ATTACHMENT I

Wolf Creek Nuclear Operating Corporation

Administrative Procedure AP 07B-003, Revision 6,

"Offsite Dose Calculation Manual"

WOLF CREEK
NUCLEAR OPERATING CORPORATION

AP 07B-003

OFFSITE DOSE CALCULATION MANUAL

Responsible Manager

Manager Chemistry/Radiation Protection

Revision Number	6
Use Category	Reference
Administrative Controls Procedure	Yes
Management Oversight Evolution	No
Program Number	07B

DC38 4/27/2007

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1.0 PURPOSE

1.1 This procedure contains the Offsite Dose Calculation Manual (ODCM) and the requirements for revision and submittal to the NRC.

2.0 SCOPE

2.1 This procedure partially fulfills the requirements of Technical Specifications 3.3.6, 3.3.7, and 3.3.8 Radiation Monitoring Instrumentation; 5.5.2 Primary Coolant Sources Outside Containment; 5.6.3 Radioactive Effluent Release Report and 5.5.1 Offsite Dose Calculation Manual.

2.2 Requirements for the Radiological Environmental Monitoring Program have been moved to AP 07B-004.

3.0 REFERENCES AND COMMITMENTS

3.1 References

3.1.1 WCGS Technical Specifications

3.1.2 AP 15C-001, PROCEDURE WRITERS GUIDE

3.1.3 AP 15C-004, PREPARATION, REVIEW, AND APPROVAL OF DOCUMENTS

3.1.4 Regulatory Guide 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFRPart50, Appendix I

3.1.5 NUREG 0133, Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants

3.1.6 AP 07B-004 OFFSITE DOSE CALCULATION MANUAL (RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM)

3.1.7 PIR 98-0112, Revising the ODCM with an OTSC

3.1.8 Technical Requirements Manual

3.1.9 NEI Letters 06-00288, 06-00331, 06-00332 ***4/07***

3.2 Commitments

3.2.1 None

4.0 DEFINITIONS

4.1 UNRESTRICTED AREA shall be any area at or beyond the SITE BOUNDARY access to which is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or for industrial, commercial, institutional and/or recreational purposes.

4.2 Source Check - A source check shall be the qualitative assessment of channel response when the channel sensor is exposed to a source of increased radioactivity.

5.0 RESPONSIBILITIES

5.1 The Manager Chemistry/Radiation Protection is responsible for the ODCM.

6.0 PROCEDURE

6.1 Revision Of The ODCM

NOTE

To comply with Technical Specification 5.5.1, revisions to the ODCM are not permitted via APF 15C-004-04, ON THE SPOT CHANGE form (3.1.7).

6.1.1 All revisions to the ODCM are to be submitted through the Manager Chemistry/Radiation Protection via a document revision request (APF 15C-004-01).

6.1.2 The Manager Chemistry/Radiation Protection shall ensure the Document Revision Request (APF 15C-004-01) package includes the following:

1. Each change shall be identified by markings in the margins of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (e.g., month/year) the change was implemented.

2. Sufficient information to support the change together with the appropriate analyses or evaluations justifying the change(s) and

3. A determination that the change will maintain the level of Radioactive Effluent Control required by 10 CFR 20.106 (gaseous effluent), 10CFR 20.1302 (liquid effluent), 40 CFR Part 190, 10 CFR 50.36A, and Appendix I to 10 CFR Part 50 and not adversely impact the accuracy or reliability of effluent dose, or setpoint calculations.

6.1.3 The ODCM revision shall become effective after review and acceptance by the PSRC and the approval of the Plant Manager.

6.2 ODCM Submittal To NRC

6.2.1 Changes to the ODCM shall be submitted to the Commission in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Annual Radioactive Effluent Release Report for the period of the report in which any change to the ODCM was made.

7.0 RECORDS

7.1 The following is a lifetime QA Record:

7.1.1 AP 07B-003, OFFSITE DOSE CALCULATION MANUAL

8.0 FORMS

8.1 None

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Wolf Creek Generating Station

Offsite Dose Calculation Manual

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1.0 Introduction

The Offsite Dose Calculation Manual describes the Radioactive Effluent Controls Program. The implementation of this program ensures compliance with the requirements of 10 CFR 50.36, 10 CFR 20.106, 10 CFR 20.1302, 10 CFR 50 Appendix I and 40 CFR 190.

On January 1, 1994, 10CFR20.20.1001-20.2402 was implemented. Wolf Creek continues to maintain the existing level of gaseous effluent control, 10 CFR 20.106. Compliance with 10 CFR 20.106 has been determined by the NRC to be ALARA.

On December 18, 1999 Wolf Creek implemented 10 CFR 20.1302 limits for radioactive liquid effluents. The concentration of radioactive material released in liquid effluents to unrestricted area conforms to 10 times the concentration values in Appendix B, Table 2, Column 2, to 10 CFR 20.1001-20.2402.

The ODCM describes the methodology and parameters used in the calculation of offsite doses due to radioactive liquid and gaseous effluents. The ODCM contents for calculation of dose are based on "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants (NUREG-0133)," and Regulatory Guide 1.109, Revision 1.

Dose calculations are performed for the limiting age group i.e., Adult age group for the liquid pathway, and the Child age group for gaseous effluent organ doses.

The ODCM provides the limitations on the operability of radioactive liquid and gaseous monitoring instrumentation including surveillance tests and setpoint determination. Each Surveillance Requirement shall be performed within the specified surveillance interval with a maximum allowable extension not to exceed 25% of the specified interval.

The ODCM provides descriptions of the information that should be included in the Annual Radioactive Effluent Release Reports.

2.0 Liquid Effluents

2.1 Concentration - Compliance With 10 CFR 20

The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentration specified in 10 CFR Part 20, Appendix B, Table II, Column 2, for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2x 10^{-4} microCurie/mL total activity. (USAR Chapter 11) ***6/01***

2.1.1 Remedial Action

With the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeding the above limits, immediately restore the concentration to within the above limits.

2.1.2 Surveillance Requirements

To show compliance with this requirement, concentrations of actual liquid effluents will be determined by performing Isotopic Analyses. Radioactive liquid wastes shall be sampled and analyzed according to the sampling and analysis program of Table 2-1.

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TABLE 2-1
RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

LIQUID RELEASE TYPE	SAMPLE FREQUENCY	PRINCIPAL GAMMA EMITTERS	I-131	DISSOLVED/ ENTRAINED GASES (GAMMA)	GROSS ALPHA AND H-3	Sr-89, Sr-90	Fe-55
1. Batch Tanks (2)							
a. THB07A&B LLD (1)	P	P(3) 5E-7	P 1E-6	M 1E-5	M Composite(4) 1E-7 for Alpha 1E-5 for H-3	Q Composite(4) 5E-8	Q Composite(4) 1E-6
b. THF04A&B LLD (1)	P	P(3) 5E-7	P 1E-6	M 1E-5	M Composite(4) 1E-7 for Alpha 1E-5 for H-3	Q Composite(4) 5E-8	Q Composite(4) 1E-6
2. Continuous Releases (5)							
a. Steam Generator Blowdown LLD(1)	Daily (6)	W(3) Composite(4) 5E-7	W Composite(4) 1E-6	M 1E-5	M Composite(4) 1E-7 for Alpha 1E-5 for H-3	Q Composite(4) 5E-8	Q Composite(4) 1E-6
b. Turbine Building Sump LLD(1)	Daily (6)	W(3) Composite(4) 5E-7	W Composite(4) 1E-6	M 1E-5	M Composite(4) 1E-7 for Alpha 1E-5 for H-3	Q Composite(4) 5E-8	Q Composite(4) 1E-6
c. Waste Water Treatment LLD(1)	Daily (6)	W(3) Composite(4) 5E-7	W Composite(4) 1E-6	M 1E-5	M Composite(4) 1E-7 for Alpha 1E-5 for H-3	Q Composite(4) 5E-8	Q Composite(4) 1E-6
d. Lime Sludge Pond LLD (1)	Daily (6)	W(3) Composite(4) 5E-7	W Composite(4) 1E-6	M 1E-5	M Composite(4) 1E-7 for Alpha 1E-5 for H-3	Q Composite(4) 5E-8	Q Composite(4) 1E-6

LLD = (μCi/mL)

TABLE 2-1 (Continued)

TABLE NOTATIONS

(1) The LLD is defined, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\, s_b}{E \times V \times 2.22 \times 10^6 \times Y \times Decay}$$

Where:

LLD = the "a priori" lower limit of detection (microCuries per unit mass or volume),

s_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, (counts per minute), $s_b = \sqrt{B} / LT$

Where: B = background sum (counts)

LT = live time (minutes),

E = the counting efficiency (counts per disintegration),

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

2.22×10^6 = the number of disintegrations per minute per microCurie,

Y = the fractional radiochemical yield, when applicable,

Decay = decay factor(s), There are three decay factors that may be appropriate for use depending on the nature of the sample and the half life of the nuclide. Any combination of the three may be used. The factors are as follows:

A) This decay factor corrects for decay from the time of sampling to the start of the analysis.

$e^{-\lambda \Delta t_s}$, where:

Δt_s = decay time = acquisition start time - sample time

TABLE 2-1 (Continued)
TABLE NOTATIONS

λ = ln2/half-life

B) This decay factor corrects for decay during the analysis.

$$\frac{1 - e^{-\lambda RT}}{\lambda \times RT}$$

λ = ln2/half-life

RT = real time of counting

C) This decay factor corrects for decay during sampling.

$$\frac{1 - e^{-\lambda \Delta td}}{\lambda \Delta td}$$

λ = ln2/half-life

td = deposition time = sample time - deposition start time

NOTE

All times used in decay calculations should be in the same units.

Typical values of E, V, Y, t_s, t_d should be used in the calculation.

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

(2) A batch release is the discharge of liquid wastes of a discrete volume. Prior to sampling for analyses, each batch shall be isolated, and then thoroughly mixed by a method described in plant procedures to assure representative sampling.

TABLE 2-1 (Continued)
TABLE NOTATIONS

(3) The principal gamma emitters for which the LLD specification applies include the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the annual Radioactive Effluent Release Report in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

(4) 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 that is representative of the liquids released. Prior to analysis, all samples taken for the composite shall be thoroughly mixed in order for the composite samples to be representative of the effluent release.

(5) A continuous release is the discharge of liquid wastes of a nondiscrete volume, e.g., from a volume of a system that has an input flow during the continuous release.

(6) Samples shall be taken at the initiation of effluent flow and at least once per 24 hours thereafter while the release is occurring. To be representative of the liquid effluent, the sample volume shall be proportioned to the effluent stream discharge volume. The ratio of sample volume to effluent discharge volume shall be maintained constant for all samples taken for the composite sample.

FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 184 days.
R	At least once per 18 months.
S/U	Prior to each reactor startup.
N.A.	Not applicable.
P	Completed prior to each release.

2.2 Dose - Compliance With 10 CFR 50 Appendix I

The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released, from each unit, to UNRESTRICTED AREAS shall be limited: ***1/01***

a. During any calendar quarter to less than or equal to 1.5 mrems to the whole body and to less than or equal to 5 mrems to any organ, and

b. During any calendar year to less than or equal to 3 mrems to the whole body and to less than or equal to 10 mrems to any organ.

2.2.1 Remedial Action

With the calculated dose from the release of radioactive materials in liquid effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, a Special Report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits. This Special Report shall also include the 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 Part 141, Clean Drinking Water Act. This requirement of (1.) and (2.) are applicable only if drinking water supply is taken from the receiving body within 3 miles of the plant discharge.

2.2.2 Surveillance Requirements

Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined using the following methodology at least once per 31 days.

$$D_T = \Sigma_i \left(A_{iT} \sum_{l=1}^{m} \Delta t_L C_{iL} F_L \right)$$

Where,

D_T = the cumulative dose commitment to the total body or any organ, T, from the liquid effluent for the total

$$\text{time period} \sum_{L=1}^{m} \Delta t_L, \text{in mrem}$$

Δt_L = the length of the Lth time period over which C_{iL} and F_L are averaged for all liquid releases, in hours.

C_{iL} = the average concentration of radionuclide, 'i', in undiluted liquid effluent flow during time period Δt_L, in µCi/mL.

F_L = the near field average dilution factor for C_{iL} during any liquid effluent release where:

$$F_L = \frac{f}{(F)K}$$

Where:

f = Liquid Radioactive Waste Flow

F = Discharge Structure Exit Flow, the sum of the release and dilution flow.

K = Applicable factor; the site dependent value for the mixing effect of the discharge structure. This value is conservatively assumed to be 1 (one) for this section.

A_{iT} = The site related ingestion dose commitment factor to the total body or any organ, 'T', for each identified principal gamma and beta emitter, mrem/hr per µCi/mL. See Tables A.4-1 through A.4-4.

The limiting age group for liquid dose calculations is the Adult age group.

$$A_{iT} = 1.14E5\,(U_W / D_W + U_F \times BF_i)DF_i$$

Where,

DW = Dilution factor from the near field area to the potable water intake for water consumption, for Wolf Creek Generating Station this factor is 1 (one).

BF_i = Bioaccumulation factor for radionuclide 'i', in fish, pCi/Kg per pCi/l, from Table A.1-1 from Regulatory Guide 1.109 (Rev. 1).

DF_i = Adult dose Conversion factor for radionuclide, 'i', in mrem/pCi, from Table A.3-1 through A.3-4, from Regulatory Guide 1.109 (Rev. 1).

U_W = Adult water consumption, (730 l/yr.from Reg. Guide 1.109)

U_F = Adult fish consumption, (21 kg/yr.from Reg. Guide 1.109)

1.14E5 = Units conversion factor = $\frac{10^6 \text{ pCi} / \mu Ci \text{ x } 10^3 \text{ ml / Kg}}{8760 \text{ hr / yr}}$

The dose calculations are based on the actual isotopic analysis of the radioactive liquid effluents, the radioactive liquid effluent flow, and the dilution flow.

2.3 Projected Dose

The Liquid Radwaste Treatment System shall be OPERABLE and appropriate portions of the system shall be used to reduce releases of radioactivity when the projected doses due the liquid effluent, from each unit, to UNRESTRICTED AREAS would exceed 0.06 mrem to the whole body or 0.2 mrem to any organ in a 31 day period. ***1/01***

2.3.1 Remedial Action

With radioactive liquid waste being discharged without treatment and in excess of the above limits and any portion of the Liquid Radwaste Treatment System not in operation, prepare and submit to the Commission within 30 days, a Special Report that includes the following information:

a. Explanation of why liquid radwaste was being discharged without treatment, identification of any inoperable equipment or subsystems, and the reason for the inoperability,

b. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

c. Summary description of action(s) taken to prevent a recurrence.

2.3.2 Surveillance Requirements

2.3.2.1 Doses due to liquid releases from each unit to UNRESTRICTED AREAS shall be projected at least once per 31 days in accordance with the following methodology when Liquid Radwaste Treatment Systems are not being fully utilized.

$$D_{31} = \left[\frac{A}{T}\right] \times 31$$

Where,

D_{31} = Projected 31 day dose

A = Cumulative dose for previous three months

T = Number of days that the cumulative dose occurred in A above

2.3.2.2 The installed Liquid Radwaste Treatment System shall be considered OPERABLE by meeting the requirements of Sections 2.1 and 2.2.

2.4 Instrumentation

The radioactive liquid effluent monitoring instrumentation channels shown in Table 2-2 shall be OPERABLE with their Alarm/Trip Setpoints set to ensure that the limits of Section 2.1 are not exceeded. The Alarm/Trip Setpoints of these channels shall be determined and adjusted in accordance with the methodology and parameters described in Section 2.4.4.

2.4.1 Remedial Action

2.4.1.1 With a radioactive liquid effluent monitoring instrumentation channel Alarm/Trip Setpoint less conservative than required by the above, immediately suspend the release of radioactive liquid effluents monitored by the affected channel, or declare the channel inoperable.

2.4.1.2 With less than the minimum number of radioactive liquid effluent monitoring instrumentation channels OPERABLE, take the ACTION shown in Table 2-2. Restore the inoperable instrumentation to OPERABLE status within the time specified in the ACTION, or explain in the next annual Radioactive Effluent Release Report, why this inoperability was not corrected within the time specified.

2.4.2 Surveillance Requirements

Each radioactive liquid effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL OPERATIONAL TEST at the frequencies shown in Table 2-3.

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TABLE 2-2
RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	ACTION
1. Radioactivity Monitors Providing Alarm and Automatic Termination of Release		
a. Liquid Radwaste Discharge Monitor (HB-RE-18)	1	31
b. Steam Generator Blowdown Discharge Monitor (BM-RE-52)	1	32
c. Turbine Building Drain Monitor (LE-RE-59)	1	32
d. Secondary Liquid Waste System Monitor (HF-RE-45)	1	31 *6/01*
e. Wastewater Treatment System Influent Monitor (HF-RE-95)	1	32
2. Flow Rate Measurement Devices		
a. Liquid Radwaste Discharge Line		
1) Waste Monitor Tank A Discharge Line	1	33
2) Waste Monitor Tank B Discharge Line	1	33
b. Steam Generator Blowdown Discharge Line	1	33
c. Secondary Liquid Waste System Discharge Line	1	33 *6/01*

TABLE 2-2 (Continued)
ACTION STATEMENTS

Action 31 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 14 days provided that prior to initiating a release:

a. At least two independent samples are analyzed in accordance with Section 2.1.2, and

b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge line valving.

Otherwise, suspend release of radioactive effluents via this pathway.

Action 32 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided grab samples are analyzed for principle gamma emitters and I-131 at a lower limit of detection as specified in Table 2-1.

a. At least once per 12 hours when the specific activity of the secondary coolant is greater than 0.01 microCurie/gram DOSE EQUIVALENT I-131, or

b. At least once per 24 hours when the specific activity of the secondary coolant is less than or equal to 0.01 microCurie/gram DOSE EQUIVALENT I-131.

TABLE 2-2 (Continued)
ACTION STATEMENTS

Action 33 - With the number of channels OPERABLE less than required by the Minimum Channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided the flow rate is estimated at least once per 4 hours during actual releases. Pump performance curves generated in place may be used to estimate flow.

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TABLE 2-3

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION
SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL OPERATIONAL TEST
1. Radioactivity Monitors providing alarm and automatic termination of release				
a. Liquid Radwaste Discharge Monitor (HB-RE-18)	D	P	R(2)	Q(1)
b. Steam Generator Blowdown Discharge Monitor (BM-RE-52)	D	M	R(2)	Q(1)
c. Turbine Building Drain Monitor (LE-RE-59)	D	M	R(2)	Q(1)
d. Secondary Liquid Waste System Monitor (HF-RE-45)	D	P	R(2)	Q(1)
e. Wastewater Treatment System Influent Monitor (HF-RE-95)	D	M	R(2)	Q(1)
2. Flow Rate Measurement Devices				
a. Liquid Radwaste Discharge Line	D(3)	N.A.	R	N.A.
b. Steam Generator Blowdown Discharge Line	D(3)	N.A.	R	N.A.
c. Secondary Liquid Waste System Discharge Line	D(3)	N.A.	R	N.A.

TABLE 2-3 (Continued)

TABLE NOTATIONS

(1) The CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occur as appropriate if any of the following conditions exists:

a. Instrument indicates measured levels above the Alarm/Trip Setpoint (isolation and alarm), or

b. Circuit failure (alarm only), or

c. Instrument indicates a downscale failure (alarm only), or

d. Instrument controls not set in operate mode (alarm only).

(2) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference (gas or liquid and solid) standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range or energy, measurement range, and establish monitor response to a solid calibration source. For subsequent CHANNEL CALIBRATION, NIST traceable standard (gas, liquid, or solid) may be used; or a gas, liquid, or solid source that has been calibrated by relating it to equipment that was previously (within 30 days) calibrated by the same geometry and type of source standard traceable to NIST.

(3) CHANNEL CHECK shall consist of verifying indication of flow during periods of release. CHANNEL CHECK shall be made at least once per 24 hours on days on which continuous, periodic, or batch releases are made.

2.4.3 Liquid Monitor Calibration Methodology

The five monitors associated with liquid releases are listed below:

Monitor ID	Description
0-BM-RE-52	Steam Generator Blowdown Discharge Monitor
0-LE-RE-59	Turbine Building Drain Monitor
0-HF-RE-45	Secondary Liquid Waste System Monitor
0-HB-RE-18	Liquid Radwaste Discharge Monitor
0-HF-RE-95	Wastewater Treatment System Influent Monitor

Liquid effluent streams are monitored by an NaI(Tl) Detector. The detector operates in a gross counting mode and is gamma sensitive.

Calibration of the liquid monitors shall be performed using three standard solutions of Cs-137. The solutions shall cover the appropriate range of the detector and have concentrations of approximately 5×10^{-7} μCi/cc, 1×10^{-5} μCi/cc, and 1×10^{-3} μCi/cc. The solutions shall be presented to the detector and the meter reading in counts per minute shall be recorded. A determination of linearity shall be produced using the counts per minute vs. concentration data.

2.4.4 Liquid Effluent Monitor Setpoints

The Alarm/Trip Setpoints for the Liquid Effluent Radiation Monitors are based on instantaneous concentration limits of 10 CFR 20, Appendix B, Table 2, Column 2 applied at the boundary of the restricted area. Specifically, the High Alarm Setpoint will correspond to the 10 CFR Part 20 limits at the Boundary of the restricted area; the Alert Alarm Setpoint is set to 80% of the High Alarm/Trip Setpoint. Since the high alarm/trip initiates isolation of the particular system and termination of the release, this setpoint represents assurance that the instantaneous liquid release limit of 10 CFR Part 20 is not exceeded. Auditable records shall be maintained indicating the actual setpoints used at all times.

