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Exelon Generation®

May 11, 2018

U.S. Nuclear Regulatory Commission
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R.E. Ginna Nuclear Power Plant
Renewed Facility Operating License No. DPR-18
NRC Docket No. 50-244

Independent Spent Fuel Storage Installation (ISFSI)
NRC Docket No. 72-67

Subject: 2017 Annual Radioactive Effluent Release Report and 2017 Annual Radiological Environmental Operating Report

Enclosed is the Annual Radioactive Effluent Release Report (ARERR) for 2017 for the R.E. Ginna Nuclear Power Plant and Independent Spent Fuel Storage Installation (ISFSI). This report is being submitted in accordance with 10 CFR 50.36a(a)(2) and Technical Specifications (TS) Sections 5.5.1c and 5.6.3. Also enclosed is the Annual Radiological Environmental Operating Report (AREOR) for 2017, submitted in accordance with Technical Specification Section 5.6.2.

Three (3) revisions to the Offsite Dose Calculation Manual (ODCM) and one (1) revision to the Process Control Program (PCP) occurred during the 2017 reporting period. In the ARERR, the ODCM revisions are described in Section 10.0 and the PCP revisions are described in Section 11.0. A complete, legible copy of the entire ODCM annotated with all changes for the period of the report is also submitted, as required by TS 5.5.1.c.

There are no regulatory commitments contained in this submittal. Should you have any other questions regarding this submittal, please contact Kyle Garnish at 315-791-5321.

Respectfully,

William Carsky

wc/jf

IE48
IE25
NMSS26
NRR
NMSS

Attachments:

1) Annual Radioactive Effluent Release Report, January 1, 2017 – December 31, 2017

2) Annual Radiological Environmental Operating Report, January 1, 2017 – December 31, 2017

3) Annotated copy of the latest revision (33) of the ODCM in the reporting period

cc: NRC Regional Administrator, Region I
NRC Project Manager, Ginna
NRC Senior Resident Inspector, Ginna

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ATTACHMENT 1

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

JANUARY 1, 2017 – DECEMBER 31, 2017

ATTACHMENT 2

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

JANUARY 1, 2017 – DECEMBER 31, 2017

R.E. Ginna Nuclear Power Plant, LLC

ATTACHMENT 3

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

Annotated copy of ODCM Revision 33

Exelon Generation®

ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT: JANUARY 1, 2017 – DECEMBER 31, 2017

MAY 2018

R.E. Ginna Nuclear Power Plant
1503 Lake Road
Ontario, New York 14519

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1.0 INTRODUCTION

R.E. Ginna Nuclear Power Plant (Ginna) has prepared this Annual Radioactive Effluent Release Report (ARERR) in accordance with the requirements of Technical Specification Section 5.6.3.

This report, covering the period from January 1, 2017 through December 31, 2017, provides a summary of the quantities of radioactive gaseous and liquid effluents and solid waste released from the plant presented in the format outlined in Appendix B of Regulatory Guide 1.21, Revision 1, June 1974.

All gaseous and liquid effluents discharged during this reporting period were in compliance with the limits of the Ginna Technical Specifications as defined in the Offsite Dose Calculation Manual (ODCM).

2.0 SUPPLEMENTAL INFORMATION

2.1 Regulatory Limits

The ODCM limits applicable to the release of radioactive material in liquid and gaseous effluents are:

2.1.1 Fission and Activation Gases

The instantaneous dose rate, as calculated in the ODCM, due to noble gases released in gaseous effluents from the site shall be limited to a release rate that would yield $\leq$ 500 mrem/yr to the total body and $\leq$ 3000 mrem/yr to the skin if allowed to continue for a full year.

The air dose, as calculated in the ODCM, due to noble gases released in gaseous effluents from the site shall be limited to the following:

(I) During any calendar quarter to $\leq$ 5 mrad for gamma radiation and to $\leq$ 10 mrad for beta radiation.

(ii) During any calendar year to $\leq$ 10 mrad for gamma radiation and to $\leq$ 20 mrad for beta radiation.

2.1.2 Radioiodine, Tritium, and Particulates

The instantaneous dose rate, as calculated in the ODCM, due to radioactive materials released in gaseous effluents from the site as radioiodines, radioactive materials in particulate form, and radionuclides other than noble

gases with half-lives greater than eight days shall be limited to a release rate that would yield ≤ 1500 mrem/yr to any organ if allowed to continue for a full year.

Dose to an individual from radioiodine, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than eight days released with gaseous effluents is calculated in accordance with ODCM methodology. The dose to an individual shall be limited to:

(i) During any calendar quarter to ≤ 7.5 mrem to any organ.

(ii) During any calendar year to ≤ 15 mrem to any organ.

2.1.3 Liquid Effluents

The release of radioactive liquid effluents shall be such that the concentration in the circulating water discharge does not exceed 10 times the limits specified in Appendix B, Table II, Column 2 and notes thereto of 10 CFR 20, as explained in Section 4 of the ODCM. For dissolved or entrained noble gases the total activity due to dissolved or entrained noble gases shall not exceed 2E-04 uCi/ml.

The dose or dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas is calculated according to ODCM methodology and is limited to:

(i) During any calendar quarter to ≤ 1.5 mrem to the total body and to ≤ 5 mrem to any organ, and

(ii) During any calendar year to ≤ 3 mrem to the total body and to ≤ 10 mrem to any organ.

