



Brunswick Nuclear Plant
P.O. Box 10429
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APR 29 2013

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Docket Nos. 50-325 and 50-324
Radioactive Effluent Release Report for 2012

Ladies and Gentlemen:

In accordance with 10 CFR 50.36a and Technical Specification (TS) 5.6.3 for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2, Duke Energy Progress, Inc., formerly known as Carolina Power & Light Company (CP&L) is submitting the enclosed Radioactive Effluent Release Report for BSEP Unit Nos. 1 and 2. This report covers the period from January 1, 2012, through December 31, 2012.

TS 5.5.1, "Offsite Dose Calculation Manual (ODCM)," requires changes to the ODCM be submitted as part of or concurrent with the Radioactive Effluent Release Report. A copy of Revision 36 of the BSEP ODCM, current as of June 7, 2012, is included as Enclosure 2. Changes made to the ODCM during 2012 are summarized in the 2012 Radioactive Effluent Release Report.

No regulatory commitments are contained in this submittal. Please refer any questions regarding this submittal to Mr. Lee Grzeck, Manager - Regulatory Affairs, at (910) 457-2487.

Sincerely,

Annette H. Pope
Manager – Organizational Effectiveness
Brunswick Steam Electric Plant

MAT/mat

Enclosures:

1. Radioactive Effluent Release Report for 2012
2. Offsite Dose Calculation Manual, Revision 36

A009
JE48
NR2

cc (with Enclosure 1 only):

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Radioactive Effluent Release Report for 2012

Brunswick Steam Electric Plant Radioactive Effluent Release Report January 1 through December 31, 2012

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Attachment 1
Effluent and Waste Disposal Report Supplemental Information

Facility: Brunswick Steam Electric Plant
Licensee: Carolina Power & Light Company

1. Regulatory Limits

A. Fission and activation gases (ODCMS 7.3.8)

(1) Calendar Quarter¹

(a) ≤ 10 mrad gamma

(b) ≤ 20 mrad beta

(2) Calendar Year

(a) ≤ 20 mrad gamma

(b) ≤ 40 mrad beta

B. Iodine-131, iodine-133, tritium, and particulates with half-lives greater than eight days (ODCMS 7.3.9)

(1) Calendar Quarter¹

(a) ≤ 15 mrem to any organ

(2) Calendar Year

(a) ≤ 30 mrem to any organ

C. Liquid Effluents (ODCMS 7.3.4)

(1) Calendar Quarter²

(a) ≤ 3 mrem to total body

(b) ≤ 10 mrem to any organ

(2) Calendar Year

(a) ≤ 6 mrem to total body

(b) ≤ 20 mrem to any organ

2. Maximum permissible concentration and dose rates which determine maximum instantaneous release rates.

A. Fission and activation gases (ODCMS 7.3.7.a)

(1) ≤ 500 mrem/year to total body

(2) ≤ 3000 mrem/year to the skin

B. Iodine-131, iodine-133, tritium, and particulates with half-lives greater than eight days (ODCMS 7.3.7.b)

(1) ≤ 1500 mrem/year to any organ

NOTE: Dose calculations are determined in accordance with the ODCM

¹ Used for percent of ODCMS limit determination in Attachment 2, Table 1A

² Used for percent of ODCMS limit determination in Attachment 2, Table 2A

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C. Liquid effluents (ODCMS 7.3.3)

The concentration of radioactive material released in liquid effluents to unrestricted areas after dilution in the discharge canal shall be limited to 10 times the concentrations specified in Appendix B, Table 2, Column 2 to 10 CFR 20.1001 - 20.2401 for radionuclides other than dissolved or entrained noble gases. The concentration shall be limited to the value given in the ODCM specifications for the following radionuclides:

(1) Tritium: limit = $1.00\text{E-}03 \mu\text{Ci/ml}^3$

(2) Dissolved and entrained noble gases: limit = $2.00\text{E-}04 \mu\text{Ci/ml}^3$

3. Measurements and Approximations of Total Radioactivity

A. Fission and activation gases

Analyses for specific radionuclides in representative grab samples by gamma spectroscopy.

B. Iodines

Analysis for specific radionuclides collected on charcoal cartridges by gamma spectroscopy.

C. Particulates

Analysis for specific radionuclides collected on filter papers by gamma spectroscopy.

D. Liquid Effluents

Analysis for specific radionuclides of individual releases by gamma spectroscopy.

E. Tritium

Analysis by liquid scintillation.

³ Used as applicable limits for Attachment 2, Table 2A

Total error where reported represents a best effort to approximate the total of all individual and sampling errors.

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4. Batch Releases

A. Liquid

(1) Number of batch releases:	2.12E+02
(2) Total time period for batch releases:	3.98E+04 Minutes
(3) Maximum time period for a batch release:	3.05E+02 Minutes
(4) Average time period for a batch release:	1.88E+02 Minutes
(5) Minimum time period for a batch release:	1.40E+01 Minutes
(6) Average stream flow during periods of release of effluent into a flowing stream:	7.91E+05 Gallons per Minute

B. Gaseous

(1) Number of batch releases:	0.00E+00
(2) Total time period for batch releases:	0.00E+00 Minutes
(3) Maximum time period for a batch release:	0.00E+00 Minutes
(4) Average time period for a batch release:	0.00E+00 Minutes
(5) Minimum time period for a batch release:	0.00E+00 Minutes

5. Abnormal Releases⁴

A. Liquid

(1) Number of releases:	0.00E+00
(2) Total activity released:	0.00E+00 Curies

B. Gaseous

(1) Number of releases:	0.00E+00
(2) Total activity released:	0.00E+00 Curies

⁴ There were no abnormal releases that exceeded 10 CFR 20 or 10 CFR 50 limits. See pages 5-6 for a discussion of release events that occurred.

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Discussion of Carbon-14 in Gaseous Effluents

BNP's Updated Final Safety Analysis Report (UFSAR) states the C-14 release rate from a BWR is approximately $9.50\text{E}+00$ Ci/yr assuming 80% plant capacity factor. Since BNP has two reactors, the release rate would be $1.90\text{E}+01$ Ci/yr. This value was scaled using Effective Full Power Days (EFPD) to give a release rate of $2.05\text{E}+01$ Ci/yr. Based on the 2012 Land Use Census, the critical receptor is located in the south sector at 1.1 miles with a garden. There are no meat or milk pathways within 5 miles. Regulatory Guide 1.109 methodology was used to determine the dose to this critical receptor. The bone dose for 2012 was $3.96\text{E}+00$ mrem and the total body dose was $7.91\text{E}-01$ mrem. The curies released are included in Attachment 2, Table 1A and the dose is included in the Annual Dose Summary, Attachment 7.

Discussion of liquid releases from the Storm Drain Collector Basin (SDCB)

During periods of heavy rain, the contents of the SDCB may be released to the discharge canal in accordance with regulatory requirements to protect plant personnel and equipment. The SDCB was released directly to the discharge canal on twenty-two occasions in 2012 due to heavy rains. Approximately $5.29\text{E}+06$ gallons containing $7.55\text{E}-01$ curies of tritium were released. There was no detectable gamma radioactivity. This resulted in an estimated maximum dose to the individual of $1.08\text{E}-06$ mrem. The volume released was not included in the average diluted concentration determination or in the volume of waste released on Attachment 2, Table 2A. The tritium released was included in the quarterly summary on Attachment 2, Table 2A and the dose is included in the Annual Dose Summary, Attachment 7.