The calculated Alarm and Trip Action Setpoints for the Liquid Effluent Line Monitors must satisfy the following equation:

$$\frac{cf}{F+f} \leq C$$

Where:

C = The liquid effluent concentration limit (ECL) implementing Section 2.1 in µCi/mL.

c = The Setpoint, in µCi/mL, of the Radioactivity Monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the Setpoint, which is inversely proportional to the Volumetric Flow of the effluent line and directly proportional to the Volumetric Flow of the dilution stream plus the effluent stream, represents a Value, which if exceeded would result in concentrations exceeding the limits of 10 CFR 20 in the restricted area.

f = The Pump Flow Rate as measured at the Radiation Monitor Location, in Volume per Unit Time, but in the same units as F, below.

F = The Dilution Water Flow Rate as measured prior to the release point, in Volume per Unit Time.

Thus, the expression for determining the setpoint on the Liquid Radwaste Effluent Line Monitor becomes:

$$c \leq \frac{C(F+f)}{f} \ (\mu Ci/ml)$$

If no gamma activity is detected calculate the monitor setpoint by assigning the available ECL fraction to I-131.

2.4.4.1 Continuous Liquid Effluent Monitors

The three monitors associated with continuous liquid releases are listed below:

Monitor ID	Description
0-BM-RE-52	Stm Generator Blowdown Discharge Monitor
0-LE-RE-59	Turbine Building Drain Monitor
0-HF-RE-95	Waste Water Treatment System Influent Monitor

The Steam Generator Blowdown Discharge Effluent Monitor continuously monitors the Blowdown Discharge Pump Outlet to detect excess radioactivity due to System Demineralizer breakthrough or abnormal Primary to Secondary leakage. The Blowdown Discharge Monitor's High Alarm Setpoint initiates CLOSURE of the Blowdown Isolation Valves and the Blowdown Discharge Valve. Similarly, the High Radiation Alarm on the Turbine Building Drain Monitor and Waste Water Treatment Monitor initiates CLOSURE of the Drain Line Isolation Valves to prevent the release of radioactive effluents.

Monitor setpoints will be conservatively based on I-131, the most restrictive isotope expected to be present. This is particularly appropriate for the Turbine Building Drain Line Monitor since the most probable source is the Secondary Steam System which is expected to have negligible activity unless there is a significant Primary to Secondary leak. Due to changing activities, it will not be possible to select a radionuclide distribution on which to base the monitor setpoint. Additionally, maximum effluent flows and minimum dilution flows will normally be assumed.

The High Alarm/Trip Setpoint will be set to correspond to the I-131 ECL limit at the boundary of the restricted area from 10 CFR Part 20, Appendix B, Table 2, Column 2. The alert alarm is set one order of magnitude below the High Alarm/Trip Setpoint for release points that have dilution and to the High Alarm value for those without dilution. This High Alarm/Trip Setpoint assures the limits of Section 2.1 are not exceeded at the boundary of the restricted area.

In the event that an alarm is TRIPPED, an evaluation of the system will be made by taking an actual isotopic and flow analysis of the discharge.

The above continuous liquid effluents are not radioactive effluents until activity has been detected by the Liquid Effluent Monitor, a Tritium analysis of the Secondary system, or a gross Beta analysis of the Secondary system. At that time an analysis of the effluent will be made to verify activity in the system effluent. During periods of time when the above liquid effluents are not radioactive the High Alarm/Trip Setpoint may be set to 1.5 times the background count rate.

2.4.4.1.1 **Steam Generator Blowdown Discharge Monitor**

$$\text{SETPOINT}\ (\mu\text{Ci/ml}) = ECL_{I\text{-}131} \times \frac{F_m + F_B}{F_B}$$

where,

$ECL_{I\text{-}131}$ = Effluent Concentration Limit of I-131, 1E-5 (10 times concentration limit of I-131)

F_m = Dilution flow rate.

F_B = Blowdown flow rate.

The setpoint calculation is based on the minimum dilution flow rate, the maximum possible blowdown flow rate, and, due to changing conditions, I-131 which is the most restrictive isotope expected to be present.

On the event that an alarm is reached, the setpoint will be reevaluated using the actual dilution flow rate, the actual blowdown flow rate, and the actual isotopic analysis as outlined in Section 2.4.4.2. This evaluation will be used to ensure the limit of Section 2.1 was not exceeded. The setpoint will still be based on 10 times the concentration limit of I-131 due to the changing conditions of activity and I-131 being the most restrictive isotope.

2.4.4.1.2 Turbine Building Drain Monitor And Waste Water Treatment System Influent Monitor

$$\text{SETPOINT}\ (\mu\text{Ci/ml}) = \text{ECL}_{\text{I-131}} \times \frac{F_m + F_T}{F_T}$$

ECL_{I-131} = 1E-5 (10 times concentration limit of I-131)

F_m = Dilution flow rate

F_t = Effluent flow rate

The setpoint is based on the minimum dilution flow rate, the maximum possible effluent flow rate, and the most restrictive isotope expected to be present, I-131.

On the event that an alarm is reached, the release will be evaluated to see if the limit of Section 2.1 was exceeded by using the actual Dilution Flow Rate, the actual Effluent Flow Rate, and the actual isotopic analysis as outlined in Section 2.4.4.2. The setpoint will still be based on the 10 times the ECL of I-131 due to the changing conditions of activity and I-131 being the most restrictive isotope.

2.4.4.2 Batch Radioactive Liquid Effluent Monitor

The two monitors associated with liquid batch releases are listed below:

Monitor ID	Description
0-HF-RE-45	Secondary Liquid Waste System Monitor
0-HB-RE-18	Liquid Radwaste Discharge Monitor

The setpoint is a function of dilution flow rate, tank flow rate, and isotopic composition. A laboratory isotopic analysis is made of each batch prior to discharge. Based on the isotopic analysis and existing flow condition, the setpoint will be calculated and set on the appropriate monitor to ensure the concentration limits of 10 CFR 20, Appendix B, Table 2, Column 2 is not exceeded.

The setpoints are determined using the following methodology:

1) Determine concentrations of radioactivity of the batch being considered for release.

The isotopic concentration of the batch is the sum of the concentrations for the isotopes present as determined from the analysis required in Table 2-1.

$$\sum_i C_i = \sum_g C_g + C_a + C_s + C_t + C_f$$

Where:

C_i = The concentration of nuclide i as determined by the analysis of the waste sample.

C_g = The sum of the concentrations C_g of each measured gamma emitting nuclide observed by gamma-ray spectroscopy of the waste sample.

*C_a = The measured concentration C_a of alpha emitting nuclides observed by gross alpha analysis of the monthly composite sample.

*C_s = The measured concentrations of Sr-89 and Sr-90 in liquid waste as determined by analysis of the quarterly composite sample.

*C_t = The measured concentration of H-3 in liquid waste.

*C_f = The measured concentration of Fe-55 in liquid waste as determined by analysis of the quarterly composite.

*Values for these concentrations will be based on previous composite sample analysis as required by Table 2-1.

2) The measured radionuclide concentrations are used to calculate a dilution factor, F_d, which is the ratio of total dilution flow rate to tank flow rate required to assure that the limiting concentrations of Section 2.1 are met at the point of discharge. This is referred to as the required dilution factor and is determined according to:

$$F_d = \left(\Sigma_i \frac{C_i}{ECL_i} \right) x F_s$$

Where:

C_i = Measured concentrations of C_g, C_a, C_s, C_t and C_f, as defined in Step 1. Terms C_a, C_s, C_t and C_f, will be included in the calculation as appropriate.

ECL_i = ECL_g, ECL_a, ECL_s, ECL_t and ECL_f, are limiting concentrations of the appropriate radionuclide from 10 CFR 20, Appendix B, Table 2, Column 2. For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-04, µCi/mL total activity.

F_s = The safety factor; a conservative factor used to compensate for statistical fluctuations and errors of measurement default value is 0.5.

3) For the case $F_d < 1$, the waste tank effluent concentration meets the limits of 10 CFR 20 without dilution and the effluent may be released at any desired flow rate. For the case $F_d > 1$, a modified dilution factor, F_{dn}, must be determined so that available dilution flow may be apportioned among simultaneous discharge pathways.

$$F_{dn} = F_d / F_a$$

Where F_a is the allocation factor which will modify the required dilution factor so that simultaneous liquid releases may be made without exceeding 10 CFR 20 limits.

The most straight-forward determination of allocation factor is:

$$F_a = 1/n$$

Where:

n = The number of liquid discharge pathways for which $F_d > 1$ and which is planned for simultaneous release.

However, this value for F_a may be unnecessarily restrictive in that all release pathways are apportioned the same fraction of the available dilution stream, regardless of the relative concentrations of each of the sources.

Since the radionuclide concentration of the two continuous sources is expected to be less than that of the batch release source, it is acceptable to allocate smaller portions of the dilution stream to the continuous releases and a larger portion to the batch releases.

Therefore, F_a is defined as a flexible quantity with a default value of 1/n. Prior to initiating simultaneous release, a check will be made to assure that the sum of the allocation factors assigned to pathways for the simultaneous release is < 1.

4) The calculated maximum permissible waste tank effluent flow rate, F_{max}, is based on the modified dilution factor, F_{dn}, and the effective dilution flow rate, F_{eff}.

The cooling lake into which the effluent is discharged is also the source of the dilution stream. It is therefore necessary to take into account the recirculation of previously emitted radionuclides should they be detected by sample analysis of the cooling lake water. This is accomplished by defining an effective dilution flow rate as:

$$F_{eff} = F_m \left[1 - \sum_i \frac{LC_i}{ECL_i} \right]$$

Where:

F_m = The expected minimum dilution water flow rate.

LC_i = Measured concentration of nuclide i in the cooling lake water sample.

ECL_i = Effluent concentration limit of radionuclide i from 10CFR20, Appendix B, Table 2, Column 2.

For the purpose of setpoint calculations the expected minimum dilution flow rate is assigned a value based upon the type and number of pumps RUNNING into the circulating water piping.

Having established the values of F_{dn} and F_{eff}, the calculated maximum permissible waste tank flow rate is given by

$$f_{max} \leq \frac{F_{eff} + f_p}{F_{dn}} \quad \frac{F_{eff}}{f_{dn}} \text{ for } f_p \langle\langle Feff$$

Where f_p if the expected effluent flow rate; normally the rated capacity of the effluent pump. Thus the pump flow rate is set at or below f_{max}. Even though the value of f_{max} may be larger than the actual effluent pump capacity, f_p, it does represent the upper limit to the effluent flow rate, whereby the requirement of 10CFR20 may still be met. If $F_d \leq 1$, the effluent pump flow rate may be assigned any value since the waste tank effluent concentration meets the limits of 10CFR20 without dilution and the release may be made without regard to the setpoints for other release pathways. For those discharge pathways selected to be secured during the release under consideration, the pump flow rate should be set at as low a value as practicable to detect any inadvertent release.

A setpoint for the dilution stream flow rate is not applicable since the minimum flow rate is administratively set.

5) The liquid radiation monitor setpoint may now be determined based on the values of Σ_i, C_i, and f_{max}. The monitor response is primarily to gamma radiation, therefore, the actual setpoint is based on Σ_g, C_g. The calculated monitor setpoint concentration is determined as follows:

$$c = A \sum_i C_g \ (\mu Ci/ml)$$

Where:

A = Adjustment factor which will allow the setpoint to be established in a practical manner for convenience and to prevent spurious alarms.

$$A = \frac{f_{max}}{f_p}$$

If A > 1, calculated c and determine the maximum value for the actual monitor setpoint (μCi/mL).

If A < 1, no release may be made.

If F_d < 1, no further dilution is required and the release may be made without regard to available dilution or to other releases made simultaneously. However, it is necessary to establish a monitor setpoint which will provide alarm should the release concentration inadvertently exceed 10CFR20 limits. This can be accomplished by establishing the adjustment factor as follows:

$$A = 1/F_d$$

3.0 Gaseous Effluents

Gaseous effluent releases from the Unit Vent and Radwaste Building Vent are monitored continuously. The Unit Vent is the release point for the Fuel/Auxiliary Building, access control area, containment purge, and condenser air discharge. The Radwaste Building Vent is the release point for Waste Gas Decay Tanks and the Radwaste Building Ventilation System.

Waste Gas Decay Tank releases and Containment Building releases are treated as batch releases. Waste Gas Decay Tank releases are monitored by the Radwaste Building Exhaust Monitor. Containment Building releases (purges) are monitored by the Containment Purge System monitors and the Plant Unit Vent Monitor.

Monitor identifications are as follows:

Monitor ID	Release Point Description
O-GT-RE-21 A and B	Unit Vent (Fuel/Auxiliary Building, access control area, containment purge, condenser air discharge)
O-GH-RE-10 A and B	Radwaste Building vent (Radwaste Building, waste gas decay tank discharge. Acts to isolate Waste Gas Decay Tank discharge)
O-GT-RE-22 & 33	Containment Purge System Monitor (acts to isolate the purge; is not an effluent monitor) *5/02*
O-GT-RE-31 & 32	Containment Atmosphere Monitor (acts to isolate purge; not an effluent monitor)

The setpoint for monitors may be determined either based on total body dose or skin dose rate. The dose rate limits are for dose rates at the unrestricted area boundary. The monitor setpoint is the lesser of the total body dose rate or skin dose rate.

3.1 Dose Rate - Compliance With 10 CFR 20

The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be limited to the following: ***1/01***

a. For noble gases: Less than or equal to 500 mrems/yr to the whole body and less than or equal to 3000 mrems/yr to the skin, and

b. For Iodine-131 and 133, for tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: Less than or equal to 1500 mrems/yr to any organ.

3.1.1 Remedial Action

With the dose rate(s) exceeding the above limits, immediately restore the release to within the above limit(s).

3.1.2 Surveillance Requirements

The dose rate to radionuclides in gaseous effluents shall be determined to be within the above limits in accordance with the methodology described below by obtaining representative samples and performing analyses in accordance with the sampling and analysis program specified in Table 3-1.

Based on the methodology of NUREG-0133;

a. Release rate limit for nobles gases:

$$\sum_i K_i\left(\overline{X/Q}\right) Q_i \;<\; 500 \text{ mrem / yr for the total body.}$$

and

$$\sum_i \left(L_i + 1.1\, M_i\right)(X/Q)\, Q_i < 3000 \text{ mrem / yr for the skin}$$

Where:

K_i = Total body dose factor due to gamma emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$, from Table A.1-2.

$\left(\overline{X/Q}\right)$ = 2.2E-06 sec/m3, the highest calculated annual average relative concentration at the restricted area boundary in the north sector.

Q_i = Release rate of radionuclide i from vent, in µCi/sec.

L_i = Skin dose factor due to beta emissions for each identified noble gas radionuclide, in mrem/yr per µCi/m^3, from Table A.1-2.

M_i = Air dose factor due to gamma emissions for each identified noble gas radionuclide, in mrad/yr per µCi/m^3 from Table A.1-2.

1.1 = Conversion constant of air dose to skin dose.

b. Release rate limit for all radionuclides and radioactive materials in particulate form and radionuclides other than noble gases:

$$\sum_i \left(P_i\right) IN \times \left(X/Q\right) \times Q_i\right) < 1500 \text{ mrem/yr to any organ.}$$

Where:

Q_i = The release rate of radionuclides, i, in gaseous effluent from all vent releases, in µCi/sec.

$P_{(i)}IN$ = The dose parameter for radionuclides other than nobles gases for the inhalation pathway, in mrem/yr per µCi/m^3. See Table A.5-1.

$\left(\overline{X/Q}\right)$ = 2.2E-06 sec/m3 (the highest annual average). The highest calculated annual average relative concentration for estimating the dose to any individual at the unrestricted area boundary in the N sector.

All radionuclides are assumed to be released in elemental form. The limit is applicable to the location (unrestricted area boundary or beyond), characterized by the value of X/Q which results in the maximum total body or skin dose commitment. The factors K_i, L_i, and M_i relate the radionuclide airborne concentrations to various dose rates assuming a semi-infinite cloud. These factors are taken from Table B-1 of the Regulatory Guide 1.109 and multiplied by 10^6 to convert pCi^{-1} to μCi^{-1} and listed in Table A.1-2.

The following equation for $P_{(i)IN}$ was taken from NUREG 0133:

$P_{(i)IN}$ (Inhalation);

$$P_{(i)IN} = K' (BR) DFA_i \left(mrem / yr \text{ per } \mu Ci / m^3\right)$$

Where:

K' = a constant of unit conversion, 10^6 pCi/μCi.

BR = the breathing rate of the child age group in m^3/yr

DFA_i = the maximum organ inhalation dose factor for the child age group for the i th radionuclide, in mrem/pCi. The total body is considered as an organ in the selection of DFA_i.

The age group considered is the child group. The child's breathing rate is taken as 3700 m^3/yr from Table E-5 of Regulatory Guide 1.109. The inhalation dose factors for the child, DFA_i are presented in Table E-9 of Regulatory Guide 1.109, in units of mrem/pCi.

Resolutions of the units yield:

$$P_i \text{ (Inhalation)} = 3.7 \times 10^9 \, DFA_i$$

The P_i value for tritium is:

$$P_i \text{ (Inhalation)} = 3.7 \times 10^9 \, DFA_i$$

ATTACHMENT A
(Page 35 of 162)
OFFSITE DOSE CALCULATION MANUAL

TABLE 3-1
RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sample Frequency	Principal Gamma Emitters	H-3 (Oxide)	I-131/ I-133	Gross Alpha	Sr-89, Sr-90
1. Unit Vent Gas LLD(1)	M	M(3)(2) 1E-4	M(4) 1E-6			
Particulate LLD(1)	Continuous(6)	W(7) 1E-11(2)			M 1E-11	Q Composite 1E-11
Charcoal LLD(1)	Continuous(6)			W(7) 1E-12/ 1E-10		
2. Radwaste Building Vent Gas LLD(1)	M	M(2) 1E-4	M 1E-6			
Particulate LLD(1)	Continuous(6)	W(7)(2) 1E-11			M 1E-11	Q (Composite) 1E-11
Charcoal LLD(1)	Continuous(6)			W(7) 1E-12/ 1E-10		
3. Containment Purge or Vent Gas LLD(1)	P(3)	P(3)(2) 1E-4	M 1E-6			
4. Waste Gas Decay Tanks Gas LLD(1)	P	P(2) 1E-4				

LLD = (μCi/ml)

TABLE 3-1 (Continued)
TABLE NOTATIONS

(1) The LLD is defined, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\ s_b}{E \times V \times (2.22E+6) \times Y \times Decay}$$

Where:

LLD = the "a priori" lower limit of detection (microCuries per unit mass or volume),

s_b = the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate, (counts per minute), $s_b = \sqrt{B / LT}$

Where: B = background sum (counts)

LT = live time (minutes),

E = the counting efficiency (counts per disintegration),

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

2.22E+6 = the number of disintegrations per minute per microCurie,

Y = the fractional radiochemical yield, when applicable,

Decay = decay factor(s), There are three decay factors that may be appropriate for use depending on the nature of the sample and the half life of the nuclide. Any combination of the three may be used. The factors are as follows:

A) This decay factor corrects for decay from the time of sampling to the start of the analysis.

$e^{-\lambda \Delta t_s}$, where:

Δts = decay time = acquisition start time - sample time

TABLE 3-1 (Continued)
TABLE NOTATIONS

λ = ln2/half-life

B) This decay factor corrects for decay during the analysis.

$$\frac{1 - e^{-\lambda RT}}{\lambda \times RT}$$

λ = ln2/half-life

RT = real time of counting

C) This decay factor corrects for decay during sampling.

$$\frac{1 - e^{-\lambda \Delta td}}{\lambda \Delta td}$$

λ = ln2/half-life

Δtd = deposition time = sample time - deposition start time

NOTE

All times used in decay calculations should be in the same units.

Typical values of E, V, Y, t_s, t_d should be used in the calculation.

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

TABLE 3-1 (Continued)

TABLE NOTATIONS

(2) The principal gamma emitters for which the LLD specification applies include the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 in noble gas releases and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, I-131, Cs-134, Cs-137, Ce-141 and Ce-144 in iodine and particulate releases. This list does not mean that only these nuclides are to be considered. Other gamma peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the annual Radioactive Effluent Release Report in the format outlined in Regulatory Guide 1.21, Appendix B, Revision 1, June 1974.

(3) Sampling and analysis shall also be performed following shutdown, startup, or a THERMAL POWER change greater than or equal to 15% of RATED THERMAL POWER within 1 hour period.

(4) Tritium grab samples shall be taken and analyzed at least once per 24 hours when the refueling canal is flooded.

(6) 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 Sections 3.1, 3.2 and 3.3.

(7) 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. For unit vent, 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 to sample once per 24 hours does not apply if analysis shows that both the DOSE EQUIVALENT I-131 concentration in the reactor coolant and the unit vent noble gas monitor activity have not increased more than a factor of 3.

FREQUENCY NOTATION

NOTATION	FREQUENCY
S	At least once per 12 hours.
D	At least once per 24 hours.
W	At least once per 7 days
M	At least once per 31 days.
Q	At least once per 92 days.
SA	At least once per 184 days.
R	At least once per 18 months.
S/U	Prior to each reactor startup.
N.A.	Not applicable.
P	Completed prior to each release.

