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Quad Cities Nuclear Power Station, Units 1 and 2
Renewed Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Annual Radiological Environmental Operating Report

Pursuant to Technical Specifications Section 5.6.2, enclosed is the 2019 Radiological Environmental Operating Report for Quad Cities Nuclear Power Station. This Report contains the results of the Radiological Environmental Monitoring Program (REMP). In addition, the 2019 Radiological Groundwater Protection Program (RGPP) Report is included as Appendix F of the enclosure.

Should you have any questions concerning this letter, please contact Ms. Rebecca Craddick at (309) 227-3200.

Respectfully,

Kenneth S. Ohr
Site Vice President
Quad Cities Nuclear Power Station

Enclosure: Annual Radiological Environmental Operating Report

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station

Docket No: 50-254
50-265

QUAD CITIES NUCLEAR POWER STATION
UNITS 1 and 2

Annual Radiological
Environmental Operating Report

1 January through 31 December 2019

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

Quad Cities Nuclear Power Station
Cordova, IL 61242

May 2020

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I. Summary and Conclusions

In 2019, the Quad Cities Generating Station released to the environment through the radioactive effluent gaseous pathways, approximately 64.2 curies of noble gas, 7.87 E-03 curies of fission and activation products, 28.7 curies of Carbon-14 (C-14) and approximately 86.9 curies of tritium. The dose from both gaseous effluents was conservatively calculated for the Maximum Exposed Member of the Public. In 2019, Quad Cities Generating Station released to the environment, through the radioactive liquid effluent pathway, approximately 1.59E-01 curies of tritium. One liquid abnormal continuous release occurred from 04/16/2019 to 11/06/2019 as part of remediation of a leak to onsite ground water. The results of those calculations and their comparison to the allowable limits were as follows:

NOTE: Percent of applicable limits are for Unit 1 and Unit 2 combined (Site)

Gaseous and liquid radiation doses to members of the public at locations								
Effluents	Applicable Organ	Estimated Dose	Age Group	Location		% of Applicable Limit	Site Limit	Unit
				Distance (meters)	Direction (toward)			
Noble Gas	Gamma - Air Dose	1.40E-03	All	1029	NNE	7.00E-03	20	mRad
Noble Gas	Beta – Air Dose	1.53E-04	All	1029	NNE	3.83E-04	40	mRad
Iodine, Particulate C-14 & Tritium	Total Body	4.36E-02	Child	1029	NNE	1.74E-01	25	mrem
Iodine, Particulate C-14 & Tritium	Bone	2.01E-01	Child	1029	NNE	6.70E-01	30	mrem
Liquid	Total Body	3.11E-07	N/A	Mississippi River		5.18E-06	6	mrem
Liquid	Liver	3.11E-07	N/A	Mississippi River		1.56E-06	20	mrem
Skyshine	Total Body	7.69E+00	All	800	N	3.08E+01	25	mrem
40CFR190	Total Body (Gas + Liq+ Skyshine)	7.73E+00	All	800	N	3.09E+01	25	mrem

The doses as a result of the radiological effluents released from the Quad Cities Generating Station were a very small percentage of the allowable limits, with the exception of 40CFR190 whole body radiation which was calculated to be 30.9% of the 25 mrem/yr limit. The largest component of 40CFR190 dose is attributable to BWR skyshine from N-16. This value is conservatively calculated for the hypothetical maximum exposed member of the public.

This report on the Radiological Environmental Monitoring Program (REMP) conducted for the Quad Cities Nuclear Power Station (QCNPS) by Exelon covers the period 01 January 2019 through 31 December 2019. During that time period, 1530 analyses were performed on 1418 samples. In assessing all the data gathered for this report and comparing these results with preoperational data, it was concluded that the operation of QCNPS had no adverse radiological impact on the environment.

Surface water samples were analyzed for concentrations of gross beta, tritium, iron, nickel and gamma-emitting nuclides. Ground water samples were analyzed for concentrations of tritium and gamma-emitting nuclides. No fission or activation

products were detected. Gross beta activities detected were consistent with those detected in previous years and consistent with the control stations.

Fish (commercially and recreationally important species) and sediment samples were analyzed for concentrations of gamma-emitting nuclides. No fission or activation products were detected in fish samples. Cesium-137 (Cs-137) was not detected above the required LLD in any sediment samples.

Air particulate samples were analyzed for concentrations of gross beta and gamma-emitting nuclides. No fission or activation products were detected.

High sensitivity Iodine-131 (I-131) analyses were performed on air samples. No I-131 was detected.

Cow milk samples were analyzed for concentrations of I-131 and gamma-emitting nuclides. No I-131 was detected. Concentrations of naturally-occurring isotopes (K-40 averaging 1226 pCi/L) were consistent with those detected in previous years. No fission or activation products were detected.

Food product samples were analyzed for concentrations of gamma-emitting nuclides. No fission or activation products were detected.

Environmental gamma radiation measurements were performed quarterly using Optically Stimulated Luminescence Dosimeters (OSLD). Beginning in 2012, Exelon changed the type of dosimetry used for the Radiological Environmental Monitoring Program (REMP). Optically Stimulated Luminescent Dosimeters were deployed and Thermoluminescent Dosimeters (TLD) were discontinued. The relative comparison to control locations remains valid. OSLD technology is different than that used in a TLD but has the same purpose (to measure direct radiation).

II. Introduction

The Quad Cities Nuclear Power Station (QCNPS), consisting of two 2,957 MWth boiling water reactors owned and operated by Exelon Corporation, is located in Cordova, Illinois along the Mississippi River. Unit No.1 went critical on 16 March 1972. Unit No. 2 went critical on 02 December 1973. The site is located in northwestern Illinois, approximately 182 miles west of Chicago, Illinois.

This report covers those analyses performed by Teledyne Brown Engineering (TBE) and Landauer on samples collected during the period 1 January 2019 through 31 December 2019.

A. Objectives of the REMP

The objectives of the REMP are to:

1. Provide data on measurable levels of radiation and radioactive materials in the site environs

2. Evaluate the relationship between quantities of radioactive material released from the plant and resultant radiation doses to individuals from principal pathways of exposure

B. Implementation of the Objectives

The implementation of the objectives is accomplished by:

1. Identifying significant exposure pathways

2. Establishing baseline radiological data of media within those pathways

3. Continuously monitoring those media before and during Station operation to assess Station radiological effects (if any) on man and the environment

C. Radiation and Radioactivity

All matter is made of atoms. An atom is the smallest part into which matter can be broken down and still maintain all its chemical properties. Nuclear radiation is energy, in the form of waves or particles that is given off by unstable, radioactive atoms. Radioactive material exists naturally and has always been a part of our environment. The earth's crust, for example, contains radioactive uranium, radium, thorium and potassium. Some radioactivity is a result of nuclear weapons testing. Examples of radioactive fallout that is normally present in environmental samples are cesium-137 and strontium-90. Some examples of radioactive materials released from a nuclear power plant are cesium-137, iodine-131, strontium-90 and cobalt-60.

Radiation is measured in units of millirem; much like temperature is measured in degrees. A millirem is a measure of the biological effect of the energy deposited in tissue. The natural and man-made radiation dose received in one year by the average American is 300 to 400 mrem (References 2, 3, 4 in Table II.D-1 below). Radioactivity is measured in curies. A curie is that amount of radioactive material needed to produce 37,000,000,000 nuclear disintegrations per second. This is an extremely large amount of radioactivity in comparison to environmental radioactivity. That is why radioactivity in the environment is measured in picocuries. One picocurie is equal to one trillionth of a curie.

D. Sources of Radiation

As mentioned previously, naturally-occurring radioactivity has always been a part of our environment. Table II D-1 shows the sources and doses of radiation from natural and man-made sources.

Table II.D-1

Radiation Sources and Corresponding Dose [1]

NATURAL		MAN-MADE	
Source	Radiation Dose (millirem/year)	Source	Radiation Dose (millirem/year)
Internal, inhalation [2]	228	Medical [3]	300
External, space	33	Consumer [4]	13
Internal, ingestion	29	Industrial[5]	0.3
External, terrestrial	21	Occupational	0.5
		Weapons Fallout	<1
		Nuclear Power Plants	<1
Approximate Total	311	Approximate Total	314

(1) Information from NCRP Reports 160 and 94

(2) Primarily from airborne radon and its radioactive progeny

(3) Includes CT (147 mrem), nuclear medicine (77 mrem), interventional fluoroscopy (43 mrem) and conventional radiography and fluoroscopy (33 mrem)

(4) Primarily from cigarette smoking (4.6 mrem), commercial air travel (3.4 mrem), building materials (3.5 mrem), and mining and agriculture (0.8 mrem)

(5) Industrial, security, medical, educational, and research

Cosmic radiation from the sun and outer space penetrates the earth's atmosphere and continuously bombards us with rays and charged particles. Some of this cosmic radiation interacts with gases and particles in the atmosphere, making them radioactive in turn. These radioactive byproducts from cosmic ray bombardment are referred to as cosmogenic radionuclides. Isotopes such as beryllium-7 and carbon-14 are formed in this way.

Exposure to cosmic and cosmogenic sources of radioactivity results in about 33 mrem of radiation dose per year.

Additionally, natural radioactivity is in our body and in the food we eat (about 29 millirem/yr), the ground we walk on (about 21 millirem/yr) and the air we breathe (about 228 millirem/yr). The majority of a person's annual dose results from exposure to radon and thoron in the air we breathe. These gases and their radioactive decay products arise from the decay of naturally-occurring uranium, thorium and radium in the soil and building products such as brick, stone and concrete. Radon and thoron levels vary greatly with location, primarily due to changes in the concentration of uranium and thorium in the soil. Residents at some locations in Colorado, New York, Pennsylvania, and New Jersey have a higher annual dose as a result of higher levels of radon/thoron gases in these areas. In total, these various sources of naturally-occurring radiation and radioactivity contribute to a total dose of about 311 mrem per year.

In addition to natural radiation, we are normally exposed to radiation from a number of man-made sources. The single largest doses from man-made sources result from therapeutic and diagnostic applications of x-rays and radiopharmaceuticals. The annual dose to an individual in the U.S. from medical and dental exposure is about 300 mrem. Consumer products, such as televisions and smoke detectors, contribute about 13 mrem/yr. Much smaller doses result from weapons fallout (less than 1 mrem/yr) and nuclear power plants. Typically, the average person in the United States receives about 314 mrem per year from man-made sources.

III. Program Description

A. Sample Collection

Samples for the QCNPS REMP were collected for Exelon Nuclear by ATI Environmental Inc. (Midwest Labs). This section describes the general sampling methods used by Environmental Inc. to obtain environmental samples for the QCNPS REMP in 2019. Sample locations and descriptions can be found in Table B–1 and Figures B–1 and B–2, Appendix B.

Aquatic Environment

The aquatic environment was evaluated by performing radiological analyses on samples of surface water, ground water, fish and sediment. Surface water samples were collected weekly from two locations, Q-33 and Q-34 (Control). Ground water samples were collected quarterly from two locations, Q-35 and Q-36. All water samples were collected in new containers, which were rinsed with source water prior to collection.

Fish samples comprising the edible portions of commercially and recreationally important species were collected semiannually at two locations, Q-24 and Q-29 (Control). Sediment samples composed of Recently-deposited substrate were collected at two locations semiannually, Q-39 and Q-40 (Control).

Atmospheric Environment

The atmospheric environment was evaluated by performing radiological analyses on samples of air particulate, and airborne iodine. Airborne iodine and particulate samples were collected and analyzed at ten locations (Q-01, Q-02, Q-03, Q-04, Q-13, Q-16, Q-37, Q-38, Q-41 and Q-42 (control)). Airborne iodine and particulate samples were obtained at each location, using a vacuum pump with charcoal and glass fiber filters attached. The pumps were run continuously and sampled air at the rate of approximately one cubic foot per minute. The air particulate filters and air iodine samples were replaced weekly and sent to the laboratory for analysis.

Terrestrial Environment

The terrestrial environment was evaluated by performing radiological analyses on samples of milk and food product. Milk samples were collected biweekly at one location (Q-26) from May through October, and monthly from November through April. All samples were collected in new plastic containers from the bulk tank, preserved with sodium bisulfite, and shipped promptly to the laboratory.

Food products were collected annually in July at five locations (Q-Control, Q-Quad 1, Q-Quad 2, Q-Quad 3, and Q-Quad 4). Various types of broadleaf and root vegetables were collected and placed in new plastic bags, and sent to the laboratory for analysis.

Ambient Gamma Radiation

Beginning in 2012, Exelon changed the type of dosimetry used for the Radiological Environmental Monitoring Program (REMP). Optically Stimulated Luminescent Dosimeters (OSLD) were deployed and Thermoluminescent Dosimeters (TLD) were discontinued. The relative comparison to control locations remains valid. OSLD technology is different than that used in a TLD but has the same purpose (to measure direct radiation).

Each location consisted of 2 OSLD sets. The OSLD locations were placed on and around the QCNPS site as follows:

An inner ring consisting of 15 locations (Q-101, Q-102, Q-103, Q-104, Q-105, Q-106, Q-107, Q-108, Q-109, Q-111, Q-112, Q-113, Q-114, Q-115 and Q-116). These OSLDs are located in 15 of the 16 meteorological sectors in the general area of the site boundary (approximately 0.1 - 3 miles from the site). There are no OSLDs located in the SSW sector because this sector is located over water.

An outer ring consisting of 16 locations (Q-201, Q-202, Q-203, Q-204, Q-205, Q-206, Q-207, Q-208, Q-209, Q-210, Q-211, Q-212, Q-213, Q-214, Q-215 and Q-216). These OSLDs are located in each of the 16 meteorological sectors (approximately 6.0 – 8.0 km from the site)

An other set consisting of 9 locations (Q-01, Q-02, Q-03, Q-04, Q-13, Q-16, Q-37, Q-38 and Q-41). The locations are at each of the air sample stations around the site.

The balance of one location (Q-42) is the control site.

The specific OSLD locations were determined by the following criteria:

1. The presence of relatively dense population;

2. Site meteorological data taking into account distance and elevation for each of the sixteen 22.5 degree sectors around the site, where estimated annual dose from QCNPS, if any, would be most significant;

3. On hills free from local obstructions and within sight of the stack (where practical);

4. Near the closest dwelling to the stack in the prevailing downwind direction.

The OSLDs were exchanged quarterly and sent to Landauer for analysis.

B. Sample Analysis

This section describes the general analytical methodologies used by TBE to analyze the environmental samples for radioactivity for the QCNPS REMP in 2019 and the type of analyses. The analytical procedures used by the TBE laboratory are listed in Table B-2.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of beta emitters in surface water and air particulates
2. Concentrations of gamma emitters in ground and surface water, air particulates, milk, fish, sediment and vegetation
3. Concentrations of tritium (H-3) in ground and surface water
4. Concentrations of I-131 in air and milk
5. Ambient gamma radiation levels at various site environs
6. Concentrations of Iron-55 (Fe-55) and Nickel-63 (Ni-63) in surface water

C. Data Interpretation

The radiological and direct radiation data collected prior to Quad Cities Nuclear Power Station becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, Quad Cities Nuclear Power Station was considered operational at initial criticality. In addition, data were compared to previous years' operational data for consistency and trending. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

   The lower limit of detection (LLD) is defined as the smallest concentration of radioactive material in a sample that would yield a net count (above background) that would be detected with only a 5% probability of falsely concluding that a blank observation represents a "real" signal. The LLD is intended as an *a priori* (a before the fact) estimate of a system (including instrumentation, procedure and sample type) and not as an *a posteriori* (after the fact) criteria for the presence of activity. All analyses were designed to achieve the required QCNPS detection capabilities for environmental sample analysis.

The minimum detectable concentration (MDC) is defined above with the exception that the measurement is an *a posteriori* (after the fact) estimate of the presence of activity.

2. Net Activity Calculation and Reporting of Results

Net activity for a sample is calculated by subtracting background activity from the sample activity. Since the REMP measures extremely small changes in radioactivity in the environment, background variations may result in sample activity being lower than the background activity effecting a negative number. An MDC is reported in all cases where positive activity was not detected.

Gamma spectroscopy results for each type of sample were grouped as follows:

For surface water, groundwater and vegetation 12 nuclides, Manganese-54 (Mn-54), Cobalt-58 (Co-58), Iron-59 (Fe-59), Colbalt-60 (Co-60), Zinc-65 (Zn-65), Zirconium-95 (Zr-95), Niobium-95 (Nb-95), I-131, Cesium-134 (Cs-134), Cs-137, Barium-140 (Ba-140), and Lanthanum-140 (La-140) were reported.

For fish, sediment, air particulate and milk 11 nuclides, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, Cs-134, Cs-137 and Ba-140 and La-140 were reported.

For air iodine, one nuclide, I-131 was reported.

Means and standard deviations of the results were calculated. The standard deviations represent the variability of measured results for different samples rather than single analysis uncertainty.

D. Program Exceptions

For 2019 the QCNPS REMP had a sample recovery rate in excess of 96%. Sample anomalies and missed samples are listed in the tables below:

Table D-1 LISTING OF SAMPLE ANOMALIES

Sample Type	Location Code	Collection Date	Reason
SW	Q-33	01/04/19	I-131 detection not met by lab due to sample age when analyzed - sample received by lab on 01/30/19
AP/AI	Q-42	01/17/19	Lower reading of 167.0 hours due to power outage
AP/AI	Q-01	01/18/19	Low time of 45.6 hours due to recent power restoration
AI	Q-38	01/25/19	Cartridge slightly damaged in transit
AP/AI	Q-41	02/01/19	Lower reading of 149.2 hrs on 8-day period due to power outage (NOTE: timer reading 166.4 hrs during the 02/08/19 collection)
AP/AI	Q-37	02/08/19	Lower reading of 151.3 hours due to power outage
AP/AI	Q-37	02/15/19	Lower reading of 151.5 hrs due to power outage (NOTE: timer reading 167.5 hrs during the 02/22/19 collection)
AP/AI	Q-38	02/15/19	Lower reading of 141.4 hrs due to power outage (NOTE: timer reading 167.4 hrs during the 02/22/19 collection)
OSLD	Q-102-3/3A	03/28/19	OSLDs found on the ground
AP/AI	Q-37	03/29/19	Power failure causing approximately 7 hrs difference
AP	Q-37	04/05/19	Filter light – no indication of pump failure (pump timer, flow and vacuum parameters show normal readings); Sample slightly damaged during exchange
AP/AI	Q-13	05/02/19	Lower reading of 151.3 hrs due to power outage (NOTE: on 05/09/19 timer indicated normal reading of 162.6 hrs)
AP	Q-37	05/03/19	Filter light – no indication of pump failure (pump timer, flow and vacuum parameters show normal readings); Pump removed on 05/05/19 for more testing
AP/AI	Q-37	05/10/19	New pump placed on 05/05/19 due to previous pump's failure; filter shows normal residue
AP	Q-37	06/07/19	Filter slightly damaged during exchange
AP	Q-38	06/28/19	Filter light - pump operates normally (NOTE: during 07/05/19 exchange in the filter residue looked normal)
AP/AI	Q-16	07/05/19	Timer indicates approximately 3 hrs missing; power outage due to thunderstorms in the area (NOTE: on 07/11/19 timer indicated 143.1 hrs; normal reading for the 6-day period)
AP/AI	Q-42	07/05/19	Timer indicates approximately 5 hrs missing; power outage due to thunderstorms in the area (NOTE: on 07/11/19 timer indicated 143.4 hrs; normal reading for the 6-day period)
MI	Q-26	09/06/19	Shipment delivered to wrong address - returned to the collector; resent on 09/16/19
AP/AI	ALL SAMPLES	09/06/19	Shipment delivered to wrong address - returned to the collector; resent on 09/16/19
AP/AI	Q-13	10/17/19	Timer indicates approximately 5 hrs missing due to a power outage - crew working at the station (NOTE: during the next week's collection in the timer indicated 163.7 hrs; nominal value for the time interval)
AP/AI	Q-13	12/26/19	Timer indicates approximately 10 hrs missing due to a pump failure – pump exchanged

Table D-2 LISTING OF MISSED SAMPLES

Sample Type	Location Code	Collection Date	Reason
AP/AI	Q-01	01/04/19	No sample; power outage
WW	Q-36	01/10/19	Sample leaked during transportation - new sampling date scheduled for 01/14/19 (NOTE: sample recollected on 01/14/19)
AP/AI	Q-01	01/11/19	No sample; power outage
SW	Q-33	01/10/19	No sample; water frozen
SW	Q-33,Q-34	01/17/19	No sample; water frozen
SW	Q-33,Q-34	01/24/19	No sample; water frozen
SW	Q-33,Q-34	02/01/19	No sample; water frozen
SW	Q-34, Q-34	02/08/19	No sample; water frozen
SW	Q-34, Q-34	02/14/19	No sample; water frozen
SW	Q-34, Q-34	02/21/19	No sample; water frozen
MI	Q-26	03/01/19	The carrier lost the package in the Chicago hub (Investigation started); New collection scheduled on 03/08/19 (NOTE: sample collected on 03/08/19)
AP/AI	Q-01, Q-02, Q-03, Q-04, Q-37, Q-38	03/01/19	The carrier lost the package in the Chicago hub (Investigation started); Sample found by carrier, shipped for testing on 03/26/19
SW	Q-33, Q-34	03/21/19	No sample; water frozen
OSLD	Q-41-2	03/01/19	OSLD missing; may be in the frozen snow
SW	Q-33, Q-34	03/08/19	No sample; water frozen
OSLD	Q-41-2	03/08/19	OSLD missing; may be in the frozen snow (NOTE: OSLD found on 03/14/19, put back in place)
OSLD	Q-216-2	03/27/19	OSLD found missing during the quarterly exchange
AP/AI	Q-01, Q-02, Q-03, Q-04, Q-37, Q-38	06/14/19	The carrier erroneously sent the package to Mississippi (NOTE; the carrier returned the empty container after 3 weeks)
MI	Q-26	06/14/19	The carrier erroneously sent the package to Mississippi (NOTE; the carrier returned the empty container after 3 weeks)
AP/AI	Q-01, Q-02, Q-03, Q-04, Q-37, Q-38	06/21/19	The carrier misplaced the package – Case investigated by UPS and determined irretrievably lost (NOTE: new shipping arrangements made to prevent future sample losses)
MI	Q-26	06/21/19	The carrier misplaced the package – Case investigated by UPS and determined irretrievably lost (NOTE: new shipping arrangements made to prevent future sample losses)
AI	Q-16	08/29/19	Cartridge missing in field
OSLD	Q-210-4, Q-210-4A	09/07/19	OSLDs found missing during the monthly visual check

Table D-2 LISTING OF MISSED SAMPLES (cont'd)

Sample Type	Location Code	Collection Date	Reason
OSLD	Q-210-1/1A, Q-203-1	09/25/19	OSLDs found missing during the quarterly check
OSLD	Q-209-2	12/05/19	OSLD found missing during the monthly visual check
SW	Q-33, Q-34	12/19/19	No sample; water frozen

The overall sample recovery rate indicates that the appropriate procedures and equipment are in place to assure reliable program implementation.

E. Program Changes

There were no program changes in 2019.

IV. Results and Discussion

A. Aquatic Environment

1. Surface Water

Samples were taken weekly and composited monthly at two locations (Q-33 and Q-34). Of these locations only Q-33, located downstream, could be affected by Quad Cities' effluent releases. The following analyses were performed:

Gross Beta

Samples from all locations were analyzed for concentrations of gross beta (Table C–I.1, Appendix C). Gross beta activity was detected in 19 of 22 samples. The values ranged from 2.7 to 8.4 pCi/L. Concentrations detected were consistent with those detected in previous years (Figure C–1, Appendix C). The required LLD was met.

Tritium

Quarterly composites of weekly collections were analyzed for tritium activity (Table C–I.2, Appendix C). No tritium activity was detected (Figure C–2, Appendix C). The 2000 pCi/L OCDM and contractually required 200 pCi/L LLDs were met.

Iron and Nickel

Quarterly composites of monthly collections were analyzed for Fe-55 and Ni-63 (Table C–I.2, Appendix C). No Fe-55 or Ni-63 were detected. The required LLDs were met.