Discussion of liquid releases from the Storm Drain Stabilization Pond (SDSP)

The SDSP collects rainwater and water from miscellaneous low volume drains on plant site, however, since the third quarter of 2012 all inputs except rainwater were routed to the Storm Drain Stabilization Facility. Treatment consists of sedimentation, evaporation and transpiration. When sufficient water has accumulated in the pond it is released into the intake canal where it is drawn into the plant circulating and service water system and eventually released into the discharge canal. There were seven SDSP releases in 2012. Approximately $2.34\text{E}+07$ gallons containing $2.55\text{E}+00$ curies of tritium were released. There was no detectable gamma radioactivity. This resulted in an estimated maximum dose to the individual of $4.23\text{E}-06$ mrem. The SDSP is a permitted release point. The volume released was not included in the average diluted concentration determination or in the volume of waste released on Attachment 2, Table 2A. The tritium released is included in the quarterly summary on Attachment 2, Table 2A and the dose is included in the Annual Dose Summary, Attachment 7.

Discussion of liquid releases from the Storm Drain Stabilization Facility (SDSF)

The SDSF collects rainwater, water from miscellaneous low volume drains on plant site, and water from the Groundwater Extraction System. Treatment consists of filtration and evaporation. When sufficient water has accumulated in the pond it is released into the intake canal where it is drawn into the plant circulating and service water system and eventually released into the discharge canal. There were nine SDSF releases in 2012. Approximately $3.24\text{E}+07$ gallons containing $4.63\text{E}+00$ curies of tritium were released from the SDSF. There was no detectable gamma radioactivity. This resulted in an estimated maximum dose to the individual of $6.08\text{E}-06$ mrem. The SDSF is a permitted release point. The volume released was not included in the average diluted concentration determination or in the volume of waste

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released on Attachment 2, Table 2A. The tritium released is included in the quarterly summary on Attachment 2, Table 2A and the dose is included in the Annual Dose Summary, Attachment 7.

Discussion of water evaporation from the Storm Drain Stabilization Pond

There was $6.23\text{E}+07$ gallons of tritiated water released via evaporation from the SDSP in 2012. This yields $7.38\text{E}+00$ curies of tritium released to the atmosphere as a ground release. The nearest resident to the pond is in the northwest sector at approximately 0.3 miles. The maximum exposed individuals at that location received a calculated dose of $2.25\text{E}-03$ mrem via the inhalation pathway in 2012. Only inhalation dose was determined because the exposed individuals do not have a garden and also do not have any milk or meat animals at this location. The curies of tritium released from the SDSP evaporation are included in Attachment 2, Table 1A. The dose is included in the Annual Dose Summary, Attachment 7.

Discussion of water evaporation from the Storm Drain Stabilization Facility

There was $2.59\text{E}+06$ gallons of tritiated water released via evaporation from the SDSF in 2012. This yields $3.74\text{E}-01$ curies of tritium released to the atmosphere as a ground release. The nearest resident to the pond is in the north northwest sector at approximately 0.5 miles. The maximum exposed individuals at that location received a calculated dose of $2.40\text{E}-04$ mrem via the inhalation pathway in 2012. Only inhalation dose was determined because the exposed individuals do not have a garden and also do not have any milk or meat animals at this location. The curies of tritium released from the SDSF evaporation are included in Attachment 2, Table 1A. The dose is included in the Annual Dose Summary, Attachment 7.

Discussion of liquid releases from the Marsh to Nancy's Creek

Samples are routinely analyzed from the marsh areas that drain into Nancy's Creek during falling tides. The marsh areas are all on company owned property. The marsh land is under the influence of high and low tides and releases to Nancy's Creek, which is offsite. This constitutes a release point for evaluation. The sampling program consists of weekly sampling and analysis at eight locations. All gamma analyses performed in 2012 were less than the Lower Limit of Detection (LLD). There were 424 tritium analyses performed, which resulted in 85 positive tritium results. The minimum concentration detected from the 85 positive results was $2.52\text{E}-07$ $\mu\text{Ci/ml}$ and the maximum concentration was $3.12\text{E}-05$ $\mu\text{Ci/ml}$. Using the average concentration of all the samples ($1.70\text{E}-06$ $\mu\text{Ci/ml}$), two high tides per day, the area of the marsh at high tide, 366 days (2012 was leap year), and a conservative factor of 2, it is calculated that $5.39\text{E}+07$ gallons were released to Nancy's Creek containing $3.47\text{E}-01$ curies of tritium. This yielded a Total Body dose of $3.32\text{E}-03$ mrem to an adult from eating fish and $8.17\text{E}-04$ mrem from eating invertebrate (shrimp, crabs, etc.) for a total dose of $4.14\text{E}-03$ mrem. The curies released are included in Attachment 2, Table 2A and the dose is included in the Annual Dose Summary, Attachment 7.

Discussion of Groundwater Monitoring

The BSEP groundwater sampling and analysis program has grown into a significant surveillance program. Wells have been installed around the SDSP, in the Protected Area (PA), and throughout the Owner Controlled Area (OCA). Ten wells are listed in the ODCM and are addressed in the Radiological Environmental Monitoring Report (REMP). The monitoring wells that are not covered in the ODCM will be discussed below. These wells consist of shallow and

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intermediate wells in different locations around the OCA and PA. These wells are used to evaluate groundwater movement and for remediation of the Condensate Storage Tank (CST) leak.

Unit 1 CST Groundwater Wells – The investigation into groundwater impacts resulting from the December 2010 Unit 1 Condensate Storage tank line leak resulted in the installation of numerous monitoring/recovery wells. Four of these wells (U1CSTREM-01, U1CSTREM-07, U1CSTREM-08 and U1CSTREM-09) are installed in the Castle Hayne aquifer (greater than 70' below ground surface) to investigate and monitor potential impacts to the aquifer. Six of these wells (U1CSTREM-05, U1CSTREM-02B, U1CSTREM-15, U1CSTREM-21B, U1CSTREM-22B and MWPA-111B) are installed in the dense sand unit (45' – 70' below ground surface) to investigate and monitor impacts to this flow zone comprised of native material beneath the plant excavation backfill. At least three of these wells are planned to be used as recovery wells as part of the groundwater remediation effort. Thirteen of these wells (U1CSTREM-02C, U1CSTREM-11, U1CSTREM-12, U1CSTREM-13, U1CSTREM-14, U1CSTREM-16, U1CSTREM-18, U1CSTREM-19, U1CSTREM-21C, U1CSTREM-22C, U1CSTREM-24, U1CSTREM-25 and MWPA-112C) are installed in the plant excavation backfill (up to 45' below ground surface) to investigate and monitor impacts to this flow zone where the leak occurred. At least ten of these wells are planned to be used as recovery wells as part of the groundwater remediation effort. Additional wells are planned for installation as part of the monitoring and remediation effort.

