Enclosure A
L-11-041

2010 Radioactive Effluent Release Report and
2010 Annual Radiological Environmental Operating Report
(Report follows)

RTL# A9.690E

FIRSTENERGY NUCLEAR OPERATING COMPANY

BEAVER VALLEY POWER STATION

2010 RADIOACTIVE EFFLUENT RELEASE REPORT

AND

2010 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

BEAVER VALLEY POWER STATION

ENVIRONMENTAL & CHEMISTRY SECTION

Technical Report Approval:

2010 RADIOACTIVE EFFLUENT RELEASE REPORT

AND

2010 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

UNITS NO. 1 AND 2

LICENSES DPR-66 AND NPF-73

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Subject: **Beaver Valley Power Station, Unit Nos. 1 and 2**
BV-1 Docket No. 50-334, License No. DPR-66
BV-2 Docket No. 50-412, License No. NPF-73
Radioactive Effluent Release Report for 2010, and
Annual Radiological Environmental Operating Report for 2010

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BVPS Document Control, RTL A9.690E
BVRC - *Keywords: Radioactive Effluent Release Report, Annual Radiological Environmental Operating Report*

Beaver Valley Power Station - Units 1 & 2

2010 Radioactive Effluent Release Report

FirstEnergy Nuclear Operating Company
FENOC

Beaver Valley Power Station - Units 1 & 2
Unit 1 License No. DPR-66
Unit 2 License No. NPF-73

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Radioactive Effluent Release Report

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Executive Summary - Report Submittal Requirements

Report Submittal and Requirements: The report was prepared and submitted in accordance with the requirements contained in the following documents:

BVPS Integrated Technical Specifications, Administrative Control 5.6.2

Offsite Dose Calculation Manual (ODCM) procedure 1/2-ODC-3.03, "*Controls for RETS and REMP Programs*", Attachment U, Control 6.9.3

BVPS procedure 1/2-ENV-01.05, *"Compliance with Regulatory Guide 1.21 and Technical Specifications"*

NUREG-1301, "*Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors, Generic Letter 89-01, Supplement No.1, April 1991"*

Regulatory Guide 1.21, "*Measuring Evaluating and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Material in Liquid and Gaseous Effluents from Light-Water Cooled Nuclear Power Plants, Revision 1, June 1974"*

BVPS Condition Report No. CR10-77489, Revision needed for 1/2-ODC-2.03.

BVPS Condition Report No. CR10-78575, Missing filter papers for effluent release samples.

BVPS Condition Report No. CR10-79472, RM-DA-100 will be inoperable for greater than 30 days.

BVPS Condition Report No. CR10-80322, Reduced flow to PAB ventilation vent FR-VS-101.

BVPS Condition Report No. CR10-82309, Elevated tritium confirmed in 4 of 7 new groundwater wells.

BVPS Condition Report No. CR10-86844, 1/2-ODC-2.01, Liquid Effluents, requires mixing eductors for discharging tanks.

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Executive Summary - Liquid and Gaseous Effluent Control (Part 1 of 2)

Onsite Groundwater Monitoring: Seventeen (17) onsite monitoring wells existed prior to 2010. In 2010, two (2) wells were closed because of damage. One (1) of these two (2) wells was not part of the original sampling program because it had previously deteriorated. In August 2010, seven (7) new wells were drilled, making a total of twenty-three (23) monitoring wells. Results from fifteen (15) wells were < 440 pCi/L (BVPS pre-operational mean). Results from two (2) wells were >440 pCi/L, but <2000 pCi/L. Results from five (5) wells (MW-12S/D & MW-14S/D & MW-15) were >2000pCi/L, but <20,000 pCi/L. Results from one (1) well (MW-16) were >20,000 pCi/L, but <30,000 pCi/L. Because BVPS groundwater is not a source of drinking water, a limit of 30,000 pCi/L is the appropriate EPA Reporting Limit. The NEI/FENOC communication level was reached for MW-12S & MW-12D during 2007, and notification to local, state & federal agencies was performed on 10/08/07. Additional communication for new well results was perfomed on 09/08/10. No adverse effect to the offsite environment has been detected at this time, because all offsite groundwater, drinking water and surface water samples were <440 pCi/L.

Onsite Spills: There were no onsite spills >100 gallons.

Decommissioning File Update: There were no items added to the site decommissioning files in accordance with 10CFR50.75(g).

Abnormal Liquid Releases: There were no abnormal liquid releases.

Abnormal Gaseous Releases: There were no abnormal gaseous releases.

Liquid Radwaste Treatment System: The site operated via a shared Liquid Radwaste Treatment System, even though each Unit has its own ion-exchange vessels. Shared operation allowed either Unit to process liquid waste at the Unit of origin, or at the other Unit. Typically, when Unit 1 or 2 high level liquid waste was processed (e.g., coolant recovery waste) it was performed at Unit 1, because it has a carbon pre-conditioning filter.

Gaseous Radwaste Treatment System: The site operated via a shared Gaseous Radwaste Treatment System, even though each Unit has its own charcoal delay beds and storage/decay tanks. Shared operation allowed either Unit to process gaseous waste at the Unit of origin, or at the other Unit. Typically, when Unit 1 or 2 went to a shutdown condition, the gaseous waste was transferred for storage and decay at Unit 2, because Unit 2 has four (4) additional storage tanks.

Radioactive Effluent Release Report

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Executive Summary - Liquid and Gaseous Effluent Control (Part 1 of 2)

Lower Limits of Detectability (LLD): All a-priori calculated LLD met the minimum requirements specified in the ODCM.

Effluent Monitoring Channels Inoperable >30 Days: There were two (2) Effluent Monitoring Instrumentation Channels not returned to Operable status within 30 days. They are described in Table 6.

ODCM Surveillance Deficiencies: There was one (1) ODCM Surveillance Deficiency. It is described in Table 8.

ODCM Changes: There were two (2) changes made to the ODCM.

Meteorological Data Recovery: The Meteorological Data Recovery met the minimum requirement of at-least 90%, as specified in Section 5 of Revision 1 to Regulatory Guide 1.23, Meteorological Monitoring Programs for Nuclear Power Plants.

Population Dose vs. Natural Background: The 0-50 mile total and average population doses were calculated using liquid and gaseous release quantities and real time meteorology. The average population dose is based on four (4) million people within 0-50 miles of the BVPS site. The following comparison to natural background radiation demonstrates that BVPS operations did not adversely affect the surrounding environment.

476 man-mrem =BVPS Total Population Dose for the year

0.0001190 mrem = BVPS Average Individual Dose for the year

296 mrem = Natural Background Individual Dose for the year. This dose value is documented as natural background radiation exposure for an individual in a year from the 1990 BEIR V Report.

Carbon-14 Dose Assessment: The maximum bounding dose to a member of the public resulting from atmospheric C-14 releases from Unit 1 was determined to be less than 2.67 mrem to the bone and less than 0.53 mrem to all other organs. The child is the controlling age group. The maximum bounding dose to a member of the public resulting from atmospheric C-14 releases from Unit 2 releases from Unit 2 was determined to be less than 2.96 mrem to the bone and less than 0.59 mrem to all other organs. The child is the controlling age group. These calculations are included in Attachment 3 and were provided by Key Solutions, Inc.

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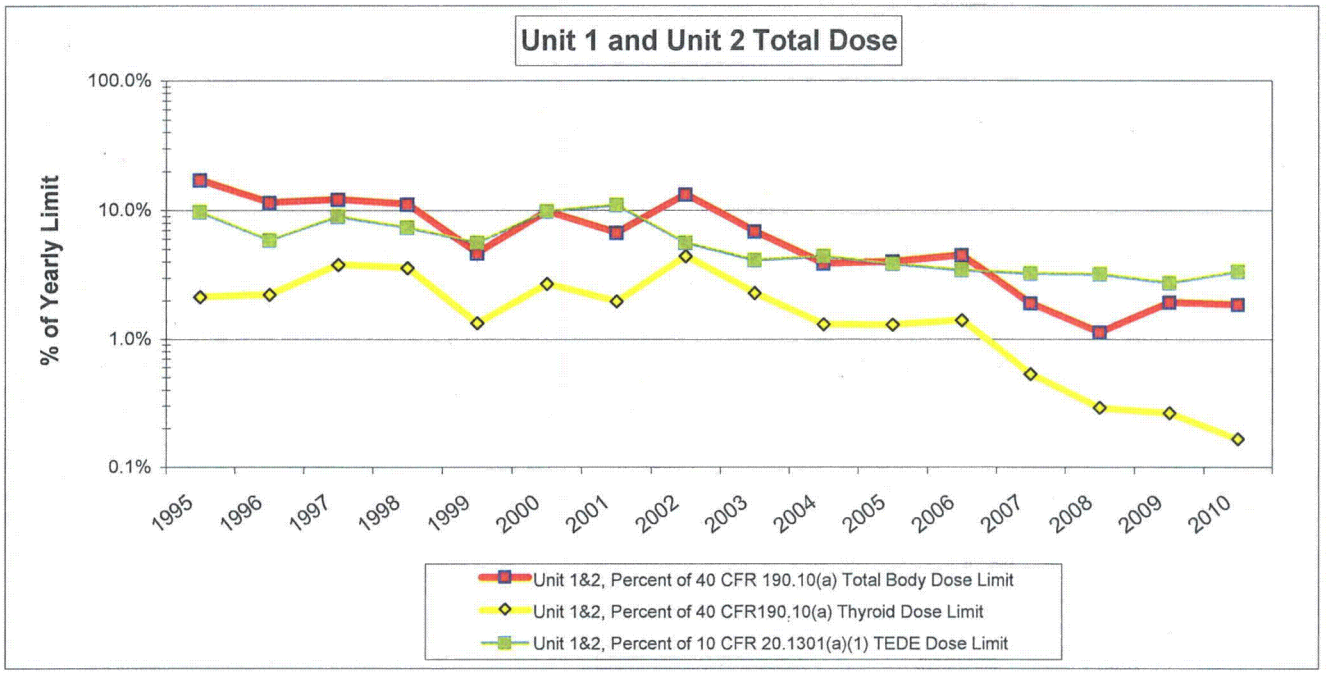
Executive Summary - Trends of Total Dose

Trends of Total Dose: The following graph provides a comparison of the ODCM dose projections from all facility releases and direct radiation exposures to show compliance with Member of the Public dose limits from 10 CFR 20.1301 and 40 CFR Part 190. The graph reflects the results of the efforts to stabilize and reduce offsite dose.



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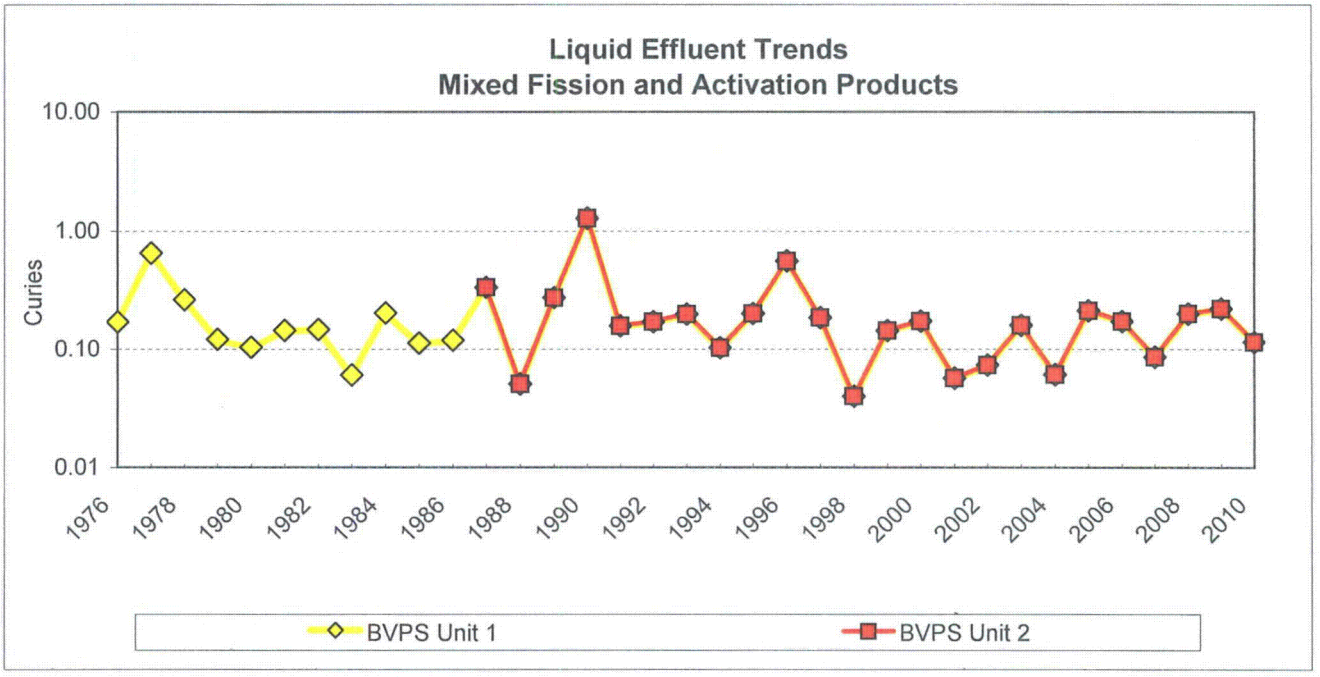
Executive Summary - Trends of Liquid Release Activity (Fission and Activation Products)

Liquid Release Activity (Fission and Activation Products): The following graph provides a comparison of total liquid mixed fission and activation product (particulate) radioactivity discharged from the site from 1976 to present. The recent increases were due to efforts to reduce overall offsite dose. Specifically, discharging liquid radioactive inventory provided the benefit of reduced total offsite dose, due to reduction in evaporative losses from the fuel pools.



Radioactive Effluent Release Report

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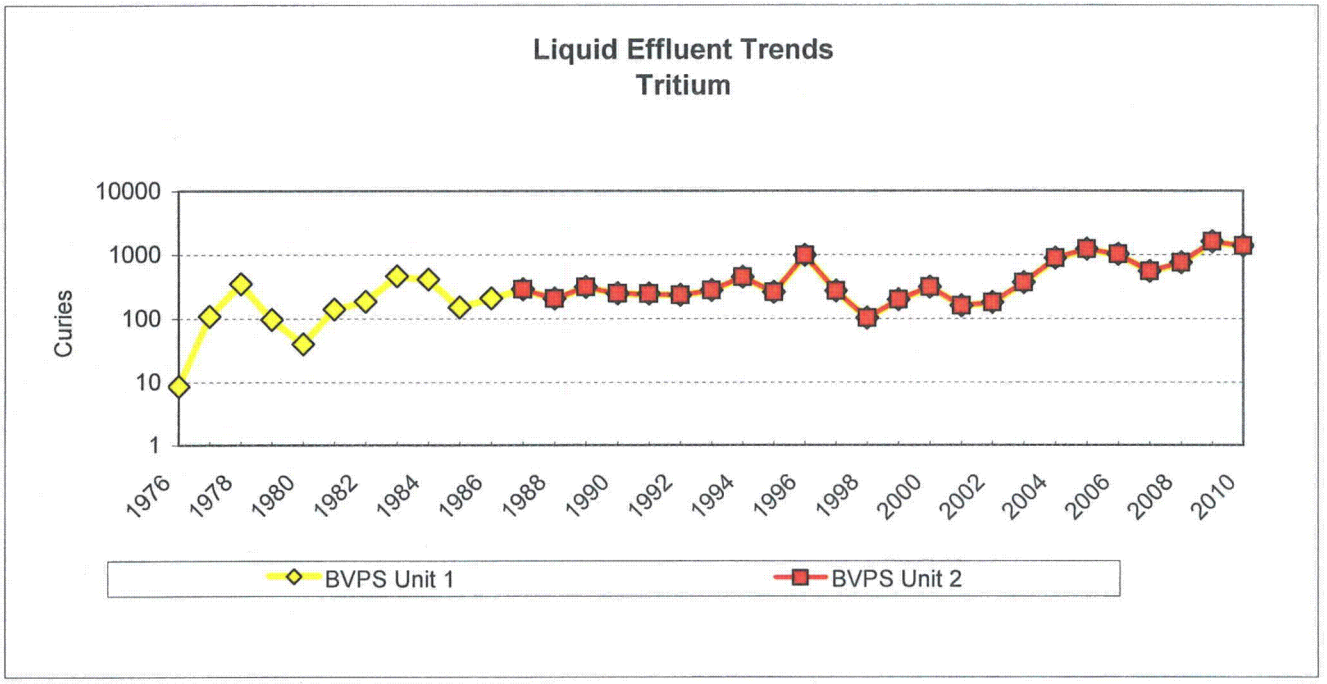
Executive Summary - Trends of Liquid Release Activity (Tritium)

Liquid Release Activity (Tritium): The following graph provides a comparison of total liquid tritium radioactivity discharged from the site from 1976 to present. The recent increases were due to efforts to reduce overall offsite dose. Specifically, discharging liquid radioactive inventory provided the benefit of reduced total offsite dose, due to reduction in evaporative losses from the fuel pools.