Gamma Spectrometry

Samples from both locations were analyzed monthly for gamma-emitting nuclides (Table C–I.3, Appendix C). No nuclides associated with QCNPS were detected and all required LLDs were met.

2. Ground Water

Quarterly grab samples were collected at two locations (Q-35 and Q-36). Both locations could be affected by Quad Cities' effluent releases. The following analyses were performed:

Tritium

Quarterly grab samples from the locations were analyzed for tritium

activity (Table C–II.1, Appendix C). No tritium activity was detected (Figure C–3, Appendix C). The 2000 pCi/L OCDM and contractually required 200 pCi/L LLDs were met.

Gamma Spectrometry

Samples from all locations were analyzed for gamma-emitting nuclides (Table C–II.2, Appendix C). No nuclides associated with QCNPS were detected and all required LLDs were met.

3. Fish

Fish samples comprised of various commercially and recreationally important species were collected at two locations (Q-24 and Q-29) semiannually. Location Q-24 could be affected by Quad Cities' effluent releases. The following analysis was performed:

Gamma Spectrometry

The edible portion of fish samples from both locations were analyzed for gamma-emitting nuclides (Table C–III.1, Appendix C). No nuclides associated with QCNPS were detected and all required LLDs were met.

4. Sediment

Aquatic sediment samples were collected at two locations (Q-39 and Q-40) semiannually. The location Q-39, located downstream, could be affected by Quad Cities' effluent releases. The following analysis was performed:

Gamma Spectrometry

Sediment samples from Q-39 and Q-40 were analyzed for gamma-emitting nuclides (Table C–IV.1, Appendix C). Cesium-137 (Cs-137) was detected in two samples with concentrations ranging from 141 to 177 pCi/kg dry. No other nuclides potentially associated with QCNPS were detected and all required LLDs were met.

B. Atmospheric Environment

1. Airborne

a. Air Particulates

Continuous air particulate samples were collected from ten locations on a weekly basis. The ten locations were separated into three groups: Near-field samplers within 4 km (2.5 miles) of the site

(Q-01, Q-02, Q-03 and Q-04), far-field samplers between 4 and 10 km (2.5 – 6.2 miles) from the site (Q-13, Q-16, Q-37, Q-38 and Q-41) and the Control sampler between 10 and 30 km (6.2 – 18.6 miles) from the site (Q-42). The following analyses were performed:

Gross Beta

Weekly samples were analyzed for concentrations of beta emitters (Table C–V.1 and C–V.2, Appendix C).

Comparison of results among the four groups aid in determining the effects, if any, resulting from the operation of QCNPS. The results from the near-field locations (Group I) ranged from 5 to 34E–03 pCi/m^3 with a mean of 15E–03 pCi/m^3. The results from the far-field locations (Group II) ranged from 4 to 38E–03 pCi/m^3 with a mean of 15E–03 pCi/m^3. The results from the Control location (Group III) ranged from 8 to 40E–03 pCi/m^3 with a mean of 16E–03 pCi/m^3. Comparison of the 2019 air particulate data with previous year's data indicate no effects from the operation of QCNPS. In addition comparisons of the weekly mean values for 2019 indicate no notable differences among the three groups (Figures C–4 through C–9, Appendix C).

Gamma Spectrometry

Weekly samples were composited quarterly and analyzed for gamma-emitting nuclides (Table C–V.3, Appendix C). No nuclides associated with QCNPS were detected and all required LLDs were met.

b. Airborne Iodine

Continuous air samples were collected from ten locations (Q-01, Q-02, Q-03, Q-04, Q-13, Q-16, Q-37, Q-38, Q-41 and Q-42) and analyzed weekly for I-131 (Table C–VI.1, Appendix C). All results were less than the LLD for I-131.

2. Terrestrial

a. Milk

Samples were collected from one location (Q-26) biweekly May through October and monthly November through April. The following analyses were performed:

Iodine-131

Milk samples from the location were analyzed for concentrations of I-131 (Table C–VII.1, Appendix C). No I-131 was detected and the LLD was met.

Gamma Spectrometry

Each milk sample was analyzed for concentrations of gamma-emitting nuclides (Table C–VII.2, Appendix C). No nuclides associated with QCNPS were detected and all required LLDs were met.

b. Food Products

Food product samples were collected at four locations plus a control location (Q-Control, Q-Quad 1, Q-Quad 2, Q-Quad 3 and Q-Quad 4) annually during growing season. Four locations, (Q-Quad 1, Q-Quad 2, Q-Quad 3 and Q-Quad 4) could be affected by Quad Cities' effluent releases. The following analysis was performed:

Gamma Spectrometry

Samples from all locations were analyzed for gamma-emitting nuclides (Table C–VIII.1, Appendix C). No nuclides associated with QCNPS were detected and all required LLDs were met.

C. Ambient Gamma Radiation

Ambient gamma radiation levels were measured utilizing optically stimulated luminescence dosimeters. Forty-one OSLD locations were established around the site. Results of OSLD measurements are listed in Tables C-IX.1 and C–IX.2, Appendix C.

All of the OSLD measurements were < 20 mRem/quarter, with a range of 7.8 to 18.2 mRem/quarter. A comparison of the Inner Ring, Outer Ring and Other data to the Control Location data, indicate that the ambient gamma radiation levels from all the locations were comparable.

D. Independent Spent Fuel Storage Installation

QCNPS commenced use of an Independent Spent Fuel Storage Installation (ISFSI) in Dec 2005. There are no measurable changes in ambient gamma radiation levels as a result of ISFSI operations.

E. Land Use Survey

A Land Use Survey conducted during August 2019 around QCNPS was performed by ATI Environmental Inc. (Midwest Labs) for Exelon Nuclear to comply with the Quad Cities' Offsite Dose Calculation Manual. The purpose of the survey was to document the nearest resident and milk producing animals in each of the sixteen 22.5 degree sectors around the site. The results from the land use census have not identified any locations, which yield a calculated dose or dose commitment, via the same pathway, that is at least 20% greater than at a location from which samples are currently being obtained. The results of this survey are summarized below:

	Distance in Miles from QCNPS		
Sector	Residence Miles	Livestock Miles	Milk Farm Miles
N	0.6	2.7	-
NNE	1.2	3.1	-
NE	1.3	3.2	-
ENE	2.9	2.9	-
E	2.0	5.5	-
ESE	2.8	3.1	3.1
SE	1.7	5.3	-
SSE	1.1	4.5	6.6
S	0.8	4.8	-
SSW	3.2	3.5	-
SW	2.9	3.3	-
WSW	2.2	2.7	-
W	2.6	4.3	-
WNW	2.7	3.8	-
NW	2.6	4.7	-
NNW	2.1	2.2	-

Of the above listed Milk Farms, only the farm located at 3.1 miles ESE of QCNPS, listed in the sample results section as Bill Stanley Dairy, has elected to participate in the QCNPS REMP program. Participation by local farmers is voluntary.

F. Errata Data

There is no errata data for 2019.

G. Summary of Results – Inter-Laboratory Comparison Program

Teledyne Brown Engineering Laboratory analyzed Performance Evaluation (PE) samples of air particulate, air iodine, milk, soil, vegetation and water matrices for various analytes (Appendix D). The PE samples supplied by Analytics Inc., Environmental Resource Associates (ERA) and Department of

Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP), were evaluated against the following pre-set acceptance criteria:

A. Analytics Evaluation Criteria

Analytics' evaluation report provides a ratio of TBE's result and Analytics' known value. Since flag values are not assigned by Analytics, TBE evaluates the reported ratios based on internal QC requirements based on the DOE MAPEP criteria.

B. ERA Evaluation Criteria

ERA's evaluation report provides an acceptance range for control and warning limits with associated flag values. ERA's acceptance limits are established per the USEPA, National Environmental Laboratory Accreditation Conference (NELAC), state-specific Performance Testing (PT) program requirements or ERA's SOP for the Generation of Performance Acceptance Limits, as applicable. The acceptance limits are either determined by a regression equation specific to each analyte or a fixed percentage limit promulgated under the appropriate regulatory document.

C. DOE Evaluation Criteria

MAPEP's evaluation report provides an acceptance range with associated flag values. MAPEP defines three levels of performance:

- Acceptable (flag = "A") - result within ± 20% of the reference value
- Acceptable with Warning (flag = "W") - result falls in the ± 20% to ± 30% of the reference value
- Not Acceptable (flag = "N") - bias is greater than 30% of the reference value

Note: The Department of Energy (DOE) Mixed Analyte Performance Evaluation Program (MAPEP) samples are created to mimic conditions found at DOE sites which do not resemble typical environmental samples obtained at commercial nuclear power facilities.

For the TBE laboratory, 119 out of 129 analyses performed met the specified acceptance criteria. Ten analyses did not meet the specified acceptance criteria for the following reasons and were addressed through the TBE Corrective Action Program. A summary is found below:

1. 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 19-10)

2. 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 19-11)

3. 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 19-12)

4. 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 19-13)

5. 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 19-14)

6. 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 19-23)

7. 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 19-24)

8. 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 19-25).

9. 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 19-26)

10. 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. (NCR 19-27)

The Inter-Laboratory Comparison Program provides evidence of "in control" counting systems and methods, and that the laboratories are producing accurate and reliable data.

APPENDIX A

RADIOLOGICAL ENVIRONMENTAL MONITORING REPORT SUMMARY

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TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR QUAD CITIES NUCLEAR POWER STATION, 2019

NAME OF FACILITY:	**QUAD CITIES**	**DOCKET NUMBER:**	**50-254 &50-265**
LOCATION OF FACILITY:	**CORDOVA, IL**	**REPORTING PERIOD:**	**2019**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SURFACE WATER *(PCI/LITER)*	**GR-B**	22	4	4.7 (9/11) *2.7 - 8.4*	5.2 (10/11) *3.6 - 7.5*	5.2 (10/11) *3.6 - 7.5*	Q-34 CONTROL CAMANCHE - UPSTREAM 4.4 MILES NNE OF SITE	0
	H-3	8	2000	<LLD	<LLD	-		0
	FE-55	8	200	<LLD	<LLD	-		0
	NI-63	8	5	<LLD	<LLD	-		0
	GAMMA	22						
	MN-54		15	<LLD	<LLD	-		0
	CO-58		15	<LLD	<LLD	-		0
	FE-59		30	<LLD	<LLD	-		0
	CO-60		15	<LLD	<LLD	-		0
	ZN-65		30	<LLD	<LLD	-		0
	NB-95		15	<LLD	<LLD	-		0
	ZR-95		30	<LLD	<LLD	-		0
	I-131		15	<LLD	<LLD	-		0
	CS-134		15	<LLD	<LLD	-		0
	CS-137		18	<LLD	<LLD	-		0
	BA-140		60	<LLD	<LLD	-		0
	LA-140		15	<LLD	<LLD	-		0
GROUND WATER (PCI/LITER)	**H-3**	8	2000	<LLD	*NA*	-		0
	GAMMA	8						
	MN-54		15	<LLD	*NA*	-		0
	CO-58		15	<LLD	*NA*	-		0
	FE-59		30	<LLD	*NA*	-		0
	CO-60		15	<LLD	*NA*	-		0
	ZN-65		30	<LLD	*NA*	-		0
	NB-95		15	<LLD	*NA*	-		0
	ZR-95		30	<LLD	*NA*	-		0
	I-131		15	<LLD	*NA*	-		0
	CS-134		15	<LLD	*NA*	-		0
	CS-137		18	<LLD	*NA*	-		0
	BA-140		60	<LLD	*NA*	-		0
	LA-140		15	<LLD	*NA*	-		0

(M) The Mean Values are calculated using the positive values. (F) Fraction of detectable measurement are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR QUAD CITIES NUCLEAR POWER STATION, 2019

NAME OF FACILITY:	**QUAD CITIES**	**DOCKET NUMBER:**	**50-254 &50-265**
LOCATION OF FACILITY:	**CORDOVA, IL**	**REPORTING PERIOD:**	**2019**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
FISH	**GAMMA**	8						
(PCI/KG WET)	*MN-54*		130	<LLD	<LLD	-		0
	CO-58		130	<LLD	<LLD	-		0
	FE-59		260	<LLD	<LLD	-		0
	CO-60		130	<LLD	<LLD	-		0
	ZN-65		260	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	CS-134		130	<LLD	<LLD	-		0
	CS-137		150	<LLD	<LLD	-		0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0
SEDIMENT	**GAMMA**	4						
(PCI/KG DRY)	*MN-54*		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	FE-59		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	ZN-65		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	CS-134		150	<LLD	<LLD	-		0
	CS-137		180	177 (1/2)	141 (1/2)	177 (1/2)	Q-39 INDICATOR CORDOVA - DOWNSTREAM MISSISSIPPI RIVER 0.8 MILES SSW OF SITE	0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0
AIR PARTICULATE	**GR-B**	506	10	15.4 (439/454) *4.3 - 38.1*	15.7 (52/52) *7.7 - 39.7*	17.7 (52/52) *8.1 - 38.1*	Q-41 INDICATOR CAMANCHE 4.3 MILES NNE OF SITE	0
(E-3 PCI/CU.METER)								

(M) The Mean Values are calculated using the positive values. (F) Fraction of detectable measurement are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR QUAD CITIES NUCLEAR POWER STATION, 2019

NAME OF FACILITY:	**QUAD CITIES**	**DOCKET NUMBER:**	**50-254 &50-265**
LOCATION OF FACILITY:	**CORDOVA, IL**	**REPORTING PERIOD:**	**2019**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIR PARTICULATE	**GAMMA**	40						
(E-3 PCI/CU.METER)	*MN-54*		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	FE-59		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	ZN-65		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	CS-134		50	<LLD	<LLD	-		0
	CS-137		60	<LLD	<LLD	-		0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0
AIR IODINE	**GAMMA**	506						
(E-3 PCI/CU.METER)	*I-131*		70	<LLD	<LLD	-		0
MILK	**I-131 (LOW LVL)**	18	1	<LLD	*NA*	-		0
(PCI/LITER)								
	GAMMA	18						
	MN-54		*NA*	<LLD	*NA*	-		0
	CO-58		*NA*	<LLD	*NA*	-		0
	FE-59		*NA*	<LLD	*NA*	-		0
	CO-60		*NA*	<LLD	*NA*	-		0
	ZN-65		*NA*	<LLD	*NA*	-		0
	NB-95		*NA*	<LLD	*NA*	-		0
	ZR-95		*NA*	<LLD	*NA*	-		0
	CS-134		15	<LLD	*NA*	-		0
	CS-137		18	<LLD	*NA*	-		0
	BA-140		60	<LLD	*NA*	-		0
	LA-140		15	<LLD	*NA*	-		0

(M) The Mean Values are calculated using the positive values. (F) Fraction of detectable measurement are indicated in parentheses.

TABLE A-1 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM ANNUAL SUMMARY FOR QUAD CITIES NUCLEAR POWER STATION, 2019

NAME OF FACILITY:	**QUAD CITIES**	**DOCKET NUMBER:**	**50-254 &50-265**
LOCATION OF FACILITY:	**CORDOVA, IL**	**REPORTING PERIOD:**	**2019**

MEDIUM OR PATHWAY SAMPLED *(UNIT OF MEASUREMENT)*	TYPES OF ANALYSIS PERFORMED	NUMBER OF ANALYSIS PERFORMED	REQUIRED LOWER LIMIT OF DETECTION (LLD)	**INDICATOR LOCATIONS** MEAN (M) (F) *RANGE*	**CONTROL LOCATION** MEAN (M) (F) *RANGE*	**LOCATION WITH HIGHEST ANNUAL MEAN (M)** MEAN (M) (F) *RANGE*	STATION # NAME DISTANCE AND DIRECTION	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
VEGETATION	**GAMMA**	15						
(PCI/KG WET)	*MN-54*		*NA*	<LLD	<LLD	-		0
	CO-58		*NA*	<LLD	<LLD	-		0
	FE-59		*NA*	<LLD	<LLD	-		0
	CO-60		*NA*	<LLD	<LLD	-		0
	ZN-65		*NA*	<LLD	<LLD	-		0
	NB-95		*NA*	<LLD	<LLD	-		0
	ZR-95		*NA*	<LLD	<LLD	-		0
	I-131		60	<LLD	<LLD	-		0
	CS-134		60	<LLD	<LLD	-		0
	CS-137		80	<LLD	<LLD	-		0
	BA-140		*NA*	<LLD	<LLD	-		0
	LA-140		*NA*	<LLD	<LLD	-		0
DIRECT RADIATION	**OSLD-QUARTERLY**	331	*NA*	12.2	13.9	16.5	Q-211-2 INDICATOR	0
(MILLI-ROENTGEN/QTR.)				(323/323)	(8/8)	(4/4)		
				7.8 - 18.2	*11.7 - 15.9*	*13.9 - 18.2*	4.5 MILES SW	

(M) The Mean Values are calculated using the positive values. (F) Fraction of detectable measurement are indicated in parentheses.

APPENDIX B

LOCATION DESIGNATION, DISTANCE & DIRECTION, AND SAMPLE COLLECTION & ANALYTICAL METHODS

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TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Quad Cities Nuclear Power Station, 2019

Location	Location Description	Distance & Direction From Site
A. Surface Water		
Q-33	Cordova (indicator)	3.1 miles SSW
Q-34	Camanche, Upstream (control)	4.4 miles NNE
B. Ground/Well Water		
Q-35	McMillan Well (indicator)	1.5 miles S
Q-36	Cordova Well (indicator)	3.3 miles SSW
C. Milk - bi-weekly / monthly		
Q-26	Bill Stanley Dairy (indicator)	3.1 miles ESE
D. Air Particulates / Air Iodine		
Q-01	Onsite 1 (indicator)	0.5 miles N
Q-02	Onsite 2 (indicator)	0.4 miles ENE
Q-03	Onsite 3 (indicator)	0.6 miles S
Q-04	Nitrin (indicator)	1.7 miles NE
Q-13	Princeton (indicator)	4.7 miles SW
Q-16	Low Moor (indicator)	5.7 miles NNW
Q-37	Meredosia Road (indicator)	4.4 miles ENE
Q-38	Fuller Road (indicator)	4.7 miles E
Q-41	Camanche, Upstream (control)	4.3 miles NNE
Q-42	LeClaire (control)	8.7 miles SSW
E. Fish		
Q-24	Pool #14 of Mississippi River, Downstream (indicator)	0.5 miles SW
Q-29	Mississippi River, Upstream (control)	1.0 miles N
F. Sediment		
Q-39	Cordova, Downstream on Mississippi River (indicator)	0.8 miles SSW
Q-40	North of Albany, Upstream on Mississippi River (control)	8.9 miles NE
G. Food Products		
Quadrant 1	Ken DeBaille	2.3 miles ENE
Quadrant 2	Dale Nimmic	3.0 miles ESE
Quadrant 3	Amy Johnston	1.8 miles S
Quadrant 4	Mike Fawcett	4.5 miles NW
Control	Charles Leavens	9.5 miles NE
H. Environmental Dosimetry - OSLD		
Inner Ring		
Q-101-1 / Q-101-1A		0.6 miles N
Q-101-2 / Q-101-2A		0.9 miles N
Q-102-1 / Q-102-1A		1.3 miles NNE
Q-102-3 / Q-102-3A		1.4 miles NNE
Q-103-1 / Q-103-1A		1.2 miles NE
Q-103-2 / Q-103-2A		1.2 miles NE
Q-104-1 / Q-104-1A		1.1 miles ENE
Q-104-2 / Q-104-2A		0.9 miles ENE
Q-105-1 / Q-105-1A		0.8 miles E
Q-105-2 / Q-105-2A		0.8 miles E
Q-106-2 / Q-106-2A		0.7 miles ESE
Q-106-3 / Q-106-3A		0.7 miles ESE
Q-107-2 / Q-107-2A		0.7 miles SE
Q-107-3 / Q-107-3A		0.8 miles SE
Q-108-1 / Q-108-1A		1.0 miles SSE
Q-108-2 / Q-108-2A		0.9 miles SSE
Q-109-1 / Q-109-1A		0.9 miles S
Q-109-2 / Q-109-2A		1.2 miles S
Q-111-1 / Q-111-1A		2.6 miles SW
Q-111-2 / Q-111-2A		2.5 miles SW

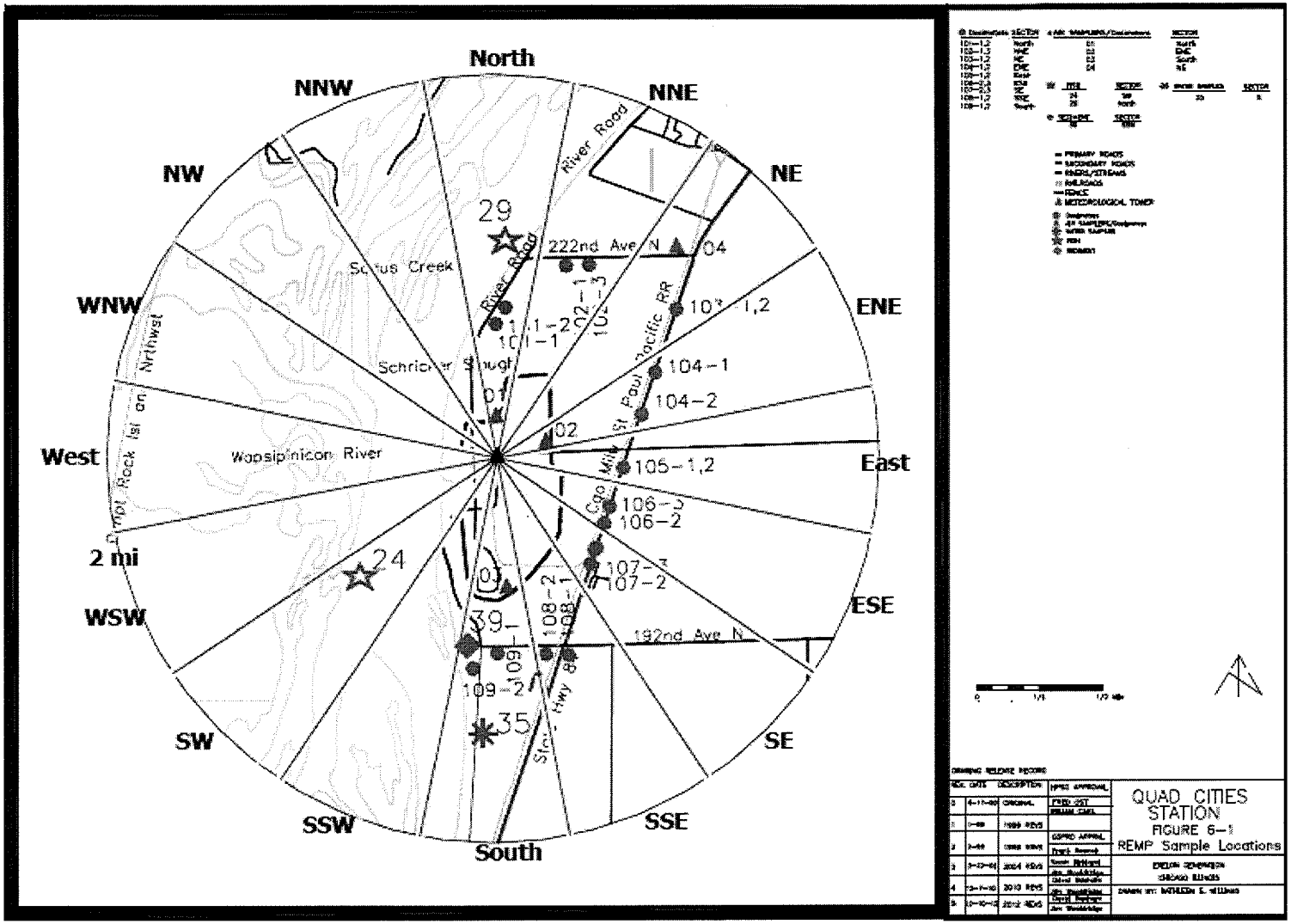
TABLE B-1: Radiological Environmental Monitoring Program - Sampling Locations, Distance and Direction, Quad Cities Nuclear Power Station, 2019