Marsh Wells - Six (6) wells (ESS-NC-1 through ESS-NC-5, and ESS-GLB-1) installed along the edge of Nancy's Creek and Gum Log Branch in the tidal marsh were abandoned in 2012. Because the installation of these wells was completed by hand to minimize impact to the wetland, the maximum depth of the wells was approximately eight (8) feet below ground surface. As a result, limited penetration (approximately 6-inches) into the surficial sand aquifer was accomplished, and the majority of the screened interval of the marsh wells intersected the silty marsh sediments, which are saturated by the brackish tidal water of Nancy's Creek and Gum Log Branch. Therefore, groundwater in these wells was likely diluted by the infiltration of surface water that saturates the marsh sediments. This was evidenced by the conductivity readings collected during groundwater purging activities, which were generally an order of magnitude higher in the marsh wells than the nearby shallow wells. As a result, the data from these wells was used primarily as a screening indicator to estimate the probability that a discharge of tritium to the creek may be occurring. ESS-NC-4A which is a deeper well was installed to monitor this area and is sampled quarterly.

Several gamma analyses were performed and all results were less than LLD. Below are the tritium results for the wells that are not included in the ODCM. Maps showing the locations of these wells are available upon request.

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Shallow Wells for Plant Site						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-2C	7	7	3.24E+04	1.43E+04	5.01E+04	27
ESS-3C	4	4	5.70E+02	4.90E+02	6.52E+02	14
ESS-12C	4	0	<LLD	<LLD	<LLD	15
ESS-13C	4	0	<LLD	<LLD	<LLD	25
ESS-16	5	5	1.00E+03	7.63E+02	1.45E+03	27
ESS-17C	4	4	8.47E+03	7.45E+03	9.87E+03	26
ESS-18C	4	4	1.45E+05	9.72E+04	1.87E+05	20
ESS-19C	4	4	2.44E+05	1.79E+05	3.26E+05	20
ESS-20C	4	4	3.48E+04	3.05E+04	3.93E+04	20
ESS-21C	5	5	6.20E+03	5.29E+03	7.47E+03	20
ESS-22C	5	5	3.15E+05	2.00E+05	4.12E+05	20
ESS-23C	4	4	1.98E+05	1.77E+05	2.20E+05	23
ESS-24C	3	3	6.28E+03	5.64E+03	6.92E+03	18
ESS-25C	4	0	<LLD	<LLD	<LLD	22
ESS-26C	4	4	1.64E+05	1.11E+05	2.00E+05	15
ESS-27C	4	4	1.77E+05	1.70E+05	1.81E+05	16
ESS-28C	4	4	5.60E+02	5.28E+02	6.02E+02	23
ESS-30C	7	6	9.47E+02	5.17E+02	1.62E+03	15
ESS-31C	16	16	4.06E+03	2.98E+02	1.66E+04	15
ESS-32C	1	0	<LLD	<LLD	<LLD	35
ESS-33C	1	0	<LLD	<LLD	<LLD	25

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Shallow Wells for Plant Site						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-34C	1	0	< LLD	< LLD	< LLD	22
ESS-35C	1	0	< LLD	< LLD	< LLD	20
ESS-36C	1	0	< LLD	< LLD	< LLD	22
ESS-37C	1	0	< LLD	< LLD	< LLD	30
ESS-38C	4	0	< LLD	< LLD	< LLD	15
ESS-39C	4	0	< LLD	< LLD	< LLD	20
ESS-40C	1	0	< LLD	< LLD	< LLD	30
ESS-41C	1	0	< LLD	< LLD	< LLD	27
ESS-42C	2	0	< LLD	< LLD	< LLD	30
ESS-43C	1	0	< LLD	< LLD	< LLD	17
ESS-44C	1	0	< LLD	< LLD	< LLD	15
ESS-45C	1	0	< LLD	< LLD	< LLD	21
ESS-46C	1	0	< LLD	< LLD	< LLD	18
ESS-47C	2	0	< LLD	< LLD	< LLD	20
ESS-48C	1	0	< LLD	< LLD	< LLD	18
ESS-49C	1	0	< LLD	< LLD	< LLD	19
ESS-50C	1	0	< LLD	< LLD	< LLD	22
ESS-51C	1	0	< LLD	< LLD	< LLD	22
ESS-54C	1	0	< LLD	< LLD	< LLD	24
ESS-55C	1	0	< LLD	< LLD	< LLD	38
ESS-56C	1	0	< LLD	< LLD	< LLD	32

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Shallow Wells for Plant Site						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-57C	1	0	< LLD	< LLD	< LLD	40
ESS-58C	1	0	< LLD	< LLD	< LLD	18
ESS-59C	1	0	< LLD	< LLD	< LLD	18
ESS-60C	1	0	< LLD	< LLD	< LLD	19
ESS-61C	1	0	< LLD	< LLD	< LLD	28
ESS-62C	1	0	< LLD	< LLD	< LLD	20
ESS-63C	1	0	< LLD	< LLD	< LLD	29
ESS-64C	1	0	< LLD	< LLD	< LLD	21
ESS-65C	1	0	< LLD	< LLD	< LLD	15
ESS-66C	1	0	< LLD	< LLD	< LLD	20
ESS-67C	10	2	3.47E+02	3.34E+02	3.59E+02	25
ESS-68C	1	0	< LLD	< LLD	< LLD	19
ESS-69C	1	0	< LLD	< LLD	< LLD	30
ESS-70C	1	0	< LLD	< LLD	< LLD	18
ESS-71C	1	0	< LLD	< LLD	< LLD	19
ESS-72C	11	3	4.64E+02	3.26E+02	5.91E+02	18
ESS-73C	4	0	< LLD	< LLD	< LLD	15
ESS-74C	1	0	< LLD	< LLD	< LLD	25
ESS-201C	4	4	1.23E+04	6.81E+03	2.04E+04	27
ESS-202C	5	5	7.63E+04	1.16E+04	1.34E+05	27
ESS-203C	4	4	5.93E+03	3.85E+03	7.72E+03	27

Attachment I
Effluent and Waste Disposal Report Supplemental Information

Shallow Wells for Plant Site						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-STAB	5	5	3.60E+04	3.01E+04	3.96E+04	31
ESS-NC-4A	4	4	4.82E+03	4.56E+03	5.17E+03	17
MW-1	5	4	2.63E+02	2.90E+02	4.03E+02	24
MW-2	5	3	3.55E+02	3.11E+02	4.31E+02	24
MW-3	5	2	2.86E+02	2.79E+02	2.93E+02	26
MWPA-100C	4	3	3.53E+02	2.56E+02	5.21E+02	30
MWPA-101C	4	4	6.00E+02	4.50E+02	8.61E+02	29
MWPA-102C	4	4	7.75E+02	7.12E+02	9.06E+02	30
MWPA-103C	4	2	3.02E+02	2.41E+02	3.63E+02	30
MWPA-104C	4	4	1.64E+04	1.01E+04	2.66E+04	29
MWPA-105C	4	4	1.55E+03	1.09E+03	2.05E+03	30
MWPA-106C	4	4	5.15E+02	3.80E+02	6.64E+02	29
MWPA-107C	12	12	3.04E+03	2.41E+03	4.09E+03	29
MWPA-108C	4	3	3.62E+02	3.02E+02	3.92E+02	29
MWPA-109C	4	4	7.91E+02	7.35E+02	8.86E+02	29
MWPA-110C	6	6	7.01E+02	3.21E+02	7.05E+02	29
MWPA-111C	5	5	2.87E+05	2.50E+05	3.33E+05	30
MWPA-112C	34	34	3.56E+05	1.41E+05	8.36E+05	34
MWPA-113C	12	11	7.72E+02	4.46E+02	1.37E+03	25
MWPA-114C	4	4	1.09E+03	4.24E+02	1.60E+03	30
MWPA-115C	12	12	1.47E+04	1.22E+04	1.75E+04	34