3.2 Dose - Compliance With 10 CFR 50 Appendix I

3.2.1 Noble Gases

The air dose due to noble gases released in gaseous effluents, from each unit, to areas at and beyond the SITE BOUNDARY shall be limited to the following: ***1/01***

a. During any calendar quarter: Less than or equal to 5 mrads for gamma radiation and less than or equal to 10 mrads for beta radiation, and

b. During any calendar year: Less than or equal to 10 mrads for gamma radiation and less than or equal to 20 mrads for beta radiation.

3.2.1.1 Remedial Action

With the calculated air dose from radioactive noble gases in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, a special report that identifies the cause(s) for exceeding the limit(s) and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

3.2.1.2 Surveillance Requirements

Cumulative dose contributions for the current calendar quarter and calendar year for noble gases shall be determined in accordance with the following methodology at least once per 31 days. The dose calculations for the actual releases of radioactive noble gases in gaseous effluent will be consistent with the methodology provided in Reg. Guide 1.109, Rev. 1. The following dose calculations will be performed:

a. During any calendar quarter;

For gamma radiation;

$$D = 3.17E-8 \sum_{i=1} M_i \left[\left(\overline{X/Q} \right) x\, Q_i \right] \leq 5 \text{ mrad.}$$

For beta radiation:

$$D = 3.17E-8 \sum_{i=1} N_i \left[\left(\overline{X/Q} \right) x\, Q_i \right] \leq 10 \text{ mrad.}$$

b. During any calendar year:

For gamma radiation;

$$D = 3.17E-8 \sum_{i=1} M_i \left[\left(\overline{X/Q} \right) x\, Q_i \right] \leq 10 \text{ mrad.}$$

For beta radiation:

$$D = 3.17E-8 \sum_{i=1} N_i \left[\left(\overline{X/Q} \right) x\, Q_i \right] \leq 20 \text{ mrad.}$$

Where:

3.17 E-8 = The inverse of the number of seconds in a year.

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 A.1-2 (Reg. Guide 1.109, Table B-1, Col. 4).

N_i = The air dose factor due to beta emissions for each identified noble gas radionuclide, in mrad/year per $\mu Ci/m^3$ from Table A.1-2 (Reg. Guide 1.109, Table B-1, Column 2).

$\left(\overline{X/Q}\right)$ = 2.2E-06 sec/m3, the highest calculated annual average relative concentration at the restricted area boundary in the north sector.

Q_i = The release of noble gas radionuclides, 'i', in gaseous effluents, in μCi. Releases shall be cumulative over the calendar quarter or year as appropriate.

An average monthly air dose schedule should be setup to ensure section 3.2.1 is not exceeded. The average monthly air dose should be as follows:

a. For gamma radiation ≤ 1.6 mrad/mo.

For beta radiation ≤ 3.3 mrad/mo.

If the monthly average air doses for: (a) is exceeded, it should be noted that if the release is continued at the same (or higher) frequencies or activities the quarterly limit of Section 3.2.1.A will be exceeded.

b. For gamma radiation ≤ 0.8 mrad/mo.

For beta radiation ≤ 1.6 mrad/mo.

If the monthly average air doses for: (b) is exceeded, it should be noted that if the release is continued at the same (or higher) frequencies or activities the annual limit of Section 3.2.1.B will be exceeded.

If any of the above monthly average air doses are exceeded, evaluation of the causes of the high air dose should be performed and steps should be taken to reduce the activity or frequency (e.g. delay the release of a Waste Gas Decay Tank) of the release.

3.2.2 Radioiodines, Particulates and Other Radionuclides

The dose to a MEMBER OF THE PUBLIC from Iodine-131 and 133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from each unit, to areas at and beyond the SITE BOUNDARY shall be limited to the following: ***1/01***

a. During any calendar quarter: Less than or equal to 7.5 mrems to any organ; and

b. During any calendar year: Less than or equal to 15 mrems to any organ.

3.2.2.1 Remedial Action

With the calculated dose from the release of Iodine-131 and 133, tritium, and radionuclides in particulate form with half-lives greater than 8 days, in gaseous effluents exceeding any of the above limits, prepare and submit to the Commission within 30 days, a special report that identifies the cause(s) for exceeding the limits and defines the corrective actions that have been taken to reduce the releases and the proposed corrective actions to be taken to assure that subsequent releases will be in compliance with the above limits.

3.2.2.2 Surveillance Requirements

Cumulative dose contributions for the current calendar quarter and current calendar year for Iodine-131 and 133, tritium, and radionuclides in particulate form with half-lives greater than 8 days shall be determined in accordance with the following methodology at least once per 31 days. To show compliance, the dose calculations for the actual releases of the subject materials are consistent with the methodology provided in Regulation Guide 1.109, Revision 1. The following dose calculations will be performed:

a. $D\,(\text{mrem}) = 3.17\text{E-}8 \sum_i R_i\left[(WQ_i)\right] \leq 7.5 \text{ mrem}$

b. $D\,(\text{mrem}) = 3.17\text{E-}8 \sum_i R_i\left[(WQ_i)\right] \leq 15 \text{ mrem}$

Where:

3.17 E-8 = The inverse of the number of seconds in a year.

Q_i = The release of radioiodines, radioactive materials in particulate form and radionuclides other than noble gases in gaseous effluents, 'i', in µCi. Releases shall be cumulative over the calendar quarter or year as appropriate. The Q_i value shall be determined as the product of the flow rate through the release point and grab samples of the effluent analyzed in accordance with Table 3-1.

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

W = $(^X/Q)$, 2.2×10^{-6} sec/m^3 for the inhalation pathway.

W = $(^D/Q)$, 1.8 E-8 m^{-2}, for the food and ground plane pathways.

R_i = The dose factor for each identified radionuclide, 'i', in mrem/yr per µCi/m^3. See Table A.5-2 through Table A.5-20.

Where:

Inhalation Pathway Factor, $R^I{}_i$ [X/Q]

$$R^I{}_i\left[X/Q\right] = K'\left(BR\right)_a\left(DFA_i\right)_a\left(\text{mrem/yr per }\mu\text{Ci/m}^3\right)$$

Where:

K' = a constant of unit conversion, 10^6pCi/µCi.

$(BR)_a$ = The breathing rate of the receptor of age group (a), in m^3/yr.

The breathing rates $(BR)_a$ for the various age groups are tabulated below, as given in Regulatory Guide 1.109, Table E-5.

AGE GROUP (a)	BREATHING RATE (m^3/yr)
Infant	1400
Child	3700
Teen	8000
Adult	8000

$(DFA_i)_a$ = The maximum organ inhalation dose factor for the receptor of age group (a) for the i th radionuclide, in mrem/pCi. The body is considered as an organ in the selection of $(DFA_i)_a$. See Tables A.2-1, A.2-2, A.2-3, & A.2-4. From Regulatory Guide 1.109, Tables E-7,E-8, E-9 and E-10.

Ground Plane Pathway Factor, $R^G{}_i[D/Q]$

$$R^G{}_i[D/Q] = K'K''(SF)\,DFG_i\left[\left(1-e^{-\lambda_i t}\right)/\lambda_i\right]\left(m^2 \text{ x mrem / yr per } \mu Ci / sec\right)$$

Where:

K′ = A constant of unit conversion, 10^6 pCi/μCi.

K″ = A constant of unit conversion, 8760 hr/year.

λ_i = The decay constant for the i th radionuclide, sec^{-1}.

t = The exposure time, 4.73 E8 sec (15 years).

DFG_i = The ground plane dose conversion factor for the i th radionuclide (mrem/hr per pCi/m^2). See Table A.2-5. (Regulatory Guide 1.109, Table E-6).

SF = The shielding factor (dimensionless), 0.7 (Reg. Guide 1.109)

Grass-Cow-Milk Pathway Factor, $R^C{}_i[D/Q]$

$$R^C{}_i[D/Q] = K'\left(\frac{Q_F(U_{ap})}{\lambda_i + \lambda_w}\right)F_m(r)\,(DFL_i)_a\left(1/Y_p\right)\left(e^{-\lambda_i t_f}\right)\left(m^2 mrem / yr \text{ per } \mu Ci / sec\right)$$

Where:

K′ = A constant of unit conversion, 10^6 pCi/μCi.

Q_F = The cow's consumption rate, in Kg/day (wet weight), 50 kg/day. (Reg. Guide 1.109, Table E-3).

U_{ap} = The receptor's milk consumption rate for age (a), in liters/yr. (Reg. Guide 1.109, Table E-5).

Infant	=	330 1/yr
Child	=	330 1/yr
Teen	=	400 1/yr
Adult	=	310 1/yr

Y_p = The agricultural productivity by unit area of pasture feed grass, in kg/m^2, 0.7 kg/m^2. (Reg. Guide 1.109, Table E-15)

F_m = The stable element transfer coefficients, in days/liter, see Table A.3-5. (Reg. Guide 1.109, Table E-1)

r = Fraction of deposited activity retained on cow's feed grass, r=1 for radioiodine and r= 0.2 for particulates. (Reg. Guide 1.109, Table E-15)

$(DFL_i)_a$ = The maximum organ ingestion dose factor for the i th radionuclide for the receptor in age group 'a', in mrem/pCi. See Tables A.3-1, A.3-2, A.3-3, and A.3-4. (Reg. Guide 1.109, Table E-11, E-12, E-13, and E-14)

λ_i = The decay constant for the i th radionuclide, in sec^{-1}.

λ_w = The decay constant for removal of activity on leaf and plant surfaces by weathering, 5.73 E-7 sec^{-1} (corresponding to a 14 day half-life).

NOTE

The fraction of the year that the cow is on pasture and the fraction of the cow feed that is pasture grass is assumed to be 1.0, which is the most restrictive case.

t_f = The transport time from pasture to cow, to milk, to receptor, in sec, 1.73 E5 sec (2 days). (Reg. Guide 1.109, Table E-15).

Grass-Goat-Milk Pathway Factor, $R^C{}_i[D/Q]$

$$R^C{}_i[D/Q] = K' \left(\frac{Q_F(U_{ap})}{\lambda_i + \lambda_w}\right) F_m(r)\,(DFL_i)_a\left({}^1/Y_p\right)\left(e^{-\lambda_i t_f}\right)\left(m^2\,mrem/yr\ per\ \mu Ci/sec\right)$$

Where:

Q_F = The goat's consumption rate, in Kg/day (wet weight), 6 Kg/day. (Reg. Guide 1.109, Table E-3).

t_f = The transport time from pasture to goat, to milk, to receptor, in sec, 1.73 E5 sec (2 days). (Reg. Guide 1.109, Table E-15).

all other terms are defined under the Grass-Cow-Milk-Pathway Factor.

NOTE

The fraction of the year that the goat is on pasture and the fraction of the goat feed that is pasture grass is assumed to be 1.0, which is the most restrictive case.

The concentration of tritium in milk is based on the airborne concentration rather than the deposition. Therefore, the $R^C{}_i$ is based on (X/Q),

$$R^C{}_i[X/Q] = K'K''' F_m Q_F U_{ap} (DFL_i)_a \left[0.75\,(0.5/H)\right]\left(mrem/yr\ per\ \mu Ci/m^3\right)$$

Where:

K''' = a constant of unit conversion, 10^3 gm/Kg.

H = Absolute humidity of the atmosphere, 8 gm/m^3 (Reg. Guide 1.109).

0.75 = The fraction of total feed that is water. (NUREG 0133)

0.5 = The ratio of the specific activity of the feed grass water to the atmospheric water. (NUREG 0133)

Grass-Cow-Meat Pathway Factor, $R^M{}_i$ [D/Q]

$$R^{M_i}[D/Q] = K'\left(\frac{Q_F(U_{ap})}{\lambda_i + \lambda_w}\right)F_f(r)\,(DFL_i)_a\left({}^1/Y_p\right)\left(e^{-\lambda_i t^1 f}\right)\left(m^2 mrem/yr \text{ per } mCi/sec\right)$$

Where:

F_f = The stable element transfer coefficients, in days/kg, Table A.3-5. (Reg. Guide 1.109, Table E-1).

U_{ap} = The receptor's meat consumption rate for age (a), in kg/yr. (Reg. Guide 1.109, Table E-5).

Infant	=	0
Child	=	41
Teen	=	65
Adult	=	110

t_f = The transport time from pasture to receptor, in sec., 1.73 E6 (20 days) (Reg. Guide 1,109, Table E-15).

The concentration of tritium in meat is based on its airborne concentration rather than the deposition. Therefore, the $R^M{}_i$ is based on (X/Q):

$$R^{M_i}[X/Q] = K'K''\,F_f Q_F U_{ap}(DFL_i)_a\left[0.75\,(0.5/H)\right]\left(mrem/yr \text{ per } \mu Ci/m^3\right)$$

Where:

All terms defined above.

Vegetation Pathway Factor, $R^V{}_i$ [D/Q]

Man is considered to consume two types of vegetation (fresh and stored) that differs only in the time period between harvest and consumption, therefore:

$$R^{V_i}[D/Q] = K'\left[\frac{r}{Y_v(\lambda_i + \lambda_w)}\right](DFL_i)_a\left[(U^L{}_a)(f_L)\left(e^{-\lambda_i t^1 L}\right) + (U^S{}_a)(f_g)\left(e^{-\lambda_i t^1 h}\right)\right]\left(m^2 \text{ x } mrem/yr \text{ per } \mu Ci/sec\right)$$

Where:

K' = A constant of unit conversion, 10^6 pCi/μCi.

U^L_a = The consumption rate of fresh leafy vegetation by the receptor in age group (a), in kg/yr. (Reg. Guide 1.109, Table E-5).

Infant = 0 kg/yr
Child = 26 kg/yr
Teen = 42 kg/yr
Adult = 64 kg/yr

U^S_a = The consumption rate of stored vegetation by the receptor in age group (a), Kg/yr. (Reg. Guide 1.109, Table E-5).

Infant = 0 kg/yr
Child = 520 kg/yr
Teen = 630 kg/yr
Adult = 520 kg/yr

f_L = The fraction of the annual intake of fresh leafy vegetation grown locally. (default = 1.0) (Reg. Guide 1.109).

f_g = The fraction of the annual intake of stored vegetation grown locally(default = 0.76) (Reg. Guide 1.109).

t_L = The average time between harvest of leafy vegetation and its consumption, in seconds, 8.6 E4 sec (1 day). (Reg. Guide 1.109).

t_h = The average time between harvest of stored vegetation and its consumption, in seconds, 5.18 E6 sec (60 days) (Reg. Guide 1.109, Table E-15).

Y_v = The vegetation area density, 2.0 kg/m^2. (Reg. Guide 1.109, Table E-15).

All other factors previously defined.

The concentration of tritium in vegetation is based on the airborne concentration rather than the deposition. Therefore, the R^V_i is based on (X/Q):

$$R^V_i[X/Q] = K'K''' \left[U^L_a f_L + U^S_a f_g\right](DFL_i)_a\left[0.75\,(0.5/H)\right]\left(\text{mrem/yr per } \mu\text{Ci/m}^3\right)$$

Where:

All terms defined previously. All values indicated are default values from Reg. Guide 1.109, Rev. 1.

An average monthly dose schedule should be setup to ensure Section 3.2.2 is not exceeded. The average monthly dose due to radioiodines, particulates, and other radionuclides which are included in this section should be as follows:

a. < 2.5 mrem/mo.

If the monthly average dose for (a) is exceeded, it should be noted that if the release is continued at the same (or higher) frequencies or activities the quarterly limit of Section 3.2.2.a will be exceeded.

b. < 1.25 mrem/mo.

If the monthly average dose for (b) is exceeded, it should be noted that if the release is continued at the same (or higher) frequencies or activities the yearly limit of Section 3.2.2.b will be exceeded.

If any of the above monthly doses are exceeded, evaluation of the causes should be performed and steps taken to reduce the activity or frequency of the release.

3.3 Projected Dose

The VENTILATION EXHAUST TREATMENT SYSTEM and the WASTE GAS HOLDUP SYSTEM shall be OPERABLE and appropriate portions of these systems shall be used to reduce releases of radioactivity when the projected doses in 31 days due to gaseous effluent releases, from each unit, to areas at and beyond the SITE BOUNDARY would exceed: ***1/01***

a. 0.2 mrad to air from gamma radiation, or

b. 0.4 mrad to air from beta radiation, or

c. 0.3 mrem to any organ of a MEMBER OF THE PUBLIC.

3.3.1 Remedial Action

With radioactive gaseous waste being discharged without treatment and in excess of the above limits, prepare and submit to the Commission within 30 days, a special report that includes the following information:

a. Identification of any inoperable equipment or subsystems, and the reason for the inoperability,

b. Action(s) taken to restore the inoperable equipment to OPERABLE status, and

c. Summary description of action(s) taken to prevent a recurrence.

3.3.2 Surveillance Requirements

3.3.2.1 Doses due to gaseous releases from each unit to areas at and beyond the SITE BOUNDARY shall be projected at least once per 31 days in accordance with the following methodology when Gaseous Radwaste Treatment Systems are not being fully utilized.

$$D_{31} = \left[\frac{A}{T}\right] x\ 31$$

Where:

D_{31} = Projected 31 day dose

A = Cumulative dose for previous three months

T = Number of days that the cumulative dose occurred in A above

3.3.2.2 The installed VENTILATION EXHAUST TREATMENT SYSTEM and WASTE GAS HOLDUP SYSTEM shall be considered OPERABLE by meeting Section 3.1 and 3.2 limits.

3.4 Instrumentation

The radioactive gaseous effluent monitoring instrumentation channels shown in Table 3-2 shall be OPERABLE with their Alarm/Trip Setpoints set to ensure that the limits of Section 3.1 are not exceeded. The Alarm/Trip Setpoints of these channels meeting Section 3.1 shall be determined and adjusted in accordance with the methodology and parameters of Section 3.4.4 below.

3.4.1 Remedial Action

a. With a radioactive gaseous effluent monitoring instrumentation channel Alarm/Trip Setpoint less conservative than required by the above specification, immediately suspend the release of radioactive gaseous effluents monitored by the affected channel, or declare the channel inoperable.

b. With less than the minimum number of radioactive gaseous effluent monitoring instrumentation channels OPERABLE take the ACTION shown in Table 3-2. Restore the inoperable instrumentation to OPERABLE status within the time specified in the ACTION, or explain in the next annual Radioactive Effluent Release Report, why this inoperability was not corrected within the time specified.

3.4.2 Surveillance Requirements

Each radioactive gaseous effluent monitoring instrumentation channel shall be demonstrated OPERABLE by performance of the CHANNEL CHECK, SOURCE CHECK, CHANNEL CALIBRATION and CHANNEL OPERATIONAL TEST at the frequencies shown in Table 3-3.

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TABLE 3-2

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	ACTION
1. Unit Vent System			
a. Noble Gas Activity Monitor - Providing Alarm (GT-RE-21B)	1	*	40
b. Iodine Sampler(GT-RE-21A)	1	*	43
c. Particulate Sampler(GT-RE-21A)	1	*	43
d. Flow Rate	N.A.	*	45
e. Sampler Flow Rate Monitor	1	*	39
2. Containment Purge System			
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release (GT-RE-22, GT-RE-33)	1	*	41
b. Flow Rate	N.A.	*	45
3. Radwaste Building Vent System			
a. Noble Gas Activity Monitor - Providing Alarm and Automatic Termination of Release (GH-RE-10B)	1	*	38,40
b. Iodine Sampler(GH-RE-10A)	1	*	43
c. Particulate Sampler(GH-RE-10A)	1	*	43
d. Flow Rate	N.A.	*	45
e. Sampler Flow Rate Monitor	1	*	39

* At all times.

TABLE 3-2 (Continued)
TABLE NOTATIONS
ACTION STATEMENTS

ACTION 38 - With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, the contents of the tank(s) may be released to the environment for up to 14 days provided that prior to initiating the release:

a. At least two independent samples of the tank's contents are analyzed, and

b. At least two technically qualified members of the facility staff independently verify the release rate calculations and discharge valve lineup.

Otherwise, suspend release of radioactive effluents via this pathway.

ACTION 39 - With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided the flow rate is estimated at least once per 4 hours.

ACTION 40 - With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via this pathway may continue for up to 30 days provided grab samples are taken at least once per 12 hours and these samples are analyzed for radioactivity within 24 hours.

ACTION 41 - With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, immediately suspend PURGING of radioactive effluents via this pathway.

ACTION 43 - With the number of channels OPERABLE less than required by the minimum channels OPERABLE requirement, effluent releases via the affected pathway may continue for up to 30 days provided samples are continuously collected with auxiliary sample equipment as required in Table 3-1.

ACTION 45 - Flow rate for this system shall be based on fan status and operating curves or actual measurements.

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TABLE 3-3

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

INSTRUMENT	CHANNEL CHECK	SOURCE CHECK	CHANNEL CALIBRATION	CHANNEL OPERATIONAL TEST	MODES FOR WHICH SURVEILLANCE IS REQUIRED
1. Unit Vent System					
a. Noble Gas Activity Monitor-Providing Alarm (GT-RE-21)	D	M	R(3)	Q(2)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate	N.A.	N.A.	R(4)	N.A.	*
e. Sampler Flow Rate Monitor	D	N.A.	R	Q	*
2. Containment Purge System					
a. Noble Gas Activity Monitor-Providing Alarm and Automatic Termination of Release (GT-RE-22, GT-RE-33)	D	P	R(3)	Q(1)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate	N.A.	N.A.	R(4)	N.A.	*
e. Sampler Flow Rate Monitor	D	N.A.	R	N.A.	*
3. Radwaste Building Vent System					
a. Noble Gas Activity Monitor-Providing Alarm and Automatic Termination of Release (GH-RE-10)	D,P	M,P	R(3)	Q(1)	*
b. Iodine Sampler	W	N.A.	N.A.	N.A.	*
c. Particulate Sampler	W	N.A.	N.A.	N.A.	*
d. Flow Rate	N.A.	N.A.	R(4)	N.A.	*
e. Sampler Flow Rate Monitor	D	N.A.	R	N.A.	*

*At all times.

