DUKE POWER COMPANY

CATAWBA NUCLEAR STATION

PROCESS CONTROL PROGRAM

1.0 PURPOSE

The purpose of the Catawba Nuclear Station Process Control Program is to insure all requirements of the DPC Corporate Process Control Program have been met for each container of solidified or dewatered radioactive waste shipped for burial at a licensed burial facility. This PCP is applicable only to the solidification or dewatering of liquid or wet solid radioactive waste.

2.0 COMPOSITION

2.1 The Catawba Nuclear Station Process Control Program shall consist of:

2.1.1 The Duke Power Company Process Control Manual Introduction (Section I).

2.1.2 The Duke Power Company Corporate Process Control Program.

2.1.3 A list of all station-specific procedures that implement the requirements of the Corporate Process Control Program.

2.1.4 Catawba Nuclear Station diagrams or drawings or drawing numbers showing all connections between CNS radwaste systems and solidifications and dewatering equipment.

2.1.5 Documentation of NRC approval of the initial Catawba Nuclear Station Process Control Program.

2.1.6 Documentation of System Radwaste Engineer, CNS Technical Services Superintendent and CNS Station Manager approval of all changes to the Corporate Process Control Program.

2.1.7 Documentation that all changes to the Corporate and/or CNS Process Control Program were sent to the NRC in the Semi-Annual Radioactive Effluent Report.

SECTION 2.1.1

Implementing Procedures

HP/O/B/1006/09	"Shipment of Radioactive Filters and Filter Media"
HP/O/B/1006/10	"Shipment of Solidified Radwaste"
HP/O/B/1006/12	"Shipment of Dewatered Resins"
HP/O/B/1006/13	"Determination of the Waste Classification for Radioactive Waste Offered for Shallow Land Burial"
OP/O/B/6500/13	"Operating Procedure for the Nuclear Solid Waste (WS) Disposal System"
OP/O/B/6500/46	"Radwaste Operating Procedure for Solidification and Dewatering of Radioactive Waste"
OP/O/B/6500/49	"Radwaste Chemistry Operating Procedure for Sampling the ECHT, ECBT, and RBT Using In-line Samples"

SECTION 2.1.2

Drawing Index

Plant Interfaces: CN-1566-1.6

DUKE POWER COMPANY
PCP REVISION APPROVAL

Revised PCP Section:

Corporate PCP, Rev 1
ONS PCP, Rev___
MNS PCP, Rev___
CNS PCP, Rev 1

This revision has been reviewed against Technical Specifications and applicable NRC guidance documents and found to be acceptable.

General Office Review	Station Review
By: H. J. Dameron	By: [signature] [signature]
Title: Assoc. H.P.	Title: Radwaste Coord. H.P. Coordinator
Date: 8-14-85	Date: 9-10-85 9/10/85

This revision is approved for use at Catawba Nuclear Station.

[signature]
System Radwaste Engineer
Date: 8/14/85

[signature]
Catawba Technical Services Superintendent
Date: 9/13/85

[signature]
Catawba Station Manager
Date: 9-13-85

Duke Power Company
Oconee Nuclear Station

Attachment 6

Revisions 9 & 10
Offsite Dose Calculation Manual

NRC

December 16, 1985

SUBJECT: Offsite Dose Calculation Manual
Revision 9

The General Office Radwaste Engineering staff is transmitting to you this date, Revision 9 of the Offsite Dose Calculation Manual. As this revision only affects McGuire Nuclear Station, the approval of other station managers is not necessary. Please update your copy No. 1, and discard affected pages.

REMOVE THESE PAGES		INSERT THESE PAGES	
B-6	Rev. 7	B-6	Rev. 9
B-7	Rev. 7	B-7	Rev. 9
B-12	Rev. 7	B-12	Rev. 9
B-13	Rev. 7	B-13	Rev. 9
B-14	Rev. 7	B-14	Rev. 9
B-15	Rev. 7	B-15	Rev. 9
B-16	Rev. 7	B-16	Rev. 9
B-17	Rev. 7	B-17	Rev. 9
Table B5.0-3	Rev. 7	Table B5.0-3	Rev. 9

NOTE: As this letter contains "LOEP" information, please insert this in front of the March 7, 1985 letter.

Approval Date: 12/6/85 Approval Date: 12-12-85

Effective Date: 1/1/86 Effective Date: 1/1/86

Mary L. Birch
M. L. Birch
System Radwaste Engineer

Tony L. McConnell
T. L. McConnell, Manager
McGuire Nuclear Station

If you have any questions concerning Revision 9, please call Jim Stewart at (704) 373-5444.

James M. Stewart, Jr.
James M. Stewart, Jr.
Associate Health Physicist
Radwaste Engineering

JMS/pja.005

enclosures

JUSTIFICATION FOR REVISION 9

Section B2.2.2 (Page B-6)	Typo error: comma inadvertently left out.
Section B2.2.2 (Page B-7)	Due to changes in the controlling receptor locations found during the 1985 Land Use Census, the "W" values and locations have changed.
Section B4.1 (Page B-12)	Change the word "shall" to "may" to agree with statement on page "iii" regarding the use of GASPAR and LADTAP. Change the word "annually" to "whenever dose limits given in technical specification 3.11.4a are exceeded" to be consistent with the requirements of Technical Specification 3.11.4.
Section B4.2.1 (Page B-12) Section B4.2.2.2 (Page B-12) Section B4.3.1 (Pages B-13 & B-14) Section B4.3.2.1 (Pages B-15 & B-16)	These sections have been updated using actual plant data rather than the estimated source terms found in the FSAR.
Section B4.3.1 (Page B-13)	Typo error: change "f_σ" to "$f\sigma$".
Section B4.3.2.2 (Page B-16)	Due to changes in the controlling receptor locations found during the 1985 Land Use Census, the "W" values and locations have changed.
Section B4.4 (Page B-16)	Delete "wind fractions" from formula as X/Q and D/Q values already incorporate wind direction frequency.
Section B4.4 (Page B-17)	Change "by a factor of 10" to "by a factor of 2" to be consistent with Technical Specification 3.11.4a.
Table B5.0-3	Typo error: delete gross beta analysis for surface water monthly composite. There is not any requirement to perform this analysis.

B2.2 GASEOUS RELEASE RATE CALCULATIONS

The unit vent is the release point for waste gas decay tanks, containment building purges, the condenser air ejector, and auxiliary building ventilation. The condenser air ejector effluent is normally considered nonradioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the condenser air ejector effluent until indicated by radiation monitoring measurements and by analyses of periodic samples collected on that line. Radiation monitoring alarm/trip setpoints in conjunction with administrative controls assure that release limits are not exceeded; see section B3.0 on radiation monitoring setpoints.

The following calculations, when solved for flowrate, are the release rates for noble gases and for radioiodines, particulates and other radionuclides with half-lives greater than 8 days; the most conservative of release rates calculated in B2.2.1 and B2.2.2 shall control the release rate for a single release point.