Radioactive Effluent Release Report

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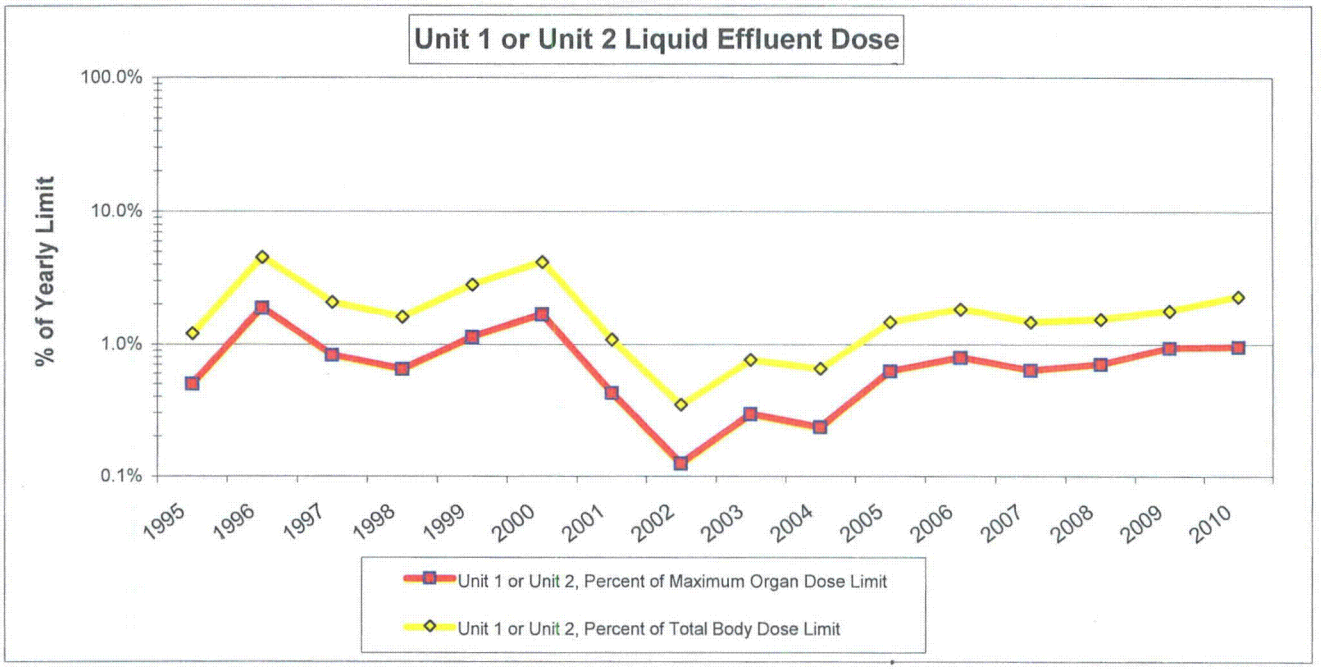
Executive Summary - Trends of Liquid Release Offsite Dose Projections

Liquid Release Offsite Dose Projections: The following graph provides a comparison of liquid offsite dose projections that were calculated to the maximum individual per 10 CFR 50, Appendix I and the ODCM. The projections use ODCM default flow rates for the receiving water (Ohio River), and were performed prior to release authorization. The recent increases were due to efforts to reduce overall offsite dose. Specifically, discharging liquid radioactive inventory provided the benefit of reduced total offsite dose, due to reduction in evaporative losses from the fuel pools.



Radioactive Effluent Release Report

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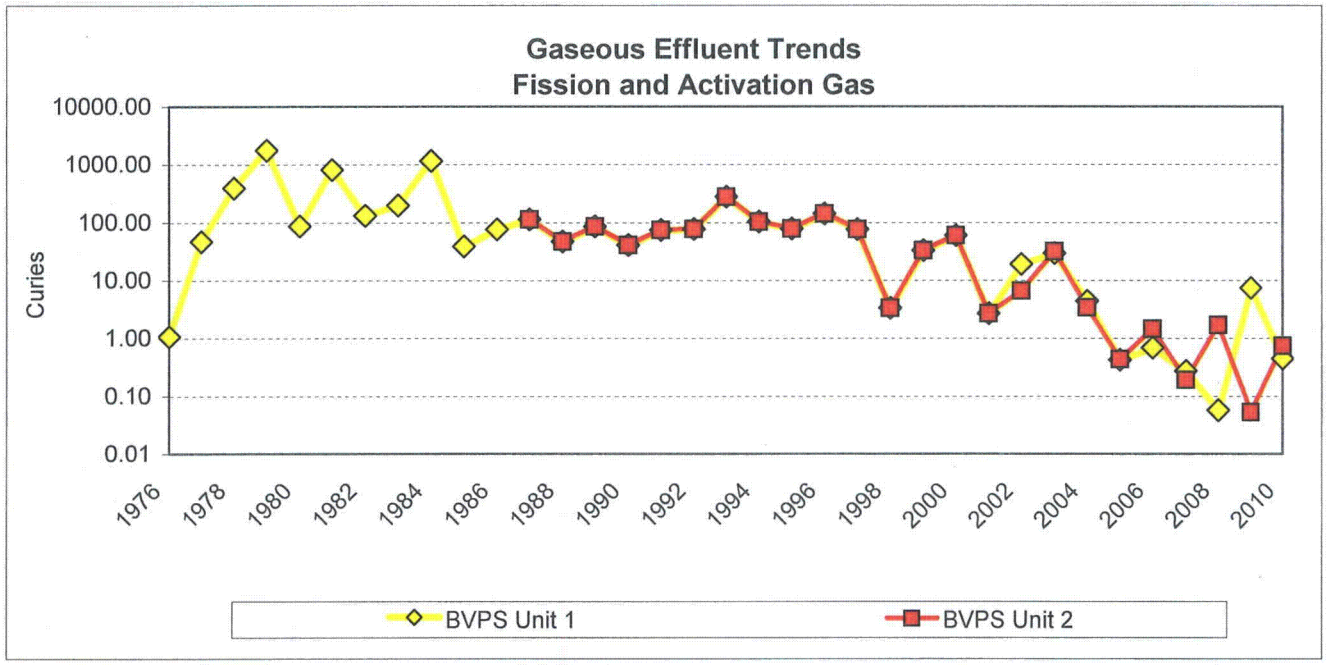
Executive Summary - Trends of Gaseous Release Activity (Fission and Activation Gas)

Gaseous Release Activity (Fission and Activation Gas): The following graph provides a comparison of total gaseous fission and activation gas discharged from the site from 1976 to present. The steady decreases are due to extended hold-up periods of gas space prior to release.



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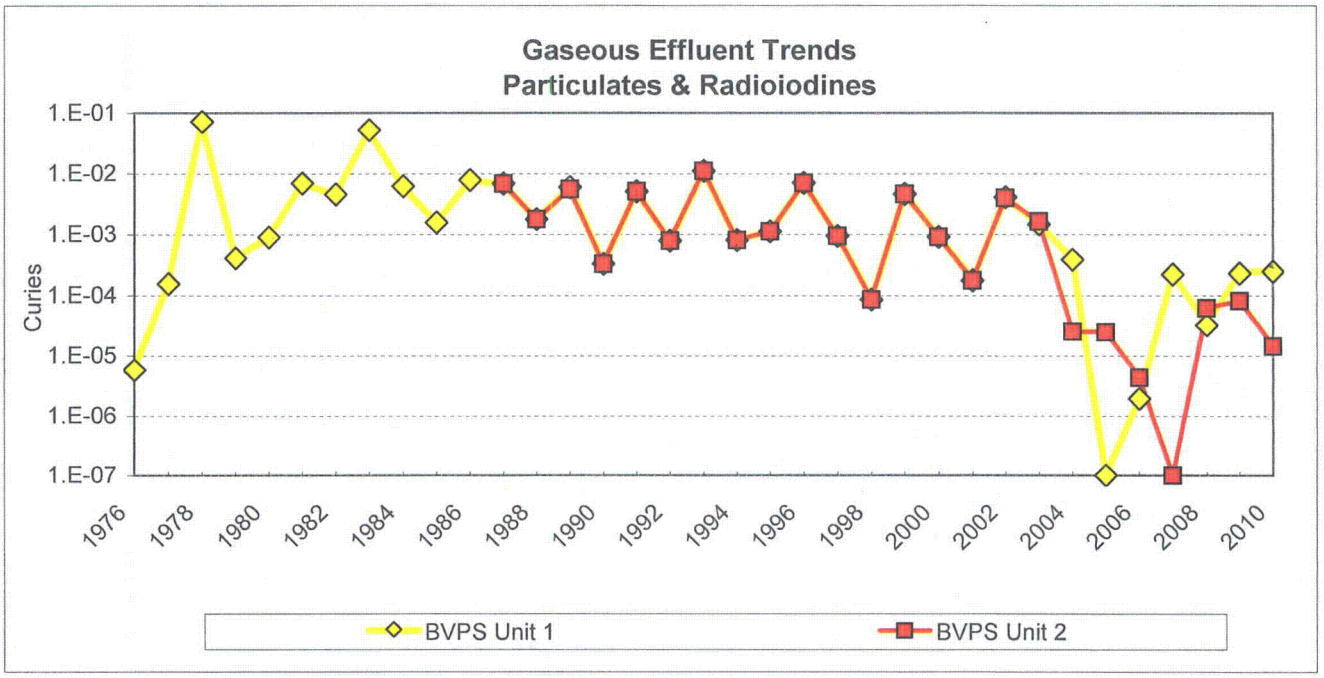
Executive Summary - Trends of Gaseous Release Activity (Particulates and Radioiodines)

Gaseous Release Activity (Particulates and Radioiodines): The following graph provides a comparison of total gaseous particulates and radioiodines discharged from the site from 1976 to present. The recent variations are due to identification of Co-58 in weekly effluent pathway samples during refueling outages at both Units 1 and 2, while decreasing trends are due to extended hold-up periods of gas space prior to release.



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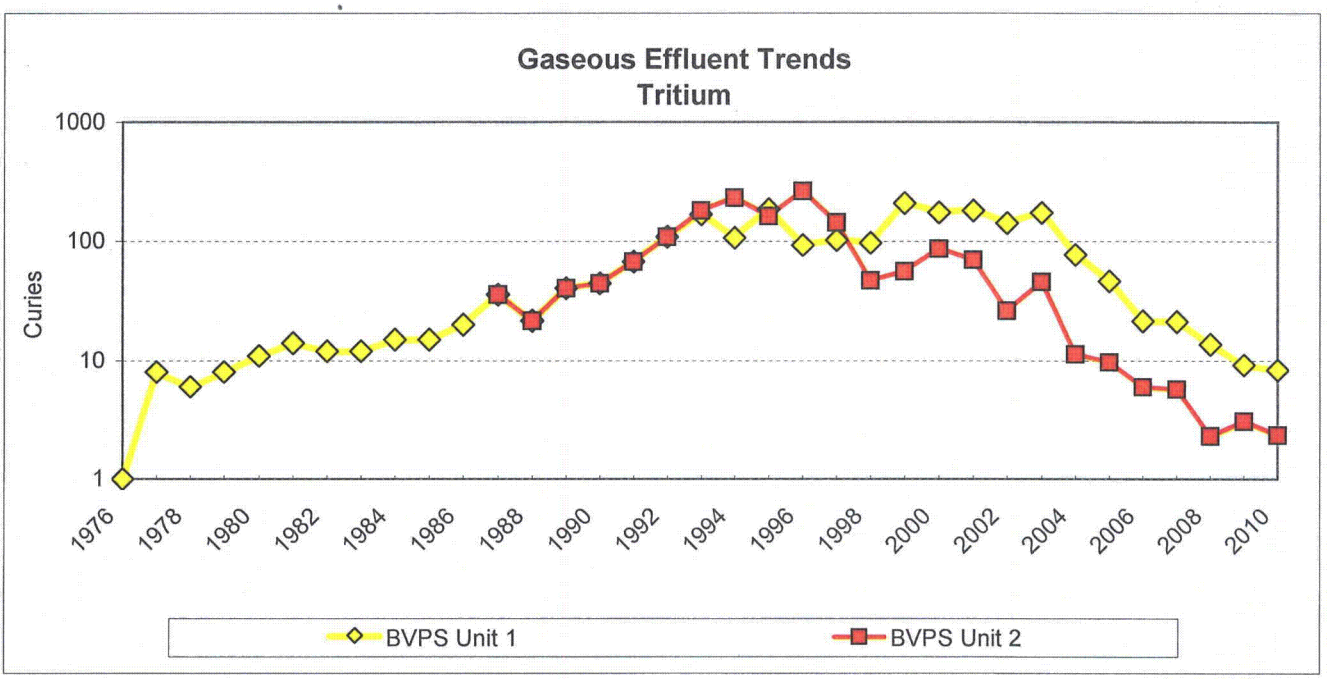
Executive Summary - Trends of Gaseous Release Activity (Tritium)

Gaseous Release Activity (Tritium): The following graph provides a comparison of total gaseous tritium discharged from the site from 1976 to present. The recent decreases were due to efforts to reduce overall offsite dose. Specifically, discharging liquid radioactive inventory provided the benefit of reduced total offsite dose, due to reduction in evaporative losses from the fuel pools.



Radioactive Effluent Release Report

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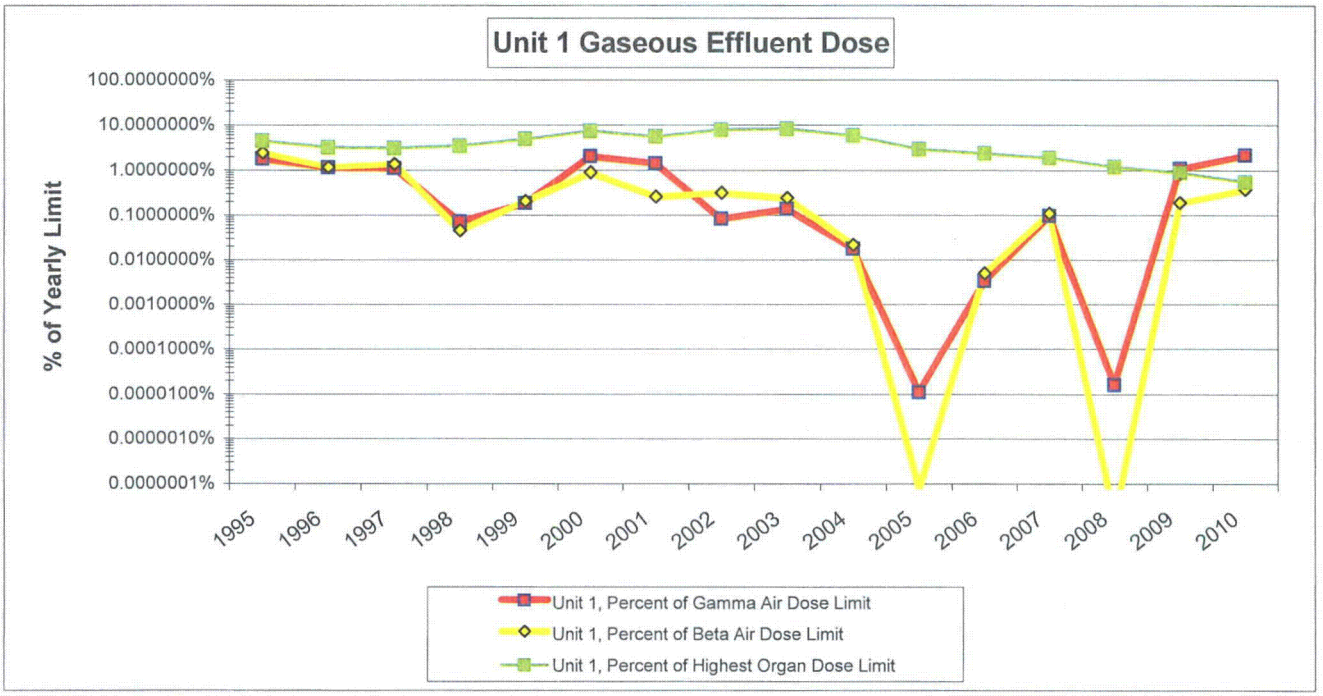
Executive Summary - Trends of Unit 1 Gaseous Release Offsite Dose Projections

Unit 1 Gaseous Release Offsite Dose Projections: The following graph provides a comparison of Unit 1 gaseous offsite dose projections that were calculated to the maximum individual per 10 CFR 50, Appendix I and the ODCM. The projections use ODCM default meteorological parameters for the atmospheric conditions surrounding the plant site, and were performed prior to release authorization. The steady decrease in highest organ dose was due to efforts to reduce overall offsite dose. Specifically, discharging liquid radioactive inventory provided the benefit of reduced total offsite dose, due to reduction in evaporative losses from the fuel pools.