Location	Location Description	Distance & Direction From Site
H. Environmental Dosimetry - OSLD (continued)		
Inner Ring (continued)		
Q-112-1 / Q-112-1A		2.5 miles WSW
Q-112-2 / Q-112-2A		2.2 miles WSW
Q-113-1 / Q-113-1A		2.5 miles W
Q-113-2 / Q-113-2A		2.5 miles W
Q-114-1 / Q-114-1A		2.1 miles WNW
Q-114-2 / Q-114-2A		2.5 miles WNW
Q-115-1 / Q-115-1A		2.6 miles NW
Q-115-2 / Q-115-2A		2.3 miles NW
Q-116-1 / Q-116-1A		2.3 miles NNW
Q-116-3 / Q-116-3A		2.4 miles NNW
Outer Ring		
Q-201-1 / Q-201-1A		4.2 miles N
Q-201-2 / Q-201-2A		4.4 miles NNE
Q-202-1 / Q-202-1A		4.8 miles NNE
Q-203-1 / Q-203-1A		4.7 miles NE
Q-203-2 / Q-203-2A		5.0 miles NE
Q-204-1 / Q-204-1A		4.7 miles ENE
Q-204-2 / Q-204-2A		4.5 miles ENE
Q-205-1 / Q-205-1A		4.7 miles E
Q-205-4 / Q-205-4A		4.8 miles E
Q-206-1 / Q-206-1A		4.8 miles ESE
Q-206-2 / Q-206-2A		4.8 miles ESE
Q-207-1 / Q-207-1A		4.7 miles SE
Q-207-4 / Q-207-4A		4.7 miles SE
Q-208-1 / Q-208-1A		4.3 miles SSE
Q-208-2 / Q-208-2A		4.9 miles SSE
Q-209-1 / Q-209-1A		4.7 miles S
Q-209-4 / Q-209-4A		4.7 miles S
Q-210-1 / Q-210-1A		4.1 miles SWW
Q-210-4* / Q-210-4A*		4.1 miles SSW
Q-210-5 / Q-210-5A		3.3 miles SSW
Q-211-1 / Q-211-1A		4.5 miles SW
Q-211-2 / Q-211-2A		4.5 miles SW
Q-212-1 / Q-212-1A		5.4 miles WSW
Q-212-2 / Q-212-2A		4.4 miles WSW
Q-213-1 / Q-213-1A		4.3 miles W
Q-213-2 / Q-213-2A		4.8 miles W
Q-214-1 / Q-214-1A		4.7 miles WNW
Q-214-2 / Q-214-2A		4.4 miles WNW
Q-215-1 / Q-215-1A		5.0 miles NW
Q-215-2 / Q-215-2A		4.2 miles NW
Q-216-1 / Q-216-1A		4.6 miles NNW
Q-216-2 / Q-216-2A		4.3 miles NNW
Other		
Q-01-1 / Q-01-2	Onsite 1 (indicator)	0.5 miles N
Q-02-1 / Q-02-2	Onsite 2 (indicator)	0.4 miles ENE
Q-03-1 / Q-03-2	Onsite 3 (indicator)	0.6 miles S
Q-04-1 / Q-04-2	Nitrin (indicator)	1.7 miles NE
Q-13-1 / Q-13-2	Princeton (indicator)	4.7 miles SW
Q-16-1 / Q-16-2	Low Moor (indicator)	5.7 miles NNW
Q-37-1 / Q-37-2	Meredosia (indicator)	4.4 miles ENE
Q-38-1 / Q-38-2	Fuller Road (indicator)	4.7 miles E
Q-41-1 / Q-41-2	Camanche (indicator)	4.3 miles NNE
Control		
Q-42-1 / Q-42-2	LeClaire	8.7 miles SSW

**Removed from ODCM in December 2006 and replaced by Q-210-5. Q-210-4 is for trending only*

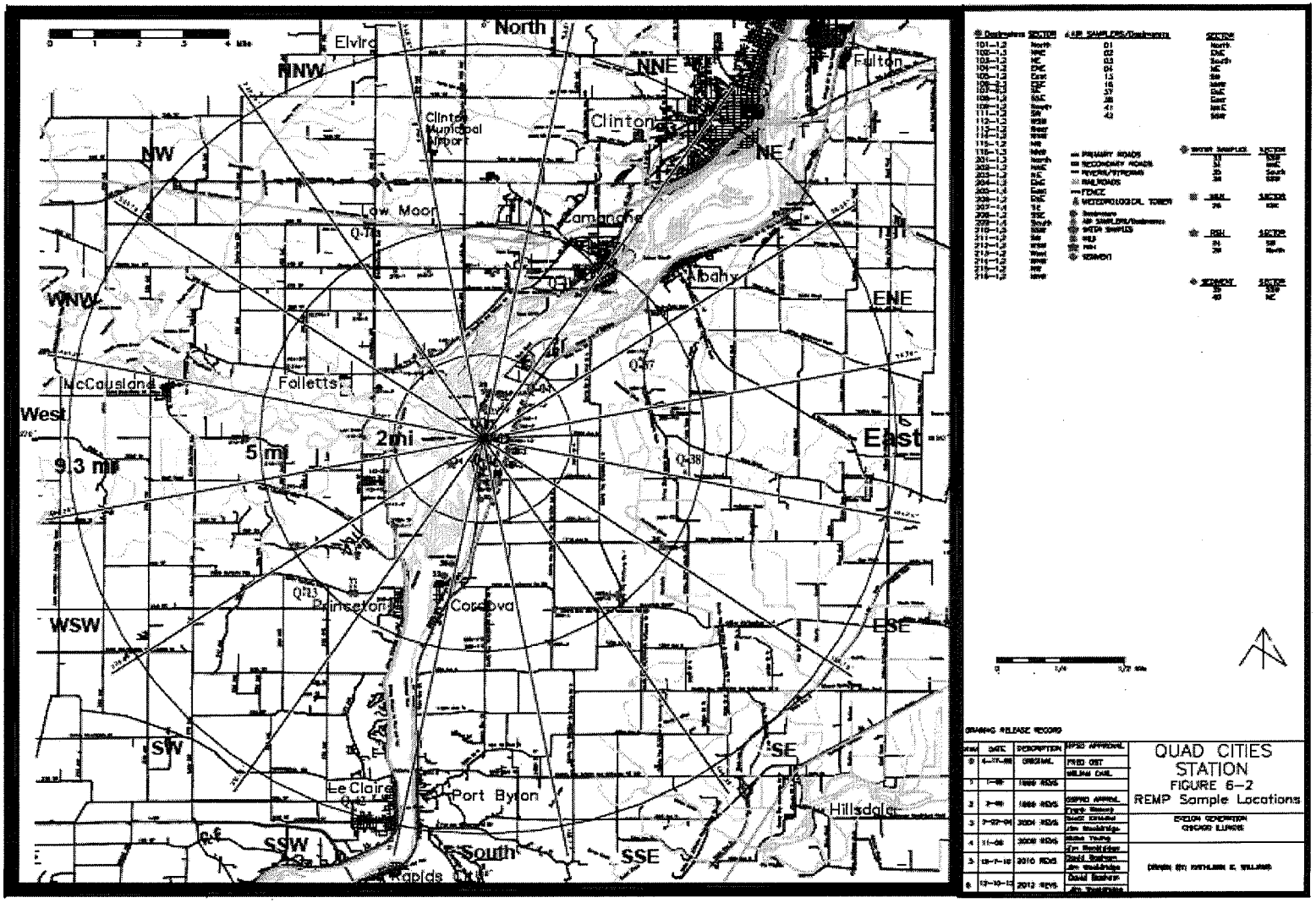
TABLE B-2: Radiological Environmental Monitoring Program - Summary of Sample Collection and Analytical Methods, Quad Cities Nuclear Power Station, 2019

Sample Medium	Analysis	Sampling Method	Analytical Procedure Number
Surface Water	Gamma Spectroscopy	Monthly composite from weekly grab samples	TBE, TBE-2007 Gamma emitting radioisotope analysis
Surface Water	Gross Beta	Monthly composite from weekly grab samples	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices
Surface Water	Tritium	Quarterly composite from weekly grab samples	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation
Surface Water	Iron and Nickel	Quarterly composite from weekly grab samples	TBE, TBE-2006 Iron-55 in various matrices TBE, TBE-2013 Radionickel in various matrices
Ground Water	Gamma Spectroscopy	Quarterly grab samples	TBE, TBE-2007 Gamma emitting radioisotope analysis
Ground Water	Tritium	Quarterly grab samples	TBE, TBE-2011 Tritium analysis in drinking water by liquid scintillation
Fish	Gamma Spectroscopy	Semi-annual samples collected via electroshocking or other techniques	TBE-2007 Gamma emitting radioisotope analysis
Sediment	Gamma Spectroscopy	Semi-annual grab samples	TBE, TBE-2007 Gamma emitting radioisotope analysis
Air Particulates	Gross Beta	One-week composite of continuous air sampling through glass fiber filter paper	TBE, TBE-2008 Gross Alpha and/or gross beta activity in various matrices
Air Particulates	Gamma Spectroscopy	Quarterly composite of each station	TBE, TBE-2007 Gamma emitting radioisotope analysis
Air Iodine	Gamma Spectroscopy	Weekly composite of continuous air sampling through charcoal filter	TBE, TBE-2007 Gamma emitting radioisotope analysis
Milk	I-131	Bi-weekly grab sample when cows are on pasture. Monthly all other times	TBE, TBE-2012 Radioiodine in various matrices
Milk	Gamma Spectroscopy	Bi-weekly grab sample when cows are on pasture. Monthly all other times	TBE, TBE-2007 Gamma emitting radioisotope analysis
Food Products	Gamma Spectroscopy	Annual grab samples	TBE, TBE-2007 Gamma emitting radioisotope analysis
OSLD	Optically Stimulated Luminescence Dosimetry	Quarterly OSLDs comprised of two Al_2O_3:C Landauer Incorporated elements	Landauer Incorporated



NOTE: All dosimeter locations contain two dosimeters, ex. numbering convention 102-1 / 102-1A

Figure B-1 Map
Quad Cities REMP Sampling Locations – 2 Mile Radius, 2019



NOTE: All dosimeter locations contain two dosimeters, ex. numbering convention 102-1 / 102-1A

Figure B-2 Map
Quad Cities REMP Sampling Locations – 9.3 Mile Radius, 2019

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APPENDIX C

DATA TABLES AND FIGURES

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Table C-I.1 CONCENTRATIONS OF GROSS BETA IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD		Q-33	Q-34
01/04/19 - 01/10/19		2.7 ± 1.9	< 2.7
02/01/19 - 02/27/19	*(1)*		
03/14/19 - 03/28/19		4.0 ± 1.6	6.2 ± 2.0
04/03/19 - 04/25/19		4.0 ± 1.6	5.6 ± 1.7
05/02/19 - 05/31/19		4.7 ± 1.7	3.6 ± 1.7
06/06/19 - 06/27/19		8.4 ± 3.5	7.3 ± 3.5
07/05/19 - 07/25/19		3.8 ± 1.8	4.9 ± 1.9
08/01/19 - 08/29/19		< 3.1	4.8 ± 2.2
09/05/19 - 09/26/19		6.4 ± 2.2	4.1 ± 2.0
10/03/19 - 10/31/19		3.7 ± 1.6	4.7 ± 1.7
11/07/19 - 11/29/19		4.6 ± 1.8	7.5 ± 2.0
12/05/19 - 12/26/19		< 2.7	3.7 ± 1.9
MEAN ± 2 STD DEV		4.7 ± 3.4	5.2 ± 2.8

Table C-I.2 CONCENTRATIONS OF TRITIUM, IRON, AND NICKEL IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD	H-3	FE-55	NI-63
Q-33	01/04/19 - 03/28/19	< 190	< 191	< 5.0
	04/05/19 - 06/27/19	< 177	< 55	< 4.6
	07/05/19 - 09/26/19	< 193	< 62	< 4.2
	10/03/19 - 12/26/19	< 193	< 60	< 4.4
	MEAN	-	-	-
Q-34	01/04/19 - 03/28/19	< 187	< 49	< 4.8
	04/03/19 - 06/27/19	< 188	< 38	< 4.6
	07/05/19 - 09/26/19	< 196	< 53	< 4.5
	10/03/19 - 12/26/19	< 194	< 55	< 4.3
	MEAN	-	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES
(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-I.3 **CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019**

RESULTS IN UNITS OF PCI/LITER + 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
Q-33	01/04/19 - 01/04/19	< 4	< 4	< 10	< 4	< 8	< 4	< 7	*(1)*	< 4	< 4	< 46	< 14
	02/01/19 - 02/27/19 *(1)*												
	03/14/19 - 03/28/19	< 7	< 9	< 24	< 9	< 15	< 10	< 15	< 12	< 13	< 9	< 41	< 10
	04/03/19 - 04/25/19	< 6	< 8	< 12	< 6	< 17	< 7	< 13	< 11	< 7	< 8	< 31	< 13
	05/02/19 - 05/31/19	< 8	< 6	< 12	< 8	< 15	< 6	< 14	< 13	< 8	< 6	< 40	< 11
	06/06/19 - 06/27/19	< 2	< 2	< 5	< 2	< 4	< 2	< 4	< 12	< 2	< 2	< 21	< 6
	07/05/19 - 07/25/19	< 1	< 2	< 4	< 2	< 3	< 2	< 3	< 9	< 2	< 2	< 15	< 5
	08/01/19 - 08/29/19	< 5	< 5	< 11	< 6	< 14	< 7	< 9	< 14	< 5	< 5	< 36	< 12
	09/05/19 - 09/26/19	< 7	< 6	< 13	< 5	< 10	< 6	< 9	< 14	< 5	< 5	< 36	< 11
	10/03/19 - 10/31/19	< 7	< 9	< 14	< 9	< 8	< 7	< 15	< 10	< 8	< 9	< 37	< 10
	11/07/19 - 11/29/19	< 2	< 2	< 5	< 2	< 5	< 3	< 4	< 7	< 2	< 2	< 16	< 5
	12/05/19 - 12/26/19	< 3	< 3	< 5	< 3	< 5	< 3	< 5	< 7	< 3	< 3	< 15	< 6
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
Q-34	01/04/19 - 01/10/19	< 2	< 3	< 6	< 2	< 5	< 3	< 5	< 14	< 3	< 2	< 24	< 8
	02/01/19 - 02/27/19 *(1)*												
	03/14/19 - 03/28/19	< 10	< 11	< 18	< 13	< 15	< 10	< 15	< 15	< 9	< 11	< 52	< 11
	04/03/19 - 04/25/19	< 6	< 6	< 10	< 3	< 8	< 7	< 16	< 10	< 7	< 8	< 34	< 12
	05/02/19 - 05/31/19	< 6	< 9	< 16	< 8	< 14	< 4	< 14	< 12	< 7	< 9	< 35	< 12
	06/06/19 - 06/27/19	< 2	< 2	< 4	< 2	< 4	< 2	< 4	< 8	< 2	< 2	< 17	< 5
	07/05/19 - 07/25/19	< 2	< 2	< 4	< 2	< 3	< 2	< 4	< 10	< 2	< 2	< 17	< 5
	08/01/19 - 08/29/19	< 4	< 5	< 12	< 4	< 10	< 5	< 6	< 13	< 4	< 5	< 26	< 12
	09/05/19 - 09/26/19	< 5	< 5	< 12	< 5	< 11	< 6	< 9	< 13	< 6	< 6	< 35	< 11
	10/03/19 - 10/31/19	< 9	< 6	< 18	< 10	< 15	< 7	< 13	< 11	< 8	< 8	< 36	< 12
	11/07/19 - 11/29/19	< 2	< 2	< 5	< 3	< 4	< 2	< 4	< 6	< 2	< 2	< 15	< 5
	12/05/19 - 12/26/19	< 2	< 2	< 5	< 3	< 5	< 3	< 5	< 7	< 3	< 2	< 15	< 5
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-II.1 CONCENTRATIONS OF TRITIUM IN GROUND WATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	Q-35	Q-36
01/10/19 - 01/14/19	< 189	< 189
04/12/19 - 04/12/19	< 182	< 188
07/11/19 - 07/11/19	< 194	< 193
10/10/19 - 10/10/19	< 173	< 170
MEAN	-	-

Table C-II.2

CONCENTRATIONS OF GAMMA EMITTERS IN GROUND WATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER + 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
Q-35	01/10/19 - 01/10/19	< 6	< 6	< 10	< 6	< 9	< 6	< 9	< 7	< 8	< 7	< 24	< 12
	04/12/19 - 04/12/19	< 7	< 7	< 11	< 7	< 14	< 7	< 12	< 9	< 7	< 6	< 30	< 11
	07/11/19 - 07/11/19	< 7	< 7	< 15	< 7	< 15	< 7	< 14	< 11	< 8	< 6	< 31	< 9
	10/10/19 - 10/10/19	< 9	< 6	< 14	< 8	< 15	< 8	< 14	< 14	< 7	< 6	< 36	< 12
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
Q-36	01/14/19 - 01/14/19	< 6	< 6	< 8	< 9	< 10	< 9	< 13	< 7	< 8	< 8	< 20	< 8
	04/12/19 - 04/12/19	< 9	< 9	< 16	< 9	< 18	< 9	< 16	< 13	< 10	< 9	< 37	< 13
	07/11/19 - 07/11/19	< 8	< 7	< 17	< 11	< 15	< 7	< 13	< 13	< 11	< 7	< 38	< 14
	10/10/19 - 10/10/19	< 7	< 7	< 17	< 7	< 14	< 8	< 14	< 14	< 8	< 7	< 34	< 14
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-III.1

CONCENTRATIONS OF GAMMA EMITTERS IN FISH SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PC/KG WET + 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Q-24												
Shorthead Redhorse	05/23/19	< 50	< 67	< 172	< 92	< 120	< 67	< 98	< 60	< 49	< 269	< 121
Walleye	05/23/19	< 40	< 43	< 100	< 49	< 99	< 37	< 64	< 46	< 40	< 243	< 88
Freshwater Drum	10/23/19	< 46	< 65	< 137	< 75	< 114	< 61	< 106	< 71	< 73	< 364	< 76
Common Carp	10/23/19	< 40	< 35	< 88	< 43	< 95	< 49	< 72	< 46	< 44	< 163	< 63
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-29												
Largemouth Bass	05/23/19	< 41	< 31	< 82	< 56	< 63	< 45	< 77	< 45	< 45	< 259	< 97
Quillback	05/23/19	< 59	< 69	< 140	< 56	< 83	< 71	< 115	< 44	< 50	< 377	< 144
Largemouth Bass	10/23/19	< 39	< 48	< 120	< 56	< 79	< 46	< 78	< 28	< 48	< 227	< 69
Freshwater Drum	10/23/19	< 38	< 31	< 77	< 32	< 76	< 42	< 68	< 56	< 42	< 201	< 57
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-IV.1

CONCENTRATIONS OF GAMMA EMITTERS IN SEDIMENT SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PC/KG DRY ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Q-39	05/30/19	< 76	< 72	< 192	< 72	< 119	< 84	< 135	< 84	177 ± 83	< 531	< 103
	10/11/19	< 83	< 81	< 174	< 82	< 223	< 80	< 133	< 110	< 120	< 347	< 120
MEAN ± 2 STD DEV		-	-	-	-	-	-	-	-	177 ± 0	-	-
Q-40	05/30/19	< 57	< 62	< 134	< 65	< 142	< 76	< 105	< 88	141 ± 55	< 356	< 118
	10/11/19	< 78	< 87	< 201	< 84	< 225	< 91	< 172	< 112	< 133	< 512	< 103
MEAN ± 2 STD DEV		-	-	-	-	-	-	-	-	141 ± 0	-	-