TABLE 3-3 (Continued)
TABLE NOTATIONS

(1) The CHANNEL OPERATIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation as appropriate occur if any of the following conditions exists:

a. Instrument indicates measured levels above the Alarm/Trip Setpoint (isolation and alarm), or

b. Circuit failure (alarm only), or

c. Instrument indicates a downscale failure (alarm only) or

d. Instrument controls not set in operate mode (alarm only).

(2) The CHANNEL OPERATIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any one or combination of the following conditions exists:

a. Instrument indicates measured levels above the alarm setpoint

b. Circuit failure

c. Instrument indicates a downscale failure

d. Instrument controls not set in operate mode.

(3) The initial CHANNEL CALIBRATION shall be performed using one or more of the reference (gas or liquid and solid) standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy, measurement range, and establish monitor response to a solid calibration source. For subsequent CHANNEL CALIBRATION, NIST traceable standard (gas, liquid or solid) may be used; or a gas, liquid, or solid source that has been calibrated by relating it to equipment that was previously (within 30 days) calibrated by the same geometry and type of source traceable to NIST.

(4) If flow rate is determined by exhaust fan status and fan performance curves, the following surveillance operations shall be performed at least once per 18 months:

a. The specific vent flows by direct measurement, or

b. The differential pressure across the exhaust fan and vent flow established by the fan's "flow- P" curve, or

c. The fan motor horsepower measured and vent flow established by the fan's "flow-horsepower" curve.

3.4.3 Airborne Radiation Monitor Calibration Methodology

The following monitors are associated with gaseous releases

Monitor ID	Monitor Description	Monitor Type
O-GT-RE-21A	Plant Unit Vent	Particulate, Iodine
O-GH-RE-10A	Radwaste Building Effluent	Particulate, Iodine
O-GT-RE-21B	Plant Unit Vent	Wide Range Gas
O-GH-RE-10B	Radwaste Building Effluent	Wide Range Gas
O-GT-RE-22 & 33	Containment Purge Exhaust	Particulate, Iodine, Gas
O-GT-RE-31 & 32	Containment Atmosphere	Particulate, Iodine, Gas

3.4.3.1 Particulate Detector

Beta particulate is monitored by a 50 mm diameter by 0.25 mm thick plastic scintillator optically coupled to a 50 mm diameter photomultiplier tube. This detector shall be calibrated over its range of energy and rate capabilities.

For energy range calibration four sources shall be used. Each source consists of a filter paper impregnated with a beta emitting radionuclide. The radionuclides used should be Tc-99, Cs-137, Cl-36, and Rh-106. Each source shall be positioned in the filter paper retaining ring and counted separately. The count rates for each radionuclide source shall be recorded and the data plotted on a graph of cpm/μCi versus average beta energy. This curve represents the detectors response characteristics over the range of beta energies observed. The efficiency for setpoint calculations shall be based on the efficiency of the detector for Cs-137.

The detector shall be calibrated for its rate capabilities using a filter paper impregnated with standard activities of Cs-137. Increasing amounts of a standard Cs-137 solution shall be impregnated on a filter paper. The counts per minute for each Cs-137 standard shall be recorded. A determination of linearity shall be produced using the counts per minute vs. concentration data. At least three sources covering approximately ¼, ½, and ¾ of full scale shall be checked.

3.4.3.2 Iodine Detector

Iodine gas is monitored by absorbing the gas on a charcoal filter element. The charcoal filter is viewed by an NaI(Tl) integral line gamma scintillator assembly.

Because of its short half-life and the difficulty in handling gaseous iodine, barium sources shall be used for calibration. The photo peaks of interest are as follows:

a. Ba-133: 356 KeV gamma is 0.69 efficient/disintegration

b. I-131: 364 KeV gamma is 0.82 efficient/disintegration

Therefore, each iodine disintegration will produce 0.82/0.69 x barium disintegrations. Assuming that the detector efficiency for 356 KeV is the same as for the 364 KeV, the sensitivity for I-131 equals 1.19 x Ba-133 (counts/min) µCi. The standard sources shall be constructed by impregnating a standard Ba-133 solution into the charcoal filter element. The geometry shall simulate the iodine retention on the first surface of the charcoal. Sources shall be prepared to cover approximately ¼, ½ and ¾ of full scale. The barium counts per minute for each standard shall be adjusted to iodine counts per minute as described above. A determination of linearity shall be produced using the corrected counts per minute vs. concentration data.

3.4.3.3 Gas Detector

The gas detectors associated with monitors O-GT-RE-22 & 33, O-GT-RE-31 & 32 and the low-range detectors of monitors O-GT-RE-21B and O-GH-RE-10B are a plastic scintillator identical to the particulate detector. The mid-range and high-range detectors of monitors O-GT-RE-21B and O-GH-RE-10B are cadmium telluride, solid state sensors.

Sources for all gas detectors shall be produced by evacuating the sample chamber with a vacuum pump. The sample chamber then shall be backfilled to the desired pressure with a source of standard Xe-133. The source is then counted and the counts per minute recorded. A determination of linearity shall be produced using the counts per minute vs. concentration data. Sources shall be prepared to cover approximately ¼, ½ and ¾ of full scale for the detectors associated with monitors O-GT-RE-22 and 33, O-GT-RE-31 and 32 and the low-range detectors of monitors O-GT-RE-21B and O-GH-RE-10B. Sources shall be prepared for the mid/high range detector to cover two points on the mid-range scale. For ALARA purposes, response for the high-range scale shall be extrapolated using the data from the mid-range calibration.

3.4.4 Airborne Monitor Setpoints

3.4.4.1 Total Body Dose Rate Setpoint Calculations

The limit of the total body dose rate is 500 mrem/yr at the unrestricted area boundary. The monitor alarm/trip setpoint based on total body dose will be calculated as follows:

$$S_{tb} \leq (SF \times AF) \times D_{tb} \times R_1$$

Where:

S_{tb} = The monitors alarm/trip setpoint based on the total body dose rate. (μCi/cc)

NOTE

If the monitor setpoint units needed are (μCi/sec), multiply (μCi/cc) calculated setpoint by the waste gas stream flow rate (cc/sec).

D_{tb} = Limit of 500 mrem/yr total body, conservatively interpreted as a continuous release over a one year period.

SF = Normally will be set to 0.85. This number is chosen since the gaseous monitors are set using Xe-133 energy level. Xe-133 comprises 85% of total noble gaseous activity expected. (See USAR Table 11.1-1). If necessary the 0.85 can be further modified to compensate for statistical fluctuations and errors of measurement.

AF = Allocation factor for each release so that simultaneous releases can be made without exceeding the limit. Normally AF is calculated as follows:

$$AF = \frac{RF}{TF}$$

Where:

RF = Release flow rate of the release point under consideration.

TF = Total flow rate of all release points including release under consideration.

R_t = monitor response per mrem/yr to the total body, determined according to:

$$R_t = \frac{c}{\left(\left(\overline{X/Q}\right)\sum_i K_i Q_i\right)}$$

Where:

c = The monitor response to the gaseous effluent noble gas (μCi/cc) corresponding to grab sample radionuclide concentrations.

$\left(\overline{X/Q}\right)$ = The highest calculated annual average atmospheric dispersion (sec/m^3) at the restricted area boundary.

K_i = The total body dose factor due to gamma emissions from isotope i (mrem/yr per μCi/m^3) from Table A.1-2.

Q_i = Rate of release of noble gas radionuclide i (μCi/sec)(concentration of radionuclide i x release flow rate)

3.4.4.2 Skin Dose Rate Calculation

The limit of the skin dose rate is 3000 mrem/yr at the restricted area boundary. The monitor alarm/trip setpoint is calculated as follows:

$$S_s \leq (SF \times AF) \times D_s \times R_s$$

Where:

S_S = The monitors alarm/trip setpoint based on the skin dose rate. (μCi/cc)

NOTE

If the monitor setpoint units needed are (μCi/sec), multiply the μCi/cc), calculated setpoint by the waste gas stream flow rate (cc/sec).

D_S = Limit of 3000 mrem/yr to the skin of the body, conservatively interpreted as a continuous release over a one year period.

R_S = Monitor response per mrem/yr to the skin of the body.

$$R_s = \frac{c}{\left(\left(\overline{X/Q}\right)\sum_i \left(L_i + 1.1M_i\right) Q_i\right)}$$

Where:

L_i = Skin dose factor due to beta emissions from isotope i (mrem/yr per μCi/m^3) from Table A.1-2.

1.1 = Conversion factor to mrem skin dose per mrad air dose.

M_i = Air dose factor due to gamma emissions from isotope i (mrad/yr per $\mu Ci/m^3$) from Table A.1-2.

The factors SF, AF, c, $\left(\overline{X/Q}\right)$ and Q_i are as defined in Section 3.4.4.1.

The results of equations from Sections 3.4.4.1 and 3.4.4.2 are compared to determine the smaller setpoint. The actual monitor setpoint is the lower of the two values.

A pre-release isotopic analysis is performed for batch releases from Waste Gas Decay Tanks and Containment Building purges to determine the identity and quantity of the principal radionuclides. The appropriate alarm/trip setpoint(s) are adjusted accordingly to ensure that the limits of 3.1 are not exceeded.

3.4.4.3 Alert Alarm Setpoint Calculations

The Noble Gas Alert Alarm for the Plant Unit Vent (O-GT-RE-21) and Radwaste Building Exhaust Monitor (O-GH-RE-10), is set to alert operators to that average concentration which if maintained for a full year would result in the 10 CFR 50, Appendix I Annual Dose Guidelines being reached. Section 3.2.1 limits the annual dose due to noble gases to $\leq$ 10 mrads for gamma radiation and $\leq$ 20 mrads for beta radiation. Section 3.2.2 limits the annual dose to a MEMBER OF THE PUBLIC from Iodine-131, Iodine-133, tritium and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents to $\leq$ 15 mrem to any organ. These two sections contain the annual dose limits due to gaseous releases found in 10 CFR 50, Appendix I.

3.4.4.3.1 Noble Gas Alert Alarm Setpoint Calculation

The alert alarm setpoint is the lesser of

$$S_\gamma \leq (SF \times AF) \times D\gamma \times R\gamma$$

$$S_\beta \leq (SF \times AF) \times D\beta \times R\beta$$

Where:

S_γ = Monitor setpoint based on gamma radiation.

D_γ = Limit of 10 mrad/yr conservatively interpreted as a continuous release over a one year period.

R_γ = Monitor response per mrad/yr determined according to:

$$R_\gamma = \frac{c}{\left(\left(\overline{X/Q}\right)\sum_i M_i \text{ x } Q_i\right)}$$

Where:

M_i = Gamma air dose factor (mrad/yr per $\mu Ci/m^3$). See Table A.1-2.

S_β = Monitor setpoint based on beta radiation.

D_β = Limit of 20 mrad/yr conservatively interpreted as a continuous release over a one year period.

R_β = Monitor response per mrad/yr determined according to:

$$R_\beta = \frac{c}{\left(\left(\overline{X/Q}\right)\sum_i N_i \text{ x } Q_i\right)}$$

Where:

N_i = Beta air dose factor (mrad/yr per $\mu Ci/m^3$). See Table A.1-2.

A semi-fixed alert alarm setpoint for the Plant Unit Vent Monitor (O-GT-RE-21) and Radwaste Building Vent Monitor (O-GH-RE-10) is calculated using the following:

$$\text{Setpoint } (\mu Ci/cc) = \left(\frac{(10 \text{ mrad/yr})(.85)(AF)}{\left(\overline{(X/Q)}\sum_i P_i \text{ x } M_i \text{ x } Q\right)}\right)$$

Where:

P_i = Fractional value of isotope expected, C_i/C_T,

Where:

C_i = Concentration in µCi/cc of isotope.

C_T = Total Gaseous Activity from USAR Table 11.1-1

AF = Either unit vent flow or Radwaste Building vent flow divided by the combined flow of the unit vent and Radwaste Building vent.

Q = Vent flow rate in cc/sec.

Isotopes used and P_i values are as follows:

ISOTOPE	P_i
Kr-85M	.018
Kr-87	.010
Kr-88	.033
Xe-133M	.017
Xe-133	.851
Xe-135	.051

Should this semi-fixed alert alarm cause a continuous alarm condition, then actual setpoints will be calculated.

3.4.4.4 Particulate And Iodine Alarm Setpoints

Setpoints for the gaseous effluent particulate and iodine channels are set using Cs-137 MPC for particulates and I-131 MPC for iodines. The following is the calculation used:

$$\text{Setpoint } (\mu\text{Ci/cc}) = \frac{(\text{MPC}_i)(\text{AF})(\text{SF})}{(\text{Q})(\overline{\text{X/Q}})}$$

Where:

MPC_i = 5×10^{-10} µCi/cc for Cs-137

= 1×10^{-10} µCi/cc for I-131

AF = as defined previously

SF = .0625 for I-131 *

= .9375 for Cs-137 *

*derived from ratio of isotope activity (either I-131 or Cs-137) to sum of activity of Cs-137 and I-131 found in USAR Table 11.1-1 for reactor coolant.

Q = Vent flow in M^3/sec

This will provide the hi alarm setpoint. The alert alarm setpoint is 10% of the hi alarm setpoint.

4.0 Total Dose

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 less than or equal to 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

4.1 Remedial Action

With the calculated doses from the release of radioactive materials in liquid or gaseous effluents exceeding twice the limits of Section 2.2a, 2.2b, 3.2.1a, 3.2.1b, 3.2.2a and 3.2.2b calculation should be made including direct radiation contributions from the units and from outside storage tanks to determine whether the above limits of Section 4.0 above has been exceeded. If such is the case, prepare and submit to the Commission within 30 days, a special report that defines the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits. This special report, as defined in 10 CFR 20.405e and 10CFR20.2203, 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 levels of radiation and concentrations of radioactive material involved, and the cause of the exposure levels or concentrations. If the estimated dose(s) exceeds the above limits, and if the release condition resulting in violation of 40 CFR Part 190 has not already been corrected, the special report shall include a request for a variance in accordance with the provisions of 40 CFR Part 190. Submittal of the report is considered a timely request, and a variance is granted until staff action on the request is complete.

4.2 Surveillance Requirements

4.2.1 Cumulative dose contributions from liquid and gaseous effluents shall be determined in accordance with the methodology of Sections 2.2 and 3.2 at least once per 31 days when the release of radioactive materials in liquid or gaseous effluents exceed twice the limits of Section 2.2a, 2.2b, 3.2.1a, 3.2.1b, 3.2.2a and 3.2.2b. Otherwise, no further evaluation is required.

4.2.2 Cumulative dose contribution from direct radiation from the reactor unit and from Radwaste storage tanks shall be determined utilizing the results of routine plane perimeter surveys, TLD data or a combination of both, when necessary. This requirement is applicable only under conditions set forth in the remedial action above.

6.0 Bases

The bases contained on the succeeding pages summarizes the general requirements of Section 2.0, 3.0, 4.0 and 5.0 of the ODCM.

Section 2.0 Liquid Effluents

Section 2.1 Concentration

This section is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than the concentration levels specified in 10 CFR Part 20, Appendix B, Table 2, Column 2. This limitation provides additional assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within: (1) the Section II. A design objective of Appendix I, 10 CFR Part 50, to a MEMBER OF THE PUBLIC, and (2) the limits of 10 CFR Part 20.1301(e) to the population. The concentration limit for dissolved or entrained noble gases are based upon the assumption that Xe-135 is the controlling radioisotope and its ECL 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 required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques, "Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

Section 2.2 Dose

This section is provided to implement the requirements of Section II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The remedial action implements the guides set forth in Section II.A of Appendix I and provides the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." Also, for fresh water sites with drinking water supplies that 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 Part 141. The dose calculation methodology and parameters in the ODCM implement the requirements in Section III.A of Appendix I which specify that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, "Revision 1, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

Section 2.3 Liquid Radwaste Treatment System

The OPERABILITY of the Liquid Radwaste Treatment Systems ensures that this system will be available for use whenever liquid effluents require treatment prior to release to the environment. The requirement 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 section implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the Liquid Radwaste Treatment System were specified as a suitable fraction of the dose design objective set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

Section 2.4 Radioactive Liquid Effluent Monitoring Instrumentation

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 of liquid effluents. The Alarm/Trip Setpoints for these instruments shall be calculated and adjusted in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding 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.

Section 3.0 Gaseous Effluents

Section 3.1 Dose Rate

This section is provided to ensure that the dose at any time at and beyond the SITE BOUNDARY from gaseous effluents from all units on the site will be within the annual dose limits of 10 CFR Part 20 to UNRESTRICTED AREAS (USAR, Chapter 11). The annual dose limits are the doses associated with the concentrations of 10 CFR Part 20, Appendix B, Table II, Column 1. These limits provide reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either within or outside the SITE BOUNDARY, to annual average concentrations exceeding the limits specified in Appendix B, Table II of 10 CFR Part 20 (10 CFR 20.106(b)). For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for any increase in the atmospheric diffusion factor above that for the SITE BOUNDARY. The specified release rate limits restrict, at all times, the corresponding gamma and beta dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrems/year to the whole body or to less than or equal to 3000 mrems/year to the skin. These release rate limits also restrict, at all times the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrems/year. ***6/01***

The required detection capabilities for radioactive materials in gaseous waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

Section 3.2.1 Dose - Noble Gases

This section is provided to implement the requirements of Section II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The remedial action implements the guides set forth in Section II.B of Appendix I and provides the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The surveillance requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculation methodology and parameters established in the ODCM for calculating the doses due to the actual release rates of radioactive materials in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," 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," Revision 1, July 1977. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon either the historical average or real time atmospheric conditions.

Section 3.2.2 Dose - Iodine-131 and 133, Tritium and Radioactive Material in Particulate Form

This section is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The remedial actions are the guides set forth in Section II.C of Appendix I, and provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in the surveillance requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methodology and parameters for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculational 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," Revision 1, July 1977. These equations also provide for determining the actual doses based upon either the historical average or real time conditions. The release rate limits for Iodine-131 and 133, tritium, and radionuclides in particulate form with half lives greater that 8 days are dependent upon the existing radionuclide pathways to man, in the areas at and beyond the SITE BOUNDARY. The pathways that were examined in the development of these calculations were: (1) individual inhalation of airborne radionuclides, (2)deposition of radionuclides onto 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, (4)deposition on the ground with subsequent exposure of man.

Section 3.3 Gaseous Radwaste Treatment System

The OPERABILITY of the WASTE GAS HOLDUP SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the systems will be available for use whenever gaseous effluents require treatment prior to release to the environment. The requirement that the appropriate portions of this system be used when specified provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This section implements the requirements of 10 CFR 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the systems were specified as a suitable fraction of the dose design objectives set forth in Section II.B and II.C of Appendix I, 10 CFR Part 50, for gaseous effluents.

Section 3.4 Radioactive Gaseous Effluent Monitoring Instrumentation

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 of gaseous effluents. The Alarm/Trip Setpoints for these instruments shall be adjusted to values calculated in accordance with the methodology and parameters in the ODCM to ensure that the alarm/trip will occur prior to exceeding 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 sensitivity of any noble gas activity monitor used to show compliance with the gaseous effluent release requirements of Section 3.2 shall be such that concentrations as low as 1×10^{-6} μCi/cc are measurable.

Section 4.0 Total Dose

This section is provided to meet the dose limitations of 40 CFR Part 190 that have been incorporated into 10 CFR Part 20 by 46 FR 18525. The section requires the preparation and submittal of a special report whenever the calculated doses due to releases of radioactivity and the radiation from uranium fuel cycle sources exceed 25 mrems to the whole body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems. For sites containing up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR Part 190 if the individual reactors remain within twice the dose design objectives of Appendix I, and if direct radiation doses from the reactor Units and from outside storage tanks are kept small. The Special Report will describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR Part 190 limits. For the purposes of the Special Report, it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that dose contributions from other nuclear fuel cycle facilities at the same site or within a radius of 8 km must be considered. If the dose to any MEMBER OF THE PUBLIC is estimated to exceed the requirements of 40 CFR Part 190, the Special Report with a request for a variance (provided the release conditions resulting in violation of 40 CFR Part 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11, 10 CFR 20.405c, and 10 CFR 20.2203, is considered to be a timely request and fulfills the requirements of 40 CFR Part 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR Part 190, and does not apply in any way to the other requirements for dose limitation of 10 CFR Part 20. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

7.2 Annual Radioactive Effluent Release Report

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 Unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof. For solid wastes, the format for Table 3 in Appendix B shall be supplemented with three additional categories: class of solid waste (as defined by 10 CFR Part 60), type of container (e.g., LSA, Type A, Type B, Large Quantity), and SOLIDIFICATION agent or absorbent (e.g., cement, urea formaldehyde).

The Annual Radioactive Effluent Release Report to be submitted before May 1 of each year shall also include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, and atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.* This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the Unit or Station during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY during the report period. All assumptions used in making these assessments, i.e., specific activity, exposure time and location, shall be included in these reports. Historical average meteorological conditions or the meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency and measurement, shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in the ODCM.