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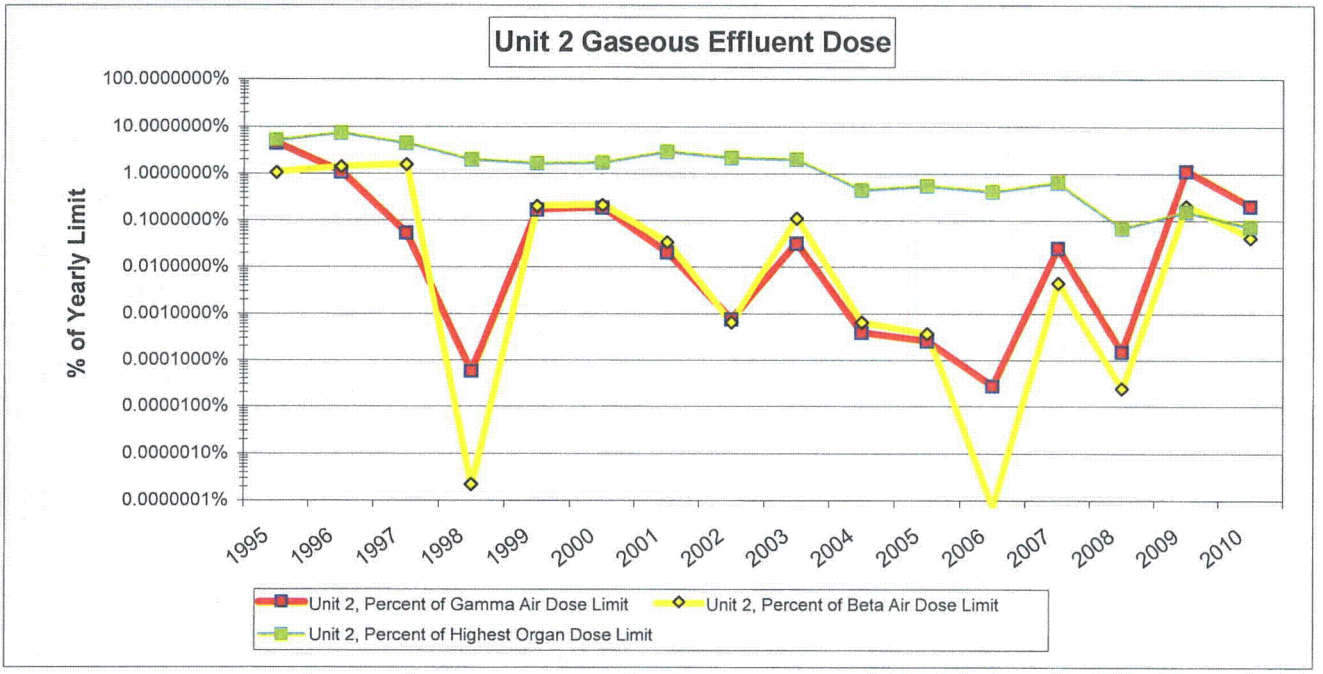
Executive Summary - Trends of Unit 2 Gaseous Release Offsite Dose Projections

Unit 2 Gaseous Release Offsite Dose Projections: The following graph provides a comparison of Unit 2 gaseous offsite dose projections that were calculated to the maximum individual per 10 CFR 50, Appendix I and the ODCM. The projections use ODCM default meteorological parameters for the atmospheric conditions surrounding the plant site, and were performed prior to release authorization. The steady decrease in highest organ dose was due to efforts to reduce overall offsite dose. Specifically, discharging liquid radioactive inventory provided the benefit of reduced total offsite dose, due to reduction in evaporative losses from the fuel pools.



Radioactive Effluent Release Report

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Results of Abnormal Releases

Abnormal Liquid Releases: None

Abnormal Gas Releases: None

Radioactive Effluent Release Report

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Results of Onsite Spills and Items Added to Decommissioning Files per 10CFR50.75(g)

Summary of Onsite Spills (>100 gallons): None

Summary of Items added to Decommissioning Files per 10CFR50.75(g) Files: None

Radioactive Effluent Release Report

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Results of Onsite Groundwater Monitoring Program

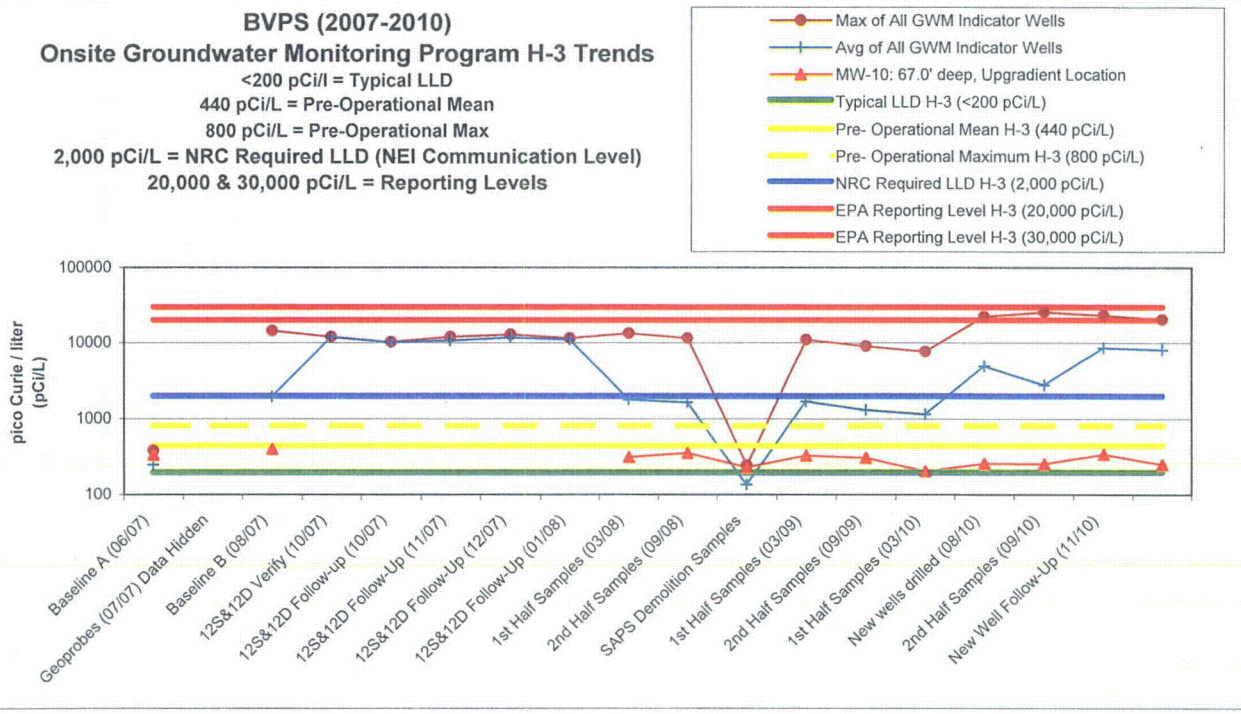
Summary of Onsite Groundwater Samples

	2010 H-3 Maximum (pCi/L)	2010 H-3 Minimum (pCi/L)	2010 H-3 Average (pCi/L)	Typical H-3 LLD (pCi/L)	Required H-3 LLD (pCi/L)	Pre Operational Mean For H-3 (pCi/L)	Are Any H-3 Analyses Greater Than The Pre Operational Mean For H-3 ?	NEI and FENOC Communication Level For H-3 (pCi/L)	EPA Reporting Level For H-3 (pCi/L)
1st Quarter	7639	144	1155	<200	<2000	440	Yes	2000	30000
Aug	22387	183	4950	<200	<2000	440	Yes	2000	30000
3rd Quarter	25583	132	2766	<200	<2000	440	Yes	2000	30000
Nov	23171	5860	8560	<200	<2000	440	Yes	2000	30000
Dec	20488	4838	8099	<200	<2000	440	Yes	2000	30000

H-3 Summary: Seventeen (17) onsite monitoring wells existed prior to 2010. In 2010, two (2) wells were closed because of damage. One (1) of these two (2) wells was not part of the original sampling program because it had previously deteriorated. In August 2010, seven (7) new wells were drilled, making a total of twenty-three (23) monitoring wells. Results from fifteen (15) wells were < 440 pCi/L (BVPS pre-operational mean). Results from two (2) wells were >440 pCi/L, but <2000 pCi/L. Results from five (5) wells (MW-12S/D & MW-14S/D & MW-15) were >2000pCi/L, but <20,000 pCi/L. Results from one (1) well (MW-16) were >20,000 pCi/L, but <30,000 pCi/L. Because BVPS groundwater is not a source of drinking water, a limit of 30,000 pCi/L is the appropriate EPA Reporting Limit. The NEI/FENOC communication level was reached for MW-12S & MW-12D during 2007, and notification to local, state & federal agencies was performed on 10/08/07. Additional communication for new well results was perfomed on 09/08/10. No adverse effect to the offsite environment has been detected at this time, because all offsite groundwater, drinking water and surface water samples were <440 pCi/L.

Principal Gamma Emmitter Summary: Twenty-three (23) onsite monitoring wells were sampled during the year, and analyzed for Principal Gamma Emitters. The results showed no positive indication of Licensed Radioactive Material (LRM) in any of the analyses.

BVPS (2007-2010)
Onsite Groundwater Monitoring Program H-3 Trends
<200 pCi/l = Typical LLD
440 pCi/L = Pre-Operational Mean
800 pCi/L = Pre-Operational Max
2,000 pCi/L = NRC Required LLD (NEI Communication Level)
20,000 & 30,000 pCi/L = Reporting Levels



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Corrections to previous Radioactive Effluent Release Reports

Correction(s) to Previous Radioactive Effluent Release Reports: None

Radioactive Effluent Release Report

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Supplemental Information Page

FACILITY: B.V.P.S. Units 1 and 2 LICENSEE: FENOC

1. Regulatory Limits	
a. Fission and activation gases:	Annual Unit 1 or 2 Dose: 10 mrad from Gamma, & 20 mrad from Beta
b. Iodines & particulates, half-lives > 8 days:	Annual Unit 1 or 2 Dose: 15 mrem to Any Organ
c. Liquid effluents:	Annual Unit 1 or 2 Dose: 3 mrem to Total Body, & 10 mrem to Any Organ

2. Maximum Permissable Concentrations Used In Determining Allowable Release Rates Or Concentrations	
a. Fission and activation gases:	Site Release Rate: 500 mrem/yr to Total Body, & 3000 mrem/yr to the Skin
b. Iodines & particulates, half-lives > 8 days:	Site Release Rate: 1500 mrem/yr to Any Organ
c. Liquid effluents:	Site Release Concentration: 10 times 10 CFR 20 Appendix B, Table 2, EC's

3. Average Energy (Not Applicable To The BVPS ODCM)

4. Measurements and Approximations of Total Radioactivity	
The methods used to measure or approximate the total radioactivity in effluents, and the methods used to determine radionuclide composition are as follows:	
a. Fission and activation gases:	Ge Gamma Spectrometry, Liquid Scintillation Counter
b. Iodines:	Ge Gamma Spectrometry
c. Particulates, half-lives > 8 days:	Ge Gamma Spectrometry, Proportional Counter
d. Liquid effluents:	Ge Gamma Spectrometry, Proportional Counter, Liquid Scintillation

5. Batch & Abnormal Release Information	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
a. Liquid Batch Releases						
1. Number of batch releases		28	31	42	37	138
2. Total time period for batch releases	minutes	8130	8480	14963	12306	43879
3. Maximum time period for a batch release	minutes	1033	1000	990	955	1033
4. Average time period for batch releases	minutes	290	274	356	333	318
5. Minimum time period for a batch release	minutes	98	96	12	100	12
6. Average river flow during release periods	cuft/sec	60167	33067	10100	32267	33900
b. Gaseous Batch Releases						
1. Number of batch releases		11	8	9	18	46
2. Total time period for batch releases	minutes	5450	104	481	7756	13791
3. Maximum time period for a batch release	minutes	4759	58	405	3933	4759
4. Average time period for batch releases	minutes	495	13	53	431	300
5. Minimum time period for a batch release	minutes	13	46	16	0.2	0
c. Abnormal Liquid Releases						
1. Number of releases		NONE	NONE	NONE	NONE	NONE
2. Total activity released	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
d. Abnormal Gaseous Releases						
1. Number of releases		NONE	NONE	NONE	NONE	NONE
2. Total activity released	Curies	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

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Table 1A

Gaseous Effluents - Summation Of All Releases

	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year	Total Error, %
A. Fission & Activation Gases							
1. Site Total release	Ci	7.85E-02	3.20E-01	0.00E+00	7.93E-01	1.19E+00	26.5%
1a. Unit 1 Gases	Ci	3.93E-02	0.00E+00	0.00E+00	4.08E-01	4.47E-01	
1b. Unit 2 Gases	Ci	3.93E-02	3.20E-01	0.00E+00	3.85E-01	7.44E-01	
2. Average release rate for period	uCi/sec	9.96E-03	4.05E-02	0.00E+00	1.01E-01	3.78E-02	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
B. Iodines							
1. Site Total iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	28.3%
1a. Unit 1 iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1b. Unit 2 iodine - 131	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
C. Particulates							
1. Particulates with half-lives > 8 days	Ci	5.47E-06	0.00E+00	3.10E-05	2.23E-04	2.60E-04	30.0%
1a. Unit 1 Particulates	Ci	0.00E+00	0.00E+00	3.10E-05	2.14E-04	2.45E-04	
1b. Unit 2 Particulates	Ci	5.47E-06	0.00E+00	0.00E+00	8.97E-06	1.44E-05	
2. Average release rate for period	uCi/sec	6.94E-07	0.00E+00	3.93E-06	2.84E-05	8.24E-06	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
D. Gross Alpha							
1. Site Gross alpha radioactivity	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	30.0%
1a. Unit 1 Gross alpha	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
1b. Unit 2 Gross alpha	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
2. Average release rate for period	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	
E. Tritium							
1. Site Total release	Ci	2.35E+00	2.66E+00	3.87E+00	1.75E+00	1.06E+01	32.9%
1a. Unit 1 Tritium	Ci	2.10E+00	2.01E+00	2.69E+00	1.50E+00	8.30E+00	
1b. Unit 2 Tritium	Ci	2.49E-01	6.46E-01	1.18E+00	2.50E-01	2.33E+00	
2. Average release rate for period	uCi/sec	2.98E-01	3.37E-01	4.91E-01	2.22E-01	3.37E-01	
3. Percent of applicable limit	%	N/A	N/A	N/A	N/A	N/A	

N/A = Not Applicable

The amount of time (in seconds) used to calculate the release rates specified in A.2, B.2, C.2, D.2 and E.2 is the average amount of seconds per calendar quarter (7.88E+06 seconds).

Radioactive Effluent Release Report

Calendar Year - 2010
Table 1B-EB
Gaseous Effluents - Elevated Batch Releases

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	5.80E-05	5.80E-05
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	5.51E-06	5.51E-06
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	2.51E-03	2.51E-03
xenon-133	Ci	LLD	LLD	LLD	5.88E-03	5.88E-03
xenon-133m	Ci	LLD	LLD	LLD	1.36E-04	1.36E-04
xenon-135	Ci	LLD	LLD	LLD	5.57E-04	5.57E-04
xenon-135m	Ci	LLD	LLD	LLD	6.98E-05	6.98E-05
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	9.22E-03	9.22E-03
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	1.05E-06	1.05E-06
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	1.59E-05	1.59E-05
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
carbon-14	Ci	*	*	*	*	*
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	1.70E-05	1.70E-05

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

* Carbon-14 data provided in Attachment 3 from Key Solutions, Inc.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 1B-EC
Gaseous Effluents - Elevated Continuous Releases

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	7.85E-02	LLD	LLD	7.53E-01	8.32E-01
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	8.31E-03	8.31E-03
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	7.85E-02	ND	ND	7.61E-01	8.40E-01
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	9.86E-07	9.86E-07
carbon-14	Ci	*	*	*	*	*
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	9.86E-07	9.86E-07

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

* Carbon-14 data provided in Attachment 3 from Key Solutions, Inc.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 1C-GB1
Gaseous Effluents - Ground Level Batch Releases (Unit 1)

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	2.25E-02	2.25E-02
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	2.25E-02	2.25E-02
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
carbon-14	Ci	*	*	*	*	*
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

* Carbon-14 data provided in Attachment 3 from Key Solutions, Inc.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 1C-GC1
Gaseous Effluents - Ground Level Continuous Releases (Unit 1)

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	4.25E-05	4.25E-05
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	8.77E-06	1.43E-04	1.52E-04
cobalt-60	Ci	LLD	LLD	2.79E-06	1.46E-05	1.74E-05
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	Ci	LLD	LLD	LLD	5.41E-06	5.41E-06
zirconium/niobium-97	Ci	LLD	LLD	LLD	LLD	LLD
molybdenum-99	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	1.94E-05	LLD	1.94E-05
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
carbon-14	Ci	*	*	*	*	*
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	3.10E-05	2.06E-04	2.36E-04

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

* Carbon-14 data provided in Attachment 3 from Key Solutions, Inc.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 1C-GB2
Gaseous Effluents - Ground Level Batch Releases (Unit 2)

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
beryllium-7	Ci	LLD	LLD	LLD	LLD	LLD
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-60	Ci	LLD	LLD	LLD	LLD	LLD
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-97	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
carbon-14	Ci	*	*	*	*	*
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	ND	ND	ND	ND

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

* Carbon-14 data provided in Attachment 3 from Key Solutions, Inc.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 1C-GC2
Gaseous Effluents - Ground Level Continuous Releases (Unit 2)

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission gases						
argon-41	Ci	LLD	2.37E-01	LLD	LLD	2.37E-01
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
krypton-85m	Ci	LLD	LLD	LLD	LLD	LLD
krypton-87	Ci	LLD	LLD	LLD	LLD	LLD
krypton-88	Ci	LLD	LLD	LLD	LLD	LLD
xenon-131m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	8.25E-02	LLD	LLD	8.25E-02
xenon-135m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-138	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	3.20E-01	ND	ND	3.20E-01
2. Iodines						
iodine-131	Ci	LLD	LLD	LLD	LLD	LLD
iodine-133	Ci	LLD	LLD	LLD	LLD	LLD
iodine-135	Ci	LLD	LLD	LLD	LLD	LLD
Total for period	Ci	ND	ND	ND	ND	ND
3. Particulates						
chromium-51	Ci	LLD	LLD	LLD	LLD	LLD
manganese-54	Ci	LLD	LLD	LLD	LLD	LLD
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-58	Ci	3.13E-06	LLD	LLD	LLD	3.13E-06
cobalt-60	Ci	2.34E-06	LLD	LLD	LLD	2.34E-06
zinc-65	Ci	LLD	LLD	LLD	LLD	LLD
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	LLD	LLD	LLD	LLD	LLD
zirconium/niobium-95	Ci	LLD	LLD	LLD	LLD	LLD
cesium-134	Ci	LLD	LLD	LLD	LLD	LLD
cesium-137	Ci	LLD	LLD	LLD	LLD	LLD
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
selenium-75	Ci	LLD	LLD	LLD	LLD	LLD
carbon-14	Ci	*	*	*	*	*
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	5.47E-06	ND	ND	ND	5.47E-06

LLD = Below the Lower Limit of Detectability, in uCi/cc (Table 4).

