Ameren MISSOURI

Callaway Plant

April 29, 2011

ULNRC-05784

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
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40 CFR 190

Ladies and Gentlemen:

DOCKET NUMBER 50-483
CALLAWAY PLANT UNIT 1
UNION ELECTRIC CO.
FACILITY OPERATING LICENSE NPF-30
2010 RADIOLOGICAL EFFLUENT RELEASE REPORT

Please find enclosed the 2010 Radiological Effluent Release Report for Callaway Plant. This report is submitted in accordance with Section 5.6.3 of the Callaway Plant Technical Specifications.

This letter does not contain new commitments.

If there are any questions, please contact us.

Sincerely,

Luke H. Graessle
Director, Operations Support

ACS/nls

Enclosure: 2010 Radiological Effluent Release Report

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Callaway Plant 2010 Annual Effluent Release Report

Facility Operating License NPF-30

Docket Number 50-483

Callaway Plant 2010 Annual Radioactive Effluent Release Report

Facility Operating License NPF-30
Docket No. 50-483

Abstract

The Radioactive Effluent Release Report covers the operation of the unit during the year 2010. The report includes a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit. The report also includes an annual summary of hourly meteorological data collected during the year and an assessment of radiation dose to the Member of the public from liquid and gaseous effluents.

1. Introduction

This Annual Radioactive Effluent Release Report (ARERR) is submitted by Union Electric Co., dba Ameren Missouri, in accordance with the requirements of 10 CFR 50.36a and Callaway Plant Technical Specification 5.6.3. This report is for the period January 1, 2010 to December 31, 2010.

The dose to the Member of the Public from all liquid and gaseous effluents discharged during the reporting period were small fractions of the NRC and EPA regulatory limits and the Radiological Effluent Control limits in the Offsite Dose Calculation Manual.

To maximize consistency, aid in the review by Members of the Public, and to allow easier industry- wide comparison of the data, this report is presented in the format recommended by Regulatory Guide 1.21, revision 2, *insofar as is practicable*. Callaway is committed to revision 1 of Regulatory Guide 1.21, and some of the information is not readily available in the format recommended by revision 2.

2. Gaseous Effluents

The quantity of radioactive material released in gaseous effluents during the reporting period is summarized in Table A-1. The quarterly and annual sums of all radionuclides discharged in gaseous effluents are reported in Tables A-1A and A-1B. All gaseous effluent releases are considered to be ground level.

^{14}C has been added to the gaseous effluent tables. Based on new Nuclear Regulatory Commission guidance, beginning with the 2010 report, all U.S. nuclear power plants will include ^{14}C doses in their ARERR.

^{14}C is a naturally occurring isotope of carbon. It is produced continuously by cosmic ray interaction with oxygen and nitrogen in the upper atmosphere. Carbon dating, using ^{14}C, is a very reliable tool in dating of organic matter up to 30,000 years old. ^{14}C is also a byproduct of nuclear weapons testing and nuclear power generation. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of ^{14}C in the atmosphere. The amount of ^{14}C produced by nuclear power generation is much less than that produced naturally or from weapons testing.[1]

The level of ^{14}C discharged in gaseous effluents has not increased. Improvements in nuclear power plant operation have significantly reduced the overall quantity of radioactivity released in plant effluents. One consequence of this success is that for most nuclear plants ^{14}C may now be a principle nuclide as defined in Regulatory Guide 1.21, revision 2, and as such must be reported in the ARERR.

The radiation dose to the public from all radionuclides, including ^{14}C, continues to be a small fraction of the regulatory limits.

The amount of ^{14}C released in gaseous effluents was calculated as described in EPRI Technical Report 1021106[2] and is documented in HPCI 11-02.[3]

3. Liquid Effluents

The quantity of radioactive material released in liquid effluents during the reporting period is summarized in Table A-2. The quarterly and annual sums of all radionuclides discharged in liquid effluents are reported in Table A-2A. All liquid effluents were discharged in batch mode; there were no continuous liquid discharges for the reporting period. Dilution by the Missouri River, in the form of the near- field dilution factor, is utilized in the ODCM dose calculation methodology.

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[1] *Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste*, Regulatory Guide 1.21, revision 2, section 1.9, USNRC, June, 2009..

[2] *Estimation of Carbon- 14 in Nuclear Power Plant Gaseous Effluents*, Technical Report 1011106, Electric Power Research Institute, December, 2010.

[3] HPCI 11-02, "Dose to the Member of the Public from the Release of ^{14}C Gaseous Effluents for 2010".

4. Solid Waste Storage and Shipments

The volume and activity of solid waste shipped for disposal is provided in Table A-3. Table A-3 is presented in the format of rev. 1 to Regulatory Guide 1.21 because the data is not readily available in the format recommended by rev. 2 to Regulatory Guide 1.21.

5. Dose Assessments

The annual evaluation of dose to the Member of the Public is calculated in accordance with the methodology and parameters in the ODCM and is reported in Tables A-4 and A-5.

5.1 Table A-4, Dose Assessments, 10 CFR 50, Appendix I

The dose assessments reported in Table A-4 were calculated using the methodology and parameters in the ODCM and demonstrate compliance with 10 CFR 50, Appendix I. The gamma air dose and beta air dose were calculated at the nearest Site Boundary location with the highest value of X/Q, as described in the ODCM. The maximum organ dose from gaseous effluents was calculated for the ingestion, inhalation, and ground plane pathways at the location of the nearest resident with the highest value of D/Q, as described in the ODCM. The organ dose includes the dose from ^{14}C.

