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April 23, 2020

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United States Nuclear Regulatory Commission
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Washington, DC 20555-0001

Byron Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Subject: 2019 Annual Radioactive Effluent Release Report

Enclosed is the Annual Radioactive Effluent Release Report for Byron Station. This report is being submitted in accordance with 10 CFR 50.36 a(2), "Technical specifications on effluents from nuclear power reactors," and includes a summary of radiological liquid and gaseous effluents and solid waste released from the site from January 2019 through December 2019. We are enclosing Revision 15 of the Byron Station Offsite Dose Calculation Manual (ODCM), the ODCM Change Determination and the ODCM Change Log in accordance with ODCM Section 5.4.1.

If you have any questions regarding this information, please contact Ms. Zoe Cox, Regulatory Assurance Manager, at (815) 406-2800.

Respectfully,

Mark E. Kanavos
Site Vice President
Byron Nuclear Generating Station

MEK/AH/ZC/rm

Enclosures

cc: Darrell J. Roberts, Regional Administrator – NRC Region III

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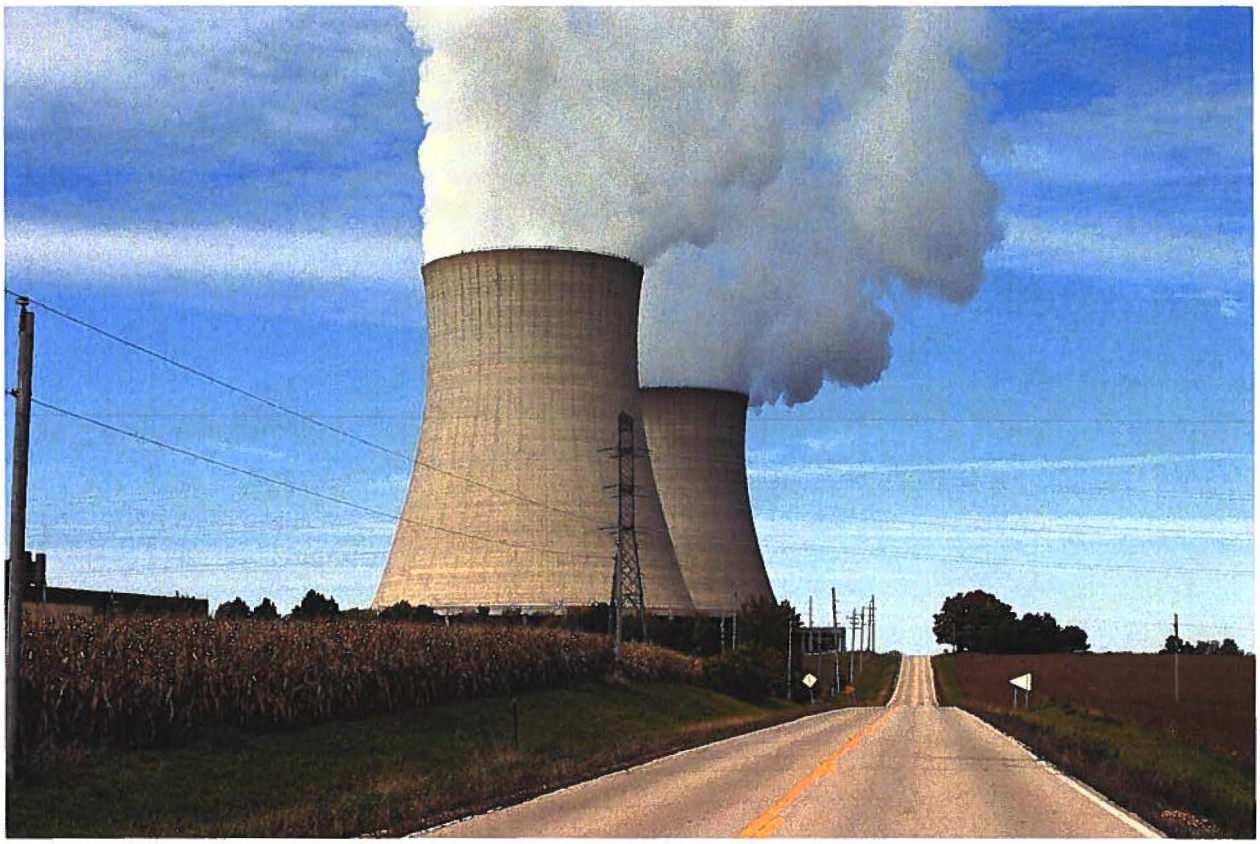
BYRON NUCLEAR POWER STATION

ANNUAL RADIOLOGICAL EFFLUENT RELEASE REPORT (ARERR)

2019



INTRODUCTION

Liquid effluents from Byron Station are released to the Rock River in controlled batches after radioassay of each batch. Gaseous effluents are released to the atmosphere and are calculated on the basis of analyses of weekly grab samples and grab samples of batch releases prior to the release of noble gases as well as continuously collected composite samples of iodine and particulate radioactivity sampled during the course of the year. The results of effluent analyses are summarized on a monthly basis. Airborne concentrations of noble gases, I-131, and particulate radioactivity in offsite areas are calculated using isotopic composition of effluents and meteorological data. C-14 concentration in offsite areas is calculated based on industry-approved methodology for estimation of the amount released and meteorological data.

Environmental monitoring is conducted by sampling at indicator and control (background) locations in the vicinity of Byron Station to measure changes in radiation or radioactivity levels that may be attributable to station operation. If significant changes attributable to Byron Station are measured, these changes are correlated with effluent releases. An environmental monitoring program is conducted which also includes all potential pathways at the site. Gaseous pathways include ground plane (direct), inhalation, vegetation, meat, and milk. Liquid pathways include potable water and freshwater fish. The critical pathway for 2019 gaseous dose was vegetation. The critical pathway for 2019 liquid dose was freshwater fish.