ND = None Detected

* Carbon-14 data provided in Attachment 3 from Key Solutions, Inc.

Radioactive Effluent Release Report

Calendar Year - 2010

Table 2A

Liquid Effluents - Summation Of All Releases

	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year	Total Error, %
A. Fission & activation products							
1. Total release (excl. H-3, gas & alpha)	Ci	1.93E-02	2.68E-02	1.94E-02	4.95E-02	1.15E-01	26.1%
2. Average diluted concentration	uCi/ml	2.96E-08	3.98E-08	1.03E-08	6.01E-08	2.85E-08	
3. Percent of applicable limit	%	7.72E-01	1.07E+00	7.75E-01	1.98E+00	1.15E+00	
B. Tritium							
1. Total release	Ci	1.02E+02	1.26E+02	5.94E+02	5.59E+02	1.38E+03	25.0%
2. Average diluted concentration	uCi/ml	1.56E-04	1.87E-04	3.14E-04	6.79E-04	3.42E-04	
3. Percent of applicable limit	%	1.56E+00	1.87E+00	3.14E+00	6.79E+00	3.42E+00	
C. Dissolved and entrained gases							
1. Total release	Ci	ND	3.47E-05	4.71E-05	ND	8.18E-05	27.0%
2. Average diluted concentration	uCi/ml		5.14E-11	2.49E-11		2.02E-11	
3. Percent of applicable limit	%		2.57E-05	1.25E-05		1.01E-05	
D. Gross alpha radioactivity (total release)	Ci	LLD	LLD	LLD	LLD	LLD	28.9%
E. Volume of waste released (prior to dilution)	liters	1.24E+06	1.39E+06	2.15E+06	1.92E+06	6.70E+06	11.2%
F. Volume of dilution water used	liters	6.51E+08	6.74E+08	1.89E+09	8.21E+08	4.03E+09	22.9%

LLD = Below the Lower Limit of Detectability, in uCi/ml (Table 4)

A.3 is based on a historical PA-DEP guide of 10 Ci/yr

B.3 is based on a ODCM limit of 1.00E-2 uCi/ml

C.3 is based on a ODCM limit of 2.00E-04 uCi/ml

The values listed at F. are the volumes during actual liquid waste discharge periods. The total dilution volume for a continuous calendar quarter is approximately 1E+10 liters for BVPS-1 & 2 (ie.; ~ 22,800 gpm is the total dilution flowrate from the site)

Radioactive Effluent Release Report

Calendar Year - 2010

Table 2B-B

Liquid Effluents - Batch Releases

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission and activation products						
beryllium-7	Ci	LLD	LLD	LLD	LLD	LLD
sodium-24	Ci	LLD	LLD	LLD	LLD	LLD
chromium-51	Ci	LLD	LLD	3.42E-04	1.20E-03	1.54E-03
manganese-54	Ci	3.13E-05	5.67E-05	3.50E-05	2.48E-04	3.71E-04
iron-55	Ci	4.37E-03	1.50E-02	7.15E-03	LLD	2.65E-02
iron-59	Ci	LLD	LLD	LLD	LLD	LLD
cobalt-57	Ci	3.72E-05	LLD	7.57E-06	1.02E-04	1.47E-04
cobalt-58	Ci	6.95E-03	1.46E-03	3.30E-03	3.17E-02	4.34E-02
cobalt-60	Ci	1.15E-03	7.29E-04	2.93E-03	3.65E-03	8.46E-03
zinc-65	Ci	LLD	LLD	1.83E-04	2.87E-04	4.70E-04
strontium-89	Ci	LLD	LLD	LLD	LLD	LLD
strontium-90	Ci	5.65E-05	LLD	LLD	LLD	5.65E-05
zirconium/niobium-95	Ci	LLD	LLD	7.59E-05	3.70E-04	4.46E-04
zirconium/niobium-97	Ci	LLD	4.94E-03	LLD	LLD	4.94E-03
molybdenum-99/technetium-99m	Ci	LLD	LLD	1.72E-06	LLD	1.72E-06
tin-113	Ci	LLD	LLD	LLD	LLD	LLD
silver-110m	Ci	2.94E-04	2.81E-03	2.09E-03	5.67E-04	5.76E-03
antimony-122	Ci	LLD	LLD	LLD	LLD	LLD
antimony-124	Ci	5.78E-04	LLD	LLD	1.02E-03	1.60E-03
antimony-125	Ci	5.28E-03	1.58E-03	2.65E-03	7.97E-03	1.75E-02
iodine-131	Ci	LLD	LLD	5.53E-06	2.27E-06	7.80E-06
iodine-133	Ci	LLD	LLD	4.17E-06	LLD	4.17E-06
cesium-134	Ci	LLD	LLD	LLD	2.53E-05	2.53E-05
cesium-137	Ci	5.42E-04	2.72E-04	6.12E-04	2.36E-03	3.79E-03
barium/lanthanum-140	Ci	LLD	LLD	LLD	LLD	LLD
cerium-141	Ci	LLD	LLD	LLD	LLD	LLD
cerium-144	Ci	LLD	LLD	LLD	LLD	LLD
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	1.93E-02	2.68E-02	1.94E-02	4.95E-02	1.15E-01
2. Dissolved and entrained gases						
krypton-85	Ci	LLD	LLD	LLD	LLD	LLD
xenon-133	Ci	LLD	3.47E-05	4.71E-05	LLD	8.18E-05
xenon-133m	Ci	LLD	LLD	LLD	LLD	LLD
xenon-135	Ci	LLD	LLD	LLD	LLD	LLD
carbon-14	Ci	*	*	*	*	*
unidentified	Ci	NONE	NONE	NONE	NONE	NONE
Total for period	Ci	ND	3.47E-05	4.71E-05	ND	8.18E-05

LLD = Below the Lower Limit of Detectability, in uCi/ml (Table 4)

* Carbon-14 data provided in Attachment 3 from Key Solutions, Inc.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 2B-C
Liquid Effluents - Continuous Releases

Nuclides released	Unit	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Calendar Year
1. Fission and activation products						
beryllium-7	Ci	N/A	N/A	N/A	N/A	N/A
sodium-24	Ci	N/A	N/A	N/A	N/A	N/A
chromium-51	Ci	N/A	N/A	N/A	N/A	N/A
manganese-54	Ci	N/A	N/A	N/A	N/A	N/A
iron-55	Ci	N/A	N/A	N/A	N/A	N/A
iron-59	Ci	N/A	N/A	N/A	N/A	N/A
cobalt-57	Ci	N/A	N/A	N/A	N/A	N/A
cobalt-58	Ci	N/A	N/A	N/A	N/A	N/A
cobalt-60	Ci	N/A	N/A	N/A	N/A	N/A
zinc-65	Ci	N/A	N/A	N/A	N/A	N/A
strontium-89	Ci	N/A	N/A	N/A	N/A	N/A
strontium-90	Ci	N/A	N/A	N/A	N/A	N/A
zirconium/niobium-95	Ci	N/A	N/A	N/A	N/A	N/A
zirconium/niobium-97	Ci	N/A	N/A	N/A	N/A	N/A
molybdenum-99	Ci	N/A	N/A	N/A	N/A	N/A
technetium-99m	Ci	N/A	N/A	N/A	N/A	N/A
ruthenium-103	Ci	N/A	N/A	N/A	N/A	N/A
silver-110m	Ci	N/A	N/A	N/A	N/A	N/A
antimony-124	Ci	N/A	N/A	N/A	N/A	N/A
antimony-125	Ci	N/A	N/A	N/A	N/A	N/A
iodine-131	Ci	N/A	N/A	N/A	N/A	N/A
iodine-133	Ci	N/A	N/A	N/A	N/A	N/A
cesium-134	Ci	N/A	N/A	N/A	N/A	N/A
cesium-137	Ci	N/A	N/A	N/A	N/A	N/A
barium/lanthanum-140	Ci	N/A	N/A	N/A	N/A	N/A
cerium-141	Ci	N/A	N/A	N/A	N/A	N/A
cerium-144	Ci	N/A	N/A	N/A	N/A	N/A
unidentified	Ci	N/A	N/A	N/A	N/A	N/A
Total for period	Ci	N/A	N/A	N/A	N/A	N/A
2. Dissolved and entrained gases						
argon-41	Ci	N/A	N/A	N/A	N/A	N/A
xenon-133	Ci	N/A	N/A	N/A	N/A	N/A
xenon-133m	Ci	N/A	N/A	N/A	N/A	N/A
xenon-135	Ci	N/A	N/A	N/A	N/A	N/A
carbon-14	Ci	N/A	N/A	N/A	N/A	N/A
unidentified	Ci	N/A	N/A	N/A	N/A	N/A
Total for period	Ci	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable (liquids not discharged in a continuous mode during this period)

Radioactive Effluent Release Report

Calendar Year - 2010

Table 3A

Solid Waste And Irradiated Fuel Shipments (Part 1 of 3)

A. Solid Waste Shipped Offsite For Burial Or Disposal (Not irradiated fuel)				
1. Type of Waste (Spent resins, Filter Sludges, Evaporator Bottoms, Oil)		1st Half	2nd Half	Estimated Total Error
a. Volume Shipped		1.98E+01 m3	4.04E+00 m3	0.0% (1)
b. Volume Buried		8.03E+00 m3	5.38E+00 m3	0.0% (1)
c. Total Activity		3.59E+02 Ci	5.50E+01 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
H-3		0.14 %	0.03 %	
C-14		0.40 %	0.01 %	
Mn-54		0.69 %	0.22 %	
Fe-55		6.96 %	2.40 %	
Co-58		5.71 %	0.16 %	
Co-60		5.78 %	48.10 %	
Ni-59		0.43 %	0.08 %	
Ni-63		50.40 %	44.00 %	
Zn-65		29.00 %	3.32 %	
Sb-125		0.24 %	1.42 %	
Cs-134		0.00 %	0.01 %	
Cs-137		0.03 %	0.17 %	
Ce-144/Pr-144		0.00 %	0.01 %	
3. Number of Shipments		8	2	
a. Type of Container Used	LSA	6	1	
	Type A	0	0	
	Type B	2	1	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	Urea Formaldehyde	0	0	
	None	8	2	
c. Mode of Transport	Truck	8	2	
	Rail	0	0	
d. Final Destination	Erwin, TN	2	1	
	Oak Ridge, TN	6	1	
e. Waste Class per 10 CFR Part 61	Class A	6	1	
	Class B	1	1	
	Class C	1	0	
	> Class C	0	0	

(1) Since container volumes are provided by the burial site, a calculational error of zero is assumed.
(2) Percent values for any nuclide that are <0.01 % are not shown on this table. Data is available upon request.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 3B
Solid Waste And Irradiated Fuel Shipments (Part 2 of 3)

A. Solid Waste Shipped Offsite For Burial Or Disposal (Not irradiated fuel)				
1. Type of Waste (Dry Compressible Waste, Contaminated Equipment, etc.)		1st Half	2nd Half	Estimated Total Error
a. Volume Shipped		6.12E+01 m3	4.28E+02 m3	0.0% (1)
b. Volume Buried		8.38E+01 m3	4.26E+01 m3	0.0% (1)
c. Total Activity		1.22E-01 Ci	1.55E-01 Ci	30.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
H-3		2.31 %	1.80 %	
C-14		1.48 %	1.04 %	
Mn-54		0.98 %	1.51 %	
Fe-55		44.60 %	29.50 %	
Co-58		3.42 %	1.63 %	
Co-60		19.80 %	24.70 %	
Ni-59		0.38 %	0.28 %	
Ni-63		22.20 %	22.40 %	
Sr-90		0.05 %	0.01 %	
Nb-95		0.31 %	0.62 %	
Zn-65		0.55 %	6.03 %	
Zr-95		0.02 %	1.03 %	
Tc-99		0.02 %	0.00 %	
Ag-110m		0.00 %	5.64 %	
Sb-125		3.16 %	2.53 %	
Cs-137		0.45 %	0.64 %	
Pu-241		0.21 %	0.38 %	
3. Number of Shipments		1	7	
a. Type of Container Used	LSA	1	7	
	Type A	0	0	
	Type B	0	0	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	Urea Formaldehyde	0	0	
	None	1	7	
c. Mode of Transport	Truck	1	7	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Oak Ridge, TN	1	7	
	Wampum, PA	0	0	
e. Waste Class per 10 CFR Part 61	Class A	1	7	
	Class B	0	0	
	Class C	0	0	
	> Class C	0	0	

(1) Since container volumes are provided by the burial site, a calculational error of zero is assumed.
(2) Percent values for any nuclide that are <0.01 % are not shown on this table. Data is available upon request.

Radioactive Effluent Release Report

Calendar Year - 2010

Table 3C

Solid Waste And Irradiated Fuel Shipments (Part 3 of 3)

A. Solid Waste Shipped Offsite For Burial Or Disposal (Not irradiated fuel)				
1. Type of Waste (Irradiated components, Control Rods, etc)		1st Half	2nd Half	Estimated Total Error
a. Volume Shipped		0.00E+00 m3	0.00E+00 m3	0.0% (1)
b. Volume Buried		0.00E+00 m3	0.00E+00 m3	0.0% (1)
c. Total Activity		0.00E+00 Ci	0.00E+00 Ci	0.0%
2. Estimate of Major Nuclide Composition by Type of Waste On This Table (2)		Percent (%)	Percent (%)	
3. Number of Shipments		0	0	
a. Type of Container Used	LSA	0	0	
	Type A	0	0	
	Type B	0	0	
	Large Quantity	0	0	
b. Solidification Agent Used	Cement	0	0	
	Urea Formaldehyde	0	0	
	None	0	0	
c. Mode of Transport	Truck	0	0	
	Rail	0	0	
	Other	0	0	
d. Final Destination	Barnwell, SC	0	0	
	Oak Ridge, TN	0	0	
e. Waste Class per 10 CFR Part 61	Class A	0	0	
	Class B	0	0	
	Class C	0	0	
	> Class C	0	0	
B. No Irradiated Fuel Shipments				

(1) Since container volumes are provided by the burial site, a calculational error of zero is assumed.
(2) Percent values for any nuclide that are <0.01 % are not shown on this table. Data is available upon request.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 4
Lower Limits Of Detectability (LLD)

