



Thomas D. Ray
Vice President
Oconee Nuclear Station

Duke Energy
ON01VP | 7800 Rochester Hwy
Seneca, SC 29672

ONS-2017-036

o: 864.873.5016
f: 864.873.4208
Tom.Ray@duke-energy.com

May 1, 2017

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC
Oconee Nuclear Station
Docket Nos. 50-269, 50-270 and 50-287
2016 Annual Radioactive Effluent Release Report (ARERR)

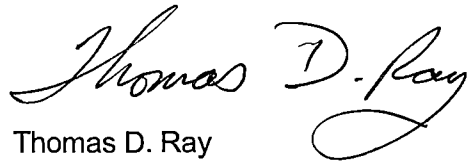
Pursuant to Oconee Nuclear Station Technical Specification (TS) 5.6.3 and Selected Licensee Commitment 16.11-9, please find attached the Annual Radioactive Effluent Release Report for the period of January 1, 2016, through December 31, 2016. In accordance with TS 5.5.1, the Offsite Dose Calculation Manual (ODCM) is included in this submittal.

- Attachment 1 Summary of Gaseous and Liquid Effluents
- Attachment 2 Supplemental Information
- Attachment 3 Solid Radioactive Waste Disposal
- Attachment 4 Meteorological Data
- Attachment 5 Unplanned Offsite Releases
- Attachment 6 Assessment of Radiation Dose from Radioactive Effluents to Members of the Public
- Attachment 7 Information to Support the NEI Ground Water Protection Initiative
- Attachment 8 Inoperable Equipment
- Attachment 9 Offsite Dose Calculation Manual (ODCM) and Summary of Changes to the ODCM
- Attachment 10 Summary of Changes to the Process Control Program
- Attachment 11 Summary of Major Modifications to the Radioactive Waste Treatment Systems
- Attachment 12 Errata to a Previous Year's ARERR

IE48
A009
NRR

Any questions concerning this report should be directed to Kay Brocklesby at 864-873-6661.

Sincerely,

A handwritten signature in black ink that reads "Thomas D. Ray". The signature is written in a cursive style with a large, looping "R" at the end.

Thomas D. Ray
Site Vice President
Oconee Nuclear Station

Attachments (12)

xc (with attachments and enclosure):

Ms. Catherine Haney
Administrator, Region II
U.S. Nuclear Regulatory Commission
Marquis One Tower
245 Peachtree Center Ave., NE, Suite 1200
Atlanta, GA 30303-1257

Mr. Eddy Crowe
NRC Senior Resident Inspector
Oconee Nuclear Station

xc (with attachments only):

Mr. Stephen Koenick, Project Manager
(by electronic mail only)
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Mail Stop OWFN/8F-14
Rockville, MD 20852

Ms. Susan E. Jenkins, Manager
(by electronic mail only)
Radioactive & Infectious Waste Management
SC Department. of Health and Environmental Control
2600 Bull St.
Columbia, SC 29201

Mr. James Twiggs
INPO
700 Galleria Place, Suite 100
Atlanta, GA 30339-5943

Mr. Gary Stewart, State Voluntary Cleanup Section
S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201-1708

Ms. Anuradha Nair Gimmi, Manager
Nuclear Response and Emergency Environmental Surveillance
Division of Emergency Response
S.C. Dept. of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201-1708



Oconee Nuclear Station Units 1, 2, and 3

Annual Radioactive Effluent Release Report

January 1, 2016 through December 31, 2016

Dockets 50-269, 50-270, and 50-287



Introduction

The Annual Radioactive Effluent Release Report is pursuant to Oconee Nuclear Station Technical Specification 5.6.3 and Selected Licensee Commitment 16.11-9. The below listed attachments to this report provide the required information. In addition, the ODCM is included pursuant to Oconee Nuclear Station Technical Specification 5.5.1.

- Attachment 1 Summary of Gaseous and Liquid Effluents
- Attachment 2 Supplemental Information
- Attachment 3 Solid Radioactive Waste Disposal
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Attachment 1
Summary of Gaseous and Liquid Effluents

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 1

Summary of Gaseous and Liquid Effluents

This attachment includes a summary of the quantities of radioactive liquid and gaseous effluents as outlined in Regulatory Guide 1.21, Appendix B.

Attachment 1
Summary of Gaseous and Liquid Effluents

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Gaseous Effluents - Summation of All Releases

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
1. Total Release	Ci	1.06E+00	2.56E+00	7.60E+00	9.71E+00	2.09E+01
2. Avg. Release Rate	μCi/sec	1.35E-01	3.26E-01	9.57E-01	1.22E+00	6.62E-01
B. Iodine-131						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	4.92E-10	4.92E-10
2. Avg. Release Rate	μCi/sec	0.00E+00	0.00E+00	0.00E+00	6.19E-11	1.56E-11
C. Particulates Half-Life ≥ 8 days						
1. Total Release	Ci	0.00E+00	1.74E-10	1.58E-10	0.00E+00	3.32E-10
2. Avg. Release Rate	μCi/sec	0.00E+00	2.22E-11	1.98E-11	0.00E+00	1.05E-11
D. Tritium						
1. Total Release	Ci	3.07E+01	3.08E+01	2.23E+01	4.93E+01	1.33E+02
2. Avg. Release Rate	μCi/sec	3.90E+00	3.92E+00	2.81E+00	6.20E+00	4.21E+00
E. Carbon-14						
1. Total Release	Ci	5.54E+00	5.52E+00	6.02E+00	5.60E+00	2.27E+01
2. Avg. Release Rate	μCi/sec	7.05E-01	7.02E-01	7.57E-01	7.05E-01	7.18E-01
F. Gross Alpha						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Release Rate	μCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1
Summary of Gaseous and Liquid Effluents**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Gaseous Effluents - Elevated Releases - Continuous Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
XE-133	Ci	1.06E+00	2.47E+00	7.56E+00	9.66E+00	2.07E+01
Total for Period	Ci	1.06E+00	2.47E+00	7.56E+00	9.66E+00	2.07E+01
B. Iodines						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Particulates Half-Life ≥ 8 days						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Tritium						
H-3	Ci	2.66E+01	2.70E+01	1.98E+01	4.32E+01	1.17E+02
E. Carbon-14						
C-14	Ci	1.66E+00	1.66E+00	1.81E+00	1.68E+00	6.81E+00
F. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

* 30% of total C-14 released is assumed to be in continuous mode. See Attachment 2, Supplemental Information, of this report.

**Attachment 1
Summary of Gaseous and Liquid Effluents**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Gaseous Effluents - Elevated Releases - Batch Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
AR-41	Ci	0.00E+00	1.61E-02	2.37E-02	2.44E-04	4.01E-02
KR-85M	Ci	0.00E+00	6.78E-05	4.27E-06	0.00E+00	7.20E-05
KR-88	Ci	0.00E+00	5.42E-05	0.00E+00	0.00E+00	5.42E-05
XE-131M	Ci	0.00E+00	0.00E+00	1.15E-04	2.33E-04	3.49E-04
XE-133	Ci	2.16E-03	7.59E-02	1.48E-02	4.40E-02	1.37E-01
XE-133M	Ci	0.00E+00	4.99E-04	1.76E-04	3.58E-04	1.03E-03
XE-135	Ci	1.14E-06	4.89E-03	3.74E-04	6.71E-04	5.93E-03
XE-138	Ci	0.00E+00	0.00E+00	8.81E-04	0.00E+00	8.81E-04
Total for Period	Ci	2.16E-03	9.75E-02	4.01E-02	4.70E-02	1.85E-01
B. Iodines						
I-131	Ci	0.00E+00	0.00E+00	0.00E+00	4.92E-10	4.92E-10
I-133	Ci	0.00E+00	8.22E-10	0.00E+00	4.84E-10	1.31E-09
Total for Period	Ci	0.00E+00	8.22E-10	0.00E+00	9.76E-10	1.80E-09
C. Particulates Half-Life ≥ 8 days						
CO-58	Ci	0.00E+00	1.74E-10	0.00E+00	0.00E+00	1.74E-10
CS-137	Ci	0.00E+00	0.00E+00	1.58E-10	0.00E+00	1.58E-10
Total for Period	Ci	0.00E+00	1.74E-10	1.58E-10	0.00E+00	3.32E-10
D. Tritium						
H-3	Ci	3.31E-05	2.19E-02	4.23E-02	1.29E-01	1.93E-01
E. Carbon-14						
C-14	Ci	3.88E+00	3.86E+00	4.21E+00	3.92E+00	1.59E+01
F. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

* 70% of total C-14 released is assumed to be in batch mode. See Attachment 2, Supplemental Information, of this report.

**Attachment 1
Summary of Gaseous and Liquid Effluents**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Gaseous Effluents - Ground Releases - Continuous Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Iodines						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Particulates Half-Life ≥ 8 days						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Tritium						
H-3	Ci	3.98E+00	3.59E+00	2.48E+00	5.94E+00	1.60E+01
E. Carbon-14						
C-14	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1
Summary of Gaseous and Liquid Effluents**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Gaseous Effluents - Ground Releases - Batch Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Iodines						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
C. Particulates Half-Life ≥ 8 days						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Tritium						
H-3	Ci	7.27E-02	1.58E-01	2.14E-02	2.39E-02	2.76E-01
E. Carbon-14						
C-14	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1
Summary of Gaseous and Liquid Effluents**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Liquid Effluents - Summation of All Releases

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products *						
1. Total Release	Ci	4.57E-04	2.15E-03	3.88E-03	3.01E-04	6.79E-03
2. Avg. Diluted Conc.	µCi/ml	1.82E-13	8.57E-13	1.57E-12	1.95E-13	7.62E-13
3. Batch Releases	µCi/ml	5.42E-11	2.55E-10	4.53E-10	3.51E-11	2.00E-10
B. Tritium						
1. Total Release	Ci	2.68E+02	2.91E+02	3.03E+02	2.76E+02	1.14E+03
2. Avg. Diluted Conc.	µCi/ml	1.34E-07	1.44E-07	1.47E-07	1.98E-07	1.52E-07
3. Batch Releases	µCi/ml	3.18E-05	3.44E-05	3.54E-05	3.22E-05	3.34E-05
C. Dissolved & Entrained Gases						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Batch Releases	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Diluted Conc.	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3. Batch Releases	µCi/ml	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
E. Volume of Liquid Waste						
1. Continuous Releases	liters	7.36E+08	7.87E+08	4.83E+08	4.98E+08	2.50E+09
2. Batch Releases	liters	2.48E+06	2.66E+06	1.68E+06	2.78E+06	9.60E+06
F. Volume of Dilution Water						
1. Continuous Releases	liters	8.44E+09	8.44E+09	8.55E+09	8.55E+09	3.40E+10
2. Batch Releases	liters	8.44E+09	8.44E+09	8.55E+09	8.55E+09	3.40E+10

* Excludes tritium, dissolved and entrained noble gases, and gross alpha.

**Attachment 1
Summary of Gaseous and Liquid Effluents**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Liquid Effluents - Continuous Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
B. Tritium						
H-3	Ci	2.49E-01	2.58E-01	2.17E-01	1.77E-01	9.00E-01
C. Dissolved & Entrained Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 1
Summary of Gaseous and Liquid Effluents**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Liquid Effluents - Batch Mode

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Fission and Activation Products						
AG-110M	Ci	0.00E+00	0.00E+00	2.16E-05	0.00E+00	2.16E-05
CO-58	Ci	4.57E-04	1.96E-03	1.52E-03	3.01E-04	4.24E-03
CO-60	Ci	0.00E+00	1.47E-05	1.45E-04	0.00E+00	1.59E-04
NB-97	Ci	0.00E+00	0.00E+00	8.34E-06	0.00E+00	8.34E-06
NI-63	Ci	0.00E+00	1.09E-04	5.27E-04	0.00E+00	6.36E-04
SB-124	Ci	0.00E+00	0.00E+00	1.27E-03	0.00E+00	1.27E-03
SB-125	Ci	0.00E+00	6.71E-05	3.72E-04	0.00E+00	4.39E-04
ZR-97	Ci	0.00E+00	0.00E+00	8.34E-06	0.00E+00	8.34E-06
Total for Period	Ci	4.57E-04	2.15E-03	3.88E-03	3.01E-04	6.79E-03
B. Tritium						
H-3	Ci	2.68E+02	2.91E+02	3.03E+02	2.76E+02	1.14E+03
C. Dissolved & Entrained Gases						
None	Ci	-	-	-	-	-
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
D. Gross Alpha						
Total for Period	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 2
Supplemental Information**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 2

Supplemental Information

This attachment includes supplemental information to the gaseous and liquid effluents report.

**Attachment 2
Supplemental Information**

**Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016**

I. Regulatory Limits - Per Unit

A. Noble Gases - Air Dose

1. Calendar Quarter Gamma Dose	= 5	mRAD
2. Calendar Quarter Beta Dose	= 10	mRAD
3. Calendar Year Gamma Dose	= 10	mRAD
4. Calendar Year Beta Dose	= 20	mRAD

B. Liquid Effluents - Dose

1. Calendar Quarter Total Body Dose	= 1.5	mREM
2. Calendar Quarter Organ Dose	= 5	mREM
3. Calendar Year Total Body Dose	= 3	mREM
4. Calendar Year Organ Dose	= 10	mREM

C. Gaseous Effluents - Iodine-131 & 133, Tritium, and Particulates with Half-lives > 8 days

1. Calendar Quarter Organ Dose	= 7.5	mREM
2. Calendar Year Organ Dose	= 15	mREM

II. Maximum Permissible Effluent Concentrations

A. Gaseous Effluents

1. Information found in Offsite Dose Calculation Manual

B. Liquid Effluents

1. Information found in 10 CFR Part 20, Appendix B, Table 2, Column 2

III. Average Energy

(not applicable)

IV. Measurements and Approximations of Total Radioactivity

Analyses of specific radionuclides in selected or composited samples as described in the Selected Licensee Commitments are used to determine the radionuclide composition of the effluent. A summary description of the method used for estimating overall errors associated with radioactivity measurements is provided as part of this attachment.

V. Batch Releases

A. Liquid Effluents

1. Total Number of Batch Releases	=	1.07E+02
2. Total Time (min) for Batch Releases	=	2.14E+04
3. Maximum Time (min) for a Batch Release	=	2.28E+02
4. Average Time (min) for Batch Releases	=	2.00E+02
5. Minimum Time (min) for a Batch Release	=	9.30E+01
6. Average Dilution Water Flow During Release (gpm)	=	1.70E+04

B. Gaseous Effluents

1. Total Number of Batch Releases	=	7.50E+01
2. Total Time (min) for Batch Releases	=	8.72E+04
3. Maximum Time (min) for a Batch Release	=	1.16E+04
4. Average Time (min) for Batch Releases	=	1.16E+03
5. Minimum Time (min) for a Batch Release	=	2.00E+00

VI. Abnormal Releases

See Attachment 5, Unplanned Offsite Releases.

Attachment 2 Supplemental Information

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Carbon-14

Carbon-14 (C-14), with a half-life of 5730 years, is a naturally occurring isotope of carbon produced by cosmic ray interactions in the atmosphere. Nuclear weapons testing in the 1950s and 1960s significantly increased the amount of C-14 in the atmosphere. C-14 is also produced in commercial nuclear reactors, but the amounts produced are much less than those produced naturally or from weapons testing.

In Regulatory Guide 1.21, Revision 2, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste", the NRC recommends U.S. nuclear power plants evaluate whether C-14 is a "principal radionuclide", and if so, report the amount of C-14 released. Improvements over the years in effluent management practices and fuel performance have resulted in a decrease in gaseous radionuclide (non-C-14) concentrations, and a change in the distribution of gaseous radionuclides released to the environment. As a result, many sites show C-14 has become a "principal radionuclide" for the gaseous effluent pathway, as defined in Regulatory Guide 1.21, Rev. 2. Oconee Nuclear Station 2016 ARERR contains estimates of C-14 radioactivity released in 2016, and estimates of public dose resulting from the C-14 effluent.

Because the dose contribution of C-14 from liquid radioactive waste is much less than that contributed by gaseous radioactive waste, evaluation of C-14 in liquid radioactive waste is not required (Ref. Reg. Guide 1.21, Rev. 2). The quantity of gaseous C-14 released to the environment can be estimated by use of a C-14 source term scaling factor based on power generation (Ref. Reg. Guide 1.21, Rev. 2). Many documents provide information related to the magnitude of C-14 in typical effluents from commercial nuclear power plants. Those documents suggest that nominal annual releases of C-14 in gaseous effluents are approximately 5 to 7.3 curies from PWRs (Ref. Reg. Guide 1.21, Rev. 2). A more recent study recommends a higher C-14 gaseous source term scaling factor of approximately 9.0 to 9.8 Ci/GWe-yr for a PWR (Westinghouse) (Ref. EPRI 1021106). For the Oconee Nuclear Station 2015 ARERR a source term scaling factor of 9.4 Ci/GWe-yr is assumed. Using a source term scaling factor of 9.4 Ci/GWe-yr and actual electric generation (MWe-hrs) from Oconee Nuclear Station in 2016 results in a site total C-14 gaseous release estimate to the environment of 2.27E+01 Curies. 70% of the C-14 gaseous effluent is assumed to be from batch releases (e.g. WGDTs), and 30% of C-14 gaseous effluent is assumed to be from continuous releases through the unit vents (ref. IAEA Technical Reports Series no. 421, "Management of Waste Containing Tritium and Carbon-14", 2004).

C-14 releases in PWRs occur primarily as a mix of organic carbon and carbon dioxide released from the waste gas system. Since the PWR operates with a reducing chemistry, most, if not all, of the C-14 species initially produced are organic (e.g., methane). As a general rule, C-14 in the primary coolant is essentially all organic with a large fraction as a gaseous species. Any time the RCS liquid or gas is exposed to an oxidizing environment (e.g. during shutdown or refueling), a slow transformation from an organic to an inorganic chemical form can occur. Various studies documenting measured C-14 releases from PWRs suggest a range of 70% to 95% organic with an average of 80% organic with the remainder being CO₂ (Ref. EPRI TR-105715). For the Oconee Nuclear Station 2016 ARERR a value of 80% organic C-14 is assumed.

Public dose estimates from airborne C-14 are performed using dose models in NUREG-0133 and Regulatory Guide 1.109. The dose models and assumptions used are documented in the Oconee ODCM. The estimated C-14 dose impact on the maximum organ dose from airborne effluents released from Oconee Nuclear Station in 2016 is well below the 10CFR50, Appendix I, ALARA design objective (i.e., 15 mrem/yr per unit).

**Attachment 2
Supplemental Information**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Overall Estimate of Error for Effluent Radioactivity Release Reported

The estimated percentage of overall error for both Liquid and Gaseous effluent release data at Oconee Nuclear Station has been determined to be $\pm 30.3\%$. This value was derived by taking the square root of the sum of the squares of the following discrete individual estimates of error:

1. Flow Rate Determining Devices = $\pm 20\%$
2. Counting Statistical Error = $\pm 20\%$
3. Calibration Error = $\pm 10\%$
4. Calibration Source Error = $\pm 2.5\%$
5. Sample Preparation Error = $\pm 3\%$

**Attachment 2
Supplemental Information**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Summary of Changes in Land Use Census Affecting Effluent Dose Calculations

The 2016 Land Use Census was performed May 18-19, 2016, and the results were certified and made available for use on July 25, 2016. The following are changes to residences, gardens, and milk animals from the previous year.

Residences

The residence in the SW sector at 1.31 miles was replaced with a residence at 1.27 miles.

Gardens

Broad leaf vegetation samples are taken in lieu of a garden census for Oconee Nuclear Station. For dose calculation purposes a garden is assumed to exist at the site boundary and beyond for every sector since a garden location cannot be ruled out.

Milk Animals

A new milk animal (goat) was identified in the E sector at 3.27 miles. Owner did not wish to participate in REMP.
A new milk animal (goat) was identified in the E sector at 4.66 miles. Owner did not wish to participate in REMP.

Environmental Monitoring Locations

No changes to environmental monitoring locations in each sector.

Attachment 3
Solid Radioactive Waste Disposal

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 3

Solid Radioactive Waste Disposal

This attachment includes a summary of the solid waste shipped off-site for burial and/or disposal, including:

- Container volume
- Total Curie content
- Principal Radionuclides
- Source/Type of waste
- Solidification agent or absorbent
- Type of shipping container
- Number of shipments
- Other relevant information as necessary

**Attachment 3
Solid Radioactive Waste Disposal**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Type of Waste Shipped	Number of Shipments	Number of Containers	Waste Class	Container Type	Solidification Agent	Burial Volume (m ³)	Total Activity (Curies)
1. <u>Waste from Liquid Systems</u>							
a. Dewatered Secondary Resins	1	2	AU	GDP	N/A	11.75	0.21
b. Dewatered Primary Resins	7	7	5 - B 2 - AS	Type A	N/A	23.85	223.42
c. Evaporator Concentrates	-	-	-	-	-	-	-
d. Dewatered Mechanical Filters	1	1	C	Type A	N/A	3.41	4.61
e. Dewatered Demineralizers	-	-	-	-	-	-	-
f. Solidified (cement) Acids, Oils, Sludge	-	-	-	-	-	-	-
2. <u>Dry Solid Waste</u>							
a. Dry Active Waste (compacted)	-	-	-	-	-	-	-
b. Dry Active Waste (non-compacted)	23	44	42 - AU 2 - AS	GDP Type A	N/A	1017.12	24.78
c. Dry Active Waste (brokered)	-	-	-	-	-	-	-
d. Irradiated Components	-	-	-	-	-	-	-
3. <u>Total Solid Waste</u>	32	54				1056.13	253.02

Attachment 3
Solid Radioactive Waste Disposal

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Type of Waste Shipped	Radionuclide	% Abundance
1. Waste from Liquid Systems		
a. Dewatered Secondary Resins	AG-110m	0.08
	C-14	4.26
	CE-144	0.03
	CO-57	0.03
	CO-58	0.56
	CO-60	1.31
	CS-134	0.13
	CS-137	0.53
	FE-55	7.58
	H-3	73.70
	MN-54	0.15
	NI-63	10.73
	SB-125	0.31
	TC-99	0.55
	ZN-65	0.05
b. Dewatered Primary Resins	AG-110m	0.08
	BE-7	2.69
	C-14	0.85
	CE-144	0.05
	CO-57	0.43
	CO-58	24.56
	CO-60	4.32
	CS-134	0.62
	CS-137	4.51
	FE-55	17.96
	FE-59	0.02
	H-3	0.02
	MN-54	1.75
	NB-95	0.11
	Ni-59	0.25
	NI-63	41.33
	SB-124	0.10
	SB-125	0.05
	SR-89	0.04
	SR-90	0.03
	ZN-65	0.16
	ZR-95	0.10
c. Evaporator Concentrates	N/A	N/A
d. Dewatered Mechanical Filters	AG-110m	0.12
	C-14	20.75
	CE-144	0.02
	CO-57	0.27
	CO-58	1.47
	CO-60	22.00
	CS-134	12.11
	CS-137	1.09
	FE-55	23.29
	H-3	1.23
	I-129	1.13
	MN-54	2.63
	NB-95	0.01
	NI-63	12.70
	SB-125	0.05
	SR-90	0.03
	TC-99	0.13
	ZN-65	0.82
	ZR-95	0.15
e. Dewatered Demineralizers	N/A	N/A

**Attachment 3
Solid Radioactive Waste Disposal**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

f. Solidified (cement) Acids, Oils, Sludge	N/A	N/A
2. <u>Dry Solid Waste</u>		
a. Dry Active Waste (compacted)	N/A	N/A
b. Dry Active Waste (non-compacted)	C-14	0.57
	CO-58	0.21
	CO-60	1.07
	CR-51	0.01
	FE-55	93.88
	FE-59	0.07
	H-3	0.02
	MN-54	0.05
	NB-95	0.02
	NI-63	3.99
	SB-124	0.01
	SB-125	0.05
	SR-90	0.01
	ZN-65	0.02
	ZR-95	0.01
c. Dry Active Waste (brokered)	N/A	N/A
d. Irradiated Components	N/A	N/A

**Attachment 4
Meteorological Data**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 4

Meteorological Data

This attachment includes a summary of meteorological joint frequency distributions of wind speed, wind direction, and atmospheric stability (hours of occurrence).

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Lower Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
A	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.76-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	1.01-1.25	1	1	0	2	0	1	0	0	0	1	0	0	0	0	0	0
	1.26-1.50	4	0	0	1	1	0	0	0	0	2	5	2	0	1	0	0
	1.51-2.00	9	4	6	2	3	1	0	0	2	14	64	46	20	6	6	7
	2.01-3.00	4	5	12	20	18	2	1	1	2	54	122	87	18	7	5	1
	3.01-4.00	1	2	1	14	14	0	0	0	2	14	20	7	9	6	5	2
	4.01-5.00	0	0	0	0	0	0	0	0	0	4	4	2	2	5	3	3
	5.01-6.00	0	0	0	0	0	0	0	0	0	0	0	0	2	9	2	1
	6.01-8.00	0	0	0	0	0	0	0	0	0	0	0	4	3	0	4	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.76-1.00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	1.01-1.25	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0
	1.26-1.50	3	0	2	0	0	0	0	1	0	1	6	5	1	11	2	0
	1.51-2.00	6	7	9	8	5	2	4	1	5	18	35	20	21	5	5	5
	2.01-3.00	2	9	8	13	16	9	7	3	5	37	40	32	9	3	3	1
	3.01-4.00	0	0	1	7	5	1	1	0	0	17	13	5	3	3	3	0
	4.01-5.00	2	0	1	1	0	0	0	0	0	4	0	1	2	4	3	0
	5.01-6.00	1	0	0	0	0	0	0	0	0	0	1	1	2	1	2	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	0	0	3	3	2	3	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Lower Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
C	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.76-1.00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
	1.01-1.25	2	0	1	0	0	2	0	0	0	0	2	4	4	2	1	4
	1.26-1.50	9	6	7	3	0	3	1	1	3	5	15	10	8	8	11	5
	1.51-2.00	4	5	10	9	9	4	3	4	3	16	29	23	21	6	5	1
	2.01-3.00	1	6	7	27	17	4	4	3	9	28	35	11	3	4	3	3
	3.01-4.00	2	2	2	6	1	0	0	1	0	12	16	10	4	3	2	1
	4.01-5.00	1	0	0	1	0	0	0	0	0	4	6	5	2	4	2	1
	5.01-6.00	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	0	0	4	3	3	4	1
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	0.46-0.75	4	4	1	3	1	3	1	1	1	0	0	3	3	0	4	3
	0.76-1.00	21	12	8	7	3	10	8	6	0	3	10	20	24	23	21	26
	1.01-1.25	24	21	11	7	12	9	13	7	15	19	19	22	25	27	20	33
	1.26-1.50	21	19	15	26	39	15	27	21	28	20	39	30	36	20	13	12
	1.51-2.00	12	19	45	123	96	43	27	38	30	53	59	37	24	12	12	14
	2.01-3.00	15	19	78	215	85	21	16	17	20	85	99	68	44	32	20	23
	3.01-4.00	7	7	25	47	7	0	1	3	5	43	79	56	39	44	23	13
	4.01-5.00	1	2	9	9	0	0	0	0	0	13	25	46	43	36	22	1
	5.01-6.00	1	0	2	2	0	0	0	0	0	0	4	16	13	12	8	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	1	8	19	9	10	1	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Lower Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
E	0.46-0.75	16	7	8	7	9	7	3	7	4	7	6	8	18	25	28	28
	0.76-1.00	93	44	37	33	36	26	31	24	31	24	43	50	59	88	108	124
	1.01-1.25	54	26	28	23	41	34	29	30	31	24	32	25	40	65	60	61
	1.26-1.50	21	20	40	34	41	34	39	26	34	31	39	20	22	37	26	46
	1.51-2.00	8	9	29	61	77	52	44	54	52	48	34	27	19	12	31	14
	2.01-3.00	7	8	30	40	27	8	8	7	17	53	58	33	26	26	14	9
	3.01-4.00	0	2	3	2	0	0	0	2	1	8	17	25	14	3	0	1
	4.01-5.00	0	0	1	1	0	0	0	2	0	1	7	5	8	3	0	0
	5.01-6.00	0	0	0	0	0	0	0	1	0	3	0	2	0	1	0	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
F	0.46-0.75	0	0	0	0	0	0	0	0	1	1	1	3	3	5	1	2
	0.76-1.00	9	3	2	3	1	3	3	3	1	5	6	10	17	46	29	8
	1.01-1.25	3	1	0	1	3	1	4	2	1	5	2	2	4	28	37	4
	1.26-1.50	1	0	1	2	4	4	5	1	0	2	2	3	3	15	28	2
	1.51-2.00	0	0	1	2	1	7	6	4	1	1	4	2	0	4	9	0
	2.01-3.00	0	0	1	1	2	1	1	0	1	0	4	2	1	0	1	0
	3.01-4.00	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
	4.01-5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5.01-6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Lower Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
G	0.46-0.75	0	0	0	0	0	0	1	0	1	0	0	0	1	7	2	0
	0.76-1.00	0	0	0	0	0	0	1	0	0	0	0	1	7	24	1	2
	1.01-1.25	0	1	0	0	0	0	0	0	0	0	3	0	6	10	2	0
	1.26-1.50	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0
	1.51-2.00	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	2.01-3.00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	3.01-4.00	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
	4.01-5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	5.01-6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Upper Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
A	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	0.76-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	1.01-1.25	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	
	1.26-1.50	0	0	0	1	0	0	1	0	1	0	0	3	1	0	0	
	1.51-2.00	7	3	0	1	0	1	0	1	1	8	22	12	9	2	4	
	2.01-3.00	7	3	6	5	4	0	0	1	1	33	92	55	10	3	3	
	3.01-4.00	1	2	2	12	9	2	1	0	3	54	70	9	1	1	0	
	4.01-5.00	3	2	1	19	10	0	0	0	5	21	19	4	4	6	2	
	5.01-6.00	1	2	2	10	7	0	0	0	0	9	13	1	7	2	3	
	6.01-8.00	0	0	2	1	2	0	0	0	1	5	19	2	0	18	7	
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	7	3	3	2	2	
10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	3	1	3		
B	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	0.76-1.00	0	0	0	0	0	0	0	0	0	0	0	1	0	0		
	1.01-1.25	0	0	0	0	0	0	0	0	0	0	0	1	1	0		
	1.26-1.50	0	1	0	0	0	0	0	0	1	1	2	6	2	4		
	1.51-2.00	4	3	5	1	0	0	1	2	2	5	15	12	14	3		
	2.01-3.00	2	7	8	10	7	5	4	2	10	28	47	18	3	1		
	3.01-4.00	2	3	4	15	6	8	2	0	5	20	14	3	1	0		
	4.01-5.00	0	5	1	5	4	3	1	2	2	16	9	4	3	2		
	5.01-6.00	0	0	1	7	2	0	1	0	1	9	6	2	2	1		
	6.01-8.00	1	0	1	3	0	0	0	0	0	5	12	0	4	9		
	8.01-10.00	1	0	0	0	0	0	0	0	0	1	5	0	4	0		
10.01-max	0	0	0	0	0	0	0	0	0	0	0	2	1	3			

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Upper Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
C	0.46-0.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.76-1.00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	1.01-1.25	0	0	0	0	0	1	0	0	0	2	1	0	5	3	2	3
	1.26-1.50	3	2	0	0	1	0	0	1	0	4	7	6	10	3	2	3
	1.51-2.00	9	9	3	6	1	4	1	2	3	9	13	17	15	6	10	1
	2.01-3.00	0	3	13	12	10	5	6	2	10	24	29	7	0	2	1	1
	3.01-4.00	0	2	4	16	10	3	4	2	5	21	11	2	1	2	0	0
	4.01-5.00	1	0	1	8	9	1	0	0	2	10	6	3	1	1	3	0
	5.01-6.00	2	0	1	4	0	0	0	1	0	7	10	6	2	4	2	3
	6.01-8.00	2	1	0	5	0	0	0	0	1	7	23	4	1	7	3	0
	8.01-10.00	1	0	0	0	0	0	0	0	0	0	6	0	2	2	3	1
10.01-max	0	0	0	0	0	0	0	0	0	0	0	5	1	3	4	0	
D	0.46-0.75	1	0	0	1	1	0	1	1	0	0	0	0	1	0	1	
	0.76-1.00	1	3	0	2	2	2	2	0	3	3	3	2	9	1	6	1
	1.01-1.25	13	10	1	3	5	3	4	7	2	4	6	7	12	10	15	4
	1.26-1.50	14	11	5	6	7	9	3	4	14	8	18	14	13	16	17	17
	1.51-2.00	23	16	23	9	13	18	19	17	17	25	32	36	26	17	36	34
	2.01-3.00	33	39	59	68	60	41	33	34	33	50	57	37	22	20	17	33
	3.01-4.00	10	23	92	124	73	15	10	15	25	46	45	29	20	19	13	13
	4.01-5.00	9	11	75	86	25	6	2	2	11	35	54	26	22	22	18	22
	5.01-6.00	4	11	27	35	11	2	0	3	6	26	55	43	36	29	19	6
	6.01-8.00	2	8	24	15	3	0	0	0	1	19	98	41	44	70	26	6
	8.01-10.00	1	0	3	1	0	0	0	0	0	5	21	16	14	18	6	1
10.01-max	0	0	3	0	0	0	0	0	0	0	11	10	8	3	1	0	

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Upper Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
E	0.46-0.75	2	0	0	1	0	0	1	0	1	0	0	1	2	5	2	2
	0.76-1.00	12	14	3	2	2	4	4	5	3	2	6	5	10	9	13	12
	1.01-1.25	23	19	9	3	5	1	2	3	5	4	7	10	17	19	28	24
	1.26-1.50	43	24	11	10	9	5	3	6	6	3	12	14	34	29	60	61
	1.51-2.00	155	59	17	16	13	13	16	10	13	10	20	27	28	34	68	123
	2.01-3.00	185	117	80	59	37	40	20	25	26	54	77	58	28	21	39	103
	3.01-4.00	22	23	45	62	47	28	13	24	32	50	72	19	18	17	19	15
	4.01-5.00	8	15	22	32	16	2	1	9	19	31	40	20	14	8	20	6
	5.01-6.00	2	2	5	5	3	0	1	4	1	17	29	19	11	13	3	4
	6.01-8.00	0	0	2	2	0	0	0	0	1	4	23	11	20	10	3	1
	8.01-10.00	0	0	0	0	0	0	0	3	0	1	10	1	2	1	0	0
	10.01-max	0	0	0	0	0	0	0	0	0	1	2	0	0	0	1	0
F	0.46-0.75	0	0	1	0	0	0	1	0	0	0	0	3	0	0	0	
	0.76-1.00	1	0	2	0	1	0	0	1	0	1	1	0	2	4	2	1
	1.01-1.25	5	2	4	1	0	3	0	1	3	0	0	1	1	3	0	
	1.26-1.50	6	6	2	4	5	1	0	1	0	1	0	1	5	3	5	4
	1.51-2.00	23	7	6	5	4	0	0	3	4	0	8	7	1	5	8	10
	2.01-3.00	40	40	11	4	2	3	3	6	4	5	7	4	4	0	8	5
	3.01-4.00	6	3	2	1	2	2	1	5	1	7	4	1	2	0	3	2
	4.01-5.00	1	1	0	1	1	0	0	1	0	4	1	3	2	4	2	0
	5.01-6.00	0	0	0	0	1	0	0	0	0	1	0	3	1	0	0	0
	6.01-8.00	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Attachment 4 Meteorological Data

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Upper Level

Stability Class	Wind Speed (m/s)	Hours of Occurrence															
		Sector															
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
G	0.46-0.75	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	0.76-1.00	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
	1.01-1.25	2	1	0	0	0	0	0	0	0	0	0	1	0	1	3	0
	1.26-1.50	2	0	1	0	2	0	1	0	0	1	1	2	1	0	2	2
	1.51-2.00	1	1	0	0	0	1	1	1	1	3	1	0	0	1	1	5
	2.01-3.00	3	1	0	0	0	1	1	3	2	1	5	2	0	3	2	1
	3.01-4.00	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0
	4.01-5.00	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0
	5.01-6.00	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0
	6.01-8.00	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	8.01-10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.01-max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

**Attachment 5
Unplanned Offsite Releases**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 5

Unplanned Offsite Releases

This attachment includes a summary of the unplanned offsite releases of gaseous and liquid radioactive effluents.

Attachment 5
Unplanned Offsite Releases

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station had zero (0) unplanned liquid offsite release radioactive effluents in 2016.

Oconee Nuclear Station had zero (0) unplanned gaseous offsite release of radioactive effluents in 2016.

Attachment 6
Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 6

Assessment of Radiation Dose from Radioactive Effluents to Members of the Public
(includes fuel cycle dose calculation results)

This attachment includes an assessment of radiation doses to the maximum exposed member of the public due to radioactive liquid and gaseous effluents released from the site for each calendar quarter for the calendar year of the report as well as the total dose for the calendar year.

This attachment also includes an assessment of radiation doses to the maximum exposed member of the public from all uranium fuel cycle sources within 8 km of the site for the calendar year of this report to show conformance with 40 CFR Part 190.

Methods for calculating the dose contribution from liquid and gaseous effluents are given in the Offsite Dose Calculation Manual (ODCM).

Attachment 6
Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Gaseous Effluents Dose Summary

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Noble Gases						
1. Maximum Gamma Air	mRAD	1.98E-05	5.60E-05	1.54E-04	1.82E-04	4.12E-04
(a) Limit	mRAD	1.50E+01	1.50E+01	1.50E+01	1.50E+01	3.00E+01
(b) % of Limit		1.32E-04	3.74E-04	1.03E-03	1.21E-03	1.37E-03
2. Maximum Beta Air	mRAD	5.90E-05	1.45E-04	4.26E-04	5.40E-04	1.17E-03
(a) Limit	mRAD	3.00E+01	3.00E+01	3.00E+01	3.00E+01	6.00E+01
(b) % of Limit		1.97E-04	4.83E-04	1.42E-03	1.80E-03	1.95E-03

Receptor Location **1.0 miles SW**

B. Iodine, H-3, & Particulates						
1. Maximum Organ Dose	mREM	8.25E-02	8.22E-02	8.96E-02	8.34E-02	3.38E-01
(a) Limit	mREM	2.25E+01	2.25E+01	2.25E+01	2.25E+01	4.50E+01
(b) % of Limit		3.67E-01	3.65E-01	3.98E-01	3.71E-01	7.51E-01

Receptor Location **1.0 miles SW**

Critical Age **CHILD**

Critical Organ **BONE**

Critical Pathway **VEGETATION**

Attachment 6
Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Liquid Effluents Dose Summary

	<u>Units</u>	<u>Qtr 1</u>	<u>Qtr 2</u>	<u>Qtr 3</u>	<u>Qtr 4</u>	<u>Year</u>
A. Batch Mode						
1. Maximum Organ Dose	mREM	3.73E-02	4.06E-02	4.24E-02	3.82E-02	1.58E-01
(a) Limit	mREM	1.50E+01	1.50E+01	1.50E+01	1.50E+01	3.00E+01
(b) % of Limit		2.49E-01	2.71E-01	2.82E-01	2.55E-01	5.28E-01
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Organ		GILLI	GILLI	Liver	GILLI	GILLI
(e) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water
2. Maximum Total Body Dose	mREM	3.73E-02	4.06E-02	4.23E-02	3.82E-02	1.58E-01
(a) Limit	mREM	4.50E+00	4.50E+00	4.50E+00	4.50E+00	9.00E+00
(b) % of Limit		8.29E-01	9.01E-01	9.40E-01	8.49E-01	1.76E+00
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water
B. Continuous Mode						
1. Maximum Organ Dose	mREM	3.18E-05	3.27E-05	2.85E-05	2.32E-05	1.16E-04
(a) Limit	mREM	1.50E+01	1.50E+01	1.50E+01	1.50E+01	3.00E+01
(b) % of Limit		2.12E-04	2.18E-04	1.90E-04	1.55E-04	3.88E-04
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Organ		Liver	Liver	Liver	Liver	Liver
(e) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water
2. Maximum Total Body Dose	mREM	3.18E-05	3.27E-05	2.85E-05	2.32E-05	1.16E-04
(a) Limit	mREM	4.50E+00	4.50E+00	4.50E+00	4.50E+00	9.00E+00
(b) % of Limit		7.07E-04	7.28E-04	6.32E-04	5.16E-04	1.29E-03
(c) Critical Age		Child	Child	Child	Child	Child
(d) Critical Pathway		Pt. Water	Pt. Water	Pt. Water	Pt. Water	Pt. Water

Attachment 6
Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

40 CFR Part 190 Uranium Fuel Cycle Dose Calculation Results

In accordance with the requirements of 40 CFR Part 190, the annual dose commitment to any member of the general public shall be calculated to assure that doses are limited to 25 millirems to the total body or any organ with the exception of the thyroid which is limited to 75 millirems. The fuel cycle dose assessment for Oconee Nuclear Station includes liquid and gaseous effluent dose contributions from Oconee Nuclear Station and direct and air-scatter dose from the onsite ISFSI. No other uranium fuel cycle facility contributes significantly to the maximum exposed individual. Included in the gaseous effluent dose calculations is an estimate of the dose contributed by Carbon-14 (Ref. Attachment 2, Supplemental Information, of this report for further information). The combined dose to a maximum exposed individual from effluent releases and direct and air-scatter dose from the ISFSI is below 40 CFR Part 190 limits as shown by the following summary.

Note: The 40 CFR Part 190 effluent dose analysis to the maximum exposed individual from liquid and gas releases includes the dose from noble gases (i.e., total body and skin).

40 CFR Part 190 Effluent Dose Summary

A. Maximum Organ Dose (other than TB)	3.45E-01 mREM
1. Location	1.0 miles SW
2. Critical Age	CHILD
3. Critical Organ	BONE
4. Gas Contribution %	97.92%
5. Liquid Contribution %	2.08%
B. Maximum Total Body Dose	2.68E-01 mREM
1. Location	1.0 miles SW
2. Critical Age	CHILD
3. Gas non-NG Contribution %	40.91%
4. Gas Contribution %	0.13%
5. Liquid Contribution %	58.96%

Direct and air-scatter radiation dose contributions from the onsite ISFSI have been determined from 10 CFR 72.212 Evaluation Report for Phase VII Standardized NUHOMS[®] Cask System Rev. 00. The maximum dose rate to the nearest real individual from the ISFSI is conservatively calculated to be less than 7 mrem/yr.

The attached excerpt from the 10 CFR 72.212 Evaluation Report for Phase VII Standardized NUHOMS[®] Cask System Rev. 00 is provided to document the method used to calculate the dose from ISFSI as less than 7 mrem/yr to the nearest real individual.

Total dose from liquid and gaseous effluents from Oconee Nuclear Station and direct and air-scatter dose from the onsite ISFSI is conservatively estimated to be less than 8 mrem/yr to the nearest real individual. This meets the 40 CFR Part 190 requirements of an annual dose commitment to any member of the general public of less than 25 mrem total body or any organ and 75 mrem to the thyroid.

Attachment 6 Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

6.0 10 CFR 72.212(b)(5)(iii) - Radioactive Materials in Effluents and Direct Radiation

6.1 Purpose

10 CFR 72.212(b)(5)(iii) requires the general licensee to perform written evaluations, before use and before applying the changes authorized by an amended CoC to a cask loaded under the initial CoC or an earlier amended CoC, that establish that the requirements of 10 CFR 72.104 have been met. A copy of this record shall be retained until spent fuel is no longer stored under the general license issued under 10 CFR 72.210.

10 CFR 72.104 provides the regulatory criteria for radioactive materials in effluents and direct radiation from an independent spent fuel storage installation (ISFSI) during normal operation and anticipated occurrences. Specifically, 10 CFR 72.104(a) limits the annual dose equivalent to any real individual who is located beyond the controlled area to 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other critical organ. This dose equivalent must include contributions from (1) planned discharges of radioactive materials (radon and its decay products excepted) to the general environment, (2) direct radiation from ISFSI operations, and (3) any other radiation from uranium fuel cycle operations within the region. In addition, 10 CFR 72.104(b) requires that operational restrictions be established to meet as low as is reasonably achievable (ALARA) objectives for radioactive materials in effluents and direct radiation levels associated with ISFSI operations. Also, 10 CFR 72.104(c) requires that operational limits be established for radioactive materials in effluents and direct radiation levels associated with ISFSI operations to meet the above-mentioned dose limits.

This section provides the written evaluation required by 10 CFR 72.212(b)(5)(iii), demonstrating Duke Energy's compliance with the requirements of 10 CFR 72.104 for the ONS ISFSI.

6.2 Evaluation

This evaluation addresses the radiological dose rate from a composite population of all ONS ISFSI cask types.

6.2.1 §72.104(a) – Dose Limits

10 CFR 72.104, as clarified by ISG-13¹, stipulates that the licensee perform dose evaluations which establish that any real individual beyond the controlled area boundary not sustain a dose equivalent in excess of 0.25 mSv (25 mrem) due to direct radiation from the Independent Spent Fuel Storage Installation and other fuel cycle operations in the area. This same dose limit is stipulated by the EPA for the fuel cycle in 40 CFR 190.10(a). Also operational restrictions for ALARA and limits for effluents must be established.

In accordance with these requirements, Duke Energy Corporation has performed dose calculations that model the characteristics (initial enrichment, burnup and cooling time) of existing fuel in Phases I – V and loaded canisters in Phase VI of the Oconee ISFSI, together with the characteristics of assumed "design basis" fuel for unloaded canisters in Phase VI and Phase VII of the Oconee ISFSI². Calculation OSC-8675³ develops the radiation source terms used in subsequent shielding and skyshine calculations using the SCALE Code System.

More specifically, the SAS2 Module of the SCALE Code System⁴ was used to create a problem-dependent pin-cell model for the purpose of building cell-weighted, multigroup cross section sets for use in subsequent depletion calculations. The ORIGEN-S Module⁵ of the SCALE Code System was used to perform the fuel depletion and characterization calculations using the cross section sets created by SAS2. These characterization calculations yielded the photon and neutron source terms to be used as input to subsequent shielding calculations. As mentioned above, problem-dependent cross section sets were developed for these analyses since ORIGEN-S was used within the SAS² sequence. Duke Energy Corporation Radiological Engineering is experienced in the use of the SCALE Code System, and the SCALE Code System is installed and maintained under the purview of the pertinent software and data quality assurance program.

Attachment 6 Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Oconee Nuclear Station Units 1, 2, & 3 Period 1/1/2016 - 12/31/2016

The results of the radiation source term calculation were used as input to Calculation OSC-8706⁶ to evaluate the shielding characteristics of a single Horizontal Storage Module. The MCNP Monte Carlo particle transport computer code⁷ was used to perform the transport calculations and to write a surface flux file for use in subsequent skyshine calculations.

Appropriate software quality controls have been implemented for the computer codes and data used in these analyses (specifically, Calculation DPC 1201.30 00 0010⁸ contains the verification and validation for MCNP5, while SDQA-30269-NGO⁹ documents the quality control measures in place for MCNP5).

6.2.2 §72.104(b) – Operational Restrictions

Operational restrictions must be established to meet ALARA objectives for direct radiation levels associated with ISFSI.

Calculation OSC-8716¹⁰, Table 23.1-1, summarizes dose rate versus distance, showing a dose rate of 6.84 mRem per year at 500 meters, which is the longest distance at which results converge. The closest residence to the ISFSI is in the SW-SSW direction approximately 1 mile (~1600 meters) from the ISFSI, or 1.36 miles from the centerline of the site.¹¹ This is conservatively farther than the distance used for computation of dose rates. The 2009 40CFR190 Uranium Fuel Cycle Dose Calculation Results for the ONS site show a maximum total body dose of less than 1 mrem per year (last reported dose was 0.266 mrem¹²). The total dose rate from all operations to the nearest real individual is therefore less than 8 mRem per year.

This calculation need not consider any effluent from Phase VII. The Phase VII HSMs use the NUHOMS-24PHB DSCs, which are designed as "leak-tight." Per Appendix N, Section N.11.2.8 of the NUHOMS FSAR¹³, accidental releases are not credible.

6.2.3 §72.104(c) – Operational Limits

Operational limits must be established for direct radiation levels associated with ISFSI to meet the limits given in 72.104(a).

The ISFSI is sited in such a way that direct radiation to the surroundings are minimized.

The station Radiation Protection Program limits for ISFSI boundary dose rates are established to maintain dose rates surrounding the ISFSI and at the owner control fence.

Calculation OSC-8716¹⁰ uses the surface flux files developed in OSC-8706⁶ in a repeating array. A skyshine calculation is performed to obtain near- and far-field dose results the Oconee ISFSI.

This calculation need not consider any effluent from Phase VII. The Phase VII HSMs use the NUHOMS-24PHB DSCs, which are designed as "leak-tight." Per Appendix N, Section N.11.2.8 of the NUHOMS FSAR¹³, accidental releases are not credible.

6.3 Regulatory Compliance/Conclusion

The evaluation summarized above demonstrates that Duke Energy meets the requirements of 10 CFR 72.212(b)(5)(iii) and 10 CFR 72.104 for the ONS ISFSI.

Attachment 6
Assessment of Radiation Dose from Radioactive Effluents to Members of the Public

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

6.4 References

1. United States Nuclear Regulatory Commission, Spent Fuel Project Office, Interim Staff Guidance - 13, "Real Individual."
2. "Design Basis" fuel (considering fuel burnup and initial enrichment) is assumed to reside in unloaded HSMS for Phase VI-VII of the Oconee ISFSI. The assumption of 5 years cooling time applies only to the most recent eight dry storage casks, while the balance of the casks are assumed to have been loaded one year earlier to be consistent with reasonable engineering practice.
3. Calculation OSC-8675, "Oconee ISFSI Spent Fuel Radiation Source Terms," Revision 2.
4. O. W. Hermann, C. V. Parks, "SAS2H: A Coupled One-Dimensional Depletion and Shielding Analysis Module," NUREG/CR-0200, Revision 6, Volume 1, Section S2, ORNLINUREG/CSD-2N21R6.
5. O. W. Hermann, R. M. Westfall, "ORIGEN-S: SCALE System Module to Calculate Fuel Depletion, Actinide Transmutation, Fission Product Buildup and Decay, and Associated Radiation Source Terms," NUREG/CR-0200, Revision 6, Volume 2, Section F7, ORNLINUREG/CSD-2N21R6.
6. Calculation OSC-8706, "Oconee Horizontal Storage Module Shielding Evaluation," Revision 1.
7. LA-UR-03-1987, "MCNP - A General Purpose Monte Carlo N-Particle Transport Code, Version 5 (Volume 1: Overview and Theory, Volume II: User's Guide, Volume III: Developer's Guide).
8. Calculation DPC-1201.30-00-0010, Revision 0, "MCNP5 Computer Code Verification and Validation."
9. SDQA-30269-NGO, MCNP 5 Version 1.4
10. Calculation OSC-8716, "Oconee ISFSI Dose Rate Evaluations," Revision 1.
11. Dale E. Holden to Libby Wehrman, "2005 Oconee Annual Land Use Census," August 31, 2005, File No: OS-778.05 (Oconee Master File Record Retention No. 000377).
12. Scott L. Batson to U.S. Nuclear Regulatory Commission, "2014 Annual Radioactive Effluent Release Report (ARERR)", April 30, 2014.
13. NUH-003, "Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel," Revision 9.

Attachment 7
Information to Support the NEI Ground Water Protection Initiative

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 7

Information to Support the NEI Ground Water Protection Initiative

This attachment includes a summary of voluntary reports made in accordance with the NEI Ground Water Protection Initiative and a summary of ground water well sample data.

Attachment 7
Information to Support the NEI Ground Water Protection Initiative

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Duke Energy implemented a Ground Water Protection program in 2007. This initiative was developed to ensure timely and effective management of situations involving inadvertent releases of licensed material to ground water. As part of this program, Oconee Nuclear Station monitored 68 wells in 2016. Tritium activity in wells GM-7R and GM-7DR was reported according to NEI 07-07, Industry Ground Water Protection Initiative, in February 2010. The probable source of this activity was determined to be discharges from the turbine building sumps to Chemical Treatment Pond #3 through the east yard drain. Discharges from the turbine building sump through this pathway were discontinued in 2008. Installation of a recovery well, currently RW-1, in 2011 has resulted in decreased tritium concentrations in well GM-7DR to below MDA.

Wells are typically sampled quarterly or semi-annually. Ground water samples are regularly analyzed for tritium and gamma emitters, with select wells being analyzed for difficult-to-detect radionuclides. No gamma or difficult-to-detect radionuclides, other than naturally occurring radionuclides, were identified in well samples during 2016. Results from sampling during 2016 confirmed existing knowledge of tritium concentrations in site ground water.

Results from sampling during 2016 are shown in the table below.

No events meeting the criteria for voluntary notification per NEI 07-07, Industry Ground Water Protection Initiative, occurred at Oconee Nuclear Station in 2016.

Key to below table.

NS	-	Not scheduled to be sampled, not sampled due to insufficient volume in well, or well inaccessible during outage.
pCi/l	-	picocuries per liter.
< MDA	-	less than minimum detectable activity, typically 250 pCi/l.
20,000 pCi/l	-	the Environmental Protection Agency drinking water standard for tritium. This standard applies only to water used for drinking.
1,000,000 pCi/l	-	the 10 CFR Part 20, Appendix B, Table 2, Column 2, Effluent Concentration Limit for tritium.

Attachment 7
Information to Support the NEI Ground Water Protection Initiative

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Well Name	Location / Description	Tritium Concentration (pCi/l)				# of Samples
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
A-1	ONS GWPI / A-1 / CTP 1/2	<MDA	<MDA	<MDA	<MDA	4
A-10	ONS GWPI / A-10 / CTP 3	3.18E+02	4.11E+02	3.63E+02	3.87E+02	4
A-11	ONS GWPI / A-11 / CTP 3	<MDA	<MDA	<MDA	<MDA	4
A-12	ONS GWPI / A-12 / CTP 3	<MDA	<MDA	<MDA	<MDA	4
A-13	ONS GWPI / A-13 / CTP 1/2	4.99E+02	7.12E+02	5.23E+02	4.42E+02	4
A-14	ONS GWPI / A-14 / CTP 1/2	<MDA	<MDA	<MDA	<MDA	4
A-17	ONS GWPI / A-17 / CTP 1/2	2.50E+02	2.19E+02	<MDA	<MDA	4
A-18	ONS GWPI / A-18 / CTP 1/2	2.35E+02	1.97E+02	1.97E+02	<MDA	4
A-2	ONS GWPI / A-2 / CTP 1/2	<MDA	<MDA	<MDA	<MDA	4
A-8	ONS GWPI / A-8 / CTP 1/2	NS	2.01E+02	<MDA	<MDA	3
A-9	ONS GWPI / A-9 / CTP 1/2	<MDA	2.02E+02	2.22E+02	<MDA	4
BG-4	ONS GWPI / BG-4 / Ball Field	<MDA	<MDA	<MDA	<MDA	4
GM-10	ONS GWPI / GM-10 / 525 kv Sw Yard	NS	<MDA	NS	<MDA	2
GM-10R	ONS GWPI / GM-10R / 525 kv Sw Yard	NS	<MDA	NS	<MDA	2
GM-11	ONS GWPI / GM-11 / ONS Garage	NS	<MDA	NS	<MDA	2
GM-11R	ONS GWPI / GM-11R / ONS Garage	NS	<MDA	NS	<MDA	2
GM-12	ONS GWPI / GM-12 / E of Access Rd.	NS	<MDA	NS	<MDA	2
GM-12R	ONS GWPI / GM-12R / E of Access Rd.	NS	<MDA	NS	<MDA	2
GM-13	ONS GWPI / GM-13 / 525 kv Sw Yard	NS	<MDA	NS	<MDA	2
GM-13R	ONS GWPI / GM-13R / 525 kv Sw Yard	NS	<MDA	NS	<MDA	2
GM-14	ONS GWPI / GM-14 / Mnt. Trg. Facility	NS	<MDA	NS	<MDA	2
GM-14R	ONS GWPI / GM-14R / Mnt. Trg. Facility	NS	<MDA	NS	<MDA	2
GM-15	ONS GWPI / GM-15	2.25E+02	<MDA	<MDA	<MDA	4
GM-15R	ONS GWPI / GM-15R	<MDA	<MDA	<MDA	<MDA	4
GM-16DDR	ONS GWPI / GM-16DDR	3.05E+02	4.47E+02	2.30E+02	3.33E+02	4
GM-16DR	ONS GWPI / GM-16DR	7.41E+03	7.44E+03	7.07E+03	7.15E+03	4
GM-16R	ONS GWPI / GM-16R	1.75E+03	1.74E+03	1.24E+03	1.39E+03	4
GM-17DR	ONS GWPI / GM-17DR	2.28E+03	2.14E+03	2.15E+03	2.32E+03	4
GM-17R	ONS GWPI / GM-17R	1.69E+03	1.31E+03	9.49E+02	8.61E+02	4
GM-18R	ONS GWPI / GM-18R	5.25E+03	4.86E+03	5.17E+03	5.13E+03	4
GM-19	ONS GWPI / GM-19	1.80E+03	1.89E+03	1.83E+03	2.04E+03	4
GM-19R	ONS GWPI / GM-19R	1.09E+03	9.73E+02	1.07E+03	1.15E+03	4
GM-1R	ONS GWPI / GM-1R / CTP 1/2	<MDA	<MDA	<MDA	<MDA	4
GM-20	ONS GWPI / GM-20	<MDA	<MDA	<MDA	<MDA	4
GM-20R	ONS GWPI / GM-20R	<MDA	<MDA	<MDA	<MDA	4
GM-21	ONS GWPI / GM-21	NS	<MDA	NS	<MDA	2
GM-22	ONS GWPI / GM-22	NS	<MDA	NS	<MDA	2
GM-23	ONS GWPI / GM-23	4.07E+02	<MDA	2.32E+02	3.70E+02	4
GM-24R	ONS GWPI / GM-24R	2.01E+03	1.15E+03	1.19E+03	9.42E+02	4
GM-25R	ONS GWPI / GM-25R	NS	3.28E+02	2.74E+02	3.42E+02	3
GM-2DR	ONS GWPI / GM-2DR / U-1/2 SFP	3.49E+02	2.25E+02	NS	<MDA	3
GM-2R	ONS GWPI / GM-2R / U-1/2 SFP	1.35E+03	1.13E+03	NS	9.28E+02	3
GM-3DR	ONS GWPI / GM-3DR / U-3 SFP	3.29E+02	2.47E+02	2.66E+02	3.15E+02	4
GM-3R	ONS GWPI / GM-3R / U-3 SFP	3.72E+02	2.55E+02	3.30E+02	3.47E+02	4

Attachment 7
Information to Support the NEI Ground Water Protection Initiative

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Well Name	Location / Description	Tritium Concentration (pCi/l)				# of Samples
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
GM-4	ONS GWPI / GM-4 / Rad. Mat. WH	5.25E+02	4.39E+02	6.33E+02	4.66E+02	4
GM-5	ONS GWPI / GM-5 / Rdwst. Bldg.	NS	<MDA	2.09E+02	2.15E+02	3
GM-5R	ONS GWPI / GM-5R / Rdwst. Bldg.	NS	<MDA	<MDA	<MDA	3
GM-6	ONS GWPI / GM-6 / Outflow to CTP-3	<MDA	NS	<MDA	<MDA	3
GM-6R	ONS GWPI / GM-6R / Outflow to CTP-3	<MDA	NS	<MDA	<MDA	3
GM-7	ONS GWPI / GM-7 / 525 kv Sw Yard	2.81E+02	2.79E+02	4.39E+02	4.56E+02	4
GM-7DR	ONS GWPI / GM-7DR	<MDA	<MDA	<MDA	<MDA	4
GM-7R	ONS GWPI / GM-7R / 525 kv Sw Yard	1.67E+03	1.52E+03	1.32E+03	1.41E+03	4
GM-8	ONS GWPI / GM-8 / E of U-3 TB	3.77E+02	2.50E+02	2.29E+02	2.11E+02	4
GM-8R	ONS GWPI / GM-8R / E of U-3 TB	<MDA	2.10E+02	<MDA	<MDA	4
GM-9	ONS GWPI / GM-9 / E of U-2 TB	3.49E+02	2.80E+02	2.47E+02	2.69E+02	4
GM-9R	ONS GWPI / GM-9R / E of U-2 TB	<MDA	<MDA	<MDA	<MDA	4
MW-11	ONS GWPI / MW-11 / Landfill	<MDA	NS	<MDA	NS	2
MW-11D	ONS GWPI / MW-11D / Landfill	<MDA	NS	<MDA	NS	2
MW-13	ONS GWPI / MW-13 / Landfill	<MDA	NS	<MDA	NS	2
MW-16	ONS GWPI / MW-16 / Landfill	<MDA	NS	<MDA	NS	2
MW-3	ONS GWPI / MW-3 / Landfill	<MDA	NS	<MDA	NS	2
MW-RP01	ONS GWPI / MW-RP01 / Landfarm/Burial	NS	<MDA	NS	NS	1
MW-RP02	ONS GWPI / MW-RP02 / Landfarm/Burial	NS	<MDA	NS	NS	1
MW-RP03	ONS GWPI / MW-RP03 / Landfarm/Burial	NS	<MDA	NS	NS	1

Well Name	Location / Description	Tritium Concentration (pCi/l)				# of Samples
		1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
011	ONS / 011 / Ball Field	<MDA	<MDA	<MDA	<MDA	4
013	ONS / 013 / WH 5	<MDA	<MDA	<MDA	<MDA	4
015	ONS / 015 / Brown's Bottom	<MDA	<MDA	<MDA	<MDA	4

Well Name	Location / Description	Tritium Concentration (pCi/l)			# of Samples
		Min	Avg	Max	
RW-1 ⁽¹⁾	525 kv Sw. Yard	7.51E+02	9.33E+02	1.08E+03	13

(1) Monthly sampling performed for this location during 2016.

**Attachment 8
Inoperable Equipment**

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 8

Inoperable Equipment

This attachment includes an explanation of inoperable instruments related to effluent monitoring in excess of allowed time defined by licensing bases and an explanation of permanent or temporary outside liquid storage tanks exceeding 10 Curies total activity (excluding tritium and dissolved or entrained noble gases).

Attachment 8
Inoperable Equipment

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station did not experience inoperable equipment relevant to effluent monitoring in excess of SLC limits during 2016.

Oconee Nuclear Station did not experience permanent or temporary outside liquid storage tanks exceeding 10 Curies total activity (excluding tritium and dissolved or entrained noble gases) during 2016.

Attachment 9
Offsite Dose Calculation Manual (ODCM) and Summary of
Changes to the ODCM
Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 9

Offsite Dose Calculation Manual (ODCM) and Summary of Changes to ODCM

This attachment includes a summary of changes to the ODCM and Radiological Effluent Controls.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ODCM Revision 58

ODCM Revision 58 is provided in entirety in this section.

All ODCM changes are reviewed by knowledgeable individual(s), and approved by either the Station Manager or Radiation Protection Manager. The below changes do not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.

ODCM Revision 58 was approved by the Station Manager on February 18, 2017. Some changes reflected in ODCM Revision 58 were implemented prior to February 18, 2017 under a different change and approval process (e.g., land use census), and in those cases the implementation date is noted below.

Table of Contents - Page ii

Marked 6.0-3, Land Use Census Map, as deleted in List of Figures. Marked 6.0-3, Land Use Census Results, as deleted in List of Tables.

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

Executive Summary - Page 2

Revised statement in first paragraph from:

"Normally RETDAS, a computer code that implements NUREG-0133 methodology, is used for the calculation of offsite doses, but the ODCM also provides a method for the calculation of offsite doses when RETDAS is not available."

to:

"Software implementing NUREG-0133 methodology is used for the calculation of offsite doses, but the ODCM also provides a method for the calculation of offsite doses when the software is not available."

Make statement more generic since RETDAS will be retired and replaced with OpenEMS at Oconee in 2017.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Executive Summary - Page 2

Revised statements in second paragraph from:

"The ODCM has been prepared as generically as possible in order to minimize the need for revisions. However, some changes to the ODCM such as land use census data are expected on an annual basis. Any changes to the methodology and parameters to be used in this ODCM shall be reviewed by knowledgeable individual(s), and approved by the Station Manager prior to implementation. Changes to the ODCM shall be submitted to the Nuclear Regulatory Commission in accordance with the SLCs and Technical Specifications."

to:

"The ODCM has been prepared as generically as possible in order to minimize the need for revisions. Any changes to the methodology and parameters to be used in this ODCM shall be reviewed by knowledgeable individual(s), and approved by the Station Manager or Radiation Protection Manager prior to implementation. Changes to the ODCM shall be submitted to the Nuclear Regulatory Commission in accordance with the SLCs and Technical Specifications."

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. Also updated ODCM approval authority statement based on NRC approved license amendments 389, 390, and 391 to Technical Specification 5.5.1, allowing for Radiation Protection Manager approval.

Section 1 - Page 3

Revised statements in third paragraph from:

"Radioactivity released from secondary system steam releases is documented and included in the site effluent release total"

to:

"Secondary side steam releases are reviewed for inclusion in the site effluent total."

Change made based on recommendation in DRR 01944566. The ODCM can be interpreted to include other secondary side releases including minor steam leaks and other miscellaneous releases. There can be numerous steam leaks that are insignificant in radioactivity released that would need to be included in the effluent release total based on how the statement is interpreted. The intent of the statement is to include significant secondary releases that could impact dose calculations and activity released. Clarifies intention of ODCM statement.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Section 4 - Page 1

Revised statements in first paragraph from:

"Dose contributions to the maximum individual shall be calculated at least every 31 days, quarterly, and annually using the RETDAS computer code which implements the ODCM methodology. RETDAS, Radioactive Effluent Tracking and Dose Assessment Software, is a database application designed by Canberra Industries, Inc. to automate many of the tasks required in the administration of effluent releases at Oconee. RETDAS performs normal operation effluent dose assessment using NUREG-0133 and Regulatory Guide 1.109 methodology."

to:

"Dose contributions to the maximum individual shall be calculated at least every 31 days, quarterly, and annually using software which implements the ODCM methodology. The software is designed to automate many of the tasks required in the administration of effluent releases at Oconee and performs normal operation effluent dose assessment using NUREG-0133 and Regulatory Guide 1.109 methodology."

Revised statements in third paragraph from:

"Dose contributions shall be calculated using the RETDAS computer program."

to:

"Dose contributions shall be calculated using the software implementing the ODCM methodology."

Make statement more generic since RETDAS will be retired and replaced with OpenEMS at Oconee in 2017.

Section 4 - Page 8

Removed reference to Table 6.0-3 in "*" note. Statement changed from:

"Dose is calculated only for pathways (e.g., garden, milk animal, etc.) that actually exist at each location as determined by the land use census shown in Table 6.0-3."

to:

"Dose is calculated only for pathways (e.g., garden, milk animal, etc.) that actually exist at each location as determined by the land use census."

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions.

Section 5.0.5 - Page 2

Revised statements in first paragraph from:

"The increments of dose resulting from liquid and gaseous effluent releases will be calculated using the ODCM methodology implemented in the RETDAS computer program."

to:

"The increments of dose resulting from liquid and gaseous effluent releases will be calculated using the software implementing the ODCM methodology."

Make statement more generic since RETDAS will be retired and replaced with OpenEMS at Oconee in 2017.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Section 6.0.2 - Page 1

Revised from:

"The Annual Land Use Census, required by Selected Licensee Commitments, is performed to ensure that changes in the use of areas at or beyond the site boundary are identified, and that modifications to the Radiological Environmental Monitoring Program are made if required by changes in land use. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR50. Results are shown in Table 6.0-3 and Figure 6.0-3."

to:

"The Annual Land Use Census, required by Selected Licensee Commitments, is performed to ensure that changes in the use of areas at or beyond the site boundary are identified, and that modifications to the Radiological Environmental Monitoring Program are made if required by changes in land use. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR50. The land use census identifies nearest pathways to the exclusion area boundary (EAB, ~ 0.5 mile) for each of the 16 meteorological sectors. Global Positioning System field measurements are taken as close as possible to the item of interest and are accurate to within 2-5 meters. Locations beyond the nearest pathway for each sector are assumed to contain that pathway for dose calculation purposes. For the 4.5-5.0 mile sector all pathways, i.e., residence, garden, milk animal (goat), and meat animal (cow), are assumed to exist for dose calculation purposes. Results are maintained on file and data reviewed in accordance with procedure AD-CP-ALL-0014, Land Use Census Evaluation."

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

Section 6 - Page 2

Revised Table 6.0-1 to remove shoreline sediment semi-annual sample collection from location 063. Added new location 091 titled "Holders Landing Road (2.09 miles S)" with a semi-annual shoreline sediment sample collection frequency.

Change made based on recommendation in DRR 02083950. Safety concerns with shoreline sediment collection at location 063, Lake Hartwell Hwy 183 Bridge, due to bank erosion, poison ivy, and snakes. A new location, 091 Holders Landing Road, was determined to be a suitable replacement location to collect a sample.

Section 6 - Page 3

Revised Table 6.0-2 to add the following locations:

- 077 (1.00 miles SW) - Skimmer Wall shared with air monitoring location
- 078.1 (0.53 miles WSW) - ONS Recreation Site shared with air monitoring location
- 085 (0.88 miles NNW) - Lake Services Bldg 9125 shared with air monitoring location
- 086 (0.83 miles NW) - Lake Keowee Service Rd at Boat Landing
- 087 (1.33 miles WNW) - End of Waterfall Road
- 088 (1.00 SSW) - Doug Hollow Rd / Transmission Tower
- 089 (1.19 miles S) - Intersection Hwy 130 & Keowee River Road
- 090 (0.79 miles SE) - Crescent Resources, Keowee River Road at Beaver Dam

Change made based on recommendation in DRR 02035396. Added new REMP TLD locations to program.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Section 6 - Page 4

Deleted Table 6.0-3 and moved relevant information from "****" and "****" Note paragraphs to Section 6.0.2.

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

Section 6 - Page 5

Updated Figure 6.0-1 Sampling Locations Map (Site Boundary) to reflect newly added REMP locations discussed in DRR 02083950 and DRR 02035396

Section 6 - Page 6

Updated Figure 6.0-2 Sampling Locations Map (Ten Mile Radius) to reflect newly added REMP locations discussed in DRR 02083950 and DRR 02035396

Section 6 - Page 7

Deleted Figure 6.0-3.

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

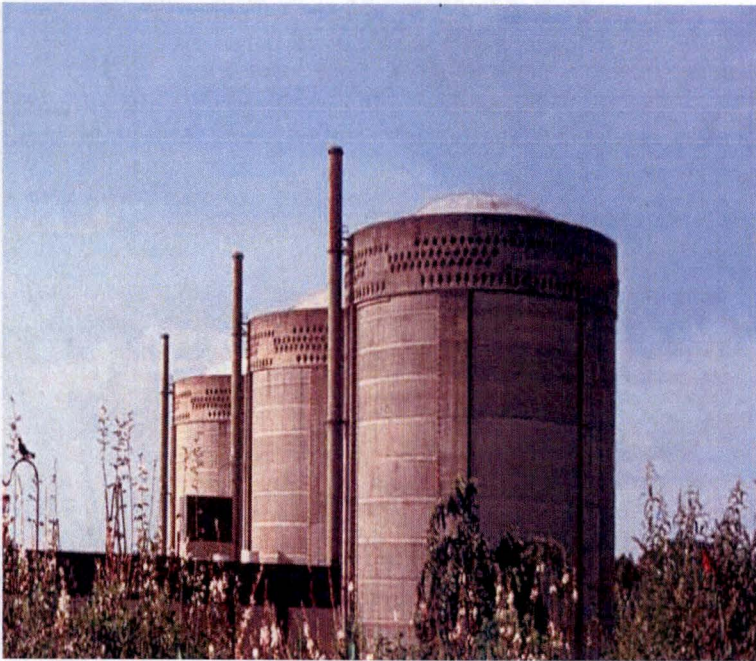
Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Radiological Effluent Controls (SLC 16.11)

The Oconee Nuclear Station Radiological Effluent Controls are contained in SLC 16.11 and are included in this section. SLC 16.11 was not revised in 2016.