2.2 Effluent Concentration Limits (ECLs)

2.2.1 For gaseous effluents, effluent concentration limits (ECLs) are not directly used in release rate calculations since the applicable limits are stated in terms of dose rate at the unrestricted area boundary, in accordance with Technical Specification 5.5.4.g.

2.2.2 For liquid effluents, ECLs ten times those specified in 10 CFR 20, Appendix B, Table II, column 2, are used to calculate release rates and permissible concentrations at the unrestricted area boundary as permitted by Technical Specification 5.5.4.b. A value of 2E-04 uCi/ml is used as the ECL for dissolved and entrained noble gases in liquid effluents.

2.3 Release Rate Limits Based on Average Nuclide Energy

The release rate limits for fission and activation gases from the R.E. Ginna Nuclear Power Plant are not based on the average energy of the radionuclide mixture in gaseous effluents; therefore, this value is not applicable. However the 2017 average beta/gamma energy of the radionuclide mixture in fission and activation gases released from Ginna is available for review upon request.

2.4 Measurements and Approximations of Total Radioactivity

Gamma spectroscopy was the primary analysis method used to determine the radionuclide composition and concentration of gaseous and liquid effluents. Composite samples were analyzed for Fe-55, Ni-63, Sr-89, and Sr-90 by a contract laboratory. Tritium and alpha analysis were performed using liquid scintillation and gas flow proportional counting respectively.

The total radioactivity in effluent releases was determined from the measured concentration of each radionuclide present in a representative sample and the total volume of effluents released.

2.5 Batch Releases

2.5.1 Liquid

1. Number of batch releases:	1.75 E+02
2. Total time period for batch releases (Minutes):	2.68 E+04
3. Maximum time period for a batch release (Minutes):	5.40 E+02
4. Average time period for batch releases (Minutes):	1.53 E+02
5. Minimum time period for a batch release:	1.00 E+01
6. Average effluent release flowrate into the discharge canal (Liters per Minute):	2.92 E+02
7. Average dilution flowrate of discharge canal during effluent releases (Liters per Minute):	1.18 E+06

2.5.2 Gaseous

1. Number of batch releases:	2.90 E+01
2. Total time period for batch releases (Minutes):	5.03 E+05
3. Maximum time period for a batch release (Minutes):	4.46 E+04
4. Average time period for batch releases (Minutes):	1.73 E+04
5. Minimum time period for a batch release (Minutes):	5.80 E+01

2.6 Abnormal Releases

One abnormal gas release occurred in 2017: A small volume of gas from a CVCS holdup tank was released as a non-routine gas release under permit G-2018056. The offsite dose consequence was small relative to total releases for the month.

Two abnormal liquid releases occurred in 2017. During maintenance on the Retention Tank on April 26, 2017 two releases of liquid waste were made from the above ground backup retention tank, described as non-routine Batch Liquid permits L-2017100 and L-2017102.

3.0 SUMMARY OF GASEOUS RADIOACTIVE EFFLUENTS

The quantities of radioactive material released in gaseous effluents are summarized in Tables 1A and 1B. Plant Vent and Containment Vent releases are modeled as mixed mode and the Air Ejector is modeled as a ground level release.

4.0 SUMMARY OF LIQUID RADIOACTIVE EFFLUENTS

The quantities of radioactive material released in liquid effluents are summarized in tables 2A and 2B.

5.0 SOLID WASTE

The quantities of radioactive material released in shipments of solid waste transported from Ginna during the reporting period are summarized in Table 3. Principal nuclides were determined by gamma spectroscopy and non-gamma emitters were calculated from scaling factors determined by an independent laboratory from representative samples of that waste type. The majority of Dry Active Waste is processed utilizing an off-site processor that reduces the volume and then transports the waste to a permitted

landfill for disposal.

6.0 LOWER LIMIT OF DETECTION

The required Lower Limit of Detection (LLD), as defined in Table 2-1 of the ODCM, was met on all effluent samples in 2017.

7.0 RADIOLOGICAL IMPACT

An assessment of doses to the hypothetical maximally exposed individual member of the public from gaseous and liquid effluents was performed for locations representing the maximum calculated dose in occupied sectors. Meteorological sectors to the north from NW through ENE are entirely over Lake Ontario, while the remaining meteorological sectors to the south (WNW through E) are over land. In all cases, doses were well below Technical Specification limits as defined in the ODCM. Doses were assessed based upon historical meteorological conditions considering the noble gas exposure, inhalation, ground plane exposure, and ingestion pathways. The ingestion pathways considered were the fruit, vegetable, fish, drinking water, goat's milk, cow's milk and cow meat pathways.

Results of this assessment are presented in Tables 4A and 4B. Population doses are inferred from the population density, distance from the plant, and drinking water source.

7.1 Total Dose

40 CFR 190 limits the total dose to members of the public due to radiation and radioactivity from uranium fuel cycle sources to:

- $\leq$ 25 mrem total body or any organ and;
- $\leq$ 75 mrem thyroid for a calendar year.

Using the maximum exposure and uptake pathways, the maximum liquid pathways, including C-14 dose, and the maximum direct radiation measurements at the site boundary, yield the following dose summaries to the hypothetical maximally exposed individual member of the public. The maximum total body dose is determined by summing the hypothetical maximum direct radiation dose exposure and the total body dose from gaseous and liquid pathways. Dose to any real member of the public should be conservatively bounded by these calculated doses:

- Maximum Annual Total Body Dose: 13.1 mRem (Sum of 13.1 mrem direction radiation, 8.18E-03 (Total Body Liquid Dose), 2.16E-03 (Total Body Gas Dose).