Nuclide	RWDA-G 1000 cc Gas Grab Sample		RWDA-L 1000 ml Liquid Grab Sample		Filter Paper / Charcoal Continuous Effluent Sample	
	(3) Calculated LLD (uCi/cc)	ODCM Required LLD (uCi/cc)	(3) Calculated LLD (uCi/ml)	ODCM Required LLD (uCi/ml)	(3) Calculated (2) LLD (uCi/cc)	ODCM Required LLD (uCi/cc)
H-3	(4) 1.00E-06	1E-06	1.00E-06	1E-05	-------	-----
Na-24	1.48E-08	1E-04	3.60E-09	5E-07	2.48E-14	1E-11
Ar-41	4.48E-08	1E-04	1.09E-08	5E-07	-------	-----
Cr-51	4.53E-07	1E-04	1.17E-07	5E-07	7.09E-13	1E-11
Mn-54	6.90E-08	1E-04	1.68E-08	5E-07	1.58E-14	1E-11
Fe-55	-------	-----	(1) 1.00E-06	1E-06	-------	-----
Fe-59	1.37E-07	1E-04	3.35E-08	5E-07	3.61E-14	1E-11
Co-57	4.54E-08	1E-04	1.35E-08	5E-07	6.07E-14	1E-11
Co-58	4.29E-08	1E-04	1.04E-08	5E-07	8.49E-14	1E-11
Co-60	5.79E-08	1E-04	1.41E-08	5E-07	9.67E-14	1E-11
Zn-65	1.18E-07	1E-04	2.89E-08	5E-07	1.61E-13	1E-11
Se-75	-------	-------	-------	-------	8.71E-14	1E-11
Kr-85	1.96E-05	1E-04	4.83E-06	1E-05	-------	-----
Kr-85m	5.91E-08	1E-04	1.69E-08	1E-05	-------	-----
Kr-87	1.20E-07	1E-04	3.02E-08	1E-05	-------	-----
Kr-88	1.57E-07	1E-04	4.31E-08	1E-05	-------	-----
Sr-89	-------	-----	(1) 5.00E-08	5E-08	(1) 1.00E-13	1E-11
Sr-90	-------	-----	(1) 5.00E-08	5E-08	(1) 1.00E-14	1E-11
Sr-92	7.40E-08	1E-04	1.80E-08	5E-07	8.81E-14	1E-11
Nb-95	2.88E-08	1E-04	6.99E-09	5E-07	6.56E-14	1E-11
Nb-97	5.15E-08	1E-04	1.26E-08	5E-07	9.19E-14	1E-11
Zr-95	1.15E-07	1E-04	2.79E-08	5E-07	8.28E-14	1E-11
Mo-99	4.97E-08	1E-04	1.44E-08	5E-07	4.55E-14	1E-11
Tc-99m	4.84E-08	1E-04	1.40E-08	5E-07	4.43E-14	1E-11
Ag-110m	5.35E-08	1E-04	1.30E-08	5E-07	8.54E-14	1E-11
Sb-124	7.18E-08	1E-04	1.76E-08	5E-07	6.59E-14	1E-11
Sb-125	1.96E-07	1E-04	4.92E-08	5E-07	1.61E-13	1E-11
I-131	5.86E-08	1E-04	1.49E-08	1E-06	7.22E-14	1E-12
I-133	5.95E-08	1E-04	1.47E-08	5E-07	7.36E-14	1E-10
I-135	2.15E-07	1E-04	5.25E-08	5E-07	8.78E-14	1E-11
Xe-131m	2.31E-06	1E-04	6.50E-07	1E-05	-------	-----
Xe-133	1.47E-07	1E-04	5.07E-08	1E-05	-------	-----
Xe-133m	5.57E-07	1E-04	1.50E-07	1E-05	-------	-----
Xe-135	5.54E-08	1E-04	1.48E-08	1E-05	-------	-----
Xe-135m	3.64E-08	1E-04	8.97E-09	1E-05	-------	-----
Xe-137	1.45E-07	1E-04	3.61E-08	1E-05	-------	-----
Xe-138	1.63E-07	1E-04	4.32E-08	1E-05	-------	-----
Cs-134	8.34E-08	1E-04	2.04E-08	5E-07	6.63E-14	1E-11
Cs-137	5.96E-08	1E-04	1.45E-08	5E-07	1.17E-13	1E-11
Ba-139	2.80E-07	1E-04	7.89E-08	5E-07	3.42E-13	1E-11
Ba-140	2.55E-07	1E-04	6.27E-08	5E-07	3.00E-13	1E-11
La-140	1.76E-08	1E-04	4.27E-09	5E-07	2.97E-14	1E-11
Ce-141	9.23E-08	1E-04	2.66E-08	5E-07	1.02E-13	1E-11
Ce-144	2.28E-06	1E-04	2.10E-07	5E-07	3.75E-13	1E-11
Gross Alpha	-------	-----	(1) 1.00E-07	1E-07	(1) 3.51E-15	1E-11

(1) Sample analyses performed by a contractor laboratory.

(2) These LLD calculations contain a default weekly continuous sample volume of 2.85E+8 cc. Therefore, grab sample LLD values reflect a different volume (ie; 10 cuft or 2.83E+5 cc).

(3) The calculated LLD's, except those denoted by (1), are from a counter/detector calibration on 07/26/10.
Detector geometry fixtures began being phased out mid-year and were replaced with a new design that slightly increased counting efficiency.
These values are typical for other counter/detectors used for effluent counting at BVPS.

(4) Based on counting 50 ml of the water that was bubbled through a 20 liter air sample.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 5A
Assessment Of Radiation Doses

		Unit 1 Liquid Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
	Bone	8.78E-03	0.1756	4.68E-03	0.0936	5.26E-03	0.1052	3.91E-02	0.7820	5.78E-02	0.5782
O	Liver	1.24E-02	0.2480	8.61E-03	0.1722	1.21E-02	0.2420	6.20E-02	1.2400	9.51E-02	0.9511
R	Total Body	9.06E-03	0.6040	6.38E-03	0.4253	9.49E-03	0.6327	4.33E-02	2.8867	6.82E-02	2.2743
G	Thyroid	1.92E-03	0.0384	2.43E-03	0.0486	4.77E-03	0.0954	7.40E-03	0.1480	1.65E-02	0.1652
A	Kidney	5.42E-03	0.1084	4.43E-03	0.0886	7.30E-03	0.1460	2.62E-02	0.5240	4.34E-02	0.4335
N	Lung	3.12E-03	0.0624	3.24E-03	0.0648	5.58E-03	0.1116	1.33E-02	0.2660	2.52E-02	0.2524
(1)	GI-LLI	2.93E-03	0.0586	3.01E-03	0.0602	5.61E-03	0.1122	1.28E-02	0.2560	2.44E-02	0.2435

		Unit 1 Gaseous Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch & Continuous Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
(2)	Gamma Air	2.15E-01	4.3000	1.09E-07	0.0000	0.00E+00	0.0000	2.89E-05	0.0006	2.15E-01	2.1503
(2)	Beta Air	7.57E-02	0.7570	5.15E-10	0.0000	0.00E+00	0.0000	7.71E-05	0.0008	7.58E-02	0.3789
	Bone	0.00E+00	0.0000	0.00E+00	0.0000	0.00E+00	0.0000	6.50E-04	0.0087	6.50E-04	0.0043
O	Liver	3.96E-02	0.5280	1.75E-02	0.2333	7.21E-03	0.0961	1.66E-02	0.2213	8.09E-02	0.5394
R	Total Body	3.96E-02	0.5280	1.75E-02	0.2333	7.21E-03	0.0961	1.64E-02	0.2187	8.07E-02	0.5381
G	Thyroid	3.96E-02	0.5280	1.75E-02	0.2333	7.21E-03	0.0961	1.63E-02	0.2173	8.06E-02	0.5374
A	Kidney	3.96E-02	0.5280	1.75E-02	0.2333	7.21E-03	0.0961	1.64E-02	0.2187	8.07E-02	0.5381
N	Lung	3.96E-02	0.5280	1.75E-02	0.2333	7.21E-03	0.0961	1.67E-02	0.2227	8.10E-02	0.5401
(3)	GI-LLI	3.96E-02	0.5280	1.75E-02	0.2333	7.21E-03	0.0961	1.64E-02	0.2187	8.07E-02	0.5381

(1) These doses are listed in mrem; they are calculated for the maximum individual for all batch liquid effluents

(2) These doses are listed in mrad; they are calculated at the site boundary for batch & continuous gaseous effluents (0.4 miles NW)

(3) These doses are listed in mrem; they are calculated for the most likely exposed real individual (child) via all real pathways at 0.89 miles NW.

Limits used for calculation of percent (%) are from ODCM procedure 1/2-ODC-3.03, Attachment H Control 3.11.1.2, Attachment L Control 3.11.2.2, and Attachment M Control 3.11.2.3 (considered to be the design objectives).

Radioactive Effluent Release Report

Calendar Year - 2010
Table 5B
Assessment Of Radiation Doses

		Unit 2 Liquid Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
	Bone	8.78E-03	0.1756	4.68E-03	0.0936	5.26E-03	0.1052	3.91E-02	0.7820	5.78E-02	0.5782
O	Liver	1.24E-02	0.2480	8.61E-03	0.1722	1.21E-02	0.2420	6.20E-02	1.2400	9.51E-02	0.9511
R	Total Body	9.06E-03	0.6040	6.38E-03	0.4253	9.49E-03	0.6327	4.33E-02	2.8867	6.82E-02	2.2743
G	Thyroid	1.92E-03	0.0384	2.43E-03	0.0486	4.77E-03	0.0954	7.40E-03	0.1480	1.65E-02	0.1652
A	Kidney	5.42E-03	0.1084	4.43E-03	0.0886	7.30E-03	0.1460	2.62E-02	0.5240	4.34E-02	0.4335
N	Lung	3.12E-03	0.0624	3.24E-03	0.0648	5.58E-03	0.1116	1.33E-02	0.2660	2.52E-02	0.2524
(1)	GI-LLI	2.93E-03	0.0586	3.01E-03	0.0602	5.61E-03	0.1122	1.28E-02	0.2560	2.44E-02	0.2435

		Unit 2 Gaseous Effluents									
		1st Quarter		2nd Quarter		3rd Quarter		4th Quarter		Calendar Year	
	Batch & Continuous Releases	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit	Dose	% of ODCM Limit
(2)	Gamma Air	3.00E-07	0.0000	1.09E-07	0.0000	2.02E-02	0.4040	2.95E-06	0.0001	2.02E-02	0.2020
(2)	Beta Air	1.41E-09	0.0000	5.15E-10	0.0000	8.39E-03	0.0839	1.40E-08	0.0000	8.39E-03	0.0420
	Bone	9.85E-05	0.0013	0.00E+00	0.0000	1.30E-12	0.0000	3.76E-06	0.0001	1.02E-04	0.0007
O	Liver	9.81E-03	0.1308	3.63E-04	0.0048	2.73E-04	0.0036	3.88E-04	0.0052	1.08E-02	0.0722
R	Total Body	9.81E-03	0.1308	3.63E-04	0.0048	2.73E-04	0.0036	3.86E-04	0.0051	1.08E-02	0.0722
G	Thyroid	9.81E-03	0.1308	3.63E-04	0.0048	2.73E-04	0.0036	3.86E-04	0.0051	1.08E-02	0.0722
A	Kidney	9.81E-03	0.1308	3.63E-04	0.0048	2.73E-04	0.0036	3.86E-04	0.0051	1.08E-02	0.0722
N	Lung	9.88E-03	0.1317	3.63E-04	0.0048	2.73E-04	0.0036	3.86E-04	0.0051	1.09E-02	0.0727
(3)	GI-LLI	9.82E-03	0.1309	3.63E-04	0.0048	2.73E-04	0.0036	3.86E-04	0.0051	1.08E-02	0.0723

(1) These doses are listed in mrem; they are calculated for the maximum individual for all batch liquid effluents

(2) These doses are listed in mrad; they are calculated at the site boundary for batch & continuous gaseous effluents (0.4 miles NW)

(3) These doses are listed in mrem; they are calculated for the most likely exposed real individual (child) via all real pathways at 0.89 miles NW.

Limits used for calculation of percent (%) are from ODCM procedure 1/2-ODC-3.03, Attachment H Control 3.11.1.2, Attachment L Control 3.11.2.2, and Attachment M Control 3.11.2.3 (considered to be the design objectives).

Radioactive Effluent Release Report

Calendar Year - 2010
Table 6

Effluent Monitoring Instrumentation Channels Not Returned To Operable Status Within 30 Days

[RM-1DA-100] - Unit 1 Auxiliary Feed Pump Bay Drain Monitor

On 06/09/10, this monitor was removed from service for performance of scheduled maintenance. During calibration, it was determined that the sample pump would need to be replaced. However, replacement parts were not immediately available and the monitor was out of service for greater than 30 days. The monitor was returned to operable status on 01/28/11. This condition is identified in BVPS Condition Report No. CR 10-79472 and was tracked via BVPS-SAP Order 200404972-0060.

As required by ODCM procedure 1/2-ODC-3.03, "Controls for RETS and REMP Programs", (as referenced in procedure Attachment E, Control 3.3.3.9, Table 3.3-12, Action 24), effluent releases via this pathway may continue provided grab samples are analyzed once per 12 hours. However, SINCE this liquid effluent pathway was diverted to the Tunnel Sump / Liquid Radwaste Treatment System on 06/09/10 (and remained diverted until the monitor was returned to operable status on 01/28/11), THEN there were no liquid releases through this effluent pathway. Therefore, grab sampling was not required.

[FR-VS-101] - Ventilation Vent Header Flow Recorder and [RM-1VS-109] Ch-10 - Unit 1 Auxiliary Building Ventilation Exhauste Monitor Flow Device

On 09/11/10 these flow devices were removed from service during routine maintenance because of the probe not working as expected. The current probe design for FR-VS-101 is obsolete and replacement parts are not expected to be available until 05/31/11, therefore this instrumentation remains out of service for greater than 30 days. This condition is documented in BVPS Condition Report No. CR 10-80322 and SAP Notification 600639358/Order 200425622, and was tracked via SAP Order 200404972-0120.

As required by ODCM procedure 1/2-ODC-3.03, "Controls for RETS and REMP Programs", (as referenced in procedure Attachment F, Control 3.3.3.10, Table 3.3-13, Action 28A), effluent releases via this pathway may continue provided that the system/process flow rate is estimate at least once per 4 hours or assumed to be at the ODCM design value. Unit 1 Ventilation Vent flow rate has been assumed at the design value of 62,000 cfm.

Radioactive Effluent Release Report

Calendar Year - 2010

Table 7

Total Dose Commitments, Total Effective Dose Equivalents and Population Doses

Total Dose Commitment From All Facility Releases To Members of the Public 40 CFR 190.10(a) Environmental Doses				
Organ	(1) Effluent Dose (mrem)	(2) Direct Radiation Dose (mrem)	Total Dose (mrem)	% of ODCM or 40 CFR 190 Limit
Bone	1.16E-01	0.00E+00	1.16E-01	0.46%
Liver	2.82E-01	0.00E+00	2.82E-01	1.13%
Total Body	4.63E-01	0.00E+00	4.63E-01	1.85%
Thyroid	1.24E-01	0.00E+00	1.24E-01	0.17%
Kidney	1.78E-01	0.00E+00	1.78E-01	0.71%
Lung	1.42E-01	0.00E+00	1.42E-01	0.57%
GI-LLI	1.40E-01	0.00E+00	1.40E-01	0.56%

(1) The cumulative dose contributions from liquid and gaseous effluents were determined in accordance with the applicable CONTROLS & SURVEILLANCE REQUIREMENTS listed in ODCM procedure 1/2-ODC-3.03. The dose commitment limits for 40 CFR 190 MEMBERS OF THE PUBLIC (ODCM 1/2-ODC-3.03 Control 3.11.4.1) are as follows:
a) < or = 25 mrem / calendar year (for the total body, or any organ except the thyroid)
b) < or = 75 mrem / calendar year (for the thyroid)

(2) The dose contribution listed for the total body is for Direct Radiation. This was calculated by comparing offsite TLD exposure at the ODCM controlling location (0.8 miles NW; Midland, PA) to TLD exposure at the REMP control location (16.5 miles SSW; Weirton, WV).

Compliance to 100 mrem Limit of 10 CFR 20.1301 For Total Effective Dose Equivalent

Pursuant to 10 CFR 20.1301(a)(1), the Total Effective Dose Equivalent from licensed operation to the maximum individual during the report period, is 3.35 mrem. This is a summation of Direct Radiation Exposure (calculated by comparing the maximum of all perimeter TLD exposures to TLD exposure at the REMP control location) plus Effluent Doses (calculated per the ODCM).

Members of the Public Doses Due To Their Activities Inside The Site Boundary

The radiation doses for MEMBER(S) OF THE PUBLIC due to their activities inside the site boundary are not greater than the doses listed in this table to show compliance with 40 CFR Part 190 or 10 CFR 20.1301. Evaluations have shown that exposure time for individuals not occupationally associated with the plant site is minimal in comparison to the exposure time considered for the dose calculation at or beyond the site boundary. Therefore, a separate assessment of radiation doses from radioactive effluents to MEMBER(S) OF THE PUBLIC, due to their activities inside the site boundary, is not necessary for this report period.

0-50 Mile Population Doses From Liquid and Gaseous Effluents

0-50 mile Total Population Dose from liquid and gaseous effluents =	476	man-mrem (Total Body)
0-50 mile Average Population Dose from liquid and gaseous effluents =	0.0001190	man-mrem (Total Body)

Radioactive Effluent Release Report

Calendar Year - 2010
Table 8

Offsite Dose Calculation Manual Surveillance Deficiencies

Inability to Include a Filter Paper as Part of the Monthly Composite Particulate Sample

The weekly particulate filter paper samples for 06/01, 06/02, 06/08, and 06/11/10 for the U2 Decon Building were unable to be located for inclusion in the monthly composite analysis. The Decon Building is monitored as required by OCDM procedure 1/2-ODC-3.03 as a potential effluent pathway when the Roll-Up Door is opened for worker activities. The particulate filter paper samples from this area are included in the monthly composite analysis for Gross Alpha and Sr-89 and Sr-90. Analysis data was available for I-133, I-131 and principle gamma emitters. This condition and associated Corrective Actions are detailed in BVPS Condition Report No. CR 10-78575.

ODCM procedure 1/2-ODC-3.03, "Controls for RETS and REMP Programs", (as referenced in procedure Attachment K, Control 3.11.2.1, Table 4.11-2), requires a monthly composite for Gross Alpha, Sr-89 and Sr-90. Activity was estimated at Lower Levels of Detection for this release pathway based on the work that occurred in the facility during the time period the sample was collected. Also the results from the monthly composite sample for the same time period were evaluated. No Licensed Radioactive Material or activity from Sr-89 or Sr-90 was detected for the weeks prior to and after the time periods of the missing particulate filter paper samples.