Oconee Nuclear Station Units 1, 2 and 3



ODCM

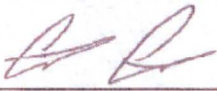
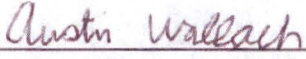
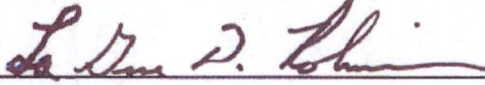
Offsite Dose
Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016



Oconee Nuclear Station Units 1, 2 and 3

OFFSITE DOSE CALCULATION MANUAL (ODCM)

Prepared By: Christopher C. Courtenay Fleet Scientific Services RP	 Signature	1/18/2017 Date
Reviewed By: Austin K. Wallach ONS Radiation Protection	 Signature	2/14/2017 Date
Approved By: Lagrone D. Robinson ONS Radiation Protection Manager	 Signature	2/18/2017 Date

Revision 58

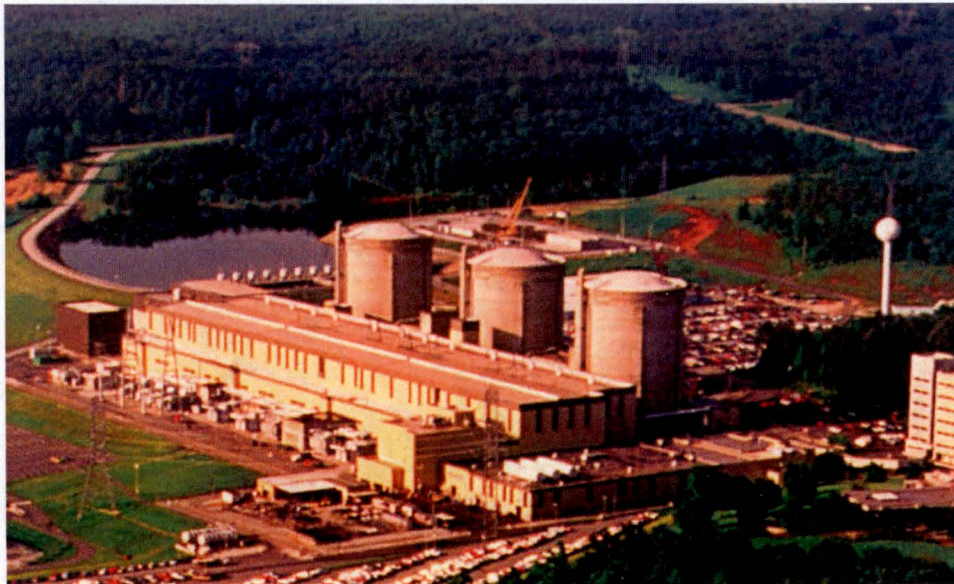


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Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

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EXECUTIVE SUMMARY

The Oconee Nuclear Station (ONS) Offsite Dose Calculation Manual (ODCM) provides the methodology and parameters to be used in the calculation of offsite doses due to normal operation radioactive liquid and gaseous effluents to assure compliance with the dose limitations of the Selected Licensee Commitments (SLCs, UFSAR Chapter 16) and Technical Specifications (TSs). These dose limitations assure that:

- (1) the concentration of radioactive liquid effluents released from the site to the unrestricted area will be limited to 10 times the effluent concentration (EC) levels of 10CFR20, Appendix B, Table 2, and 2.0E-04 $\mu\text{Ci/ml}$ for dissolved and entrained noble gases (TS 5.5.5(b), SLC 16.11.1(a)) ;
- (2) the exposures to any individual member of the public from radioactive liquid effluents will not result in doses greater than the ALARA design objectives of 10CFR50, Appendix I or the 10CFR20 limits (TS 5.5.5(d), SLC 16.11.1(b)) ;
- (3) the dose rate at any time at the site boundary from radioactive gaseous effluents will be limited to: for noble gases; less than or equal to 500 mrem/yr to the whole body, and less than or equal to 3000 mrem/yr to the skin; and for iodine-131 and iodine-133, for tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days; less than or equal to 1500 mrem/yr to any organ (TS 5.5.5(g), SLC 16.11.2(a));
- (4) the exposure to any individual member of the public from radioactive gaseous effluents will not result in doses greater than the ALARA design objectives of 10CFR50, Appendix I or the 10CFR20 limits (TS 5.5.5(h and i), SLC 16.11.2(b)); and
- (5) the dose to any individual member of the public from the nuclear fuel cycle will not exceed the limits of 40CFR190 (TS 5.5.5(j), SLC 16.11.7).

The methodology and parameters used to assure compliance with the dose limitations described above shall be used to prepare the radioactive liquid and gaseous effluent reports required by the SLCs and Technical Specifications. Dose calculations that demonstrate compliance with 40CFR190 will be considered to demonstrate compliance with 10CFR20 0.1-rem annual dose limit.



Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

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The ODCM also provides the methodology and parameters to be used in the calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints to assure compliance with the concentration and dose rate limitations of the SLCs and Technical Specifications. Software implementing NUREG-0133 methodology is used for the calculation of offsite doses, but the ODCM also provides a method for the calculation of offsite doses when the software is not available

The ODCM has been prepared as generically as possible in order to minimize the need for revisions. Any changes to the methodology and parameters to be used in this ODCM shall be reviewed by knowledgeable individual(s), and approved by the Station Manager or Radiation Protection Manager prior to implementation. Changes to the ODCM shall be submitted to the Nuclear Regulatory Commission in accordance with the SLCs and Technical Specifications.

The ODCM does not replace any station implementing procedures. Programmatic controls for radioactive effluents and radiological environmental monitoring are contained in the Administrative Controls chapter of the Technical Specifications. Procedural details for radioactive effluents and radiological environmental monitoring consisting of licensee commitments, applicability, remedial actions, surveillance requirements, and the bases for these requirements are contained in Section 16.11 of the SLCs.

1.0 RADWASTE SYSTEMS

1.0.1 LIQUID RADWASTE PROCESSING

The liquid radwaste system at Oconee Nuclear Station is used to collect and treat liquid chemical and radiochemical byproducts of unit operation. The system produces effluents that are discharged in small, dilute quantities to the environment. The means of treatment vary with waste type and desired product in the various systems:

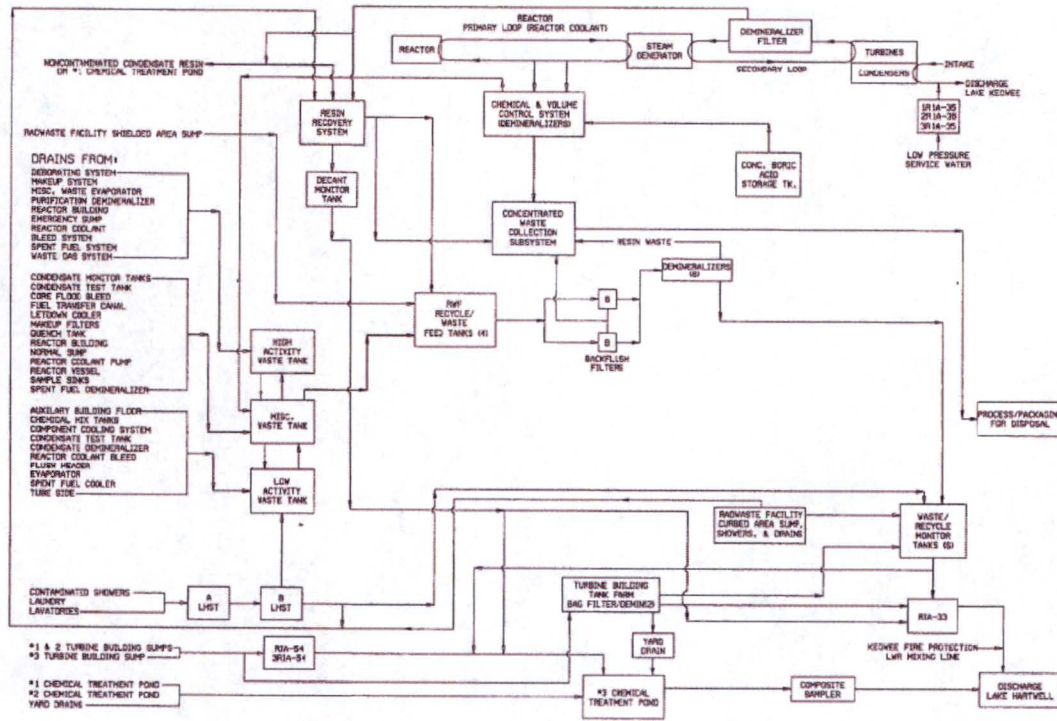
- (A) Filtration - Waste sources are filtered prior to processing as necessary.
- (B) Ion Exchange - Ion exchange is used to remove radioactive ions from solution. Also, ion exchange is normally used in removing cations (cobalt, cesium, manganese) and anions (chloride, fluoride) from the filtrate in order to purify the filtrate for release.
- (C) Gas Stripping - Removal of gaseous radioactive fission products is accomplished through venting of atmospheric holdup tanks.

Figure 1.0-1 is a schematic representation of the liquid radwaste system at Oconee.

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Figure 1.0-1 Oconee Nuclear Station Liquid Radwaste System



1.0.2 GASEOUS RADWASTE PROCESSING

The purpose of the gaseous waste disposal system is to:

- (1) Maintain a non-oxidizing cover gas of nitrogen in tanks and equipment that contain potentially radioactive gas;
- (2) Hold up radioactive gas for decay; and
- (3) Release gases (radioactive and non-radioactive) to the atmosphere under controlled conditions.

During power operation of the facilities, radioactive materials released to the atmosphere in gaseous effluents include low concentrations of fission product noble gases (krypton and xenon), halogens (mostly iodines), tritium contained in water vapor, and particulate material including both fission products and activated corrosion products.

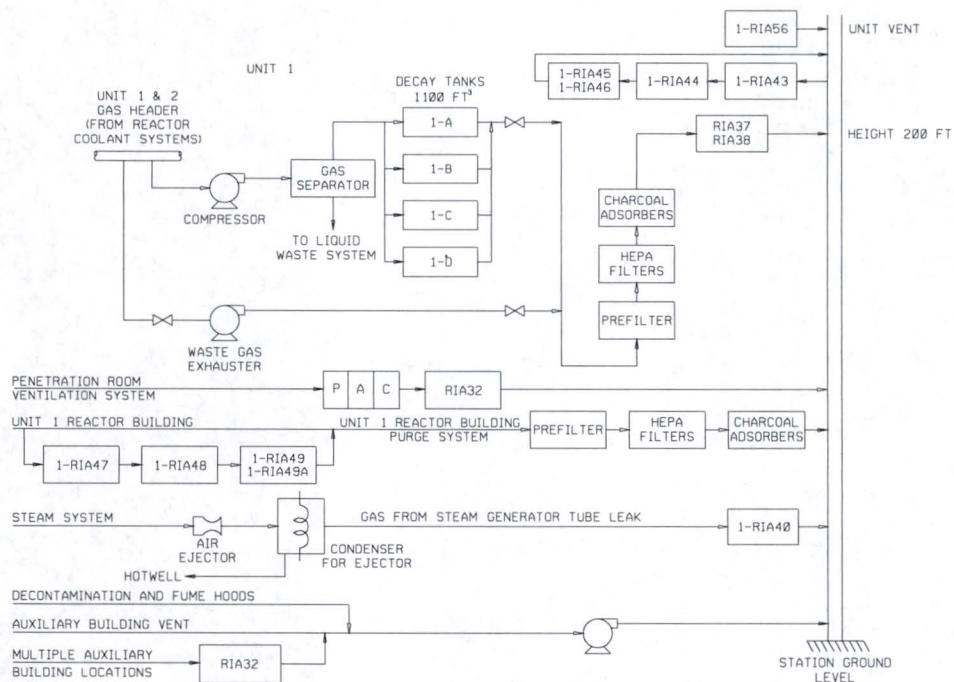
The primary source of gaseous radioactive wastes is from the degassing of the primary coolant during letdown of the cooling water into various holding tanks. Additional sources of gaseous waste activity include the auxiliary building exhaust, spent fuel area exhaust, the discharge from the steam jet air ejectors, and purging and venting of the reactor containment building. Some low radioactivity secondary system steam releases can occur at the site such as from infrequent lifts of the main steam relief valves and testing of the main steam manual atmospheric dump valves. Secondary side steam releases are reviewed for inclusion in the site effluent total.

All components that can contain potentially radioactive gases are vented to a vent header. The vent gases are subsequently drawn from this header by one of four waste gas compressors or a waste gas exhauster. The waste gas compressor discharges through a waste gas separator to one of seven waste gas tanks. The waste gas tanks and the waste gas exhauster discharge to the unit vent after passing through a filter bank consisting of a prefilter, an absolute filter, and a charcoal filter.

Radioactive gases may be released inside the reactor containment building when components of the primary system are opened to the building atmosphere for operational reasons or where minor leaks occur in the primary system. Prior to access, the reactor containment atmosphere will be monitored for radioactivity and, when necessary, purged through prefilters, high-efficiency particulate air (HEPA) filters, and charcoal filters, and released to the atmosphere through the unit vent. The purge equipment is sized for a flow rate of 50,000 cfm providing approximately 1.5 air changes per hour in the reactor building. Units 1, 2, and 3 have a separate vent stack which services each unit.

Figure 1.0-2 is a schematic representation of the gaseous radwaste system at Oconee.

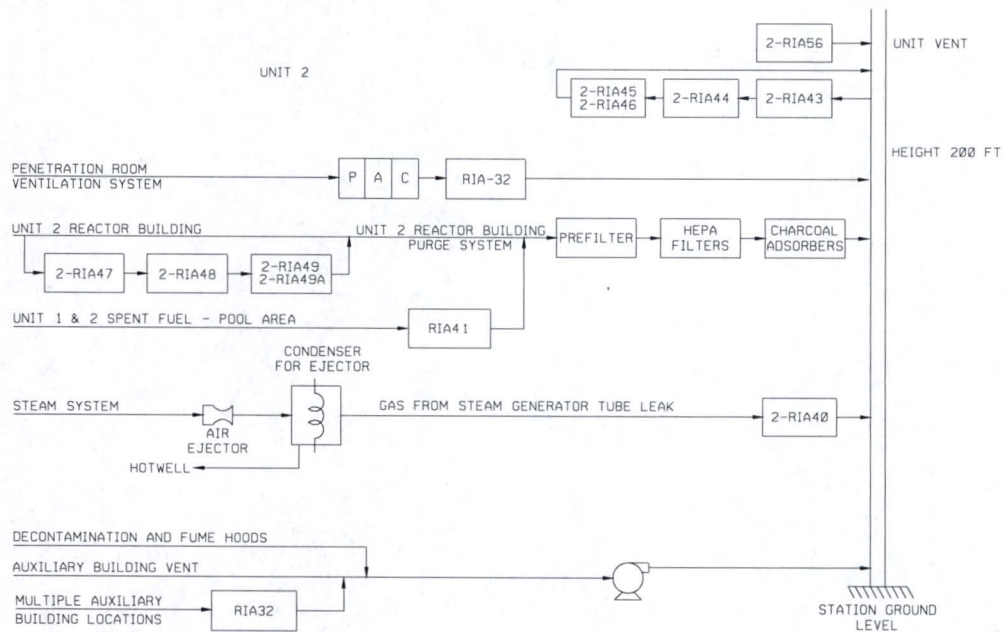
Figure 1.0-2 Oconee Nuclear Station Gaseous Radwaste System
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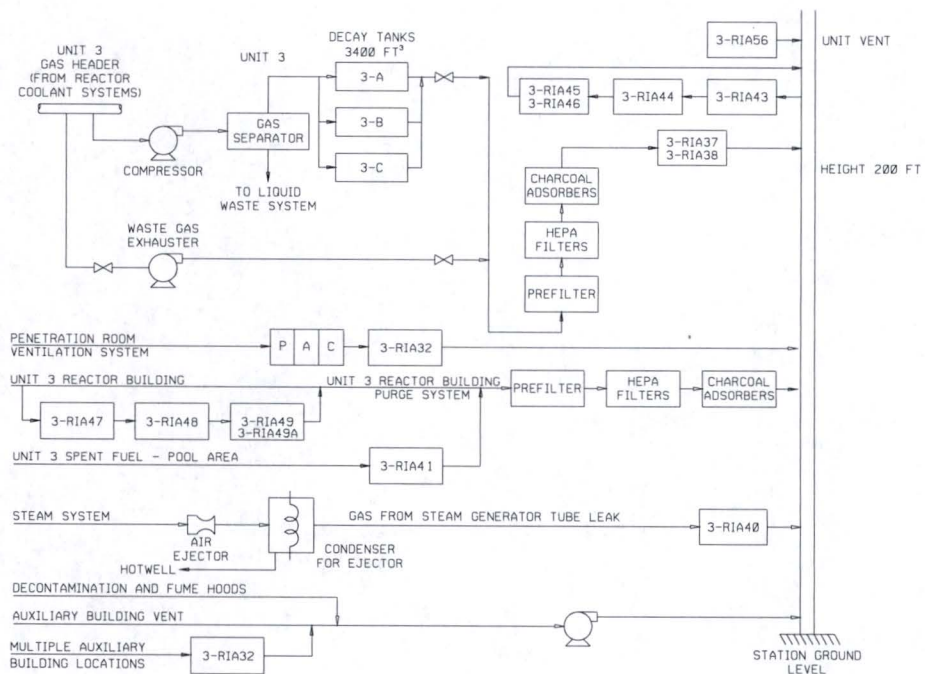
Figure 1.0-2 Oconee Nuclear Station Gaseous Radwaste System
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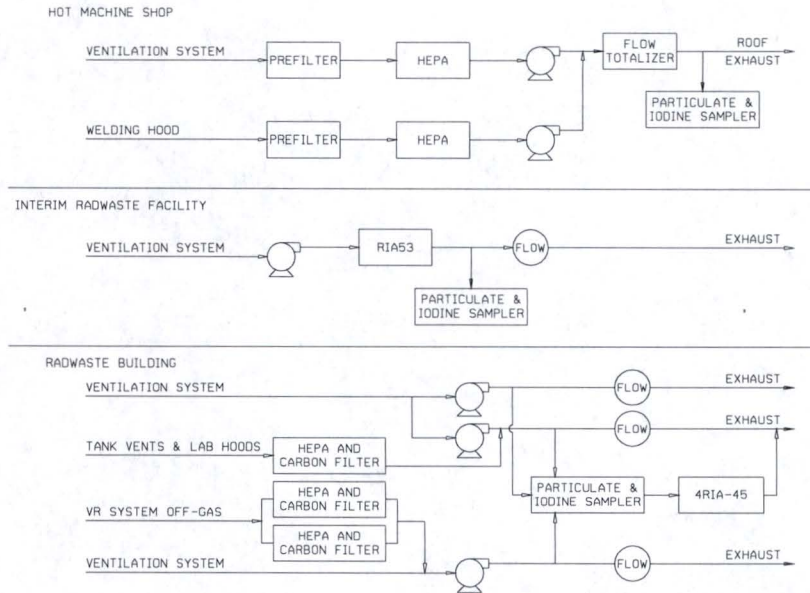
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Figure 1.0-2 Oconee Nuclear Station Gaseous Radwaste System
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**Figure 1.0-2 Oconee Nuclear Station Gaseous Radwaste System
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2.0 RELEASE RATE CALCULATIONS

2.0.1 LIQUID RELEASE RATE LIMIT CALCULATIONS

There are two liquid radwaste discharge points to the environment at Oconee; (1) the liquid radwaste effluent line to the Keowee Hydroelectric Unit Tailrace, and (2) the #3 Chemical Treatment Pond effluent line to the Keowee River (See Figure 2.0-1).

2.0.1.1 LIQUID RADWASTE EFFLUENT LINE RELEASE RATE LIMIT CALCULATION

Liquid releases to the Keowee Hydroelectric Unit Tailrace normally contain the radioactive releases from the site including effluents from the Waste Monitor Tanks, Recycle Monitor Tanks, and Decant Monitor Tank. The Keowee Tailrace discharge point can also contain Turbine Building Sump Monitor Tank (TBSMT) releases, however TBSMT effluent normally contains very low (if any) activity, and, therefore is transferred to the #3 Chemical Treatment Pond prior to release. Dilution flow for the liquid radwaste effluent line is provided by the Keowee Hydroelectric Unit and the Keowee Hydro Fire Protection liquid waste release mixing line. For purposes of the release rate calculation, Keowee hydro dilution flow is assumed to be a minimum leakage flow of 38 cfs, and a maximum flow of 6600 cfs based on one hydro unit operating at 50% power. The Keowee Hydro Fire Protection liquid waste release mixing line provides an additional 38 cfs dilution flow. Since Keowee Hydro typically releases only a small percentage of time during the year, 76 cfs (38 cfs leakage + 38 cfs mixing line) is normally assumed for dilution flow when performing liquid release rate calculations.

To comply with Technical Specifications and Selected Licensee Commitments, and to assure that the concentration of radioactive liquid effluents released from the site to the unrestricted area is limited to 10 times the effluent concentrations (ECs) of 10CFR20, Appendix B, Table 2, Column 2, and 2.0E-04 $\mu\text{Ci/ml}$ for dissolved and entrained noble gases, the following release rate limit calculation shall be performed for liquid releases to the Keowee Hydro Tailrace via the liquid radwaste effluent line:

$$f \leq (F \div (DF - 1)) \quad \text{Condition: } DF > 1.0 \quad \text{Equation 2.1}$$

where:

f = the undiluted effluent flow, in gpm.

- F = the dilution flow available, in gpm.
= normally $3.41\text{E}+04$ gpm (76 cfs, based on a leakage rate of 38 cfs (19 cfs per Keowee Hydro unit), plus the Keowee Hydro Fire Protection liquid waste release mixing line whose flow rate is 38 cfs. When Keowee Hydro enters an outage one of the two units is taken offline which temporarily reduces the amount of leakage by half. Therefore, during a Keowee Hydro outage the dilution flow is assumed to be 57 cfs (19 cfs leakage plus 38 cfs raw water, $2.56\text{E}+04$ gpm)).
= or $2.96\text{E}+06$ gpm (6600 cfs, based on one hydro unit operating at 50% power). This value is only used if it is known that Keowee Hydro is discharging.

DF = required dilution factor to be applied to the undiluted effluent flow, unitless.

$$DF = \sigma \times \sum_i \frac{C_i}{(10 \times EC_i)} \quad \text{Equation 2.2}$$

Note:

If $DF \leq 1.0$ then no dilution is required and the release rate is unrestricted.

If $DF > 1.0$ then dilution flow is required and the release rate is calculated using Equation 2.1. Equation 2.1 is used only when $DF > 1.0$.

σ = the most restrictive recirculation factor at equilibrium, (dimensionless). The recirculation factor accounts for the fraction of discharged water reused by the station. This value equals 1.0 since discharged liquid effluent is not reused at Oconee.

C_i = the concentration of radionuclide, 'i', in the undiluted liquid effluent, in $\mu\text{Ci/ml}$.

EC_i = the concentration of radionuclide, 'i', from 10CFR20, Appendix B, Table 2, Column 2, in $\mu\text{Ci/ml}$. Note: if radionuclide, 'i', is a dissolved noble gas, then $EC_i = 2.00\text{E}-05 \mu\text{Ci/ml}$.

Once the maximum release rate, f_j is calculated the value is multiplied by 0.8 for additional conservatism.

2.0.1.2 #3 CHEMICAL TREATMENT POND EFFLUENT LINE DISCHARGE

The #3 Chemical Treatment Pond (CTP) effluent line is the release point for station effluents that are normally considered to be non-radioactive; that is, the pond's effluent will not normally contain measurable activity above background with the exception of very low tritium activity. Tritium releases from the #3 CTP typically account for much less than 1% of the station total tritium release. It is assumed that no activity is present in the effluent until indicated by radiation monitoring measurements on the pond's inputs and/or by periodic analyses of the composite sample collected at the pond's discharge point. Inputs to this pond include the station's yard drain system, #1 CTP discharge, #2 CTP discharge, recovery well water, the decant water from the Powdex system, and the discharge from the Turbine Building Sump/TBSMT system whose contents have been determined to be below 10EC. Inputs that have radiation monitors associated with them will be set to assure that Selected Licensee Commitment 16.11-1 will not be exceeded. #3 CTP is a continuous release path that discharges to the Keowee River (see Figure 2.0-1).

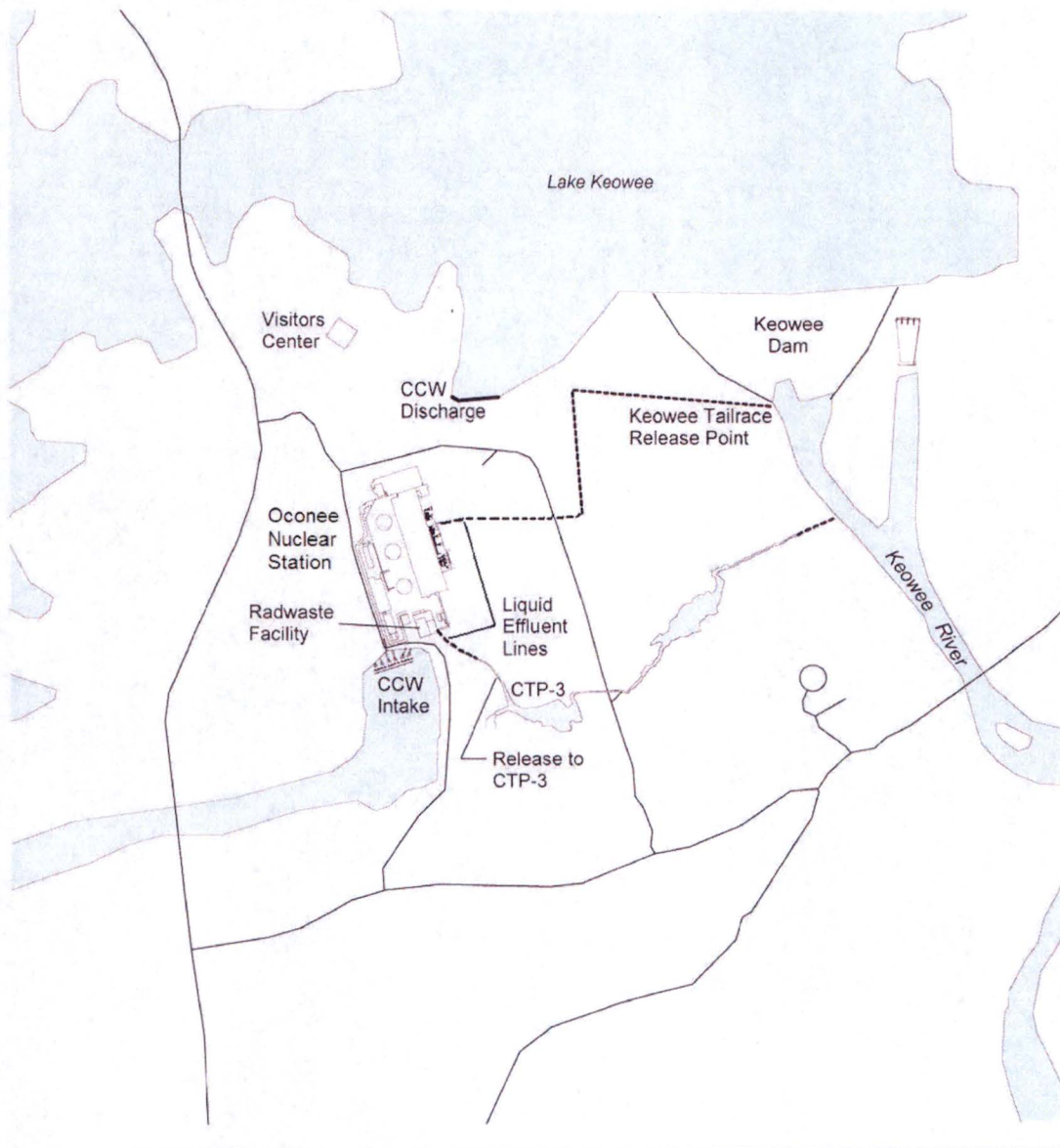
The #3 CTP may also be the discharge path for large volumes of slightly contaminated water following a primary-to-secondary leak so long as administrative procedures are implemented to assure that release rate calculations similar to that used in Section 2.0.1.1 are performed, that all detectable radionuclides will be accounted for, and that no station limits will be exceeded.

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Figure 2.0-1 Liquid Radwaste Discharge Locations

Oconee Nuclear Station
Figure 2.0-1
Liquid Radwaste Discharge Locations



2.0.2 GASEOUS RELEASE RATE LIMIT CALCULATIONS

The three unit vents are the primary gaseous radioactive release points at Oconee. The unit vents are the semi-elevated release points for waste gas decay tanks, containment building purges, auxiliary building ventilation, spent fuel pool ventilation, and the condenser air ejector (see Figure 1.0-2, pages 1, 2, and 3). Each unit vent contains multi-range radiation monitors (RIAs) and flow rate measuring instrumentation.

There are three other separate gaseous effluent release points at Oconee; the Hot Machine Shop, Interim Radwaste Building and Radwaste Facility that are normally considered non-radioactive; that is, it is possible but unlikely that the effluent will contain measurable activity above background. Each of these release points are considered ground-level, and each has an effluent sampler and flow monitoring device (see Figure 1.0-2, page 4). In addition, the Interim Radwaste Building and Radwaste Facility have a RIA.

2.0.2.1 UNIT VENT DISCHARGE RELEASE RATE LIMIT CALCULATION

In order to comply with Technical Specifications and Selected Licensee Commitments and to assure that the dose rate, at any time, at or beyond the site boundary due to radioactive materials released in gaseous effluents from the site is limited to: ≤ 500 mrem/yr to the total body, and ≤ 3000 mrem/yr to the skin for the noble gases, and is limited to ≤ 1500 mrem/yr to any organ for radioiodine and for radioactive materials in particulate form, and radionuclides other than noble gases with half lives greater than 8 days, the following release rate and radiation monitor setpoint calculations shall be performed for releases from the waste gas decay tanks and the containment building. The release rate calculations when solved for the flow rate, 'F', are the release rates for noble gases and for radioiodines, particulates and other radionuclides with half-lives greater than 8 days. The most conservative release rate calculated shall control the flow rate. The following equations are based on the site dose rate limits. When applied to the individual release points the site dose rate values are apportioned 1/3 to each unit vent.

a. Noble Gases

Total Body:

$$\sum_i \left(K_i \times \frac{\lambda}{Q} \times Q_i \right) < 500 \text{ mrem/yr} \quad \text{Equation 2.3}$$

Skin:

$$\sum_i \left((L_i + 1.1M_i) \times \frac{\lambda}{Q} \times Q_i \right) < 3000 \text{ mrem/yr} \quad \text{Equation 2.4}$$

b. Radioiodines, Particulates, and Others

Inhalation, Ingestion and Ground Organ Pathways:

$$\sum_p \sum_i (P_{opi} \times W \times Q_i \times E_i) < 1500 \text{ mrem/yr}$$

To include both the food and ground organ dose and the inhalation organ dose the equation can be expanded to:

$$\sum_p \sum_i ((P_{opi})_{\text{food/gr}} \times W_{D/Q} + (P_{opi})_{\text{inhal}} \times W_{\chi/Q}) \times Q_i \times E_i < 1500 \text{ mrem/yr}$$

Equation 2.5

where:

K_i = the total body dose factor due to gamma emissions for each identified noble gas radionuclide, 'i', in mrem/yr per $\mu\text{Ci}/\text{m}^3$ (See Appendix A).

L_i = the skin dose factor due to beta emissions for each identified noble gas radionuclide, 'i', in mrem/yr per $\mu\text{Ci}/\text{m}^3$ (See Appendix A).

M_i = the air dose factor due to gamma emissions for each identified noble gas radionuclide, 'i', in mrad/yr per $\mu\text{Ci}/\text{m}^3$ (See Appendix A).

1.1 = ratio to convert dose (mrad) to dose equivalent (mrem).

P_{opi} = the dose parameter for radionuclides other than noble gases for the inhalation pathway, in mrem/yr per $\mu\text{Ci}/\text{m}^3$ and for the food and ground plane pathways in ($\text{m}^2 \times (\text{mrem/yr per } \mu\text{Ci}/\text{sec})$) for organ, 'o', and radionuclide, 'i', (See Appendix B for the pathway specific dose commitment factors). Note: NUREG-1301, page 75, specifies use of the Child age group, Inhalation pathway, for the P_{opi} values.

χ/Q = the highest calculated annual average dispersion parameter for any area at or beyond the site boundary in sec/m^3 . For the Oconee Unit Vents this value is $1.672\text{E}-6 \text{ sec}/\text{m}^3$. The location is the SW sector at 1.0 mile for semi-elevated releases. For the Hot Machine Shop, Interim Radwaste Building and Radwaste Facility this value is $7.308\text{E}-6 \text{ sec}/\text{m}^3$. The location is the SE sector at 1.0 mile for ground-level releases. As discussed in Oconee UFSAR Section 2.1.1.3, the boundary for establishing gaseous effluent release limits is the exclusion area boundary (EAB). The EAB is defined as a 1 mile radius from the station center.

W = the highest calculated annual average dispersion or deposition parameter for estimating the maximum dose rate to an individual from the total inhalation, food, and ground plane pathways resulting from semi-elevated releases or ground-level releases:

$W_{\chi/Q_{se}}$ = 1.672E-6 sec/m³, for the inhalation pathway and the airborne H-3 food pathway. The location is the SW sector at 1.0 mile for semi-elevated releases.

$W_{D/Q_{se}}$ = 1.295E-8 m⁻², for the food and ground plane pathways. The location is the NE sector at 1.0 mile for semi-elevated releases.

$W_{\chi/Q_{gl}}$ = 7.308E-6 sec/m³, for the inhalation pathway and the airborne H-3 food pathway. The location is the SE sector at 1.0 mile for ground-level releases.

$W_{D/Q_{gl}}$ = 2.259E-8 m⁻², for the food and ground plane pathways. The location is the NE sector at 1.0 mile for ground-level releases.

E_i = the filter removal factor for radionuclide, 'i', e.g., for 99% removal $E_i = 0.01$.
 For iodine removal by charcoal adsorbers $E_i = 0.1$.
 For particulate removal by HEPA filters $E_i = 0.01$.

Q_i = the release rate of radionuclide, 'i', in gaseous effluent from all release points at the site, in $\mu\text{Ci}/\text{sec}$.

$$Q_i = k_1 C_i f \div k_2 = 472 \times C_i f \quad \text{Equation 2.6}$$

where:

C_i = the concentration of radionuclide, 'i', in undiluted gaseous effluent, in $\mu\text{Ci}/\text{ml}$.

f = the undiluted effluent flow, in ft³/min.

k_1 = conversion factor, 2.83E+04 cc/ft³.

k_2 = conversion factor, 60 sec/min.

Substituting the expression for Q_i in Equation 2.6 into Equations 2.3, 2.4, and 2.5, and solving for the flow rate, ' f ', in each equation gives:

Noble Gases - Total Body Maximum Release Rate:

$$f_{ib} < \frac{500}{472 \times \chi/Q \times \sum_i (K_i \times C_i)}$$

Noble Gases - Skin Maximum Release Rate:

$$f_{sk} < \frac{3000}{472 \times \chi/Q \times \sum_i [(L_i + 1.1M_i) \times C_i]}$$

Radioiodines, Particulates, and Others - Organ Maximum Release Rate:

$$f_{or} < \frac{1500}{472 \times \sum_p \sum_i \{((P_{opi})_{food/gr} \times W_{DIQ} + (P_{opi})_{inhal} \times W_{\chi/Q}) \times E_i \times C_i\}}$$

f_{tb} , f_{sk} , and f_{or} , are calculated for each batch prior to release. The most limiting gaseous release rate is used to assure that no instantaneous dose rate limit is exceeded.

Once the maximum release rate, f , is calculated the value is multiplied by 0.8 for additional conservatism.

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Derivations of Iodine, Particulate, and H-3 Dose Commitment Factors (P_{opi})

Inhalation Pathway - Child Age Group

$$P_{opi} = K'(BR)(DFA_{oi})$$

Formula: from NUREG-0133, page 25.	
Where:	
P_{opi}	Dose commitment factor for Child age group, organ o, nuclide i, for the inhalation pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendix B for the pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
BR	Breathing rate for the Child age group (m^3/yr , from Regulatory Guide 1.109): Child – 3700
DFA_{oi}	Organ inhalation dose conversion factor for Child age group, organ o, nuclide i, (mrem/pCi), from Table E-9 of Regulatory Guide 1.109.

3.0 SETPOINT CALCULATIONS

3.0.1 LIQUID RADIATION MONITOR SETPOINT CALCULATIONS

As shown on Figure 1.0-1, RIA-33 is the controlling radiation monitor for liquid batch releases at Oconee. Once the liquid release rate parameters have been established radiation monitor setpoints shall be calculated to assure that the concentration of radioactive liquid effluents released from the site to the unrestricted area is limited to ten times the effluent concentrations (ECs) of 10CFR20, Appendix B, Table 2, Column 2, and 2.0E-04 $\mu\text{Ci/ml}$ for dissolved and entrained noble gases. By substituting the dilution factor (DF) from Equation 2.2 into Equation 2.1, solving for the undiluted liquid effluent concentration, C_i , and accounting for the monitor background reading, the liquid radiation monitor setpoint can be readily obtained by multiplying C_i by the radiation monitor correlation factor, CF_i , as follows:

$$C_i \leq \frac{(F + f) \times (10 \times EC_i)}{\sigma \times f} \quad \text{Equation 3.1}$$

$$SP \leq \sum_i (C_i \times CF_i) + bkg \quad \text{Equation 3.2}$$

where:

C_i = the maximum allowable concentration of radionuclide, 'i', in the undiluted liquid effluent, in $\mu\text{Ci/ml}$.

SP = radiation monitor setpoint, in cpm.

CF_i = radiation monitor correlation factor for radionuclide, 'i', in cpm/ $\mu\text{Ci/ml}$, e.g., 8.00E+07 cpm/ $\mu\text{Ci/ml}$ (Cs-137) for RIA-33.

bkg = background reading for the radiation monitor, in cpm.

All other parameters were previously defined.

Using conservative or "worst-case" parameters in Equation 3.1 and Equation 3.2 can provide a liquid radiation monitor setpoint that does not need to be revised for every release if activity is low enough to allow for this type of operation such as with continuous releases from the #3 CTP release point. However, for batch releases, e.g., waste monitor tanks, through the liquid radwaste effluent line to the Keowee hydro

tailrace the RIA-33 radiation monitor setpoints are calculated based on the actual expected activity in the release as follows:

First the "Correlation Concentration" (C CONC) is calculated:

$$C\ CONC = \sum_i (C_i \times EQ_i)$$

where:

C_i = Undiluted liquid effluent concentration for each isotope, excluding tritium, $\mu\text{Ci/ml}$.

EQ_i = RIA-33 Cs-137 equivalence factor for each isotope, excluding tritium, to that of Cs-137 due to different gamma energies and abundance. This factor includes a 4-hour decay time due to the average time between sample and release. (See Table 3.0-1)

Next the RIA-33 setpoints are determined as follows:

If C CONC is $> 9.0\text{E-}6 \mu\text{Ci/ml}$ then three setpoint values are calculated. The actual "expected" count rate for the release is defined as the "Midpoint of Expected Range". The "Alert" setpoint is defined as 1.5 times the expected counts from activity in the liquid effluent plus background. If the "Alert" setpoint is exceeded, but there is no upward trend, the release will be allowed to continue. If RIA-33 continues to trend upward then the release will be manually terminated. The "Upper Limit of Expected Range" is defined as 3 times the expected counts from activity in the liquid effluent plus background. The "Upper Limit of Expected Range" is called the "Trip" setpoint. If the "Trip" setpoint is exceeded the release will be automatically terminated. The "Lower Limit of Expected Range" is defined as 3 times lower than the expected counts from activity in the liquid effluent plus background. The "Lower Limit of Expected Range" provides assurance that the correct liquid effluent is being released. If the RIA-33 count rate does not increase to at least the "Lower Limit of the Expected Range" then the release will be terminated, and a new sample analysis will be performed. The four RIA-33 setpoints are calculated as follows:

$$\text{Lower Limit of Expected Range} = C\ CONC \times (8.00\text{E}7/3) \text{ cpm}/(\mu\text{Ci/ml}) + \text{RIA-33 BKG}$$

$$\text{Midpoint of Expected Range} = C\ CONC \times 8.00\text{E}7 \text{ cpm}/(\mu\text{Ci/ml}) + \text{RIA-33 BKG}$$

$$\text{Alert Setpoint} = C\ CONC \times (8.00\text{E}7 \times 1.5) \text{ cpm}/(\mu\text{Ci/ml}) + \text{RIA-33 BKG}$$

$$\text{Upper Limit of Expected Range (Trip Setpoint)} = C\ CONC \times (8.00\text{E}7 \times 3) \text{ cpm}/(\mu\text{Ci/ml}) + \text{RIA-33 BKG}$$

If C CONC is $\leq 9.0E-6$ $\mu\text{Ci/ml}$ then the RIA-33 setpoint is $2.16E3$ cpm ($9.0E-6 \times 8.00E7 \times 3$) plus background (BKG) as the "Upper Limit of Expected Range". This setpoint is used for low activity releases, and is based on limiting the concentration in the effluent to 10 times the 10CFR20 EC of Cs-134 which has the lowest effluent concentration value ($9.0E-7$ $\mu\text{Ci/ml}$) for any detectable radionuclide in the effluent. Similarly, the RIA-33 "Alert" setpoint for low activity releases is $1.08E3$ cpm ($9.0E-6 \times 8.00E7 \times 1.5$) plus background (BKG).

As shown in Figure 1.0-1, Turbine Building Sump (TBS) discharge can be routed to either #3 CTP or to the Turbine Building Sump Monitor Tank (TBSMT). The TBS discharge is monitored by RIA-54 which is operated as a continuous sampler. Normally, TBS discharge is sent to #1 CTP or #2 CTP where the effluent is processed if it contains chemicals prior to being sent to #3 CTP. However, if RIA-54 trips on high radiation, then the TBS discharge is processed through the TBSMT where it can go to #3 CTP via the yard drain system if it is $< 10\text{EC}$ or be released through RIA-33 if it is $\geq 10\text{EC}$. RIA-54 alarm setpoints are set to provide an early warning of increased activity, and prevent TBS effluent releases in excess of station regulatory release limits (i.e., 10EC). Setpoint calculations are based on a monitor correlation factor of $7.81E-9$ $\mu\text{Ci/ml/cpm}$ (Cs-137 equivalent) and a Cs-134 10CFR20 Effluent Concentration of $9E-7$ $\mu\text{Ci/ml}$. Cs-134 is the most limiting radionuclide 10CFR20 Effluent Concentration not known to be absent from the TBS effluent. The Cs-134 10CFR20 EC value of $9E-7$ $\mu\text{Ci/ml}$ is conservatively used as a Cs-137 concentration since Cs-137 has a 10CFR20 EC value of $1E-6$ $\mu\text{Ci/ml}$. Setpoints are conservatively calculated using a rounded RIA-54 correlation factor of $8E-9$ $\mu\text{Ci/ml/cpm}$. The Alert setpoint limit is set to $1/2$ of the 10EC release limit, and is based upon ten times the EC value for Cs-134 as follows:

RIA-54 Alert Setpoint = Background + 562 cpm; (i.e., $1/2 \times 10 \times 9E-7/8E-9 = 562$).

Similarly, the Alarm setpoint limit is set to the 10EC release limit, and is based upon ten times the EC value for Cs-134 as follows:

RIA-54 Alarm Setpoint = Background + 1125 cpm; (i.e., $10 \times 9E-7/8E-9 = 1125$).

Attachment 9
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Table 3.0-1

RIA-33 Cs-137 Equivalents

Isotope	Equivalence Factor	Isotope	Equivalence Factor	Isotope	Equivalence Factor
Be-7	0.1462	Mo-99	0.2668	La-141	0.0155
F-18	0.5788	Tc-99m	0.00	La-142	0.2942
Na-24	0.8519	Tc-101	0.00	Ce-141	0.00
Cl-38	0.0090	Ru-103	1.3368	Ce-143	0.7826
K-40	0.1094	Ru-105	0.8783	Ce-144	0.0273
Cr-51	0.1438	Ru-106	0.4429	I-130	3.3095
Mn-54	1.0617	Ag-108m	3.4473	I-131	1.4051
Mn-56	0.4992	Ag-110m	3.5179	I-132	1.0259
Fe-59	1.0556	Cd-115	0.5201	I-133	1.1857
Co-57	0.0022	Cd-115m	0.0235	I-134	0.1388
Co-58	1.4735	In-115m	0.3631	I-135	0.9374
Co-60	2.0495	Sb-122	0.9218	Ar-41	0.2229
Cu-64	0.3954	Sb-124	2.1617	Kr-85	0.0059
Ni-65	0.1591	Sb-125	1.1308	Kr-85m	0.4280
Zn-65	0.5584	Sb-126	5.1762	Kr-87	0.1213
Zn-69m	1.1391	Sn-113	0.9971	Kr-88	0.5278
Se-75	1.3092	Sn-123	0.0066	Kr-89	0.00
Br-80m	0.0860	Sn-126	0.00	Xe-131m	0.0167
Br-82	3.4691	Te-125m	0.00	Xe-133	0.0006
Br-83	0.0059	Te-127	0.0134	Xe-133m	0.1172
Br-84	0.0053	Te-127m	0.0001	Xe-135	0.8564
Br-85	0.00	Te-129	0.0138	Xe-135m	0.00
Rb-86	0.0894	Te-129m	0.0507	Xe-137	0.00
Rb-88	0.00	Te-131	0.0008	Xe-138	0.00
Rb-89	0.00	Te-131m	1.8463	Nd-147	0.2619
Sr-89	0.0002	Te-132	0.9766	Hf-181	1.4209
Sr-91	0.6460	Te-134	0.0408	W-187	0.8027
Sr-92	0.3900	Cs-134	2.5804	Tl-208	0.00
Y-91	0.0031	Cs-136	3.1916	Bi-212	0.0144
Y-91m	0.0439	Cs-137	1.00	Bi-214	0.0003
Y-92	0.1334	Cs-138	0.0120	Pb-212	0.4497
Y-93	0.1091	Ba-133	1.3648	Pb-214	0.0020
Zr-95	1.0909	Ba-139	0.0203	Ra-226	0.0320
Zr-97	1.1210	Ba-140	0.5307	Ac-228	0.8261
Nb-95	1.0821	Ba-141	0.0002	Th-228	0.0038
Nb-95m	0.2919	Ba-142	0.00	Np-239	0.3996
Nb-97	0.1164	La-140	2.3237		

3.0.2 GASEOUS RADIATION MONITOR SETPOINT CALCULATIONS

The unit vent radiation monitor setpoints are established at the Oconee Nuclear Station to help ensure that gaseous release rate limits are not exceeded. For some release pathways in which a specific RIA exists, the setpoints also help to ensure that the effluent being released is the same concentration as indicated by manual samples, e.g. effluent from waste gas decay tanks, thereby reducing the likelihood of releasing the wrong tank. For instances in which the RIA which normally controls the release is not operable, or is "out of service", independent manual samples (IMS) are collected and the noble gas constituents from both samples are compared to help ensure that the intended "batch" is being released. For certain low potential release types, e.g. Integrated Leak Rate Tests, no RIA exists to ensure that release rate limits are not exceeded or to ensure that the effluent being released is the "expected" concentration. For such pathways, independent manual samples are required to be collected and noble gas constituents compared prior to release. The following list defines the controlling RIA for the various gaseous effluent release types at Oconee:

<u>Pathway</u>	<u>Controlling RIA</u>
Unit 1 "A" Waste Gas Decay Tank	1&2 RIA 37/38
Unit 1 "B" Waste Gas Decay Tank	1&2 RIA 37/38
Unit 1 "C" Waste Gas Decay Tank	1&2 RIA 37/38
Unit 1 "D" Waste Gas Decay Tank	1&2 RIA 37/38
Unit 3 "A" Waste Gas Decay Tank	3 RIA 37/38
Unit 3 "B" Waste Gas Decay Tank	3 RIA 37/38
Unit 3 "C" Waste Gas Decay Tank	3 RIA 37/38
Unit 1 Reactor Building Purge	1 RIA 45/46
Unit 2 Reactor Building Purge	2 RIA 45/46
Unit 3 Reactor Building Purge	3 RIA 45/46
Unit 1 Depressurization	IMS 1 RIA 45/46 Alarm Only
Unit 2 Depressurization	IMS 2 RIA 45/46 Alarm Only
Unit 3 Depressurization	IMS 3 RIA 45/46 Alarm Only
Unit 1 Hydrogen Recombiner	IMS 1 RIA 45/46 Alarm Only
Unit 2 Hydrogen Recombiner	IMS 2 RIA 45/46 Alarm Only
Unit 3 Hydrogen Recombiner	IMS 3 RIA 45/46 Alarm Only
Unit 1 Integrated Leak Rate Test	IMS
Unit 2 Integrated Leak Rate Test	IMS
Unit 3 Integrated Leak Rate Test	IMS

The following sections describe the methods by which setpoints are established. In general, gaseous radiation monitors are calibrated to Xe-133, and for continuous release points, e.g., the three unit vents, are preset at a maximum value based on the 500 mrem/year total body gaseous release rate limit according to the following methodology:

Note: when applied to the individual release points the 500 mrem/year site dose rate value is apportioned 30% to each Unit Vent (RIA-45 and RIA-46) semi-elevated release point. The remaining 10% is allocated to the three ground-level release points, the Hot Machine Shop (no monitor), Interim Radwaste Building (RIA-53) and Radwaste Facility (4RIA-45) that are normally considered non-radioactive. Recall from Section 2.0.2.1 the following equation:

$$K_{Xe-133} \times \chi/Q \times Q_{Xe-133} < 500 \text{ mrem/yr}$$

Solve for Q_{Xe-133} :

$$Q_{Xe-133} < \frac{500}{K_{Xe-133} \times \chi/Q} \quad \text{Equation 3.4}$$

From Equation 2.6:

$$Q_{Xe-133} = 472 \times C_{Xe-133} \times f \quad \text{Equation 3.5}$$

Substitute Equation 3.5 into Equation 3.4:

$$472 \times C_{Xe-133} \times f < \frac{500}{K_{Xe-133} \times \chi/Q}$$

Solve for C_{Xe-133} :

$$C_{Xe-133} < \frac{500}{472 \times f \times K_{Xe-133} \times \chi/Q}$$

$$SP = \frac{C_{Xe-133}}{CF} + bkg \quad \text{Equation 3.6}$$

where:

K_{Xe-133} = 2.94E+02, the total body dose factor due to gamma emissions for Xe-133, in mrem/year per $\mu\text{Ci}/\text{m}^3$ (See Appendix A).

χ/Q = the highest calculated semi-elevated annual average dispersion parameter for any area at or beyond the site boundary in sec/m^3 . For Oconee this value is $1.672\text{E}-6 \text{ sec}/\text{m}^3$. The location is the SW sector at 1.0 mile.

Q_{Xe-133} = Xe-133 equivalent release rate limit for the noble gas total body dose pathway, in $\mu\text{Ci}/\text{sec}$.

472 = Conversion factor, $(\text{cc}/\text{ft}^3)/(\text{sec}/\text{min})$.

C_{Xe-133} = the maximum allowable Xe-133 equivalent concentration in the gaseous effluent, in $\mu\text{Ci/cc}$.

f = the gaseous effluent flow from the tank, building, or vent, in ft^3/min .

SP = radiation monitor setpoint, in cpm.

CF = the Xe-133 equivalent monitor correlation factor, in $\mu\text{Ci/cc/cpm}$.

bkG = the radiation monitor background reading, in cpm.

Equation 3.6 provides the methodology to calculate the maximum setpoint for releases from the Unit Vents (RIA-45 and RIA-46), Radwaste Facility (4RIA-45), and Interim Radwaste Building (RIA-53). The maximum setpoints are termed "High" setpoints.

In addition to High setpoints, Oconee uses "Alert" setpoints that are approximately 1/3 of the High setpoint for each specific release point. Alert setpoints provide early indication to plant operating staff of increased radioactivity.

3.0.2.1 UNIT VENTS SETPOINTS (RIA-45 and RIA-46)

Reactor Building purges from all 3 units are released via the applicable unit vent, either Unit 1, Unit 2, or Unit 3. Each of the 3 unit vents are monitored by a normal/low range RIA (RIA-45) and a high range RIA (RIA-46). In addition to Reactor Building purges, all other releases from the main plant, including the Auxiliary Building ventilation, Waste Gas Decay Tanks, and the Spent Fuel Pools are monitored by each unit's RIA-45 and RIA-46. However, RIA-45 and RIA-46 on each unit vent have release termination authority only for Reactor Building purge releases. Each unit's RIA-45 and RIA-46 will, when operable, activate Control Room alarms if the unit vent concentration exceeds the monitor's setpoint value. The setpoints for each unit's RIA-45 and RIA-46 are established on a "worst case" basis, with the upper bound normally set at 30 percent of the station release rate limit for noble gases in Xe-133 equivalent concentration as follows:

Recall Equation 3.6:

$$SP = \frac{C_{Xe-133}}{CF} + bkG$$

where:

$$C_{Xe-133} < \frac{500}{472 \times f \times K_{Xe-133} \times \chi/Q}$$

$$RIA-45_{unit\ vent, high} = \frac{150}{472 \times 6.5E+04 \times 294 \times 1.672E-06 \times 7.09E-08}$$

$$RIA-45_{unit\ vent, high} \cong 1.40E+05\ cpm +\ bkg$$

where:

150 = 30% of the 500 mrem/yr total body release rate limit.

6.5E+04 = Unit Vent flow rate with Reactor Building Purge off, ft³/min.

1.672E-06 = Highest Semi-Elevated release point dispersion factor, sec/m³.

7.09E-08 = RIA-45 Correlation Factor, μCi/ml/cpm.

All other factors were previously defined.

$$RIA-46_{unit\ vent, high} = \frac{150}{472 \times 6.5E+04 \times 294 \times 1.672E-06 \times 3.17E-04}$$

$$RIA-46_{unit\ vent, high} \cong 31\ cpm +\ bkg$$

where:

3.17E-04 = RIA-46 Correlation Factor, μCi/ml/cpm.

All other factors were previously defined.

Alert setpoints are determined as follows:

$$RIA-45_{unit\ vent, alert} = RIA-45_{unit\ vent, high} \times \frac{1}{3}$$

$$RIA-45_{unit\ vent, alert} \cong 4.66E+04\ cpm +\ bkg$$

$$RIA-46_{unit\ vent, alert} = RIA-46_{unit\ vent, high} \times \frac{1}{3}$$

$$RIA-46_{unit\ vent, alert} \cong 10\ cpm +\ bkg$$

1/3 = divisor to account for each of 3 unit vent release points, dimensionless.

All other factors were previously defined.

For instances in which the Reactor Building Purge is on, the High and Alert setpoints are multiplied by 0.65 (65,000 cfm/ (65,000 cfm + 35,000 cfm purge flow)).

3.0.2.2 RADWASTE FACILITY SETPOINTS (4RIA-45)

$$4RIA-45_{\text{high}} = \frac{25}{472 \times 1.297E+05 \times 294 \times 7.308E-06}$$

$$4RIA-45_{\text{high}} \cong 1.90E-04 \mu\text{Ci/cc}$$

where:

25 = 5% of the 500 mrem/yr total body release rate limit.

1.297E+05 = Radwaste Facility Vent flow rate, ft³/min.

7.308E-06 = Highest Ground-Level release point dispersion factor, sec/m³.

All other factors were previously defined.

4RIA-45 reads in units of concentration, $\mu\text{Ci/cc}$.

Alert setpoint is determined as follows:

$$4RIA-45_{\text{alert}} = 4RIA-45_{\text{high}} \times \frac{1}{3}$$

$$4RIA-45_{\text{alert}} \cong 6.33E-05 \mu\text{Ci/cc} + \text{bkg}$$

All factors were previously defined.

3.0.2.3 INTERIM RADWASTE BUILDING SETPOINTS (RIA-53)

$$RIA - 53_{\text{high}} = \frac{25}{472 \times 1.5E+04 \times 294 \times 7.308E-06 \times 3.4E-08}$$

$$RIA - 53_{\text{high}} \cong 4.8E+04 \text{ cpm} + \text{bkg}$$

where:

25 = 5% of the 500 mrem/yr total body release rate limit.

1.5E+04 = Interim Radwaste Building Vent flow rate, ft³/min.

7.308E-06 = Highest Ground-Level release point dispersion factor, sec/m³.

3.4E-08 = RIA-53 Correlation Factor, μCi/ml/cpm.

All other factors were previously defined.

Alert setpoint is determined as follows:

$$RIA - 53_{\text{alert}} = RIA - 53_{\text{high}} \times \frac{1}{3}$$

$$RIA - 53_{\text{alert}} \cong 1.6E+04 \text{ cpm} + \text{bkg}$$

All factors were previously defined.

3.0.2.4 WASTE GAS DECAY TANK SETPOINTS (RIA-37 and RIA-38)

For batch releases where the effluent can contain activity significantly above background, e.g., Waste Gas Decay Tank (WGDT), two additional monitors, RIA-37 and RIA-38 are used to establish setpoints for each WGDT batch released. RIA-37 is the normal/low range noble gas monitor, and RIA-38 is the high range noble gas monitor. The following setpoint methodology is used:

$$C_{Xe-133} = \sum_i (C_i \times E_{q_i})$$

$$\text{Expected Cpm} = \frac{C_{Xe-133}}{CF_{Xe-133}} + \text{bkg}$$

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$$RIA-37 \text{ and } RIA-38 \text{ Setpoint} = \frac{C_{Xe-133}}{CF_{Xe-133}} \times 1.5 + bkg \quad \text{Equation 3.7}$$

where:

C_{Xe-133} = Xe-133 equivalent concentration of the WGDT to be released, in $\mu\text{Ci/ml}$.

Eq_i = Xe-133 equivalence factor for each noble gas isotope, excluding tritium, to that of Xe-133 due to different beta energies and abundance.
(See Table 3.0-2).

CF_{Xe-133} = The expected RIA response to a given Xe-133 equivalent concentration, in $\mu\text{Ci/ml/cpm}$. 1RIA-37 = $4.20\text{E-}08 \mu\text{Ci/ml/cpm}$, 3RIA-37 = $4.20\text{E-}08 \mu\text{Ci/ml/cpm}$, 1RIA-38 and 3RIA-38 = $1.34\text{E-}03 \mu\text{Ci/ml/cpm}$.

1.5 = An adjustment factor to account for expected minor variations in effluent concentration and RIA background.

bkg = The radiation monitor background reading, in cpm.

When the release pathway is from any Unit 1 WGDT (A-D), and the Xe-133 equivalent concentration is less than $2.8\text{E-}01 \mu\text{Ci/ml}$, the 1&2 RIA-38 setpoint is established at 313 cpm, and the 1&2 RIA-37 setpoint is calculated using Equation 3.7.

When the release pathway is from any Unit 1 WGDT (A-D), and the Xe-133 equivalent concentration is greater than $2.8\text{E-}01 \mu\text{Ci/ml}$, the 1&2 RIA-37 setpoint is established as offscale high, and the 1&2 RIA-38 setpoint is calculated using Equation 3.7.

When the release pathway is from any Unit 3 WGDT (A-C), and the Xe-133 equivalent concentration is less than $2.8\text{E-}01 \mu\text{Ci/ml}$, the 3 RIA-38 setpoint is established at 313 cpm, and the 3 RIA-37 setpoint is calculated using Equation 3.7.

When the release pathway is from any Unit 3 WGDT (A-C), and the Xe-133 equivalent concentration is greater than $2.8\text{E-}01 \mu\text{Ci/ml}$, the 3 RIA-37 setpoint is established as offscale high, and the 3 RIA-38 setpoint is calculated using Equation 3.7.

Low activity levels in the WGDTs can result in calculated setpoint values close to background. To prevent spurious alarms, if the 1&2 RIA-37 or 3 RIA-37 setpoint is calculated to be less than 2000 cpm, then the setpoint is established at 2000 cpm above background.

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Table 3.0-2

Xe-133 Equivalentents

Isotope	Equivalence Factor
Kr-83m	0
Kr-85m	2.48
Kr-85	2.56
Kr-87	2.93
Kr-88	2.78
Kr-89	2.93
Kr-90	2.93
Xe-131m	1.69
Xe-133m	1.99
Xe-133	1.0
Xe-135m	0.83
Xe-135	2.63
Xe-137	2.93
Xe-138	2.93
Ar-41	2.82
C-11	2.70

4.0 EFFLUENT DOSE MODELS

The effluent dose models used to show compliance with 10CFR50, Appendix I ALARA design objectives, 40CFR190 fuel cycle dose limits, and the dose values given in station SLCs are based on the methodology given in NUREG-0133 and Regulatory Guide 1.109. Dose contributions to the maximum individual shall be calculated at least every 31 days, quarterly, and annually using software which implements the ODCM methodology. The software is designed to automate many of the tasks required in the administration of effluent releases at Oconee and performs normal operation effluent dose assessment using NUREG-0133 and Regulatory Guide 1.109 methodology.

Station long-term historical and dose projection calculations are performed periodically to determine the station's status with respect to meeting annual ALARA goals specified in the Oconee SLCs. Such calculations are used to verify that adequate margin remains during a report period to allow normal station and radwaste system operation, including anticipated operational occurrences, for the remainder of the report period without exceeding applicable goals. Station 31-day dose projections that are used to assess the need to reduce effluent releases with the Gaseous Waste (GW) or Liquid Waste (LW) systems as required in the Oconee SLCs are estimated by the previous month's calculated dose results.

Fuel cycle dose calculations shall be performed annually or as required by special reports. Dose contributions shall be calculated using the software implementing the ODCM methodology.

4.0.1 LIQUID EFFLUENT DOSE MODEL FOR THE MAXIMUM EXPOSED INDIVIDUAL

Of the possible exposure pathways in the aquatic environment, only three contribute significantly to the total dose; these pathways are ingestion of potable water and aquatic foods, and direct exposure from radioactivity deposited on the shoreline. The dose contribution from these pathways for measured quantities of radioactive materials identified in liquid effluents released to unrestricted areas shall be calculated for the maximum exposed individual in each age group using the methodology provided in this section.

Liquid waste processed by the LW system can be released to the environment at Oconee from two liquid discharge points; (1) directly to the Keowee Tailrace through RIA-33 and (2) to the Chemical Treatment Pond #3 discharge point into the Keowee River (See Figure 2.0-1). Liquid dose calculations for the maximum exposed individual are performed and documented in the Annual Radioactive Effluent Release Report for both locations using the applicable activity release and dilution data for each liquid effluent release point. The primary liquid effluent discharge point for Oconee is to the Keowee Tailrace through RIA-33. In general, only low activity tritium releases (<1% station

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total) occur through the Chemical Treatment Pond #3 discharge point into the Keowee River. Dose calculations are performed for each of the two liquid discharge points for dose reporting purposes. The highest calculated dose from the two dose calculations is used to define the maximum individual dose from liquid releases at Oconee.

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Liquid Dose Calculations

The following equation is used for calculating liquid dose to the maximum exposed individual from each of the two liquid effluent release points:

$$Dose_{oa} = \sum_p \sum_i (A_{oapi} \times C_i) \times \Delta t \times F_n \times \frac{1}{D_w}$$

$$F_n = \frac{f}{f + F} \times \sigma$$

Formula: adapted from NUREG-0133, pages 15-17. Where:

Dose _{oa}	The cumulative dose commitment for organ o and age group a, from the liquid effluent for the total time period, Δt. (mrem)
A _{oapi}	Dose commitment factor for organ o, age group a, pathway p, and nuclide i (mrem/hr per μCi/ml). (See Appendices C through F for age group and pathway specific dose commitment factors).
C _i	The average concentration of nuclide i, in undiluted liquid effluent during the time period, Δt. (μCi/ml)
Δt	The length of time over which C _i and F _n are averaged for all liquid releases. (hr)
F _n	The near field average dilution factor for C _i during the period of interest, Δt. Includes the recirculation factor. (dimensionless)
f	Average liquid radwaste flow during the period of interest, Δt. (gpm)
F	Average dilution flow during the period of interest, Δt. (gpm) Normally this value is conservatively assumed to be 1.71E+04 gpm (38 cfs). A dilution flow of 76 cfs is more realistic since it includes bypass Keowee bypass leakage (19 cfs per Keowee Hydro unit, plus the Keowee Hydro Fire Protection liquid waste release mixing line whose flow rate is 38 cfs). No dilution credit is taken for the relatively short period of time during the year that the Keowee Hydro units are running.
σ	Recirculation factor. (dimensionless) *
D _w	Dilution factor from the near field area to the potable water intake; = 30.0 for Oconee. This factor applies to the potable water pathway only. The nearest potable water intake to Oconee is located at the Anderson water intake approximately 31.5 miles from the site on a separate arm of Lake Hartwell. From a hydrology standpoint the Anderson water intake should not be significantly affected by liquid effluent discharges from Oconee. 30.0 is a conservatively small dilution factor based on environmental sample data.

* The recirculation factor accounts for the fraction of discharged water reused by the station. Liquid effluent discharge cannot be recirculated back into the Oconee station. Therefore, the recirculation factor is 1.0 at Oconee.

Derivation of Liquid Dose Commitment Factors (A_{oapi})

Potable Water

$$A_{oapi} = 1.14 \times 10^5 \times U_{aw} \times D_{aoi} \times e^{-\lambda_i t_p}$$

Formula: from NUREG-0133, page 16 and Regulatory Guide 1.109, page 1.109-12.	
Where:	
A_{oapi}	Dose commitment factor for organ o, age group a, pathway p, and nuclide i, (mrem/hr per $\mu\text{Ci/ml}$). (See Appendices C through F for age group and pathway specific dose commitment factors).
1.14×10^5	Units conversion factor (pCi-yr-ml)/($\mu\text{Ci-hr-l}$).
U_{aw}	Water consumption rate in liters per year for age group a. From Table E-5, Regulatory Guide 1.109. Adult – 730 Teen – 510 Child – 510 Infant – 330
D_{aoi}	Dose factor for age group a, organ o, nuclide i, in mrem/pCi. From tables E-11 through E-14 of Regulatory Guide 1.109.
λ_i	Decay constant for nuclide i, in sec^{-1} .
t_p	Environmental transit time from release to receptor. Default = $4.32\text{E}+04$ sec (12 hours). From Regulatory Guide 1.109, Table E-15.

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Aquatic Foods

$$A_{oapi} = 1.14 \times 10^5 \times U_{af} \times BF_i \times D_{aoi} \times e^{-\lambda_i t_p}$$

Formula: from NUREG-0133, page 16 and Regulatory Guide 1.109, page 1.109-12.	
Where:	
A_{oapi}	Dose commitment factor for organ o, age group a, pathway p, and nuclide i, (mrem/hr per $\mu\text{Ci/ml}$). (See Appendices C through F for age group and pathway specific dose commitment factors).
1.14×10^5	Units conversion factor (pCi-yr-ml)/($\mu\text{Ci-hr-l}$).
U_{af}	Fish consumption rate for age group a (kg/yr). From Table E-5, Regulatory Guide 1.109. Adult – 21 Teen – 16 Child – 6.9 Infant – 0
BF_i	Bioaccumulation factor for nuclide i, in fish, in units of pCi/kg per pCi/liter . From Table A-1 of Regulatory Guide 1.109.
D_{aoi}	Dose factor for age group a, organ o, nuclide i, in mrem/pCi . From tables E-11 through E-14 of Regulatory Guide 1.109.
λ_i	Decay constant for nuclide i, in sec^{-1} .
t_p	Environmental transit time from release to receptor. Default = $8.64\text{E}+04$ sec (1 day). From Regulatory Guide 1.109, Table E-15.

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Shoreline Sediment

$$A_{oapi} = 1.14 \times 10^5 \times 100 \times DFG_{oi} \times w \times U_{as} \times T_i^{1/2} \times e^{-\lambda_i t_p} \times (1 - e^{-\lambda_i t_b})$$

Formula: adapted from Regulatory Guide 1.109, page 1.109-14.	
Where:	
A_{oapi}	Dose commitment factor for organ o, age group a, pathway p, and nuclide i, (mrem/hr per $\mu\text{Ci/ml}$). (See Appendices C through F for age group and pathway specific dose commitment factors).
1.14×10^5	Units conversion factor ($\text{pCi-yr-ml}/(\mu\text{Ci-hr-l})$).
100	Proportionality constant used in the sediment radioactivity model, ($\text{liters}/(\text{m}^2\text{-day})$).
DFG_{oi}	Ground plane dose conversion factor for organ o, nuclide i ($\text{mrem/hr per pCi}/\text{m}^2$), from Table E-6 of Regulatory Guide 1.109.
w	Shoreline width factor. For Oconee = 0.2, from Table A-2, Regulatory Guide 1.109.
U_{as}	Shoreline exposure rate for age group a (hr/yr), From Table E-5, Regulatory Guide 1.109. Adult – 12 Teen – 67 Child – 14 Infant – 0
$T_i^{1/2}$	Nuclide half life for nuclide i, in days.
λ_i	Nuclide decay constant for nuclide i.
t_p	Average transit time to point of exposure (0 hours).
t_b	Sediment exposure time (15 years). Page 1.109-14.

4.0.2 GASEOUS EFFLUENT DOSE MODEL FOR THE MAXIMUM EXPOSED INDIVIDUAL

The dose contributions from measured quantities of radioactive materials identified in gaseous effluent released to unrestricted areas shall be calculated for the maximum gamma and beta air dose from noble gases, and for the maximum exposed individual from radioiodines, particulates, and others using the following equations:

Gaseous Dose Calculations

Noble Gas Dose Calculations

Gamma Air Dose

$$Dose_{\gamma} = 3.17 \times 10^{-8} \times \chi / Q \times \sum_i (M_i \times Q_i)$$

Formula: adapted from NUREG-0133, page 28.	
Where:	
$Dose_{\gamma}$	Gamma air dose for the time period of interest (mrad).
3.17×10^{-8}	Inverse number of seconds in year (year/seconds).
M_i	Gamma air dose factor due to gamma emissions for nuclide i (mrad/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendix A).
χ/Q	The highest calculated annual average relative concentration for any area at or beyond the site boundary (sec/m^3)*. (See Table 6.0-9).
Q_i	Activity for nuclide i released during the time period of interest (μCi).

Beta Air Dose

$$Dose_{\beta} = 3.17 \times 10^{-8} \times \chi / Q \times \sum_i (N_i \times Q_i)$$

Formula: adapted from NUREG-0133, page 28.	
Where:	
$Dose_{\beta}$	Beta air dose for the time period of interest (mrad).
3.17×10^{-8}	Inverse number of seconds in year (year/seconds).
N_i	Beta air dose factor due to beta emissions for nuclide i (mrad/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendix A).
χ/Q	The highest calculated annual average relative concentration for any area at or beyond the site boundary (sec/m^3)*. (See Table 6.0-9).
Q_i	Activity for nuclide i released during the time period of interest (μCi).

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Iodine, Particulates, and H-3 Dose Organ Dose Calculation

$$Dose_{oa} = 3.17 \times 10^{-8} \times W \times \sum_p \sum_i (R_{oapi} \times Q_i)$$

Formula: adapted from NUREG-0133, pages 29 & 30.															
Where:															
Dose _{oa}	The cumulative dose commitment to the total body or any organ o, for an individual of age group a (mrem).														
3.17×10 ⁻⁸	Inverse number of seconds in year (year/seconds).														
R _{oapi}	Dose commitment factor for organ o, age group a, pathway p, and nuclide i. The units are based on whether a dispersion or deposition factor is used. When a χ/Q is used the units are mrem/yr per $\mu\text{Ci}/\text{m}^3$. When a D/Q is used the units are (m ² · mrem/yr) per $\mu\text{Ci}/\text{sec}$. (See Appendices G through J for age group and pathway specific dose commitment factors).														
W*	Dispersion (χ/Q) or deposition factor (D/Q). The factor used is based upon the pathway. Note: χ/Q is always used for tritium and C-14.														
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Pathway</th> <th style="text-align: left;">Factor Used</th> </tr> </thead> <tbody> <tr> <td>Ground Plane Deposition</td> <td>D/Q (m⁻²)</td> </tr> <tr> <td>Inhalation</td> <td>χ/Q (sec/m³)</td> </tr> <tr> <td>Vegetation</td> <td>D/Q (m⁻²)</td> </tr> <tr> <td>Grass/Cow/Milk</td> <td>D/Q (m⁻²)</td> </tr> <tr> <td>Grass/Goat/Milk</td> <td>D/Q (m⁻²)</td> </tr> <tr> <td>Grass/Cow/Meat</td> <td>D/Q (m⁻²)</td> </tr> </tbody> </table>	Pathway	Factor Used	Ground Plane Deposition	D/Q (m ⁻²)	Inhalation	χ/Q (sec/m ³)	Vegetation	D/Q (m ⁻²)	Grass/Cow/Milk	D/Q (m ⁻²)	Grass/Goat/Milk	D/Q (m ⁻²)	Grass/Cow/Meat	D/Q (m ⁻²)
Pathway	Factor Used														
Ground Plane Deposition	D/Q (m ⁻²)														
Inhalation	χ/Q (sec/m ³)														
Vegetation	D/Q (m ⁻²)														
Grass/Cow/Milk	D/Q (m ⁻²)														
Grass/Goat/Milk	D/Q (m ⁻²)														
Grass/Cow/Meat	D/Q (m ⁻²)														
Q _i **	Activity for nuclide i, released during the time period of interest (μCi).														

* The dose from noble gases released from semi-elevated release points, e.g., unit vent, is calculated using the semi-elevated dispersion factors. The dose from noble gases released from ground level release points, e.g., Radwaste Facility vent, is calculated using the ground level dispersion factors. The total dose is the sum of the semi-elevated and ground level dose calculations. Maximum individual organ dose is determined by calculating the organ dose at each of the χ/Q and D/Q locations shown in Table 6.0-9 and Table 6.0-10 (128 locations) for both semi-elevated release points and ground level release points, summing the two at each location, and then choosing the dose from the maximum location. Dose is calculated only for those pathways (e.g., garden, milk animal, etc.) that actually exist at each location as determined by the land use census. As discussed in Oconee UFSAR Section 2.1.1.3, the boundary for establishing gaseous effluent release limits is the exclusion area boundary (EAB). The EAB is defined as a 1 mile radius from the station center.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

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** C-14 airborne activity released to the environment is estimated based on actual power generation as discussed in Regulatory Guide 1.21, Revision 2. A value of 9.4 Ci/GWe-yr is used along with actual power generation to estimate C-14 activity released to the environment via gaseous effluents from Oconee. 9.4 Ci/GWe-yr is based on information from "*Estimation of Carbon-14 in Nuclear Power Plant Gaseous Effluents*", EPRI, Palo Alto, CA: 2010. 1021106.