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

Table C-V.1

CONCENTRATIONS OF GROSS BETA IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION PERIOD	GROUP I				GROUP II					GROUP III
	Q-01	Q-02	Q-03	Q-04	Q-13	Q-16	Q-37	Q-38	Q-41	Q-42
01/04/19 - 01/11/19	*(1)*	26 ± 5	27 ± 5	24 ± 5	26 ± 5	23 ± 5	22 ± 5	11 ± 4	28 ± 5	25 ± 5
01/10/19 - 01/18/19	19 ± 11	18 ± 4	18 ± 4	13 ± 4	17 ± 4	15 ± 4	15 ± 4	10 ± 3	17 ± 4	19 ± 4
01/17/19 - 01/25/19	19 ± 4	15 ± 4	20 ± 4	16 ± 4	19 ± 4	18 ± 4	18 ± 4	12 ± 3	10 ± 3	13 ± 4
01/24/19 - 02/01/19	23 ± 4	27 ± 5	25 ± 4	19 ± 4	20 ± 4	23 ± 4	22 ± 4	17 ± 4	29 ± 5	8 ± 3
02/01/19 - 02/08/19	13 ± 4	14 ± 4	17 ± 4	15 ± 4	12 ± 4	19 ± 4	12 ± 4	11 ± 4	18 ± 4	16 ± 4
02/08/19 - 02/14/19	16 ± 4	19 ± 4	17 ± 4	17 ± 4	18 ± 5	12 ± 4	17 ± 5	10 ± 4	16 ± 5	17 ± 5
02/14/19 - 02/22/19	22 ± 4	25 ± 5	25 ± 5	19 ± 4	20 ± 4	25 ± 4	24 ± 5	15 ± 4	25 ± 4	30 ± 5
02/22/19 - 03/01/19	23 ± 4	20 ± 4	20 ± 4	15 ± 4	21 ± 5	26 ± 5	10 ± 4	8 ± 3	25 ± 5	24 ± 5
03/01/19 - 03/08/19	20 ± 4	22 ± 4	14 ± 4	16 ± 4	14 ± 4	19 ± 4	6 ± 3	17 ± 4	18 ± 4	18 ± 4
03/08/19 - 03/16/19	13 ± 4	14 ± 4	12 ± 4	12 ± 4	16 ± 5	19 ± 5	12 ± 4	16 ± 4	16 ± 5	9 ± 5
03/14/19 - 03/22/19	13 ± 4	8 ± 3	14 ± 4	8 ± 3	13 ± 3	11 ± 3	< 4	14 ± 4	14 ± 4	11 ± 3
03/21/19 - 03/29/19	16 ± 4	14 ± 4	15 ± 4	13 ± 4	15 ± 4	5 ± 3	< 4	9 ± 3	12 ± 4	16 ± 4
03/28/19 - 04/05/19	7 ± 3	8 ± 4	6 ± 3	5 ± 3	9 ± 3	10 ± 3	< 5	7 ± 3	9 ± 3	8 ± 3
04/05/19 - 04/12/19	10 ± 4	8 ± 3	7 ± 3	7 ± 3	8 ± 3	8 ± 3	< 4	6 ± 3	9 ± 4	9 ± 4
04/12/19 - 04/19/19	8 ± 3	9 ± 3	8 ± 3	8 ± 3	8 ± 3	8 ± 3	< 4	4 ± 3	8 ± 4	10 ± 4
04/19/19 - 04/25/19	13 ± 4	11 ± 4	15 ± 4	10 ± 4	12 ± 4	15 ± 5	< 5	11 ± 4	14 ± 5	14 ± 5
04/25/19 - 05/03/19	6 ± 4	6 ± 4	7 ± 4	8 ± 4	8 ± 4	< 5	< 5	< 5	11 ± 4	8 ± 4
05/02/19 - 05/10/19	14 ± 4	9 ± 3	11 ± 3	9 ± 3	12 ± 4	11 ± 3	5 ± 3	9 ± 3	15 ± 4	11 ± 4
05/09/19 - 05/17/19	13 ± 4	17 ± 4	15 ± 4	13 ± 4	15 ± 4	13 ± 4	19 ± 4	12 ± 4	15 ± 4	13 ± 4
05/16/19 - 05/24/19	< 5	< 5	< 5	6 ± 3	8 ± 3	10 ± 4	< 5	7 ± 3	12 ± 4	8 ± 4
05/23/19 - 05/31/19	11 ± 4	9 ± 3	8 ± 3	12 ± 4	9 ± 3	9 ± 3	10 ± 4	7 ± 3	10 ± 3	13 ± 4
05/31/19 - 06/07/19	16 ± 4	11 ± 4	18 ± 4	19 ± 4	16 ± 5	13 ± 5	12 ± 4	11 ± 4	16 ± 5	19 ± 5
06/06/19 - 06/13/19	*(1)*	*(1)*	*(1)*	*(1)*	12 ± 4	13 ± 4	*(1)*	*(1)*	19 ± 4	16 ± 4
06/13/19 - 06/20/19	*(1)*	*(1)*	*(1)*	*(1)*	10 ± 4	10 ± 4	*(1)*	*(1)*	13 ± 4	11 ± 4
06/20/19 - 06/28/19	19 ± 5	15 ± 4	17 ± 4	17 ± 4	16 ± 4	14 ± 4	12 ± 4	< 4	13 ± 4	13 ± 4
06/27/19 - 07/05/19	18 ± 4	15 ± 4	17 ± 4	12 ± 4	15 ± 3	16 ± 4	16 ± 4	11 ± 3	19 ± 4	17 ± 4
07/05/19 - 07/12/19	13 ± 4	13 ± 4	7 ± 3	9 ± 4	16 ± 5	12 ± 4	9 ± 4	8 ± 4	12 ± 4	13 ± 4
07/11/19 - 07/19/19	5 ± 3	13 ± 3	15 ± 4	12 ± 3	11 ± 3	11 ± 3	11 ± 3	10 ± 3	15 ± 4	15 ± 4
07/18/19 - 07/26/19	12 ± 4	10 ± 4	7 ± 4	9 ± 4	12 ± 4	8 ± 4	8 ± 4	9 ± 4	15 ± 4	13 ± 4
07/25/19 - 08/02/19	14 ± 4	14 ± 4	13 ± 3	11 ± 3	10 ± 3	14 ± 4	10 ± 3	14 ± 4	15 ± 4	15 ± 4
08/01/19 - 08/09/19	14 ± 4	18 ± 4	17 ± 4	17 ± 4	19 ± 4	20 ± 4	16 ± 4	19 ± 4	20 ± 4	18 ± 4
08/09/19 - 08/16/19	8 ± 3	17 ± 4	14 ± 4	16 ± 4	19 ± 5	17 ± 5	15 ± 4	11 ± 4	20 ± 5	19 ± 5
08/15/19 - 08/24/19	18 ± 4	13 ± 3	14 ± 3	16 ± 3	19 ± 4	20 ± 4	14 ± 3	15 ± 3	18 ± 4	19 ± 4
08/22/19 - 08/31/19	14 ± 4	13 ± 4	12 ± 4	16 ± 4	12 ± 4	14 ± 4	< 4	11 ± 4	11 ± 4	13 ± 4
08/29/19 - 09/06/19	26 ± 5	16 ± 4	22 ± 5	15 ± 4	17 ± 4	16 ± 4	13 ± 4	15 ± 4	19 ± 4	18 ± 4
09/05/19 - 09/14/19	14 ± 4	14 ± 3	14 ± 3	15 ± 4	18 ± 4	17 ± 4	12 ± 3	13 ± 3	18 ± 4	21 ± 4
09/12/19 - 09/20/19	27 ± 5	21 ± 5	24 ± 5	29 ± 5	18 ± 4	20 ± 4	20 ± 5	21 ± 5	24 ± 5	24 ± 5
09/19/19 - 09/28/19	15 ± 4	15 ± 4	14 ± 4	17 ± 4	19 ± 5	20 ± 5	11 ± 4	20 ± 4	19 ± 5	17 ± 5
09/26/19 - 10/04/19	13 ± 4	11 ± 4	7 ± 3	15 ± 4	15 ± 4	15 ± 4	11 ± 4	15 ± 4	14 ± 4	8 ± 3
10/03/19 - 10/11/19	14 ± 4	20 ± 4	16 ± 4	13 ± 4	13 ± 4	13 ± 4	15 ± 4	16 ± 4	13 ± 4	9 ± 3
10/10/19 - 10/19/19	14 ± 3	11 ± 3	13 ± 3	10 ± 3	14 ± 4	14 ± 4	12 ± 3	11 ± 3	16 ± 4	17 ± 4
10/17/19 - 10/25/19	15 ± 5	10 ± 4	12 ± 5	12 ± 5	17 ± 4	15 ± 4	12 ± 5	17 ± 5	17 ± 5	14 ± 4
10/24/19 - 11/01/19	8 ± 4	10 ± 4	11 ± 4	10 ± 4	10 ± 4	11 ± 4	11 ± 4	8 ± 4	16 ± 4	11 ± 4
10/31/19 - 11/08/19	18 ± 4	14 ± 4	14 ± 4	19 ± 4	20 ± 4	15 ± 4	16 ± 4	18 ± 4	18 ± 4	14 ± 4
11/07/19 - 11/15/19	25 ± 5	15 ± 4	23 ± 5	26 ± 5	21 ± 4	22 ± 4	18 ± 5	25 ± 5	26 ± 5	14 ± 4
11/15/19 - 11/22/19	16 ± 4	20 ± 4	17 ± 4	20 ± 4	17 ± 4	19 ± 4	17 ± 4	15 ± 4	19 ± 5	15 ± 4
11/22/19 - 11/29/19	16 ± 4	15 ± 4	13 ± 4	14 ± 4	13 ± 4	15 ± 4	12 ± 4	13 ± 4	18 ± 4	11 ± 4
11/29/19 - 12/06/19	13 ± 4	10 ± 3	11 ± 3	13 ± 4	12 ± 4	13 ± 4	13 ± 4	11 ± 3	15 ± 4	12 ± 4
12/05/19 - 12/13/19	24 ± 5	26 ± 5	24 ± 5	16 ± 4	24 ± 5	22 ± 5	23 ± 5	20 ± 4	31 ± 5	26 ± 5
12/12/19 - 12/20/19	30 ± 5	34 ± 5	30 ± 5	34 ± 5	32 ± 5	32 ± 5	29 ± 5	35 ± 5	37 ± 6	40 ± 6
12/19/19 - 12/28/19	28 ± 4	28 ± 4	32 ± 5	31 ± 5	19 ± 4	30 ± 5	27 ± 4	28 ± 4	38 ± 5	24 ± 5
12/26/19 - 01/03/20	12 ± 4	18 ± 5	14 ± 5	*(1)*	18 ± 5	19 ± 4	13 ± 5	15 ± 5	27 ± 5	24 ± 5
MEAN ± 2 STD DEV	16 ± 12	15 ± 12	16 ± 12	15 ± 12	15 ± 10	16 ± 11	15 ± 11	13 ± 12	18 ± 13	16 ± 13

THE MEAN AND TWO STANDARD DEVIATION ARE CALCULATED USING THE POSITIVE VALUES

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-V.2 **MONTHLY AND YEARLY MEAN VALUES OF GROSS BETA CONCENTRATIONS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

GROUP I - NEAR-SITE LOCATIONS				GROUP II - FAR-FIELD LOCATIONS				GROUP III - CONTROL LOCATION			
COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD	COLLECTION PERIOD	MIN	MAX	MEAN ± 2SD
01/04/19 - 02/01/19	13	27	21 ± 9	01/04/19 - 02/01/19	10	29	19 ± 11	01/04/19 - 02/01/19	8	25	16 ± 15
02/01/19 - 03/01/19	13	25	19 ± 8	02/01/19 - 03/01/19	8	26	17 ± 12	02/01/19 - 03/01/19	16	30	22 ± 13
03/01/19 - 03/29/19	8	22	14 ± 7	03/01/19 - 03/29/19	5	19	14 ± 8	03/01/19 - 03/28/19	9	18	13 ± 9
03/29/19 - 05/03/19	5	15	8 ± 5	03/28/19 - 05/03/19	4	15	9 ± 5	03/28/19 - 05/02/19	8	14	10 ± 5
05/03/19 - 05/31/19	6	17	11 ± 6	05/02/19 - 05/31/19	5	19	11 ± 7	05/02/19 - 05/31/19	8	13	11 ± 5
05/31/19 - 06/28/19	11	19	16 ± 5	05/31/19 - 06/28/19	10	19	13 ± 5	05/31/19 - 06/27/19	11	19	15 ± 7
06/28/19 - 08/02/19	5	18	12 ± 7	06/27/19 - 08/02/19	8	19	12 ± 6	06/27/19 - 08/01/19	13	17	14 ± 3
08/02/19 - 08/31/19	8	18	15 ± 5	08/01/19 - 08/31/19	11	20	16 ± 7	08/01/19 - 08/29/19	13	19	17 ± 6
08/31/19 - 10/04/19	7	29	17 ± 11	08/29/19 - 10/04/19	11	24	17 ± 7	08/29/19 - 10/03/19	8	24	18 ± 13
10/04/19 - 11/01/19	8	20	12 ± 6	10/03/19 - 11/01/19	8	17	14 ± 6	10/03/19 - 10/31/19	9	17	13 ± 7
11/01/19 - 11/29/19	13	26	18 ± 8	10/31/19 - 11/29/19	12	26	18 ± 7	10/31/19 - 11/29/19	11	15	14 ± 3
11/29/19 - 01/03/20	10	34	23 ± 17	11/29/19 - 01/03/20	11	38	23 ± 17	11/29/19 - 01/02/20	12	40	25 ± 19
01/04/19 - 01/03/20	5	34	15 ± 12	01/04/19 - 01/03/20	4	38	15 ± 12	01/04/19 - 01/02/20	8	40	16 ± 13

Table C-V.3

CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Q-01	01/11/19 - 03/29/19	< 2	< 2	< 6	< 3	< 6	< 2	< 4	< 2	< 3	< 22	< 10
	03/29/19 - 06/28/19	< 3	< 3	< 6	< 3	< 5	< 3	< 5	< 2	< 2	< 29	< 10
	06/28/19 - 10/04/19	< 2	< 2	< 4	< 2	< 6	< 3	< 4	< 2	< 2	< 18	< 6
	10/04/19 - 01/03/20	< 2	< 2	< 5	< 3	< 7	< 3	< 5	< 3	< 2	< 11	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-02	01/04/19 - 03/29/19	< 2	< 2	< 9	< 2	< 5	< 3	< 5	< 2	< 2	< 16	< 6
	03/29/19 - 06/28/19	< 3	< 4	< 9	< 3	< 6	< 3	< 5	< 4	< 2	< 37	< 6
	06/28/19 - 10/04/19	< 3	< 3	< 5	< 3	< 5	< 3	< 4	< 2	< 2	< 17	< 5
	10/04/19 - 01/03/20	< 2	< 2	< 4	< 2	< 4	< 2	< 3	< 1	< 2	< 10	< 5
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-03	01/04/19 - 03/29/19	< 2	< 3	< 8	< 3	< 5	< 3	< 6	< 3	< 3	< 25	< 10
	03/29/19 - 06/28/19	< 3	< 4	< 9	< 4	< 7	< 4	< 6	< 3	< 3	< 48	< 11
	06/28/19 - 10/04/19	< 2	< 2	< 5	< 3	< 5	< 2	< 4	< 2	< 2	< 13	< 6
	10/04/19 - 01/03/20	< 2	< 2	< 3	< 2	< 3	< 2	< 2	< 2	< 1	< 11	< 4
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-04	01/04/19 - 03/29/19	< 2	< 3	< 7	< 2	< 4	< 2	< 5	< 2	< 3	< 29	< 10
	03/29/19 - 06/28/19	< 2	< 2	< 7	< 3	< 6	< 3	< 5	< 2	< 3	< 26	< 10
	06/28/19 - 10/04/19	< 2	< 2	< 6	< 3	< 6	< 2	< 4	< 2	< 2	< 19	< 8
	10/04/19 - 01/03/20	< 4	< 4	< 9	< 4	< 8	< 4	< 7	< 4	< 4	< 22	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-13	01/04/19 - 03/28/19	< 3	< 4	< 9	< 4	< 7	< 5	< 6	< 3	< 3	< 30	< 12
	03/28/19 - 06/27/19	< 2	< 3	< 5	< 1	< 5	< 3	< 5	< 3	< 2	< 25	< 9
	06/27/19 - 10/03/19	< 2	< 3	< 6	< 2	< 6	< 3	< 4	< 2	< 2	< 16	< 8
	10/03/19 - 01/02/20	< 2	< 2	< 4	< 2	< 3	< 2	< 3	< 2	< 2	< 12	< 2
	MEAN	-	-	-	-	-	-	-	-	-	-	-

Table C-V.3 **CONCENTRATIONS OF GAMMA EMITTERS IN AIR PARTICULATE SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Q-16	01/04/19 - 03/28/19	< 2	< 3	< 8	< 2	< 7	< 2	< 5	< 3	< 2	< 27	< 4
	03/28/19 - 06/27/19	< 2	< 3	< 7	< 3	< 8	< 2	< 5	< 2	< 2	< 26	< 13
	06/27/19 - 10/03/19	< 2	< 2	< 4	< 2	< 6	< 2	< 3	< 2	< 2	< 17	< 7
	10/03/19 - 01/02/20	< 2	< 2	< 6	< 2	< 6	< 3	< 5	< 3	< 2	< 12	< 5
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-37	01/04/19 - 03/29/19	< 2	< 3	< 3	< 2	< 5	< 2	< 5	< 2	< 2	< 22	< 9
	03/29/19 - 06/28/19	< 3	< 4	< 9	< 2	< 7	< 4	< 7	< 4	< 4	< 46	< 24
	06/28/19 - 10/04/19	< 2	< 3	< 5	< 2	< 7	< 3	< 4	< 3	< 2	< 18	< 5
	10/04/19 - 01/03/20	< 3	< 3	< 4	< 3	< 6	< 2	< 4	< 3	< 3	< 13	< 5
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-38	01/04/19 - 03/29/19	< 3	< 3	< 7	< 3	< 8	< 3	< 6	< 3	< 3	< 29	< 9
	03/29/19 - 06/28/19	< 2	< 3	< 7	< 3	< 6	< 3	< 4	< 3	< 3	< 31	< 12
	06/28/19 - 10/04/19	< 3	< 3	< 7	< 4	< 7	< 3	< 5	< 3	< 3	< 21	< 10
	10/04/19 - 01/03/20	< 2	< 1	< 4	< 3	< 4	< 2	< 2	< 2	< 1	< 11	< 3
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-41	01/04/19 - 03/28/19	< 3	< 3	< 5	< 2	< 5	< 2	< 5	< 2	< 2	< 20	< 12
	03/28/19 - 06/27/19	< 2	< 3	< 6	< 2	< 6	< 2	< 4	< 2	< 2	< 30	< 16
	06/27/19 - 10/03/19	< 2	< 2	< 4	< 2	< 6	< 2	< 4	< 2	< 2	< 15	< 7
	10/03/19 - 01/02/20	< 2	< 1	< 5	< 2	< 5	< 2	< 2	< 1	< 2	< 12	< 4
	MEAN	-	-	-	-	-	-	-	-	-	-	-
Q-42	01/04/19 - 03/28/19	< 3	< 4	< 9	< 3	< 7	< 4	< 7	< 4	< 3	< 34	< 8
	03/28/19 - 06/27/19	< 2	< 2	< 4	< 2	< 5	< 2	< 5	< 2	< 2	< 25	< 6
	06/27/19 - 10/03/19	< 2	< 2	< 5	< 2	< 5	< 2	< 3	< 2	< 2	< 16	< 8
	10/03/19 - 01/02/20	< 3	< 4	< 7	< 3	< 8	< 3	< 5	< 3	< 3	< 19	< 7
	MEAN	-	-	-	-	-	-	-	-	-	-	-

TABLE C-VI.1 **CONCENTRATIONS OF I-131 IN AIR IODINE SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019**

RESULTS IN UNITS OF E-3 PCI/CU METER ± 2 SIGMA

COLLECTION	GROUP I				GROUP II					GROUP III
PERIOD	Q-01	Q-02	Q-03	Q-04	Q-13	Q-16	Q-37	Q-38	Q-41	Q-42
01/04/19 - 01/11/19	*(1)*	< 46	< 46	< 46	< 56	< 49	< 41	< 22	< 49	< 50
01/10/19 - 01/18/19	< 42	< 11	< 11	< 11	< 6	< 16	< 37	< 35	< 38	< 39
01/17/19 - 01/25/19	< 17	< 20	< 20	< 20	< 23	< 37	< 40	< 39	< 44	< 46
01/24/19 - 02/01/19	< 27	< 27	< 27	< 27	< 10	< 13	< 19	< 18	< 20	< 16
02/01/19 - 02/08/19	< 23	< 41	< 41	< 41	< 42	< 27	< 37	< 32	< 33	< 34
02/08/19 - 02/15/19	< 15	< 42	< 42	< 42	< 53	< 29	< 31	< 33	< 35	< 35
02/14/19 - 02/22/19	< 54	< 52	< 52	< 52	< 25	< 20	< 55	< 53	< 47	< 48
02/22/19 - 03/01/19	< 42	< 30	< 49	< 49	< 33	< 33	< 50	< 49	< 33	< 34
03/01/19 - 03/08/19	< 41	< 47	*< 47*	< 47	< 47	< 62	< 64	< 62	< 26	< 64
03/08/19 - 03/16/19	< 18	< 42	< 42	< 42	< 65	< 37	< 25	< 20	< 37	< 39
03/14/19 - 03/22/19	< 29	< 67	< 67	< 67	< 58	< 21	< 59	< 57	< 50	< 52
03/21/19 - 03/29/19	< 22	< 50	< 50	< 50	< 57	< 27	< 32	< 30	< 33	< 34
03/28/19 - 04/05/19	< 22	< 59	< 59	< 59	< 50	< 27	< 33	< 32	< 27	< 23
04/05/19 - 04/12/19	< 15	< 17	< 17	< 17	< 17	< 11	< 27	< 26	< 27	< 27
04/12/19 - 04/19/19	< 19	< 43	< 43	< 43	< 44	< 30	< 36	< 35	< 37	< 37
04/19/19 - 04/26/19	< 22	< 50	< 50	< 50	< 60	< 30	< 31	< 30	< 38	< 38
04/25/19 - 05/03/19	< 24	< 54	< 54	< 54	< 63	< 35	< 42	< 40	< 43	< 44
05/02/19 - 05/10/19	< 51	< 49	< 21	< 49	< 55	< 35	< 33	< 33	< 37	< 31
05/09/19 - 05/17/19	< 21	< 48	< 48	< 48	< 52	< 32	< 36	< 35	< 39	< 39
05/16/19 - 05/24/19	< 37	< 36	< 36	< 35	< 30	< 22	< 54	< 52	< 54	< 55
05/23/19 - 05/31/19	< 39	< 63	< 63	< 63	< 58	< 24	< 38	< 37	< 36	< 30
05/31/19 - 06/07/19	< 53	< 66	< 22	< 52	< 65	< 48	< 38	< 38	< 49	< 41
06/06/19 - 06/13/19	*(1)*	*(1)*	*(1)*	*(1)*	< 26	< 26	*(1)*	*(1)*	< 27	< 27
06/13/19 - 06/20/19	*(1)*	*(1)*	*(1)*	*(1)*	< 52	< 52	*(1)*	*(1)*	< 54	< 54
06/20/19 - 06/28/19	< 27	< 31	< 31	< 31	< 30	< 25	< 33	< 33	< 31	< 31
06/27/19 - 07/05/19	< 27	< 26	< 26	< 26	< 8	< 20	< 10	< 23	< 20	< 21
07/05/19 - 07/12/19	< 21	< 25	< 25	< 24	< 31	< 45	< 15	< 36	< 47	< 47
07/11/19 - 07/19/19	< 43	< 17	< 41	< 41	< 47	< 32	< 29	< 29	< 33	< 28
07/18/19 - 07/26/19	< 24	< 43	< 43	< 43	< 45	< 21	< 49	< 49	< 50	< 51
07/25/19 - 08/02/19	< 10	< 23	< 23	< 23	< 25	< 29	< 11	< 26	< 30	< 30
08/01/19 - 08/09/19	< 20	< 47	< 47	< 46	< 40	< 28	< 29	< 33	< 29	< 29
08/09/19 - 08/16/19	< 30	< 29	< 24	< 29	< 35	< 49	< 42	< 41	< 21	< 51
08/15/19 - 08/24/19	< 26	< 26	*< 26*	< 26	< 14	< 24	< 22	< 18	< 29	< 29
08/22/19 - 08/31/19	*< 55*	*< 53*	*< 53*	*< 53*	< 26	*(1)*	*< 41*	*< 40*	< 49	< 49
08/29/19 - 09/06/19	< 24	< 56	*< 56*	< 56	< 54	< 47	< 61	< 59	< 59	< 59
09/05/19 - 09/14/19	< 15	< 34	< 34	< 34	< 46	< 32	< 24	< 24	< 33	< 28
09/12/19 - 09/20/19	< 28	< 33	< 33	< 33	< 30	< 28	< 31	< 30	< 29	< 24
09/19/19 - 09/28/19	< 39	< 38	< 38	< 16	< 49	< 38	< 31	< 30	< 39	< 33
09/26/19 - 10/04/19	< 41	< 47	< 47	< 47	< 46	< 49	< 52	< 50	< 42	< 51
10/03/19 - 10/11/19	< 32	< 31	< 13	< 31	< 33	< 23	< 25	< 24	< 26	< 26
10/10/19 - 10/19/19	< 37	< 35	< 35	< 35	< 20	< 33	< 26	< 21	< 34	< 34
10/17/19 - 10/25/19	< 20	< 23	< 23	< 23	< 22	< 11	< 28	< 27	< 27	< 27
10/24/19 - 11/01/19	< 9	< 21	< 21	< 21	< 22	< 18	< 15	< 17	< 19	< 18
10/31/19 - 11/08/19	< 45	< 18	< 43	< 43	< 49	< 25	< 24	< 23	< 22	< 26
11/07/19 - 11/15/19	< 20	< 39	< 39	< 38	< 33	< 37	< 45	< 44	< 39	< 18
11/15/19 - 11/22/19	< 53	< 53	< 53	< 53	< 45	< 30	< 30	< 29	< 26	< 30
11/22/19 - 11/29/19	< 38	< 38	< 18	< 20	< 40	< 40	< 40	< 39	< 40	< 39
11/29/19 - 12/06/19	< 31	< 31	< 31	< 31	< 16	< 30	< 25	< 20	< 31	< 30
12/05/19 - 12/13/19	< 48	< 20	< 48	< 48	< 51	< 22	< 26	< 25	< 27	< 27
12/12/19 - 12/20/19	*< 29*	< 29	< 29	< 29	< 35	< 60	*< 54*	< 52	< 62	< 33
12/19/19 - 12/28/19	*< 41*	< 41	< 41	< 41	< 47	< 45	< 36	< 35	< 38	< 46
12/26/19 - 01/03/20	*< 59*	< 59	< 59	< 59	< 27	< 52	< 56	< 54	< 54	< 22
MEAN	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VII.1 CONCENTRATIONS OF I-131 IN MILK SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

COLLECTION PERIOD	INDICATOR FARM Q-26
01/04/19	< 0.8
02/01/19	< 0.8
03/08/19	< 0.8
04/05/19	< 1.0
05/03/19	< 0.6
05/17/19	< 0.8
05/31/19	< 0.8
06/14/19	*(1)*
06/28/19	< 0.8
07/12/19	< 0.8
07/26/19	< 0.8
08/09/19	< 0.5
08/24/19	< 0.9
09/06/19	< 0.8
09/20/19	< 0.8
10/04/19	< 1.0
10/19/19	< 0.8
11/01/19	< 0.8
12/06/19	< 1.0
MEAN	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VII.2

