Progress Energy

April 30, 2012

Serial: BSEP 12-0047

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Brunswick Steam Electric Plant, Unit Nos. 1 and 2
Renewed Facility Operating License Nos. DPR-71 and DPR-62
Docket Nos. 50-325 and 50-324
Radioactive Effluent Release Report for 2011

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, Carolina Power & Light Company, now doing business as Progress Energy Carolinas, Inc., is submitting the enclosed Radioactive Effluent Release Report for BSEP Unit Nos. 1 and 2. This report covers the period from January 1, 2011, through December 31, 2011.

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 35 of the BSEP ODCM, current as of November 15, 2011, is included as Enclosure 2. Changes made to the ODCM during 2011 are summarized in the 2011 Radioactive Effluent Release Report.

No regulatory commitments are contained in this submittal. Please refer any questions regarding this submittal to Mr. Lee Grzeck, Acting Supervisor - Licensing/Regulatory Programs, at (910) 457-2487.

Sincerely,

Annette H. Pope

Annette H. Pope
Manager - Support Services
Brunswick Steam Electric Plant

MAT/mat

Enclosures:

1. Radioactive Effluent Release Report for 2011
2. Offsite Dose Calculation Manual, Revision 35

A009
IE48
NRR

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Brunswick Nuclear Plant
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cc (with Enclosure 1 only):

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Radioactive Effluent Release Report for 2011

Brunswick Steam Electric Plant
Radioactive Effluent Release Report
January 1 through December 31, 2011

Table of Contents

Attachment 1
Effluent and Waste Disposal Report Supplemental Information

Facility: Brunswick Steam Electric Plant
Licensee: Carolina Power & Light Company, now doing business as Progress Energy Carolinas, Inc.

1. Regulatory Limits
   A. Fission and activation gases (ODCM 7.3.8)
      (1) Calendar Quarter[1]
         (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 Quarter[1]
         (a) ≤ 15 mrem to any organ
      (2) Calendar Year
         (a) ≤ 30 mrem to any organ
   C. Liquid Effluents (ODCMS 7.3.4)
      (1) Calendar Quarter[2]
         (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

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 = 1.00E-03 μCi/ml [3]
(2) Dissolved and entrained noble gases: limit = 2.00E-04 μCi/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

Nuclear counting statistics are reported utilizing 1-sigma error. Total error where reported represents a best effort to approximate the total of all individual and sampling errors.

4. Batch Releases

A. Liquid

(1) Number of batch releases:	2.42E+02
(2) Total time period for batch releases:	3.75E+04 Minutes
(3) Maximum time period for a batch release:	5.52E+02 Minutes
(4) Average time period for a batch release:	1.55E+02 Minutes
(5) Minimum time period for a batch release:	1.30E+01 Minutes
(6) Average stream flow during periods of release of effluent into a flowing stream:	8.12E+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 Releases[4]

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.

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 9.50E+00 Ci/yr assuming 80% plant capacity factor. Since BNP has two reactors, the release rate would be 1.90E+01 Ci/yr. This value was scaled using Effective Full Power Days (EFPD) to give a release rate of 2.08E+01 Ci/yr. Based on the 2011 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 2011 was 4.01E+00 mrem and the total body dose was 8.01E-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 seventeen occasions in 2011 due to heavy rains. Approximately 4.65E+06 gallons containing 2.13E-01 curies of tritium were released. There was no detectable gamma radioactivity. This resulted in an estimated maximum dose to the individual of 3.33E-07 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. 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. In 2011, approximately 5.28E+07 gallons containing 3.97E+00 curies of tritium were released from the SDSP to the intake canal. There was no detectable gamma radioactivity. This resulted in an estimated maximum dose to the individual of 5.34E-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 water evaporation from the Storm Drain Stabilization Pond

There was 5.68E+07 gallons of tritiated water released via evaporation from the SDSP in 2011. This yields 7.02E+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 2.15E-03 mrem via the inhalation pathway in 2011. 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 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 2011 were less than the Lower Limit of Detection (LLD). There were 416 tritium analyses performed, which resulted in 127 positive tritium results. The minimum concentration detected from the 127 positive results was 2.43E-07 μCi/ml and the maximum concentration was 1.22E-05 μCi/ml. Using the average concentration of all the samples (6.67E-07 μCi/ml), two high tides per day, the area of the marsh at high tide, 365 days, and a conservative factor of 2, it is calculated that 5.37E+07 gallons were released to Nancy's Creek containing 1.36E-01 curies of tritium. This yielded a Total Body dose of 1.30E-03 mrem to an adult from eating fish and 3.20E-04 mrem from eating invertebrate (shrimp, crabs, etc.) for a total dose of 1.62E-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 over the past few years. 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 intermediate wells in different locations around the OCA and PA and are used to evaluate groundwater movement. Several gamma analyses were performed and all results were less than LLD. Below are the tritium results and maps showing the well location for the wells that are not included in the ODCM:

Attachment 1
Effluent and Waste Disposal Report Supplemental Information

Shallow Wells for Plant Site						
Well Name	Number of Samples in 2011	Number of Positive Samples in 2011	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-2C	7	7	5.17E+04	4.13E+04	6.34E+04	27
ESS-3C	5	4	5.21E+02	3.70E+02	5.98E+02	14
ESS-12C	5	1	3.54E+02	3.54E+02	3.54E+02	15
ESS-13C	4	0	<LLD	<LLD	<LLD	25
ESS-16	8	8	1.76E+03	1.05E+03	4.33E+03	27
ESS-17C	4	4	6.76E+03	4.94E+03	9.29E+03	26
ESS-18C	8	8	2.24E+05	8.01E+04	2.83E+05	20
ESS-19C	8	8	3.02E+05	1.74E+05	4.77E+05	20
ESS-20C	8	8	2.84E+04	2.34E+04	3.48E+04	20
ESS-21C	5	5	1.23E+03	3.73E+02	2.82E+03	20
ESS-22C	8	8	2.27E+05	1.47E+05	2.95E+05	20
ESS-23C	4	4	1.59E+05	1.26E+05	2.12E+05	23
ESS-24C	3	3	7.39E+03	6.38E+03	8.40E+03	18
ESS-25C	4	0	< LLD	< LLD	< LLD	22
ESS-26C	8	8	1.64E+05	1.12E+05	2.10E+05	15
ESS-27C	4	4	2.25E+05	1.90E+05	2.65E+05	16
ESS-28C	4	3	4.46E+02	2.51E+02	7.12E+02	23
ESS-30C	13	13	3.01E+03	3.11E+02	1.88E+04	15
ESS-31C	13	11	7.73E+02	2.74E+02	1.52E+03	15
ESS-32C	1	0	< LLD	< LLD	< LLD	35

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Shallow Wells for Plant Site						
Well Name	Number of Samples in 2011	Number of Positive Samples in 2011	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-33C	1	0	< LLD	< LLD	< LLD	25
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	1	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	1	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

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Shallow Wells for Plant Site						
Well Name	Number of Samples in 2011	Number of Positive Samples in 2011	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-56C	1	0	< LLD	< LLD	< LLD	32
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	9	2	2.63E+02	2.52E+02	2.74E+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	1	0	< LLD	< LLD	< LLD	18
ESS-73C	9	0	< LLD	< LLD	< LLD	15
ESS-74C	1	0	< LLD	< LLD	< LLD	25
ESS-201C	6	6	8.48E+03	3.53E+03	1.66E+04	27
ESS-202C	6	6	7.50E+04	1.38E+04	1.59E+05	27

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Shallow Wells for Plant Site						
Well Name	Number of Samples in 2011	Number of Positive Samples in 2011	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-203C	5	5	8.89E+03	1.25E+03	1.38E+04	27
ESS-STAB	4	4	2.74E+04	2.24E+04	3.24E+04	31
ESS-NC-1	4	0	< LLD	< LLD	< LLD	8
ESS-NC-2	4	0	< LLD	< LLD	< LLD	8
ESS-NC-3	4	0	< LLD	< LLD	< LLD	8
ESS-NC-4	4	0	< LLD	< LLD	< LLD	8
ESS-NC-4A	4	4	4.74E+03	4.34E+03	5.64E+03	17
ESS-NC-5	4	1	3.84E+02	3.84E+02	3.84E+02	8
ESS-GLB-1	4	0	< LLD	< LLD	< LLD	8
MW-1	4	2	2.46E+02	2.38E+02	2.54E+02	24
MW-2	4	2	3.73E+02	3.71E+02	3.75E+02	24
MW-3	4	2	3.09E+02	2.85E+02	3.32E+02	26
MWPA-100C	4	3	3.82E+02	2.71E+02	4.71E+02	30
MWPA-101C	4	4	1.55E+03	2.39E+02	3.40E+03	29
MWPA-102C	4	4	1.13E+03	9.33E+02	1.26E+03	30
MWPA-103C	4	0	< LLD	< LLD	< LLD	30
MWPA-104C	6	6	1.71E+04	1.36E+04	2.05E+04	29
MWPA-105C	4	4	1.57E+03	1.36E+03	1.86E+03	30
MWPA-106C	4	4	6.53E+02	4.59E+02	7.88E+02	29
MWPA-107C	11	11	3.55E+03	3.36E+03	3.77E+03	29
MWPA-108C	4	4	3.69E+02	2.27E+02	5.69E+02	29

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Effluent and Waste Disposal Report Supplemental Information

Shallow Wells for Plant Site						
Well Name	Number of Samples in 2011	Number of Positive Samples in 2011	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
MWPA-109C	4	2	5.14E+02	2.69E+02	7.59E+02	29
MWPA-110C	7	5	5.66E+02	3.74E+02	8.78E+02	29
MWPA-111C	35	35	8.61E+04	1.30E+04	3.36E+05	30
MWPA-112C	37	37	4.72E+06	9.16E+05	1.22E+07	34
MWPA-113C	12	6	4.97E+02	2.73+02	8.06E+02	25
MWPA-114C	8	8	1.23E+03	4.14E+02	3.30E+03	30
MWPA-115C	13	13	1.60E+04	1.07E+04	1.81E+04	34
MWPA-116C	12	2	2.70E+02	2.62E+02	2.78E+02	30
MWPA-117C	13	13	7.43E+02	4.72E+02	1.06E+03	30
MWPA-118C	10	10	6.99E+02	5.98E+02	8.58E+02	30

Intermediate Wells for Plant Site						
Well Name	Number of Samples in 2011	Number of Positive Samples in 2011	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-2B	4	0	< LLD	< LLD	< LLD	58
ESS-3B	4	1	2.43E+02	2.43E+02	2.43E+02	52
ESS-18B	4	0	< LLD	< LLD	< LLD	23
ESS-19B	8	8	3.15E+03	2.75E+03	3.83E+03	42
ESS-20B	4	0	< LLD	< LLD	< LLD	43
ESS-22B	4	4	8.25E+02	6.94E+02	1.10E+03	76

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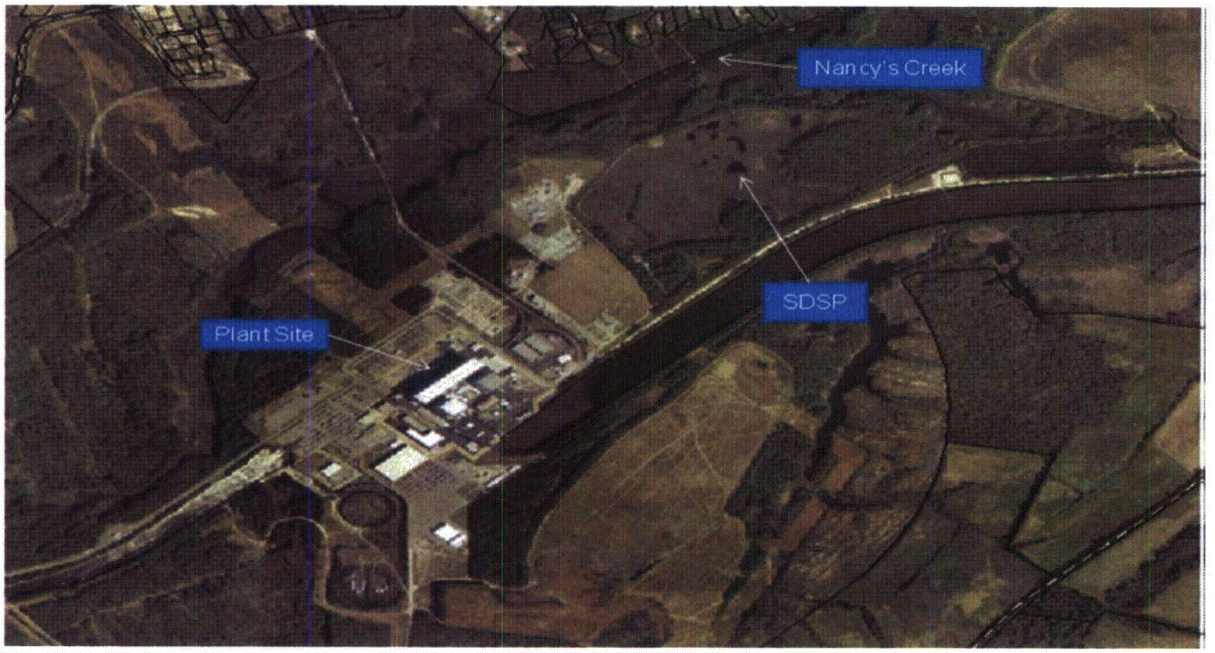
Effluent and Waste Disposal Report Supplemental Information