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Shallow Wells for Plant Site						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
MWPA-116C	12	3	4.26E+02	3.37E+02	5.38E+02	30
MWPA-117C	12	12	7.51E+02	4.68E+02	9.94E+02	30
MWPA-118C	12	10	6.76E+02	3.45E+02	9.88E+02	30

Intermediate Wells for Plant Site						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-2B	5	0	< LLD	< LLD	< LLD	58
ESS-3B	4	1	3.15E+02	3.15E+02	3.15E+02	52
ESS-18B	4	3	4.02E+02	3.55E+02	4.92E+02	23
ESS-19B	4	4	3.78E+03	2.96E+03	4.61E+03	42
ESS-20B	5	0	< LLD	< LLD	< LLD	43
ESS-22B	5	5	1.21E+03	1.13E+03	1.28E+03	76
ESS-38B	4	0	< LLD	< LLD	< LLD	55
ESS-39B	4	0	< LLD	< LLD	< LLD	55
ESS-51B	4	0	< LLD	< LLD	< LLD	45
ESS-52B	4	0	< LLD	< LLD	< LLD	51
ESS-53B	4	0	< LLD	< LLD	< LLD	76
MWPA-104B	4	4	1.26E+04	7.61E+03	1.77E+04	59

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Intermediate Wells for Plant Site						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
MWPA-107B	4	4	5.33E+04	4.80E+04	6.19E+04	60
MWPA-111B	33	28	1.34E+04	3.06E+03	1.15E+05	59

Unit 1 CST Groundwater Wells						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
U1CSTREM-01	9	0	< LLD	< LLD	< LLD	80
U1CSTREM-02B	4	4	9.13E+04	2.52E+03	1.77E+05	65
U1CSTREM-02C	132	132	1.51E+06	1.74E+05	4.49E+06	45
U1CSTREM-05	5	1	4.34E+02	4.34E+02	4.34E+02	60
U1CSTREM-07	7	1	9.25E+02	9.25E+02	9.25E+02	80
U1CSTREM-08	7	5	1.54E+03	3.41E+02	1.95E+03	80
U1CSTREM-09	7	4	9.19E+02	2.86E+02	2.42E+03	68
U1CSTREM-11	8	1	3.69E+02	3.69E+02	3.69E+02	35

Attachment 1
Effluent and Waste Disposal Report Supplemental Information

Unit 1 CST Groundwater Wells						
Well Name	Number of Samples in 2012	Number of Positive Samples in 2012	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
U1CSTREM-13	62	62	5.40E+05	1.38E+05	2.18E+06	45
U1CSTREM-14	61	61	5.62E+05	3.42E+05	1.32E+06	45
U1CSTREM-15	139	139	6.68E+05	3.24E+04	4.62E+06	59
U1CSTREM-16	131	131	2.16E+06	1.23E+05	5.17E+06	41
U1CSTREM-18	62	62	7.30E+06	5.12E+06	9.64E+06	29
U1CSTREM-19	61	61	5.00E+05	2.96E+05	8.12E+05	41
U1CSTREM-21B	1	1	4.61E+04	4.61E+04	4.61E+04	60
U1CSTREM-21C	1	1	3.17E+03	3.17E+03	3.17E+03	45
U1CSTREM-22B	1	1	2.49E+04	2.49E+04	2.49E+04	60
U1CSTREM-22C	1	1	5.50E+04	5.50E+04	5.50E+04	45
U1CSTREM-24	12	12	2.00E+05	1.05E+05	3.95E+05	30
U1CSTREM-25	62	62	6.21E+05	1.65E+05	1.56E+06	45

Attachment 2
Effluent and Waste Disposal Data

Table 1A	Gaseous Effluents - Summation of all Releases
Table 1B	Gaseous Effluents - Elevated Releases
Table 1C	Gaseous Effluents - Ground Level Releases
Table 2A	Liquid Effluents - Summation of all Releases
Table 2B	Liquid Effluents - Batch Mode
	Lower Limits of Detection
Table 3A	Solid Waste and Irradiated Fuel Shipments - Waste Class A
Table 3B	Solid Waste and Irradiated Fuel Shipments - Waste Class B
Table 3C	Solid Waste and Irradiated Fuel Shipments - Waste Class C

Attachment 2
Effluent and Waste Disposal Data

Table 1A: Gaseous Effluents – Summation of all Releases

A. FISSION AND ACTIVATION GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	3.69E+01	6.57E+01	5.35E+01	3.86E+01	2.50E+01
2. Average release rate for period	μCi/sec	4.69E+00	8.35E+00	6.74E+00	4.85E+00	NA
3. Percent of ODCM limit	%	3.20E-02	4.83E-02	4.15E-02	3.72E-02	NA

B. IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total Iodine - 131 release	Ci	1.50E-03	1.85E-03	2.14E-03	1.97E-03	2.50E+01
2. Average release rate for period	μCi/sec	1.91E-04	2.35E-04	2.69E-04	2.48E-04	NA

C. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	7.15E-04	1.22E-03	7.01E-04	5.08E-04	2.50E+01
2. Average release rate for period	μCi/sec	9.10E-05	1.55E-04	8.82E-05	6.40E-05	NA
3. Gross Alpha	Ci	1.90E-10	1.12E-07	≤ LLD	2.46E-07	2.50E+01

D. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	4.92E+01	3.84E+01	5.49E+01	8.68E+01	1.50E+01
2. Average release rate for period	μCi/sec	6.26E+00	4.89E+00	6.90E+00	1.09E+01	NA

Attachment 2
Effluent and Waste Disposal Data

Table 1A: Gaseous Effluents – Summation of all Releases

E. IODINE-131, IODINE-133, TRITIUM AND PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1. Total release	Ci	4.93E+01	3.85E+01	5.49E+01	8.68E+01
2. Average release rate for period	μCi/sec	6.26E+00	4.89E+00	6.91E+00	1.09E+01
3. Percent of ODCM limit	%	1.07E-01	1.35E-01	1.67E-01	1.63E-01

D. CARBON-14

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1. Total release	Ci	4.56E+00	4.71E+00	5.54E+00	5.71E+00
2. Average release rate for period	μCi/sec	5.79E-01	5.99E-01	6.98E-01	7.18E-01