B2.2.1 Noble Gases

$$\sum_i (K_i \; [\overline{(\chi/Q)}\tilde{Q}_i] \; < 500 \text{ mrem/yr, and}$$

$$\sum_i (L_i + 1.1 \; M_i) \quad [\overline{(\chi/Q)}\tilde{Q}_i] \; < 3000 \text{ mrem/yr}$$

where the terms are defined below.

B2.2.2 Radioiodines, Particulates, and Others

$$\sum_i \; P_i \; [W \; \tilde{Q}_i] \; < 1500 \text{ mrem/yr}$$

where:

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$ from Table 1.2-1.

L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$ from Table 1.2-1.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide, in mrad/yr per $\mu Ci/m^3$ from Table 1.2-1 (unit conversion constant of 1.1 mrem/mrad converts air dose to skin dose).

P_i = The dose parameter for radionuclides other than noble gases for the inhalation pathway, in mrem/yr per $\mu Ci/m^3$ and for the food and ground plane pathways, in $m^2 \bullet$(mrem/yr) per μCi/sec from Table 1.2-2. The dose factors are based on the critical individual organ and most restrictive age group (child or infant).

$\tilde{Q}_i$ = The release rate of radionuclides, i, in gaseous effluent from all release points at the site, in µCi/sec.

$\overline{\chi/Q}$ = 7.2E-5 sec/m^3. The highest calculated annual average relative concentration (dispersion parameter) for any area at or beyond the unrestricted area boundary.

W = The highest calculated annual average dispersion or deposition parameter for estimating the dose to an individual at the controlling location:

W = 7.2E-5 sec/m^3, for the inhalation pathway. The location is the unrestricted area boundary in the NNE sector.

W = 1.3E-7 meter^{-2}, for the food and gound plane pathways. The location is the unrestricted area boundary in the NNE sector.

$$\tilde{Q}_i = k_1 C_i f \div k_2 = 4.72E{+}2 C_i f$$

where:

C_i = the concentration of radionuclide, i, in undiluted gaseous effluent, in µCi/ml.

f = the undiluted effluent flow, in cfm

k_1 = conversion factor, 2.83E4 ml/ft^3

k_2 = conversion factor, 6E1 sec/min

B4.0 DOSE CALCULATIONS

B4.1 FREQUENCY OF CALCULATIONS

Dose contributions to the maximum exposed individual shall be calculated every 31 days, quarterly, semiannually, and annually (as required by Technical Specifications) using the methodology in the generic information sections. This methodology shall also be used for any special reports. Dose projections may be performed using simplified estimates. Fuel cycle dose calculations shall be performed whenever dose limits given in Technical Specification 3.11.4a are exceeded or as required by special reports. Dose contributions may be calculated using the methodology in the appropriate generic information sections.

B4.2 DOSE MODELS FOR MAXIMUM EXPOSED INDIVIDUAL

B4.2.1 Liquid Effluents

For dose contributions from liquid radioactive releases, one of the two following cases will apply:

1. If the radionuclides Co-58 and/or Co-60 have been detected and Cs-134 and/or Cs-137 have not been detected (i.e., plants without any fuel failure) dose calculations indicate that the maximum exposed individual would be a child who consumed fish caught in the discharge canal and who drank water from the nearest "downstream" potable water intake. The dose from these two radionuclides has been calculated to be 10% of that individual's total body dose.

2. If the radionuclides Cs-134 and/or Cs-137 have been detected, dose calculations indicate that the maximum exposed individual would be an adult who consumed fish caught in the discharge canal and who drank water from the nearest "downstream" potable water intake. The dose from these two radionuclides has been calculated to be 70% of that individual's total body dose.

B4.2.2 Gaseous Effluents

B4.2.2.1 Noble Gases

For dose contributions from exposure to beta and gamma radiation from noble gases, it is assumed that the maximum exposed individual is an adult on the site boundary in each meteorological sectors.

B4.2.2.2 Radioiodines, Particulates, and Other Radionuclides $T_{1/2} > 8$ days

For dose contributions from radioiodines, particulates and other radionuclides; it is assumed that the maximum exposed individual is a child or infant in each meteorological sector at a location (i.e., controlling location) where the total inhalation, food and ground plane pathway dose is determined to be a maximum based on operational source term data, land use surveys, and NUREG-0133 guidance.

B4.3 SIMPLIFIED DOSE ESTIMATE

B4.3.1 Liquid Effluents

For dose estimates, two simplified calculations using the assumptions presented in Section B4.2.1 are presented. Operational source term data shall be used to update these calculations, as necessary.

Case 1 - No Cs-134 or Cs-137 present in effluent.

$$D_{WB} = 1.52E{+}04 \sum_{\ell=1}^{m} (F_\ell)(T_\ell)\ (C_{Co-60} + 0.35\ C_{Co-58})$$

where:

$1.52E{+}04 = 1.14E{+}05\ (U_{aw}/D_w + U_{af}\ BF_i)\ DF_{ai\tau}\ (10)$

where:

$1.14E{+}05 = 10^6 pCi/\mu Ci \times 10^3 ml/kg \div 8760\ hr/yr$

U_{aw} = 510 kg/yr, child water consumption

D_w = 1, dilution factor from the near field area to the nearest potable water intake, Huntersville Water Intake

U_{af} = 6.9 kg/yr, child fish consumption

BF_i = 5.0E+01, bioaccumulation factor for Cobalt (Table 3.1-1)

$DF_{ai\tau}$ = 1.56E-05, child, total body, ingestion dose factor for Co-60 (Table 3.1-4)

10 = factor derived from assumption that 10% of dose is from Co-58 and Co-60 or 100% ÷ 10% = 10

m = number of releases

And where:

$$F_\ell = \frac{f\sigma}{F + f}$$

where:

f = liquid radwaste flow, in gpm

σ = recirculation factor at equilibrium, 2.4

F = dilution flow, in gpm

And where:

T_ℓ = The length of time, in hours, over which C_{Co-58}, C_{Co-60}, and F_ℓ are averaged. (The time period during which all releases (m) are made)

C_{Co-58} = the average concentration of Co-58 in undiluted effluent, in µCi/ml, during the time period considered.

C_{Co-60} = the average concentration of Co-60 in undiluted effluent, in µCi/ml, during the time period considered.

0.35 = The ratio of the child total body ingestion dose factors for Co-58 and Co-60 or 5.51E-06 ÷ 1.56E-05 - Table 3.1-4.