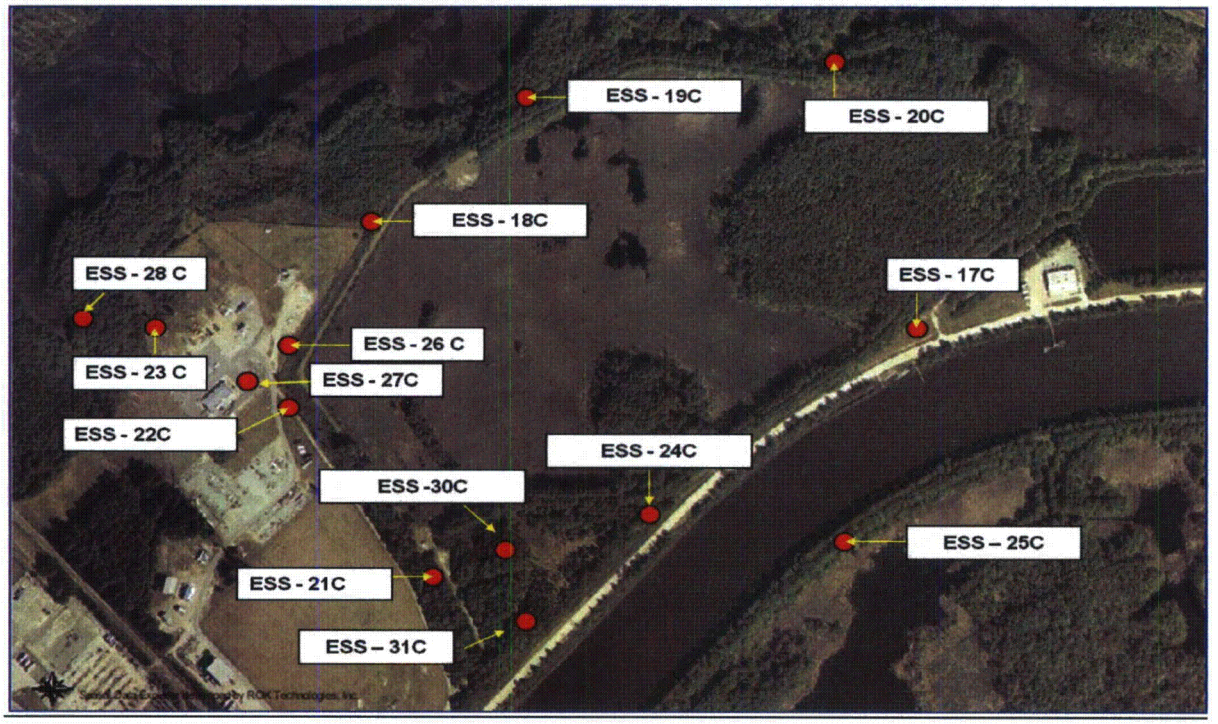
Intermediate Wells for Plant Site						
Well Name	Number of Samples in 2011	Number of Positive Samples in 2011	Average Pos Act (pCi/L)	Minimum Pos Act (pCi/L)	Maximum Pos Act (pCi/L)	Depth of Well (ft)
ESS-38B	4	0	< LLD	< LLD	< LLD	55
ESS-39B	4	0	< LLD	< LLD	< LLD	55
ESS-51B	4	0	< LLD	< LLD	< LLD	45
ESS-52B	4	0	< LLD	< LLD	< LLD	51
ESS-53B	4	0	< LLD	< LLD	< LLD	76
MWPA-104B	6	6	1.99E+04	1.83E+04	2.45E+04	59
MWPA-107B	4	4	5.46E+04	4.88E+04	5.88E+04	60
MWPA-111B	33	31	1.20E+04	1.17E+03	5.06E+04	59