The Annual Radioactive Effluent Release Report to be submitted before May 1 of each year 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 Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation." Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev. 1, October 1977.

The Annual Radioactive Effluent Release Report shall include:

a. 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.

*In lieu of submission with the Annual Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

b. Any changes made during the reporting period to the ODCM, pursuant to Technical Specification 5.5.1.

c. Major changes to the Radwaste Treatment Systems for the period in which the evaluation was reviewed and accepted by the PSRC. The discussion of each change shall contain:

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

2) Sufficient detailed information to totally support the reason for the change without benefit of additional and supplemental information;

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

4) An evaluation of the change which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

5) An evaluation of the change, which shows the expected maximum exposures to a MEMBER OF THE PUBLIC in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

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

7) An estimate of the exposure to plant operating personnel as a result of the change; and

8) Documentation of the fact that the change was reviewed and found acceptable by the PSRC.

d. A listing of new locations for dose calculations identified by the Land Use Census,

e. A description of the events leading to liquid holdup tanks or gas storage tanks exceeding the limits of TR 3.10.1 OR TSR 3.10.3.1.

f. An explanation as to why the inoperability of a liquid or gaseous effluent monitoring instrumentation was not corrected within the time specified.

g. A description of the events leading to a missed sample required by Table 2-1 or 3-1.

h. NEI Groundwater Protection Initiative requirements (Ref. 3.1.9)

1. A report of onsite groundwater sample results.

2. A description of dose calculations for releases from site.

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3. A summary of onsite spills & leaks that require notification to county, state & NRC. ***4/07***

APPENDIX A

Dose Conversion Factor Tables

TABLE A.1-1*

BIOACCUMULATION FACTORS TO BE USED IN THE ABSENCE OF SITE-SPECIFIED DATA
(pCi/kg per pCi/liter)

ELEMENT	FRESHWATER FISH
H	9.0E-01
C	4.6E 03
Na	1.0E 02
P	1.0E 05
Cr	2.0E 02
Mn	4.0E 02
Fe	1.0E 02
Co	5.0E 01
Ni	1.0E 02
Cu	5.0E 01
Zn	2.0E 03
Br	4.2E 02
Rb	2.0E 03
Sr	3.0E 01
Y	2.5E 01
Zr	3.3E 00
Nb	3.0E 04
Mo	1.0E 01
Tc	1.5E 01
Ru	1.0E 01
Rh	1.0E 01
Te	4.0E 02
I	1.5E 01
Cs	2.0E 03
Ba	4.0E 00
La	2.5E 01
Ce	1.0E 00
Pr	2.5E 01
Nd	2.5E 01
W	1.2E 03
Np	1.0E 01
**Ag	2.3E 00
**Sb	1.0E 00

* Taken from Regulatory Guide 1.109 (Rev.1)
** Taken from Regulatory Guide 1.109 (Rev.0)

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TABLE A.1-2

DOSE FACTORS FOR NOBLE GASES AND DAUGHTERS*

Radionuclide	Total Body Dose Factor K_i (mrem/yr per $\mu Ci/m^3$)	Skin Dose Factor L_i (mrem/yr per $\mu Ci/m^3$)	Gamma Air Dose Factor M_i (mrad/yr per $\mu Ci/m^3$)	Beta Air Dose Factor N_i (mrad/yr per $\mu Ci/m^3$)
Kr-83M	7.56E-02**	---	1.93E+01	2.88E+02
Kr-85M	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131M	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-133M	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-135M	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

*Based on Regulatory Guide 1.109 (Rev.1)
**7.56E-02 = 7.56×10^{-2}

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TABLE A.2-1*
INHALATION DOSE FACTORS FOR ADULTS
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
C	14	2.27E-06	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07	4.26E-07
NA	24	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06	1.28E-06
P	32	1.65E-04	9.64E-06	6.26E-06	NO DATA	NO DATA	NO DATA	1.08E-05
CR	51	NO DATA	NO DATA	1.25E-08	7.44E-09	2.85E-09	1.80E-06	4.15E-07
MN	54	NO DATA	4.95E-06	7.87E-07	NO DATA	1.23E-06	1.75E-04	9.67E-06
MN	56	NO DATA	1.55E-10	2.29E-11	NO DATA	1.63E-10	1.18E-06	2.53E-06
FE	55	3.07E-06	2.12E-06	4.93E-07	NO DATA	NO DATA	9.01E-06	7.54E-07
FE	59	1.47E-06	3.47E-06	1.32E-06	NO DATA	NO DATA	1.27E-04	2.35E-05
CO	58	NO DATA	1.98E-07	2.59E-07	NO DATA	NO DATA	1.16E-04	1.33E-05
CO	60	NO DATA	1.44E-06	1.85E-06	NO DATA	NO DATA	7.46E-04	3.56E-05
NI	63	5.40E-05	3.93E-06	1.81E-06	NO DATA	NO DATA	2.23E-05	1.67E-06
NI	65	1.92E-10	2.62E-11	1.14E-11	NO DATA	NO DATA	7.00E-07	1.54E-06
CU	64	NO DATA	1.83E-10	7.69E-11	NO DATA	5.78E-10	8.48E-07	6.12E-06
ZN	65	4.05E-06	1.29E-05	5.82E-06	NO DATA	8.62E-06	1.08E-04	6.68E-06
ZN	69	4.23E-12	8.14E-12	5.65E-13	NO DATA	5.27E-12	1.15E-07	2.04E-09
BR	83	NO DATA	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	2.90E-08
BR	84	NO DATA	NO DATA	3.91E-08	NO DATA	NO DATA	NO DATA	2.05E-13
BR	85	NO DATA	NO DATA	1.60E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	1.69E-05	7.37E-06	NO DATA	NO DATA	NO DATA	2.08E-06
RB	88	NO DATA	4.84E-08	2.41E-08	NO DATA	NO DATA	NO DATA	4.18E-19
RB	89	NO DATA	3.20E-08	2.12E-08	NO DATA	NO DATA	NO DATA	1.16E-21
SR	89	3.80E-05	NO DATA	1.09E-06	NO DATA	NO DATA	1.75E-04	4.37E-05
SR	90	1.24E-02	NO DATA	7.62E-04	NO DATA	NO DATA	1.20E-03	9.02E-05
SR	91	7.74E-09	NO DATA	3.13E-10	NO DATA	NO DATA	4.56E-06	2.39E-05
SR	92	8.43E-10	NO DATA	3.64E-11	NO DATA	NO DATA	2.06E-06	5.38E-06
Y	90	2.61E-07	NO DATA	7.01E-09	NO DATA	NO DATA	2.12E-05	6.32E-05
Y	91M	3.26E-11	NO DATA	1.27E-12	NO DATA	NO DATA	2.40E-07	1.66E-10
Y	91	5.78E-05	NO DATA	1.55E-06	NO DATA	NO DATA	2.13E-04	4.81E-05
Y	92	1.29E-09	NO DATA	3.77E-11	NO DATA	NO DATA	1.96E-06	9.19E-06
Y	93	1.18E-08	NO DATA	3.26E-10	NO DATA	NO DATA	6.06E-06	5.27E-05
ZR	95	1.34E-05	4.30E-06	2.91E-06	NO DATA	6.77E-06	2.21E-04	1.88E-05
ZR	97	1.21E-08	2.45E-09	1.13E-09	NO DATA	3.71E-09	9.84E-06	6.54E-05
NB	95	1.76E-06	9.77E-07	5.26E-07	NO DATA	9.67E-07	6.31E-05	1.30E-05
MO	99	NO DATA	1.51E-08	2.87E-09	NO DATA	3.64E-08	1.14E-05	3.10E-05
TC	99M	1.29E-13	3.64E-13	4.63E-12	NO DATA	5.52E-12	9.55E-08	5.20E-07

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TABLE A.2-1* (cont'd)
INHALATION DOSE FACTORS FOR ADULTS
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	5.22E-15	7.52E-15	7.38E-14	NO DATA	1.35E-13	4.99E-08	1.36E-21
RU	103	1.91E-07	NO DATA	8.23E-08	NO DATA	7.29E-07	6.31E-05	1.38E-05
RU	105	9.88E-11	NO DATA	3.89E-11	NO DATA	1.27E-10	1.37E-06	6.02E-06
RU	106	8.64E-06	NO DATA	1.09E-06	NO DATA	1.67E-05	1.17E-03	1.14E-04
AG	110M	1.35E-06	1.25E-06	7.43E-07	NO DATA	2.46E-06	5.79E-04	3.78E-05
TE	125M	4.27E-07	1.98E-07	5.84E-08	1.31E-07	1.55E-06	3.92E-05	8.83E-06
TE	127M	1.58E-06	7.21E-07	1.96E-07	4.11E-07	5.72E-06	1.20E-04	1.87E-05
TE	127	1.75E-10	8.03E-11	3.87E-11	1.32E-10	6.37E-10	8.14E-07	7.17E-06
TE	129M	1.22E-06	5.84E-07	1.98E-07	4.30E-07	4.57E-06	1.45E-04	4.79E-05
TE	129	6.22E-12	2.99E-12	1.55E-12	4.87E-12	2.34E-11	2.42E-07	1.96E-08
TE	131M	8.74E-09	5.45E-09	3.63E-09	6.88E-09	3.86E-08	1.82E-05	6.95E-05
TE	131	1.39E-12	7.44E-13	4.49E-13	1.17E-12	5.46E-12	1.74E-07	2.30E-09
TE	132	3.25E-08	2.69E-08	2.02E-08	2.37E-08	1.82E-07	3.60E-05	6.37E-05
I	130	5.72E-07	1.68E-06	6.60E-07	1.42E-04	2.61E-06	NO DATA	9.61E-07
I	131	3.15E-06	4.47E-06	2.56E-06	1.49E-03	7.66E-06	NO DATA	7.85E-07
I	132	1.45E-07	4.07E-07	1.45E-07	1.43E-05	6.48E-07	NO DATA	5.08E-08
I	133	1.08E-06	1.85E-06	5.65E-07	2.69E-04	3.23E-06	NO DATA	1.11E-06
I	134	8.05E-08	2.16E-07	7.69E-08	3.73E-06	3.44E-07	NO DATA	1.26E-10
I	135	3.35E-07	8.73E-07	3.21E-07	5.60E-05	1.39E-06	NO DATA	6.56E-07
CS	134	4.66E-05	1.06E-04	9.10E-05	NO DATA	3.59E-05	1.22E-05	1.30E-06
CS	136	4.88E-06	1.83E-05	1.38E-05	NO DATA	1.07E-05	1.50E-06	1.46E-06
CS	137	5.98E-05	7.76E-05	5.35E-05	NO DATA	2.78E-05	9.40E-06	1.05E-06
CS	138	4.14E-08	7.76E-08	4.05E-08	NO DATA	6.00E-08	6.07E-09	2.33E-13
BA	139	1.17E-10	8.32E-14	3.42E-12	NO DATA	7.78E-14	4.70E-07	1.12E-07
BA	140	4.88E-06	6.13E-09	3.21E-07	NO DATA	2.09E-09	1.59E-04	2.73E-05
BA	141	1.25E-11	9.41E-15	4.20E-13	NO DATA	8.75E-15	2.42E-07	1.45E-17
BA	142	3.29E-12	3.38E-15	2.07E-13	NO DATA	2.86E-15	1.49E-07	1.96E-26
LA	140	4.30E-08	2.17E-08	5.73E-09	NO DATA	NO DATA	1.70E-05	5.73E-05
LA	142	8.54E-11	3.88E-11	9.65E-12	NO DATA	NO DATA	7.91E-07	2.64E-07
CE	141	2.49E-06	1.69E-06	1.91E-07	NO DATA	7.83E-07	4.52E-05	1.50E-05
CE	143	2.33E-08	1.72E-08	1.91E-09	NO DATA	7.60E-09	9.97E-06	2.83E-05
CE	144	4.29E-04	1.79E-04	2.30E-05	NO DATA	1.06E-04	9.72E-04	1.02E-04
PR	143	1.17E-06	4.69E-07	5.80E-08	NO DATA	2.70E-07	3.51E-05	2.50E-05
PR	144	3.76E-12	1.56E-12	1.91E-13	NO DATA	8.81E-13	1.27E-07	2.69E-18
ND	147	6.59E-07	7.62E-07	4.56E-08	NO DATA	4.45E-07	2.76E-05	2.16E-05
W	187	1.06E-09	8.85E-10	3.10E-10	NO DATA	NO DATA	3.63E-06	1.94E-05
NP	239	2.87E-08	2.82E-09	1.55E-09	NO DATA	8.75E-09	4.70E-06	1.49E-05

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TABLE A.2-2*
INHALATION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07	1.59E-07
C	14	3.25E-06	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07	6.09E-07
NA	24	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06	1.72E-06
P	32	2.36E-04	1.37E-05	8.95E-06	NO DATA	NO DATA	NO DATA	1.16E-05
CR	51	NO DATA	NO DATA	1.69E-08	9.37E-09	3.84E-09	2.62E-06	3.75E-07
MN	54	NO DATA	6.39E-06	1.05E-06	NO DATA	1.59E-06	2.48E-04	8.35E-06
MN	56	NO DATA	2.12E-10	3.15E-11	NO DATA	2.24E-10	1.90E-06	7.18E-06
FE	55	4.18E-06	2.98E-06	6.93E-07	NO DATA	NO DATA	1.55E-05	7.99E-07
FE	59	1.99E-06	4.62E-06	1.79E-06	NO DATA	NO DATA	1.91E-04	2.23E-05
CO	58	NO DATA	2.59E-07	3.47E-07	NO DATA	NO DATA	1.68E-04	1.19E-05
CO	60	NO DATA	1.89E-06	2.48E-06	NO DATA	NO DATA	1.09E-03	3.24E-05
NI	63	7.25E-05	5.43E-06	2.47E-06	NO DATA	NO DATA	3.84E-05	1.77E-06
NI	65	2.73E-10	3.66E-11	1.59E-11	NO DATA	NO DATA	1.17E-06	4.59E-06
CU	64	NO DATA	2.54E-10	1.06E-10	NO DATA	8.01E-10	1.39E-06	7.68E-06
ZN	65	4.82E-06	1.67E-05	7.80E-06	NO DATA	1.08E-05	1.55E-04	5.83E-06
ZN	69	6.04E-12	1.15E-11	8.07E-13	NO DATA	7.53E-12	1.98E-07	3.56E-08
BR	83	NO DATA	NO DATA	4.30E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR	84	NO DATA	NO DATA	5.41E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR	85	NO DATA	NO DATA	2.29E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	2.38E-05	1.05E-05	NO DATA	NO DATA	NO DATA	2.21E-06
RB	88	NO DATA	6.82E-08	3.40E-08	NO DATA	NO DATA	NO DATA	3.65E-15
RB	89	NO DATA	4.40E-08	2.91E-08	NO DATA	NO DATA	NO DATA	4.22E-17
SR	89	5.43E-05	NO DATA	1.56E-06	NO DATA	NO DATA	3.02E-04	4.64E-05
SR	90	1.35E-02	NO DATA	8.35E-04	NO DATA	NO DATA	2.06E-03	9.56E-05
SR	91	1.10E-08	NO DATA	4.39E-10	NO DATA	NO DATA	7.59E-06	3.24E-05
SR	92	1.19E-09	NO DATA	5.08E-11	NO DATA	NO DATA	3.43E-06	1.49E-05
Y	90	3.73E-07	NO DATA	1.00E-08	NO DATA	NO DATA	3.66E-05	6.99E-05
Y	91M	4.63E-11	NO DATA	1.77E-12	NO DATA	NO DATA	4.00E-07	3.77E-09
Y	91	8.26E-05	NO DATA	2.21E-06	NO DATA	NO DATA	3.67E-04	5.11E-05
Y	92	1.84E-09	NO DATA	5.36E-11	NO DATA	NO DATA	3.35E-06	2.06E-05
Y	93	1.69E-08	NO DATA	4.65E-10	NO DATA	NO DATA	1.04E-05	7.24E-05
ZR	95	1.82E-05	5.73E-06	3.94E-06	NO DATA	8.42E-06	3.36E-04	1.86E-05
ZR	97	1.72E-08	3.40E-09	1.57E-09	NO DATA	5.15E-09	1.62E-05	7.88E-05
NB	95	2.32E-06	1.29E-06	7.08E-07	NO DATA	1.25E-06	9.39E-05	1.21E-05
MO	99	NO DATA	2.11E-08	4.03E-09	NO DATA	5.14E-08	1.92E-05	3.36E-05
TC	99M	1.73E-13	4.83E-13	6.24E-12	NO DATA	7.20E-12	1.44E-07	7.66E-07

***Taken from Regulatory Guide 1.109 (Rev. 1)**

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TABLE A.2-2* (cont'd)
INHALATION DOSE FACTORS FOR TEENAGER
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	7.40E-15	1.05E-14	1.03E-13	NO DATA	1.90E-13	8.34E-08	1.09E-16
RU	103	2.63E-07	NO DATA	1.12E-07	NO DATA	9.29E-07	9.79E-05	1.36E-05
RU	105	1.40E-10	NO DATA	5.42E-11	NO DATA	1.76E-10	2.27E-06	1.13E-05
RU	106	1.23E-05	NO DATA	1.55E-06	NO DATA	2.38E-05	2.01E-03	1.20E-04
AG	110M	1.73E-06	1.64E-06	9.99E-07	NO DATA	3.13E-06	8.44E-04	3.41E-05
TE	125M	6.10E-07	2.80E-07	8.34E-08	1.75E-07	NO DATA	6.70E-05	9.38E-06
TE	127M	2.25E-06	1.02E-06	2.73E-07	5.48E-07	8.17E-06	2.07E-04	1.99E-05
TE	127	2.51E-10	1.14E-10	5.52E-11	1.77E-10	9.10E-10	1.40E-06	1.01E-05
TE	129M	1.74E-06	8.23E-07	2.81E-07	5.72E-07	6.49E-06	2.47E-04	5.06E-05
TE	129	8.87E-12	4.22E-12	2.20E-12	6.48E-12	3.32E-11	4.12E-07	2.02E-07
TE	131M	1.23E-08	7.51E-09	5.03E-09	9.06E-09	5.49E-08	2.97E-05	7.76E-05
TE	131	1.97E-12	1.04E-12	6.30E-13	1.55E-12	7.72E-12	2.92E-07	1.89E-09
TE	132	4.50E-08	3.63E-08	2.74E-08	3.07E-08	2.44E-07	5.61E-05	5.79E-05
I	130	7.80E-07	2.24E-06	8.96E-07	1.86E-04	3.44E-06	NO DATA	1.14E-06
I	131	4.43E-06	6.14E-06	3.30E-06	1.83E-03	1.05E-05	NO DATA	8.11E-07
I	132	1.99E-07	5.47E-07	1.97E-07	1.89E-05	8.65E-07	NO DATA	1.59E-07
I	133	1.52E-06	2.56E-06	7.78E-07	3.65E-04	4.49E-06	NO DATA	1.29E-06
I	134	1.11E-07	2.90E-07	1.05E-07	4.94E-06	4.58E-07	NO DATA	2.55E-09
I	135	4.62E-07	1.18E-06	4.36E-07	7.76E-05	1.86E-06	NO DATA	8.69E-07
CS	134	6.28E-05	1.41E-04	6.86E-05	NO DATA	4.69E-05	1.83E-05	1.22E-06
CS	136	6.44E-06	2.42E-05	1.71E-05	NO DATA	1.38E-05	2.22E-06	1.36E-06
CS	137	8.38E-05	1.06E-04	3.89E-05	NO DATA	3.80E-05	1.51E-05	1.06E-06
CS	138	5.82E-08	1.07E-07	5.58E-08	NO DATA	8.28E-08	9.84E-09	3.38E-11
BA	139	1.67E-10	1.18E-13	4.87E-12	NO DATA	1.11E-13	8.08E-07	8.06E-07
BA	140	6.84E-06	8.38E-09	4.40E-07	NO DATA	2.85E-09	2.54E-04	2.86E-05
BA	141	1.78E-11	1.32E-14	5.93E-13	NO DATA	1.23E-14	4.11E-07	9.33E-14
BA	142	4.62E-12	4.63E-15	2.84E-13	NO DATA	3.92E-15	2.39E-07	5.99E-20
LA	140	5.99E-08	2.95E-08	7.82E-09	NO DATA	NO DATA	2.68E-05	6.09E-05
LA	142	1.20E-10	5.31E-11	1.32E-11	NO DATA	NO DATA	1.27E-06	1.50E-06
CE	141	3.55E-06	2.37E-06	2.71E-07	NO DATA	1.11E-06	7.67E-05	1.58E-05
CE	143	3.32E-08	2.42E-08	2.70E-09	NO DATA	1.08E-08	1.63E-05	3.19E-05
CE	144	6.11E-04	2.53E-04	3.28E-05	NO DATA	1.51E-04	1.67E-03	1.08E-04
PR	143	1.67E-06	6.64E-07	8.28E-08	NO DATA	3.86E-07	6.04E-05	2.67E-05
PR	144	5.37E-12	2.20E-12	2.72E-13	NO DATA	1.26E-12	2.19E-07	2.94E-14
ND	147	9.83E-07	1.07E-06	6.41E-08	NO DATA	6.28E-07	4.65E-05	2.28E-05
W	187	1.50E-09	1.22E-09	4.29E-10	NO DATA	NO DATA	5.92E-06	2.21E-05
NP	239	4.23E-08	3.99E-09	2.21E-09	NO DATA	1.25E-08	8.11E-06	1.65E-05