CONCENTRATIONS OF GAMMA EMITTERS IN MILK SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION PERIOD		Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	Cs-134	Cs-137	Ba-140	La-140
Q-26	01/04/19		< 4	< 4	< 10	< 5	< 10	< 5	< 8	< 5	< 5	< 23	< 8
	02/01/19		< 5	< 5	< 13	< 6	< 12	< 6	< 10	< 6	< 6	< 29	< 11
	03/08/19		< 7	< 9	< 19	< 9	< 19	< 7	< 15	< 7	< 10	< 53	< 6
	04/05/19		< 5	< 6	< 12	< 5	< 13	< 5	< 9	< 6	< 6	< 29	< 7
	05/03/19		< 6	< 8	< 18	< 6	< 16	< 7	< 12	< 7	< 6	< 28	< 11
	05/17/19		< 8	< 7	< 18	< 8	< 16	< 8	< 13	< 7	< 7	< 35	< 11
	05/31/19		< 6	< 8	< 19	< 8	< 15	< 8	< 14	< 7	< 8	< 41	< 12
	06/14/19	*(1)*											
	06/28/19		< 7	< 6	< 13	< 5	< 15	< 7	< 11	< 7	< 7	< 31	< 7
	07/12/19		< 7	< 7	< 14	< 7	< 16	< 7	< 12	< 6	< 7	< 27	< 7
	07/26/19		< 7	< 9	< 17	< 6	< 18	< 7	< 13	< 8	< 7	< 35	< 9
	08/09/19		< 6	< 6	< 13	< 8	< 14	< 7	< 10	< 7	< 7	< 29	< 9
	08/24/19		< 7	< 6	< 15	< 8	< 15	< 7	< 11	< 7	< 7	< 28	< 7
	09/06/19		< 6	< 7	< 14	< 7	< 16	< 8	< 11	< 6	< 7	< 42	< 11
	09/20/19		< 7	< 9	< 18	< 10	< 19	< 8	< 15	< 9	< 8	< 50	< 12
	10/04/19		< 5	< 6	< 14	< 7	< 14	< 6	< 11	< 7	< 6	< 35	< 12
	10/19/19		< 7	< 7	< 16	< 8	< 24	< 9	< 13	< 8	< 9	< 37	< 10
	11/01/19		< 5	< 6	< 15	< 6	< 17	< 5	< 10	< 6	< 6	< 27	< 12
	12/06/19		< 9	< 7	< 21	< 10	< 15	< 7	< 12	< 8	< 9	< 31	< 14
	MEAN		-	-	-	-	-	-	-	-	-	-	-

(1) SEE PROGRAM EXCEPTIONS SECTION FOR EXPLANATION

Table C-VIII.1

CONCENTRATIONS OF GAMMA EMITTERS IN FOOD PRODUCT SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/KG WET ± 2 SIGMA

SITE	COLLECTION PERIOD	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
Q-CONTROL													
RADISHES/BROCCOLI	07/24/19	< 32	< 25	< 62	< 36	< 63	< 28	< 49	< 51	< 22	< 31	< 167	< 29
POTATOES	07/24/19	< 31	< 27	< 66	< 36	< 71	< 32	< 54	< 50	< 35	< 33	< 133	< 34
ONIONS	07/24/19	< 29	< 22	< 52	< 23	< 64	< 26	< 35	< 44	< 28	< 22	< 108	< 30
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
Q-QUAD 1													
POTATOES	07/24/19	< 31	< 31	< 77	< 31	< 62	< 33	< 57	< 46	< 40	< 30	< 119	< 30
LETTUCE	07/24/19	< 31	< 31	< 56	< 25	< 60	< 31	< 50	< 33	< 28	< 28	< 121	< 46
PARSNIPS	07/24/19	< 39	< 37	< 70	< 44	< 91	< 40	< 61	< 52	< 43	< 30	< 183	< 55
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
Q-QUAD 2													
ZUCCHINI LEAVES	07/24/19	< 34	< 43	< 97	< 36	< 95	< 40	< 67	< 58	< 41	< 36	< 158	< 35
CABBAGE	07/24/19	< 20	< 21	< 39	< 23	< 38	< 21	< 38	< 33	< 23	< 22	< 89	< 22
ONIONS	07/24/19	< 16	< 15	< 32	< 18	< 33	< 17	< 29	< 24	< 18	< 18	< 77	< 21
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
Q-QUAD 3													
TURNIP GREENS	07/24/19	< 18	< 25	< 52	< 17	< 56	< 23	< 35	< 28	< 22	< 23	< 99	< 20
DILL	07/24/19	< 30	< 28	< 69	< 26	< 62	< 28	< 51	< 38	< 35	< 30	< 123	< 35
HORSERADISH	07/24/19	< 31	< 30	< 59	< 37	< 73	< 32	< 57	< 44	< 30	< 29	< 141	< 44
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-
Q-QUAD 4													
CABBAGE	07/25/19	< 32	< 32	< 76	< 36	< 75	< 50	< 72	< 55	< 40	< 37	< 164	< 47
POTATOES	07/25/19	< 26	< 29	< 69	< 22	< 81	< 27	< 41	< 48	< 33	< 31	< 141	< 26
RHUBARB	07/25/19	< 23	< 15	< 35	< 22	< 54	< 25	< 42	< 38	< 19	< 24	< 95	< 30
	MEAN	-	-	-	-	-	-	-	-	-	-	-	-

Table C-IX.1 QUARTERLY DLR RESULTS FOR QUAD CITIES NUCLEAR POWER STATION, 2019

Monitoring Location		Location Quarterly Baseline, B_Q (mrem)	B_Q + MDD_Q (mrem)	2019 Normalized Net Dose, M_{QX} (mrem/std. Qtr.)				Quarterly Facility Dose, F_Q (mrem)			
				1	2	3	4	1	2	3	4
Other	Q-01-1	11.02	15.6	10.3	12.3	11.1	12.6	ND	ND	ND	ND
	Q-01-2	11.32	15.9	9.2	11.5	12.5	14.5	ND	ND	ND	ND
	Q-02-1	11.9	16.4	8.8	14.0	13.7	13.0	ND	ND	ND	ND
	Q-02-2	11.18	15.7	8.1	12.0	12.9	11.0	ND	ND	ND	ND
	Q-03-1	10.35	14.9	8.8	10.1	10.8	9.4	ND	ND	ND	ND
	Q-03-2	10.32	14.9	7.8	10.4	10.3	12.2	ND	ND	ND	ND
	Q-04-1	11.84	16.4	9.2	10.6	11.2	13.3	ND	ND	ND	ND
	Q-04-2	12.59	17.1	9.6	11.2	10.5	13.2	ND	ND	ND	ND
	Q-13-1	13.05	17.6	9.7	12.5	14.6	14.3	ND	ND	ND	ND
	Q-13-2	13.2	17.7	10.9	10.5	13.7	12.0	ND	ND	ND	ND
	Q-16-1	10.93	15.5	9.0	10.0	9.8	11.5	ND	ND	ND	ND
	Q-16-2	10.78	15.3	9.4	11.4	11.5	11.1	ND	ND	ND	ND
	Q-37-1	13.65	18.2	11.1	13.4	11.9	14.3	ND	ND	ND	ND
	Q-37-2	13.58	18.1	12.3	15.3	13.2	12.2	ND	ND	ND	ND
	Q-38-1	14.55	19.1	9.8	12.8	14.6	16.9	ND	ND	ND	ND
	Q-38-2	14.53	19.1	10.9	14.5	12.7	14.6	ND	ND	ND	ND
	Q-41-1	13.69	18.2	11.0	11.7	12.5	15.1	ND	ND	ND	ND
	Q-41-2	13.7	18.2	9.8	11.7	12.9	13.7	ND	ND	ND	ND
	Q-42-1	14.29	18.8	12.4	13.8	15.7	13.6	ND	ND	ND	ND
	Q-42-2	14.61	19.1	11.7	14.1	14.3	15.9	ND	ND	ND	ND
Inner	Q-101-1	11.62	16.2	9.5	11.2	12.8	12.8	ND	ND	ND	ND
	Q-101-2	12.19	16.7	8.8	12.8	12.1	13.1	ND	ND	ND	ND
	Q-102-1	12.9	17.4	12.0	12.6	14.6	13.7	ND	ND	ND	ND
	Q-102-3	12.23	16.8	10.9	11.7	12.9	11.0	ND	ND	ND	ND
	Q-103-1	10.82	15.4	9.1	9.7	9.9	12.5	ND	ND	ND	ND
	Q-103-2	10.78	15.3	8.0	11.2	12.7	11.3	ND	ND	ND	ND
	Q-104-1	11.11	15.6	9.1	9.9	10.6	11.8	ND	ND	ND	ND
	Q-104-2	11.94	16.5	9.1	10.6	11.0	12.3	ND	ND	ND	ND
	Q-105-1	11.37	15.9	8.3	10.6	10.9	10.4	ND	ND	ND	ND
	Q-105-2	11.68	16.2	10.4	10.7	11.2	13.4	ND	ND	ND	ND
	Q-106-2	11.81	16.3	9.6	11.6	10.7	12.9	ND	ND	ND	ND
	Q-106-3	11.47	16.0	9.1	11.3	11.3	11.9	ND	ND	ND	ND
	Q-107-2	11.38	15.9	10.8	12.3	11.2	11.1	ND	ND	ND	ND
	Q-107-3	11.54	16.1	9.6	11.1	11.3	12.0	ND	ND	ND	ND
	Q-108-1	11.72	16.3	8.3	10.4	12.7	12.5	ND	ND	ND	ND
	Q-108-2	11.44	16.0	9.4	11.3	10.6	11.7	ND	ND	ND	ND
	Q-109-1	12.25	16.8	8.7	11.1	11.5	11.4	ND	ND	ND	ND
	Q-109-2	11.79	16.3	9.3	11.9	11.2	13.1	ND	ND	ND	ND
	Q-111-1	11.87	16.4	10.2	8.3	13.7	13.2	ND	ND	ND	ND
	Q-111-2	11.94	16.5	10.2	14.3	13.2	15.2	ND	ND	ND	ND
	Q-112-1	11.98	16.5	10.1	12.1	12	12.8	ND	ND	ND	ND
	Q-112-2	11.35	15.9	8.5	11.1	12.1	10.6	ND	ND	ND	ND
	Q-113-1	11.38	15.9	9.2	11.3	12.3	12.3	ND	ND	ND	ND
	Q-113-2	10.82	15.4	7.9	10.2	11.7	10.8	ND	ND	ND	ND
	Q-114-1	10.87	15.4	8.3	10.2	10.7	13.1	ND	ND	ND	ND
	Q-114-2	12.21	16.7	10.6	13.4	12.3	13	ND	ND	ND	ND
	Q-115-1	11.91	16.4	9.1	12.8	12.8	14.7	ND	ND	ND	ND
	Q-115-2	10.99	15.5	9.1	11.1	12.9	13.8	ND	ND	ND	ND
	Q-116-1	13.33	17.86	10.7	12.8	13.5	13.8	ND	ND	ND	ND
	Q-116-3	12.14	16.67	10	10.9	14.1	14	ND	ND	ND	ND

Table C-IX.1 QUARTERLY DLR RESULTS FOR QUAD CITIES NUCLEAR POWER STATION, 2019

Monitoring Location		Location Quarterly Baseline, B_Q (mrem)	B_Q + MDD_Q (mrem)	2019 Normalized Net Dose, M_{QX} (mrem/std. Qtr.)				Quarterly Facility Dose, F_Q (mrem)			
				1	2	3	4	1	2	3	4
Outer	Q-201-1	12.86	17.39	8.7	10.2	12.3	14.1	ND	ND	ND	ND
	Q-201-2	13.58	18.11	12.1	14.2	13.5	14.5	ND	ND	ND	ND
	Q-202-1	11.55	16.08	8.8	10.6	12.4	13.4	ND	ND	ND	ND
	Q-202-2	12.64	17.17	9.7	14	13.4	14.6	ND	ND	ND	ND
	Q-203-1	13.12	17.65	11	12.8	LOST	14.4	ND	ND	ND	ND
	Q-203-2	15.73	20.26	13.2	13.9	15	16.3	ND	ND	ND	ND
	Q-204-1	14.03	18.56	11.5	12.1	14.1	14.7	ND	ND	ND	ND
	Q-204-2	15.33	19.86	14	14.8	15.3	17.7	ND	ND	ND	ND
	Q-205-1	13.57	18.1	11.1	12.6	11.8	15.8	ND	ND	ND	ND
	Q-205-4	15.16	19.69	10.4	15.7	15.7	14.7	ND	ND	ND	ND
	Q-206-1	12.57	17.1	9.7	11.9	13.2	11.2	ND	ND	ND	ND
	Q-206-2	11.46	15.99	10.8	11.6	11.8	13.6	ND	ND	ND	ND
	Q-207-1	12.88	17.41	9.9	12.5	16.3	15.1	ND	ND	ND	ND
	Q-207-4	13.72	18.25	10	12.8	15.7	15	ND	ND	ND	ND
	Q-208-1	12.94	17.47	9.8	13.1	13.4	13.3	ND	ND	ND	ND
	Q-208-2	14.47	19	10.7	13.9	14.5	13.6	ND	ND	ND	ND
	Q-209-1	13.45	17.98	13	13.5	14.3	17	ND	ND	ND	ND
	Q-209-4	13.19	17.72	11.7	12.7	13.3	15	ND	ND	ND	ND
	Q-210-1	14.97	19.5	11.5	15.2	LOST	15.7	ND	ND	ND	ND
	Q-210-4	14.5	19.03	11.3	13.9	14.4	17.2	ND	ND	ND	ND
	Q-210-5	10.51	15.04	8.2	9.8	10.5	10.5	ND	ND	ND	ND
	Q-211-1	16.11	20.64	12.7	14.4	16.8	17	ND	ND	ND	ND
	Q-211-2	16.28	20.81	13.4	15.5	18.1	19	ND	ND	ND	ND
	Q-212-1	12.93	17.46	10	13.2	12.5	13.5	ND	ND	ND	ND
	Q-212-2	10.76	15.29	8.6	11	10.7	11.7	ND	ND	ND	ND
	Q-213-1	11.9	16.43	8.3	12	13.4	12	ND	ND	ND	ND
	Q-213-2	11.36	15.89	9	10	13.1	12.5	ND	ND	ND	ND
	Q-214-1	12.54	17.07	10.6	10.7	14.1	12.9	ND	ND	ND	ND
	Q-214-2	13.31	17.84	11.5	14	15.6	14.7	ND	ND	ND	ND
	Q-215-1	12.02	16.55	9	11.4	13	14.8	ND	ND	ND	ND
	Q-215-2	13.89	18.42	12.6	13.4	14.5	13.2	ND	ND	ND	ND
	Q-216-1	14.94	19.47	13.8	15.6	16.5	14.6	ND	ND	ND	ND
	Q-216-2	13.72	18.25	LOST	13.4	16.4	15.6	ND	ND	ND	ND

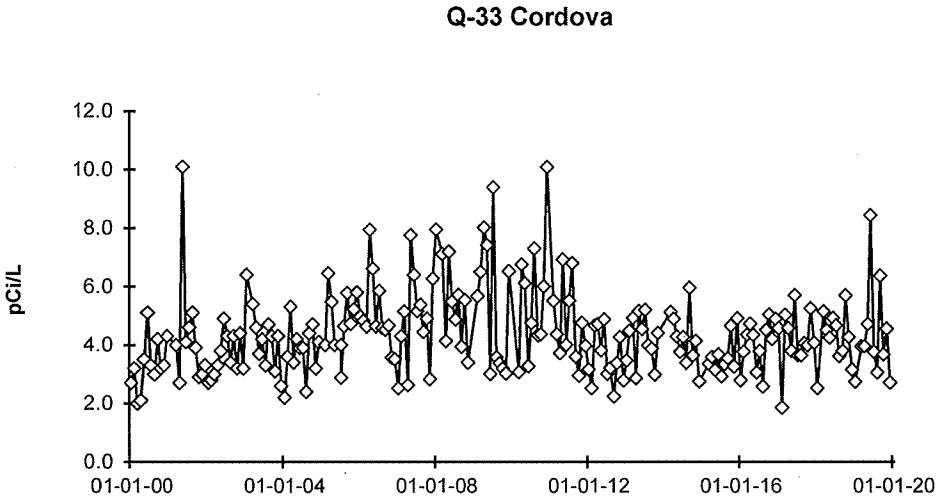
Table C-IX.2 ANNUAL DLR RESULTS FOR QUAD CITIES NUCLEAR POWER STATION, 2019

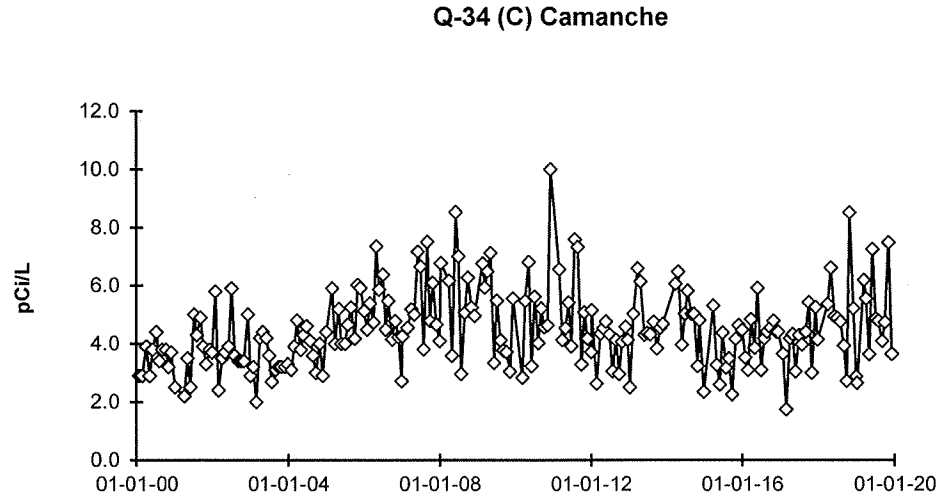
Monitoring Location		Annual Baseline, B_A (mrem)	B_A + MDD_A (mrem)	Normalized Annual Dose, M_A (mrem/yr)	Annual Facility Dose, F_A
Other	Q-01-1	44.07	52.9	46.3	ND
	Q-01-2	45.26	54.1	47.7	ND
	Q-02-1	47.61	56.5	49.5	ND
	Q-02-2	44.72	53.6	44.0	ND
	Q-03-1	41.42	50.3	39.1	ND
	Q-03-2	41.3	50.2	40.7	ND
	Q-04-1	45	53.9	44.3	ND
	Q-04-2	47.83	56.7	44.5	ND
	Q-13-1	52.21	61.1	51.1	ND
	Q-13-2	52.78	61.6	47.1	ND
	Q-16-1	43.73	52.6	40.3	ND
	Q-16-2	43.11	52.0	43.4	ND
	Q-37-1	54.61	63.5	50.7	ND
	Q-37-2	54.33	63.2	53.0	ND
	Q-38-1	55.31	64.2	54.1	ND
	Q-38-2	55.23	64.1	52.7	ND
	Q-41-1	54.76	63.6	50.3	ND
	Q-41-2	54.81	63.7	48.1	ND
	Q-42-1	57.16	66.0	55.5	ND
	Q-42-2	58.46	67.3	56.0	ND
Inner	Q-101-1	46.47	55.3	46.3	ND
	Q-101-2	48.77	57.6	46.8	ND
	Q-102-1	51.59	60.4	52.9	ND
	Q-102-3	48.9	57.8	46.5	ND
	Q-103-1	43.29	52.1	41.2	ND
	Q-103-2	43.12	52.0	43.2	ND
	Q-104-1	42.2	51.1	41.4	ND
	Q-104-2	47.75	56.6	43.0	ND
	Q-105-1	45.49	54.3	40.2	ND
	Q-105-2	46.73	55.6	45.7	ND
	Q-106-2	47.23	56.1	44.8	ND
	Q-106-3	45.89	54.7	43.6	ND
	Q-107-2	43.25	52.1	45.4	ND
	Q-107-3	46.16	55.0	44.0	ND
	Q-108-1	44.52	53.4	43.9	ND
	Q-108-2	45.75	54.6	43.0	ND
	Q-109-1	46.53	55.4	42.7	ND
	Q-109-2	47.17	56.0	45.5	ND
	Q-111-1	47.48	56.3	45.4	ND
	Q-111-2	47.75	56.6	52.9	ND
	Q-112-1	45.53	54.4	47	ND
	Q-112-2	45.4	54.3	42.3	ND
	Q-113-1	45.52	54.4	45.1	ND
	Q-113-2	43.3	52.2	40.6	ND
	Q-114-1	43.46	52.3	42.3	ND
	Q-114-2	48.83	57.7	49.3	ND
	Q-115-1	45.26	54.1	49.4	ND
	Q-115-2	41.76	50.6	46.9	ND
	Q-116-1	53.32	62.17	50.8	ND
	Q-116-3	48.55	57.4	49	ND

Table C-IX.2 ANNUAL DLR RESULTS FOR QUAD CITIES NUCLEAR POWER STATION, 2019

Monitoring Location		Annual Baseline, B_A (mrem)	$B_A + MDD_A$ (mrem)	Normalized Annual Dose, M_A (mrem/yr)	Annual Facility Dose, F_A
Outer	Q-201-1	48.87	57.72	45.3	ND
	Q-201-2	51.6	60.45	54.3	ND
	Q-202-1	46.2	55.05	45.2	ND
	Q-202-2	50.58	59.43	51.7	ND
	Q-203-1	49.87	58.72	38.2	ND
	Q-203-2	62.91	71.76	58.4	ND
	Q-204-1	53.31	62.16	52.4	ND
	Q-204-2	61.34	70.19	61.8	ND
	Q-205-1	54.28	63.13	51.3	ND
	Q-205-4	57.6	66.45	56.5	ND
	Q-206-1	50.28	59.13	46	ND
	Q-206-2	45.85	54.7	47.8	ND
	Q-207-1	51.51	60.36	53.8	ND
	Q-207-4	54.89	63.74	53.5	ND
	Q-208-1	51.77	60.62	49.6	ND
	Q-208-2	57.89	66.74	52.7	ND
	Q-209-1	53.81	62.66	57.8	ND
	Q-209-4	52.76	61.61	52.7	ND
	Q-210-1	59.88	68.73	42.4	ND
	Q-210-4	55.09	63.94	56.8	ND
	Q-210-5	42.02	50.87	39	ND
	Q-211-1	64.43	73.28	60.9	ND
	Q-211-2	65.14	73.99	66	ND
	Q-212-1	49.15	58	49.2	ND
	Q-212-2	40.89	49.74	42	ND
	Q-213-1	47.61	56.46	45.7	ND
	Q-213-2	45.46	54.31	44.6	ND
	Q-214-1	50.14	58.99	48.3	ND
	Q-214-2	53.24	62.09	55.8	ND
	Q-215-1	45.69	54.54	48.2	ND
	Q-215-2	55.56	64.41	53.7	ND
	Q-216-1	56.78	65.63	60.5	ND
	Q-216-2	54.87	63.72	45.4	ND

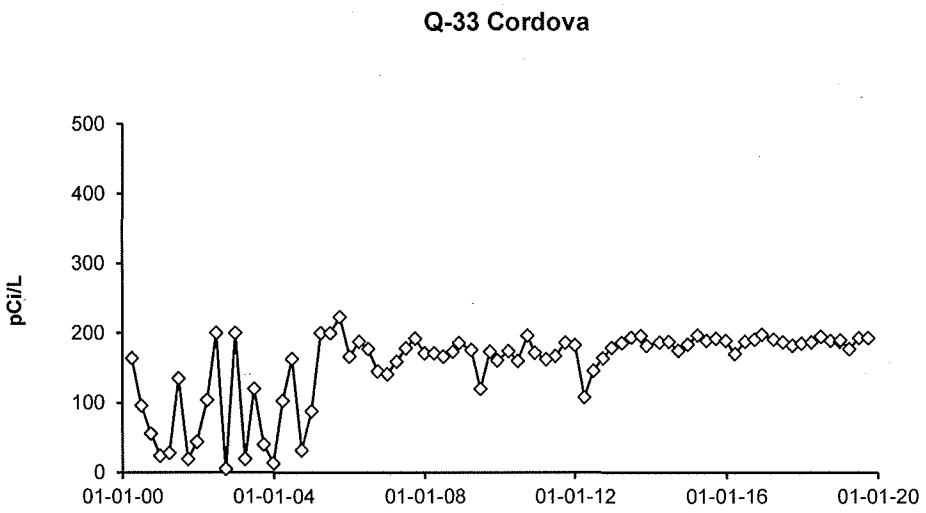
FIGURE C-1
Surface Water - Gross Beta - Stations Q-33 and Q-34 (C) Collected in the Vicinity of QCNPS, 2000 - 2019