Overview of Plant Site, SDSP, and Nancy's Creek

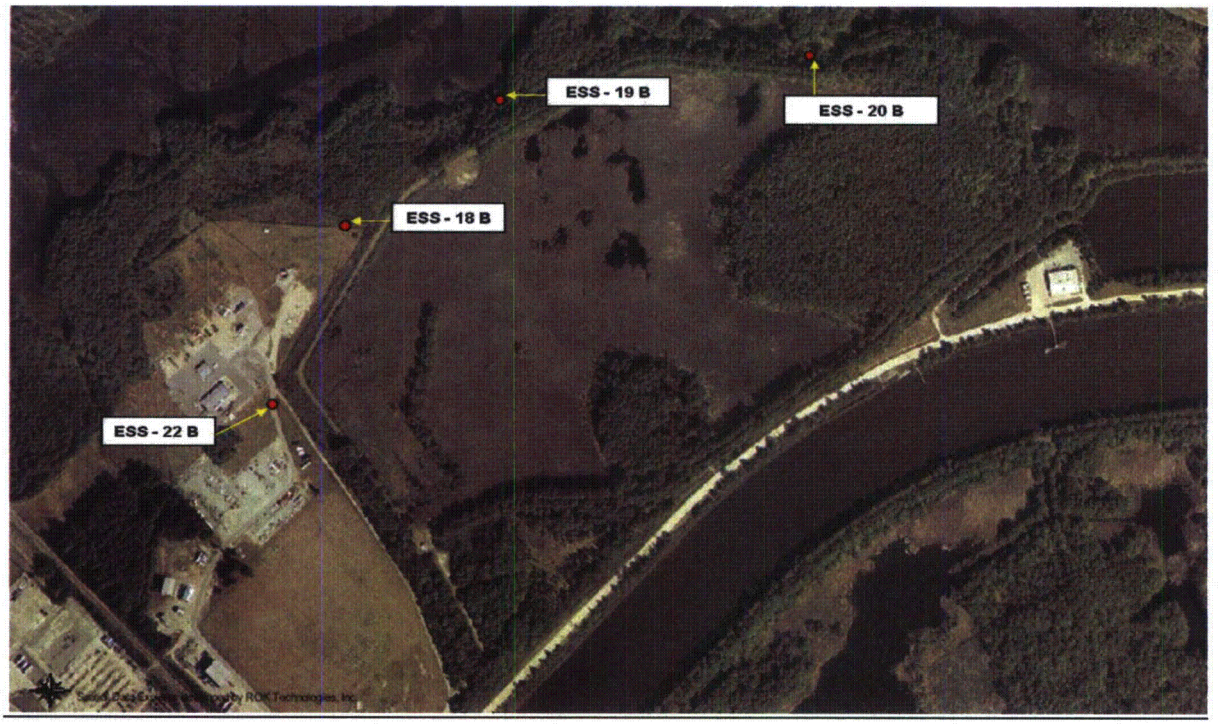


Attachment 1
Effluent and Waste Disposal Report Supplemental Information

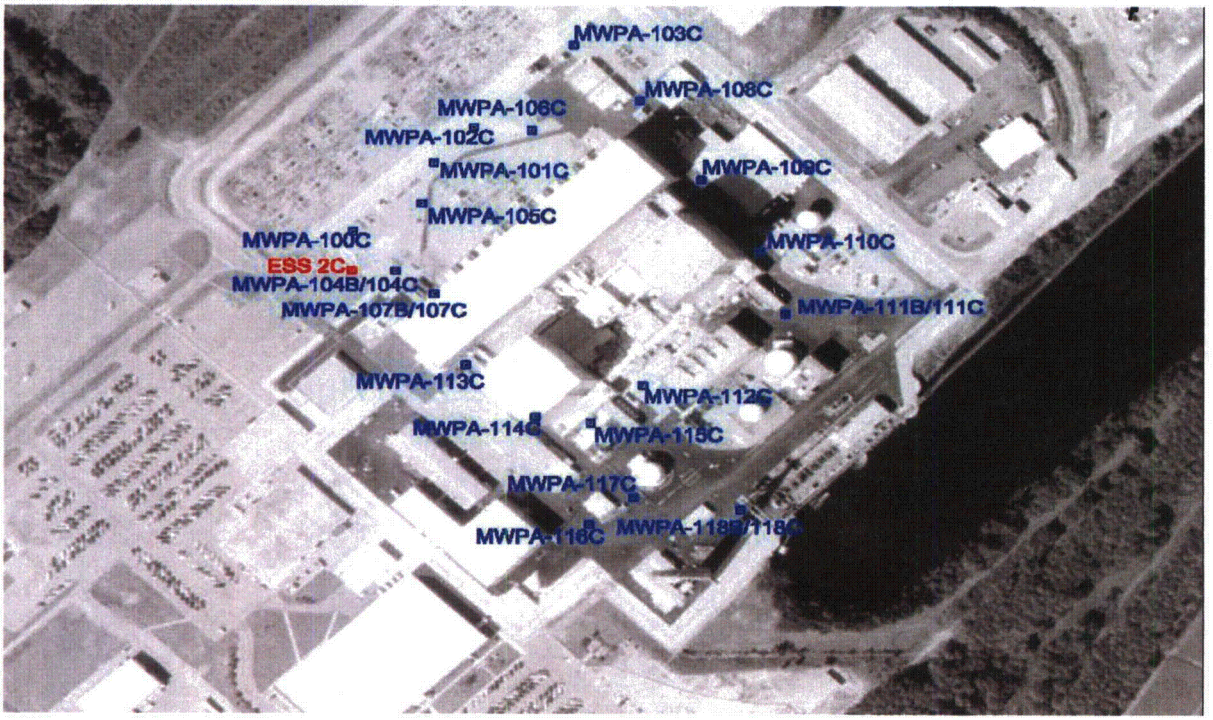
Shallow Wells



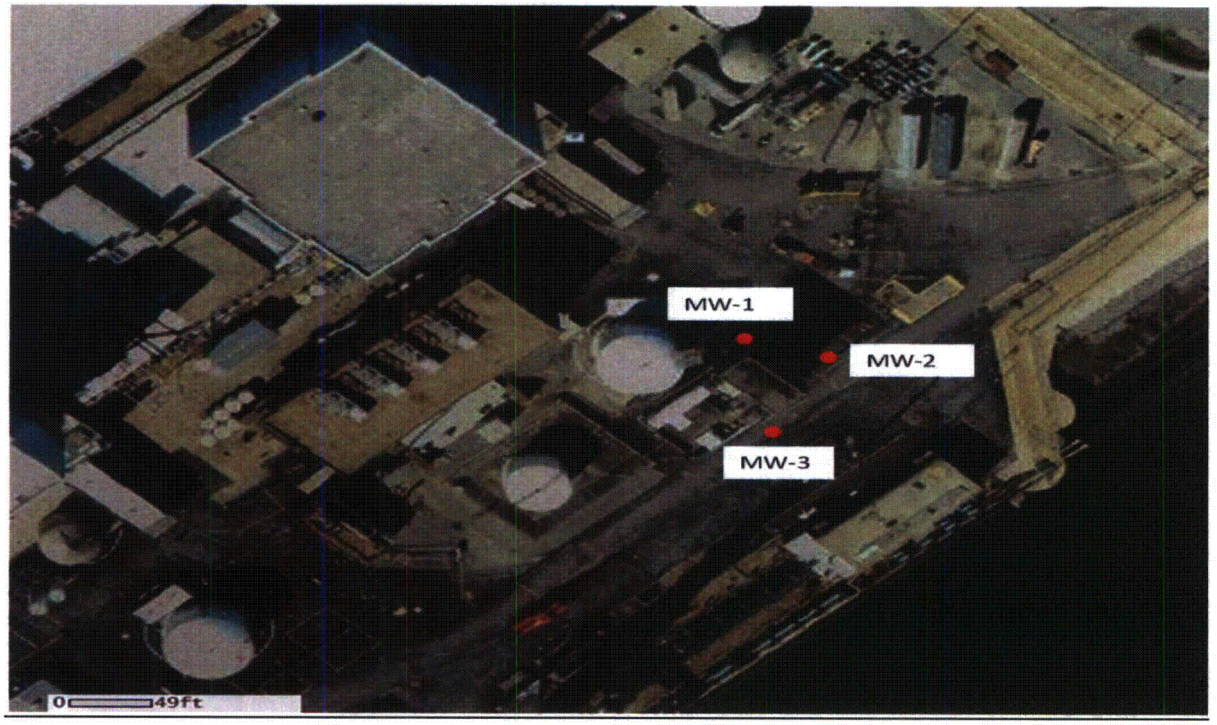
Intermediate Wells



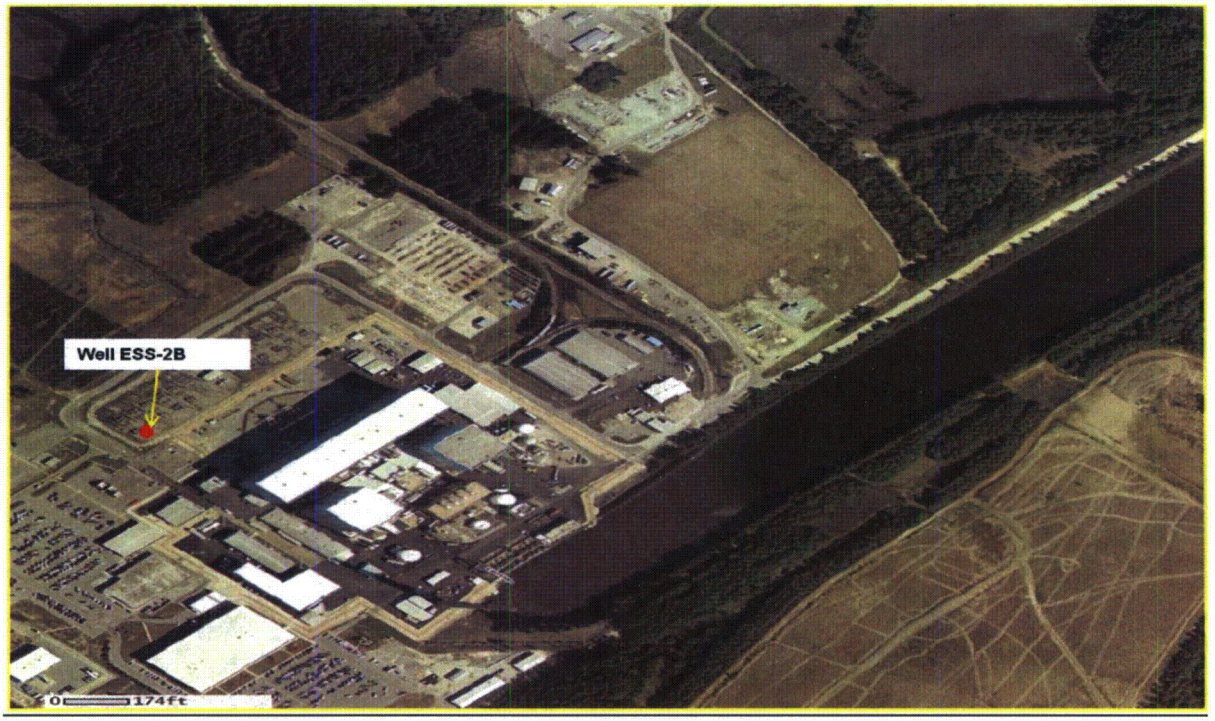
Protected Area Wells



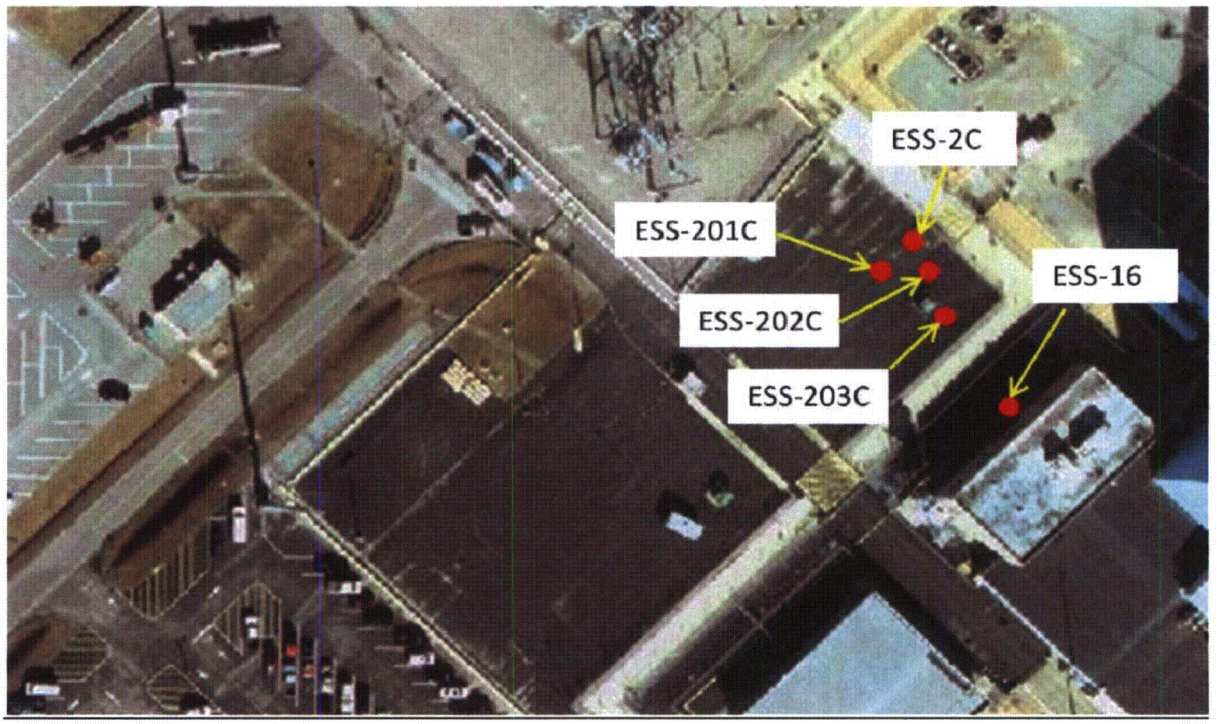
Protected Area Wells



Protected Area Wells



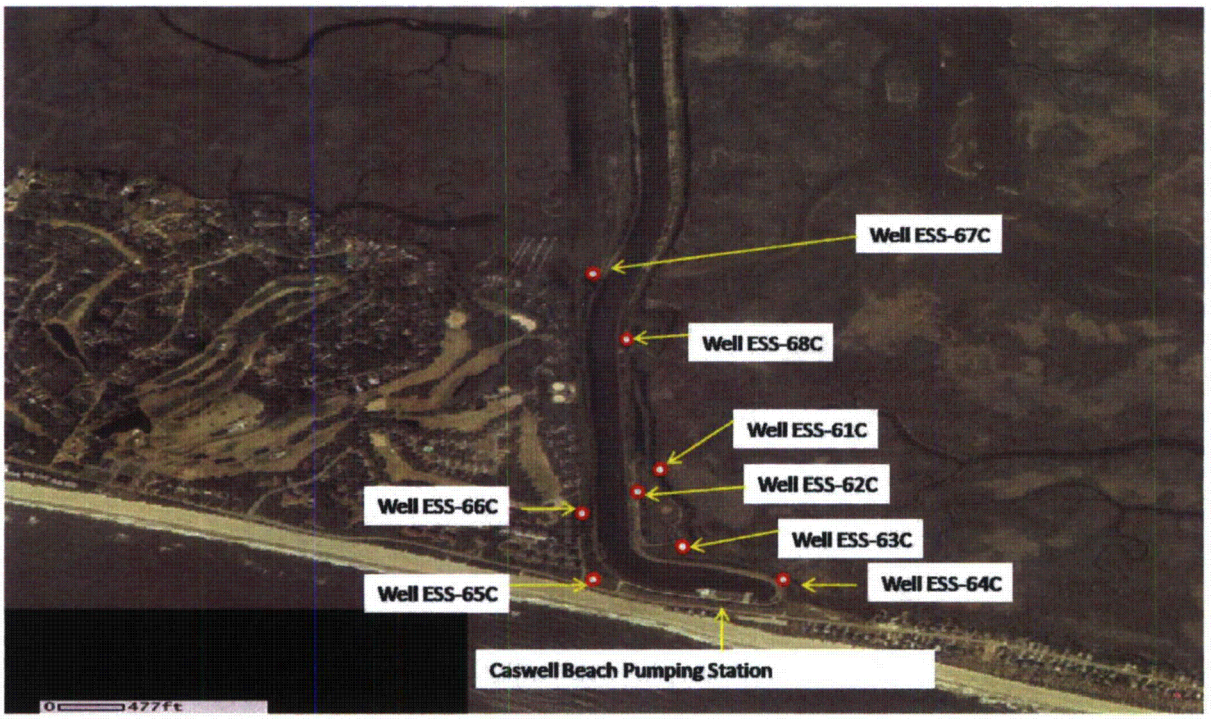
Protected Area Wells



Attachment 1
Effluent and Waste Disposal Report Supplemental Information

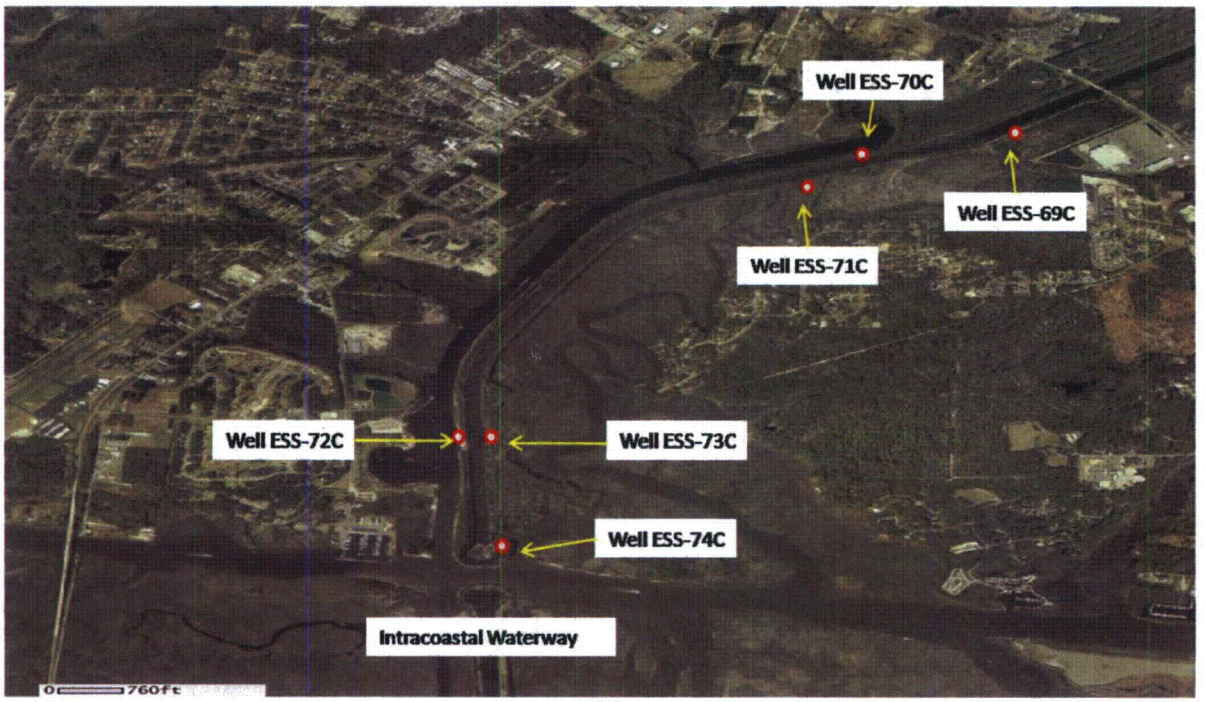
Marsh Wells

Area One Wells Near Caswell Beach

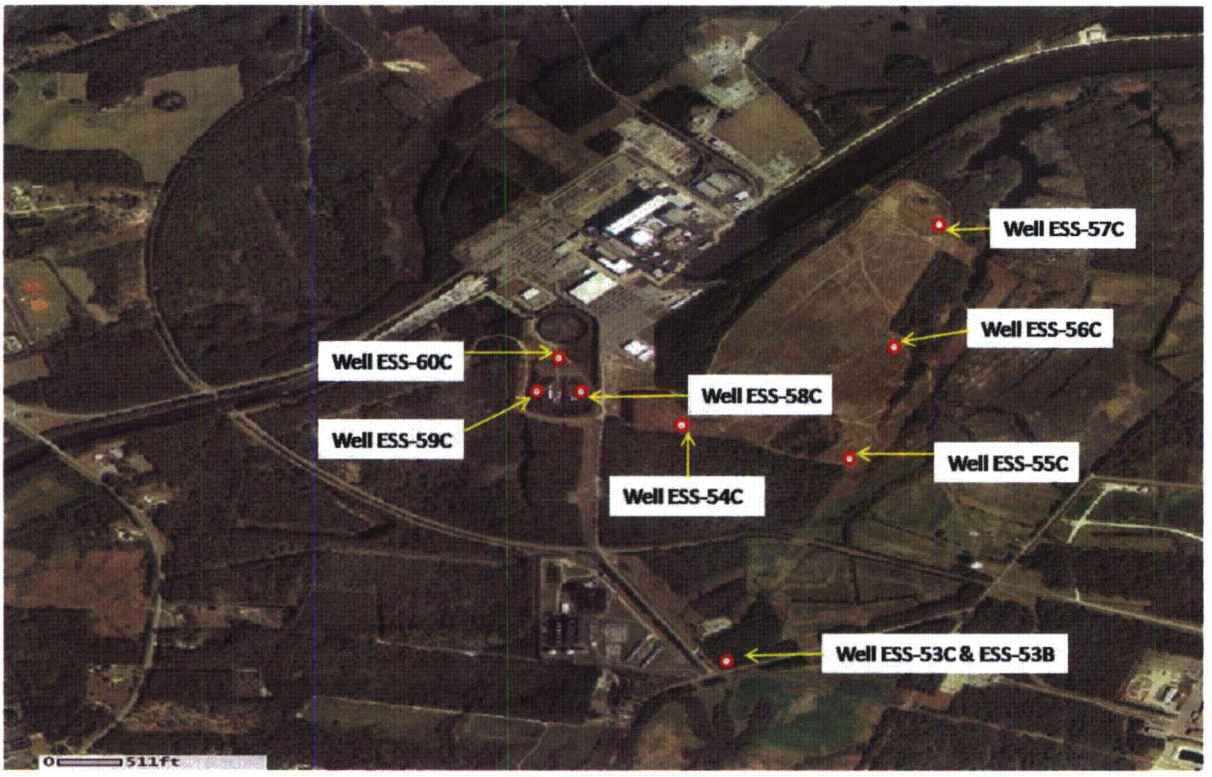


Attachment 1
Effluent and Waste Disposal Report Supplemental Information

Area 2 Wells Near Intracoastal Waterway

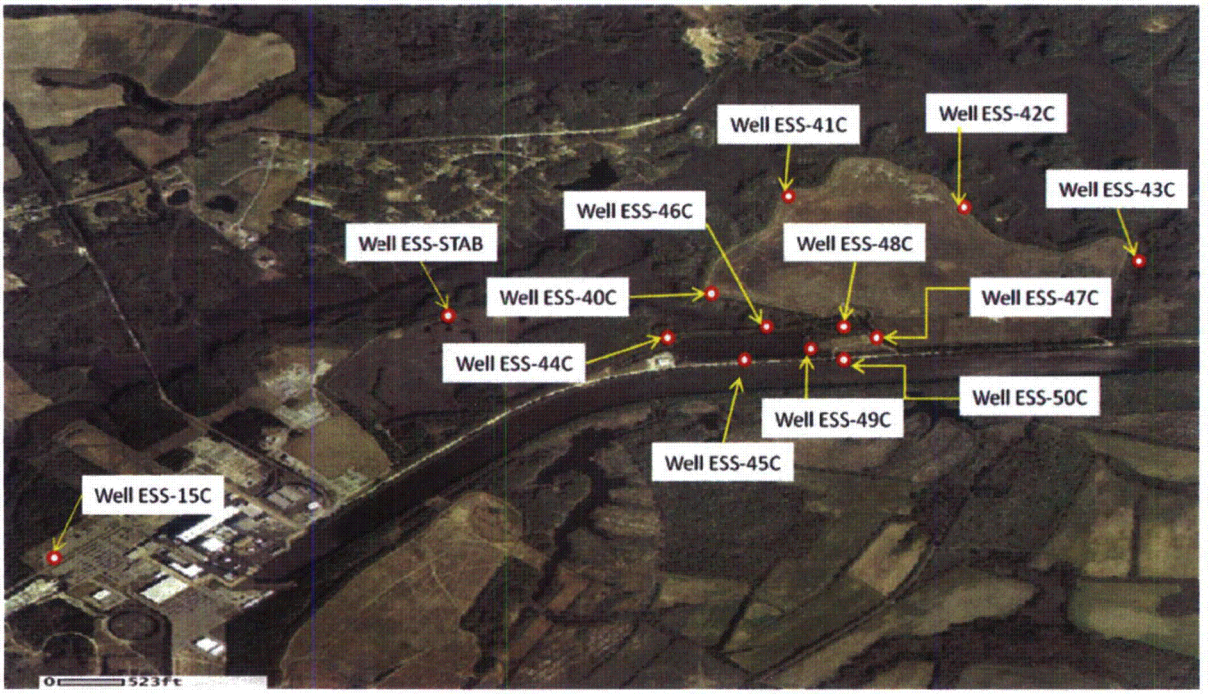


Area 3 and Area 4 Near Plant

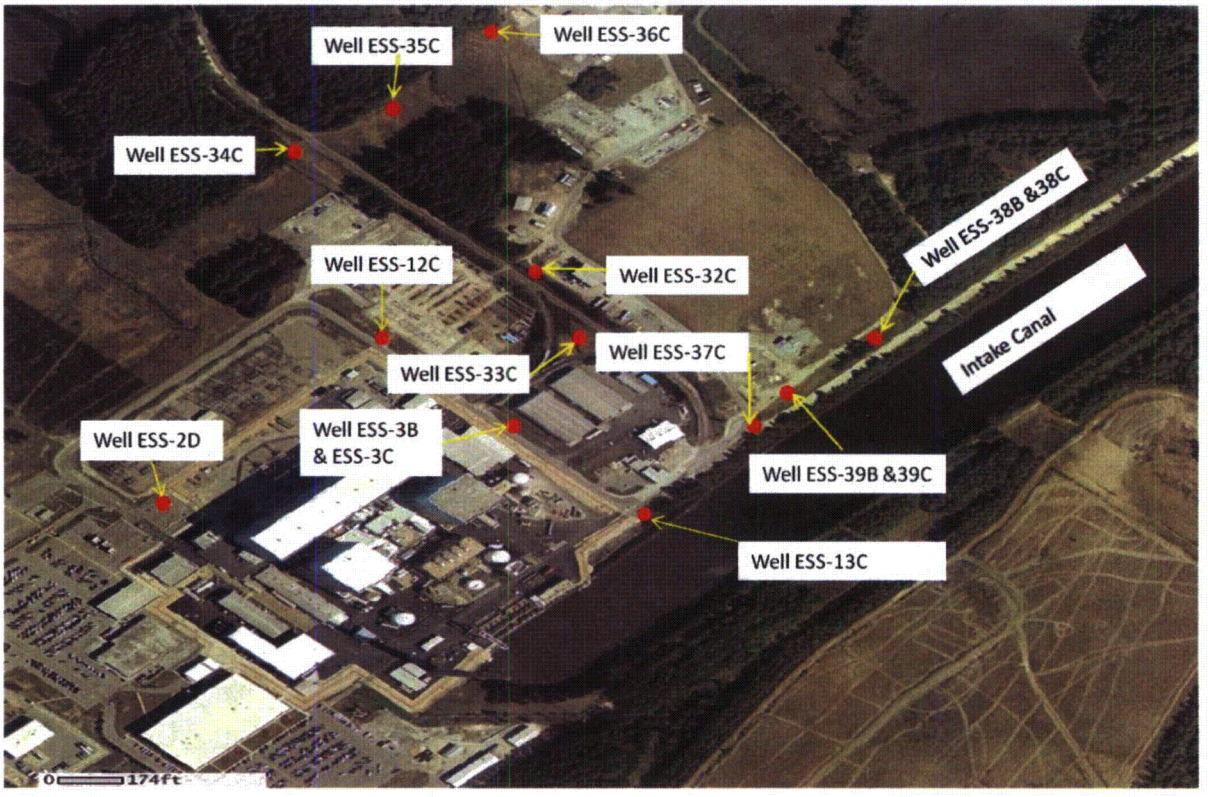


Attachment 1
Effluent and Waste Disposal Report Supplemental Information

Area 5, Area 6, and Area 10 Wells in OCA

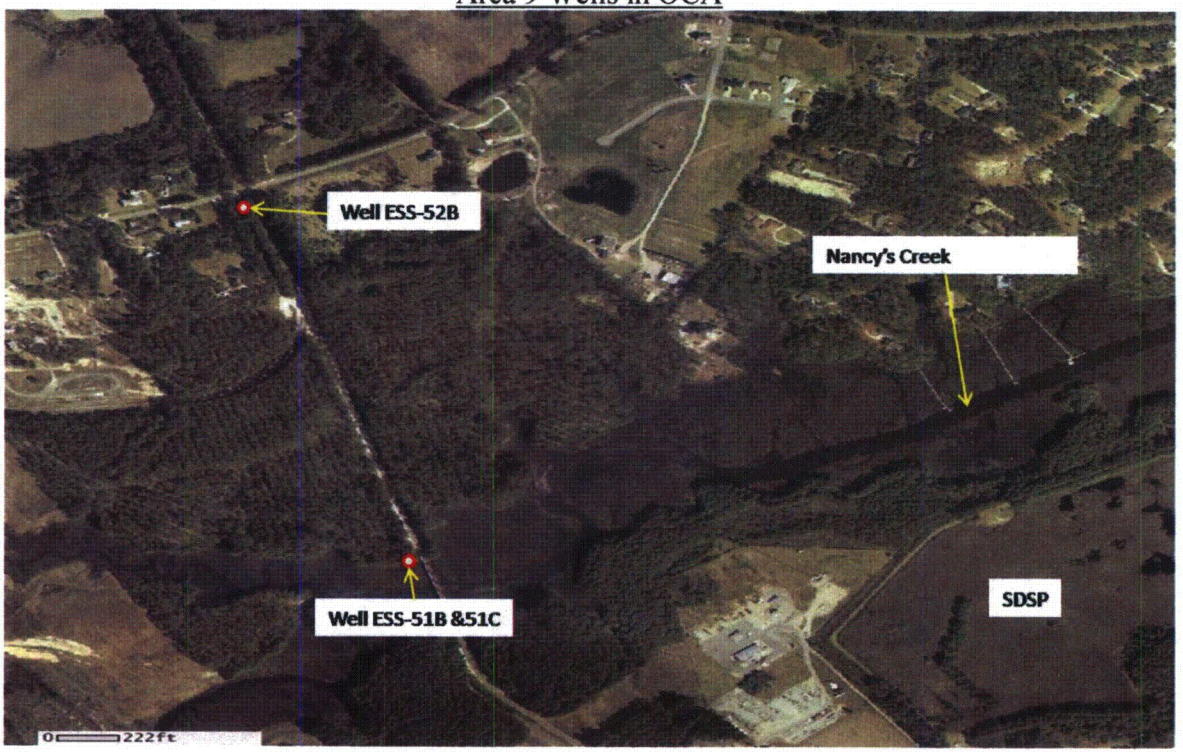


Area 8 and Area 11 Wells in OCA



Attachment 1
Effluent and Waste Disposal Report Supplemental Information

Area 9 Wells in OCA



Attachment 2
Effluent and Waste Disposal Data

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	7.29E+01	1.05E+02	6.33E+01	3.82E+01	4.50E+01
2. Average release rate for period	µCi/sec	9.38E+00	1.33E+01	7.96E+00	4.80E+00	NA
3. Percent of ODCM limit	%	3.48E-02	4.53E-02	3.94E-02	3.47E-02	NA

B. IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total Iodine - 131 release	Ci	4.50E-03	1.93E-03	4.65E-03	2.63E-03	3.50E+01
2. Average release rate for period	µCi/sec	5.78E-04	2.46E-04	5.85E-04	3.31E-04	NA

C. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	7.51E-04	1.02E-03	6.54E-04	7.12E-04	3.50E+01
2. Average release rate for period	µCi/sec	9.65E-05	1.30E-04	8.23E-05	8.96E-05	NA
3. Gross Alpha	Ci	4.48E-11	1.18E-10	≤ LLD	1.61E-07	3.50E+01

D. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	4.67E+01	5.97E+01	9.14E+01	1.02E+02	3.00E+01