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Derivations of Iodine, Particulate, and H-3 Dose Commitment Factors (R_{oapi})

Ground Plane Deposition Pathway

$$R_{oapi} = K'K''(SF)DFG_{oi} \left[\frac{(1 - e^{-\lambda_i t})}{\lambda_i} \right]$$

Formula: from NUREG-0133, page 32.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for ground plane deposition pathway ($m^2 \cdot mrem/yr$ per $\mu Ci/sec$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor $pCi/\mu Ci$ (10^6).
K''	Units conversion factor 8760 hr/year.
SF	Shielding factor (dimensionless) (0.7, from Regulatory Guide 1.109).
DFG_{oi}	Ground plane dose conversion factor for organ o, nuclide i ($mrem/hr$ per pCi/m^2), from Table E-6 of Regulatory Guide 1.109.
λ_i	Nuclide decay constant for nuclide i (sec^{-1}).
t	Exposure time, 4.73×10^8 seconds (15 years).

Inhalation Pathway

$$R_{oapi} = K'(BR_a)(DFA_{oi})_a$$

Formula: from NUREG-0133, page 31.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for inhalation pathway ($mrem/yr$ per $\mu Ci/m^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor $pCi/\mu Ci$ (10^6).
BR_a	Breathing rate for age group (m^3/yr), from Regulatory Guide 1.109: Adult – 8000 Teen – 8000 Child – 3700 Infant – 1400
$(DFA_{oi})_a$	Organ inhalation factor dose conversion factor for organ o, nuclide i, age group a ($mrem/pCi$), from Tables E-7 through E-10 of Regulatory Guide 1.109.

Vegetation

$$R_{oapi} = K' \left[\frac{(r)}{Y_v (\lambda_i + \lambda_w)} \right] \times (DFL_{oi})_a \times \left[U_a^L f_L e^{-\lambda_i t_L} + U_a^S f_g e^{-\lambda_i t_h} \right]$$

Formula: from NUREG-0133, page 35. Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for vegetation pathway ($m^2 \cdot mrem/yr$ per $\mu Ci/sec$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor $pCi/\mu Ci$ (10^6).
r	Fraction of deposited activity retained on vegetation, from Regulatory Guide 1.109. 1.0 for radioiodine. 0.2 for particulates.
Y_v	Vegetation areal density (kg/m^2) (2.0, from Regulatory Guide 1.109).
λ_i	Nuclide decay constant for nuclide i (sec^{-1}).
λ_w	Decay constant for removal of activity on leaf and plant surfaces by weathering ($5.73 \times 10^{-7} sec^{-1}$, from NUREG-0133).
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Reg. Guide 1.109 ($mrem/pCi$).
U_a^L	Consumption rate of fresh leafy vegetation for age group a (kg/yr) (from Regulatory Guide 1.109). Adult – 64 Teen – 42 Child – 26 Infant – 0
f_L	Fraction of annual intake of fresh leafy vegetation grown locally (1.0, from NUREG-0133).
t_L	Average time between harvest of leafy vegetation and consumption (8.6×10^4 seconds, (1 day), from Regulatory Guide 1.109).
U_a^S	Consumption rate of stored vegetation for age group a (kg/yr) (from Regulatory Guide 1.109). Adult – 520 Teen – 630 Child – 520 Infant – 0
f_g	Fraction of annual intake of stored vegetation (0.76, from Regulatory Guide 1.109).
t_h	Average time between harvest of stored vegetation and consumption (5.18×10^6 seconds, (60 days), from Regulatory Guide 1.109).

Vegetation – Tritium

$$R_{oapi} = K' K''' [U_a^L f_L + U_a^S f_g] (DFL_{oi})_a [0.75(0.5/H)]$$

Formula: from NUREG-0133, page 36.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, for vegetation pathway and tritium (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K'''	Units conversion factor gm/kg (10^3).
U_a^L	Consumption rate of fresh leafy vegetation for age group a (kg/yr) (from Regulatory Guide 1.109). Adult – 64 Teen – 42 Child – 26 Infant – 0
f_L	Fraction of annual intake of fresh leafy vegetation grown locally (1.0, from NUREG-0133).
U_a^S	Consumption rate of stored vegetation for age group a (kg/yr) (from Regulatory Guide 1.109). Adult – 520 Teen – 630 Child – 520 Infant – 0
f_g	Fraction of annual intake of stored vegetation (0.76, from Regulatory Guide 1.109).
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
0.75	Fraction of total feed that is water. (From NUREG-0133).
0.5	Ratio of specific activity of feed grass water to atmospheric water. (From NUREG-0133).
H	Absolute humidity of the atmosphere ($8 \text{ gm}/\text{m}^3$, from Regulatory Guide 1.109).

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Vegetation – Carbon-14

$$R_{oapi} = K'K''' [U_a^L f_L + U_a^S f_g] (DFL_{oi})_a [0.11/0.16](p)(f_I)$$

Formula: from NUREG-0133, page 36 and Regulatory Guide 1.109, page 26.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, for vegetation pathway and carbon-14 (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K'''	Units conversion factor gm/kg (10^3).
U_a^L	Consumption rate of fresh leafy vegetation for age group a (kg/yr) (from Regulatory Guide 1.109). Adult – 64 Teen – 42 Child – 26 Infant – 0
f_L	Fraction of annual intake of fresh leafy vegetation grown locally (1.0, from NUREG-0133).
U_a^S	Consumption rate of stored vegetation for age group a (kg/yr) (from Regulatory Guide 1.109). Adult – 520 Teen – 630 Child – 520 Infant – 0
f_g	Fraction of annual intake of stored vegetation (0.76, from Regulatory Guide 1.109).
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
0.11	Fraction of total plant mass that is natural carbon.
0.16	Concentration of natural carbon in the atmosphere (gm/m^3).
p	Ratio of the total annual C-14 release time to the total annual time during which photosynthesis occurs. This value is assumed to be 0.35, based on 70% of C-14 releases being from WGDTs, and 30% of C-14 releases being continuous from the unit vents (ref. IAEA Technical Reports Series no. 421, "Management of Waste Containing Tritium and Carbon-14", 2004).
f_I	The fraction of C-14 assumed to be in inorganic form (e.g., CO_2). Assumed to be 20%. Reference EPRI TR-105715, "Characterization of Carbon-14 Generated by the Nuclear Power Industry", Table 5-1.

Grass/Cow/Milk

$$R_{oapi} = K' \frac{Q_F (U_{ap})}{\lambda_i + \lambda_w} F_{mi}(r)(DFL_{oi})_a \left[\frac{f_p f_s}{Y_p} + \frac{(1 - f_p f_s) e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_f}$$

Formula: from NUREG-0133, pages 32 & 33. Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/cow/milk pathway ($m^2 \cdot mrem/yr$ per $\mu Ci/sec$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor $pCi/\mu Ci$ (10^6).
Q_F	Cow consumption rate (50 kg/day, from Regulatory Guide 1.109)
U_{ap}	Consumption rate of cow milk for age group a (liters/yr, from Regulatory Guide 1.109). Adult – 310 Teen – 400 Child – 330 Infant – 330
r	Fraction of deposited activity retained on cow's feed grass, (from Regulatory Guide 1.109). 1.0 for radioiodine. 0.2 for particulates.
Y_p	Agricultural productivity by unit area of pasture feed grass ($0.7 kg/m^2$, from Regulatory Guide 1.109).
Y_s	Agricultural productivity by unit area of stored feed ($2.0 kg/m^2$, from Regulatory Guide 1.109).
λ_i	Nuclide decay constant for nuclide i (sec^{-1}).
λ_w	Decay constant for removal of activity on leaf and plant surfaces by weathering ($5.73 \times 10^{-7} sec^{-1}$, from NUREG-0133).
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 ($mrem/pCi$).
F_{mi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-1 of Regulatory Guide 1.109 for cow milk.
f_p	Fraction of year that the cow is on pasture (1.0, from RG 1.109).
f_s	Fraction of the cow feed that is pasture grass while the cow is on pasture (1.0, from Regulatory Guide 1.109).
t_f	Transport time for pasture to cow, to milk, to receptor ($1.73E+05$ seconds, from Regulatory Guide 1.109).
t_h	Transport time from pasture, to harvest, to cow, to milk, to receptor ($7.78e+06$ seconds, from Regulatory Guide 1.109).

Grass/Cow/Milk – Tritium

$$R_{oapi} = K' K''' F_{mi} Q_f U_{ap} (DFL_{io})_a [0.75(0.5/H)]$$

Formula: from NUREG-0133, page 34.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/cow/milk pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K'''	Units conversion factor gm/kg (10^3).
Q_f	Cow consumption rate (50 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of cow milk for age group a (liters/yr, from Regulatory Guide 1.109). Adult – 310 Teen – 400 Child – 330 Infant – 330
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
F_{mi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-1 of Regulatory Guide 1.109 for cow milk.
0.75	Fraction of total feed that is water (from NUREG-0133).
0.5	Ratio of specific activity of feed grass water to atmospheric water (from NUREG-0133).
H	Absolute humidity of the atmosphere ($8 \text{ gm}/\text{m}^3$, from Regulatory Guide 1.109).

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Grass/Cow/Milk – Carbon-14

$$R_{oapi} = K' K'' F_{mi} Q_F U_{ap} (DFL_{oi})_a [0.11/0.16](p)(f_I)$$

Formula: from NUREG-0133, page 34 and Regulatory Guide 1.109, page 26.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/cow/meat pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K''	Units conversion factor gm/kg (10^3).
F_{mi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-1 of Regulatory Guide 1.109 for cow milk.
Q_F	Cow consumption rate (50 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of cow milk for age group a (liters/yr) (from Regulatory Guide 1.109). Adult – 310 Teen – 400 Child – 330 Infant – 330
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
0.11	Fraction of total plant mass that is natural carbon.
0.16	Concentration of natural carbon in the atmosphere (gm/m^3).
p	Ratio of the total annual C-14 release time to the total annual time during which photosynthesis occurs. This value is assumed to be 0.35, based on 70% of C-14 releases being from WGDTs, and 30% of C-14 releases being continuous from the unit vents (ref. IAEA Technical Reports Series no. 421, "Management of Waste Containing Tritium and Carbon-14", 2004).
f_I	The fraction of C-14 assumed to be in inorganic form (e.g., CO_2). Assumed to be 20%. Reference EPRI TR-105715, "Characterization of Carbon-14 Generated by the Nuclear Power Industry", Table 5-1.

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Offsite Dose Calculation Manual (ODCM)

Grass/Goat/Milk

$$R_{oapi} = K' \frac{Q_F (U_{ap})}{\lambda_i + \lambda_w} F_{mi}(r) (DFL_{oi})_a \left[\frac{f_p f_s}{Y_p} + \frac{(1 - f_p f_s) e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_f}$$

Formula: from NUREG-0133, pages 32 & 33. Where:

R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/goat/milk pathway ($m^2 \cdot mrem/yr$ per $\mu Ci/sec$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor $pCi/\mu Ci$ (10^6).
Q_F	Goat consumption rate (6 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of goat milk for age group a (liters/yr, from Regulatory Guide 1.109). Adult – 310 Teen – 400 Child – 330 Infant – 330
r	Fraction of deposited activity retained on goat's feed grass, from Regulatory Guide 1.109. 1.0 for radioiodine. 0.2 for particulates.
Y_p	Agricultural productivity by unit area of pasture feed grass ($0.7 kg/m^2$, from Regulatory Guide 1.109).
Y_s	Agricultural productivity by unit area of stored feed ($2.0 kg/m^2$, from Regulatory Guide 1.109).
λ_i	Nuclide decay constant for nuclide i (sec^{-1}).
λ_w	Decay constant for removal of activity on leaf and plant surfaces by weathering ($5.73 \times 10^{-7} sec^{-1}$, from NUREG-0133).
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 ($mrem/pCi$).
F_{mi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-2 of Regulatory Guide 1.109 for goat milk.
f_p	Fraction of year that the goat is on pasture (1.0, from RG 1.109).
f_s	Fraction of the goat feed that is pasture grass while the goat is on pasture (1.0, from Regulatory Guide 1.109).
t_f	Transport time for pasture to goat, to milk, to receptor ($1.73E+05$ seconds, from Regulatory Guide 1.109).
t_h	Transport time from pasture, to harvest, to goat, to milk, to receptor ($7.78e+06$ seconds, from Regulatory Guide 1.109).

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Grass/Goat/Milk – Tritium

$$R_{oapi} = K' K''' F_{mi} Q_f U_{ap} (DFL_{oi})_a [0.75(0.5 / H)]$$

Formula: from NUREG-0133, page 34:	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/goat/milk pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K'''	Units conversion factor gm/kg (10^3).
Q_f	Goat consumption rate (6 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of goat milk for age group a (liters/yr, from Regulatory Guide 1.109). Adult – 310 Teen – 400 Child – 330 Infant – 330
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
F_{mi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-2 of Regulatory Guide 1.109 for goat milk.
0.75	Fraction of total feed that is water (from NUREG-0133).
0.5	Ratio of specific activity of feed grass water to atmospheric water (from NUREG-0133).
H	Absolute humidity of the atmosphere ($8 \text{ gm}/\text{m}^3$, from Regulatory Guide 1.109).

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Grass/Goat/Milk – Carbon-14

$$R_{oapi} = K'K'' F_{mi} Q_F U_{ap} (DFL_{oi})_a [0.11/0.16](p)(f_I)$$

Formula: from NUREG-0133, page 34 and Regulatory Guide 1.109, page 26.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/cow/meat pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K''	Units conversion factor gm/kg (10^3).
F_{mi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-2 of Regulatory Guide 1.109 for goat milk (0.10).
Q_F	Goat consumption rate (6 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of goat milk for age group a (liters/yr) (from Regulatory Guide 1.109). Adult – 310 Teen – 400 Child – 330 Infant – 330
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
0.11	Fraction of total plant mass that is natural carbon.
0.16	Concentration of natural carbon in the atmosphere (gm/m^3).
p	Ratio of the total annual C-14 release time to the total annual time during which photosynthesis occurs. This value is assumed to be 0.35, based on 70% of C-14 releases being from WGDTs, and 30% of C-14 releases being continuous from the unit vents (ref. IAEA Technical Reports Series no. 421, "Management of Waste Containing Tritium and Carbon-14", 2004).
f_I	The fraction of C-14 assumed to be in inorganic form (e.g., CO_2). Assumed to be 20%. Reference EPRI TR-105715, "Characterization of Carbon-14 Generated by the Nuclear Power Industry", Table 5-1.

Grass/Cow/Meat

$$R_{oapi} = K' \frac{Q_F (U_{ap})}{\lambda_i + \lambda_w} F_{fi}(r) (DFL_{oi})_a \left[\frac{f_p f_s}{Y_p} + \frac{(1 - f_p f_s) e^{-\lambda_i t_h}}{Y_s} \right] e^{-\lambda_i t_f}$$

Formula: from NUREG-0133, pages 34 & 35. Where:

R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/cow/meat pathway ($m^2 \cdot mrem/yr$ per $\mu Ci/sec$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor $pCi/\mu Ci$ (10^6).
Q_F	Cow consumption rate (50 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of cow meat for age group a (kg/yr, from Regulatory Guide 1.109). Adult – 110 Teen – 65 Child – 41 Infant – 0
r	Fraction of deposited activity retained on cow's feed grass (from Regulatory Guide 1.109). 1.0 for radioiodine. 0.2 for particulates.
Y_p	Agricultural productivity by unit area of pasture feed grass ($0.7 kg/m^2$, from Regulatory Guide 1.109).
Y_s	Agricultural productivity by unit area of stored feed ($2.0 kg/m^2$, from Regulatory Guide 1.109).
λ_i	Nuclide decay constant for nuclide i (sec^{-1}).
λ_w	Decay constant for removal of activity on leaf and plant surfaces by weathering ($5.73 \times 10^{-7} sec^{-1}$, from NUREG-0133).
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 ($mrem/pCi$).
F_{fi}	Stable element transfer coefficient for nuclide i, in days/kg, from Table E-1 of Regulatory Guide 1.109 for cow meat.
f_p	Fraction of year that the cow is on pasture (1.0, from RG 1.109).
f_s	Fraction of the cow feed that is pasture grass while the cow is on pasture (1.0, from Regulatory Guide 1.109).
t_f	Transport time from pasture to receptor ($1.73E+06$ seconds, from Regulatory Guide 1.109).
t_h	Transport time from crop field to receptor ($7.78E+06$ seconds, from Regulatory Guide 1.109).

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Grass/Cow/Meat – Tritium

$$R_{oapi} = K' K''' F_{fi} Q_F U_{ap} (DFL_{oi})_a [0.75(0.5/H)]$$

Formula: from NUREG-0133, page 35.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/cow/meat pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K'''	Units conversion factor gm/kg (10^3).
Q_F	Cow consumption rate (50 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of cow meat for age group a (kg/yr, from Regulatory Guide 1.109). Adult – 110 Teen – 65 Child – 41 Infant – 0
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
F_{fi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-1 of Regulatory Guide 1.109 for cow meat.
0.75	Fraction of total feed that is water (from NUREG-0133).
0.5	Ratio of specific activity of feed grass water to atmospheric water (from NUREG-0133).
H	Absolute humidity of the atmosphere ($8 \text{ gm}/\text{m}^3$, from Regulatory Guide 1.109).

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Grass/Cow/Meat – Carbon-14

$$R_{oapi} = K'K''' F_{fi} Q_F U_{ap} (DFL_{oi})_a [0.11/0.16](p)(f_I)$$

Formula: from NUREG-0133, page 35 and Regulatory Guide 1.109, page 26.	
Where:	
R_{oapi}	Dose commitment factor for organ o, age group a, nuclide i, for grass/cow/meat pathway (mrem/yr per $\mu\text{Ci}/\text{m}^3$). (See Appendices G through J for age group and pathway specific dose commitment factors).
K'	Units conversion factor pCi/ μCi (10^6).
K'''	Units conversion factor gm/kg (10^3).
F_{fi}	Stable element transfer coefficient for nuclide i, in days/liter, from Table E-1 of Regulatory Guide 1.109 for cow meat.
Q_F	Cow consumption rate (50 kg/day, from Regulatory Guide 1.109).
U_{ap}	Consumption rate of cow meat for age group a (kg/yr) (from Regulatory Guide 1.109). Adult – 110 Teen – 65 Child – 41 Infant – 0
$(DFL_{oi})_a$	Ingestion dose conversion factor for nuclide i, organ o, and age group a, from Tables E-11 through E-14 of Regulatory Guide 1.109 (mrem/pCi).
0.11	Fraction of total plant mass that is natural carbon.
0.16	Concentration of natural carbon in the atmosphere (gm/m^3).
p	Ratio of the total annual C-14 release time to the total annual time during which photosynthesis occurs. This value is assumed to be 0.35, based on 70% of C-14 releases being from WGDTs, and 30% of C-14 releases being continuous from the unit vents (ref. IAEA Technical Reports Series no. 421, "Management of Waste Containing Tritium and Carbon-14", 2004).
f_I	The fraction of C-14 assumed to be in inorganic form (e.g., CO_2). Assumed to be 20%. Reference EPRI TR-105715, "Characterization of Carbon-14 Generated by the Nuclear Power Industry", Table 5-1.

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4.0.3 DIRECT RADIATION

Direct radiation is that radiation from confined sources, and does not include any external component from radioactive effluents. The point kernel method has been used to calculate offsite dose rates from radioactive materials stored in the refueling water storage tanks, reactor makeup water storage tanks, and temporary onsite radwaste storage tanks. Dose calculations using this method performed for Oconee Nuclear Station indicate direct radiation doses are much less than 0.01 mrem/yr and, therefore, make a negligible contribution to individual dose.

Likewise, direct and air-scatter radiation dose contributions from the onsite Independent Spent Fuel Storage Installation (ISFSI) at Oconee have been calculated and documented in the Oconee 10CFR72.212 evaluation report. The results of the calculation demonstrate that the annual dose to any "real individual" beyond the controlled area boundary is below the 10CFR72.104(a) and 40CFR190.10(a) limit of 25 mrem from direct and skyshine radiation, and all other fuel cycle sources (e.g., effluent).

Direct radiation doses will not be calculated routinely.

4.0.4 EFFLUENT APPORTIONMENT

For the Oconee Nuclear Station the effluent releases are apportioned equally to each unit for each site as recommended by Section 3.1 of NUREG-0133, because the shared radwaste treatment systems at each site make it impractical to accurately ascribe releases to a specific reactor unit. For Annual Effluent Release Report purposes effluent releases are summed for each unit, and the maximum individual dose to the public is reported as a site total.

5.0 FUEL CYCLE CALCULATIONS

In accordance with the requirements of 40CFR190, the annual dose commitment to any member of the general public shall be calculated to assure that doses are limited to 25 millirems to the total body or any organ with the exception of the thyroid which is limited to 75 millirems. In accordance with the requirements of the Selected Licensee Commitments, the annual dose commitment shall also be calculated any time twice the specified quarterly dose limit of the Selected Licensee Commitments is exceeded; these annual dose commitments may not just be calculated for the calendar year.

The "Uranium fuel cycle" is defined in 40CFR Part 190.02(b) as:

"Uranium fuel cycle means the operations of milling or uranium ore, chemical conversion of uranium, isotopic enrichment of uranium, fabrication of uranium fuel, generation of electricity by a light-water-cooled nuclear power plant using uranium fuel, and reprocessing of spent uranium fuel, to the extent that these directly support the production of electrical power for public use utilizing nuclear energy, but excludes mining operations, operations at waste disposal sites, transportation of any radioactive material in support of these operations, and the reuse of recovered non-uranium special nuclear and by-product materials from the cycle."

Based on this definition of the fuel cycle and the information in 10CFR51, Table S-3, and Wash-1248, the radiological impact of the following operations has been assessed for Oconee Nuclear Station:

5.0.1 MILLING

No milling operations occur within fifty miles of the Oconee Nuclear Station.

5.0.2 CONVERSION

No uranium hexafluoride production occurs within fifty miles of the Oconee Nuclear Station.

5.0.3 ENRICHMENT

No uranium enrichment operations occur within fifty miles of the Oconee Nuclear Station.

5.0.4 FUEL FABRICATION

No fuel fabrication operations occur within fifty miles of the Oconee Nuclear Station.

5.0.5 NUCLEAR POWER PRODUCTION

The production of electricity for public use using light-water-cooled nuclear power stations results in increments of dose to individuals within fifty miles of any station due to liquid and gaseous effluent releases and direct radiation or skyshine. The increments of dose resulting from liquid and gaseous effluent releases will be calculated using the software implementing the ODCM methodology. The dose from direct radiation, skyshine, and radiation from the station storage facilities has been estimated using conservative assumptions (see Section 4.0.3).

In certain situations more than one nuclear power station site may contribute to the doses to be considered in making fuel cycle dose assessments in accordance with 40CFR190. However, since the Oconee nuclear station is located over 100 miles from the Catawba and McGuire nuclear stations, the relative dose contribution from each site to the other is insignificant, and can be ignored in assessing compliance with 40CFR190.

5.0.6 FUEL REPROCESSING

No fuel reprocessing operations occur within fifty miles of the Oconee Nuclear Station.

5.0.7 40CFR190 TOTAL DOSE DETERMINATION

To summarize, only dose increments from nuclear power production operations (Section 5.0.5) need be considered in calculations to demonstrate compliance with the requirements of 40CFR190. The fuel cycle dose assessments for Oconee Nuclear Station only include liquid and gaseous dose contributions from Oconee and dose from Oconee's ISFSI since no other uranium fuel cycle facility contributes significantly to Oconee's maximum exposed individual. For this dose assessment, the total body and maximum organ dose contributions to the maximum exposed individual from Oconee's liquid and gaseous effluents are estimated using the following calculations:

$$D_{wb}(T) = D_{wb}(l) + D_{wb}(g)$$

$$D_{mo}(T) = D_{mo}(l) + D_{mo}(g)$$

where:

$D_{wb}(T)$ = Total estimated fuel cycle whole body dose commitment resulting from the combined liquid and gaseous effluents of Oconee during the calendar year of interest, in mrem.

$D_{mo}(T)$ = Total estimated fuel cycle maximum organ dose commitment resulting from the combined liquid and gaseous effluents of Oconee during the calendar year of interest, in mrem.

6.0 ENVIRONMENTAL LOCATIONS

6.0.1 SITE DESCRIPTION AND SAMPLE LOCATIONS

Oconee Nuclear Station (ONS) is located in Oconee County, South Carolina, approximately 8 miles northeast of Seneca, South Carolina, on the shore of Lake Keowee. This lake was formed by damming the Keowee and Little Rivers in that location. Immediately to the south is the U.S. Government Hartwell Project. The Keowee Hydroelectric Plant near the station joins Lake Keowee and the upper reaches of Lake Hartwell. To the north, the Jocassee Hydroelectric Plant joins Lake Jocassee and Lake Keowee. Jocassee is a pumped storage plant. The ONS exclusion area boundary is 1 mile.

Table 6.0-1 and Table 6.0-2 define the sampling and TLD locations for the Oconee Radiological Monitoring Program. Figure 6.0-1 and Figure 6.0-2 illustrate these locations as compared to Oconee Nuclear Station.

6.0.2 LAND USE CENSUS DATA

The Annual Land Use Census, required by Selected Licensee Commitments, is performed to ensure that changes in the use of areas at or beyond the site boundary are identified, and that modifications to the Radiological Environmental Monitoring Program are made if required by changes in land use. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR50. The land use census identifies nearest pathways to the exclusion area boundary (EAB, ~ 1.0 mile) for each of the 16 meteorological sectors. Global Positioning System field measurements are taken as close as possible to the item of interest and are accurate to within 2-5 meters. Locations beyond the nearest pathway for each sector are assumed to contain that pathway for dose calculation purposes. For the 4.5-5.0 mile sector all pathways, i.e., residence, garden, milk animal (goat), and meat animal (cow), are assumed to exist for dose calculation purposes. Results are maintained on file and data reviewed in accordance with procedure AD-CP-ALL-0014, Land Use Census Evaluation.

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TABLE 6.0-1

**OCONEE RADIOLOGICAL MONITORING PROGRAM
SAMPLING LOCATIONS**

Code	Frequency	Code	Frequency
W	Weekly	SM	Semimonthly
BW	BiWeekly	Q	Quarterly
M	Monthly	SA	Semiannually
C	Control		

Site #	Location Description*	Air Rad. & Particulate	Surface Water	Drinking Water	Shoreline Sediment	Fish	Milk	Broadleaf Vegetation
060	Greenville Water Intake Road (3.23 NE)			M				
060 C **	Greenville Water Intake Road (2.28 NE)					SA		
062 C	Lake Keowee Hydro Intake (0.85 mi ENE)		M					
063	Lake Hartwell Hwy 183 Bridge (0.80 mi ESE) [000.7]					SA		
063.1	Lake Hartwell Hwy 183 (0.79 mi E)		M					
064 C	Seneca Municipal Water Supply (6.67 mi SSW) [004.1]			M				
066	Anderson Municipal Water Supply (18.9 mi SSE) [012]			M				
067	Lawrence Ramsey Bridge Hwy 27 (4.34 mi SSE) [005.2]				SA	SA		
068 C	High Falls County Park (1.82 mi W)				SA			
071 C	Clemson Dairy (10.2 mi SSE) [006.3]						SM	
077	Skimmer Wall (1.00 mi SW)	W						M
078.1	Recreation Site (0.53 mi WSW)	W						
079	Keowee Dam (0.56 mi NE)	W						M
081 C	Clemson Operations Center (9.33 mi SE)	W						M
084	Sue Craig Road (2.58 mi NNE)	W						M
085	Lake Services / Building B9125 (0.88 mi NNW)	W						
091	Holders Landing Road (2.09 miles S)				SA			

* GPS data reflect approximate accuracy to within 2-5 meters. GPS field measurements were taken as close as possible to the item of interest.

** Control for Fish Only

[] Location Numbers prior to 1984

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

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TABLE 6.0-2

**OCONEE RADIOLOGICAL MONITORING PROGRAM SAMPLING LOCATIONS
(TLD SITES)**

Site #	Location*	Distance *	Sector	Site #	Location*	Distance *	Sector
020	Site boundary	0.16 miles	N	044	HWY 130 at Little River Dam	3.96 miles	S
021	Site boundary	0.25 miles	NNE	045	Terminus of HWY 588 at Crooked Creek	4.78 miles	SSW
022	Site boundary	0.53 miles	NE	046	HWY 188 at Crooked Creek	4.61 miles	SW
023	Site boundary	0.93 miles	ENE	047	New Hope Church, HWY 188	3.58 miles	WSW
024	Site boundary	0.81 miles	E	048	JCT HWY 175 & 188	3.64 miles	W
025	Site boundary	0.42 miles	ESE	049	JCT HWY 201 & 92	3.60 miles	WNW
026	Site boundary	0.34 miles	SE	050	Stamp Creek Landing, End of HWY 92	3.53 miles	NW
027	Site boundary	0.49 miles	SSE	051	HWY 128, 1 mile N of HWY 130	4.64 miles	NNW
028	Site boundary	0.46 miles	S	052 SI	DPC Branch Office Site, Pickens	12.4 miles	ENE
029	Site boundary	0.56 miles	SSW	053 SI	DPC Branch Office Site, Liberty	11.7 miles	E
030	Site boundary	0.42 miles	SW	054 SI	Post Office - HWY 93 Norris	8.60 miles	ESE
031	Site boundary	0.27 miles	WSW	055 SI	Clemson Meteorology Plot	9.27 miles	SSE
076	Site boundary	0.19 miles	W	056 SI	Water Tower - Seneca	7.30 miles	SSW
032	Site boundary	0.19 miles	WNW	057 SI	Oconee Memorial Hospital	8.42 miles	SW
033	Site boundary	0.21 miles	WNW	058 C	Branch Rd Substation, Walhalla	9.39 miles	WSW
034	Site boundary	0.22 miles	NW	059 SI	Tamassee Dar School	9.20 miles	NW
035	Site boundary	0.17 miles	NNW	077	Skimmer wall shared with air monitoring station	1.00 miles	SW
036	Mile Creek Landing	4.18 miles	N	078.1	ONS Recreation Site shared with air monitoring station	0.53 miles	WSW
037	Keowee Church, HWY 327	4.85 miles	NNE	081 C	Clemson Operations Center	9.33 miles	SE
038	Convenience Mart, JCT HWY 183 & 133	4.24 miles	NE	085	Lake Services Bldg 9125 shared with air monitoring location	0.88 miles	NNW
039	HWY 133, 1 mile East of JCT HWY 183 & 133	4.02 miles	ENE	086	Lake Keowee Service Rd at Boat Landing	0.83 miles	NW
040	Microwave Tower, Six Mile	4.74 miles	E	087	End of Waterfall Rd	1.33 miles	WNW
041	JCT HWY 101 & 133	4.25 miles	ESE	088	Doug Hollow Rd / Transmission Tower	1.00 miles	SSW
042	Lawrence Chapel Church, HWY 133	4.93 miles	SE	089	Intersection Hwy 130 & Keowee River Rd	1.19 miles	S
043	HWY 291 at Issaqueena Park	4.09 miles	SSE	090	Crescent Resources, Keowee River Rd at Beaver Dam	0.79 miles	SE

C = Control

SI = Special Interest

* = GPS data reflect approximate accuracy to within 2-5 meters. GPS field measurements were taken as close as possible to the item of interest.

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TABLE 6.0-3

Land Use Census Results

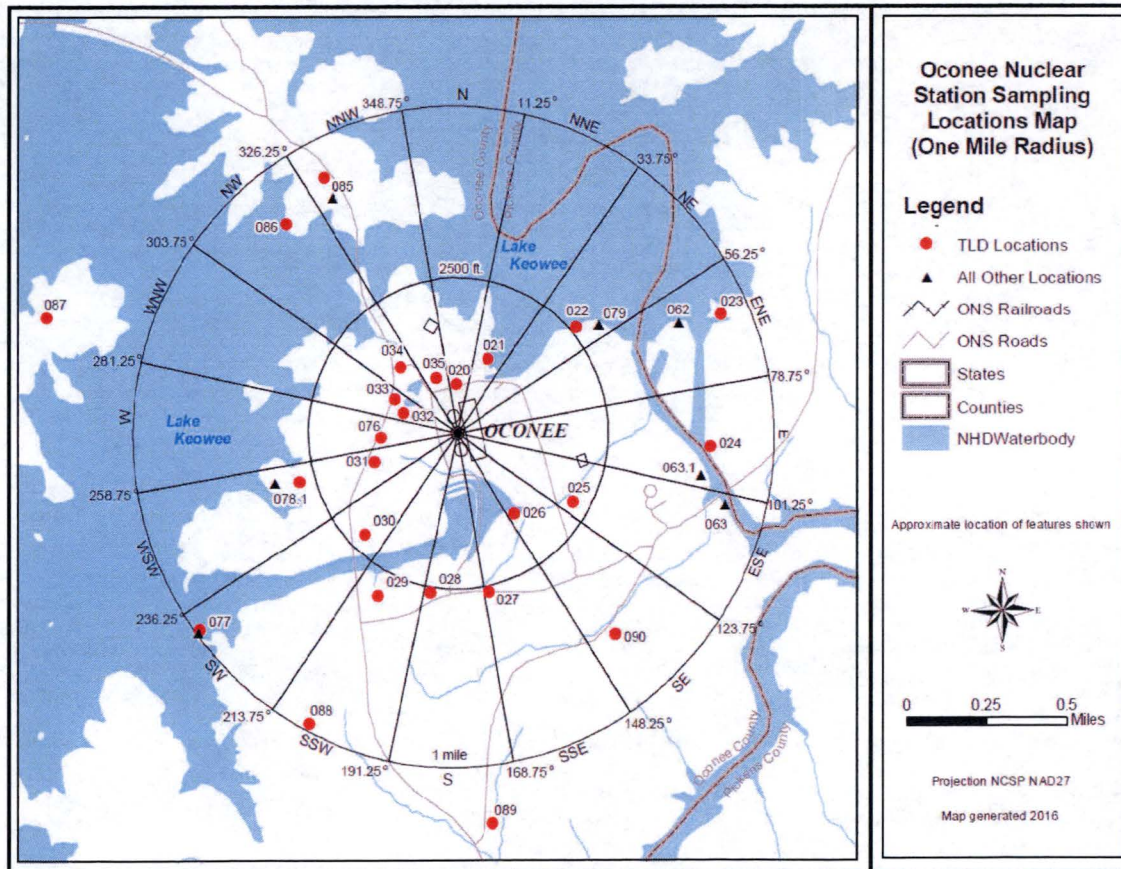
Deleted in ODCM Revision 58.

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Figure 6.0-1 Sampling Locations Map (Site Boundary)

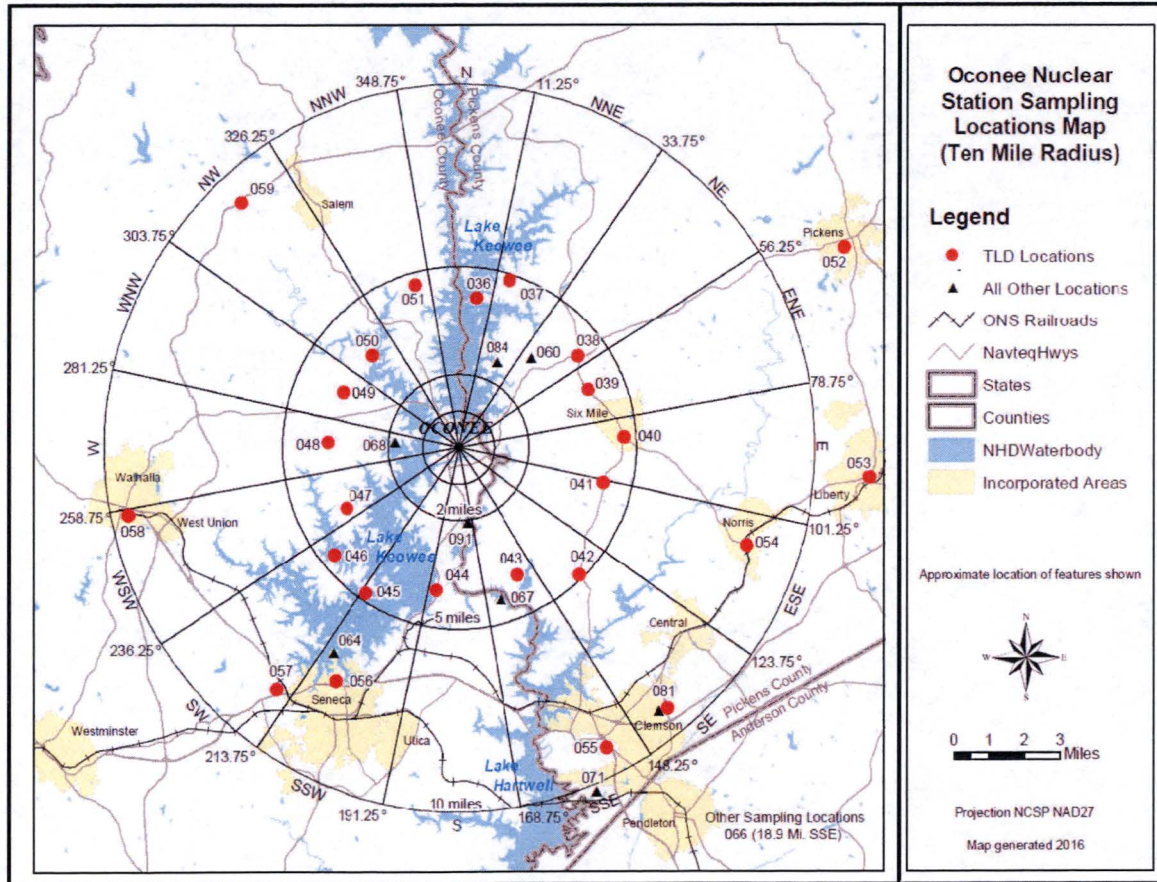


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Figure 6.0-2 Sampling Locations Map (Ten Mile Radius)



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Figure 6.0-3 Land Use Census Map

Deleted in ODCM Revision 58.

6.0.3 OCONEE METEOROLOGY: RELATIVE AIR CONCENTRATIONS AND DEPOSITION

Calculations of annually averaged air concentrations and deposition values from routine releases provide the air dispersion and deposition factors needed for dose assessment. The methodology is based upon Regulatory Guide 1.111, as implemented by the NRC's computer model "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations," NUREG/CR-2919, PNL-4380, September 1982.

Five years of hourly meteorological data from the onsite instruments are processed into a representative joint frequency distribution of winds and atmospheric stability for input into the XOQDOQ model (Version 2.0). Thus, the air dispersion and deposition factors (χ/Q and D/Q) output by the model are based on a five-year climatology for the site.

6.0.3.1 XOQDOQ METHODOLOGY AND ASSUMPTIONS

A continuous, routine release (non-purge) is simulated from each unit vent. The unit vent release type is categorized as semi-elevated, being elevated approximately 92% of the time and being at ground-level approximately 8% of the time. This is based on RG 1.111 criteria, with the ratio (i.e. 3.64) of the average exit velocity (11.39 m/s) to the mean wind speed at the 60 m release height (3.13 m/s). To account for all release pathways, Oconee is modeled as both a totally "ground-level" release and as a "mixed-mode" release, with two model runs of XOQDOQ.

Surrounding terrain heights are not input for ground-level releases, but are used for the elevated portion of mixed-mode releases. The locale consists of rolling terrain, so the default open terrain recirculation factor is applied in XOQDOQ [KOPT(8)=1]. This correction factor is recommended in RG 1.111 to adjust the straight-line airflow of the model for spatial and temporal variations that are produced by large scale weather patterns, or other non-linear flow conditions at local and regional scales.

In order for XOQDOQ to treat the plume as a ground-level release, the exit velocity and the inside diameter of the unit vent must be input as zero. The heat emission rate of each vent is also assumed to be zero, as recommended by the model. A release height of 10 m is assumed for the ground-level release, with actual plant grade of 796 ft msl. Using the building height (58 m) and minimum cross-sectional area of the containment building (2296 m²), XOQDOQ applies a building wake correction to the relative air concentrations.

For the mixed-mode release, the exit velocities (11.1, 11.3, and 11.7 m/s for U1-U3, respectively) and inside diameters (1.8 m) of the unit vents are input to the XOQDOQ model for each vent. The heat emission rate of each vent is still assumed to be zero, as in the ground-level release. Plant grade elevation is now input as zero, however, to properly

utilize the input terrain heights above yard grade elevation (Table 6.0-4). The height of the vent (60.7 m) above plant grade is used to determine the plume centerline height.

Table 6.0-4

Terrain Heights Above ONS Yard Grade Elevation (m)

Distance:	0.5 mile	1 mile	1.5 miles	2.0 miles	2.5 miles	3.0 miles	3.5 miles	4.0 miles	4.5 miles	5.0 miles
S	29	38	38	38	38	38	50	50	50	50
SSW	32	44	50	50	50	50	50	50	50	50
SW	38	44	44	44	50	50	50	50	50	50
WSW	44	44	44	44	44	44	44	48	48	57
W	48	48	48	48	48	55	58	73	73	73
WNW	29	29	29	38	65	65	71	71	77	80
NW	30	30	30	48	50	68	69	69	71	71
NNW	30	30	30	48	50	68	69	69	71	71
N	29	30	30	30	30	30	62	62	62	74
NNE	24	24	35	35	53	53	82	82	82	82
NE	7	13	35	44	44	50	78	88	99	100
ENE	4	23	35	38	53	62	74	80	99	100
E	1	24	24	24	57	68	68	74	84	84
ESE	1	1	13	35	62	62	62	65	71	71
SE	7	20	20	44	67	67	67	67	67	67
SSE	7	38	38	38	47	62	62	62	62	62

Calculations of relative air concentrations and deposition are made for gridded receptor distances per sector. The "no decay" assumption is used in the XOQDOQ model.

6.0.3.2 METEOROLOGICAL DATA

Five years (1988-1992) of hourly, onsite meteorological data are used to produce the joint frequency distributions of wind speed and direction per stability class. The 10 m level winds are used. It is these joint frequency distributions which are input to the XOQDOQ model. XOQDOQ extrapolates the 10 m wind speed to the release height during the elevated portion of mixed-mode releases. Hours of calm winds are distributed by direction with the same frequency as the lowest "noncalm" wind speed class [KOPT(1)=1]. Thus, wind speed classes are established so that the lowest wind speed class is the starting threshold of the anemometer (i.e. the "calm" wind speed class). The largest wind speed class has the upper bound of (5 m/s + max hourly wind speed). Stability classes (A-G) are based on the vertical temperature gradient, measured by the hourly averaged delta-T variable.

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6.0.3.3 ANNUAL XOQDOQ COMPARISON TO THE ODCM

Each year, the prevailing winds and stability class frequencies for ONS are compared to the 5-year period (1988-1992) upon which the χ/Q and D/Q calculations have been made. The 5-year climatology is summarized in Table 6.0-5 and Table 6.0-6 below. Since the comparison is being made to a 5-year climatology, significant differences should not occur in the meteorological variables of concern (i.e. winds and delta-T). The meteorological comparison serves to verify this assumption.

Table 6.0-5
ONS Atmospheric Stability Frequency (1988-1992)

	A	B	C	D	E	F	G
Frequency (%)	8.8	5.6	6.2	40.4	32.5	5.0	1.4

Table 6.0-6
ONS Frequency of Wind Direction (From) and Speed (1988-1992)

Sector	Wind Direction Frequency (%)	Wind Speed Class (m/s)	Wind Speed Frequency (%)
N	5.3	CALM	1.0
NNE	5.2	0.45 - 0.74 m/s	4.1
NE	9.0	0.75 - 0.99 m/s	10.3
ENE	8.2	1.00 - 1.24 m/s	10.9
E	5.2	1.25 - 1.49 m/s	13.4
ESE	3.1	1.50 - 1.99 m/s	18.3
SE	3.1	2.00 - 2.99 m/s	22.2
SSE	3.5	3.00 - 3.99 m/s	10.5
S	3.6	4.00 - 4.99 m/s	4.9
SSW	8.6	5.00 - 5.99 m/s	2.0
SW	11.8	6.00 - 7.99 m/s	1.5
WSW	7.5	8.00 - 9.99 m/s	0.3
W	5.2	> 9.99 m/s	0.5
WNW	7.0		
NW	7.3		
NNW	6.4		

The joint frequency distributions of wind speed and direction versus atmospheric stability class are also determined from the annual data to provide input to the XOQDOQ model. Modeled χ/Q and D/Q values for the 1.0 mile Exclusion Area Boundary at ONS are compared to the maximum of the (1988-1992) χ/Q and D/Q values from all sectors. If

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the newly calculated annual dispersion and deposition values do not result in a significant increase in the calculated offsite dose relative to the 10CFR50, Appendix I dose objectives then the 5-year χ/Q and D/Q values used in the Annual Radiological Effluent Release Report (ARERR) are not revised. An increase in calculated offsite dose that is greater than five percent of the 10CFR50, Appendix I dose objectives would be considered significant enough to warrant a change in the χ/Q and D/Q values used in the ARERR. If an increasing trend in the annual χ/Q and D/Q values compared to the 5-year values is noted then a revised set of 5-year χ/Q and D/Q values will be generated. These limiting values are listed in Table 6.0-7. The entire χ/Q and D/Q list based on directional sector and distance is given in Table 6.0-9 and Table 6.0-10.

Table 6.0-7
ONS Maximum χ/Q and D/Q Values (1988-1992)

	($\chi/Q, s/m^3$) (D/Q, $1/m^2$)	Distance	Sector
Ground-level Release: Maximum χ/Q	7.308E-06	1 mile EAB	SE
Ground-level Release: Maximum D/Q	2.259E-08	1 mile EAB	NE
Mixed-mode Release: Maximum χ/Q	1.672E-06	1 mile EAB	SW
Mixed-mode Release: Maximum D/Q	1.295E-08	1 mile EAB	NE

Note:

The Oconee meteorological instruments were relocated from the 46 m microwave tower to a new 60 m onsite meteorological tower in April 1988. The 60 m tower became operational at 1700 hours on April 23, 1988. Therefore, determination of atmospheric stability should use the 36 m separation criteria for the period February 24, 1977-April 22, 1988 shown in Table 6.0-8. Data starting on April 23, 1988 or later should use the 50 m separation criteria.

Table 6.0-8
ONS Delta-T Ranges per Vertical Separation Distances

Stability Class	36m separation Delta-T (between 46m-10m levels) FEB 24, 1977 - APRIL 18, 1988 (4/18/88 ending hour 1430)	50m separation Delta-T (between 60m-10m levels) Starting at hour 1700 on April 23, 1988.
A	$dT \leq -0.68$	$dT \leq -0.95$
B	$-0.68 < dT \leq -0.61$	$-0.95 < dT \leq -0.85$
C	$-0.61 < dT \leq -0.54$	$-0.85 < dT \leq -0.75$
D	$-0.54 < dT \leq -0.18$	$-0.75 < dT \leq -0.25$
E	$-0.18 < dT \leq 0.54$	$-0.25 < dT \leq 0.75$
F	$0.54 < dT \leq 1.44$	$0.75 < dT \leq 2.00$
G	$1.44 < dT$	$2.00 < dT$

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Table 6.0-9
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Oconee Semi-Elevated χ/Q Average Values (1988-1992)
(sec/m^3)

Sector	1.0-1.5*	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	5.220E-07	2.650E-07	1.594E-07	1.069E-07	7.719E-08	7.321E-08	5.665E-08	4.542E-08
NNE	8.379E-07	4.734E-07	2.690E-07	2.003E-07	1.385E-07	1.091E-07	8.379E-08	6.676E-08
NE	9.503E-07	6.350E-07	3.962E-07	2.535E-07	1.847E-07	1.497E-07	1.157E-07	9.246E-08
ENE	8.116E-07	4.856E-07	2.919E-07	2.196E-07	1.619E-07	1.239E-07	9.609E-08	7.720E-08
E	5.950E-07	3.202E-07	2.015E-07	2.270E-07	1.745E-07	1.292E-07	1.024E-07	8.308E-08
ESE	4.531E-07	3.300E-07	3.623E-07	4.020E-07	2.822E-07	2.109E-07	1.688E-07	1.405E-07
SE	7.505E-07	4.573E-07	5.490E-07	5.110E-07	3.560E-07	2.648E-07	2.063E-07	1.665E-07
SSE	1.419E-06	7.428E-07	4.527E-07	3.489E-07	2.866E-07	2.131E-07	1.659E-07	1.337E-07
S	1.170E-06	6.099E-07	3.701E-07	2.496E-07	1.810E-07	1.552E-07	1.218E-07	9.867E-08
SSW	1.214E-06	6.327E-07	3.564E-07	2.301E-07	1.621E-07	1.213E-07	9.481E-08	7.660E-08
SW	1.672E-06	7.285E-07	4.057E-07	2.720E-07	1.891E-07	1.400E-07	1.085E-07	8.708E-08
WSW	1.558E-06	6.820E-07	3.804E-07	2.438E-07	1.708E-07	1.271E-07	1.010E-07	8.114E-08
W	1.193E-06	5.214E-07	2.909E-07	1.867E-07	1.372E-07	1.032E-07	8.326E-08	6.654E-08
WNW	4.658E-07	2.480E-07	1.760E-07	1.482E-07	1.024E-07	7.695E-08	5.943E-08	4.796E-08
NW	4.831E-07	2.524E-07	1.965E-07	1.291E-07	9.959E-08	7.356E-08	5.682E-08	4.566E-08
NNW	5.375E-07	2.769E-07	2.128E-07	1.394E-07	1.072E-07	7.913E-08	6.110E-08	4.907E-08

* Units are in miles from the station. As discussed in Oconee UFSAR Section 2.1.1.3, the boundary for establishing gaseous effluent release limits is the exclusion area boundary (EAB). The EAB is at a radius of 1.0 mile from the station center. Each χ/Q value is calculated at the closest location for the sector, e.g., 1.672E-06 sec/m^3 is the χ/Q value at 1.0 mile (SW) from the station.

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Oconee Semi-Elevated D/Q Average Values (1988-1992)
(m^{-2})

Sector	1.0-1.5*	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	2.890E-09	1.184E-09	6.225E-10	3.812E-10	2.586E-10	3.380E-10	2.510E-10	1.943E-10
NNE	9.113E-09	3.989E-09	2.013E-09	1.248E-09	8.235E-10	8.997E-10	6.667E-10	5.138E-10
NE	1.295E-08	5.666E-09	2.919E-09	1.729E-09	1.145E-09	1.224E-09	9.140E-10	7.067E-10
ENE	7.899E-09	3.385E-09	1.756E-09	1.095E-09	9.819E-10	7.671E-10	5.749E-10	4.466E-10
E	4.454E-09	1.775E-09	9.252E-10	7.164E-10	7.491E-10	5.267E-10	3.981E-10	3.125E-10
ESE	4.361E-09	1.838E-09	1.086E-09	1.322E-09	8.696E-10	6.161E-10	5.153E-10	4.139E-10
SE	3.397E-09	1.385E-09	8.341E-10	1.649E-09	1.080E-09	7.595E-10	5.629E-10	4.340E-10
SSE	3.333E-09	1.323E-09	6.920E-10	4.404E-10	7.307E-10	5.202E-10	3.922E-10	3.091E-10
S	3.192E-09	1.256E-09	6.530E-10	4.020E-10	2.788E-10	2.177E-10	1.759E-10	1.501E-10
SSW	5.190E-09	1.972E-09	9.899E-10	5.895E-10	3.928E-10	2.842E-10	2.192E-10	1.778E-10
SW	1.205E-08	4.399E-09	2.193E-09	1.299E-09	8.521E-10	6.028E-10	4.518E-10	3.546E-10
WSW	1.047E-08	3.824E-09	1.908E-09	1.127E-09	7.422E-10	5.277E-10	3.980E-10	3.145E-10
W	5.577E-09	2.044E-09	1.025E-09	6.094E-10	4.134E-10	3.405E-10	3.962E-10	3.052E-10
WNW	2.185E-09	9.042E-10	5.220E-10	6.464E-10	4.227E-10	3.188E-10	2.360E-10	1.868E-10
NW	2.097E-09	8.759E-10	5.225E-10	3.196E-10	4.521E-10	3.178E-10	2.353E-10	1.812E-10
NNW	2.461E-09	1.028E-09	6.219E-10	3.765E-10	5.128E-10	3.604E-10	2.667E-10	2.054E-10

* Units are in miles from the station. As discussed in Oconee UFSAR Section 2.1.1.3, the boundary for establishing gaseous effluent release limits is the exclusion area boundary (EAB). The EAB is defined as a 1 mile radius from the station center. Each D/Q value is calculated at the closest location for the sector, e.g., 1.205E-08 m^{-2} is the D/Q value at 1.0 mile (SW) from the station.

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Oconee Ground Level χ/Q Average Values (1988-1992)
 (sec/m³)

Sector	1.0-1.5*	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	2.115E-06	8.389E-07	4.495E-07	2.822E-07	1.952E-07	1.443E-07	1.117E-07	8.961E-08
NNE	2.898E-06	1.137E-06	6.047E-07	3.775E-07	2.602E-07	1.916E-07	1.480E-07	1.184E-07
NE	3.886E-06	1.529E-06	8.158E-07	5.108E-07	3.529E-07	2.604E-07	2.015E-07	1.616E-07
ENE	3.226E-06	1.277E-06	6.848E-07	4.305E-07	2.983E-07	2.207E-07	1.711E-07	1.374E-07
E	3.522E-06	1.410E-06	7.658E-07	4.866E-07	3.400E-07	2.534E-07	1.977E-07	1.596E-07
ESE	5.964E-06	2.407E-06	1.321E-06	8.459E-07	5.950E-07	4.457E-07	3.493E-07	2.832E-07
SE	7.308E-06	2.972E-06	1.631E-06	1.044E-06	7.342E-07	5.497E-07	4.307E-07	3.490E-07
SSE	6.604E-06	2.657E-06	1.440E-06	9.117E-07	6.354E-07	4.723E-07	3.676E-07	2.962E-07
S	5.278E-06	2.121E-06	1.146E-06	7.237E-07	5.032E-07	3.734E-07	2.901E-07	2.335E-07
SSW	3.986E-06	1.589E-06	8.536E-07	5.370E-07	3.721E-07	2.753E-07	2.135E-07	1.714E-07
SW	4.108E-06	1.620E-06	8.628E-07	5.390E-07	3.715E-07	2.735E-07	2.112E-07	1.689E-07
WSW	3.804E-06	1.503E-06	8.018E-07	5.015E-07	3.460E-07	2.549E-07	1.970E-07	1.577E-07
W	2.978E-06	1.186E-06	6.361E-07	3.995E-07	2.765E-07	2.043E-07	1.583E-07	1.270E-07
WNW	2.201E-06	8.791E-07	4.726E-07	2.974E-07	2.062E-07	1.526E-07	1.183E-07	9.502E-08
NW	2.104E-06	8.385E-07	4.499E-07	2.826E-07	1.957E-07	1.447E-07	1.121E-07	8.991E-08
NNW	2.221E-06	8.860E-07	4.755E-07	2.988E-07	2.069E-07	1.529E-07	1.185E-07	9.508E-08

* Units are in miles from the station. As discussed in Oconee UFSAR Section 2.1.1.3, the boundary for establishing gaseous effluent release limits is the exclusion area boundary (EAB). The EAB is defined as a 1 mile radius from the station center. Each χ/Q value is calculated at the closest location for the sector, e.g., 4.108E-06 sec/m³ is the χ/Q value at 1.0 mile (SW) from the station.

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Oconee Ground Level D/Q Average Values (1988-1992)
(m^{-2})

Sector	1.0-1.5*	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0
N	6.916E-09	2.484E-09	1.232E-09	7.255E-10	4.750E-10	3.342E-10	2.477E-10	1.909E-10
NNE	1.642E-08	5.897E-09	2.924E-09	1.722E-09	1.128E-09	7.934E-10	5.880E-10	4.531E-10
NE	2.259E-08	8.114E-09	4.024E-09	2.369E-09	1.551E-09	1.092E-09	8.090E-10	6.235E-10
ENE	1.428E-08	5.130E-09	2.544E-09	1.498E-09	9.810E-10	6.902E-10	5.115E-10	3.942E-10
E	9.899E-09	3.556E-09	1.763E-09	1.038E-09	6.798E-10	4.784E-10	3.545E-10	2.732E-10
ESE	1.336E-08	4.798E-09	2.379E-09	1.401E-09	9.174E-10	6.455E-10	4.784E-10	3.686E-10
SE	1.401E-08	5.034E-09	2.496E-09	1.470E-09	9.625E-10	6.772E-10	5.019E-10	3.868E-10
SSE	1.226E-08	4.404E-09	2.184E-09	1.286E-09	8.420E-10	5.925E-10	4.391E-10	3.384E-10
S	1.008E-08	3.620E-09	1.795E-09	1.057E-09	6.922E-10	4.871E-10	3.610E-10	2.782E-10
SSW	9.941E-09	3.571E-09	1.771E-09	1.043E-09	6.828E-10	4.804E-10	3.560E-10	2.744E-10
SW	1.717E-08	6.169E-09	3.059E-09	1.801E-09	1.180E-09	8.300E-10	6.151E-10	4.740E-10
WSW	1.574E-08	5.655E-09	2.804E-09	1.651E-09	1.081E-09	7.608E-10	5.638E-10	4.345E-10
W	9.988E-09	3.588E-09	1.779E-09	1.048E-09	6.860E-10	4.827E-10	3.577E-10	2.757E-10
WNW	5.953E-09	2.138E-09	1.060E-09	6.244E-10	4.088E-10	2.877E-10	2.132E-10	1.643E-10
NW	5.891E-09	2.116E-09	1.049E-09	6.179E-10	4.046E-10	2.847E-10	2.110E-10	1.626E-10
NNW	6.672E-09	2.397E-09	1.188E-09	6.998E-10	4.582E-10	3.224E-10	2.390E-10	1.841E-10

* Units are in miles from the station. As discussed in Oconee UFSAR Section 2.1.1.3, the boundary for establishing gaseous effluent release limits is the exclusion area boundary (EAB). The EAB is defined as a 1 mile radius from the station center. Each D/Q value is calculated at the closest location for the sector, e.g., 1.717E-08 m^{-2} is the D/Q value at 1.0 mile (SW) from the station.

7.0 LICENSEE INITIATED CHANGES

All ODCM changes are reviewed by knowledgeable individual(s), and approved by either the Station Manager or Radiation Protection Manager. The below changes do not adversely impact the accuracy or reliability of effluent, dose, or setpoint calculations.

ODCM Revision 58 - Implementation Date: February 18, 2017

ODCM Revision 58 was approved by the Station Manager on February 18, 2017. Some changes reflected in ODCM Revision 58 were implemented prior to February 18, 2017 under a different change and approval process (e.g., land use census), and in those cases the implementation date is noted below.

Table of Contents - Page ii

Marked 6.0-3, Land Use Census Map, as deleted in List of Figures. Marked 6.0-3, Land Use Census Results, as deleted in List of Tables.

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

Executive Summary - Page 2

Revised statement in first paragraph from:

"Normally RETDAS, a computer code that implements NUREG-0133 methodology, is used for the calculation of offsite doses, but the ODCM also provides a method for the calculation of offsite doses when RETDAS is not available."

to:

"Software implementing NUREG-0133 methodology is used for the calculation of offsite doses, but the ODCM also provides a method for the calculation of offsite doses when the software is not available."

Make statement more generic since RETDAS will be retired and replaced with OpenEMS at Oconee in 2017.

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Revised statements in second paragraph from:

"The ODCM has been prepared as generically as possible in order to minimize the need for revisions. However, some changes to the ODCM such as land use census data are expected on an annual basis. Any changes to the methodology and parameters to be used in this ODCM shall be reviewed by knowledgeable individual(s), and approved by the Station Manager prior to implementation. Changes to the ODCM shall be submitted to the Nuclear Regulatory Commission in accordance with the SLCs and Technical Specifications."

to:

"The ODCM has been prepared as generically as possible in order to minimize the need for revisions. Any changes to the methodology and parameters to be used in this ODCM shall be reviewed by knowledgeable individual(s), and approved by the Station Manager or Radiation Protection Manager prior to implementation. Changes to the ODCM shall be submitted to the Nuclear Regulatory Commission in accordance with the SLCs and Technical Specifications."

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. Also updated ODCM approval authority statement based on NRC approved license amendments 389, 390, and 391 to Technical Specification 5.5.1, allowing for Radiation Protection Manager approval.

Section 1 - Page 3

Revised statements in third paragraph from:

"Radioactivity released from secondary system steam releases is documented and included in the site effluent release total"

to:

"Secondary side steam releases are reviewed for inclusion in the site effluent total."

Change made based on recommendation in DRR 01944566. The ODCM can be interpreted to include other secondary side releases including minor steam leaks and other miscellaneous releases. There can be numerous steam leaks that are insignificant in radioactivity released that would need to be included in the effluent release total based on how the statement is interpreted. The intent of the statement is to include significant secondary releases that could impact dose calculations and activity released. Clarifies intention of ODCM statement.

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Section 4 - Page 1

Revised statements in first paragraph from:

"Dose contributions to the maximum individual shall be calculated at least every 31 days, quarterly, and annually using the RETDAS computer code which implements the ODCM methodology. RETDAS, Radioactive Effluent Tracking and Dose Assessment Software, is a database application designed by Canberra Industries, Inc. to automate many of the tasks required in the administration of effluent releases at Oconee. RETDAS performs normal operation effluent dose assessment using NUREG-0133 and Regulatory Guide 1.109 methodology."

to:

"Dose contributions to the maximum individual shall be calculated at least every 31 days, quarterly, and annually using software which implements the ODCM methodology. The software is designed to automate many of the tasks required in the administration of effluent releases at Oconee and performs normal operation effluent dose assessment using NUREG-0133 and Regulatory Guide 1.109 methodology."

Revised statements in third paragraph from:

"Dose contributions shall be calculated using the RETDAS computer program."

to:

"Dose contributions shall be calculated using the software implementing the ODCM methodology."

Make statement more generic since RETDAS will be retired and replaced with OpenEMS at Oconee in 2017.

Section 4 - Page 8

Removed reference to Table 6.0-3 in "*" note. Statement changed from:

"Dose is calculated only for pathways (e.g., garden, milk animal, etc.) that actually exist at each location as determined by the land use census shown in Table 6.0-3."

to:

"Dose is calculated only for pathways (e.g., garden, milk animal, etc.) that actually exist at each location as determined by the land use census."

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions.

Section 5.0.5 - Page 2

Revised statements in first paragraph from:

"The increments of dose resulting from liquid and gaseous effluent releases will be calculated using the ODCM methodology implemented in the RETDAS computer program."

to:

"The increments of dose resulting from liquid and gaseous effluent releases will be calculated using the software implementing the ODCM methodology."

Make statement more generic since RETDAS will be retired and replaced with OpenEMS at Oconee in 2017.

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Section 6.0.2 - Page 1

Revised from:

"The Annual Land Use Census, required by Selected Licensee Commitments, is performed to ensure that changes in the use of areas at or beyond the site boundary are identified, and that modifications to the Radiological Environmental Monitoring Program are made if required by changes in land use. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR50. Results are shown in Table 6.0-3 and Figure 6.0-3."

to:

"The Annual Land Use Census, required by Selected Licensee Commitments, is performed to ensure that changes in the use of areas at or beyond the site boundary are identified, and that modifications to the Radiological Environmental Monitoring Program are made if required by changes in land use. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10CFR50. The land use census identifies nearest pathways to the exclusion area boundary (EAB, ~ 0.5 mile) for each of the 16 meteorological sectors. Global Positioning System field measurements are taken as close as possible to the item of interest and are accurate to within 2-5 meters. Locations beyond the nearest pathway for each sector are assumed to contain that pathway for dose calculation purposes. For the 4.5-5.0 mile sector all pathways, i.e., residence, garden, milk animal (goat), and meat animal (cow), are assumed to exist for dose calculation purposes. Results are maintained on file and data reviewed in accordance with procedure AD-CP-ALL-0014, Land Use Census Evaluation."

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

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Section 6 - Page 2

Revised Table 6.0-1 to remove shoreline sediment semi-annual sample collection from location 063. Added new location 091 titled "Holders Landing Road (2.09 miles S)" with a semi-annual shoreline sediment sample collection frequency.

Change made based on recommendation in DRR 02083950. Safety concerns with shoreline sediment collection at location 063, Lake Hartwell Hwy 183 Bridge, due to bank erosion, poison ivy, and snakes. A new location, 091 Holders Landing Road, was determined to be a suitable replacement location to collect a sample.

Section 6 - Page 3

Revised Table 6.0-2 to add the following locations:

- 077 (1.00 miles SW) - Skimmer Wall shared with air monitoring location
- 078.1 (0.53 miles WSW) - ONS Recreation Site shared with air monitoring location
- 085 (0.88 miles NNW) - Lake Services Bldg 9125 shared with air monitoring location
- 086 (0.83 miles NW) - Lake Keowee Service Rd at Boat Landing
- 087 (1.33 miles WNW) - End of Waterfall Road
- 088 (1.00 SSW) - Doug Hollow Rd / Transmission Tower
- 089 (1.19 miles S) - Intersection Hwy 130 & Keowee River Road
- 090 (0.79 miles SE) - Crescent Resources, Keowee River Road at Beaver Dam

Change made based on recommendation in DRR 02035396. Added new REMP TLD locations to program.

Section 6 - Page 4

Deleted Table 6.0-3 and moved relevant information from "*" and "***" Note paragraphs to Section 6.0.2.

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

Section 6 - Page 5

Updated Figure 6.0-1 Sampling Locations Map (Site Boundary) to reflect newly added REMP locations discussed in DRR 02083950 and DRR 02035396

Section 6 - Page 6

Updated Figure 6.0-2 Sampling Locations Map (Ten Mile Radius) to reflect newly added REMP locations discussed in DRR 02083950 and DRR 02035396

Section 6 - Page 7

Deleted Figure 6.0-3.

Change made based on recommendation in DRR 02068939 to improve efficiency by eliminating annual ODCM revisions. This does not adversely impact the accuracy or reliability of dose calculations, as records of the Land Use Census are maintained in EnRad files and documented with procedure AD-CP-ALL-0014, Land Use Census Evaluation. Changes to Effluent Management Software are implemented based on results of annual Land Use Census, once approved.