5.2 Table A-5, EPA 40 CFR 190 Individual in the Unrestricted Area

The dose assessments reported in Table A-5 are the doses to the Member of the Public from activities within the Site Boundary. A large portion of the residual land of the Callaway Site is managed by the State of Missouri Conservation Department as the Reform Wildlife Management Area. As described in the ODCM, the dose from gaseous effluents, plus the dose contribution from direct radiation sources, including dose from outdoor water storage tanks, direct dose due to ^{16}N from operation of the unit, and organ dose from ^{14}C. The dose assessments in Table A-5 demonstrate compliance with 10 CFR 20.1301(e) and 40 CFR 190.

6. Supplemental Information

6.1 Abnormal Releases or Abnormal Discharges

There were no abnormal releases or abnormal discharges during the reporting period.

6.2 Non- routine Planned Discharges

There were no non- routine planned discharges during the reporting period.

6.3 Radioactive Waste Treatment System Changes

Modification 06-0102 installed diaphragms in the Reactor water Holdup Tanks (RHUTs). The diaphragms allow degassing of the water. The fission product gas is stored in the Waste Gas Decay Tanks (WGDTs) for holdup prior to discharge. This change should reduce the quantity of noble gases discharged in gaseous effluents.

There were no other major changes to the liquid or gaseous radwaste treatment system during the reporting period.

6.4 Annual Land Use Census Changes

The evaluation of the 2010 Land Use Census is documented in HPCI 10-03. There were no changes in the location of the nearest resident or the location of the nearest vegetable garden with the highest value of D/Q. There were no milk sample providers identified and the Callaway Plant continues to sample green leafy vegetation in lieu of milk. There were no changes in the green leafy vegetation sample locations.

6.5 Effluent Monitoring System Inoperability

Specifications covering the Limiting Conditions of Operations (LCO) for effluent monitoring instrumentation are provided in Radiological Effluent Control (REC) 16.11.1. 3 and 16.11.2.4. The ACTION statement implements provisions that when taken as specified complete requirements to demonstrate functionality. When the required ACTION is not met, the equipment is removed from service or declared non- functional. This report provides explanation for periods of time when inoperability occurred.

GHRE0010B, Radwaste Building Wide Range Gaseous Effluents Monitor, Not Functional for More than 30 Days

On 12/23/2009, an instrument loop calibration was completed for the wide range Radwaste Building ventilation monitor, GHRE0010B. The check source functioned satisfactorily for the low range detector, the mid range detector, and the high range detector. However, when the calibration was completed the high range detector channel would not return from blue status to green status (blue status means an operate failure alarm on the channel). This resulted in a condition where the monitor was correctly performing its indication and ODCM sampling for the low and mid range channels, but the high range channel could not be confirmed functional.

Following a review by the Engineering Department and the Control Room, GHRE0010B was returned to service on 12/23/2009 with the high range channel still in operate failure status. The low range channel was operating normally. It was thought that the ODCM setpoint providing alarm and isolation was in the range of the low range channel, therefore the monitor met the operability requirements of REC 16.11.2.4 without a functional high range channel. This reflects a basic misunderstanding of the monitor design: The ODCM setpoint and the alarm and isolation functions are provided by the effluent channel, not the detector channels. An algorithm is used to determine which channel- low, mid, or high range- provides the input to the effluent channel. A new work request, job 09008605 was created to trouble shoot the operate failure condition on the high range channel along with a corrective action request (CAR 200910504) to document the status.

Monitor GHRE0010B operated in this condition until March 5, 2010, when the vendor's analysis of certain parameters indicated the operate failure status on the high range channel was due to

timing issues which affected the algorithm used to determine which channel provides the input to the effluent channel. This resulted in CAR 201001963 to evaluate functionality of GHRE0010B. Although GHRE0010B was correctly monitoring in accordance with REC 16.11.5.2, GHRE0010B was declared non- functional because it was not certain that the algorithm would always select the correct detector for input to the effluents channel.

Under on- site direction by the vendor, the monitor database was reset and a new high range channel check source was installed. The high range channel was subsequently returned to normal and the monitor was returned to functional status on March 18, 2010. A review of the data for the effluents channel from 12/23/2009- 3/18/2010 indicates the monitor output was stable during that time period and there are no indications the algorithm selected the wrong channel for input to the effluent channel.

HBLT2004, Discharge Monitoring Tank A Level Transmitter, Not Functional for More than 30 Days

On July 21, 2010, during surveillance testing of HBLT2004, it was noted that the as- found condition was not within calibration for the lower trip and rest values. The unit was slow to respond which is indicative of a problem with the sensing bellows. This conclusion was supported by sludge fluid present when the plug was removed at a test connection. HBLT2004 was declared non- functional and entered into the Equipment Out of Service Log (EOSL). The EOSL entry correctly stated that there was a 30 day limit on the ACTION statement.

There was a design change already planned and a job written to replace the whole transmitter. Repair of HBLT2004 was tied to that job. Pursuant to ACTION 33, alternate methods were implemented to allow discharges to continue. There is no time limit stated in ACTION 33, however REC 16.11.1.3, ACTION b states that releases can continue for 30 days provided the ACTION is taken. The job for replacing the whole transmitter was planned for September 30, 2010. Those responsible for planning the work did not understand at the time that there is a 30 day limit on the ACTION statement.

On August 18, 2010, CAR 201007873 was written stating that HBLT2004 exceeded the 30 day limit stated in REC 16.11.1.3, ACTION b. HBLT2004 was returned to functional status on September 30, 2010.

6.6 Offsite Dose Calculation Manual Changes

There were no changes to the Offsite Dose Calculation Manual during the reporting period.