- Maximum Annual Organ Dose: 2.32E-02 mrem (Child
- C-14)
- Maximum Annual Thyroid Dose: 9.95E-03 mrem (Adult)

8.0 METEOROLOGICAL DATA

The annual summary report of meteorological data collected during 2017 is included with this report, as Appendix A, Annual Report on the Meteorological Monitoring Program at the Ginna Nuclear Power Plant by Murray and Trettle, Incorporated.

9.0 LAND USE CENSUS CHANGES

In September 2017, Ginna staff conducted a Land Use Survey to identify the location of the nearest milk animal, the nearest residence, and the nearest garden greater than 50 square meters in each of the nine sectors within a 5-mile radius of the power plant. The Land Use Survey is conducted in accordance with Ginna procedures.

Over the past year, the following land use observations were made within a 5-mile radius of the power plant:

- The nearest residence remains in the SSE sector, approximately 610 meters from the reactor.
- Single-family home / housing subdivision construction was observed near the plant on Ridge Road (Union Hill, Ontario), northeast corner of Lake Road and Slocum Road, and Lakeside Road.
- New apartment complex construction observed north of Ridge Road in Ontario.
- Other single-family home construction was observed sporadically within 5-miles of the plant.
- A new 120-acre commercial hydroponic farm began construction on the east-end of Timothy Lane (North of Route 104).
- A new 22-acre solar farm is located north of Route 104 (Dean Parkway, Ontario).
- Commercial fishing information was collected from the New York State Department of Environmental Conservation (NYSDEC) which shows activity only in the Eastern basin of Lake Ontario. Commercial fishing operations have not changed in the last five-years.
- No new agricultural land use was identified.
- No new food producing facilities were identified.
- No new milk producing animals were identified. Eaton Farm (supplemental sample) changed names / owner to Field Craft Farms. Their location remains unchanged.

10.0 CHANGES TO THE OFFSITE DOSE CALCULATION MANUAL

There were three changes to the Offsite Dose Calculation Manual (ODCM) in 2017.

- Revision 31, implemented March 30, 2017, was a change to fleet procedure format with inclusion of a six year frequency for Containment Vent flow rate test. This revision had no adverse impact on radiological controls as verified in PORC 17-0004.
- Revision 32, implemented May 4, 2017, removed a shutdown recommendation for R-47 out of service that is controlled in Operations procedure AP-SG.1, and not required in an ODCM. This revision had no adverse impact on radiological controls as verified in PORC 17-0009.
- Revision 33, implemented December 29, 2017, updated effluent ventilation flows to the bounding flows in ECP-16-000033. This revision had no adverse impact on radiological controls as verified in PORC 17-0004

Revision 33 of the ODCM is included with this report as Appendix B.

11.0 CHANGES TO THE PROCESS CONTROL PROGRAM

There was one change to the Process Control Program on 8/23/17 as follows:

- Former in-plant systems GE or Stock Drum Transfer Cart and Drum Storage Areas may be USED for higher dose DAW storage at Clinton, Dresden, Quad Cities, Braidwood, Byron and Nine Mile Point, and James A. Fitzpatrick Nuclear Power Plant was included in the Exelon fleet.

This revision does not impact effluent controls or Radwaste programs at Ginna

12.0 MAJOR CHANGES TO RADWASTE TREATMENT SYSTEMS

There were no significant changes to the Radwaste Treatment Systems during the reporting period.

13.0 INOPERABLE MONITORS

There were one occurrence in 2017 satisfying the requirement stated in Section 6.3 and Table 6.3-1, Action 1 of the ODCM for reporting inoperable radiation monitors.

R-48 was declared out of service @ 1757 on 1/6/17 due to an unexplained spike. R-48 was repaired and returned to service @ 1422 on 1/20/17. Cause was water in detector. Detector was replaced with a moisture sealed detector.

14.0 CHANGES TO PREVIOUS ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORTS

None

15.0 GROUNDWATER MONITORING

In accordance Ginna's Chemistry procedures, environmental groundwater monitoring wells are sampled on a routine frequency. In 2017, Ginna staff collected and analyzed samples collected from a total of 14 groundwater monitoring wells:

- GW01: Warehouse Access Road (Control)
- GW03: Screenhouse West, South Well
- GW04: Screenhouse West, North Well
- GW05: Screenhouse East, South
- GW06: Screenhouse East, Middle
- GW07: Screenhouse East, North
- GW08: All Volatiles Treatment Building
- GW10: Technical Support Center, South
- GW11: Southeast of Contaminated Storage Building (CSB)
- GW12: West of Orchard Access Road
- GW13: North of Independent Spent Fuel Storage Installation (ISFSI)
- GW14: South of Canister Preparation Building*
- GW15: West of Manor House
- GW16: Southeast of Manor House

Groundwater samples are analyzed for tritium to a detection limit of 500 pCi/L and for gamma emitting radionuclides to the environmental LLDs. The analytical results for groundwater monitoring well samples collected during 2017 are presented in Table 5.

All samples collected during 2017, which were analyzed for tritium and gamma emitting nuclides, did not yield a concentration greater than the calculated MDA.