BYRON NUCLEAR POWER STATION
UNIT 1/2 DOCKET NUMBER STN-50-454/455
RADIOACTIVE EFFLUENT RELEASE REPORT
January 2019 - December 2019
Supplemental Information

1. Regulatory Limits

   a. Fission and activation products:

Tech Spec Whole Body	=	500 mrem/year
Skin	=	3000 mrem/year
10CFR50 Gamma	=	5 mrad/quarter; 10 mrad/year
Beta	=	10 mrad/quarter; 20 mrad/year

   b. Iodine: (summed with particulate, see below)

   c. Particulates with half-lives > 8 days:

Tech Spec Organ	=	1500 mrem/year
10CFR50 Organ	=	7.5 mrem/quarter; 15 mrem/year

   d. Liquid Effluents:

10CFR50 Whole Body	=	1.5 mrem/quarter; 3 mrem/year
Organ	=	5 mrem/quarter; 10 mrem/year

2. Maximum Permissible Concentration

   a. Fission and Activation Products: 10CFR20 Appendix B Table 2
   b. Iodine: 10CFR20 Appendix B Table 2
   c. Particulates: 10CFR20 Appendix B Table 2
   d. Liquid Effluents: 10 X 10CFR20 Appendix B Table 2

3. Average Energy: This item is not applicable. The ODCM limits the dose equivalent rates due to the release of noble gases to less than or equal to 500 mrem/year to the total body and less than or equal to 3000 mrem/year to the skin.

4. Measurements and Approximations of Total Radioactivity

   a. Fission and activation products: Prior to release, the isotopic content is determined. Released activity is calculated using volume of release, which is determined by the change in tank level, containment pressure, or containment purge fan flow rates.

   b. Particulate and iodine sampling media for the plant vent stacks are continuously collected and analyzed weekly. Tritium and noble gas analysis for the plant vent stacks are obtained and analyzed weekly.

c. Liquid effluents: Isotopic analysis is performed on each batch liquid release tank prior to its release. Total release activity is calculated using volume of release. Total tritium activity released is calculated from the highest of a monthly circulating water blowdown composite activity or a sum of the effluent input composite activities.

d. All positive results (i.e. higher than the lower limit of detection (LLD)) are reported in units of uCi/cc or uCi/ml unless otherwise noted. All LLD values and the associated LLD requirements are listed in Attachment A.

5. Batch Releases:

a. Liquid:

1. Number of batch releases = 71
2. Total time period for batch releases = 11,777 minutes
3. Maximum time period for a batch release = 595 minutes
4. Average time period for a batch release = 166 minutes
5. Minimum time period for a batch release = 31 minutes
6. Average Rock River stream flow during periods of release of effluent into a flowing stream =317 m^3/sec, based on information from the U.S. Geological Survey Byron Gauging Station.

b. Gaseous:

1. Number of batch releases = 384
2. Total time period for batch releases = 43,300 minutes
3. Maximum time period for a batch release = 2072 minutes
4. Average time period for batch releases = 113 minutes
5. Minimum time period for a batch release = 10 minutes

6. Abnormal Releases:

a. Liquid - None

b. Gaseous – None

7. There was one revision to the Offsite Dose Calculation Manual (ODCM), which was implemented in February 2019 under Revision 15. The revision included administrative changes, an update to the SGBD figure to show the flow path to CP, an update to figures to reflect the Bypass of U1/U2 SJAE offgas filter units, and a FSAR footnote update.

The SGBD Overboard modification, documented in EC #624333 installed piping to allow SGBD water at a total flow rate of up to 100 gpm to bypass the SGBD demineralizers and be routed directly to the CP trench to extend the life of the SGBD demineralizers, allow overall reduction in SGBD flow, and recover thermal output. The EC increases the amount of water being discharged, which normally contains tritium. However, the amount of tritium present in secondary process water when discharged is negligible compared to the amount of tritium being discharged via liquid release tanks. Therefore, this modification has no impact to effluent release concentrations or offsite dose calculations.

The Bypass of the U1/U2 SJAE offgas filter units are documented under EC's #402667/402668. The EC's removed the existing actuators from 1/2OG035, Unit 1/2 Off Gas (OG) System Vent Stack Isolation Valve(s), and installed a block to restrain the valve in the open position. Originally, the system was designed to route flow through the charcoal filter unit OG01S upon sensing radiation in the steam jet air ejector (SJAE) exhaust. However, the filter unit was isolated early on in plant operation due to problems with wetting the charcoal. That left the flow path through 1/2OG035 as the

only vent path for the exhaust of the vacuum hogging pumps and SJAEs. As such, 1/2OG035 represented a significant single point vulnerability (SPV) in that it would cause a loss of condenser vacuum potentially leading to a reduction in reactor power if it were to spuriously close. Removal of the actuator and installation of a block ensured that the valve remains in the open position at all times, but the ability to filter radioiodines in the event of a high rad alarm has been eliminated. Engineering calcs associated with these modifications concluded that the permanent bypass of the filter units does not result in a significant increase in radioactive materials or dose to the public. ODCM figures were updated to reflect the new plant configuration in previous ODCM revisions, however, ODCM Section 1.24 Ventilation Exhaust Treatment System definition was not updated to include the words "as required" as recommended in EC 402667, when describing that vent exhaust gases pass through charcoal absorbers.

Per the ODCM, major changes to Liquid and Gaseous Radwaste Treatment Systems are required to be reported to the NRC in the Annual Radioactive Effluent Release Report. The ODCM contains a footnote that states "Licensees may choose to submit the information called for in this standard as part of the annual FSAR update." Station FSAR updates are now being performed biannually, so the footnote is being revised to reflect the biannual FSAR updates.

