.57E-05	5.57E-05	6.55E-05
VEGET								
ADULT	1.43E-06	7.21E-06	1.61E-06	1.29E-06	5.88E-07	6.49E-05	8.12E-08	0.00E+00
TEEN	1.89E-06	7.71E-06	2.64E-06	2.02E-06	9.10E-07	8.73E-05	1.52E-07	0.00E+00
CHILD	3.28E-06	5.07E-06	6.39E-06	3.36E-06	1.48E-06	1.67E-04	2.31E-07	0.00E+00
MEAT								
ADULT	2.63E-07	1.89E-06	5.59E-08	1.64E-07	2.90E-08	1.74E-06	6.63E-09	0.00E+00
TEEN	1.94E-07	1.02E-06	4.66E-08	1.30E-07	2.36E-08	1.26E-06	6.28E-09	0.00E+00
CHILD	2.86E-07	5.13E-07	8.62E-08	1.61E-07	2.99E-08	1.90E-06	7.38E-09	0.00E+00
COW MILK								
ADULT	4.62E-07	4.75E-07	5.15E-07	6.74E-07	4.34E-07	4.92E-05	5.61E-08	0.00E+00
TEEN	5.36E-07	5.69E-07	9.35E-07	1.19E-06	7.72E-07	7.79E-05	1.16E-07	0.00E+00
CHILD	6.67E-07	3.88E-07	2.26E-06	2.06E-06	1.28E-06	1.55E-04	1.78E-07	0.00E+00
INFANT	1.01E-06	3.48E-07	3.90E-06	4.26E-06	2.17E-06	3.76E-04	3.23E-07	0.00E+00
GOATMILK								
ADULT	1.09E-06	1.49E-07	1.31E-06	1.68E-06	8.25E-07	5.90E-05	1.68E-07	0.00E+00
TEEN	1.10E-06	1.91E-07	2.38E-06	2.97E-06	1.46E-06	9.34E-05	3.48E-07	0.00E+00
CHILD	1.03E-06	1.45E-07	5.75E-06	5.14E-06	2.43E-06	1.86E-04	5.35E-07	0.00E+00
INFANT	1.29E-06	1.39E-07	9.59E-06	1.03E-05	4.04E-06	4.51E-04	9.68E-07	0.00E+00
INHAL								
ADULT	1.85E-08	1.43E-07	2.04E-08	3.05E-08	3.44E-08	3.96E-06	2.23E-06	0.00E+00
TEEN	2.14E-08	2.13E-07	2.87E-08	4.16E-08	4.75E-08	5.07E-06	3.28E-06	0.00E+00
CHILD	2.15E-08	8.07E-07	3.91E-08	4.03E-08	4.46E-08	6.07E-06	2.67E-06	0.00E+00
INFANT	1.32E-08	6.84E-07	2.82E-08	3.41E-08	2.93E-08	5.57E-06	1.74E-06	0.00E+00

TABLE 7. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2019

SPECIAL LOCATION NO. 1A Site Boundary
AT .67 MILES N

ANNUAL BETA AIR DOSE = 5.52E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 5.91E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.93E-05	3.93E-05	3.93E-05	3.93E-05	3.93E-05	3.93E-05	3.99E-05	9.00E-05
GROUND	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.27E-03	2.67E-03
VEGET								
ADULT	5.58E-05	2.89E-04	3.94E-05	4.92E-05	1.56E-05	9.51E-04	3.49E-06	0.00E+00
TEEN	7.28E-05	3.09E-04	6.48E-05	7.75E-05	2.45E-05	1.28E-03	6.54E-06	0.00E+00
CHILD	1.24E-04	2.02E-04	1.56E-04	1.29E-04	4.00E-05	2.45E-03	9.95E-06	0.00E+00
MEAT								
ADULT	1.07E-05	7.70E-05	2.05E-06	6.70E-06	9.91E-07	2.54E-05	2.85E-07	0.00E+00
TEEN	7.90E-06	4.14E-05	1.70E-06	5.28E-06	8.04E-07	1.84E-05	2.70E-07	0.00E+00
CHILD	1.16E-05	2.09E-05	3.14E-06	6.56E-06	1.02E-06	2.77E-05	3.17E-07	0.00E+00
COW MILK								
ADULT	1.73E-05	1.80E-05	1.79E-05	2.46E-05	1.12E-05	7.22E-04	2.41E-06	0.00E+00
TEEN	1.87E-05	2.14E-05	3.25E-05	4.33E-05	1.98E-05	1.14E-03	4.99E-06	0.00E+00
CHILD	2.06E-05	1.43E-05	7.84E-05	7.48E-05	3.29E-05	2.27E-03	7.66E-06	0.00E+00
INFANT	2.80E-05	1.27E-05	1.29E-04	1.50E-04	5.45E-05	5.52E-03	1.39E-05	0.00E+00
GOATMILK								
ADULT	4.38E-05	4.33E-06	5.02E-05	6.70E-05	2.65E-05	8.66E-04	7.24E-06	0.00E+00
TEEN	4.24E-05	5.44E-06	9.11E-05	1.18E-04	4.69E-05	1.37E-03	1.50E-05	0.00E+00
CHILD	3.47E-05	3.98E-06	2.20E-04	2.05E-04	7.79E-05	2.73E-03	2.30E-05	0.00E+00
INFANT	3.78E-05	3.76E-06	3.57E-04	4.04E-04	1.27E-04	6.63E-03	4.16E-05	0.00E+00
INHAL								
ADULT	8.04E-07	6.11E-06	6.99E-07	1.15E-06	9.35E-07	9.36E-05	1.22E-04	0.00E+00
TEEN	8.78E-07	5.63E-06	9.82E-07	1.56E-06	1.29E-06	1.20E-04	1.79E-04	0.00E+00
CHILD	8.31E-07	2.21E-06	1.33E-06	1.50E-06	1.21E-06	1.45E-04	1.45E-04	0.00E+00
INFANT	4.71E-07	7.91E-07	9.15E-07	1.19E-06	7.89E-07	1.33E-04	9.25E-05	0.00E+00

TABLE 7. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 2A Site Boundary
AT .60 MILES NNE

ANNUAL BETA AIR DOSE = 3.30E-05 MILLRADS
ANNUAL GAMMA AIR DOSE = 3.06E-05 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.03E-05	2.06E-05	4.94E-05
GROUND	1.55E-03	1.55E-03	1.55E-03	1.55E-03	1.55E-03	1.55E-03	1.55E-03	1.82E-03
VEGET								
ADULT	3.80E-05	1.97E-04	2.67E-05	3.35E-05	1.06E-05	6.38E-04	2.38E-06	0.00E+00
TEEN	4.96E-05	2.10E-04	4.39E-05	5.28E-05	1.66E-05	8.58E-04	4.46E-06	0.00E+00
CHILD	8.46E-05	1.38E-04	1.06E-04	8.75E-05	2.71E-05	1.64E-03	6.78E-06	0.00E+00
MEAT								
ADULT	7.31E-06	5.25E-05	1.39E-06	4.57E-06	6.74E-07	1.70E-05	1.94E-07	0.00E+00
TEEN	5.39E-06	2.82E-05	1.16E-06	3.60E-06	5.46E-07	1.23E-05	1.84E-07	0.00E+00
CHILD	7.89E-06	1.43E-05	2.14E-06	4.47E-06	6.94E-07	1.86E-05	2.16E-07	0.00E+00
COW MILK								
ADULT	1.18E-05	1.23E-05	1.22E-05	1.67E-05	7.58E-06	4.85E-04	1.64E-06	0.00E+00
TEEN	1.27E-05	1.46E-05	2.21E-05	2.95E-05	1.34E-05	7.68E-04	3.40E-06	0.00E+00
CHILD	1.40E-05	9.77E-06	5.33E-05	5.09E-05	2.23E-05	1.53E-03	5.22E-06	0.00E+00
INFANT	1.90E-05	8.67E-06	8.80E-05	1.02E-04	3.69E-05	3.71E-03	9.45E-06	0.00E+00
GOATMILK								
ADULT	2.98E-05	2.94E-06	3.42E-05	4.56E-05	1.80E-05	5.82E-04	4.93E-06	0.00E+00
TEEN	2.89E-05	3.69E-06	6.20E-05	8.05E-05	3.19E-05	9.22E-04	1.02E-05	0.00E+00
CHILD	2.36E-05	2.70E-06	1.50E-04	1.40E-04	5.29E-05	1.83E-03	1.57E-05	0.00E+00
INFANT	2.57E-05	2.55E-06	2.43E-04	2.75E-04	8.63E-05	4.45E-03	2.83E-05	0.00E+00
INHAL								
ADULT	6.28E-07	4.79E-06	5.43E-07	8.95E-07	7.19E-07	7.17E-05	9.60E-05	0.00E+00
TEEN	6.85E-07	4.41E-06	7.64E-07	1.22E-06	9.93E-07	9.21E-05	1.40E-04	0.00E+00
CHILD	6.47E-07	1.69E-06	1.04E-06	1.16E-06	9.31E-07	1.11E-04	1.14E-04	0.00E+00
INFANT	3.66E-07	5.82E-07	7.10E-07	9.25E-07	6.06E-07	1.02E-04	7.27E-05	0.00E+00

TABLE 7. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 3A Nearest Resident
AT .90 MILES NW

ANNUAL BETA AIR DOSE = 2.98E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 4.82E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.23E-04	3.23E-04	3.23E-04	3.23E-04	3.23E-04	3.23E-04	3.26E-04	6.36E-04
GROUND	6.20E-04	6.20E-04	6.20E-04	6.20E-04	6.20E-04	6.20E-04	6.20E-04	7.30E-04
VEGET								
ADULT	1.59E-05	8.06E-05	1.45E-05	1.44E-05	5.51E-06	4.78E-04	9.82E-07	0.00E+00
TEEN	2.07E-05	8.61E-05	2.38E-05	2.26E-05	8.58E-06	6.43E-04	1.84E-06	0.00E+00
CHILD	3.53E-05	5.67E-05	5.72E-05	3.75E-05	1.40E-05	1.23E-03	2.80E-06	0.00E+00
MEAT								
ADULT	2.95E-06	2.11E-05	6.29E-07	1.87E-06	3.08E-07	1.28E-05	8.02E-08	0.00E+00
TEEN	2.17E-06	1.13E-05	5.23E-07	1.47E-06	2.50E-07	9.25E-06	7.59E-08	0.00E+00
CHILD	3.17E-06	5.73E-06	9.66E-07	1.83E-06	3.17E-07	1.40E-05	8.91E-08	0.00E+00
COW MILK								
ADULT	5.12E-06	5.13E-06	5.51E-06	7.40E-06	4.00E-06	3.62E-04	6.78E-07	0.00E+00
TEEN	5.71E-06	6.12E-06	1.00E-05	1.30E-05	7.11E-06	5.74E-04	1.40E-06	0.00E+00
CHILD	6.62E-06	4.15E-06	2.42E-05	2.26E-05	1.18E-05	1.14E-03	2.15E-06	0.00E+00
INFANT	9.45E-06	3.70E-06	4.07E-05	4.59E-05	1.98E-05	2.77E-03	3.90E-06	0.00E+00
GOATMILK								
ADULT	1.27E-05	1.42E-06	1.48E-05	1.94E-05	8.48E-06	4.35E-04	2.04E-06	0.00E+00
TEEN	1.25E-05	1.81E-06	2.68E-05	3.43E-05	1.50E-05	6.89E-04	4.21E-06	0.00E+00
CHILD	1.08E-05	1.35E-06	6.47E-05	5.95E-05	2.50E-05	1.37E-03	6.46E-06	0.00E+00
INFANT	1.26E-05	1.29E-06	1.06E-04	1.18E-04	4.10E-05	3.33E-03	1.17E-05	0.00E+00
INHAL								
ADULT	1.46E-07	1.20E-06	1.36E-07	2.17E-07	1.92E-07	1.99E-05	2.11E-05	0.00E+00
TEEN	1.62E-07	1.28E-06	1.92E-07	2.95E-07	2.64E-07	2.55E-05	3.09E-05	0.00E+00
CHILD	1.55E-07	1.80E-06	2.61E-07	2.83E-07	2.48E-07	3.07E-05	2.51E-05	0.00E+00
INFANT	8.96E-08	1.34E-06	1.81E-07	2.29E-07	1.62E-07	2.82E-05	1.61E-05	0.00E+00

TABLE 7. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 1.29E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 2.10E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.41E-04	1.42E-04	2.77E-04
GROUND	2.24E-05	2.24E-05	2.24E-05	2.24E-05	2.24E-05	2.24E-05	2.24E-05	2.64E-05
VEGET								
ADULT	5.83E-07	2.93E-06	5.77E-07	5.32E-07	2.17E-07	2.04E-05	3.59E-08	0.00E+00
TEEN	7.61E-07	3.14E-06	9.48E-07	8.36E-07	3.37E-07	2.74E-05	6.72E-08	0.00E+00
CHILD	1.30E-06	2.07E-06	2.28E-06	1.39E-06	5.48E-07	5.26E-05	1.02E-07	0.00E+00
MEAT								
ADULT	1.07E-07	7.61E-07	2.37E-08	6.80E-08	1.17E-08	5.46E-07	2.93E-09	0.00E+00
TEEN	7.86E-08	4.10E-07	1.98E-08	5.36E-08	9.48E-09	3.95E-07	2.77E-09	0.00E+00
CHILD	1.15E-07	2.07E-07	3.65E-08	6.68E-08	1.20E-08	5.97E-07	3.26E-09	0.00E+00
COW MILK								
ADULT	1.91E-07	1.88E-07	2.08E-07	2.77E-07	1.58E-07	1.55E-05	2.48E-08	0.00E+00
TEEN	2.15E-07	2.25E-07	3.78E-07	4.89E-07	2.81E-07	2.45E-05	5.13E-08	0.00E+00
CHILD	2.53E-07	1.53E-07	9.13E-07	8.46E-07	4.67E-07	4.86E-05	7.88E-08	0.00E+00
INFANT	3.67E-07	1.37E-07	1.55E-06	1.73E-06	7.83E-07	1.18E-04	1.43E-07	0.00E+00
GOATMILK								
ADULT	4.68E-07	5.48E-08	5.50E-07	7.19E-07	3.24E-07	1.86E-05	7.44E-08	0.00E+00
TEEN	4.65E-07	7.01E-08	9.98E-07	1.27E-06	5.75E-07	2.94E-05	1.54E-07	0.00E+00
CHILD	4.10E-07	5.26E-08	2.41E-06	2.20E-06	9.54E-07	5.83E-05	2.36E-07	0.00E+00
INFANT	4.90E-07	5.03E-08	3.97E-06	4.38E-06	1.57E-06	1.42E-04	4.28E-07	0.00E+00
INHAL								
ADULT	1.50E-08	1.50E-07	1.71E-08	2.45E-08	2.69E-08	3.03E-06	1.76E-06	0.00E+00
TEEN	1.71E-08	2.15E-07	2.40E-08	3.35E-08	3.72E-08	3.88E-06	2.59E-06	0.00E+00
CHILD	1.70E-08	6.60E-07	3.27E-08	3.24E-08	3.49E-08	4.65E-06	2.11E-06	0.00E+00
INFANT	1.05E-08	5.46E-07	2.35E-08	2.74E-08	2.29E-08	4.27E-06	1.39E-06	0.00E+00