16.0 OFFSITE DOSE DUE TO ISFSI

A review of direct radiation between the Ginna ISFSI facility and the nearest residents was conducted. Environmental TLD station 64 is the highest direct radiation dose offsite and is the basis for the maximum direct radiation dose reported in 7.1 A review of TLD stations 14, 15, 16 since fuel was first stored in ISFSI in 2010 indicate no change in offsite direct radiation dose as measured by TLDs.
Ginna ISFSI design is such that effluent releases of noble gases are precluded.

17.0 OFFSITE DOSE DUE TO CARBON-14

A study of Carbon-14 in effluent releases from Ginna was conducted in 1982 by Charles Kunz of New York State Department of Health, Center for Laboratories and Research. Results of this study are used as the basis for current Carbon-14 production and releases at Ginna. Using the Carbon-14 releases measured in the Kunz study at 4.3 Curies, adjusted for power uprate from 490 MWe to 580 MWe, and adjusted for increased capacity factor and 18 month fuel cycles, leads to a conservative estimate of 6.8 Curies released in gaseous effluents in 2017. Kunz further determined the chemical form of the Carbon-14 at Ginna to be approximately 10% Carbon Dioxide (CO_2).

As a cross-check, the EPRI Carbon-14 Source Term Calculator was used to estimate Carbon-14 releases from Ginna, using Ginna specific reactor core data and reactor coolant chemistry to estimate the products of the activation reactions. The resulting estimate of 6.9 Curies per Equivalent Full Power Year (EFPY) agrees with the Kunz data, adjusted for current operating cycles.

17.1 Gaseous Effluents

Dose due to Carbon-14 in gaseous effluents was calculated using the following conditions:

a. 6.8 Curies of C-14 were released to atmosphere in 2017.
b. There was a refueling outage in 2017. However, according to the Kunz study it has little or no impact on the C-14 effluents and was not considered in this report.
c. 10% of the C-14 was in the chemical form of carbon dioxide (CO2), which is the only dose contributor. The bulk of C-14 is released in the chemical form of methane (CH4). Methane would exhibit high upward velocity due to its low density relative to air. Additionally, CH4 does not have an uptake pathway for humans.
d. Meteorological dispersion factor, (X/Q), at the site boundary to the hypothetical maximally exposed member of the public is 2.43E-07 sec/m^3.
e. Dose calculations and dose factors are from Regulatory Guide 1.109 methodology.
f. Pathways considered were inhalation, milk consumption, and vegetation ingestion.
g. The critical receptor is a child at the site boundary in the ESE direction.

See Table 6 for an estimate of Carbon-14 in gaseous effluents during 2017.

17.2 Liquid Effluents

Dose due to Carbon-14 in liquid effluents was calculated using the following conditions:

a. The liquid waste processing system at Ginna has not been evaluated for efficiency of removal of Carbon-14. Therefore no removal term was used in estimation of offsite dose.
b. Average concentration of C-14 in waste water as measured in the Kunz study was adjusted for current operating conditions and was 6.0E-07 uCi/cc.
c. 1.92E+06 liters of liquid waste (with the potential to contain C-14) were released with a total dilution flow of 1.88E+12 liters.
d. Average diluted concentration of C-14 released was 6.13E-13 uCi/cc.
e. Liquid effluent dilution factor for potable water pathway is 200.
f. Liquid effluent dilution factor for fish pathway is 1.
g. Dose calculations and dose factors are from Regulatory Guide 1.109 methodology.
h. The critical receptor is a child for the fish consumption pathway and the child is the critical receptor for the potable water pathway.

See Table 6 for an estimate of Carbon-14 in liquid effluents during 2017.

TABLE 1A
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES
2017

Effluent Type	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Gases						
1. Total release	Ci	1.43E-01	2.85E+00	3.29E-01	2.07E-01	2.80E+01
2. Average release rate for period	uCi/sec	1.82E-02	3.61E-01	4.17E-02	2.63E-02	
3. Percent of technical specification limit	%	2.89E-06	5.73E-05	6.62E-06	4.17E-06	
B. Iodines						
1. Total iodine-131	Ci	5.42E-07	2.43E-05	9.09E-09	6.91E-07	2.20E+01
2. Average release rate for period	uCi/sec	6.88E-08	3.08E-06	1.26E-09	8.76E-08	
3. Percent of technical specification limit	%	1.50E-04	6.70E-03	2.74E-06	1.90E-04	
C. Particulates						
1. Particulates with half-lives > 8days	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	N/A
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of technical specification limit	%	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
4. Gross alpha radioactivity	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
D. Tritium						
1. Total release	Ci	2.03E+01	1.47E+01	2.52E+01	1.99E+01	1.50E+01
2. Average release rate for period	uCi/sec	2.58E+00	1.87E+00	3.20E+00	2.53E+00	
3. Percent of technical specification limit	%	3.02E-06	2.19E-06	3.74E-06	2.96E-06	

Notes: Isotopes for which no value is given were not identified in applicable releases.