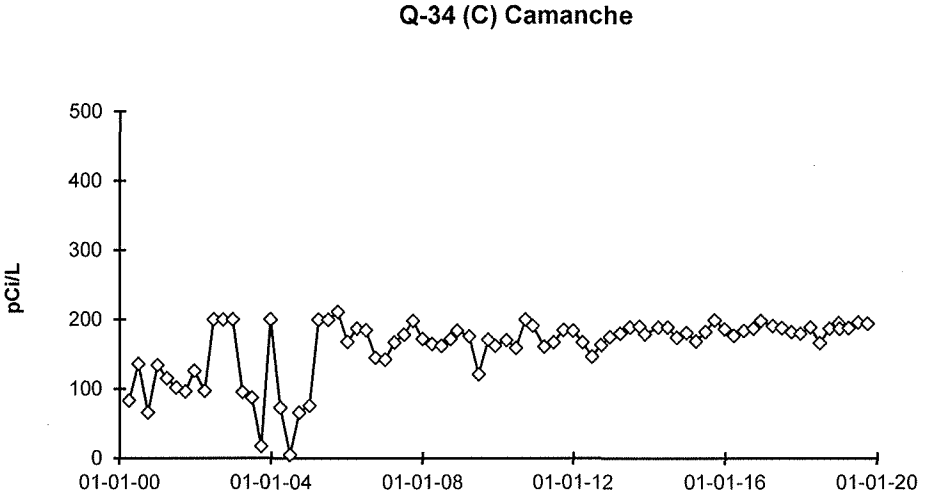




DUE TO VENDOR CHANGE, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JULY 2005

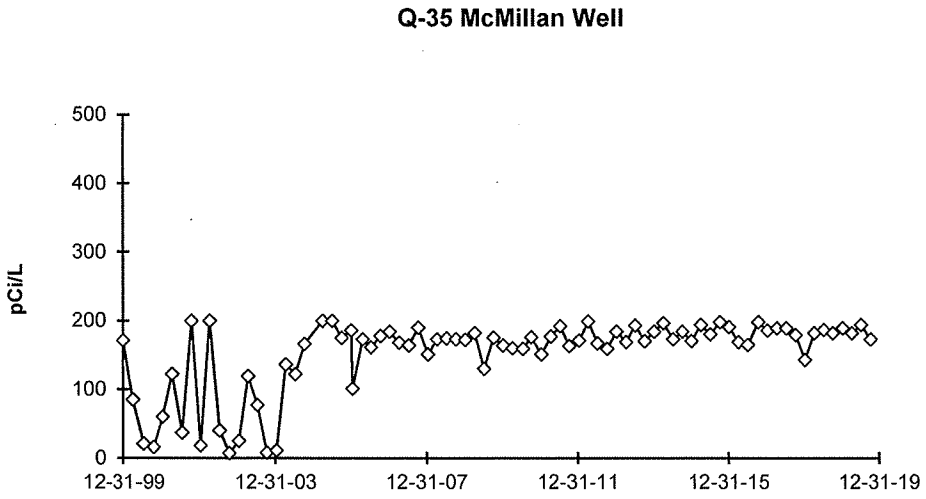
FIGURE C-2
Surface Water - Tritium - Stations Q-33 and Q-34 (C) Collected in the Vicinity of QCNPS, 2000 - 2019

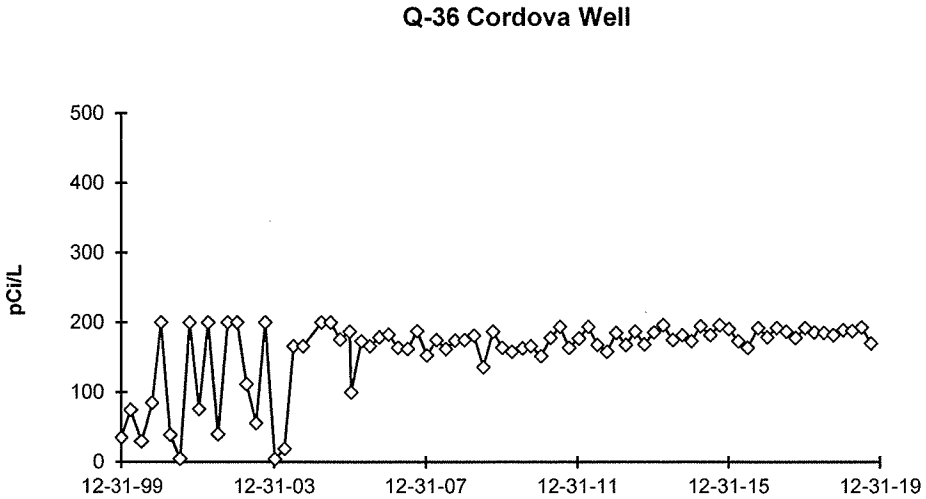




DUE TO VENDOR CHANGE, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JULY 2005

FIGURE C-3
Ground Water - Tritium - Stations Q-35 and Q-36 Collected in the Vicinity of QCNPS, 2000 - 2019

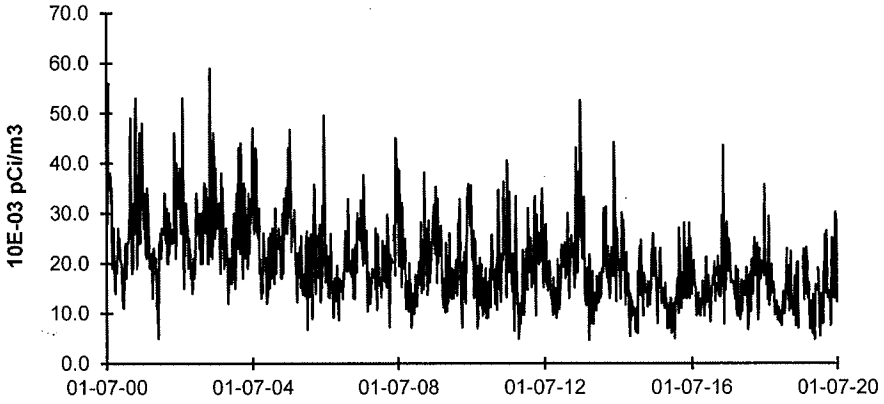




DUE TO VENDOR CHANGE, < VALUES ARE LLD VALUES JANUARY THROUGH JUNE 2005 AND MDC VALUES AFTER JULY 2005

FIGURE C-4
Air Particulates - Gross Beta- Stations Q-01 and Q-02 Collected in the Vicinity of QCNPS, 2000 - 2019

Q-01 Onsite No. 1



Q-02 Onsite No. 2

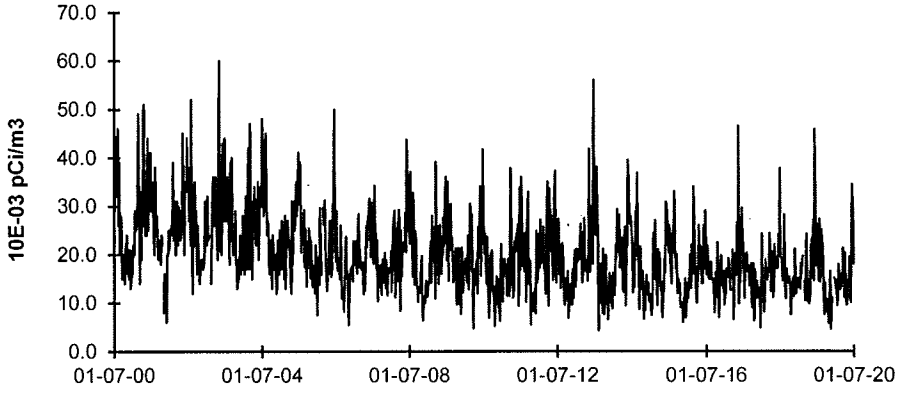
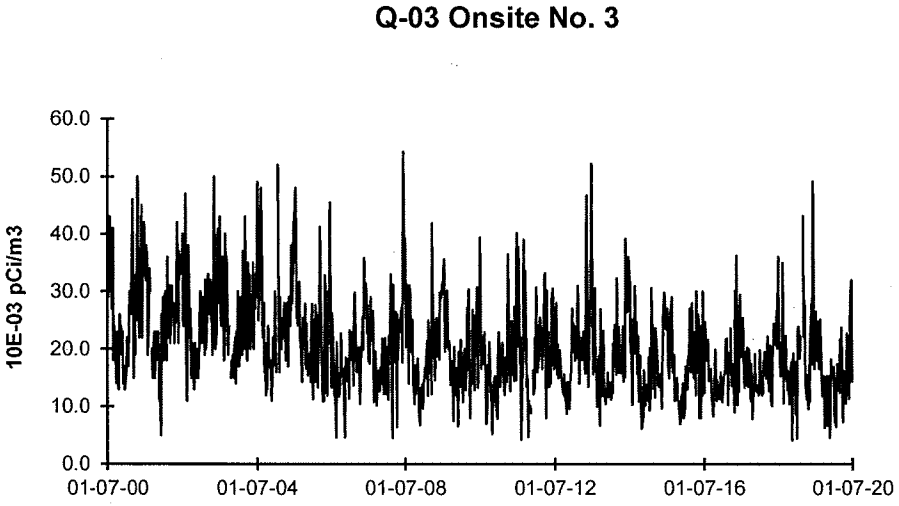


FIGURE C-5
Air Particulates - Gross Beta- Stations Q-03 and Q-04 Collected in the Vicinity of QCNPS, 2000 - 2019



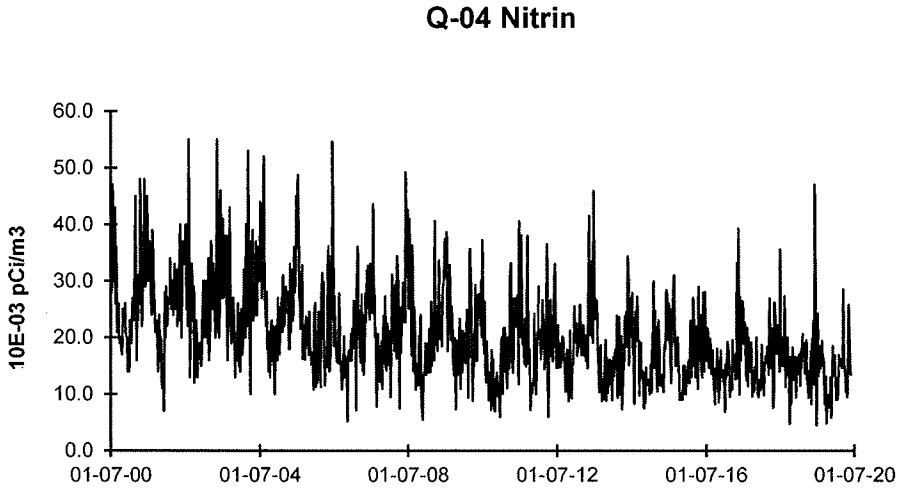
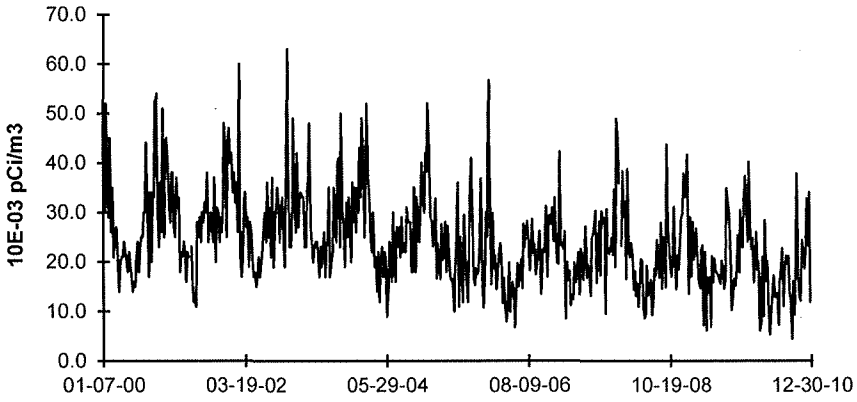
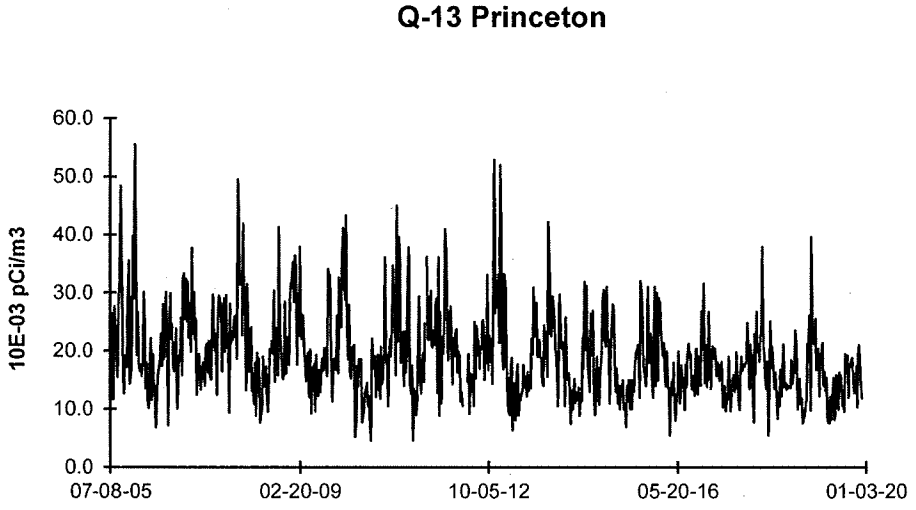


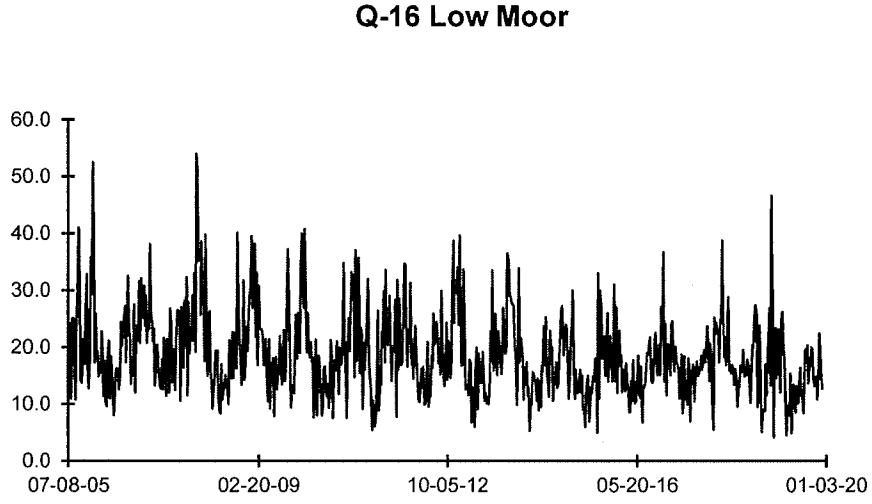
FIGURE C-6
Air Particulates - Gross Beta- Station Q-07 (C)
Collected in the Vicinity of QCNPS, 2000 - 2010



This location was removed from the program in January 2011 due to updated annual average meteorology. This data is retained in the report for historical comparision.

FIGURE C-7
Air Particulates - Gross Beta- Stations Q-13 and Q-16 Collected in the Vicinity of QCNPS, 2005 - 2019

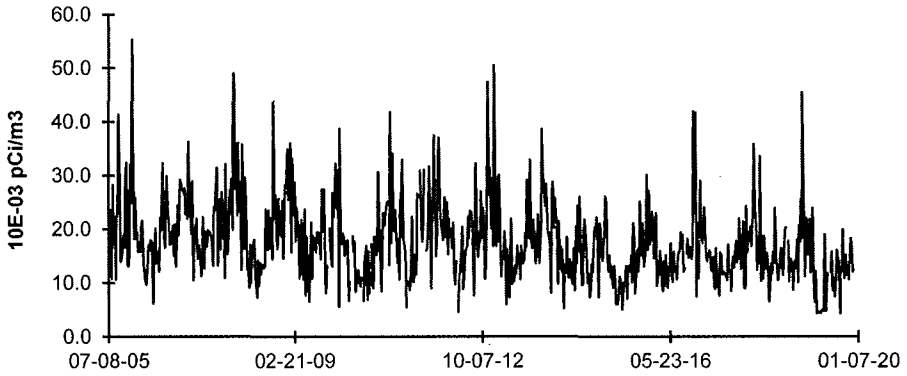




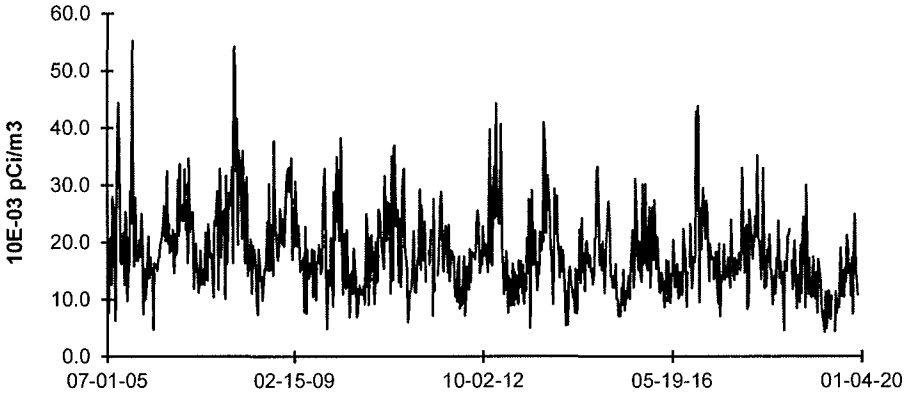
AIR PARTICULATE GROSS BETA ANALYSES OF FAR FIELD LOCATIONS STARTED IN JULY 2005

FIGURE C-8
Air Particulates - Gross Beta- Stations Q-37 and Q-38 Collected in the Vicinity of QCNPS, 2005 - 2018

Q-37 Meredosia Road

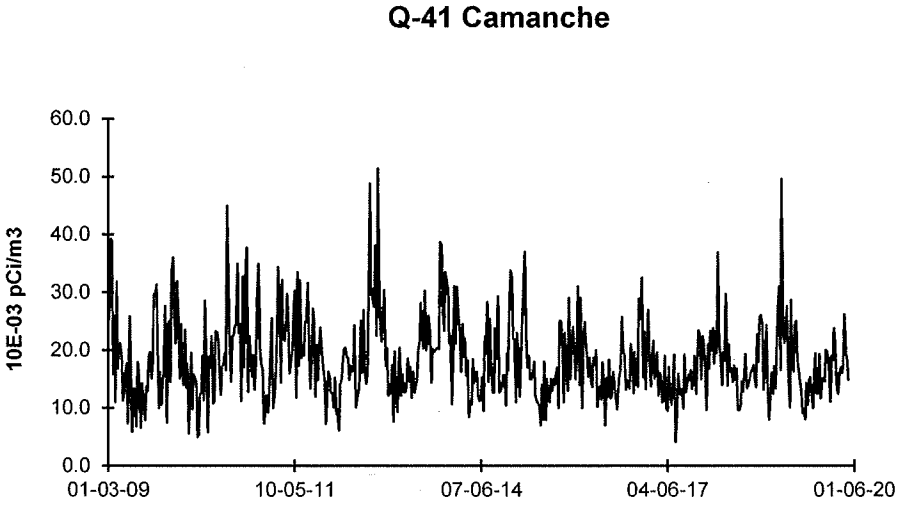


Q-38 Fuller Road

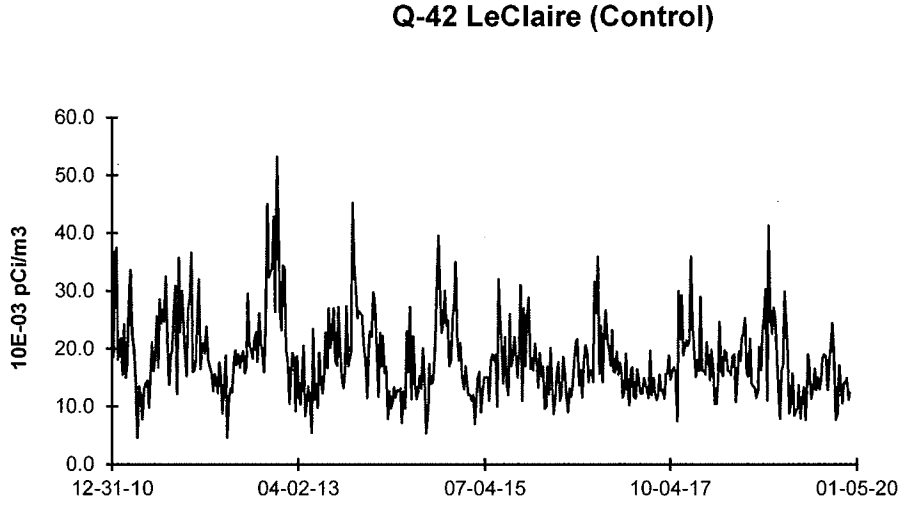


AIR PARTICULATE GROSS BETA ANALYSES OF FAR FIELD LOCATIONS STARTED IN JULY 2005

FIGURE C-9
Air Particulates - Gross Beta- Station Q-41
Collected in the Vicinity of QCNPS, 2009 - 2019



Air Particulates - Gross Beta- Station Q-42 (C)
Collected in the Vicinity of QCNPS, 2010 - 2019



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APPENDIX D

INTER-LABORATORY COMPARISON PROGRAM

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Table D.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

Table D.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***

DOE's Mixed Analyte Performance Evaluation Program (MAPEP)

Table D.2 **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

(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***

Table D.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***

APPENDIX E

ERRATA DATA

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There is no errata data for 2019.

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Docket No: 50-254
50-265

QUAD CITIES NUCLEAR POWER STATION
UNITS 1 and 2

Annual Radiological
Groundwater Protection Program Report

1 January through 31 December 2019

Prepared By
Teledyne Brown Engineering
Environmental Services

Exelon Generation®

Quad Cities Nuclear Power Station
Cordova, IL 61242

April 2020

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Table Of Contents

Appendices

I. Summary and Conclusions

In 2006, Exelon undertook a Fleetwide Assessment of groundwater at and in the vicinity of its nuclear power generating facilities for the presence of radionuclides. The data collected from the Quad Cities Station as part of the Fleetwide Assessment was summarized in a report entitled "Hydrogeologic Investigation Report, Fleetwide Assessment, Quad Cities Generation Station, Cordova, Illinois", dated September 2006. This report on the Radiological Groundwater Protection Program (RGPP) conducted for the Quad Cities Nuclear Power Station (QCNPS) by Exelon Nuclear covers the period 01 January 2019 through 31 December 2019.

The Quad Cities Nuclear Power Station (QCNPS) has experienced leaks from underground piping and spills from systems containing radioactive water over its 40+ year history. These incidents have created a few areas of localized contamination within the owner-controlled area. The liquid scintillation analyses of groundwater in some of these areas show measurable concentrations of tritium (H-3).

On March 28, 2018, approximately three to four feet of water was observed in a Radwaste Piping Vault, located adjacent to monitoring well QC-GP-18. Samples were collected from the water in the vault as well as the groundwater in QC-GP-18. Both samples had tritium concentration of approximately 4.5 million pCi/L. Approximately 5,000 gallons of water was pumped from the vault and processed through the Station's Radwaste System on March 28, 2018. Remediation of the groundwater near the RW Pipe Vault began on March 29, 2018 via pumping from monitoring well QC-GP-18 and processing through the Stations Radwaste System.