8. Errata Data

There was no errata data to report for 2019.

9. 2019 Radiological Groundwater Protection Program (RGPP) Results Summary:

In 2019, seventeen (17) Radiological Groundwater Protection Program (RGPP) monitoring wells were sampled in total. Groundwater samples were obtained in March, May, August, and November and analyzed for tritium. In addition, a study of gamma, gross beta, and gross alpha radioisotopes was performed in accordance with Nuclear Energy Institute (NEI) 07-07, Groundwater Protection Initiative, for the samples obtained in May. None of these May samples showed concentrations of radionuclides above what is considered background levels. Three wells contained levels of tritium above the lower limit of detection (LLD) of 200 pCi/L. They were: AR-4 (201 pCi/L in March, 298 pCi/L in May, 272 pCi/L in August, <200 pCi/L in November) and AR-11 (520 pCi/L in March, 611 pCi/L in May, 549 pCi/L in August, 566 pCi/L in November) and AR-7 (246 pCi/L in March, 231 pCi/L in May, 280 pCi/L in August, <200 pCi/L in October). Wells AR-4 and AR-11 are near the Circulating Water Blowdown piping, where historical leakage through vacuum breakers was known to have occurred. Tritium in Well AR-7, located on-site just west of plant structures, has been measured in this well slightly above detection limits on an intermittent basis since the well was first drilled in 2006. The tritium present in this well is likely due to legacy tritium prior to 2006 or precipitation recapture and is not believed to be the result of new leaks. The tritium measured in this well has been at or below tritium levels that have been historically measured in rainwater as a result of precipitation recapture from permitted gaseous releases. In August 2014, a break in the well piping was discovered about six feet below the surface that could have served as the entry point for tritium in the recapture water. Tritium present in well AR-7 has shown a gradual decrease since 2014 and was less than detectable in the most recent November 2019 sample. Should any of the water in these aquifers migrate to off-site wells used for drinking, the off-site dose consequence from tritium present in this water would be negligible. There are no existing or new leaks evident at the site and all groundwater well sample results are well below the drinking water standard of 20,000 pCi/L tritium.

In December 2018, two new wells, AR-12 and AR-13, were installed near well AR-7. These wells were added to provide additional monitoring capabilities in the area directly west of plant structures. No tritium was detected in these wells during 2019.

SUMMARY

Calculations based on gaseous and liquid effluents and meteorological data indicate that public dose due to radioactive material attributable to Byron Station during the period does not exceed regulatory or Offsite Dose Calculation Manual (ODCM) limits.

The Total Effective Dose Equivalent (TEDE) due to licensed activities at Byron Station calculated for the maximum exposed individual for the period is 2.54E-01 mrem. The annual limit on TEDE is 100 mrem.

The assessment of radiation doses to the public is performed in accordance with the ODCM. The results of these analyses confirm that the station is operating in compliance with 10CFR50 Appendix I, 10CFR20 and 40CFR190.

There were no additional operational controls implemented which affected the areas of radiological effluents in 2019.

There were no measurements which exceeded the reporting levels, including any which would not have been attributable to station effluents.

The results of the current radiological environmental monitoring program are approximately the same as those found during the pre-operational studies conducted at Byron Station.

EFFLUENTS

Gaseous Effluents to the Atmosphere

Measured concentrations and isotopic composition of noble gases, radioiodine, tritium and particulate radioactivity released to the atmosphere during the year are listed in Table 1.1-1.

A total of 6.62E-1 curies of fission and activation gases were released with a maximum average quarterly release rate of 2.41E-2 µCi/sec.

A total of 1.06E-6 curies of I-131 were released during the year with a maximum average quarterly release rate of 1.35E-07 µCi/sec.

A total of 0.00E+00 curies were released as airborne particulate matter with a maximum average quarterly release rate of 0.00E+00 µCi/sec.

A total of 8.53E+00 curies of other (C-14) radioisotopes were released with a maximum average quarterly release rate of 2.82E-1 µCi/sec.

A total of 51.7 curies of tritium were released with a maximum average quarterly release rate of

2.69E+00 µCi/sec.

Gross alpha-emitting radionuclides were below detectable limits.

Liquids Released to Rock River

A total of 3.00E+10 liters of radioactive liquid wastes containing 1.17E-02 curies of fission and activation products were discharged with a maximum quarterly average concentration of 1.37E-13 µCi/ml.

A total of 2.12E+03 curies of tritium were discharged with a maximum quarterly average concentration of 1.99E-05 uCi/ml.

A total of 1.28E-4 curies of dissolved and entrained gases were discharged with a maximum quarterly average concentration of 2.16E-15 uCi/ml.

Gross alpha-emitting radionuclides were below detectable limits.

Quarterly release totals of principal radionuclides in liquid effluents are given in Table 1.2-1.

SOLID RADIOACTIVE WASTE

Solid radioactive wastes were shipped by truck. For detail, refer to Byron Station 2019 ARERR

DOSE TO MAN

Gaseous Effluent Pathways

Table 3.2-1 summarizes the doses resulting from releases of airborne radioactivity via the different exposure pathways.

Noble Gases

Gamma Dose Rates

Offsite Gamma air and whole body dose rates are shown in Table 3.2-1 and were calculated based on measured release rates, isotopic composition of the noble gases, and average meteorological data for the period. Dose rates based on concurrent meteorological data are shown in Table 3.4-1. Based on measured effluents and average meteorological data, the maximum gamma air dose was 1.85E-4 mrad based on measured effluents and average meteorological data, and 2.68E-5 mrad based on measured effluents and concurrent meteorological data. (Table 3.4-1).