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX A

Dose Factors for Exposure to a Semi-Infinite Cloud of Noble Gases*

Nuclide	K _i Total Body mrem/yr/ μCi/m ³	L _i Skin mrem/yr/ μCi/m ³	M _i Gamma Air mrad/yr/ μCi/m ³	N _i Beta Air mrad/yr/ μCi/m ³
AR-41	8.840E+03	2.690E+03	9.300E+03	3.280E+03
KR-83M	7.560E-02	0.000E+00	1.930E+01	2.880E+02
KR-85M	1.170E+03	1.460E+03	1.230E+03	1.970E+03
KR-85	1.610E+01	1.340E+03	1.720E+01	1.950E+03
KR-87	5.920E+03	9.730E+03	6.170E+03	1.030E+04
KR-88	1.470E+04	2.370E+03	1.520E+04	2.930E+03
KR-89	1.660E+04	1.010E+04	1.730E+04	1.060E+04
KR-90	1.560E+04	7.290E+03	1.630E+04	7.830E+03
XE-131M	9.150E+01	4.760E+02	1.560E+02	1.110E+03
XE-133M	2.510E+02	9.940E+02	3.270E+02	1.480E+03
XE-133	2.940E+02	3.060E+02	3.530E+02	1.050E+03
XE-135M	3.120E+03	7.110E+02	3.360E+03	7.390E+02
XE-135	1.810E+03	1.860E+03	1.920E+03	2.460E+03
XE-137	1.420E+03	1.220E+04	1.510E+03	1.270E+04
XE-138	8.830E+03	4.130E+03	9.210E+03	4.750E+03

* Reference Regulatory Guide 1.109, Table B-1

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APPENDIX B

P_i Dose Factors for use in the Gaseous Release Rate Limit Calculations

Agegroup:	CHILD	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
	Bone		Liver	Thyroid	Kidney		Lung	Gilli
H-3	0.000E+00	1.120E+03	1.120E+03	1.120E+03	1.120E+03	1.120E+03	0.000E+00	1.120E+03
C-14	3.590E+04	6.730E+03	6.730E+03	6.730E+03	6.730E+03	6.730E+03	0.000E+00	6.730E+03
NA-24	1.610E+04	1.610E+04	1.610E+04	1.610E+04	1.610E+04	1.610E+04	0.000E+00	1.610E+04
P-32	2.600E+06	1.140E+05	0.000E+00	0.000E+00	0.000E+00	4.220E+04	0.000E+00	9.880E+04
CR-51	0.000E+00	0.000E+00	8.550E+01	2.430E+01	1.700E+04	1.080E+03	0.000E+00	1.540E+02
MN-54	0.000E+00	4.290E+04	0.000E+00	1.000E+04	1.580E+06	2.290E+04	0.000E+00	9.510E+03
MN-56	0.000E+00	1.660E+00	0.000E+00	1.670E+00	1.310E+04	1.230E+05	0.000E+00	3.120E-01
FE-55	4.740E+04	2.520E+04	0.000E+00	0.000E+00	1.110E+05	2.870E+03	0.000E+00	7.770E+03
FE-59	2.070E+04	3.340E+04	0.000E+00	0.000E+00	1.270E+06	7.070E+04	0.000E+00	1.670E+04
CO-58	0.000E+00	1.770E+03	0.000E+00	0.000E+00	1.110E+06	3.440E+04	0.000E+00	3.160E+03
CO-60	0.000E+00	1.310E+04	0.000E+00	0.000E+00	7.070E+06	9.620E+04	0.000E+00	2.260E+04
NI-63	8.210E+05	4.620E+04	0.000E+00	0.000E+00	2.750E+05	6.330E+03	0.000E+00	2.800E+04
NI-65	2.990E+00	2.960E-01	0.000E+00	0.000E+00	8.180E+03	8.400E+04	0.000E+00	1.640E-01
CU-64	0.000E+00	1.990E+00	0.000E+00	6.030E+00	9.580E+03	3.670E+04	0.000E+00	1.070E+00
ZN-65	4.260E+04	1.130E+05	0.000E+00	7.140E+04	9.950E+05	1.630E+04	0.000E+00	7.030E+04
ZN-69	6.700E-02	9.660E-02	0.000E+00	5.850E-02	1.420E+03	1.020E+04	0.000E+00	8.920E-03
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.740E+02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.480E+02
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.530E+01
RB-86	0.000E+00	1.980E+05	0.000E+00	0.000E+00	0.000E+00	7.990E+03	0.000E+00	1.140E+05
RB-88	0.000E+00	5.620E+02	0.000E+00	0.000E+00	0.000E+00	1.720E+01	0.000E+00	3.660E+02
RB-89	0.000E+00	3.450E+02	0.000E+00	0.000E+00	0.000E+00	1.890E+00	0.000E+00	2.900E+02
SR-89	5.990E+05	0.000E+00	0.000E+00	0.000E+00	2.160E+06	1.670E+05	0.000E+00	1.720E+04
SR-90	1.010E+08	0.000E+00	0.000E+00	0.000E+00	1.480E+07	3.430E+05	0.000E+00	6.440E+06
SR-91	1.210E+02	0.000E+00	0.000E+00	0.000E+00	5.330E+04	1.740E+05	0.000E+00	4.590E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX B

P_i Dose Factors for use in the Gaseous Release Rate Limit Calculations

Agegroup:	CHILD	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	1.310E+01	0.000E+00	0.000E+00	0.000E+00	2.400E+04	2.420E+05	0.000E+00	5.250E-01
Y-90	4.110E+03	0.000E+00	0.000E+00	0.000E+00	2.620E+05	2.680E+05	0.000E+00	1.110E+02
Y-91	9.140E+05	0.000E+00	0.000E+00	0.000E+00	2.630E+06	1.840E+05	0.000E+00	2.440E+04
Y-91M	5.070E-01	0.000E+00	0.000E+00	0.000E+00	2.810E+03	1.720E+03	0.000E+00	1.840E-02
Y-92	2.030E+01	0.000E+00	0.000E+00	0.000E+00	2.390E+04	2.390E+05	0.000E+00	5.810E-01
Y-93	1.860E+02	0.000E+00	0.000E+00	0.000E+00	7.440E+04	3.880E+05	0.000E+00	5.110E+00
ZR-95	1.900E+05	4.180E+04	0.000E+00	5.960E+04	2.230E+06	6.110E+04	0.000E+00	3.700E+04
ZR-97	1.880E+02	2.720E+01	0.000E+00	3.880E+01	1.130E+05	3.510E+05	0.000E+00	1.600E+01
NB-95	2.350E+04	9.180E+03	0.000E+00	8.620E+03	6.140E+05	3.700E+04	0.000E+00	6.550E+03
MO-99	0.000E+00	1.720E+02	0.000E+00	3.920E+02	1.350E+05	1.270E+05	0.000E+00	4.260E+01
TC-99M	1.780E-03	3.480E-03	0.000E+00	5.070E-02	9.510E+02	4.810E+03	0.000E+00	5.770E-02
TC-101	8.100E-05	8.510E-05	0.000E+00	1.450E-03	5.850E+02	1.630E+01	0.000E+00	1.080E-03
RU-103	2.790E+03	0.000E+00	0.000E+00	7.030E+03	6.620E+05	4.480E+04	0.000E+00	1.070E+03
RU-105	1.530E+00	0.000E+00	0.000E+00	1.340E+00	1.590E+04	9.950E+04	0.000E+00	5.550E-01
RU-106	1.360E+05	0.000E+00	0.000E+00	1.840E+05	1.430E+07	4.290E+05	0.000E+00	1.690E+04
AG-110M	1.690E+04	1.140E+04	0.000E+00	2.120E+04	5.480E+06	1.000E+05	0.000E+00	9.140E+03
TE-125M	6.730E+03	2.330E+03	1.920E+03	0.000E+00	4.770E+05	3.380E+04	0.000E+00	9.140E+02
TE-127	2.770E+00	9.510E-01	1.960E+00	7.070E+00	1.000E+04	5.620E+04	0.000E+00	6.100E-01
TE-127M	2.490E+04	8.550E+03	6.070E+03	6.360E+04	1.480E+06	7.140E+04	0.000E+00	3.020E+03
TE-129	9.770E-02	3.500E-02	7.140E-02	2.570E-01	2.930E+03	2.550E+04	0.000E+00	2.380E-02
TE-129M	1.920E+04	6.840E+03	6.330E+03	5.030E+04	1.760E+06	1.820E+05	0.000E+00	3.040E+03
TE-131	2.170E-02	8.440E-03	1.700E-02	5.880E-02	2.050E+03	1.330E+03	0.000E+00	6.590E-03
TE-131M	1.340E+02	5.920E+01	9.770E+01	4.000E+02	2.060E+05	3.080E+05	0.000E+00	5.070E+01
TE-132	4.810E+02	2.720E+02	3.170E+02	1.770E+03	3.770E+05	1.380E+05	0.000E+00	2.630E+02
I-130	8.180E+03	1.640E+04	1.850E+06	2.450E+04	0.000E+00	5.110E+03	0.000E+00	8.440E+03

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Summary of Changes to the Offsite Dose Calculation Manual

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APPENDIX B

P_i Dose Factors for use in the Gaseous Release Rate Limit Calculations

Agegroup:	CHILD	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	4.810E+04	4.810E+04	1.620E+07	7.880E+04	0.000E+00	2.840E+03	0.000E+00	2.730E+04
I-132	2.120E+03	4.070E+03	1.940E+05	6.250E+03	0.000E+00	3.200E+03	0.000E+00	1.880E+03
I-133	1.660E+04	2.030E+04	3.850E+06	3.380E+04	0.000E+00	5.480E+03	0.000E+00	7.700E+03
I-134	1.170E+03	2.160E+03	5.070E+04	3.300E+03	0.000E+00	9.550E+02	0.000E+00	9.950E+02
I-135	4.920E+03	8.730E+03	7.920E+05	1.340E+04	0.000E+00	4.440E+03	0.000E+00	4.140E+03
CS-134	6.510E+05	1.010E+06	0.000E+00	3.300E+05	1.210E+05	3.850E+03	0.000E+00	2.250E+05
CS-136	6.510E+04	1.710E+05	0.000E+00	9.550E+04	1.450E+04	4.180E+03	0.000E+00	1.160E+05
CS-137	9.060E+05	8.250E+05	0.000E+00	2.820E+05	1.040E+05	3.620E+03	0.000E+00	1.280E+05
CS-138	6.330E+02	8.400E+02	0.000E+00	6.220E+02	6.810E+01	2.700E+02	0.000E+00	5.550E+02
BA-139	1.840E+00	9.840E-04	0.000E+00	8.620E-04	5.770E+03	5.770E+04	0.000E+00	5.360E-02
BA-140	7.400E+04	6.480E+01	0.000E+00	2.110E+01	1.740E+06	1.020E+05	0.000E+00	4.330E+03
BA-141	1.960E-01	1.090E-04	0.000E+00	9.470E-05	2.920E+03	2.750E+02	0.000E+00	6.360E-03
BA-142	5.000E-02	3.600E-05	0.000E+00	2.910E-05	1.640E+03	2.740E+00	0.000E+00	2.790E-03
LA-140	6.440E+02	2.250E+02	0.000E+00	0.000E+00	1.830E+05	2.260E+05	0.000E+00	7.550E+01
LA-142	1.300E+00	4.110E-01	0.000E+00	0.000E+00	8.700E+03	7.580E+04	0.000E+00	1.290E-01
CE-141	3.920E+04	1.950E+04	0.000E+00	8.550E+03	5.440E+05	5.660E+04	0.000E+00	2.900E+03
CE-143	3.660E+02	1.990E+02	0.000E+00	8.360E+01	1.150E+05	1.270E+05	0.000E+00	2.870E+01
CE-144	6.770E+06	2.120E+06	0.000E+00	1.170E+06	1.200E+07	3.880E+05	0.000E+00	3.610E+05
PR-143	1.850E+04	5.550E+03	0.000E+00	3.000E+03	4.330E+05	9.730E+04	0.000E+00	9.140E+02
PR-144	5.960E-02	1.850E-02	0.000E+00	9.770E-03	1.570E+03	1.970E+02	0.000E+00	3.000E-03
ND-147	1.080E+04	8.730E+03	0.000E+00	4.810E+03	3.280E+05	8.210E+04	0.000E+00	6.810E+02
W-187	1.630E+01	9.660E+00	0.000E+00	0.000E+00	4.110E+04	9.100E+04	0.000E+00	4.330E+00
NP-239	4.660E+02	3.340E+01	0.000E+00	9.730E+01	5.810E+04	6.400E+04	0.000E+00	2.350E+01

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	8.740E+00	8.740E+00	8.740E+00	8.740E+00	8.740E+00	0.000E+00	8.740E+00
C-14	2.360E+02	4.730E+01	4.730E+01	4.730E+01	4.730E+01	4.730E+01	0.000E+00	4.730E+01
NA-24	8.140E+01	8.140E+01	8.140E+01	8.140E+01	8.140E+01	8.140E+01	0.000E+00	8.140E+01
P-32	1.570E+04	9.750E+02	0.000E+00	0.000E+00	0.000E+00	1.760E+03	0.000E+00	6.060E+02
CR-51	0.000E+00	0.000E+00	1.310E-01	4.820E-02	2.900E-01	5.500E+01	0.000E+00	2.190E-01
MN-54	0.000E+00	3.800E+02	0.000E+00	1.130E+02	0.000E+00	1.160E+03	0.000E+00	7.250E+01
MN-56	0.000E+00	3.800E-01	0.000E+00	4.820E-01	0.000E+00	1.210E+01	0.000E+00	6.740E-02
FE-55	2.290E+02	1.580E+02	0.000E+00	0.000E+00	8.820E+01	9.070E+01	0.000E+00	3.690E+01
FE-59	3.580E+02	8.420E+02	0.000E+00	0.000E+00	2.350E+02	2.810E+03	0.000E+00	3.230E+02
CO-58	0.000E+00	6.170E+01	0.000E+00	0.000E+00	0.000E+00	1.250E+03	0.000E+00	1.380E+02
CO-60	0.000E+00	1.780E+02	0.000E+00	0.000E+00	0.000E+00	3.340E+03	0.000E+00	3.930E+02
NI-63	1.080E+04	7.500E+02	0.000E+00	0.000E+00	0.000E+00	1.560E+02	0.000E+00	3.630E+02
NI-65	1.620E+00	2.100E-01	0.000E+00	0.000E+00	0.000E+00	5.340E+00	0.000E+00	9.600E-02
CU-64	0.000E+00	3.590E+00	0.000E+00	9.060E+00	0.000E+00	3.060E+02	0.000E+00	1.690E+00
ZN-65	4.020E+02	1.280E+03	0.000E+00	8.560E+02	0.000E+00	8.060E+02	0.000E+00	5.780E+02
ZN-69	1.070E-04	2.050E-04	0.000E+00	1.330E-04	0.000E+00	3.080E-05	0.000E+00	1.430E-05
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.480E-01	0.000E+00	1.030E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.270E-12	0.000E+00	6.710E-07
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.380E-77
RB-86	0.000E+00	1.720E+03	0.000E+00	0.000E+00	0.000E+00	3.400E+02	0.000E+00	8.030E+02
RB-88	0.000E+00	3.360E-12	0.000E+00	0.000E+00	0.000E+00	4.640E-23	0.000E+00	1.780E-12
RB-89	0.000E+00	3.090E-14	0.000E+00	0.000E+00	0.000E+00	1.790E-27	0.000E+00	2.170E-14
SR-89	2.550E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.080E+03	0.000E+00	7.310E+02
SR-90	6.310E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.820E+04	0.000E+00	1.550E+05
SR-91	1.960E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.350E+02	0.000E+00	7.930E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

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APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	8.290E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.640E+02	0.000E+00	3.590E-01
Y-90	7.030E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.460E+03	0.000E+00	1.890E-02
Y-91	1.170E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.420E+03	0.000E+00	3.120E-01
Y-91M	3.360E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.860E-07	0.000E+00	1.300E-08
Y-92	6.710E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.170E+02	0.000E+00	1.960E-04
Y-93	9.770E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.100E+03	0.000E+00	2.700E-03
ZR-95	2.520E+00	8.070E-01	0.000E+00	1.270E+00	0.000E+00	2.560E+03	0.000E+00	5.460E-01
ZR-97	8.540E-02	1.720E-02	0.000E+00	2.600E-02	0.000E+00	5.340E+03	0.000E+00	7.880E-03
NB-95	5.130E-01	2.850E-01	0.000E+00	2.820E-01	0.000E+00	1.730E+03	0.000E+00	1.530E-01
MO-99	0.000E+00	3.160E+02	0.000E+00	7.160E+02	0.000E+00	7.330E+02	0.000E+00	6.020E+01
TC-99M	5.160E-03	1.460E-02	0.000E+00	2.210E-01	7.140E-03	8.630E+00	0.000E+00	1.860E-01
TC-101	1.130E-17	1.630E-17	0.000E+00	2.930E-16	8.320E-18	4.890E-29	0.000E+00	1.600E-16
RU-103	1.530E+01	0.000E+00	0.000E+00	5.820E+01	0.000E+00	1.780E+03	0.000E+00	6.570E+00
RU-105	1.970E-01	0.000E+00	0.000E+00	2.540E+00	0.000E+00	1.200E+02	0.000E+00	7.760E-02
RU-106	2.290E+02	0.000E+00	0.000E+00	4.410E+02	0.000E+00	1.480E+04	0.000E+00	2.890E+01
AG-110M	1.330E+01	1.230E+01	0.000E+00	2.420E+01	0.000E+00	5.020E+03	0.000E+00	7.300E+00
TE-125M	2.220E+02	8.030E+01	6.670E+01	9.020E+02	0.000E+00	8.850E+02	0.000E+00	2.970E+01
TE-127	3.780E+00	1.360E+00	2.800E+00	1.540E+01	0.000E+00	2.980E+02	0.000E+00	8.170E-01
TE-127M	5.620E+02	2.010E+02	1.440E+02	2.280E+03	0.000E+00	1.880E+03	0.000E+00	6.840E+01
TE-129	1.920E-03	7.230E-04	1.480E-03	8.080E-03	0.000E+00	1.450E-03	0.000E+00	4.690E-04
TE-129M	9.470E+02	3.530E+02	3.250E+02	3.950E+03	0.000E+00	4.770E+03	0.000E+00	1.500E+02
TE-131	3.520E-09	1.470E-09	2.900E-09	1.540E-08	0.000E+00	4.990E-10	0.000E+00	1.110E-09
TE-131M	1.090E+02	5.340E+01	8.450E+01	5.400E+02	0.000E+00	5.300E+03	0.000E+00	4.450E+01
TE-132	1.880E+02	1.220E+02	1.350E+02	1.170E+03	0.000E+00	5.770E+03	0.000E+00	1.140E+02
I-130	3.210E+01	9.460E+01	8.020E+03	1.480E+02	0.000E+00	8.140E+01	0.000E+00	3.730E+01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	3.320E+02	4.740E+02	1.550E+05	8.130E+02	0.000E+00	1.250E+02	0.000E+00	2.720E+02
I-132	4.540E-01	1.220E+00	4.250E+01	1.940E+00	0.000E+00	2.280E-01	0.000E+00	4.250E-01
I-133	7.920E+01	1.380E+02	2.020E+04	2.400E+02	0.000E+00	1.240E+02	0.000E+00	4.200E+01
I-134	6.580E-04	1.790E-03	3.100E-02	2.840E-03	0.000E+00	1.560E-06	0.000E+00	6.390E-04
I-135	1.050E+01	2.750E+01	1.810E+03	4.400E+01	0.000E+00	3.100E+01	0.000E+00	1.010E+01
CS-134	5.170E+03	1.230E+04	0.000E+00	3.980E+03	1.320E+03	2.150E+02	0.000E+00	1.010E+04
CS-136	5.280E+02	2.080E+03	0.000E+00	1.160E+03	1.590E+02	2.370E+02	0.000E+00	1.500E+03
CS-137	6.630E+03	9.070E+03	0.000E+00	3.080E+03	1.020E+03	1.760E+02	0.000E+00	5.940E+03
CS-138	8.450E-07	1.670E-06	0.000E+00	1.230E-06	1.210E-07	7.120E-12	0.000E+00	8.260E-07
BA-139	1.990E-02	1.420E-05	0.000E+00	1.330E-05	8.050E-06	3.530E-02	0.000E+00	5.830E-04
BA-140	1.640E+03	2.070E+00	0.000E+00	7.020E-01	1.180E+00	3.390E+03	0.000E+00	1.080E+02
BA-141	5.440E-12	4.120E-15	0.000E+00	3.830E-15	2.340E-15	2.570E-21	0.000E+00	1.840E-13
BA-142	6.290E-21	6.470E-24	0.000E+00	5.460E-24	3.660E-24	8.860E-39	0.000E+00	3.960E-22
LA-140	1.690E-01	8.530E-02	0.000E+00	0.000E+00	0.000E+00	6.260E+03	0.000E+00	2.250E-02
LA-142	5.720E-05	2.600E-05	0.000E+00	0.000E+00	0.000E+00	1.900E-01	0.000E+00	6.480E-06
CE-141	7.710E-01	5.210E-01	0.000E+00	2.420E-01	0.000E+00	1.990E+03	0.000E+00	5.910E-02
CE-143	1.070E-01	7.890E+01	0.000E+00	3.470E-02	0.000E+00	2.950E+03	0.000E+00	8.730E-03
CE-144	4.060E+01	1.700E+01	0.000E+00	1.010E+01	0.000E+00	1.370E+04	0.000E+00	2.180E+00
PR-143	7.460E-01	2.990E-01	0.000E+00	1.730E-01	0.000E+00	3.270E+03	0.000E+00	3.700E-02
PR-144	7.350E-16	3.050E-16	0.000E+00	1.720E-16	0.000E+00	1.060E-22	0.000E+00	3.730E-17
ND-147	5.070E-01	5.860E-01	0.000E+00	3.430E-01	0.000E+00	2.810E+03	0.000E+00	3.510E-02
W-187	6.050E+00	5.050E+00	0.000E+00	0.000E+00	0.000E+00	1.660E+03	0.000E+00	1.770E+00
NP-239	8.550E-02	8.400E-03	0.000E+00	2.620E-02	0.000E+00	1.720E+03	0.000E+00	4.630E-03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	2.260E-01	2.260E-01	2.260E-01	2.260E-01	2.260E-01	0.000E+00	2.260E-01
C-14	3.130E+04	6.260E+03	6.260E+03	6.260E+03	6.260E+03	6.260E+03	0.000E+00	6.260E+03
NA-24	1.350E+02	1.350E+02	1.350E+02	1.350E+02	1.350E+02	1.350E+02	0.000E+00	1.350E+02
P-32	1.320E+06	8.210E+04	0.000E+00	0.000E+00	0.000E+00	1.480E+05	0.000E+00	5.100E+04
CR-51	0.000E+00	0.000E+00	7.420E-01	2.740E-01	1.650E+00	3.120E+02	0.000E+00	1.240E+00
MN-54	0.000E+00	4.370E+03	0.000E+00	1.300E+03	0.000E+00	1.340E+04	0.000E+00	8.330E+02
MN-56	0.000E+00	1.730E-01	0.000E+00	2.200E-01	0.000E+00	5.530E+00	0.000E+00	3.070E-02
FE-55	6.580E+02	4.550E+02	0.000E+00	0.000E+00	2.540E+02	2.610E+02	0.000E+00	1.060E+02
FE-59	1.020E+03	2.400E+03	0.000E+00	0.000E+00	6.720E+02	8.010E+03	0.000E+00	9.220E+02
CO-58	0.000E+00	8.830E+01	0.000E+00	0.000E+00	0.000E+00	1.790E+03	0.000E+00	1.980E+02
CO-60	0.000E+00	2.560E+02	0.000E+00	0.000E+00	0.000E+00	4.810E+03	0.000E+00	5.650E+02
NI-63	3.110E+04	2.160E+03	0.000E+00	0.000E+00	0.000E+00	4.500E+02	0.000E+00	1.040E+03
NI-65	1.720E-01	2.230E-02	0.000E+00	0.000E+00	0.000E+00	5.660E-01	0.000E+00	1.020E-02
CU-64	0.000E+00	2.680E+00	0.000E+00	6.760E+00	0.000E+00	2.290E+02	0.000E+00	1.260E+00
ZN-65	2.310E+04	7.350E+04	0.000E+00	4.920E+04	0.000E+00	4.630E+04	0.000E+00	3.320E+04
ZN-69	7.730E-07	1.480E-06	0.000E+00	9.610E-07	0.000E+00	2.220E-07	0.000E+00	1.030E-07
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.500E-02	0.000E+00	3.820E-02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.850E-18	0.000E+00	1.250E-12
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	9.730E+04	0.000E+00	0.000E+00	0.000E+00	1.920E+04	0.000E+00	4.530E+04
RB-88	0.000E+00	1.290E-22	0.000E+00	0.000E+00	0.000E+00	1.780E-33	0.000E+00	6.830E-23
RB-89	0.000E+00	1.640E-26	0.000E+00	0.000E+00	0.000E+00	9.560E-40	0.000E+00	1.160E-26
SR-89	2.180E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.500E+03	0.000E+00	6.260E+02
SR-90	5.440E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.570E+04	0.000E+00	1.340E+05
SR-91	7.050E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.360E+02	0.000E+00	2.850E+00

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	3.320E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.570E+00	0.000E+00	1.430E-02
Y-90	4.440E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.710E+03	0.000E+00	1.190E-02
Y-91	8.340E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.590E+03	0.000E+00	2.230E-01
Y-91M	1.070E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.150E-11	0.000E+00	4.150E-13
Y-92	4.600E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.060E+00	0.000E+00	1.340E-05
Y-93	3.080E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.770E+02	0.000E+00	8.500E-04
ZR-95	2.380E-01	7.620E-02	0.000E+00	1.200E-01	0.000E+00	2.410E+02	0.000E+00	5.160E-02
ZR-97	4.960E-03	1.000E-03	0.000E+00	1.510E-03	0.000E+00	3.100E+02	0.000E+00	4.570E-04
NB-95	4.380E+02	2.440E+02	0.000E+00	2.410E+02	0.000E+00	1.480E+06	0.000E+00	1.310E+02
MO-99	0.000E+00	8.020E+01	0.000E+00	1.820E+02	0.000E+00	1.860E+02	0.000E+00	1.530E+01
TC-99M	5.590E-04	1.580E-03	0.000E+00	2.400E-02	7.740E-04	9.340E-01	0.000E+00	2.010E-02
TC-101	2.610E-33	3.760E-33	0.000E+00	6.770E-32	1.920E-33	1.130E-44	0.000E+00	3.690E-32
RU-103	4.350E+00	0.000E+00	0.000E+00	1.660E+01	0.000E+00	5.080E+02	0.000E+00	1.870E+00
RU-105	8.670E-03	0.000E+00	0.000E+00	1.120E-01	0.000E+00	5.300E+00	0.000E+00	3.420E-03
RU-106	6.570E+01	0.000E+00	0.000E+00	1.270E+02	0.000E+00	4.250E+03	0.000E+00	8.320E+00
AG-110M	8.790E-01	8.130E-01	0.000E+00	1.600E+00	0.000E+00	3.320E+02	0.000E+00	4.830E-01
TE-125M	2.540E+03	9.190E+02	7.630E+02	1.030E+04	0.000E+00	1.010E+04	0.000E+00	3.400E+02
TE-127	1.790E+01	6.440E+00	1.330E+01	7.300E+01	0.000E+00	1.410E+03	0.000E+00	3.880E+00
TE-127M	6.440E+03	2.300E+03	1.650E+03	2.620E+04	0.000E+00	2.160E+04	0.000E+00	7.850E+02
TE-129	1.630E-05	6.120E-06	1.250E-05	6.850E-05	0.000E+00	1.230E-05	0.000E+00	3.970E-06
TE-129M	1.080E+04	4.020E+03	3.710E+03	4.500E+04	0.000E+00	5.430E+04	0.000E+00	1.710E+03
TE-131	8.710E-17	3.640E-17	7.160E-17	3.820E-16	0.000E+00	1.230E-17	0.000E+00	2.750E-17
TE-131M	9.510E+02	4.650E+02	7.370E+02	4.710E+03	0.000E+00	4.620E+04	0.000E+00	3.880E+02
TE-132	1.950E+03	1.260E+03	1.390E+03	1.210E+04	0.000E+00	5.960E+04	0.000E+00	1.180E+03
I-130	7.050E+00	2.080E+01	1.760E+03	3.250E+01	0.000E+00	1.790E+01	0.000E+00	8.210E+00

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.370E+02	1.960E+02	6.420E+04	3.360E+02	0.000E+00	5.170E+01	0.000E+00	1.120E+02
I-132	5.270E-03	1.410E-02	4.940E-01	2.250E-02	0.000E+00	2.650E-03	0.000E+00	4.940E-03
I-133	2.290E+01	3.990E+01	5.860E+03	6.950E+01	0.000E+00	3.580E+01	0.000E+00	1.210E+01
I-134	2.120E-08	5.750E-08	9.960E-07	9.140E-08	0.000E+00	5.010E-11	0.000E+00	2.060E-08
I-135	1.290E+00	3.370E+00	2.220E+02	5.410E+00	0.000E+00	3.810E+00	0.000E+00	1.240E+00
CS-134	2.980E+05	7.080E+05	0.000E+00	2.290E+05	7.610E+04	1.240E+04	0.000E+00	5.790E+05
CS-136	2.960E+04	1.170E+05	0.000E+00	6.500E+04	8.900E+03	1.330E+04	0.000E+00	8.400E+04
CS-137	3.820E+05	5.220E+05	0.000E+00	1.770E+05	5.890E+04	1.010E+04	0.000E+00	3.420E+05
CS-138	8.940E-12	1.770E-11	0.000E+00	1.300E-11	1.280E-12	7.530E-17	0.000E+00	8.750E-12
BA-139	5.650E-06	4.030E-09	0.000E+00	3.760E-09	2.280E-09	1.000E-05	0.000E+00	1.660E-07
BA-140	1.840E+02	2.310E-01	0.000E+00	7.860E-02	1.320E-01	3.790E+02	0.000E+00	1.210E+01
BA-141	8.700E-25	6.580E-28	0.000E+00	6.120E-28	3.730E-28	4.100E-34	0.000E+00	2.940E-26
BA-142	2.570E-42	2.640E-45	0.000E+00	2.230E-45	1.490E-45	3.620E-60	0.000E+00	1.610E-43
LA-140	9.900E-02	4.990E-02	0.000E+00	0.000E+00	0.000E+00	3.660E+03	0.000E+00	1.320E-02
LA-142	2.210E-07	1.000E-07	0.000E+00	0.000E+00	0.000E+00	7.330E-04	0.000E+00	2.500E-08
CE-141	2.190E-02	1.480E-02	0.000E+00	6.890E-03	0.000E+00	5.670E+01	0.000E+00	1.680E-03
CE-143	2.380E-03	1.760E+00	0.000E+00	7.760E-04	0.000E+00	6.590E+01	0.000E+00	1.950E-04
CE-144	1.170E+00	4.870E-01	0.000E+00	2.890E-01	0.000E+00	3.940E+02	0.000E+00	6.260E-02
PR-143	5.230E-01	2.100E-01	0.000E+00	1.210E-01	0.000E+00	2.290E+03	0.000E+00	2.590E-02
PR-144	1.550E-28	6.440E-29	0.000E+00	3.630E-29	0.000E+00	2.230E-35	0.000E+00	7.880E-30
ND-147	3.530E-01	4.080E-01	0.000E+00	2.390E-01	0.000E+00	1.960E+03	0.000E+00	2.440E-02
W-187	1.470E+02	1.230E+02	0.000E+00	0.000E+00	0.000E+00	4.030E+04	0.000E+00	4.300E+01
NP-239	2.120E-02	2.090E-03	0.000E+00	6.510E-03	0.000E+00	4.280E+02	0.000E+00	1.150E-03

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APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μ Ci/ml	
	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NA-24	4.270E-01	4.270E-01	4.270E-01	4.270E-01	4.270E-01	4.270E-01	4.960E-01	4.270E-01
P-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	1.670E-01	1.670E-01	1.670E-01	1.670E-01	1.670E-01	1.670E-01	1.970E-01	1.670E-01
MN-54	4.960E+01	4.960E+01	4.960E+01	4.960E+01	4.960E+01	4.960E+01	5.820E+01	4.960E+01
MN-56	3.230E-02	3.230E-02	3.230E-02	3.230E-02	3.230E-02	3.230E-02	3.820E-02	3.230E-02
FE-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	9.770E+00	9.770E+00	9.770E+00	9.770E+00	9.770E+00	9.770E+00	1.150E+01	9.770E+00
CO-58	1.360E+01	1.360E+01	1.360E+01	1.360E+01	1.360E+01	1.360E+01	1.590E+01	1.360E+01
CO-60	7.690E+02	7.690E+02	7.690E+02	7.690E+02	7.690E+02	7.690E+02	9.050E+02	7.690E+02
NI-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI-65	1.060E-02	1.060E-02	1.060E-02	1.060E-02	1.060E-02	1.060E-02	1.240E-02	1.060E-02
CU-64	2.170E-02	2.170E-02	2.170E-02	2.170E-02	2.170E-02	2.170E-02	2.460E-02	2.170E-02
ZN-65	2.670E+01	2.670E+01	2.670E+01	2.670E+01	2.670E+01	2.670E+01	3.080E+01	2.670E+01
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	1.740E-04	1.740E-04	1.740E-04	1.740E-04	1.740E-04	1.740E-04	2.530E-04	1.740E-04
BR-84	7.250E-03	7.250E-03	7.250E-03	7.250E-03	7.250E-03	7.250E-03	8.460E-03	7.250E-03
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	3.220E-01	3.220E-01	3.220E-01	3.220E-01	3.220E-01	3.220E-01	3.680E-01	3.220E-01
RB-88	1.180E-03	1.180E-03	1.180E-03	1.180E-03	1.180E-03	1.180E-03	1.350E-03	1.180E-03
RB-89	4.400E-03	4.400E-03	4.400E-03	4.400E-03	4.400E-03	4.400E-03	5.280E-03	4.400E-03
SR-89	7.740E-04	7.740E-04	7.740E-04	7.740E-04	7.740E-04	7.740E-04	8.990E-04	7.740E-04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-91	7.690E-02	7.690E-02	7.690E-02	7.690E-02	7.690E-02	7.690E-02	8.990E-02	7.690E-02

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
 Offsite Dose Calculation Manual (ODCM)

APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	2.780E-02	2.780E-02	2.780E-02	2.780E-02	2.780E-02	2.780E-02	3.090E-02	2.780E-02
Y-90	1.610E-04	1.610E-04	1.610E-04	1.610E-04	1.610E-04	1.610E-04	1.900E-04	1.610E-04
Y-91	3.840E-02	3.840E-02	3.840E-02	3.840E-02	3.840E-02	3.840E-02	4.320E-02	3.840E-02
Y-91M	3.590E-03	3.590E-03	3.590E-03	3.590E-03	3.590E-03	3.590E-03	4.150E-03	3.590E-03
Y-92	6.460E-03	6.460E-03	6.460E-03	6.460E-03	6.460E-03	6.460E-03	7.670E-03	6.460E-03
Y-93	6.560E-03	6.560E-03	6.560E-03	6.560E-03	6.560E-03	6.560E-03	8.980E-03	6.560E-03
ZR-95	8.760E+00	8.760E+00	8.760E+00	8.760E+00	8.760E+00	8.760E+00	1.020E+01	8.760E+00
ZR-97	1.060E-01	1.060E-01	1.060E-01	1.060E-01	1.060E-01	1.060E-01	1.230E-01	1.060E-01
NB-95	4.890E+00	4.890E+00	4.890E+00	4.890E+00	4.890E+00	4.890E+00	5.750E+00	4.890E+00
MO-99	1.430E-01	1.430E-01	1.430E-01	1.430E-01	1.430E-01	1.430E-01	1.660E-01	1.430E-01
TC-99M	6.590E-03	6.590E-03	6.590E-03	6.590E-03	6.590E-03	6.590E-03	7.550E-03	6.590E-03
TC-101	7.280E-04	7.280E-04	7.280E-04	7.280E-04	7.280E-04	7.280E-04	8.090E-04	7.280E-04
RU-103	3.870E+00	3.870E+00	3.870E+00	3.870E+00	3.870E+00	3.870E+00	4.520E+00	3.870E+00
RU-105	2.280E-02	2.280E-02	2.280E-02	2.280E-02	2.280E-02	2.280E-02	2.580E-02	2.280E-02
RU-106	1.510E+01	1.510E+01	1.510E+01	1.510E+01	1.510E+01	1.510E+01	1.810E+01	1.510E+01
AG-110M	1.230E+02	1.230E+02	1.230E+02	1.230E+02	1.230E+02	1.230E+02	1.440E+02	1.230E+02
TE-125M	5.550E-02	5.550E-02	5.550E-02	5.550E-02	5.550E-02	5.550E-02	7.620E-02	5.550E-02
TE-127	1.070E-04	1.070E-04	1.070E-04	1.070E-04	1.070E-04	1.070E-04	1.170E-04	1.070E-04
TE-127M	3.280E-03	3.280E-03	3.280E-03	3.280E-03	3.280E-03	3.280E-03	3.880E-03	3.280E-03
TE-129	9.390E-04	9.390E-04	9.390E-04	9.390E-04	9.390E-04	9.390E-04	1.110E-03	9.390E-04
TE-129M	7.080E-01	7.080E-01	7.080E-01	7.080E-01	7.080E-01	7.080E-01	8.270E-01	7.080E-01
TE-131	1.040E-03	1.040E-03	1.040E-03	1.040E-03	1.040E-03	1.040E-03	1.230E+00	1.040E-03
TE-131M	2.870E-01	2.870E-01	2.870E-01	2.870E-01	2.870E-01	2.870E-01	3.390E-01	2.870E-01
TE-132	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.780E-01	1.520E-01
I-130	1.970E-01	1.970E-01	1.970E-01	1.970E-01	1.970E-01	1.970E-01	2.390E-01	1.970E-01

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX C

A_i Adult Dose Factors for use in the Liquid Dose Calculations

Agegroup:	ADULT	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	6.160E-01	6.160E-01	6.160E-01	6.160E-01	6.160E-01	6.160E-01	7.480E-01	6.160E-01
I-132	4.460E-02	4.460E-02	4.460E-02	4.460E-02	4.460E-02	4.460E-02	5.240E-02	4.460E-02
I-133	8.770E-02	8.770E-02	8.770E-02	8.770E-02	8.770E-02	8.770E-02	1.070E-01	8.770E-02
I-134	1.600E-02	1.600E-02	1.600E-02	1.600E-02	1.600E-02	1.600E-02	1.900E-02	1.600E-02
I-135	9.040E-02	9.040E-02	9.040E-02	9.040E-02	9.040E-02	9.040E-02	1.050E-01	9.040E-02
CS-134	2.450E+02	2.450E+02	2.450E+02	2.450E+02	2.450E+02	2.450E+02	2.860E+02	2.450E+02
CS-136	5.400E+00	5.400E+00	5.400E+00	5.400E+00	5.400E+00	5.400E+00	6.120E+00	5.400E+00
CS-137	3.680E+02	3.680E+02	3.680E+02	3.680E+02	3.680E+02	3.680E+02	4.290E+02	3.680E+02
CS-138	1.280E-02	1.280E-02	1.280E-02	1.280E-02	1.280E-02	1.280E-02	1.470E-02	1.280E-02
BA-139	3.790E-03	3.790E-03	3.790E-03	3.790E-03	3.790E-03	3.790E-03	4.260E-03	3.790E-03
BA-140	7.350E-01	7.350E-01	7.350E-01	7.350E-01	7.350E-01	7.350E-01	8.400E-01	7.350E-01
BA-141	1.490E-03	1.490E-03	1.490E-03	1.490E-03	1.490E-03	1.490E-03	1.700E-03	1.490E-03
BA-142	1.610E-03	1.610E-03	1.610E-03	1.610E-03	1.610E-03	1.610E-03	1.830E-03	1.610E-03
LA-140	6.880E-01	6.880E-01	6.880E-01	6.880E-01	6.880E-01	6.880E-01	7.790E-01	6.880E-01
LA-142	2.720E-02	2.720E-02	2.720E-02	2.720E-02	2.720E-02	2.720E-02	3.260E-02	2.720E-02
CE-141	4.890E-01	4.890E-01	4.890E-01	4.890E-01	4.890E-01	4.890E-01	5.510E-01	4.890E-01
CE-143	8.270E-02	8.270E-02	8.270E-02	8.270E-02	8.270E-02	8.270E-02	9.400E-02	8.270E-02
CE-144	2.490E+00	2.490E+00	2.490E+00	2.490E+00	2.490E+00	2.490E+00	2.880E+00	2.490E+00
PR-143	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR-144	6.570E-05	6.570E-05	6.570E-05	6.570E-05	6.570E-05	6.570E-05	7.550E-05	6.570E-05
ND-147	3.000E-01	3.000E-01	3.000E-01	3.000E-01	3.000E-01	3.000E-01	3.600E-01	3.000E-01
W-187	8.420E-02	8.420E-02	8.420E-02	8.420E-02	8.420E-02	8.420E-02	9.780E-02	8.420E-02
NP-239	6.120E-02	6.120E-02	6.120E-02	6.120E-02	6.120E-02	6.120E-02	7.090E-02	6.120E-02

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX D

A_i Teen Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μ Ci/ml	
	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	6.160E+00	6.160E+00	6.160E+00	6.160E+00	6.160E+00	0.000E+00	6.160E+00
C-14	2.360E+02	4.720E+01	4.720E+01	4.720E+01	4.720E+01	4.720E+01	0.000E+00	4.720E+01
NA-24	7.690E+01	7.690E+01	7.690E+01	7.690E+01	7.690E+01	7.690E+01	0.000E+00	7.690E+01
P-32	1.570E+04	9.700E+02	0.000E+00	0.000E+00	0.000E+00	1.320E+03	0.000E+00	6.070E+02
CR-51	0.000E+00	0.000E+00	1.150E-01	4.530E-02	2.950E-01	3.470E+01	0.000E+00	2.070E-01
MN-54	0.000E+00	3.430E+02	0.000E+00	1.020E+02	0.000E+00	7.030E+02	0.000E+00	6.790E+01
MN-56	0.000E+00	3.640E-01	0.000E+00	4.610E-01	0.000E+00	2.400E+01	0.000E+00	6.480E-02
FE-55	2.200E+02	1.560E+02	0.000E+00	0.000E+00	9.880E+01	6.740E+01	0.000E+00	3.630E+01
FE-59	3.390E+02	7.900E+02	0.000E+00	0.000E+00	2.490E+02	1.870E+03	0.000E+00	3.050E+02
CO-58	0.000E+00	5.620E+01	0.000E+00	0.000E+00	0.000E+00	7.750E+02	0.000E+00	1.300E+02
CO-60	0.000E+00	1.630E+02	0.000E+00	0.000E+00	0.000E+00	2.130E+03	0.000E+00	3.680E+02
NI-63	1.030E+04	7.270E+02	0.000E+00	0.000E+00	0.000E+00	1.160E+02	0.000E+00	3.490E+02
NI-65	1.610E+00	2.050E-01	0.000E+00	0.000E+00	0.000E+00	1.110E+01	0.000E+00	9.350E-02
CU-64	0.000E+00	3.470E+00	0.000E+00	8.770E+00	0.000E+00	2.690E+02	0.000E+00	1.630E+00
ZN-65	3.340E+02	1.160E+03	0.000E+00	7.430E+02	0.000E+00	4.920E+02	0.000E+00	5.420E+02
ZN-69	1.070E-04	2.040E-04	0.000E+00	1.330E-04	0.000E+00	3.760E-04	0.000E+00	1.430E-05
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.030E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.500E-07
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.360E-77
RB-86	0.000E+00	1.700E+03	0.000E+00	0.000E+00	0.000E+00	2.520E+02	0.000E+00	7.990E+02
RB-88	0.000E+00	3.300E-12	0.000E+00	0.000E+00	0.000E+00	2.830E-19	0.000E+00	1.760E-12
RB-89	0.000E+00	2.960E-14	0.000E+00	0.000E+00	0.000E+00	4.540E-23	0.000E+00	2.090E-14
SR-89	2.540E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.030E+03	0.000E+00	7.280E+02
SR-90	4.830E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.350E+04	0.000E+00	1.190E+05
SR-91	1.950E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.850E+02	0.000E+00	7.760E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX D

A_i Teen Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	8.220E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.090E+02	0.000E+00	3.500E-01
Y-90	7.000E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.770E+03	0.000E+00	1.880E-02
Y-91	1.160E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.760E+03	0.000E+00	3.120E-01
Y-91M	3.330E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.570E-05	0.000E+00	1.270E-08
Y-92	6.710E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.840E+02	0.000E+00	1.940E-04
Y-93	9.760E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.980E+03	0.000E+00	2.670E-03
ZR-95	2.380E+00	7.520E-01	0.000E+00	1.100E+00	0.000E+00	1.730E+03	0.000E+00	5.170E-01
ZR-97	8.420E-02	1.670E-02	0.000E+00	2.530E-02	0.000E+00	4.510E+03	0.000E+00	7.670E-03
NB-95	4.730E-01	2.630E-01	0.000E+00	2.540E-01	0.000E+00	1.120E+03	0.000E+00	1.440E-01
MO-99	0.000E+00	3.090E+02	0.000E+00	7.070E+02	0.000E+00	5.530E+02	0.000E+00	5.890E+01
TC-99M	4.840E-03	1.350E-02	0.000E+00	2.010E-01	7.500E-03	8.870E+00	0.000E+00	1.750E-01
TC-101	1.120E-17	1.590E-17	0.000E+00	2.880E-16	9.700E-18	2.720E-24	0.000E+00	1.560E-16
RU-103	1.470E+01	0.000E+00	0.000E+00	5.180E+01	0.000E+00	1.230E+03	0.000E+00	6.280E+00
RU-105	1.940E-01	0.000E+00	0.000E+00	2.450E+00	0.000E+00	1.570E+02	0.000E+00	7.540E-02
RU-106	2.280E+02	0.000E+00	0.000E+00	4.390E+02	0.000E+00	1.090E+04	0.000E+00	2.870E+01
AG-110M	1.190E+01	1.130E+01	0.000E+00	2.150E+01	0.000E+00	3.160E+03	0.000E+00	6.850E+00
TE-125M	2.210E+02	7.980E+01	6.180E+01	0.000E+00	0.000E+00	6.530E+02	0.000E+00	2.960E+01
TE-127	3.790E+00	1.340E+00	2.610E+00	1.530E+01	0.000E+00	2.930E+02	0.000E+00	8.150E-01
TE-127M	5.600E+02	1.990E+02	1.330E+02	2.270E+03	0.000E+00	1.400E+03	0.000E+00	6.660E+01
TE-129	1.920E-03	7.150E-04	1.370E-03	8.040E-03	0.000E+00	1.050E-02	0.000E+00	4.660E-04
TE-129M	9.380E+02	3.480E+02	3.030E+02	3.920E+03	0.000E+00	3.520E+03	0.000E+00	1.480E+02
TE-131	3.490E-09	1.440E-09	2.690E-09	1.520E-08	0.000E+00	2.860E-10	0.000E+00	1.090E-09
TE-131M	1.080E+02	5.150E+01	7.750E+01	5.380E+02	0.000E+00	4.140E+03	0.000E+00	4.300E+01
TE-132	1.820E+02	1.150E+02	1.220E+02	1.110E+03	0.000E+00	3.660E+03	0.000E+00	1.090E+02
I-130	3.050E+01	8.830E+01	7.200E+03	1.360E+02	0.000E+00	6.790E+01	0.000E+00	3.530E+01

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
 Offsite Dose Calculation Manual (ODCM)

APPENDIX D

A_i Teen Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	3.260E+02	4.560E+02	1.330E+05	7.850E+02	0.000E+00	9.020E+01	0.000E+00	2.450E+02
I-132	4.360E-01	1.140E+00	3.850E+01	1.800E+00	0.000E+00	4.970E-01	0.000E+00	4.100E-01
I-133	7.830E+01	1.330E+02	1.860E+04	2.330E+02	0.000E+00	1.010E+02	0.000E+00	4.050E+01
I-134	6.330E-04	1.680E-03	2.800E-02	2.640E-03	0.000E+00	2.210E-05	0.000E+00	6.020E-04
I-135	1.010E+01	2.600E+01	1.670E+03	4.100E+01	0.000E+00	2.880E+01	0.000E+00	9.630E+00
CS-134	4.860E+03	1.140E+04	0.000E+00	3.640E+03	1.390E+03	1.420E+02	0.000E+00	5.310E+03
CS-136	4.860E+02	1.910E+03	0.000E+00	1.040E+03	1.640E+02	1.540E+02	0.000E+00	1.290E+03
CS-137	6.510E+03	8.660E+03	0.000E+00	2.950E+03	1.150E+03	1.230E+02	0.000E+00	3.020E+03
CS-138	8.300E-07	1.590E-06	0.000E+00	1.180E-06	1.370E-07	7.230E-10	0.000E+00	7.970E-07
BA-139	1.990E-02	1.400E-05	0.000E+00	1.320E-05	9.670E-06	1.780E-01	0.000E+00	5.810E-04
BA-140	1.610E+03	1.970E+00	0.000E+00	6.680E-01	1.320E+00	2.480E+03	0.000E+00	1.040E+02
BA-141	5.420E-12	4.050E-15	0.000E+00	3.760E-15	2.770E-15	1.150E-17	0.000E+00	1.810E-13
BA-142	6.170E-21	6.170E-24	0.000E+00	5.220E-24	4.100E-24	1.890E-32	0.000E+00	3.800E-22
LA-140	1.650E-01	8.090E-02	0.000E+00	0.000E+00	0.000E+00	4.640E+03	0.000E+00	2.150E-02
LA-142	5.590E-05	2.480E-05	0.000E+00	0.000E+00	0.000E+00	7.550E-01	0.000E+00	6.180E-06
CE-141	7.650E-01	5.110E-01	0.000E+00	2.400E-01	0.000E+00	1.460E+03	0.000E+00	5.870E-02
CE-143	1.060E-01	7.730E+01	0.000E+00	3.460E-02	0.000E+00	2.320E+03	0.000E+00	8.630E-03
CE-144	4.040E+01	1.670E+01	0.000E+00	9.990E+00	0.000E+00	1.020E+04	0.000E+00	2.170E+00
PR-143	7.420E-01	2.960E-01	0.000E+00	1.720E-01	0.000E+00	2.440E+03	0.000E+00	3.700E-02
PR-144	7.330E-16	3.000E-16	0.000E+00	1.720E-16	0.000E+00	8.080E-19	0.000E+00	3.720E-17
ND-147	5.280E-01	5.750E-01	0.000E+00	3.370E-01	0.000E+00	2.070E+03	0.000E+00	3.440E-02
W-187	5.990E+00	4.880E+00	0.000E+00	0.000E+00	0.000E+00	1.320E+03	0.000E+00	1.710E+00
NP-239	8.830E-02	8.330E-03	0.000E+00	2.610E-02	0.000E+00	1.340E+03	0.000E+00	4.630E-03

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APPENDIX D

A_i Teen Dose Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.740E-01	1.740E-01	1.740E-01	1.740E-01	1.740E-01	0.000E+00	1.740E-01
C-14	3.410E+04	6.810E+03	6.810E+03	6.810E+03	6.810E+03	6.810E+03	0.000E+00	6.810E+03
NA-24	1.390E+02	1.390E+02	1.390E+02	1.390E+02	1.390E+02	1.390E+02	0.000E+00	1.390E+02
P-32	1.440E+06	8.910E+04	0.000E+00	0.000E+00	0.000E+00	1.210E+05	0.000E+00	5.580E+04
CR-51	0.000E+00	0.000E+00	7.120E-01	2.810E-01	1.830E+00	2.150E+02	0.000E+00	1.280E+00
MN-54	0.000E+00	4.300E+03	0.000E+00	1.280E+03	0.000E+00	8.810E+03	0.000E+00	8.520E+02
MN-56	0.000E+00	1.810E-01	0.000E+00	2.300E-01	0.000E+00	1.190E+01	0.000E+00	3.230E-02
FE-55	6.890E+02	4.880E+02	0.000E+00	0.000E+00	3.100E+02	2.110E+02	0.000E+00	1.140E+02
FE-59	1.050E+03	2.460E+03	0.000E+00	0.000E+00	7.760E+02	5.820E+03	0.000E+00	9.500E+02
CO-58	0.000E+00	8.780E+01	0.000E+00	0.000E+00	0.000E+00	1.210E+03	0.000E+00	2.020E+02
CO-60	0.000E+00	2.560E+02	0.000E+00	0.000E+00	0.000E+00	3.340E+03	0.000E+00	5.770E+02
NI-63	3.230E+04	2.280E+03	0.000E+00	0.000E+00	0.000E+00	3.630E+02	0.000E+00	1.090E+03
NI-65	1.860E-01	2.370E-02	0.000E+00	0.000E+00	0.000E+00	1.290E+00	0.000E+00	1.080E-02
CU-64	0.000E+00	2.820E+00	0.000E+00	7.140E+00	0.000E+00	2.190E+02	0.000E+00	1.330E+00
ZN-65	2.100E+04	7.280E+04	0.000E+00	4.660E+04	0.000E+00	3.080E+04	0.000E+00	3.390E+04
ZN-69	8.410E-07	1.600E-06	0.000E+00	1.050E-06	0.000E+00	2.950E-06	0.000E+00	1.120E-07
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.160E-02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.320E-12
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	1.050E+05	0.000E+00	0.000E+00	0.000E+00	1.550E+04	0.000E+00	4.920E+04
RB-88	0.000E+00	1.380E-22	0.000E+00	0.000E+00	0.000E+00	1.180E-29	0.000E+00	7.360E-23
RB-89	0.000E+00	1.720E-26	0.000E+00	0.000E+00	0.000E+00	2.630E-35	0.000E+00	1.220E-26
SR-89	2.370E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.830E+03	0.000E+00	6.800E+02
SR-90	4.540E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.270E+04	0.000E+00	1.120E+05
SR-91	7.640E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.470E+02	0.000E+00	3.040E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX D

A_i Teen Dose Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	3.590E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.130E+00	0.000E+00	1.530E-02
Y-90	4.820E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.980E+03	0.000E+00	1.300E-02
Y-91	9.060E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.710E+03	0.000E+00	2.430E-01
Y-91M	1.160E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.470E-10	0.000E+00	4.430E-13
Y-92	5.020E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.380E+01	0.000E+00	1.450E-05
Y-93	3.350E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.020E+03	0.000E+00	9.190E-04
ZR-95	2.450E-01	7.740E-02	0.000E+00	1.140E-01	0.000E+00	1.790E+02	0.000E+00	5.320E-02
ZR-97	5.330E-03	1.050E-03	0.000E+00	1.600E-03	0.000E+00	2.850E+02	0.000E+00	4.860E-04
NB-95	4.410E+02	2.450E+02	0.000E+00	2.370E+02	0.000E+00	1.050E+06	0.000E+00	1.350E+02
MO-99	0.000E+00	8.550E+01	0.000E+00	1.960E+02	0.000E+00	1.530E+02	0.000E+00	1.630E+01
TC-99M	5.720E-04	1.600E-03	0.000E+00	2.380E-02	8.860E-04	1.050E+00	0.000E+00	2.070E-02
TC-101	2.820E-33	4.010E-33	0.000E+00	7.240E-32	2.440E-33	6.840E-40	0.000E+00	3.930E-32
RU-103	4.570E+00	0.000E+00	0.000E+00	1.610E+01	0.000E+00	3.820E+02	0.000E+00	1.950E+00
RU-105	9.350E-03	0.000E+00	0.000E+00	1.180E-01	0.000E+00	7.550E+00	0.000E+00	3.630E-03
RU-106	7.140E+01	0.000E+00	0.000E+00	1.380E+02	0.000E+00	3.420E+03	0.000E+00	8.990E+00
AG-110M	8.580E-01	8.120E-01	0.000E+00	1.550E+00	0.000E+00	2.280E+02	0.000E+00	4.940E-01
TE-125M	2.760E+03	9.950E+02	7.710E+02	0.000E+00	0.000E+00	8.150E+03	0.000E+00	3.690E+02
TE-127	1.960E+01	6.950E+00	1.350E+01	7.940E+01	0.000E+00	1.510E+03	0.000E+00	4.220E+00
TE-127M	7.010E+03	2.490E+03	1.670E+03	2.840E+04	0.000E+00	1.750E+04	0.000E+00	8.340E+02
TE-129	1.770E-05	6.600E-06	1.260E-05	7.430E-05	0.000E+00	9.680E-05	0.000E+00	4.310E-06
TE-129M	1.160E+04	4.320E+03	3.760E+03	4.870E+04	0.000E+00	4.370E+04	0.000E+00	1.840E+03
TE-131	9.400E-17	3.870E-17	7.240E-17	4.110E-16	0.000E+00	7.710E-18	0.000E+00	2.940E-17
TE-131M	1.020E+03	4.900E+02	7.370E+02	5.110E+03	0.000E+00	3.930E+04	0.000E+00	4.090E+02
TE-132	2.060E+03	1.300E+03	1.370E+03	1.250E+04	0.000E+00	4.130E+04	0.000E+00	1.230E+03
I-130	7.320E+00	2.120E+01	1.730E+03	3.260E+01	0.000E+00	1.630E+01	0.000E+00	8.460E+00

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APPENDIX D

A_i Teen Dose Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.470E+02	2.060E+02	6.000E+04	3.540E+02	0.000E+00	4.070E+01	0.000E+00	1.100E+02
I-132	5.520E-03	1.440E-02	4.870E-01	2.280E-02	0.000E+00	6.290E-03	0.000E+00	5.180E-03
I-133	2.470E+01	4.190E+01	5.850E+03	7.350E+01	0.000E+00	3.170E+01	0.000E+00	1.280E+01
I-134	2.220E-08	5.890E-08	9.810E-07	9.280E-08	0.000E+00	7.760E-10	0.000E+00	2.110E-08
I-135	1.350E+00	3.480E+00	2.240E+02	5.490E+00	0.000E+00	3.850E+00	0.000E+00	1.290E+00
CS-134	3.050E+05	7.180E+05	0.000E+00	2.280E+05	8.710E+04	8.930E+03	0.000E+00	3.330E+05
CS-136	2.970E+04	1.170E+05	0.000E+00	6.370E+04	1.000E+04	9.410E+03	0.000E+00	7.860E+04
CS-137	4.090E+05	5.440E+05	0.000E+00	1.850E+05	7.190E+04	7.730E+03	0.000E+00	1.890E+05
CS-138	9.580E-12	1.840E-11	0.000E+00	1.360E-11	1.580E-12	8.340E-15	0.000E+00	9.190E-12
BA-139	6.170E-06	4.340E-09	0.000E+00	4.090E-09	2.990E-09	5.510E-05	0.000E+00	1.800E-07
BA-140	1.960E+02	2.410E-01	0.000E+00	8.160E-02	1.620E-01	3.030E+02	0.000E+00	1.260E+01
BA-141	9.450E-25	7.050E-28	0.000E+00	6.550E-28	4.830E-28	2.010E-30	0.000E+00	3.150E-26
BA-142	2.750E-42	2.750E-45	0.000E+00	2.320E-45	1.830E-45	8.430E-54	0.000E+00	1.690E-43
LA-140	1.050E-01	5.160E-02	0.000E+00	0.000E+00	0.000E+00	2.960E+03	0.000E+00	1.370E-02
LA-142	2.350E-07	1.040E-07	0.000E+00	0.000E+00	0.000E+00	3.180E-03	0.000E+00	2.600E-08
CE-141	2.370E-02	1.590E-02	0.000E+00	7.460E-03	0.000E+00	4.540E+01	0.000E+00	1.820E-03
CE-143	2.590E-03	1.880E+00	0.000E+00	8.450E-04	0.000E+00	5.660E+01	0.000E+00	2.100E-04
CE-144	1.270E+00	5.240E-01	0.000E+00	3.130E-01	0.000E+00	3.180E+02	0.000E+00	6.810E-02
PR-143	5.680E-01	2.270E-01	0.000E+00	1.320E-01	0.000E+00	1.870E+03	0.000E+00	2.830E-02
PR-144	1.690E-28	6.900E-29	0.000E+00	3.960E-29	0.000E+00	1.860E-31	0.000E+00	8.550E-30
ND-147	4.020E-01	4.370E-01	0.000E+00	2.560E-01	0.000E+00	1.580E+03	0.000E+00	2.620E-02
W-187	1.590E+02	1.300E+02	0.000E+00	0.000E+00	0.000E+00	3.510E+04	0.000E+00	4.540E+01
NP-239	2.390E-02	2.260E-03	0.000E+00	7.080E-03	0.000E+00	3.630E+02	0.000E+00	1.250E-03

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Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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APPENDIX D

A_i Teen Dose Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NA-24	2.390E+00	2.390E+00	2.390E+00	2.390E+00	2.390E+00	2.390E+00	2.770E+00	2.390E+00
P-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	9.310E-01	9.310E-01	9.310E-01	9.310E-01	9.310E-01	9.310E-01	1.100E+00	9.310E-01
MN-54	2.770E+02	2.770E+02	2.770E+02	2.770E+02	2.770E+02	2.770E+02	3.250E+02	2.770E+02
MN-56	1.800E-01	1.800E-01	1.800E-01	1.800E-01	1.800E-01	1.800E-01	2.130E-01	1.800E-01
FE-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	5.450E+01	5.450E+01	5.450E+01	5.450E+01	5.450E+01	5.450E+01	6.410E+01	5.450E+01
CO-58	7.570E+01	7.570E+01	7.570E+01	7.570E+01	7.570E+01	7.570E+01	8.870E+01	7.570E+01
CO-60	4.300E+03	4.300E+03	4.300E+03	4.300E+03	4.300E+03	4.300E+03	5.050E+03	4.300E+03
NI-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI-65	5.930E-02	5.930E-02	5.930E-02	5.930E-02	5.930E-02	5.930E-02	6.900E-02	5.930E-02
CU-64	1.210E-01	1.210E-01	1.210E-01	1.210E-01	1.210E-01	1.210E-01	1.370E-01	1.210E-01
ZN-65	1.490E+02	1.490E+02	1.490E+02	1.490E+02	1.490E+02	1.490E+02	1.720E+02	1.490E+02
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	9.730E-04	9.730E-04	9.730E-04	9.730E-04	9.730E-04	9.730E-04	1.410E-03	9.730E-04
BR-84	4.050E-02	4.050E-02	4.050E-02	4.050E-02	4.050E-02	4.050E-02	4.720E-02	4.050E-02
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	1.800E+00	1.800E+00	1.800E+00	1.800E+00	1.800E+00	1.800E+00	2.050E+00	1.800E+00
RB-88	6.610E-03	6.610E-03	6.610E-03	6.610E-03	6.610E-03	6.610E-03	7.550E-03	6.610E-03
RB-89	2.460E-02	2.460E-02	2.460E-02	2.460E-02	2.460E-02	2.460E-02	2.950E-02	2.460E-02
SR-89	4.320E-03	4.320E-03	4.320E-03	4.320E-03	4.320E-03	4.320E-03	5.020E-03	4.320E-03
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-91	4.290E-01	4.290E-01	4.290E-01	4.290E-01	4.290E-01	4.290E-01	5.020E-01	4.290E-01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX D

A_i Teen Dose Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	1.550E-01	1.550E-01	1.550E-01	1.550E-01	1.550E-01	1.550E-01	1.720E-01	1.550E-01
Y-90	8.970E-04	8.970E-04	8.970E-04	8.970E-04	8.970E-04	8.970E-04	1.060E-03	8.970E-04
Y-91	2.140E-01	2.140E-01	2.140E-01	2.140E-01	2.140E-01	2.140E-01	2.410E-01	2.140E-01
Y-91M	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.000E-02	2.320E-02	2.000E-02
Y-92	3.600E-02	3.600E-02	3.600E-02	3.600E-02	3.600E-02	3.600E-02	4.280E-02	3.600E-02
Y-93	3.660E-02	3.660E-02	3.660E-02	3.660E-02	3.660E-02	3.660E-02	5.010E-02	3.660E-02
ZR-95	4.890E+01	4.890E+01	4.890E+01	4.890E+01	4.890E+01	4.890E+01	5.670E+01	4.890E+01
ZR-97	5.910E-01	5.910E-01	5.910E-01	5.910E-01	5.910E-01	5.910E-01	6.880E-01	5.910E-01
NB-95	2.730E+01	2.730E+01	2.730E+01	2.730E+01	2.730E+01	2.730E+01	3.210E+01	2.730E+01
MO-99	7.980E-01	7.980E-01	7.980E-01	7.980E-01	7.980E-01	7.980E-01	9.240E-01	7.980E-01
TC-99M	3.680E-02	3.680E-02	3.680E-02	3.680E-02	3.680E-02	3.680E-02	4.210E-02	3.680E-02
TC-101	4.070E-03	4.070E-03	4.070E-03	4.070E-03	4.070E-03	4.070E-03	4.520E-03	4.070E-03
RU-103	2.160E+01	2.160E+01	2.160E+01	2.160E+01	2.160E+01	2.160E+01	2.520E+01	2.160E+01
RU-105	1.270E-01	1.270E-01	1.270E-01	1.270E-01	1.270E-01	1.270E-01	1.440E-01	1.270E-01
RU-106	8.430E+01	8.430E+01	8.430E+01	8.430E+01	8.430E+01	8.430E+01	1.010E+02	8.430E+01
AG-110M	6.870E+02	6.870E+02	6.870E+02	6.870E+02	6.870E+02	6.870E+02	8.010E+02	6.870E+02
TE-125M	3.100E-01	3.100E-01	3.100E-01	3.100E-01	3.100E-01	3.100E-01	4.250E-01	3.100E-01
TE-127	5.950E-04	5.950E-04	5.950E-04	5.950E-04	5.950E-04	5.950E-04	6.540E-04	5.950E-04
TE-127M	1.830E-02	1.830E-02	1.830E-02	1.830E-02	1.830E-02	1.830E-02	2.160E-02	1.830E-02
TE-129	5.240E-03	5.240E-03	5.240E-03	5.240E-03	5.240E-03	5.240E-03	6.200E-03	5.240E-03
TE-129M	3.950E+00	3.950E+00	3.950E+00	3.950E+00	3.950E+00	3.950E+00	4.620E+00	3.950E+00
TE-131	5.830E-03	5.830E-03	5.830E-03	5.830E-03	5.830E-03	5.830E-03	6.890E+00	5.830E-03
TE-131M	1.600E+00	1.600E+00	1.600E+00	1.600E+00	1.600E+00	1.600E+00	1.890E+00	1.600E+00
TE-132	8.460E-01	8.460E-01	8.460E-01	8.460E-01	8.460E-01	8.460E-01	9.950E-01	8.460E-01
I-130	1.100E+00	1.100E+00	1.100E+00	1.100E+00	1.100E+00	1.100E+00	1.340E+00	1.100E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX D

A_i Teen Dose Factors for use in the Liquid Dose Calculations

Agegroup:	TEEN	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	3.440E+00	3.440E+00	3.440E+00	3.440E+00	3.440E+00	3.440E+00	4.170E+00	3.440E+00
I-132	2.490E-01	2.490E-01	2.490E-01	2.490E-01	2.490E-01	2.490E-01	2.930E-01	2.490E-01
I-133	4.900E-01	4.900E-01	4.900E-01	4.900E-01	4.900E-01	4.900E-01	5.960E-01	4.900E-01
I-134	8.930E-02	8.930E-02	8.930E-02	8.930E-02	8.930E-02	8.930E-02	1.060E-01	8.930E-02
I-135	5.050E-01	5.050E-01	5.050E-01	5.050E-01	5.050E-01	5.050E-01	5.890E-01	5.050E-01
CS-134	1.370E+03	1.370E+03	1.370E+03	1.370E+03	1.370E+03	1.370E+03	1.600E+03	1.370E+03
CS-136	3.010E+01	3.010E+01	3.010E+01	3.010E+01	3.010E+01	3.010E+01	3.420E+01	3.010E+01
CS-137	2.050E+03	2.050E+03	2.050E+03	2.050E+03	2.050E+03	2.050E+03	2.400E+03	2.050E+03
CS-138	7.170E-02	7.170E-02	7.170E-02	7.170E-02	7.170E-02	7.170E-02	8.200E-02	7.170E-02
BA-139	2.120E-02	2.120E-02	2.120E-02	2.120E-02	2.120E-02	2.120E-02	2.380E-02	2.120E-02
BA-140	4.100E+00	4.100E+00	4.100E+00	4.100E+00	4.100E+00	4.100E+00	4.690E+00	4.100E+00
BA-141	8.330E-03	8.330E-03	8.330E-03	8.330E-03	8.330E-03	8.330E-03	9.490E-03	8.330E-03
BA-142	8.970E-03	8.970E-03	8.970E-03	8.970E-03	8.970E-03	8.970E-03	1.020E-02	8.970E-03
LA-140	3.840E+00	3.840E+00	3.840E+00	3.840E+00	3.840E+00	3.840E+00	4.350E+00	3.840E+00
LA-142	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.520E-01	1.820E-01	1.520E-01
CE-141	2.730E+00	2.730E+00	2.730E+00	2.730E+00	2.730E+00	2.730E+00	3.080E+00	2.730E+00
CE-143	4.620E-01	4.620E-01	4.620E-01	4.620E-01	4.620E-01	4.620E-01	5.250E-01	4.620E-01
CE-144	1.390E+01	1.390E+01	1.390E+01	1.390E+01	1.390E+01	1.390E+01	1.610E+01	1.390E+01
PR-143	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR-144	3.670E-04	3.670E-04	3.670E-04	3.670E-04	3.670E-04	3.670E-04	4.220E-04	3.670E-04
ND-147	1.680E+00	1.680E+00	1.680E+00	1.680E+00	1.680E+00	1.680E+00	2.010E+00	1.680E+00
W-187	4.700E-01	4.700E-01	4.700E-01	4.700E-01	4.700E-01	4.700E-01	5.460E-01	4.700E-01
NP-239	3.420E-01	3.420E-01	3.420E-01	3.420E-01	3.420E-01	3.420E-01	3.960E-01	3.420E-01

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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.180E+01	1.180E+01	1.180E+01	1.180E+01	1.180E+01	0.000E+00	1.180E+01
C-14	7.030E+02	1.410E+02	1.410E+02	1.410E+02	1.410E+02	1.410E+02	0.000E+00	1.410E+02
NA-24	1.940E+02	1.940E+02	1.940E+02	1.940E+02	1.940E+02	1.940E+02	0.000E+00	1.940E+02
P-32	4.680E+04	2.190E+03	0.000E+00	0.000E+00	0.000E+00	1.290E+03	0.000E+00	1.800E+03
CR-51	0.000E+00	0.000E+00	2.840E-01	7.750E-02	5.180E-01	2.710E+01	0.000E+00	5.110E-01
MN-54	0.000E+00	6.210E+02	0.000E+00	1.740E+02	0.000E+00	5.220E+02	0.000E+00	1.660E+02
MN-56	0.000E+00	7.700E-01	0.000E+00	9.320E-01	0.000E+00	1.120E+02	0.000E+00	1.740E-01
FE-55	6.680E+02	3.550E+02	0.000E+00	0.000E+00	2.010E+02	6.570E+01	0.000E+00	1.100E+02
FE-59	9.520E+02	1.540E+03	0.000E+00	0.000E+00	4.470E+02	1.600E+03	0.000E+00	7.670E+02
CO-58	0.000E+00	1.040E+02	0.000E+00	0.000E+00	0.000E+00	6.070E+02	0.000E+00	3.190E+02
CO-60	0.000E+00	3.080E+02	0.000E+00	0.000E+00	0.000E+00	1.700E+03	0.000E+00	9.070E+02
NI-63	3.130E+04	1.670E+03	0.000E+00	0.000E+00	0.000E+00	1.130E+02	0.000E+00	1.060E+03
NI-65	4.760E+00	4.480E-01	0.000E+00	0.000E+00	0.000E+00	5.490E+01	0.000E+00	2.610E-01
CU-64	0.000E+00	7.390E+00	0.000E+00	1.780E+01	0.000E+00	3.470E+02	0.000E+00	4.460E+00
ZN-65	7.950E+02	2.120E+03	0.000E+00	1.340E+03	0.000E+00	3.720E+02	0.000E+00	1.320E+03
ZN-69	3.190E-04	4.610E-04	0.000E+00	2.800E-04	0.000E+00	2.900E-02	0.000E+00	4.260E-05
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.060E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.780E-06
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.300E-76
RB-86	0.000E+00	3.820E+03	0.000E+00	0.000E+00	0.000E+00	2.460E+02	0.000E+00	2.350E+03
RB-88	0.000E+00	7.360E-12	0.000E+00	0.000E+00	0.000E+00	3.610E-13	0.000E+00	5.110E-12
RB-89	0.000E+00	6.300E-14	0.000E+00	0.000E+00	0.000E+00	5.490E-16	0.000E+00	5.600E-14
SR-89	7.620E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.950E+03	0.000E+00	2.180E+03
SR-90	9.880E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.330E+04	0.000E+00	2.510E+05
SR-91	5.810E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.280E+03	0.000E+00	2.190E+01

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APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	2.430E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.610E+02	0.000E+00	9.760E-01
Y-90	2.100E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.980E+03	0.000E+00	5.620E-02
Y-91	3.480E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.640E+03	0.000E+00	9.310E-01
Y-91M	9.860E-07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.930E-03	0.000E+00	3.590E-08
Y-92	2.000E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.770E+02	0.000E+00	5.710E-04
Y-93	2.900E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.330E+03	0.000E+00	7.970E-03
ZR-95	6.710E+00	1.470E+00	0.000E+00	2.110E+00	0.000E+00	1.540E+03	0.000E+00	1.310E+00
ZR-97	2.480E-01	3.590E-02	0.000E+00	5.150E-02	0.000E+00	5.440E+03	0.000E+00	2.120E-02
NB-95	1.300E+00	5.040E-01	0.000E+00	4.740E-01	0.000E+00	9.330E+02	0.000E+00	3.600E-01
MO-99	0.000E+00	6.820E+02	0.000E+00	1.460E+03	0.000E+00	5.640E+02	0.000E+00	1.690E+02
TC-99M	1.350E-02	2.640E-02	0.000E+00	3.840E-01	1.340E-02	1.500E+01	0.000E+00	4.380E-01
TC-101	3.330E-17	3.480E-17	0.000E+00	5.940E-16	1.840E-17	1.110E-16	0.000E+00	4.410E-16
RU-103	4.210E+01	0.000E+00	0.000E+00	1.060E+02	0.000E+00	1.090E+03	0.000E+00	1.620E+01
RU-105	5.750E-01	0.000E+00	0.000E+00	5.060E+00	0.000E+00	3.750E+02	0.000E+00	2.090E-01
RU-106	6.800E+02	0.000E+00	0.000E+00	9.180E+02	0.000E+00	1.060E+04	0.000E+00	8.480E+01
AG-110M	3.130E+01	2.110E+01	0.000E+00	3.940E+01	0.000E+00	2.510E+03	0.000E+00	1.690E+01
TE-125M	6.590E+02	1.790E+02	1.850E+02	0.000E+00	0.000E+00	6.360E+02	0.000E+00	8.780E+01
TE-127	1.130E+01	3.050E+00	7.820E+00	3.210E+01	0.000E+00	4.410E+02	0.000E+00	2.420E+00
TE-127M	1.670E+03	4.510E+02	4.000E+02	4.780E+03	0.000E+00	1.360E+03	0.000E+00	1.990E+02
TE-129	5.730E-03	1.600E-03	4.090E-03	1.680E-02	0.000E+00	3.570E-01	0.000E+00	1.360E-03
TE-129M	2.800E+03	7.830E+02	9.030E+02	8.230E+03	0.000E+00	3.420E+03	0.000E+00	4.350E+02
TE-131	1.040E-08	3.160E-09	7.930E-09	3.140E-08	0.000E+00	5.450E-08	0.000E+00	3.090E-09
TE-131M	3.170E+02	1.100E+02	2.260E+02	1.060E+03	0.000E+00	4.450E+03	0.000E+00	1.170E+02
TE-132	5.280E+02	2.340E+02	3.400E+02	2.170E+03	0.000E+00	2.350E+03	0.000E+00	2.820E+02
I-130	8.650E+01	1.750E+02	1.930E+04	2.610E+02	0.000E+00	8.180E+01	0.000E+00	9.010E+01

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APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	9.580E+02	9.630E+02	3.190E+05	1.580E+03	0.000E+00	8.580E+01	0.000E+00	5.470E+02
I-132	1.250E+00	2.300E+00	1.070E+02	3.520E+00	0.000E+00	2.710E+00	0.000E+00	1.060E+00
I-133	2.310E+02	2.850E+02	5.300E+04	4.750E+02	0.000E+00	1.150E+02	0.000E+00	1.080E+02
I-134	1.820E-03	3.370E-03	7.760E-02	5.160E-03	0.000E+00	2.240E-03	0.000E+00	1.550E-03
I-135	2.890E+01	5.210E+01	4.610E+03	7.990E+01	0.000E+00	3.970E+01	0.000E+00	2.460E+01
CS-134	1.360E+04	2.230E+04	0.000E+00	6.920E+03	2.480E+03	1.200E+02	0.000E+00	4.710E+03
CS-136	1.330E+03	3.660E+03	0.000E+00	1.950E+03	2.910E+02	1.290E+02	0.000E+00	2.370E+03
CS-137	1.900E+04	1.820E+04	0.000E+00	5.930E+03	2.130E+03	1.140E+02	0.000E+00	2.690E+03
CS-138	2.440E-06	3.390E-06	0.000E+00	2.380E-06	2.570E-07	1.560E-06	0.000E+00	2.150E-06
BA-139	5.940E-02	3.170E-05	0.000E+00	2.770E-05	1.860E-05	3.430E+00	0.000E+00	1.720E-03
BA-140	4.700E+03	4.120E+00	0.000E+00	1.340E+00	2.460E+00	2.380E+03	0.000E+00	2.740E+02
BA-141	1.620E-11	9.050E-15	0.000E+00	7.830E-15	5.310E-14	9.210E-12	0.000E+00	5.260E-13
BA-142	1.800E-20	1.300E-23	0.000E+00	1.050E-23	7.630E-24	2.350E-22	0.000E+00	1.010E-21
LA-140	4.780E-01	1.670E-01	0.000E+00	0.000E+00	0.000E+00	4.650E+03	0.000E+00	5.630E-02
LA-142	1.640E-04	5.210E-05	0.000E+00	0.000E+00	0.000E+00	1.030E+01	0.000E+00	1.630E-05
CE-141	2.280E+00	1.140E+00	0.000E+00	4.990E-01	0.000E+00	1.420E+03	0.000E+00	1.690E-01
CE-143	3.160E-01	1.710E+02	0.000E+00	7.180E-02	0.000E+00	2.510E+03	0.000E+00	2.480E-02
CE-144	1.210E+02	3.790E+01	0.000E+00	2.100E+01	0.000E+00	9.870E+03	0.000E+00	6.450E+00
PR-143	2.230E+00	6.690E-01	0.000E+00	3.620E-01	0.000E+00	2.400E+03	0.000E+00	1.110E-01
PR-144	2.200E-15	6.800E-16	0.000E+00	3.600E-16	0.000E+00	1.460E-12	0.000E+00	1.110E-16
ND-147	1.570E+00	1.270E+00	0.000E+00	6.990E-01	0.000E+00	2.020E+03	0.000E+00	9.860E-02
W-187	1.760E+01	1.040E+01	0.000E+00	0.000E+00	0.000E+00	1.460E+03	0.000E+00	4.680E+00
NP-239	2.630E-01	1.890E-02	0.000E+00	5.470E-02	0.000E+00	1.400E+03	0.000E+00	1.330E-02