2. Average release rate for period	µCi/sec	6.01E+00	7.60E+00	1.15E+01	1.28E+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	4.68E+01	5.98E+01	9.15E+01	1.02E+02
2. Average release rate for period	µCi/sec	6.01E+00	7.60E+00	1.15E+01	1.28E+01
3. Percent of ODCM limit	%	3.24E-01	1.56E-01	4.52E-01	2.52E-01

D. CARBON-14

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
1. Total release	Ci	4.86E+00	5.04E+00	5.89E+00	4.97E+00
2. Average release rate for period	µCi/sec	6.25E-01	6.42E-01	7.40E-01	6.26E-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	3.75E-01	2.19E-01	5.70E-01
krypton-85m	Ci	≤ LLD	3.91E+00	2.56E+00	1.26E-01
krypton-87	Ci	≤ LLD	7.90E+00	3.73E+00	≤ LLD
krypton-88	Ci	≤ LLD	1.06E+01	6.53E+00	≤ LLD
xenon-133	Ci	5.94E+00	8.92E+00	2.64E+00	2.33E+00
xenon-135	Ci	8.19E+00	3.64E+01	2.47E+01	8.55E+00
xenon-135m	Ci	1.53E+01	7.96E+00	5.50E+00	5.81E+00
xenon-137	Ci	≤ LLD	5.71E+00	≤ LLD	≤ LLD
xenon-138	Ci	3.53E+01	1.45E+01	8.96E+00	1.19E+01
total for period	Ci	6.48E+01	9.62E+01	5.48E+01	2.93E+01

2. GASEOUS IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
iodine-131	Ci	2.92E-03	1.18E-03	1.48E-03	9.77E-04
iodine-132	Ci	1.99E-02	1.06E-02	1.33E-02	8.82E-03
iodine-133	Ci	2.21E-02	9.85E-03	1.02E-02	7.35E-03
iodine-134	Ci	2.97E-02	1.81E-02	2.81E-02	1.48E-02
iodine-135	Ci	3.52E-02	1.77E-02	1.82E-02	1.24E-02
total for period	Ci	1.10E-01	5.74E-02	7.12E-02	4.43E-02

3. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
chromium-51	Ci	1.41E-04	4.67E-05	≤ LLD	5.51E-05
manganese-54	Ci	8.74E-06	1.52E-05	2.50E-06	1.13E-06
cobalt-58	Ci	3.93E-05	5.46E-05	≤ LLD	9.66E-06
cobalt-60	Ci	1.32E-04	4.59E-05	1.64E-05	1.75E-05
zinc-65	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
strontium-89	Ci	2.77E-05	3.13E-04	5.86E-05	1.60E-05
strontium-90	Ci	5.13E-07	6.73E-07	7.36E-07	≤ LLD
cesium-137	Ci	9.14E-06	4.35E-06	8.43E-07	1.48E-06
barium-140	Ci	1.77E-05	1.18E-04	1.22E-04	6.40E-05
lanthanum-140	Ci	2.89E-05	2.01E-04	2.02E-04	9.52E-05
total for period	Ci	4.05E-04	7.99E-04	4.02E-04	2.60E-04

4. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
hydrogen-3	Ci	1.20E+01	2.07E+01	2.51E+01	1.66E+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	2.78E+00	9.00E-01	7.60E-01	1.19E+00
xenon-135	Ci	5.14E+00	7.40E+00	7.72E+00	7.74E+00
xenon-135m	Ci	2.43E-01	≤ LLD	≤ LLD	≤ LLD
total for period	Ci	8.16E+00	8.30E+00	8.48E+00	8.93E+00

2. GASEOUS IODINES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
iodine-131	Ci	1.58E-03	7.52E-04	3.16E-03	1.66E-03
iodine-132	Ci	1.65E-02	9.56E-03	5.89E-02	2.52E-02
iodine-133	Ci	1.08E-02	6.39E-03	3.59E-02	1.59E-02
iodine-134	Ci	6.93E-03	3.80E-03	1.08E-01	4.78E-02
iodine-135	Ci	2.34E-02	1.29E-02	6.77E-02	3.52E-02
total for period	Ci	5.92E-02	3.34E-02	2.74E-01	1.26E-01

3. PARTICULATES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
chromium-51	Ci	6.31E-05	5.84E-05	≤ LLD	1.46E-04
manganese-54	Ci	3.21E-06	2.79E-06	≤ LLD	4.01E-06
cobalt-58	Ci	3.23E-05	1.68E-05	≤ LLD	4.27E-05
iron-59	Ci	≤ LLD	≤ LLD	≤ LLD	3.11E-06
cobalt-60	Ci	1.31E-04	1.27E-04	8.67E-05	2.02E-04
zinc-65	Ci	≤ LLD	≤ LLD	≤ LLD	≤ LLD
strontium-89	Ci	3.53E-05	1.52E-05	2.66E-05	7.57E-06
strontium-90	Ci	1.32E-06	2.28E-07	3.08E-07	≤ LLD
ruthenium-103	Ci	1.04E-05	≤ LLD	≤ LLD	≤ LLD
cesium-137	Ci	7.32E-06	≤ LLD	≤ LLD	≤ LLD
barium-140	Ci	3.70E-05	≤ LLD	4.75E-05	1.59E-05
lanthanum-140	Ci	2.28E-05	≤ LLD	9.06E-05	2.90E-05
cerium-141	Ci	1.47E-06	4.94E-08	≤ LLD	1.70E-06
cerium-144	Ci	≤ LLD	2.22E-07	≤ LLD	≤ LLD
total for period	Ci	3.46E-04	2.21E-04	2.52E-04	4.52E-04

4. TRITIUM

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
hydrogen-3	Ci	3.37E+01	3.60E+01	6.42E+01	8.44E+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	3.73E-04	1.41E-03	2.45E-03	1.11E-04	4.00E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	1.54E-11	4.03E-11	6.69E-11	5.71E-12	NA
3. Percent of applicable limit	%	4.47E-03	3.53E-03	3.10E-03	2.30E-03	NA

B. TRITIUM (NOTE 1)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total release	Ci	6.96E+01	5.73E+01	3.23E+01	4.55E+01	4.50E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	2.87E-06	1.64E-06	8.82E-07	2.34E-06	NA
3. Percent of applicable limit	%	2.87E-01	1.64E-01	8.82E-02	2.34E-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	1.43E-02	3.20E-03	2.32E-03	4.06E-03	4.00E+01
2. Average diluted concentration (NOTE 2)	µCi/ml	5.87E-10	9.14E-11	6.35E-11	2.09E-10	NA
3. Percent of applicable limit	%	2.94E-04	4.57E-05	3.18E-05	1.04E-04	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	4.00E+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 and/or Storm Drain Stabilization Pond)

Attachment 2
Effluent and Waste Disposal Data

Table 2A: Liquid Effluents – Summation of all Releases

E. VOLUME OF WASTE RELEASED (NOTE 2)

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total volume	liters	4.03E+06	4.58E+06	4.50E+06	2.73E+06	1.50E+01

F. VOLUME OF DILUTION WATER

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total volume (used during release for average diluted concentration)	liters	2.43E+10	3.50E+10	3.66E+10	1.94E+10	1.50E+01

G. VOLUME OF COOLING WATER DISCHARGED FROM PLANT

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Estimated Total Percent Error
1. Total volume	liters	3.60E+11	4.70E+11	5.25E+11	4.56E+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 Collection Basin and/or Storm Drain Stabilization Pond)

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	≤ LLD	3.04E-04	≤ LLD	≤ LLD
manganese-54	Ci	≤ LLD	3.96E-05	2.37E-04	1.35E-06
cobalt-58	Ci	2.42E-05	1.03E-04	1.88E-04	4.72E-06
cobalt-60	Ci	2.01E-04	6.83E-04	1.38E-03	2.06E-05
ruthenium-103	Ci	1.56E-05	2.08E-05	≤ LLD	≤ LLD
tellurium-129m	Ci	≤ LLD	6.80E-06	≤ LLD	≤ LLD
iodine-131	Ci	3.20E-05	7.15E-05	1.05E-04	4.25E-05
iodine-133	Ci	1.79E-05	9.73E-05	2.09E-04	3.73E-05
cesium-134	Ci	≤ LLD	8.26E-06	4.74E-06	≤ LLD
cesium-137	Ci	8.25E-05	6.16E-05	3.26E-04	4.36E-06
lanthanum-140	Ci	≤ LLD	7.13E-06	≤ LLD	≤ LLD
lanthanum-142	Ci	≤ LLD	8.14E-06	≤ LLD	≤ LLD
total for period	Ci	3.73E-04	1.41E-03	2.45E-03	1.11E-04

2. DISSOLVED AND ENTRAINED GASES

	Unit	Quarter 1	Quarter 2	Quarter 3	Quarter 4
krypton-87	Ci	2.83E-06	≤ LLD	≤ LLD	≤ LLD
xenon-133	Ci	2.64E-03	5.48E-04	3.65E-04	5.43E-04
xenon-135	Ci	1.16E-02	2.66E-03	1.96E-03	3.51E-03
xenon-135m	Ci	≤ LLD	≤ LLD	3.42E-06	2.16E-06
total for period	Ci	1.43E-02	3.20E-03	2.32E-03	4.06E-03

Attachment 2
Effluent and Waste Disposal Data

Lower Limits of Detection

Units: µCi/ml

1. LIQUID RELEASES

Alpha	1.80E-08
H-3	2.65E-06
H-3	2.40E-07*
Cr-51	1.39E-07
Mn-54	1.48E-08
Fe-55	5.21E-08
Co-58	1.71E-08
Fe-59	2.94E-08
Co-60	1.76E-08
Zn-65	5.98E-08
Sr-89	1.58E-08
Sr-90	1.24E-08
Mo-99	1.15E-07
Ru-103	1.75E-08
Te-129m	5.99E-07
I-131	1.81E-08
Cs-134	2.07E-08
La-140	2.53E-08
La-142	3.87E-08
Cs-137	2.48E-08
Ce-141	2.44E-08
Ce-144	1.11E-07
Kr-87	3.90E-08
Kr-88	6.26E-08
Xe-133	3.50E-08
Xe-133m	1.54E-07
Xe-135	1.56E-08
Xe-135m	7.38E-08
Xe-138	2.16E-07

2. GASEOUS RELEASES

Ar-41	8.95E-09
Kr-85	2.32E-06
Kr-85m	6.68E-09
Kr-87	1.86E-08
Kr-88	2.82E-08
Xe-133	1.63E-08
Xe-133m	6.65E-08
Xe-135	6.68E-09
Xe-135m	9.63E-08
Xe-137	6.92E-07
Xe-138	2.78E-07

3. IODINES AND PARTICULATES

Alpha	9.47E-16
H-3	2.11E-11
Cr-51	2.44E-12
Mn-54	4.72E-13
Co-58	6.13E-13
Fe-59	8.08E-13
Co-60	5.04E-13
Zn-65	8.52E-13
Sr-89	2.21E-15
Sr-90	1.38E-15
Ru-103	3.30E-13
Mo-99	4.16E-12
I-131	7.853E-13
Cs-134	3.59E-13
Cs-137	5.49E-13
Ba-140	1.43E-12
La-140	4.99E-13
Ce-141	4.81E-13
Ce-144	1.90E-12

NOTES:

1. The above values represent typical "a priori" LLDs for isotopes where values of "≤ 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 "≤ 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. Total volume shipped (cubic meters) 9.45E+02

   Total curie quantity (estimated) 8.18E+01

2. Type of Waste

		Unit	Period	Estimated Total %Error
a.	Spent resins, filter, sludges	meter^3	3.95E+01	
		Curies	7.43E+01	1.00E+01
b.	Dry active waste, compacted/non-compacted	meter^3	9.06E+02	
		Curies	7.49E+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. Estimate of major radionuclides composition

   a. Mn-54 1.29E+00%
      Fe-55 1.62E+01%
      Co-60 7.33E+01%
      Ni-63 5.54E+00%
      Zn-65 1.43E+00%

   b. Mn-54 1.83E+00%
      Fe-55 3.51E+01 %
      Co-60 5.57E+01 %
      Ni-63 3.93E+00 %
      Cs-137 1.79E+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

Stream	Form	Container Type Type A/Type B	No. of shipments
a. Resin	Dewatered	Type A or GDP	1.40E+01
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

Number of Shipments	Mode of Transportation	Destination
1.60E+01	Highway	Oak Ridge, TN
4.00E+00	Rail	Clive, UT
1.40E+01	Highway	Erwin, TN

b. Irradiated Fuel

Number of Shipments	Mode of Transportation	Destination
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. Total volume shipped (cubic meters) 4.80E+00

   Total curie quantity (estimated) 3.37E+01

2. Type of Waste

		Unit	Period	Estimated Total %Error
a.	Spent resins, filter, sludges	meter^3	4.80E+00	
		Curies	3.37E+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. Estimate of major radionuclides composition

   a. Co-60 4.45E+01 %
      Ni-63 4.03E+01 %
      Cs-134 1.10E+00 %
      Cs-137 1.16E+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.

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

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

Stream	Form	Container Type Type A/Type B	No. of shipments
a. Resin & Filters	Dewatered	Type A/Type B	2.00E+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

Number of Shipments	Mode of Transportation	Destination
2.00E+00	Highway	Erwin, TN

b. Irradiated Fuel

Number of Shipments	Mode of Transportation	Destination
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. Total volume shipped (cubic meters) 0.00E+00

   Total curie quantity (estimated) 0.00E+00

2. Type of Waste

	Unit	Period	Estimated Total %Error
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. Estimate of major radionuclides composition

   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

Stream	Form	Container Type Type A/Type B	No. of shipments
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

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

b. Irradiated Fuel

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

Enclosure 1: Milk and Vegetable Sample Location

Enclosure 2: Land Use Census

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 2011 Land Use Census did not identify any locations that are reportable in the Radioactive Effluent Release Report for 2011.

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.

Direction	Residence	Garden
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	1.8 miles
SW	1.1 miles	1.9 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	0.8 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

Enclosure 1: Radioactive Liquid Effluent Monitoring Instrumentation

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

Enclosure 2: Radioactive Gaseous Effluent Monitoring Instrumentation

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

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). The following changes were made during this reporting period:

1. The following design upgrades were implemented under Engineering Change 70823 to the Unit 1 Salt Water Release (SWR) System:

   - Installed epoxy lining to the SWR Tank interior to protect the concrete, improve the ability to clean the tank wall, and reduce maintenance.
   - Upgraded tank level instrumentation including installation of a stilling well and local indicator for improved performance.
   - Upgraded the obsolete level indicator in the Radwaste Control Room.
   - Upgraded filters to reduce maintenance dose rate exposure. The new horizontal filters are single cartridge design compared to nearly sixty cartridges on the old unit. The old filter housing design has long since been discontinued due to poor sealing performance.
   - Filter isolation valves are now operable from the outside the high radiation area on top of the tank to reduce maintenance dose rate exposure.
   - Modified DPI instrument valve configuration to facilitate in-place calibration of instruments.

   This change was submitted under Licensing Document Change Request 10FSAR-035.

2. Phase 1 of Facility Change Traveler (FCT) BNP 142 installed 92 wells strategically located around the Storm Drain Stabilization Pond (SDSP) to remove tritiated groundwater before it can migrate off BNP property and into adjacent waterways. These wells will be pumped at a rate that will not adversely affect groundwater levels but will intercept off site flow. Initial testing determined that the total flow from all 92 wells will be around 35 GPM. Each well discharges into a header and all headers gravity drain into a wet well with submerged pumps that transfer the water to either the SDSP, a new Storm Drain Stabilization Facility (SDSF), or directly into the intake canal. In addition to the 92 wells, about 20 GPM of water seeping through the west side of the SDSP berm is being captured by a sock drain and routed into the Groundwater Extraction (GWE) System wet well. Effluent released directly into the intake canal has to be monitored to account for the radiation being discharged. Before the groundwater is discharged into the intake canal it will pass through a 6" Parshall flume which is equipped with a bubbler flow meter and a composite sampler. The bubbler flow meter is designed to record the amount of flow through the Parshall Flume and to cause the composite sampler to extract a sample of the water at prearranged increments. This system is designed to operate automatically 24 hours per day and discharge whenever the water level in the wet well reaches a predetermined level. No releases were made from this system in 2011. This change was submitted under Licensing Document Change Request 10FSAR-036. More discussion on this change is listed under Attachment 8, Off-Site Dose Calculation Manual (ODCM) and Process Control Program (PCP) Revisions.