6.7 Process Control Program Changes

Administrative changes were made to APA-ZZ-01011, “Process Control Program” due to organizational realignment. There were no substantive changes to the Process Control Program during the reporting period.

6.8 Corrections to Previous Reports

Corrections to the 2008 and 2009 Annual Radiological Effluent Release Reports are provided in Appendix C and Appendix D, respectively. These changes are necessary because the dose from ^{63}Ni in gaseous effluents was not included in the original reports, although the quantity of ^{63}Ni was properly reported in each report.

6.9 Other Information Related to Radioactive Effluents

Meteorological Joint Frequency Tables for the monitoring period are attached as Appendix B.

Appendix A

Tables of Quantities Released in Liquid and Gaseous Radioactive Effluents and in Solid Radioactive Waste Shipments

Tables of Doses from the Discharge of Liquid and Gaseous Radioactive Effluents

Table A-1: Gaseous Effluents- Summation of All Releases							
Summation of All Releases	**Unit**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total**	**Estimated Uncertainty (%)[4]**
Fission & Activation Gases	Ci	5.37E+1	1.09E+2	2.12E+0	7.74E-1	1.66E2	20
Avg Rel Rate	µCi/s	6.91E+0	1.39E+1	2.67E-1	9.74E-2	5.29E0	
% of Limit	%	N/A	N/A	N/A	N/A	N/A	
^{131}Iodine	Ci	3.56E-7	7.04E-5	0.00E+0	0.00E+0	7.08E-5	23
Avg Rel Rate	µCi/s	4.57E-8	8.95E-6	0.00E+0	0.00E+0	2.25E-6	
% of Limit	%	N/A	N/A	N/A	N/A	N/A	
Particulates	Ci	1.06E-6	1.96E-5	1.68E-6	1.04E-6	2.34E-5	30
Avg Rel Rate	µCi/s	1.37E-7	2.49E-6	2.12E-7	1.31E-7	7.43E-7	
% of Limit	%	N/A	N/A	N/A	N/A	N/A	
Gross Alpha	Ci	3.00E-7	3.17E-7	1.55E-7	6.84E-7	1.46E-6	
^{3}H	Ci	5.00E+0	1.08E+1	8.49E+0	9.21E+0	3.35E+1	14
Avg Rel Rate	µCi/s	6.43E-1	1.37E+0	1.07E+0	1.16E+0	1.06E0	
% of Limit	%	N/A	N/A	N/A	N/A	N/A	
^{14}C [5]	Ci	2.78E0	2.78E0	2.78E0	2.78E0	1.11E1	

[4] Safety Analysis calculation 87-063-00, January 6, 1988
[5] ^{14}C activity is estimated based on EPRI report TR-1021106, *Estimation of ^{14}C in Nuclear Power Plant Effluents*, December, 2010.

Table A-1A: Gaseous Effluents- Ground Level Release- Batch Mode						
Fission & Activation Gases	**Units**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total for the year**
^{41}Ar	Ci	8.02E-2	3.92E-1	3.51E-2	1.23E-1	6.30E-1
^{133}Xe	Ci	1.06E-1	2.24E0	9.35E-3	9.82E-2	2.45E0
^{135}Xe	Ci	1.11E-3	1.15E-2	1.41E-3	1.09E-2	2.49E-2
^{85}Kr	Ci	1.73E0	0.00E0	5.53E-3	0.00E0	1.74E0
^{87}Kr	Ci	0.00E0	8.35E-3	0.00E0	0.00E0	8.35E-3
^{85m}Kr	Ci	2.08E-5	0.00E0	3.71E-5	1.32E-5	7.11E-5
^{133m}Xe	Ci	0.00E0	0.00E0	0.00E0	1.35E-4	1.35E-4
^{131m}Xe	Ci	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0
Iodines & Halogens	**Units**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total for the year**
^{131}I	Ci	0.00E0	1.10E-5	0.00E0	0.00E0	1.10E-5
^{132}I	Ci	0.00E0	1.57E-5	0.00E0	0.00E0	1.57E-5
Particulates	**Units**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total for the year**
^{63}Ni	Ci	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0
^{60}Co	Ci	0.00E0	1.85E-5	6.44E-7	0.00E0	1.91E-5
^{3}H	Ci	1.76E-1	2.05E0	7.86E0	1.80E-1	1.03E1
Gross α	Ci	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0
^{14}C	Ci	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0

Table A-1B: Gaseous Effluents- Ground Level Release- Continuous Mode						
Fission & Activation Gases	**Units**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total for the year**
^{41}Ar	Ci	0.00E0	4.69E-1	0.00E0	0.00E0	4.69E-1
^{133}Xe	Ci	5.07E+1	1.03E+2	1.73e0	4.30E-1	1.56E2
^{135}Xe	Ci	1.03E0	6.81E-1	1.12E-1	1.41E-3	1.82
^{85}Kr	Ci	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0
^{87}Kr	Ci	3.85E-2	1.03E-1	0.00E0	0.00E0	1.42E-1
^{85m}Kr	Ci	1.31E-2	4.83E-4	0.00E0	0.00E0	1.36E-2
^{133m}Xe	Ci	0.00E0	1.20E0	0.00E0	0.00E0	1.20E0
^{131m}Xe	Ci	0.00E0	1.57E0	0.00E0	0.00E0	1.57E0
Total	Ci	5.18E1	1.07E2	2.07E0	5.41E-1	1.61E2
Iodines & Halogens	**Units**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total for the year**
^{131}I	Ci	3.56E-7	5.94E-5	0.00E0	0.00E0	5.98E-5
^{132}I	Ci	0.00E0	1.92E-5	0.00E0	0.00E0	1.92E-5
Total	Ci	3.56E-7	7.86E-5	0.00E0	0.00E0	7.90E-5
Particulates	**Units**	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Total for the year**
^{63}Ni	Ci	1.06E-6	1.08E-6	1.04E-6	1.04E-6	4.22E-6
^{60}Co	Ci	0.00E0	0.00E0	0.00E0	0.00E0	0.00E0
Total	Ci	3.00E-7	3.17E-7	1.04E-6	1.04E-6	3.04E-4
^{3}H	Ci	4.82E0	8.74E0	7.86E0	1.80E-1	2.16E1
Gross α	Ci	3.00E-7	3.17E-7	1.55E-7	6.84E-7	1.46E-6
^{14}C	Ci	2.78E0	2.78E0	2.78E0	2.78E0	1.11E1