Case 2 - Cs-134 and/or Cs-137 present in effluent.

$$D_{WB} = 8.43E{+}05 \sum_{\ell=1}^{m} (F_\ell)(T_\ell)\ (C_{Cs-134} + 0.59\ C_{Cs-137})$$

where:

$8.43E{+}05 = 1.14E{+}05\ (U_{aw}/D_w + U_{af}\ BF_i)\ DF_{ai\tau}\ (1.43)$

where:

$1.14E{+}05 = 10^6 pCi/\mu Ci \times 10^3 ml/kg \div 8760\ hr/yr$

U_{aw} = 730 kg/yr, adult water consumption

D_w = 1, dilution factor from the near field area to the nearest potable water intake, Hunterville Water Intake

U_{af} = 21 kg/yr, adult fish consumption

BF_i = 2.00E+03, bioaccumulation factor for Cesium (Table 3.1-1)

$DF_{ai\tau}$ = 1.21E-04, adult, total body, ingestion dose factor for Cs-134 (Table 3.1-2)

1.43 = factor derived from the assumption that 70% of dose is from Cs-134 and Cs-137 or 100% ÷ 70% = 1.43

m = number of releases

And where:

$$F_\ell = \frac{f\sigma}{F + f}$$

where:

f = liquid radwaste flow, in gpm

σ = recirculation factor at equilibrium, 2.4

F = dilution flow, in gpm

And where:

T_ℓ = The length of time, in hours, over which C_{Cs-134}, C_{Cs-137}, and F_ℓ are averaged. (The time period during which all releases (m) are made)

C_{Cs-134} = the average concentration of Cs-134 in undiluted effluent, in µCi/ml, during the time period considered.

C_{Cs-137} = the average concentration of Cs-137 in undiluted effluent, in µCi/ml, during the time period considered.

0.59 = The ratio of the adult total body ingestion dose factors for Cs-134 and Cs-137 or 7.14E-05 ÷ 1.21E-04 = 0.59

B4.3.2 Gaseous Effluents

Meteorological data is provided in Tables B4.0-1 and B4.0-2.

B4.3.2.1 Noble Gases

For dose estimates, simplified dose estimates using the assumptions in B4.2.2.1 are presented below. Operational source term data shall be used to update these calculations, as necessary. These calculations further assume that the annual average dispersion parameter is used and that Xenon-133 contributes 60% of the gamma air dose and 80% of the beta air dose.

$$D_\gamma = 8.06E-10\ [\tilde{Q}]_{Xe-133}\ (1.67)$$

$$D_\beta = 2.40E-09\ [\tilde{Q}]_{Xe-133}\ (1.25)$$

where:

$\overline{X/Q}$ = 7.2E-05 sec/m^3, as defined in Section B2.2.2

8.06E-10 = (3.17E-8)(353) ($\overline{X/Q}$), derived from equation presented in Section 3.1.2.1.

2.40E-09 = (3.17E-08) (1050) ($\overline{X/Q}$), derived from equation presented in Section 3.1.2.1.

$[\tilde{Q}]_{Xe-133}$ = the total Xenon-133 activity released in µCi

1.67 = factor derived from the assumption that 60% of the gamma air dose is contributed by Xe-133.

1.25 = factor derived from the assumption that 80% of the beta air dose is contributed by Xe-133.

B4.3.2.2 Radioiodines, Particulates, and Other Radionuclides with T 1/2 > 8 days

For dose estimates, simplified dose estimates using the methods and assumptions in B4.2.2.2 are presented below. Operational source term data shall be used to update these calculations, as necessary. These calculations further assume that the annual average dispersion/deposition parameter is used and that 43% of the dose is from Iodine-131 inhaled by the maximally exposed individual at the controlling location. The simplified dose estimate to the thyroid of a child is:

$$D = 5.14E\text{-}01 \; W \; (\tilde{Q})_{I\text{-}131} \; (2.33)$$

where:

$W = 7.2E\text{-}05 = \overline{X/Q}$ for inhalation pathway, in sec/m^3 from Table B4.0-1 for the controlling location (NNE sector at 0.5 miles).

$(\tilde{Q})_{I\text{-}131}$ = the total Iodine-131 activity released in µCi.

5.14E-01 = (3.17E-08)(R_i^I [$\overline{X/Q}$]) with the appropriate substitution for the inhalation pathway factor, R_i^I [$\overline{X/Q}$] for Iodine-131. See Section 3.1.2.2.

2.33 = factor derived from the assumption that 43% of the total inhalation, food and ground plane pathway dose to the maximally exposed individual is contributed by I-131 via the inhalation pathway.

B4.4 FUEL CYCLE CALCULATIONS

As discussed in Section 3.3.5, 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. The fuel cycle dose assessments for McGuire Nuclear Station must include dose contributions from Catawba Nuclear Station, which is located approximately thirty miles SSW of McGuire. For this dose assessment, the maximum exposed individual is conservatively assumed to live 5 miles NNE of Catawba and 5 miles SSW of McGuire. Doses from Catawba's liquid effluents will not affect McGuire since Catawba is downstream of McGuire.

The dose contributions resulting from gaseous effluents are calculated using the methodology in Section 3.1.2:

$$D_f(g) < D_M(g) + D_C(g)$$

where:

$D_f(g)$ = Total airborne dose contribution from nuclear power plant operation to the fuel cycle dose assessment.

$D_M(g)$ = dose contribution from McGuire calculated using $\overline{X/Q}$ = 1.5E-07 sec/m^3 and $\overline{D/Q}$ = 3.8 E-10 m^{-2}. The location is 5 miles SSW of McGuire.

$D_C(g)$ = dose contribution from Catawba calculated using $\overline{X/Q}$ = 3.3E-07 sec/m^3 and $\overline{D/Q}$ = 5.8E-10 m^{-2}. The location is 5 miles NNE of Catawba.

Using the methodology above and the assumption that each station releases their maximum Technical Specification dose limit, the gaseous effluent contribution to the fuel cycle calculation is but a small fraction (< 1/100) of the allowable dose. Therefore, fuel cycle calculations will not normally be performed unless either station exceeds their gaseous effluent Technical Specifications by a factor of 2.

In summary, Technical Specification 3.11.4 will be the deciding criteria for fuel cycle calculations since it is more restrictive than the case outlined above.

TABLE B5.0-3

MCGUIRE RADIOLOGICAL MONITORING PROGRAM ANALYSES

SAMPLE MEDIUM	ANALYSIS SCHEDULE	ANALYSES: GAMMA ISOTOPIC	TRITIUM	LOW LEVEL I-131	GROSS BETA	TLD
1. Air Radioiodine and		X				
Particulates	Weekly	X			X	
2. Direct Radiation	Quarterly					X
3. Surface Water	Biweekly			X		
	Monthly Composite	X				
	Quarterly Composite		X			
4. Drinking Water	Biweekly			X		
	Monthly Composite	X			X	
	Quarterly Composite		X			
5. Shoreline Sediment	Semiannually	X				
6. Milk	Semimonthly	X		X		
7. Fish	Semiannually	X				
8. Broadleaf Vegetation	Monthly	X				
9. Food Products	Monthly [(a)]	X				

(a) during harvest season

December 17, 1985

SUBJECT: Offsite Dose Calculation Manual
Revision 10

The General Office Radwaste Engineering staff is transmitting to you this date, Revision 10 of the Offsite Dose Calculation Manual. As this revision only affects Oconee Nuclear Station, the approval of other station managers is not necessary. Please update your copy No. 1, and discard affected pages.