3. Phase 2 of FCT BNP 142 will install a separate lined pond to replace the existing SDSP. The SDSF is to be a three acre double lined pond that will be located outside the footprint of the existing pond with a leak detection system between the liners. Water currently pumped to the SDSP will be redirected to the SDSF when it is placed in service. Due to its smaller size the SDSF will require more frequent releases of shorter duration than the existing SDSP. Effluent releases will be monitored similar to the process for used for the existing SDSP except that the monitoring equipment will be similar to the process used for the existing SDSP except that the monitoring equipment will be similar to the equipment provided for the groundwater extraction system. When the effluent is discharged into the intake canal it will pass through a 12" Parshall Flume which is equipped with a bubbler flow meter and a composite sampler. The bubbler flow meter is designed to record the amount of flow through the Parshall Flume and to cause the sampler to extract a sample of the water at prearranged increments. This change was submitted under Licensing Document Change Request 11FSAR-017. More discussion on this change is listed under Attachment 8, Off-Site Dose Calculation Manual (ODCM) and Process Control Program (PCP) Revisions.

4. Engineering Change 71137 reoriented the sparger nozzle and installed a baffle/barrier plate just below the ventilation piping penetration in Floor Drain Sample Tank (FDST) A and B. The original plant design created a potential for undesirable and inadvertent transfers between Waste Sample Tanks and FDSTs. The FDSTs are a potential release point, however, releases from these tanks have not occurred in several years.

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	SDCB	Marsh[1]	Total
mrem	5.34E-06	3.33E-07	1.62E-03	1.63E-03

*Reference page 5-6 of Supplemental Information

	Routine ODCM Dose (mrem)	Supplemental Dose (mrem)	Total Dose (mrem)	Limit (mrem)
GI-LLI	7.85E-04	1.63E-03	2.41E-03	2.00E+01
Bone	2.53E-05	0.00E+00	2.53E-05	2.00E+01
Liver	3.89E-04	1.63E-03	2.01E-03	2.00E+01
Lung	3.25E-04	1.63E-03	1.95E-03	2.00E+01
Total Body	3.96E-04	1.63E-03	2.02E-03	6.00E+00
Thyroid	4.96E-04	1.63E-03	2.12E-03	2.00E+01
Kidney	3.37E-04	1.63E-03	1.96E-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.

Gaseous Effluents

Noble Gas:
Critical Age: Infant
Controlling location: ENE sector at 0.7 mile

	Routine ODCM Dose (mrad)	Limit (mrad)
Gamma	1.54E-02	2.00E+01
Beta	1.47E-02	4.00E+01

Iodine, Particulates, and Tritium:

Supplemental Dose*	SDSP Evaporation	Carbon-14 (All except Bone and Skin)	Carbon-14 (Bone)
mrem	2.15E-03	8.01E-01	4.01E+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]

	Routine ODCM Dose (mrem)	Supplemental Dose (mrem)	Total Dose (mrem)	Limit (mrem)
Thyroid	1.76E-01	8.03E-01	9.79E-01	3.00E+01
Kidney	6.60E-03	8.03E-01	8.10E-01	3.00E+01
Liver	6.52E-03	8.03E-01	8.10E-01	3.00E+01
Total Body	6.18E-03	8.03E-01	8.09E-01	3.00E+01
Skin	6.01E-03	2.15E-03	8.16E-03	3.00E+01
GI-LLI	5.98E-03	8.03E-01	8.09E-01	3.00E+01
Lung	5.97E-03	8.03E-01	8.09E-01	3.00E+01
Bone	8.50E-04	4.01E+00	4.01E+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 5 of supplemental information.

[3] 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.

The PCP was not revised during the report period.

ODCM Revision 35 was effective on November 15, 2011. The changes and justifications are described in the table below. Additional justification is provided in Attachments A through D of this section.

Page	Changes and Justifications
Cover Page	Updated revision number.
LEP	Updated to reflect Revision 35 changes.
TOC	Added information about Appendix H to the Table of Contents.
2-1	Updated 2.1.3 from Stabilization Pond Releases to Stabilization Pond and Stabilization Facility Releases. Added 2.1.4 Groundwater Extraction System Releases and 2.1.5 Marsh Releases. Justification: Engineering Change 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct a new 3-4 acre Stabilization Facility and 92 extraction wells to recover tritium laden groundwater. See Attachment A and B for more information about the Stabilization Facility and Groundwater Extraction System. The Marsh Release section was already in the ODCM, it was just missing from the Section 2 index and the number changed to 2.1.5 due to the addition of the Groundwater Extraction System Releases.
2-2	Changed page number for Section 2.2-1 from 2-13 to 2-14.
2-8	Added the Groundwater Extraction (GWE) System to Section 2.1.2 Continuous Releases. Reworded sentence in Section 2.1.2 dealing with the service water system to include all continuous releases. Prior to the GWE system there were no continuous releases, only the possibility of one in the service water system. Justification: Engineering Change 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct 92 extraction wells to recover tritium laden groundwater. See Attachment B for more information about the Groundwater Extraction System.
2-9	Updated Section 2.1.3 to include the Stabilization Facility. In Section 2.1.3 removed the specific analyses to be performed and referenced Table 7.3.3-1 since it specifies which analyses are required. Added Section 2.1.4 to discuss the Groundwater Extraction System releases. Justification: Engineering Change 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct a new 3-4 acre Stabilization Facility to recover tritium laden groundwater. See Attachment A and B for more information about the Stabilization Facility and Groundwater Extraction System.

Page	Changes and Justifications
2-10	Marsh Releases was renumbered to 2.1.5 and moved to the next page due to addition of previous sections. Section 2.1.5 was previously on page 2-9. Added missing bioaccumulation factor to the equation listed in Section 2.1.5 and added the bioaccumulation factor, decay constant, and transit time definitions, reference DRR 330296. Justification: This equation is consistent with the Regulatory Guide (RG) 1.109 equation for determining internal dose from the consumption of aquatic foods. The ODCM states marsh release doses will be calculated following the RG 1.109 methodology.
2-11	Table 2.1-1 was moved from page 2-10 due to addition of previous sections.
2-12	Section 2.2.1 Cumulation of Doses was updated to remove sentence that stated only batch releases occur at BSEP and that the dose contribution for all releases (not just batch) would be calculated using equation 2.2-1. This was previously on page 2-11. Justification: The GWE System will be considered a continuous release.
2-13 to 2-16	The page numbers were shifted due to addition of previous sections. These pages were previously 2-12 to 2-15.
3-4	Corrected typographical error in Section 3.1. The noble gas whole body dose rate limit was changed from 500 rem/year to 500 mrem/year. Justification: The noble gas whole body dose rate is listed in Technical Specifications 5.5.4 and NUREG-0133 as 500 mrems/year.
3-23	Corrected typographical error for the particulate, radioiodines, and tritium dose rate from 500 mrem/year to 1500 mrem/year. Justification: The particulate, radioiodines, and tritium dose rate is listed in Technical Specifications 5.5.4 and NUREG-0133 as 1500 mrems/year.
3-27	Corrected typographical error for the particulate, radioiodines, and tritium dose rate from 1500 rem/year to 1500 mrem/year. Justification: The particulate, radioiodines, and tritium dose rate is listed in Technical Specifications 5.5.4 and NUREG-0133 as 1500 mrems/year.
3-44	Updated Airborne Tritium Releases from the Storm Drain Stabilization Pond to also include airborne tritium releases from the Stabilization Facility. Justification: Engineering Change 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct a new 3-4 acre Stabilization Facility to recover tritium laden groundwater. See Attachment C for more information about the airborne tritium releases from the Stabilization Facility.

Page	Changes and Justifications
4-7	Table 4.0-1 Changes: • Added location information (Bio. Lab Road) and what PMAC stands for (Projected Maximum Annual Concentration) to Sample ID No. 201. • Added Sample ID. No. 206, the new control location located at the Brunswick County Complex. • Updated Sample ID No. 204 to indicate it is the historical control location. Justification: The NRC recommended a control sample location that was not in the prevailing wind direction. Sample ID. No. 206 was added to the air monitoring program based on this recommendation. Sample ID. No. 204 was the previous control location that was in the prevailing wind direction.
4-8 – 4-13	Table 4.0-1 Changes: • Renamed Sample ID No. 494 to Nancy's Creek Marsh Area – WP 106. • Corrected typographical error for Sample ID No. 499, WP-61 was previous a superscript. • Inserted Waterborne Surface Sample Identification Numbers 604-610 for Nancy's Creek Marsh Area (WP – 72, 74, 76, 82, 84, 88, 92). • Removed Monitoring Well ESS-2C (402), ESS-16 (403), ESS-2B (405), ESS-3B (406), ESS-13C (408), ESS-17C (411), ESS-18B (412), ESS-18C (413), ESS-19B (414), ESS-19C (415), ESS-20B (416), ESS- 20C (417), ESS-21C (419), ESS-22B (420), ESS-22C (421), ESS-23C (422), ESS-24C (425), ESS-25C (427), ESS-26C (428), ESS-27C (430), ESS-30C (431), ESS-31C (432), MW-2 (433), MW-3 (434), ESS-Nancy Creek-1 (435), ESS-Nancy Creek-2 (436), ESS-Nancy Creek-3 (437), ESS-Nancy Creek-4 (438), ESS-Nancy Creek-5 (439), ESS-Gum Log Branch-1 (440), and ESS-28C (447). *Note – Sample Identification numbers are listed in the parenthesis. • Added Monitoring Well ESS MWPA-118B (612). *Note – Sample Identification number is listed in the parenthesis. • Updated footnote (a) to include the LLD requirements for the Nancy's Creek Marsh Area samples that were added. Justification: Nancy's Creek Marsh Area Way Points 72, 74, 76, 82, 84, 88, 92, and 106 are the points that are used to assess the liquid release from the Marsh to Nancy's Creek. See Attachment D for justification for removing the monitoring wells listed above. Added MWPA-118B, which is a well on top of the Castle Hayne aquifer to monitor movement of water offsite.
5-3	The NRC acceptance criteria established in NRC Inspection Procedure (IP) 84750 listed in Section 5.2.3 does not include criteria for a resolution of less than 4, therefore the criteria listed in Attachment 83502.01 was used. Reference DRR 329873. Justification: The resolution less than 4 was added based off the criteria for accepting the Licensee's measurements out of IP83502.01. All other ratios currently listed in the ODCM matched the ratios listed in this procedure.

Page	Changes and Justifications
7.3.1-4	Added Condition J, to estimate the flow rate through the associated pathway using the Parshall flume or other acceptable method once per 24 hours and restore the channel to operable status within 30 days. In addition, added J.2 to Condition I. Justification: Engineering Change 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct 92 extraction wells and a new 3-4 acre Stabilization Facility to recover tritium laden groundwater. See Attachment B for more information about the Groundwater Extraction System and Attachments A and C for the Stabilization Facility.
7.3.1-7	Added Functions 7 and 8 for the Groundwater Extraction System and Functions 9 and 10 for the Stabilization Facility to Table 7.3.1-1. Added note (g) and (h) to state that the composite samplers are triggered directly from flow measurement devices. Justification: Engineering Change 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct 92 extraction wells and a new 3-4 acre Stabilization Facility to recover tritium laden groundwater. See Attachment B for more information about the Groundwater Extraction System and Attachments A and C for the Stabilization Facility.
7.3.3-2	Removed stabilization pond from Note since the stabilization pond does not have a trigger level. Justification: The Stabilization Pond is a monitored release pathway and does not need a trigger level. It is treated similar to any other batch release, which also do not have trigger levels. In years past the Stabilization Pond was treated as a potential release pathway and was only sampled for principal gamma emitters. Today it is an actual release pathway and is sampled for principal gamma emitters, tritium, and hard to detects. The service water has a trigger level since it is a potential release pathway and not an actual release pathway.
7.3.3-3	Added the Groundwater Extraction System and Stabilization Facility analysis requirements to Table 7.3.3-1. Justification: Engineering Change 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct 92 extraction wells and a new 3-4 acre Stabilization Facility to recover tritium laden groundwater. See Attachment B for more information about the Groundwater Extraction System and Attachments A and C for the Stabilization Facility.
7.3.3-5	Added stabilization facility to note (f). Justification: The Stabilization Facility will be released over several-day period like the original Stabilization Pond. The requirements are the same for the new and old pond. See Attachment A for more information on liquid releases from the Stabilization Facility.