Attachment 2
Effluent and Waste Disposal Data

Table 1B: Gaseous Effluents – Elevated Releases
Continuous Release

Nuclides Released

1. FISSION GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
argon-41	Ci	≤ LLD	1.71E+01	1.96E+01	6.99E+00
krypton-85	Ci	≤ LLD	2.01E+00	8.05E-01	≤ LLD
krypton-85m	Ci	≤ LLD	1.35E+00	1.74E+00	1.29E+00
krypton-87	Ci	8.12E-01	2.30E+00	3.30E-01	≤ LLD
krypton-88	Ci	≤ LLD	3.14E+00	3.04E-01	≤ LLD
xenon-133	Ci	≤ LLD	2.62E+00	4.76E+00	2.37E+00
xenon-135	Ci	1.76E+01	1.50E+01	4.17E+00	4.31E+00
xenon-135m	Ci	4.88E+00	1.67E+00	7.19E+00	5.01E+00
xenon-137	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
xenon-138	Ci	5.38E+00	1.07E+01	6.35E+00	1.05E+01
total for period	Ci	2.86E+01	5.58E+01	4.53E+01	3.05E+01

2. GASEOUS IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
iodine-131	Ci	1.10E-03	1.33E-03	1.39E-03	1.18E-03
iodine-132	Ci	9.53E-03	1.29E-02	1.42E-02	8.91E-03
iodine-133	Ci	7.93E-03	1.17E-02	1.21E-02	8.28E-03
iodine-134	Ci	2.00E-02	2.78E-02	4.72E-02	2.25E-02
iodine-135	Ci	1.38E-02	2.10E-02	2.13E-02	1.30E-02
total for period	Ci	5.23E-02	7.47E-02	9.62E-02	5.38E-02

3. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
chromium-51	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
manganese-54	Ci	≤ LLD	≤ LLD	5.75E-07	≤ LLD
cobalt-58	Ci	≤ LLD	1.52E-06	≤ LLD	≤ LLD
cobalt-60	Ci	3.39E-06	1.84E-05	1.28E-06	≤ LLD
zinc-65	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
strontium-89	Ci	6.27E-05	1.25E-04	4.18E-05	3.32E-05
strontium-90	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
niobium-95	Ci	7.58E-07	≤ LLD	≤ LLD	≤ LLD
cesium-137	Ci	≤ LLD	4.06E-05	≤ LLD	≤ LLD
barium-140	Ci	1.40E-04	2.32E-04	2.24E-04	1.48E-04
lanthanum-140	Ci	2.50E-04	3.83E-04	3.87E-04	2.37E-04
total for period	Ci	4.56E-04	8.01E-04	6.55E-04	4.19E-04

4. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
hydrogen-3	Ci	1.14E+01	1.51E+01	2.67E+01	2.60E+01

Attachment 2
Effluent and Waste Disposal Data

Table 1C: Gaseous Effluents – Ground Level Releases
Continuous Release

Nuclides Released

1. FISSION GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
xenon-133	Ci	7.50E-01	7.40E-01	2.36E-01	≤ LLD
xenon-135	Ci	7.51E+00	9.14E+00	8.03E+00	8.07E+00
xenon-135m	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	8.26E+00	9.88E+00	8.27E+00	8.07E+00

2. GASEOUS IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
iodine-131	Ci	4.02E-04	5.24E-04	7.48E-04	7.91E-04
iodine-132	Ci	5.66E-03	8.90E-03	1.53E-02	1.37E-02
iodine-133	Ci	4.16E-03	5.64E-03	8.58E-03	8.42E-03
iodine-134	Ci	3.17E-03	1.25E-02	1.93E-02	1.77E-02
iodine-135	Ci	2.78E-03	1.04E-02	2.04E-02	1.75E-02
total for period	Ci	1.62E-02	3.80E-02	6.43E-02	5.81E-02

3. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
chromium-51	Ci	9.54E-05	1.68E-04	≤ LLD	≤ LLD
manganese-54	Ci	5.73E-06	1.46E-05	≤ LLD	2.18E-06
cobalt-58	Ci	1.38E-05	3.61E-05	≤ LLD	≤ LLD
iron-59	Ci	≤ LLD	5.28E-06	≤ LLD	≤ LLD
cobalt-60	Ci	1.37E-04	1.98E-04	4.66E-05	7.13E-05
zinc-65	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
strontium-89	Ci	≤ LLD	≤ LLD	≤ LLD	1.64E-05
strontium-90	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
cesium-137	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
barium-140	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
lanthanum-140	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
cerium-141	Ci	7.62E-06	≤ LLD	≤ LLD	≤ LLD
cerium-144	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	2.59E-04	4.21E-04	4.66E-05	8.99E-05

4. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
hydrogen-3	Ci	3.66E+01	2.03E+01	2.55E+01	6.00E+01

Attachment 2
Effluent and Waste Disposal Data

Table 2A: Liquid Effluents – Summation of all Releases

A. FISSION AND ACTIVATION PRODUCTS (NOTE 1)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release (excluding tritium, gases, and alpha)	Ci	5.66E-04	5.31E-04	1.08E-03	4.35E-04	1.70E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	3.17E-11	1.58E-11	2.52E-11	1.76E-11	NA
3. Percent of applicable limit	%	3.15E-03	3.18E-03	2.84E-03	2.66E-03	NA

B. TRITIUM (NOTE 1)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	4.31E+01	5.36E+01	3.79E+01	5.77E+01	2.30E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	2.41E-06	1.59E-06	8.85E-07	2.33E-06	NA
3. Percent of applicable limit	%	2.41E-01	1.59E-01	8.85E-02	2.33E-01	NA

C. DISSOLVED AND ENTRAINED GASES (NOTE 1)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	3.38E-03	3.36E-03	2.04E-03	1.51E-03	1.70E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	1.89E-10	9.96E-11	4.77E-11	6.12E-11	NA
3. Percent of applicable limit	%	9.47E-05	4.98E-05	2.38E-05	3.06E-05	NA

D. GROSS ALPHA RADIOACTIVITY

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD	3.20E+01

NOTE 1: Includes radionuclides released via abnormal and/or non-routine releases

NOTE 2: Does not include rainwater (i.e. Storm Drain Collector Basin, Storm Drain Stabilization Pond, and/or Storm Drain Stabilization Facility)

Attachment 2
Effluent and Waste Disposal Data

Table 2A: Liquid Effluents – Summation of all Releases

E. VOLUME OF WASTE RELEASED (NOTE 2)

	<u>Unit</u>	<u>Quarter 1</u>	<u>Quarter 2</u>	<u>Quarter 3</u>	<u>Quarter 4</u>	<u>Estimated Total Percent Error</u>
1. Total volume	liters	3.06E+06	4.82E+06	5.25E+06	3.02E+06	1.50E+01

F. VOLUME OF DILUTION WATER

	<u>Unit</u>	<u>Quarter 1</u>	<u>Quarter 2</u>	<u>Quarter 3</u>	<u>Quarter 4</u>	<u>Estimated Total Percent Error</u>
1. Total volume (used during release for average diluted concentration)	liters	1.79E+10	3.37E+10	4.28E+10	2.47E+10	1.50E+01