On March 29, 2018, the station contacted the Illinois Environmental Protection Agency (IEPA) and Illinois Emergency Management Agency (IEMA) to report a release of a radionuclide pursuant to 35 Ill. Adm. Code 1010.202. The station also notified the Nuclear Regulatory Commission (NRC) of these report to state agencies to satisfy 10CFR50.72(b)(2)(xi), notification of the NRC for any event related to the health and safety of the public for which a notification to other government agencies has been or will be made (EN #53299).

The cause of release into the vault and QC-GP-18 was determined to be a leaking pipe clamp located within the RW Pipe Vault and degraded seams in the concrete vault which allowed water to seep from the vault into the surrounding groundwater. The pipe clamp was repaired and the concrete/degraded seams in the vault sealed.

On April 2, 2018, a remediation well (RW-1) was installed near the vault and QC-GP-18 to assist in remediating the tritium activity in groundwater. The remediation well began pumping groundwater on April 10, 2018 for processing through the Station's Radwaste System. On May 2, 2018 effluent from RW-1 was

routed to the Discharge bay for release. On May 7, 2018 effluent from QC-GP-18 was routed to the Discharge Bay for release. On November 24, 2018, both well remediation pumps were shut down for the winter season.

Remediation of the groundwater tritium activity in vicinity of the RW Pipe Vault resumed on April 16, 2019 via pumping from remediation well QC-RW-1 with pump effluent routed to the Discharge Bay for release. Active pumping for remediation was discontinued for remainder of 2019 on November 6, 2019 due to winter weather. Between April 16, 2019 and November 6, 2019, approximately 1.1 million gallons of groundwater was pumped from the vicinity of the RW Pipe Vault for remediation purposes.

The RGPP designates wells into categories. Well designation categories include background, detection, elevated, long-term shut down, plume and idle. The RGPP also requires the sampling of surface water locations that may be impacted due to a spill or release.

This report covers groundwater samples collected from the environment on station property in 2019. During that period, RGPP samples were collected from 43 locations.

2019 sample locations included 36 designated monitoring wells, 2 surface water monitoring points and 4 production wells (two of which are used for site drinking water), and 1 remediation well. Sample frequency and analysis varies with well designation. Typical frequency/analysis include quarterly for tritium and annual for gamma, gross alpha, gross beta, strontium, select transuranics and Iron-55 (Fe-55)/Nickel-63 (Ni-63), depending on the designated well category. Samples from 18 of the designated monitoring wells and 2 surface water sample points were collected by a contractor (Environmental Inc.) and analyzed by a contract lab (Teledyne Brown). The remaining sample locations are collected by site personnel and analyzed for tritium/gamma onsite by station personnel or by Teledyne Brown for tritium/gamma and other parameters.

In the case of tritium, Exelon specified that its contract laboratories achieve a lower limit of detection 10 times lower than that required by federal regulation. Most of the tritium that was detected in groundwater at the Station is on the south and west side of the Reactor/Turbine buildings. Tritium concentrations ranged from less than the LLD of 200 pCi/L up to 60,100 pCi/L in a monitoring well. Tritium concentrations were less than the LLD of 200 pCi/L in surface water monitoring locations.

Gamma-emitting radionuclides associated with licensed plant operations were not detected at concentrations greater than their respective Lower Limits of Detection (LLDs) as specified in the Offsite Dose Calculation Manual (ODCM).

Strontium-89 (Sr-89) was not detected at concentrations greater than the Lower Limit of Detection (LLD) of 10.0 pCi/L. Strontium-90 (Sr-90) was detected at one

location with concentrations ranging from 4.5 - 7.1 pCi/L.

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions were performed on groundwater samples in 2019.

Gross Alpha (dissolved) was not detected at concentrations greater than the Lower Limit of Detection (LLD). Gross Alpha (suspended) was not detected at concentrations greater than the Lower Limit of Detection (LLD).

Gross Beta (dissolved) was detected at 2 locations with concentrations ranging from 4.1 pCi/L to 13.9 pCi/L. Gross Beta (suspended) was not detected at concentrations greater than the Lower Limit of Detection (LLD).

Select Transuranic/Hard-To-Detect analyses were performed on 1 monitoring well. The analyses included Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-234, U-235, U-238, Fe-55 and Ni-63. U-234 was detected at one location with a concentration of 0.58 pCi/L. U-238 was detected at one location at a concentration of 0.38 pCi/L. U-234 and U-238 are commonly found in groundwater at low concentrations due to the naturally-occurring Radium (Uranium) Decay Series. All other Select Transuranic/Hard-To-Detect nuclides were not detected at concentrations greater than their respective MDCs.

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

II. Introduction

The Quad Cities Nuclear Power Station (QCNPS), consisting of two 2957 MWth boiling water reactor owned and operated by Exelon Corporation, is located in Cordova, Illinois along the Mississippi River. Unit No. 1 went critical on 16 March 1972. Unit No. 2 went critical on 02 December 1973. The site is located in northern Illinois, approximately 182 miles west of Chicago, Illinois.

A. Objectives of the RGPP

The long-term objectives of the RGPP are as follows:

1. Identify suitable locations to monitor and evaluate potential impacts from station operations before significant radiological impact to the environment and potential drinking water sources.

2. Understand the local hydrogeologic regime in the vicinity of the station and maintain up-to-date knowledge of flow patterns on the surface and shallow subsurface.

3. Perform routine water sampling and radiological analysis of water from

selected locations.

4. Report new leaks, spills, or other detections with potential radiological significance to stakeholders in a timely manner.

5. Regularly assess analytical results to identify adverse trends.

6. Take necessary corrective actions to protect groundwater resources

B. Implementation of the Objectives.

The objectives identified have been implemented at QCNPS as discussed below:

1. Exelon and its consultant identified locations as described in the Phase 1 study. Phase 1 studies were conducted by Conestoga Rovers and Associates (CRA) and the results and conclusions were made available to state and federal regulators in station specific reports.

2. The QCNPS reports describe the local hydrogeologic regime. Periodically, the flow patterns on the surface and shallow subsurface are updated based on ongoing measurements.

3. QCNPS will continue to perform routine sampling and radiological analysis of water from selected locations.

4. QCNPS has implemented procedures to identify and report leaks, spills, or other detections with potential radiological significance in a timely manner.

5. QCNPS staff and consulting hydrogeologist assess analytical results on an ongoing basis to identify adverse trends.

C. Program Description

1. Sample Collection

Sample locations can be found in Table A-1 and Figures A-1 & A-2, Appendix A.

<u>Groundwater and Surface Water</u>

Samples of water are collected, managed, transported and analyzed in accordance with approved procedures following regulatory methods. Both groundwater and surface water are collected. Sample locations, sample collection frequencies and analytical frequencies

are controlled in accordance with approved station procedures. Contractor and/or station personnel are trained in the collection, preservation management, analysis and shipment of samples, as well as in documentation of sampling events. Analytical laboratories are subject to internal quality assurance programs, inter-laboratory cross-check programs, as well as nuclear industry audits. Station personnel review and evaluate all analytical data deliverables after initial review by the contractor.

Analytical data results are reviewed by both station personnel and an independent hydrogeologist for adverse trends or changes to hydrogeologic conditions.

III. Program Description

This section covers those analyses performed by Teledyne Brown Engineering (TBE) on samples collected in 2019.

A. Sample Analysis

This section describes the general analytical methodologies used by TBE and station personnel to analyze the environmental samples for radioactivity for the Quad Cities Nuclear Power Station RGPP in 2019. Sample analysis and frequency is based upon well location, assessed risk, and site hydrogeology as described in the RGPP.

In order to achieve the stated objectives, the current program includes the following analyses:

1. Concentrations of gamma emitters in groundwater and surface water
2. Concentrations of strontium in groundwater
3. Concentrations of tritium in groundwater and surface water
4. Concentration of gross alpha and gross beta in groundwater
5. Concentrations of Am-241 in groundwater
6. Concentrations of Cm-242 and Cm-243/244 in groundwater
7. Concentrations of Pu-238 and PU-239/240 in groundwater
8. Concentrations of U-234, U-235 and U-238 in groundwater
9. Concentrations of Fe-55 in groundwater
10. Concentrations of Ni-63 in groundwater

B. Data Interpretation

The radiological data collected prior to QCNPS becoming operational were used as a baseline with which these operational data were compared. For the purpose of this report, QCNPS was considered operational at initial criticality. Several factors were important in the interpretation of the data:

1. Lower Limit of Detection and Minimum Detectable Concentration

   The lower limit of detection (LLD) is specified by federal regulation as a minimum sensitivity value that must be achieved routinely by the analytical parameter.

2. Laboratory Measurements Uncertainty

   The estimated uncertainty in measurement of tritium in environmental samples is frequently on the order of 50% of the measurement value.

   Statistically, the exact value of a measurement is expressed as a range with a stated level of confidence. The convention is to report results with a 95% level of confidence. The uncertainty comes from calibration standards, sample volume or weight measurements, sampling uncertainty and other factors. Exelon reports the uncertainty of a measurement created by statistical process (counting error) as well as all sources of error (Total Propagated Uncertainty or TPU). Each result has two values calculated. Exelon reports the TPU by following the result with plus or minus ± the estimated sample standard deviation, as TPU, that is obtained by propagating all sources of analytical uncertainty in measurements.

   Analytical uncertainties are reported at the 95% confidence level in this report for reporting consistency with the Annual Radiological Environmental Operating Report (AREOR) for samples analyzed by TBE.

   Gamma spectroscopy results for each type of sample were grouped as follows:

      For groundwater and surface water 14 nuclides, Be-7, K-40, Mn-54, Co-58, Fe-59, Co-60, Zn-65, Nb-95, Zr-95, I-131, Cs-134, Cs-137, Ba-140 and La-140 were reported.

IV. Results and Discussion

A. Groundwater Results

Groundwater samples were collected from on-site wells in accordance with the station RGPP. Analytical results and anomalies are discussed below:

Tritium

Samples from all locations were analyzed for tritium activity (Table B–I.1 & B-III.1 Appendix B). Tritium values ranged from less than LLD of 200 pCi/L to 60,100 pCi/L. Samples obtained near the site boundaries ranged from <200 pCi/L to 230 pCi/L. Based on Quad Cities 2017 GHD Hydrogeological Investigation Report, "there is no risk of exposure associated with groundwater ingestion off Station property", "there is no risk of exposure associated with groundwater ingestion at the Station" and "there is no current risk of exposure associated with surface water users off the Station property. The location most representative of potential offsite user of drinking water was <200 pCi/L.

Strontium

Sr-89 was not detected above the Lower Limit of Detection of 10.0 pCi/L. Sr-90 was detected at one location with concentrations ranging from 4.5 – 7.1 pCi/L. All other sample results were not above the Lower Limit of Detection (LLD) of 1.0 pCi/L. (Table B–I.1 Appendix B)

Gross Alpha and Gross Beta (dissolved and suspended)

Gross Alpha and Gross Beta analyses in the dissolved and suspended fractions performed on designated groundwater locations in 2019.

Gross Alpha (dissolved) was not detected at concentrations greater than the LLD. Gross Alpha (suspended) was not detected at concentrations greater than the LLD.

Gross Beta (dissolved) was detected at 2 locations. The concentrations ranged from 4.1 pCi/L to 13.9 pCi/L. Gross Beta (suspended) was not detected at concentrations greater than the LLD. (Table B-I.1 Appendix B)

Gamma Emitters

No gamma-emitting nuclides were detected above the LLD. (Table B–I.2, Appendix B).

Select Transuranics/Hard-To-Detect

Select Transuranic/Hard-To-Detect analyses were performed on 1 groundwater location. The analyses included Am-241, Cm-242, Cm-243/244, Pu-238, Pu-239/240, U-234, U-235, U-238, Fe-55 and Ni-63. U-234 was detected at one location with a concentration of 0.58 pCi/L. U-238 was detected at one location with a concentration of 0.38 pCi/L. U-234 and U-238 are commonly found in groundwater at low concentrations due to the naturally-occurring Radium (Uranium) Decay Series. The concentrations of U-234 and U-238 discussed above are considered to be background and are not the result of station effluents. All other Select Transuranic/Hard-To-Detect nuclides were not detected at concentrations greater than their respective MDCs.
(Table B–I.3 Appendix B).

B. Surface Water Results

Tritium

Samples from 2 locations were analyzed for tritium activity. Tritium concentrations were less than the LLD of 200 pCi/L. (Table B–II.1 Appendix B).

Gamma Emitters

No gamma-emitting nuclides were detected at either surface water location. (Table B–II.2, Appendix B).

C. Summary of Results – Inter-Laboratory Comparison Program

Inter-Laboratory Comparison Program results for TBE are presented in the Annual Radiological Environmental Operating Report.

D. Leaks, Spills, and Releases

No leaks, spills or releases were identified during the year.

E. Trends

The March 28, 2018 Radwaste Pipe Vault release was >99% remediated as of November 6, 2019. Overall, groundwater tritium concentrations have been decreasing over time at the Station.

F. Investigations

Currently no investigations are on-going.

G. Actions Taken

1. Compensatory Actions

   There have been no station events requiring compensatory actions at the Quad Cities Nuclear Power Station in 2019.

2. Actions to Recover/Reverse Plumes

   Remediation of the groundwater tritium activity in vicinity of the RW Pipe Vault resumed on April 16, 2019, via pumping from remediation well QC-RW-1 with pump effluent routed to the Discharge Bay for release. Active pumping for remediation was discontinued for the remainder of 2019 on November 6, 2019, due to winter weather. Between April 16, 2019 and November 6, 2019, approximately 1.1 million gallons of groundwater was pumped from the vicinity of the RW Pipe Vault for remediation purposes. Quad Cities Station Migration Control Plan (MCP) continues to employ Monitored Natural Attenuation for remediation of legacy H-3 plumes.

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APPENDIX A

LOCATION DESIGNATION

TABLE A-1: Radiological Groundwater Protection Program - Sampling Locations
Quad Cities Nuclear Power Station, 2019

Site	Site Type	Well Designation	Minimum Sample Frequency
MW-QC-1	Monitoring Well	Plume	Quarterly
MW-QC-2	Monitoring Well	Plume	Quarterly
MW-QC-3	Monitoring Well	Plume	Quarterly
MW-QC-101I	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-101S	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-102D	Monitoring Well	Plume	Quarterly
MW-QC-102I	Monitoring Well	Plume	Quarterly
MW-QC-102S	Monitoring Well	Plume	Quarterly
MW-QC-103I	Monitoring Well	Detection	Quarterly
MW-QC-104S	Monitoring Well	Detection	Quarterly
MW-QC-105I	Monitoring Well	Plume	Quarterly
MW-QC-106I	Monitoring Well	Plume	Quarterly
MW-QC-106S	Monitoring Well	Plume	Quarterly
MW-QC-107I	Monitoring Well	Background	Annual
MW-QC-108D	Monitoring Well	Plume	Quarterly
MW-QC-108I	Monitoring Well	Plume	Quarterly
MW-QC-108S	Monitoring Well	Plume	Quarterly
MW-QC-109I	Monitoring Well	Plume	Quarterly
MW-QC-109S	Monitoring Well	Plume	Quarterly
MW-QC-110I	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-111D1	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-111D2	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-111I	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-112I	Monitoring Well	Plume	Quarterly
MW-QC-113I	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-114I	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-115S	*Monitoring Well*	*Idle*	*Not Required*
MW-QC-116S	*Monitoring Well*	*Idle*	*Not Required*
SURFACE WATER #1	Surface Water	Surface Water	Quarterly
SURFACE WATER #2	Surface Water	Surface Water	Quarterly
WELL #1	*Production Well*	*Idle*	*Not Required*
WELL #5	*Production Well*	*Idle*	*Not Required*
WELL #6 LITTLE FISH	*Production Well*	*Idle*	*Not Required*
WELL #7 BIG FISH WELL	Production Well	Plume	Quarterly
WELL #8 FIRE TRAINING WELL	*Production Well*	*Idle*	*Not Required*
WELL #9 Dry Cask Storage	Production Well	Background	Annual
WELL #10 FISH HOUSE WELL	*Production Well*	*Idle*	*Not Required*
WELL #11 SPRAY CANAL WELL	*Production Well*	*Idle*	*Not Required*
STP SAND POINT WELL	*Production Well*	*Idle*	*Not Required*
QC-GP-1	Sentinel Well	Plume	Quarterly
QC-GP-2	Sentinel Well	Plume	Quarterly
QC-GP-3	*Sentinel Well*	*Idle*	*Not Required*
QC-GP-4	Sentinel Well	Plume	Quarterly
QC-GP-5	Sentinel Well	Plume	Quarterly
QC-GP-6	Sentinel Well	Plume	Quarterly
QC-GP-7	Sentinel Well	Plume	Quarterly
QC-GP-8	*Sentinel Well*	*Idle*	*Not Required*
QC-GP-9	Sentinel Well	Plume	Quarterly
QC-GP-10	Sentinel Well	Detection	Quarterly
QC-GP-11	Sentinel Well	Detection	Quarterly
QC-GP-12	Sentinel Well	Detection	Quarterly
QC-GP-13	Sentinel Well	Plume	Quarterly
QC-GP-14	Sentinel Well	Detection	Quarterly
QC-GP-15	Sentinel Well	Elevated	Quarterly
QC-GP-16	Sentinel Well	Detection	Quarterly
QC-GP-17	Sentinel Well	Plume	Quarterly
QC-GP-18	Sentinel Well	Plume	Quarterly
QC-RW-1	*Remediation Well*	*NA*	*Not Required*

Note: Idle designated wells are not required to be sampled as part of the RGPP

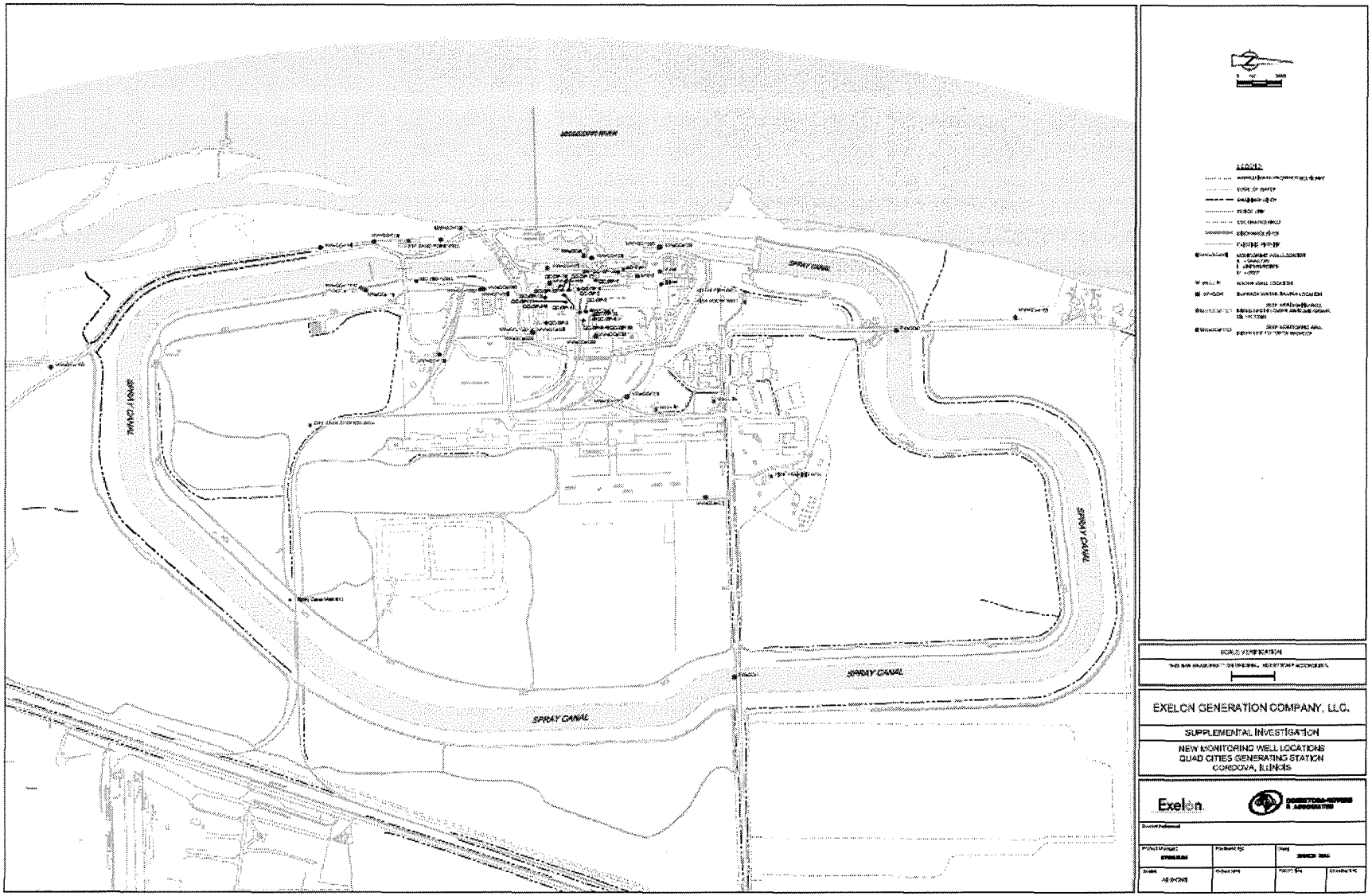

FIGURE A-1
Sampling Locations Near the Site Boundary of the Quad Cities Nuclear Power Station, 2019

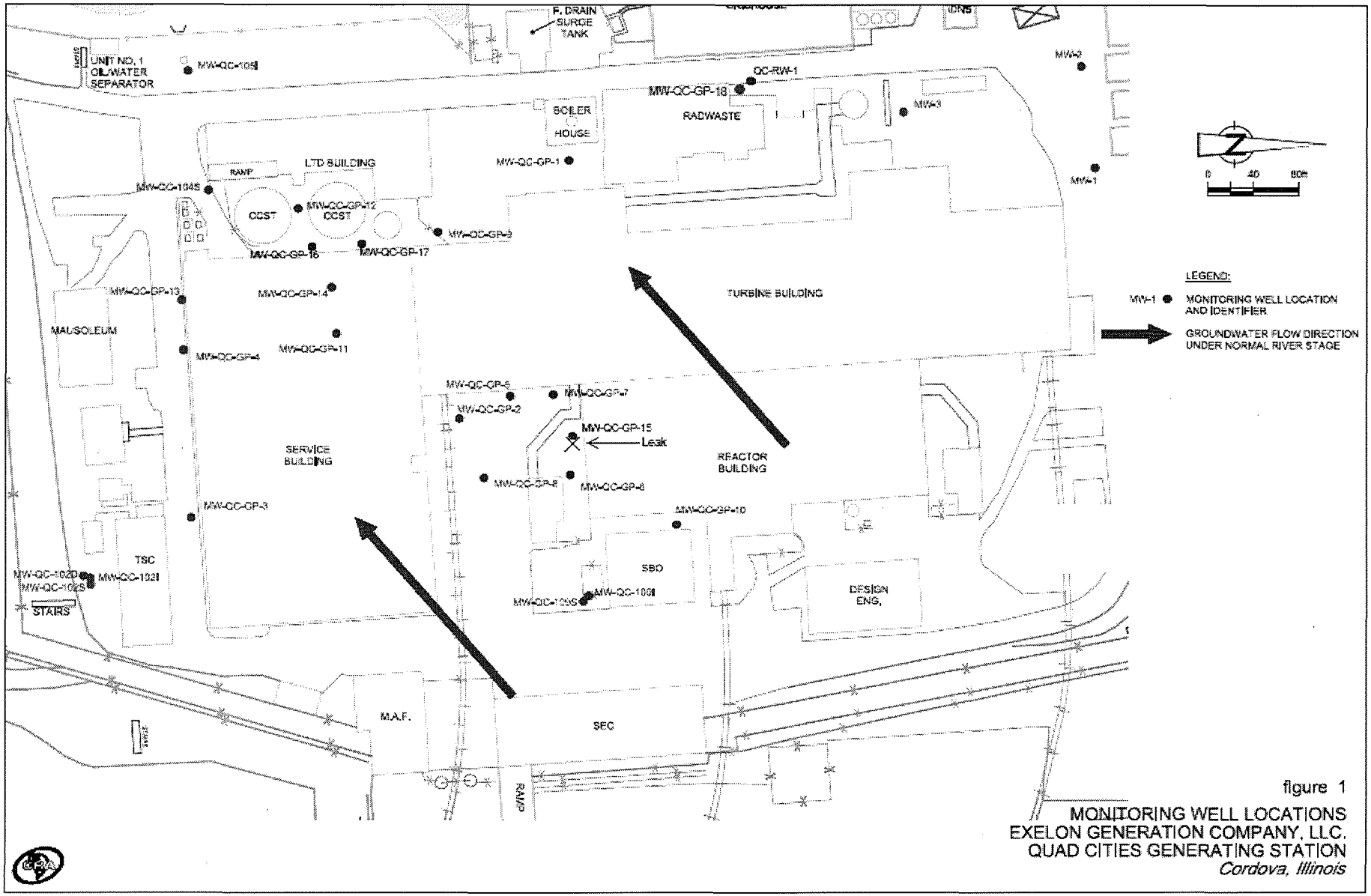

figure 1
MONITORING WELL LOCATIONS
EXELON GENERATION COMPANY, LLC.
QUAD CITIES GENERATING STATION
Cordova, Illinois

FIGURE A-2
Sentinel Monitoring Point Locations, Quad Cities Nuclear Power Station, 2019