TABLE 1B
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS - CONTINUOUS AND BATCH RELEASES
2017

Nuclides Released	Units	Continuous Mode				Batch Mode			
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
1. Fission Gases									
Argon-41	Ci		3.12E-01			3.92E-02	4.41E-02	8.36E-02	8.19E-02
Krypton-85	Ci								
Krypton-85m	Ci								
Krypton-87	Ci								
Krypton-88	Ci								
Xenon-131m	Ci								
Xenon-133	Ci		8.76E-01			3.24E-02	1.33E-01	8.08E-02	2.17E-02
Xenon-133m	Ci								
Xenon-135	Ci		5.75E-02				8.72E-04		
Xenon-135m	Ci								
Xenon-138	Ci								
Total for period	Ci		1.25E+00			7.16E-02	1.78E-01	1.64E-01	1.04E-01
2. Iodines									
Iodine-131	Ci		4.39E-06			2.71E-07	7.77E-06	4.95E-09	3.45E-07
Iodine-132	Ci								
Iodine-133	Ci		5.33E-08			1.42E-06	7.44E-06	2.59E-09	1.72E-06
Iodine-135	Ci						8.50E-07		
Total for period	Ci		4.44E-06			1.92E-08	1.61E-05	7.54E-09	2.07E-06

TABLE 1B (Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
GASEOUS EFFLUENTS - CONTINUOUS AND BATCH RELEASES
2017

Nuclides Released	Units	Continuous Mode				Batch Mode			
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
3. Particulates									
strontium-89	Ci								
strontium-90	Ci								
cesium-137	Ci								
cobalt-57	Ci								
cobalt-58	Ci								
cobalt-60	Ci								
Unidentified	Ci								
Total for period	Ci								
4. Tritium									
Hydrogen-3	Ci	1.01E+01	7.31E+00	1.25E+01	9.78E+00	1.81E-02	3.50E-02	1.04E-01	1.81E-01

Note: Isotopes for which no value is given were not identified in applicable releases.

TABLE 2A
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES
2017

Effluent Type	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Est. Total Error, %
A. Fission & Activation Products						
1. Total Release (not including tritium, gases, alpha)	Ci	0.00E+00	5.87E-03	7.74E-05	0.00E+00	2.80E+01
2. Average Diluted concentration	uCi/ml	0.00E+00	1.39E-11	1.51E-13	0.00E+00	
3. Percent of applicable limit	%	0.00E+00	1.39E-04	1.51E-06	0.00E+00	
B. Tritium						
1. Total Release	Ci	3.22E+02	1.53E+02	1.63E+01	5.09E+01	9.20E+00
2. Average Diluted Concentration	uCi/ml	7.17E-07	3.62E-07	3.17E-08	1.03E-07	
3. Percent of applicable limit	%	7.17E-03	3.62E-03	3.17E-04	1.03E-03	
C. Dissolved and Entrained Gases						
1. Total Release	Ci	2.22E-03	2.29E-04	0.00E+00	0.00E+00	2.80E+01
2. Average Diluted Concentration	uCi/ml	4.89E-12	5.43E-13	0.00E+00	0.00E+00	
3. Percent of applicable limit	%	2.45E-06	2.72E-07	0.00E+00	0.00E+00	
D. Gross Alpha Radioactivity						
1. Total release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
E. Vol. of Waste Released (prior to dilution)	Liters	1.33E+08	1.20E+08	1.32E+08	1.24E+08	
F. Vol. of Dilution Water Used During Period	Liters	4.53E+11	4.22E+11	5.13E+11	4.92E+11	

Note: Isotopes for which no value is given were not identified in applicable releases.

TABLE 2B
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS – CONTINUOUS AND BATCH RELEASES
2017

Nuclides Released	Units	Continuous Mode				Batch Mode			
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Fission & Activation Products									
Chromium-51	Ci								
Manganese-54	Ci								
Iron-55	Ci								
Iron-59	Ci								
Cobalt-57	Ci								
Cobalt-58	Ci						5.08E-03	7.44E-05	
Cobalt-60	Ci								
Zinc-65	Ci								
Strontium-89	Ci								
Strontium-90	Ci								
Niobium-95	Ci								
Molybdenum-99	Ci								
Zirconium-95	Ci								
Silver-110m	Ci								
Antimony-122	Ci								
Tellurium-123m	Ci						7.88E-04		
Antimony-124	Ci								
Antimony-125	Ci								
Iodine-131	Ci								
Iodine-132	Ci								
Tellurium-132	Ci						6.00E-06		
Iodine-135	Ci								
Cesium-134	Ci								
Cesium-136	Ci								
Cesium-137	Ci						2.15E-07		

TABLE 2B (Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
LIQUID EFFLUENTS – CONTINUOUS AND BATCH RELEASES
2017

Nuclides Released	Units	Continuous Mode				Batch Mode			
		1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Barium/Lanthanum-140	Ci								
Cerium-141	Ci								
Total (above)	Ci						5.87E-03	7.44E-05	
Unidentified (from total above)	Ci								
Tritium									
Hydrogen-3	Ci	2.22E-02	1.37E-02	0.00E+00	6.62E-02	3.22E+02	1.53E+02	1.63E+01	5.08E+01
Dissolved And Entrained Gases									
Xenon-133	Ci					2.22E-03	2.29E-04		
Xenon-135	Ci								

Note: Isotopes for which no value is given were not identified in applicable releases.