G. VOLUME OF COOLING WATER DISCHARGED FROM PLANT

	<u>Unit</u>	<u>Quarter 1</u>	<u>Quarter 2</u>	<u>Quarter 3</u>	<u>Quarter 4</u>	<u>Estimated Total Percent Error</u>
1. Total volume	liters	3.23E+11	4.41E+11	5.18E+11	4.70E+11	1.50E+01

NOTE 1: Includes radionuclides released via abnormal and/or non-routine releases

NOTE 2: Does not include rainwater (i.e. Storm Drain Collector Basin, Storm Drain Stabilization Pond, and/or Storm Drain Stabilization Facility)

Attachment 2
Effluent and Waste Disposal Data
Table 2B: Liquid Effluents - Batch Mode

Nuclides Released

1. FISSION AND ACTIVATION PRODUCTS

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
chromium-51	Ci	2.50E-04	9.53E-05	≤ LLD	1.40E-05
manganese-54	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
cobalt-58	Ci	2.79E-05	3.98E-05	≤ LLD	≤ LLD
cobalt-60	Ci	1.80E-04	1.45E-04	3.23E-05	7.30E-05
silver-110m	Ci	≤ LLD	≤ LLD	≤ LLD	1.30E-06
tellurium-129m	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
iodine-131	Ci	4.56E-05	8.62E-05	2.87E-04	1.37E-04
iodine-132	Ci	5.19E-07	≤ LLD	≤ LLD	≤ LLD
iodine-133	Ci	2.58E-05	1.42E-04	7.43E-04	2.08E-04
iodine-135	Ci	6.12E-06	≤ LLD	1.52E-05	≤ LLD
cesium-134	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
cesium-137	Ci	3.09E-05	2.32E-05	5.39E-07	1.53E-06
lanthanum-140	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
lanthanum-142	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	5.66E-04	5.31E-04	1.08E-03	4.35E-04

2. DISSOLVED AND ENTRAINED GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
krypton-88	Ci	≤ LLD	≤ LLD	≤ LLD	5.49E-06
xenon-133	Ci	5.27E-04	5.27E-04	3.68E-04	2.64E-04
xenon-135	Ci	2.86E-03	2.84E-03	1.67E-03	1.24E-03
xenon-135m	Ci	6.71E-07	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	3.38E-03	3.36E-03	2.04E-03	1.51E-03

Attachment 2
Effluent and Waste Disposal Data
Lower Limits of Detection

Units: $\mu\text{Ci/ml}$

1. LIQUID RELEASES

Alpha	1.81E-08
H-3	2.87E-06
H-3	2.33E-07*
Mn-54	1.72E-08
Fe-55	5.46E-07
Co-58	1.46E-08
Fe-59	4.71E-08
Co-60	2.30E-08
Zn-65	3.76E-08
Sr-89	1.04E-08
Sr-90	1.75E-08
Mo-99	1.61E-07
Ag-110m	1.97E-08
I-131	1.81E-08
I-132	2.53E-08
Cs-134	1.64E-08
Cs-137	2.49E-08
Ce-141	2.77E-08
Ce-144	1.26E-07
Kr-87	5.52E-08
Kr-88	6.80E-08
Xe-133	4.79E-08
Xe-133m	1.32E-07
Xe-135	1.80E-08
Xe-135m	9.03E-08
Xe-138	1.82E-07

2. GASEOUS RELEASES

Ar-41	2.13E-08
Kr-85	2.51E-06
Kr-85m	7.88E-09
Kr-87	1.99E-08
Kr-88	3.42E-08
Xe-133	1.73E-08
Xe-133m	5.79E-08
Xe-135	7.78E-09
Xe-135m	1.28E-07
Xe-137	1.49E-06
Xe-138	2.27E-07

3. IODINES AND PARTICULATES

Alpha	9.55E-16
H-3	3.85E-11
Cr-51	3.36E-12
Mn-54	6.53E-13
Co-58	4.96E-13
Fe-59	1.16E-12
Co-60	4.49E-13
Zn-65	1.06E-12
Sr-89	8.37E-15
Sr-90	5.20E-15
Nb-95	5.42E-13
Mo-99	5.06E-12
I-131	4.99E-13
Cs-134	3.81E-13
Cs-137	5.51E-13
Ba-140	1.56E-12
La-140	8.94E-13
Ce-141	5.08E-13
Ce-144	1.89E-12

NOTES:

1. The above values represent typical "a priori" LLDs for isotopes where values of " \leq LLD" are indicated in Tables 1A, 1B, 1C, 2A, and 2B. Also included are isotopes specified in ODCMS 7.3.3 and 7.3.7.
2. Where activity for any nuclide is reported as " \leq LLD," that nuclide is considered not present and the LLD activity listed is not considered in the summary data.

*Tritium LLD value for ground water monitoring.

Attachment 2
Effluent and Waste Disposal Data

Table 3A: Solid Waste and Irradiated Fuel Shipments – Waste Class A

Waste Class A

1. <u>Total volume shipped</u> (cubic meters)			7.71E+02
Total curie quantity (estimated)			8.49E+01
2. <u>Type of Waste</u>			
	<u>Unit</u>	<u>Period</u>	<u>Estimated Total %Error</u>
a. Spent resins, filter, sludges	meter ³	4.71E+01	
	Curies	7.79E+01	1.00E+01
b. Dry active waste, compacted/non-compacted	meter ³	7.24E+02	
	Curies	6.98E+00	1.00E+01
c. Irradiated components	meters ³	0.00E+00	
	Curies	0.00E+00	N/A
d. Others (describe)	meters ³	0.00E+00	
	Curies	0.00E+00	N/A
3. <u>Estimate of major radionuclides composition</u>			
a. C-14	1.11E+00 %		
Mn-54	0.82E+00 %		
Fe-55	1.29E+01 %		
Co-60	5.59E+01 %		
Ni-63	2.05E+01 %		
Cs-137	7.13E+00 %		
b. Fe-55	3.70E+01 %		
Co-60	5.38E+01 %		
Ni-63	7.48E+00 %		
Cs-137	0.84E+00 %		
c. N/A			
d. N/A			

NOTE:

Solid Radioactive Waste listed above was shipped for processing to various waste processing services or directly shipped to a licensed disposal facility.