Table A-2: Liquid Effluents- Summation of All Releases

Summation of All Liquid Releases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	Estimated Uncert. (%)[6]
Fission and Activation Products[7]	Ci	7.69E-3	1.75E-1	1.90E-2	8.15E-3	2.01E-1	20
Avg Diluted Conc	µCi/ ml	1.89E-8	4.39E-7	4.20E-8	3.92E-8	1.19E-7	
% of Limit	%	N/A	N/A	N/A	N/A	N/A	
^{3}H	Ci	8.55E2	2.16E2	1.03E1	8.16E1	1.16E3	14
Avg Diluted Conc	µCi/ ml	2.10E-3	5.41E-4	2.28E-5	3.92E-4	6.61E-4	
% of Limit	%	N/A	N/A	N/A	N/A	N/A	
Dissolved & Entrained Gases	Ci	3.84E-1	7.60E-1	1.44E-4	2.57E-5	1.14E0	27
Avg Diluted Conc	µCi/ ml	9.41E-7	1.90E-6	3.19E-10	1.23E-10	6.50E-7	
% of Limit	%	N/A	N/A	N/A	N/A	N/A	
Gross α	Ci	7.42E-5	2.19E-4	1.06E-3	2.49E-4	1.60E-3	29
Avg Diluted Conc	µCi/ ml	1.83E-10	5.50E-10	2.36E-9	1.20E-9	9.10E-10	
Vol Liquid Effluent[8]	Liters	9.31E6	1.17E7	1.48E7	6.21E6	4.20E7	
Dilution Volume[9]	Liters	3.97E8	3.86E8	4.35E8	2.02E8	1.72E9	
Avg river flow[10]	m^3/s	3290	5600	4570	2420	4200	

[6] Safety Analysis calculation 87-063-00, January 6, 1988
[7] Excludes ^{3}H, noble gases, and gross alpha.
[8] Primary system liquid effluent plus secondary liquid effluent, prior to dilution.
[9] Does not include Missouri River dilution.
[10] Average Missouri River flow for the year at the Hermann, MO monitoring station as reported by the USGS.

Table A-2A: Liquid Effluents- Batch Mode

Fission & Activation Products	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
^{58}Co	Ci	2.92E-05	4.37E-03	1.89E-04	1.24E-05	4.60E-03
^{60}Co	Ci	2.65E-04	2.08E-03	3.75E-04	5.24E-05	2.77E-03
^{134}Cs	Ci	2.79E-04	2.44E-04	4.04E-05	4.07E-05	6.04E-04
^{137}Cs	Ci	1.47E-03	1.26E-03	2.73E-04	2.64E-04	3.27E-03
^{63}Ni	Ci	1.67E-03	1.52E-03	2.37E-03	8.22E-04	6.38E-03
^{125}Sb	Ci	3.95E-03	1.31E-01	1.40E-02	6.52E-03	1.55E-01
^{124}Sb	Ci	6.99E-06	1.79E-02	1.22E-03	3.14E-04	1.94E-02
^{91m}Y	Ci	3.04E-06	0.00E+00	0.00E+00	0.00E+00	3.04E-06
^{51}Cr	Ci	1.64E-05	5.15E-03	1.20E-04	1.15E-04	5.40E-03
^{122}Sb	Ci	5.54E-06	3.92E-05	3.99E-06	2.05E-06	5.08E-05
^{54}Mn	Ci	0.00E+00	3.57E-05	0.00E+00	0.00E+00	3.57E-05
^{95}Zr	Ci	0.00E+00	4.60E-06	0.00E+00	0.00E+00	4.60E-06
^{95}Nb	Ci	0.00E+00	3.57E-06	0.00E+00	0.00E+00	3.57E-06
^{131}I	Ci	0.00E+00	3.71E-03	1.37E-06	0.00E+00	3.71E-03
^{133}I	Ci	0.00E+00	6.04E-06	0.00E+00	0.00E+00	6.04E-06
^{132}I	Ci	0.00E+00	5.20E-04	0.00E+00	3.18E-06	5.23E-04
^{24}Na	Ci	0.00E+00	3.64E-04	1.42E-05	0.00E+00	3.78E-04
^{132}Te	Ci	0.00E+00	3.44E-04	0.00E+00	0.00E+00	3.44E-04
^{65}Zn	Ci	0.00E+00	2.21E-05	0.00E+00	0.00E+00	2.21E-05
^{129}Te	Ci	0.00E+00	5.95E-03	3.68E-04	0.00E+00	6.32E-03
^{138}Cs	Ci	0.00E+00	2.90E-04	0.00E+00	0.00E+00	2.90E-04
Total	Ci	7.70E-03	1.75E-01	1.90E-02	8.15E-03	2.09E-01

Table A-2A: Liquid Effluents- Batch Mode (continued)