TABLE 3

EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

2017

A. SOLID WASTE SHIPPED OFFSITE FOR BURIAL OR DISPOSAL (Not Irradiated Fuel)

1. Type of Waste	Units	12 Month Period	Est. total Error (%)
A – Spent Resins, Filter Sludge, Evaporator Bottoms, Etc.	m^3	7.87E+00	2.5E+01
	Ci	8.50E+01	2.5E+01
B – Dry Active Waste (DAW), Contaminated Equipment, Etc.	m^3	2.70E+02	2.5E+01
	Ci	1.64E-01	2.5E+01
C – Irradiated Components, Control Rods, Etc.	m^3	None	N/A
	Ci		
D – Other: Sources, Filters	m^3	2.83E+00	2.5E+01
	Ci	5.74E+00	2.5E+01

Note: Estimated total error for solid waste shipped offsite not available.

TABLE 3 (Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
2017

2. Estimate of Major Nuclide Composition By Type of Waste					
Isotope	**Unit**	**Class A**	**Class B**	**Type C**	**Type D**
Co-58	%	2.53			
Co-60	%	26.45			
Cr-51	%	0.3			
Cs-137	%	3.51			
Fe-55	%	22.70			
Mn-54	%	5.12			
Nb-95	%	0.97			
Ni-63	%	30.96			
Sb-125	%	1.16			
Zr-95	%	0.46			
Cs-134	%	0.29			
Zn-65	%	0.18			
H-3	%	2.21			
C-14	%	1.87			
Total	%	98.7			

Note: Blank cells indicate nuclide composition not at significant levels.

TABLE 3 (Continued)
EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
SOLID WASTE AND IRRADIATED FUEL SHIPMENTS
2017

# of Shipments	Mode of Transportation	Type of Container	Solidification Agent	Processing Destination
4	Sole Use Truck	Metal Containers	None	Energy Solutions, BC
1	Sole Use Truck	Metal Containers	None	Energy Solutions, (Bulk Waste Facility)
2	Sole Use Truck	High Integrity Containers (HICs)	None	Energy Solutions, (Bulk Waste Facility)
2	Sole Use Truck	High Integrity Containers (HICs)	None	ALARON Corporation

B. IRRADIATED FUEL SHIPMENTS (Disposition)

# of Shipments	Mode of Transportation	Destination
None	N/A	N/A

TABLE 4A

Radiation Dose to Maximum Individual Receptor from Gaseous Effluents

First Quarter 2017

(Units In milliRem)

	All Gamma Air	All Beta Air	Adult THYRD	Teen THYRD	Child THYRD	Infant THYRD
N	1.02E-06	4.40E-07	1.64E-04	1.80E-04	2.47E-04	1.08E-04
NNE	8.56E-07	3.69E-07	1.38E-04	1.50E-04	2.07E-04	9.06E-05
NE	9.86E-07	4.25E-07	1.59E-04	1.73E-04	2.39E-04	1.04E-04
ENE	1.25E-06	5.40E-07	2.02E-04	2.20E-04	3.04E-04	1.33E-04
E	2.28E-06	9.83E-07	3.67E-04	4.01E-04	5.53E-04	2.41E-04
ESE	2.90E-06	1.25E-06	4.67E-04	5.10E-04	7.03E-04	3.07E-04
SE	1.75E-06	7.56E-07	2.83E-04	3.09E-04	4.25E-04	1.86E-04
SSE	7.22E-07	3.11E-07	1.16E-04	1.27E-04	1.75E-04	7.64E-05
S	1.26E-06	5.45E-07	2.04E-04	2.22E-04	3.07E-04	1.34E-04
SSW	1.26E-06	5.45E-07	2.04E-04	2.22E-04	3.07E-04	1.34E-04
SW	1.26E-06	5.45E-07	2.04E-04	2.22E-04	3.07E-04	1.34E-04
WSW	1.35E-06	5.81E-07	2.17E-04	2.37E-04	3.27E-04	1.43E-04
W	8.58E-07	3.70E-07	1.38E-04	1.51E-04	2.08E-04	9.09E-05
WNW	7.25E-08	3.13E-08	1.17E-05	1.28E-05	1.76E-05	7.67E-06
NW	2.38E-07	1.03E-07	3.83E-05	4.18E-05	5.76E-05	2.52E-05
NNW	7.42E-07	3.20E-07	1.20E-04	1.31E-04	1.80E-04	7.89E-05
MAX.	2.90E-06	1.25E-06	4.67E-04	5.10E-04	7.03E-04	3.07E-04

Note: Shaded regions indicate areas over Lake Ontario.

TABLE 4A (Continued)
Radiation Dose to Maximum Individual Receptor from Gaseous Effluents
Second Quarter 2017
(Units In milliRem)