REMOVE THESE PAGES		INSERT THESE PAGES	
Appendix A - Table of Contents	Rev. 3	Appendix A - Table of Contents	Rev. 10
A-5	Rev. 3	A-5	Rev. 10
A-6	Rev. 3	A-6	Rev. 10
A-8	Rev. 3	A-8	Rev. 10
A-9	Rev. 3	A-9	Rev. 10
A-10, A-11, A-12	Rev. 3	A-10, A-11, A-12 & A-13	Rev. 10
Table A4.0-1	Rev. 3	Table A4.0-1	Rev. 10
Table A4.0-2	Rev. 3	Table A4.0-2	Rev. 10
Table A4.0-3 (3 pages)	Rev. 3	Table A4.0-3 (3 pages)	Rev. 10
------------------	-----	A-14	Rev. 10
Table A5.0-3	Rev. 3	Table A5.0-3	Rev. 10

NOTE: As this letter contains "LOEP" information, please insert this in front of the December 16, 1985 letter.

Approval Date: 12/6/85

Effective Date: 1/1/86

Mary L. Birch
Mary L. Birch
System Radwaste Engineer

Approval Date: 12/10/85

Effective Date: 1/1/86

M. S. Tuckman
M. S. Tuckman, Manager
Oconee Nuclear Station

If you have any questions concerning Revision 10, please call Jim Stewart at (704) 373-5444.

James M. Stewart
James M. Stewart, Jr.
Associate Health Physicist
Radwaste Engineering

JMS/pja.020

Enclosures

JUSTIFICATIONS FOR REVISION 10

Section A2.2.2 (Page A-5)	Typo error: "m^2 (mrem/yr) per μCi/sec" should read "$m^2 \cdot$ (mrem/yr) per μCi/sec". Due to a change in controlling receptor locations: Change "4.5E-9" to "7.5E-8"; change "S sector" to "NE sector". Change "2.5E-9" to "2.7E-9"; change "SSW sector" to "NE sector"; delete the word "residence" for clarification purposes.
Section A3.0 (Page A-6)	Added/changed words for clarification purposes, no change in meaning.
Section A3.2 (Page A-8)	Added words for clarification purposes, no change in meaning.
Section A3.2.1 (Page A-8)	Added section to describe gaseous Radwaste effluent line similar to section A.3.1.1 which describes the liquid radwaste effluent line. Changed subsequent section numbers to reflect added section (pages A-8 and A-9).
Page A-10	Began section A4.3 on next page (A-11) for clarification purposes.
Section A.4.3	This section has been updated using the latest plant release data and land use census data available.
Section A4.3.2.1 (Page A-12)	Typo error: added bar over "X/Q" for clarification purposes, no change in meaning (3 places).
Section A4.3.2.2 (Page A-13)	Changed "95%" to "99%" as a result of using the latest plant release data and land use census data available (3 places). Typo error: added bar over "D/Q" for clarification purposes, no change in meaning (3 places).

Due to a change in controlling receptor locations:

> Change "3.0E-10" to "2.7E-9"; change "ESE" to "NE"; change "2.8 miles" to "1.0 miles".

Typo error: change "R^C" to "R_i^C".

Change "1.67E+04" to "1.53E+04" (2 places);

> This updated number is found by using information found in Table 3.1-22 rather than deriving the old number by longhand.

Add "and Table 3.1-22" for clarification purposes.

Section A4.3 (Page A-13)	Typo error: "A4.3" should read "A4.4".
Table A4.0-1	Typo errors: added bar over "X/Q" for clarification purposes; added "s" to "Release"; added units "sec/m^3" for clarification purposes.
Table A4.0-2	Typo errors: added bar over "D/Q" for clarification purposes; added "s" to "Release"; added units "m^{-2}" for clarification purposes
Table A4.0-3 (3 pages)	Typo error: added units "mrem/hr per μCi/mL" for clarification purposes.
Page A-14	Page number change only.
Table A5.0-3	See attached letter dated November 26, 1985 from J. W. Crain (ONS) for justification.

November 26, 1985

ATTN: J. M. Stewart, Jr.
Associate Health Physicist
Radwaste Engineering

SUBJECT: Offsite Dose Calculation Manual
File No.: OS-778.00

Please incorporate the following changes to Table A5.0-2:

1) Add semi-annual fish collection to Location 067, which will allow comparison of historical data with fish collected at Location 063.

2) Add shoreline sedimentation sample at Location 063 to allow comparison with fish results.

3) Add drinking water sample at Location 060 to respond to change in land use. Greenville Water Treatment Plant started water production mid-October.

4) Add broad leaf vegetation sample at Location 060 due to D/Q values as identified by audit of R. E. Sorber on April 4, 1985.

5) Add fish collection at Location 060 and delete fish collection at Location 064. Catfish are extremely difficult to collect at 064 due to water depth and lack of suitable habitat for catfish. Location 060 should prove to be a more suitable location.

J. W. Crain
Environmental Chemistry Supervisor

JWC/dcr

xc: Sarah Coy
Mike Thorne

APPENDIX A-TABLE OF CONTENTS

where:

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$ from Table 1.2-1.

L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$ from Table 1.2-1.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide, in mrad/yr per $\mu Ci/m^3$ from Table 1.2-1 (unit conversion constant of 1.1 mrem/mrad converts air dose to skin dose).

P_i = The dose parameter for radionuclides other than noble gases for the inhalation pathway, in mrem/yr per $\mu Ci/m^3$ and for the food and ground plane pathways in $m^2 \cdot$(mrem/yr) per μCi/sec from Table 1.1-2. The dose factors are based on the critical individual organ and most restrictive age group (child or infant).

$\tilde{Q}_i$ = The release rate of radionuclides, i, in gaseous effluent from all release points at the site, in μCi/sec.

$\overline{X/Q}$ = 4.1E-7 sec/m^3. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary.

W = The highest calculated annual average dispersion parameter for estimating the dose to an individual at the controlling location:

W = 7.5E-8 sec/m^3, for the inhalation pathway. The location is the unrestricted area boundary in the NE sector.

W = 2.7E-9 m^{-2}, for the food and ground plane pathways. The location is the unrestricted area boundary in the NE sector (nearest cow, and vegetable garden)

$$\tilde{Q}_i = k_1 C_i f \div k_2 = 4.72E{+}2\ C_i f$$

where:

C_i = the concentration of radionuclide, i, in undiluted gaseous effluent, in μCi/ml.

f = the undiluted effluent flow, in cfm

k_1 = conversion factor, 2.83E+04 ml/ft^3

k_2 = conversion factor, 6.0E+01 sec/min

A3.0 RADIATION MONITOR SETPOINTS

Using the generic calculations presented in Section 2.0, final radiation monitoring setpoints are calculated for monitoring as required by the Technical Specifications.

All final effluent radiation monitors for Oconee are off-line. These monitors alarm on low flow; the minimum flow alarm level for the liquid monitors is 3 gallons per minute and for the gas monitors is 7 standard cubic feet per minute. These monitors measure the activity in the liquid or gas volume exposed to the detector and are independent of flow rate if a minimum flow rate is assured.