Radioactive Effluent Release Report

Calendar Year - 2010
Table 9

Unit 1 and 2 Offsite Dose Calculation Manual Changes (Description)
There were two changes made to the Unit 1 and 2 Offsite Dose Calculation Manual during this report period. Change 27 to the ODCM in August 2010 added the revision history to capture Changes 25 and 26, removed the requirement for PORC review and acceptance of changes made to the ODCM, removed references to retired NPDES Outfalls, incorporated setpoints for detector upgrades to RM-1DA-100, added the Coolant Recovery Tanks [1BR-TK-4A/B] as Liquid Waste Discharge Tanks, corrected REMP sampling designations, clarified alternates for use with Action 25A for cooling tower blowdown flow rate measuring devices, and updated procedure references throughout the document. Change 28 to the ODCM in December 2010 removed references to the CTS and ITS conversion project and removed the description that batch releases of liquid waste are processed by recirculation through eductors. This change also deleted Attachment B which referenced minimum liquid waste batch release recirculation times and added a description that liquid waste recirculation times to achieve two tank volumes are calculated based upon actual tank volume and pump capacity.

Enclosure 2, Attachment 1

Beaver Valley Power Station - Units 1 & 2

Radioactive Effluent Release Report

Calendar Year - 2010
Attachment 1
Joint Frequency Distribution Tables

Attachment 1
As specified in the ODCM, an annual summary of hourly meteorological data (in the form of joint frequency distribution) is provided for the calendar year.

Meteorological Data Recovery
The Meteorological Data Recovery for the calendar year met the minimum requirement of at-least 90% (as specified in Section 5 of Revision 1 to Regulatory Guide 1.23, Meteorological Monitoring Programs for Nuclear Power Plants). The actual Meteorological Data Recovery is shown in the following table:
PERCENT RECOVERY OF INDIVIDUAL METEOROLOGICAL PARAMETERS
96.6% = Wind Speed 35'
99.1% = Wind Speed 150'
98.5% = Wind Speed 500'
99.6% = Wind Direction 35'
99.4% = Wind Direction 150'
99.0% = Wind Direction 500'
99.6% = Delta Temperature (150' - 35') 1P
99.6% = Delta Temperature (500' - 35') 2P
99.6% = Temperature 35'
99.6% = Precipitation
99.4% = Average Recovery of Individual Meteorological Parameters
PERCENT RECOVERY OF COMPOSITE VARIABLES
99.6% = Wind Speed 35', Wind Direction 35', Delta Temperature 1P
98.8% = Wind Speed 150', Wind Direction 150', Delta Temperature 1P
97.8% = Wind Speed 500', Wind Direction 500', Delta Temperature 2P
99.3% = Average Recovery of Composite Variables

Attachment 1 Clarification
Hourly meteorological data is not provided for specific periods of Abnormal Gaseous Release during the calendar quarters (as indicated in Regulatory Guide 1.21), for the following reasons: 1) All routine Gaseous Releases for the calendar year were determined to be within design objectives, where as, the ODCM Dose Limits and the ODCM Dose Rate Limits are considered to be the design objectives. 2) There were no Abnormal Gaseous Releases during the calendar year.
For a copy of the hourly meteorological data during the calendar quarters, contact Ms. Lara Renz at 724-682-4255.

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	22	40	0	0	0	0	62
NNE	19	25	1	0	0	0	45
NE	18	9	0	0	0	0	27
ENE	27	20	0	0	0	0	47
E	15	20	0	0	0	0	35
ESE	14	9	0	0	0	0	23
SE	16	3	0	0	0	0	19
SSE	4	4	0	0	0	0	8
S	6	12	1	0	0	0	19
SSW	6	32	3	0	0	0	41
SW	14	44	30	2	0	0	90
WSW	6	81	35	0	0	0	122
W	9	162	25	0	0	0	196
WNW	25	110	6	0	0	0	141
NW	18	69	4	0	0	0	91
NNW	24	43	1	0	0	0	68
Total	243	683	106	2	0	0	1034

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	1034
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	8	6	0	0	0	0	14
NNE	3	5	0	0	0	0	8
NE	9	1	0	0	0	0	10
ENE	9	2	0	0	0	0	11
E	1	2	0	0	0	0	3
ESE	4	0	0	0	0	0	4
SE	0	0	0	0	0	0	0
SSE	2	0	0	0	0	0	2
S	2	1	0	0	0	0	3
SSW	2	1	1	0	0	0	4
SW	2	20	11	0	0	0	33
WSW	4	15	5	0	0	0	24
W	5	29	7	0	0	0	41
WNW	8	13	0	0	0	0	21
NW	7	9	0	0	0	0	16
NNW	10	9	0	0	0	0	19
Total	76	113	24	0	0	0	213

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	213
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	7	10	0	0	0	0	17
NNE	4	2	0	0	0	0	6
NE	5	4	0	0	0	0	9
ENE	7	2	0	0	0	0	9
E	4	1	0	0	0	0	5
ESE	3	2	0	0	0	0	5
SE	1	1	0	0	0	0	2
SSE	0	2	0	0	0	0	2
S	1	1	1	0	0	0	3
SSW	4	2	0	0	0	0	6
SW	4	12	9	1	0	0	26
WSW	5	31	14	0	0	0	50
W	7	38	15	0	0	0	60
WNW	4	18	0	0	0	0	22
NW	8	8	3	0	0	0	19
NNW	3	14	1	0	0	0	18
Total	67	148	43	1	0	0	259

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	259
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	62	52	0	0	0	0	114
NNE	70	15	0	0	0	0	85
NE	65	8	0	0	0	0	73
ENE	68	31	0	0	0	0	99
E	56	18	2	0	0	0	76
ESE	33	0	0	0	0	0	33
SE	20	0	0	0	0	0	20
SSE	24	1	0	0	0	0	25
S	26	10	3	0	0	0	39
SSW	44	26	3	0	0	0	73
SW	67	148	77	4	0	0	296
WSW	92	235	100	12	0	0	439
W	102	447	127	0	0	0	676
WNW	122	220	23	0	0	0	365
NW	134	142	3	0	0	0	279
NNW	82	101	3	0	0	0	186
Total	1067	1454	341	16	0	0	2878

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	2878
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	69	27	0	0	0	0	96
NNE	61	10	0	0	0	0	71
NE	133	17	0	0	0	0	150
ENE	147	98	1	0	0	0	246
E	114	26	1	0	0	0	141
ESE	96	2	0	0	0	0	98
SE	98	0	0	0	0	0	98
SSE	90	3	0	0	0	0	93
S	143	17	0	0	0	0	160
SSW	154	47	3	0	0	0	204
SW	109	75	15	1	0	0	200
WSW	82	75	20	1	0	0	178
W	58	102	10	0	0	0	170
WNW	76	38	0	0	0	0	114
NW	94	24	0	0	0	0	118
NNW	87	14	0	0	0	0	101
Total	1611	575	50	2	0	0	2238

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	2238
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)
Page 6 of 8

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	14	1	0	0	0	0	15
NNE	21	2	0	0	0	0	23
NE	37	0	0	0	0	0	37
ENE	42	3	0	0	0	0	45
E	85	2	0	0	0	0	87
ESE	182	2	0	0	0	0	184
SE	279	1	0	0	0	0	280
SSE	164	0	0	0	0	0	164
S	174	9	0	0	0	0	183
SSW	95	12	2	0	0	0	109
SW	47	12	2	0	0	0	61
WSW	16	12	5	0	0	0	33
W	8	2	3	0	0	0	13
WNW	15	3	0	0	0	0	18
NW	8	0	0	0	0	0	8
NNW	11	0	0	0	0	0	11
Total	1198	61	12	0	0	0	1271

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	1271
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35
Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	3	0	0	0	0	0	3
NNE	7	0	0	0	0	0	7
NE	14	0	0	0	0	0	14
ENE	28	0	0	0	0	0	28
E	40	0	0	0	0	0	40
ESE	135	0	0	0	0	0	135
SE	228	0	0	0	0	0	228
SSE	155	0	0	0	0	0	155
S	77	1	0	0	0	0	78
SSW	32	5	0	0	0	0	37
SW	18	3	0	0	0	0	21
WSW	2	0	0	0	0	0	2
W	5	0	0	0	0	0	5
WNW	6	0	0	0	0	0	6
NW	7	0	0	0	0	0	7
NNW	2	0	0	0	0	0	2
Total	759	9	0	0	0	0	768

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	768
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 1: Joint Frequency Distribution Tables (35ft)
Page 8 of 8

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00

Elevation: **Speed:** SP35P **Direction:** DI35P **Lapse:** DT150-35

Delta Temperature

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	185	136	0	0	0	0	321
NNE	185	59	1	0	0	0	245
NE	281	39	0	0	0	0	320
ENE	328	156	1	0	0	0	485
E	315	69	3	0	0	0	387
ESE	467	15	0	0	0	0	482
SE	642	5	0	0	0	0	647
SSE	439	10	0	0	0	0	449
S	429	51	5	0	0	0	485
SSW	337	125	12	0	0	0	474
SW	261	314	144	8	0	0	727
WSW	207	449	179	13	0	0	848
W	194	780	187	0	0	0	1161
WNW	256	402	29	0	0	0	687
NW	276	252	10	0	0	0	538
NNW	219	181	5	0	0	0	405
Total	5021	3043	576	21	0	0	8661

Calm Hours not Included above for :	**Total Period**	65
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	34
Valid Hours for this Stability Class for:	**Total Period**	8661
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	3	39	32	1	0	0	75
NNE	2	25	16	2	0	0	45
NE	5	10	2	0	0	0	17
ENE	2	25	15	0	0	0	42
E	1	32	18	0	0	0	51
ESE	0	15	10	1	0	0	26
SE	0	14	9	0	0	0	23
SSE	0	9	5	0	0	0	14
S	0	14	16	2	0	0	32
SSW	1	11	15	3	1	0	31
SW	5	9	34	16	0	0	64
WSW	6	17	53	14	1	0	91
W	1	59	95	33	1	0	189
WNW	2	56	87	34	2	0	181
NW	7	30	30	3	0	0	70
NNW	7	37	22	0	0	0	66
Total	42	402	459	109	5	0	1017

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	1017
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	> 25	Total
N	2	13	5	0	0	0	20
NNE	2	4	4	0	0	0	10
NE	1	6	0	0	0	0	7
ENE	0	6	2	0	0	0	8
E	0	5	3	0	0	0	8
ESE	0	4	0	0	0	0	4
SE	1	2	0	0	0	0	3
SSE	1	1	0	0	0	0	2
S	0	1	0	0	0	0	1
SSW	0	4	1	2	0	0	7
SW	3	4	17	1	0	0	25
WSW	1	4	11	2	0	0	18
W	4	14	16	9	0	0	43
WNW	2	13	12	4	0	0	31
NW	2	6	2	0	0	0	10
NNW	2	5	7	0	0	0	14
Total	21	92	80	18	0	0	211

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	211
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	2	10	4	0	0	0	16
NNE	3	1	2	0	0	0	6
NE	1	6	1	0	0	0	8
ENE	2	3	3	0	0	0	8
E	1	5	0	0	0	0	6
ESE	0	2	1	2	0	0	5
SE	0	2	1	0	0	0	3
SSE	0	1	3	0	0	0	4
S	1	0	1	1	0	0	3
SSW	1	1	0	1	0	0	3
SW	2	3	7	3	1	0	16
WSW	2	9	25	5	0	0	41
W	2	18	27	20	0	0	67
WNW	3	9	19	6	0	0	37
NW	0	6	6	1	0	0	13
NNW	3	9	9	0	0	0	21
Total	23	85	109	39	1	0	257

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	257
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	22	65	38	2	0	0	127
NNE	35	43	13	1	0	0	92
NE	24	33	4	1	0	0	62
ENE	21	73	27	1	0	0	122
E	15	40	12	2	0	0	69
ESE	11	13	3	0	0	0	27
SE	10	12	2	0	0	0	24
SSE	10	8	1	0	0	0	19
S	8	18	11	4	0	0	41
SSW	12	26	21	2	0	0	61
SW	35	38	93	25	1	0	192
WSW	39	98	126	42	4	1	310
W	45	152	409	244	19	3	872
WNW	27	195	198	56	1	1	478
NW	35	121	56	2	0	0	214
NNW	30	82	43	2	0	0	157
Total	379	1017	1057	384	25	5	2867

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	2867
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)
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Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	40	38	23	1	0	0	102
NNE	79	31	12	1	0	0	123
NE	83	57	6	2	0	0	148
ENE	56	156	83	5	0	0	300
E	38	83	24	6	0	0	151
ESE	18	22	3	0	0	0	43
SE	17	19	4	0	0	0	40
SSE	22	18	3	2	0	0	45
S	30	21	18	6	0	0	75
SSW	45	58	22	1	0	0	126
SW	76	75	41	7	1	0	200
WSW	67	107	37	12	1	0	224
W	37	104	100	28	5	0	274
WNW	27	122	57	11	0	0	217
NW	21	66	9	0	0	0	96
NNW	29	45	2	0	0	0	76
Total	685	1022	444	82	7	0	2240

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	2240
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	82	7	1	0	0	0	90
NNE	138	27	0	0	0	0	165
NE	117	52	2	0	0	0	171
ENE	50	40	4	0	0	0	94
E	16	12	2	0	0	0	30
ESE	10	8	0	0	0	0	18
SE	13	9	3	0	0	0	25
SSE	9	7	1	0	0	0	17
S	31	17	9	0	0	0	57
SSW	62	52	3	1	0	0	118
SW	119	46	12	1	0	0	178
WSW	60	75	6	4	0	0	145
W	28	32	8	5	1	0	74
WNW	18	23	4	3	0	0	48
NW	15	11	1	0	0	0	27
NNW	23	15	0	0	0	0	38
Total	791	433	56	14	1	0	1295

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	1295
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35
Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	38	5	0	0	0	0	43
NNE	67	18	0	0	0	0	85
NE	77	38	0	0	0	0	115
ENE	23	22	0	0	0	0	45
E	15	4	0	0	0	0	19
ESE	7	4	0	0	0	0	11
SE	7	3	0	0	0	0	10
SSE	9	11	2	0	0	0	22
S	11	29	11	0	0	0	51
SSW	53	40	0	0	0	0	93
SW	87	38	5	0	0	0	130
WSW	41	21	5	0	0	0	67
W	19	6	0	0	0	0	25
WNW	9	5	0	0	0	0	14
NW	10	1	0	0	0	0	11
NNW	18	2	0	0	0	0	20
Total	491	247	23	0	0	0	761

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	761
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 2: Joint Frequency Distribution Tables (150ft)
Page 8 of 8

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00

Elevation: **Speed:** SP150P **Direction:** DI150P **Lapse:** DT150-35

Delta Temperature

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	189	177	103	4	0	0	473
NNE	326	149	47	4	0	0	526
NE	308	202	15	3	0	0	528
ENE	154	325	134	6	0	0	619
E	86	181	59	8	0	0	334
ESE	46	68	17	3	0	0	134
SE	48	61	19	0	0	0	128
SSE	51	55	15	2	0	0	123
S	81	100	66	13	0	0	260
SSW	174	192	62	10	1	0	439
SW	327	213	209	53	3	0	805
WSW	216	331	263	79	6	1	896
W	136	385	655	339	26	3	1544
WNW	88	423	377	114	3	1	1006
NW	90	241	104	6	0	0	441
NNW	112	195	83	2	0	0	392
Total	2432	3298	2228	646	39	5	8648

Calm Hours not Included above for :	**Total Period**	4
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	108
Valid Hours for this Stability Class for:	**Total Period**	8648
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35
Stability Class A Delta Temperature Extremely Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	0	3	1	0	0	0	4
NNE	0	2	2	0	0	0	4
NE	0	1	0	0	0	0	1
ENE	2	0	2	0	0	0	4
E	0	3	0	0	0	0	3
ESE	0	3	3	0	0	0	6
SE	0	3	1	0	0	0	4
SSE	0	2	0	0	0	0	2
S	0	2	1	0	0	0	3
SSW	0	1	1	1	0	0	3
SW	0	2	0	0	0	0	2
WSW	0	1	4	0	0	0	5
W	0	0	6	0	0	0	6
WNW	0	1	3	4	1	0	9
NW	0	1	1	0	0	0	2
NNW	0	1	0	2	0	0	3
Total	2	26	25	7	1	0	61

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	61
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35
Stability Class B Delta Temperature Moderately Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	1	5	13	2	0	0	21
NNE	0	0	2	0	0	0	2
NE	0	3	1	0	0	0	4
ENE	1	2	9	0	0	0	12
E	1	7	5	0	0	0	13
ESE	0	2	8	3	0	0	13
SE	0	1	3	1	0	0	5
SSE	0	2	3	1	0	0	6
S	0	1	7	2	0	0	10
SSW	0	4	1	1	0	0	6
SW	1	1	3	1	2	0	8
WSW	0	1	8	6	0	0	15
W	0	7	6	4	1	0	18
WNW	0	3	14	6	3	0	26
NW	0	4	6	2	0	0	12
NNW	0	6	5	1	0	0	12
Total	4	49	94	30	6	0	183