TABLE 7. DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 2.93E-04 MILLRADS
ANNUAL GAMMA AIR DOSE = 4.78E-04 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	3.21E-04	3.21E-04	3.21E-04	3.21E-04	3.21E-04	3.21E-04	3.24E-04	6.29E-04
GROUND	8.98E-05	8.98E-05	8.98E-05	8.98E-05	8.98E-05	8.98E-05	8.98E-05	1.06E-04
VEGET								
ADULT	2.40E-06	1.19E-05	2.67E-06	2.22E-06	9.91E-07	1.03E-04	1.46E-07	0.00E+00
TEEN	3.13E-06	1.27E-05	4.39E-06	3.48E-06	1.54E-06	1.39E-04	2.74E-07	0.00E+00
CHILD	5.34E-06	8.42E-06	1.06E-05	5.80E-06	2.49E-06	2.66E-04	4.17E-07	0.00E+00
MEAT								
ADULT	4.31E-07	3.05E-06	1.02E-07	2.76E-07	5.05E-08	2.76E-06	1.20E-08	0.00E+00
TEEN	3.16E-07	1.64E-06	8.47E-08	2.18E-07	4.10E-08	2.00E-06	1.13E-08	0.00E+00
CHILD	4.62E-07	8.30E-07	1.57E-07	2.71E-07	5.20E-08	3.02E-06	1.33E-08	0.00E+00
COW MILK								
ADULT	8.05E-07	7.74E-07	8.95E-07	1.18E-06	7.28E-07	7.83E-05	1.01E-07	0.00E+00
TEEN	9.19E-07	9.29E-07	1.63E-06	2.08E-06	1.29E-06	1.24E-04	2.09E-07	0.00E+00
CHILD	1.11E-06	6.36E-07	3.93E-06	3.60E-06	2.15E-06	2.46E-04	3.21E-07	0.00E+00
INFANT	1.65E-06	5.72E-07	6.74E-06	7.41E-06	3.62E-06	5.99E-04	5.81E-07	0.00E+00
GOATMILK								
ADULT	1.94E-06	2.44E-07	2.31E-06	2.99E-06	1.42E-06	9.40E-05	3.04E-07	0.00E+00
TEEN	1.95E-06	3.14E-07	4.19E-06	5.28E-06	2.52E-06	1.49E-04	6.27E-07	0.00E+00
CHILD	1.78E-06	2.38E-07	1.01E-05	9.15E-06	4.19E-06	2.96E-04	9.64E-07	0.00E+00
INFANT	2.19E-06	2.29E-07	1.68E-05	1.83E-05	6.93E-06	7.18E-04	1.74E-06	0.00E+00
INHAL								
ADULT	3.19E-08	3.20E-07	3.69E-08	5.30E-08	5.92E-08	6.66E-06	3.67E-06	0.00E+00
TEEN	3.66E-08	4.63E-07	5.19E-08	7.24E-08	8.18E-08	8.53E-06	5.41E-06	0.00E+00
CHILD	3.66E-08	1.44E-06	7.06E-08	7.01E-08	7.68E-08	1.02E-05	4.40E-06	0.00E+00
INFANT	2.26E-08	1.19E-06	5.10E-08	5.94E-08	5.04E-08	9.40E-06	2.90E-06	0.00E+00

TABLE 8. DOSES TO POPULATION WITHIN 50 MILES, JANUARY-MARCH 2019

ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.18E-04	: 1.18E-04	: 1.18E-04	: 1.18E-04	: 1.18E-04	: 1.18E-04	: 1.20E-04	: 2.77E-04
	: 93.76%	: 92.58%	: 93.48%	: 93.63%	: 93.88%	: 63.19%	: 93.27%	: 97.04%
GROUND	: 7.20E-06	: 7.20E-06	: 7.20E-06	: 7.20E-06	: 7.20E-06	: 7.20E-06	: 7.20E-06	: 8.47E-06
	: 5.72%	: 5.65%	: 5.70%	: 5.71%	: 5.73%	: 3.85%	: 5.61%	: 2.96%
INHAL	: 1.52E-08	: 2.86E-07	: 2.81E-08	: 2.90E-08	: 4.07E-08	: 5.23E-06	: 1.38E-06	: 0.00E+00
	: .01%	: .22%	: .02%	: .02%	: .03%	: 2.80%	: 1.07%	: .00%
VEGET	: 3.22E-07	: 1.31E-06	: 5.15E-07	: 2.90E-07	: 6.91E-08	: 7.27E-07	: 2.26E-08	: 0.00E+00
	: .26%	: 1.03%	: .41%	: .23%	: .05%	: .39%	: .02%	: .00%
COW MILK	: 2.35E-07	: 2.09E-07	: 4.58E-07	: 4.61E-07	: 3.78E-07	: 5.44E-05	: 3.29E-08	: 0.00E+00
	: .19%	: .16%	: .36%	: .37%	: .30%	: 29.15%	: .03%	: .00%
MEAT	: 7.62E-08	: 4.57E-07	: 2.93E-08	: 4.74E-08	: 1.14E-08	: 1.14E-06	: 1.86E-09	: 0.00E+00
	: .06%	: .36%	: .02%	: .04%	: .01%	: .61%	: .00%	: .00%
TOTAL	: 1.26E-04	: 1.27E-04	: 1.26E-04	: 1.26E-04	: 1.26E-04	: 1.87E-04	: 1.28E-04	: 2.86E-04

TABLE 9. DOSES TO POPULATION WITHIN 50 MILES, APRIL-JUNE 2019

ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 2.15E-06	: 2.15E-06	: 2.15E-06	: 2.15E-06	: 2.15E-06	: 2.15E-06	: 2.16E-06	: 4.42E-06
	: 8.04%	: 7.09%	: 7.97%	: 7.80%	: 8.33%	: 3.81%	: 7.85%	: 14.19%
GROUND	: 2.27E-05	: 2.27E-05	: 2.27E-05	: 2.27E-05	: 2.27E-05	: 2.27E-05	: 2.27E-05	: 2.67E-05
	: 85.01%	: 75.00%	: 84.26%	: 82.51%	: 88.16%	: 40.35%	: 82.42%	: 85.81%
INHAL	: 1.88E-08	: 1.51E-07	: 2.14E-08	: 3.14E-08	: 2.72E-08	: 2.83E-06	: 2.43E-06	: 0.00E+00
	: .07%	: .50%	: .08%	: .11%	: .11%	: 5.02%	: 8.80%	: .00%
VEGET	: 1.00E-06	: 3.57E-06	: 8.15E-07	: 1.10E-06	: 2.80E-07	: 3.63E-07	: 9.62E-08	: 0.00E+00
	: 3.74%	: 11.77%	: 3.02%	: 3.98%	: 1.09%	: .65%	: .35%	: .00%
COW MILK	: 6.18E-07	: 4.61E-07	: 1.20E-06	: 1.39E-06	: 5.68E-07	: 2.77E-05	: 1.49E-07	: 0.00E+00
	: 2.31%	: 1.52%	: 4.45%	: 5.04%	: 2.20%	: 49.14%	: .54%	: .00%
MEAT	: 2.22E-07	: 1.25E-06	: 6.03E-08	: 1.52E-07	: 2.72E-08	: 5.78E-07	: 8.26E-09	: 0.00E+00
	: .83%	: 4.12%	: .22%	: .55%	: .11%	: 1.03%	: .03%	: .00%
TOTAL	: 2.67E-05	: 3.03E-05	: 2.70E-05	: 2.75E-05	: 2.58E-05	: 5.63E-05	: 2.76E-05	: 3.11E-05

TABLE 10. DOSES TO POPULATION WITHIN 50 MILES, JANUARY-JUNE 2019

ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.22E-04 : : 79.41% :	: 1.22E-04 : : 76.82% :	: 1.22E-04 : : 79.08% :	: 1.22E-04 : : 78.90% :	: 1.22E-04 : : 79.98% :	: 1.22E-04 : : 49.89% :	: 1.24E-04 : : 78.69% :	: 2.86E-04 : : 89.28% :
GROUND	: 2.92E-05 : : 18.96% :	: 2.92E-05 : : 18.35% :	: 2.92E-05 : : 18.89% :	: 2.92E-05 : : 18.84% :	: 2.92E-05 : : 19.10% :	: 2.92E-05 : : 11.92% :	: 2.92E-05 : : 18.53% :	: 3.44E-05 : : 10.72% :
INHAL	: 3.59E-08 : : .02% :	: 4.48E-07 : : .28% :	: 5.16E-08 : : .03% :	: 6.33E-08 : : .04% :	: 6.93E-08 : : .05% :	: 8.13E-06 : : 3.31% :	: 4.07E-06 : : 2.58% :	: 0.00E+00 : : .00% :
VEGET	: 1.32E-06 : : .86% :	: 4.88E-06 : : 3.06% :	: 1.34E-06 : : .86% :	: 1.39E-06 : : .89% :	: 3.50E-07 : : .23% :	: 1.10E-06 : : .45% :	: 1.19E-07 : : .08% :	: 0.00E+00 : : .00% :
COW MILK	: 8.55E-07 : : .55% :	: 6.72E-07 : : .42% :	: 1.66E-06 : : 1.07% :	: 1.85E-06 : : 1.20% :	: 9.50E-07 : : .62% :	: 8.27E-05 : : 33.72% :	: 1.82E-07 : : .12% :	: 0.00E+00 : : .00% :
MEAT	: 2.99E-07 : : .19% :	: 1.71E-06 : : 1.07% :	: 9.00E-08 : : .06% :	: 2.00E-07 : : .13% :	: 3.87E-08 : : .03% :	: 1.73E-06 : : .71% :	: 1.01E-08 : : .01% :	: 0.00E+00 : : .00% :
TOTAL	: 1.54E-04 : : 1.59E-04 :	: 1.59E-04 : : 1.55E-04 :	: 1.55E-04 : : 1.55E-04 :	: 1.55E-04 : : 1.53E-04 :	: 1.53E-04 : : 2.45E-04 :	: 2.45E-04 : : 1.58E-04 :	: 1.58E-04 : : 3.21E-04 :	: 3.21E-04 : : 3.21E-04 :

TABLE 11. DOSES TO POPULATION WITHIN 50 MILES, JULY-SEPTEMBER 2019

ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.66E-06 : : 2.68% :	: 1.66E-06 : : 2.34% :	: 1.66E-06 : : 2.70% :	: 1.66E-06 : : 2.65% :	: 1.66E-06 : : 2.78% :	: 1.66E-06 : : 1.02% :	: 1.68E-06 : : 2.55% :	: 3.75E-06 : : 5.34% :
GROUND	: 5.65E-05 : : 91.33% :	: 5.65E-05 : : 79.50% :	: 5.65E-05 : : 91.88% :	: 5.65E-05 : : 90.18% :	: 5.65E-05 : : 94.46% :	: 5.65E-05 : : 34.57% :	: 5.65E-05 : : 85.80% :	: 6.65E-05 : : 94.66% :
INHAL	: 5.01E-08 : : .08% :	: 3.99E-07 : : .56% :	: 5.21E-08 : : .08% :	: 8.01E-08 : : .13% :	: 7.93E-08 : : .13% :	: 9.63E-06 : : 5.89% :	: 7.29E-06 : : 11.07% :	: 0.00E+00 : : .00% :
VEGET	: 2.07E-06 : : 3.34% :	: 8.44E-06 : : 11.87% :	: 1.26E-06 : : 2.05% :	: 1.86E-06 : : 2.96% :	: 4.17E-07 : : .70% :	: 1.15E-06 : : .70% :	: 1.44E-07 : : .22% :	: 0.00E+00 : : .00% :
COW MILK	: 1.09E-06 : : 1.76% :	: 1.10E-06 : : 1.54% :	: 1.93E-06 : : 3.13% :	: 2.26E-06 : : 3.60% :	: 1.11E-06 : : 1.86% :	: 9.26E-05 : : 56.64% :	: 2.22E-07 : : .34% :	: 0.00E+00 : : .00% :
MEAT	: 4.98E-07 : : .80% :	: 2.98E-06 : : 4.19% :	: 9.29E-08 : : .15% :	: 3.00E-07 : : .48% :	: 4.60E-08 : : .08% :	: 1.93E-06 : : 1.18% :	: 1.23E-08 : : .02% :	: 0.00E+00 : : .00% :
TOTAL	: 6.19E-05 : : 1.00E-04 % :	: 7.11E-05 : : 1.17E-04 % :	: 6.15E-05 : : 1.00E-04 % :	: 6.27E-05 : : 1.01E-04 % :	: 5.98E-05 : : 9.66E-05 % :	: 1.64E-04 : : 2.65E-04 % :	: 6.59E-05 : : 1.05E-04 % :	: 7.02E-05 : : 1.11E-04 % :