Radiation monitoring setpoints calculated in the following sections are expressed in activity concentrations; in reality the monitor readout is in counts per minute. The relationship between concentration and counts per minute shall be established by station procedure using the following relationship: Station radiation monitor setpoint procedures which correlate concentration and counts per minute shall be based on the formula below and will be determined using the monitor's correlation graph. The correlation graph shows concentration (µCi/ml) vs. monitor reading (cpm) based on empirical data.

$$c = \frac{r}{2.22 \times 10^6 e V}$$

where:

- c = the gross activity, in µCi/ml
- r = the count rate, in cpm
- 2.22×10^6 = the disintegration per minute per µCi
- e = the counting efficiency, cpm/dpm
- v = the volume of fluid exposed to the detector, in ml.

A3.1 LIQUID RADIATION MONITORS

A3.1.1 Liquid Radwaste Effluent Line

As described in Section A2.1.1 of this manual on release rate calculations for the waste liquid effluent, the release is controlled by limiting the flow rate of effluent from the station. Although the release rate is flow rate controlled, the radiation monitor setpoint shall be set to terminate the release if the effluent activity should exceed that determined by laboratory analyses and that used to calculate the release rate.

A3.1.2 Turbine Building Sump Discharge Line

As described in Section A2.1.2 of this manual on release rate calculations for the turbine building sump effluent, the effluent is normally considered nonradioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring and by routine analysis of the composite sample collected at the #3 Chemical Treatment Pond. Since the system discharges automatically, the maximum system concentration, which also is the radiation monitor setpoint, is calculated to assure compliance with release limits.

A3.2 GAS MONITORS

The following equation shall be used to calculate final effluent noble gas radiation monitor setpoints based on Xe-133:

$K(\overline{X/Q})\tilde{Q}_i < 500$ (See Section A2.2.1)

$\tilde{Q}_i = 4.72E+2\ C_i f$ (See Section A2.2.2)

$C_i < 8.79E+3/f$

where:

C = the gross activity in undiluted effluent, in μCi/ml

f = the flow from the tank or building and varies for various release sources, in cfm

K = from Table 1.2-1 for Xe-133, 2.94E+2 mrem/yr per $\mu Ci/m^3$

$\overline{X/Q}$ = 4.1E-7 sec/m^3, as defined in section A2.2.2.

A3.2.1 Gaseous Radwaste Effluent Line

As described in Section 2.2, the release is controlled by limiting the flow rate of the effluent from the station. Although the release rate is flow rate controlled, the radiation monitor setpoint shall be set to terminate the release if the effluent activity should exceed that determined by laboratory analyses and that used to calculate the release rate.

A3.2.2 Unit Vent

As stated in Section A2.2, the unit vent is the release point for waste gas decay tanks, containment building purges, the condenser air ejector, and auxiliary building ventilation. Since all of these releases are through the unit vent, the radiation monitor on the unit vent may be used to assure that station release limits are not exceeded. Depending on the stack flow, a typical radiation monitor setpoint may be calculated as follows:

$C < 8.79E+3/f = 9.25E-2 \mu Ci/ml$

where:

f = 45,000 cfm (auxiliary building) + 50,000 cfm (containment purge) = 95,000 cfm

or may be:

$C < 8.79E+3/f = 1.95E-1\ \mu Ci/ml$

where:

f = 45,000 cfm (auxiliary building ventilation)

A3.2.3 Interim Radwaste Building Ventilation Exhaust

Ventilation exhaust from the Interim Radwaste Building is not released through the unit vent and is considered a separate release point. This exhaust is normally considered non-radioactive; that is, it is possible but unlikely that the effluent will contain measurable activity above background. Since the exhaust is continuous, a maximum concentration of gases in the exhaust, which also is the radiation monitor setpoint, is calculated to assure compliance with release limits. A typical radiation monitor setpoint may be calculated as follows:

$$C < 8.79E{+}3/f = 5.98E{-}1\ \mu Ci/ml$$

where:

$f = 1.47E{+}04$ cfm

A3.2.4 Hot Machine Shop Building Ventilation Exhaust

Ventilation exhaust from the Hot Machine Shop is not released through the unit vent and is considered to be a separate release point. This filtered exhaust is sampled and analyzed for particulates and radioiodines to assure that the effluent released has not exceeded station release limits. Since it is assumed that no noble gases will be generated by machine shop work, no provision for monitoring noble gas releases are provided.

A3.2.5 Contaminated Oil Burning In Auxiliary Boiler

Contaminated oil is burned in the auxiliary boiler which is not released through the unit vent and is considered a separate release point. The contaminated oil is filtered, mixed, and sampled to determine the total activity to be released and the allowable release (burn) rate.

By Technical Specification, releases from the auxiliary boiler from incineration of contaminated oil must meet the instantaneous release rate for iodines and particulates given in Section A2.2.2. Also, the total dose due to these releases must be less than 0.1% of the allowable yearly dose from particulate gaseous effluents.

Doses from incineration of contaminated oil are calculated for all organs and all pathways using the models provided in Section 3.1.2.2 of this manual and the GASPAR computer program. Doses are calculated quarterly at a minimum.

All the activity in the contaminated oil is assumed to be released during incineration and the total is added to the station's quarterly and annual release records.

A4.0 DOSE CALCULATIONS

A4.1 FREQUENCY OF CALCULATIONS

Dose contributions to the maximum individual shall be calculated at least every 31 days, quarterly, semiannually, and annually (or as required by Technical Specifications) using the methodology in the generic information sections. This methodology shall also be used for any special reports. Dose projections may be performed using simplified dose estimates.

Fuel cycle dose calculations shall be performed annually or as required by special reports. Dose contributions shall be calculated using the methodology in the appropriate generic information sections.

A4.2 DOSE MODELS FOR MAXIMUM EXPOSED INDIVIDUAL

A4.2.1 Liquid Effluents

For dose contributions from liquid radioactive effluent releases, it is assumed that the maximum exposed individual is an adult who consumes fish caught in the discharge area and drinks water from the nearest downstream water supply.

A4.2.2 Gaseous Effluents

A4.2.2.1 Noble Gases

For dose contributions from exposure to beta and gamma radiations from noble gases, it is assumed that the maximum exposed individual is an adult on the site boundary in each meteorological sector.

A4.2.2.2 Radioiodines, Particulates, and Other Radionuclides with T 1/2 > 8 days

For dose contributions from radioiodines, particulates, and other radionuclides; it is assumed that the maximum exposed individual is an infant who breathes the air and consumes milk from the nearest goat or cow in each meteorological sector.

A4.3 SIMPLIFIED DOSE ESTIMATES

A4.3.1 Liquid Effluents

For dose estimates, a simplified calculation using the assumptions presented in Section A4.2.1 and operational source term data is presented below. Dose calculations used to evaluate Appendix I to 10CFR50 compliance indicate that the maximum exposed individual is an adult who consumes fish caught in the discharge area and that 75% of the dose is from Cesium-134 and Cesium-137.

$$D_{WB} = 7.71E{+}05 \sum_{\ell=1}^{m} (F_\ell)(T_\ell)\,(C_{Cs-134} + 0.59\, C_{Cs-137})$$

where:

$$7.71E{+}05 = 1.14E{+}05\,(U_{aw}/D_w + U_{af}\,BF_i)\,DF_{ai\tau}\quad(1.33)$$

where:

$1.14E{+}05 = 10^6 pCi/\mu Ci \times 10^3 ml/kg \div 8760\ hr/yr$

U_{aw} = 730 kg/yr, adult water consumption

D_w = 27.5, dilution factor from the near field area to the potable water intake.