Beta Air and Skin Dose Rates

The range of beta particles in air is relatively small (on the order of a few meters or less); consequently, plumes of gaseous effluents may be considered "semi-infinite" for purpose of calculating the dose from beta radiation incident on the skin. However, the actual dose to sensitive skin tissues is difficult to calculate due to the effect of the beta particle energies, thickness of inert skin and clothing covering sensitive tissues. For purposes of this report the skin is taken to have a thickness of 7.0 mg/cm^2 and an occupancy factor of 1.0 is used. The skin dose based on measured effluents and average meteorological data was 1.122E-4 mrem, and 2.92E-5 mrem based on measured effluents and

concurrent meteorological data.

The maximum offsite beta air dose for the year based on measured effluents and average meteorological data was 2.05E-05 mrad. The beta air dose based on measured effluents and concurrent meteorological data was 1.21E-05 mrad.

Radioactive Iodine & Particulate

The human thyroid exhibits a significant capacity to concentrate ingested or inhaled iodine. I-131 released during routine operation of the station may be made available to man resulting in a dose to the thyroid. C-14 is also included in this category. C-14 exhibits a capacity to concentrate in bone. C-14 is released in gaseous form and is absorbed into vegetation through photosynthesis. The principal pathways of interest for C-14 are the consumption of vegetation by humans and milk from which animals have ingested C-14 through the consumption of vegetation. With the addition of C-14 to plant effluents, human dose in this category is primarily driven by the release of C-14 from the plant.

The hypothetical dose to the maximum exposed individual living near the station via ingestion of milk and vegetation was calculated. The source of milk and vegetation was assumed to be at the nearest site boundary with the cows pastured and vegetation grown from May through October. The maximum dose from radioactive iodine and particulate (including C-14) to any organ was 6.95E-01 mrem (child/bone) based on measured effluents and average meteorological data and 5.39-01 mrem based on measured effluents and concurrent meteorological data. The maximum dose from radioactive iodine and particulate (including C-14) to the whole body was 1.42E-01 mrem (child) based on measured effluents and average meteorological data and 1.10E-01 mrem based on measured effluents and concurrent meteorological data.

Gaseous Total Dose

The maximum total dose from gaseous releases to any organ was 6.95E-01 mrem (child/bone) based on measured effluents and average meteorological data, and 5.39E-01 mrem (child/bone) based on measured effluents and concurrent meteorological data. The maximum total dose from gaseous releases to the whole body was 1.42E-01 mrem (child) based on measured effluents and average meteorological data, and 1.10E-01 mrem (child) based on measured effluents and concurrent meteorological data.

Liquid Effluent Pathways

The principal pathways through the aquatic environment for potential doses to man from liquid waste are ingestion of potable water and eating aquatic foods. Liquid dose was calculated based on the ingestion of potable water and sport fish. It should be noted, however, there were no communities within 10 km downstream of the plant using the Rock River for drinking water. NRC-developed equations were used to calculate the doses to the whole body, bone, liver, thyroid, kidney, lung, lower GI tract, and skin. Specific parameters for use in the equations are given in the Exelon Offsite Dose Calculation Manual (ODCM). The maximum dose from liquid releases to any organ was 1.45E-01 mrem (adult/gilli). The maximum dose from liquid releases to the whole body was 1.34E-01 mrem (adult).

Total Dose

The maximum total dose to any organ via both gaseous and liquid effluents to any organ is 7.29E-01 mrem (child/bone). The maximum dose to the whole body via both gaseous and liquid effluents is 2.54E-01 mrem (child).

Assessment of Dose to Member of Public

Byron Station did not exceed any of the dose limits as shown below based on concurrent or historical meteorological data.

- The RETS limits on dose or dose commitment to a member of the public due to radioactive materials in liquid effluents from each reactor is 1.5 mrem to the whole body or 5 mrem to any organ during any calendar quarter and 3 mrem to the whole body or 10 mrem to any organ during a calendar year.

- The RETS limits on air dose in noble gases released in gaseous effluents to a member of the public from each reactor is 5 mrad for gamma radiation or 10 mrad for beta radiation during any calendar quarter and 10 mrad for gamma radiation or 20 mrad for beta radiation during a calendar year.

- The RETS limits on dose to a member of the public due to radioactive iodine & particulate with half-lives greater than eight days in gaseous effluents released from each reactor is 7.5 mrem to any organ during any calendar quarter and 15 mrem during a calendar year.

- The 10CFR20 limit on Total Effective Dose Equivalent to individual members of the public is 100 mrem during a calendar year.

- The 40CFR190 limits on individual members of the public is 25 mrem to the whole body, 25 mrem to any organ (except thyroid), and 75 mrem to the thyroid.

SITE METEOROLOGY

Detailed records of the site meteorological measurements taken during each calendar quarter of the year are maintained by the meteorological vendor, retained on site, and are available upon request. The data are presented as cumulative joint frequency distributions of the wind direction for the 250' level and wind speed class by atmospheric stability class determined from the temperature difference between the 250' and 30' levels. Data recovery for all measurements on the meteorological tower was 99.8% during 2019.