TABLE 12. DOSES TO POPULATION WITHIN 50 MILES, OCTOBER-DECEMBER 2019

ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 2.50E-06	: 2.50E-06	: 2.50E-06	: 2.50E-06	: 2.50E-06	: 2.50E-06	: 2.53E-06	: 5.94E-06
	: 20.75%	: 18.37%	: 19.13%	: 20.31%	: 21.14%	: 3.49%	: 19.12%	: 36.52%
GROUND	: 8.78E-06	: 8.78E-06	: 8.78E-06	: 8.78E-06	: 8.78E-06	: 8.78E-06	: 8.78E-06	: 1.03E-05
	: 72.73%	: 64.38%	: 67.04%	: 71.19%	: 74.09%	: 12.22%	: 66.31%	: 63.48%
INHAL	: 2.25E-08	: 1.49E-07	: 4.10E-08	: 4.22E-08	: 5.58E-08	: 7.23E-06	: 1.85E-06	: 0.00E+00
	: .19%	: 1.09%	: .31%	: .34%	: .47%	: 10.06%	: 13.96%	: .00%
VEGET	: 3.94E-07	: 1.49E-06	: 1.08E-06	: 3.71E-07	: 9.19E-08	: 6.66E-07	: 3.10E-08	: 0.00E+00
	: 3.27%	: 10.91%	: 8.26%	: 3.00%	: .78%	: .93%	: .23%	: .00%
COW MILK	: 2.83E-07	: 2.18E-07	: 6.51E-07	: 5.78E-07	: 4.05E-07	: 5.16E-05	: 4.76E-08	: 0.00E+00
	: 2.34%	: 1.60%	: 4.97%	: 4.69%	: 3.42%	: 71.78%	: .36%	: .00%
MEAT	: 8.73E-08	: 4.98E-07	: 3.62E-08	: 5.74E-08	: 1.34E-08	: 1.09E-06	: 2.64E-09	: 0.00E+00
	: .72%	: 3.65%	: .28%	: .47%	: .11%	: 1.52%	: .02%	: .00%
TOTAL	: 1.21E-05	: 1.36E-05	: 1.31E-05	: 1.23E-05	: 1.18E-05	: 7.18E-05	: 1.32E-05	: 1.63E-05

TABLE 13. DOSES TO POPULATION WITHIN 50 MILES, JULY-DECEMBER 2019

ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 4.20E-06 :	: 4.20E-06 :	: 4.20E-06 :	: 4.20E-06 :	: 4.20E-06 :	: 4.20E-06 :	: 4.25E-06 :	: 9.81E-06 :
	: 5.81% :	: 5.06% :	: 5.76% :	: 5.73% :	: 6.00% :	: 1.79% :	: 5.39% :	: 11.61% :
GROUND	: 6.35E-05 :	: 6.35E-05 :	: 6.35E-05 :	: 6.35E-05 :	: 6.35E-05 :	: 6.35E-05 :	: 6.35E-05 :	: 7.47E-05 :
	: 87.94% :	: 76.47% :	: 87.15% :	: 86.67% :	: 90.80% :	: 27.09% :	: 80.59% :	: 88.39% :
INHAL	: 8.04E-08 :	: 5.96E-07 :	: 9.79E-08 :	: 1.33E-07 :	: 1.42E-07 :	: 1.77E-05 :	: 1.06E-05 :	: 0.00E+00 :
	: .11% :	: .72% :	: .13% :	: .18% :	: .20% :	: 7.55% :	: 13.43% :	: .00% :
VEGET	: 2.47E-06 :	: 9.94E-06 :	: 2.35E-06 :	: 2.23E-06 :	: 5.11E-07 :	: 1.81E-06 :	: 1.76E-07 :	: 0.00E+00 :
	: 3.42% :	: 11.97% :	: 3.22% :	: 3.05% :	: .73% :	: .77% :	: .22% :	: .00% :
COW MILK	: 1.38E-06 :	: 1.32E-06 :	: 2.59E-06 :	: 2.84E-06 :	: 1.52E-06 :	: 1.44E-04 :	: 2.71E-07 :	: 0.00E+00 :
	: 1.90% :	: 1.59% :	: 3.55% :	: 3.88% :	: 2.18% :	: 61.51% :	: .34% :	: .00% :
MEAT	: 5.86E-07 :	: 3.48E-06 :	: 1.30E-07 :	: 3.58E-07 :	: 5.96E-08 :	: 3.02E-06 :	: 1.50E-08 :	: 0.00E+00 :
	: .81% :	: 4.19% :	: .18% :	: .49% :	: .09% :	: 1.29% :	: .02% :	: .00% :
TOTAL	: 7.22E-05 :	: 8.30E-05 :	: 7.28E-05 :	: 7.33E-05 :	: 6.99E-05 :	: 2.34E-04 :	: 7.88E-05 :	: 8.45E-05 :

TABLE 14. DOSES TO POPULATION WITHIN 50 MILES, JANUARY-DECEMBER 2019

ALARA ANNUAL INTEGRATED POPULATION DOSE SUMMARY (PERSON-REM)

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	: 1.33E-04	: 1.33E-04	: 1.33E-04	: 1.33E-04	: 1.33E-04	: 1.33E-04	: 1.34E-04	: 3.11E-04
	: 57.29%	: 53.58%	: 56.98%	: 56.79%	: 58.14%	: 27.43%	: 55.78%	: 74.21%
GROUND	: 9.18E-05	: 9.18E-05	: 9.18E-05	: 9.18E-05	: 9.18E-05	: 9.18E-05	: 9.18E-05	: 1.08E-04
	: 39.68%	: 37.11%	: 39.46%	: 39.33%	: 40.27%	: 19.00%	: 38.09%	: 25.79%
INHAL	: 1.12E-07	: 1.03E-06	: 1.45E-07	: 1.90E-07	: 2.05E-07	: 2.49E-05	: 1.40E-05	: 0.00E+00
	: .05%	: .42%	: .06%	: .08%	: .09%	: 5.15%	: 5.81%	: .00%
VEGET	: 3.79E-06	: 1.48E-05	: 3.67E-06	: 3.61E-06	: 8.57E-07	: 2.91E-06	: 2.93E-07	: 0.00E+00
	: 1.64%	: 5.99%	: 1.58%	: 1.55%	: .38%	: .60%	: .12%	: .00%
COW MILK	: 2.22E-06	: 1.99E-06	: 4.23E-06	: 4.68E-06	: 2.46E-06	: 2.26E-04	: 4.52E-07	: 0.00E+00
	: .96%	: .80%	: 1.82%	: 2.01%	: 1.08%	: 46.84%	: .19%	: .00%
MEAT	: 8.85E-07	: 5.19E-06	: 2.19E-07	: 5.57E-07	: 9.80E-08	: 4.75E-06	: 2.51E-08	: 0.00E+00
	: .38%	: 2.10%	: .09%	: .24%	: .04%	: .98%	: .01%	: .00%
TOTAL	: 2.31E-04	: 2.47E-04	: 2.33E-04	: 2.33E-04	: 2.28E-04	: 4.83E-04	: 2.41E-04	: 4.19E-04

CARBON-14 GASEOUS EFFLUENT DOSE CALCULATIONS

Doses to the maximum individual resulting from the release of Carbon-14 in gaseous effluents from the Cooper Nuclear Station (CNS) were calculated using the latest version of the GASPAR computer code included as part of NRC Dose 2.3.20 (ORNL 2015). Four pathways were selected for individual dose calculations: the nearest site boundary for inhalation, nearest garden for vegetation ingestion, nearest animal for meat ingestion, and the nearest milk animal (cow). Based on the 2019 Land Use Census, there are no meat or milk animals identified within 5 miles of CNS. However, CNS maintains a virtual cow receptor at 3.5 miles north-northwest of the plant and conservatively includes this receptor in dose calculations.

Use of a normalized Carbon-14 source term and scaling factors based on the annual thermal gigawatts (GW_T) power generation were utilized to determine the quantity of Carbon-14 in the CNS gaseous effluent discharge for 2019. Specifically, the Boiling Water Reactor proxy production rate of 5.1 curies Carbon-14 per GW_T generation using the methodology described in EPRI, 2010 was the basis for the CNS total calculated emissions of 12.2 curies of Carbon-14 in 2019.

GASPAR implements the radiological dose models of Regulatory Guide 1.109 for determining the radiation exposure to man from four principal atmospheric exposure pathways: plume, ground, inhalation, and ingestion. Doses to the maximum individual are calculated as a function of age group and pathway for significant body organs.

Tables 15 through 21 present maximum individual doses. Note that the inhalation pathway was calculated at the closest site boundary receptor and was negligible for Carbon-14 and is not included in the tables. In addition, the doses presented were conservatively calculated based on the annual site X/Qs. These X/Qs result in doses approximately 20% higher than those calculated with the X/Qs based on growing season meteorology.

Additional assumptions and data used for input to the GASPAR code are described in a separate section of this appendix (see page F-67).

TABLE 15. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-MARCH 2019

SPECIAL LOCATION NO. 4A Nearest Cow

AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS

ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	4.82E-03	4.82E-03	2.41E-02	4.82E-03	4.82E-03	4.82E-03	4.82E-03	4.82E-03
TEEN	8.06E-03	8.06E-03	4.03E-02	8.06E-03	8.06E-03	8.06E-03	8.06E-03	8.06E-03
CHILD	1.96E-02	1.96E-02	9.81E-02	1.96E-02	1.96E-02	1.96E-02	1.96E-02	1.96E-02
MEAT								
ADULT	1.92E-03	1.92E-03	9.62E-03	1.92E-03	1.92E-03	1.92E-03	1.92E-03	1.92E-03
TEEN	1.63E-03	1.63E-03	8.13E-03	1.63E-03	1.63E-03	1.63E-03	1.63E-03	1.63E-03
CHILD	3.06E-03	3.06E-03	1.53E-02	3.06E-03	3.06E-03	3.06E-03	3.06E-03	3.06E-03
COW MILK								
ADULT	2.10E-03	2.10E-03	1.05E-02	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03
TEEN	3.87E-03	3.87E-03	1.94E-02	3.87E-03	3.87E-03	3.87E-03	3.87E-03	3.87E-03
CHILD	9.52E-03	9.52E-03	4.76E-02	9.52E-03	9.52E-03	9.52E-03	9.52E-03	9.52E-03
INFANT	1.99E-02	1.99E-02	9.32E-02	1.99E-02	1.99E-02	1.99E-02	1.99E-02	1.99E-02
GOATMILK								
ADULT	2.10E-03	2.10E-03	1.05E-02	2.10E-03	2.10E-03	2.10E-03	2.10E-03	2.10E-03
TEEN	3.87E-03	3.87E-03	1.94E-02	3.87E-03	3.87E-03	3.87E-03	3.87E-03	3.87E-03
CHILD	9.52E-03	9.52E-03	4.76E-02	9.52E-03	9.52E-03	9.52E-03	9.52E-03	9.52E-03
INFANT	1.99E-02	1.99E-02	9.32E-02	1.99E-02	1.99E-02	1.99E-02	1.99E-02	1.99E-02

TABLE 15. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-MARCH 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	9.16E-03	9.16E-03	4.58E-02	9.16E-03	9.16E-03	9.16E-03	9.16E-03	9.16E-03
TEEN	1.53E-02	1.53E-02	7.66E-02	1.53E-02	1.53E-02	1.53E-02	1.53E-02	1.53E-02
CHILD	3.73E-02	3.73E-02	1.86E-01	3.73E-02	3.73E-02	3.73E-02	3.73E-02	3.73E-02
MEAT								
ADULT	3.66E-03	3.66E-03	1.83E-02	3.66E-03	3.66E-03	3.66E-03	3.66E-03	3.66E-03
TEEN	3.09E-03	3.09E-03	1.54E-02	3.09E-03	3.09E-03	3.09E-03	3.09E-03	3.09E-03
CHILD	5.80E-03	5.80E-03	2.90E-02	5.80E-03	5.80E-03	5.80E-03	5.80E-03	5.80E-03
COW MILK								
ADULT	3.99E-03	3.99E-03	1.99E-02	3.99E-03	3.99E-03	3.99E-03	3.99E-03	3.99E-03
TEEN	7.36E-03	7.36E-03	3.68E-02	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03
CHILD	1.81E-02	1.81E-02	9.04E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02
INFANT	3.78E-02	3.78E-02	1.77E-01	3.78E-02	3.78E-02	3.78E-02	3.78E-02	3.78E-02
GOATMILK								
ADULT	3.99E-03	3.99E-03	1.99E-02	3.99E-03	3.99E-03	3.99E-03	3.99E-03	3.99E-03
TEEN	7.36E-03	7.36E-03	3.68E-02	7.36E-03	7.36E-03	7.36E-03	7.36E-03	7.36E-03
CHILD	1.81E-02	1.81E-02	9.04E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02
INFANT	3.78E-02	3.78E-02	1.77E-01	3.78E-02	3.78E-02	3.78E-02	3.78E-02	3.78E-02

TABLE 16. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), APRIL-JUNE 2019

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	2.92E-03	2.92E-03	1.46E-02	2.92E-03	2.92E-03	2.92E-03	2.92E-03	2.92E-03
TEEN	4.89E-03	4.89E-03	2.44E-02	4.89E-03	4.89E-03	4.89E-03	4.89E-03	4.89E-03
CHILD	1.19E-02	1.19E-02	5.95E-02	1.19E-02	1.19E-02	1.19E-02	1.19E-02	1.19E-02
MEAT								
ADULT	1.17E-03	1.17E-03	5.83E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03	1.17E-03
TEEN	9.85E-04	9.85E-04	4.92E-03	9.85E-04	9.85E-04	9.85E-04	9.85E-04	9.85E-04
CHILD	1.85E-03	1.85E-03	9.26E-03	1.85E-03	1.85E-03	1.85E-03	1.85E-03	1.85E-03
COW MILK								
ADULT	1.27E-03	1.27E-03	6.36E-03	1.27E-03	1.27E-03	1.27E-03	1.27E-03	1.27E-03
TEEN	2.35E-03	2.35E-03	1.17E-02	2.35E-03	2.35E-03	2.35E-03	2.35E-03	2.35E-03
CHILD	5.77E-03	5.77E-03	2.88E-02	5.77E-03	5.77E-03	5.77E-03	5.77E-03	5.77E-03
INFANT	1.21E-02	1.21E-02	5.65E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02
GOATMILK								
ADULT	1.27E-03	1.27E-03	6.36E-03	1.27E-03	1.27E-03	1.27E-03	1.27E-03	1.27E-03
TEEN	2.35E-03	2.35E-03	1.17E-02	2.35E-03	2.35E-03	2.35E-03	2.35E-03	2.35E-03
CHILD	5.77E-03	5.77E-03	2.88E-02	5.77E-03	5.77E-03	5.77E-03	5.77E-03	5.77E-03
INFANT	1.21E-02	1.21E-02	5.65E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02	1.21E-02