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	183
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35
Stability Class C Delta Temperature Slightly Unstable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	2	13	17	5	0	0	37
NNE	1	3	4	0	0	0	8
NE	0	3	1	0	0	0	4
ENE	0	5	6	0	0	0	11
E	2	4	2	2	0	0	10
ESE	0	8	5	0	0	0	13
SE	0	3	2	0	0	0	5
SSE	0	2	2	0	0	0	4
S	3	1	4	0	0	0	8
SSW	0	1	10	6	0	0	17
SW	2	1	19	8	4	0	34
WSW	1	7	20	11	1	0	40
W	2	6	28	18	8	1	63
WNW	1	11	27	18	4	1	62
NW	0	4	11	5	1	0	21
NNW	0	4	16	5	0	0	25
Total	14	76	174	78	18	2	362

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	362
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35
Stability Class D Delta Temperature Neutral

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	17	48	115	41	2	0	223
NNE	24	39	30	18	3	0	114
NE	18	39	8	10	3	0	78
ENE	24	47	87	29	2	0	189
E	24	58	85	31	6	0	204
ESE	14	30	60	33	3	0	140
SE	10	28	26	11	2	0	77
SSE	11	14	11	5	0	1	42
S	10	12	31	16	4	1	74
SSW	8	11	35	39	13	2	108
SW	21	21	73	155	46	6	322
WSW	20	58	158	185	44	6	471
W	28	80	270	437	193	20	1028
WNW	28	82	344	231	73	6	764
NW	11	70	167	58	5	0	311
NNW	8	63	164	39	2	0	276
Total	276	700	1664	1338	401	42	4421

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	4421
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35
Stability Class E Delta Temperature Slightly Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	20	19	37	17	0	0	93
NNE	18	17	17	16	0	0	68
NE	23	19	7	4	0	0	53
ENE	38	63	40	20	2	0	163
E	45	63	40	11	3	0	162
ESE	25	59	27	28	1	0	140
SE	21	30	23	28	1	0	103
SSE	21	26	17	21	4	1	90
S	21	18	27	23	7	0	96
SSW	16	16	21	37	18	0	108
SW	35	31	52	102	37	3	260
WSW	45	94	65	32	3	0	239
W	53	132	123	52	13	4	377
WNW	28	64	67	16	4	1	180
NW	15	20	20	17	0	0	72
NNW	7	20	34	12	0	0	73
Total	431	691	617	436	93	9	2277

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	2277
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35
Stability Class F Delta Temperature Moderately Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	13	18	12	4	0	0	47
NNE	8	12	2	0	0	0	22
NE	19	9	1	0	0	0	29
ENE	25	23	9	1	0	0	58
E	20	50	4	0	0	0	74
ESE	19	27	11	1	0	0	58
SE	24	16	6	4	0	0	50
SSE	15	25	15	5	0	0	60
S	12	24	22	19	2	0	79
SSW	16	16	17	13	1	0	63
SW	25	39	38	27	9	0	138
WSW	26	51	40	4	0	0	121
W	32	56	40	3	0	0	131
WNW	16	50	18	1	0	0	85
NW	20	20	6	0	0	0	46
NNW	22	12	4	0	0	0	38
Total	312	448	245	82	12	0	1099

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	1099
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

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Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00
Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35
Stability Class G Delta Temperature Extremely Stable

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	1	0	0	0	0	0	1
NNE	5	2	0	0	0	0	7
NE	1	3	0	0	0	0	4
ENE	1	5	1	0	0	0	7
E	2	10	0	0	0	0	12
ESE	5	7	2	0	0	0	14
SE	0	7	3	0	0	0	10
SSE	2	16	4	1	0	0	23
S	2	11	12	7	1	0	33
SSW	2	8	7	2	1	0	20
SW	2	4	6	2	0	0	14
WSW	2	5	5	0	0	0	12
W	0	1	8	2	0	0	11
WNW	1	3	0	0	0	0	4
NW	2	2	1	0	0	0	5
NNW	0	0	0	0	0	0	0
Total	28	84	49	14	2	0	177

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	177
Total Hours for Period		8760

Beaver Valley Power Station – Units 1 & 2

Radioactive Effluent Release Report

Calendar Year – 2010
Attachment 1

Part 3: Joint Frequency Distribution Tables (500ft)

Hours at Each Wind Speed and Direction

Summary of All Stability Classes

Total Period

Period of Record = 1/1/2010 00:00 - 12/31/2010 23:00

Elevation: **Speed:** SP500P **Direction:** DI500P **Lapse:** DT500-35

Delta Temperature

Wind Speed (mph)

Wind Direction	1 - 4	4 - 8	8 - 13	13 - 19	19 - 25	≥ 25	Total
N	54	106	195	69	2	0	426
NNE	56	75	57	34	3	0	225
NE	61	77	18	14	3	0	173
ENE	91	145	154	50	4	0	444
E	94	195	136	44	9	0	478
ESE	63	136	116	65	4	0	384
SE	55	88	64	44	3	0	254
SSE	49	87	52	33	4	2	227
S	48	69	104	67	14	1	303
SSW	42	57	92	99	33	2	325
SW	86	99	191	295	98	9	778
WSW	94	217	300	238	48	6	903
W	115	282	481	516	215	25	1634
WNW	74	214	473	276	85	8	1130
NW	48	121	212	82	6	0	469
NNW	37	106	223	59	2	0	427
Total	1067	2074	2868	1985	533	53	8580

Calm Hours not Included above for :	**Total Period**	6
Variable Direction Hours for:	**Total Period**	0
Invalid Hours for:	**Total Period**	174
Valid Hours for this Stability Class for:	**Total Period**	8580
Total Hours for Period		8760

Enclosure 2, Attachment 2

Beaver Valley Power Station - Units 1 & 2

Radioactive Effluent Release Report

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Attachment 2
Unit 1 and 2 Offsite Dose Calculation Manual Changes

Attachment 2
Attached is a complete copy of the ODCM that includes: Change (28) of the ODCM (Effective: December 2010)

Attachment 2 Clarification
A complete copy of the ODCM has been provided to the following offices: United States Nuclear Regulatory Commission Attention: Document Control Desk Washington, DC 20555-0001 United States Nuclear Regulatory Commission Regional Administrator 475 Allendale Road King of Prussia, PA 19406
For a complete copy of the ODCM, contact Ms. Lara Renz at 724-682-4255.

Enclosure 2, Attachment 3

Key Solutions

C-14 Dose Assessment for Routine Effluent Releases

Prepared for Beaver Valley Power Station, First Energy Corp.

By
James F. Key, Jr.
Key Solutions, Inc.

Introduction

The U.S. Nuclear Regulatory Commission (NRC) is now requiring nuclear power plants to assess the dose impact from C-14 to members of the public which can arise due to routine releases in radiological effluents. Until 2010 the industry was not required to do so because the dose impact of C-14 releases had been considered negligible as compared to the doses from noble gases, tritium, particulates and radioiodines. The regulatory guidance for the radiological effluent technical specifications (RETS) simply ignored releases of C-14 [USNRC (1978b), USNRC(1978c), USNRC (1991a), USNRC (1991b)]. The rationale was based on studies by the EPA [USEPA (1979)] and others [(Till (1978), Key (2010)] The NRC stated its position to exclude the requirement for C-14 dose assessment in 1981 [Willis(1981)].

There is little regulatory guidance on the details as to how C-14 dose calculations are to be performed. Key Solutions, Inc. was contracted to perform the C-14 offsite dose assessment for the 2010 annual radiological effluent release report. This document describes the methodology, bases and results of that assessment for the Beaver Valley Power Station (BVPS).

Technical Discussion

Total C-14 Activity Released to the Atmosphere

C-14 atmospheric releases were not addressed in NRC guidance for the establishment of Standard Radiological Effluent Technical Specifications (SRETS). As a result the nuclear industry, with a few exceptions, performs no monitoring of releases of C-14 to the environment.

As there has been, and still is, no regulatory guidance addressing C-14 releases, the NRC has indicated that various methods of estimating C-14 releases are acceptable. At present, lacking any analytical quantification of release activity, the general accepted industry practice is to estimate annual C-14 release activity based on C-14 production in reactor coolant.

Key Solutions

For PWRs, NRCP Report 81 provides a conservative approximation based on GW(e)-yr for individual power reactors. Section 3.4.2.4 suggest C-14 activity releases be derived assuming an atmospheric release of about 6 Curies per gigawatt-electical per year (GW(e)-yr).

Most recently EPRI has published estimations of C-14 released to the atmosphere based upon thermal power [EPRI(2010)]. This EPRI document proposes 3.4 - 3.9 GW(th)-yr (or 10.0 - 11.5 GW(e) – yr) as an industry proxy value for PWRs.

EPRI considers the $^{17}O(n,\alpha)^{14}C$ and $^{14}N(n,p)^{14}C$ reactions to be the principal production mechanisms in the reactor coolant and presumes 100% of the C-14 generated in the coolant is released in gaseous effluents.

The C-14 activity discharged in liquid effluents is considered negligible and has little potential environmental or dose impact. An estimate of C-14 dose resulting from liquid effluents is reported here in mrem per Ci of C-14 released annually.

This report only considers C-14 released in liquid and gaseous effluents and does not address shipments of solid waste and irradiated fuel.

Chemical Form of Interest

C-14 being a pure beta emitter generates no dose from direct radiation. C-14 is inhaled in the form of CO2 and is incorporated into all body tissue. However, inhaled CO2 enters body compartments with high turnover and thus the predominate exposure pathway C-14 is though ingestion [NCRP(1985)].

The dose from C-14 via the potable water pathway is determined using the specific activity approach [Faw(1999), IAEA(2001), NCRP(1984), USNRC(1983)] but is applicable only to the dose limits for liquid effluents. The ingestion of total carbon and therefore C-14 in drinking water is very small as compared to the dose resulting from ingestion of food stuffs. For Beaver Valley the C-14 liquid effluent dose was estimated to be approximately 4.5E-3 mrem per Ci of C-14 released.

What remains of concern is that portion of C-14 incorporated into the human food chain through vegetation by the photosynthesis process. The only chemical form of C-14 incorporated into plant matter is CO2. All other chemical forms of C-14 have inconsequential dose impact on the human food chain. Studies have found that the chemical species of C-14 can vary greatly depending on the reactor type (PWR or BWR) [Hayes(1977), Killough(1978), Till(1978)]. Organic forms include: methane, ethane, propane and butane, all of which are not incorporated into vegetation. In the case of BVPS the fraction of carbon released to the atmosphere in CO2 form (CO2 Fraction) was taken to be 0.4. This is based on the EPRI study [EPRI(2010)] which states that for PWRs operating without a recombiner, release of carbon to the atmosphere is primarily in

organic form. Only a small fraction is released as CO2. EPRI suggests a CO2 fraction 0.05 to 0.3.

As already indicated, C-14 enters the human food chain only in CO2 form and only when it is incorporated into plant matter with subsequent direct ingestion of vegetation. Human ingestion of C-14 also occurs as a result of consumption of animal products from livestock feeding on contaminated vegetation.

Environmental Transport

The carbon incorporated into plant matter comes only from atmospheric CO2. Therefore the concentration of C-14 in plant materials is directly dependant on the airborne concentration. The atmospheric dispersion value X/Q is used to model airborne concentration of CO2 at locations of interest. Ground plane deposition of CO2 is negligible in the environs local (within 5 miles) of the point of release and therefore is not addressed.

Modeling the concentration of C-14 in plant matter as well as animal food products assumes that C-14 is in equilibrium in all ingested food. The assumption of equilibrium, while conservative, simplifies the modeling of C-14 in the human food chain. The specific activity of C-14 in the food stuffs is considered to be the same as the atmospheric specific activity. In turn, the total uptake of C-14 by humans is derived from the total carbon dietary intake. This approach provides an upper bound on C-14 ingestion in food stuffs as the specific activity in vegetation, milk or meat can never exceed the airborne specific activity.

Meteorology

The BVPS ODCM contains dispersion values (X/Q) for various locations of interest. X/Q is a function of meteorology, mode of release and receptor location. ODCM Table 2.3-1 lists the release points at BVPS and the associated release modes. X/Q tables (Tables 2.3-3 to 2.3-7 and Attachment M, Tables 2.3-35 to 2.3-37) provide dispersion values for the locations of dose pathways identified in land use census.

ODCM Table 2.2-4, 2.2-5 and 2.2-7 provide receptor X/Q values for ground level releases from containment vent (CV-1 and CV-2), ventilation vent (VV-1 and VV-2) and turbine building vent (TV2). The X/Q values represent annual average dispersion and are derived from historical meteorological data. The annual average X/Qs are applied to the case of continuous releases.

Table 2.2-6 lists process vent (PV-1/2) X/Q values for continuous elevated releases.

Key Solutions

Intermittent releases (batch releases) can make use of annual average dispersion values provided such releases are made under random meteorological conditions [USNRC(1982a)]. It is also possible to calculate "short term" X/Qs from historical meteorology and apply to batch releases [USNRC(1978) and USNRC(1982a)]. The short term X/Q is a statistically weighted value and only provides a level of conservatism. It does not improve the accuracy of the dispersion values.

Intermittent releases are classified as short term if the cumulative release time is less than 500 per year. Intermittent releases with cumulative duration greater than 500 hours per year can be considered as long term releases and be modeled using annual average X/Qs.

The BVPS 2009 Radioactive Effluent Release Report reports the total batch release period for the year as being 83,598 minutes (~ 1393 hrs). It is assumed that 2010 cumulative batch release times also exceeded 500 hours per year and can therefore be modeled using annual average X/Q if so desired.

ODCM Attachment D, Tables 2.2-2a and 2.2-2b lists the FSAR source terms for Units 1 and 2. It details the unit's atmospheric release points and expected nuclide mix for that discharge path. For both units, the C-14 source term is given as 8 Ci/yr with 12.5 % being released from containment venting and 87.5% processed by the gaseous waste system and released through the process vent (PV). This study assumed a 20% ground level and 80% elevated release apportionment.

Methodology for Calculation of C-14 Dose

Determination of C-14 concentration in food products is based on specific activity and assumes that the ratio of C-14 to stable carbon reaches equilibrium in all food products. The incorporation of CO2 into the human food chain occurs only through direct or indirect vegetation ingestion. This process is complex and very dynamic; therefore, it is unlikely that true equilibrium is ever reached. The specific activity approach assumes constant environmental concentrations and is therefore admittedly conservative. However, the specific activity methodology does provide an upper bound of the maximum possible concentration of C-14 in food stuffs and currently is the de-facto approach used for C-14 as well as for H-3 [Killough(1978), NCRP(1985), USNRC(1983)].

The vegetation ingestion dose model presented here is derived from Equation *C-8* of Regulatory Guide 1.109, Appendix C.3 [USNRC(1977a)]. However the 1.109 default value for the concentration of natural carbon in the atmosphere has been updated to reflect the increase of anthropomorphic CO2 over the past several decades. The default value of 0.16 gm/m^3 has been changed to 0.19 gm/m^3 based on the current EPA published value of 383 ppm atmospheric CO2. Equation *C-8* only addresses C-14

concentration in vegetation, but it does not address C-14 concentration in meat or milk products.

Equation *C-8* makes use of a fractional equilibrium ratio (defined as parameter "p"). This parameter was intended to correct for growing season photosynthesis but is improperly applied and has been dropped [Faw(1999), Killough(1978), USNRC(1983)].

The methodology presented in Reg Guide 1.109 to model the C-14 concentrations in meat and milk lacks sound technical bases. C-14 concentration in food products is more appropriately modeled using the same approach as for vegetation. That is to say, a specific activity equilibrium model [Faw(1999), Killough(1978), IAEA(2001), NCRP(1985) and USNRC(1983)]. The methodology used in this report for milk and meat concentrations is based on the specific activity equilibrium model.

C-14 Dose Factors

The NRC continues to require the reporting of organ doses for demonstration of compliance with 10 CFR 50, Appendix I. EPA 40 CFR 190 also is stated in terms of organ dose. Factors for organ doses are derived from the internal dosimetry methodology of International Commission on Radiological Protection Publication 2 or ICRP-2 [ICRP(1959)]. ICRP 2 has long been superseded by more recent methodology. Nevertheless, organ doses must still be reported to demonstrate compliance with NRC and EPA regulations. The ICRP 2 organ dose conversion factors used are taken from Reg Guide 1.109.

Inhalation and Ingestion dose conversion factors (Table 1) are taken from Tables E-7 through E-14 of Reg Guide 1.109. Dose factors are provided for infant, child, teen and adult age groups and for 7 organs. In the case of C-14, 6 organ (liver, total body, thyroid, kidney, lung, gi-tract) dose factors are the same. Only the bone dose factor is different.

Table 1. Reg Guide 1.109 Organ Dose Conversion Factors
Reg Guide 1.109 Tables E-7 to E-14

	Age Group	Bone	Liver	TBody	Thyroid	Kidney	Lung	GI-LLI
Inhalation	Infant	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
	Child	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
	Teen	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
	Adult	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
Ingestion	Infant	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
	Child	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
	Teen	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
	Adult	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07

Key Solutions

Inhalation Dose Methodology

The dose from the inhalation exposure pathway is given as:

$$D_{aj}^{Inh} = 3.17\times10^{4} \cdot \chi/Q \cdot BR_{a} \cdot DFI_{aj}^{C-14} \cdot \tilde{Q}_{C-14}$$

Where:

D_{aj}^{Inh} = C-14 dose from the Inhalation Pathway for age group ***a*** and organ ***j*** in mrem/yr.

3.17×10^{4} = Conversion factor: 3.17×10^{-8} yr/sec x 10^{12} pCi/Ci.