U_{af} = 21 kg/yr, adult fish consumption

BF_i = 2.00E+03, bioaccumulation factor for Cesium (Table 3.1-1)

$DF_{ai\tau}$ = 1.21E-04, adult, total body, ingestion dose factor (Table 3.1-2)

1.33 = factor derived from the assumption that 75% of dose is from Cs-134 and Cs-137 or 100% ÷ 75% = 1.33

where:

$$F_\ell = \frac{f\sigma}{F + f}$$

f = liquid radwaste flow, in gpm

σ = recirculation factor at equilibrium, 1.0

F = dilution flow, in gpm

and where:

T_ℓ = the length of time, in hours, over which C_{Cs-134}, C_{Cs-137}, and F_ℓ are averaged

C_{Cs-134} = the average concentration of Cs-134 in undiluted effluent, in µCi/ml, during the time period considered.

C_{Cs-137} = the average concentration of Cs-137 in undiluted effluent, in µCi/ml, during the time period considered.

0.59 = the ratio of the adult total body ingestion dose factors for Cs-134 and Cs-137 or 7.14E-05 ÷ 1.21E-04 = 0.59

A4.3.2 Gaseous Effluents

Meteorological data is provided in Table A4.0-1 and A4.0-2.

A4.3.2.1 Noble Gases

For dose estimates, simplified dose estimates using the assumptions in A4.2.2.1 and operational source term data is presented below. These calculations further assume that the annual average dispersion parameter is used and that Xenon-133 contributes 90% of the gamma air dose and 80% of the beta air dose.

$$D_\gamma = 4.59E-12 \; [\tilde{Q}]_{Xe-133} \; (1.11)$$

$$D_\beta = 1.36E-11 \; [\tilde{Q}]_{Xe-133} \; (1.25)$$

where:

4.59E-12 = (3.17E-8) (353) ($\overline{X/Q}$), derived from equation presented in Section 3.1.2.1.

1.36E-11 = (3.17E-8) (1050) ($\overline{X/Q}$), derived from equation presented in Section 3.1.2.1.

$[\tilde{Q}]_{Xe-133}$ = the total Xenon-133 activity released in μCi

$\overline{X/Q}$ = 4.1E-07 sec/m^3, as defined in Section A2.2.2

1.11 = factor derived from the assumption that 90% of the Gamma Air dose is contributed by Xe-133

1.25 = factor derived from the assumption that 80% of the Beta-Air dose is contributed by Xe-133

A4.3.2.2 Radioiodines, Particulates, and Other Radionuclides with T 1/2 > 8 Days

For dose estimates, simplified dose estimates using the assumptions in A4.2.2.2 and operational source term data is presented below. These calcualations further assume that the annual average dispersion/deposition parameter is used and that 99% of the dose is from Iodine-131 concentrated in cow's milk. The simplified dose estimate to the thyroid of an infant is:

$$D = 1.53E{+}04\ W\ (\tilde{Q})_{I-131}\ (1.01)$$

where:

W = 2.7E-9 ($\overline{D/Q}$) for food and ground plane pathway, in m^{-2} from Table A4.0-2 for the location of the nearest real cow (NE @ 1.0 miles).

$(\tilde{Q})_{I-131}$ = the total Iodine-131 activity released in μCi.

1.53E+04 = (3.17E-08) (R_i^C [$\overline{D/Q}$]) with the appropriate substitutions for cow's milk in the grass-cow-milk-pathway factor, R_i^C [$\overline{D/Q}$], for Iodine-131. See Section 3.1.2.2 and Table 3.1-22.

1.01 = factor derived from the assumption that 99% of the dose is contributed by I-131.

A4.4 FUEL CYCLE CALCULATIONS

These calculations shall be performed using models presented in generic information Section 3.3

TABLE A4.0-1

OCONEE NUCLEAR STATION
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DISPERSION PARAMETER ($\overline{X/Q}$) FOR LONG TERM RELEASES > 500 HR/YR OR > 125 HR/QTR

(sec/m^3)

Distance to the control location, in miles

Sector	0-0.5*	0.5-1.0*	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			6.5E-8	4.8E-8	4.7E-8	4.7E-8	4.7E-8	6.3E-8	5.9E-8	5.6E-8
NNE			1.1E-7	9.3E-8	8.7E-8	8.9E-8	9.2E-8	9.2E-8	7.2E-8	5.9E-8
NE			7.5E-8	7.2E-8	6.8E-8	5.8E-8	6.1E-8	6.4E-8	6.0E-8	5.7E-8
ENE			6.0E-8	6.4E-8	5.9E-8	6.1E-8	5.7E-8	5.7E-8	5.6E-8	5.6E-8
E			4.1E-8	3.7E-8	5.7E-8	4.8E-8	5.2E-8	4.9E-8	4.7E-8	4.5E-8
ESE			3.0E-8	4.0E-8	6.7E-8	5.8E-8	4.3E-8	5.3E-8	4.9E-8	4.7E-8
SE			2.8E-8	2.8E-8	6.0E-8	5.1E-8	4.1E-8	3.7E-8	3.8E-8	3.8E-8
SSE			2.3E-7	2.0E-7	3.2E-7	2.5E-7	3.7E-7	2.9E-7	2.7E-7	2.5E-7
S			2.6E-7	3.0E-7	2.1E-7	2.1E-7	3.6E-7	4.1E-7	3.7E-7	3.6E-7
SSW			3.2E-7	3.1E-7	2.9E-7	2.7E-7	2.0E-7	1.7E-7	1.7E-7	1.7E-7
SW			7.3E-8	7.1E-8	7.1E-8	5.9E-8	3.9E-8	4.4E-8	4.5E-8	4.5E-8
WSW			5.3E-8	5.2E-8	5.3E-8	4.2E-8	4.8E-8	4.3E-8	4.2E-8	4.2E-8
W			2.7E-8	3.2E-8	3.7E-8	3.7E-8	3.9E-8	3.9E-8	3.7E-8	3.6E-8
WNW			2.3E-8	2.5E-8	3.5E-8	3.5E-8	3.3E-8	3.2E-8	3.0E-8	2.9E-8
NW			3.2E-8	3.7E-8	3.1E-8	3.3E-8	3.0E-8	3.1E-8	2.9E-8	2.8E-8
NNW			6.8E-8	7.7E-8	8.3E-8	7.7E-8	7.8E-8	6.5E-8	6.3E-8	6.2E-8

* Inside Exclusion Area Boundary (EAB)

TABLE A4.0-2

OCONEE NUCLEAR STATION
(1 of 1)

DEPOSITION PARAMETER ($\overline{D/Q}$) FOR LONG TERM RELEASES > 500 HR/YR OR > 125 HR/QTR

(m^{-2})