TABLE 16. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), APRIL-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	7.63E-03	7.63E-03	3.81E-02	7.63E-03	7.63E-03	7.63E-03	7.63E-03	7.63E-03
TEEN	1.28E-02	1.28E-02	6.38E-02	1.28E-02	1.28E-02	1.28E-02	1.28E-02	1.28E-02
CHILD	3.11E-02	3.11E-02	1.55E-01	3.11E-02	3.11E-02	3.11E-02	3.11E-02	3.11E-02
MEAT								
ADULT	3.04E-03	3.04E-03	1.52E-02	3.04E-03	3.04E-03	3.04E-03	3.04E-03	3.04E-03
TEEN	2.57E-03	2.57E-03	1.29E-02	2.57E-03	2.57E-03	2.57E-03	2.57E-03	2.57E-03
CHILD	4.83E-03	4.83E-03	2.42E-02	4.83E-03	4.83E-03	4.83E-03	4.83E-03	4.83E-03
COW MILK								
ADULT	3.32E-03	3.32E-03	1.66E-02	3.32E-03	3.32E-03	3.32E-03	3.32E-03	3.32E-03
TEEN	6.13E-03	6.13E-03	3.06E-02	6.13E-03	6.13E-03	6.13E-03	6.13E-03	6.13E-03
CHILD	1.51E-02	1.51E-02	7.53E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02
INFANT	3.15E-02	3.15E-02	1.48E-01	3.15E-02	3.15E-02	3.15E-02	3.15E-02	3.15E-02
GOATMILK								
ADULT	3.32E-03	3.32E-03	1.66E-02	3.32E-03	3.32E-03	3.32E-03	3.32E-03	3.32E-03
TEEN	6.13E-03	6.13E-03	3.06E-02	6.13E-03	6.13E-03	6.13E-03	6.13E-03	6.13E-03
CHILD	1.51E-02	1.51E-02	7.53E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02	1.51E-02
INFANT	3.15E-02	3.15E-02	1.48E-01	3.15E-02	3.15E-02	3.15E-02	3.15E-02	3.15E-02

TABLE 17. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-JUNE 2019

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	7.75E-03	7.75E-03	3.88E-02	7.75E-03	7.75E-03	7.75E-03	7.75E-03	7.75E-03
TEEN	1.30E-02	1.30E-02	6.48E-02	1.30E-02	1.30E-02	1.30E-02	1.30E-02	1.30E-02
CHILD	3.16E-02	3.16E-02	1.58E-01	3.16E-02	3.16E-02	3.16E-02	3.16E-02	3.16E-02
MEAT								
ADULT	3.09E-03	3.09E-03	1.55E-02	3.09E-03	3.09E-03	3.09E-03	3.09E-03	3.09E-03
TEEN	2.61E-03	2.61E-03	1.31E-02	2.61E-03	2.61E-03	2.61E-03	2.61E-03	2.61E-03
CHILD	4.91E-03	4.91E-03	2.46E-02	4.91E-03	4.91E-03	4.91E-03	4.91E-03	4.91E-03
COW MILK								
ADULT	3.37E-03	3.37E-03	1.69E-02	3.37E-03	3.37E-03	3.37E-03	3.37E-03	3.37E-03
TEEN	6.23E-03	6.23E-03	3.11E-02	6.23E-03	6.23E-03	6.23E-03	6.23E-03	6.23E-03
CHILD	1.53E-02	1.53E-02	7.65E-02	1.53E-02	1.53E-02	1.53E-02	1.53E-02	1.53E-02
INFANT	3.20E-02	3.20E-02	1.50E-01	3.20E-02	3.20E-02	3.20E-02	3.20E-02	3.20E-02
GOATMILK								
ADULT	3.37E-03	3.37E-03	1.69E-02	3.37E-03	3.37E-03	3.37E-03	3.37E-03	3.37E-03
TEEN	6.23E-03	6.23E-03	3.11E-02	6.23E-03	6.23E-03	6.23E-03	6.23E-03	6.23E-03
CHILD	1.53E-02	1.53E-02	7.65E-02	1.53E-02	1.53E-02	1.53E-02	1.53E-02	1.53E-02
INFANT	3.20E-02	3.20E-02	1.50E-01	3.20E-02	3.20E-02	3.20E-02	3.20E-02	3.20E-02

TABLE 17. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-JUNE 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	1.65E-02	1.65E-02	8.24E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02	1.65E-02
TEEN	2.75E-02	2.75E-02	1.38E-01	2.75E-02	2.75E-02	2.75E-02	2.75E-02	2.75E-02
CHILD	6.71E-02	6.71E-02	3.35E-01	6.71E-02	6.71E-02	6.71E-02	6.71E-02	6.71E-02
MEAT								
ADULT	6.57E-03	6.57E-03	3.29E-02	6.57E-03	6.57E-03	6.57E-03	6.57E-03	6.57E-03
TEEN	5.55E-03	5.55E-03	2.78E-02	5.55E-03	5.55E-03	5.55E-03	5.55E-03	5.55E-03
CHILD	1.04E-02	1.04E-02	5.22E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02	1.04E-02
COW MILK								
ADULT	7.17E-03	7.17E-03	3.59E-02	7.17E-03	7.17E-03	7.17E-03	7.17E-03	7.17E-03
TEEN	1.32E-02	1.32E-02	6.61E-02	1.32E-02	1.32E-02	1.32E-02	1.32E-02	1.32E-02
CHILD	3.25E-02	3.25E-02	1.63E-01	3.25E-02	3.25E-02	3.25E-02	3.25E-02	3.25E-02
INFANT	6.80E-02	6.80E-02	3.19E-01	6.80E-02	6.80E-02	6.80E-02	6.80E-02	6.80E-02
GOATMILK								
ADULT	7.17E-03	7.17E-03	3.59E-02	7.17E-03	7.17E-03	7.17E-03	7.17E-03	7.17E-03
TEEN	1.32E-02	1.32E-02	6.61E-02	1.32E-02	1.32E-02	1.32E-02	1.32E-02	1.32E-02
CHILD	3.25E-02	3.25E-02	1.63E-01	3.25E-02	3.25E-02	3.25E-02	3.25E-02	3.25E-02
INFANT	6.80E-02	6.80E-02	3.19E-01	6.80E-02	6.80E-02	6.80E-02	6.80E-02	6.80E-02

TABLE 18. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-SEPTEMBER 2019

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	2.96E-03	2.96E-03	1.48E-02	2.96E-03	2.96E-03	2.96E-03	2.96E-03	2.96E-03
TEEN	4.95E-03	4.95E-03	2.47E-02	4.95E-03	4.95E-03	4.95E-03	4.95E-03	4.95E-03
CHILD	1.20E-02	1.20E-02	6.02E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02	1.20E-02
MEAT								
ADULT	1.18E-03	1.18E-03	5.91E-03	1.18E-03	1.18E-03	1.18E-03	1.18E-03	1.18E-03
TEEN	9.98E-04	9.98E-04	4.99E-03	9.98E-04	9.98E-04	9.98E-04	9.98E-04	9.98E-04
CHILD	1.88E-03	1.88E-03	9.38E-03	1.88E-03	1.88E-03	1.88E-03	1.88E-03	1.88E-03
COW MILK								
ADULT	1.29E-03	1.29E-03	6.44E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03
TEEN	2.38E-03	2.38E-03	1.19E-02	2.38E-03	2.38E-03	2.38E-03	2.38E-03	2.38E-03
CHILD	5.84E-03	5.84E-03	2.92E-02	5.84E-03	5.84E-03	5.84E-03	5.84E-03	5.84E-03
INFANT	1.22E-02	1.22E-02	5.72E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02
GOATMILK								
ADULT	1.29E-03	1.29E-03	6.44E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03	1.29E-03
TEEN	2.38E-03	2.38E-03	1.19E-02	2.38E-03	2.38E-03	2.38E-03	2.38E-03	2.38E-03
CHILD	5.84E-03	5.84E-03	2.92E-02	5.84E-03	5.84E-03	5.84E-03	5.84E-03	5.84E-03
INFANT	1.22E-02	1.22E-02	5.72E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02	1.22E-02

TABLE 18. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-SEPTEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	9.21E-03	9.21E-03	4.60E-02	9.21E-03	9.21E-03	9.21E-03	9.21E-03	9.21E-03
TEEN	1.54E-02	1.54E-02	7.70E-02	1.54E-02	1.54E-02	1.54E-02	1.54E-02	1.54E-02
CHILD	3.75E-02	3.75E-02	1.87E-01	3.75E-02	3.75E-02	3.75E-02	3.75E-02	3.75E-02
MEAT								
ADULT	3.67E-03	3.67E-03	1.84E-02	3.67E-03	3.67E-03	3.67E-03	3.67E-03	3.67E-03
TEEN	3.10E-03	3.10E-03	1.55E-02	3.10E-03	3.10E-03	3.10E-03	3.10E-03	3.10E-03
CHILD	5.84E-03	5.84E-03	2.92E-02	5.84E-03	5.84E-03	5.84E-03	5.84E-03	5.84E-03
COW MILK								
ADULT	4.01E-03	4.01E-03	2.00E-02	4.01E-03	4.01E-03	4.01E-03	4.01E-03	4.01E-03
TEEN	7.39E-03	7.39E-03	3.70E-02	7.39E-03	7.39E-03	7.39E-03	7.39E-03	7.39E-03
CHILD	1.82E-02	1.82E-02	9.09E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02
INFANT	3.80E-02	3.80E-02	1.78E-01	3.80E-02	3.80E-02	3.80E-02	3.80E-02	3.80E-02
GOATMILK								
ADULT	4.01E-03	4.01E-03	2.00E-02	4.01E-03	4.01E-03	4.01E-03	4.01E-03	4.01E-03
TEEN	7.39E-03	7.39E-03	3.70E-02	7.39E-03	7.39E-03	7.39E-03	7.39E-03	7.39E-03
CHILD	1.82E-02	1.82E-02	9.09E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02	1.82E-02
INFANT	3.80E-02	3.80E-02	1.78E-01	3.80E-02	3.80E-02	3.80E-02	3.80E-02	3.80E-02

TABLE 19. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), OCTOBER-DECEMBER 2019

SPECIAL LOCATION NO. 4A Nearest Cow

AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS

ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	4.44E-03	4.44E-03	2.22E-02	4.44E-03	4.44E-03	4.44E-03	4.44E-03	4.44E-03
TEEN	7.42E-03	7.42E-03	3.71E-02	7.42E-03	7.42E-03	7.42E-03	7.42E-03	7.42E-03
CHILD	1.81E-02	1.81E-02	9.04E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02	1.81E-02
MEAT								
ADULT	1.77E-03	1.77E-03	8.86E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03	1.77E-03
TEEN	1.50E-03	1.50E-03	7.48E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03	1.50E-03
CHILD	2.81E-03	2.81E-03	1.41E-02	2.81E-03	2.81E-03	2.81E-03	2.81E-03	2.81E-03
COW MILK								
ADULT	1.93E-03	1.93E-03	9.66E-03	1.93E-03	1.93E-03	1.93E-03	1.93E-03	1.93E-03
TEEN	3.57E-03	3.57E-03	1.78E-02	3.57E-03	3.57E-03	3.57E-03	3.57E-03	3.57E-03
CHILD	8.77E-03	8.77E-03	4.38E-02	8.77E-03	8.77E-03	8.77E-03	8.77E-03	8.77E-03
INFANT	1.83E-02	1.83E-02	8.59E-02	1.83E-02	1.83E-02	1.83E-02	1.83E-02	1.83E-02
GOATMILK								
ADULT	1.93E-03	1.93E-03	9.66E-03	1.93E-03	1.93E-03	1.93E-03	1.93E-03	1.93E-03
TEEN	3.57E-03	3.57E-03	1.78E-02	3.57E-03	3.57E-03	3.57E-03	3.57E-03	3.57E-03
CHILD	8.77E-03	8.77E-03	4.38E-02	8.77E-03	8.77E-03	8.77E-03	8.77E-03	8.77E-03
INFANT	1.83E-02	1.83E-02	8.59E-02	1.83E-02	1.83E-02	1.83E-02	1.83E-02	1.83E-02

TABLE 19. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), OCTOBER-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 3.00 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	5.92E-03	5.92E-03	2.96E-02	5.92E-03	5.92E-03	5.92E-03	5.92E-03	5.92E-03
TEEN	9.90E-03	9.90E-03	4.95E-02	9.90E-03	9.90E-03	9.90E-03	9.90E-03	9.90E-03
CHILD	2.41E-02	2.41E-02	1.20E-01	2.41E-02	2.41E-02	2.41E-02	2.41E-02	2.41E-02
MEAT								
ADULT	2.36E-03	2.36E-03	1.18E-02	2.36E-03	2.36E-03	2.36E-03	2.36E-03	2.36E-03
TEEN	2.00E-03	2.00E-03	9.98E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03	2.00E-03
CHILD	3.75E-03	3.75E-03	1.88E-02	3.75E-03	3.75E-03	3.75E-03	3.75E-03	3.75E-03
COW MILK								
ADULT	2.58E-03	2.58E-03	1.29E-02	2.58E-03	2.58E-03	2.58E-03	2.58E-03	2.58E-03
TEEN	4.75E-03	4.75E-03	2.38E-02	4.75E-03	4.75E-03	4.75E-03	4.75E-03	4.75E-03
CHILD	1.17E-02	1.17E-02	5.84E-02	1.17E-02	1.17E-02	1.17E-02	1.17E-02	1.17E-02
INFANT	2.44E-02	2.44E-02	1.14E-01	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02
GOATMILK								
ADULT	2.58E-03	2.58E-03	1.29E-02	2.58E-03	2.58E-03	2.58E-03	2.58E-03	2.58E-03
TEEN	4.75E-03	4.75E-03	2.38E-02	4.75E-03	4.75E-03	4.75E-03	4.75E-03	4.75E-03
CHILD	1.17E-02	1.17E-02	5.84E-02	1.17E-02	1.17E-02	1.17E-02	1.17E-02	1.17E-02
INFANT	2.44E-02	2.44E-02	1.14E-01	2.44E-02	2.44E-02	2.44E-02	2.44E-02	2.44E-02