Attachment 2
Effluent and Waste Disposal Data

Table 3A: Solid Waste and Irradiated Fuel Shipments – Waste Class A

4. Cross reference table, waste stream, form, and container type

<u>Stream</u>	<u>Form</u>	<u>Container Type</u> Type A/Type B	<u>No. of shipments</u>
a. Resin	Dewatered	Type A or GDP	9.00E+00
b. Dry active waste	Compacted/ Non-compacted	Type A or GDP	2.00E+01
c. Irradiated components		N/A	N/A
d. Others (describe)		N/A	N/A

5. Shipment Disposition

a. Solid Waste

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
1.60E+01	Highway	Oak Ridge, TN
7.00E+00	Rail	Clive, UT
1.00E+00	Highway	Clive, UT
4.00E+00	Highway	Erwin, TN
1.00E+00	Highway	Richland, WA

b. Irradiated Fuel

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
0	N/A	N/A

Attachment 2
Effluent and Waste Disposal Data

Table 3B: Solid Waste and Irradiated Fuel Shipments – Waste Class B

Waste Class B

1. <u>Total volume shipped</u> (cubic meters)			7.40E+00
Total curie quantity (estimated)			6.98E+01
2. <u>Type of Waste</u>			
	<u>Unit</u>	<u>Period</u>	<u>Estimated Total %Error</u>
a. Spent resins, filter, sludges	meter ³	7.40E+00	
	Curies	6.98E+01	1.00E+01
b. Dry active waste, compacted/non-compacted	meter ³	0.00E+00	
	Curies	0.00E+00	N/A
c. Irradiated components	meters ³	0.00E+00	
	Curies	0.00E+00	N/A
d. Others (describe)	meters ³	0.00E+00	
	Curies	0.00E+00	N/A
3. <u>Estimate of major radionuclides composition</u>			
a. Mn-54	1.14E+00 %		
Fe-55	5.44E+00 %		
Co-60	5.32E+01 %		
Ni-63	2.73E+01 %		
Zn-65	0.82E+00 %		
Cs-137	1.00E+01 %		
b. N/A			
c. N/A			
d. N/A			

NOTE:

Solid Radioactive Waste was shipped to a waste processor for processing and then transported for storage pending future disposal by the processor.

Attachment 2
Effluent and Waste Disposal Data

Table 3B: Solid Waste and Irradiated Fuel Shipments – Waste Class B

4. Cross reference table, waste stream, form, and container type

<u>Stream</u>	<u>Form</u>	<u>Container Type</u> Type A/Type B	<u>No. of shipments</u>
a. Resin & Filters	Dewatered	Type A/Type B	3.00E+00
b. Dry active waste	Compacted/ Non-compacted	N/A	N/A
c. Irradiated components		N/A	N/A
d. Others (describe)		N/A	N/A

5. Shipment Disposition

a. Solid Waste

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
3.00E+00	Highway	Erwin, TN

b. Irradiated Fuel

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
0	N/A	N/A

Attachment 2
Effluent and Waste Disposal Data

Table 3C: Solid Waste and Irradiated Fuel Shipments – Waste Class C

Waste Class C

1. <u>Total volume shipped</u> (cubic meters)			0.00E+00
Total curie quantity (estimated)			0.00E+00
2. <u>Type of Waste</u>			
	<u>Unit</u>	<u>Period</u>	Estimated Total <u>%Error</u>
a. Spent resins, filter, sludges	meter ³	0.00E+00	
	Curies	0.00E+00	N/A
b. Dry active waste, compacted/non-compacted	meter ³	0.00E+00	
	Curies	0.00E+00	N/A
c. Irradiated components	meters ³	0.00E+00	
	Curies	0.00E+00	N/A
d. Others (describe)	meters ³	0.00E+00	
	Curies	0.00E+00	N/A
3. <u>Estimate of major radionuclides composition</u>			
a. N/A			
b. N/A			
c. N/A			
d. N/A			

NOTE:

No Waste Class C material or spent fuel was shipped offsite for storage or disposal during the reporting period.

Attachment 2
Effluent and Waste Disposal Data

Table 3C: Solid Waste and Irradiated Fuel Shipments – Waste Class C

4. Cross reference table, waste stream, form, and container type

<u>Stream</u>	<u>Form</u>	<u>Container Type</u> Type A/Type B	<u>No. of shipments</u>
a. Resin & Filters	Dewatered	N/A	N/A
b. Dry active waste	Compacted/ Non-compacted	N/A	N/A
c. Irradiated components		N/A	N/A
d. Others (describe)		N/A	N/A

5. Shipment Disposition

a. Solid Waste

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
0.00E+00	N/A	N/A

b. Irradiated Fuel

<u>Number of Shipments</u>	<u>Mode of Transportation</u>	<u>Destination</u>
0.00E+00	N/A	N/A

Attachment 3
Environmental Monitoring Program

Enclosure 1: Milk and Vegetable Sample Location

Enclosure 2: Land Use Census

Attachment 3
Environmental Monitoring Program
Enclosure 1: Milk and Vegetable Sample Location

No milk animals are located in the area evaluated by the last Land Use Census, therefore, no milk sampling locations were available during this time period.

Attachment 3
Environmental Monitoring Program
Enclosure 2: Land Use Census

The 2012 Land Use Census identified a garden at 1.1 miles in the South sector. Dose was calculated at this location assuming a vegetable-child pathway. The thyroid dose calculated at this location was slightly higher (9.85E-01 mrem) than the thyroid dose calculated at the ODCM controlling location of 4.75 miles in the North-East sector using a cow milk-infant pathway (8.77E-01 mrem). This location in the South sector is already in the Radiological Environmental Monitoring Program. Airborne radioiodine and particulate sampling occurs at 1.0 mile and broadleaf vegetation sampling occurs at 0.7 mile in the South sector.

The following is a summary of the nearest resident and garden locations identified within five miles of the plant for each of the 16 meteorological sectors. No milk animals were found within five miles of the plant.

<u>Direction</u>	<u>Residence</u>	<u>Garden</u>
NNE	0.8 miles	0.9 miles
NE	None	None
ENE	None	None
E	None	None
ESE	1.4 miles	None
SE	None	None
SSE	2.1 miles	None
S	1.1 miles	1.1 miles
SSW	1.2 miles	1.6 miles
SW	1.1 miles	1.4 miles
WSW	1.2 miles	1.2 miles
W	0.9 miles	0.9 mile
WNW	0.9 miles	1.0 miles
NW	0.9 miles	4.9 miles
NNW	0.8 miles	0.9 miles
N	0.7 miles	0.9 miles

Attachment 4
Effluent Instrumentation

- Enclosure 1: Radioactive Liquid Effluent Monitoring Instrumentation
- Enclosure 2: Radioactive Gaseous Effluent Monitoring Instrumentation
- Enclosure 3: Liquid Hold-Up Tank

Attachment 4
Effluent Instrumentation

Enclosure 1: Radioactive Liquid Effluent Monitoring Instrumentation

No Radioactive Liquid Effluent Monitoring Instruments were inoperable for a period of greater than 30 days.

Attachment 4
Effluent Instrumentation

Enclosure 2: Radioactive Gaseous Effluent Monitoring Instrumentation

No Radioactive Gaseous Effluent Monitoring Instruments were inoperable for a period of greater than 30 days.

Attachment 4
Effluent Instrumentation
Enclosure 3: Liquid Hold-Up Tank

No Liquid Hold-Up Tank exceeded the 10-Curie limit of ODCMS 7.3.6 during this reporting period.

Attachment 5

Major Modification To The Radioactive Waste Treatment Systems

In accordance with ODCMS 7.5.1, major changes to the liquid, gaseous, and solid Radioactive Waste Treatment Systems shall be reported to the NRC as part of the Radioactive Effluent Release Report or as part of the Updated Final Safety Analysis Report (UFSAR) update. Any major modifications to the radioactive waste treatment systems will be submitted with the UFSAR in accordance with 10 CFR 50.71(e). There were no major modifications to the Radioactive Waste Treatment System during the reporting period.