Page	Changes and Justifications
7.3.3-6	Updated (b) beside Service Water Principal Gamma Emitters LLD of 5 x 10^{-7} µCi/ml to a superscript. Justification: This is an editorial change since the (b) was supposed to be a superscript.
7.3.15-6 – 7.3.15-8	Table 7.3.15-1 Changes: • Corrected the number of dosimeters under Direct Radiation to forty-nine. • Removed the total number listed for Airborne-Radioiodine and Particulate since it breaks out the requirements in that section. • Updated Nancy's Creek locations from five to four. • Nancy's Creek Marsh Areas and the requirements. • Updated the number of Groundwater Monitoring Wells due to well deletions in Table 4.0-1. • Formatted the table with borders so it is easier to read. Justification: The number of Direct Radiation locations was incorrect so it was updated. Removed the total number listed for the Airborne-Radioiodine and Particulate because it splits it out with more information and tells how many samples with the vicinity. Added the eight locations for the release from the Marsh to Nancy's Creek. These areas have been sampled for several years, but were not in the previous revision. These points are used for effluent accountability.
B 7.3.3-1	Removed reference to the Stabilization Pond in the last paragraph. Justification: The reference was to the Stabilization Pond having a trigger limit. The Stabilization Pond is a monitored release pathway and does not need a trigger level. It is treated similar to any other batch release, which also do not have trigger levels. In years past the Stabilization Pond was treated as a potential release pathway and was only sampled for principal gamma emitters. Today it is an actual release pathway and is sampled for principal gamma emitters, tritium, and hard to detects.
Appendix E	Added the following Liquid Effluent Monitoring Instruments to Appendix E: G. Groundwater Extraction Effluent Composite Sampler 0-GWE-COMP-SAMPLER-1 H. Groundwater Extraction Effluent Flow Measurement Device 0-GWE-FIT-1 I. Stabilization Facility Effluent Composite Sampler 0-SDSF-COMP-SAMPLER-2 J. Stabilization Facility Effluent Flow Measurement Device 0-SDSF-FIT-2 Justification: Engineering Change (EC) 79612 and Facility Change Traveler (FCT) BNP-142 were developed to construct 92 extraction wells and a new 3-4 acre Stabilization Facility to recover tritium laden groundwater. These tag numbers are from the EC. See Attachment B for more information about the Groundwater Extraction System and Attachments A and C for the Stabilization Facility.

Page	Changes and Justifications
Appendix H	Added the Chi/Q values for the Stabilization Facility. Justification: Currently evaporation dose for the Stabilization Pond is calculated using Chi/Q values from the Turbine Buildings. Since the new Stabilization Facility is much smaller in size, new Chi/Q values have been calculated and are more reflective and accurate than using values from the Turbine Building.

Attachment A

Justifications for Liquid Effluent Dose Due to the New Storm Drain Stabilization Facility

a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59;

The ability to operate the new Storm Drain Stabilization Facility has been evaluated. While in normal operation the new Storm Drain Stabilization Facility will have several liquid discharges during the course of the year. The source of water to the new Storm Drain Stabilization Facility (SDSF) is essentially the same as the existing Storm Drain Stabilization Pond (SDSP), which has been in service for several years and released several times per year. The only radionuclide measured in the existing SDSP effluent is tritium. The SDSF is designed to be released to the intake canal is a similar method as the SDSP. The concern for offsite dose is due to tritium releases to the intake canal. Dilution water for pre-release permits for radioactive releases will reserve 2 service water pumps, and actual releases will use only 1 service water pump (n-1) for conservatism in dilution. Each service water pump is rated at 8,000 gallons per minute (gpm).

For normal operations the new Storm Drain Stabilization Facility will receive water from the plant storm drain system and may receive water from Groundwater Extraction System (EC 79416). The tritiated water from the Groundwater Extraction System is from groundwater that was previously discharged into the existing SDSP. Therefore, the receiving waters of the new SDSF are essentially the same waters as have been historically sent to the existing SDSP. The differences between the SDSP and the SDSF consist of size and construction. The existing SDSP covers approximately 64 acres; however, water is only allowed to collect in approximately 39 acres. The new SDSF is approximately 3.2 acres and unlike the SDSP, is double lined and has a leak detection system for the liner. Based on this information it is unlikely that the new SDSF would encounter any tritium activity not previously encountered by the SDSP.

It should be noted that the tritium concentration in the SDSF should be expected to be much less than levels experienced prior to 2007 in the SDSP. Previously high elevated levels of tritium were from the plant airwash system in the Turbine Building which has been rerouted to the plant radwaste system for processing. This modification was started in 2007 as a temporary plant modification and completed as a permanent modification in 2010. While there is still some level of tritium in the waters routed to the SDSP, the levels have been greatly reduced, hence the levels anticipated in the SDSF should be at approximately the same level. The SDSF may receive the Groundwater Extraction System water; the anticipated average activity levels, based on system test results that would be placed into the SDSF for tritium are approximately 2.1E-04 μCi/ml. The anticipated average tritium concentration in the SDSP is approximately 2.3E-05 μCi/ml. This would indicate that an approximate average tritium concentration would be approximately 2.3E-04 μCi/ml.

Attachment A (continued)

The flow rate from the Groundwater Extraction System is anticipated to be approximately 60 gallons per minute. The maximum anticipated flow rate for releases from the SDSF is 1200 gallons per minute. Design documentation indicates that, including storm water events, it is anticipated that there would be 29 releases per year (each release is anticipated to be seven days).

Compliance with 10 CFR Part 20 for tritium releases is demonstrated by the following equation:

$$\Sigma_i \, (CONC_i/Ec_i) \leq 1$$

Where:

$CONC_i$ = Post dilution concentration of radionuclide i at the unrestricted area per, μCi/ml

ECi = Annual average effluent concentration limit of radionuclide i from Appendix B, Table 2, Column 2 of 10 CFR Part 20, μCi/ml.

Based on the average anticipated activity (2.3E-04 μCi/ml) in the SDSF, the maximum release rate of 1200 gpm, and the dilution flow for 1 service water pump (8,000 gpm), the value from the above equation would be 0.0000345, which is less than 1, therefore compliance with 10 CFR Part 20 is achieved.

The limits to demonstrate compliance with 10 CFR Part 50, Appendix I are:

≤3 mrem to the total body and ≤10 mrem to any organ during any calendar quarter; and

≤6 mrem to the total body and ≤ 20 mrem to any organ during any calendar year.

Compliance with 10 CFR Part 50, Appendix I is demonstrated by the following equation:

$$R_{apj} = 1100 \frac{U_{ap} M_p}{F} \sum_i Q_i B_{ip} D_{aipj} \exp(-\lambda_i t_p)$$

1100 is the factor to convert from (Ci/yr)/(ft^3/sec) to pCi/liter;

U_{ap} is the usage factor that specifies the exposure time or intake rate for an individual of age group "a" associated with pathway "p" in hr/yr, L/yr, or kg/yr;

M_p is the mixing ratio (reciprocal of the dilution factor) at the point exposure (or the point of withdrawal of drinking or point of harvest of aquatic food), dimensionless;

F is the flow rate of the liquid effluent, in ft^3/sec;

Q_i is the release rate of nuclide "i", in Ci/yr;

B_{ip} is the equilibrium bioaccumulation factor for nuclide "i" in pathway "p", expressed as the ratio of the concentration in biota (in pCi/kg) to the radionuclide concentration in water (in pCi/liter), in liters/kg;

D_{aipj} is the dose factor, specific to a given age group "a", radionuclide "i", pathway "p", and organ "j", which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi, or from exposure to a given concentration of a radionuclide in sediment, expressed as a ration of the dose rate (in mrem/hr) and the areal radionuclide concentration (in pCi/m^2);

Attachment A (continued)

Based on data from the above equation and using parameters from Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I", it can be determined that the maximum doses from the SDSF for routine operations is below numerical guidelines in 10 CFR Part 50, Appendix I as indicated below:

Dose Calculations for the SDSF using Regulatory Guide 1.109 Methodology				
	Adult	Teen	Child	Maximum Dose, mrem
Max Organ dose (mrem), Fish	3.251E-02	2.501E-02	2.065E-02	3.251E-02
Max Organ Dose (mrem), Invertebrate	8.000E-03	6.138E-03	5.258E-03	8.000E-03

b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

1) As indicated above the calculated offsite radioactive releases from the new Storm Drain Stabilization Facility were well within the 10 CFR 50, Appendix I numerical guidelines which is As Low As Reasonably Achievable (ALARA) for offsite doses.

2) Any dose from the new SDSF will replace similar doses from the old SDSP as there will be no new routine additions to the old SDSP.

c. A detailed description of the equipment, components, and processes involved and the interfaces with other plant systems;

The new Storm Drain Stabilization Facility only interfaces with the plant Storm Drain system. The components consist of a double lined pond, associated liquid flow instrumentation, and a liquid composite sampler. Prior to each release the SDSF will be sampled and analyzed for tritium and gamma emitters.

d. An evaluation of the change that shows the predicted release of radioactive materials in the liquid and gaseous effluents and quantity of solid waste differ from those previously predicted in the license application and amendments thereto;
The evaluation in the above descriptive text indicates that the predicted liquid release is a very small fraction of any release limits and all expected results will be within Updated FSAR Design Basis requirements (10 CFR 20 and Appendix I to 10 CFR 50).

Attachment A (continued)

e. An evaluation of the change that shows the expected maximum exposure to an individual in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

The evaluation in the above descriptive text indicates that the predicted liquid release is a very small fraction of any release limits and all expected results will be within Updated FSAR Design Basis requirements (10 CFR 20 and Appendix I to 10 CFR 50).

f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid wastes, to the actual releases for the period prior to when the changes are to be made;

There are no changes to the existing prediction of releases from the plant site. Releases from the old (existing) SDSP will be replaced with releases from the new Storm Drain Stabilization Facility and as source terms for both the old and new SDSP are essentially the same. The old (existing) SDSP is currently included in the ODCM.

g. An estimate of the exposure to plant operating personnel as a result of the change;

There is not expected to be any additional exposure to existing plant personnel as this new Storm Drain Stabilization Facility will be in the same vicinity of the old SDSP and workers would receive the same exposure working on the new Storm Drain Stabilization Facility as the old SDSP.

Attachment B
Justifications for Liquid Effluent Dose Due to Releases of the Groundwater Extraction Well System

a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59;

The ability to operate the new Groundwater Extraction Well System has been evaluated. While in normal operation the new Groundwater Extraction Well System operate as a continuous release or will be routed to the new Storm Drain Stabilization Facility (SDSF). Operation of the SDSF has been previously addressed. The source of water to the Groundwater Extraction Well System is from tritiated water in the old Storm Drain Stabilization Pond (SDSP) that leached into the ground. The only radionuclide measured in the Groundwater Extraction Well System has been tritium. The Groundwater Extraction Well System is designed to be released to the intake canal or the SDSF. The concern for offsite dose is due to tritium releases to the intake canal. Dilution water for pre-release permits for radioactive releases will reserve 2 service water pumps, and actual releases will use only 1 service water pump (n-1) for conservatism in dilution. Each service water pump is rated at 8,000 gallons per minute (gpm).

For normal operations the new Groundwater Extraction Well System will receive water from the 92 wells in the Groundwater Extraction Well System (EC 79416). The tritiated water from the Groundwater Extraction System is from groundwater that was previously discharged into the existing SDSP. Therefore, the receiving waters of the new Groundwater Extraction Well System are essentially the same waters as have been historically sent to the existing SDSP. Based on this information it is unlikely that the new Groundwater Extraction Well System would encounter any tritium activity not previously encountered by the old SDSP.

The Groundwater Extraction System water anticipated average activity levels, based on system test results that would released to in intake canal are approximately 2.1E-04 μCi/ml. The anticipated flow rate from the Groundwater Extraction System is anticipated to be approximately 60 gallons per minute.

Compliance with 10 CFR Part 20 for tritium releases is demonstrated by the following equation:

$$\Sigma_i \, (CONC_i/Ec_i) \leq 1$$

Where:
$CONC_i$ = Post dilution concentration of radionuclide i at the unrestricted area per, μCi/ml
ECi = Annual average effluent concentration limit of radionuclide i from Appendix B, Table 2, Column 2 of 10 CFR Part 20, μCi/ml.

Attachment B (continued)

Based on the average anticipated activity (2.1E-04 μCi/ml) in the Groundwater Extraction Well System and the dilution flow for 1 service water pump (8,000 gpm), the value from the above equation would be 0.00000158, which is less than 1, therefore compliance with 10 CFR Part 20 is achieved.
The limits to demonstrate compliance with 10 CFR Part 50, Appendix I are:
≤3 mrem to the total body and ≤10 mrem to any organ during any calendar quarter; and
≤6 mrem to the total body and ≤ 20 mrem to any organ during any calendar year.