TABLE 20. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-DECEMBER 2019

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	7.55E-03	7.55E-03	3.78E-02	7.55E-03	7.55E-03	7.55E-03	7.55E-03	7.55E-03
TEEN	1.26E-02	1.26E-02	6.31E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02
CHILD	3.07E-02	3.07E-02	1.54E-01	3.07E-02	3.07E-02	3.07E-02	3.07E-02	3.07E-02
MEAT								
ADULT	3.01E-03	3.01E-03	1.51E-02	3.01E-03	3.01E-03	3.01E-03	3.01E-03	3.01E-03
TEEN	2.55E-03	2.55E-03	1.27E-02	2.55E-03	2.55E-03	2.55E-03	2.55E-03	2.55E-03
CHILD	4.79E-03	4.79E-03	2.39E-02	4.79E-03	4.79E-03	4.79E-03	4.79E-03	4.79E-03
COW MILK								
ADULT	3.29E-03	3.29E-03	1.64E-02	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03
TEEN	6.06E-03	6.06E-03	3.03E-02	6.06E-03	6.06E-03	6.06E-03	6.06E-03	6.06E-03
CHILD	1.49E-02	1.49E-02	7.46E-02	1.49E-02	1.49E-02	1.49E-02	1.49E-02	1.49E-02
INFANT	3.12E-02	3.12E-02	1.46E-01	3.12E-02	3.12E-02	3.12E-02	3.12E-02	3.12E-02
GOATMILK								
ADULT	3.29E-03	3.29E-03	1.64E-02	3.29E-03	3.29E-03	3.29E-03	3.29E-03	3.29E-03
TEEN	6.06E-03	6.06E-03	3.03E-02	6.06E-03	6.06E-03	6.06E-03	6.06E-03	6.06E-03
CHILD	1.49E-02	1.49E-02	7.46E-02	1.49E-02	1.49E-02	1.49E-02	1.49E-02	1.49E-02
INFANT	3.12E-02	3.12E-02	1.46E-01	3.12E-02	3.12E-02	3.12E-02	3.12E-02	3.12E-02

TABLE 20. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JULY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	1.48E-02	1.48E-02	7.39E-02	1.48E-02	1.48E-02	1.48E-02	1.48E-02	1.48E-02
TEEN	2.47E-02	2.47E-02	1.24E-01	2.47E-02	2.47E-02	2.47E-02	2.47E-02	2.47E-02
CHILD	6.01E-02	6.01E-02	3.01E-01	6.01E-02	6.01E-02	6.01E-02	6.01E-02	6.01E-02
MEAT								
ADULT	5.90E-03	5.90E-03	2.95E-02	5.90E-03	5.90E-03	5.90E-03	5.90E-03	5.90E-03
TEEN	4.98E-03	4.98E-03	2.49E-02	4.98E-03	4.98E-03	4.98E-03	4.98E-03	4.98E-03
CHILD	9.36E-03	9.36E-03	4.68E-02	9.36E-03	9.36E-03	9.36E-03	9.36E-03	9.36E-03
COW MILK								
ADULT	6.43E-03	6.43E-03	3.22E-02	6.43E-03	6.43E-03	6.43E-03	6.43E-03	6.43E-03
TEEN	1.19E-02	1.19E-02	5.93E-02	1.19E-02	1.19E-02	1.19E-02	1.19E-02	1.19E-02
CHILD	2.92E-02	2.92E-02	1.46E-01	2.92E-02	2.92E-02	2.92E-02	2.92E-02	2.92E-02
INFANT	6.10E-02	6.10E-02	2.86E-01	6.10E-02	6.10E-02	6.10E-02	6.10E-02	6.10E-02
GOATMILK								
ADULT	6.43E-03	6.43E-03	3.22E-02	6.43E-03	6.43E-03	6.43E-03	6.43E-03	6.43E-03
TEEN	1.19E-02	1.19E-02	5.93E-02	1.19E-02	1.19E-02	1.19E-02	1.19E-02	1.19E-02
CHILD	2.92E-02	2.92E-02	1.46E-01	2.92E-02	2.92E-02	2.92E-02	2.92E-02	2.92E-02
INFANT	6.10E-02	6.10E-02	2.86E-01	6.10E-02	6.10E-02	6.10E-02	6.10E-02	6.10E-02

TABLE 21. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2019

SPECIAL LOCATION NO. 4A Nearest Cow
AT 3.50 MILES NNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	1.56E-02	1.56E-02	7.82E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02
TEEN	2.61E-02	2.61E-02	1.31E-01	2.61E-02	2.61E-02	2.61E-02	2.61E-02	2.61E-02
CHILD	6.36E-02	6.36E-02	3.18E-01	6.36E-02	6.36E-02	6.36E-02	6.36E-02	6.36E-02
MEAT								
ADULT	6.24E-03	6.24E-03	3.12E-02	6.24E-03	6.24E-03	6.24E-03	6.24E-03	6.24E-03
TEEN	5.27E-03	5.27E-03	2.63E-02	5.27E-03	5.27E-03	5.27E-03	5.27E-03	5.27E-03
CHILD	9.91E-03	9.91E-03	4.95E-02	9.91E-03	9.91E-03	9.91E-03	9.91E-03	9.91E-03
COW MILK								
ADULT	6.81E-03	6.81E-03	3.40E-02	6.81E-03	6.81E-03	6.81E-03	6.81E-03	6.81E-03
TEEN	1.26E-02	1.26E-02	6.28E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02
CHILD	3.09E-02	3.09E-02	1.54E-01	3.09E-02	3.09E-02	3.09E-02	3.09E-02	3.09E-02
INFANT	6.45E-02	6.45E-02	3.02E-01	6.45E-02	6.45E-02	6.45E-02	6.45E-02	6.45E-02
GOATMILK								
ADULT	6.81E-03	6.81E-03	3.40E-02	6.81E-03	6.81E-03	6.81E-03	6.81E-03	6.81E-03
TEEN	1.26E-02	1.26E-02	6.28E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02	1.26E-02
CHILD	3.09E-02	3.09E-02	1.54E-01	3.09E-02	3.09E-02	3.09E-02	3.09E-02	3.09E-02
INFANT	6.45E-02	6.45E-02	3.02E-01	6.45E-02	6.45E-02	6.45E-02	6.45E-02	6.45E-02

TABLE 21. CARBON-14 DOSES TO MAXIMUM INDIVIDUAL (MREM), JANUARY-DECEMBER 2019 (Continued)

SPECIAL LOCATION NO. 5A Nearest Garden
AT 1.90 MILES WNW

ANNUAL BETA AIR DOSE = 0.00E+00 MILLRADS
ANNUAL GAMMA AIR DOSE = 0.00E+00 MILLRADS

PATHWAY	T.BODY	GI-TRACT	BONE	LIVER	KIDNEY	THYROID	LUNG	SKIN
PLUME	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
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	3.13E-02	3.13E-02	1.56E-01	3.13E-02	3.13E-02	3.13E-02	3.13E-02	3.13E-02
TEEN	5.23E-02	5.23E-02	2.61E-01	5.23E-02	5.23E-02	5.23E-02	5.23E-02	5.23E-02
CHILD	1.27E-01	1.27E-01	6.36E-01	1.27E-01	1.27E-01	1.27E-01	1.27E-01	1.27E-01
MEAT								
ADULT	1.25E-02	1.25E-02	6.24E-02	1.25E-02	1.25E-02	1.25E-02	1.25E-02	1.25E-02
TEEN	1.05E-02	1.05E-02	5.27E-02	1.05E-02	1.05E-02	1.05E-02	1.05E-02	1.05E-02
CHILD	1.98E-02	1.98E-02	9.91E-02	1.98E-02	1.98E-02	1.98E-02	1.98E-02	1.98E-02
COW MILK								
ADULT	1.36E-02	1.36E-02	6.81E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02
TEEN	2.51E-02	2.51E-02	1.26E-01	2.51E-02	2.51E-02	2.51E-02	2.51E-02	2.51E-02
CHILD	6.17E-02	6.17E-02	3.09E-01	6.17E-02	6.17E-02	6.17E-02	6.17E-02	6.17E-02
INFANT	1.29E-01	1.29E-01	6.05E-01	1.29E-01	1.29E-01	1.29E-01	1.29E-01	1.29E-01
GOATMILK								
ADULT	1.36E-02	1.36E-02	6.81E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02	1.36E-02
TEEN	2.51E-02	2.51E-02	1.26E-01	2.51E-02	2.51E-02	2.51E-02	2.51E-02	2.51E-02
CHILD	6.17E-02	6.17E-02	3.09E-01	6.17E-02	6.17E-02	6.17E-02	6.17E-02	6.17E-02
INFANT	1.29E-01	1.29E-01	6.05E-01	1.29E-01	1.29E-01	1.29E-01	1.29E-01	1.29E-01

DOSE CALCULATION MODELS

To evaluate the radiological consequences of the routine release of liquid and gaseous effluents from the Cooper Nuclear Station, the latest versions of two computer codes were used: LADTAP II for liquid doses and GASPARG for gaseous doses included as part of NRCDOSE 2.3.20 (ORNL 2015). Both of these computer codes implement the dose calculational methodologies of U.S. NRC Regulatory Guide 1.109, Revision 1.

Source terms for each quarter are combined with station-specific demographic data and either hydrological dilution factors, for liquid dose calculations, or atmospheric diffusion estimates, for gaseous dose calculations.

For liquid dose calculations, the hydrological dilution factors used for input to LADTAP II, as well as other input parameters, are listed in Table 22. Other inputs not specifically listed in this table are taken from Regulatory Guide 1.109, Revision 1. Semiannual doses are obtained by summing the contributions from the appropriate quarters.

For gaseous dose calculations, atmospheric diffusion estimates are obtained from the reduction and processing of onsite meteorological data, as described in Appendix B. Source terms for the semiannual period are obtained by summing source terms for the appropriate quarters. Additional input to GASPARG includes the following station-supplied data:

- 0 to 50 mile population distribution
- 0 to 50 mile meat, milk, and vegetable distributions
- Absolute humidity at Cooper Nuclear Station (14.61 g/m^3)
- The fraction of the year that the vegetables are grown (0.5)
- The fraction of the daily feed intake derived from pasture for milk and meat animals (0.5)

Other values used for input to GASPARG are default values from Regulatory Guide 1.109, Rev. 1.

TABLE 22. Values of Parameters Used to Make Dose Estimates Resulting From Liquid Discharges at Cooper Nuclear Station January-December 2019

Parameter	Values Assigned	
	Individual	Population
Cooling flow rate (cfs) * (Average daily value)	Q1 1248	1248
	Q2 1246	1246
	Q3 1454	1454
	Q4 1323	1323
Dilution factor*	Q1 1	2.23
	Q2 1	3.45
	Q3 1	2.53
	Q4 1	1.96
Holding time:		
Fish	24 hr ***	168 hr ***
Drinking water	12 hr ***	22.4 hr **
Shoreline exposure	0 hr ***	22.4 hr **
Swimming	0 hr ***	22.4 hr **
Boating	0 hr ***	22.4 hr **

* Q1, Q2, Q3, and Q4 represent first, second, third and fourth quarter station data for 2019, respectively.

** Based on an average Missouri River water flow of 5.5 ft/sec, 84 miles down the river.

*** Values from Regulatory Guide 1.109, Revision 1.

NR- No release

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U.S. Nuclear Regulatory Commission, NUREG/CR-1276, "User's Manual for LADTAP II: A Computer Code for Calculating Radiation Exposure to Man From Routine Release of Nuclear Reactor Liquid Effluents", 1980.

U.S. Nuclear Regulatory Commission, Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I", Revision 1, 1977.

APPENDIX G
REMP SAMPLE STATION DESCRIPTIONS

REMP SAMPLE STATION DESCRIPTIONS

The following pages contain descriptions of the CNS REMP Sample Stations that were active or were used for part or all of 2019.