Dissolved & Entrained Gases	Units	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total for the year
^{133}Xe	Ci	3.71E-01	7.37E-01	5.28E-05	2.57E-05	1.11E+00
^{131m} Xe	Ci	1.24E-02	1.79E-02	0.00E+00	0.00E+00	3.03E-02
^{137}Xe	Ci	5.60E-05	0.00E+00	0.00E+00	0.00E+00	5.60E-05
^{133m} Xe	Ci	5.87E-04	3.94E-03	0.00E+00	0.00E+00	4.53E-03
^{135}Xe	Ci	1.00E-05	1.31E-03	0.00E+00	0.00E+00	1.32E-03
^{89}KR	Ci	0.00E+00	0.00E+00	9.11E-05	0.00E+00	9.11E-05
Total	Ci	3.84E-01	7.60E-01	1.44E-04	2.57E-05	1.15E+00
^{3}H	Ci	8.55E+02	2.16E+02	1.03E+01	8.16E+01	1.16E+03
Gross α	Ci	7.42E-05	2.19E-04	1.06E-03	2.49E-04	1.60E-03

Table A-3: Solid Waste & Irradiated Fuel Shipments

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

1. TYPE OF WASTE	Units	Period Jan – Jun	Period Jul - Dec	Est. Total Error (%)
Spent resins, filter sludges, evaporator bottoms, etc.	m^3	0.00E+00	1.47E+01	
	Ci	0.00E+02	5.72E-04	± 25%
Dry compressible waste, contaminated equip., etc.	m^3	2.32E+02	1.16E+02	
	Ci	1.37E-01	7.32E-02	± 25%
Irradiated components, control rods, etc.	m^3	0.00E+00	0.00E+00	
	Ci	0.00E+00	0.00E+00	± 25%
Other (low level secondary resin, oily waste)	m^3	0.00E+00	4.67E+00	
	Ci	0.00E+00	3.72E+00	± 25%

Table A-3: Solid Waste & Irradiated Fuel Shipments (continued)

2. ESTIMATE OF MAJOR NUCLIDE COMPOSITION (by Type of Waste)				
a. Spent resins, filters, evaporator bottoms, etc.				
Nuclide	**% Abundance**	**Jan – Jun Ci**	**% Abundance**	**Jul – Dec Ci**
^{58}Co	0 %	0.00E+00	1.975 %	1.13E-05
^{60}Co	0 %	0.00E+00	32.230 %	1.84E-04
^{125}Sb	0 %	0.00E+00	1.640 %	9.39E-06
^{134}Cs	0 %	0.00E+00	1.323 %	7.57E-06
^{137}Cs	0 %	0.00E+00	8.085 %	4.63E-05
^{144}Ce	0 %	0.00E+00	53.068 %	3.04E-04
b. Dry compressible waste, contaminated equipment, etc.				
^{3}H	1.979 %	2.71E-03	1.980 %	1.45E-03
^{55}Fe	29.333 %	4.02E-02	29.346 %	2.15E-02
^{58}Co	1.351 %	1.85E-03	1.344 %	9.84E-04
^{60}Co	14.830 %	2.03E-02	14.839 %	1.09E-02
^{63}Ni	29.435 %	4.04E-02	29.458 %	2.16E-02
^{95}Zr	1.617 %	2.22E-03	1.608 %	1.18E-03
^{95}Nb	3.474 %	4.76E-03	3.433 %	2.51E-03
^{134}Cs	4.602 %	6.31E-03	4.604 %	3.37E-03
^{137}Cs	12.083 %	1.66E-02	12.092 %	8.85E-03
c. Irradiated components, control rods, etc.				
None	N/A	N/A	N/A	N/A

Table A-3: Solid Waste & Irradiated Fuel Shipments (continued)

d. Other				
^{3}H	0 %	0.00E+00	15.091 %	5.62E-01
^{55}Fe	0 %	0.00E+00	17.570 %	6.54E-01
^{58}Co	0 %	0.00E+00	4.016 %	1.50E-01
^{60}Co	0 %	0.00E+00	8.080 %	3.01E-01
^{63}Ni	0 %	0.00E+00	22.139 %	8.24E-01
^{134}Cs	0 %	0.00E+00	5.796 %	2.16E-01
^{137}Cs	0 %	0.00E+00	24.915 %	9.28E-01

3. SOLID WASTE DISPOSITION				
Number of Shipments	**Mode of Transport**	**Destination**	**Class of Solid Waste Shipped**	**Type of Container**
6*	Truck	Energy Solutions Bear Creek	A	Intermodal Container
1*	Truck	Energy Solutions Gallaher Road	A	Intermodal Container/B-25 boxes/Flatbed
1*	Cask	Studsvik	A	Poly Liner

*Sent to waste processors for volume reduction before burial.

4. SOLIDIFICATION AGENT

None used.

B. IRRADIATED FUEL SHIPMENTS (Disposition)

There were no shipments of irradiated fuel during the reporting period.