Compliance with 10 CFR Part 50, Appendix I is demonstrated by the following equation:

$$R_{apj} = 1100 \frac{U_{ap} M_p}{F} \sum_i Q_i B_{ip} D_{aipj} \exp(-\lambda_i t_p)$$

1100	is the factor to convert from (Ci/yr)/(ft^3/sec) to pCi/liter;
U_{ap}	is the usage factor that specifies the exposure time or intake rate for an individual of age group "a" associated with pathway "p" in hr/yr, L/yr, or kg/yr;
M_p	is the mixing ratio (reciprocal of the dilution factor) at the point exposure (or the point of withdrawal of drinking or point of harvest of aquatic food), dimensionless;
F	is the flow rate of the liquid effluent, in ft^3/sec;
Q_i	is the release rate of nuclide "i", in Ci/yr;
B_{ip}	is the equilibrium bioaccumulation factor for nuclide "i" in pathway "p", expressed as the ratio of the concentration in biota (in pCi/kg) to the radionuclide concentration in water (in pCi/liter), in liters/kg;
D_{aipj}	is the dose factor, specific to a given age group "a", radionuclide "i", pathway "p", and organ "j", which can be used to calculate the radiation dose from an intake of a radionuclide, in mrem/pCi, or from exposure to a given concentration of a radionuclide in sediment, expressed as a ration of the dose rate (in mrem/hr) and the areal radionuclide concentration (in pCi/m^2);

Based on data from the above equation and using parameters from Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I", it can be determined that the maximum doses from the Groundwater Extraction Well System for routine operations is below numerical guidelines in 10 CFR Part 50, Appendix I as indicated below:

Attachment B (continued)

Dose Calculations for the Groundwater Extraction Well System using Regulatory Guide 1.109 Methodology				
	Adult	Teen	Child	Maximum Dose, mrem
Max Organ dose (mrem), Fish	3.047E-03	2.321E-03	1.001E-03	3.047E-03
Max Organ Dose (mrem), Invertebrate	7.254E-04	5.513E-04	2.466E-04	7.254E-04

b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

1) As indicated above the calculated offsite radioactive releases from the new Groundwater Extraction Well System were well within the 10 CFR 50, Appendix I numerical guidelines which are As Low as Reasonably Achievable (ALARA) for offsite doses.

2) Any dose from the Groundwater Extraction Well System will have similar doses as from the old SDSP as there will be no new routine additions to the old SDSP.

c. A detailed description of the equipment, components, and processes involved and the interfaces with other plant systems;

The Groundwater Extraction Well System only interfaces with the groundwater in the vicinity of the old SDSP. The components consist of a 92 extraction wells, associated liquid flow instrumentation, and a liquid composite sampler. The Groundwater Extraction Well System will be sampled and analyzed for tritium and gamma emitters via composite sampler or grab samplers if the composite sampler in inoperable.

d. An evaluation of the change that shows the predicted release of radioactive materials in the liquid and gaseous effluents and quantity of solid waste differ from those previously predicted in the license application and amendments thereto;

The evaluation in the above descriptive text indicates that the predicted liquid release is a very small fraction of any release limits and all expected results will be within Updated FSAR Design Basis requirements (10 CFR 20 and Appendix I to 10 CFR 50).

Attachment B (continued)

e. An evaluation of the change that shows the expected maximum exposure to an individual in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

The evaluation in the above descriptive text indicates that the predicted liquid release is a very small fraction of any release limits and all expected results will be within Updated FSAR Design Basis requirements (10 CFR 20 and Appendix I to 10 CFR 50).

f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid wastes, to the actual releases for the period prior to when the changes are to be made;

There are no changes to the existing prediction of releases from the plant site. Releases from the Groundwater Extraction Well System are similar in radioactivity concentration as the old SDSP since the water originated from the old SDSP. The old (existing) SDSP is currently included in the ODCM.

g. An estimate of the exposure to plant operating personnel as a result of the change;

There is not expected to be any additional exposure to existing plant personnel as this new Groundwater Extraction Well System will be in the same vicinity of the old SDSP and workers would receive the same exposure working on the Groundwater Extraction Well System as the old SDSP.

Attachment C
Justifications for Airborne Dose Due to Evaporative Losses from the New Storm Drain Stabilization Facility

a. A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59;

The ability to operate the new Storm Drain Stabilization Facility has been evaluated. While in normal operation the new Storm Drain Stabilization Facility will experience evaporative losses during the course of the year. The concern for offsite dose is due to tritium evaporating with the pond water during normal evaporative losses.

For normal operations the new Storm Drain Stabilization Facility will receive water from the plant storm drain system. The highly tritiated water from the plant airwash has been rerouted to the plant radwaste system for processing. This modification was started in 2007 as a temporary plant modification and completed as a permanent modification in 2010. While there is still some level of tritium in the waters routed to the new Storm Drain Stabilization Facility, the levels have been greatly reduced. The maximum release rate from the site to be in compliance with 10 CFR 20 is < 1500 mrem/yr. The airborne release point from are new Stabilization Facility is due to water evaporation of the pond which contains tritium. The pond will be sampled weekly and evaluated monthly. Due to the nature of evaporation there are no particulates leaving the pond via evaporation.
Each week the pond will be analyzed for tritium, the data averaged, and evaporative losses calculated on a monthly basis. Using the methodology in the ODCM and the results from sample analyses, the doses and dose rates are calculated on an annual basis. Dose and dose rates are compared to 10 CFR 20 and Appendix I, 10 CFR 50 values for compliance. The only airborne releases from the pond are from tritium from evaporative losses therefore there are no noble gasses or particulates released via the airborne pathway.

10 CFR 20 (Release Rate Limits)- Noble Gas Whole Body - 500 mrem/year;
Noble Gas Skin - 3000 mrem/year; Air Particulates To any organ - 1500 mrem/year

Appendix I, 10 CFR 50 (Dose Limit from the site (2 units)

Noble Gas Calendar Quarter
≤ 10 mrads gamma radiation
≤ 20 mrads beta radiation

Calendar Year
≤ 20 mrads gamma radiation
≤ 40 mrads beta radiation

Attachment C (continued)

Air Particulates:
Calendar Quarter
≤ 15 mrem to any organ
Calendar Year
≤ 30 mrem to any organ

A review of the tritium released by evaporation for 12 months from the existing Storm Drain Stabilization Pond for the period of July 2010 through June 2011 was performed. The tritium concentrations are the actual tritium concentrations for the existing SDSP which are expected to be similar to future years. The evaporation rates in the table are calculated evaporation rates for the new facility. The results are indicated in the table below:

Month/Year	Tritium Concentration, µCi/ml	Evaporation Rate, mm Water	Tritium Monthly Release Rate, Ci	Monthly Evaporation Rate, Liters	Monthly Evaporation Rate, Gallons
July 2010	1.047E-05	179.00	0.023	2.203E+06	5.823E+05
August 2010	1.251E-05	157.00	0.024	1.929E+06	5.098E+05
September 2010	1.066E-05	122.00	0.016	1.496E+06	3.954E+05
October 2010	5.864E-06	83.60	0.006	1.029E+06	2.719E+05
November 2010	1.056E-05	64.10	0.008	7.878E+05	2.083E+05
December 2010	1.394E-05	58.50	0.01	7.199E+05	1.903E+05
January 2011	1.674E-05	42.87	0.009	5.273E+05	1.394E+05
February 2011	2.297E-05	62.09	0.018	7.637E+05	2.019E+05
March 2011	4.323E-05	98.68	0.052	1.214E+06	3.208E+05
April 2011	3.351E-05	137.44	0.057	1.691E+06	4.469E+05
May 2011	4.253E-05	169.06	0.088	2.079E+06	5.497E+05
June 2011	4.119E-05	184.51	0.093	2.269E+06	5.999E+05

Using the above data and a review of nearby residents, the nearest resident is in the NNW Sector at approximately 0.5 miles. As a part of the bounding calculations dose calculations will be performed using the Chi/Q value at 0.5 miles to the NNW and using the highest Chi/Q value for the highest sector at 0.5 miles. The highest Chi/Q value for 0.5 miles is to the SSE. Both bounding dose calculations assume a garden for the ingestion pathway; therefore doses will be demonstrated for the ingestion and inhalation pathways. The results are tabulated below.

Attachment C (continued)

Potential Dose in mrem to Actual Resident in NNW	
	Inhalation and Vegetation dose, mrem for one year
Organ	T. Body
Age Group Adult	7.28E-04
Age Group Teen	7.98E-04
Age Group Child	1.06E-03
Age Group Infant	1.32E-04
Maximum, Inhalation and Vegetation Dose	**1.06E-03**

Potential Dose in mrem to Hypothetical Resident in SSE at 0.5 Miles [1]	
	Inhalation and Vegetation dose, mrem for one year
Organ	T. Body
Age Group Adult	8.80E-03
Age Group Teen	9.64E-03
Age Group Child	1.28E-02
Age Group Infant	1.61E-03
Maximum, Inhalation and Vegetation Dose	**1.28E-02**

[1] Actual resident location is greater than 1 mile

As demonstrated in the above tables the potential dose to members of the public is much less than regulatory requirements.

b. Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

1) As indicated above the calculated offsite radioactive releases from the new Storm Drain Stabilization Facility were well within the 10 CFR 50, Appendix I numerical values which is As Low As Reasonably Achievable (ALARA) for offsite doses.

2) Any dose from the new SDSP will replace similar doses from the old SDSP as there will be no new routine additions to the old SDSP.

Attachment C (continued)

c. A detailed description of the equipment, components, and processes involved and the interfaces with other plant systems;

The new Storm Drain Stabilization Facility only interfaces with the plant Storm Drain system. The components consist of a double lined pond, associated liquid flow instrumentation, and a liquid composite sampler. There are no airborne release instruments associated with the new Storm Drain Stabilization Facility. Weekly samples will be collected to assist in the determination tritium curies evaporated.

d. An evaluation of the change that shows the predicted release of radioactive materials in the liquid and gaseous effluents and quantity of solid waste differ from those previously predicted in the license application and amendments thereto;

The evaluation in the above descriptive text indicates that the predicted airborne release area is a very small fraction of any release limits and all expected results will be within Updated FSAR Design Basis requirements (10 CFR 20 and Appendix I to 10 CFR 50).

e. An evaluation of the change that shows the expected maximum exposure to an individual in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

The evaluation in the above descriptive text indicates that the predicted airborne release area is a very small fraction of any release limits and all expected results will be within Updated FSAR Design Basis requirements (10 CFR 20 and Appendix I to 10 CFR 50).

f. A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid wastes, to the actual releases for the period prior to when the changes are to be made;

There are no changes to the existing prediction of releases from the plant site. Releases from the old (existing) SDSP will be replaced with releases from the new Storm Drain Stabilization Facility and as source terms for both the old and new SDSP are essentially the same. The old (existing) SDSP is currently included in the ODCM.

g. An estimate of the exposure to plant operating personnel as a result of the change;

There is not expected to be any additional exposure to existing plant personnel as this new Storm Drain Stabilization Facility will be in the same vicinity of the old SDSP and workers would receive the same exposure working on the new Storm Drain Stabilization Facility as the old SDSP.

Attachment D
Monitoring Well Justification

Removed the following Monitoring Wells from Table 4.0-1: ESS-2C, ESS-16, ESS-2B, ESS-3B, ESS-13C, ESS-17C, ESS-18B, ESS-18C, ESS-19B, ESS-19C, ESS-20B, ESS- 20C, ESS-21C, ESS-22B, ESS-22C, ESS-23C, ESS-24C, ESS-25C, ESS-26C, ESS-27C, ESS-28C, ESS-30C, ESS-31C, MW-2, MW-3, ESS-Nancy Creek-1, ESS-Nancy Creek-2, ESS-Nancy Creek-3, ESS-Nancy Creek-4, ESS-Nancy Creek-5, and ESS-Gum Log Branch-1.

10 CFR Parts 20 and 50 require that radiological environmental monitoring programs be established to provide data on measurable levels of radiation and radioactive materials in the site environs. Additionally, Appendix I to 10 CFR Part 50 requires that the relationship between quantities of radioactive material released in effluents during normal operation, including anticipated operational occurrences, including resultant radiation doses to individuals from principal pathways of exposure be evaluated. These programs should be conducted to verify the effectiveness of in-plant measures used for controlling the release of radioactive materials.

The requirements from the NRC's Branch Technical Position, dated November 27, 1979, for "An Acceptable Environmental Monitoring Program" indicate that "Groundwater samples should be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination." None of the wells being removed from the ODCM meet this criterion. These wells were originally placed in the ODCM to monitor groundwater due to the discovery of elevated tritium concentrations around the plant. The wells are not being abandoned nor is sampling being eliminated, from this point forward, these wells will be sampled and analyzed in accordance with approved plant procedures in the POM, as the wells being eliminated from the ODCM are not monitoring areas used for drinking water or used for irrigation.

The Monitoring Wells that will be in the ODCM are: ESS-1B, ESS-13B, ESS-17A, ESS-17B, ESS-21B, ESS-24A, ESS-24B, ESS-25B, ESS-27A, and ESS MWPA-118B. The monitoring wells designated with a "B "suffix are included because they are intermediate depth wells which are near the Castle Hayne Aquifer. These wells are down gradient from potential contamination sources, and monitor the water at the appropriate depths to detect contamination that could potentially get into the Castle Hayne Aquifer. The Castle Hayne Aquifer can be used as a drinking water aquifer, however, in the direction of flow from the plant site, there are no known drinking water wells in the Castle Hayne Aquifer.

The monitoring wells designated with a "A "suffix are included because they are deep wells which are near the Pee Dee Aquifer. These wells are down gradient from potential contamination sources, and monitor the water at the appropriate depths to detect contamination that could potentially get into the Pee Dee Aquifer. The Pee Dee Aquifer can be used as a drinking water aquifer, however, in the direction of flow from the plant site, there are no known drinking water wells in the Pee Dee Aquifer.

Attachment 9

Special Groundwater Protection

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