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TABLE A.2-3*
INHALATION DOSE FACTORS FOR CHILD
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07	3.04E-07
C	14	9.70E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06	1.82E-06
NA	24	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
P	32	7.04E-04	3.09E-05	2.67E-05	NO DATA	NO DATA	NO DATA	1.14E-05
CR	51	NO DATA	NO DATA	4.17E-08	2.31E-08	6.57E-09	4.59E-06	2.93E-07
MN	54	NO DATA	1.16E-05	2.57E-06	NO DATA	2.71E-06	4.26E-04	6.19E-06
MN	56	NO DATA	4.48E-10	8.43E-11	NO DATA	4.52E-10	3.55E-06	3.33E-05
FE	55	1.28E-05	6.80E-06	2.10E-06	NO DATA	NO DATA	3.00E-05	7.75E-07
FE	59	5.59E-06	9.04E-06	4.51E-06	NO DATA	NO DATA	3.43E-04	1.91E-05
CO	58	NO DATA	4.79E-07	8.55E-07	NO DATA	NO DATA	2.99E-04	9.29E-06
CO	60	NO DATA	3.55E-06	6.12E-06	NO DATA	NO DATA	1.91E-03	2.60E-05
NI	63	2.22E-04	1.25E-05	7.56E-06	NO DATA	NO DATA	7.43E-05	1.71E-06
NI	65	8.08E-10	7.99E-11	4.44E-11	NO DATA	NO DATA	2.21E-06	2.27E-05
CU	64	NO DATA	5.39E-10	2.90E-10	NO DATA	1.63E-09	2.59E-06	9.92E-06
ZN	65	1.15E-05	3.06E-05	1.90E-05	NO DATA	1.93E-05	2.69E-04	4.41E-06
ZN	69	1.81E-11	2.61E-11	2.41E-12	NO DATA	1.58E-11	3.84E-07	2.75E-06
BR	83	NO DATA	NO DATA	1.28E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	84	NO DATA	NO DATA	1.48E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	85	NO DATA	NO DATA	6.84E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	5.36E-05	3.09E-05	NO DATA	NO DATA	NO DATA	2.16E-06
RB	88	NO DATA	1.52E-07	9.90E-08	NO DATA	NO DATA	NO DATA	4.66E-09
RB	89	NO DATA	9.33E-08	7.83E-08	NO DATA	NO DATA	NO DATA	5.11E-10
SR	89	1.62E-04	NO DATA	4.66E-06	NO DATA	NO DATA	5.83E-04	4.52E-05
SR	90	2.73E-02	NO DATA	1.74E-03	NO DATA	NO DATA	3.99E-03	9.28E-05
SR	91	3.28E-08	NO DATA	1.24E-09	NO DATA	NO DATA	1.44E-05	4.70E-05
SR	92	3.54E-09	NO DATA	1.42E-10	NO DATA	NO DATA	6.49E-06	6.55E-05
Y	90	1.11E-06	NO DATA	2.99E-08	NO DATA	NO DATA	7.07E-05	7.24E-05
Y	91M	1.37E-10	NO DATA	4.98E-12	NO DATA	NO DATA	7.60E-07	4.64E-07
Y	91	2.47E-04	NO DATA	6.59E-06	NO DATA	NO DATA	7.10E-04	4.97E-05
Y	92	5.50E-09	NO DATA	1.57E-10	NO DATA	NO DATA	6.46E-06	6.46E-05
Y	93	5.04E-08	NO DATA	1.38E-09	NO DATA	NO DATA	2.01E-05	1.05E-04
ZR	95	5.13E-05	1.13E-05	1.00E-05	NO DATA	1.61E-05	6.03E-04	1.65E-05
ZR	97	5.07E-08	7.34E-09	4.32E-09	NO DATA	1.05E-08	3.06E-05	9.49E-05
NB	95	6.35E-06	2.48E-06	1.77E-06	NO DATA	2.33E-06	1.66E-04	1.00E-05
MO	99	NO DATA	4.66E-08	1.15E-08	NO DATA	1.06E-07	3.66E-05	3.42E-05
TC	99M	4.81E-13	9.41E-13	1.56E-11	NO DATA	1.37E-11	2.57E-07	1.30E-06

***Taken from Regulatory Guide 1.109 (Rev. 1)**

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TABLE A.2-3* (cont'd)
INHALATION DOSE FACTORS FOR CHILD
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	2.19E-14	2.30E-14	2.91E-13	NO DATA	3.92E-13	1.58E-07	4.41E-09
RU	103	7.55E-07	NO DATA	2.90E-07	NO DATA	1.90E-06	1.79E-04	1.21E-05
RU	105	4.13E-10	NO DATA	1.50E-10	NO DATA	3.63E-10	4.30E-06	2.69E-05
RU	106	3.68E-05	NO DATA	4.57E-06	NO DATA	4.97E-05	3.87E-03	1.16E-04
AG	110M	4.56E-06	3.08E-06	2.47E-06	NO DATA	5.74E-06	1.48E-03	2.71E-05
TE	125M	1.82E-06	6.29E-07	2.47E-07	5.20E-07	NO DATA	1.29E-04	9.13E-06
TE	127M	6.72E-06	2.31E-06	8.16E-07	1.64E-06	1.72E-05	4.00E-04	1.93E-05
TE	127	7.49E-10	2.57E-10	1.65E-10	5.30E-10	1.91E-09	2.71E-06	1.52E-05
TE	129M	5.19E-06	1.85E-06	8.22E-07	1.71E-06	1.36E-05	4.76E-04	4.91E-05
TE	129	2.64E-11	9.45E-12	6.44E-12	1.93E-11	6.94E-11	7.93E-07	6.89E-06
TE	131M	3.63E-08	1.60E-08	1.37E-08	2.64E-08	1.08E-07	5.56E-05	8.32E-05
TE	131	5.87E-12	2.28E-12	1.78E-12	4.59E-12	1.59E-11	5.55E-07	3.60E-07
TE	132	1.30E-07	7.36E-08	7.12E-08	8.58E-08	4.79E-07	1.02E-04	3.72E-05
I	130	2.21E-06	4.43E-06	2.28E-06	4.99E-04	6.61E-06	NO DATA	1.38E-06
I	131	1.30E-05	1.30E-05	7.37E-06	4.39E-03	2.13E-05	NO DATA	7.68E-07
I	132	5.72E-07	1.10E-06	5.07E-07	5.23E-05	1.69E-06	NO DATA	8.65E-07
I	133	4.48E-06	5.49E-06	2.08E-06	1.04E-03	9.13E-06	NO DATA	1.48E-06
I	134	3.17E-07	5.84E-07	2.69E-07	1.37E-05	8.92E-07	NO DATA	2.58E-07
I	135	1.33E-06	2.36E-06	1.12E-06	2.14E-04	3.62E-06	NO DATA	1.20E-06
CS	134	1.76E-04	2.74E-04	6.07E-05	NO DATA	8.93E-05	3.27E-05	1.04E-06
CS	136	1.76E-05	4.62E-05	3.14E-05	NO DATA	2.58E-05	3.93E-06	1.13E-06
CS	137	2.45E-04	2.23E-04	3.47E-05	NO DATA	7.63E-05	2.81E-05	9.78E-07
CS	138	1.71E-07	2.27E-07	1.50E-07	NO DATA	1.68E-07	1.84E-08	7.29E-08
BA	139	4.98E-10	2.66E-13	1.45E-11	NO DATA	2.33E-13	1.56E-06	1.56E-05
BA	140	2.00E-05	1.75E-08	1.17E-06	NO DATA	5.71E-09	4.71E-04	2.75E-05
BA	141	5.29E-11	2.95E-14	1.72E-12	NO DATA	2.56E-14	7.89E-07	7.44E-08
BA	142	1.35E-11	9.73E-15	7.54E-13	NO DATA	7.87E-15	4.44E-07	7.41E-10
LA	140	1.74E-07	6.08E-08	2.04E-08	NO DATA	NO DATA	4.94E-05	6.10E-05
LA	142	3.50E-10	1.11E-10	3.49E-11	NO DATA	NO DATA	2.35E-06	2.05E-05
CE	141	1.06E-05	5.28E-06	7.83E-07	NO DATA	2.31E-06	1.47E-04	1.53E-05
CE	143	9.89E-08	5.37E-08	7.77E-09	NO DATA	2.26E-08	3.12E-05	3.44E-05
CE	144	1.83E-03	5.72E-04	9.77E-05	NO DATA	3.17E-04	3.23E-03	1.05E-04
PR	143	4.99E-06	1.50E-06	2.47E-07	NO DATA	8.11E-07	1.17E-04	2.63E-05
PR	144	1.61E-11	4.99E-12	8.10E-13	NO DATA	2.64E-12	4.23E-07	5.32E-08
ND	147	2.92E-06	2.36E-06	1.84E-07	NO DATA	1.30E-06	8.87E-05	2.22E-05
W	187	4.41E-09	2.61E-09	1.17E-09	NO DATA	NO DATA	1.11E-05	2.46E-05
NP	239	1.26E-07	9.04E-09	6.35E-09	NO DATA	2.63E-08	1.57E-05	1.73E-05

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TABLE A.2-4*
INHALATION DOSE FACTORS FOR INFANT
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07	4.62E-07
C	14	1.89E-05	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06	3.79E-06
NA	24	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06	7.54E-06
P	32	1.45E-03	8.03E-05	5.53E-05	NO DATA	NO DATA	NO DATA	1.15E-05
CR	51	NO DATA	NO DATA	6.39E-08	4.11E-08	9.45E-09	9.17E-06	2.55E-07
MN	54	NO DATA	1.81E-05	3.56E-06	NO DATA	3.56E-06	7.14E-04	5.04E-06
MN	56	NO DATA	1.10E-09	1.58E-10	NO DATA	7.86E-10	8.95E-06	5.12E-05
FE	55	1.41E-05	8.39E-06	2.38E-06	NO DATA	NO DATA	6.21E-05	7.82E-07
FE	59	9.69E-06	1.68E-05	6.77E-06	NO DATA	NO DATA	7.25E-04	1.77E-05
CO	58	NO DATA	8.71E-07	1.30E-06	NO DATA	NO DATA	5.55E-04	7.95E-06
CO	60	NO DATA	5.73E-06	8.41E-06	NO DATA	NO DATA	3.22E-03	2.28E-05
NI	63	2.42E-04	1.46E-05	8.29E-06	NO DATA	NO DATA	1.49E-04	1.73E-06
NI	65	1.71E-09	2.03E-10	8.79E-11	NO DATA	NO DATA	5.80E-06	3.58E-05
CU	64	NO DATA	1.34E-09	5.53E-10	NO DATA	2.84E-09	6.64E-06	1.07E-05
ZN	65	1.38E-05	4.47E-05	2.22E-05	NO DATA	2.32E-05	4.62E-04	3.67E-05
ZN	69	3.85E-11	6.91E-11	5.13E-12	NO DATA	2.87E-11	1.05E-06	9.44E-06
BR	83	NO DATA	NO DATA	2.72E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	84	NO DATA	NO DATA	2.86E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	85	NO DATA	NO DATA	1.46E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	1.36E-04	6.30E-05	NO DATA	NO DATA	NO DATA	2.17E-06
RB	88	NO DATA	3.98E-07	2.05E-07	NO DATA	NO DATA	NO DATA	2.42E-07
RB	89	NO DATA	2.29E-07	1.47E-07	NO DATA	NO DATA	NO DATA	4.87E-08
SR	89	2.84E-04	NO DATA	8.15E-06	NO DATA	NO DATA	1.45E-03	4.57E-05
SR	90	2.92E-02	NO DATA	1.85E-03	NO DATA	NO DATA	8.03E-03	9.36E-05
SR	91	6.83E-08	NO DATA	2.47E-09	NO DATA	NO DATA	3.76E-05	5.24E-05
SR	92	7.50E-09	NO DATA	2.79E-10	NO DATA	NO DATA	1.70E-05	1.00E-04
Y	90	2.35E-06	NO DATA	6.30E-08	NO DATA	NO DATA	1.92E-04	7.43E-05
Y	91M	2.91E-10	NO DATA	9.90E-12	NO DATA	NO DATA	1.99E-06	1.68E-06
Y	91	4.20E-04	NO DATA	1.12E-05	NO DATA	NO DATA	1.75E-03	5.02E-05
Y	92	1.17E-08	NO DATA	3.29E-10	NO DATA	NO DATA	1.75E-05	9.04E-05
Y	93	1.07E-07	NO DATA	2.91E-09	NO DATA	NO DATA	5.46E-05	1.19E-04
ZR	95	8.24E-05	1.99E-05	1.45E-05	NO DATA	2.22E-05	1.25E-03	1.55E-05
ZR	97	1.07E-07	1.83E-08	8.36E-09	NO DATA	1.85E-08	7.88E-05	1.00E-04
NB	95	1.12E-05	4.59E-06	2.70E-06	NO DATA	3.37E-06	3.42E-04	9.05E-06
MO	99	NO DATA	1.18E-07	2.31E-08	NO DATA	1.89E-07	9.63E-05	3.48E-05
TC	99M	9.98E-13	2.06E-12	2.66E-11	NO DATA	2.22E-11	5.79E-07	1.45E-06

***Taken from Regulatory Guide 1.109 (Rev. 1)**

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TABLE A.2-4* (cont'd)
INHALATION DOSE FACTORS FOR INFANT
(MREM PER PCI INHALED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	4.65E-14	5.88E-14	5.80E-13	NO DATA	6.99E-13	4.17E-07	6.03E-07
RU	103	1.44E-06	NO DATA	4.85E-07	NO DATA	3.03E-06	3.94E-04	1.15E-05
RU	105	8.74E-10	NO DATA	2.93E-10	NO DATA	6.42E-10	1.12E-05	3.46E-05
RU	106	6.20E-05	NO DATA	7.77E-06	NO DATA	7.61E-05	8.26E-03	1.17E-04
AG	110M	7.13E-06	5.16E-06	3.57E-06	NO DATA	7.80E-06	2.62E-03	2.36E-05
TE	125M	3.40E-06	1.42E-06	4.70E-07	1.16E-06	NO DATA	3.19E-04	9.22E-06
TE	127M	1.19E-05	4.93E-06	1.48E-06	3.48E-06	2.68E-05	9.37E-04	1.95E-05
TE	127	1.59E-09	6.81E-10	3.49E-10	1.32E-09	3.47E-09	7.39E-06	1.74E-05
TE	129M	1.01E-05	4.35E-06	1.59E-06	3.91E-06	2.27E-05	1.20E-03	4.93E-05
TE	129	5.63E-11	2.48E-11	1.34E-11	4.82E-11	1.25E-10	2.14E-06	1.88E-05
TE	131M	7.62E-08	3.93E-08	2.59E-08	6.38E-08	1.89E-07	1.42E-04	8.51E-05
TE	131	1.24E-11	5.87E-12	3.57E-12	1.13E-11	2.85E-11	1.47E-06	5.87E-06
TE	132	2.66E-07	1.69E-07	1.26E-07	1.99E-07	7.39E-07	2.43E-04	3.15E-05
I	130	4.54E-06	9.91E-06	3.98E-06	1.14E-03	1.09E-05	NO DATA	1.42E-06
I	131	2.71E-05	3.17E-05	1.40E-05	1.06E-02	3.70E-05	NO DATA	7.56E-07
I	132	1.21E-06	2.53E-06	8.99E-07	1.21E-04	2.82E-06	NO DATA	1.36E-06
I	133	9.46E-06	1.37E-05	4.00E-06	2.54E-03	1.60E-05	NO DATA	1.54E-06
I	134	6.58E-07	1.34E-06	4.75E-07	3.18E-05	1.49E-06	NO DATA	9.21E-07
I	135	2.76E-06	5.43E-06	1.98E-06	4.97E-04	6.05E-06	NO DATA	1.31E-06
CS	134	2.83E-04	5.02E-04	5.32E-05	NO DATA	1.36E-04	5.69E-05	9.53E-07
CS	136	3.45E-05	9.61E-05	3.78E-05	NO DATA	4.03E-05	8.40E-06	1.02E-06
CS	137	3.92E-04	4.37E-04	3.25E-05	NO DATA	1.23E-04	5.09E-05	9.53E-07
CS	138	3.61E-07	5.58E-07	2.84E-07	NO DATA	2.93E-07	4.67E-08	6.26E-07
BA	139	1.06E-09	7.03E-13	3.07E-11	NO DATA	4.23E-13	4.25E-06	3.64E-05
BA	140	4.00E-05	4.00E-08	2.07E-06	NO DATA	9.59E-09	1.14E-03	2.74E-05
BA	141	1.12E-10	7.70E-14	3.55E-12	NO DATA	4.64E-14	2.12E-06	3.39E-06
BA	142	2.84E-11	2.36E-14	1.40E-12	NO DATA	1.36E-14	1.11E-06	4.95E-07
LA	140	3.61E-07	1.43E-07	3.68E-08	NO DATA	NO DATA	1.20E-04	6.06E-05
LA	142	7.36E-10	2.69E-10	6.46E-11	NO DATA	NO DATA	5.87E-06	4.25E-05
CE	141	1.98E-05	1.19E-05	1.42E-06	NO DATA	3.75E-06	3.69E-04	1.54E-05
CE	143	2.09E-07	1.38E-07	1.58E-08	NO DATA	4.03E-08	8.30E-05	3.55E-05
CE	144	2.28E-03	8.65E-04	1.26E-04	NO DATA	3.84E-04	7.03E-03	1.06E-04
PR	143	1.00E-05	3.74E-06	4.99E-07	NO DATA	1.41E-06	3.09E-04	2.66E-05
PR	144	3.42E-11	1.32E-11	1.72E-12	NO DATA	4.80E-12	1.15E-06	3.06E-06
ND	147	5.67E-06	5.81E-06	3.57E-07	NO DATA	2.25E-06	2.30E-04	2.23E-05
W	187	9.26E-09	6.44E-09	2.23E-09	NO DATA	NO DATA	2.83E-05	2.54E-05
NP	239	2.65E-07	2.37E-08	1.34E-08	NO DATA	4.73E-08	4.25E-05	1.78E-05

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TABLE A.2-5*

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
H-3	0.0	0.0
C-14	0.0	0.0
Na-24	2.50E-08	2.90E-08
P-32	0.0	0.0
Cr-51	2.20E-10	2.60E-10
Mn-54	5.80E-09	6.80E-09
Mn-56	1.10E-08	1.30E-08
Fe-55	0.0	0.0
Fe-59	8.00E-09	9.40E-09
Co-58	7.00E-09	8.20E-09
Co-60	1.70E-08	2.00E-08
Ni-63	0.0	0.0
Ni-65	3.70E-09	4.30E-09
Cu-64	1.50E-09	1.70E-09
Zn-65	4.00E-09	4.60E-09
Zn-69	0.0	0.0
Br-83	6.40E-11	9.30E-11
Br-84	1.20E-08	1.40E-08
Br-85	0.0	0.0
Rb-86	6.30E-10	7.20E-10
Rb-88	3.50E-09	4.00E-09
Rb-89	1.50E-08	1.80E-08
Sr-89	5.60E-13	6.50E-13
Sr-91	7.10E-09	8.30E-09
Sr-92	9.00E-09	1.00E-08
Y-90	2.20E-12	2.60E-12
Y-91M	3.80E-09	4.40E-09
Y-91	2.40E-11	2.70E-11
Y-92	1.60E-09	1.90E-09
Y-93	5.70E-10	7.80E-10
Zr-95	5.00E-09	5.80E-09
Zr-97	5.50E-09	6.40E-09
Nb-95	5.10E-09	6.00E-09
Mo-99	1.90E-09	2.20E-09
Tc-99M	9.60E-10	1.10E-09
Tc-101	2.70E-09	3.00E-09
Ru-103	3.60E-09	4.20E-09
Ru-105	4.50E-09	5.10E-09
Ru-106	1.50E-09	1.80E-09
Ag-110M	1.80E-08	2.10E-08
Te-125M	3.50E-11	4.80E-11
Te-127M	1.10E-12	1.30E-12
Te-127	1.00E-11	1.10E-11
Te-129M	7.70E-10	9.00E-10
Te-129	7.10E-10	8.40E-10

*Taken from Regulatory Guide 1.109 (Rev. 1)

TABLE A.2-5* (cont'd)

EXTERNAL DOSE FACTORS FOR STANDING ON CONTAMINATED GROUND
(mrem/hr per pCi/m^2)

ELEMENT	TOTAL BODY	SKIN
Te-131M	8.40E-09	9.90E-09
Te-131	2.20E-09	2.60E-06
Te-132	1.70E-09	2.00E-09
I-130	1.40E-08	1.70E-08
I-131	2.80E-09	3.40E-09
I-132	1.70E-08	2.00E-08
I-133	3.70E-09	4.50E-09
I-134	1.60E-08	1.90E-08
I-135	1.20E-08	1.40E-08
Cs-134	1.20E-08	1.40E-08
Cs-136	1.50E-08	1.70E-08
Cs-137	4.20E-09	4.90E-09
Cs-138	2.10E-08	2.40E-08
Ba-139	2.40E-09	2.70E-09
Ba-140	2.10E-09	2.40E-09
Ba-141	4.30E-09	4.90E-09
Ba-142	7.90E-09	9.00E-09
La-140	1.50E-08	1.70E-08
La-142	1.50E-08	1.80E-08
Ce-141	5.50E-10	6.20E-10
Ce-143	2.20E-09	2.50E-09
Ce-144	3.20E-10	3.70E-10
Pr-143	0.0	0.0
Pr-144	2.00E-10	2.30E-10
Nd-147	1.00E-09	1.20E-09
W-187	3.10E-09	3.60E-09
Np-239	9.50E-10	1.10E-09