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
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APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.440E-01	1.440E-01	1.440E-01	1.440E-01	1.440E-01	0.000E+00	1.440E-01
C-14	4.380E+04	8.760E+03	8.760E+03	8.760E+03	8.760E+03	8.760E+03	0.000E+00	8.760E+03
NA-24	1.510E+02	1.510E+02	1.510E+02	1.510E+02	1.510E+02	1.510E+02	0.000E+00	1.510E+02
P-32	1.850E+06	8.680E+04	0.000E+00	0.000E+00	0.000E+00	5.130E+04	0.000E+00	7.150E+04
CR-51	0.000E+00	0.000E+00	7.580E-01	2.070E-01	1.380E+00	7.240E+01	0.000E+00	1.370E+00
MN-54	0.000E+00	3.360E+03	0.000E+00	9.420E+02	0.000E+00	2.820E+03	0.000E+00	8.950E+02
MN-56	0.000E+00	1.650E-01	0.000E+00	2.000E-01	0.000E+00	2.400E+01	0.000E+00	3.730E-02
FE-55	9.040E+02	4.790E+02	0.000E+00	0.000E+00	2.710E+02	8.880E+01	0.000E+00	1.490E+02
FE-59	1.280E+03	2.070E+03	0.000E+00	0.000E+00	5.990E+02	2.150E+03	0.000E+00	1.030E+03
CO-58	0.000E+00	7.010E+01	0.000E+00	0.000E+00	0.000E+00	4.090E+02	0.000E+00	2.150E+02
CO-60	0.000E+00	2.080E+02	0.000E+00	0.000E+00	0.000E+00	1.150E+03	0.000E+00	6.130E+02
NI-63	4.230E+04	2.270E+03	0.000E+00	0.000E+00	0.000E+00	1.530E+02	0.000E+00	1.440E+03
NI-65	2.370E-01	2.230E-02	0.000E+00	0.000E+00	0.000E+00	2.740E+00	0.000E+00	1.300E-02
CU-64	0.000E+00	2.590E+00	0.000E+00	6.260E+00	0.000E+00	1.220E+02	0.000E+00	1.570E+00
ZN-65	2.150E+04	5.730E+04	0.000E+00	3.610E+04	0.000E+00	1.010E+04	0.000E+00	3.560E+04
ZN-69	1.080E-06	1.560E-06	0.000E+00	9.470E-07	0.000E+00	9.840E-05	0.000E+00	1.440E-07
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.340E-02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.570E-12
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	1.020E+05	0.000E+00	0.000E+00	0.000E+00	6.530E+03	0.000E+00	6.250E+04
RB-88	0.000E+00	1.330E-22	0.000E+00	0.000E+00	0.000E+00	6.510E-24	0.000E+00	9.220E-23
RB-89	0.000E+00	1.580E-26	0.000E+00	0.000E+00	0.000E+00	1.370E-28	0.000E+00	1.400E-26
SR-89	3.070E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.190E+03	0.000E+00	8.780E+02
SR-90	4.010E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.400E+03	0.000E+00	1.020E+05
SR-91	9.800E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.160E+02	0.000E+00	3.700E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	4.580E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.670E+00	0.000E+00	1.840E-02
Y-90	6.240E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.780E+03	0.000E+00	1.670E-02
Y-91	1.170E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.560E+03	0.000E+00	3.130E-01
Y-91M	1.480E-11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.900E-08	0.000E+00	5.390E-13
Y-92	6.440E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.860E+01	0.000E+00	1.840E-05
Y-93	4.300E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.420E+02	0.000E+00	1.180E-03
ZR-95	2.980E-01	6.550E-02	0.000E+00	9.370E-02	0.000E+00	6.830E+01	0.000E+00	5.830E-02
ZR-97	6.780E-03	9.790E-04	0.000E+00	1.410E-03	0.000E+00	1.480E+02	0.000E+00	5.780E-04
NB-95	5.210E+02	2.030E+02	0.000E+00	1.900E+02	0.000E+00	3.750E+05	0.000E+00	1.450E+02
MO-99	0.000E+00	8.130E+01	0.000E+00	1.740E+02	0.000E+00	6.720E+01	0.000E+00	2.010E+01
TC-99M	6.860E-04	1.350E-03	0.000E+00	1.950E-02	6.830E-04	7.650E-01	0.000E+00	2.230E-02
TC-101	3.610E-33	3.780E-33	0.000E+00	6.440E-32	2.000E-33	1.200E-32	0.000E+00	4.790E-32
RU-103	5.650E+00	0.000E+00	0.000E+00	1.420E+01	0.000E+00	1.460E+02	0.000E+00	2.170E+00
RU-105	1.190E-02	0.000E+00	0.000E+00	1.050E-01	0.000E+00	7.790E+00	0.000E+00	4.330E-03
RU-106	9.190E+01	0.000E+00	0.000E+00	1.240E+02	0.000E+00	1.430E+03	0.000E+00	1.150E+01
AG-110M	9.720E-01	6.570E-01	0.000E+00	1.220E+00	0.000E+00	7.810E+01	0.000E+00	5.250E-01
TE-125M	3.540E+03	9.610E+02	9.950E+02	0.000E+00	0.000E+00	3.420E+03	0.000E+00	4.730E+02
TE-127	2.520E+01	6.800E+00	1.750E+01	7.170E+01	0.000E+00	9.850E+02	0.000E+00	5.410E+00
TE-127M	9.040E+03	2.430E+03	2.160E+03	2.580E+04	0.000E+00	7.320E+03	0.000E+00	1.070E+03
TE-129	2.280E-05	6.370E-06	1.630E-05	6.680E-05	0.000E+00	1.420E-03	0.000E+00	5.420E-06
TE-129M	1.500E+04	4.190E+03	4.840E+03	4.410E+04	0.000E+00	1.830E+04	0.000E+00	2.330E+03
TE-131	1.210E-16	3.680E-17	9.220E-17	3.650E-16	0.000E+00	6.330E-16	0.000E+00	3.590E-17
TE-131M	1.300E+03	4.500E+02	9.250E+02	4.350E+03	0.000E+00	1.820E+04	0.000E+00	4.790E+02
TE-132	2.570E+03	1.140E+03	1.650E+03	1.050E+04	0.000E+00	1.140E+04	0.000E+00	1.370E+03
I-130	8.950E+00	1.810E+01	1.990E+03	2.700E+01	0.000E+00	8.460E+00	0.000E+00	9.320E+00

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Summary of Changes to the Offsite Dose Calculation Manual

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APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Fresh Water Fish - Sport (FFSP)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.860E+02	1.870E+02	6.190E+04	3.070E+02	0.000E+00	1.670E+01	0.000E+00	1.060E+02
I-132	6.830E-03	1.250E-02	5.820E-01	1.920E-02	0.000E+00	1.480E-02	0.000E+00	5.770E-03
I-133	3.140E+01	3.880E+01	7.210E+03	6.470E+01	0.000E+00	1.560E+01	0.000E+00	1.470E+01
I-134	2.750E-08	5.100E-08	1.170E-06	7.800E-08	0.000E+00	3.380E-08	0.000E+00	2.350E-08
I-135	1.670E+00	3.010E+00	2.660E+02	4.610E+00	0.000E+00	2.290E+00	0.000E+00	1.420E+00
CS-134	3.680E+05	6.040E+05	0.000E+00	1.870E+05	6.710E+04	3.250E+03	0.000E+00	1.270E+05
CS-136	3.510E+04	9.640E+04	0.000E+00	5.130E+04	7.660E+03	3.390E+03	0.000E+00	6.240E+04
CS-137	5.140E+05	4.920E+05	0.000E+00	1.600E+05	5.770E+04	3.080E+03	0.000E+00	7.270E+04
CS-138	1.210E-11	1.690E-11	0.000E+00	1.190E-11	1.280E-12	7.770E-12	0.000E+00	1.070E-11
BA-139	7.930E-06	4.230E-09	0.000E+00	3.700E-09	2.490E-09	4.580E-04	0.000E+00	2.300E-07
BA-140	2.480E+02	2.170E-01	0.000E+00	7.060E-02	1.290E-01	1.250E+02	0.000E+00	1.450E+01
BA-141	1.210E-24	6.800E-28	0.000E+00	5.880E-28	3.990E-27	6.920E-25	0.000E+00	3.950E-26
BA-142	3.460E-42	2.490E-45	0.000E+00	2.020E-45	1.470E-45	4.510E-44	0.000E+00	1.930E-43
LA-140	1.310E-01	4.590E-02	0.000E+00	0.000E+00	0.000E+00	1.280E+03	0.000E+00	1.550E-02
LA-142	2.970E-07	9.470E-08	0.000E+00	0.000E+00	0.000E+00	1.880E-02	0.000E+00	2.960E-08
CE-141	3.060E-02	1.520E-02	0.000E+00	6.680E-03	0.000E+00	1.900E+01	0.000E+00	2.260E-03
CE-143	3.320E-03	1.800E+00	0.000E+00	7.550E-04	0.000E+00	2.640E+01	0.000E+00	2.610E-04
CE-144	1.630E+00	5.120E-01	0.000E+00	2.830E-01	0.000E+00	1.330E+02	0.000E+00	8.710E-02
PR-143	7.340E-01	2.200E-01	0.000E+00	1.190E-01	0.000E+00	7.920E+02	0.000E+00	3.640E-02
PR-144	2.180E-28	6.750E-29	0.000E+00	3.570E-29	0.000E+00	1.450E-25	0.000E+00	1.100E-29
ND-147	5.150E-01	4.170E-01	0.000E+00	2.290E-01	0.000E+00	6.610E+02	0.000E+00	3.230E-02
W-187	2.010E+02	1.190E+02	0.000E+00	0.000E+00	0.000E+00	1.680E+04	0.000E+00	5.350E+01
NP-239	3.080E-02	2.210E-03	0.000E+00	6.390E-03	0.000E+00	1.630E+02	0.000E+00	1.550E-03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NA-24	4.990E-01	4.990E-01	4.990E-01	4.990E-01	4.990E-01	4.990E-01	5.780E-01	4.990E-01
P-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	1.950E-01	1.950E-01	1.950E-01	1.950E-01	1.950E-01	1.950E-01	2.300E-01	1.950E-01
MN-54	5.790E+01	5.790E+01	5.790E+01	5.790E+01	5.790E+01	5.790E+01	6.790E+01	5.790E+01
MN-56	3.770E-02	3.770E-02	3.770E-02	3.770E-02	3.770E-02	3.770E-02	4.450E-02	3.770E-02
FE-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	1.140E+01	1.140E+01	1.140E+01	1.140E+01	1.140E+01	1.140E+01	1.340E+01	1.140E+01
CO-58	1.580E+01	1.580E+01	1.580E+01	1.580E+01	1.580E+01	1.580E+01	1.850E+01	1.580E+01
CO-60	8.980E+02	8.980E+02	8.980E+02	8.980E+02	8.980E+02	8.980E+02	1.060E+03	8.980E+02
NI-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI-65	1.240E-02	1.240E-02	1.240E-02	1.240E-02	1.240E-02	1.240E-02	1.440E-02	1.240E-02
CU-64	2.530E-02	2.530E-02	2.530E-02	2.530E-02	2.530E-02	2.530E-02	2.870E-02	2.530E-02
ZN-65	3.120E+01	3.120E+01	3.120E+01	3.120E+01	3.120E+01	3.120E+01	3.590E+01	3.120E+01
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	2.030E-04	2.030E-04	2.030E-04	2.030E-04	2.030E-04	2.030E-04	2.960E-04	2.030E-04
BR-84	8.460E-03	8.460E-03	8.460E-03	8.460E-03	8.460E-03	8.460E-03	9.870E-03	8.460E-03
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	3.750E-01	3.750E-01	3.750E-01	3.750E-01	3.750E-01	3.750E-01	4.290E-01	3.750E-01
RB-88	1.380E-03	1.380E-03	1.380E-03	1.380E-03	1.380E-03	1.380E-03	1.580E-03	1.380E-03
RB-89	5.130E-03	5.130E-03	5.130E-03	5.130E-03	5.130E-03	5.130E-03	6.160E-03	5.130E-03
SR-89	9.030E-04	9.030E-04	9.030E-04	9.030E-04	9.030E-04	9.030E-04	1.050E-03	9.030E-04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-91	8.970E-02	8.970E-02	8.970E-02	8.970E-02	8.970E-02	8.970E-02	1.050E-01	8.970E-02

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Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	3.240E-02	3.240E-02	3.240E-02	3.240E-02	3.240E-02	3.240E-02	3.600E-02	3.240E-02
Y-90	1.880E-04	1.880E-04	1.880E-04	1.880E-04	1.880E-04	1.880E-04	2.220E-04	1.880E-04
Y-91	4.480E-02	4.480E-02	4.480E-02	4.480E-02	4.480E-02	4.480E-02	5.040E-02	4.480E-02
Y-91M	4.190E-03	4.190E-03	4.190E-03	4.190E-03	4.190E-03	4.190E-03	4.850E-03	4.190E-03
Y-92	7.530E-03	7.530E-03	7.530E-03	7.530E-03	7.530E-03	7.530E-03	8.940E-03	7.530E-03
Y-93	7.660E-03	7.660E-03	7.660E-03	7.660E-03	7.660E-03	7.660E-03	1.050E-02	7.660E-03
ZR-95	1.020E+01	1.020E+01	1.020E+01	1.020E+01	1.020E+01	1.020E+01	1.190E+01	1.020E+01
ZR-97	1.240E-01	1.240E-01	1.240E-01	1.240E-01	1.240E-01	1.240E-01	1.440E-01	1.240E-01
NB-95	5.710E+00	5.710E+00	5.710E+00	5.710E+00	5.710E+00	5.710E+00	6.710E+00	5.710E+00
MO-99	1.670E-01	1.670E-01	1.670E-01	1.670E-01	1.670E-01	1.670E-01	1.930E-01	1.670E-01
TC-99M	7.680E-03	7.680E-03	7.680E-03	7.680E-03	7.680E-03	7.680E-03	8.810E-03	7.680E-03
TC-101	8.500E-04	8.500E-04	8.500E-04	8.500E-04	8.500E-04	8.500E-04	9.440E-04	8.500E-04
RU-103	4.520E+00	4.520E+00	4.520E+00	4.520E+00	4.520E+00	4.520E+00	5.270E+00	4.520E+00
RU-105	2.660E-02	2.660E-02	2.660E-02	2.660E-02	2.660E-02	2.660E-02	3.010E-02	2.660E-02
RU-106	1.760E+01	1.760E+01	1.760E+01	1.760E+01	1.760E+01	1.760E+01	2.110E+01	1.760E+01
AG-110M	1.440E+02	1.440E+02	1.440E+02	1.440E+02	1.440E+02	1.440E+02	1.670E+02	1.440E+02
TE-125M	6.480E-02	6.480E-02	6.480E-02	6.480E-02	6.480E-02	6.480E-02	8.880E-02	6.480E-02
TE-127	1.240E-04	1.240E-04	1.240E-04	1.240E-04	1.240E-04	1.240E-04	1.370E-04	1.240E-04
TE-127M	3.830E-03	3.830E-03	3.830E-03	3.830E-03	3.830E-03	3.830E-03	4.520E-03	3.830E-03
TE-129	1.100E-03	1.100E-03	1.100E-03	1.100E-03	1.100E-03	1.100E-03	1.300E-03	1.100E-03
TE-129M	8.260E-01	8.260E-01	8.260E-01	8.260E-01	8.260E-01	8.260E-01	9.650E-01	8.260E-01
TE-131	1.220E-03	1.220E-03	1.220E-03	1.220E-03	1.220E-03	1.220E-03	1.440E+00	1.220E-03
TE-131M	3.350E-01	3.350E-01	3.350E-01	3.350E-01	3.350E-01	3.350E-01	3.950E-01	3.350E-01
TE-132	1.770E-01	1.770E-01	1.770E-01	1.770E-01	1.770E-01	1.770E-01	2.080E-01	1.770E-01
I-130	2.300E-01	2.300E-01	2.300E-01	2.300E-01	2.300E-01	2.300E-01	2.790E-01	2.300E-01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX E

A_i Child Dose Factors for use in the Liquid Dose Calculations

Agegroup:	CHILD	Pathway:	Shoreline Sediment (SHDp)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	7.180E-01	7.180E-01	7.180E-01	7.180E-01	7.180E-01	7.180E-01	8.720E-01	7.180E-01
I-132	5.200E-02	5.200E-02	5.200E-02	5.200E-02	5.200E-02	5.200E-02	6.120E-02	5.200E-02
I-133	1.020E-01	1.020E-01	1.020E-01	1.020E-01	1.020E-01	1.020E-01	1.240E-01	1.020E-01
I-134	1.870E-02	1.870E-02	1.870E-02	1.870E-02	1.870E-02	1.870E-02	2.210E-02	1.870E-02
I-135	1.050E-01	1.050E-01	1.050E-01	1.050E-01	1.050E-01	1.050E-01	1.230E-01	1.050E-01
CS-134	2.860E+02	2.860E+02	2.860E+02	2.860E+02	2.860E+02	2.860E+02	3.340E+02	2.860E+02
CS-136	6.300E+00	6.300E+00	6.300E+00	6.300E+00	6.300E+00	6.300E+00	7.140E+00	6.300E+00
CS-137	4.290E+02	4.290E+02	4.290E+02	4.290E+02	4.290E+02	4.290E+02	5.010E+02	4.290E+02
CS-138	1.500E-02	1.500E-02	1.500E-02	1.500E-02	1.500E-02	1.500E-02	1.710E-02	1.500E-02
BA-139	4.420E-03	4.420E-03	4.420E-03	4.420E-03	4.420E-03	4.420E-03	4.970E-03	4.420E-03
BA-140	8.570E-01	8.570E-01	8.570E-01	8.570E-01	8.570E-01	8.570E-01	9.800E-01	8.570E-01
BA-141	1.740E-03	1.740E-03	1.740E-03	1.740E-03	1.740E-03	1.740E-03	1.980E-03	1.740E-03
BA-142	1.870E-03	1.870E-03	1.870E-03	1.870E-03	1.870E-03	1.870E-03	2.130E-03	1.870E-03
LA-140	8.020E-01	8.020E-01	8.020E-01	8.020E-01	8.020E-01	8.020E-01	9.090E-01	8.020E-01
LA-142	3.170E-02	3.170E-02	3.170E-02	3.170E-02	3.170E-02	3.170E-02	3.810E-02	3.170E-02
CE-141	5.700E-01	5.700E-01	5.700E-01	5.700E-01	5.700E-01	5.700E-01	6.430E-01	5.700E-01
CE-143	9.650E-02	9.650E-02	9.650E-02	9.650E-02	9.650E-02	9.650E-02	1.100E-01	9.650E-02
CE-144	2.900E+00	2.900E+00	2.900E+00	2.900E+00	2.900E+00	2.900E+00	3.360E+00	2.900E+00
PR-143	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR-144	7.660E-05	7.660E-05	7.660E-05	7.660E-05	7.660E-05	7.660E-05	8.810E-05	7.660E-05
ND-147	3.500E-01	3.500E-01	3.500E-01	3.500E-01	3.500E-01	3.500E-01	4.200E-01	3.500E-01
W-187	9.820E-02	9.820E-02	9.820E-02	9.820E-02	9.820E-02	9.820E-02	1.140E-01	9.820E-02
NP-239	7.140E-02	7.140E-02	7.140E-02	7.140E-02	7.140E-02	7.140E-02	8.270E-02	7.140E-02

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX F

A_i Infant Dose Factors for use in the Liquid Dose Calculations

Agegroup:	INFANT	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.160E+01	1.160E+01	1.160E+01	1.160E+01	1.160E+01	0.000E+00	1.160E+01
C-14	8.920E+02	1.900E+02	1.900E+02	1.900E+02	1.900E+02	1.900E+02	0.000E+00	1.900E+02
NA-24	2.190E+02	2.190E+02	2.190E+02	2.190E+02	2.190E+02	2.190E+02	0.000E+00	2.190E+02
P-32	6.240E+04	3.670E+03	0.000E+00	0.000E+00	0.000E+00	8.450E+02	0.000E+00	2.420E+03
CR-51	0.000E+00	0.000E+00	3.420E-01	7.470E-02	6.650E-01	1.530E+01	0.000E+00	5.240E-01
MN-54	0.000E+00	7.480E+02	0.000E+00	1.660E+02	0.000E+00	2.750E+02	0.000E+00	1.690E+02
MN-56	0.000E+00	1.220E+00	0.000E+00	1.050E+00	0.000E+00	1.110E+02	0.000E+00	2.100E-01
FE-55	5.230E+02	3.380E+02	0.000E+00	0.000E+00	1.650E+02	4.290E+01	0.000E+00	9.030E+01
FE-59	1.150E+03	2.010E+03	0.000E+00	0.000E+00	5.940E+02	9.590E+02	0.000E+00	7.910E+02
CO-58	0.000E+00	1.350E+02	0.000E+00	0.000E+00	0.000E+00	3.360E+02	0.000E+00	3.360E+02
CO-60	0.000E+00	4.060E+02	0.000E+00	0.000E+00	0.000E+00	9.670E+02	0.000E+00	9.590E+02
NI-63	2.390E+04	1.470E+03	0.000E+00	0.000E+00	0.000E+00	7.340E+01	0.000E+00	8.280E+02
NI-65	6.520E+00	7.380E-01	0.000E+00	0.000E+00	0.000E+00	5.620E+01	0.000E+00	3.360E-01
CU-64	0.000E+00	1.190E+01	0.000E+00	2.010E+01	0.000E+00	2.440E+02	0.000E+00	5.500E+00
ZN-65	6.910E+02	2.370E+03	0.000E+00	1.150E+03	0.000E+00	2.000E+03	0.000E+00	1.090E+03
ZN-69	4.390E-04	7.910E-04	0.000E+00	3.290E-04	0.000E+00	6.450E-02	0.000E+00	5.890E-05
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.200E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.220E-06
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.800E-76
RB-86	0.000E+00	6.280E+03	0.000E+00	0.000E+00	0.000E+00	1.610E+02	0.000E+00	3.100E+03
RB-88	0.000E+00	1.250E-11	0.000E+00	0.000E+00	0.000E+00	1.220E-11	0.000E+00	6.840E-12
RB-89	0.000E+00	9.960E-14	0.000E+00	0.000E+00	0.000E+00	3.390E-14	0.000E+00	6.860E-14
SR-89	9.380E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.930E+03	0.000E+00	2.690E+03
SR-90	6.960E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.690E+03	0.000E+00	1.770E+05
SR-91	7.830E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.270E+02	0.000E+00	2.830E+01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
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APPENDIX F

A_i Infant Dose Factors for use in the Liquid Dose Calculations

Agegroup:	INFANT	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μ Ci/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	3.350E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.610E+02	0.000E+00	1.240E+00
Y-90	2.870E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.970E+03	0.000E+00	7.700E-02
Y-91	4.230E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.030E+03	0.000E+00	1.130E+00
Y-91M	1.350E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.510E-03	0.000E+00	4.610E-08
Y-92	2.740E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.240E+02	0.000E+00	7.710E-04
Y-93	4.010E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.170E+03	0.000E+00	1.090E-02
ZR-95	7.710E+00	1.880E+00	0.000E+00	2.020E+00	0.000E+00	9.350E+02	0.000E+00	1.330E+00
ZR-97	3.400E-01	5.840E-02	0.000E+00	5.890E-02	0.000E+00	3.720E+03	0.000E+00	2.670E-02
NB-95	1.560E+00	6.440E-01	0.000E+00	4.620E-01	0.000E+00	5.440E+02	0.000E+00	3.720E-01
MO-99	0.000E+00	1.130E+03	0.000E+00	1.680E+03	0.000E+00	3.710E+02	0.000E+00	2.200E+02
TC-99M	1.810E-02	3.740E-02	0.000E+00	4.020E-01	1.950E-02	1.090E+01	0.000E+00	4.820E-01
TC-101	4.570E-17	5.750E-17	0.000E+00	6.840E-16	3.140E-17	9.780E-15	0.000E+00	5.690E-16
RU-103	5.520E+01	0.000E+00	0.000E+00	1.150E+02	0.000E+00	6.710E+02	0.000E+00	1.850E+01
RU-105	7.850E-01	0.000E+00	0.000E+00	5.770E+00	0.000E+00	3.120E+02	0.000E+00	2.640E-01
RU-106	9.060E+02	0.000E+00	0.000E+00	1.070E+03	0.000E+00	6.880E+03	0.000E+00	1.130E+02
AG-110M	3.740E+01	2.730E+01	0.000E+00	3.910E+01	0.000E+00	1.420E+03	0.000E+00	1.810E+01
TE-125M	8.710E+02	2.910E+02	2.930E+02	0.000E+00	0.000E+00	4.150E+02	0.000E+00	1.180E+02
TE-127	1.550E+01	5.200E+00	1.260E+01	3.790E+01	0.000E+00	3.260E+02	0.000E+00	3.340E+00
TE-127M	2.190E+03	7.280E+02	6.340E+02	5.400E+03	0.000E+00	8.850E+02	0.000E+00	2.660E+02
TE-129	7.860E-03	2.710E-03	6.590E-03	1.960E-02	0.000E+00	6.280E-01	0.000E+00	1.840E-03
TE-129M	3.720E+03	1.280E+03	1.430E+03	9.310E+03	0.000E+00	2.220E+03	0.000E+00	5.730E+02
TE-131	1.420E-08	5.250E-09	1.270E-08	3.640E-08	0.000E+00	5.750E-07	0.000E+00	3.990E-09
TE-131M	4.330E+02	1.740E+02	3.540E+02	1.200E+03	0.000E+00	2.940E+03	0.000E+00	1.440E+02
TE-132	7.030E+02	3.480E+02	5.140E+02	2.180E+03	0.000E+00	1.290E+03	0.000E+00	3.250E+02
I-130	1.150E+02	2.530E+02	2.840E+04	2.780E+02	0.000E+00	5.430E+01	0.000E+00	1.020E+02

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

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Oconee Nuclear Station
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APPENDIX F

A_i Infant Dose Factors for use in the Liquid Dose Calculations

Agegroup:	INFANT	Pathway:	Potable Water (PWtr)			Units:	mrem/hr / μCi/ml	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.290E+03	1.520E+03	5.010E+05	1.780E+03	0.000E+00	5.440E+01	0.000E+00	6.700E+02
I-132	1.680E+00	3.410E+00	1.600E+02	3.800E+00	0.000E+00	2.760E+00	0.000E+00	1.210E+00
I-133	3.150E+02	4.590E+02	8.350E+04	5.400E+02	0.000E+00	7.770E+01	0.000E+00	1.340E+02
I-134	2.440E-03	4.990E-03	1.160E-01	5.580E-03	0.000E+00	5.160E-03	0.000E+00	1.780E-03
I-135	3.900E+01	7.750E+01	6.950E+03	8.640E+01	0.000E+00	2.800E+01	0.000E+00	2.830E+01
CS-134	1.420E+04	2.640E+04	0.000E+00	6.810E+03	2.790E+03	7.180E+01	0.000E+00	2.670E+03
CS-136	1.680E+03	4.950E+03	0.000E+00	1.970E+03	4.030E+02	7.510E+01	0.000E+00	1.850E+03
CS-137	1.960E+04	2.300E+04	0.000E+00	6.170E+03	2.500E+03	7.190E+01	0.000E+00	1.630E+03
CS-138	3.330E-06	5.410E-06	0.000E+00	2.700E-06	4.210E-07	8.650E-06	0.000E+00	2.620E-06
BA-139	8.180E-02	5.420E-05	0.000E+00	3.260E-05	3.290E-05	5.180E+00	0.000E+00	2.370E-03
BA-140	6.260E+03	6.260E+00	0.000E+00	1.490E+00	3.840E+00	1.540E+03	0.000E+00	3.230E+02
BA-141	2.220E-11	1.520E-14	0.000E+00	9.140E-15	9.250E-15	2.710E-10	0.000E+00	7.000E-13
BA-142	2.460E-20	2.040E-23	0.000E+00	1.180E-23	1.240E-23	1.010E-19	0.000E+00	1.210E-21
LA-140	6.460E-01	2.550E-01	0.000E+00	0.000E+00	0.000E+00	2.990E+03	0.000E+00	6.550E-02
LA-142	2.220E-04	8.160E-05	0.000E+00	0.000E+00	0.000E+00	1.390E+01	0.000E+00	1.950E-05
CE-141	2.930E+00	1.790E+00	0.000E+00	5.510E-01	0.000E+00	9.230E+02	0.000E+00	2.100E-01
CE-143	4.330E-01	2.870E+02	0.000E+00	8.360E-02	0.000E+00	1.670E+03	0.000E+00	3.270E-02
CE-144	1.120E+02	4.580E+01	0.000E+00	1.850E+01	0.000E+00	6.430E+03	0.000E+00	6.270E+00
PR-143	2.980E+00	1.110E+00	0.000E+00	4.140E-01	0.000E+00	1.570E+03	0.000E+00	1.480E-01
PR-144	3.020E-15	1.170E-15	0.000E+00	4.240E-16	0.000E+00	5.440E-11	0.000E+00	1.520E-16
ND-147	2.020E+00	2.070E+00	0.000E+00	7.980E-01	0.000E+00	1.310E+03	0.000E+00	1.270E-01
W-187	2.400E+01	1.670E+01	0.000E+00	0.000E+00	0.000E+00	9.790E+02	0.000E+00	5.760E+00
NP-239	3.600E-01	3.220E-02	0.000E+00	6.430E-02	0.000E+00	9.320E+02	0.000E+00	1.820E-02

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

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APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m²·mrem/yr / μCi/sec; mrem/yr / μCi/m³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	7.630E+02	7.630E+02	7.630E+02	7.630E+02	7.630E+02	0.000E+00	7.630E+02
C-14	2.540E+04	5.080E+03	5.080E+03	5.080E+03	5.080E+03	5.080E+03	0.000E+00	5.080E+03
NA-24	2.440E+06	2.440E+06	2.440E+06	2.440E+06	2.440E+06	2.440E+06	0.000E+00	2.440E+06
P-32	1.710E+10	1.060E+09	0.000E+00	0.000E+00	0.000E+00	1.920E+09	0.000E+00	6.610E+08
CR-51	0.000E+00	0.000E+00	1.710E+04	6.300E+03	3.790E+04	7.190E+06	0.000E+00	2.860E+04
MN-54	0.000E+00	8.410E+06	0.000E+00	2.500E+06	0.000E+00	2.580E+07	0.000E+00	1.610E+06
MN-56	0.000E+00	4.090E-03	0.000E+00	5.190E-03	0.000E+00	1.310E-01	0.000E+00	7.260E-04
FE-55	2.510E+07	1.740E+07	0.000E+00	0.000E+00	9.680E+06	9.950E+06	0.000E+00	4.050E+06
FE-59	2.970E+07	6.980E+07	0.000E+00	0.000E+00	1.950E+07	2.330E+08	0.000E+00	2.680E+07
CO-58	0.000E+00	4.710E+06	0.000E+00	0.000E+00	0.000E+00	9.550E+07	0.000E+00	1.060E+07
CO-60	0.000E+00	1.640E+07	0.000E+00	0.000E+00	0.000E+00	3.080E+08	0.000E+00	3.620E+07
NI-63	6.730E+09	4.660E+08	0.000E+00	0.000E+00	0.000E+00	9.730E+07	0.000E+00	2.260E+08
NI-65	3.700E-01	4.810E-02	0.000E+00	0.000E+00	0.000E+00	1.220E+00	0.000E+00	2.190E-02
CU-64	0.000E+00	2.380E+04	0.000E+00	6.010E+04	0.000E+00	2.030E+06	0.000E+00	1.120E+04
ZN-65	1.370E+09	4.370E+09	0.000E+00	2.920E+09	0.000E+00	2.750E+09	0.000E+00	1.970E+09
ZN-69	2.090E-12	4.000E-12	0.000E+00	2.600E-12	0.000E+00	6.010E-13	0.000E+00	2.780E-13
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.400E-01	0.000E+00	9.720E-02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.260E-28	0.000E+00	1.610E-23
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	2.590E+09	0.000E+00	0.000E+00	0.000E+00	5.120E+08	0.000E+00	1.210E+09
RB-88	0.000E+00	2.140E-45	0.000E+00	0.000E+00	0.000E+00	2.960E-56	0.000E+00	1.140E-45
RB-89	0.000E+00	4.330E-53	0.000E+00	0.000E+00	0.000E+00	2.510E-66	0.000E+00	3.040E-53
SR-89	1.450E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.330E+08	0.000E+00	4.160E+07
SR-90	4.680E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.350E+09	0.000E+00	1.150E+10
SR-91	2.890E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.380E+05	0.000E+00	1.170E+03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m²·mrem/yr / μCi/sec; mrem/yr / μCi/m³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	4.880E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.680E+00	0.000E+00	2.110E-02
Y-90	7.080E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.510E+05	0.000E+00	1.900E+00
Y-91	8.590E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.730E+06	0.000E+00	2.300E+02
Y-91M	5.980E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.760E-19	0.000E+00	2.320E-21
Y-92	5.580E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.770E-01	0.000E+00	1.630E-06
Y-93	2.230E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.090E+03	0.000E+00	6.170E-03
ZR-95	9.430E+02	3.030E+02	0.000E+00	4.750E+02	0.000E+00	9.590E+05	0.000E+00	2.050E+02
ZR-97	4.330E-01	8.740E-02	0.000E+00	1.320E-01	0.000E+00	2.710E+04	0.000E+00	4.000E-02
NB-95	8.260E+04	4.590E+04	0.000E+00	4.540E+04	0.000E+00	2.790E+08	0.000E+00	2.470E+04
MO-99	0.000E+00	2.480E+07	0.000E+00	5.610E+07	0.000E+00	5.740E+07	0.000E+00	4.710E+06
TC-99M	3.320E+00	9.380E+00	0.000E+00	1.420E+02	4.600E+00	5.550E+03	0.000E+00	1.200E+02
TC-101	2.590E-60	3.740E-60	0.000E+00	6.730E-59	1.910E-60	1.120E-71	0.000E+00	3.670E-59
RU-103	1.020E+03	0.000E+00	0.000E+00	3.890E+03	0.000E+00	1.190E+05	0.000E+00	4.390E+02
RU-105	8.570E-04	0.000E+00	0.000E+00	1.110E-02	0.000E+00	5.240E-01	0.000E+00	3.380E-04
RU-106	2.040E+04	0.000E+00	0.000E+00	3.940E+04	0.000E+00	1.320E+06	0.000E+00	2.580E+03
AG-110M	5.820E+07	5.390E+07	0.000E+00	1.060E+08	0.000E+00	2.200E+10	0.000E+00	3.200E+07
TE-125M	1.630E+07	5.900E+06	4.900E+06	6.630E+07	0.000E+00	6.500E+07	0.000E+00	2.180E+06
TE-127	6.530E+02	2.340E+02	4.840E+02	2.660E+03	0.000E+00	5.150E+04	0.000E+00	1.410E+02
TE-127M	4.580E+07	1.640E+07	1.170E+07	1.860E+08	0.000E+00	1.540E+08	0.000E+00	5.580E+06
TE-129	2.830E-10	1.060E-10	2.170E-10	1.190E-09	0.000E+00	2.130E-10	0.000E+00	6.880E-11
TE-129M	6.020E+07	2.250E+07	2.070E+07	2.510E+08	0.000E+00	3.030E+08	0.000E+00	9.530E+06
TE-131	3.600E-33	1.500E-33	2.960E-33	1.580E-32	0.000E+00	5.100E-34	0.000E+00	1.140E-33
TE-131M	3.610E+05	1.770E+05	2.800E+05	1.790E+06	0.000E+00	1.750E+07	0.000E+00	1.470E+05
TE-132	2.400E+06	1.550E+06	1.720E+06	1.500E+07	0.000E+00	7.350E+07	0.000E+00	1.460E+06
I-130	4.200E+05	1.240E+06	1.050E+08	1.930E+06	0.000E+00	1.070E+06	0.000E+00	4.890E+05

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
 Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	2.960E+08	4.230E+08	1.390E+11	7.260E+08	0.000E+00	1.120E+08	0.000E+00	2.430E+08
I-132	1.640E-01	4.390E-01	1.540E+01	7.000E-01	0.000E+00	8.250E-02	0.000E+00	1.540E-01
I-133	3.870E+06	6.730E+06	9.890E+08	1.170E+07	0.000E+00	6.050E+06	0.000E+00	2.050E+06
I-134	2.020E-12	5.480E-12	9.490E-11	8.710E-12	0.000E+00	4.770E-15	0.000E+00	1.960E-12
I-135	1.280E+04	3.360E+04	2.220E+06	5.390E+04	0.000E+00	3.800E+04	0.000E+00	1.240E+04
CS-134	5.650E+09	1.350E+10	0.000E+00	4.350E+09	1.450E+09	2.350E+08	0.000E+00	1.100E+10
CS-136	2.630E+08	1.040E+09	0.000E+00	5.780E+08	7.930E+07	1.180E+08	0.000E+00	7.480E+08
CS-137	7.380E+09	1.010E+10	0.000E+00	3.430E+09	1.140E+09	1.950E+08	0.000E+00	6.610E+09
CS-138	9.050E-24	1.790E-23	0.000E+00	1.310E-23	1.300E-24	7.620E-29	0.000E+00	8.850E-24
BA-139	4.420E-08	3.150E-11	0.000E+00	2.940E-11	1.790E-11	7.830E-08	0.000E+00	1.290E-09
BA-140	2.690E+07	3.380E+04	0.000E+00	1.150E+04	1.930E+04	5.530E+07	0.000E+00	1.760E+06
BA-141	4.090E-46	3.090E-49	0.000E+00	2.880E-49	1.760E-49	1.930E-55	0.000E+00	1.380E-47
BA-142	2.640E-80	2.720E-83	0.000E+00	2.300E-83	1.540E-83	3.720E-98	0.000E+00	1.660E-81
LA-140	4.510E+00	2.270E+00	0.000E+00	0.000E+00	0.000E+00	1.670E+05	0.000E+00	6.010E-01
LA-142	1.860E-11	8.460E-12	0.000E+00	0.000E+00	0.000E+00	6.170E-08	0.000E+00	2.110E-12
CE-141	4.840E+03	3.280E+03	0.000E+00	1.520E+03	0.000E+00	1.250E+07	0.000E+00	3.720E+02
CE-143	4.160E+01	3.070E+04	0.000E+00	1.350E+01	0.000E+00	1.150E+06	0.000E+00	3.400E+00
CE-144	3.580E+05	1.500E+05	0.000E+00	8.870E+04	0.000E+00	1.210E+08	0.000E+00	1.920E+04
PR-143	1.580E+02	6.330E+01	0.000E+00	3.660E+01	0.000E+00	6.920E+05	0.000E+00	7.830E+00
PR-144	5.870E-54	2.440E-54	0.000E+00	1.380E-54	0.000E+00	8.450E-61	0.000E+00	2.990E-55
ND-147	9.420E+01	1.090E+02	0.000E+00	6.360E+01	0.000E+00	5.220E+05	0.000E+00	6.510E+00
W-187	6.510E+03	5.450E+03	0.000E+00	0.000E+00	0.000E+00	1.780E+06	0.000E+00	1.900E+03
NP-239	3.670E+00	3.610E-01	0.000E+00	1.130E+00	0.000E+00	7.410E+04	0.000E+00	1.990E-01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
H-3	0.000E+00	1.560E+03	1.560E+03	1.560E+03	1.560E+03	1.560E+03	0.000E+00	1.560E+03
C-14	2.540E+04	5.080E+03	5.080E+03	5.080E+03	5.080E+03	5.080E+03	0.000E+00	5.080E+03
NA-24	2.930E+05	2.930E+05	2.930E+05	2.930E+05	2.930E+05	2.930E+05	0.000E+00	2.930E+05
P-32	2.050E+10	1.280E+09	0.000E+00	0.000E+00	0.000E+00	2.310E+09	0.000E+00	7.930E+08
CR-51	0.000E+00	0.000E+00	2.050E+03	7.550E+02	4.550E+03	8.620E+05	0.000E+00	3.430E+03
MN-54	0.000E+00	1.010E+06	0.000E+00	3.000E+05	0.000E+00	3.090E+06	0.000E+00	1.930E+05
MN-56	0.000E+00	4.910E-04	0.000E+00	6.230E-04	0.000E+00	1.570E-02	0.000E+00	8.710E-05
FE-55	3.260E+05	2.260E+05	0.000E+00	0.000E+00	1.260E+05	1.290E+05	0.000E+00	5.260E+04
FE-59	3.860E+05	9.070E+05	0.000E+00	0.000E+00	2.540E+05	3.020E+06	0.000E+00	3.480E+05
CO-58	0.000E+00	5.660E+05	0.000E+00	0.000E+00	0.000E+00	1.150E+07	0.000E+00	1.270E+06
CO-60	0.000E+00	1.970E+06	0.000E+00	0.000E+00	0.000E+00	3.700E+07	0.000E+00	4.340E+06
NI-63	8.070E+08	5.600E+07	0.000E+00	0.000E+00	0.000E+00	1.170E+07	0.000E+00	2.710E+07
NI-65	4.440E-02	5.770E-03	0.000E+00	0.000E+00	0.000E+00	1.460E-01	0.000E+00	2.630E-03
CU-64	0.000E+00	2.660E+03	0.000E+00	6.700E+03	0.000E+00	2.260E+05	0.000E+00	1.250E+03
ZN-65	1.650E+08	5.240E+08	0.000E+00	3.500E+08	0.000E+00	3.300E+08	0.000E+00	2.370E+08
ZN-69	2.510E-13	4.800E-13	0.000E+00	3.120E-13	0.000E+00	7.210E-14	0.000E+00	3.340E-14
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.680E-02	0.000E+00	1.170E-02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.520E-29	0.000E+00	1.930E-24
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	3.110E+08	0.000E+00	0.000E+00	0.000E+00	6.140E+07	0.000E+00	1.450E+08
RB-88	0.000E+00	2.570E-46	0.000E+00	0.000E+00	0.000E+00	3.550E-57	0.000E+00	1.360E-46
RB-89	0.000E+00	5.190E-54	0.000E+00	0.000E+00	0.000E+00	3.020E-67	0.000E+00	3.650E-54
SR-89	3.050E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.890E+08	0.000E+00	8.750E+07
SR-90	9.830E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.840E+09	0.000E+00	2.410E+10
SR-91	6.070E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.890E+05	0.000E+00	2.450E+03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
SR-92	1.030E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.030E+01	0.000E+00	4.440E-02
Y-90	8.500E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.010E+04	0.000E+00	2.280E-01
Y-91	1.030E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.670E+05	0.000E+00	2.760E+01
Y-91M	7.170E-21	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.110E-20	0.000E+00	2.780E-22
Y-92	6.690E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.170E-01	0.000E+00	1.960E-07
Y-93	2.680E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.500E+02	0.000E+00	7.400E-04
ZR-95	1.130E+02	3.630E+01	0.000E+00	5.700E+01	0.000E+00	1.150E+05	0.000E+00	2.460E+01
ZR-97	5.200E-02	1.050E-02	0.000E+00	1.580E-02	0.000E+00	3.250E+03	0.000E+00	4.800E-03
NB-95	9.910E+03	5.510E+03	0.000E+00	5.450E+03	0.000E+00	3.340E+07	0.000E+00	2.960E+03
MO-99	0.000E+00	2.970E+06	0.000E+00	6.730E+06	0.000E+00	6.890E+06	0.000E+00	5.660E+05
TC-99M	3.980E-01	1.130E+00	0.000E+00	1.710E+01	5.520E-01	6.660E+02	0.000E+00	1.430E+01
TC-101	3.110E-61	4.490E-61	0.000E+00	8.080E-60	2.290E-61	1.350E-72	0.000E+00	4.400E-60
RU-103	1.220E+02	0.000E+00	0.000E+00	4.660E+02	0.000E+00	1.430E+04	0.000E+00	5.260E+01
RU-105	1.030E-04	0.000E+00	0.000E+00	1.330E-03	0.000E+00	6.290E-02	0.000E+00	4.060E-05
RU-106	2.450E+03	0.000E+00	0.000E+00	4.730E+03	0.000E+00	1.580E+05	0.000E+00	3.100E+02
AG-110M	6.990E+06	6.460E+06	0.000E+00	1.270E+07	0.000E+00	2.640E+09	0.000E+00	3.840E+06
TE-125M	1.950E+06	7.080E+05	5.880E+05	7.950E+06	0.000E+00	7.800E+06	0.000E+00	2.620E+05
TE-127	7.830E+01	2.810E+01	5.800E+01	3.190E+02	0.000E+00	6.180E+03	0.000E+00	1.700E+01
TE-127M	5.490E+06	1.960E+06	1.400E+06	2.230E+07	0.000E+00	1.840E+07	0.000E+00	6.690E+05
TE-129	3.390E-11	1.270E-11	2.600E-11	1.430E-10	0.000E+00	2.560E-11	0.000E+00	8.260E-12
TE-129M	7.220E+06	2.690E+06	2.480E+06	3.020E+07	0.000E+00	3.640E+07	0.000E+00	1.140E+06
TE-131	4.320E-34	1.810E-34	3.550E-34	1.890E-33	0.000E+00	6.120E-35	0.000E+00	1.360E-34
TE-131M	4.330E+04	2.120E+04	3.360E+04	2.150E+05	0.000E+00	2.100E+06	0.000E+00	1.770E+04
TE-132	2.880E+05	1.860E+05	2.060E+05	1.800E+06	0.000E+00	8.820E+06	0.000E+00	1.750E+05
I-130	5.040E+05	1.490E+06	1.260E+08	2.320E+06	0.000E+00	1.280E+06	0.000E+00	5.870E+05

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	3.550E+08	5.080E+08	1.670E+11	8.710E+08	0.000E+00	1.340E+08	0.000E+00	2.910E+08
I-132	1.970E-01	5.270E-01	1.840E+01	8.400E-01	0.000E+00	9.900E-02	0.000E+00	1.840E-01
I-133	4.640E+06	8.080E+06	1.190E+09	1.410E+07	0.000E+00	7.260E+06	0.000E+00	2.460E+06
I-134	2.420E-12	6.570E-12	1.140E-10	1.050E-11	0.000E+00	5.730E-15	0.000E+00	2.350E-12
I-135	1.540E+04	4.030E+04	2.660E+06	6.470E+04	0.000E+00	4.560E+04	0.000E+00	1.490E+04
CS-134	1.700E+10	4.040E+10	0.000E+00	1.310E+10	4.340E+09	7.060E+08	0.000E+00	3.300E+10
CS-136	7.900E+08	3.120E+09	0.000E+00	1.730E+09	2.380E+08	3.540E+08	0.000E+00	2.240E+09
CS-137	2.210E+10	3.030E+10	0.000E+00	1.030E+10	3.420E+09	5.860E+08	0.000E+00	1.980E+10
CS-138	2.710E-23	5.360E-23	0.000E+00	3.940E-23	3.890E-24	2.290E-28	0.000E+00	2.650E-23
BA-139	5.300E-09	3.780E-12	0.000E+00	3.530E-12	2.140E-12	9.400E-09	0.000E+00	1.550E-10
BA-140	3.230E+06	4.050E+03	0.000E+00	1.380E+03	2.320E+03	6.640E+06	0.000E+00	2.110E+05
BA-141	4.910E-47	3.710E-50	0.000E+00	3.450E-50	2.110E-50	2.310E-56	0.000E+00	1.660E-48
BA-142	3.170E-81	3.260E-84	0.000E+00	2.750E-84	1.850E-84	0.000E+00	0.000E+00	2.000E-82
LA-140	5.410E-01	2.730E-01	0.000E+00	0.000E+00	0.000E+00	2.000E+04	0.000E+00	7.210E-02
LA-142	2.230E-12	1.010E-12	0.000E+00	0.000E+00	0.000E+00	7.410E-09	0.000E+00	2.530E-13
CE-141	5.810E+02	3.930E+02	0.000E+00	1.830E+02	0.000E+00	1.500E+06	0.000E+00	4.460E+01
CE-143	4.990E+00	3.690E+03	0.000E+00	1.620E+00	0.000E+00	1.380E+05	0.000E+00	4.080E-01
CE-144	4.290E+04	1.790E+04	0.000E+00	1.060E+04	0.000E+00	1.450E+07	0.000E+00	2.300E+03
PR-143	1.890E+01	7.600E+00	0.000E+00	4.390E+00	0.000E+00	8.300E+04	0.000E+00	9.390E-01
PR-144	7.050E-55	2.930E-55	0.000E+00	1.650E-55	0.000E+00	1.010E-61	0.000E+00	3.580E-56
ND-147	1.130E+01	1.310E+01	0.000E+00	7.630E+00	0.000E+00	6.270E+04	0.000E+00	7.810E-01
W-187	7.820E+02	6.530E+02	0.000E+00	0.000E+00	0.000E+00	2.140E+05	0.000E+00	2.280E+02
NP-239	4.410E-01	4.330E-02	0.000E+00	1.350E-01	0.000E+00	8.890E+03	0.000E+00	2.390E-02

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	3.250E+02	3.250E+02	3.250E+02	3.250E+02	3.250E+02	0.000E+00	3.250E+02
C-14	2.330E+04	4.660E+03	4.660E+03	4.660E+03	4.660E+03	4.660E+03	0.000E+00	4.660E+03
NA-24	1.360E-03	1.360E-03	1.360E-03	1.360E-03	1.360E-03	1.360E-03	0.000E+00	1.360E-03
P-32	4.660E+09	2.900E+08	0.000E+00	0.000E+00	0.000E+00	5.240E+08	0.000E+00	1.800E+08
CR-51	0.000E+00	0.000E+00	4.210E+03	1.550E+03	9.350E+03	1.770E+06	0.000E+00	7.050E+03
MN-54	0.000E+00	9.180E+06	0.000E+00	2.730E+06	0.000E+00	2.810E+07	0.000E+00	1.750E+06
MN-56	0.000E+00	1.320E-53	0.000E+00	1.680E-53	0.000E+00	4.220E-52	0.000E+00	2.350E-54
FE-55	2.930E+08	2.030E+08	0.000E+00	0.000E+00	1.130E+08	1.160E+08	0.000E+00	4.720E+07
FE-59	2.660E+08	6.240E+08	0.000E+00	0.000E+00	1.740E+08	2.080E+09	0.000E+00	2.390E+08
CO-58	0.000E+00	1.820E+07	0.000E+00	0.000E+00	0.000E+00	3.690E+08	0.000E+00	4.090E+07
CO-60	0.000E+00	7.520E+07	0.000E+00	0.000E+00	0.000E+00	1.410E+09	0.000E+00	1.660E+08
NI-63	1.890E+10	1.310E+09	0.000E+00	0.000E+00	0.000E+00	2.730E+08	0.000E+00	6.330E+08
NI-65	2.250E-52	2.920E-53	0.000E+00	0.000E+00	0.000E+00	7.400E-52	0.000E+00	1.330E-53
CU-64	0.000E+00	2.710E-07	0.000E+00	6.830E-07	0.000E+00	2.310E-05	0.000E+00	1.270E-07
ZN-65	3.560E+08	1.130E+09	0.000E+00	7.570E+08	0.000E+00	7.130E+08	0.000E+00	5.120E+08
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.650E-57	0.000E+00	6.000E-57
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	4.870E+08	0.000E+00	0.000E+00	0.000E+00	9.600E+07	0.000E+00	2.270E+08
RB-88	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-89	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-89	3.020E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.840E+07	0.000E+00	8.660E+06
SR-90	1.240E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.590E+08	0.000E+00	3.050E+09
SR-91	1.520E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.240E-10	0.000E+00	6.140E-12

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	1.180E-49	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.340E-48	0.000E+00	5.100E-51
Y-90	1.080E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.140E+06	0.000E+00	2.890E+00
Y-91	1.130E+06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.230E+08	0.000E+00	3.030E+04
Y-91M	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Y-92	1.520E-39	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.660E-35	0.000E+00	4.430E-41
Y-93	4.690E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.490E-07	0.000E+00	1.300E-13
ZR-95	1.870E+06	6.010E+05	0.000E+00	9.420E+05	0.000E+00	1.900E+09	0.000E+00	4.070E+05
ZR-97	2.070E-05	4.170E-06	0.000E+00	6.300E-06	0.000E+00	1.290E+00	0.000E+00	1.910E-06
NB-95	2.300E+06	1.280E+06	0.000E+00	1.260E+06	0.000E+00	7.760E+09	0.000E+00	6.870E+05
MO-99	0.000E+00	1.000E+05	0.000E+00	2.260E+05	0.000E+00	2.320E+05	0.000E+00	1.900E+04
TC-99M	4.450E-21	1.260E-20	0.000E+00	1.910E-19	6.150E-21	7.430E-18	0.000E+00	1.600E-19
TC-101	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RU-103	1.050E+08	0.000E+00	0.000E+00	4.010E+08	0.000E+00	1.230E+10	0.000E+00	4.530E+07
RU-105	5.780E-28	0.000E+00	0.000E+00	7.460E-27	0.000E+00	3.530E-25	0.000E+00	2.280E-28
RU-106	2.800E+09	0.000E+00	0.000E+00	5.400E+09	0.000E+00	1.810E+11	0.000E+00	3.540E+08
AG-110M	6.680E+06	6.180E+06	0.000E+00	1.220E+07	0.000E+00	2.520E+09	0.000E+00	3.670E+06
TE-125M	3.590E+08	1.300E+08	1.080E+08	1.460E+09	0.000E+00	1.430E+09	0.000E+00	4.810E+07
TE-127	2.120E-10	7.610E-11	1.570E-10	8.640E-10	0.000E+00	1.670E-08	0.000E+00	4.590E-11
TE-127M	1.120E+09	3.990E+08	2.850E+08	4.530E+09	0.000E+00	3.740E+09	0.000E+00	1.360E+08
TE-129	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE-129M	1.130E+09	4.230E+08	3.900E+08	4.730E+09	0.000E+00	5.710E+09	0.000E+00	1.790E+08
TE-131	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE-131M	4.510E+02	2.210E+02	3.490E+02	2.230E+03	0.000E+00	2.190E+04	0.000E+00	1.840E+02
TE-132	1.420E+06	9.180E+05	1.010E+06	8.840E+06	0.000E+00	4.340E+07	0.000E+00	8.620E+05
I-130	2.110E-06	6.220E-06	5.270E-04	9.700E-06	0.000E+00	5.350E-06	0.000E+00	2.450E-06

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Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.070E+07	1.540E+07	5.030E+09	2.630E+07	0.000E+00	4.050E+06	0.000E+00	8.800E+06
I-132	6.970E-59	1.860E-58	6.530E-57	2.970E-58	0.000E+00	3.500E-59	0.000E+00	6.530E-59
I-133	3.650E-01	6.350E-01	9.340E+01	1.110E+00	0.000E+00	5.710E-01	0.000E+00	1.940E-01
I-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-135	4.420E-17	1.160E-16	7.640E-15	1.860E-16	0.000E+00	1.310E-16	0.000E+00	4.270E-17
CS-134	6.580E+08	1.560E+09	0.000E+00	5.060E+08	1.680E+08	2.740E+07	0.000E+00	1.280E+09
CS-136	1.210E+07	4.760E+07	0.000E+00	2.650E+07	3.630E+06	5.410E+06	0.000E+00	3.420E+07
CS-137	8.720E+08	1.190E+09	0.000E+00	4.050E+08	1.350E+08	2.310E+07	0.000E+00	7.810E+08
CS-138	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-139	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-140	2.870E+07	3.610E+04	0.000E+00	1.230E+04	2.070E+04	5.920E+07	0.000E+00	1.880E+06
BA-141	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-142	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
LA-140	3.710E-02	1.870E-02	0.000E+00	0.000E+00	0.000E+00	1.370E+03	0.000E+00	4.940E-03
LA-142	3.470E-92	1.580E-92	0.000E+00	0.000E+00	0.000E+00	1.150E-88	0.000E+00	3.940E-93
CE-141	1.400E+04	9.500E+03	0.000E+00	4.410E+03	0.000E+00	3.630E+07	0.000E+00	1.080E+03
CE-143	2.010E-02	1.480E+01	0.000E+00	6.530E-03	0.000E+00	5.550E+02	0.000E+00	1.640E-03
CE-144	1.460E+06	6.090E+05	0.000E+00	3.610E+05	0.000E+00	4.930E+08	0.000E+00	7.830E+04
PR-143	2.100E+04	8.410E+03	0.000E+00	4.850E+03	0.000E+00	9.180E+07	0.000E+00	1.040E+03
PR-144	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ND-147	7.070E+03	8.170E+03	0.000E+00	4.780E+03	0.000E+00	3.920E+07	0.000E+00	4.890E+02
W-187	2.070E-02	1.730E-02	0.000E+00	0.000E+00	0.000E+00	5.660E+00	0.000E+00	6.040E-03
NP-239	2.590E-01	2.550E-02	0.000E+00	7.950E-02	0.000E+00	5.230E+03	0.000E+00	1.400E-02

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	2.260E+03	2.260E+03	2.260E+03	2.260E+03	2.260E+03	0.000E+00	2.260E+03
C-14	6.280E+04	1.260E+04	1.260E+04	1.260E+04	1.260E+04	1.260E+04	0.000E+00	1.260E+04
NA-24	2.690E+05	2.690E+05	2.690E+05	2.690E+05	2.690E+05	2.690E+05	0.000E+00	2.690E+05
P-32	1.400E+09	8.730E+07	0.000E+00	0.000E+00	0.000E+00	1.580E+08	0.000E+00	5.430E+07
CR-51	0.000E+00	0.000E+00	2.780E+04	1.020E+04	6.160E+04	1.170E+07	0.000E+00	4.640E+04
MN-54	0.000E+00	3.130E+08	0.000E+00	9.310E+07	0.000E+00	9.590E+08	0.000E+00	5.970E+07
MN-56	0.000E+00	1.580E+01	0.000E+00	2.000E+01	0.000E+00	5.040E+02	0.000E+00	2.800E+00
FE-55	2.100E+08	1.450E+08	0.000E+00	0.000E+00	8.080E+07	8.310E+07	0.000E+00	3.380E+07
FE-59	1.260E+08	2.960E+08	0.000E+00	0.000E+00	8.280E+07	9.880E+08	0.000E+00	1.140E+08
CO-58	0.000E+00	3.070E+07	0.000E+00	0.000E+00	0.000E+00	6.230E+08	0.000E+00	6.890E+07
CO-60	0.000E+00	1.670E+08	0.000E+00	0.000E+00	0.000E+00	3.140E+09	0.000E+00	3.690E+08
NI-63	1.040E+10	7.210E+08	0.000E+00	0.000E+00	0.000E+00	1.500E+08	0.000E+00	3.490E+08
NI-65	6.150E+01	7.990E+00	0.000E+00	0.000E+00	0.000E+00	2.030E+02	0.000E+00	3.640E+00
CU-64	0.000E+00	9.200E+03	0.000E+00	2.320E+04	0.000E+00	7.840E+05	0.000E+00	4.320E+03
ZN-65	3.170E+08	1.010E+09	0.000E+00	6.750E+08	0.000E+00	6.360E+08	0.000E+00	4.560E+08
ZN-69	5.490E-06	1.050E-05	0.000E+00	6.830E-06	0.000E+00	1.580E-06	0.000E+00	7.310E-07
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.470E+00	0.000E+00	3.110E+00
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.940E-16	0.000E+00	2.480E-11
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	2.190E+08	0.000E+00	0.000E+00	0.000E+00	4.330E+07	0.000E+00	1.020E+08
RB-88	0.000E+00	3.430E-22	0.000E+00	0.000E+00	0.000E+00	4.740E-33	0.000E+00	1.820E-22
RB-89	0.000E+00	3.890E-26	0.000E+00	0.000E+00	0.000E+00	2.260E-39	0.000E+00	2.730E-26
SR-89	9.970E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.600E+09	0.000E+00	2.860E+08
SR-90	6.050E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.750E+10	0.000E+00	1.480E+11
SR-91	3.050E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.450E+06	0.000E+00	1.230E+04

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Agegroup:	ADULT	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	4.270E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.450E+03	0.000E+00	1.850E+01
Y-90	1.330E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.410E+08	0.000E+00	3.570E+02
Y-91	5.110E+06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.810E+09	0.000E+00	1.370E+05
Y-91M	5.220E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.530E-08	0.000E+00	2.020E-10
Y-92	9.150E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.600E+04	0.000E+00	2.680E-02
Y-93	1.700E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.380E+06	0.000E+00	4.680E+00
ZR-95	1.170E+06	3.770E+05	0.000E+00	5.910E+05	0.000E+00	1.190E+09	0.000E+00	2.550E+05
ZR-97	3.370E+02	6.810E+01	0.000E+00	1.030E+02	0.000E+00	2.110E+07	0.000E+00	3.110E+01
NB-95	1.420E+05	7.920E+04	0.000E+00	7.830E+04	0.000E+00	4.810E+08	0.000E+00	4.260E+04
MO-99	0.000E+00	6.150E+06	0.000E+00	1.390E+07	0.000E+00	1.430E+07	0.000E+00	1.170E+06
TC-99M	3.100E+00	8.770E+00	0.000E+00	1.330E+02	4.300E+00	5.190E+03	0.000E+00	1.120E+02
TC-101	8.220E-31	1.180E-30	0.000E+00	2.130E-29	6.050E-31	3.560E-42	0.000E+00	1.160E-29
RU-103	4.770E+06	0.000E+00	0.000E+00	1.820E+07	0.000E+00	5.570E+08	0.000E+00	2.060E+06
RU-105	5.390E+01	0.000E+00	0.000E+00	6.960E+02	0.000E+00	3.290E+04	0.000E+00	2.130E+01
RU-106	1.930E+08	0.000E+00	0.000E+00	3.720E+08	0.000E+00	1.250E+10	0.000E+00	2.440E+07
AG-110M	1.050E+07	9.750E+06	0.000E+00	1.920E+07	0.000E+00	3.980E+09	0.000E+00	5.790E+06
TE-125M	9.660E+07	3.500E+07	2.900E+07	3.930E+08	0.000E+00	3.860E+08	0.000E+00	1.290E+07
TE-127	5.660E+03	2.030E+03	4.190E+03	2.310E+04	0.000E+00	4.470E+05	0.000E+00	1.220E+03
TE-127M	3.490E+08	1.250E+08	8.920E+07	1.420E+09	0.000E+00	1.170E+09	0.000E+00	4.260E+07
TE-129	7.630E-04	2.870E-04	5.850E-04	3.210E-03	0.000E+00	5.760E-04	0.000E+00	1.860E-04
TE-129M	2.510E+08	9.380E+07	8.630E+07	1.050E+09	0.000E+00	1.270E+09	0.000E+00	3.980E+07
TE-131	1.500E-15	6.270E-16	1.230E-15	6.570E-15	0.000E+00	2.130E-16	0.000E+00	4.740E-16
TE-131M	9.120E+05	4.460E+05	7.060E+05	4.520E+06	0.000E+00	4.430E+07	0.000E+00	3.720E+05
TE-132	4.300E+06	2.780E+06	3.070E+06	2.680E+07	0.000E+00	1.320E+08	0.000E+00	2.610E+06
I-130	3.920E+05	1.160E+06	9.810E+07	1.810E+06	0.000E+00	9.960E+05	0.000E+00	4.570E+05

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
I-131	8.080E+07	1.160E+08	3.790E+10	1.980E+08	0.000E+00	3.050E+07	0.000E+00	6.620E+07
I-132	5.760E+01	1.540E+02	5.390E+03	2.450E+02	0.000E+00	2.890E+01	0.000E+00	5.390E+01
I-133	2.090E+06	3.630E+06	5.330E+08	6.330E+06	0.000E+00	3.260E+06	0.000E+00	1.110E+06
I-134	9.650E-05	2.620E-04	4.540E-03	4.170E-04	0.000E+00	2.290E-07	0.000E+00	9.380E-05
I-135	3.900E+04	1.020E+05	6.730E+06	1.640E+05	0.000E+00	1.150E+05	0.000E+00	3.770E+04
CS-134	4.670E+09	1.110E+10	0.000E+00	3.590E+09	1.190E+09	1.940E+08	0.000E+00	9.080E+09
CS-136	4.270E+07	1.680E+08	0.000E+00	9.380E+07	1.290E+07	1.910E+07	0.000E+00	1.210E+08
CS-137	6.360E+09	8.700E+09	0.000E+00	2.950E+09	9.810E+08	1.680E+08	0.000E+00	5.700E+09
CS-138	3.920E-11	7.730E-11	0.000E+00	5.680E-11	5.610E-12	3.300E-16	0.000E+00	3.830E-11
BA-139	2.860E-02	2.030E-05	0.000E+00	1.900E-05	1.150E-05	5.060E-02	0.000E+00	8.360E-04
BA-140	1.280E+08	1.610E+05	0.000E+00	5.490E+04	9.240E+04	2.650E+08	0.000E+00	8.420E+06
BA-141	1.150E-21	8.700E-25	0.000E+00	8.090E-25	4.940E-25	5.430E-31	0.000E+00	3.890E-23
BA-142	5.960E-39	6.120E-42	0.000E+00	5.170E-42	3.470E-42	8.390E-57	0.000E+00	3.750E-40
LA-140	1.980E+03	9.970E+02	0.000E+00	0.000E+00	0.000E+00	7.320E+07	0.000E+00	2.630E+02
LA-142	2.020E-04	9.190E-05	0.000E+00	0.000E+00	0.000E+00	6.710E-01	0.000E+00	2.290E-05
CE-141	1.970E+05	1.330E+05	0.000E+00	6.190E+04	0.000E+00	5.100E+08	0.000E+00	1.510E+04
CE-143	9.980E+02	7.380E+05	0.000E+00	3.250E+02	0.000E+00	2.760E+07	0.000E+00	8.160E+01
CE-144	3.290E+07	1.380E+07	0.000E+00	8.160E+06	0.000E+00	1.110E+10	0.000E+00	1.770E+06
PR-143	6.260E+04	2.510E+04	0.000E+00	1.450E+04	0.000E+00	2.740E+08	0.000E+00	3.100E+03
PR-144	3.090E-26	1.280E-26	0.000E+00	7.230E-27	0.000E+00	4.440E-33	0.000E+00	1.570E-27
ND-147	3.330E+04	3.850E+04	0.000E+00	2.250E+04	0.000E+00	1.850E+08	0.000E+00	2.310E+03
W-187	3.800E+04	3.180E+04	0.000E+00	0.000E+00	0.000E+00	1.040E+07	0.000E+00	1.110E+04
NP-239	1.430E+03	1.400E+02	0.000E+00	4.380E+02	0.000E+00	2.880E+07	0.000E+00	7.740E+01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.260E+03	1.260E+03	1.260E+03	1.260E+03	1.260E+03	0.000E+00	1.260E+03
C-14	1.820E+04	3.410E+03	3.410E+03	3.410E+03	3.410E+03	3.410E+03	0.000E+00	3.410E+03
NA-24	1.020E+04	1.020E+04	1.020E+04	1.020E+04	1.020E+04	1.020E+04	0.000E+00	1.020E+04
P-32	1.320E+06	7.710E+04	0.000E+00	0.000E+00	0.000E+00	8.640E+04	0.000E+00	5.010E+04
CR-51	0.000E+00	0.000E+00	5.950E+01	2.280E+01	1.440E+04	3.320E+03	0.000E+00	1.000E+02
MN-54	0.000E+00	3.960E+04	0.000E+00	9.840E+03	1.400E+06	7.740E+04	0.000E+00	6.300E+03
MN-56	0.000E+00	1.240E+00	0.000E+00	1.300E+00	9.440E+03	2.020E+04	0.000E+00	1.830E-01
FE-55	2.460E+04	1.700E+04	0.000E+00	0.000E+00	7.210E+04	6.030E+03	0.000E+00	3.940E+03
FE-59	1.180E+04	2.780E+04	0.000E+00	0.000E+00	1.020E+06	1.880E+05	0.000E+00	1.060E+04
CO-58	0.000E+00	1.580E+03	0.000E+00	0.000E+00	9.280E+05	1.060E+05	0.000E+00	2.070E+03
CO-60	0.000E+00	1.150E+04	0.000E+00	0.000E+00	5.970E+06	2.850E+05	0.000E+00	1.480E+04
NI-63	4.320E+05	3.140E+04	0.000E+00	0.000E+00	1.780E+05	1.340E+04	0.000E+00	1.450E+04
NI-65	1.540E+00	2.100E-01	0.000E+00	0.000E+00	5.600E+03	1.230E+04	0.000E+00	9.120E-02
CU-64	0.000E+00	1.460E+00	0.000E+00	4.620E+00	6.780E+03	4.900E+04	0.000E+00	6.150E-01
ZN-65	3.240E+04	1.030E+05	0.000E+00	6.900E+04	8.640E+05	5.340E+04	0.000E+00	4.660E+04
ZN-69	3.380E-02	6.510E-02	0.000E+00	4.220E-02	9.200E+02	1.630E+01	0.000E+00	4.520E-03
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.320E+02	0.000E+00	2.410E+02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.640E-03	0.000E+00	3.130E+02
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.280E+01
RB-86	0.000E+00	1.350E+05	0.000E+00	0.000E+00	0.000E+00	1.660E+04	0.000E+00	5.900E+04
RB-88	0.000E+00	3.870E+02	0.000E+00	0.000E+00	0.000E+00	3.340E-09	0.000E+00	1.930E+02
RB-89	0.000E+00	2.560E+02	0.000E+00	0.000E+00	0.000E+00	9.280E-12	0.000E+00	1.700E+02
SR-89	3.040E+05	0.000E+00	0.000E+00	0.000E+00	1.400E+06	3.500E+05	0.000E+00	8.720E+03
SR-90	9.920E+07	0.000E+00	0.000E+00	0.000E+00	9.600E+06	7.220E+05	0.000E+00	6.100E+06
SR-91	6.190E+01	0.000E+00	0.000E+00	0.000E+00	3.650E+04	1.910E+05	0.000E+00	2.500E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
			Bone	Liver	Thyroid		Kidney	Lung
SR-92	6.740E+00	0.000E+00	0.000E+00	0.000E+00	1.650E+04	4.300E+04	0.000E+00	2.910E-01
Y-90	2.090E+03	0.000E+00	0.000E+00	0.000E+00	1.700E+05	5.060E+05	0.000E+00	5.610E+01
Y-91	4.620E+05	0.000E+00	0.000E+00	0.000E+00	1.700E+06	3.850E+05	0.000E+00	1.240E+04
Y-91M	2.610E-01	0.000E+00	0.000E+00	0.000E+00	1.920E+03	1.330E+00	0.000E+00	1.020E-02
Y-92	1.030E+01	0.000E+00	0.000E+00	0.000E+00	1.570E+04	7.350E+04	0.000E+00	3.020E-01
Y-93	9.440E+01	0.000E+00	0.000E+00	0.000E+00	4.850E+04	4.220E+05	0.000E+00	2.610E+00
ZR-95	1.070E+05	3.440E+04	0.000E+00	5.420E+04	1.770E+06	1.500E+05	0.000E+00	2.330E+04
ZR-97	9.680E+01	1.960E+01	0.000E+00	2.970E+01	7.870E+04	5.230E+05	0.000E+00	9.040E+00
NB-95	1.410E+04	7.820E+03	0.000E+00	7.740E+03	5.050E+05	1.040E+05	0.000E+00	4.210E+03
MO-99	0.000E+00	1.210E+02	0.000E+00	2.910E+02	9.120E+04	2.480E+05	0.000E+00	2.300E+01
TC-99M	1.030E-03	2.910E-03	0.000E+00	4.420E-02	7.640E+02	4.160E+03	0.000E+00	3.700E-02
TC-101	4.180E-05	6.020E-05	0.000E+00	1.080E-03	3.990E+02	1.090E-11	0.000E+00	5.900E-04
RU-103	1.530E+03	0.000E+00	0.000E+00	5.830E+03	5.050E+05	1.100E+05	0.000E+00	6.580E+02
RU-105	7.900E-01	0.000E+00	0.000E+00	1.020E+00	1.100E+04	4.820E+04	0.000E+00	3.110E-01
RU-106	6.910E+04	0.000E+00	0.000E+00	1.340E+05	9.360E+06	9.120E+05	0.000E+00	8.720E+03
AG-110M	1.080E+04	1.000E+04	0.000E+00	1.970E+04	4.630E+06	3.020E+05	0.000E+00	5.940E+03
TE-125M	3.420E+03	1.580E+03	1.050E+03	1.240E+04	3.140E+05	7.060E+04	0.000E+00	4.670E+02
TE-127	1.400E+00	6.420E-01	1.060E+00	5.100E+00	6.510E+03	5.740E+04	0.000E+00	3.100E-01
TE-127M	1.260E+04	5.770E+03	3.290E+03	4.580E+04	9.600E+05	1.500E+05	0.000E+00	1.570E+03
TE-129	4.980E-02	2.390E-02	3.900E-02	1.870E-01	1.940E+03	1.570E+02	0.000E+00	1.240E-02
TE-129M	9.760E+03	4.670E+03	3.440E+03	3.660E+04	1.160E+06	3.830E+05	0.000E+00	1.580E+03
TE-131	1.110E-02	5.950E-03	9.360E-03	4.370E-02	1.390E+03	1.840E+01	0.000E+00	3.590E-03
TE-131M	6.990E+01	4.360E+01	5.500E+01	3.090E+02	1.460E+05	5.560E+05	0.000E+00	2.900E+01
TE-132	2.600E+02	2.150E+02	1.900E+02	1.460E+03	2.880E+05	5.100E+05	0.000E+00	1.620E+02
I-130	4.580E+03	1.340E+04	1.140E+06	2.090E+04	0.000E+00	7.690E+03	0.000E+00	5.280E+03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	2.520E+04	3.580E+04	1.190E+07	6.130E+04	0.000E+00	6.280E+03	0.000E+00	2.050E+04
I-132	1.160E+03	3.260E+03	1.140E+05	5.180E+03	0.000E+00	4.060E+02	0.000E+00	1.160E+03
I-133	8.640E+03	1.480E+04	2.150E+06	2.580E+04	0.000E+00	8.880E+03	0.000E+00	4.520E+03
I-134	6.440E+02	1.730E+03	2.980E+04	2.750E+03	0.000E+00	1.010E+00	0.000E+00	6.150E+02
I-135	2.680E+03	6.980E+03	4.480E+05	1.110E+04	0.000E+00	5.250E+03	0.000E+00	2.570E+03
CS-134	3.730E+05	8.480E+05	0.000E+00	2.870E+05	9.760E+04	1.040E+04	0.000E+00	7.280E+05
CS-136	3.900E+04	1.460E+05	0.000E+00	8.560E+04	1.200E+04	1.170E+04	0.000E+00	1.100E+05
CS-137	4.780E+05	6.210E+05	0.000E+00	2.220E+05	7.520E+04	8.400E+03	0.000E+00	4.280E+05
CS-138	3.310E+02	6.210E+02	0.000E+00	4.800E+02	4.860E+01	1.860E-03	0.000E+00	3.240E+02
BA-139	9.360E-01	6.660E-04	0.000E+00	6.220E-04	3.760E+03	8.960E+02	0.000E+00	2.740E-02
BA-140	3.900E+04	4.900E+01	0.000E+00	1.670E+01	1.270E+06	2.180E+05	0.000E+00	2.570E+03
BA-141	1.000E-01	7.530E-05	0.000E+00	7.000E-05	1.940E+03	1.160E-07	0.000E+00	3.360E-03
BA-142	2.630E-02	2.700E-05	0.000E+00	2.290E-05	1.190E+03	1.570E-16	0.000E+00	1.660E-03
LA-140	3.440E+02	1.740E+02	0.000E+00	0.000E+00	1.360E+05	4.580E+05	0.000E+00	4.580E+01
LA-142	6.830E-01	3.100E-01	0.000E+00	0.000E+00	6.330E+03	2.110E+03	0.000E+00	7.720E-02
CE-141	1.990E+04	1.350E+04	0.000E+00	6.260E+03	3.620E+05	1.200E+05	0.000E+00	1.530E+03
CE-143	1.860E+02	1.380E+02	0.000E+00	6.080E+01	7.980E+04	2.260E+05	0.000E+00	1.530E+01
CE-144	3.430E+06	1.430E+06	0.000E+00	8.480E+05	7.780E+06	8.160E+05	0.000E+00	1.840E+05
PR-143	9.360E+03	3.750E+03	0.000E+00	2.160E+03	2.810E+05	2.000E+05	0.000E+00	4.640E+02
PR-144	3.010E-02	1.250E-02	0.000E+00	7.050E-03	1.020E+03	2.150E-08	0.000E+00	1.530E-03
ND-147	5.270E+03	6.100E+03	0.000E+00	3.560E+03	2.210E+05	1.730E+05	0.000E+00	3.650E+02
W-187	8.480E+00	7.080E+00	0.000E+00	0.000E+00	2.900E+04	1.550E+05	0.000E+00	2.480E+00
NP-239	2.300E+02	2.260E+01	0.000E+00	7.000E+01	3.760E+04	1.190E+05	0.000E+00	1.240E+01