SOLID RADIOACTIVE WASTE FOR BURIAL 1ST QUARTER 2019

DATE Shipment # Description	DISPOSITION OF MATERIAL (DESCRIPTION, CLASS, TYPE AND SOLIDIFYING AGENT)	MODE OF TRANSPORT/ CARRIER	DESTINATION	VOLUME (m^3) PER SHIPMENT	CURIES* PER SHIPMENT
1/2/19 RWS 19-001 Bead Resin	UN3321, RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), 7, FISSILE EXCEPTED, METAL CASK(1), CLASS A, NONE	Highway Hittman Transport EXCLUSIVE-USE	Energy Solutions Clive, UT	4.96E+00	2.62E+00
Quarterly Totals		Number of Shipments:	1	4.96E+00	2.62E+00
*Calculated using measured ratios				CUBIC M	CURIES

SOLID RADIOACTIVE WASTE FOR BURIAL 2ND QUARTER 2019

DATE Shipment # Description	DISPOSITION OF MATERIAL (DESCRIPTION, CLASS, TYPE AND SOLIDIFYING AGENT)	MODE OF TRANSPORT/ CARRIER	DESTINATION	VOLUME (m^3) PER SHIPMENT	CURIES* PER SHIPMENT
6/12/19 RWS 19-02 DAW/Resin	UN2912, RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-I), 7,METAL BOX(1), CLASS A, NONE	Highway Hittman Transport EXCLUSIVE-USE	Bear Creek Oak Ridge, TN	6.09E+01	3.50E-2
Quarterly Totals		Number of Shipments:	1	6.09E+01	3.50E-02
* Calculated using measured ratios				CUBIC M	CURIES

SOLID RADIOACTIVE WASTE FOR BURIAL 3RD QUARTER 2019

DATE Shipment # Description	DISPOSITION OF MATERIAL (DESCRIPTION, CLASS, TYPE AND SOLIDIFYING AGENT)	MODE OF TRANSPORT/ CARRIER	DESTINATION	VOLUME (m^3) PER SHIPMENT	CURIES* PER SHIPMENT
7/15/2019 RWS 19-03 DAW	UN3321, RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), 7, METAL BOX(1), CLASS A, NONE	Highway Hittman Transport EXCLUSIVE-USE	Bear Creek Oak Ridge, TN	3.16E+01	8.52E-02
8/15/2019 SR-2256-0015 Bead Resin	UN2916, Radioactive material, Type B(U) package, 7 RQ-Radionuclides, (1) Robatel RT-100 Cask	Highway Visionary Solutions	Waste Control Specialist LLC Andrews, TX	3.11E+00	1.18E+02
Quarterly Totals		Number of Shipments:	2	3.47E+01	1.18E+02
* Calculated using measured ratios				CUBIC M	CURIES

SOLID RADIOACTIVE WASTE FOR BURIAL 4TH QUARTER 2019

DATE Shipment # Description	DISPOSITION OF MATERIAL (DESCRIPTION, CLASS, TYPE AND SOLIDIFYING AGENT)	MODE OF TRANSPORT/ CARRIER	DESTINATION	VOLUME(m^3) PER SHIPMENT	CURIES* PER SHIPMENT
10/28/2019 RWS 19-05 Bead Resin	UN3321, RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), 7, METAL CASK(1), CLASS A, NONE	Highway Hittman Transport EXCLUSIVE-USE	Energy Solutions Clive, UT	4.53E+00	5.59E+00
10/31/2019 RWS 19-08 DAW/Trash	UN3321, RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), 7, METAL BOX(1), CLASS A, NONE	Highway Hittman Transport EXCLUSIVE-USE	Bear Creek Oak Ridge, TN	3.13E+01	1.01E-01

11/04/2019 RWS 19-06 Bead Resin	UN3321, RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), 7, 20' METAL CASK(1), CLASS A, NONE	Highway Hittman Transport EXCLUSIVE-USE	Energy Solutions Clive, UT	4.67E+00	5.56E+00
11/12/2019 RWS 19-07 Charcoal/Bed Resin	UN3321, RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA-II), 7, METAL CASK(1), CLASS A, NONE	Highway Hittman Transport EXCLUSIVE-USE	Energy Solutions Clive, UT	4.33e+00	3.99e+00
Quarterly Totals		Number of Shipments:	4	4.48E+01	1.52E+01
* Calculated using measured ratios				CUBIC M	CURIES

SOLID RADIOACTIVE WASTE FOR BURIAL
Estimated Solid Waste Composition
2019

Resins, Filters, Evap Bottoms			
2019			
Volume (m3) 1.85E+01			
Class A			
Nuclide	% Abund	Curies	uCi/ml
H-3	59.14	1.05E+01	5.68E-01
C-14	1.88	3.34E-01	1.81E-02
Mn-54	0.37	6.65E-02	3.59E-03
Fe-55	1.14	2.03E-01	1.10E-02
Co-57	0.08	1.40E-02	7.57E-04
Co-58	1.11	1.96E-01	1.06E-02
Co-60	12.32	2.19E+00	1.18E-01
Ni-59	0.21	3.72E-02	2.01E-03
Ni-63	17.73	3.51E+00	1.90E-01
Zn-65	0.01	1.04E-03	5.62E-05
Sr-90	0.00	7.88E-04	4.26E-05
Zr-95	0.01	1.10E-03	5.95E-05
Nb-95	0.04	2.44E-03	1.32E-04
Ag-110m	0.01	6.34E-03	3.43E-04
Sn-113	2.71	9.55E-04	5.16E-05
Sb-125	0.16	4.82E-01	2.61E-02
Cs-134	1.05	2.85E-02	1.54E-03
Cs-137	0.01	1.87E-01	1.01E-02
Ce-144	0.00	2.41E-03	1.30E-04
Pu-241	0.00	4.23E-04	2.29E-05
Am-241	0.00	8.62E-06	4.66E-07
Cm-242	0.00	1.64E-06	8.86E-08
Cm-244	0.00	7.81E-06	4.22E-07