REMP SAMPLE STATION DESCRIPTIONS
SAMPLE TYPES AND SAMPLE LOCATIONS

<u>Sample Station (a)</u>	<u>Sample Description – Type and Location</u>
No. 1	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Outside the northwest edge of fence, east of the gate to the LLRW storage pad on the CNS site, NW ¼, S32, T5N, R16E, Nemaha County, Nebraska. Lon. 095.38.634 W – Lat. 40.21.523 N
No. 2	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: North side of county road to the south portion of CNS site, SW ¼, S32, T5N, R16E, Nemaha County, Nebraska. Lon. 095.38.954 W – Lat. 40.21.126 N
No. 3	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Located on the north side of the Brownville State Recreation Park access road near water gauging station, SE ¼, S18, T5N, R16E, Nemaha County, Nebraska. Lon. 095.39.108 W – Lat. 40.23.777 N
No. 4	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Located ½ mile south of Phelps City, Missouri, on west side of highway “U”, NE ¼, S2, T64N, R42W, Atchison County, Missouri. Lon. 095.35.792 W – Lat. 40.23.797 N
No. 5	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Located ¼ mile south and ¼ mile east of Langdon, Missouri, on north side of road, west of railroad tracks, SW ¼, T64N, R41W, Atchison County, Missouri. Lon. 095.34.434 W – Lat. 40.21.151 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

<u>Sample Station (a)</u>	<u>Sample Description – Type and Location</u>
No. 6	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: One mile west of the end of Missouri State Highway “U”, SW corner of the intersection, NW $\frac{1}{4}$, S34, T64N, R42W, Atchison County, Missouri. Lon. 095.37.620 W – Lat. 40.19.459 N
No 7	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: 300 yards east of Highway 67 on north side of road, SW $\frac{1}{4}$, S6, T4N, R16E, Nemaha, Nebraska. Lon. 095.40.207 W – Lat. 40.20.287 N
No. 8	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: $\frac{1}{2}$ mile north, $\frac{3}{4}$ mile west and $\frac{3}{4}$ mile north of Nemaha, on west side of road adjacent to transmission line, NE $\frac{1}{4}$, S35, T5N, R15E, Nemaha County, Nebraska. Lon. 095.41.220 W – Lat. 40.21.570 N
No. 9	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: Four miles north of Highway 136, on Highway 67. Then 1 mile east of Highway 67 and $\frac{1}{2}$ mile north on west side of road, SW $\frac{1}{4}$, S26, T6N, R15E, Nemaha County, Nebraska. Lon. 095.41.810 W – Lat. 40.27.259 N
No. 10	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry Location: One mile north of Barada, Nebraska, in SW corner of intersection, NE $\frac{1}{4}$, S14, T3N, R16E, Richardson County, Nebraska. Lon. 095.34.723 W – Lat. 40.13.970 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

<u>Sample Station (a)</u>	<u>Sample Description – Type and Location</u>
No. 11	Type: (1) Water – Ground Location: Plant well water supply header at well pits, NW ¼, S32, T5N, R16E, Nemaha County, Nebraska. Lon. 095.53.866 W – Lat. 40.18.970 N
No.20	Type: (1) Environmental Thermoluminescent Dosimetry Location: On NNW boundary of NPPD property, east side of county road, SE, S30, T5N, R16E, Nemaha County, Nebraska. Lon. 095.39.226 W – Lat. 40.22.260 N
No.28	Type: (1) Water – River, (2) Fish (3) Sediment from Shoreline Location: Samples (1), (3), and (4) are taken from the Missouri River or its shore downstream near River Mile 530, Sample (2) is taken from the Missouri River ½ to 3 miles downstream of the plant site. Lon. 095.37.301 W – Lat. 40.20.336 N
No. 35	Type: (1) Fish (2) Water – River (Alternate Site) (3) Food Products – Broadleaf Vegetation Location: Sample (1) will be taken from the Missouri River about 1 to 3 miles above the CNS intake structure. During periods when unsafe conditions warrant, Station 35 may be used as an alternate to Station 12 (upstream collection site) for sample type (2). Sample (3) is taken about ¼ mile south of the Brownville State Recreation Area in Sector A. Lon. 095.39.046 W – Lat. 40.23.737 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample
Station (a)

Sample Description – Type and Location

No. 44

Type: (1) Environmental Thermoluminescent Dosimetry

Location: ¼ mile south of Auburn Country Club on Highway 75,
then ½ mile east of Highway 75 at fence line north of
county road, SE1/4, S27, T5N, R14E, Nemaha County,
Nebraska.

Lon. 095.49.759 W – Lat. 40.21.840 N

No. 47

Type: (1) Water – Ground

Location: At Falls City Municipal water supply well.

Lon. 095.25.537 W – Lat. 40.01.939 N

No. 56

Type: (1) Environmental Thermoluminescent Dosimetry

Location: 1 ¼ miles SW of Langdon, Missouri, on Highway “U”,
on the right side of the highway, NW ¼, S23, T64N,
R42W, Atchison County, Missouri.

Lon. 095.36.383 W – Lat. 40.21.157 N

No. 58

Type: (1) Environmental Thermoluminescent Dosimetry

Location: Three miles south of Brownville, Nebraska, on county
road, at the SE corner of the intersection with the farm
road leading to Sample Station No. 2, SE1/4, S31, T5N,
R16E, Nemaha County, Nebraska.

Lon. 095.39.338 W – Lat. 40.21.126 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample
Station (a)

Sample Description – Type and Location

- No. 59 Type: (1) Environmental Thermoluminescent Dosimetry
- Location: One mile SSE of the CNS Elevated Release Point, in the vicinity of the levee at the south boundary of NPPD property, SE ¼, S32, T5N, R16E, Nemaha County, Nebraska.
Lon. 095.38.223 W – Lat. 40.20.986 N
- No. 66 Type: (1) Environmental Thermoluminescent Dosimetry
- Location: Two miles south of Nemaha, Nebraska, on Highway 67 east side of road, NW1/4, S19, T4N, R16E, Nemaha County, Nebraska.
Lon. 095.40.307 W – Lat. 40.18.277 N
- No. 67 Type: (1) Environmental Thermoluminescent Dosimetry
- Location: 2 miles west of Brownville, Nebraska, on Highway 136, then north 1 ½ miles on county road and east ½ mile, on north side of road, NE1/4, S11, T5N, R15E, Nemaha County, Nebraska.
Lon. 095.41.520 W – Lat. 40.24.898 N
- No. 71 Type: (1) Environmental Thermoluminescent Dosimetry
- Location: Two miles east of Phelps City, Missouri, on Highway 36, then south 1 ½ miles on county road and west ¼ mile, SE1/4, S6, T64N, R41W, Atchison County, Missouri.
Lon. 095.34.727 W – Lat. 40.21.664 N
- No. 79 Type: (1) Environmental Thermoluminescent Dosimetry
- Location: 1 7/8 miles south of Brownville, NE, on east side of paved road, NPPD property, SE1/4, S30, T5N, R16E, Nemaha County, Nebraska.
Lon. 095.39.238 W – Lat. 40.22.006 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

<u>Sample Station (a)</u>	<u>Sample Description – Type and Location</u>
No. 80	Type: (1) Environmental Thermoluminescent Dosimetry Location: 2 1/8 miles south of Brownville, on east side of paved road, NPPD property, NE1/4, S31, T5N, R16E, Nemaha County, Nebraska. Lon. 095.39.259 W – Lat. 40.21.834 N
No. 81	Type: (1) Environmental Thermoluminescent Dosimetry Location: 2 3/8 miles south of Brownville, Nebraska, in the NE corner of the intersection of the paved county road and CNS access road, NPPD property, NE1/4, S31, T5N, R16E, Nemaha County, Nebraska. Lon. 095.39.291 W – Lat. 40.21.582 N
No. 82	Type: (1) Environmental Thermoluminescent Dosimetry Location: 7/8 mile south of CNS in a field, on NPPD property, SW1/4, S32, T5N, R16E, Nemaha County, Nebraska. Lon. 095.38.395 W – Lat. 40.20.961 N
No. 83	Type: (1) Environmental Thermoluminescent Dosimetry Location: 2 ¼ miles south of Nemaha, Nebraska, on Highway 67, then east 1 mile to the junction of the driveway and county road (east side of drive), NE1/4, S19, T4N, R16E, Nemaha County, Nebraska. Lon. 095.39.411 W – Lat. 40.18.119 N
No. 84	Type: (1) Environmental Thermoluminescent Dosimetry Location: 2 ½ miles west of Brownville, NE, south side of Highway 136 west of Locust Grove School, NW1/4, S22, T5N, R15E, Nemaha County, Nebraska. Lon. 095.42.993 W – Lat. 40.23.564 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample
Station (a)

Sample Description – Type and Location

No. 85

Type: (1) Environmental Thermoluminescent Dosimetry

Location: One mile east of Brownville, Nebraska, on Highway 136, then north $\frac{1}{4}$ mile on the east side of the county road, NE1/4, S33, T65N, R42W, Atchison County, Missouri.

Lon. 095.38.309 W – Lat. 40.24.508 N

No. 86

Type: (1) Environmental Thermoluminescent Dosimetry

Location: One mile west of Phelps City, Missouri, on Highway 136, then north $1\frac{1}{2}$ miles on Highway "D" on west side, SE1/4, S22, T65N, R42W, Atchison County, Missouri.

Lon. 095.36.938 W – Lat. 40.25.563 N

No. 87

Type: (1) Environmental Thermoluminescent Dosimetry

Location: One mile west of Phelps City, Missouri, on Highway 136, then south $\frac{1}{2}$ mile on county road and $\frac{3}{4}$ mile west on county road to the end of the road, NW1/4, S3, T64N, R42W, Atchison County, Missouri.

Lon. 095.37.806 W – Lat. 40.23.818 N

No. 88

Type: (1) Environmental Thermoluminescent Dosimetry

Location: One mile west of Phelps City, Missouri, on Highway 136, then south 2 miles at the end of the county road, NW1/4, S11, T64N, R42W, Atchison County, Missouri.

Lon. 095.37.771 W – Lat. 40.24.762 N

No. 89

Type: (1) Environmental Thermoluminescent Dosimetry

Location: $2\frac{1}{2}$ miles south of Phelps City, Missouri, on Highway "U", then $\frac{1}{2}$ mile west in the SE corner of the county road intersection, NE1/4, S14, T64N, R42W, Atchison County, Missouri.

Lon. 095.36.361 W – Lat. 40.21.962 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

<u>Sample Station (a)</u>	<u>Sample Description – Type and Location</u>
No. 90	Type: (1) Environmental Thermoluminescent Dosimetry Location: 1 ½ miles west and ¾ mile south of Langdon, Missouri, on Highway “U”, then ¼ mile west, SW1/4, S23, T64N, R42W, Atchison County, Missouri. Lon. 095.35.808 W – Lat. 40.19.472 N
No. 91	Type: (1) Environmental Thermoluminescent Dosimetry Location: ½ mile west of Rockport, Missouri, on the south side of the intersection of U.S. Highway 136 and U.S. Highway 275, at the south side of the water tower, NW1/4, S28, T65N, R41W, Atchison County, Missouri. Lon. 095.32.217 W – Lat. 40.25.181 N
No. 94	Type: (1) Environmental Thermoluminescent Dosimetry Location: ¼ mile of Langdon, Missouri, on the west side of the road, NE1/4, S24, T64N, R42W, Atchison County, Missouri. Lon. 095.34.673 W – Lat. 40.20.931 N
No. 96	Type: (1) Food products – Broadleaf Vegetation Location: Approximately 1 mile south of Brownville, Nebraska, along the paved road, in the road ditch in Sector R, SW1/4, S19, T5N, R16E, Nemaha County, Nebraska. Lon. 095.39.318 W – Lat. 40.23.144 N
No. 99	Type: (1) Milk (Nearest and Other Producer) Location: 1 ¼ mile south of Shubert, Nebraska, on the west side of Highway 67, NE1/4, S24, T3N, R15E, Richardson County, Nebraska. Lon. 095.40.368 W – Lat. 40.12.850 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

Sample
Station (a)

Sample Description – Type and Location

No. 101

Type: (1) Food Products – Broadleaf Vegetation

Location: 5 ½ miles east and ½ mile north of Rock Port, Missouri,
near the junction of Highway 136 and Highway 59, in
Sector D, encompasses portions of several sections,
Athison County, Missouri.

Lon. 095.23.822 W – Lat. 40.25.222 N

NOTES:

(a) Sample station numbers missing from the sequence are for inactive or discontinued sampling locations.

APPENDIX H
NON-ODAM REQUIRED SAMPLING, SUPPLEMENTARY STATIONS

NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
Non-ODAM Required Sampling, Supplementary Stations
2019 Annual Report
January 1, 2019 to December 31, 2019

Prepared by
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SECTION I. INTRODUCTION

I. INTRODUCTION

This report contains a complete tabulation of data for non-ODAM required sampling stations collected during the period January 1 through December 31, 2019 by Teledyne Brown Engineering - Environmental Services.

In assessing all the data gathered for this report, it was concluded that the operation of CNS had no adverse radiological impact on the environment.

SECTION II. SUMMARY

II. Summary

Data from the radiological analyses of environmental media collected during 2019 for non-ODAM required stations are tabulated and discussed below.

Radiological analyses of environmental media characteristically approach and frequently fall below the detection limits of state-of-the-art measurement methods. The "less than" values in the data tables were calculated from each specific analysis and are dependent on sample size, detector efficiency, length of counting time, chemical yield (when appropriate) and the radioactive decay factor from time of counting to time of collection. Teledyne Brown Engineering meets the Lower Limit of Detection (LLD) requirements given in Table 2 of the USNRC Branch Technical Position, Radiological Monitoring Acceptable Program (November 1979, Revision 1).

SECTION III. RESULTS and Discussion of 2019 Analytical Results

III. Results and Discussion of 2019 Analytical Results

A. *Airborne Particulates*

Gross beta activity was observed in 74 of the 81 samples collected during 2019. The average concentration was 0.025 pCi/m³ with a range of 0.004 to 0.291 pCi/m³. The results of the gross beta activities are presented in Table B-1. The gross beta activities for 2019 were comparable to levels measured in the previous several years. Prior to that period the gross beta activities were higher due to atmospheric nuclear weapons testing performed in other countries. The preoperational period of 1971 through 1974 averaged 0.098 pCi/m³ gross beta.

Air particulate filters were collected weekly and composited by locations on a quarterly basis, unless otherwise specified in Table B-1. They were analyzed by gamma ray spectroscopy. Beryllium-7 was observed in all eight of the composites. The average concentration was 0.102 pCi/m³ with a range of 0.070 to 0.141 pCi/m³. The results are presented in Table B-2. All other gamma emitters were below the detection limits.

B. *Airborne Iodine*

Charcoal cartridges used to collect airborne iodine were collected weekly and analyzed by gamma spectrometry for iodine-131. The results are presented in Table B-1. All results are below the lower limit of detection.

C. *Thermoluminescent Dosimeters*

Thermoluminescent dosimeters (TLDs) determine environmental radiation doses and the results are presented in Table B-3. Ambient radiation was monitored at 26 non-ODAM required locations and collected quarterly, unless otherwise specified in Table B-3. The annual average for the locations was 22.9 millirem/quarter and a range from 18.0 to 25.8 millirem/quarter. The preoperational period of 1971 through 1974 averaged 37.0 millirem/quarter. Current year TLD averages deviate from the preoperational averages due to instrument variations from previous vendors.

The data from year to year is in good agreement and indicates no adverse changes in radiation exposure to the population near Cooper Nuclear Station.