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NA-24	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.390E+07	1.190E+07
P-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	5.510E+06	4.660E+06
MN-54	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.630E+09	1.390E+09
MN-56	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	1.070E+06	9.020E+05
FE-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	3.210E+08	2.730E+08
CO-58	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	4.440E+08	3.790E+08
CO-60	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.530E+10	2.150E+10
NI-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI-65	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	3.450E+05	2.970E+05
CU-64	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.880E+05	6.070E+05
ZN-65	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	8.590E+08	7.470E+08
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	7.080E+03	4.870E+03
BR-84	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.360E+05	2.030E+05
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	1.030E+07	8.990E+06
RB-88	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.780E+04	3.310E+04
RB-89	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.480E+05	1.230E+05
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.510E+04	2.160E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-91	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.510E+06	2.150E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Ground Plane Deposition (GPD)			Units:	m²·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	8.630E+05	7.770E+05
Y-90	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	5.310E+03	4.490E+03
Y-91	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.210E+06	1.070E+06
Y-91M	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.160E+05	1.000E+05
Y-92	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	2.140E+05	1.800E+05
Y-93	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	2.510E+05	1.830E+05
ZR-95	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.840E+08	2.450E+08
ZR-97	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	3.440E+06	2.960E+06
NB-95	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.610E+08	1.370E+08
MO-99	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	4.630E+06	3.990E+06
TC-99M	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	2.110E+05	1.840E+05
TC-101	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.260E+04	2.040E+04
RU-103	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.260E+08	1.080E+08
RU-105	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	7.210E+05	6.360E+05
RU-106	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	5.070E+08	4.220E+08
AG-110M	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	4.010E+09	3.440E+09
TE-125M	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	2.130E+06	1.550E+06
TE-127	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	3.280E+03	2.980E+03
TE-127M	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	1.080E+05	9.160E+04
TE-129	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	3.100E+04	2.620E+04
TE-129M	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	2.310E+07	1.980E+07
TE-131	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	3.450E+07	2.920E+04
TE-131M	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	9.460E+06	8.030E+06
TE-132	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.980E+06	4.230E+06
I-130	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	6.690E+06	5.510E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX G

R_i Adult Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	ADULT	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.090E+07	1.720E+07
I-132	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.470E+06	1.250E+06
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06
I-134	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	5.300E+05	4.470E+05
I-135	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.950E+06	2.530E+06
CS-134	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	8.000E+09	6.860E+09
CS-136	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.710E+08	1.510E+08
CS-137	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.200E+10	1.030E+10
CS-138	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	4.100E+05	3.590E+05
BA-139	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.190E+05	1.060E+05
BA-140	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.350E+07	2.050E+07
BA-141	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.750E+04	4.170E+04
BA-142	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	5.110E+04	4.490E+04
LA-140	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	2.180E+07	1.920E+07
LA-142	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	9.120E+05	7.600E+05
CE-141	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.540E+07	1.370E+07
CE-143	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.630E+06	2.310E+06
CE-144	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	8.040E+07	6.950E+07
PR-143	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR-144	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	2.110E+03	1.830E+03
ND-147	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	1.010E+07	8.390E+06
W-187	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.730E+06	2.350E+06
NP-239	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.980E+06	1.710E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	9.940E+02	9.940E+02	9.940E+02	9.940E+02	9.940E+02	0.000E+00	9.940E+02
C-14	4.690E+04	9.380E+03	9.380E+03	9.380E+03	9.380E+03	9.380E+03	0.000E+00	9.380E+03
NA-24	4.260E+06	4.260E+06	4.260E+06	4.260E+06	4.260E+06	4.260E+06	0.000E+00	4.260E+06
P-32	3.150E+10	1.950E+09	0.000E+00	0.000E+00	0.000E+00	2.650E+09	0.000E+00	1.220E+09
CR-51	0.000E+00	0.000E+00	2.770E+04	1.090E+04	7.130E+04	8.390E+06	0.000E+00	4.990E+04
MN-54	0.000E+00	1.400E+07	0.000E+00	4.180E+06	0.000E+00	2.870E+07	0.000E+00	2.780E+06
MN-56	0.000E+00	7.250E-03	0.000E+00	9.180E-03	0.000E+00	4.770E-01	0.000E+00	1.290E-03
FE-55	4.450E+07	3.160E+07	0.000E+00	0.000E+00	2.000E+07	1.370E+07	0.000E+00	7.360E+06
FE-59	5.180E+07	1.210E+08	0.000E+00	0.000E+00	3.810E+07	2.860E+08	0.000E+00	4.670E+07
CO-58	0.000E+00	7.940E+06	0.000E+00	0.000E+00	0.000E+00	1.090E+08	0.000E+00	1.830E+07
CO-60	0.000E+00	2.780E+07	0.000E+00	0.000E+00	0.000E+00	3.620E+08	0.000E+00	6.260E+07
NI-63	1.180E+10	8.350E+08	0.000E+00	0.000E+00	0.000E+00	1.330E+08	0.000E+00	4.010E+08
NI-65	6.770E-01	8.650E-02	0.000E+00	0.000E+00	0.000E+00	4.690E+00	0.000E+00	3.940E-02
CU-64	0.000E+00	4.250E+04	0.000E+00	1.070E+05	0.000E+00	3.290E+06	0.000E+00	2.000E+04
ZN-65	2.110E+09	7.320E+09	0.000E+00	4.680E+09	0.000E+00	3.100E+09	0.000E+00	3.410E+09
ZN-69	3.850E-12	7.330E-12	0.000E+00	4.790E-12	0.000E+00	1.350E-11	0.000E+00	5.130E-13
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.790E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.880E-23
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	4.730E+09	0.000E+00	0.000E+00	0.000E+00	7.000E+08	0.000E+00	2.220E+09
RB-88	0.000E+00	3.890E-45	0.000E+00	0.000E+00	0.000E+00	3.330E-52	0.000E+00	2.070E-45
RB-89	0.000E+00	7.660E-53	0.000E+00	0.000E+00	0.000E+00	1.170E-61	0.000E+00	5.420E-53
SR-89	2.670E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.190E+08	0.000E+00	7.660E+07
SR-90	6.610E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.860E+09	0.000E+00	1.630E+10
SR-91	5.310E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.410E+05	0.000E+00	2.110E+03

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	8.940E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.280E+01	0.000E+00	3.810E-02
Y-90	1.300E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.070E+06	0.000E+00	3.510E+00
Y-91	1.580E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.480E+06	0.000E+00	4.240E+02
Y-91M	1.090E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.170E-18	0.000E+00	4.180E-21
Y-92	1.030E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.830E+00	0.000E+00	2.980E-06
Y-93	4.120E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.260E+04	0.000E+00	1.130E-02
ZR-95	1.650E+03	5.200E+02	0.000E+00	7.650E+02	0.000E+00	1.200E+06	0.000E+00	3.580E+02
ZR-97	7.880E-01	1.560E-01	0.000E+00	2.370E-01	0.000E+00	4.220E+04	0.000E+00	7.190E-02
NB-95	1.410E+05	7.810E+04	0.000E+00	7.570E+04	0.000E+00	3.340E+08	0.000E+00	4.300E+04
MO-99	0.000E+00	4.470E+07	0.000E+00	1.020E+08	0.000E+00	8.010E+07	0.000E+00	8.530E+06
TC-99M	5.760E+00	1.610E+01	0.000E+00	2.390E+02	8.920E+00	1.050E+04	0.000E+00	2.080E+02
TC-101	4.740E-60	6.750E-60	0.000E+00	1.220E-58	4.110E-60	1.150E-66	0.000E+00	6.630E-59
RU-103	1.810E+03	0.000E+00	0.000E+00	6.380E+03	0.000E+00	1.510E+05	0.000E+00	7.740E+02
RU-105	1.560E-03	0.000E+00	0.000E+00	1.970E-02	0.000E+00	1.260E+00	0.000E+00	6.070E-04
RU-106	3.750E+04	0.000E+00	0.000E+00	7.240E+04	0.000E+00	1.800E+06	0.000E+00	4.730E+03
AG-110M	9.630E+07	9.110E+07	0.000E+00	1.740E+08	0.000E+00	2.560E+10	0.000E+00	5.540E+07
TE-125M	3.000E+07	1.080E+07	8.390E+06	0.000E+00	0.000E+00	8.860E+07	0.000E+00	4.020E+06
TE-127	1.210E+03	4.290E+02	8.350E+02	4.900E+03	0.000E+00	9.340E+04	0.000E+00	2.600E+02
TE-127M	8.440E+07	2.990E+07	2.010E+07	3.420E+08	0.000E+00	2.100E+08	0.000E+00	1.000E+07
TE-129	5.200E-10	1.940E-10	3.720E-10	2.180E-09	0.000E+00	2.840E-09	0.000E+00	1.270E-10
TE-129M	1.100E+08	4.090E+07	3.550E+07	4.610E+08	0.000E+00	4.130E+08	0.000E+00	1.740E+07
TE-131	6.580E-33	2.710E-33	5.070E-33	2.880E-32	0.000E+00	5.400E-34	0.000E+00	2.060E-33
TE-131M	6.570E+05	3.150E+05	4.740E+05	3.290E+06	0.000E+00	2.530E+07	0.000E+00	2.630E+05
TE-132	4.290E+06	2.720E+06	2.870E+06	2.610E+07	0.000E+00	8.610E+07	0.000E+00	2.560E+06
I-130	7.380E+05	2.140E+06	1.740E+08	3.290E+06	0.000E+00	1.640E+06	0.000E+00	8.530E+05

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	5.370E+08	7.520E+08	2.190E+11	1.290E+09	0.000E+00	1.490E+08	0.000E+00	4.040E+08
I-132	2.910E-01	7.620E-01	2.570E+01	1.200E+00	0.000E+00	3.320E-01	0.000E+00	2.740E-01
I-133	7.070E+06	1.200E+07	1.670E+09	2.100E+07	0.000E+00	9.070E+06	0.000E+00	3.660E+06
I-134	3.580E-12	9.500E-12	1.580E-10	1.500E-11	0.000E+00	1.250E-13	0.000E+00	3.410E-12
I-135	2.280E+04	5.870E+04	3.780E+06	9.270E+04	0.000E+00	6.510E+04	0.000E+00	2.180E+04
CS-134	9.820E+09	2.310E+10	0.000E+00	7.340E+09	2.800E+09	2.870E+08	0.000E+00	1.070E+10
CS-136	4.480E+08	1.760E+09	0.000E+00	9.600E+08	1.510E+08	1.420E+08	0.000E+00	1.180E+09
CS-137	1.340E+10	1.780E+10	0.000E+00	6.060E+09	2.350E+09	2.530E+08	0.000E+00	6.200E+09
CS-138	1.640E-23	3.150E-23	0.000E+00	2.330E-23	2.710E-24	1.430E-26	0.000E+00	1.580E-23
BA-139	8.170E-08	5.750E-11	0.000E+00	5.420E-11	3.960E-11	7.290E-07	0.000E+00	2.380E-09
BA-140	4.850E+07	5.950E+04	0.000E+00	2.020E+04	4.000E+04	7.480E+07	0.000E+00	3.130E+06
BA-141	7.520E-46	5.620E-49	0.000E+00	5.210E-49	3.850E-49	1.600E-51	0.000E+00	2.510E-47
BA-142	4.790E-80	4.790E-83	0.000E+00	4.050E-83	3.190E-83	1.470E-91	0.000E+00	2.950E-81
LA-140	8.100E+00	3.980E+00	0.000E+00	0.000E+00	0.000E+00	2.290E+05	0.000E+00	1.060E+00
LA-142	3.360E-11	1.490E-11	0.000E+00	0.000E+00	0.000E+00	4.540E-07	0.000E+00	3.710E-12
CE-141	8.880E+03	5.930E+03	0.000E+00	2.790E+03	0.000E+00	1.700E+07	0.000E+00	6.810E+02
CE-143	7.640E+01	5.560E+04	0.000E+00	2.490E+01	0.000E+00	1.670E+06	0.000E+00	6.210E+00
CE-144	6.580E+05	2.720E+05	0.000E+00	1.630E+05	0.000E+00	1.660E+08	0.000E+00	3.540E+04
PR-143	2.900E+02	1.160E+02	0.000E+00	6.730E+01	0.000E+00	9.540E+05	0.000E+00	1.440E+01
PR-144	1.080E-53	4.430E-54	0.000E+00	2.540E-54	0.000E+00	1.190E-56	0.000E+00	5.490E-55
ND-147	1.810E+02	1.970E+02	0.000E+00	1.160E+02	0.000E+00	7.110E+05	0.000E+00	1.180E+01
W-187	1.190E+04	9.710E+03	0.000E+00	0.000E+00	0.000E+00	2.630E+06	0.000E+00	3.400E+03
NP-239	7.010E+00	6.610E-01	0.000E+00	2.070E+00	0.000E+00	1.060E+05	0.000E+00	3.670E-01

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APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Nuclide	Bone	Liver		Thyroid	Kidney
H-3	0.000E+00	2.030E+03	2.030E+03	2.030E+03	2.030E+03	2.030E+03	0.000E+00	2.030E+03
C-14	4.690E+04	9.380E+03	9.380E+03	9.380E+03	9.380E+03	9.380E+03	0.000E+00	9.380E+03
NA-24	5.110E+05	5.110E+05	5.110E+05	5.110E+05	5.110E+05	5.110E+05	0.000E+00	5.110E+05
P-32	3.780E+10	2.340E+09	0.000E+00	0.000E+00	0.000E+00	3.180E+09	0.000E+00	1.470E+09
CR-51	0.000E+00	0.000E+00	3.330E+03	1.310E+03	8.550E+03	1.010E+06	0.000E+00	5.990E+03
MN-54	0.000E+00	1.680E+06	0.000E+00	5.020E+05	0.000E+00	3.450E+06	0.000E+00	3.340E+05
MN-56	0.000E+00	8.700E-04	0.000E+00	1.100E-03	0.000E+00	5.730E-02	0.000E+00	1.550E-04
FE-55	5.790E+05	4.110E+05	0.000E+00	0.000E+00	2.600E+05	1.780E+05	0.000E+00	9.570E+04
FE-59	6.740E+05	1.570E+06	0.000E+00	0.000E+00	4.960E+05	3.720E+06	0.000E+00	6.070E+05
CO-58	0.000E+00	9.520E+05	0.000E+00	0.000E+00	0.000E+00	1.310E+07	0.000E+00	2.190E+06
CO-60	0.000E+00	3.340E+06	0.000E+00	0.000E+00	0.000E+00	4.350E+07	0.000E+00	7.520E+06
NI-63	1.420E+09	1.000E+08	0.000E+00	0.000E+00	0.000E+00	1.590E+07	0.000E+00	4.810E+07
NI-65	8.120E-02	1.040E-02	0.000E+00	0.000E+00	0.000E+00	5.630E-01	0.000E+00	4.730E-03
CU-64	0.000E+00	4.730E+03	0.000E+00	1.200E+04	0.000E+00	3.670E+05	0.000E+00	2.230E+03
ZN-65	2.530E+08	8.780E+08	0.000E+00	5.620E+08	0.000E+00	3.720E+08	0.000E+00	4.100E+08
ZN-69	4.620E-13	8.800E-13	0.000E+00	5.750E-13	0.000E+00	1.620E-12	0.000E+00	6.160E-14
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.150E-02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.450E-24
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	5.670E+08	0.000E+00	0.000E+00	0.000E+00	8.400E+07	0.000E+00	2.670E+08
RB-88	0.000E+00	4.670E-46	0.000E+00	0.000E+00	0.000E+00	4.000E-53	0.000E+00	2.490E-46
RB-89	0.000E+00	9.190E-54	0.000E+00	0.000E+00	0.000E+00	1.410E-62	0.000E+00	6.500E-54
SR-89	5.620E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.690E+08	0.000E+00	1.610E+08
SR-90	1.390E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.900E+09	0.000E+00	3.430E+10
SR-91	1.120E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.060E+05	0.000E+00	4.440E+03

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			Bone	Liver	Thyroid		Kidney	Lung
SR-92	1.880E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.780E+01	0.000E+00	8.000E-02
Y-90	1.560E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.290E+05	0.000E+00	4.210E-01
Y-91	1.900E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.770E+05	0.000E+00	5.080E+01
Y-91M	1.310E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.200E-19	0.000E+00	5.020E-22
Y-92	1.240E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.390E-01	0.000E+00	3.580E-07
Y-93	4.940E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.510E+03	0.000E+00	1.360E-03
ZR-95	1.980E+02	6.250E+01	0.000E+00	9.180E+01	0.000E+00	1.440E+05	0.000E+00	4.300E+01
ZR-97	9.460E-02	1.870E-02	0.000E+00	2.840E-02	0.000E+00	5.070E+03	0.000E+00	8.620E-03
NB-95	1.690E+04	9.370E+03	0.000E+00	9.080E+03	0.000E+00	4.010E+07	0.000E+00	5.160E+03
MO-99	0.000E+00	5.370E+06	0.000E+00	1.230E+07	0.000E+00	9.610E+06	0.000E+00	1.020E+06
TC-99M	6.910E-01	1.930E+00	0.000E+00	2.870E+01	1.070E+00	1.270E+03	0.000E+00	2.500E+01
TC-101	5.690E-61	8.100E-61	0.000E+00	1.460E-59	4.930E-61	1.380E-67	0.000E+00	7.950E-60
RU-103	2.170E+02	0.000E+00	0.000E+00	7.660E+02	0.000E+00	1.810E+04	0.000E+00	9.290E+01
RU-105	1.880E-04	0.000E+00	0.000E+00	2.370E-03	0.000E+00	1.520E-01	0.000E+00	7.290E-05
RU-106	4.500E+03	0.000E+00	0.000E+00	8.680E+03	0.000E+00	2.160E+05	0.000E+00	5.670E+02
AG-110M	1.160E+07	1.090E+07	0.000E+00	2.080E+07	0.000E+00	3.070E+09	0.000E+00	6.650E+06
TE-125M	3.600E+06	1.300E+06	1.010E+06	0.000E+00	0.000E+00	1.060E+07	0.000E+00	4.820E+05
TE-127	1.450E+02	5.150E+01	1.000E+02	5.880E+02	0.000E+00	1.120E+04	0.000E+00	3.120E+01
TE-127M	1.010E+07	3.590E+06	2.410E+06	4.100E+07	0.000E+00	2.520E+07	0.000E+00	1.200E+06
TE-129	6.240E-11	2.330E-11	4.460E-11	2.620E-10	0.000E+00	3.410E-10	0.000E+00	1.520E-11
TE-129M	1.320E+07	4.900E+06	4.260E+06	5.530E+07	0.000E+00	4.960E+07	0.000E+00	2.090E+06
TE-131	7.900E-34	3.260E-34	6.090E-34	3.450E-33	0.000E+00	6.480E-35	0.000E+00	2.470E-34
TE-131M	7.880E+04	3.780E+04	5.690E+04	3.940E+05	0.000E+00	3.030E+06	0.000E+00	3.150E+04
TE-132	5.150E+05	3.260E+05	3.440E+05	3.130E+06	0.000E+00	1.030E+07	0.000E+00	3.070E+05
I-130	8.860E+05	2.560E+06	2.090E+08	3.950E+06	0.000E+00	1.970E+06	0.000E+00	1.020E+06

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	Bone		Liver	Thyroid	Kidney	Lung	Gilli	Skin
I-131	6.450E+08	9.030E+08	2.630E+11	1.550E+09	0.000E+00	1.790E+08	0.000E+00	4.850E+08
I-132	3.500E-01	9.150E-01	3.080E+01	1.440E+00	0.000E+00	3.980E-01	0.000E+00	3.280E-01
I-133	8.480E+06	1.440E+07	2.010E+09	2.520E+07	0.000E+00	1.090E+07	0.000E+00	4.390E+06
I-134	4.300E-12	1.140E-11	1.900E-10	1.800E-11	0.000E+00	1.500E-13	0.000E+00	4.090E-12
I-135	2.740E+04	7.040E+04	4.530E+06	1.110E+05	0.000E+00	7.810E+04	0.000E+00	2.610E+04
CS-134	2.940E+10	6.930E+10	0.000E+00	2.200E+10	8.410E+09	8.620E+08	0.000E+00	3.220E+10
CS-136	1.340E+09	5.290E+09	0.000E+00	2.880E+09	4.540E+08	4.260E+08	0.000E+00	3.550E+09
CS-137	4.020E+10	5.340E+10	0.000E+00	1.820E+10	7.060E+09	7.600E+08	0.000E+00	1.860E+10
CS-138	4.920E-23	9.450E-23	0.000E+00	6.980E-23	8.120E-24	4.290E-26	0.000E+00	4.730E-23
BA-139	9.800E-09	6.900E-12	0.000E+00	6.500E-12	4.750E-12	8.750E-08	0.000E+00	2.860E-10
BA-140	5.820E+06	7.130E+03	0.000E+00	2.420E+03	4.800E+03	8.980E+06	0.000E+00	3.750E+05
BA-141	9.030E-47	6.740E-50	0.000E+00	6.260E-50	4.610E-50	1.920E-52	0.000E+00	3.010E-48
BA-142	5.750E-81	5.750E-84	0.000E+00	4.860E-84	3.820E-84	1.760E-92	0.000E+00	3.540E-82
LA-140	9.720E-01	4.780E-01	0.000E+00	0.000E+00	0.000E+00	2.740E+04	0.000E+00	1.270E-01
LA-142	4.030E-12	1.790E-12	0.000E+00	0.000E+00	0.000E+00	5.440E-08	0.000E+00	4.450E-13
CE-141	1.070E+03	7.120E+02	0.000E+00	3.350E+02	0.000E+00	2.040E+06	0.000E+00	8.170E+01
CE-143	9.170E+00	6.670E+03	0.000E+00	2.990E+00	0.000E+00	2.000E+05	0.000E+00	7.450E-01
CE-144	7.900E+04	3.270E+04	0.000E+00	1.950E+04	0.000E+00	1.990E+07	0.000E+00	4.240E+03
PR-143	3.480E+01	1.390E+01	0.000E+00	8.080E+00	0.000E+00	1.150E+05	0.000E+00	1.730E+00
PR-144	1.300E-54	5.320E-55	0.000E+00	3.050E-55	0.000E+00	1.430E-57	0.000E+00	6.590E-56
ND-147	2.170E+01	2.360E+01	0.000E+00	1.390E+01	0.000E+00	8.530E+04	0.000E+00	1.420E+00
W-187	1.430E+03	1.170E+03	0.000E+00	0.000E+00	0.000E+00	3.150E+05	0.000E+00	4.080E+02
NP-239	8.410E-01	7.930E-02	0.000E+00	2.490E-01	0.000E+00	1.280E+04	0.000E+00	4.410E-02

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Agegroup:	TEEN	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.940E+02	1.940E+02	1.940E+02	1.940E+02	1.940E+02	0.000E+00	1.940E+02
C-14	1.970E+04	3.940E+03	3.940E+03	3.940E+03	3.940E+03	3.940E+03	0.000E+00	3.940E+03
NA-24	1.080E-03	1.080E-03	1.080E-03	1.080E-03	1.080E-03	1.080E-03	0.000E+00	1.080E-03
P-32	3.930E+09	2.440E+08	0.000E+00	0.000E+00	0.000E+00	3.310E+08	0.000E+00	1.530E+08
CR-51	0.000E+00	0.000E+00	3.130E+03	1.240E+03	8.050E+03	9.470E+05	0.000E+00	5.640E+03
MN-54	0.000E+00	7.000E+06	0.000E+00	2.090E+06	0.000E+00	1.440E+07	0.000E+00	1.390E+06
MN-56	0.000E+00	1.070E-53	0.000E+00	1.360E-53	0.000E+00	7.070E-52	0.000E+00	1.910E-54
FE-55	2.380E+08	1.690E+08	0.000E+00	0.000E+00	1.070E+08	7.310E+07	0.000E+00	3.940E+07
FE-59	2.120E+08	4.950E+08	0.000E+00	0.000E+00	1.560E+08	1.170E+09	0.000E+00	1.910E+08
CO-58	0.000E+00	1.410E+07	0.000E+00	0.000E+00	0.000E+00	1.940E+08	0.000E+00	3.240E+07
CO-60	0.000E+00	5.830E+07	0.000E+00	0.000E+00	0.000E+00	7.600E+08	0.000E+00	1.310E+08
NI-63	1.520E+10	1.070E+09	0.000E+00	0.000E+00	0.000E+00	1.710E+08	0.000E+00	5.150E+08
NI-65	1.880E-52	2.410E-53	0.000E+00	0.000E+00	0.000E+00	1.300E-51	0.000E+00	1.100E-53
CU-64	0.000E+00	2.210E-07	0.000E+00	5.600E-07	0.000E+00	1.720E-05	0.000E+00	1.040E-07
ZN-65	2.500E+08	8.690E+08	0.000E+00	5.560E+08	0.000E+00	3.680E+08	0.000E+00	4.050E+08
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.070E-57
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	4.070E+08	0.000E+00	0.000E+00	0.000E+00	6.020E+07	0.000E+00	1.910E+08
RB-88	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-89	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-89	2.550E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.030E+07	0.000E+00	7.290E+06
SR-90	8.050E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.260E+08	0.000E+00	1.990E+09
SR-91	1.280E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.800E-10	0.000E+00	5.090E-12

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	9.880E-50	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.520E-48	0.000E+00	4.210E-51
Y-90	9.060E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.470E+05	0.000E+00	2.440E+00
Y-91	9.540E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.910E+08	0.000E+00	2.560E+04
Y-91M	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Y-92	1.280E-39	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.520E-35	0.000E+00	3.710E-41
Y-93	3.960E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.210E-07	0.000E+00	1.090E-13
ZR-95	1.500E+06	4.730E+05	0.000E+00	6.950E+05	0.000E+00	1.090E+09	0.000E+00	3.250E+05
ZR-97	1.720E-05	3.410E-06	0.000E+00	5.170E-06	0.000E+00	9.230E-01	0.000E+00	1.570E-06
NB-95	1.790E+06	9.950E+05	0.000E+00	9.650E+05	0.000E+00	4.260E+09	0.000E+00	5.480E+05
MO-99	0.000E+00	8.270E+04	0.000E+00	1.890E+05	0.000E+00	1.480E+05	0.000E+00	1.580E+04
TC-99M	3.530E-21	9.850E-21	0.000E+00	1.470E-19	5.470E-21	6.470E-18	0.000E+00	1.280E-19
TC-101	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RU-103	8.570E+07	0.000E+00	0.000E+00	3.020E+08	0.000E+00	7.160E+09	0.000E+00	3.660E+07
RU-105	4.830E-28	0.000E+00	0.000E+00	6.090E-27	0.000E+00	3.900E-25	0.000E+00	1.880E-28
RU-106	2.360E+09	0.000E+00	0.000E+00	4.550E+09	0.000E+00	1.130E+11	0.000E+00	2.970E+08
AG-110M	5.060E+06	4.790E+06	0.000E+00	9.130E+06	0.000E+00	1.340E+09	0.000E+00	2.910E+06
TE-125M	3.030E+08	1.090E+08	8.470E+07	0.000E+00	0.000E+00	8.940E+08	0.000E+00	4.050E+07
TE-127	1.800E-10	6.380E-11	1.240E-10	7.290E-10	0.000E+00	1.390E-08	0.000E+00	3.870E-11
TE-127M	9.410E+08	3.340E+08	2.240E+08	3.820E+09	0.000E+00	2.350E+09	0.000E+00	1.120E+08
TE-129	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE-129M	9.500E+08	3.530E+08	3.070E+08	3.970E+09	0.000E+00	3.570E+09	0.000E+00	1.500E+08
TE-131	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE-131M	3.760E+02	1.800E+02	2.710E+02	1.880E+03	0.000E+00	1.450E+04	0.000E+00	1.500E+02
TE-132	1.160E+06	7.360E+05	7.750E+05	7.060E+06	0.000E+00	2.330E+07	0.000E+00	6.920E+05
I-130	1.700E-06	4.910E-06	4.000E-04	7.560E-06	0.000E+00	3.770E-06	0.000E+00	1.960E-06

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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	8.920E+06	1.250E+07	3.650E+09	2.150E+07	0.000E+00	2.470E+06	0.000E+00	6.710E+06
I-132	5.660E-59	1.480E-58	4.990E-57	2.330E-58	0.000E+00	6.450E-59	0.000E+00	5.320E-59
I-133	3.050E-01	5.180E-01	7.230E+01	9.090E-01	0.000E+00	3.920E-01	0.000E+00	1.580E-01
I-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-135	3.600E-17	9.260E-17	5.960E-15	1.460E-16	0.000E+00	1.030E-16	0.000E+00	3.430E-17
CS-134	5.230E+08	1.230E+09	0.000E+00	3.910E+08	1.490E+08	1.530E+07	0.000E+00	5.710E+08
CS-136	9.400E+06	3.700E+07	0.000E+00	2.010E+07	3.170E+06	2.980E+06	0.000E+00	2.480E+07
CS-137	7.240E+08	9.630E+08	0.000E+00	3.280E+08	1.270E+08	1.370E+07	0.000E+00	3.360E+08
CS-138	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-139	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-140	2.380E+07	2.910E+04	0.000E+00	9.870E+03	1.960E+04	3.660E+07	0.000E+00	1.530E+06
BA-141	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-142	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
LA-140	3.050E-02	1.500E-02	0.000E+00	0.000E+00	0.000E+00	8.610E+02	0.000E+00	3.990E-03
LA-142	2.870E-92	1.280E-92	0.000E+00	0.000E+00	0.000E+00	3.880E-88	0.000E+00	3.180E-93
CE-141	1.180E+04	7.870E+03	0.000E+00	3.710E+03	0.000E+00	2.250E+07	0.000E+00	9.040E+02
CE-143	1.690E-02	1.230E+01	0.000E+00	5.510E-03	0.000E+00	3.690E+02	0.000E+00	1.370E-03
CE-144	1.230E+06	5.080E+05	0.000E+00	3.040E+05	0.000E+00	3.090E+08	0.000E+00	6.600E+04
PR-143	1.760E+04	7.040E+03	0.000E+00	4.090E+03	0.000E+00	5.800E+07	0.000E+00	8.780E+02
PR-144	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ND-147	6.230E+03	6.770E+03	0.000E+00	3.980E+03	0.000E+00	2.440E+07	0.000E+00	4.060E+02
W-187	1.730E-02	1.410E-02	0.000E+00	0.000E+00	0.000E+00	3.820E+00	0.000E+00	4.940E-03
NP-239	2.260E-01	2.140E-02	0.000E+00	6.700E-02	0.000E+00	3.440E+03	0.000E+00	1.190E-02

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Oconee Nuclear Station
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APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
H-3	0.000E+00	2.590E+03	2.590E+03	2.590E+03	2.590E+03	2.590E+03	0.000E+00	2.590E+03
C-14	1.020E+05	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	0.000E+00	2.040E+04
NA-24	2.390E+05	2.390E+05	2.390E+05	2.390E+05	2.390E+05	2.390E+05	0.000E+00	2.390E+05
P-32	1.610E+09	9.970E+07	0.000E+00	0.000E+00	0.000E+00	1.350E+08	0.000E+00	6.240E+07
CR-51	0.000E+00	0.000E+00	3.430E+04	1.350E+04	8.810E+04	1.040E+07	0.000E+00	6.170E+04
MN-54	0.000E+00	4.540E+08	0.000E+00	1.360E+08	0.000E+00	9.320E+08	0.000E+00	9.010E+07
MN-56	0.000E+00	1.420E+01	0.000E+00	1.800E+01	0.000E+00	9.360E+02	0.000E+00	2.530E+00
FE-55	3.260E+08	2.310E+08	0.000E+00	0.000E+00	1.470E+08	1.000E+08	0.000E+00	5.390E+07
FE-59	1.790E+08	4.190E+08	0.000E+00	0.000E+00	1.320E+08	9.900E+08	0.000E+00	1.620E+08
CO-58	0.000E+00	4.360E+07	0.000E+00	0.000E+00	0.000E+00	6.010E+08	0.000E+00	1.000E+08
CO-60	0.000E+00	2.490E+08	0.000E+00	0.000E+00	0.000E+00	3.240E+09	0.000E+00	5.600E+08
NI-63	1.610E+10	1.130E+09	0.000E+00	0.000E+00	0.000E+00	1.810E+08	0.000E+00	5.450E+08
NI-65	5.720E+01	7.310E+00	0.000E+00	0.000E+00	0.000E+00	3.970E+02	0.000E+00	3.330E+00
CU-64	0.000E+00	8.340E+03	0.000E+00	2.110E+04	0.000E+00	6.470E+05	0.000E+00	3.920E+03
ZN-65	4.240E+08	1.470E+09	0.000E+00	9.420E+08	0.000E+00	6.230E+08	0.000E+00	6.870E+08
ZN-69	5.140E-06	9.800E-06	0.000E+00	6.400E-06	0.000E+00	1.810E-05	0.000E+00	6.860E-07
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.910E+00
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.250E-11
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	2.740E+08	0.000E+00	0.000E+00	0.000E+00	4.050E+07	0.000E+00	1.290E+08
RB-88	0.000E+00	3.170E-22	0.000E+00	0.000E+00	0.000E+00	2.720E-29	0.000E+00	1.690E-22
RB-89	0.000E+00	3.500E-26	0.000E+00	0.000E+00	0.000E+00	5.360E-35	0.000E+00	2.470E-26
SR-89	1.510E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.800E+09	0.000E+00	4.340E+08
SR-90	7.510E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.110E+10	0.000E+00	1.850E+11
SR-91	2.850E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.290E+06	0.000E+00	1.130E+04

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APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
	Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin
SR-92	3.970E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.010E+04	0.000E+00	1.690E+01
Y-90	1.240E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.020E+08	0.000E+00	3.350E+02
Y-91	7.840E+06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.210E+09	0.000E+00	2.100E+05
Y-91M	4.860E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.290E-07	0.000E+00	1.860E-10
Y-92	8.600E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.360E+04	0.000E+00	2.490E-02
Y-93	1.590E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.860E+06	0.000E+00	4.360E+00
ZR-95	1.720E+06	5.430E+05	0.000E+00	7.980E+05	0.000E+00	1.250E+09	0.000E+00	3.730E+05
ZR-97	3.120E+02	6.180E+01	0.000E+00	9.370E+01	0.000E+00	1.670E+07	0.000E+00	2.850E+01
NB-95	1.920E+05	1.070E+05	0.000E+00	1.030E+05	0.000E+00	4.560E+08	0.000E+00	5.870E+04
MO-99	0.000E+00	5.650E+06	0.000E+00	1.290E+07	0.000E+00	1.010E+07	0.000E+00	1.080E+06
TC-99M	2.740E+00	7.630E+00	0.000E+00	1.140E+02	4.240E+00	5.010E+03	0.000E+00	9.890E+01
TC-101	7.640E-31	1.090E-30	0.000E+00	1.970E-29	6.620E-31	1.860E-37	0.000E+00	1.070E-29
RU-103	6.820E+06	0.000E+00	0.000E+00	2.400E+07	0.000E+00	5.700E+08	0.000E+00	2.920E+06
RU-105	5.000E+01	0.000E+00	0.000E+00	6.310E+02	0.000E+00	4.040E+04	0.000E+00	1.940E+01
RU-106	3.100E+08	0.000E+00	0.000E+00	5.970E+08	0.000E+00	1.480E+10	0.000E+00	3.900E+07
AG-110M	1.520E+07	1.430E+07	0.000E+00	2.740E+07	0.000E+00	4.030E+09	0.000E+00	8.720E+06
TE-125M	1.480E+08	5.340E+07	4.140E+07	0.000E+00	0.000E+00	4.370E+08	0.000E+00	1.980E+07
TE-127	5.330E+03	1.890E+03	3.680E+03	2.160E+04	0.000E+00	4.120E+05	0.000E+00	1.150E+03
TE-127M	5.510E+08	1.960E+08	1.310E+08	2.240E+09	0.000E+00	1.370E+09	0.000E+00	6.560E+07
TE-129	7.140E-04	2.660E-04	5.100E-04	3.000E-03	0.000E+00	3.910E-03	0.000E+00	1.740E-04
TE-129M	3.620E+08	1.340E+08	1.170E+08	1.510E+09	0.000E+00	1.360E+09	0.000E+00	5.730E+07
TE-131	1.390E-15	5.750E-16	1.070E-15	6.100E-15	0.000E+00	1.140E-16	0.000E+00	4.360E-16
TE-131M	8.440E+05	4.050E+05	6.090E+05	4.220E+06	0.000E+00	3.250E+07	0.000E+00	3.380E+05
TE-132	3.910E+06	2.470E+06	2.610E+06	2.370E+07	0.000E+00	7.840E+07	0.000E+00	2.330E+06
I-130	3.510E+05	1.010E+06	8.280E+07	1.560E+06	0.000E+00	7.800E+05	0.000E+00	4.050E+05

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Agegroup:	TEEN	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	7.690E+07	1.080E+08	3.140E+10	1.850E+08	0.000E+00	2.130E+07	0.000E+00	5.780E+07
I-132	5.190E+01	1.360E+02	4.580E+03	2.140E+02	0.000E+00	5.920E+01	0.000E+00	4.880E+01
I-133	1.940E+06	3.290E+06	4.590E+08	5.760E+06	0.000E+00	2.490E+06	0.000E+00	1.000E+06
I-134	8.720E-05	2.310E-04	3.850E-03	3.640E-04	0.000E+00	3.050E-06	0.000E+00	8.310E-05
I-135	3.520E+04	9.070E+04	5.830E+06	1.430E+05	0.000E+00	1.000E+05	0.000E+00	3.360E+04
CS-134	7.100E+09	1.670E+10	0.000E+00	5.310E+09	2.030E+09	2.080E+08	0.000E+00	7.750E+09
CS-136	4.370E+07	1.720E+08	0.000E+00	9.370E+07	1.480E+07	1.380E+07	0.000E+00	1.160E+08
CS-137	1.010E+10	1.350E+10	0.000E+00	4.590E+09	1.780E+09	1.920E+08	0.000E+00	4.690E+09
CS-138	3.610E-11	6.940E-11	0.000E+00	5.120E-11	5.960E-12	3.150E-14	0.000E+00	3.470E-11
BA-139	2.690E-02	1.890E-05	0.000E+00	1.780E-05	1.300E-05	2.400E-01	0.000E+00	7.830E-04
BA-140	1.380E+08	1.690E+05	0.000E+00	5.740E+04	1.140E+05	2.130E+08	0.000E+00	8.900E+06
BA-141	1.080E-21	8.040E-25	0.000E+00	7.460E-25	5.500E-25	2.290E-27	0.000E+00	3.590E-23
BA-142	5.490E-39	5.490E-42	0.000E+00	4.640E-42	3.650E-42	1.680E-50	0.000E+00	3.380E-40
LA-140	1.810E+03	8.880E+02	0.000E+00	0.000E+00	0.000E+00	5.100E+07	0.000E+00	2.360E+02
LA-142	1.850E-04	8.240E-05	0.000E+00	0.000E+00	0.000E+00	2.510E+00	0.000E+00	2.050E-05
CE-141	2.830E+05	1.890E+05	0.000E+00	8.890E+04	0.000E+00	5.400E+08	0.000E+00	2.170E+04
CE-143	9.330E+02	6.790E+05	0.000E+00	3.040E+02	0.000E+00	2.040E+07	0.000E+00	7.580E+01
CE-144	5.270E+07	2.180E+07	0.000E+00	1.300E+07	0.000E+00	1.330E+10	0.000E+00	2.830E+06
PR-143	7.000E+04	2.800E+04	0.000E+00	1.630E+04	0.000E+00	2.300E+08	0.000E+00	3.490E+03
PR-144	2.900E-26	1.190E-26	0.000E+00	6.800E-27	0.000E+00	3.190E-29	0.000E+00	1.470E-27
ND-147	3.620E+04	3.940E+04	0.000E+00	2.310E+04	0.000E+00	1.420E+08	0.000E+00	2.360E+03
W-187	3.540E+04	2.880E+04	0.000E+00	0.000E+00	0.000E+00	7.800E+06	0.000E+00	1.010E+04
NP-239	1.390E+03	1.310E+02	0.000E+00	4.100E+02	0.000E+00	2.100E+07	0.000E+00	7.260E+01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.270E+03	1.270E+03	1.270E+03	1.270E+03	1.270E+03	0.000E+00	1.270E+03
C-14	2.600E+04	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	0.000E+00	4.870E+03
NA-24	1.380E+04	1.380E+04	1.380E+04	1.380E+04	1.380E+04	1.380E+04	0.000E+00	1.380E+04
P-32	1.890E+06	1.100E+05	0.000E+00	0.000E+00	0.000E+00	9.280E+04	0.000E+00	7.160E+04
CR-51	0.000E+00	0.000E+00	7.500E+01	3.070E+01	2.100E+04	3.000E+03	0.000E+00	1.350E+02
MN-54	0.000E+00	5.110E+04	0.000E+00	1.270E+04	1.980E+06	6.680E+04	0.000E+00	8.400E+03
MN-56	0.000E+00	1.700E+00	0.000E+00	1.790E+00	1.520E+04	5.740E+04	0.000E+00	2.520E-01
FE-55	3.340E+04	2.380E+04	0.000E+00	0.000E+00	1.240E+05	6.390E+03	0.000E+00	5.540E+03
FE-59	1.590E+04	3.700E+04	0.000E+00	0.000E+00	1.530E+06	1.780E+05	0.000E+00	1.430E+04
CO-58	0.000E+00	2.070E+03	0.000E+00	0.000E+00	1.340E+06	9.520E+04	0.000E+00	2.780E+03
CO-60	0.000E+00	1.510E+04	0.000E+00	0.000E+00	8.720E+06	2.590E+05	0.000E+00	1.980E+04
NI-63	5.800E+05	4.340E+04	0.000E+00	0.000E+00	3.070E+05	1.420E+04	0.000E+00	1.980E+04
NI-65	2.180E+00	2.930E-01	0.000E+00	0.000E+00	9.360E+03	3.670E+04	0.000E+00	1.270E-01
CU-64	0.000E+00	2.030E+00	0.000E+00	6.410E+00	1.110E+04	6.140E+04	0.000E+00	8.480E-01
ZN-65	3.860E+04	1.340E+05	0.000E+00	8.640E+04	1.240E+06	4.660E+04	0.000E+00	6.240E+04
ZN-69	4.830E-02	9.200E-02	0.000E+00	6.020E-02	1.580E+03	2.850E+02	0.000E+00	6.460E-03
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.440E+02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.330E+02
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.830E+01
RB-86	0.000E+00	1.900E+05	0.000E+00	0.000E+00	0.000E+00	1.770E+04	0.000E+00	8.400E+04
RB-88	0.000E+00	5.460E+02	0.000E+00	0.000E+00	0.000E+00	2.920E-05	0.000E+00	2.720E+02
RB-89	0.000E+00	3.520E+02	0.000E+00	0.000E+00	0.000E+00	3.380E-07	0.000E+00	2.330E+02
SR-89	4.340E+05	0.000E+00	0.000E+00	0.000E+00	2.420E+06	3.710E+05	0.000E+00	1.250E+04
SR-90	1.080E+08	0.000E+00	0.000E+00	0.000E+00	1.650E+07	7.650E+05	0.000E+00	6.680E+06
SR-91	8.800E+01	0.000E+00	0.000E+00	0.000E+00	6.070E+04	2.590E+05	0.000E+00	3.510E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	9.520E+00	0.000E+00	0.000E+00	0.000E+00	2.740E+04	1.190E+05	0.000E+00	4.060E-01
Y-90	2.980E+03	0.000E+00	0.000E+00	0.000E+00	2.930E+05	5.590E+05	0.000E+00	8.000E+01
Y-91	6.610E+05	0.000E+00	0.000E+00	0.000E+00	2.940E+06	4.090E+05	0.000E+00	1.770E+04
Y-91M	3.700E-01	0.000E+00	0.000E+00	0.000E+00	3.200E+03	3.020E+01	0.000E+00	1.420E-02
Y-92	1.470E+01	0.000E+00	0.000E+00	0.000E+00	2.680E+04	1.650E+05	0.000E+00	4.290E-01
Y-93	1.350E+02	0.000E+00	0.000E+00	0.000E+00	8.320E+04	5.790E+05	0.000E+00	3.720E+00
ZR-95	1.460E+05	4.580E+04	0.000E+00	6.740E+04	2.690E+06	1.490E+05	0.000E+00	3.150E+04
ZR-97	1.380E+02	2.720E+01	0.000E+00	4.120E+01	1.300E+05	6.300E+05	0.000E+00	1.260E+01
NB-95	1.860E+04	1.030E+04	0.000E+00	1.000E+04	7.510E+05	9.680E+04	0.000E+00	5.660E+03
MO-99	0.000E+00	1.690E+02	0.000E+00	4.110E+02	1.540E+05	2.690E+05	0.000E+00	3.220E+01
TC-99M	1.380E-03	3.860E-03	0.000E+00	5.760E-02	1.150E+03	6.130E+03	0.000E+00	4.990E-02
TC-101	5.920E-05	8.400E-05	0.000E+00	1.520E-03	6.670E+02	8.720E-07	0.000E+00	8.240E-04
RU-103	2.100E+03	0.000E+00	0.000E+00	7.430E+03	7.830E+05	1.090E+05	0.000E+00	8.960E+02
RU-105	1.120E+00	0.000E+00	0.000E+00	1.410E+00	1.820E+04	9.040E+04	0.000E+00	4.340E-01
RU-106	9.840E+04	0.000E+00	0.000E+00	1.900E+05	1.610E+07	9.600E+05	0.000E+00	1.240E+04
AG-110M	1.380E+04	1.310E+04	0.000E+00	2.500E+04	6.750E+06	2.730E+05	0.000E+00	7.990E+03
TE-125M	4.880E+03	2.240E+03	1.400E+03	0.000E+00	5.360E+05	7.500E+04	0.000E+00	6.670E+02
TE-127	2.010E+00	9.120E-01	1.420E+00	7.280E+00	1.120E+04	8.080E+04	0.000E+00	4.420E-01
TE-127M	1.800E+04	8.160E+03	4.380E+03	6.540E+04	1.660E+06	1.590E+05	0.000E+00	2.180E+03
TE-129	7.100E-02	3.380E-02	5.180E-02	2.660E-01	3.300E+03	1.620E+03	0.000E+00	1.760E-02
TE-129M	1.390E+04	6.580E+03	4.580E+03	5.190E+04	1.980E+06	4.050E+05	0.000E+00	2.250E+03
TE-131	1.580E-02	8.320E-03	1.240E-02	6.180E-02	2.340E+03	1.510E+01	0.000E+00	5.040E-03
TE-131M	9.840E+01	6.010E+01	7.250E+01	4.390E+02	2.380E+05	6.210E+05	0.000E+00	4.020E+01
TE-132	3.600E+02	2.900E+02	2.460E+02	1.950E+03	4.490E+05	4.630E+05	0.000E+00	2.190E+02
I-130	6.240E+03	1.790E+04	1.490E+06	2.750E+04	0.000E+00	9.120E+03	0.000E+00	7.170E+03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	3.540E+04	4.910E+04	1.460E+07	8.400E+04	0.000E+00	6.490E+03	0.000E+00	2.640E+04
I-132	1.590E+03	4.380E+03	1.510E+05	6.920E+03	0.000E+00	1.270E+03	0.000E+00	1.580E+03
I-133	1.220E+04	2.050E+04	2.920E+06	3.590E+04	0.000E+00	1.030E+04	0.000E+00	6.220E+03
I-134	8.880E+02	2.320E+03	3.950E+04	3.660E+03	0.000E+00	2.040E+01	0.000E+00	8.400E+02
I-135	3.700E+03	9.440E+03	6.210E+05	1.490E+04	0.000E+00	6.950E+03	0.000E+00	3.490E+03
CS-134	5.020E+05	1.130E+06	0.000E+00	3.750E+05	1.460E+05	9.760E+03	0.000E+00	5.490E+05
CS-136	5.150E+04	1.940E+05	0.000E+00	1.100E+05	1.780E+04	1.090E+04	0.000E+00	1.370E+05
CS-137	6.700E+05	8.480E+05	0.000E+00	3.040E+05	1.210E+05	8.480E+03	0.000E+00	3.110E+05
CS-138	4.660E+02	8.560E+02	0.000E+00	6.620E+02	7.870E+01	2.700E-01	0.000E+00	4.460E+02
BA-139	1.340E+00	9.440E-04	0.000E+00	8.880E-04	6.460E+03	6.450E+03	0.000E+00	3.900E-02
BA-140	5.470E+04	6.700E+01	0.000E+00	2.280E+01	2.030E+06	2.290E+05	0.000E+00	3.520E+03
BA-141	1.420E-01	1.060E-04	0.000E+00	9.840E-05	3.290E+03	7.460E-04	0.000E+00	4.740E-03
BA-142	3.700E-02	3.700E-05	0.000E+00	3.140E-05	1.910E+03	4.790E-10	0.000E+00	2.270E-03
LA-140	4.790E+02	2.360E+02	0.000E+00	0.000E+00	2.140E+05	4.870E+05	0.000E+00	6.260E+01
LA-142	9.600E-01	4.250E-01	0.000E+00	0.000E+00	1.020E+04	1.200E+04	0.000E+00	1.060E-01
CE-141	2.840E+04	1.900E+04	0.000E+00	8.880E+03	6.140E+05	1.260E+05	0.000E+00	2.170E+03
CE-143	2.660E+02	1.940E+02	0.000E+00	8.640E+01	1.300E+05	2.550E+05	0.000E+00	2.160E+01
CE-144	4.890E+06	2.020E+06	0.000E+00	1.210E+06	1.340E+07	8.640E+05	0.000E+00	2.620E+05
PR-143	1.340E+04	5.310E+03	0.000E+00	3.090E+03	4.830E+05	2.140E+05	0.000E+00	6.620E+02
PR-144	4.300E-02	1.760E-02	0.000E+00	1.010E-02	1.750E+03	2.350E-04	0.000E+00	2.180E-03
ND-147	7.860E+03	8.560E+03	0.000E+00	5.020E+03	3.720E+05	1.820E+05	0.000E+00	5.130E+02
W-187	1.200E+01	9.760E+00	0.000E+00	0.000E+00	4.740E+04	1.770E+05	0.000E+00	3.430E+00
NP-239	3.380E+02	3.190E+01	0.000E+00	1.000E+02	6.490E+04	1.320E+05	0.000E+00	1.770E+01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Ground Plane Deposition (GPD)			Units:	m²·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NA-24	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.390E+07	1.190E+07
P-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	5.510E+06	4.660E+06
MN-54	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.630E+09	1.390E+09
MN-56	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	1.070E+06	9.020E+05
FE-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	3.210E+08	2.730E+08
CO-58	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	4.440E+08	3.790E+08
CO-60	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.530E+10	2.150E+10
NI-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI-65	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	3.450E+05	2.970E+05
CU-64	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.880E+05	6.070E+05
ZN-65	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	8.590E+08	7.470E+08
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	7.080E+03	4.870E+03
BR-84	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.360E+05	2.030E+05
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	1.030E+07	8.990E+06
RB-88	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.780E+04	3.310E+04
RB-89	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.480E+05	1.230E+05
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.510E+04	2.160E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-91	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.510E+06	2.150E+06

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
 Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	8.630E+05	7.770E+05
Y-90	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	5.310E+03	4.490E+03
Y-91	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.210E+06	1.070E+06
Y-91M	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.160E+05	1.000E+05
Y-92	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	2.140E+05	1.800E+05
Y-93	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	2.510E+05	1.830E+05
ZR-95	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.840E+08	2.450E+08
ZR-97	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	3.440E+06	2.960E+06
NB-95	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.610E+08	1.370E+08
MO-99	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	4.630E+06	3.990E+06
TC-99M	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	2.110E+05	1.840E+05
TC-101	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.260E+04	2.040E+04
RU-103	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.260E+08	1.080E+08
RU-105	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	7.210E+05	6.360E+05
RU-106	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	5.070E+08	4.220E+08
AG-110M	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	4.010E+09	3.440E+09
TE-125M	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	2.130E+06	1.550E+06
TE-127	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	3.280E+03	2.980E+03
TE-127M	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	1.080E+05	9.160E+04
TE-129	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	3.100E+04	2.620E+04
TE-129M	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	2.310E+07	1.980E+07
TE-131	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	3.450E+07	2.920E+04
TE-131M	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	9.460E+06	8.030E+06
TE-132	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.980E+06	4.230E+06
I-130	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	6.690E+06	5.510E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX H

R_i Teen Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	TEEN	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.090E+07	1.720E+07
I-132	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.470E+06	1.250E+06
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06
I-134	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	5.300E+05	4.470E+05
I-135	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.950E+06	2.530E+06
CS-134	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	8.000E+09	6.860E+09
CS-136	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.710E+08	1.510E+08
CS-137	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.200E+10	1.030E+10
CS-138	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	4.100E+05	3.590E+05
BA-139	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.190E+05	1.060E+05
BA-140	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.350E+07	2.050E+07
BA-141	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.750E+04	4.170E+04
BA-142	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	5.110E+04	4.490E+04
LA-140	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	2.180E+07	1.920E+07
LA-142	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	9.120E+05	7.600E+05
CE-141	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.540E+07	1.370E+07
CE-143	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.630E+06	2.310E+06
CE-144	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	8.040E+07	6.950E+07
PR-143	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR-144	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	2.110E+03	1.830E+03
ND-147	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	1.010E+07	8.390E+06
W-187	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.730E+06	2.350E+06
NP-239	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.980E+06	1.710E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
H-3	0.000E+00	1.570E+03	1.570E+03	1.570E+03	1.570E+03	1.570E+03	0.000E+00	1.570E+03
C-14	1.150E+05	2.310E+04	2.310E+04	2.310E+04	2.310E+04	2.310E+04	0.000E+00	2.310E+04
NA-24	8.850E+06	8.850E+06	8.850E+06	8.850E+06	8.850E+06	8.850E+06	0.000E+00	8.850E+06
P-32	7.780E+10	3.640E+09	0.000E+00	0.000E+00	0.000E+00	2.150E+09	0.000E+00	3.000E+09
CR-51	0.000E+00	0.000E+00	5.650E+04	1.540E+04	1.030E+05	5.400E+06	0.000E+00	1.020E+05
MN-54	0.000E+00	2.100E+07	0.000E+00	5.880E+06	0.000E+00	1.760E+07	0.000E+00	5.590E+06
MN-56	0.000E+00	1.260E-02	0.000E+00	1.530E-02	0.000E+00	1.830E+00	0.000E+00	2.860E-03
FE-55	1.120E+08	5.930E+07	0.000E+00	0.000E+00	3.350E+07	1.100E+07	0.000E+00	1.840E+07
FE-59	1.200E+08	1.950E+08	0.000E+00	0.000E+00	5.640E+07	2.030E+08	0.000E+00	9.690E+07
CO-58	0.000E+00	1.210E+07	0.000E+00	0.000E+00	0.000E+00	7.070E+07	0.000E+00	3.710E+07
CO-60	0.000E+00	4.320E+07	0.000E+00	0.000E+00	0.000E+00	2.390E+08	0.000E+00	1.270E+08
NI-63	2.960E+10	1.590E+09	0.000E+00	0.000E+00	0.000E+00	1.070E+08	0.000E+00	1.010E+09
NI-65	1.660E+00	1.560E-01	0.000E+00	0.000E+00	0.000E+00	1.910E+01	0.000E+00	9.100E-02
CU-64	0.000E+00	7.460E+04	0.000E+00	1.800E+05	0.000E+00	3.500E+06	0.000E+00	4.510E+04
ZN-65	4.130E+09	1.100E+10	0.000E+00	6.940E+09	0.000E+00	1.930E+09	0.000E+00	6.850E+09
ZN-69	9.460E-12	1.370E-11	0.000E+00	8.300E-12	0.000E+00	8.620E-10	0.000E+00	1.260E-12
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.400E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.510E-23
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	8.770E+09	0.000E+00	0.000E+00	0.000E+00	5.640E+08	0.000E+00	5.390E+09
RB-88	0.000E+00	7.160E-45	0.000E+00	0.000E+00	0.000E+00	3.510E-46	0.000E+00	4.970E-45
RB-89	0.000E+00	1.340E-52	0.000E+00	0.000E+00	0.000E+00	1.170E-54	0.000E+00	1.190E-52
SR-89	6.620E+09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.560E+08	0.000E+00	1.890E+08
SR-90	1.120E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.510E+09	0.000E+00	2.830E+10
SR-91	1.300E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.880E+05	0.000E+00	4.920E+03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
SR-92	2.180E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.130E+01	0.000E+00	8.750E-02
Y-90	3.220E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.170E+05	0.000E+00	8.620E+00
Y-91	3.900E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.200E+06	0.000E+00	1.040E+03
Y-91M	2.670E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.240E-16	0.000E+00	9.730E-21
Y-92	2.530E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.310E+00	0.000E+00	7.240E-06
Y-93	1.010E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.510E+04	0.000E+00	2.780E-02
ZR-95	3.830E+03	8.420E+02	0.000E+00	1.210E+03	0.000E+00	8.790E+05	0.000E+00	7.500E+02
ZR-97	1.920E+00	2.770E-01	0.000E+00	3.980E-01	0.000E+00	4.200E+04	0.000E+00	1.640E-01
NB-95	3.180E+05	1.240E+05	0.000E+00	1.160E+05	0.000E+00	2.290E+08	0.000E+00	8.840E+04
MO-99	0.000E+00	8.140E+07	0.000E+00	1.740E+08	0.000E+00	6.730E+07	0.000E+00	2.010E+07
TC-99M	1.320E+01	2.590E+01	0.000E+00	3.760E+02	1.320E+01	1.470E+04	0.000E+00	4.290E+02
TC-101	1.160E-59	1.220E-59	0.000E+00	2.080E-58	6.440E-60	3.870E-59	0.000E+00	1.540E-58
RU-103	4.280E+03	0.000E+00	0.000E+00	1.080E+04	0.000E+00	1.110E+05	0.000E+00	1.650E+03
RU-105	3.820E-03	0.000E+00	0.000E+00	3.360E-02	0.000E+00	2.490E+00	0.000E+00	1.390E-03
RU-106	9.240E+04	0.000E+00	0.000E+00	1.250E+05	0.000E+00	1.440E+06	0.000E+00	1.150E+04
AG-110M	2.090E+08	1.410E+08	0.000E+00	2.630E+08	0.000E+00	1.680E+10	0.000E+00	1.130E+08
TE-125M	7.380E+07	2.000E+07	2.070E+07	0.000E+00	0.000E+00	7.120E+07	0.000E+00	9.840E+06
TE-127	2.980E+03	8.020E+02	2.060E+03	8.470E+03	0.000E+00	1.160E+05	0.000E+00	6.380E+02
TE-127M	2.080E+08	5.600E+07	4.970E+07	5.930E+08	0.000E+00	1.680E+08	0.000E+00	2.470E+07
TE-129	1.280E-09	3.580E-10	9.160E-10	3.750E-09	0.000E+00	7.990E-08	0.000E+00	3.050E-10
TE-129M	2.710E+08	7.580E+07	8.750E+07	7.970E+08	0.000E+00	3.310E+08	0.000E+00	4.210E+07
TE-131	1.620E-32	4.920E-33	1.240E-32	4.890E-32	0.000E+00	8.490E-32	0.000E+00	4.810E-33
TE-131M	1.600E+06	5.530E+05	1.140E+06	5.350E+06	0.000E+00	2.240E+07	0.000E+00	5.890E+05
TE-132	1.020E+07	4.530E+06	6.600E+06	4.210E+07	0.000E+00	4.570E+07	0.000E+00	5.480E+06
I-130	1.730E+06	3.490E+06	3.840E+08	5.220E+06	0.000E+00	1.630E+06	0.000E+00	1.800E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHLD	Pathway:	Grs/Cow/Milk (CMLK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
I-131	1.300E+09	1.310E+09	4.330E+11	2.150E+09	0.000E+00	1.170E+08	0.000E+00	7.450E+08
I-132	6.890E-01	1.270E+00	5.870E+01	1.940E+00	0.000E+00	1.490E+00	0.000E+00	5.820E-01
I-133	1.720E+07	2.120E+07	3.940E+09	3.540E+07	0.000E+00	8.560E+06	0.000E+00	8.030E+06
I-134	8.480E-12	1.570E-11	3.620E-10	2.410E-11	0.000E+00	1.040E-11	0.000E+00	7.250E-12
I-135	5.400E+04	9.720E+04	8.610E+06	1.490E+05	0.000E+00	7.400E+04	0.000E+00	4.600E+04
CS-134	2.260E+10	3.720E+10	0.000E+00	1.150E+10	4.130E+09	2.000E+08	0.000E+00	7.840E+09
CS-136	1.010E+09	2.780E+09	0.000E+00	1.480E+09	2.210E+08	9.770E+07	0.000E+00	1.800E+09
CS-137	3.220E+10	3.090E+10	0.000E+00	1.010E+10	3.620E+09	1.930E+08	0.000E+00	4.550E+09
CS-138	3.980E-23	5.530E-23	0.000E+00	3.890E-23	4.190E-24	2.550E-23	0.000E+00	3.510E-23
BA-139	2.010E-07	1.070E-10	0.000E+00	9.360E-11	6.300E-11	1.160E-05	0.000E+00	5.820E-09
BA-140	1.170E+08	1.030E+05	0.000E+00	3.340E+04	6.120E+04	5.930E+07	0.000E+00	6.840E+06
BA-141	1.850E-45	1.040E-48	0.000E+00	8.960E-49	6.090E-48	1.050E-45	0.000E+00	6.020E-47
BA-142	1.150E-79	8.310E-83	0.000E+00	6.720E-83	4.890E-83	1.510E-81	0.000E+00	6.450E-81
LA-140	1.940E+01	6.780E+00	0.000E+00	0.000E+00	0.000E+00	1.890E+05	0.000E+00	2.290E+00
LA-142	8.100E-11	2.580E-11	0.000E+00	0.000E+00	0.000E+00	5.120E-06	0.000E+00	8.090E-12
CE-141	2.190E+04	1.090E+04	0.000E+00	4.780E+03	0.000E+00	1.360E+07	0.000E+00	1.620E+03
CE-143	1.870E+02	1.020E+05	0.000E+00	4.260E+01	0.000E+00	1.490E+06	0.000E+00	1.470E+01
CE-144	1.620E+06	5.090E+05	0.000E+00	2.820E+05	0.000E+00	1.330E+08	0.000E+00	8.660E+04
PR-143	7.180E+02	2.160E+02	0.000E+00	1.170E+02	0.000E+00	7.750E+05	0.000E+00	3.560E+01
PR-144	2.680E-53	8.290E-54	0.000E+00	4.380E-54	0.000E+00	1.780E-50	0.000E+00	1.350E-54
ND-147	4.450E+02	3.600E+02	0.000E+00	1.980E+02	0.000E+00	5.700E+05	0.000E+00	2.790E+01
W-187	2.890E+04	1.710E+04	0.000E+00	0.000E+00	0.000E+00	2.400E+06	0.000E+00	7.670E+03
NP-239	1.720E+01	1.240E+00	0.000E+00	3.580E+00	0.000E+00	9.170E+04	0.000E+00	8.710E-01

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Oconee Nuclear Station
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APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	3.200E+03	3.200E+03	3.200E+03	3.200E+03	3.200E+03	0.000E+00	3.200E+03
C-14	1.150E+05	2.310E+04	2.310E+04	2.310E+04	2.310E+04	2.310E+04	0.000E+00	2.310E+04
NA-24	1.060E+06	1.060E+06	1.060E+06	1.060E+06	1.060E+06	1.060E+06	0.000E+00	1.060E+06
P-32	9.330E+10	4.370E+09	0.000E+00	0.000E+00	0.000E+00	2.580E+09	0.000E+00	3.600E+09
CR-51	0.000E+00	0.000E+00	6.780E+03	1.850E+03	1.240E+04	6.480E+05	0.000E+00	1.220E+04
MN-54	0.000E+00	2.520E+06	0.000E+00	7.060E+05	0.000E+00	2.110E+06	0.000E+00	6.700E+05
MN-56	0.000E+00	1.520E-03	0.000E+00	1.840E-03	0.000E+00	2.200E-01	0.000E+00	3.430E-04
FE-55	1.450E+06	7.710E+05	0.000E+00	0.000E+00	4.360E+05	1.430E+05	0.000E+00	2.390E+05
FE-59	1.560E+06	2.530E+06	0.000E+00	0.000E+00	7.330E+05	2.630E+06	0.000E+00	1.260E+06
CO-58	0.000E+00	1.450E+06	0.000E+00	0.000E+00	0.000E+00	8.490E+06	0.000E+00	4.450E+06
CO-60	0.000E+00	5.180E+06	0.000E+00	0.000E+00	0.000E+00	2.870E+07	0.000E+00	1.530E+07
NI-63	3.560E+09	1.900E+08	0.000E+00	0.000E+00	0.000E+00	1.280E+07	0.000E+00	1.210E+08
NI-65	1.990E-01	1.870E-02	0.000E+00	0.000E+00	0.000E+00	2.290E+00	0.000E+00	1.090E-02
CU-64	0.000E+00	8.320E+03	0.000E+00	2.010E+04	0.000E+00	3.900E+05	0.000E+00	5.020E+03
ZN-65	4.960E+08	1.320E+09	0.000E+00	8.330E+08	0.000E+00	2.320E+08	0.000E+00	8.220E+08
ZN-69	1.140E-12	1.640E-12	0.000E+00	9.960E-13	0.000E+00	1.030E-10	0.000E+00	1.520E-13
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.280E-02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.820E-24
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	1.050E+09	0.000E+00	0.000E+00	0.000E+00	6.770E+07	0.000E+00	6.470E+08
RB-88	0.000E+00	8.590E-46	0.000E+00	0.000E+00	0.000E+00	4.210E-47	0.000E+00	5.970E-46
RB-89	0.000E+00	1.610E-53	0.000E+00	0.000E+00	0.000E+00	1.410E-55	0.000E+00	1.430E-53
SR-89	1.390E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.380E+08	0.000E+00	3.970E+08
SR-90	2.350E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.160E+09	0.000E+00	5.950E+10
SR-91	2.740E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.040E+05	0.000E+00	1.030E+04

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
SR-92	4.580E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.680E+01	0.000E+00	1.840E-01
Y-90	3.870E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.100E+05	0.000E+00	1.030E+00
Y-91	4.680E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.240E+05	0.000E+00	1.250E+02
Y-91M	3.210E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.280E-17	0.000E+00	1.170E-21
Y-92	3.040E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.770E-01	0.000E+00	8.690E-07
Y-93	1.210E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.810E+03	0.000E+00	3.330E-03
ZR-95	4.600E+02	1.010E+02	0.000E+00	1.450E+02	0.000E+00	1.050E+05	0.000E+00	9.000E+01
ZR-97	2.300E-01	3.330E-02	0.000E+00	4.780E-02	0.000E+00	5.040E+03	0.000E+00	1.960E-02
NB-95	3.810E+04	1.490E+04	0.000E+00	1.400E+04	0.000E+00	2.750E+07	0.000E+00	1.060E+04
MO-99	0.000E+00	9.760E+06	0.000E+00	2.090E+07	0.000E+00	8.080E+06	0.000E+00	2.420E+06
TC-99M	1.590E+00	3.110E+00	0.000E+00	4.520E+01	1.580E+00	1.770E+03	0.000E+00	5.150E+01
TC-101	1.400E-60	1.460E-60	0.000E+00	2.490E-59	7.720E-61	4.640E-60	0.000E+00	1.850E-59
RU-103	5.140E+02	0.000E+00	0.000E+00	1.290E+03	0.000E+00	1.330E+04	0.000E+00	1.980E+02
RU-105	4.580E-04	0.000E+00	0.000E+00	4.030E-03	0.000E+00	2.990E-01	0.000E+00	1.660E-04
RU-106	1.110E+04	0.000E+00	0.000E+00	1.500E+04	0.000E+00	1.720E+05	0.000E+00	1.380E+03
AG-110M	2.510E+07	1.690E+07	0.000E+00	3.150E+07	0.000E+00	2.010E+09	0.000E+00	1.350E+07
TE-125M	8.850E+06	2.400E+06	2.480E+06	0.000E+00	0.000E+00	8.540E+06	0.000E+00	1.180E+06
TE-127	3.570E+02	9.630E+01	2.470E+02	1.020E+03	0.000E+00	1.390E+04	0.000E+00	7.660E+01
TE-127M	2.500E+07	6.720E+06	5.970E+06	7.120E+07	0.000E+00	2.020E+07	0.000E+00	2.960E+06
TE-129	1.540E-10	4.300E-11	1.100E-10	4.510E-10	0.000E+00	9.590E-09	0.000E+00	3.660E-11
TE-129M	3.260E+07	9.090E+06	1.050E+07	9.560E+07	0.000E+00	3.970E+07	0.000E+00	5.060E+06
TE-131	1.940E-33	5.910E-34	1.480E-33	5.860E-33	0.000E+00	1.020E-32	0.000E+00	5.770E-34
TE-131M	1.920E+05	6.640E+04	1.360E+05	6.420E+05	0.000E+00	2.690E+06	0.000E+00	7.060E+04
TE-132	1.230E+06	5.440E+05	7.920E+05	5.050E+06	0.000E+00	5.480E+06	0.000E+00	6.570E+05
I-130	2.070E+06	4.190E+06	4.610E+08	6.260E+06	0.000E+00	1.960E+06	0.000E+00	2.160E+06

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R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Grs/Goat/Milk (GMLK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Nuclide	Bone	Liver		Thyroid	Kidney
I-131	1.560E+09	1.570E+09	5.200E+11	2.580E+09	0.000E+00	1.400E+08	0.000E+00	8.940E+08
I-132	8.270E-01	1.520E+00	7.050E+01	2.330E+00	0.000E+00	1.790E+00	0.000E+00	6.990E-01
I-133	2.060E+07	2.550E+07	4.730E+09	4.250E+07	0.000E+00	1.030E+07	0.000E+00	9.640E+06
I-134	1.020E-11	1.890E-11	4.350E-10	2.890E-11	0.000E+00	1.250E-11	0.000E+00	8.700E-12
I-135	6.480E+04	1.170E+05	1.030E+07	1.790E+05	0.000E+00	8.880E+04	0.000E+00	5.520E+04
CS-134	6.790E+10	1.110E+11	0.000E+00	3.450E+10	1.240E+10	6.010E+08	0.000E+00	2.350E+10
CS-136	3.030E+09	8.340E+09	0.000E+00	4.440E+09	6.630E+08	2.930E+08	0.000E+00	5.400E+09
CS-137	9.670E+10	9.260E+10	0.000E+00	3.020E+10	1.090E+10	5.800E+08	0.000E+00	1.370E+10
CS-138	1.190E-22	1.660E-22	0.000E+00	1.170E-22	1.260E-23	7.640E-23	0.000E+00	1.050E-22
BA-139	2.410E-08	1.290E-11	0.000E+00	1.120E-11	7.560E-12	1.390E-06	0.000E+00	6.980E-10
BA-140	1.410E+07	1.230E+04	0.000E+00	4.010E+03	7.340E+03	7.120E+06	0.000E+00	8.200E+05
BA-141	2.220E-46	1.240E-49	0.000E+00	1.080E-49	7.300E-49	1.270E-46	0.000E+00	7.230E-48
BA-142	1.390E-80	9.970E-84	0.000E+00	8.070E-84	5.870E-84	1.810E-82	0.000E+00	7.740E-82
LA-140	2.330E+00	8.140E-01	0.000E+00	0.000E+00	0.000E+00	2.270E+04	0.000E+00	2.740E-01
LA-142	9.730E-12	3.100E-12	0.000E+00	0.000E+00	0.000E+00	6.140E-07	0.000E+00	9.710E-13
CE-141	2.620E+03	1.310E+03	0.000E+00	5.740E+02	0.000E+00	1.630E+06	0.000E+00	1.940E+02
CE-143	2.250E+01	1.220E+04	0.000E+00	5.120E+00	0.000E+00	1.790E+05	0.000E+00	1.770E+00
CE-144	1.950E+05	6.110E+04	0.000E+00	3.380E+04	0.000E+00	1.590E+07	0.000E+00	1.040E+04
PR-143	8.620E+01	2.590E+01	0.000E+00	1.400E+01	0.000E+00	9.300E+04	0.000E+00	4.280E+00
PR-144	3.220E-54	9.950E-55	0.000E+00	5.260E-55	0.000E+00	2.140E-51	0.000E+00	1.620E-55
ND-147	5.330E+01	4.320E+01	0.000E+00	2.370E+01	0.000E+00	6.850E+04	0.000E+00	3.350E+00
W-187	3.470E+03	2.050E+03	0.000E+00	0.000E+00	0.000E+00	2.880E+05	0.000E+00	9.210E+02
NP-239	2.070E+00	1.490E-01	0.000E+00	4.300E-01	0.000E+00	1.100E+04	0.000E+00	1.040E-01