Resins, Filters, Evap Bottoms			
2019			
Volume (m3) 3.11E+00			
Class B			
Nuclide	% Abund	Curies	uCi/ml
H-3	1.95	2.29E+00	7.36E-01
Be-7	0.00	4.20E-03	1.35E-03
C-14	0.25	2.91E-01	9.36E-02
Mn-54	2.11	2.49E+00	8.01E-01
Fe-55	9.00	1.06E+01	3.41E+00
Co-57	0.08	9.66E-02	3.11E-02
Co-58	0.09	1.02E-01	3.28E-02
Co-60	47.31	5.57E+01	1.79E+01
Ni-59	0.04	5.00E-02	1.61E-02
Ni-63	34.98	4.12E+01	1.32E+01
Zn-65	0.30	3.56E-01	1.14E-01
Sr-90	0.01	1.73E-02	5.56E-03
Nb-95	0.00	9.41E-06	3.03E-06
Tc-99	0.00	3.44E-02	1.11E-02
Sn-113	0.00	1.80E-02	5.79E-03
Sb-124	0.00	4.60E-04	1.48E-04
Sb-125	3.24	3.81E+00	1.23E+00
Cs-137	0.47	5.56E-01	1.79E-01
Ce-144	0.11	1.35E-01	4.34E-02

Irradiated Components
2019
Volume (m3) 0.00E+00
Class N/A
No Shipments

Dry Active Waste			
2019			
Volume (m3) 1.24E+02			
Class A			
Nuclide	% Abund	Curies	uCi/ml
H-3	14.18	3.59E-02	2.90E-04
Cr-51	0.35	3.57E-02	2.88E-04
Mn-54	0.60	2.65E-03	2.14E-05
Fe-55	29.86	3.75E-02	3.02E-04
Fe-59	0.11	8.74E-04	7.05E-06
Co-57	1.89	1.87E-04	1.51E-06
Co-58	26.69	4.50E-02	3.63E-04
Co-60	23.94	3.91E-02	3.15E-04
Ni-63	0.12	7.37E-03	5.94E-05
Zr-95	0.24	5.90E-03	4.76E-05
Nb-95	1.55	9.72E-03	7.84E-05
Sn-113	0.26	3.38E-04	2.73E-06
Sb-124	0.04	1.61E-04	1.30E-06
Sb-125	0.00	1.73E-03	1.40E-05
Cs-137	0.00	2.11E-04	1.70E-06
Ce-144	0.17	6.80E-04	5.48E-06

Other Waste
2019
Volume (m3) 0.00E+00
Class A
No Shipments

SOLID RADIOACTIVE WASTE FOR BURIAL
Estimated Solid Waste Composition
2019

Sum of All Categories			
2019			
Volume (m3) 1.42E+02			
Class A			
Nuclide	% Abund	Curies	uCi/ml
H-3	58.61	1.05E+01	7.39E-02
C-14	1.86	3.34E-01	2.35E-03
Cr-51	0.20	3.57E-02	2.51E-04
Mn-54	0.38	6.91E-02	4.87E-04
Fe-55	1.34	2.41E-01	1.70E-03
Fe-59	0.00	8.74E-04	6.15E-06
Co-57	0.08	1.42E-02	1.00E-04
Co-58	1.34	2.41E-01	1.70E-03
Co-60	12.39	2.23E+00	1.57E-02
Ni-59	0.21	3.72E-02	2.62E-04
Ni-63	19.52	3.51E+00	2.47E-02
Zn-65	0.01	1.04E-03	7.32E-06
Sr-90	0.00	7.88E-04	5.55E-06
Zr-95	0.04	7.00E-03	4.93E-05
Nb-95	0.07	1.22E-02	8.59E-05
Ag-110m	0.04	6.34E-03	4.46E-05
Sn-113	0.01	1.29E-03	9.08E-06
Sb-124	0.00	1.61E-04	1.13E-06
Sb-125	2.69	4.84E-01	3.41E-03
Cs-134	0.16	2.85E-02	2.01E-04
Cs-137	1.04	1.87E-01	1.32E-03
Ce-144	0.02	3.09E-03	2.18E-05
Pu-241	0.00	4.23E-04	2.98E-06
Am-241	0.00	8.62E-06	6.07E-08
Cm-242	0.00	1.64E-06	1.15E-08
Cm-244	0.00	7.81E-06	5.50E-08

Sum of All Categories			
2019			
Volume (m3) 3.11E+00			
Class B			
Nuclide	% Abund	Curies	uCi/ml
H-3	1.95	2.29E+00	7.36E-01
Be-7	0.00	4.20E-03	1.35E-03
C-14	0.25	2.91E-01	9.36E-02
Mn-54	2.11	2.49E+00	8.01E-01
Fe-55	9.00	1.06E+01	3.41E+00
Co-57	0.08	9.66E-02	3.11E-02
Co-58	0.09	1.02E-01	3.28E-02
Co-60	47.31	5.57E+01	1.79E+01
Ni-59	0.04	5.00E-02	1.61E-02
Ni-63	34.98	4.12E+01	1.32E+01
Zn-65	0.30	3.56E-01	1.14E-01
Sr-90	0.01	1.73E-02	5.56E-03
Nb-95	0.00	9.41E-06	3.03E-06
Tc-99	0.03	3.44E-02	1.11E-02
Sn-113	0.02	1.80E-02	5.79E-03
Sb-124	0.00	4.60E-04	1.48E-04
Sb-125	3.24	3.81E+00	1.23E+00
Cs-137	0.47	5.56E-01	1.79E-01
Ce-144	0.11	1.35E-01	4.34E-02