APPENDIX A
NON-ODAM REQUIRED SAMPLING STATIONS

**TABLE A-1: NON-ODAM SAMPLE STATION DESCRIPTION,
SAMPLE TYPE AND SAMPLE LOCATION,
NEBRASKA PUBLIC POWER DISTRICT,
COOPER NUCLEAR STATION, 2019**

<u>Sample Station</u>	<u>Sample Description – Type and Location</u>	
No. 111	Type: (1) Air Particulate and Charcoal Filters (2) Environmental Thermoluminescent Dosimetry	
	Location:	Five miles south of Auburn, Nebraska at junction of Hwy 75 and Howe Rd. In northwest corner of intersection. (40.3196, -95.84167)
SOL 1	Type: (1) Air Particulate and Charcoal Filters	
	Location:	7.44 miles from CNS at 153.5 degrees. Fifty yards east of Indian Cave State Park Main Office. (40.26565, -95.57838)
SOL 2	Type: (1) Air Particulate and Charcoal Filters	
	Location:	1.86 miles from CNS at 338.2 degrees. 0.7 miles south of Brownville on 648A Avenue. On east side of road, on top of levee. (40.38700, -95.65451)
N01	Type: (1) Environmental Thermoluminescent Dosimetry	
	Location:	One mile west of Phelps City, Missouri, on Highway 136, then 2.5 miles north on Highway D, then 0.7 miles west on 200th St. (40.4406, -95.62873)
N02	Type: (1) Environmental Thermoluminescent Dosimetry	
	Location:	From junction of Main St. and N 4th St. in Brownville, Nebraska, then north 0.25 miles. In parking lot on east side. (40.40062, -95.65980)
N03	Type: (1) Environmental Thermoluminescent Dosimetry	
	Location:	1.25 miles southeast of Peru, Nebraska, On Hwy 67, then north on county road 645A Avenue 0.75 miles. On west side of road. (40.47236, -95.71675)

**TABLE A-1: NON-ODAM SAMPLE STATION DESCRIPTION,
SAMPLE TYPE AND SAMPLE LOCATION,
NEBRASKA PUBLIC POWER DISTRICT,
COOPER NUCLEAR STATION, 2019**

<u>Sample Station</u>	<u>Sample Description – Type and Location</u>	
N04	Type: (1)	Environmental Thermoluminescent Dosimetry
	Location:	Five and 1/2 miles South of Phelps City, Missouri on Hwy U, then 0.5 miles west on 280th St., then 0.4 miles south on D Ave. (40.31793, -95.61650)
N05	Type: (1)	Environmental Thermoluminescent Dosimetry
	Location:	At the entrance to Indian Cave State Park, located approximately 50 yards west of Main Office. (40.26555, -95.57936)
N06	Type: (1)	Environmental Thermoluminescent Dosimetry
	Location:	Five miles south of Auburn, Nebraska, then 1.25 miles east on Howe Rd. Site is on west side of resident's driveway, north side of road. (40.31975, -95.81673)
N07	Type: (1)	Environmental Thermoluminescent Dosimetry
	Location:	Approximately 0.75 miles north of Nemaha, Nebraska on Hwy 67, then 0.75 miles west on 726 Rd. On north side of road. (40.34936, -95.68569)
N08	Type: (1)	Environmental Thermoluminescent Dosimetry
	Location:	From junction of Hwy 136 and Hwy 111 in Rock Port, Missouri then south 1.0 mile on Hwy 111. On east side of Hwy 111. (40.40224, -95.51313)
N09	Type: (1)	Environmental Thermoluminescent Dosimetry
	Location:	Two miles west of Rock Port, Missouri on Hwy 136, then 3.6 miles north on Outer Rd. On west side of road. (40.45553, -95.58272)
N10	Type: (1)	Environmental Thermoluminescent Dosimetry
	Location:	One mile west of Brownville, Nebraska, at junction of Hwy 136 and Main Street. In northwest corner of junction. (40.39283, -95.67590)

**TABLE A-1: NON-ODAM SAMPLE STATION DESCRIPTION,
SAMPLE TYPE AND SAMPLE LOCATION,
NEBRASKA PUBLIC POWER DISTRICT,
COOPER NUCLEAR STATION, 2019**

<u>Sample Station</u>	<u>Sample Description – Type and Location</u>
N11	Type: (1) Environmental Thermoluminescent Dosimetry Location: Located in Brownville, Nebraska, at the junction of Nebraska St. and N 1st St. In the southwest corner of junction. (40.40055, -95.65518)
N12	Type: (1) Environmental Thermoluminescent Dosimetry Location: Approximately 0.3 miles west of Watson, Missouri, near the junction of Highway A and C Ave. Located west of junction. (40.47706, -95.62920)
N13	Type: (1) Environmental Thermoluminescent Dosimetry Location: Two miles east of Auburn, Nebraska, on Hwy 136, then 0.6 miles north on 641 Ave. On east side of road. (40.40208, -95.80033)
N14	Type: (1) Environmental Thermoluminescent Dosimetry Location: Approximately 1.25 miles south of Nemaha, Nebraska on Hwy 67, then 0.6 miles west on 724 Rd, then 0.1 miles west on 647 Ave. Located on Jarvis Creek levee. (40.31998, -95.68995)
N15	Type: (1) Environmental Thermoluminescent Dosimetry Location: Approximately 4.1 miles northwest of Corning, Missouri on Hwy 111, then 2 miles west on Route Z, then 0.3 miles north on Golden Ave., then 0.5 miles west on 297th street to levee. (40.29750, -95.55442)
N16	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile west of Brownville, Nebraska on Hwy 136, then 1.25 miles south on Hwy 67. Located on west side of highway. (40.37526, -95.67331)

**TABLE A-1: NON-ODAM SAMPLE STATION DESCRIPTION,
SAMPLE TYPE AND SAMPLE LOCATION
NEBRASKA PUBLIC POWER DISTRICT,
COOPER NUCLEAR STATION, 2019**

<u>Sample Station</u>	<u>Sample Description – Type and Location</u>
N17	Type: (1) Environmental Thermoluminescent Dosimetry Location: Approximately 0.4 miles west of Shubert, Nebraska on Hwy 62, then north 0.5 miles on 647 Ave. (40.24026, -95.69086)
N18	Type: (1) Environmental Thermoluminescent Dosimetry Location: Approximately 0.75 miles west of Rock Port, Missouri, on Hwy 136, then 350 feet on Burke Rd. On southwest side of Burke Rd. (40.41705, -95.50112)
N19	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile west of entrance to Indian Cave State Park on Hwy 64E, then 1.5 miles north on 652 Ave., then 0.1 miles west on 721A Rd. Located east of residence. (40.28341, -95.60014)
N20	Type: (1) Environmental Thermoluminescent Dosimetry Location: One mile south of Nemaha, Nebraska on Hwy 67, then 0.9 miles east on the levee. On north side of levee. (40.32331, -95.66007)
N21	Type: (1) Environmental Thermoluminescent Dosimetry Location: From entrance to Indian Cave State Park, follow Indian Cave Recreation Road for 2.5 miles. Located on east side of road on siren pole. (40.25270, -95.55357)
N22	Type: (1) Environmental Thermoluminescent Dosimetry Location: 1.5 miles southwest of CNS on 648A Ave., follow access road into Langdon Bend Wildlife Management Area 1.5 miles to levee. In southeast corner of parking lot. (40.34198, -95.63790)
N23	Type: (1) Environmental Thermoluminescent Dosimetry Location: 2.1 miles east of Phelps City, Missouri, on Hwy 136 at the former City of Rock Port Water Treatment Plant. South side of Hwy 136. (40.40330, -95.55858)

**TABLE A-1: NON-ODAM SAMPLE STATION DESCRIPTION,
SAMPLE TYPE AND SAMPLE LOCATION
NEBRASKA PUBLIC POWER DISTRICT,
COOPER NUCLEAR STATION, 2019**

<u>Sample Station</u>	<u>Sample Description – Type and Location</u>
N24	Type: (1) Environmental Thermoluminescent Dosimetry Location: Two miles east of Watson, Missouri at Charity Lake. Located on the southwest corner of the lake near the boat ramp. (40.47547, -95.58370)
N25	Type: (1) Environmental Thermoluminescent Dosimetry Location: Three miles south of Rock Port, Missouri on Hwy 111, then 0.6 miles south on Outer Rd. Located on west side of road, across from Hunter Cemetery. (40.36291, -95.52197)

APPENDIX B
DATA TABLES OF NON-ODAM REQUIRED SAMPLING LOCATIONS

B-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 111

COLL START DATE	TIME STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	01/08/19	8.61E+03	CU.FT.	1.43E-02 ± 4.00E-03	< 5.E-02
01/08/19	01/15/19	1.01E+04	CU.FT.	3.86E-03 ± 2.76E-03	< 6.E-02
01/15/19	01/21/19	8.61E+03	CU.FT.	3.07E-02 ± 5.13E-03	< 4.E-02
01/21/19	01/29/19	1.15E+04	CU.FT.	1.99E-02 ± 3.89E-03	< 4.E-02
01/29/19	02/05/19	1.01E+04	CU.FT.	4.01E-03 ± 2.77E-03	< 5.E-02
02/05/19	02/11/19	8.55E+03	CU.FT.	1.45E-02 ± 4.57E-03	< 6.E-02
02/11/19	02/18/19	1.01E+04	CU.FT.	3.39E-02 ± 5.08E-03	< 5.E-02
02/18/19	02/26/19	1.15E+04	CU.FT.	2.86E-02 ± 4.34E-03	< 3.E-02
02/26/19	03/04/19	8.71E+03	CU.FT.	1.74E-02 ± 4.29E-03	< 7.E-02
03/04/19	03/12/19	1.14E+04	CU.FT.	1.98E-02 ± 3.74E-03	< 6.E-02
03/12/19	03/26/19 (a)	2.00E+04	CU.FT.	8.58E-03 ± 1.82E-03	< 3.E-02
03/26/19	04/02/19	1.02E+04	CU.FT.	< 4.24E-03	< 2.E-02
04/02/19	04/09/19	1.01E+04	CU.FT.	7.27E-03 ± 2.98E-03	< 6.E-02
04/09/19	04/16/19	1.00E+04	CU.FT.	4.94E-03 ± 3.01E-03	< 2.E-02
04/16/19	04/23/19	1.01E+04	CU.FT.	5.43E-03 ± 2.89E-03	< 2.E-02
04/23/19	04/30/19	1.00E+04	CU.FT.	1.48E-02 ± 3.92E-03	< 3.E-02
04/30/19	05/07/19	9.97E+03	CU.FT.	1.25E-02 ± 3.62E-03	< 1.E-02
05/07/19	05/15/19	1.16E+04	CU.FT.	6.77E-03 ± 2.65E-03	< 2.E-02
05/15/19	05/20/19	7.28E+03	CU.FT.	< 6.01E-03	< 3.E-02
05/20/19	05/28/19	1.14E+04	CU.FT.	1.11E-02 ± 4.22E-03	< 1.E-02
05/28/19	06/04/19	1.00E+04	CU.FT.	1.31E-02 ± 3.56E-03	< 2.E-02
06/04/19	06/11/19	1.01E+04	CU.FT.	2.01E-02 ± 4.02E-03	< 2.E-02
06/11/19	06/18/19	1.01E+04	CU.FT.	1.36E-02 ± 3.94E-03	< 2.E-02
06/18/19	06/25/19	1.00E+04	CU.FT.	5.18E-03 ± 2.72E-03	< 1.E-02
06/25/19	07/02/19	1.00E+04	CU.FT.	8.84E-03 ± 2.89E-03	< 6.E-02
07/02/19	07/08/19	8.61E+03	CU.FT.	< 4.14E-03	< 6.E-02

(a) Due to impassible road conditions, sample was collected over a 14 day period instead of a 7 day period.

B-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER 111					
COLL START DATE	TIME STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
07/08/19	07/16/19	1.15E+04	CU.FT.	1.04E-02 ± 2.94E-03	< 2.E-02
07/16/19	07/23/19	1.02E+04	CU.FT.	4.70E-03 ± 2.49E-03	< 3.E-02
07/23/19	07/30/19	1.00E+04	CU.FT.	8.43E-03 ± 3.17E-03	< 4.E-02
07/30/19	08/06/19	6.21E+03	CU.FT.	2.07E-02 ± 5.63E-03	< 3.E-02
08/06/19	08/13/19	8.61E+03	CU.FT.	< 5.06E-03	< 4.E-02
08/13/19	08/21/19	1.15E+04	CU.FT.	7.34E-03 ± 2.90E-03	< 5.E-02
08/21/19	08/27/19	8.78E+03	CU.FT.	7.12E-03 ± 3.27E-03	< 4.E-02
08/27/19	09/04/19	1.14E+04	CU.FT.	6.17E-03 ± 2.84E-03	< 2.E-02
09/04/19	09/10/19	8.70E+03	CU.FT.	8.66E-03 ± 3.57E-03	< 4.E-02
09/10/19	09/17/19	9.96E+03	CU.FT.	1.50E-02 ± 3.95E-03	< 3.E-02
09/17/19	09/24/19	1.01E+04	CU.FT.	1.85E-02 ± 3.93E-03	< 4.E-02
09/24/19	09/30/19	8.59E+03	CU.FT.	< 4.75E-03	< 3.E-02
09/30/19	10/08/19	1.15E+04	CU.FT.	< 3.69E-03	< 1.E-02
10/08/19	10/15/19	1.02E+04	CU.FT.	8.00E-03 ± 3.14E-03	< 4.E-02
10/15/19	10/22/19	9.98E+03	CU.FT.	1.69E-02 ± 3.91E-03	< 2.E-02
10/22/19	10/29/19	9.96E+03	CU.FT.	6.93E-03 ± 2.95E-03	< 4.E-02
10/29/19	11/05/19	1.01E+04	CU.FT.	1.17E-02 ± 3.48E-03	< 5.E-02
11/05/19	11/12/19	1.03E+04	CU.FT.	1.59E-02 ± 3.91E-03	< 4.E-02
11/12/19	11/19/19	1.00E+04	CU.FT.	6.75E-03 ± 3.27E-03	< 4.E-02
11/19/19	11/26/19	1.01E+04	CU.FT.	1.37E-02 ± 3.78E-03	< 3.E-02
11/26/19	12/03/19	1.00E+04	CU.FT.	< 3.11E-03	< 4.E-02
12/03/19	12/10/19	1.00E+04	CU.FT.	1.54E-02 ± 3.94E-03	< 6.E-02
12/10/19	12/17/19	9.92E+03	CU.FT.	2.69E-02 ± 4.70E-03	< 6.E-02
12/17/19	12/23/19	8.49E+03	CU.FT.	1.90E-02 ± 4.43E-03	< 5.E-02
12/23/19	12/31/19	1.17E+04	CU.FT.	7.84E-03 ± 3.08E-03	< 3.E-02