Table A-4: Dose Assessments, 10 CFR 50, Appendix I

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Yearly total
Liquid Effluent Dose Limit, Total Body (mrem)	1.5	1.5	1.5	1.5	3
Total Body Dose (mrem)	6.57E-03	4.90E-03	7.33E-04	1.73E-03	1.38E-02
% Limit (%)	0.44%	0.33%	0.05%	0.12%	0.46%
Liquid Effluent Dose Limit, Maximum Organ (mrem)	5	5	5	5	10
Maximum Organ Dose (mrem)	8.88E-03	6.93E-03	1.14E-03	2.43E-03	1.92E-02
% Limit (%)	0.18%	0.14%	0.02%	0.05%	0.19%
Gaseous Effluent Dose Limit, Gamma Air (mrem)	5	5	5	5	10
Gamma Air Dose (mrad)	7.73E-04	1.77E-03	5.85E-05	5.79E-05	2.65E-03
% Limit (%)	0.02%	0.04%	0.00%	0.00%	0.03%
Gaseous Effluent Dose Limit, Beta Air (mrem)	10	10	10	10	20
Beta Air Dose (mrad)	2.21E-03	4.41E-03	1.03E-04	4.66E-05	6.77E-03
% Limit (%)	0.02%	0.04%	0.00%	0.00%	0.03%
Gaseous Effluent Dose Limit, Maximum Organ (mrem)	7.5	7.5	7.5	7.5	15
Maximum organ dose[11] (mrem)	1.16E-02	2.08E-02	3.22E-03	3.49E-03	1.26E-02
% Limit (%)	0.15%	0.28%	0.04%	0.05%	0.08%

[11] Iodine, ^{3}H, and particulates with greater than an 8 day half- life.

Table A-5: EPA 40 CFR 190 Individual in the Unrestricted Area			
	Whole Body	**Thyroid**	**Any Other Organ**
Dose Limit	25 mrem	75 mrem	25 mrem
Dose	1.04E-2 mrem	1.01E-2 mrem	1.01E-2 mrem
% Limit	0.04%	0.04%	0.04%

Appendix B

Joint Frequency Tables; Totals of Hours at Each Wind Speed & Direction for the period January 1, 2010- December 31, 2010