Total Combined			
2019			
Volume (m3) 1.45E+02			
Class A & B			
Nuclide	% Abund	Curies	uCi/ml
H-3	9.46	1.28E+01	8.83E-02
Be-7	0.00	4.20E-03	2.90E-05
C-14	0.46	6.25E-01	4.31E-03
Cr-51	0.03	3.57E-02	2.46E-04
Mn-54	1.88	2.56E+00	1.77E-02
Fe-55	7.99	1.08E+01	7.45E-02
Fe-59	0.00	8.74E-04	6.03E-06
Co-57	0.08	1.11E-01	7.66E-04
Co-58	0.25	3.43E-01	2.37E-03
Co-60	42.68	5.79E+01	3.99E-01
Ni-59	0.06	8.72E-02	6.01E-04
Ni-63	32.93	4.47E+01	3.08E-01
Zn-65	0.26	3.57E-01	2.46E-03
Sr-90	0.01	1.81E-02	1.25E-04
Zr-95	0.01	7.00E-03	4.83E-05
Nb-95	0.01	1.22E-02	8.41E-05
Tc-99	0.03	3.44E-02	2.37E-04
Ag-110m	0.00	6.34E-03	4.37E-05
Sn-113	0.01	1.93E-02	1.33E-04
Sb-124	0.00	6.20E-04	4.28E-06
Sb-125	3.16	4.29E+00	2.96E-02
Cs-134	0.02	2.85E-02	1.97E-04
Cs-137	0.55	7.42E-01	5.12E-03
Ce-144	0.01	1.38E-01	9.52E-04
Pu-241	0.00	4.23E-04	2.92E-06
Am-241	0.00	8.62E-06	5.94E-08
Cm-242	0.00	1.64E-06	1.13E-08
Cm-244	0.00	7.81E-06	5.39E-08

Process Control Program (PCP) for Radioactive Wastes

There were no changes to RW-AA-100, Process Control Program (PCP) for Radioactive Waste, in 2019.

Error Analysis

The following is an estimate of the errors associated with effluent monitoring and analysis. The estimate is calculated using the square root of the sum of the squares methodology.

1. Gaseous Effluents

   Qme=3.33%
   RM=N/A
   ECe=5%
   Stdcse/Smplcse=5%
   qme=N/A
   Total error = 7.8%

2. Liquid Effluents

   Qme=3.33%
   RM=N/A
   ECe=N/A
   Stdcse/Smplcse=5%
   qme=2.22%
   Total error = 6.4%

3. Waste Resin

   Qme=10.0%
   RM=N/A
   ECe=5%
   Stdcse/Smplcse=5%
   qme=1.0%
   Total error = 12.3%

4. DAW, Mechanical Filters, and Contaminated Metal

   Qme=10.0%
   RM=N/A
   ECe=N/A
   Stdcse/Smplcse=5%
   qme=N/A

   Instrument calibration error = 10%
   Total error = 11.2%

Qme = the process quantity measurement error associated with the release point (e.g. flow, level measurements)

RM = error associated with the radiation monitor used in quantifying releases through the release point

ECe = error associated with the collection efficiency of the sample media

Stdcse = one-sigma counting error associated with the counting instrument of interest

Smplcse = one-sigma counting error associated with a sample of a given geometry that is used for the release point of interest

qme = sample quantity measurement error associated with the sample of interest

Miscellaneous Information

A. As required by Technical Specification 5.6.2, meteorological and environmental impact information is reported in the 2019 Annual Radiological Environmental Operating Report (AREOR) or is retained on file to be provided upon request.

B. No limits were exceeded during the 2019 reporting period in liquid hold up tanks or waste gas decay tanks as stated in Technical Specification 5.5.12.

C. There were no irradiated fuel shipments during the 2019 reporting period. An Independent Spent Fuel Storage Installation (ISFSI) campaign began in 2010 when used fuel was removed from the Spent Fuel Pool (SFP), placed into six (6) casks, each containing 32 fuel bundles, and transferred to an outdoor storage pad. No additional casks were placed on the pad in 2011. In 2012, eight (8) additional casks were placed on the pad for a total of fourteen (14) casks. No additional casks were placed on the pad in 2013 or 2014. In 2015, six (6) additional casks were placed on the pad for a total of twenty (20) casks. In 2016, six (6) additional casks were placed on the pad. No additional casks were placed on the pad in 2017. In 2018, five (5) additional casks were placed on the pad. In 2019, six (6) additional cask were placed on the pad for a total of thirty-seven (37).Prior to the first ISFSI campaign, additional dosimeters were placed at the site boundary nearest to the storage pad (in between the pad and the nearest resident) for the purpose of measuring any potential offsite dose to the public from the storage pad Environmental dosimeter data analysis was performed in accordance with ANSI/HPS N13.37, Environmental Dosimeter determining that there is no facility related dose from the ISFSI in 2019. As a result, there is currently no offsite dose contribution from the ISFSI facility or any other on-site storage facility, including the Dry Active Waste (DAW) Building and the Old Steam Generator (OSG) Storage Building, as evidenced by dosimetry data that is indistinguishable from the existing environmental dosimeters.

D. There were no effluent releases or offsite dose calculations that exceeded technical specification or TRM limits during the 2019 reporting period. There were no REMP sample results that exceeded TRM or analytical result investigation levels. Above LLD results of C-137 were detected in our sediment samples at our control and sample stations, BY-12 and BY-34. This isn't unusual as it can be present in local sediment/soil samples as a result of fallout from weapons testing and/or the Chernobyl and Fukushima nuclear accidents and this measured Cs-137 is not attributed to Byron plant effluents. No radionuclides that were a result of plant effluents were detected in any of the other REMP samples.

E. There were no elevated releases during the 2019 reporting period. All planned gaseous releases are considered mixed mode releases and were discharged by way of the plant vent stacks.

F. There was one liquid effluent monitors that exceeded their respective inoperability time limits in 2019 as stated in TRM TLCO 3.11.b:

   On 6/5/2019 09:40, 0PR41J effluent monitor entered LCO 0BOL 11.a, Conditions B&E, due to a failed flow transmitter, the cause of the delay (>30 days) in restoration to operable status was due to parts unavailability. The condition was exited on 7/5/2019 at 14:49 after repairs were complete.