APPENDIX B

DATA TABLES

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TABLE B-I.1

CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-QC-1	02/26/19		236 ± 126						
MW-QC-1	05/21/19		< 198						
MW-QC-1	08/20/19		397 ± 138						
MW-QC-1	12/03/19		331 ± 126						
MW-QC-2	02/26/19		< 191						
MW-QC-2	05/21/19		< 190						
MW-QC-2	08/20/19		< 194						
MW-QC-2	12/03/19		< 185						
MW-QC-3	02/26/19		1060 ± 174						
MW-QC-3	02/26/19	*NP*	1180 ± 186						
MW-QC-3	05/21/19		579 ± 146						
MW-QC-3	05/21/19	*NP*	664 ± 151						
MW-QC-3	08/20/19		279 ± 129	< 6.3	< 0.8				
MW-QC-3	08/20/19	*NP*	193 ± 124						
MW-QC-3	12/03/19		427 ± 133						
MW-QC-3	12/03/19	*MP*	375 ± 128						
MW-QC-102D	02/26/19		335 ± 129						
MW-QC-102D	02/26/19	*NP*	1440 ± 208						
MW-QC-102D	05/21/19		763 ± 149						
MW-QC-102D	05/21/19	*NP*	1280 ± 201						
MW-QC-102D	08/20/19		746 ± 159						
MW-QC-102D	08/20/19	*NP*	814 ± 160						
MW-QC-102D	12/03/19		812 ± 161						
MW-QC-102D	12/03/19	*NP*	1150 ± 185						
MW-QC-102I	02/25/19		251 ± 125						
MW-QC-102I	05/21/19		258 ± 125						
MW-QC-102I	08/20/19		< 197						
MW-QC-102I	12/03/19		< 191						
MW-QC-102S	02/25/19		< 191						
MW-QC-102S	05/21/19		< 185						
MW-QC-102S	08/20/19		< 198						
MW-QC-102S	12/03/19		< 192						
MW-QC-103I	02/26/19		< 196	< 5.9	< 0.7	< 1.1	< 0.5	4.1 ± 0.8	< 1.5
MW-QC-103I	05/21/19		< 186						
MW-QC-103I	08/20/19		< 196						
MW-QC-103I	12/03/19		< 192						
MW-QC-104S	02/26/19		744 ± 148	< 8.5	< 0.7	< 1.4	< 0.5	13.9 ± 1.6	< 1.5
MW-QC-104S	02/26/19	*NP*	879 ± 160						
MW-QC-104S	05/21/19		< 175						
MW-QC-104S	05/21/19	*NP*	< 193						
MW-QC-104S	08/20/19		< 198						
MW-QC-104S	08/20/19	*NP*	< 193						
MW-QC-104S	12/03/19		< 190						
MW-QC-104S	12/03/19	*NP*	204 ± 121						
MW-QC-105I	02/26/19		617 ± 147						
MW-QC-105I	05/21/19		< 194						
MW-QC-105I	08/20/19		1040 ± 174						
MW-QC-105I	12/03/19		< 192						
MW-QC-106I	02/26/19		< 191						

TABLE B-I.1

CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
MW-QC-106I	05/21/19		< 190						
MW-QC-106I	08/20/19		< 193						
MW-QC-106I	12/03/19		< 193						
MW-QC-106S	02/26/19		230 ± 127						
MW-QC-106S	05/21/19		< 188						
MW-QC-106S	08/20/19		< 197						
MW-QC-106S	12/03/19		< 191						
MW-QC-107I	02/25/19		< 185						
MW-QC-108D	02/25/19		261 ± 126						
MW-QC-108D	02/25/19	*NP*	308 ± 131						
MW-QC-108D	05/20/19		< 196						
MW-QC-108D	05/20/19	*NP*	261 ± 131						
MW-QC-108D	08/19/19		< 195						
MW-QC-108D	08/19/19	*NP*	< 190						
MW-QC-108D	12/02/19		< 184						
MW-QC-108D	12/03/19	*NP*	< 186						
MW-QC-108I	02/25/19		< 186						
MW-QC-108I	05/20/19		413 ± 140						
MW-QC-108I	08/19/19		< 192						
MW-QC-108I	12/02/19		< 183						
MW-QC-108S	02/25/19		247 ± 126						
MW-QC-108S	05/20/19		< 193						
MW-QC-108S	08/19/19		< 193						
MW-QC-108S	12/02/19		< 183						
MW-QC-109I	02/26/19		< 183						
MW-QC-109I	05/20/19		< 196						
MW-QC-109I	08/20/19		< 189						
MW-QC-109I	12/03/19		< 182						
MW-QC-109S	02/26/19		< 189						
MW-QC-109S	05/20/19		< 197						
MW-QC-109S	08/20/19		< 194						
MW-QC-109S	12/03/19		< 181						
MW-QC-112I	02/25/19		< 189						
MW-QC-112I	05/20/19		< 195						
MW-QC-112I	08/19/19		< 197						
MW-QC-112I	12/02/19		< 181						
QC-GP-1	03/12/19		634 ± 146	< 4.5	< 0.6				
QC-GP-1	05/22/19		348 ± 137						
QC-GP-1	05/22/19	*NP*	382 ± 139						
QC-GP-1	08/06/19	*NP*	200 ± 130						
QC-GP-1	08/06/19		271 ± 131						
QC-GP-1	12/04/19	*NP*	615 ± 149						
QC-GP-1	12/04/19		605 ± 147						
QC-GP-4	02/27/19	*NP*	9000 ± 953						
QC-GP-4	02/27/19		8730 ± 925						
QC-GP-4	05/22/19		6390 ± 701						
QC-GP-4	05/22/19	*NP*	5600 ± 623						
QC-GP-4	08/05/19	*NP*	10600 ± 1120						
QC-GP-4	08/05/19		11700 ± 1230						

TABLE B-I.1 **CONCENTRATIONS OF TRITIUM, STRONTIUM, GROSS ALPHA AND GROSS BETA IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019**

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE		H-3	Sr-89	Sr-90	Gr-A (Dis)	Gr-A (Sus)	Gr-B (Dis)	Gr-B (Sus)
QC-GP-4	12/05/19	*NP*	7530 ± 816						
QC-GP-4	12/05/19		8560 ± 919						
QC-GP-5	02/27/19		209 ± 129	< 8.4	4.5 ± 0.8				
QC-GP-5	05/23/19		513 ± 142	< 9.9	5.3 ± 0.7				
QC-GP-5	08/05/19			< 6.0	6.5 ± 1.0				
QC-GP-5	12/04/19			< 7.7	7.1 ± 0.7				
QC-GP-6	02/27/19		< 195	< 6.6	< 0.9				
QC-GP-7	02/27/19		272 ± 133	< 5.9	< 0.7				
QC-GP-9	02/28/19	*NP*	5390 ± 603						
QC-GP-9	02/28/19		3790 ± 440						
QC-GP-9	05/23/19		1830 ± 254						
QC-GP-9	05/23/19	*NP*	2950 ± 361						
QC-GP-9	08/06/19	*NP*	4430 ± 501						
QC-GP-9	08/06/19		5140 ± 573						
QC-GP-9	12/04/19	*NP*	4570 ± 522						
QC-GP-9	12/04/19		4860 ± 547						
QC-GP-10	02/27/19		< 195	< 4.8	< 0.4	< 1.8	< 0.5		
QC-GP-11	03/01/19		292 ± 133	< 7.8	< 0.7	< **4.4**	< 0.9		
QC-GP-12	02/28/19		203 ± 128	< 8.3	< 0.7	< 0.8	< 0.5		
QC-GP-13	02/27/19	*NP*	6910 ± 747						
QC-GP-13	02/27/19		11200 ± 1170						
QC-GP-13	05/22/19		4230 ± 488						
QC-GP-13	05/22/19	*NP*	4740 ± 538						
QC-GP-13	08/05/19	*NP*	4670 ± 528						
QC-GP-13	08/08/19		4450 ± 506						
QC-GP-13	12/05/19	*NP*	3290 ± 398						
QC-GP-13	12/05/19		3190 ± 386						
QC-GP-14	02/28/19		205 ± 130	< 7.8	< 0.7	< 1.9	< 0.5		
QC-GP-15	02/27/19		< 188	< 5.7	< 0.5	< **3.5**	< 0.5		
QC-GP-16	02/28/19		2790 ± 346	< 6.4	< 0.6	< 1.7	< 0.5		
QC-GP-17	02/28/19	*NP*	799 ± 158						
QC-GP-17	02/28/19		710 ± 154						
QC-GP-17	05/22/19		211 ± 129						
QC-GP-17	05/22/19	*NP*	344 ± 136						
QC-GP-17	08/06/19	*NP*	2610 ± 325						
QC-GP-17	08/06/19		3010 ± 363						
QC-GP-17	12/04/19	*NP*	1440 ± 220						
QC-GP-17	12/04/19		1440 ± 219						
QC-GP-18	02/25/19	*NP*	24000 ± 2450						
QC-GP-18	02/25/19		20800 ± 2130	< 3.8	< 0.2	< 2.1	< 0.5		
QC-GP-18	05/22/19		762 ± 157						
QC-GP-18	05/22/19	*NP*	1050 ± 184						
QC-GP-18	08/06/19	*NP*	1280 ± 197						
QC-GP-18	08/06/19		1010 ± 173						
QC-GP-18	12/04/19	*NP*	10100 ± 1070						
QC-GP-18	12/04/19		10300 ± 1100						
WELL #9 DRY CASK STORAGE	05/22/19		< 197						

TABLE B-I.2

CONCENTRATIONS OF GAMMA EMITTERS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
MW-QC-103I	02/26/19	< 42	< 105	< 5	< 5	< 13	< 6	< 12	< 6	< 10	< 15	< 6	< 5	< 33	< 9
MW-QC-104S	02/26/19	< 45	< 56	< 5	< 6	< 9	< 7	< 11	< 6	< 10	< 13	< 6	< 6	< 32	< 9
MW-QC-107I	02/25/19	< 42	< 97	< 6	< 5	< 11	< 5	< 12	< 6	< 10	< 15	< 5	< 6	< 32	< 10
MW-QC-3	02/26/19	< 52	< 119	< 6	< 4	< 14	< 8	< 11	< 6	< 12	< 13	< 6	< 6	< 33	< 12
QC-GP-10	08/05/19	< 61	< 89	< 7	< 6	< 14	< 6	< 14	< 8	< 11	< 15	< 6	< 7	< 30	< 12
QC-GP-11	08/06/19	< 62	< 145	< 7	< 8	< 15	< 10	< 16	< 7	< 15	< 13	< 9	< 8	< 44	< 14
QC-GP-12	08/06/19	< 58	< 151	< 8	< 8	< 18	< 7	< 10	< 7	< 12	< 14	< 5	< 5	< 37	< 12
QC-GP-14	08/06/19	< 58	< 50	< 6	< 6	< 13	< 7	< 14	< 7	< 12	< 13	< 7	< 6	< 34	< 14
QC-GP-15	08/05/19	< 45	< 70	< 6	< 6	< 15	< 7	< 11	< 6	< 14	< 13	< 7	< 6	< 34	< 12
QC-GP-16	08/06/19	< 55	< 108	< 8	< 7	< 12	< 8	< 15	< 6	< 12	< 14	< 9	< 7	< 36	< 8
QC-GP-18	06/17/19	< 64	< 72	< 7	< 8	< 17	< 8	< 20	< 8	< 14	< 11	< 8	< 8	< 38	< 13
QC-GP-18	08/06/19	< 61	< 65	< 7	< 6	< 13	< 8	< 13	< 7	< 12	< 13	< 8	< 6	< 27	< 12
WELL #9 DRY CASK STORAGE	05/22/19	< 26	< 26	< 3	< 3	< 6	< 3	< 6	< 3	< 5	< 14	< 3	< 3	< 23	< 8

TABLE B-I.3

CONCENTRATIONS OF HARD-TO-DETECTS IN GROUNDWATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Am-241	Cm-242	Cm-243/244	Pu-238	Pu-239/240	U-234	U-235	U-238	Fe-55	Ni-63
MW-QC-3	08/20/19									< 31	< 4.4
MW-QC-103I	08/20/19									< 52	< 4.4
QC-GP-1	03/12/19									< 100	< 3.8
QC-GP-5	02/27/19									< 86	< 4.2
QC-GP-6	02/27/19									< 66	< 4.3
QC-GP-7	02/27/19									< 31	< 4.6
QC-GP-15	02/27/19									< 162	< 4.3
QC-GP-18	02/25/19	< 0.02	< 0.04	< 0.02	< 0.16	< 0.06	0.58 ± 0.18	< 0.02	0.38 ± 0.14	< 182	< 4.3

TABLE B-II.1 CONCENTRATIONS OF TRITIUM IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER + 2 SIGMA

SITE	COLLECTION DATE	H-3
QC-SW-1	02/26/19	*(1)*
QC-SW-1	05/20/19	< 196
QC-SW-1	08/19/19	< 190
QC-SW-1	12/02/19	< 183
QC-SW-2	02/26/19	*(1)*
QC-SW-2	05/20/19	< 192
QC-SW-2	08/19/19	< 193
QC-SW-2	12/02/19	< 183

(1) No Sample - Canal Frozen

TABLE B-II.2

CONCENTRATIONS OF GAMMA EMITTERS IN SURFACE WATER SAMPLES COLLECTED IN THE VICINITY OF QUAD CITIES NUCLEAR POWER STATION, 2019

RESULTS IN UNITS OF PCI/LITER ± 2 SIGMA

SITE	COLLECTION DATE	Be-7	K-40	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140
QC-SW-1	05/20/19	< 45	< 82	< 5	< 6	< 14	< 5	< 12	< 5	< 9	< 14	< 6	< 5	< 30	< 15
QC-SW-2	05/20/19	< 56	< 61	< 6	< 6	< 13	< 5	< 11	< 8	< 9	< 13	< 6	< 6	< 33	< 12

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN GROUNDWATER SAMPLES COLLECTED AND ANALYZED BY QUAD CITIES STATION PERSONNEL, 2019

RESULTS IN UNITS OF PCI/LITER

SITE	COLLECTION DATE	ACTIVITY	AQUIFER
QC-GP-1	03/12/19	<2,000	Sentinel Well
QC-GP-1	05/22/19	<2,000	Sentinel Well
QC-GP-1	08/06/19	<2,000	Sentinel Well
QC-GP-1	11/05/19	<2,000	Sentinel Well
QC-GP-1	12/04/19	<2,000	Sentinel Well
QC-GP-2	02/27/19	<2,000	Sentinel Well
QC-GP-2	05/22/19	<2,000	Sentinel Well
QC-GP-2	08/05/19	<2,000	Sentinel Well
QC-GP-2	12/04/19	<2,000	Sentinel Well
QC-GP-3	05/22/19	<2,000	Sentinel Well
QC-GP-4	02/27/19	9,460	Sentinel Well
QC-GP-4	05/22/19	5,120	Sentinel Well
QC-GP-4	08/05/19	11,700	Sentinel Well
QC-GP-4	12/05/19	8,640	Sentinel Well
QC-GP-5	02/27/19	<2,000	Sentinel Well
QC-GP-5	05/23/19	<2,000	Sentinel Well
QC-GP-5	08/05/19	<2,000	Sentinel Well
QC-GP-5	12/04/19	<2,000	Sentinel Well
QC-GP-6	02/27/19	<2,000	Sentinel Well
QC-GP-6	05/23/19	<2,000	Sentinel Well
QC-GP-6	08/05/19	<2,000	Sentinel Well
QC-GP-6	12/04/19	<2,000	Sentinel Well
QC-GP-7	02/27/19	<2,000	Sentinel Well
QC-GP-7	05/22/19	<2,000	Sentinel Well
QC-GP-7	08/05/19	<2,000	Sentinel Well
QC-GP-7	12/04/19	<2,000	Sentinel Well
QC-GP-8	05/22/19	<2,000	Sentinel Well
QC-GP-9	02/28/19	3,930	Sentinel Well
QC-GP-9	05/23/19	<2,000	Sentinel Well
QC-GP-9	08/06/19	5,290	Sentinel Well
QC-GP-9	12/04/19	4,390	Sentinel Well
QC-GP-10	02/27/19	<2,000	Sentinel Well
QC-GP-10	05/23/19	<2,000	Sentinel Well
QC-GP-10	08/05/19	<2,000	Sentinel Well
QC-GP-10	12/04/19	<2,000	Sentinel Well
QC-GP-11	03/01/19	<2,000	Sentinel Well
QC-GP-11	05/23/19	<2,000	Sentinel Well
QC-GP-11	08/06/19	<2,000	Sentinel Well
QC-GP-11	12/04/19	<2,000	Sentinel Well
QC-GP-12	02/28/19	<2,000	Sentinel Well
QC-GP-12	05/22/19	<2,000	Sentinel Well
QC-GP-12	08/06/19	<2,000	Sentinel Well
QC-GP-12	12/05/19	<2,000	Sentinel Well
QC-GP-13	02/27/19	9,930	Sentinel Well
QC-GP-13	05/22/19	4,000	Sentinel Well
QC-GP-13	08/08/19	4,490	Sentinel Well
QC-GP-13	12/05/19	3,630	Sentinel Well
QC-GP-14	02/28/19	<2,000	Sentinel Well
QC-GP-14	05/23/19	<2.000	Sentinel Well
QC-GP-14	08/06/19	<2,000	Sentinel Well
QC-GP-14	12/04/19	<2,000	Sentinel Well

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN GROUNDWATER SAMPLES COLLECTED AND ANALYZED BY QUAD CITIES STATION PERSONNEL, 2019

RESULTS IN UNITS OF PCI/LITER

SITE	COLLECTION DATE	ACTIVITY	AQUIFER
QC-GP-15	02/27/19	<2,000	Sentinel Well
QC-GP-15	05/23/19	<2,000	Sentinel Well
QC-GP-15	08/05/19	<2,000	Sentinel Well
QC-GP-15	12/04/19	<2,000	Sentinel Well
QC-GP-16	02/28/19	2,540	Sentinel Well
QC-GP-16	05/22/19	<2,000	Sentinel Well
QC-GP-16	08/06/19	2,480	Sentinel Well
QC-GP-16	12/04/19	<2,000	Sentinel Well
QC-GP-17	02/28/19	<2,000	Sentinel Well
QC-GP-17	05/22/19	<2,000	Sentinel Well
QC-GP-17	08/06/19	3,600	Sentinel Well
QC-GP-17	12/04/19	<2,000	Sentinel Well
QC-GP-18	01/07/19	33,200	Sentinel Well
QC-GP-18	02/25/19	18,500	Sentinel Well
QC-GP-18	03/12/19	17,300	Sentinel Well
QC-GP-18	04/08/19	14,600	Sentinel Well
QC-GP-18	04/16/19	5,080	Sentinel Well
QC-GP-18	04/22/19	5,040	Sentinel Well
QC-GP-18	04/29/19	<2,000	Sentinel Well
QC-GP-18	05/06/19	<2,000	Sentinel Well
QC-GP-18	05/13/19	<2,000	Sentinel Well
QC-GP-18	05/20/19	<2,000	Sentinel Well
QC-GP-18	05/28/19	<2,000	Sentinel Well
QC-GP-18	06/03/19	<2,000	Sentinel Well
QC-GP-18	06/10/19	<2,000	Sentinel Well
QC-GP-18	06/17/19	<2,000	Sentinel Well
QC-GP-18	07/01/19	<2,000	Sentinel Well
QC-GP-18	07/15/19	<2,000	Sentinel Well
QC-GP-18	07/29/19	<2,000	Sentinel Well
QC-GP-18	08/06/19	<2,000	Sentinel Well
QC-GP-18	08/12/19	<2,000	Sentinel Well
QC-GP-18	08/26/19	2,320	Sentinel Well
QC-GP-18	09/09/19	<2,000	Sentinel Well
QC-GP-18	09/23/19	<2,000	Sentinel Well
QC-GP-18	10/07/19	<2,000	Sentinel Well
QC-GP-18	10/21/19	5,560	Sentinel Well
QC-GP-18	11/04/19	9,640	Sentinel Well
QC-GP-18	12/04/19	10,600	Sentinel Well
MW-QC-3	08/06/19	<2,000	Monitoring Well
MW-QC-3	11/05/19	<2,000	Monitoring Well
MW-QC-103I	08/06/19	<2,000	Monitoring Well
MW-QC-103I	11/05/19	<2,000	Monitoring Well
QC-RW-1	01/07/19	52,800	Remediation Well
QC-RW-1	02/25/19	27,800	Remediation Well
QC-RW-1	03/12/19	42,500	Remediation Well
QC-RW-1	04/08/19	43,500	Remediation Well
QC-RW-1	04/16/19	42,700	Remediation Well
QC-RW-1	04/22/19	60,100	Remediation Well
QC-RW-1	04/29/19	42,900	Remediation Well
QC-RW-1	05/06/19	45,200	Remediation Well
QC-RW-1	05/13/19	50,700	Remediation Well

TABLE B-III.1 CONCENTRATIONS OF TRITIUM IN GROUNDWATER SAMPLES COLLECTED AND ANALYZED BY QUAD CITIES STATION PERSONNEL, 2019

RESULTS IN UNITS OF PCI/LITER

SITE	COLLECTION DATE	ACTIVITY	AQUIFER
QC-RW-1	05/20/19	56,900	Remediation Well
QC-RW-1	05/28/19	54,700	Remediation Well
QC-RW-1	06/03/19	47,300	Remediation Well
QC-RW-1	06/10/19	50,300	Remediation Well
QC-RW-1	06/17/19	55,600	Remediation Well
QC-RW-1	07/01/19	52,300	Remediation Well
QC-RW-1	07/15/19	43,500	Remediation Well
QC-RW-1	07/29/19	42,600	Remediation Well
QC-RW-1	08/06/19	42,400	Remediation Well
QC-RW-1	08/12/19	47,400	Remediation Well
QC-RW-1	08/26/19	48,200	Remediation Well
QC-RW-1	09/09/19	41,700	Remediation Well
QC-RW-1	09/23/19	32,700	Remediation Well
QC-RW-1	10/07/19	32,000	Remediation Well
QC-RW-1	10/21/19	35,700	Remediation Well
QC-RW-1	11/04/19	40,500	Remediation Well
QC-RW-1	12/04/19	31,300	Remediation Well
Well #1	05/14/19	<200	Production Well
Well #1	10/17/19	<200	Production Well
Well #5	05/14/19	<200	Production Well
Well #5	10/17/19	<200	Production Well
Well #7	02/28/19	<2,000	Production Well
Well #7	05/20/19	<2,000	Production Well
Well #7	08/19/19	<2,000	Production Well
Well #7	12/02/19	<2,000	Production Well