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class A							
	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	0	0	0	0	0	0	0
NNE	0	0	1	1	0	0	2
NE	0	0	0	0	0	0	0
ENE	0	0	0	0	0	0	0
E	2	0	2	0	0	0	4
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	1	0	0	0	1
SSW	0	0	7	1	0	0	8
SW	0	3	11	1	0	0	15
WSW	0	6	6	5	0	0	17
W	0	2	13	1	0	0	16
WNW	0	4	17	0	0	0	21
NW	0	2	16	1	0	0	19
NNW	0	0	2	0	0	0	2
Total	2	17	76	10	0	0	105
Hours of calm data: 0							
Hours of invalid data:3							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class B							
	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	0	4	1	2	0	0	7
NNE	0	4	5	1	0	0	10
NE	1	0	1	0	0	0	2
ENE	0	1	4	0	0	0	5
E	0	0	1	0	0	0	1
ESE	0	0	1	1	0	0	2
SE	0	3	1	0	0	0	4
SSE	0	3	8	1	0	0	12
S	0	1	9	1	0	0	11
SSW	0	6	15	4	0	0	25
SW	1	9	11	6	0	0	27
WSW	0	4	1	2	0	0	7
W	0	4	8	0	0	0	12
WNW	0	7	12	0	0	0	19
NW	0	4	16	2	0	0	22
NNW	0	2	6	3	0	0	11
Total	2	52	100	23	0	0	177
Hours of calm data: 0							
Hours of invalid data:3							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class C							
	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	2	7	14	0	0	0	23
NNE	1	11	8	0	0	0	20
NE	1	8	3	0	0	0	12
ENE	0	13	7	0	0	0	20
E	2	5	4	0	0	0	11
ESE	0	9	11	3	0	0	23
SE	0	9	15	0	0	0	24
SSE	0	22	18	1	0	0	41
S	0	21	17	10	0	0	48
SSW	3	31	25	7	0	0	66
SW	4	22	15	0	1	0	42
WSW	1	11	2	2	0	0	16
W	1	15	5	0	0	0	21
WNW	0	21	16	0	0	0	37
NW	1	34	19	4	0	0	58
NNW	1	29	11	3	0	0	44
Total	17	268	190	30	1	0	506
Hours of calm data: 0							
Hours of invalid data:0							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class D							
	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	34	134	114	10	0	0	292
NNE	44	146	102	22	1	0	315
NE	21	83	40	0	0	0	144
ENE	22	89	56	2	0	0	169
E	17	76	57	0	0	0	150
ESE	23	120	112	4	0	0	259
SE	27	127	73	21	0	0	248
SSE	35	140	111	22	1	0	309
S	25	124	107	52	9	0	317
SSW	19	91	117	40	1	0	268
SW	20	70	59	6	0	0	155
WSW	14	39	21	8	0	0	82
W	20	59	64	47	0	0	190
WNW	25	127	139	25	0	0	316
NW	37	146	117	28	0	0	328
NNW	26	157	119	23	0	0	325
Total	409	1728	1408	310	12	0	3867
Hours of calm data: 3							
Hours of invalid data:15							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class E							
	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	35	79	24	0	0	0	138
NNE	27	69	3	0	0	0	99
NE	24	33	1	0	0	0	58
ENE	29	33	5	0	0	0	67
E	39	26	3	0	0	0	68
ESE	25	48	20	0	0	0	93
SE	25	112	50	2	0	0	189
SSE	30	218	99	16	0	0	363
S	19	143	110	15	2	0	289
SSW	15	63	55	8	1	0	142
SW	29	40	11	2	0	0	82
WSW	29	40	5	0	0	0	74
W	24	46	14	3	0	0	87
WNW	40	99	10	0	0	0	149
NW	46	75	20	0	0	0	141
NNW	27	91	27	0	0	0	145
Total	463	1215	457	46	3	0	2184
Hours of calm data: 13							
Hours of invalid data: 5							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class F							
	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	25	35	1	0	0	0	61
NNE	33	17	0	0	0	0	50
NE	35	7	0	0	0	0	42
ENE	34	13	0	0	0	0	47
E	38	10	0	0	0	0	48
ESE	38	12	0	0	0	0	50
SE	49	72	13	0	0	0	134
SSE	38	234	19	0	0	0	291
S	25	81	11	0	0	0	117
SSW	26	31	3	1	0	0	61
SW	18	27	0	0	0	0	45
WSW	16	14	0	0	0	0	30
W	21	15	3	0	0	0	39
WNW	46	20	0	0	0	0	66
NW	43	33	1	0	0	0	77
NNW	26	36	0	0	0	0	62
Total	511	657	51	1	0	0	1220
Hours of calm data: 29							
Hours of invalid data 0:							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class G							
	Wind Speed at 10.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	41	7	0	0	0	0	48
NNE	33	2	0	0	0	0	35
NE	26	2	0	0	0	0	28
ENE	19	0	0	0	0	0	19
E	12	0	0	0	0	0	12
ESE	12	1	0	0	0	0	13
SE	30	7	0	0	0	0	37
SSE	55	60	3	0	0	0	118
S	28	13	0	0	0	0	41
SSW	22	28	0	0	0	0	50
SW	24	13	0	0	0	0	37
WSW	10	1	0	0	0	0	11
W	8	0	0	0	0	0	8
WNW	23	4	0	0	0	0	27
NW	40	6	0	0	0	0	46
NNW	54	14	0	0	0	0	68
Total	437	158	3	0	0	0	598
Hours of calm data: 31							
Hours of invalid data: 0							
Hours of good data: 8733=99.7% of total hours							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class A							
	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	0	0	0	0	0	0	0
NNE	0	0	1	1	0	0	2
NE	0	0	0	0	0	0	0
ENE	1	0	0	0	0	0	1
E	1	0	0	2	0	0	3
ESE	0	0	0	0	0	0	0
SE	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0
SSW	0	0	4	4	1	0	9
SW	0	0	5	8	1	0	14
WSW	0	0	8	6	2	3	19
W	0	0	5	11	1	0	17
WNW	0	1	6	14	0	0	21
NW	0	0	4	11	3	0	18
NNW	0	0	0	1	0	0	1
Total	2	1	33	58	8	3	105
Hours of calm data: 0							
Hours of invalid data: 3							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class B							
	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	0	3	1	3	0	0	7
NNE	0	2	3	3	1	0	9
NE	0	1	1	0	0	0	2
ENE	1	1	1	2	0	0	5
E	0	0	1	1	0	0	2
ESE	0	0	1	0	0	0	1
SE	0	2	3	0	1	0	6
SSE	0	1	5	5	0	0	11
S	0	0	7	2	1	0	10
SSW	0	3	8	11	4	0	26
SW	0	8	9	5	3	2	27
WSW	0	0	3	1	0	2	6
W	0	1	6	5	2	0	14
WNW	0	1	12	6	1	0	20
NW	0	1	9	10	3	0	23
NNW	0	2	2	3	1	0	8
Total	1	26	72	57	17	4	177
Hours of calm data: 0							
Hours of invalid data: 3							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class C							
	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	2	8	6	7	0	0	23
NNE	1	6	11	0	0	0	18
NE	0	4	7	0	0	0	11
ENE	1	8	8	2	0	0	19
E	1	4	4	0	0	0	9
ESE	0	6	10	3	1	0	20
SE	0	5	21	1	1	0	28
SSE	0	13	24	5	1	0	43
S	0	9	21	13	3	0	46
SSW	0	23	21	17	3	0	64
SW	0	14	25	6	0	1	46
WSW	1	7	2	3	0	2	15
W	0	14	5	3	0	0	22
WNW	1	11	17	15	0	0	44
NW	0	19	34	6	5	3	67
NNW	0	14	14	1	2	0	31
Total	7	165	230	82	16	6	506
Hours of calm data: 0							
Hours of invalid data: 0							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class D							
	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	12	70	124	51	2	0	259
NNE	16	88	132	49	14	1	300
NE	14	52	68	14	0	0	148
ENE	18	41	88	10	1	0	158
E	7	33	59	18	0	0	117
ESE	14	47	124	62	1	0	248
SE	15	82	127	54	10	0	288
SSE	17	93	103	77	15	1	306
S	12	99	99	61	36	12	319
SSW	12	56	85	70	36	3	262
SW	10	46	59	53	7	3	178
WSW	7	30	30	21	8	5	101
W	8	28	43	47	42	17	185
WNW	18	37	110	130	45	9	349
NW	3	61	146	95	31	7	343
NNW	19	77	121	58	16	0	291
Total	202	940	1518	870	264	58	3852
Hours of calm data: 2							
Hours of invalid data: 31							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class E							
	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	5	33	55	26	0	0	119
NNE	4	25	81	3	0	0	113
NE	3	32	53	2	0	0	90
ENE	1	24	25	7	0	0	57
E	2	17	32	2	0	0	53
ESE	5	22	50	11	0	0	88
SE	5	27	117	46	2	0	197
SSE	3	30	140	138	13	0	324
S	3	29	113	136	17	3	301
SSW	3	21	66	81	12	2	185
SW	2	19	41	36	1	1	100
WSW	5	22	31	11	1	0	70
W	2	23	30	32	3	1	91
WNW	2	5	90	49	5	0	151
NW	4	13	83	31	5	0	136
NNW	0	16	67	36	1	0	120
Total	49	358	1074	647	60	7	2195
Hours of calm data: 2							
Hours of invalid data: 5							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class F							
	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	1	13	29	10	0	0	53
NNE	5	10	30	10	0	0	55
NE	4	10	39	3	0	0	56
ENE	4	11	23	0	0	0	38
E	1	10	41	0	0	0	52
ESE	2	17	42	5	0	0	66
SE	6	14	88	16	0	0	124
SSE	2	18	93	74	0	0	187
S	3	12	110	60	1	0	186
SSW	2	11	63	35	1	0	112
SW	2	10	23	20	0	0	55
WSW	2	14	25	12	0	0	53
W	2	7	12	12	3	0	36
WNW	1	8	27	18	0	0	54
NW	1	6	31	23	0	0	61
NNW	2	5	31	22	0	0	60
Total	40	176	707	320	5	0	1248
Hours of calm data: 1							
Hours of invalid data: 0							