G. There were no unplanned gaseous or liquid releases to unrestricted areas during the 2019 reporting period.

H. All Rock River flow measurements during liquid effluent discharges were obtained from the U.S. Geological Survey Byron Gauging Station for the Rock River with the following exceptions. Due to icing conditions near the Byron gauging stations 1/23/2019 and 1/25/2019, flow was obtained from the Rockton flow gauge, located approximately 30 miles downstream of the Byron flow gauge. There were no flows obtained on 2/2/2019, 2/8/2019, 2/14/2019, and 2/17/2019 due to icing conditions at Bryon, Rockton, Dixon, and Como.

I. Byron obtains a Waste Water Treatment composited sample daily when it is being discharged for isotopic analysis. On 3/3/2019, chemistry was not informed that the system had been started. Therefore, the technician did not obtain a daily sample as required by procedure. As a result, the compositor overflowed, and shut off, Chemistry did not obtain a representative sample in that 3-day time period. The compositor was restarted upon discovery, and sample was obtained March 6, 2019 per procedure. As a result, the sample obtained on March 6 was unrepresentative of the effluent discharged that occurred between March 3rd and March 6th.

J. Attached are offsite dose calculation reports for January through December of 2019.

The following are the maximum annual calculated cumulative offsite doses resulting from Byron airborne releases in 2019 based on concurrent meteorological data:

Unit 1:

Dose	*Maximum Value*		*Sector Affected*
gamma air [1]	1.400×10^{-5}	mrad	East
beta air [2]	6.300×10^{-5}	mrad	East
whole body [3]	5.630×10^{-2}	mrem	East
skin [4]	1.530×10^{-5}	mrem	East
organ [5] (child-bone)	2.780×10^{-1}	mrem	East

Unit 1 Compliance Status

10 CFR 50 Appendix I	**Yearly Objective**		**% of Appendix I**
gamma air	10.0	mrad	0.00
beta air	20.0	mrad	0.00
whole body	5.0	mrem	1.13
skin	15.0	mrem	0.00
organ	15.0	mrem	1.85

Unit 2:

Dose	*Maximum Value*		*Sector Affected*
gamma air [1]	1.280×10^{-5}	mrad	East
beta air [2]	5.820×10^{-5}	mrad	East
whole body [3]	5.400×10^{-2}	mrem	East
skin [4]	1.390×10^{-5}	mrem	East
organ [5] (child-bone)	2.610×10^{-1}	mrem	East

Unit 2 Compliance Status

10 CFR 50 Appendix I	**Yearly Objective**		**% of Appendix I**
gamma air	10.0	mrad	0.00
beta air	20.0	mrad	0.00
whole body	5.0	mrem	1.08
skin	15.0	mrem	0.00
organ	15.0	mrem	1.74

(1) Gamma Air Dose - GASPAR II, NUREG-0597
(2) Beta Air Dose - GASPAR II, NUREG-0597
(3) Whole Body Dose - GASPAR II, NUREG-0597
(4) Skin Dose - GASPAR II, NUREG-0597
(5) Inhalation and Food Pathways Dose - GASPAR II, NUREG-0597

Data recovery: 99.8%

Attachment A, 2019 Radioactive Effluent Release Report
2019 Lower Limits of Detection (LLD's)

Nuclide	Gaseous LLD (uCi/cc)	Required Gaseous LLD (uCi/cc)	Nuclide	Liquid LLD (uCi/ml)	Required Liquid LLD (uCi/cc)
H3	4.82E-08	1.00E-07	H3	1.93E-06	1.00E-05
Mn54	5.39E-14	1.00E-11	Mn54	2.80E-08	5.00E-07
Co58	6.58E-14	1.00E-11	Fe55	5.27E-07	1.00E-06
Fe59	1.04E-13	1.00E-11	Co58	2.74E-08	5.00E-07
Co60	8.74E-14	1.00E-11	Fe59	2.87E-08	5.00E-07
Zn65	1.14E-13	1.00E-11	Co60	6.80E-08	5.00E-07
Kr87	5.94E-08	1.00E-04	Zn65	7.63E-08	5.00E-07
Kr88	6.34E-08	1.00E-04	Kr85m	2.39E-08	1.00E-05
Sr89	1.68E-14	1.00E-11	Kr87	7.45E-08	1.00E-05
Sr-90	2.28E-15	1.00E-11	Kr88	8.22E-08	1.00E-05
Mo99	1.03E-13	1.00E-11	Sr89	3.51E-08	5.00E-08
I131	1.08E-13	1.00E-12	Sr90	1.14E-08	5.00E-08
I133	4.37E-13	1.00E-10	Mo99	1.95E-08	5.00E-07
Xe133	5.38E-08	1.00E-04	Xe131m	8.68E-07	1.00E-05
Xe133m	1.69E-07	1.00E-04	I131	3.03E-08	1.00E-06
Cs134	5.13E-14	1.00E-11	Xe133	5.75E-08	1.00E-05
Xe135	2.07E-08	1.00E-04	Xe133m	2.07E-07	1.00E-05
Cs137	6.63E-14	1.00E-11	Cs134	4.85E-08	5.00E-07
Xe138	1.25E-06	1.00E-04	Xe135	2.45E-08	1.00E-05
Ce141	9.28E-14	1.00E-11	Cs137	3.33E-08	5.00E-07
Ce144	3.86E-13	1.00E-11	Xe138	2.19E-07	1.00E-05
Gross Alpha	2.58E-15	1.00E-11	Ce141	3.23E-08	5.00E-07
			Ce144	1.70E-07	5.00E-06
			Gross Alpha	3.09E-08	1.00E-07
			Gross Beta	8.60E-07	