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TABLE A.3-1*
INGESTION DOSE FACTORS FOR ADULTS
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C	14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA	24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P	32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR	51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN	54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN	56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE	55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE	59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO	58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO	60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI	63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI	65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU	64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN	65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN	69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR	83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR	84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR	85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB	88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB	89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR	89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR	90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR	91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR	92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y	90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y	91M	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y	91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y	92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05
Y	93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR	95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR	97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB	95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO	99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC	99M	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07

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TABLE A.3-1* (cont'd)
INGESTION DOSE FACTORS FOR ADULTS
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU	103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU	105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU	106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG	110M	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
TE	125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE	127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE	127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE	129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE	129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE	131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE	131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE	132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I	130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I	131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I	132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I	133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I	134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I	135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS	134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS	136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06
CS	137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.23E-05	2.11E-06
CS	138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA	139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA	140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA	141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA	142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA	140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA	142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE	141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE	143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE	144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR	143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR	144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND	147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W	187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05

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TABLE A.3-1* (cont'd)
INGESTION DOSE FACTORS FOR ADULTS
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP	239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05
Sb	124**	2.80E-06	5.29E-08	1.11E-06	6.79E-09	NO DATA	2.18E-06	7.95E-05
Sb	125**	1.79E-06	2.00E-08	4.26E-07	1.82E-09	NO DATA	1.38E-06	1.97E-05
Sb	126**	1.15E-06	2.34E-08	4.15E-07	7.04E-09	NO DATA	7.05E-07	9.40E-05
Co	57**	NO DATA	1.75E-07	2.91E-07	NO DATA	NO DATA	NO DATA	4.44E-06

****Taken from Regulatory Guide 1.109 (Rev. 0)**

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TABLE A-3.2
INGESTION DOSE FACTORS FOR TEENAGERS
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07	1.06E-07
C	14	4.06E-06	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07	8.12E-07
NA	24	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06	2.30E-06
P	32	2.76E-04	1.71E-05	1.07E-05	NO DATA	NO DATA	NO DATA	2.32E-05
CR	51	NO DATA	NO DATA	3.60E-09	2.00E-09	7.89E-10	5.14E-09	6.05E-07
MN	54	NO DATA	5.90E-06	1.17E-06	NO DATA	1.76E-06	NO DATA	1.21E-05
MN	56	NO DATA	1.58E-07	2.81E-08	NO DATA	2.00E-07	NO DATA	1.04E-05
FE	55	3.78E-06	2.68E-06	6.25E-07	NO DATA	NO DATA	1.70E-06	1.16E-06
FE	59	5.87E-06	1.37E-05	5.29E-06	NO DATA	NO DATA	4.32E-06	3.24E-05
CO	58	NO DATA	9.72E-07	2.24E-06	NO DATA	NO DATA	NO DATA	1.34E-05
CO	60	NO DATA	2.81E-06	6.33E-06	NO DATA	NO DATA	NO DATA	3.66E-05
NI	63	1.77E-04	1.25E-05	6.00E-06	NO DATA	NO DATA	NO DATA	1.99E-06
NI	65	7.49E-07	9.57E-08	4.36E-08	NO DATA	NO DATA	NO DATA	5.19E-06
CU	64	NO DATA	1.15E-07	5.41E-08	NO DATA	2.91E-07	NO DATA	8.92E-06
ZN	65	5.76E-06	2.00E-05	9.33E-06	NO DATA	1.28E-05	NO DATA	8.47E-06
ZN	69	1.47E-08	2.80E-08	1.96E-09	NO DATA	1.83E-08	NO DATA	5.16E-08
BR	83	NO DATA	NO DATA	5.74E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR	84	NO DATA	NO DATA	7.22E-08	NO DATA	NO DATA	NO DATA	LT E-24
BR	85	NO DATA	NO DATA	3.05E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	2.98E-05	1.40E-05	NO DATA	NO DATA	NO DATA	4.41E-06
RB	88	NO DATA	8.52E-08	4.54E-08	NO DATA	NO DATA	NO DATA	7.30E-15
RB	89	NO DATA	5.50E-08	3.89E-08	NO DATA	NO DATA	NO DATA	8.43E-17
SR	89	4.40E-04	NO DATA	1.26E-05	NO DATA	NO DATA	NO DATA	5.24E-05
SR	90	8.30E-03	NO DATA	2.05E-03	NO DATA	NO DATA	NO DATA	2.33E-04
SR	91	8.07E-06	NO DATA	3.21E-07	NO DATA	NO DATA	NO DATA	3.66E-05
SR	92	3.05E-06	NO DATA	1.30E-07	NO DATA	NO DATA	NO DATA	7.77E-05
Y	90	1.37E-08	NO DATA	3.69E-10	NO DATA	NO DATA	NO DATA	1.13E-04
Y	91M	1.29E-10	NO DATA	4.93E-12	NO DATA	NO DATA	NO DATA	6.09E-09
Y	91	2.01E-07	NO DATA	5.39E-09	NO DATA	NO DATA	NO DATA	8.24E-05
Y	92	1.21E-09	NO DATA	3.50E-11	NO DATA	NO DATA	NO DATA	3.32E-05
Y	93	3.83E-09	NO DATA	1.05E-10	NO DATA	NO DATA	NO DATA	1.17E-04
ZR	95	4.12E-08	1.30E-08	8.94E-09	NO DATA	1.91E-08	NO DATA	3.00E-05
ZR	97	2.37E-09	4.69E-10	2.16E-10	NO DATA	7.11E-10	NO DATA	1.27E-04
NB	95	8.22E-09	4.56E-09	2.51E-09	NO DATA	4.42E-09	NO DATA	1.95E-05
MO	99	NO DATA	6.03E-06	1.15E-06	NO DATA	1.38E-05	NO DATA	1.08E-05
TC	99M	3.32E-10	9.26E-10	1.20E-08	NO DATA	1.38E-08	5.14E-10	6.08E-07

***Taken from Regulatory Guide 1.109 (Rev. 1)**

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TABLE A-3.2 (cont'd)
INGESTION DOSE FACTORS FOR TEENAGERS
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	3.60E-10	5.12E-10	5.03E-09	NO DATA	9.26E-09	3.12E-10	8.75E-17
RU	103	2.55E-07	NO DATA	1.09E-07	NO DATA	8.99E-07	NO DATA	2.13E-05
RU	105	2.18E-08	NO DATA	8.46E-09	NO DATA	2.75E-07	NO DATA	1.76E-05
RU	106	3.92E-06	NO DATA	4.94E-07	NO DATA	7.56E-06	NO DATA	1.88E-04
AG	110M	2.05E-07	1.94E-07	1.18E-07	NO DATA	3.70E-07	NO DATA	5.45E-05
TE	125M	3.83E-06	1.38E-06	5.12E-07	1.07E-06	NO DATA	NO DATA	1.13E-05
TE	127M	9.67E-06	3.43E-06	1.15E-06	2.30E-06	3.92E-05	NO DATA	2.41E-05
TE	127	1.58E-07	5.60E-08	3.40E-08	1.09E-07	6.40E-07	NO DATA	1.22E-05
TE	129M	1.63E-05	6.05E-06	2.58E-06	5.26E-06	6.82E-05	NO DATA	6.12E-05
TE	129	4.48E-08	1.67E-08	1.09E-08	3.20E-08	1.88E-07	NO DATA	2.45E-07
TE	131M	2.44E-06	1.17E-06	9.76E-07	1.76E-06	1.22E-05	NO DATA	9.39E-05
TE	131	2.79E-08	1.15E-08	8.72E-09	2.15E-08	1.22E-07	NO DATA	2.29E-09
TE	132	3.49E-06	2.21E-06	2.08E-06	2.33E-06	2.12E-05	NO DATA	7.00E-05
I	130	1.03E-06	2.98E-06	1.19E-06	2.43E-04	4.59E-06	NO DATA	2.29E-06
I	131	5.85E-06	8.19E-06	4.40E-06	2.39E-03	1.41E-05	NO DATA	1.62E-06
I	132	2.79E-07	7.30E-07	2.62E-07	2.46E-05	1.15E-06	NO DATA	3.18E-07
I	133	2.01E-06	3.41E-06	1.04E-06	4.76E-04	5.98E-06	NO DATA	2.58E-06
I	134	1.46E-07	3.87E-07	1.39E-07	6.45E-06	6.10E-07	NO DATA	5.10E-09
I	135	6.10E-07	1.57E-06	5.82E-07	1.01E-04	2.48E-06	NO DATA	1.74E-06
CS	134	8.37E-05	1.97E-04	9.14E-05	NO DATA	6.26E-05	2.39E-05	2.45E-06
CS	136	8.59E-06	3.38E-05	2.27E-05	NO DATA	1.84E-05	2.90E-06	2.72E-06
CS	137	1.12E-04	1.49E-04	5.19E-05	NO DATA	5.07E-05	1.97E-05	2.12E-06
CS	138	7.76E-08	1.49E-07	7.45E-08	NO DATA	1.10E-07	1.28E-08	6.76E-11
BA	139	1.39E-07	9.78E-11	4.05E-09	NO DATA	9.22E-11	6.74E-11	1.24E-06
BA	140	2.84E-05	3.48E-08	1.83E-06	NO DATA	1.18E-08	2.34E-08	4.38E-05
BA	141	6.71E-08	5.01E-11	2.24E-09	NO DATA	4.65E-11	3.43E-11	1.43E-13
BA	142	2.99E-08	2.99E-11	1.84E-09	NO DATA	2.53E-11	1.99E-11	9.18E-20
LA	140	3.48E-09	1.71E-09	4.55E-10	NO DATA	NO DATA	NO DATA	9.82E-05
LA	142	1.79E-10	7.95E-11	1.98E-11	NO DATA	NO DATA	NO DATA	2.42E-06
CE	141	1.33E-08	8.88E-09	1.02E-09	NO DATA	4.18E-09	NO DATA	2.54E-05
CE	143	2.35E-09	1.71E-06	1.91E-10	NO DATA	7.67E-10	NO DATA	5.14E-05
CE	144	6.96E-07	2.88E-07	3.74E-08	NO DATA	1.72E-07	NO DATA	1.75E-04
PR	143	1.31E-08	5.23E-09	6.52E-10	NO DATA	3.04E-09	NO DATA	4.31E-05
PR	144	4.30E-11	1.76E-11	2.18E-12	NO DATA	1.01E-11	NO DATA	4.74E-14
ND	147	9.38E-09	1.02E-08	6.11E-10	NO DATA	5.99E-09	NO DATA	3.68E-05
W	187	1.46E-07	1.19E-07	4.17E-08	NO DATA	NO DATA	NO DATA	3.22E-05

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TABLE A-3.2 (cont'd)
INGESTION DOSE FACTORS FOR TEENAGERS
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP	239	1.76E-09	1.66E-10	9.22E-11	NO DATA	5.21E-10	NO DATA	2.67E-05
Sb	124**	3.87E-06	7.13E-08	1.51E-06	8.78E-09	NO DATA	3.38E-06	7.80E-05
Sb	125**	2.48E-06	2.71E-08	5.80E-07	2.37E-09	NO DATA	2.18E-06	1.93E-05
Sb	126**	1.59E-06	3.25E-08	5.71E-07	8.99E-09	NO DATA	1.14E-06	9.41E-05
Co	57**	NO DATA	2.38E-07	3.99E-07	NO DATA	NO DATA	NO DATA	4.44E-06

****Taken from Regulatory Guide 1.109 (Rev. 0)**

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TABLE A.3-3
INGESTION DOSE FACTORS FOR CHILD
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
C	14	1.21E-05	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06	2.42E-06
NA	24	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06	5.80E-06
P	32	8.25E-04	3.86E-05	3.18E-05	NO DATA	NO DATA	NO DATA	2.28E-05
CR	51	NO DATA	NO DATA	8.90E-09	4.94E-09	1.35E-09	9.02E-09	4.72E-07
MN	54	NO DATA	1.07E-05	2.85E-06	NO DATA	3.00E-06	NO DATA	8.98E-06
MN	56	NO DATA	3.34E-07	7.54E-08	NO DATA	4.04E-07	NO DATA	4.84E-05
FE	55	1.15E-05	6.10E-06	1.89E-06	NO DATA	NO DATA	3.45E-06	1.13E-06
FE	59	1.65E-05	2.67E-05	1.33E-05	NO DATA	NO DATA	7.74E-06	2.78E-05
CO	58	NO DATA	1.80E-06	5.51E-06	NO DATA	NO DATA	NO DATA	1.05E-05
CO	60	NO DATA	5.29E-06	1.56E-05	NO DATA	NO DATA	NO DATA	2.93E-05
NI	63	5.38E-04	2.88E-05	1.83E-05	NO DATA	NO DATA	NO DATA	1.94E-06
NI	65	2.22E-06	2.09E-07	1.22E-07	NO DATA	NO DATA	NO DATA	2.56E-05
CU	64	NO DATA	2.45E-07	1.48E-07	NO DATA	5.92E-07	NO DATA	1.15E-05
ZN	65	1.37E-05	3.65E-05	2.27E-05	NO DATA	2.30E-05	NO DATA	6.41E-06
ZN	69	4.38E-08	6.33E-08	5.85E-09	NO DATA	3.84E-08	NO DATA	3.99E-06
BR	83	NO DATA	NO DATA	1.71E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	84	NO DATA	NO DATA	1.98E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	85	NO DATA	NO DATA	9.12E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	6.70E-05	4.12E-05	NO DATA	NO DATA	NO DATA	4.31E-06
RB	88	NO DATA	1.90E-07	1.32E-07	NO DATA	NO DATA	NO DATA	9.32E-09
RB	89	NO DATA	1.17E-07	1.04E-07	NO DATA	NO DATA	NO DATA	1.02E-09
SR	89	1.32E-03	NO DATA	3.77E-05	NO DATA	NO DATA	NO DATA	5.11E-05
SR	90	1.70E-02	NO DATA	4.31E-03	NO DATA	NO DATA	NO DATA	2.29E-04
SR	91	2.40E-05	NO DATA	9.06E-07	NO DATA	NO DATA	NO DATA	5.30E-05
SR	92	9.03E-06	NO DATA	3.62E-07	NO DATA	NO DATA	NO DATA	1.71E-04
Y	90	4.11E-08	NO DATA	1.10E-09	NO DATA	NO DATA	NO DATA	1.17E-04
Y	91M	3.82E-10	NO DATA	1.39E-11	NO DATA	NO DATA	NO DATA	7.48E-07
Y	91	6.02E-07	NO DATA	1.61E-08	NO DATA	NO DATA	NO DATA	8.02E-05
Y	92	3.60E-09	NO DATA	1.03E-10	NO DATA	NO DATA	NO DATA	1.04E-04
Y	93	1.14E-08	NO DATA	3.13E-10	NO DATA	NO DATA	NO DATA	1.70E-04
ZR	95	1.16E-07	2.55E-08	2.27E-08	NO DATA	3.65E-08	NO DATA	2.66E-05
ZR	97	6.99E-09	1.01E-09	5.96E-10	NO DATA	1.45E-09	NO DATA	1.53E-04
NB	95	2.25E-08	8.76E-09	6.26E-09	NO DATA	8.23E-09	NO DATA	1.62E-05
MO	99	NO DATA	1.33E-05	3.29E-06	NO DATA	2.84E-05	NO DATA	1.10E-05
TC	99M	9.23E-10	1.81E-09	3.00E-08	NO DATA	2.63E-08	9.19E-10	1.03E-06

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TABLE A.3-3 (cont'd)
INGESTION DOSE FACTORS FOR CHILD
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	1.07E-09	1.12E-09	1.42E-08	NO DATA	1.91E-08	5.92E-10	3.56E-09
RU	103	7.31E-07	NO DATA	2.81E-07	NO DATA	1.84E-06	NO DATA	1.89E-05
RU	105	6.45E-08	NO DATA	2.34E-08	NO DATA	5.67E-07	NO DATA	4.21E-05
RU	106	1.17E-05	NO DATA	1.46E-06	NO DATA	1.58E-05	NO DATA	1.82E-04
AG	110M	5.39E-07	3.64E-07	2.91E-07	NO DATA	6.78E-07	NO DATA	4.33E-05
TE	125M	1.14E-05	3.09E-06	1.52E-06	3.20E-06	NO DATA	NO DATA	1.10E-05
TE	127M	2.89E-05	7.78E-06	3.43E-06	6.91E-06	8.24E-05	NO DATA	2.34E-05
TE	127	4.71E-07	1.27E-07	1.01E-07	3.26E-07	1.34E-06	NO DATA	1.84E-05
TE	129M	4.87E-05	1.36E-05	7.56E-06	1.57E-05	1.43E-04	NO DATA	5.94E-05
TE	129	1.34E-07	3.74E-08	3.18E-08	9.56E-08	3.92E-07	NO DATA	8.34E-06
TE	131M	7.20E-06	2.49E-06	2.65E-06	5.12E-06	2.41E-05	NO DATA	1.01E-04
TE	131	8.30E-08	2.53E-08	2.47E-08	6.35E-08	2.51E-07	NO DATA	4.36E-07
TE	132	1.01E-05	4.47E-06	5.40E-06	6.51E-06	4.15E-05	NO DATA	4.50E-05
I	130	2.92E-06	5.90E-06	3.04E-06	6.50E-04	8.82E-06	NO DATA	2.76E-06
I	131	1.72E-05	1.73E-05	9.83E-06	5.72E-03	2.84E-05	NO DATA	1.54E-06
I	132	8.00E-07	1.47E-06	6.76E-07	6.82E-05	2.25E-06	NO DATA	1.73E-06
I	133	5.92E-06	7.32E-06	2.77E-06	1.36E-03	1.22E-05	NO DATA	2.95E-06
I	134	4.19E-07	7.78E-07	3.58E-07	1.79E-05	1.19E-06	NO DATA	5.16E-07
I	135	1.75E-06	3.15E-06	1.49E-06	2.79E-04	4.83E-06	NO DATA	2.40E-06
CS	134	2.34E-04	3.84E-04	8.10E-05	NO DATA	1.19E-04	4.27E-05	2.07E-06
CS	136	2.35E-05	6.46E-05	4.18E-05	NO DATA	3.44E-05	5.13E-06	2.27E-06
CS	137	3.27E-04	3.13E-04	4.62E-05	NO DATA	1.02E-04	3.67E-05	1.96E-06
CS	138	2.28E-07	3.17E-07	2.01E-07	NO DATA	2.23E-07	2.40E-08	1.46E-07
BA	139	4.14E-07	2.21E-10	1.20E-08	NO DATA	1.93E-10	1.30E-10	2.39E-05
BA	140	8.31E-05	7.28E-08	4.85E-06	NO DATA	2.37E-08	4.34E-08	4.21E-05
BA	141	2.00E-07	1.12E-10	6.51E-09	NO DATA	9.69E-11	6.58E-10	1.14E-07
BA	142	8.74E-08	6.29E-11	4.88E-09	NO DATA	5.09E-11	3.70E-11	1.14E-09
LA	140	1.01E-08	3.53E-09	1.19E-09	NO DATA	NO DATA	NO DATA	9.84E-05
LA	142	5.24E-10	1.67E-10	5.23E-11	NO DATA	NO DATA	NO DATA	3.31E-05
CE	141	3.97E-08	1.98E-08	2.94E-09	NO DATA	8.68E-09	NO DATA	2.47E-05
CE	143	6.99E-09	3.79E-06	5.49E-10	NO DATA	1.59E-09	NO DATA	5.55E-05
CE	144	2.08E-06	6.52E-07	1.11E-07	NO DATA	3.61E-07	NO DATA	1.70E-04
PR	143	3.93E-08	1.18E-08	1.95E-09	NO DATA	6.39E-09	NO DATA	4.24E-05
PR	144	1.29E-10	3.99E-11	6.49E-12	NO DATA	2.11E-11	NO DATA	8.59E-08
ND	147	2.79E-08	2.26E-08	1.75E-09	NO DATA	1.24E-08	NO DATA	3.58E-05
W	187	4.29E-07	2.54E-07	1.14E-07	NO DATA	NO DATA	NO DATA	3.57E-05

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TABLE A.3-3 (cont'd)
INGESTION DOSE FACTORS FOR CHILD
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP	239	5.25E-09	3.77E-10	2.65E-10	NO DATA	1.09E-09	NO DATA	2.79E-05
Sb	124**	1.11E-05	1.44E-07	3.89E-06	2.45E-08	NO DATA	6.16E-06	6.94E-05
Sb	125**	7.16E-06	5.52E-08	1.50E-06	6.63E-09	NO DATA	3.99E-06	1.71E-05
Sb	126**	4.40E-06	6.73E-08	1.58E-06	2.58E-08	NO DATA	2.10E-06	8.87E-05
Co	57**	NO DATA	4.93E-07	9.98E-07	NO DATA	NO DATA	NO DATA	4.04E-06