Totals of Hours at Each wind Speed and Direction
January 1, 2010 - December 31, 2010

Stability Class G							
	Wind Speed at 60.00 Meter Level (MPH)						
	1-3	*4-7*	*8-12*	*13-18*	*19-24*	*>24*	*TOTAL*
N	5	16	15	7	0	0	43
NNE	0	11	26	6	0	0	43
NE	0	19	28	11	0	0	58
ENE	5	6	20	1	0	0	32
E	3	9	19	1	0	0	32
ESE	0	10	22	1	0	0	33
SE	2	15	25	0	0	0	42
SSE	2	7	24	3	0	0	36
S	3	16	33	23	0	0	75
SSW	3	19	28	17	0	0	67
SW	2	5	18	20	0	0	45
WSW	4	8	19	9	0	0	40
W	2	8	13	1	0	0	24
WNW	1	9	5	1	1	0	17
NW	2	3	7	8	0	0	20
NNW	1	5	12	1	0	0	19
Total	35	166	314	110	1	0	626
Hours of calm data: 3							
Hours of invalid data: 0							
Hours of good data: 8717=99.5% of total hours							

Appendix C

Corrections to the 2008 Annual Radiological Effluent Release Report

Table A-4: Dose Assessments, 10 CFR 50, Appendix I for 2008

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Yearly total
Liquid Effluent Dose Limit, Total Body (mrem)	1.5	1.5	1.5	1.5	3
Total Body Dose (mrem)	*	*	*	*	1.65E-02
% Limit (%)	*	*	*	*	0.55%
Liquid Effluent Dose Limit, Maximum Organ (mrem)	5	5	5	5	10
Maximum Organ Dose (mrem)	*	*	*	*	2.19E-2
% Limit (%)	*	*	*	*	0.22%
Gaseous Effluent Dose Limit, Gamma Air (mrem)	5	5	5	5	10
Gamma Air Dose (mrad)	*	*	*	*	1.50E-03
% Limit (%)	*	*	*	*	0.01%
Gaseous Effluent Dose Limit, Beta Air (mrem)	10	10	10	10	20
Beta Air Dose (mrad)	*	*	*	*	3.88E-03
% Limit (%)	*	*	*	*	0.02%
Gaseous Effluent Dose Limit, Maximum Organ (mrem)	7.5	7.5	7.5	7.5	15
Maximum organ dose[12] (mrem)	4.00E-03	2.78E-03	4.97E-03	8.06E-03	1.97E-02
% Limit (%)	0.05%	0.04%	0.07%	0.11%	0.13%

* Originally presented in the format of Regulatory Guide 1.21, rev. 1.

[12] Iodine, ^{3}H, and particulates with greater than an 8 day half- life.

Table A-5: EPA 40 CFR 190 Individual in the Unrestricted Area for 2008			
	Whole Body	**Thyroid**	**Any Other Organ**
Dose Limit	25 mrem	75 mrem	25 mrem
Dose	1.13E-02	1.09E-02	1.09E-02
% Limit	0.05%	0.01%	0.04%

Appendix D

Corrections to the 2009 Annual Radiological Effluent Release Report

Table A-4: Dose Assessments, 10 CFR 50, Appendix I for 2009

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Yearly total
Liquid Effluent Dose Limit, Total Body (mrem)	1.5	1.5	1.5	1.5	3
Total Body Dose (mrem)	*	*	*	*	5.67E-03
% Limit (%)	*	*	*	*	0.19%
Liquid Effluent Dose Limit, Maximum Organ (mrem)	5	5	5	5	10
Maximum Organ Dose (mrem)	*	*	*	*	8.18E-03
% Limit (%)	*	*	*	*	0.08%
Gaseous Effluent Dose Limit, Gamma Air (mrem)	5	5	5	5	10
Gamma Air Dose (mrad)	*	*	*	*	2.97E-03
% Limit (%)	*	*	*	*	0.03%
Gaseous Effluent Dose Limit, Beta Air (mrem)	10	10	10	10	20
Beta Air Dose (mrad)	*	*	*	*	7.38E-03
% Limit (%)	*	*	*	*	0.04%
Gaseous Effluent Dose Limit, Maximum Organ (mrem)	7.5	7.5	7.5	7.5	15
Maximum organ dose[13] (mrem)	1.27E-03	1.88E-03	4.29E-03	1.59E-03	9.03E-03
% Limit (%)	0.02%	0.03%	0.06%	0.02%	0.06%

* Originally presented in the format of Regulatory Guide 1.21, rev. 1.

[13] Iodine, ^{3}H, and particulates with greater than an 8 day half- life.

Table A-5: EPA 40 CFR 190 Individual in the Unrestricted Area for 2009			
	Whole Body	**Thyroid**	**Any Other Organ**
Dose Limit	25 mrem	75 mrem	25 mrem
Dose	1.01E-2	9.47E-3	9.47E-3
% Limit	0.04%	0.01%	0.04%