Distance to the control location, in miles

Sector	0-0.5*	0.5-1.0*	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			2.4E-9	1.4E-9	8.7E-10	6.0E-10	4.7E-10	3.6E-10	2.8E-10	2.3E-10
NNE			4.1E-9	2.2E-9	1.4E-9	9.6E-10	7.4E-10	5.7E-10	4.4E-10	3.6E-10
NE			2.7E-9	1.5E-9	9.7E-10	6.6E-10	5.0E-10	3.9E-10	3.1E-10	2.5E-10
ENE			1.5E-9	8.4E-10	5.4E-10	3.7E-10	2.8E-10	2.2E-10	1.7E-10	1.4E-10
E			1.6E-9	8.7E-10	5.6E-10	3.9E-10	3.0E-10	2.3E-10	1.8E-10	1.5E-10
ESE			1.3E-9	7.0E-10	4.5E-10	3.0E-10	2.3E-10	1.8E-10	1.4E-10	1.1E-10
SE			8.0E-10	4.4E-10	2.9E-10	2.0E-10	1.5E-10	1.2E-10	8.9E-11	7.3E-11
SSE			2.7E-9	1.6E-9	1.1E-9	7.5E-10	6.0E-10	4.6E-10	3.6E-10	3.0E-10
S			4.5E-9	2.6E-9	1.7E-9	1.2E-9	9.0E-10	7.0E-10	5.5E-10	4.5E-10
SSW			4.3E-9	2.5E-9	1.6E-9	1.1E-9	8.5E-10	6.5E-10	5.0E-10	4.2E-10
SW			1.4E-9	8.4E-10	5.5E-10	3.9E-10	3.0E-10	2.3E-10	1.8E-10	1.5E-10
WSW			1.6E-9	9.1E-10	6.0E-10	4.1E-10	3.2E-10	2.5E-10	1.9E-10	1.6E-10
W			1.4E-9	7.9E-10	5.1E-10	3.6E-10	2.7E-10	2.1E-10	1.6E-10	1.3E-10
WNW			7.7E-10	4.4E-10	2.9E-10	2.0E-10	1.5E-10	1.2E-10	9.2E-11	7.4E-11
NW			1.1E-9	5.9E-10	3.8E-10	2.6E-10	2.0E-10	1.6E-10	1.2E-10	9.9E-11
NNW			1.9E-9	1.0E-9	6.6E-10	4.5E-10	3.5E-10	2.7E-10	2.1E-10	1.7E-10

* Inside Exclusion Area Boundary (EAB)

TABLE A4.0-3 *

(1 of 3)

OCONEE NUCLEAR STATION
ADULT A_{ait} DOSE PARAMETERS

(mrem/hr per μCi/ml)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	0.0	5.44E-01	5.44E-01	5.44E-01	5.44E-01	5.44E-01	5.44E-01
NA 24	4.12E+02	4.12E+02	4.12E+02	4.12E+02	4.12E+02	4.12E+02	4.12E+02
CR 51	0.0	0.0	1.28E+00	7.66E-01	2.82E-01	1.70E+00	3.22E+02
MN 54	0.0	4.39E+03	8.38E+02	0.0	1.31E+03	0.0	1.34E+04
MN 56	0.0	1.10E+02	1.96E+01	0.0	1.40E+02	0.0	3.53E+03
FE 55	6.67E+02	4.61E+02	1.07E+02	0.0	0.0	2.57E+02	2.64E+02
FE 59	1.05E+03	2.47E+03	9.48E+02	0.0	0.0	6.91E+02	8.24E+03
CO 58	0.0	9.14E+01	2.05E+02	0.0	0.0	0.0	1.85E+03
CO 60	0.0	2.63E+02	5.79E+02	0.0	0.0	0.0	4.93E+03
NI 63	3.15E+04	2.18E+03	1.06E+03	0.0	0.0	0.0	4.56E+02
NI 65	1.28E+02	1.66E+01	7.59E+00	0.0	0.0	0.0	4.22E+02
CU 64	0.0	1.02E+01	4.80E+00	0.0	2.58E+01	0.0	8.71E+02
ZN 65	2.32E+04	7.38E+04	3.33E+04	0.0	4.93E+04	0.0	4.65E+04
ZN 69	4.93E+01	9.44E+01	6.56E+00	0.0	6.13E+01	0.0	1.42E+01
BR 83	0.0	0.0	4.05E+01	0.0	0.0	0.0	5.84E+01
BR 84	0.0	0.0	5.25E+01	0.0	0.0	0.0	4.12E-04
BR 85	0.0	0.0	2.16E+00	0.0	0.0	0.0	0.0
RB 86	0.0	1.01E+05	4.71E+04	0.0	0.0	0.0	1.99E+04
RB 88	0.0	2.90E+02	1.54E+02	0.0	0.0	0.0	4.01E-09
RB 89	0.0	1.92E+02	1.35E+02	0.0	0.0	0.0	1.12E-11
SR 89	2.31E+04	0.0	6.62E+02	0.0	0.0	0.0	3.70E+03
SR 90	2.87E+05	0.0	7.71E+04	0.0	0.0	0.0	1.64E+04
SR 91	4.24E+02	0.0	1.71E+01	0.0	0.0	0.0	2.02E+03
SR 92	1.61E+02	0.0	6.96E+00	0.0	0.0	0.0	3.19E+03
Y 90	6.05E-01	0.0	1.62E-02	0.0	0.0	0.0	6.41E+03
Y 91M	5.72E-03	0.0	2.21E-04	0.0	0.0	0.0	1.68E-02
Y 91	8.87E+00	0.0	2.37E-01	0.0	0.0	0.0	4.88E+03
Y 92	5.31E-02	0.0	1.55E-03	0.0	0.0	0.0	9.31E+02

* Methodology for table provided by: M. E. Wrangler, RAB:NRR:NRC on 3/17/83

TABLE A4.0-3

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OCONEE NUCLEAR STATION
ADULT $A_{ai\tau}$ DOSE PARAMETERS