	All Gamma Air	All Beta Air	Adult THYRD	Teen THYRD	Child THYRD	Infant THYRD
N	1.03E-05	6.62E-06	1.71E-03	1.87E-03	2.57E-03	1.12E-03
NNE	8.67E-06	5.55E-06	1.43E-03	1.56E-03	2.16E-03	9.41E-04
NE	1.00E-05	6.39E-06	1.65E-03	1.80E-03	2.49E-03	1.08E-03
ENE	1.27E-05	8.12E-06	2.10E-03	2.29E-03	3.16E-03	1.38E-03
E	2.31E-05	1.48E-05	3.81E-03	4.17E-03	5.75E-03	2.51E-03
ESE	2.94E-05	1.88E-05	4.85E-03	5.30E-03	7.31E-03	3.19E-03
SE	1.78E-05	1.14E-05	2.93E-03	3.21E-03	4.42E-03	1.93E-03
SSE	7.32E-06	4.68E-06	1.21E-03	1.32E-03	1.82E-03	7.94E-04
S	1.28E-05	8.20E-06	2.11E-03	2.31E-03	3.19E-03	1.39E-03
SSW	1.28E-05	8.20E-06	2.11E-03	2.31E-03	3.19E-03	1.39E-03
SW	1.28E-05	8.20E-06	2.11E-03	2.31E-03	3.19E-03	1.39E-03
WSW	1.37E-05	8.74E-06	2.26E-03	2.46E-03	3.40E-03	1.48E-03
W	8.70E-06	5.56E-06	1.44E-03	1.57E-03	2.16E-03	9.44E-04
WNW	7.35E-07	4.70E-07	1.21E-04	1.33E-04	1.83E-04	7.98E-05
NW	2.41E-06	1.54E-06	3.98E-04	4.35E-04	5.99E-04	2.62E-04
NNW	7.53E-06	4.81E-06	1.24E-03	1.36E-03	1.87E-03	8.17E-04
MAX.	2.95E-05	1.88E-05	4.88E-03	5.30E-03	7.31E-03	3.19E-03

Note: Shaded regions indicate areas over Lake Ontario.

TABLE 4A (Continued)
Radiation Dose to Maximum Individual Receptor from Gaseous Effluents
Third Quarter 2017
(Units In milliRem)

	All Gamma Air	All Beta Air	Adult THYRD	Teen THYRD	Child THYRD	Infant THYRD
N	2.19E-06	9.75E-07	1.58E-04	1.73E-04	2.39E-04	1.04E-04
NNE	1.83E-06	8.17E-07	1.33E-04	1.45E-04	2.00E-04	8.73E-05
NE	2.11E-06	9.42E-07	1.53E-04	1.67E-04	2.31E-04	1.01E-04
ENE	2.68E-06	1.20E-06	1.94E-04	2.12E-04	2.93E-04	1.28E-04
E	4.88E-06	2.18E-06	3.54E-04	3.86E-04	5.33E-04	2.33E-04
ESE	6.21E-06	2.77E-06	4.50E-04	4.91E-04	6.78E-04	2.96E-04
SE	3.76E-06	1.68E-06	2.72E-04	2.97E-04	4.10E-04	1.79E-04
SSE	1.55E-06	6.90E-07	1.12E-04	1.22E-04	1.69E-04	7.37E-05
S	2.71E-06	1.21E-06	1.96E-04	2.14E-04	2.96E-04	1.29E-04
SSW	2.71E-06	1.21E-06	1.96E-04	2.14E-04	2.96E-04	1.29E-04
SW	2.71E-06	1.21E-06	1.96E-04	2.14E-04	2.96E-04	1.29E-04
WSW	2.89E-06	1.29E-06	2.09E-04	2.28E-04	3.15E-04	1.38E-04
W	1.84E-06	8.20E-07	1.33E-04	1.45E-04	2.01E-04	8.76E-05
WNW	1.55E-07	6.93E-08	1.13E-05	1.23E-05	1.70E-05	7.40E-06
NW	5.09E-07	2.27E-07	3.69E-05	4.03E-05	5.56E-05	2.43E-05
NNW	1.59E-06	7.09E-07	1.15E-04	1.26E-04	1.74E-04	7.58E-05
MAX.	6.21E-06	2.77E-06	4.50E-04	4.91E-04	6.78E-04	2.96E-04

Note: Shaded regions indicate areas over Lake Ontario.

TABLE 4A (Continued)
Radiation Dose to Maximum Individual Receptor from Gaseous Effluents
Fourth Quarter 2017
(Units In milliRem)

	All Gamma Air	All Beta Air	Adult THYRD	Teen THYRD	Child THYRD	Infant THYRD
N	2.09E-06	7.92E-07	1.72E-04	1.88E-04	2.59E-04	1.13E-04
NNE	1.75E-06	6.64E-07	1.44E-04	1.58E-04	2.17E-04	9.50E-05
NE	2.02E-06	7.65E-07	1.66E-04	1.82E-04	2.51E-04	1.09E-04
ENE	2.56E-06	9.72E-07	2.11E-04	2.31E-04	3.18E-04	1.39E-04
E	4.66E-06	1.77E-06	3.84E-04	4.21E-04	5.79E-04	2.53E-04
ESE	5.93E-06	2.25E-06	4.89E-04	5.35E-04	7.37E-04	3.22E-04
SE	3.59E-06	1.36E-06	2.96E-04	3.24E-04	4.46E-04	1.95E-04
SSE	1.48E-06	5.60E-07	1.22E-04	1.33E-04	1.84E-04	8.02E-05
S	2.59E-06	9.81E-07	2.13E-04	2.33E-04	3.21E-04	1.40E-04
SSW	2.59E-06	9.81E-07	2.13E-04	2.33E-04	3.21E-04	1.40E-04
SW	2.59E-06	9.81E-07	2.13E-04	2.33E-04	3.21E-04	1.40E-04
WSW	2.76E-06	1.05E-06	2.27E-04	2.49E-04	3.43E-04	1.50E-04
W	1.76E-06	6.66E-07	1.45E-04	1.58E-04	2.18E-04	9.53E-05
WNW	1.48E-07	5.63E-08	1.22E-05	1.34E-05	1.84E-05	8.05E-06
NW	4.86E-07	1.85E-07	4.01E-05	4.39E-05	6.04E-05	2.64E-05
NNW	1.52E-06	5.76E-07	1.25E-04	1.37E-04	1.89E-04	8.24E-05
MAX.	5.93E-06	2.25E-06	4.89E-04	5.35E-04	7.37E-04	3.22E-04

Note: Shaded regions indicate areas over Lake Ontario.