B-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER SOL 1					
COLL START DATE	TIME STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	08/21/19			(a)	(a)
08/21/19	08/27/19	7.26E+03	CU.FT.	1.83E-02 ± 4.95E-03	< 3.E-02
08/27/19	09/04/19	8.13E+03	CU.FT.	2.47E-02 ± 5.25E-03	< 4.E-02
09/04/19	09/10/19	6.19E+03	CU.FT.	1.98E-02 ± 5.08E-03	< 4.E-02
09/10/19	09/17/19	7.20E+03	CU.FT.	3.13E-02 ± 5.93E-03	< 5.E-02
09/17/19	09/24/19	7.05E+03	CU.FT.	2.23E-02 ± 5.53E-03	< 2.E-02
09/24/19	09/30/19	6.02E+03	CU.FT.	2.02E-02 ± 5.74E-03	< 4.E-02
09/30/19	10/08/19	8.33E+03	CU.FT.	2.49E-02 ± 4.97E-03	< 2.E-02
10/08/19	10/15/19	7.02E+03	CU.FT.	2.85E-02 ± 6.20E-03	< 4.E-02
10/15/19	10/22/19	7.15E+03	CU.FT.	2.63E-02 ± 5.66E-03	< 3.E-02
10/22/19	11/12/19	2.16E+04	CU.FT.	1.62E-02 ± 2.37E-03	< 1.E-02
11/12/19	11/17/19	5.35E+03	CU.FT.	3.14E-02 ± 7.94E-03	< 6.E-02
12/02/19	12/03/19	8.41E+02	CU.FT.	2.24E-01 ± 4.68E-02	(b)
12/03/19	12/10/19	7.24E+03	CU.FT.	3.35E-02 ± 6.37E-03	< 6.E-02
12/10/19	12/13/19	2.75E+03	CU.FT.	5.75E-02 ± 1.43E-02	(b)
12/13/19	12/31/19			(c)	(c)

(a) Solar Station 1 is brand new. First time Solar Station 1 was ever utilized was 8/21/19.

(b) Due to sample pump failure, no sample was able to be collected.

(c) Due to repeated equipment issues, CNS stopped utilizing Solar Station 1 on 12/31/19.

B-1
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
AIR PARTICULATE AND CHARCOAL FILTERS

STATION NUMBER SOL 2					
COLL START DATE	TIME STOP DATE	SAMPLE VOLUME	UNITS	AP FILTER GROSS BETA (PCI/CU.M.)	CHARCOAL FILTER I-131 (PCI/CU.M.)
01/02/19	08/21/19			(a)	(a)
08/21/19	08/27/19	7.20E+03	CU.FT.	2.22E-02 ± 5.30E-03	< 3.E-02
08/27/19	09/04/19	8.12E+03	CU.FT.	2.96E-02 ± 5.59E-03	< 4.E-02
09/04/19	09/10/19	6.20E+03	CU.FT.	8.58E-03 ± 3.46E-03	< 5.E-02
09/10/19	09/17/19	7.08E+03	CU.FT.	3.44E-02 ± 6.21E-03	< 4.E-02
09/24/19	09/30/19	6.09E+03	CU.FT.	1.97E-02 ± 5.65E-03	< 4.E-02
10/01/19	10/01/19	3.40E+02	CU.FT.	2.91E-01 ± 9.46E-02	(b)
10/08/19	10/10/19	1.70E+03	CU.FT.	6.80E-02 ± 2.18E-02	(b)
10/15/19	10/22/19	7.16E+03	CU.FT.	1.67E-02 ± 4.90E-03	< 3.E-02
10/22/19	11/12/19	2.16E+04	CU.FT.	1.81E-02 ± 2.47E-03	< 4.E-02
11/12/19	11/19/19	6.63E+03	CU.FT.	3.43E-02 ± 7.04E-03	< 5.E-02
11/19/19	11/26/19	7.15E+03	CU.FT.	1.15E-02 ± 4.94E-03	< 2.E-02
11/26/19	12/03/19	7.21E+03	CU.FT.	1.92E-02 ± 4.91E-03	< 4.E-02
12/03/19	12/10/19	7.02E+03	CU.FT.	2.76E-02 ± 6.09E-03	< 6.E-02
12/10/19	12/17/19	7.38E+03	CU.FT.	4.47E-02 ± 7.17E-03	< 4.E-02
12/17/19	12/23/19	5.87E+03	CU.FT.	4.21E-02 ± 7.76E-03	< 3.E-02
12/23/19	12/31/19	8.28E+03	CU.FT.	2.81E-02 ± 4.85E-03	< 3.E-02

(a) Solar Station 2 is brand new. First time Solar Station 2 was ever utilized was 8/21/19.

(b) Due to sample pump failure, no sample was able to be collected.

B-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
(PCU/CU.M.)

STATION NUMBER 111

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	07/02-09/30/2019	09/30-12/31/2019
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GAMMA SPECTRUM ANALYSIS:

BE-7	9.95E-02 ± 2.90E-02	8.89E-02 ± 3.04E-02	7.46E-02 ± 2.88E-02	1.11E-01 ± 4.07E-02
K-40	< 2.E-02	< 4.E-02	< 3.E-02	< 5.E-02
MN-54	< 2.E-03	< 3.E-03	< 2.E-03	< 4.E-03
CO-58	< 4.E-03	< 4.E-03	< 3.E-03	< 6.E-03
FE-59	< 1.E-02	< 1.E-02	< 9.E-03	< 2.E-02
CO-60	< 2.E-03	< 3.E-03	< 1.E-03	< 5.E-03
ZN-65	< 4.E-03	< 9.E-03	< 5.E-03	< 8.E-03
ZR-95	< 6.E-03	< 8.E-03	< 5.E-03	< 1.E-02
RU-103	< 6.E-03	< 6.E-03	< 6.E-03	< 8.E-03
RU-106	< 2.E-02	< 2.E-02	< 2.E-02	< 3.E-02
I-131	< 9.E-01	< 5.E-01	< 7.E-01	< 8.E-01
CS-134	< 3.E-03	< 3.E-03	< 2.E-03	< 3.E-03
CS-137	< 2.E-03	< 2.E-03	< 2.E-03	< 4.E-03
BA-140	< 3.E-01	< 2.E-01	< 3.E-01	< 3.E-01
LA-140	< 8.E-02	< 1.E-01	< 8.E-02	< 1.E-01
CE-141	< 9.E-03	< 9.E-03	< 8.E-03	< 1.E-02
CE-144	< 1.E-02	< 1.E-02	< 8.E-03	< 1.E-02
RA-226	< 3.E-02	< 4.E-02	< 3.E-02	< 5.E-02
TH-228	< 3.E-03	< 4.E-03	< 3.E-03	< 4.E-03

B-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
 (PCI/CU.M.)

STATION NUMBER SOL 1

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	08/21-09/30/2019	09/30-12/31/2019
GAMMA SPECTRUM ANALYSIS:	(a)	(a)		
BE-7			1.12E-01 ± 6.49E-02	1.40E-01 ± 7.82E-02
K-40			< 1.E-01	< 1.E-01
MN-54			< 8.E-03	< 6.E-03
CO-58			< 1.E-02	< 1.E-02
FE-59			< 2.E-02	< 3.E-02
CO-60			< 9.E-03	< 5.E-03
ZN-65			< 2.E-02	< 2.E-02
ZR-95			< 2.E-02	< 2.E-02
RU-103			< 1.E-02	< 1.E-02
RU-106			< 7.E-02	< 5.E-02
I-131			< 3.E-01	< 1.E+00
CS-134			< 7.E-03	< 5.E-03
CS-137			< 8.E-03	< 6.E-03
BA-140			< 2.E-01	< 5.E-01
LA-140			< 1.E-01	< 3.E-01
CE-141			< 2.E-02	< 2.E-02
CE-144			< 3.E-02	< 3.E-02
RA-226			< 1.E-01	< 8.E-02
TH-228			< 1.E-02	< 8.E-03

(a) Solar Station 1 is brand new. First time Solar Station 1 was ever utilized was 8/21/19.

B-2
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - AIRBORNE
COMPOSITE AIR PARTICULATE FILTERS
 (PCI/CU.M.)

STATION NUMBER SOL 2

DATE COLLECTED	01/02-04/02/2019	04/02-07/02/2019	08/21-09/30/2019	10/01-12/31/2019
GAMMA SPECTRUM ANALYSIS:	(a)	(a)		
BE-7			1.21E-01 ± 4.98E-02	7.00E-02 ± 3.64E-02
K-40			< 1.E-01	< 6.E-02
MN-54			< 7.E-03	< 4.E-03
CO-58			< 9.E-03	< 5.E-03
FE-59			< 2.E-02	< 2.E-02
CO-60			< 6.E-03	< 5.E-03
ZN-65			< 2.E-02	< 1.E-02
ZR-95			< 2.E-02	< 1.E-02
RU-103			< 1.E-02	< 7.E-03
RU-106			< 6.E-02	< 3.E-02
I-131			< 2.E-01	< 7.E-01
CS-134			< 7.E-03	< 3.E-03
CS-137			< 6.E-03	< 3.E-03
BA-140			< 2.E-01	< 2.E-01
LA-140			< 7.E-02	< 1.E-01
CE-141			< 2.E-02	< 1.E-02
CE-144			< 4.E-02	< 2.E-02
RA-226			< 1.E-01	< 5.E-02
TH-228			< 1.E-02	< 4.E-03

(a) Solar Station 2 is brand new. First time Solar Station 2 was ever utilized was 8/21/19.

B-3
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - THERMOLUMINESCENT DOSIMETRY - TLD
COOPER NUCLEAR STATION 2019

Sample Nuclide	Station Number	First Quarter 01/01-03/31	Second Quarter 04/01-06/30	Third Quarter 07/01-09/30	Fourth Quarter 10/01-01/01	Quarter Average - 1 S.D.
TLD	111	22.2 ± 0.8	24.4 ± 0.4	21.8 ± 0.5	21.3 ± 0.3	22.4 ± 1.4
	N01	(a)	(a)	(a)	(a)	(b)
	N02	22.1 ± 0.7	24.5 ± 0.8	22.0 ± 0.9	20.7 ± 0.3	22.3 ± 1.6
	N03	21.5 ± 0.4	24.7 ± 0.8	24.3 ± 1.5	21.3 ± 0.3	22.9 ± 1.8
	N04	(a)	(a)	(a)	(a)	(b)
	N05	21.2 ± 0.0	21.4 ± 0.7	21.9 ± 0.6	19.9 ± 0.5	21.1 ± 0.8
	N06	21.6 ± 0.4	(a)	23.4 ± 0.4	21.5 ± 0.7	22.1 ± 1.1
	N07	(a)	25.5 ± 0.4	24.8 ± 0.5	(a)	25.2 ± 0.5
	N08	20.9 ± 0.3	22.7 ± 0.5	23.3 ± 0.5	18.0 ± 0.9	21.2 ± 2.4
	N09	(a)	24.2 ± 0.6	23.0 ± 0.7	(a)	23.6 ± 0.8
	N10	22.4 ± 0.4	25.2 ± 0.8	24.6 ± 0.3	(a)	24.1 ± 1.5
	N11	25.0 ± 0.3	23.0 ± 0.5	23.7 ± 0.1	24.2 ± 0.2	24.0 ± 0.9
	N12	(a)	(a)	(a)	(a)	(b)
	N13	22.4 ± 0.2	(a)	25.0 ± 0.6	(a)	23.7 ± 1.8
	N14	20.8 ± 0.9	22.3 ± 1.3	24.0 ± 0.5	(a)	22.4 ± 1.6
	N15	(a)	(a)	(a)	(a)	(b)
	N16	23.8 ± 0.4	25.8 ± 1.5	24.6 ± 0.9	25.8 ± 1.1	25.0 ± 1.0
	N17	22.5 ± 0.7	25.4 ± 1.0	25.1 ± 0.5	22.6 ± 0.2	23.9 ± 1.5
	N18	20.9 ± 0.3	22.3 ± 0.8	23.6 ± 0.6	(a)	22.3 ± 1.3
	N19	22.1 ± 0.3	24.2 ± 1.4	25.2 ± 1.2	21.8 ± 0.2	23.3 ± 1.6
	N20	(a)	(a)	(a)	(a)	(b)
	N21	20.8 ± 0.5	23.1 ± 0.8	22.2 ± 0.3	20.5 ± 0.4	21.6 ± 1.2

(a) Due to Missouri River flooding, sample station was either inaccessible or TLD was lost/damaged in flood waters.

(b) Quarterly average and standard deviation unable to be calculated.

B-3
NEBRASKA PUBLIC POWER DISTRICT
COOPER NUCLEAR STATION
EXPOSURE PATHWAY - THERMOLUMINESCENT DOSIMETRY - TLD
COOPER NUCLEAR STATION 2019

Sample Nuclide	Station Number	First Quarter 01/01-03/31	Second Quarter 04/01-06/30	Third Quarter 07/01-09/30	Fourth Quarter 10/01-01/01	Quarter Average - 1 S.D.
N22		(a)	(a)	(a)	(a)	(b)
N23		21.8 ± 0.3	20.6 ± 1.5	22.7 ± 0.5	21.1 ± 0.4	21.5 ± 0.9
N24		22.8 ± 0.6	25.3 ± 0.5	24.7 ± 0.5	23.6 ± 1.7	24.1 ± 1.1
N25		25.0 ± 0.0	21.2 ± 0.7	24.3 ± 0.6	(a)	23.5 ± 2.0
Average/Quarter		22.2 ± 1.3	23.7 ± 1.6	23.7 ± 1.1	21.7 ± 2.0	
Range		(20.8-25.0)	(20.6-25.8)	(21.8-25.2)	(18.0-25.8)	
Detection/Total		18/18	18/18	20/20	13/13	

(a) Due to Missouri River flooding, sample station was either inaccessible or TLD was lost/damaged in flood waters.

(b) Quarterly average and standard deviation unable to be calculated.