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APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	2.340E+02	2.340E+02	2.340E+02	2.340E+02	2.340E+02	0.000E+00	2.340E+02
C-14	3.700E+04	7.400E+03	7.400E+03	7.400E+03	7.400E+03	7.400E+03	0.000E+00	7.400E+03
NA-24	1.720E-03	1.720E-03	1.720E-03	1.720E-03	1.720E-03	1.720E-03	0.000E+00	1.720E-03
P-32	7.420E+09	3.470E+08	0.000E+00	0.000E+00	0.000E+00	2.050E+08	0.000E+00	2.860E+08
CR-51	0.000E+00	0.000E+00	4.880E+03	1.330E+03	8.910E+03	4.660E+05	0.000E+00	8.790E+03
MN-54	0.000E+00	8.010E+06	0.000E+00	2.250E+06	0.000E+00	6.720E+06	0.000E+00	2.130E+06
MN-56	0.000E+00	1.430E-53	0.000E+00	1.730E-53	0.000E+00	2.070E-51	0.000E+00	3.230E-54
FE-55	4.570E+08	2.420E+08	0.000E+00	0.000E+00	1.370E+08	4.490E+07	0.000E+00	7.510E+07
FE-59	3.760E+08	6.090E+08	0.000E+00	0.000E+00	1.770E+08	6.340E+08	0.000E+00	3.030E+08
CO-58	0.000E+00	1.640E+07	0.000E+00	0.000E+00	0.000E+00	9.580E+07	0.000E+00	5.020E+07
CO-60	0.000E+00	6.930E+07	0.000E+00	0.000E+00	0.000E+00	3.840E+08	0.000E+00	2.040E+08
NI-63	2.910E+10	1.560E+09	0.000E+00	0.000E+00	0.000E+00	1.050E+08	0.000E+00	9.910E+08
NI-65	3.520E-52	3.310E-53	0.000E+00	0.000E+00	0.000E+00	4.060E-51	0.000E+00	1.930E-53
CU-64	0.000E+00	2.970E-07	0.000E+00	7.180E-07	0.000E+00	1.390E-05	0.000E+00	1.800E-07
ZN-65	3.750E+08	1.000E+09	0.000E+00	6.300E+08	0.000E+00	1.760E+08	0.000E+00	6.220E+08
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.520E-57
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	5.770E+08	0.000E+00	0.000E+00	0.000E+00	3.710E+07	0.000E+00	3.550E+08
RB-88	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-89	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-89	4.820E+08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.870E+07	0.000E+00	1.380E+07
SR-90	1.040E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.400E+08	0.000E+00	2.640E+09
SR-91	2.400E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.300E-10	0.000E+00	9.050E-12

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R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Grs/Cow/Meat (CMEAT)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
SR-92	1.850E-49	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.490E-48	0.000E+00	7.400E-51
Y-90	1.710E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.880E+05	0.000E+00	4.590E+00
Y-91	1.800E+06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.400E+08	0.000E+00	4.820E+04
Y-91M	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Y-92	2.410E-39	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.960E-35	0.000E+00	6.890E-41
Y-93	7.440E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.110E-07	0.000E+00	2.040E-13
ZR-95	2.660E+06	5.850E+05	0.000E+00	8.380E+05	0.000E+00	6.110E+08	0.000E+00	5.210E+05
ZR-97	3.200E-05	4.630E-06	0.000E+00	6.650E-06	0.000E+00	7.010E-01	0.000E+00	2.730E-06
NB-95	3.100E+06	1.210E+06	0.000E+00	1.130E+06	0.000E+00	2.230E+09	0.000E+00	8.620E+05
MO-99	0.000E+00	1.150E+05	0.000E+00	2.460E+05	0.000E+00	9.510E+04	0.000E+00	2.840E+04
TC-99M	6.190E-21	1.210E-20	0.000E+00	1.760E-19	6.160E-21	6.910E-18	0.000E+00	2.010E-19
TC-101	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RU-103	1.550E+08	0.000E+00	0.000E+00	3.900E+08	0.000E+00	4.010E+09	0.000E+00	5.960E+07
RU-105	9.020E-28	0.000E+00	0.000E+00	7.930E-27	0.000E+00	5.890E-25	0.000E+00	3.270E-28
RU-106	4.440E+09	0.000E+00	0.000E+00	5.990E+09	0.000E+00	6.900E+10	0.000E+00	5.540E+08
AG-110M	8.390E+06	5.670E+06	0.000E+00	1.060E+07	0.000E+00	6.740E+08	0.000E+00	4.530E+06
TE-125M	5.690E+08	1.540E+08	1.600E+08	0.000E+00	0.000E+00	5.490E+08	0.000E+00	7.590E+07
TE-127	3.380E-10	9.120E-11	2.340E-10	9.630E-10	0.000E+00	1.320E-08	0.000E+00	7.260E-11
TE-127M	1.770E+09	4.780E+08	4.240E+08	5.060E+09	0.000E+00	1.440E+09	0.000E+00	2.110E+08
TE-129	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE-129M	1.790E+09	5.000E+08	5.770E+08	5.260E+09	0.000E+00	2.180E+09	0.000E+00	2.780E+08
TE-131	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
TE-131M	7.000E+02	2.420E+02	4.980E+02	2.340E+03	0.000E+00	9.820E+03	0.000E+00	2.580E+02
TE-132	2.120E+06	9.380E+05	1.370E+06	8.710E+06	0.000E+00	9.450E+06	0.000E+00	1.130E+06
I-130	3.030E-06	6.130E-06	6.750E-04	9.160E-06	0.000E+00	2.870E-06	0.000E+00	3.160E-06

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			Bone	Liver	Thyroid		Kidney	Lung
I-131	1.650E+07	1.660E+07	5.500E+09	2.730E+07	0.000E+00	1.480E+06	0.000E+00	9.460E+06
I-132	1.020E-58	1.880E-58	8.730E-57	2.880E-58	0.000E+00	2.210E-58	0.000E+00	8.650E-59
I-133	5.670E-01	7.020E-01	1.300E+02	1.170E+00	0.000E+00	2.830E-01	0.000E+00	2.660E-01
I-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
I-135	6.510E-17	1.170E-16	1.040E-14	1.800E-16	0.000E+00	8.930E-17	0.000E+00	5.550E-17
CS-134	9.220E+08	1.510E+09	0.000E+00	4.690E+08	1.680E+08	8.160E+06	0.000E+00	3.190E+08
CS-136	1.620E+07	4.460E+07	0.000E+00	2.370E+07	3.540E+06	1.570E+06	0.000E+00	2.880E+07
CS-137	1.330E+09	1.280E+09	0.000E+00	4.160E+08	1.500E+08	7.990E+06	0.000E+00	1.880E+08
CS-138	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-139	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-140	4.380E+07	3.840E+04	0.000E+00	1.250E+04	2.290E+04	2.220E+07	0.000E+00	2.560E+06
BA-141	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BA-142	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
LA-140	5.590E-02	1.950E-02	0.000E+00	0.000E+00	0.000E+00	5.440E+02	0.000E+00	6.580E-03
LA-142	5.300E-92	1.690E-92	0.000E+00	0.000E+00	0.000E+00	3.350E-87	0.000E+00	5.290E-93
CE-141	2.220E+04	1.110E+04	0.000E+00	4.850E+03	0.000E+00	1.380E+07	0.000E+00	1.640E+03
CE-143	3.170E-02	1.720E+01	0.000E+00	7.210E-03	0.000E+00	2.520E+02	0.000E+00	2.490E-03
CE-144	2.320E+06	7.260E+05	0.000E+00	4.020E+05	0.000E+00	1.890E+08	0.000E+00	1.240E+05
PR-143	3.340E+04	1.000E+04	0.000E+00	5.430E+03	0.000E+00	3.600E+07	0.000E+00	1.660E+03
PR-144	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ND-147	1.170E+04	9.470E+03	0.000E+00	5.190E+03	0.000E+00	1.500E+07	0.000E+00	7.330E+02
W-187	3.210E-02	1.900E-02	0.000E+00	0.000E+00	0.000E+00	2.670E+00	0.000E+00	8.530E-03
NP-239	4.260E-01	3.060E-02	0.000E+00	8.850E-02	0.000E+00	2.260E+03	0.000E+00	2.150E-02

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
H-3	0.000E+00	4.010E+03	4.010E+03	4.010E+03	4.010E+03	4.010E+03	0.000E+00	4.010E+03
C-14	2.450E+05	4.910E+04	4.910E+04	4.910E+04	4.910E+04	4.910E+04	0.000E+00	4.910E+04
NA-24	3.730E+05	3.730E+05	3.730E+05	3.730E+05	3.730E+05	3.730E+05	0.000E+00	3.730E+05
P-32	3.370E+09	1.580E+08	0.000E+00	0.000E+00	0.000E+00	9.310E+07	0.000E+00	1.300E+08
CR-51	0.000E+00	0.000E+00	6.500E+04	1.780E+04	1.190E+05	6.210E+06	0.000E+00	1.170E+05
MN-54	0.000E+00	6.650E+08	0.000E+00	1.860E+08	0.000E+00	5.580E+08	0.000E+00	1.770E+08
MN-56	0.000E+00	1.860E+01	0.000E+00	2.250E+01	0.000E+00	2.700E+03	0.000E+00	4.200E+00
FE-55	8.010E+08	4.250E+08	0.000E+00	0.000E+00	2.400E+08	7.870E+07	0.000E+00	1.320E+08
FE-59	3.980E+08	6.430E+08	0.000E+00	0.000E+00	1.860E+08	6.700E+08	0.000E+00	3.200E+08
CO-58	0.000E+00	6.440E+07	0.000E+00	0.000E+00	0.000E+00	3.760E+08	0.000E+00	1.970E+08
CO-60	0.000E+00	3.780E+08	0.000E+00	0.000E+00	0.000E+00	2.100E+09	0.000E+00	1.120E+09
NI-63	3.950E+10	2.110E+09	0.000E+00	0.000E+00	0.000E+00	1.420E+08	0.000E+00	1.340E+09
NI-65	1.050E+02	9.890E+00	0.000E+00	0.000E+00	0.000E+00	1.210E+03	0.000E+00	5.770E+00
CU-64	0.000E+00	1.100E+04	0.000E+00	2.660E+04	0.000E+00	5.160E+05	0.000E+00	6.640E+03
ZN-65	8.130E+08	2.160E+09	0.000E+00	1.360E+09	0.000E+00	3.800E+08	0.000E+00	1.350E+09
ZN-69	9.490E-06	1.370E-05	0.000E+00	8.320E-06	0.000E+00	8.640E-04	0.000E+00	1.270E-06
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.370E+00
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.820E-11
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	4.520E+08	0.000E+00	0.000E+00	0.000E+00	2.910E+07	0.000E+00	2.780E+08
RB-88	0.000E+00	4.380E-22	0.000E+00	0.000E+00	0.000E+00	2.150E-23	0.000E+00	3.040E-22
RB-89	0.000E+00	4.610E-26	0.000E+00	0.000E+00	0.000E+00	4.020E-28	0.000E+00	4.090E-26
SR-89	3.600E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.390E+09	0.000E+00	1.030E+09
SR-90	1.240E+12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.670E+10	0.000E+00	3.150E+11
SR-91	5.240E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.160E+06	0.000E+00	1.980E+04

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APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
SR-92	7.280E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.380E+04	0.000E+00	2.920E+01
Y-90	2.310E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.570E+07	0.000E+00	6.180E+02
Y-91	1.860E+07	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.480E+09	0.000E+00	4.990E+05
Y-91M	8.910E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.740E-05	0.000E+00	3.240E-10
Y-92	1.580E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.580E+04	0.000E+00	4.530E-02
Y-93	2.930E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.370E+06	0.000E+00	8.040E+00
ZR-95	3.860E+06	8.480E+05	0.000E+00	1.210E+06	0.000E+00	8.850E+08	0.000E+00	7.550E+05
ZR-97	5.700E+02	8.240E+01	0.000E+00	1.180E+02	0.000E+00	1.250E+07	0.000E+00	4.860E+01
NB-95	4.110E+05	1.600E+05	0.000E+00	1.500E+05	0.000E+00	2.960E+08	0.000E+00	1.140E+05
MO-99	0.000E+00	7.710E+06	0.000E+00	1.650E+07	0.000E+00	6.380E+06	0.000E+00	1.910E+06
TC-99M	4.710E+00	9.230E+00	0.000E+00	1.340E+02	4.690E+00	5.260E+03	0.000E+00	1.530E+02
TC-101	1.410E-30	1.470E-30	0.000E+00	2.510E-29	7.780E-31	4.680E-30	0.000E+00	1.870E-29
RU-103	1.530E+07	0.000E+00	0.000E+00	3.860E+07	0.000E+00	3.970E+08	0.000E+00	5.900E+06
RU-105	9.160E+01	0.000E+00	0.000E+00	8.050E+02	0.000E+00	5.980E+04	0.000E+00	3.320E+01
RU-106	7.450E+08	0.000E+00	0.000E+00	1.010E+09	0.000E+00	1.160E+10	0.000E+00	9.300E+07
AG-110M	3.210E+07	2.170E+07	0.000E+00	4.040E+07	0.000E+00	2.580E+09	0.000E+00	1.730E+07
TE-125M	3.510E+08	9.500E+07	9.840E+07	0.000E+00	0.000E+00	3.380E+08	0.000E+00	4.670E+07
TE-127	9.850E+03	2.650E+03	6.810E+03	2.800E+04	0.000E+00	3.850E+05	0.000E+00	2.110E+03
TE-127M	1.320E+09	3.560E+08	3.160E+08	3.770E+09	0.000E+00	1.070E+09	0.000E+00	1.570E+08
TE-129	1.320E-03	3.690E-04	9.430E-04	3.870E-03	0.000E+00	8.230E-02	0.000E+00	3.140E-04
TE-129M	8.410E+08	2.350E+08	2.710E+08	2.470E+09	0.000E+00	1.030E+09	0.000E+00	1.310E+08
TE-131	2.570E-15	7.830E-16	1.960E-15	7.770E-15	0.000E+00	1.350E-14	0.000E+00	7.640E-16
TE-131M	1.540E+06	5.330E+05	1.100E+06	5.160E+06	0.000E+00	2.160E+07	0.000E+00	5.680E+05
TE-132	7.000E+06	3.100E+06	4.510E+06	2.880E+07	0.000E+00	3.120E+07	0.000E+00	3.740E+06
I-130	6.160E+05	1.240E+06	1.370E+08	1.860E+06	0.000E+00	5.820E+05	0.000E+00	6.410E+05

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Vegetation (VEG)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
I-131	1.430E+08	1.440E+08	4.750E+10	2.360E+08	0.000E+00	1.280E+07	0.000E+00	8.170E+07
I-132	9.220E+01	1.690E+02	7.860E+03	2.590E+02	0.000E+00	1.990E+02	0.000E+00	7.790E+01
I-133	3.530E+06	4.370E+06	8.110E+08	7.280E+06	0.000E+00	1.760E+06	0.000E+00	1.650E+06
I-134	1.550E-04	2.880E-04	6.620E-03	4.400E-04	0.000E+00	1.910E-04	0.000E+00	1.320E-04
I-135	6.260E+04	1.130E+05	9.970E+06	1.730E+05	0.000E+00	8.580E+04	0.000E+00	5.330E+04
CS-134	1.600E+10	2.630E+10	0.000E+00	8.150E+09	2.930E+09	1.420E+08	0.000E+00	5.550E+09
CS-136	8.240E+07	2.270E+08	0.000E+00	1.210E+08	1.800E+07	7.960E+06	0.000E+00	1.470E+08
CS-137	2.390E+10	2.290E+10	0.000E+00	7.460E+09	2.680E+09	1.430E+08	0.000E+00	3.380E+09
CS-138	6.570E-11	9.130E-11	0.000E+00	6.430E-11	6.920E-12	4.210E-11	0.000E+00	5.790E-11
BA-139	4.950E-02	2.640E-05	0.000E+00	2.310E-05	1.560E-05	2.860E+00	0.000E+00	1.440E-03
BA-140	2.770E+08	2.420E+05	0.000E+00	7.890E+04	1.450E+05	1.400E+08	0.000E+00	1.610E+07
BA-141	1.990E-21	1.110E-24	0.000E+00	9.620E-25	6.530E-24	1.130E-21	0.000E+00	6.460E-23
BA-142	9.930E-39	7.150E-42	0.000E+00	5.780E-42	4.200E-42	1.300E-40	0.000E+00	5.540E-40
LA-140	3.250E+03	1.130E+03	0.000E+00	0.000E+00	0.000E+00	3.160E+07	0.000E+00	3.820E+02
LA-142	3.360E-04	1.070E-04	0.000E+00	0.000E+00	0.000E+00	2.120E+01	0.000E+00	3.350E-05
CE-141	6.560E+05	3.270E+05	0.000E+00	1.430E+05	0.000E+00	4.080E+08	0.000E+00	4.860E+04
CE-143	1.720E+03	9.310E+05	0.000E+00	3.910E+02	0.000E+00	1.360E+07	0.000E+00	1.350E+02
CE-144	1.270E+08	3.980E+07	0.000E+00	2.210E+07	0.000E+00	1.040E+10	0.000E+00	6.780E+06
PR-143	1.460E+05	4.370E+04	0.000E+00	2.370E+04	0.000E+00	1.570E+08	0.000E+00	7.230E+03
PR-144	5.380E-26	1.660E-26	0.000E+00	8.800E-27	0.000E+00	3.580E-23	0.000E+00	2.710E-27
ND-147	7.150E+04	5.790E+04	0.000E+00	3.180E+04	0.000E+00	9.170E+07	0.000E+00	4.480E+03
W-187	6.430E+04	3.810E+04	0.000E+00	0.000E+00	0.000E+00	5.350E+06	0.000E+00	1.710E+04
NP-239	2.560E+03	1.840E+02	0.000E+00	5.310E+02	0.000E+00	1.360E+07	0.000E+00	1.290E+02

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Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	1.120E+03	1.120E+03	1.120E+03	1.120E+03	1.120E+03	0.000E+00	1.120E+03
C-14	3.590E+04	6.730E+03	6.730E+03	6.730E+03	6.730E+03	6.730E+03	0.000E+00	6.730E+03
NA-24	1.610E+04	1.610E+04	1.610E+04	1.610E+04	1.610E+04	1.610E+04	0.000E+00	1.610E+04
P-32	2.600E+06	1.140E+05	0.000E+00	0.000E+00	0.000E+00	4.220E+04	0.000E+00	9.880E+04
CR-51	0.000E+00	0.000E+00	8.550E+01	2.430E+01	1.700E+04	1.080E+03	0.000E+00	1.540E+02
MN-54	0.000E+00	4.290E+04	0.000E+00	1.000E+04	1.580E+06	2.290E+04	0.000E+00	9.510E+03
MN-56	0.000E+00	1.660E+00	0.000E+00	1.670E+00	1.310E+04	1.230E+05	0.000E+00	3.120E-01
FE-55	4.740E+04	2.520E+04	0.000E+00	0.000E+00	1.110E+05	2.870E+03	0.000E+00	7.770E+03
FE-59	2.070E+04	3.340E+04	0.000E+00	0.000E+00	1.270E+06	7.070E+04	0.000E+00	1.670E+04
CO-58	0.000E+00	1.770E+03	0.000E+00	0.000E+00	1.110E+06	3.440E+04	0.000E+00	3.160E+03
CO-60	0.000E+00	1.310E+04	0.000E+00	0.000E+00	7.070E+06	9.620E+04	0.000E+00	2.260E+04
NI-63	8.210E+05	4.620E+04	0.000E+00	0.000E+00	2.750E+05	6.330E+03	0.000E+00	2.800E+04
NI-65	2.990E+00	2.960E-01	0.000E+00	0.000E+00	8.180E+03	8.400E+04	0.000E+00	1.640E-01
CU-64	0.000E+00	1.990E+00	0.000E+00	6.030E+00	9.580E+03	3.670E+04	0.000E+00	1.070E+00
ZN-65	4.260E+04	1.130E+05	0.000E+00	7.140E+04	9.950E+05	1.630E+04	0.000E+00	7.030E+04
ZN-69	6.700E-02	9.660E-02	0.000E+00	5.850E-02	1.420E+03	1.020E+04	0.000E+00	8.920E-03
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.740E+02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.480E+02
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.530E+01
RB-86	0.000E+00	1.980E+05	0.000E+00	0.000E+00	0.000E+00	7.990E+03	0.000E+00	1.140E+05
RB-88	0.000E+00	5.620E+02	0.000E+00	0.000E+00	0.000E+00	1.720E+01	0.000E+00	3.660E+02
RB-89	0.000E+00	3.450E+02	0.000E+00	0.000E+00	0.000E+00	1.890E+00	0.000E+00	2.900E+02
SR-89	5.990E+05	0.000E+00	0.000E+00	0.000E+00	2.160E+06	1.670E+05	0.000E+00	1.720E+04
SR-90	1.010E+08	0.000E+00	0.000E+00	0.000E+00	1.480E+07	3.430E+05	0.000E+00	6.440E+06
SR-91	1.210E+02	0.000E+00	0.000E+00	0.000E+00	5.330E+04	1.740E+05	0.000E+00	4.590E+00

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APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
			Bone	Liver	Thyroid		Kidney	Lung
SR-92	1.310E+01	0.000E+00	0.000E+00	0.000E+00	2.400E+04	2.420E+05	0.000E+00	5.250E-01
Y-90	4.110E+03	0.000E+00	0.000E+00	0.000E+00	2.620E+05	2.680E+05	0.000E+00	1.110E+02
Y-91	9.140E+05	0.000E+00	0.000E+00	0.000E+00	2.630E+06	1.840E+05	0.000E+00	2.440E+04
Y-91M	5.070E-01	0.000E+00	0.000E+00	0.000E+00	2.810E+03	1.720E+03	0.000E+00	1.840E-02
Y-92	2.030E+01	0.000E+00	0.000E+00	0.000E+00	2.390E+04	2.390E+05	0.000E+00	5.810E-01
Y-93	1.860E+02	0.000E+00	0.000E+00	0.000E+00	7.440E+04	3.880E+05	0.000E+00	5.110E+00
ZR-95	1.900E+05	4.180E+04	0.000E+00	5.960E+04	2.230E+06	6.110E+04	0.000E+00	3.700E+04
ZR-97	1.880E+02	2.720E+01	0.000E+00	3.880E+01	1.130E+05	3.510E+05	0.000E+00	1.600E+01
NB-95	2.350E+04	9.180E+03	0.000E+00	8.620E+03	6.140E+05	3.700E+04	0.000E+00	6.550E+03
MO-99	0.000E+00	1.720E+02	0.000E+00	3.920E+02	1.350E+05	1.270E+05	0.000E+00	4.260E+01
TC-99M	1.780E-03	3.480E-03	0.000E+00	5.070E-02	9.510E+02	4.810E+03	0.000E+00	5.770E-02
TC-101	8.100E-05	8.510E-05	0.000E+00	1.450E-03	5.850E+02	1.630E+01	0.000E+00	1.080E-03
RU-103	2.790E+03	0.000E+00	0.000E+00	7.030E+03	6.620E+05	4.480E+04	0.000E+00	1.070E+03
RU-105	1.530E+00	0.000E+00	0.000E+00	1.340E+00	1.590E+04	9.950E+04	0.000E+00	5.550E-01
RU-106	1.360E+05	0.000E+00	0.000E+00	1.840E+05	1.430E+07	4.290E+05	0.000E+00	1.690E+04
AG-110M	1.690E+04	1.140E+04	0.000E+00	2.120E+04	5.480E+06	1.000E+05	0.000E+00	9.140E+03
TE-125M	6.730E+03	2.330E+03	1.920E+03	0.000E+00	4.770E+05	3.380E+04	0.000E+00	9.140E+02
TE-127	2.770E+00	9.510E-01	1.960E+00	7.070E+00	1.000E+04	5.620E+04	0.000E+00	6.100E-01
TE-127M	2.490E+04	8.550E+03	6.070E+03	6.360E+04	1.480E+06	7.140E+04	0.000E+00	3.020E+03
TE-129	9.770E-02	3.500E-02	7.140E-02	2.570E-01	2.930E+03	2.550E+04	0.000E+00	2.380E-02
TE-129M	1.920E+04	6.840E+03	6.330E+03	5.030E+04	1.760E+06	1.820E+05	0.000E+00	3.040E+03
TE-131	2.170E-02	8.440E-03	1.700E-02	5.880E-02	2.050E+03	1.330E+03	0.000E+00	6.590E-03
TE-131M	1.340E+02	5.920E+01	9.770E+01	4.000E+02	2.060E+05	3.080E+05	0.000E+00	5.070E+01
TE-132	4.810E+02	2.720E+02	3.170E+02	1.770E+03	3.770E+05	1.380E+05	0.000E+00	2.630E+02
I-130	8.180E+03	1.640E+04	1.850E+06	2.450E+04	0.000E+00	5.110E+03	0.000E+00	8.440E+03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	4.810E+04	4.810E+04	1.620E+07	7.880E+04	0.000E+00	2.840E+03	0.000E+00	2.730E+04
I-132	2.120E+03	4.070E+03	1.940E+05	6.250E+03	0.000E+00	3.200E+03	0.000E+00	1.880E+03
I-133	1.660E+04	2.030E+04	3.850E+06	3.380E+04	0.000E+00	5.480E+03	0.000E+00	7.700E+03
I-134	1.170E+03	2.160E+03	5.070E+04	3.300E+03	0.000E+00	9.550E+02	0.000E+00	9.950E+02
I-135	4.920E+03	8.730E+03	7.920E+05	1.340E+04	0.000E+00	4.440E+03	0.000E+00	4.140E+03
CS-134	6.510E+05	1.010E+06	0.000E+00	3.300E+05	1.210E+05	3.850E+03	0.000E+00	2.250E+05
CS-136	6.510E+04	1.710E+05	0.000E+00	9.550E+04	1.450E+04	4.180E+03	0.000E+00	1.160E+05
CS-137	9.060E+05	8.250E+05	0.000E+00	2.820E+05	1.040E+05	3.620E+03	0.000E+00	1.280E+05
CS-138	6.330E+02	8.400E+02	0.000E+00	6.220E+02	6.810E+01	2.700E+02	0.000E+00	5.550E+02
BA-139	1.840E+00	9.840E-04	0.000E+00	8.620E-04	5.770E+03	5.770E+04	0.000E+00	5.360E-02
BA-140	7.400E+04	6.480E+01	0.000E+00	2.110E+01	1.740E+06	1.020E+05	0.000E+00	4.330E+03
BA-141	1.960E-01	1.090E-04	0.000E+00	9.470E-05	2.920E+03	2.750E+02	0.000E+00	6.360E-03
BA-142	5.000E-02	3.600E-05	0.000E+00	2.910E-05	1.640E+03	2.740E+00	0.000E+00	2.790E-03
LA-140	6.440E+02	2.250E+02	0.000E+00	0.000E+00	1.830E+05	2.260E+05	0.000E+00	7.550E+01
LA-142	1.300E+00	4.110E-01	0.000E+00	0.000E+00	8.700E+03	7.580E+04	0.000E+00	1.290E-01
CE-141	3.920E+04	1.950E+04	0.000E+00	8.550E+03	5.440E+05	5.660E+04	0.000E+00	2.900E+03
CE-143	3.660E+02	1.990E+02	0.000E+00	8.360E+01	1.150E+05	1.270E+05	0.000E+00	2.870E+01
CE-144	6.770E+06	2.120E+06	0.000E+00	1.170E+06	1.200E+07	3.880E+05	0.000E+00	3.610E+05
PR-143	1.850E+04	5.550E+03	0.000E+00	3.000E+03	4.330E+05	9.730E+04	0.000E+00	9.140E+02
PR-144	5.960E-02	1.850E-02	0.000E+00	9.770E-03	1.570E+03	1.970E+02	0.000E+00	3.000E-03
ND-147	1.080E+04	8.730E+03	0.000E+00	4.810E+03	3.280E+05	8.210E+04	0.000E+00	6.810E+02
W-187	1.630E+01	9.660E+00	0.000E+00	0.000E+00	4.110E+04	9.100E+04	0.000E+00	4.330E+00
NP-239	4.660E+02	3.340E+01	0.000E+00	9.730E+01	5.810E+04	6.400E+04	0.000E+00	2.350E+01

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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NA-24	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.390E+07	1.190E+07
P-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	5.510E+06	4.660E+06
MN-54	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.630E+09	1.390E+09
MN-56	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	1.070E+06	9.020E+05
FE-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	3.210E+08	2.730E+08
CO-58	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	4.440E+08	3.790E+08
CO-60	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.530E+10	2.150E+10
NI-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI-65	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	3.450E+05	2.970E+05
CU-64	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.880E+05	6.070E+05
ZN-65	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	8.590E+08	7.470E+08
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	7.080E+03	4.870E+03
BR-84	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.360E+05	2.030E+05
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	1.030E+07	8.990E+06
RB-88	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.780E+04	3.310E+04
RB-89	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.480E+05	1.230E+05
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.510E+04	2.160E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-91	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.510E+06	2.150E+06

Attachment 9-
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Ground Plane Deposition (GPD)			Units:	m²·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	8.630E+05	7.770E+05
Y-90	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	5.310E+03	4.490E+03
Y-91	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.210E+06	1.070E+06
Y-91M	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.160E+05	1.000E+05
Y-92	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	2.140E+05	1.800E+05
Y-93	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	2.510E+05	1.830E+05
ZR-95	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.840E+08	2.450E+08
ZR-97	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	3.440E+06	2.960E+06
NB-95	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.610E+08	1.370E+08
MO-99	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	4.630E+06	3.990E+06
TC-99M	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	2.110E+05	1.840E+05
TC-101	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.260E+04	2.040E+04
RU-103	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.260E+08	1.080E+08
RU-105	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	7.210E+05	6.360E+05
RU-106	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	5.070E+08	4.220E+08
AG-110M	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	4.010E+09	3.440E+09
TE-125M	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	2.130E+06	1.550E+06
TE-127	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	3.280E+03	2.980E+03
TE-127M	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	1.080E+05	9.160E+04
TE-129	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	3.100E+04	2.620E+04
TE-129M	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	2.310E+07	1.980E+07
TE-131	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	3.450E+07	2.920E+04
TE-131M	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	9.460E+06	8.030E+06
TE-132	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.980E+06	4.230E+06
I-130	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	6.690E+06	5.510E+06

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APPENDIX I

R_i Child Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	CHILD	Pathway:	Ground Plane Deposition (GPD)			Units:	m²·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.090E+07	1.720E+07
I-132	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.470E+06	1.250E+06
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06
I-134	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	5.300E+05	4.470E+05
I-135	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.950E+06	2.530E+06
CS-134	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	8.000E+09	6.860E+09
CS-136	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.710E+08	1.510E+08
CS-137	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.200E+10	1.030E+10
CS-138	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	4.100E+05	3.590E+05
BA-139	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.190E+05	1.060E+05
BA-140	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.350E+07	2.050E+07
BA-141	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.750E+04	4.170E+04
BA-142	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	5.110E+04	4.490E+04
LA-140	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	2.180E+07	1.920E+07
LA-142	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	9.120E+05	7.600E+05
CE-141	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.540E+07	1.370E+07
CE-143	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.630E+06	2.310E+06
CE-144	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	8.040E+07	6.950E+07
PR-143	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR-144	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	2.110E+03	1.830E+03
ND-147	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	1.010E+07	8.390E+06
W-187	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.730E+06	2.350E+06
NP-239	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.980E+06	1.710E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX J

R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Grs/Cow/Milk (CMLK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
H-3	0.000E+00	2.380E+03	2.380E+03	2.380E+03	2.380E+03	2.380E+03	0.000E+00	2.380E+03
C-14	2.260E+05	4.820E+04	4.820E+04	4.820E+04	4.820E+04	4.820E+04	0.000E+00	4.820E+04
NA-24	1.540E+07	1.540E+07	1.540E+07	1.540E+07	1.540E+07	1.540E+07	0.000E+00	1.540E+07
P-32	1.600E+11	9.430E+09	0.000E+00	0.000E+00	0.000E+00	2.170E+09	0.000E+00	6.210E+09
CR-51	0.000E+00	0.000E+00	1.050E+05	2.300E+04	2.050E+05	4.700E+06	0.000E+00	1.610E+05
MN-54	0.000E+00	3.900E+07	0.000E+00	8.640E+06	0.000E+00	1.430E+07	0.000E+00	8.840E+06
MN-56	0.000E+00	3.100E-02	0.000E+00	2.660E-02	0.000E+00	2.810E+00	0.000E+00	5.340E-03
FE-55	1.350E+08	8.730E+07	0.000E+00	0.000E+00	4.270E+07	1.110E+07	0.000E+00	2.330E+07
FE-59	2.240E+08	3.920E+08	0.000E+00	0.000E+00	1.160E+08	1.870E+08	0.000E+00	1.540E+08
CO-58	0.000E+00	2.420E+07	0.000E+00	0.000E+00	0.000E+00	6.040E+07	0.000E+00	6.050E+07
CO-60	0.000E+00	8.820E+07	0.000E+00	0.000E+00	0.000E+00	2.100E+08	0.000E+00	2.080E+08
NI-63	3.490E+10	2.160E+09	0.000E+00	0.000E+00	0.000E+00	1.070E+08	0.000E+00	1.210E+09
NI-65	3.510E+00	3.970E-01	0.000E+00	0.000E+00	0.000E+00	3.020E+01	0.000E+00	1.800E-01
CU-64	0.000E+00	1.850E+05	0.000E+00	3.140E+05	0.000E+00	3.810E+06	0.000E+00	8.590E+04
ZN-65	5.550E+09	1.900E+10	0.000E+00	9.230E+09	0.000E+00	1.610E+10	0.000E+00	8.780E+09
ZN-69	2.020E-11	3.630E-11	0.000E+00	1.510E-11	0.000E+00	2.960E-09	0.000E+00	2.700E-12
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.340E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.260E-22
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	2.230E+10	0.000E+00	0.000E+00	0.000E+00	5.690E+08	0.000E+00	1.100E+10
RB-88	0.000E+00	1.880E-44	0.000E+00	0.000E+00	0.000E+00	1.830E-44	0.000E+00	1.030E-44
RB-89	0.000E+00	3.290E-52	0.000E+00	0.000E+00	0.000E+00	1.120E-52	0.000E+00	2.260E-52
SR-89	1.260E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.590E+08	0.000E+00	3.610E+08
SR-90	1.220E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.520E+09	0.000E+00	3.100E+10
SR-91	2.720E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.220E+05	0.000E+00	9.830E+03

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R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Grs/Cow/Milk (CMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	4.640E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.000E+01	0.000E+00	1.720E-01
Y-90	6.810E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.410E+05	0.000E+00	1.830E+01
Y-91	7.330E+04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.250E+06	0.000E+00	1.950E+03
Y-91M	5.670E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.890E-15	0.000E+00	1.930E-20
Y-92	5.380E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.030E+01	0.000E+00	1.510E-05
Y-93	2.160E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.700E+04	0.000E+00	5.870E-02
ZR-95	6.800E+03	1.660E+03	0.000E+00	1.790E+03	0.000E+00	8.260E+05	0.000E+00	1.180E+03
ZR-97	4.060E+00	6.970E-01	0.000E+00	7.030E-01	0.000E+00	4.450E+04	0.000E+00	3.180E-01
NB-95	5.930E+05	2.440E+05	0.000E+00	1.750E+05	0.000E+00	2.060E+08	0.000E+00	1.410E+05
MO-99	0.000E+00	2.080E+08	0.000E+00	3.110E+08	0.000E+00	6.850E+07	0.000E+00	4.060E+07
TC-99M	2.750E+01	5.670E+01	0.000E+00	6.100E+02	2.960E+01	1.650E+04	0.000E+00	7.300E+02
TC-101	2.470E-59	3.110E-59	0.000E+00	3.700E-58	1.700E-59	5.280E-57	0.000E+00	3.080E-58
RU-103	8.670E+03	0.000E+00	0.000E+00	1.800E+04	0.000E+00	1.050E+05	0.000E+00	2.900E+03
RU-105	8.050E-03	0.000E+00	0.000E+00	5.920E-02	0.000E+00	3.200E+00	0.000E+00	2.740E-03
RU-106	1.900E+05	0.000E+00	0.000E+00	2.250E+05	0.000E+00	1.440E+06	0.000E+00	2.380E+04
AG-110M	3.860E+08	2.820E+08	0.000E+00	4.030E+08	0.000E+00	1.460E+10	0.000E+00	1.860E+08
TE-125M	1.510E+08	5.040E+07	5.070E+07	0.000E+00	0.000E+00	7.180E+07	0.000E+00	2.040E+07
TE-127	6.320E+03	2.120E+03	5.140E+03	1.540E+04	0.000E+00	1.330E+05	0.000E+00	1.360E+03
TE-127M	4.210E+08	1.400E+08	1.220E+08	1.040E+09	0.000E+00	1.700E+08	0.000E+00	5.100E+07
TE-129	2.720E-09	9.380E-10	2.280E-09	6.770E-09	0.000E+00	2.170E-07	0.000E+00	6.350E-10
TE-129M	5.570E+08	1.910E+08	2.140E+08	1.390E+09	0.000E+00	3.330E+08	0.000E+00	8.580E+07
TE-131	3.430E-32	1.270E-32	3.060E-32	8.760E-32	0.000E+00	1.380E-30	0.000E+00	9.610E-33
TE-131M	3.380E+06	1.360E+06	2.750E+06	9.350E+06	0.000E+00	2.290E+07	0.000E+00	1.120E+06
TE-132	2.110E+07	1.040E+07	1.540E+07	6.530E+07	0.000E+00	3.870E+07	0.000E+00	9.750E+06
I-130	3.550E+06	7.810E+06	8.750E+08	8.580E+06	0.000E+00	1.670E+06	0.000E+00	3.130E+06

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R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Grs/Cow/Milk (CMLK)			Units:	m²·mrem/yr / μCi/sec; mrem/yr / μCi/m³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	2.720E+09	3.200E+09	1.050E+12	3.740E+09	0.000E+00	1.140E+08	0.000E+00	1.410E+09
I-132	1.430E+00	2.900E+00	1.360E+02	3.240E+00	0.000E+00	2.350E+00	0.000E+00	1.030E+00
I-133	3.630E+07	5.280E+07	9.600E+09	6.210E+07	0.000E+00	8.930E+06	0.000E+00	1.550E+07
I-134	1.760E-11	3.600E-11	8.400E-10	4.030E-11	0.000E+00	3.720E-11	0.000E+00	1.280E-11
I-135	1.120E+05	2.230E+05	2.000E+07	2.490E+05	0.000E+00	8.080E+04	0.000E+00	8.140E+04
CS-134	3.650E+10	6.800E+10	0.000E+00	1.750E+10	7.180E+09	1.850E+08	0.000E+00	6.870E+09
CS-136	1.980E+09	5.810E+09	0.000E+00	2.320E+09	4.740E+08	8.820E+07	0.000E+00	2.170E+09
CS-137	5.150E+10	6.020E+10	0.000E+00	1.620E+10	6.550E+09	1.880E+08	0.000E+00	4.270E+09
CS-138	8.390E-23	1.360E-22	0.000E+00	6.800E-23	1.060E-23	2.180E-22	0.000E+00	6.610E-23
BA-139	4.270E-07	2.830E-10	0.000E+00	1.700E-10	1.720E-10	2.710E-05	0.000E+00	1.240E-08
BA-140	2.410E+08	2.410E+05	0.000E+00	5.720E+04	1.480E+05	5.920E+07	0.000E+00	1.240E+07
BA-141	3.930E-45	2.690E-48	0.000E+00	1.620E-48	1.640E-48	4.800E-44	0.000E+00	1.240E-46
BA-142	2.430E-79	2.020E-82	0.000E+00	1.160E-82	1.220E-82	1.000E-78	0.000E+00	1.200E-80
LA-140	4.050E+01	1.600E+01	0.000E+00	0.000E+00	0.000E+00	1.880E+05	0.000E+00	4.110E+00
LA-142	1.700E-10	6.250E-11	0.000E+00	0.000E+00	0.000E+00	1.060E-05	0.000E+00	1.500E-11
CE-141	4.340E+04	2.640E+04	0.000E+00	8.150E+03	0.000E+00	1.370E+07	0.000E+00	3.110E+03
CE-143	3.970E+02	2.630E+05	0.000E+00	7.670E+01	0.000E+00	1.540E+06	0.000E+00	3.000E+01
CE-144	2.330E+06	9.520E+05	0.000E+00	3.850E+05	0.000E+00	1.330E+08	0.000E+00	1.300E+05
PR-143	1.490E+03	5.550E+02	0.000E+00	2.060E+02	0.000E+00	7.840E+05	0.000E+00	7.360E+01
PR-144	5.690E-53	2.200E-53	0.000E+00	7.980E-54	0.000E+00	1.020E-48	0.000E+00	2.870E-54
ND-147	8.810E+02	9.050E+02	0.000E+00	3.490E+02	0.000E+00	5.740E+05	0.000E+00	5.550E+01
W-187	6.080E+04	4.230E+04	0.000E+00	0.000E+00	0.000E+00	2.480E+06	0.000E+00	1.460E+04
NP-239	3.650E+01	3.260E+00	0.000E+00	6.510E+00	0.000E+00	9.430E+04	0.000E+00	1.840E+00

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R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
			Bone	Liver	Thyroid		Kidney	Lung
H-3	0.000E+00	4.860E+03	4.860E+03	4.860E+03	4.860E+03	4.860E+03	0.000E+00	4.860E+03
C-14	2.260E+05	4.820E+04	4.820E+04	4.820E+04	4.820E+04	4.820E+04	0.000E+00	4.820E+04
NA-24	1.850E+06	1.850E+06	1.850E+06	1.850E+06	1.850E+06	1.850E+06	0.000E+00	1.850E+06
P-32	1.920E+11	1.130E+10	0.000E+00	0.000E+00	0.000E+00	2.600E+09	0.000E+00	7.460E+09
CR-51	0.000E+00	0.000E+00	1.260E+04	2.760E+03	2.460E+04	5.640E+05	0.000E+00	1.940E+04
MN-54	0.000E+00	4.680E+06	0.000E+00	1.040E+06	0.000E+00	1.720E+06	0.000E+00	1.060E+06
MN-56	0.000E+00	3.720E-03	0.000E+00	3.190E-03	0.000E+00	3.380E-01	0.000E+00	6.410E-04
FE-55	1.760E+06	1.130E+06	0.000E+00	0.000E+00	5.550E+05	1.440E+05	0.000E+00	3.030E+05
FE-59	2.920E+06	5.100E+06	0.000E+00	0.000E+00	1.510E+06	2.430E+06	0.000E+00	2.010E+06
CO-58	0.000E+00	2.910E+06	0.000E+00	0.000E+00	0.000E+00	7.250E+06	0.000E+00	7.260E+06
CO-60	0.000E+00	1.060E+07	0.000E+00	0.000E+00	0.000E+00	2.520E+07	0.000E+00	2.500E+07
NI-63	4.190E+09	2.590E+08	0.000E+00	0.000E+00	0.000E+00	1.290E+07	0.000E+00	1.450E+08
NI-65	4.210E-01	4.760E-02	0.000E+00	0.000E+00	0.000E+00	3.620E+00	0.000E+00	2.170E-02
CU-64	0.000E+00	2.070E+04	0.000E+00	3.500E+04	0.000E+00	4.240E+05	0.000E+00	9.570E+03
ZN-65	6.660E+08	2.280E+09	0.000E+00	1.110E+09	0.000E+00	1.930E+09	0.000E+00	1.050E+09
ZN-69	2.420E-12	4.360E-12	0.000E+00	1.810E-12	0.000E+00	3.550E-10	0.000E+00	3.240E-13
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.120E-01
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.510E-23
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	0.000E+00	2.670E+09	0.000E+00	0.000E+00	0.000E+00	6.830E+07	0.000E+00	1.320E+09
RB-88	0.000E+00	2.250E-45	0.000E+00	0.000E+00	0.000E+00	2.190E-45	0.000E+00	1.230E-45
RB-89	0.000E+00	3.940E-53	0.000E+00	0.000E+00	0.000E+00	1.340E-53	0.000E+00	2.720E-53
SR-89	2.640E+10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.430E+08	0.000E+00	7.580E+08
SR-90	2.550E+11	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.190E+09	0.000E+00	6.500E+10
SR-91	5.700E+05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.750E+05	0.000E+00	2.060E+04

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			Bone	Liver	Thyroid		Kidney	Lung
SR-92	9.750E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.050E+02	0.000E+00	3.620E-01
Y-90	8.170E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.130E+05	0.000E+00	2.190E+00
Y-91	8.790E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.300E+05	0.000E+00	2.340E+02
Y-91M	6.810E-20	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.270E-16	0.000E+00	2.320E-21
Y-92	6.450E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.230E+00	0.000E+00	1.810E-06
Y-93	2.590E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.040E+03	0.000E+00	7.050E-03
ZR-95	8.170E+02	1.990E+02	0.000E+00	2.140E+02	0.000E+00	9.910E+04	0.000E+00	1.410E+02
ZR-97	4.870E-01	8.360E-02	0.000E+00	8.430E-02	0.000E+00	5.340E+03	0.000E+00	3.820E-02
NB-95	7.120E+04	2.930E+04	0.000E+00	2.100E+04	0.000E+00	2.480E+07	0.000E+00	1.700E+04
MO-99	0.000E+00	2.500E+07	0.000E+00	3.730E+07	0.000E+00	8.220E+06	0.000E+00	4.870E+06
TC-99M	3.300E+00	6.800E+00	0.000E+00	7.320E+01	3.550E+00	1.970E+03	0.000E+00	8.760E+01
TC-101	2.960E-60	3.730E-60	0.000E+00	4.440E-59	2.030E-60	6.340E-58	0.000E+00	3.690E-59
RU-103	1.040E+03	0.000E+00	0.000E+00	2.170E+03	0.000E+00	1.270E+04	0.000E+00	3.480E+02
RU-105	9.660E-04	0.000E+00	0.000E+00	7.110E-03	0.000E+00	3.840E-01	0.000E+00	3.250E-04
RU-106	2.280E+04	0.000E+00	0.000E+00	2.700E+04	0.000E+00	1.730E+05	0.000E+00	2.850E+03
AG-110M	4.630E+07	3.380E+07	0.000E+00	4.830E+07	0.000E+00	1.750E+09	0.000E+00	2.240E+07
TE-125M	1.810E+07	6.050E+06	6.090E+06	0.000E+00	0.000E+00	8.620E+06	0.000E+00	2.450E+06
TE-127	7.580E+02	2.540E+02	6.170E+02	1.850E+03	0.000E+00	1.590E+04	0.000E+00	1.630E+02
TE-127M	5.050E+07	1.680E+07	1.460E+07	1.240E+08	0.000E+00	2.040E+07	0.000E+00	6.120E+06
TE-129	3.260E-10	1.130E-10	2.740E-10	8.130E-10	0.000E+00	2.610E-08	0.000E+00	7.620E-11
TE-129M	6.690E+07	2.290E+07	2.570E+07	1.670E+08	0.000E+00	3.990E+07	0.000E+00	1.030E+07
TE-131	4.110E-33	1.520E-33	3.670E-33	1.050E-32	0.000E+00	1.660E-31	0.000E+00	1.150E-33
TE-131M	4.050E+05	1.630E+05	3.310E+05	1.120E+06	0.000E+00	2.750E+06	0.000E+00	1.350E+05
TE-132	2.530E+06	1.250E+06	1.850E+06	7.840E+06	0.000E+00	4.640E+06	0.000E+00	1.170E+06
I-130	4.260E+06	9.370E+06	1.050E+09	1.030E+07	0.000E+00	2.010E+06	0.000E+00	3.760E+06

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX J

R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Grs/Goat/Milk (GMILK)			Units:	m ² ·mrem/yr / μCi/sec; mrem/yr / μCi/m ³ (H-3, C-14)	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	3.260E+09	3.850E+09	1.260E+12	4.490E+09	0.000E+00	1.370E+08	0.000E+00	1.690E+09
I-132	1.720E+00	3.480E+00	1.630E+02	3.890E+00	0.000E+00	2.820E+00	0.000E+00	1.240E+00
I-133	4.350E+07	6.340E+07	1.150E+10	7.450E+07	0.000E+00	1.070E+07	0.000E+00	1.860E+07
I-134	2.110E-11	4.320E-11	1.010E-09	4.830E-11	0.000E+00	4.470E-11	0.000E+00	1.540E-11
I-135	1.350E+05	2.680E+05	2.400E+07	2.990E+05	0.000E+00	9.700E+04	0.000E+00	9.770E+04
CS-134	1.090E+11	2.040E+11	0.000E+00	5.250E+10	2.150E+10	5.540E+08	0.000E+00	2.060E+10
CS-136	5.930E+09	1.740E+10	0.000E+00	6.950E+09	1.420E+09	2.650E+08	0.000E+00	6.510E+09
CS-137	1.540E+11	1.810E+11	0.000E+00	4.850E+10	1.960E+10	5.650E+08	0.000E+00	1.280E+10
CS-138	2.520E-22	4.090E-22	0.000E+00	2.040E-22	3.190E-23	6.540E-22	0.000E+00	1.980E-22
BA-139	5.130E-08	3.400E-11	0.000E+00	2.040E-11	2.060E-11	3.250E-06	0.000E+00	1.480E-09
BA-140	2.890E+07	2.890E+04	0.000E+00	6.870E+03	1.780E+04	7.100E+06	0.000E+00	1.490E+06
BA-141	4.720E-46	3.230E-49	0.000E+00	1.940E-49	1.960E-49	5.760E-45	0.000E+00	1.490E-47
BA-142	2.920E-80	2.430E-83	0.000E+00	1.400E-83	1.470E-83	1.200E-79	0.000E+00	1.440E-81
LA-140	4.860E+00	1.920E+00	0.000E+00	0.000E+00	0.000E+00	2.250E+04	0.000E+00	4.930E-01
LA-142	2.040E-11	7.500E-12	0.000E+00	0.000E+00	0.000E+00	1.270E-06	0.000E+00	1.790E-12
CE-141	5.200E+03	3.170E+03	0.000E+00	9.790E+02	0.000E+00	1.640E+06	0.000E+00	3.740E+02
CE-143	4.760E+01	3.160E+04	0.000E+00	9.200E+00	0.000E+00	1.840E+05	0.000E+00	3.600E+00
CE-144	2.790E+05	1.140E+05	0.000E+00	4.620E+04	0.000E+00	1.600E+07	0.000E+00	1.560E+04
PR-143	1.780E+02	6.670E+01	0.000E+00	2.480E+01	0.000E+00	9.410E+04	0.000E+00	8.840E+00
PR-144	6.830E-54	2.640E-54	0.000E+00	9.570E-55	0.000E+00	1.230E-49	0.000E+00	3.440E-55
ND-147	1.060E+02	1.090E+02	0.000E+00	4.190E+01	0.000E+00	6.880E+04	0.000E+00	6.650E+00
W-187	7.300E+03	5.070E+03	0.000E+00	0.000E+00	0.000E+00	2.980E+05	0.000E+00	1.750E+03
NP-239	4.380E+00	3.910E-01	0.000E+00	7.810E-01	0.000E+00	1.130E+04	0.000E+00	2.210E-01

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
 Offsite Dose Calculation Manual (ODCM)

APPENDIX J

R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
H-3	0.000E+00	6.470E+02	6.470E+02	6.470E+02	6.470E+02	6.470E+02	0.000E+00	6.470E+02
C-14	2.650E+04	5.310E+03	5.310E+03	5.310E+03	5.310E+03	5.310E+03	0.000E+00	5.310E+03
NA-24	1.060E+04	1.060E+04	1.060E+04	1.060E+04	1.060E+04	1.060E+04	0.000E+00	1.060E+04
P-32	2.030E+06	1.120E+05	0.000E+00	0.000E+00	0.000E+00	1.610E+04	0.000E+00	7.740E+04
CR-51	0.000E+00	0.000E+00	5.750E+01	1.320E+01	1.280E+04	3.570E+02	0.000E+00	8.950E+01
MN-54	0.000E+00	2.530E+04	0.000E+00	4.980E+03	1.000E+06	7.060E+03	0.000E+00	4.980E+03
MN-56	0.000E+00	1.540E+00	0.000E+00	1.100E+00	1.250E+04	7.170E+04	0.000E+00	2.210E-01
FE-55	1.970E+04	1.170E+04	0.000E+00	0.000E+00	8.690E+04	1.090E+03	0.000E+00	3.330E+03
FE-59	1.360E+04	2.350E+04	0.000E+00	0.000E+00	1.010E+06	2.480E+04	0.000E+00	9.480E+03
CO-58	0.000E+00	1.220E+03	0.000E+00	0.000E+00	7.770E+05	1.110E+04	0.000E+00	1.820E+03
CO-60	0.000E+00	8.020E+03	0.000E+00	0.000E+00	4.510E+06	3.190E+04	0.000E+00	1.180E+04
NI-63	3.390E+05	2.040E+04	0.000E+00	0.000E+00	2.090E+05	2.420E+03	0.000E+00	1.160E+04
NI-65	2.390E+00	2.840E-01	0.000E+00	0.000E+00	8.120E+03	5.010E+04	0.000E+00	1.230E-01
CU-64	0.000E+00	1.880E+00	0.000E+00	3.980E+00	9.300E+03	1.500E+04	0.000E+00	7.740E-01
ZN-65	1.930E+04	6.260E+04	0.000E+00	3.250E+04	6.470E+05	5.140E+04	0.000E+00	3.110E+04
ZN-69	5.390E-02	9.670E-02	0.000E+00	4.020E-02	1.470E+03	1.320E+04	0.000E+00	7.180E-03
BR-83	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.810E+02
BR-84	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	4.000E+02
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.040E+01
RB-86	0.000E+00	1.900E+05	0.000E+00	0.000E+00	0.000E+00	3.040E+03	0.000E+00	8.820E+04
RB-88	0.000E+00	5.570E+02	0.000E+00	0.000E+00	0.000E+00	3.390E+02	0.000E+00	2.870E+02
RB-89	0.000E+00	3.210E+02	0.000E+00	0.000E+00	0.000E+00	6.820E+01	0.000E+00	2.060E+02
SR-89	3.980E+05	0.000E+00	0.000E+00	0.000E+00	2.030E+06	6.400E+04	0.000E+00	1.140E+04
SR-90	4.090E+07	0.000E+00	0.000E+00	0.000E+00	1.120E+07	1.310E+05	0.000E+00	2.590E+06
SR-91	9.560E+01	0.000E+00	0.000E+00	0.000E+00	5.260E+04	7.340E+04	0.000E+00	3.460E+00

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX J

R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	1.050E+01	0.000E+00	0.000E+00	0.000E+00	2.380E+04	1.400E+05	0.000E+00	3.910E-01
Y-90	3.290E+03	0.000E+00	0.000E+00	0.000E+00	2.690E+05	1.040E+05	0.000E+00	8.820E+01
Y-91	5.880E+05	0.000E+00	0.000E+00	0.000E+00	2.450E+06	7.030E+04	0.000E+00	1.570E+04
Y-91M	4.070E-01	0.000E+00	0.000E+00	0.000E+00	2.790E+03	2.350E+03	0.000E+00	1.390E-02
Y-92	1.640E+01	0.000E+00	0.000E+00	0.000E+00	2.450E+04	1.270E+05	0.000E+00	4.610E-01
Y-93	1.500E+02	0.000E+00	0.000E+00	0.000E+00	7.640E+04	1.670E+05	0.000E+00	4.070E+00
ZR-95	1.150E+05	2.790E+04	0.000E+00	3.110E+04	1.750E+06	2.170E+04	0.000E+00	2.030E+04
ZR-97	1.500E+02	2.560E+01	0.000E+00	2.590E+01	1.100E+05	1.400E+05	0.000E+00	1.170E+01
NB-95	1.570E+04	6.430E+03	0.000E+00	4.720E+03	4.790E+05	1.270E+04	0.000E+00	3.780E+03
MO-99	0.000E+00	1.650E+02	0.000E+00	2.650E+02	1.350E+05	4.870E+04	0.000E+00	3.230E+01
TC-99M	1.400E-03	2.880E-03	0.000E+00	3.110E-02	8.110E+02	2.030E+03	0.000E+00	3.720E-02
TC-101	6.510E-05	8.230E-05	0.000E+00	9.790E-04	5.840E+02	8.440E+02	0.000E+00	8.120E-04
RU-103	2.020E+03	0.000E+00	0.000E+00	4.240E+03	5.520E+05	1.610E+04	0.000E+00	6.790E+02
RU-105	1.220E+00	0.000E+00	0.000E+00	8.990E-01	1.570E+04	4.840E+04	0.000E+00	4.100E-01
RU-106	8.680E+04	0.000E+00	0.000E+00	1.070E+05	1.160E+07	1.640E+05	0.000E+00	1.090E+04
AG-110M	9.980E+03	7.220E+03	0.000E+00	1.090E+04	3.670E+06	3.300E+04	0.000E+00	5.000E+03
TE-125M	4.760E+03	1.990E+03	1.620E+03	0.000E+00	4.470E+05	1.290E+04	0.000E+00	6.580E+02
TE-127	2.230E+00	9.530E-01	1.850E+00	4.860E+00	1.030E+04	2.440E+04	0.000E+00	4.890E-01
TE-127M	1.670E+04	6.900E+03	4.870E+03	3.750E+04	1.310E+06	2.730E+04	0.000E+00	2.070E+03
TE-129	7.880E-02	3.470E-02	6.750E-02	1.750E-01	3.000E+03	2.630E+04	0.000E+00	1.880E-02
TE-129M	1.410E+04	6.090E+03	5.470E+03	3.180E+04	1.680E+06	6.900E+04	0.000E+00	2.230E+03
TE-131	1.740E-02	8.220E-03	1.580E-02	3.990E-02	2.060E+03	8.220E+03	0.000E+00	5.000E-03
TE-131M	1.070E+02	5.500E+01	8.930E+01	2.650E+02	1.990E+05	1.190E+05	0.000E+00	3.630E+01
TE-132	3.720E+02	2.370E+02	2.790E+02	1.030E+03	3.400E+05	4.410E+04	0.000E+00	1.760E+02
I-130	6.360E+03	1.390E+04	1.600E+06	1.530E+04	0.000E+00	1.990E+03	0.000E+00	5.570E+03

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
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Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX J

R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Inhalation (INHL)			Units:	mrem/yr / $\mu\text{Ci}/\text{m}^3$	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	3.790E+04	4.440E+04	1.480E+07	5.180E+04	0.000E+00	1.060E+03	0.000E+00	1.960E+04
I-132	1.690E+03	3.540E+03	1.690E+05	3.950E+03	0.000E+00	1.900E+03	0.000E+00	1.260E+03
I-133	1.320E+04	1.920E+04	3.560E+06	2.240E+04	0.000E+00	2.160E+03	0.000E+00	5.600E+03
I-134	9.210E+02	1.880E+03	4.450E+04	2.090E+03	0.000E+00	1.290E+03	0.000E+00	6.650E+02
I-135	3.860E+03	7.600E+03	6.960E+05	8.470E+03	0.000E+00	1.830E+03	0.000E+00	2.770E+03
CS-134	3.960E+05	7.030E+05	0.000E+00	1.900E+05	7.970E+04	1.330E+03	0.000E+00	7.450E+04
CS-136	4.830E+04	1.350E+05	0.000E+00	5.640E+04	1.180E+04	1.430E+03	0.000E+00	5.290E+04
CS-137	5.490E+05	6.120E+05	0.000E+00	1.720E+05	7.130E+04	1.330E+03	0.000E+00	4.550E+04
CS-138	5.050E+02	7.810E+02	0.000E+00	4.100E+02	6.540E+01	8.760E+02	0.000E+00	3.980E+02
BA-139	1.480E+00	9.840E-04	0.000E+00	5.920E-04	5.950E+03	5.100E+04	0.000E+00	4.300E-02
BA-140	5.600E+04	5.600E+01	0.000E+00	1.340E+01	1.600E+06	3.840E+04	0.000E+00	2.900E+03
BA-141	1.570E-01	1.080E-04	0.000E+00	6.500E-05	2.970E+03	4.750E+03	0.000E+00	4.970E-03
BA-142	3.980E-02	3.300E-05	0.000E+00	1.900E-05	1.550E+03	6.930E+02	0.000E+00	1.960E-03
LA-140	5.050E+02	2.000E+02	0.000E+00	0.000E+00	1.680E+05	8.480E+04	0.000E+00	5.150E+01
LA-142	1.030E+00	3.770E-01	0.000E+00	0.000E+00	8.220E+03	5.950E+04	0.000E+00	9.040E-02
CE-141	2.770E+04	1.670E+04	0.000E+00	5.250E+03	5.170E+05	2.160E+04	0.000E+00	1.990E+03
CE-143	2.930E+02	1.930E+02	0.000E+00	5.640E+01	1.160E+05	4.970E+04	0.000E+00	2.210E+01
CE-144	3.190E+06	1.210E+06	0.000E+00	5.380E+05	9.840E+06	1.480E+05	0.000E+00	1.760E+05
PR-143	1.400E+04	5.240E+03	0.000E+00	1.970E+03	4.330E+05	3.720E+04	0.000E+00	6.990E+02
PR-144	4.790E-02	1.850E-02	0.000E+00	6.720E-03	1.610E+03	4.280E+03	0.000E+00	2.410E-03
ND-147	7.940E+03	8.130E+03	0.000E+00	3.150E+03	3.220E+05	3.120E+04	0.000E+00	5.000E+02
W-187	1.300E+01	9.020E+00	0.000E+00	0.000E+00	3.960E+04	3.560E+04	0.000E+00	3.120E+00
NP-239	3.710E+02	3.320E+01	0.000E+00	6.620E+01	5.950E+04	2.490E+04	0.000E+00	1.880E+01

Attachment 9
Summary of Changes to the Offsite Dose Calculation Manual

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Oconee Nuclear Station
Offsite Dose Calculation Manual (ODCM)

APPENDIX J

R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
			Bone	Liver	Thyroid		Kidney	Lung
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NA-24	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.190E+07	1.390E+07	1.190E+07
P-32	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
CR-51	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	4.660E+06	5.510E+06	4.660E+06
MN-54	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.390E+09	1.630E+09	1.390E+09
MN-56	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	9.020E+05	1.070E+06	9.020E+05
FE-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
FE-59	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	2.730E+08	3.210E+08	2.730E+08
CO-58	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	3.790E+08	4.440E+08	3.790E+08
CO-60	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.150E+10	2.530E+10	2.150E+10
NI-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NI-65	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	2.970E+05	3.450E+05	2.970E+05
CU-64	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.070E+05	6.880E+05	6.070E+05
ZN-65	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	7.470E+08	8.590E+08	7.470E+08
ZN-69	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
BR-83	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	4.870E+03	7.080E+03	4.870E+03
BR-84	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.030E+05	2.360E+05	2.030E+05
BR-85	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	8.990E+06	1.030E+07	8.990E+06
RB-88	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.310E+04	3.780E+04	3.310E+04
RB-89	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.230E+05	1.480E+05	1.230E+05
SR-89	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.160E+04	2.510E+04	2.160E+04
SR-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SR-91	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.150E+06	2.510E+06	2.150E+06

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R_i Infant Dose Factors for use in the Gaseous Dose Calculations

Agegroup:	INFANT	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
SR-92	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	7.770E+05	8.630E+05	7.770E+05
Y-90	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	4.490E+03	5.310E+03	4.490E+03
Y-91	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.070E+06	1.210E+06	1.070E+06
Y-91M	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.000E+05	1.160E+05	1.000E+05
Y-92	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	1.800E+05	2.140E+05	1.800E+05
Y-93	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	1.830E+05	2.510E+05	1.830E+05
ZR-95	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.450E+08	2.840E+08	2.450E+08
ZR-97	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	2.960E+06	3.440E+06	2.960E+06
NB-95	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.370E+08	1.610E+08	1.370E+08
MO-99	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	3.990E+06	4.630E+06	3.990E+06
TC-99M	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	1.840E+05	2.110E+05	1.840E+05
TC-101	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.040E+04	2.260E+04	2.040E+04
RU-103	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.080E+08	1.260E+08	1.080E+08
RU-105	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	6.360E+05	7.210E+05	6.360E+05
RU-106	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	4.220E+08	5.070E+08	4.220E+08
AG-110M	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	3.440E+09	4.010E+09	3.440E+09
TE-125M	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	1.550E+06	2.130E+06	1.550E+06
TE-127	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	2.980E+03	3.280E+03	2.980E+03
TE-127M	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	9.160E+04	1.080E+05	9.160E+04
TE-129	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	2.620E+04	3.100E+04	2.620E+04
TE-129M	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	1.980E+07	2.310E+07	1.980E+07
TE-131	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	2.920E+04	3.450E+07	2.920E+04
TE-131M	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	8.030E+06	9.460E+06	8.030E+06
TE-132	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.230E+06	4.980E+06	4.230E+06
I-130	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	5.510E+06	6.690E+06	5.510E+06

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Agegroup:	INFANT	Pathway:	Ground Plane Deposition (GPD)			Units:	m ² ·mrem/yr / μCi/sec	
Nuclide	Bone	Liver	Thyroid	Kidney	Lung	Gilli	Skin	Total Body
I-131	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	1.720E+07	2.090E+07	1.720E+07
I-132	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.250E+06	1.470E+06	1.250E+06
I-133	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.450E+06	2.980E+06	2.450E+06
I-134	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	4.470E+05	5.300E+05	4.470E+05
I-135	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.530E+06	2.950E+06	2.530E+06
CS-134	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	6.860E+09	8.000E+09	6.860E+09
CS-136	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.510E+08	1.710E+08	1.510E+08
CS-137	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.030E+10	1.200E+10	1.030E+10
CS-138	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	3.590E+05	4.100E+05	3.590E+05
BA-139	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.060E+05	1.190E+05	1.060E+05
BA-140	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.050E+07	2.350E+07	2.050E+07
BA-141	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.170E+04	4.750E+04	4.170E+04
BA-142	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	4.490E+04	5.110E+04	4.490E+04
LA-140	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	1.920E+07	2.180E+07	1.920E+07
LA-142	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	7.600E+05	9.120E+05	7.600E+05
CE-141	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.370E+07	1.540E+07	1.370E+07
CE-143	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.310E+06	2.630E+06	2.310E+06
CE-144	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	6.950E+07	8.040E+07	6.950E+07
PR-143	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
PR-144	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	1.830E+03	2.110E+03	1.830E+03
ND-147	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	8.390E+06	1.010E+07	8.390E+06
W-187	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.350E+06	2.730E+06	2.350E+06
NP-239	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.710E+06	1.980E+06	1.710E+06

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16.10.5	---	Deleted 08/24/04
16.10.6	000	03/27/99
16.10.7	001	09/21/15
16.10.8	000	11/27/06
16.10.9	000	11/25/09
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16.11.2	000	01/31/00
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16.11.4	000	06/30/14
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Note: With the introduction of Fusion in June 2015, all controlled documents require a three-digit revision number. Thus, the revision numbers were set to "000" in the summer of 2015. As such, the revision dates for Revision 000 are based on the implementation dates for revisions in effect prior to this change.

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.1 Radioactive Liquid Effluents

COMMITMENT Establish conditions for the controlled release of radioactive liquid effluents. Implement the requirements of 10 CFR 20, 10 CFR 50.36a, Appendix A to 10 CFR 50, Appendix I to 10 CFR 50, 40 CFR 141 and 40 CFR 190.

a. Concentration

The concentration of radioactive material released at anytime from the site boundary for liquid effluents to Unrestricted Areas [denoted in Figure 2-5 of the Oconee Nuclear Station Updated Final Safety Analysis Report] shall be limited to 10 times the effluent concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases the concentration shall be limited to 2×10^{-4} $\mu\text{Ci/ml}$ total activity.

b. Dose

The dose or dose commitment to a Member Of The Public from radioactive materials in liquid effluents to Unrestricted Areas shall be limited to:

1. during any calendar quarter:

≤ 4.5 mrem to the total body

≤ 15 mrem to any organ; and

2. during any calendar year:

≤ 9 mrem to the total body

≤ 30 mrem to any organ.

c. Liquid Waste Treatment

The appropriate subsystems of the liquid radwaste treatment system shall be used to reduce the radioactive materials in liquid waste prior to their discharge, if the projected dose due to liquid effluent releases to unrestricted areas, when averaged over 31 days would exceed 0.18 mrem to the total body or 0.6 mrem to any organ.

-----NOTE-----

Appendix I dose limits for radioactive liquid effluent releases are applicable only during normal operating conditions which include expected operational occurrences, and are not applicable during unusual operating conditions that result in activation of the Oconee Emergency Plan.

APPLICABILITY: At all times

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Concentration of radioactive material released in liquid effluents to Unrestricted Areas exceeds the limits specified in Commitment a.	A.1 Restore concentration to within the limit.	Immediately

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>B. Calculated dose from the release of radioactive materials in liquid effluents exceeds any of the limits in Commitment b.</p>	<p>B.1 -----NOTE----- Not required during unusual operating conditions that result in activation of the Oconee Emergency Plan. -----</p> <p>Submit report to the regional NRC Office which includes the following:</p> <ul style="list-style-type: none"> a. Cause(s) for exceeding the limit(s). b. A description of the program of corrective action initiated to: reduce the releases of radioactive materials in liquid effluents, and to keep these levels of radioactive materials in liquid effluents in compliance with the above limits, or as low as reasonably achievable. c. Results of radiological analyses of the drinking water source and the radiological impact on finished drinking water supplies with regard to the requirements of 40 CFR 141. 	<p>30 days from the end of the quarter during which the release occurred</p>

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Radioactive liquid waste is discharged without treatment and in excess of the specified limit.	C.1 Submit report to the regional NRC Office which includes the following: <ul style="list-style-type: none"> a. Cause of equipment or subsystem inoperability. b. Corrective action to restore equipment and prevent recurrence. 	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.1.1 N/A	N/A

BASES

The concentration commitment is provided to ensure that the concentration of radioactive materials released in liquid waste effluents from the site to unrestricted areas will be less than 10 times the effluent concentration levels specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. The concentration limit for noble gases is based upon the assumption that Xe-135 is the controlling radioisotope and its EC in air (submersion) was converted to an equivalent concentration in water using the methods described in International Commission on Radiological Protection (ICRP) Publication 2.

The basic requirements for Selected Licensee Commitments concerning effluent from nuclear power reactors are stated in 10 CFR 50.36a. Compliance with effluent Selected Licensee Commitments will ensure that average annual releases of radioactive material in effluents will be small percentages of the limits specified in the old 10 CFR 20.106 (new 10 CFR 20.1302). The requirements contained in 10 CFR 50.36a further indicate that operational flexibility is allowed, compatible with considerations of health and safety, which may temporarily result in releases higher than such small percentages, but still within the limits specified in the old 10 CFR 20.106 which references Appendix B, Table II concentrations (MPCs). These referenced concentrations are specific values which relate to an annual dose of 500 mrem. It is further indicated in 10 CFR 50.36a that when using operational flexibility, best efforts shall be exerted to keep levels of radioactive materials in effluents as low as reasonably achievable (ALARA) as set forth in 10 CFR 50 Appendix I. Also, for fresh water sites with drinking water supplies which can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR 141. Therefore, to accommodate operational flexibility needed for effluent releases, the limits associated with this SLC are based on ten times the instantaneous dose rate value of 50 mrem/year to apply at all times. Compliance with the limits of the new 10 CFR 20.1001 will be demonstrated by operating within the limits of 10 CFR 50, Appendix I, 40 CFR 141 and 40 CFR 190.

Section I of Appendix I of 10 CFR 50 states that this appendix provides specific numerical guides for design objectives and limiting conditions for operation, to assist holders of licenses for light water cooled nuclear power reactors in meeting the requirements to keep releases of radioactive material to unrestricted areas as low as practical and reasonably achievable, during normal reactor operations, including expected operational occurrences. Using the flexibility granted during unusual operating conditions, and the stated applicability of the design objectives for the Oconee Nuclear Station, Appendix I dose limits for radioactive liquid effluent releases are concluded to be not applicable during unusual operating conditions that result in the activation of the Oconee Emergency Plan.

For units with shared radwaste treatment systems, the liquid effluents from the shared system are proportioned among the units sharing that system.