Attachment 6

Meteorological Data

Per Technical Specification 5.6.3 and ODCMS 7.4.2, the annual summary of meteorological data collected over the calendar year has been retained in a file and is available for NRC review upon request.

Attachment 7

Annual Dose Assessment

Liquid Effluents

Critical Age: Adult

Controlling location for liquid releases: SW sector at 0.1 miles⁽¹⁾

Supplemental Dose*	SDSP	SDSF	SDCB	Marsh ⁽¹⁾	Total
mrem	4.23E-06	6.08E-06	1.08E-06	4.14E-03	4.15E-03

*Reference page 5-6 of Supplemental Information

	Routine ODCM Dose (mrem)	Supplemental Dose (mrem)	Total Dose (mrem)	Limit (mrem)
GI-LLI	4.18E-04	4.15E-03	4.57E-03	2.00E+01
Bone	4.84E-06	0.00E+00	4.84E-06	2.00E+01
Liver	3.19E-04	4.15E-03	4.47E-03	2.00E+01
Lung	3.07E-04	4.15E-03	4.46E-03	2.00E+01
Total Body	3.23E-04	4.15E-03	4.47E-03	6.00E+00
Thyroid	7.30E-04	4.15E-03	4.88E-03	2.00E+01
Kidney	3.11E-04	4.15E-03	4.46E-03	2.00E+01

⁽¹⁾ Dose from the Marsh was calculated based on guidance from Regulatory Guide 1.109 assuming a fish and invertebrate ingestion pathway for an adult.

Attachment 7

Annual Dose Assessment

Gaseous Effluents

Noble Gas:

Critical Age: Infant

Controlling location: ENE sector at 0.7 mile

	Routine ODCM Dose (mrad)	Limit (mrad)
Gamma	1.59E-02	2.00E+01
Beta	1.61E-02	4.00E+01

Iodine, Particulates, and Tritium:

Supplemental Dose*	SDSP Evaporation	SDSF Evaporation	Carbon-14 (All except Bone and Skin)	Carbon-14 (Bone)
mrem	2.25E-03	2.40E-04	7.91E-01	3.96E+00

*Reference page 5-6 of Supplemental Information

Critical Age: Infant

Controlling location: NE sector at 4.75 mile, assuming a cow milk pathway⁽²⁾⁽³⁾⁽⁴⁾

	Routine ODCM Dose (mrem)	Supplemental Dose (mrem)	Total Dose (mrem)	Limit (mrem)
Thyroid	8.34E-02	7.93E-01	8.77E-01	3.00E+01
Kidney	4.79E-03	7.93E-01	7.98E-01	3.00E+01
Liver	4.76E-03	7.93E-01	7.98E-01	3.00E+01
Total Body	4.59E-03	7.93E-01	7.98E-01	3.00E+01
Skin	4.52E-03	2.49E-03	7.01E-03	3.00E+01
GI-LLI	4.50E-03	7.93E-01	7.98E-01	3.00E+01
Lung	4.49E-03	7.93E-01	7.98E-01	3.00E+01
Bone	4.85E-04	3.96E+00	3.96E+00	3.00E+01

⁽²⁾ The controlling location for the SDSP evaporation is the NW sector at approximately 0.3 miles assuming inhalation pathway only, since no garden is present. The critical age is a teen. Reference page 6 of supplemental information.

⁽³⁾ The controlling location for the SDSF evaporation is the NNW sector at approximately 0.5 miles assuming inhalation pathway only, since no garden is present. The critical age is a teen. Reference page 6 of supplemental information.

⁽⁴⁾ The controlling location for the Carbon-14 supplemental dose is the south sector at 1.1 miles with a garden. The critical age is a child. Reference page 5 of supplemental information.

Attachment 8

Off-Site Dose Calculation Manual (ODCM) And Process Control Program (PCP) Revisions

The PCP was not revised during the report period.

ODCM Revision 36 was effective on June 7, 2012. The changes and justifications are described below.

The changes included in ODCM Revision 36 are as follows (reference DRR 508688):

- The cover page was updated to reflect Revision 36
- The List of Effective Pages was updated to reflect the changes of this revision
- Page iv, List of Tables, was updated to include Table 3.3-20 Inhalation Dose Factors for Carbon-14 and Table 3.3-21 Ingestion Dose Factors for Carbon-14
- The Index on page 3-1 was updated to include Section 3.3.3 Carbon-14
- Page 3-3, List of Tables, was updated to include Table 3.3-20 Inhalation Dose Factors for Carbon-14 and Table 3.3-21 Ingestion Dose Factors for Carbon-14
- Section 3.3.3 Carbon-14 on Pages 3-67 to 3-71 was added to provide the methodology to calculate the Carbon-14 (C-14) curies and the associated dose to the public from gaseous releases from the plant

These changes are in response to new information in Regulatory Guide 1.21 Revision 2. Regulatory Guide 1.21 Revision 1 (1974), to which BSEP is committed, did not address C-14. However, since that time analytical methods for determining C-14 have improved and Revision 2 (2009) states that Licensees should evaluate whether C-14 is a principal radionuclide for gaseous effluents. Improvements in fuel performance have resulted in a decrease in radioactive effluents from BSEP to the point that C-14 is now considered a principal radionuclide. In Boiling Water Reactors (BWRs), such as BSEP, the gaseous C-14 releases are primarily in the form of carbon dioxide. The dose contribution of C-14 in liquid radioactive waste is minimal, therefore, evaluation of C-14 in liquid discharges is not required.

BSEP's Updated Final Safety Analysis Report (UFSAR) states the C-14 release rate from a BWR is approximately 9.5 Ci/yr assuming 80% plant capacity factor. Since BSEP has two reactors, the release rate would be 19 Ci/yr at 80% plant capacity factor. This value was scaled using actual Effective Full Power Days (EFPD) to give a release rate of 21 Ci/yr for 2010. Based on the 2010 Land Use Census, the critical receptor is located in the south sector at 1.6 miles with a garden. There are no meat or milk pathways within 5 miles. Regulatory Guide 1.109 methodology was used to determine the dose to this critical receptor. The C-14 bone dose for 2010 was 2.36E+00 mrem and the C-14 total body dose was 4.71E-01 mrem. The total dose due to I-131, I-133, Tritium, and Radionuclides in Particulate Form from BSEP in 2010 is as follows:

Attachment 8

Off-Site Dose Calculation Manual (ODCM) And Process Control Program (PCP) Revisions

	Dose in mrem
Thyroid	8.43E-01
Kidney	4.77E-01
Liver	4.77E-01
Total Body	4.76E-01
Skin	4.82E-03
GI-LLI	4.76E-01
Lung	4.76E-01
Bone	2.36E+00

The dose due to I-131, I-133, Tritium, and Radionuclides in Particulate Form as shown above is well below the limits of 10 CFR 50 Appendix I and 40 CFR 190. Therefore, the actual exposure of a member of the public through appropriate pathways using this methodology is unlikely to be substantially underestimated.

Attachment 9
Special Groundwater Protection

No special reports were made as a result of any radioactive spills or leaks.