(mrem/hr per μCi/ml)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
Y 93	1.69E-01	0.0	4.65E-03	0.0	0.0	0.0	5.34E+03
ZR 95	3.32E-01	1.07E-01	7.21E-02	0.0	1.67E-01	0.0	3.38E+02
ZR 97	1.84E-02	3.70E-03	1.69E-03	0.0	5.59E-03	0.0	1.15E+03
NB 95	4.47E+02	2.49E+02	1.34E+02	0.0	2.46E+02	0.0	1.51E+06
MO 99	0.0	1.16E+02	2.21E+01	0.0	2.63E+02	0.0	2.69E+02
TC 99M	9.62E-03	2.72E-02	3.46E-01	0.0	4.13E-01	1.33E-02	1.61E+01
TC 101	9.89E-03	1.43E-02	1.40E-01	0.0	2.57E-01	7.28E-03	4.28E-14
RU 103	4.99E+00	0.0	2.15E+00	0.0	1.90E+01	0.0	5.82E+02
RU 105	4.15E-01	0.0	1.64E-01	0.0	5.37E+00	0.0	2.54E+02
RU 106	7.42E+01	0.0	9.38E+00	0.0	1.43E+02	0.0	4.80E+03
AG 110M	1.37E+00	1.26E+00	7.50E-01	0.0	2.48E+00	0.0	5.15E+02
TE 125M	2.57E+03	9.33E+02	3.45E+02	7.74E+02	1.05E+04	0.0	1.03E+04
TE 127M	6.50E+03	2.32E+03	7.93E+02	1.66E+03	2.64E+04	0.0	2.18E+04
TE 127	1.06E+02	3.79E+01	2.29E+01	7.83E+01	4.30E+02	0.0	8.34E+03
TE 129M	1.10E+04	4.12E+03	1.75E+03	3.79E+03	4.61E+04	0.0	5.56E+04
TE 129	3.02E+01	1.13E+01	7.35E+00	2.32E+01	1.27E+02	0.0	2.28E+01
TE 131M	1.66E+03	8.13E+02	6.77E+02	1.29E+03	8.23E+03	0.0	8.07E+04
TE 131	1.89E+01	7.91E+00	5.98E+00	1.56E+01	8.29E+01	0.0	2.68E+00
TE 132	2.42E+03	1.57E+03	1.47E+03	1.73E+03	1.51E+04	0.0	7.41E+04
I 130	2.94E+01	8.68E+01	3.43E+01	7.36E+03	1.35E+02	0.0	7.48E+01
I 131	1.62E+02	2.32E+02	1.33E+02	7.59E+04	3.97E+02	0.0	6.11E+01
I 132	7.90E+00	2.11E+01	7.40E+00	7.40E+02	3.37E+01	0.0	3.97E+00
I 133	5.53E+01	9.62E+01	2.93E+01	1.41E+04	1.68E+02	0.0	8.64E+01
I 134	4.13E+00	1.12E+01	4.01E+00	1.94E+02	1.78E+01	0.0	9.77E-03
I 135	1.72E+01	4.52E+01	1.67E+01	2.98E+03	7.24E+01	0.0	5.10E+01
CS 134	2.98E+05	7.09E+05	5.80E+05	0.0	2.29E+05	7.62E+04	1.24E+04
CS 136	3.12E+04	1.23E+05	8.86E+04	0.0	6.85E+04	9.39E+03	1.40E+04
CS 137	3.82E+05	5.22E+05	3.42E+05	0.0	1.77E+05	5.89E+04	1.01E+04
CS 138	2.64E+02	5.22E+02	2.59E+02	0.0	3.84E+02	3.79E+01	2.23E-03
BA 139	1.22E+00	8.71E-04	3.58E-02	0.0	8.14E-04	4.94E-04	2.17E+00

TABLE A4.0-3

(3 of 3)

OCONEE NUCLEAR STATION
ADULT $A_{ai\tau}$ DOSE PARAMETERS

(mrem/hr per μCi/ml)

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
BA 140	2.56E+02	3.21E-01	1.68E+01	0.0	1.09E-01	1.84E-01	5.27E+02
BA 141	5.94E-01	4.49E-04	2.00E-02	0.0	4.17E-04	2.55E-04	2.80E-10
BA 142	2.68E-01	2.76E-04	1.69E-02	0.0	2.33E-04	1.56E-04	3.78E-19
LA 140	1.57E-01	7.92E-02	2.09E-02	0.0	0.0	0.0	5.82E+03
LA 142	8.05E-03	3.66E-03	9.12E-04	0.0	0.0	0.0	2.67E+01
CE 141	5.07E-02	3.43E-02	3.89E-03	0.0	1.59E-02	0.0	1.31E+02
CE 143	8.94E-03	6.61E+00	7.32E-04	0.0	2.91E-03	0.0	2.47E+02
CE 144	2.65E+00	1.11E+00	1.42E-01	0.0	6.56E-01	0.0	8.94E+02
PR 143	5.78E-01	2.32E-01	2.87E-02	0.0	1.34E-01	0.0	2.53E+03
PR 144	1.89E-03	7.86E-04	9.62E-05	0.0	4.43E-04	0.0	2.72E-10
ND 147	3.95E-01	4.57E-01	2.74E-02	0.0	2.67E-01	0.0	2.19E+03
W 187	2.96E+02	2.48E+02	8.66E+01	0.0	0.0	0.0	8.11E+04
NP 239	3.21E-02	3.16E-03	1.74E-03	0.0	9.84E-03	0.0	6.47E+02

A5.0 RADIOLOGICAL ENVIRONMENTAL MONITORING

The radiological environmental monitoring program shall be conducted in accordance with Technical Specification 4.11.

The monitoring program locations and analyses are given in Tables A5.0-1 through A5.0-3 and Figure A5.0-1.

Site specific characteristics make ground water sampling, special low-level I-131 analyses on drinking water, and food product sampling unnecessary. Ground water recharge is from precipitation and the ground water gradient is toward the effluent discharge area; therefore, contamination of ground water from liquid effluents is highly improbable. Special low level I-131 analyses in drinking water will not be performed routinely since the expected I-131 dose from this pathway is less than 1 mrem/year. Food products will not be sampled since lake water irrigation of crops is not practiced in the vicinity.

The laboratory performing the radiological environmental analyses shall participate in an interlaboratory comparison program which has been approved by the NRC. This program is the Environmental Protection Agency's (EPA's) Environmental Radioactivity Laboratory Intercomparison Studies (Crosscheck) Program, our participation code is CP.

TABLE A5.0-2
(1 of 1)

OCONEE RADIOLOGICAL MONITORING PROGRAM SAMPLING LOCATIONS
(OTHER SAMPLING LOCATIONS)

CODE:

W - Weekly ($\leq$ 7 days)
SM - Semimonthly ($\leq$ 15 days)
M - Monthly ($\leq$ 31 days)
SA - Semiannually ($\leq$ 184 days)

	SAMPLING LOCATION DESCRIPTION	Air Radioiodines and Particulates	Surface Water	Drinking Water	Shoreline Sediment	Milk	Fish	Broadleaf Vegetation
028	Site Boundary (0.5 miles S)							M
060	New Greenville Water Intake Rd. (2.5 miles NNE)	W		M			SA	M
061	Old Hwy. 183 (1.5 miles SSW)	W						
062	Lake Keowee/Hydro Intake (0.7 mile ENE) (CONTROL)		M					
063	Lake Hartwell - Hwy 183 Bridge (0.8 mile ESE) (000.7)		M		SA		SA	
064	Seneca (6.7 miles SW) (004.1) (CONTROL)			M				
065	Clemson (8.1 miles SSE) (006.1)			M				
066	Anderson (19.0 miles SSE) (012) (CONTROL FOR MILK ONLY)			M		SM		
067	Lawrence Ramsey Bridge, Hwy 27 (4.2 miles SSE) (005.2)				SA		SA	
068	High Falls County Park (2.0 miles W) (CONTROL)				SA			
069	Powell Residence (4.5 miles WNW) (002.1)					SM		
070	(Deleted)							
071	Clemson Dairy (10.3 miles SSE) (006.3)					SM		
072	Hwy 130 (1.7 miles S)	W						
073	Tamassee Dar School (9.0 miles NW) (CONTROL)	W						M
074	Keowee Key Resort (1.7 miles NNW)	W						