TABLE 4B
Radiation Dose To Maximum Individual Receptor
From Liquid Effluents for 2017
(Units in milliRem)

	Adult	Teen	Child	Infant
First Quarter				
T. Body	1.41E-03	8.83E-04	8.76E-04	2.45E-04
GI-LLI	1.41E-03	8.83E-04	8.76E-04	2.45E-04
Thyroid	1.41E-03	8.83E-04	8.76E-04	2.45E-04
Second Quarter				
T. Body	6.51E-03	4.08E-05	4.04E-05	1.13E-05
GI-LLI	9.26E-03	5.80E-05	5.75E-05	1.61E-05
Thyroid	6.29E-03	3.94E-05	3.91E-05	1.09E-05
Third Quarter				
T. Body	5.71E-05	3.57E-05	3.54E-05	9.94E-06
GI-LLI	5.87E-05	3.68E-04	3.64E-04	1.02E-05
Thyroid	5.69E-05	3.56E-04	3.53E-04	9.90E-06
Fourth Quarter				
T. Body	2.11E-04	1.32E-04	1.31E-04	3.67E-05
GI-LLI	2.11E-04	1.32E-04	1.31E-04	3.67E-05
Thyroid	2.11E-04	1.32E-04	1.31E-04	3.67E-05

TABLE 5
Groundwater Monitoring Wells

Location	Sample Date	Tritium (uCi/ml)
GW01: Warehouse Access Road (Control)	3/23/2017	< 383
	6/15/2017	< 490
	9/27/2017	< 457
	12/19/2017	< 443
GW03: Screenhouse West, South Well	1/27/2017	< 477
	2/24/2017	< 402
	3/23/2017	< 376
	4/23/2017	< 362
	5/26/2017	< 364
	6/15/2017	< 496
	7/20/2017	< 430
	8/20/2017	< 373
	9/27/2017	< 451
	10/26/2017	< 444
	11/30/2017	< 389
	12/19/2017	< 453
GW04: Screenhouse West, North Well	3/23/2017	< 378
	6/15/2017	< 486
	9/27/2017	< 449
	12/19/2017	< 444
GW05: Screenhouse East, South (15.5')	3/23/2017	< 420
	6/15/2017	< 496
	9/27/2017	< 449
	12/19/2017	< 444

GW06: Screenhouse East, Middle (20.0')	3/23/2017	< 453
	6/15/2017	< 493
	9/27/2017	< 441
	12/19/2017	< 441
GW07: Screenhouse East, North (24.0')	3/23/2017	< 419
	6/15/2017	< 490
	9/27/2017	< 439
	12/19/2017	< 448
GW08: All Volatiles Treatment Building	1/27/2017	< 476
	2/24/2017	< 401
	3/23/2017	< 376
	4/23/2017	< 362
	5/26/2017	< 366
	6/15/2017	< 456
	7/20/2017	< 427
	8/20/2017	< 370
	9/27/2017	< 453
	10/26/2017	< 446
	11/30/2017	< 390
	12/19/2017	< 443
GW10: Technical Support Center, South	3/23/2017	< 373
	6/15/2017	< 494
	9/27/2017	< 449
	12/19/2017	< 390
GW11: Southeast of Contaminated Service Building (CSB)	3/23/2017	< 370
	6/15/2017	< 458
	9/27/2017	< 450
	12/20/2017	< 441

GW12: West of Orchard Access Road	3/23/2017	< 371
	6/15/2017	< 460
	9/27/2017	< 442
	12/19/2017	< 444
GW13: North of (ISFSI)	3/23/2017	< 373
	6/15/2017	< 491
	9/27/2017	< 443
	12/19/2017	< 441
GW14: South of Canister Preparation Building	3/23/2017	< 379
	6/15/2017	< 496
	9/27/2017	< 444
	12/19/2017	< 445
GW15: West of Manor House	3/23/2017	< 369
	6/15/2017	< 494
	9/27/2017	< 441
	12/19/2017	< 442
GW16: Southeast of Manor House	3/23/2017	< 372
	6/15/2017	< 491
	9/27/2017	< 443
	12/19/2017	< 441

LLD conservatively established at 500 pCi/L

TABLE 6
Offsite Dose Due to Carbon-14 in Gaseous and Liquid Effluents

MAXIMUM DOSE VALUES DUE TO C-14 IN GASEOUS EFFLUENTS IN 2017		
Organ	**Age Group**	**mRem/yr**
NRC Reg. Guide 1.109, Annual Bone Dose	Child	1.94E-02
NRC Reg. Guide 1.109, Annual Total Body/Organ Dose	Child	3.86E-03

MAXIMUM DOSE VALUES DUE TO C-14 IN LIQUID EFFLUENTS IN 2017		
Organ	**Age**	**mRem/yr**
NRC Reg. Guide 1.109, Annual Bone Dose	Child	2.30E-04
NRC Reg. Guide 1.109, Annual Total Body/Organ Dose	Child	4.60E-05