The requirements that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This SLC implements the requirements of 10 CFR Part 50.36a. General Design Criterion 60 of Appendix A to 10 CFR Part 50 and design objective Section II.D of Appendix A to 10 CFR Part 50.

REFERENCES:

1. 10 CFR Part 20, Appendix B.
2. 40 CFR Part 141.
3. 10 CFR Part 50, Appendices A and I.
4. 40 CFR Part 190.
5. Offsite Dose Calculation Manual.
6. Regulatory Guide 1.109.
7. NUREG-1301

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.2 Radioactive Gaseous Effluents

COMMITMENT Establish conditions for the controlled release of radioactive gaseous effluents. Implement the requirements of 10 CFR 20, 10 CFR 50.36a, Appendix A to 10 CFR 50, Appendix I to 10 CFR 50, and 40 CFR 190.

a. Dose Rate

The instantaneous dose rate at the site (exclusion area) boundary for gaseous effluents [Figure 2.1-4(a) of the Oconee Nuclear Station Updated Final Safety Analysis Report] due to radioactive materials released in gaseous effluents from the site shall be limited to the following values:

1. The dose rate limit for noble gases shall be:
 - ≤ 500 mrem/yr to the total body
 - ≤ 3000 mrem/yr to the skin; and
2. The dose rate limit for all radioiodines and for all radioactive materials in particulate form and radionuclides other than noble gases with half-lives greater than 8 days shall be ≤ 1500 mrem/yr to any organ.

b. Dose

1. The air dose due to noble gases released in gaseous effluent from the site shall be limited to the following:
 - i. During any calendar quarter:
 - ≤ 15 mrad for gamma radiation
 - ≤ 30 mrad for beta radiation
 - ii. During any calendar year:
 - ≤ 30 mrad for gamma radiation
 - ≤ 60 mrad for beta radiation
2. The dose to a Member Of The Public from radioiodines, tritium and radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents released from the site, shall be limited to the following:

- i. During any calendar quarter:
 - ≤ 22.5 mrem to any organ
 - ii. During any calendar year:
 - ≤ 45 mrem to any organ.
- c. Gaseous Radwaste Treatment
- 1. The Gaseous Radwaste Treatment System shall be used to reduce the noble gases in gaseous wastes prior to their discharge, if the projected gaseous effluent air dose due to gaseous effluent release from the site, when averaged over 31 days exceeds 0.6 mrad for gamma radiation and 1.2 mrad for beta radiation.
 - 2. The Ventilation Treatment Exhaust System shall be used to reduce radioactive materials other than noble gases in gaseous waste prior to their discharge when the projected doses due to effluent releases to unrestricted areas when averaged over 31 days would exceed 0.9 mrem to any organ.
- d. Used Oil Incineration
- During incineration of used oil contaminated by radioactive material in the Station Auxiliary Boiler, the dose to a Member Of The Public from radioiodines, tritium and radioactive materials in particulate form with half-lives greater than 8 days in gaseous effluents released from the Station Auxiliary Boiler shall be ≤ 0.045 mrem to any organ in any calendar year.

-----NOTE-----
The requirement of c.2 does not apply to the Auxiliary Building Exhaust System since it is not "treated" prior to release.

APPLICABILITY: At all times

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Dose rate exceeds the limits specified in Commitment a.	A.1 Restore release rate to within limits.	Immediately
B. Calculated dose exceeds specified limits.	B.1 Submit report to the regional NRC Office which includes the following: <ul style="list-style-type: none"> a. Cause(s) for exceeding the limit(s), and b. A description of the program of corrective action initiated to: reduce the releases of radioactive materials in gaseous effluents, and to keep these levels of radioactive materials in gaseous effluents in compliance with the specified limits or as low as reasonably achievable. 	30 days from the end of the quarter during which the release occurred

Radioactive Gaseous Effluents
 16.11.2

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>C. Radioactive gaseous waste is discharged greater than limits specified in Commitment c.1 or c.2.</p> <p><u>AND</u></p> <p>Radioactive gaseous waste is discharged without treatment for more than 31 days.</p>	<p>C.1 Submit a report to the regional NRC Office which includes the following:</p> <ul style="list-style-type: none"> a. Cause of equipment or subsystems inoperability, and b. Corrective action to restore equipment and prevent recurrence. 	<p>30 days</p>

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
<p>SR 16.11.2.1 N/A</p>	<p>N/A</p>

BASES

The basic requirements for Selected Licensee Commitments concerning effluent from nuclear power reactors are stated in 10CFR50.36. Compliance with effluent Selected Licensee Commitments will ensure that average annual releases of radioactive material in effluents will be small percentages of the limits specified in the old 10CFR20.106 (new 10CFR20.1302). The requirements contained in 10CFR50.36a further indicate that operational flexibility is allowed, compatible with considerations of health and safety, which may temporarily result in releases higher than such small percentages, but still within the limits specified in the old 10CFR20.106 which references Appendix B, Table II concentrations (MPCs). These referenced concentrations are specific values which relate to an annual dose of 500 mrem to the total body, 3000 mrem to the skin, and 1500 mrem to an infant via the milk animal-milk-infant pathway. It is further indicated in 10CFR50.36a that when using operational flexibility, best efforts shall be exerted to keep levels of radioactive materials in effluents as low as reasonably achievable (ALARA) as set forth in 10CFR50 Appendix I. Therefore, to accommodate operational flexibility needed for effluent releases, the limits associated with gaseous release rate SLCs will be maintained at the current instantaneous dose rate limit for noble gases of 500 mrem/year to the total body and 3000 mrem/year to the skin; and for Iodine-131, for Iodine-133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days, an instantaneous dose rate limit of 1500 mrem/year.

The ODCM calculational methods for calculating the doses due to the actual release rates of the subject materials will be consistent with the methodology provided in Regulatory Guide 1.109, "Calculating of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."

Equations in the ODCM are provided for determining the actual doses based upon the historical average atmospheric conditions. The release rate commitments for radioiodines, radioactive material in particulate form and radionuclides other than noble gases are dependent on the existing radionuclide pathways to man, in the unrestricted area. The pathways which are examined in the development of these calculations are: 1) individual inhalation of airborne radionuclides, 2) deposition of radionuclides into green leafy vegetation with subsequent consumption by man, 3) deposition onto grassy areas where milk animals and meat producing animals graze with consumption of the milk and meat by man, and 4) deposition on the ground with subsequent exposure of man.

The requirement that the appropriate portions of these systems be used when specified provides reasonable assurance that the release of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This commitment implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and design objective Section IID of Appendix I to 10 CFR Part 50.

REFERENCES:

1. 10 CFR Part 20, Appendix 8.
2. 10 CFR Part 50, Appendices A and I.
3. Regulatory Guide 1.109.
4. 40 CFR Part 190.
5. Offsite Dose Calculation Manual.

Radioactive Effluent Monitoring Instrumentation
 16.11.3

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.3 Radioactive Effluent Monitoring Instrumentation

COMMITMENT Radioactive Effluent Monitoring Instrumentation shall be OPERABLE as follows:

a. Liquid Effluents

The radioactive liquid effluent monitoring instrumentation channels shown in Table 16.11.3-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of SLC 16.11.1.a are not exceeded.

b. Gaseous Process and Effluents

The radioactive gaseous process and effluent monitoring instrumentation channels shown in Table 16.11.3-2 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of SLC 16.11.2.a are not exceeded.

c. The setpoints shall be determined in accordance with the methodology described in the ODCM and shall be recorded.

-----NOTE-----
 Correction to setpoints determined in accordance with Commitment c may be permitted without declaring the channel inoperable.

APPLICABILITY: According to Table 16.11.3-1 and Table 16.11.3-2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Alarm/trip setpoint less conservative than required for one or more effluent monitoring instrument channels.	A.1 Declare channel inoperable.	Immediately
	<u>OR</u> A.2 Suspend release of effluent monitored by the channel.	Immediately

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One or more required liquid effluent monitoring instrument channels inoperable.	B.1 Enter the Condition referenced in Table 16.11.3-1 for the function. <u>AND</u> B.2 Restore the instrument(s) to OPERABLE status.	Immediately 30 days
C. One or more required gaseous effluent monitoring instrument channels inoperable.	C.1 Enter the Condition referenced in Table 16.11.3-2 for the function. <u>AND</u> C.2 Restore the instrument(s) to OPERABLE status.	Immediately 30 days
D. Required Action and associated Completion Time of Required Action B.2 or C.2 not met.	D.1 Explain in next Annual Radiological Effluent Release Report why inoperability was not corrected in a timely manner.	April 30 of following calendar year

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>G. As required by Required Action B.1 and referenced in Table 16.11.3-1. (Liquid Radwaste Effluent Line Flow Rate Monitor)</p>	<p>-----NOTE----- Not required during short, controlled outages of liquid effluent monitoring instrumentation. Short controlled outages are defined as planned removals from service for durations not to exceed 1 hour, for purposes of sample filter changeouts, setpoint adjustments, service checks, and/or routine maintenance procedures. This guidance may be applied successively, provided that time between successive short, controlled outages is always at least equal to duration of immediately preceding outage. -----</p> <p>G.1 Suspend release of radioactive effluents by this pathway.</p> <p><u>OR</u></p> <p>G.2 Estimate flow rate during actual releases.</p>	<p>Immediately</p> <p>Immediately</p> <p><u>AND</u></p> <p>Once per 4 hours thereafter</p>

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
H. As required by Required Action B.1 and referenced in Table 16.11.3-1. (RIA-35, #3 Chemical Treatment Pond Composite Sampler and Sampler Flow Monitor (Turbine Building Sumps Effluent))	<p style="text-align: center;">-----NOTE-----</p> Not required during short, controlled outages of liquid effluent monitoring instrumentation. Short controlled outages are defined as planned removals from service for durations not to exceed 1 hour, for purposes of sample filter changeouts, setpoint adjustments, service checks, and/or routine maintenance procedures. This guidance may be applied successively, provided that time between successive short, controlled outages is always at least equal to duration of immediately preceding outage.	
	H.1 Suspend release of radioactive effluents by this pathway.	Immediately
	<p style="text-align: center;"><u>OR</u></p> H.2 Collect and analyze grab samples for gross radioactivity (beta and/or gamma) at a lower limit of detection of at least 10^{-7} $\mu\text{Ci/ml}$.	Immediately <u>AND</u> Once per 12 hours thereafter

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
I. As required by Required Action C.1 and referenced in Table 16.11.3-2 for effluent releases from waste gas tanks (RIA-37, RIA-38) or containment purges (RIA-45).	<p style="text-align: center;">-----NOTE-----</p> Not required during short, controlled outages of gaseous effluent monitoring instrumentation. Short controlled outages are defined as planned removals from service for durations not to exceed 1 hour, for purposes of sample filter changeouts, setpoint adjustments, service checks, and/or routine maintenance procedures. This guidance may be applied successively, provided that time between successive short, controlled outages is always at least equal to duration of immediately preceding outage.	
	I.1.1 Analyze two independent samples.	Prior to initiating subsequent release
	<p style="text-align: center;"><u>AND</u></p>	
	I.1.2 Conduct two independent data entry checks for release rate calculations	Prior to initiating subsequent release
	<p style="text-align: center;"><u>AND</u></p> I.1.3 Conduct two independent valve lineups of the effluent pathway.	Prior to initiating subsequent release
<p style="text-align: center;"><u>OR</u></p> I.2 Suspend release of radioactive effluents by this pathway.	Immediately	

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
J. As required by Required Action C.1 and referenced in Table 16.11.3-2. (Effluent Flow Rate Monitor (Unit Vent, Containment Purge, Interim Radwaste Exhaust, Hot Machine Shop Exhaust, Radwaste Facility Exhaust, Waste Gas Discharge))	<p>-----NOTE----- Not required during short, controlled outages of gaseous effluent monitoring instrumentation. Short controlled outages are defined as planned removals from service for durations not to exceed 1 hour, for purposes of sample filter changeouts, setpoint adjustments, service checks, and/or routine maintenance procedures. This guidance may be applied successively, provided that time between successive short, controlled outages is always at least equal to duration of immediately preceding outage.</p> <p>-----</p>	
	J.1 Suspend release of radioactive effluents by this pathway.	Immediately
	<p><u>OR</u></p> J.2 Estimate flow rate	Immediately <u>AND</u> Once per 4 hours thereafter

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
K. As required by Required Action C.1 and referenced in Table 16.11.3-2. (RIA-45, RIA-53, 4RIA-45)	<p style="text-align: center;">-----NOTE-----</p> Not required during short, controlled outages of gaseous effluent monitoring instrumentation. Short controlled outages are defined as planned removals from service for durations not to exceed 1 hour, for purposes of sample filter changeouts, setpoint adjustments, service checks, and/or routine maintenance procedures. This guidance may be applied successively, provided that time between successive short, controlled outages is always at least equal to duration of immediately preceding outage.	
	K.1 Suspend release of radioactive effluents by this pathway.	Immediately
	<p style="text-align: center;"><u>OR</u></p> K.2.1 Collect grab sample.	Immediately <u>AND</u> Once per 8 hours
	<p style="text-align: center;"><u>AND</u></p> K.2.2 Analyze grab samples for gross activity (beta and/or gamma).	24 hours from collection of sample

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
L. As required by Required Action C.1 and referenced in Table 16.11.3-2. (Unit Vent Monitoring Iodine Sampler, Unit Vent Monitoring Particulate Sampler, Interim Radwaste Building Ventilation Monitoring Iodine Sampler, Interim Radwaste Building Ventilation Monitoring Particulate Sampler, Hot Machine Shop Iodine Sampler, Hot Machine Shop Particulate Sampler, Radwaste Facility Iodine Sampler, Radwaste Facility Particulate Sampler)	<p>-----NOTE----- Not required during short, controlled outages of gaseous effluent monitoring instrumentation. Short controlled outages are defined as planned removals from service for durations not to exceed 1 hour, for purposes of sample filter changeouts, setpoint adjustments, service checks, and/or routine maintenance procedures. This guidance may be applied successively, provided that time between successive short, controlled outages is always at least equal to duration of immediately preceding outage.</p>	
	L.1 Suspend release of radioactive effluents by this pathway.	Immediately
	<p><u>OR</u></p>	
	L.2.1 -----NOTE----- The collection time of each sample shall not exceed 7 days. ----- Collect samples continuously using auxiliary sampling equipment.	Immediately
<p><u>AND</u></p>		
L.2.2 Analyze each sample.	48 hours from end of each sample collection	

Radioactive Effluent Monitoring Instrumentation
 16.11.3

CONDITION	REQUIRED ACTION	COMPLETION TIME
M. As required by Required Action C.1 and referenced in Table 16.11.3-2 for effluent from ventilation system or condenser air ejectors. (RIA-40)	<p>-----NOTE----- Not required during short, controlled outages of gaseous effluent monitoring instrumentation. Short controlled outages are defined as planned removals from service for durations not to exceed 1 hour, for purposes of sample filter changeouts, setpoint adjustments, service checks, and/or routine maintenance procedures. This guidance may be applied successively, provided that time between successive short, controlled outages is always at least equal to duration of immediately preceding outage.</p> <p>-----</p>	
	M.1 Continuously monitor release through the unit vent.	Immediately
	<u>OR</u>	
	M.2 Suspend release of radioactive effluents by this pathway.	Immediately
	<u>OR</u>	
M.3.1 Collect grab sample.	Immediately <u>AND</u> Once per 8 hours	
<u>AND</u> M.3.2 Analyze grab sample for gross activity (beta and/or gamma).	24 hours from collection of grab sample	

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
<p>SR 16.11.3.1 -----NOTE----- The Channel Response check shall consist of verifying indications during periods of release. Channel response checks shall be made at least once per calendar day on days in which continuous, periodic or batch releases are made. ----- Perform Channel Response Check.</p>	<p>During each release via this pathway</p>
<p>SR 16.11.3.2 -----NOTE----- The Channel Response check shall consist of verifying indications during periods of release. Channel response checks shall be made at least once per calendar day on days in which continuous, periodic or batch releases are made. ----- Perform Channel Response Check.</p>	<p>24 hours</p>
<p>SR 16.11.3.3 Perform Source Check.</p>	<p>24 hours</p>
<p>SR 16.11.3.4 Perform Source Check.</p>	<p>31 days</p>
<p>SR 16.11.3.5 Perform Source Check.</p>	<p>92 days</p>

Radioactive Effluent Monitoring Instrumentation
 16.11.3

SURVEILLANCE	FREQUENCY
<p>SR 16.11.3.6 -----NOTE----- The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room annunciation occurs if any of the following conditions exist:</p> <ol style="list-style-type: none"> 1. Instrument indicates measured levels above the alarm/trip setpoint. 2. Circuit failure (downscale only). <p>----- Perform CHANNEL FUNCTIONAL TEST.</p>	<p>92 days</p>
<p>SR 16.11.3.7 -----NOTE----- The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room annunciation occurs if any of the following conditions exist:</p> <ol style="list-style-type: none"> 1. Instrument indicates measured levels above the alarm/trip setpoint. 2. Circuit failure (downscale only). <p>----- Perform CHANNEL FUNCTIONAL TEST.</p>	<p>92 days</p>
<p>SR 16.11.3.8 Perform CHANNEL FUNCTIONAL TEST.</p>	<p>92 days</p>

Radioactive Effluent Monitoring Instrumentation
 16.11.3

SURVEILLANCE	FREQUENCY
<p>SR 16.11.3.9 -----NOTE----- The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Bureau of Standards or using standards that have been obtained from suppliers that participate in measurement assurance activities with the National Institute of Standards and Technology (NIST). The standards shall permit calibrating the system over its intended range of energy and measurement. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used. (Operating plants may substitute previously established calibration procedures for these requirements.) ----- Perform CHANNEL CALIBRATION.</p>	<p>12 months</p>
<p>SR 16.11.3.10 Perform CHANNEL CALIBRATION.</p>	<p>12 months</p>
<p>SR 16.11.3.11 Perform leak test.</p>	<p>When cylinder gates or wicket gates are reworked</p>
<p>SR 16.11.3.12 Perform Source Check.</p>	<p>Within 24 hours prior to each release via associated pathway</p>

Radioactive Effluent Monitoring Instrumentation
 16.11.3

Table 16.11.3-1
 LIQUID EFFLUENT MONITORING INSTRUMENTATION
 OPERATING CONDITIONS AND SURVEILLANCE REQUIREMENTS

INSTRUMENT	MINIMUM OPERABLE CHANNELS	APPLICABILITY	SURVEILLANCE REQUIREMENTS	CONDITION REFERENCED FROM REQUIRED ACTION B.1
1. Monitors Providing Automatic Termination of Release				
a. Liquid Radwaste Effluent Line Monitor, RIA-33	1	At all times	SR 16.11.3.1 SR 16.11.3.3 SR 16.11.3.6 SR 16.11.3.9	E
b. Turbine Building Sump, RIA-54	1	At all times	SR 16.11.3.2 SR 16.11.3.4 SR 16.11.3.7 SR 16.11.3.9	F
2. Monitors not Providing Automatic Termination of Release				
Low Pressure Service Water RIA-35	1	At all times	SR 16.11.3.2 SR 16.11.3.4 SR 16.11.3.7 SR 16.11.3.9	H
3. Flow Rate Measuring Devices				
a. Liquid Radwaste Effluent Line Flow Rate Monitor (0LW CR0725 or 0LW SS0920)	1	At all times	SR 16.11.3.1 SR 16.11.3.10	G
b. Liquid Radwaste Effluent Line Minimum Flow Device	NA	NA	SR 16.11.3.1 SR 16.11.3.10	NA
c. Turbine Building Sump Minimum Flow Device	NA	NA	SR 16.11.3.1 SR 16.11.3.10	NA
d. Low Pressure Service Water Minimum Flow Device	NA	NA	SR 16.11.3.1 SR 16.11.3.10	NA

Radioactive Effluent Monitoring Instrumentation
16.11.3

Table 16.11.3-1
LIQUID EFFLUENT MONITORING INSTRUMENTATION
OPERATING CONDITIONS AND SURVEILLANCE REQUIREMENTS

INSTRUMENT	MINIMUM OPERABLE CHANNELS	APPLICABILITY	SURVEILLANCE REQUIREMENTS	CONDITION REFERENCED FROM REQUIRED ACTION B.1
e. Keowee Hydroelectric Tailrace Discharge ^(a)	NA	NA	SR 16.11.3.11	NA
4. Continuous Composite Sampler				
#3 Chemical Treatment Pond Composite Sampler and Sampler Flow Monitor (Turbine Building Sumps Effluent)	1	At all times	SR 16.11.3.2 SR 16.11.3.10	H

(a) Flow is determined from the number of hydro units operating. If no hydro units are operating, leakage flow will be assumed to be 38 cfs based on historical data.

Oconee Nuclear Station Units 1, 2, & 3
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Radioactive Effluent Monitoring Instrumentation
16.11.3

Table 16.11.3-2
GASEOUS EFFLUENT MONITORING INSTRUMENTATION
OPERATING CONDITIONS AND SURVEILLANCE REQUIREMENTS

INSTRUMENT	MINIMUM OPERABLE CHANNELS (PER RELEASE PATH)	APPLICABILITY	SURVEILLANCE REQUIREMENTS	CONDITION REFERENCED FROM REQUIRED ACTION C.1
1. Unit Vent Monitoring System				
a. Noble Gas Activity Monitor Providing Alarm and Automatic Termination of Containment Purge Release (RIA-45 - Purge Isolation Function)	1	At All Times	SR 16.11.3.2 SR 16.11.3.4 SR 16.11.3.7 SR 16.11.3.9	I
b. Noble Gas Activity Monitor Providing Alarm. (RIA-45 - Vent Stack Monitor Function)	1	At all times	SR 16.11.3.2 SR 16.11.3.4 SR 16.11.3.7 SR 16.11.3.9	K
c. Iodine Sampler	1	At All Times	SR 16.11.3.2	L
d. Particulate Sampler	1	At All Times	SR 16.11.3.2	L
e. Effluent Flow Rate Monitor (Unit Vent Flow) (MSC CR0001)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	J
f. Sampler Flow Rate Monitor ^(a) (Annunciator)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	NA
g. Effluent Flow Rate Monitor (Containment Purge)(MSC CR0001)	1	During Containment Purge Operation	SR 16.11.3.2 SR 16.11.3.10	J
h. CSAE Off Gas Monitor (RIA-40)	1	During Operation of CSAE	SR 16.11.3.2 SR 16.11.3.5 SR 16.11.3.8 SR 16.11.3.9	M
2. Interim Radwaste Building Ventilation Monitoring System				
a. Noble Gas Activity Monitor (RIA - 53)	1	At All Times	SR 16.11.3.2 SR 16.11.3.4 SR 16.11.3.7 SR 16.11.3.9	K
b. Iodine Sampler	1	At All Times	SR 16.11.3.2	L
c. Particulate Sampler	1	At All Times	SR 16.11.3.2	L
d. Effluent Flow Rate Monitor (Interim Radwaste Exhaust) (GWD FT0082)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	J
e. Sampler Flow Rate Monitor ^(a) (Annunciator)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	NA

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

Radioactive Effluent Monitoring Instrumentation
16.11.3

Table 16.11.3-2
GASEOUS EFFLUENT MONITORING INSTRUMENTATION
OPERATING CONDITIONS AND SURVEILLANCE REQUIREMENTS

INSTRUMENT	MINIMUM OPERABLE CHANNELS (PER RELEASE PATH)	APPLICABILITY	SURVEILLANCE REQUIREMENTS	CONDITION REFERENCED FROM REQUIRED ACTION C.1
3. Hot Machine Shop Ventilation Sampling System				
a. Iodine Sampler	1	At All Times	SR 16.11.3.2	L
b. Particulate Sampler	1	At All Times	SR 16.11.3.2	L
c. Effluent Flow Rate Monitor (Hot Machine Shop Exhaust) (Totalizer)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	J
d. Sampler Flow Rate Monitor ^(a) (Annunciator)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	NA
4. Radwaste Facility Ventilation Monitoring System				
a. Noble Gas Activity Monitor (4-RIA-45)	1	At All Times	SR 16.11.3.2 SR 16.11.3.4 SR 16.11.3.7 SR 16.11.3.9	K
b. Iodine Sampler	1	At All Times	SR 16.11.3.2	L
c. Particulate Sampler	1	At All Times	SR 16.11.3.2	L
d. Effluent Flow Rate Monitor (Radwaste Facility Exhaust) (OVS CR2060)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	J
e. Sampler Flow Rate Monitor ^(a) (Annunciator)	1	At All Times	SR 16.11.3.2 SR 16.11.3.10	NA
5. Waste Gas Holdup Tanks				
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release (RIA-37,-38) ^b	1	During Waste Gas Holdup Tank Releases	SR 16.11.3.1 SR 16.11.3.6 SR 16.11.3.9 SR 16.11.3.12	I
b. Effluent Flow Rate Monitor (Waste Gas Discharge Flow) (MSC CR0001)	1	During Waste Gas Holdup Tank Releases	SR 16.11.3.1 SR 16.11.3.10	J

(a)Alarms indicating low flow may be substituted for flow measuring devices.

(b)Either Normal or High Range monitor is required dependent upon activity in tank being released.

BASES

The radioactive liquid effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases. The alarm/trip setpoints for these instruments shall be calculated in accordance with NRC approved methods in the ODCM to assure that the alarm/trip will occur prior to exceeding 10 times the limits of 10 CFR Part 20. The operability and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

The radioactive gaseous effluent instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in gaseous effluents during actual or potential releases. The alarm/trip setpoints for these instruments shall be calculated in accordance with NRC approved methods in the ODCM to assure that the alarm/trip will occur prior to exceeding applicable dose limits in SLC 16.11.2. The operability end use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63, and 64 of Appendix A to 10 CFR Part 50.

For certain applicable cases, grab samples or flow estimates are required at frequencies between every 4 hours and every 12 hours upon RIA removal from service. SLC 16.11.3 does not explicitly require Action (grab samples or flow estimates) to be initiated immediately upon RIA removal from service, when removal is for the purposes of sample filter changeouts, setpoint adjustments, service checks, or routine maintenance. Therefore, during the defined short, controlled outages, Action is not required.

For the cases in which Action is defined as continuous sampling by auxiliary equipment (Action L) initiation of continuous sampling by auxiliary sampling equipment requires approximately 1 hour. One hour is the accepted reasonable time to initiate collect and change samples. Therefore, for the defined short, controlled outages (not to exceed 1 hour), Action is not required.

Failures such as blown instrument fuses, defective indicators, and faulted amplifiers are, in many cases, revealed by alarm or annunciator action. Comparison of output and/or state of independent channels measuring the same variable supplements this type of built-in surveillance. Based on experience in operation of both conventional and nuclear systems, when the unit is in operation, the minimum checking frequency stated is deemed adequate.

REFERENCES:

1. 10 CFR Part 20.
2. 10 CFR Part 50, Appendix A.
3. Offsite Dose Calculation Manual.
4. UFSAR, Section 7.2.3.4.

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.4 Operational Safety Review

COMMITMENT Required sampling should be performed as detailed in Table 16.11.4-1.

APPLICABILITY: At all times

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. NA	A.1 NA	NA

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.4.1 N/A	N/A

Table 16.11.4-1
Minimum Sampling Frequency and Analysis Program

Item	Check	Frequency	Lower Limit of Detection ^(b) of Lab Analysis for Waste
1. Decant Monitor Tank, Turbine Building Sump Monitor Tanks, Waste and Recycle Monitor Tanks	a. Principal Gamma Emitters ^(c) including Dissolved Noble Gases	Composite Grab Sample prior to release of each batch ^(h)	<5E-06 µCi/ml (Ce-144) <5E-07 µCi/ml (Other Gamma Nuclides) <1E-05 µCi/ml (Dissolved Gases) <1E-06 µCi/ml (I-131)
	b. Radiochemical Analysis Sr-89 and Sr-90	Quarterly from all composited batches ^(f)	<5E-08 µCi/ml
	c. Tritium	Monthly Composite	<1E-05 µCi/ml
	d. Gross Alpha Activity	Monthly Composite	<1E-07 µCi/ml
2. Unit Vent Sampling (Includes Waste Gas Decay Tanks, Reactor Building Purges, Auxiliary Building Ventilation, Spent Fuel Pool Ventilation, Air Ejectors)	a. Iodine Spectrum ^(a)	Continuous monitor, weekly sample ^(e)	<1E-10 µCi/cc (I-133) ^(j) <1E-12 µCi/cc (I-131) ^(j)
	b. Particulates ^(a)		
	i. Ce-144 & Mo-99	Weekly Composite ^(e)	<5E-10 µCi/cc ^{(j)(k)}
	ii. Other Principle Gamma Emitters ^(a)	Weekly Composite ^(e)	<1E-11 µCi/cc ^(j)
	iii. Gross Alpha Activity	Monthly, using composite samples of one week	<1E-11 µCi/cc
	iv. Radiochemical Analysis Sr-89, Sr-90	Quarterly Composite	<1E-11 µCi/cc
	c. Gases by Principle Gamma Emitters ^(d)	Weekly Grab Sample	<1E-04 µCi/cc
	d. Tritium	Weekly Grab Sample	<1E-06 µCi/cc
3. Waste Gas Decay Tank	a. Principle Gamma Emitters ^(d)	Grab Sample prior to release of each batch	<1E-04 µCi/cc (gases) <1E-10 µCi/cc (particulates and iodines) <5E-09 µCi/cc (Ce-144 and Mo-99)
	b. Tritium	Grab Sample prior to release of each batch	<1E-06 µCi/cc
4. Reactor Building	a. Principle Gamma Emitters ^(d)	Grab sample each purge	<1E-04 µCi/cc (gases) <1E-10 µCi/cc (particulates and iodines) <5E-09 µCi/cc (Ce-144 and Mo-99)
	b. Tritium	Grab sample each purge	<1E-06 µCi/cc

**Table 16.11.4-1
Minimum Sampling Frequency and Analysis Program**

Item	Check	Frequency	Lower Limit of Detection ^(b) of Lab Analysis for Waste	
5.	Not Used			
6.	#3 Chemical Treatment Pond Effluent ^(f)	a. Principle Gamma Emitters ^(c)	Weekly Continuous Composite ^(g)	<5E-07 μCi/ml
		b. I-131	Weekly Continuous Composite ^(g)	<1E-06 μCi/ml
		c. Tritium	Monthly Continuous Composite ^(g)	<1E-05 μCi/ml
		d. Gross Alpha Activity	Monthly Continuous Composite ^(g)	<1E-07 μCi/ml
		e. Sr-89 & Sr-90	Quarterly Continuous Composite ^(g)	<5E-08 μCi/ml
		f. Dissolved and Entrained gases (Gamma Emitters)	Monthly Grab	<1E-05 μCi/ml
7.	Radwaste Facility Ventilation	a. Iodine Spectrum ^(a)	Continuous monitor, weekly sample ^(e)	(I-133) <1E-09 μCi/cc (I-131) <1E-11 μCi/cc
		b. Particulate ^(a)		
		i. Ce-144 and Mo-99	Weekly Composite ^(e)	<5E-10 μCi/cc ⁽ⁱ⁾
		ii. Other Principle Gamma Emitters ^(d)	Weekly Composite ^(e)	<1E-11 μCi/cc ⁽ⁱ⁾
		iii. Gross Alpha Activity	Monthly, using composite samples of one week	<1E-11 μCi/cc
		iv. Radiochemical Analysis Sr-89, Sr-90	Quarterly Composite	<1E-11 μCi/cc
		c. Gases by Principle Gamma ^(d) Emitters	Weekly Grab Sample	<1E-04 μCi/cc
		d. Tritium	Weekly Grab Sample	<1E-06 μCi/cc

Table 16.11.4-1
 Minimum Sampling Frequency and Analysis Program

Item	Check	Frequency	Lower Limit of Detection ^(b) of Lab Analysis for Waste	
8. Hot Machine Shop Ventilation	a. Iodine Spectrum	Weekly Sample ^(e)	(I-133) <1E-10 μCi/cc ^(f) (I-131) <1E-12 μCi/cc ^(f)	
	b. Particulate			
	i. Ce-144 and Mo-99	Weekly Composite ^(e)	<5E-10 μCi/cc ^{(f)(k)}	
	ii. Other Principle Gamma Emitters ^(d)	Weekly Composite ^(e)	<1E-11 μCi/cc ^(f)	
	iii. Gross Alpha Activity	Monthly, using composite samples of one week	<1E-11 μCi/cc	
	iv. Radiochemical Analysis Sr-89, Sr-90	Quarterly Composite	<1E-11 μCi/cc	
	c. Gases by Principle Gamma Emitters	NA	NA	
	d. Tritium	NA	NA	
	9. Interim Radwaste Building Ventilation	a. Iodine Spectrum	Weekly sample ^(e)	(I-133) <1E-10 μCi/cc ^(f) (I-131) <1E-12 μCi/cc ^(f)
		b. Particulate		
i. Ce-144 and Mo-99		Weekly Composite ^(e)	<5E-10 μCi/cc ^(f)	
ii. Other Principle Gamma Emitters ^(d)		Weekly Composite ^(e)	<1E-11 μCi/cc ^(f)	
iii. Gross Alpha Activity		Monthly, using composite samples of one week	<1E-11 μCi/cc	
iv. Radiochemical Analysis Sr-89, Sr-90		Quarterly Composite	<1E-11 μCi/cc	
c. Gases by Principle Gamma ^(d) Emitters		Weekly Grab Sample	<1E-04 μCi/cc	
d. Tritium		Weekly Grab Sample	<1E-06 μCi/cc	

- (a) Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing, or after removal from sampler. Sampling shall also be performed at least once per 24 hours for at least 7 days following each shutdown, startup, or THERMAL POWER change exceeding 15% of RATED THERMAL POWER within a 1-hour period and analyses shall be completed within 48 hours of changing. When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10. This requirement does not apply if (1) analyses show that the DOSE EQUIVALENT I-131 concentration in the reactor coolant has not increased more than a factor of 3; and (2) the noble gas monitor shows that effluent activity has not increased more than a factor of 3.
- (b) The LLD is defined for purposes of these commitments as the smallest concentration of radioactive material in a sample that would be detected with 95% probability with 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation) :

$$LLD = \frac{(2.71 / T) + 4.65 s_b}{E \times V \times 2.22E06 \times Y \times \exp(-\lambda \Delta t)}$$

Where:

LLD is the "a priori" lower limit of detection as defined above (as micro Curies per unit mass or volume),

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute),

E is the counting efficiency (as counts per disintegration),

V is the sample size (in units of mass or volume),

2.22E06 is the number of disintegrations per minute per micro Curie,

Y is the fractional radiochemical yield (when applicable),

λ is the radioactive decay constant for the particular nuclide

Δt is the elapsed time between midpoint of sample collection and time of counting (for plant effluents, not environmental samples). NOTE: This assumes decay correction is applied (at the time of analysis) for the duration of sample collection, for the time between collection and analysis, and for the duration of the counting. Additionally, it does not apply to isolated systems such as Waste Gas Decay Tanks and Waste Monitor Tanks.

T is the sample counting time in minutes

Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is an a priori (before the fact) limit representing the capability of a measurement system and not an a posteriori (after the fact) limit for a particular measurement.

- (c) The principal gamma emitters for which the LLD control applies include the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, and Ce-141. Ce-144 shall also be measured, but with a LLD of 5E-06 μ Ci/ml. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with the above nuclides shall also be analyzed and reported in the Annual Radioactive Effluent Release Report.
- (d) The principal gamma emitters for which the LLD commitment applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144 for particulates. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides shall also be identified and reported.
- (e) The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with SLC 16.11.2.a, SLC 16.11.2.b.1, and SLC 16.11.2.b.2.
- (f) A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

- (g) To be representative of the quantities and concentrations of radioactive materials in liquid effluents, samples shall be collected continuously in proportion to the rate of flow of the effluent stream. Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite sample to be representative of the effluent release.
- (h) A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analysis, each batch shall be isolated, and then thoroughly mixed, to assure representative sampling.
- (i) A continuous release is the discharge of liquid wastes of a non-discrete volume, e.g., from a volume of a system that has an input flow during the continuous release. Samples shall be analyzed within 48 hours after changing (on or after removal from sampler).
- (j) When samples collected for 24 hours are analyzed, the corresponding LLDs may be increased by a factor of 10. Samples shall be analyzed within 48 hours after changing (on or after removal from sampler).
- (k) Ce-144 and Mo-99 LLD as approved by NRC SER dated January 16, 1984 (Reference 1).

BASES

N/A

REFERENCES:

1. Safety Evaluation Report dated January 16, 1984, supporting Amendment Nos. 125, 125, and 122 for Oconee Nuclear Station to revise Technical Specifications to incorporate changes to the Radiological Effluent Technical Specifications (RETS) in order to bring them into compliance with Appendix I of 10 CFR Part 50.

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.5 Solid Radioactive Waste

COMMITMENT Radioactive wastes shall be processed and packaged to ensure compliance with the applicable requirements of 10 CFR Part 20, 10 CFR Part 61, 10 CFR Part 71, and State regulations governing the transportation and disposal of radioactive wastes.

The Solid Radwaste System or an approved alternative process shall be used in accordance with a Process Control Program (PCP), for the solidification of liquid or wet radioactive wastes or the dewatering of wet radioactive wastes to be shipped for direct disposal at a 10 CFR 61 licensed disposal site. Wastes shipped for off site processing in accordance with the processor's specifications and transportation requirements are not required to be solidified or dewatered to meet disposal requirements.

- The PCP describes administrative and operational controls used for the solidification of liquid or wet solid radioactive wastes in order to meet applicable 10 CFR 61 waste form requirements.
- The PCP describes the administrative and operational controls used for the dewatering of wet radioactive wastes to meet 10 CFR 61 free standing water requirements.
- The process parameters used in establishing the PCP shall be based on demonstrated processing of actual or simulated liquid or wet solid wastes and must adequately verify that the final product of solidification or dewatering meets all applicable Federal, State and disposal site requirements.

APPLICABILITY: At all times

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>A. Applicable regulatory requirements for solidified or dewatered wastes are not satisfied.</p>	<p>A.1 Suspend shipments of defectively packaged solid radioactive wastes from the site.</p> <p><u>AND</u></p> <p>A.2 Initiate action to correct PCP, procedures, or solid waste equipment as necessary to prevent recurrence.</p>	<p>Immediately</p> <p>Prior to next shipment for disposal of solidified or dewatered wastes</p>
<p>B. A solidification test as described in the PCP fails to verify Solidification.</p>	<p>B.1 Suspend solidification of the batch under test and follow PCP guidance for test failures until solidification of the batch is verified by subsequent tests.</p> <p><u>AND</u></p> <p>B.2 The PCP shall be modified as required to assure Solidification of subsequent batches of waste.</p>	<p>Immediately</p> <p>Prior to next solidification for shipment of waste for disposal at a 10 CFR 61 disposal site</p>

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. With solidification or dewatering for disposal not performed in accordance with the PCP.	C.1 Reprocess or repackage the waste in accordance with PCP requirements. <u>OR</u> C.2 Follow PCP or procedure guidance for alternative free standing liquid verification to ensure the waste in each container meets disposal requirements and take appropriate administrative action to prevent recurrence.	Prior to shipment for disposal of the inadequately processed waste that requires solidification or dewatering
D. With the solid waste equipment incapable of meeting commitment or not in service.	D.1 Restore the equipment to OPERABLE status or provide for alternative capability to process wastes as necessary to satisfy all applicable disposal requirements.	In a time frame that supports the commitment

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.5.1 The Process Control Program shall be used to verify the solidification of at least one representative test specimen from at least every tenth batch of each type of radioactive waste to be solidified for disposal at a 10 CFR 61 disposal site.	Every tenth batch of each type of radioactive waste to be solidified.

BASES

This commitment implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of 10 CFR Part 50, Appendix A and requirements to use a Process Control Program to meet applicable 10CFR61 waste form criteria for solidified and dewatered radioactive wastes.

REFERENCES:

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities".
2. 10 CFR Part 50, Appendix A.
3. 10 CFR20, "Standards for Protection Against Radiation".
4. 10 CFR61, "Licensing Requirements for Land Disposal of Radioactive Waste".
5. 10 CFR71, "Packaging and Transportation of Radioactive Materials".
6. DPCo Process Control Program Manual.
7. NRC Generic Letter 87-12, "Compliance with 10 CFR Part 61 And Implementation Of the Radiological Effluent Technical Specifications (Rets) and Attendant Process Control Program (PCP)".
8. NRC Generic Letter 89-01, "Implementation of Programmatic Controls for Radiological Effluent Technical Specifications In the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of Rets to the Offsite Dose Calculation Manual or to the Process Control Program".

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.6 Radiological Environmental Monitoring

- COMMITMENT
- a. The radiological environmental monitoring samples shall be collected in accordance with Table 16.11.6-1 and shall be analyzed pursuant to the requirements of Tables 16.11.6-1 and 16.11.6-2.
 - b. A land use census shall be conducted and shall identify the location of the nearest milk animal and the nearest residence in each of the 16 meteorological sectors within a distance of eight kilometers (five miles). Broad leaf vegetation sampling shall be performed at the site boundary in the direction sector with the highest D/Q in lieu of the garden census.
 - c. Analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program. A summary of the results obtained as part of the Interlaboratory Comparison Program shall be included in the Annual Radiological Environmental Operating Report. The Interlaboratory Comparison Program shall be described in the Annual Radiological Environmental Operating Report.
 - d. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report.

-----NOTE-----
If samples required by Commitment part a, become permanently unavailable from any of the required sample locations, the locations from which samples were unavailable may then be deleted from the program provided replacement samples were obtained and added to the environmental monitoring program, if available. These new locations will be identified in the Annual Radioactive Effluent Release Report.

APPLICABILITY: At all times

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>A. Radiological environmental monitoring program is not conducted as required.</p>	<p>A.1 Submit a description of the reason for not conducting the program as required and plans to prevent a recurrence shall be included in the Annual Radiological Environmental Operating Report.</p>	<p>May 15 of following calendar year</p>
<p>B. Land use census identifies a Location which yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than a location from which samples are currently being obtained.</p>	<p>B.1 -----NOTE----- The sampling location having the lowest calculated dose or dose commitment (via the same exposure pathway) may be deleted from this monitoring program after October 31 of the year in which this land use census was conducted. ----- Add new location to the radiological environmental monitoring program.</p> <p><u>AND</u></p> <p>B.2 Identify new locations in the next Annual Radioactive Effluent Release Report.</p>	<p>30 days</p> <p>April 30 of following calendar year</p>

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Interlaboratory Comparison Program analyses not performed as required.	C.1 Report corrective actions in the Annual Radiological Environmental Operating Report.	May 15 of following calendar year
D. Radioactivity level resulting from plant effluents in environmental sampling medium at a specified location in excess of reporting limits of Table 16.11.6-3 when averaged over a calendar quarter.	D.1 Prepare and submit a Special report that identifies the cause for exceeding the limits and defines the corrective actions to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of SLC 16.11.1 or 16.11.2.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.6.1 Conduct land use census during growing season using that information that will provide the best results, such as by a door-to-door survey, aerial survey, or by consulting local agriculture authorities.	12 months

Table 16.11.6-1
 Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Number of Sample Locations (b)	Sampling and Collection Frequency (d)	Time and Frequency of Analysis
1. AIRBORNE			
Radioiodine and Particulates	5	Continuous sampler operation with sample collection weekly, or more frequently if required by dust loading.	Radioiodine canister: I-131 analysis weekly. Particulate sampler: Gross beta radioactivity analysis following filter change; and gamma isotopic analysis of composite (by location) quarterly. (c)
2. DIRECT RADIATION	40	Quarterly.	Gamma dose quarterly.
3. WATERBORNE			
a. Surface	2	Composite (a) sample over a 1-month period.	Gamma isotopic analysis monthly. Composite for tritium analysis quarterly.
b. Drinking	3	Composite (a) sample over a 1-month period.	Composite for gross beta and gamma isotopic analyses monthly. Composite for tritium analysis quarterly.
c. Sediment from Shoreline	2	Semiannually.	Gamma isotopic analysis semiannually.

Table 16.11.6-1
 Radiological Environmental Monitoring Program

Exposure Pathway and/or Sample	Number of Sample Locations (b)	Sampling and Collection Frequency (d)	Time and Frequency of Analysis
4. INGESTION			
a. Milk	4(e)	Semimonthly when animals are on pasture; monthly at other times.	Gamma isotopic and I-131 analysis semimonthly when animals are on pasture; monthly at other times.
b. Fish	2	Semiannually. One sample each commercially and recreationally important species.	Gamma isotopic analysis semiannually on edible portion.
c. Broad-leaf Vegetation	2	Monthly.	Gamma isotopic analysis monthly.

- (a) Composite samples shall be collected by collecting an aliquot at intervals not exceeding 2 hours.
- (b) Sample locations are identified in the ODCM.
- (c) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more after sampling to allow radon and thoron daughter decay. If gross beta activity in air particulate samples is greater than 10 times the yearly mean of control samples, gamma isotopic analysis shall be performed on the individual samples.
- (d) Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, or to malfunction of automatic sampling equipment. If the latter, every effort shall be made to complete corrective action prior to the end of the next sampling period.
- (e) Samples from milking animals in three locations within 5 km distance having the highest dose potential. If there are none, then one sample from milking animals in each of three areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per year. One sample from milking animals at a control location, as for example 15 to 30 km distant and in the least prevalent wind direction.

Table 16.11.6-2
 Maximum Values for the Lower Limits of Detection (LLD) (a) (c)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m ³)	Fish (pCi/kg, wet)	Milk (pCi/l)	Broad-leaf Vegetation (pCi/kg, wet)	Sediment (pCi/kg, dry)
Gross Beta	4	1E-02				
H ₃	2,000					
Mn-54	15		130			
Fe-59	30		260			
Co-58	15		130			
Co-60	15		130			
Zn-65	30		260			
Zr-95	15					
Nb-95	15					
I-131	15(b)	7E-02		1	60	
Cs-134	15	5E-02	130	15	60	150
Cs-137	18	6E-02	150	18	80	180
Ba-140	15			60		
La-140	15			15		

(a) The LLD is defined, for purposes of these commitments, as the smallest concentration of radioactive material in a sample with 95% probability of detection and with 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{(2.71 / T) + 4.65 s_b}{E \times V \times 2.22 \times Y \times \exp(-\lambda \Delta t)}$$

Where:

LLD is the lower limit of detection as defined above (as pCi per unit mass or volume)

S_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

Table 16.11.6-2
Maximum Values for the Lower Limits of Detection (LLD) (a) (c)

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22 is the number of disintegrations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between sample collection (or end of the sample collection period) and time of counting

T is the sample counting time in minutes

Typical values of E, V, Y and Δt should be used in the calculation.

The LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particular measurement.

Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances, may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

- (b) LLD for gamma isotopic analysis for I-131 in drinking water samples. Low level I-131 analysis on drinking water will not be routinely performed because the calculated dose from I-131 in drinking water at all locations is less than 1 mrem per year. Low level I-131 analyses will be performed if abnormal releases occur which could reasonably result in > 1 pCi/liter of I-131 in drinking water. For low level analyses of I-131 an LLD of 1 pCi/liter will be achieved.
- (c) Other peaks which are measurable and identifiable, together with the radionuclides in Table 16.11.6-2, shall be identified and reported.

Table 16.11.6-3
Reporting Levels for Radioactivity Concentrations in Environmental Samples (c) (d)

Analysis	Water (pCi/l)	Airborne Particulate or Gases (pCi/m ³)	Fish (pCi/kg, wet)	Milk (pCi/l)	Broad-leaf Vegetation (pCi/kg, wet)
H-3	2E04(a)				
Mn-54	1E03		3E04		
Fe-59	4E02		1E04		
Co-58	1E03		3E04		
Co-60	3E02		1E04		
Zn-65	3E02		2E04		
Zr-Nb-95	4E02				
I-131	2(b)	0.9		3	1E02
Cs-134	30	10	1E03	60	1E03
Cs-137	50	20	2E03	70	2E03
Ba-La-140	2E02			3E02	

(a) For drinking water samples. This is 40 CFR Part 141 value.

(b) If low level I-131 analyses are performed.

(c) Report shall be submitted when any single radionuclide exceeds the reporting level in Table 16.11.6-3 or when more than one of the radionuclides in Table 16.11.6-3 are detected in sampling medium and

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \dots \geq 1.0$$

(d) Report shall be submitted when radionuclides other than those in table 16.11.6-3 are detected and are the result of plant effluents if the potential annual dose to a MEMBER OF THE PUBLIC from all radionuclides is equal to or greater than the calendar year limits of SLC 16.11.1 or 16.11.2.

BASES

The environmental monitoring program required by this commitment provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides which lead to the highest potential radiation exposures of individuals resulting from the station operation. This monitoring program thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of exposure pathways. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The detection capabilities required by Table 16.11.6-2 are considered optimum for routine environmental measurements in industrial laboratories. The specified lower limits of detection correspond to less than the 10 CFR 50, Appendix I, design objective dose-equivalent of 45 mrem/year for atmospheric releases to the most sensitive organ and individual. The land use census commitment is provided to assure that changes in the use of unrestricted areas are identified and that modifications to the monitoring program are provided if required by the results of this census.

The requirements for participation in an Interlaboratory Comparison Program is provided to assure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of a quality assurance program for environmental monitoring in order to demonstrate that the results are reasonably valid.

With the level of radioactivity in an environmental sampling medium at a specified location exceeding the reporting levels of Table 16.11.6-3 when averaged over any calendar quarter, in lieu of a Licensee Event Report, prepare and submit to the Commission within 30 days a Special Report that defines the corrective action to be taken to reduce radioactive effluents so that the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of SLC 16.11.1 or SLC 16.11.2. When more than one of the radionuclides in Table 16.11.6-3 are detected in the sampling medium, this report shall be submitted if

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \dots \geq 1.0$$

When radionuclides other than those in Table 16.11.6-3 are detected and are the result of plant effluents, this report shall be submitted if the potential annual dose to a MEMBER OF THE PUBLIC from all radionuclides is equal to or greater than the calendar year limits of SLC 16.11.1 or SLC 16.11.2. This report is not required if the measured level of radioactivity was not the result of plant effluents; however, in such an event, the condition shall be reported and described in the Annual Radiological Environmental Operating Report required by Technical Specification 5.6.2. The methodology and parameters used to estimate the potential annual dose to a MEMBER OF THE PUBLIC shall be indicated in the 30-day Special Report.

The following requirement(s) were relocated from the CTS 6.4.4.f during the conversion to ITS.

The station shall have a program to monitor the radiation and radionuclides in the environs of the plant. The program shall provide (1) representative measurements of radioactivity in the highest potential exposure pathways, and (2) verification of the accuracy of the effluent monitoring program and modeling of environmental exposure pathways. The program shall (1) be contained in UFSAR Chapter 16, (2) conform to the guidance of Appendix I to 10 CFR Part 50, and (3) include the following:

1. Monitoring, sampling, analysis, and reporting of radiation and radionuclides in the environment in accordance with the methodology and parameters in the ODCM;
2. A Land Use Census to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the monitoring program are made if required by the results of this census; and,
3. Participation in an Interlaboratory Comparison Program to ensure that independent checks on the precision and accuracy of the measurements of radioactive materials in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring.

REFERENCES:

1. 10 CFR Part 50, Appendix I.
2. Offsite Dose Calculation Manual.

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.7 Dose Calculations

COMMITMENT The annual (calendar year) dose or dose commitment, to any Member of the Public due to releases of radioactivity and to radiation from uranium fuel cycle sources shall be limited to ≤ 25 mrems to the total body or to any organ, except the thyroid, which shall be limited to ≤ 75 mrems.

APPLICABILITY: At all times

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of SLC 16.11.1.b, SLC 16.11.2.b.1, or SLC 16.11.2.b.2	A.1 Determine by calculation, including direct radiation contributions from the reactor units and from outside storage tanks, whether the limits of Commitment 16.11.7 have been exceeded.	None

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>B. Calculated dose exceeds limits of Commitment 16.11.7.</p>	<p>-----NOTE----- This Special Report, as defined in 10 CFR Part 20.2203(a), shall include an analysis that estimates the radiation exposure (dose) to a Member of the Public from uranium fuel cycle sources, (including all effluent pathways and direct radiation), for the calendar year that includes the release(s) covered by this report. It shall also describe the levels of radiation and concentration of radioactive material involved, and the cause of the exposure levels or concentrations.</p> <p>-----</p> <p>B.1 Prepare and submit to the Commission a Special Report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the specified limits and includes the schedule for achieving conformance with the specified limits.</p>	<p>30 days</p>

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Calculated dose exceeds limit of Commitment 16.11.7. <u>AND</u> Release condition resulting in violation of 40 CFR 190 not corrected at time of report submittal.	C.1 -----NOTE----- Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete. ----- Include a request for a variance in accordance with the provisions of 40 CFR Part 190.	30 days from exceeding the limit

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.7.1 Determine cumulative dose contributions from liquid effluents in accordance with Offsite Dose Calculation Manual.	31 days
SR 16.11.7.2 Determine cumulative dose contributions from gaseous effluents in accordance with Offsite Dose Calculation Manual.	31 days

BASES

The dose commitment is provided to assure that the release of radioactive material in liquid and gaseous effluents will be kept "as low as is reasonably achievable." The dose calculations in the ODCM implement the requirements in Section III.A of Appendix I in that conformance with the guides of Appendix I is to be shown by calculations and procedures based on models and data such that the actual exposure of an individual through appropriate pathways is unlikely to be substantially underestimated.

REFERENCES:

1. 10 CFR Part 20.
2. 40 CFR Part 190.
3. Offsite Dose Calculation Manual.
4. 10 CFR Part 50, Appendix I.

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.8 Reports

COMMITMENT Special reports shall be submitted to the Regional Administrator, Region II, within the time period specified for each report. These reports shall be submitted covering the activities identified below pursuant to the requirements of the applicable SLC:

- a. Radioactive Liquid Effluents,
 Dose, SLC 16.11.1.b
 Liquid Waste Treatment, SLC 16.11.1.c
- b. Radioactive Gaseous Effluents,
 Dose, SLC 16.11.2.b
 Gaseous Radwaste Treatment, SLC 16.11.2.c
- c. Radiological Environmental Monitoring Program, SLC 16.11.6.a, b,
 and c
- d. Land Use Census, SLC 16.11.6.d
- e. Dose Calculations, SLC 16.11.7

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Individual milk samples show I-131 concentrations of 10 picocuries per liter or greater.	A.1 Submit plan advising the NRC of the proposed action to ensure the plant related annual doses will be within the design objective of 45 mrem/yr to the thyroid of any individual.	7 days

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Milk samples collected over a calendar quarter show I-131 average concentrations of 4.8 picoCuries per liter or greater	B.1 Submit a plan advising the NRC of the proposed action to ensure the plant related annual doses will be within the design objective of 45 mrem/yr to the thyroid of any individual.	30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.8.1 NA	NA

BASES

Reference applicable commitments.

REFERENCES:

1. 10 CFR Part 20.
2. 40 CFR Part 190.
3. Offsite Dose Calculation Manual.

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.9 Radioactive Effluent Release Report

COMMITMENT The Annual Radioactive Effluent Release Report covering the operation of the unit during the previous calendar year shall be submitted before May 1 of each year.

A single submittal may be made for a multiple unit station. The submittal shall combine those sections that are common to all units at the station; however, for units with separate radwaste systems, the submittal shall specify the release of radioactive material from each unit.

The Annual Radioactive Effluent Release Report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the station during the reporting period.

The annual Radioactive Effluent Release Report shall include a summary of the meteorological conditions concurrent with the release of gaseous effluents during each quarter.

The Annual Radioactive Effluent Release Report shall include the following information for all unplanned releases to unrestricted areas of radioactive materials in gaseous and liquid effluents:

- a. A description of the event and equipment involved;
- b. Cause(s) for the unplanned release;
- c. Actions taken to prevent recurrence; and,
- d. Consequences of the unplanned release.

The Annual Radioactive Effluent Release Report shall include an assessment of radiation doses from the radioactive liquid and gaseous effluents released from the station during each calendar quarter. In addition, the unrestricted area boundary maximum noble gas gamma air and beta air doses shall be evaluated. The annual average meteorological conditions shall be used for determining the gaseous pathway doses. Approximate and conservative approximate methods are acceptable. The assessment of radiation doses shall be performed in accordance with the Offsite Dose Calculation Manual.

The Annual Radioactive Effluent Release Report shall include an explanation of why the inoperability of liquid or gaseous effluent monitoring instrumentation out of service for greater than 30 days was not corrected in a timely manner per SLC 16.11.3.

Radioactive Effluent Release Report
16.11.9

The Annual Radioactive Effluent Release Report shall include the following information for each type of solid waste shipped offsite during the report period:

- a. Total container volume (cubic meters);
- b. Total curie quantity (determined by measurement or estimate);
- c. Principal radionuclides (determined by measurement or estimate);
- d. Type of waste, (e.g., spent resin, compacted dry waste evaporator bottoms);
- e. Number of shipments; and,
- f. Solidification agent (e.g., cement, or other approved agents (media)).

The Annual Radioactive Effluent Release Report shall include a list and description of unplanned releases from the site to Unrestricted Areas of radioactive materials in gaseous and liquid effluents made during the reporting period.

The Annual Radioactive Effluent Release Report shall include any changes made during the reporting period to the Offsite Dose Calculation Manual (ODCM), as well as a listing of new locations for dose calculations and/or environmental monitoring identified by the land use census.

The Annual Radioactive Effluent Release Report shall also include an assessment of radiation doses to the likely most exposed Member of the Public from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) for the previous calendar year to show conformance with 40 CFR 190, Environmental Radiation Protection Standards for Nuclear Power Operation. Methods for calculating the dose contribution from liquid and gaseous effluents are given in the ODCM.

APPLICABILITY: At all times.

Oconee Nuclear Station Units 1, 2, & 3
 Period 1/1/2016 - 12/31/2016

Radioactive Effluent Release Report
 16.11.9

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. N/A	A.1 N/A	N/A

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.9.1 N/A	N/A

BASES

N/A

REFERENCES:

- Oconee ITS.
- Offsite Dose Calculation Manual.

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.10 Radiological Environmental Operating Report

COMMITMENT Routine Radiological Environmental Operating Reports covering the operation of the unit during the previous calendar year shall be submitted by May 15 of each year.

The Annual Radiological Environmental Operating Report shall include summaries, interpretations, and statistical evaluation of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of the land use censuses. If harmful effects are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

The Annual Radiological Environmental Operating Report shall include a summary of the results obtained as part of the required Interlaboratory Comparison Program. The Interlaboratory Comparison Program shall be described in the Annual Radiological Environmental Operating Report.

The Annual Radiological Environmental Operating Report shall include summarized and tabulated results of the radiological environmental samples required by SLCs taken during the report period. In the event that some results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as practical in a supplementary report.

The initial report shall also include the following: a summary description of the radiological environmental monitoring program including sampling methods for each sample type, size and physical characteristics of each sample type, sample preparation methods, analytical methods, and measuring equipment used; a map of all sampling locations keyed to a table giving distances and directions from one reactor; and, the result of land use censuses. Subsequent reports shall describe all substantial changes in these aspects.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. NA	A.1 NA	NA

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.10.1 NA	NA

BASES

NA

REFERENCES:

1. Oconee ITS
2. Offsite Dose Calculation Manual

Iodine Radiation Monitoring filters
 16.11.11

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.11 Iodine Radiation Monitoring Filters

COMMITMENT Assure that the iodine radiation monitoring filters perform their intended function.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. NA	A.1 NA	NA

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.11.1 Remove and replace iodine radiation monitoring filters in RIA-44.	30 days of operation
SR 16.11.11.2 Discard spare iodine radiation monitoring filters.	After 24 months of shelf life.

BASES

The purpose of this commitment is to assure the reliability of the iodine radiation monitoring charcoal filters.

REFERENCES:

- Oconee CTS Amendment No. 3/3 SER date July, 1974.

Radioactive Material in Outside Temporary Tanks Exceeding Limit
 16.11.12

16.11. RADIOLOGICAL EFFLUENTS CONTROL

16.11.12 Radioactive Material in Outside Temporary Tanks Exceeding Limit

COMMITMENT The quantity of radioactive material in outside temporary storage tanks shall not exceed the limit specified in ITS 5.5.13.c.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The quantity of radioactive material in outside temporary storage tank not within limit.	A.1 Suspend addition of radioactive material to tank.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.12.1 Verify the quantity of radioactive material contained in each of the outside temporary tanks is within the limit by analyzing a representative sample of the tanks' contents. <u>OR</u> Verify the quantity of radioactive material in each of the outside temporary tanks does not result in exceeding the limit by analyzing a representative sample of radioactive material to be added.	Within 7 days after addition of radioactive materials to an outside temporary tank Prior to addition of radioactive materials to an outside temporary tank.

Radioactive Material in Outside Temporary Tanks Exceeding Limit
16.11.12

BASES

The requirement(s) of this SLC section were relocated from CTS 3.9.1.c during the conversion to ITS.

The tanks included in this specification are all those outdoor radwaste liquid storage tanks that are not surrounded by liners, dikes, or walls capable of holding the tank contents and that do not have tank overflows and surrounding area drains connected to the liquid radwaste treatment system. Restricting the quantity of radioactive material contained in the specified tanks provides assurance that in the event of an uncontrolled release of a tank's contents, the resulting concentrations would be less than the limits of 10CFR Part 20, Appendix B, Table II, Column 2, at the nearest potable water supply and the nearest surface water supply in an UNRESTRICTED AREA.

REFERENCES

N/A

Radioactive Material in Waste Gas Holdup tank Exceeding Limit
 16.11.13

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.13 Radioactive Material in Waste Gas Holdup Tank Exceeding Limit

COMMITMENT The quantity of radioactive material in the Waste Gas Holdup tanks shall not exceed the limit specified in ITS 5.5.13.b.

APPLICABILITY: At all times.

ACTIONS

NOTE

Separate Condition Entry is allowed for each tank.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The quantity of radioactive material in the Waste Gas Holdup tank not within limit.	A.1 Suspend addition of radioactive material to tank.	Immediately
	<u>AND</u> A.2 Reduce tank contents to within limit.	48 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.13.1 Verify quantity of radioactive materials in each tank is within limit.	24 hours when tank is being filled

BASES

The requirement(s) of this SLC section were relocated from CTS 3.10.1.b and 3.10.1.c during the conversion to ITS.

Radioactive Material in Waste Gas Holdup tank Exceeding Limit
16.11.13

Restricting the quantity of radioactivity contained in each waste gas holdup tank provides assurance that in the event of an uncontrolled release of the tank contents, the resulting total body exposure to an individual at the exclusion area boundary will not exceed 0.5 rem.

REFERENCE

UFSAR, Section 15.10

16.11 RADIOLOGICAL EFFLUENTS CONTROL

16.11.14 Explosive Gas Mixture

COMMITMENT The concentration of Hydrogen in the Waste Gas Holdup Tanks shall be $\leq 3\%$ by volume.

APPLICABILITY: At all times.

ACTIONS

NOTE

Separate Condition Entry is allowed for each tank.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Concentration of Hydrogen in Waste Gas Holdup tank is $> 3\%$ and $\leq 4\%$ by volume.	A.1 Reduce Concentration of Hydrogen to within limit.	48 hours
B. Concentration of Hydrogen in Waste Gas Holdup tank is $> 4\%$ by volume.	B.1 Suspend addition of waste gases to tank.	Immediately
	AND B.2 Reduce Concentration of Hydrogen to within limit.	24 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 16.11.14.1 Verify Hydrogen concentration in Waste Gas Holdup Tank is \leq 3% by volume.	5 times/week on each tank when in service <u>AND</u> once within 24 hours after isolation of the tank

BASES

The requirement(s) of this SLC section were relocated from CTS 3.10.2 and Table 4.1-3, Item 13 during the conversion to ITS.

This Commitment is provided to ensure that the concentration of potentially explosive gas mixtures contained in the Waste Gas Holdup Tanks is maintained below the flammability limits of hydrogen. (Administrative controls are used to prevent the hydrogen concentrations from reaching the flammability limit.) These controls include sampling each tank 5 times a week while in service, and/or once in 24 hours after isolation of the tank; injection of dilutants to reduce the concentration of hydrogen below its flammability limits provides assurance that the releases of radioactive material will be controlled in conformance with the requirements of GDC 60 of Appendix A to CFR Part 50.

REFERENCES

N/A

Attachment 10
Summary of Changes to the Process Control Program

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 10

Summary of Changes to the Process Control Program

This attachment includes a summary of changes to the PCP.

Attachment 10
Summary of Changes to the Process Control Program

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

The Oconee Nuclear Station PCP was not revised in 2016. The most recent revision was provided with the Oconee Nuclear Station 2014 ARERR.

Attachment 11
Summary of Major Modifications to the Radioactive Waste Treatment Systems

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 11

Summary of Major Modifications to the Radioactive Waste Treatment Systems

This attachment includes a description of major modifications to the radioactive waste treatment systems that are anticipated to affect effluent releases.

Attachment 11
Summary of Major Modifications to the Radioactive Waste Treatment Systems

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

No major modifications to Oconee Nuclear Station liquid, gaseous, solid, or mobile radioactive waste treatment systems occurred in 2016.

Attachment 12
Errata to a Previous Year's ARERR

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

ATTACHMENT 12

Errata to a Previous Year's ARERR

This attachment includes any amended pages from a previous year's ARERR.

Attachment 12
Errata to a Previous Year's ARERR

Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016

The following contains amended pages to the Oconee Nuclear Station 2014 ARERR. Amended pages are identified with "Amendment #" on page. Specific changes are identified with change bars in right margin.

NCR 02024126

NCR 02024126 identifies that Unit 2 and Unit 3 Purge Charcoal Filters were less than 90% efficient as described in ODCM Section 2.0.2, Gaseous Release Rate Limit Calculations. Per vendor testing, Unit 2 charcoal filters were 66.87% efficient, and Unit 3 charcoal filters were 78.58% efficient. The lower efficiency extends back to 2012. A search of GWRs revealed that only Unit 3 Reactor Building released iodine activity between 2012 and 2016. Unit 2 did not release iodine activity over this time period. The affected GWRs were revised to account for lower than assumed charcoal filter efficiency. Refer to the following sheet for a summary of the GWRs that include iodine activity and a summary of additional activity.

An additional $1.27\text{E-}06$ Ci of I-132 activity was released in the second quarter of 2012 due to lower filter efficiency.

An additional $1.66\text{E-}05$ Ci of I-132 and $1.45\text{E-}7$ Ci of I-131 was released in the second quarter of 2014 due to lower filter efficiency.

RETDAS Gaseous Release and Dose Summary Reports (maximum) were run to determine the approximate dose contribution due to the additional activity released.

Additional activity released in 2012 added approximately $1.37\text{E-}08$ mrem to child thyroid organ dose and $7.79\text{E-}10$ mrem to child total body dose. All additional dose was due to I-132 activity. Note in the 2012 ARERR, C-14 dose calculation results in $7.06\text{E-}02$ mrem child bone (organ) dose for the second quarter.

Additional activity released in 2014 added approximately $7.55\text{E-}05$ mrem to infant thyroid organ dose due primarily to I-131 activity and $1.12\text{E-}07$ mrem to infant total body dose due to I-131 and I-132 activity. Note in the 2014 AERR, C-14 dose calculation results in $8.02\text{E-}02$ mrem child bone (organ) dose for the second quarter.

NOTE: Attachment 1 for the 2014 ARERR as amended are shown in this section to reflect changes in activity released. Since I-132 is not a reported radioiodine in accordance with NRC Regulatory Guide 1.21 Revision 1, due to its very short half-life, an amended Attachment 1 for the 2012 ARERR was not generated. Also, since the quarterly and annual maximum Total Body and Organ dose from gaseous effluents as shown in Attachment 6 of the 2012 and 2014 ARERRs did not change, no amendment was generated.

**Attachment 12
Errata to a Previous Year's ARERR**

**Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016**

The Oconee Nuclear Station 2014 ARERR Amendment #1 requires the following change from Attachment 1 Page 2 of 9:

Oconee Nuclear Station 2014 ARERR as submitted:

B. Iodine-131						
1. Total Release	Ci	0.00E+00	1.20E-07	0.00E+00	4.90E-06	5.02E-06
2. Avg. Release Rate	uCi/sec	0.00E+00	1.53E-08	0.00E+00	6.17E-07	1.59E-07

Oconee Nuclear Station 2014 ARERR Amendment #1 as revised:

B. Iodine-131						
1. Total Release	Ci	0.00E+00	2.65E-07	0.00E+00	4.90E-06	5.17E-06
2. Avg. Release Rate	uCi/sec	0.00E+00	3.36E-08	0.00E+00	6.17E-07	1.64E-07

The Oconee Nuclear Station 2014 ARERR Amendment #1 requires the following change from Attachment 1 Page 4 of 9:

Oconee Nuclear Station 2014 ARERR as submitted:

2. Iodines						
I-131	Ci	0.00E+00	1.20E-07	0.00E+00	0.00E+00	1.20E-07
I-133	Ci	2.43E-10	0.00E+00	0.00E+00	0.00E+00	2.43E-10
		-----	-----	-----	-----	-----
Totals for Period...	Ci	2.43E-10	1.20E-07	0.00E+00	0.00E+00	1.20E-07

Oconee Nuclear Station 2014 ARERR Amendment #1 as revised:

2. Iodines						
I-131	Ci	0.00E+00	2.65E-07	0.00E+00	0.00E+00	2.65E-07
I-133	Ci	2.43E-10	0.00E+00	0.00E+00	0.00E+00	2.43E-10
		-----	-----	-----	-----	-----
Totals for Period...	Ci	2.43E-10	2.65E-07	0.00E+00	0.00E+00	2.65E-07

**Attachment 12
Errata to a Previous Year's ARERR**

**Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016**

TABLE 1A

EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
PERIOD 1/1/14 TO 1/1/15
GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

Oconee Nuclear Station Units 1, 2, & 3

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
A. Fission and Activation Gases						
1. Total Release	Ci	6.11E+00	2.27E+00	1.00E+01	2.36E+01	4.20E+01
2. Avg. Release Rate	uCi/sec	7.86E-01	2.89E-01	1.26E+00	2.96E+00	1.33E+00
B. Iodine-131						
1. Total Release	Ci	0.00E+00	2.65E-07	0.00E+00	4.90E-06	5.17E-06
2. Avg. Release Rate	uCi/sec	0.00E+00	3.36E-08	0.00E+00	6.17E-07	1.64E-07
C. Particulates Half Life >= 8 days						
1. Total Release	Ci	9.49E-07	0.00E+00	0.00E+00	9.33E-12	9.49E-07
2. Avg. Release Rate	uCi/sec	1.22E-07	0.00E+00	0.00E+00	1.17E-12	3.01E-08
D. Tritium						
1. Total Release	Ci	3.12E+01	3.04E+01	6.04E+01	7.13E+01	1.93E+02
2. Avg. Release Rate	uCi/sec	4.01E+00	3.86E+00	7.60E+00	8.97E+00	6.13E+00
E. Carbon-14						
1. Total Release	Ci	6.06E+00	5.38E+00	6.07E+00	5.23E+00	2.27E+01
2. Avg. Release Rate	uCi/sec	7.80E-01	6.85E-01	7.64E-01	6.58E-01	7.21E-01
F. Gross Alpha Radioactivity						
1. Total Release	Ci	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2. Avg. Release Rate	uCi/sec	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

**Attachment 12
Errata to a Previous Year's ARERR**

**Oconee Nuclear Station Units 1, 2, & 3
Period 1/1/2016 - 12/31/2016**

TABLE 1B

EFFLUENT AND WASTE DISPOSAL ANNUAL REPORT
PERIOD 1/1/14 TO 1/1/15
GASEOUS EFFLUENTS - ELEVATED RELEASES - BATCH MODE

Oconee Nuclear Station Units 1, 2, & 3

REPORT FOR 2014	Units	QTR 1	QTR 2	QTR 3	QTR 4	YEAR
1. Fission and Activation Gases						
AR-41	Ci	4.70E-06	2.14E-02	2.67E-02	1.51E-02	6.33E-02
KR-85	Ci	3.41E-03	3.10E-03	1.10E-02	5.22E-03	2.27E-02
KR-85M	Ci	3.09E-06	0.00E+00	0.00E+00	3.45E-05	3.76E-05
XE-131M	Ci	1.00E-04	3.66E-05	9.01E-05	6.81E-04	9.08E-04
XE-133	Ci	1.17E-02	1.30E-01	2.92E-02	1.03E-01	2.74E-01
XE-133M	Ci	2.40E-04	6.29E-06	3.45E-04	1.72E-03	2.31E-03
XE-135'	Ci	7.53E-04	2.43E-03	3.90E-04	6.10E-03	9.68E-03
Totals for Period...	Ci	1.62E-02	1.57E-01	6.78E-02	1.32E-01	3.73E-01
2. Iodines						
I-131	Ci	0.00E+00	2.65E-07	0.00E+00	0.00E+00	2.65E-07
I-133	Ci	2.43E-10	0.00E+00	0.00E+00	0.00E+00	2.43E-10
Totals for Period...	Ci	2.43E-10	2.65E-07	0.00E+00	0.00E+00	2.65E-07
3. Particulates Half Life >= 8 days						
CO-58	Ci	0.00E+00	0.00E+00	0.00E+00	9.33E-12	9.33E-12
4. Tritium						
H-3	Ci	3.60E-05	8.49E-02	5.87E-02	6.99E-02	2.13E-01
5. Carbon-14						
C-14	Ci	4.24E+00	3.77E+00	4.25E+00	3.66E+00	1.59E+01
6. Gross Alpha Radioactivity						
** No Nuclide Activities **	
7. Others						
C-11	Ci	1.48E-08	0.00E+00	0.00E+00	0.00E+00	1.48E-08