χ/Q = Atmospheric dispersion for location of interest. Ground level or elevated dispersion values are used as appropriate. The units are sec/m^3.

BR_a = Annual breathing rate in m^3/year for age group ***a***. From Reg Guide 1.109, Table E-5.

DFI_{aj}^{C-14} = C-14 Inhalation Dose Conversion Factor for age group ***a*** and organ ***j*** from Reg Guide 1.109, Tables E-7 to E-10. Units are mrem per pCi inhaled.

$\tilde{Q}_{C-14}$ = Total C-14 released to the atmosphere in Ci for the period of interest. For inhalation this is the total C-14 annual atmospheric release.

Vegetation Dose Methodology

The vegetation dose methodology is based on the assumption of specific activity equilibrium between atmospheric C-14 and vegetative C-14. The dose from the vegetation ingestion exposure pathway is given as:

$$D_{aj}^{Veg} = 3.17\times10^{7} \cdot \chi/Q \cdot U_{a}^{Veg} \cdot 0.11/0.19 \cdot DFL_{aj}^{C-14} \cdot \tilde{Q}_{C-14}^{CO2}$$

Where:

D_{aj}^{Veg} = C-14 dose from the Vegetation Ingestion Pathway for age group ***a*** and organ ***j*** in mrem/yr.

3.17×10^{7} = Conversion factor: 3.17 x 10^{-8} yr/sec x 10^{12} pCi/Ci x 10^{3} gm/Kg.

Key Solutions

χ/Q = Atmospheric Dispersion for location of interest. Ground level or elevated dispersion values are used as appropriate. The units are sec/m^3.

U_a^{Veg} = Annual local garden vegetation ingestion for age group ***a*** in Kg-Vegetation per year. From Reg Guide 1.109, Table E-5.

0.11 = Fraction of plant mass that is carbon in kg-carbon per kg-plant. Taken from Reg Guide 1.109, Equation C-8.

0.19 = Atmospheric concentration of natural carbon in gm/m^3 based on current EPA published value of 383 ppm.

DFL_{aj}^{C-14} = C-14 Ingestion Dose Conversion Factor for age group ***a*** and organ ***j*** from Reg Guide 1.109, Tables E-11 to E-14. Units are mrem per pCi ingested.

$\tilde{Q}_{C-14}^{CO2}$ = Total C-14 (in Curies) released to the atmosphere as CO2 during the period of interest.

Milk Dose Methodology

The milk dose methodology is based on the assumption of specific activity equilibrium among atmospheric C-14, vegetation C-14 and animal milk. The dose from the milk ingestion exposure pathway is given as:

$$D_{aj}^{Milk} = 3.17\times10^{7} \cdot \chi/Q \cdot U_a^{Milk} \cdot 0.11/0.19 \cdot DFL_{aj}^{C-14} \cdot \tilde{Q}_{C-14}^{CO2}$$

Where:

D_{aj}^{Milk} = C-14 dose from the Milk Ingestion Pathway for age group ***a*** and organ ***j*** in mrem/yr.

3.17×10^{7} = Conversion factor: 3.17 x 10^{-8} yr/sec x 10^{12} pCi/Ci x 10^{3} gm/liter.

χ/Q = Atmospheric Dispersion for location of interest. Ground level or elevated dispersion values are used as appropriate. The units are sec/m^3.

U_a^{Milk} = Annual consumption of locally supplied milk for age group ***a*** in liters-milk per year. From Reg Guide 1.109, Table E-5.

0.11 = Fraction of plant mass that is carbon in kg-carbon per kg-plant. Taken from Reg Guide 1.109, Equation C-8.

Key Solutions

0.19 = Atmospheric concentration of natural carbon in gm/m^3 based on current EPA published value of 383 ppm.

DFL_{aj}^{C-14} = C-14 Ingestion Dose Conversion Factor for age group ***a*** and organ ***j*** from Reg Guide 1.109, Tables E-11 to E-14. Units are mrem per pCi ingested.

$\tilde{Q}_{C-14}^{CO2}$ = Total C-14 (in Curies) released to the atmosphere as CO2 during the period of interest.

Meat Dose Methodology

The meat dose methodology is based on the assumption of specific activity equilibrium among atmospheric C-14, vegetation C-14 and animal meat. The dose from the meat ingestion exposure pathway is given as:

$$D_{aj}^{Meat} = 3.17\times10^{7} \cdot \chi/Q \cdot U_a^{Meat} \cdot 0.11/0.19 \cdot DFL_{aj}^{C-14} \cdot \tilde{Q}_{C-14}^{CO2}$$

Where:

D_{aj}^{Meat} = C-14 dose from the Meat Ingestion Pathway for age group ***a*** and organ ***j*** in mrem/yr.

3.17×10^{7} = Conversion factor: 3.17×10^{-8} yr/sec x 10^{12} pCi/Ci x 10^{3} gm/Kg.

χ/Q = Atmospheric Dispersion for location of interest. Ground level or elevated dispersion values are used as appropriate. The units are sec/m^3.

U_a^{Meat} = Annual consumption of locally supplied meat for age group ***a*** in Kg-meat per year. From Reg Guide 1.109, Table E-5.

0.11 = Fraction of plant mass that is carbon in kg-carbon per kg-plant. Taken from Reg Guide 1.109, Equation C-8.

0.19 = Atmospheric concentration of natural carbon in gm/m^3 based on current EPA published value of 383 ppm.

DFL_{aj}^{C-14} = C-14 Ingestion Dose Conversion Factor for age group ***a*** and organ ***j*** from Reg Guide 1.109, Tables E-11 to E-14. Units are mrem per pCi ingested.

$\tilde{Q}_{C-14}^{CO2}$ = Total C-14 (in Curies) released to the atmosphere as CO2 during the period of interest.

Key Solutions

Dose Assessment Results

Dose to a member of the public was determined for various scenarios as detailed in Table 3. Dose is dependent on consumption and usage habits as well as organ mass and metabolism; thus it is appropriate to calculate dose for different age groups. Reg Guide 1.109 defines four age groups: infant (0 to 1 year), child (1 to 11 years), teen (11 to 17 years), adult (17 years and older). Lacking site specific information, all four age groups were assumed to be present and consuming at the location of interest.

Consumption rates (Table 2) were those associated with the maximum individual for each age group as defined in Reg Guide 1.109, Section B. Values were taken from Table E-5 of the same document. The maximum individual represents a person with reasonable consumption habits greater than that of the average for the population in general.

Table 2. Maximum Exposed Individual Usage
Reg Guide 1.109 - Table E-5

	Age Group			
Pathway	**Infant**	**Child**	**Teen**	**Adult**
Inhalation	**1400 m^3/yr**	**3700 m^3/yr**	**8000 m^3/yr**	**8000 m^3/yr**
Vegetation - Leafy	-	26 kg/yr	42 kg/yr	64 kg/yr
Vegetation - Produce	-	520 kg/yr	630 kg/yr	520 kg/yr
Vegetation - Total	**-**	**546 kg/yr**	**672 kg/yr**	**584 kg/yr**
Cow Milk	**330 liters/yr**	**330 liters/yr**	**400 liters/yr**	**310 liters/yr**
Cow Meat	**-**	**41 kg/yr**	**65 kg/yr**	**110 kg/yr**

Doses were calculated at those locations with the highest dose potential as determined by exposure pathways.

For information purposes, doses for all potentially significant pathways (inhalation, vegetation, milk and meat) are shown regardless of whether the pathways were or were not present. Doses are also calculated for the real pathways present as documented in the ODCM. The inhalation pathway was assumed to be present at all locations where ingestion pathways were considered.

Dispersion (X/Q) Values

Dispersion values are taken from ODCM Attachment F, Tables 2.2-4 through 2.2-7 and Attachment M, Table 2.3-37. Dispersion values were selected based on receptor locations as described in ODCM Attachment F, Table 2.2-3. Tables 2.2-4, 2.2-5 and 2.2-7 list X/Q values for ground mode release points. The highest ground level X/Q for a location of interest was selected from among these tables.

Key Solutions

For elevated releases from the process vent, annual average X/Q values were taken from Table 2.2-6. Elevated short term X/Q values come from Table 2.3-37

Other Considerations

Residency time was assumed to be 100%. And 100% of ingested food stuffs was assumed to be grown and consumed at the receptor location.

The annual source term (11 Ci) was determined using the PWR proxy value as provided in EPRI guidance [EPRI(2011)]. The capacity factor for Unit 1 was 90% based on the 32 day 2010 outage of September 23 to October 25. A 100% capacity factor was assumed for Unit 2.

Doses were based on the assumed continual release of the calculated source term spread out over an entire year.

Releases were apportioned as 20% ground level and 80% elevated based on ODCM Attachment D, Tables 2.2-2a and 2.2-2b.

Estimated Critical Receptor Dose

The critical receptor is defined to be that individual located where the combination of existing pathways and receptor age groups have the highest dose potential. The critical receptor for this report was determined to be located in the Northwest sector at 1432 meters.

Doses for various scenarios were calculated and are shown in Table 3. They are listed in order of increasing technical sophistication.

Scenarios 1 and 2 assume an arbitrary C-14 release of 20 Ci per year per unit. These reflect simplistic calculations based on the conservative assumption that all releases were ground mode and 100% of the C-14 present in CO2 form. Scenario 1 dose incorporates for all pathways (**All**) of interest whether actually present or not. Scenario 2 dose addresses actual pathways (**Inhalation** and **Vegetation**) indicated by the ODCM. These scenarios obviously reflect an unreasonable level of conservatism and the dose estimates are unrealistic.

Scenarios 3 and 4 utilized the EPRI C-14 proxy source term (11 Ci/yr) released as 100% CO2. Scenario 3 assumes ground level releases and the presence of all pathways. As the milk and meat pathways are known to be absent at this location, this provides an overly conservative estimate, but has been included for comparison. Scenario 4 assumes ground level release and considers only those exposure pathways actually present.

Key Solutions

Scenario 5 uses the conservative CO2 fraction of 40%; the other 60% being in organic form. For the inhalation exposure pathway 100% of the C-14 source term was used. For ingestion pathways, 40%. The EPRI proxy source term was used and the release mode was assumed to be ground level.

Scenario 6 apportions 20% of the C-14 release to ground level and 80% to elevated release points. Only doses for the existing pathways were considered. The X/Q used for the elevated release is the annual average dispersion for the nearest residence in the NW sector at 1464 meters. This assumes short term releases from the process vent can be modeled using annual average X/Q. The basis for this is from the observation that cumulative releases from the process vent exceeded 500 hours per year for 2009. It was assumed that process vent releases during 2010 would also exceed 500 hours per year.

Scenario 7 apportions 20% of the C-14 release to ground level and 80% to elevated release points. Only doses for the existing pathways were considered. The X/Q used for the elevated release is the short term dispersion value for the nearest residence in the NW sector at 1464 meters. This value was taken from ODCM Attachment M, Table 2.3-37.

Scenarios 8 and 9 provide estimates of meat (WNW @ 3605 meters) and milk (WNW at 4538 meters) exposure pathways at the locations of the highest dose potential. It was assumed that inhalation and vegetation exposure pathways were also present.

Key Solutions

Table 3.
C-14 Dose Assessment Scenarios

	Scenario Description	Ground X/Q	Elevated X/Q	GndCi Per yr	Elev Ci Per yr	CO2 Fraction	Exposure Pathways	Critical Age Group	Bone Dose mrem/yr	Total Body Dose mrem/yr
1	Arbitrary release of 20 Ci/yr. Nearest residence. All pathways. Ground release.	2.71E-5	-	20	-	1	All NW - 1432m	Child (Bone)	111.0	22.2
2	Arbitrary release of 20 Ci/yr. Nearest residence. Real pathways. Ground release.	2.71E-5	-	20	-	1	Inhalation Vegetation NW - 1432m	Child (Bone)	66.3	27.6
3	C-14 EPRI PWR value. Ground release.	2.71E-5	-	11	-	1	All NW - 1432m	Child (Bone)	61.0	12.2
4	C-14 EPRI PWR value. Ground release. Real pathways.	2.71E-5	-	11	-	1	Inhalation Vegetation NW - 1432m	Child (Bone)	36.5	15.2
5	C-14 EPRI PWR value. Ground release. Real pathways. 40% CO2	2.71E-5	-	11	-	.4	Inhalation Vegetation NW - 1432m	Child (Bone)	14.8	3.0
6	C-14 EPRI PWR value. Ground and elevated release points. Short term X/Q. 40% CO2	2.71E-5	7.30E-9	2.2	8.8	.4	Inhalation Vegetation NW - 1432m	Child (Bone)	3.0	0.6
7	C-14 EPRI PWR value. Critical receptor. Short term elevated X/Q. 40% CO2	2.71E-5	3.31E-8	2.2	8.8	.4	Inhalation Vegetation NW - 1432m	Child (Bone)	3.0	0.6
8	C-14 EPRI PWR value. Highest meat pathway. Short term elevated X/Q. 40% CO2.	4.8E-6	2.53E-7	2.2	8.8	.4	Inhalation Vegetation Meat WNW @ 3605 m	Child (Bone)	1.3	0.3
9	C-14 EPRI PWR value. Highest milk pathway. Short term elevated X/Q. 40% CO2.	3.5E-6	1.78E-7	2.2	8.8	.4	Inhalation Vegetation Milk WNW @ 4538m	Child (Bone)	1.2	0.2

Key Solutions

Discussion

Scenarios 7, 8 and 9 reflect the most technically detailed dose calculation. Nevertheless the reported doses are still conservative based upon the following presumptions:

- 100% of C-14 generated in reactor coolant is released in effluents.
- 100% of C-14 released in effluents is released to the atmosphere.
- The CO2 fraction was assumed to be 40%. Actual values expected to be 5%-30% based on EPRI guidelines.
- Releases were apportioned as 20% ground level and 80% elevated. ODCM Attachment D, Tables 2.2-2a and 2.2-2b indicate 12.5% and 87.5%.
- The most radio-sensitive age group is actually present.
- The receptor consumes at the maximum individual rate as given in Reg Guide 1.09, Table E-5.
- All food products are produced in the immediate vicinity of the receptor.
- 100% of the receptors annual consumption for vegetation, milk and/or meat come from locally produced products.
- The specific activity of carbon-14 has reached equilibrium in all environmental compartments.

Scenario 7 gives the dose estimate for the maximum exposed individual (critical receptor) based on pathways actually present at 1432 meters in the NW direction. Values were 3.0 mrem for bone and 0.6 mrem for all other body organs, the critical age group being child.

Scenario 8 provides the dose estimate at the location of the highest real meat exposure pathway (WNW at 3605 meters). Inhalation and vegetation pathways were considered present as indicated by ODCM Table 2.2-3.

Scenario 9 provides the dose estimate at the location of the highest real milk exposure pathway (WNW at 4539 meters). Although ODCM Table 2.2-3 shows no inhalation or vegetation present at this location, these exposure pathways were included.

Summary

Liquid effluent release doses were found to be insignificant - less than 5.0 E-3 mrem per Ci of C-14 released in liquid effluents. The adult was the controlling age group.

The highest airborne dose potential was determined to be at the location of the nearest garden in the NW direction at 1432 meters. Best estimates for C-14 organ dose to the receptors in each age group at this location for Units 1 and 2 are shown in Tables 4a and 4b.

Key Solutions

Table 4a.
BVPS Unit 1 – 90% Capacity Factor
C-14 Dose in mrem/yr at Highest Dose Receptor
NW at 1332 meters

Exposure Pathway	Infant		Child		Teen		Adult	
	Bone	Other*	Bone	Other*	Bone	Other*	Bone	Other*
Inhalation	4.51E-02	9.04E-03	6.11E-02	1.15E-02	4.43E-02	8.30E-03	3.09E-02	5.80E-03
Vegetation Ingestion	-	-	2.61E+00	5.21E-01	1.08E+00	2.15E-01	6.54E-01	1.31E-01
Total	0.05	0.01	2.67	0.53	1.12	0.22	0.68	0.14

* "Other" refers to liver, total body, thyroid, kidney, lung and GI. Doses for these organs are assumed to be equal.

Table 4b.
BVPS Unit 2 - 100% Capacity Factor
C-14 Dose in mrem/yr at Highest Dose Receptor
NW at 1332 meters

Exposure Pathway	Infant		Child		Teen		Adult	
	Bone	Other*	Bone	Other*	Bone	Other*	Bone	Other*
Inhalation	5.01E-02	1.00E-02	6.79E-02	1.27E-02	4.92E-02	9.22E-03	3.44E-02	6.45E-03
Vegetation Ingestion	-	-	2.89E+00	5.79E-01	1.20E+00	2.39E-01	7.27E-01	1.45E-01
Total	0.05	0.01	2.96	0.59	1.24	0.25	0.76	0.15

* "Other" refers to liver, total body, thyroid, kidney, lung and GI. Doses for these organs are assumed to be equal.

The maximum bounding dose to a member of the public resulting from atmospheric C-14 releases from Unit 1 was determined to be less than 2.67 mrem to the bone and less than 0.53 mrem to all other organs. The child is the controlling age group.

The maximum bounding dose to a member of the public resulting from atmospheric C-14 releases from Unit 2 was determined to be less than 2.96 mrem to the bone and less than 0.59 mrem to all other organs. The child is the controlling age group.

Key Solutions

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