****Taken from Regulatory Guide 1.109 (Rev. 0)**

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TABLE A.3-4*
INGESTION DOSE FACTORS FOR INFANT
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	NO DATA	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07	3.08E-07
C	14	2.37E-05	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06	5.06E-06
NA	24	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05	1.01E-05
P	32	1.70E-03	1.00E-04	6.59E-05	NO DATA	NO DATA	NO DATA	2.30E-05
CR	51	NO DATA	NO DATA	1.41E-08	9.20E-09	2.01E-09	1.79E-08	4.11E-07
MN	54	NO DATA	1.99E-05	4.51E-06	NO DATA	4.41E-06	NO DATA	7.31E-06
MN	56	NO DATA	8.18E-07	1.41E-07	NO DATA	7.03E-07	NO DATA	7.43E-05
FE	55	1.39E-05	8.98E-06	2.40E-06	NO DATA	NO DATA	4.39E-06	1.14E-06
FE	59	3.08E-05	5.38E-05	2.12E-05	NO DATA	NO DATA	1.59E-05	2.57E-05
CO	58	NO DATA	3.60E-06	8.98E-06	NO DATA	NO DATA	NO DATA	8.97E-06
CO	60	NO DATA	1.08E-05	2.55E-05	NO DATA	NO DATA	NO DATA	2.57E-05
NI	63	6.34E-04	3.92E-05	2.20E-05	NO DATA	NO DATA	NO DATA	1.95E-06
NI	65	4.70E-06	5.32E-07	2.42E-07	NO DATA	NO DATA	NO DATA	4.05E-05
CU	64	NO DATA	6.09E-07	2.82E-07	NO DATA	1.03E-06	NO DATA	1.25E-05
ZN	65	1.84E-05	6.31E-05	2.91E-05	NO DATA	3.06E-05	NO DATA	5.33E-05
ZN	69	9.33E-08	1.68E-07	1.25E-08	NO DATA	6.98E-08	NO DATA	1.37E-05
BR	83	NO DATA	NO DATA	3.63E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	84	NO DATA	NO DATA	3.82E-07	NO DATA	NO DATA	NO DATA	LT E-24
BR	85	NO DATA	NO DATA	1.94E-08	NO DATA	NO DATA	NO DATA	LT E-24
RB	86	NO DATA	1.70E-04	8.40E-05	NO DATA	NO DATA	NO DATA	4.35E-06
RB	88	NO DATA	4.98E-07	2.73E-07	NO DATA	NO DATA	NO DATA	4.85E-07
RB	89	NO DATA	2.86E-07	1.97E-07	NO DATA	NO DATA	NO DATA	9.74E-08
SR	89	2.51E-03	NO DATA	7.20E-05	NO DATA	NO DATA	NO DATA	5.16E-05
SR	90	1.85E-02	NO DATA	4.71E-03	NO DATA	NO DATA	NO DATA	2.31E-04
SR	91	5.00E-05	NO DATA	1.81E-06	NO DATA	NO DATA	NO DATA	5.92E-05
SR	92	1.92E-05	NO DATA	7.13E-07	NO DATA	NO DATA	NO DATA	2.07E-04
Y	90	8.69E-08	NO DATA	2.33E-09	NO DATA	NO DATA	NO DATA	1.20E-04
Y	91M	8.10E-10	NO DATA	2.76E-11	NO DATA	NO DATA	NO DATA	2.70E-06
Y	91	1.13E-06	NO DATA	3.01E-08	NO DATA	NO DATA	NO DATA	8.10E-05
Y	92	7.65E-09	NO DATA	2.15E-10	NO DATA	NO DATA	NO DATA	1.46E-04
Y	93	2.43E-08	NO DATA	6.62E-10	NO DATA	NO DATA	NO DATA	1.92E-04
ZR	95	2.06E-07	5.02E-08	3.56E-08	NO DATA	5.41E-08	NO DATA	2.50E-05
ZR	97	1.48E-08	2.54E-09	1.16E-09	NO DATA	2.56E-09	NO DATA	1.62E-04
NB	95	4.20E-08	1.73E-08	1.00E-08	NO DATA	1.24E-08	NO DATA	1.46E-05
MO	99	NO DATA	3.40E-05	6.63E-06	NO DATA	5.08E-05	NO DATA	1.12E-05
TC	99M	1.92E-09	3.96E-09	5.10E-08	NO DATA	4.26E-08	2.07E-09	1.15E-06

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TABLE A.3-4* (cont'd)
INGESTION DOSE FACTORS FOR INFANT
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	2.27E-09	2.86E-09	2.83E-08	NO DATA	3.40E-08	1.56E-09	4.86E-07
RU	103	1.48E-06	NO DATA	4.95E-07	NO DATA	3.08E-06	NO DATA	1.80E-05
RU	105	1.36E-07	NO DATA	4.58E-08	NO DATA	1.00E-06	NO DATA	5.41E-05
RU	106	2.41E-05	NO DATA	3.01E-06	NO DATA	2.85E-05	NO DATA	1.83E-04
AG	110M	9 96E-07	7.27E-07	4.81E-07	NO DATA	1.04E-06	NO DATA	3.77E-05
TE	125M	2.33E-05	7.79E-06	3.15E-06	7.84E-06	NO DATA	NO DATA	1.11E-05
TE	127M	5.85E-05	1.94E-05	7.08E-06	1.69E-05	1.44E-04	NO DATA	2.36E-05
TE	127	1.00E-06	3.35E-07	2.15E-07	8.14E-07	2.44E-06	NO DATA	2.10E-05
TE	129M	1.00E-04	3.43E-05	1.54E-05	3.84E-05	2.50E-04	NO DATA	5.97E-05
TE	129	2.84E-07	9.79E-08	6.63E-08	2.38E-07	7.07E-07	NO DATA	2.27E-05
TE	131M	1.52E-05	6.12E-06	5.05E-06	1.24E-05	4.21E-05	NO DATA	1.03E-04
TE	131	1.76E-07	6.50E-08	4.94E-08	1.57E-07	4.50E-07	NO DATA	7.11E-06
TE	132	2.08E-05	1.03E-05	9.61E-06	1.52E-05	6.44E-05	NO DATA	3.81E-05
I	130	6.00E-06	1.32E-05	5.30E-06	1.48E-03	1.45E-05	NO DATA	2.83E-06
I	131	3.59E-05	4.23E-05	1.86E-05	1.39E-02	4.94E-05	NO DATA	1.51E-06
I	132	1.66E-06	3.37E-06	1.20E-06	1.58E-04	3.76E-06	NO DATA	2.73E-06
I	133	1.25E-05	1.82E-05	5.33E-06	3.31E-03	2.14E-05	NO DATA	3.08E-06
I	134	8.69E-07	1.78E-06	6.33E-07	4.15E-05	1.99E-06	NO DATA	1.84E-06
I	135	3.64E-06	7.24E-06	2.64E-06	6.49E-04	8.07E-06	NO DATA	2.62E-06
CS	134	3.77E-04	7.03E-04	7.10E-05	NO DATA	1.81E-04	7.42E-05	1.91E-06
CS	136	4.59E-05	1.35E-04	5.04E-05	NO DATA	5.38E-05	1.10E-05	2.05E-06
CS	137	5.22E-04	6.11E-04	4.33E-05	NO DATA	1.64E-04	6.64E-05	1.91E-06
CS	138	4.81E-07	7.82E-07	3.79E-07	NO DATA	3.90E-07	6.09E-08	1.25E-06
BA	139	8.81E-07	5.84E-10	2.55E-08	NO DATA	3.51E-10	3.54E-10	5.58E-05
BA	140	1.71E-04	1.71E-07	8.81E-06	NO DATA	4.06E-08	1.05E-07	4.20E-05
BA	141	4.25E-07	2.91E-10	1.34E-08	NO DATA	1.75E-10	1.77E-10	5.19E-06
BA	142	1.84E-07	1.53E-10	9.06E-09	NO DATA	8.81E-11	9.26E-11	7.59E-07
LA	140	2.11E-08	8.32E-09	2.14E-09	NO DATA	NO DATA	NO DATA	9.77E-05
LA	142	1.10E-09	4.04E-10	9.67E-11	NO DATA	NO DATA	NO DATA	6.86E-05
CE	141	7.87E-08	4.80E-08	5.65E-09	NO DATA	1.48E-08	NO DATA	2.48E-05
CE	143	1.48E-08	9.82E-06	1.12E-09	NO DATA	2.86E-09	NO DATA	5.73E-05
CE	144	2.98E-06	1.22E-06	1.67E-07	NO DATA	4.93E-07	NO DATA	1.71E-04
PR	143	8.13E-08	3.04E-08	4.03E-09	NO DATA	1.13E-08	NO DATA	4.29E-05
PR	144	2.74E-10	1.06E-10	1.38E-11	NO DATA	3.84E-11	NO DATA	4.93E-06
ND	147	5.53E-08	5.68E-08	3.48E-09	NO DATA	2.19E-08	NO DATA	3.60E-05
W	187	9.03E-07	6.28E-07	2.17E-07	NO DATA	NO DATA	NO DATA	3.69E-05

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TABLE A.3-4* (cont'd)
INGESTION DOSE FACTORS FOR INFANT
(MREM PER PCI INGESTED)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP	239	1.11E-08	9.93E-10	5.61E-10	NO DATA	1.98E-09	NO DATA	2.87E-05
Sb	124**	2.14E-05	3.15E-07	6.63E-06	5.68E-08	NO DATA	1.34E-05	6.60E-05
Sb	125**	1.23E-05	1.19E-07	2.53E-06	1.54E-08	NO DATA	7.72E-06	1.64E-05
Sb	126**	8.06E-06	1.58E-07	2.91E-06	6.19E-08	NO DATA	5.07E-06	8.35E-06
Co	57**	NO DATA	1.15E-06	1.87E-06	NO DATA	NO DATA	NO DATA	3.92E-06

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TABLE A.3-5*

STABLE ELEMENT TRANSFER DATA

Element	B_{iv} Veg/soil	F_m (Cow) Milk (d/l)	F_f Meat (d/kg)
H	4.8E 00	1.0E-02 +	1.20E-02
C	5.5E 00	1.2E-02 +	3.1E-02
Na	5.2E-02	4.0E-02	3.0E-02
P	1.1E 00	2.5E-02	4.6E-02
Cr	2.5E-04	2.2E-03	2.4E-03
Mn	2.9E-02	2.5E-04	8.0E-04
Fe	6.6E-04	1.2E-03 +	4.0E-02
Co	9.4E-03	1.0E-03	1.3E-02
Ni	1.9E-02	6.7E-03	5.3E-02
Cu	1.2E-01	1.4E-02 +	8.0E-03
Zn	4.0E-01	3.9E-02	3.0E-02
Rb	1.3E-01	3.0E-02	3.1E-02
Sr	1.7E-02	8.0E-04 +	6.0E-04
Y	2.6E-03	1.0E-05	4.6E-03
Zr	1.7E-04	5.0E-06	3.4E-02
Nb	9.4E-03	2.5E-03	2.8E-01
Mo	1.2E-01	7.5E-03	8.0E-03
Tc	2.5E-01	2.5E-02	4.0E-01
Ru	5.0E-02	1.0E-06	4.0E-01
Rh	1.3E 01	1.0E-02	1.5E-03
Ag	1.5E-01	5.0E-02	1.7E-02
Te	1.3E 00	1.0E-03	7.7E-02
I	2.0E-02	6.0E-03 +	2.9E-03
Cs	1.0E-02	1.2E-02 +	4.0E-03
Ba	5.0E-03	4.0E-04	3.2E-03
La	2.5E-03	5.0E-06	2.0E-04
Ce	2.5E-03	1.0E-04	1.2E-03
Pr	2.5E-03	5.0E-06	4.7E-03
Nd	2.4E-03	5.0E-06	3.3E-03
W	1.8E-02	5.0E-04	1.3E-03
Np	2.5E-03	5.0E-06	2.0E-04

+ F_m (Goat) values for milk (d/l)

Element	Milk (d/l)
H	1.7E-01
C	1.0E-01
P	2.5E-01
Fe	1.3E-04
Cu	1.3E-02
Sr	1.4E-02
I	6.0E-02
Cs	3.0E-01

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TABLE A.4-1
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
ADULT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	8.96E 00	8.96E 00	8.96E 00	8.96E 00	8.96E 00	8.96E 00
C	14	3.15E 04	6.30E 03	6.30E 03	6.30E 03	6.30E 03	6.30E 03	6.30E 03
NA	24	5.48E 02	5.48E 02	5.48E 02	5.48E 02	5.48E 02	5.48E 02	5.48E 02
P	32	4.62E 07	2.87E 06	1.79E 06	0.00E-01	0.00E-01	0.00E-01	5.20E 06
CR	51	0.00E-01	0.00E-01	1.49E 00	8.94E-01	3.29E-01	1.98E 00	3.76E 02
MN	54	0.00E-01	4.76E 03	9.08E 02	0.00E-01	1.42E 03	0.00E-01	1.46E 04
MN	56	0.00E-01	1.20E 02	2.12E 01	0.00E-01	1.52E 02	0.00E-01	3.82E 03
FE	55	8.87E 02	6.13E 02	1.43E 02	0.00E-01	0.00E-01	3.42E 02	3.52E 02
FE	59	1.40E 03	3.29E 03	1.26E 03	0.00E-01	0.00E-01	9.19E 02	1.10E 04
CO	58	0.00E-01	1.51E 02	3.39E 02	0.00E-01	0.00E-01	0.00E-01	3.06E 03
CO	60	0.00E-01	4.34E 02	9.58E 02	0.00E-01	0.00E-01	0.00E-01	8.16E 03
NI	63	4.19E 04	2.94E 03	1.41E 03	0.00E-01	0.00E-01	0.00E-01	6.07E 02
NI	65	1.70E 02	2.21E 01	1.01E 01	0.00E-01	0.00E-01	0.00E-01	5.61E 02
CU	64	0.00E-01	1.69E 01	7.93E 00	0.00E-01	4.26E-01	0.00E-01	1.44E 03
ZN	65	2.36E 04	7.50E 04	3.39E 04	0.00E-01	5.02E 04	0.00E-01	4.73E 04
ZN	69	5.02E 01	9.60E 01	6.67E 00	0.00E-01	6.24E-01	0.00E-01	1.44E 01
BR	83	0.00E-01	0.00E-01	4.38E 01	0.00E-01	0.00E-01	0.00E-01	6.30E 01
BR	84	0.00E-01	0.00E-01	5.67E 01	0.00E-01	0.00E-01	0.00E-01	4.45E-04
BR	85	0.00E-01	0.00E-01	2.33E 00	0.00E-01	0.00E-01	0.00E-01	1.09E-15
RB	86	0.00E-01	1.03E 05	4.79E 04	0.00E-01	0.00E-01	0.00E-01	2.03E 04
RB	88	0.00E-01	2.95E 02	1.56E 02	0.00E-01	0.00E-01	0.00E-01	4.07E-09
RB	89	0.00E-01	1.95E 02	1.37E 02	0.00E-01	0.00E-01	0.00E-01	1.13E-11
SR	89	4.78E 04	0.00E-01	1.37E 03	0.00E-01	0.00E-01	0.00E-01	7.66E 03
SR	90	1.18E 06	0.00E-01	2.88E 05	0.00E-01	0.00E-01	0.00E-01	3.40E 04
SR	91	8.79E 02	0.00E-01	3.55E 01	0.00E-01	0.00E-01	0.00E-01	4.19E 03
SR	92	3.33E 02	0.00E-01	1.44E 01	0.00E-01	0.00E-01	0.00E-01	6.60E 03
Y	90	1.38E 00	0.00E-01	3.69E-02	0.00E-01	0.00E-01	0.00E-01	1.46E 04
Y	91M	1.30E-02	0.00E-01	5.04E-04	0.00E-01	0.00E-01	0.00E-01	3.82E-02
Y	91	2.02E 01	0.00E-01	5.39E-01	0.00E-01	0.00E-01	0.00E-01	1.11E 04
Y	92	1.21E-01	0.00E-01	3.53E-03	0.00E-01	0.00E-01	0.00E-01	2.12E 03
Y	93	3.83E-01	0.00E-01	1.06E-02	0.00E-01	0.00E-01	0.00E-01	1.22E 04
ZR	95	2.77E 00	8.88E-01	6.01E-01	0.00E-01	1.39E 00	0.00E-01	2.82E 03
ZR	97	1.53E-01	3.09E-02	1.41E-02	0.00E-01	4.67E-02	0.00E-01	9.57E 03
NB	95	4.47E 02	2.49E 02	1.34E 02	0.00E-01	2.46E 02	0.00E-01	1.51E 06
MO	99	0.00E-01	4.62E 02	8.79E 01	0.00E-01	1.05E 03	0.00E-01	1.07E 03
TC	99M	2.94E-02	8.32E-02	1.06E 00	0.00E-01	1.26E 00	4.07E-02	4.92E 01

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TABLE A.4-1 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
ADULT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	3.03E-02	4.36E-02	4.28E-01	0.00E-01	7.85E-01	2.23E-02	1.31E-13
RU	103	1.98E 01	0.00E-01	8.54E 00	0.00E-01	7.57E 01	0.00E-01	2.31E 03
RU	105	1.65E 00	0.00E-01	6.52E-01	0.00E-01	2.13E 01	0.00E-01	1.01E 03
RU	106	2.95E 02	0.00E-01	3.73E 01	0.00E-01	5.69E 02	0.00E-01	1.91E 04
AG	110M	1.42E 01	1.31E 01	7.80E 00	0.00E-01	2.58E 01	0.00E-01	5.36E 03
TE	125M	2.79E 03	1.01E 03	3.74E 02	8.39E 02	1.13E 04	0.00E-01	1.11E 04
TE	127M	7.05E 03	2.52E 03	8.59E 02	1.80E 03	2.86E 04	0.00E-01	2.36E 04
TE	127	1.14E 02	4.11E 01	2.48E 01	8.48E 01	4.66E 02	0.00E-01	9.03E 03
TE	129M	1.20E 04	4.47E 03	1.89E 03	4.11E 03	5.00E 04	0.00E-01	6.03E 04
TE	129	3.27E 01	1.23E 01	7.96E 00	2.51E 01	1.37E 02	0.00E-01	2.47E 01
TE	131M	1.80E 03	8.81E 02	7.34E 02	1.39E 03	8.92E 03	0.00E-01	8.74E 04
TE	131	2.05E 01	8.57E 00	6.47E 00	1.69E 01	8.98E 01	0.00E-01	2.90E 00
TE	132	2.62E 03	1.70E 03	1.59E 03	1.87E 03	1.63E 04	0.00E-01	8.02E 04
I	130	9.01E 01	2.66E 02	1.05E 02	2.25E 04	4.15E 02	0.00E-01	2.29E 02
I	131	4.96E 02	7.09E 02	4.06E 02	2.32E 05	1.22E 03	0.00E-01	1.87E 02
I	132	2.42E 01	6.47E 01	2.26E 01	2.26E 03	1.03E 02	0.00E-01	1.22E 01
I	133	1.69E 02	2.94E 02	8.97E 01	4.32E 04	5.13E 02	0.00E-01	2.64E 02
I	134	1.26E 01	3.43E 01	1.23E 01	5.94E 02	5.46E 01	0.00E-01	2.99E-02
I	135	5.28E 01	1.38E 02	5.10E 01	9.11E 03	2.22E 02	0.00E-01	1.56E 02
CS	134	3.03E 05	7.21E 05	5.89E 05	0.00E-01	2.33E 05	7.75E 04	1.26E 04
CS	136	3.17E 04	1.25E 05	9.01E 04	0.00E-01	6.97E 04	9.55E 03	1.42E 04
CS	137	3.88E 05	5.31E 05	3.48E 05	0.00E-01	1.80E 05	5.99E 04	1.03E 04
CS	138	2.69E 02	5.31E 02	2.63E 02	0.00E-01	3.90E 02	3.85E 01	2.27E-03
BA	139	9.00E 00	6.41E-03	2.64E-01	0.00E-01	5.99E-03	3.64E-03	1.60E 01
BA	140	1.88E 03	2.37E 00	1.23E 02	0.00E-01	8.05E-01	1.35E 00	3.88E 03
BA	141	4.37E 00	3.30E-03	1.48E-01	0.00E-01	3.07E-03	1.87E-03	2.06E-09
BA	142	1.98E 00	2.03E-03	1.24E-01	0.00E-01	1.72E-03	1.15E-03	2.78E-18
LA	140	3.58E-01	1.80E-01	4.76E-02	0.00E-01	0.00E-01	0.00E-01	1.32E 04
LA	142	1.83E-02	8.33E-03	2.07E-03	0.00E-01	0.00E-01	0.00E-01	6.08E 01
CE	141	8.01E-01	5.42E-01	6.15E-02	0.00E-01	2.52E-01	0.00E-01	2.07E 03
CE	143	1.41E-01	1.04E 02	1.16E-02	0.00E-01	4.60E-02	0.00E-01	3.90E 03
CE	144	4.18E 01	1.75E 01	2.24E 00	0.00E-01	1.04E 01	0.00E-01	1.41E 04
PR	143	1.32E 00	5.28E-01	6.52E-02	0.00E-01	3.05E-01	0.00E-01	5.77E 03
PR	144	4.31E-03	1.79E-03	2.19E-04	0.00E-01	1.01E-03	0.00E-01	6.19E-10
ND	147	9.00E-01	1.04E 00	6.22E-02	0.00E-01	6.08E-01	0.00E-01	4.99E 03
W	187	3.04E 02	2.55E 02	8.90E 01	0.00E-01	0.00E-01	0.00E-01	8.34E 04

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TABLE A.4-1 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
ADULT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP	239	1.28E-01	1.25E-02	6.91E-03	0.00E-01	3.91E-02	0.00E-01	2.57E 03
Sb	124	2.40E 02	4.53E 00	9.50E 01	5.81E-01	0.00E-01	1.87E 02	6.81E 03
Sb	125	1.53E 02	1.71E 00	3.65E 01	1.56E-01	0.00E-01	1.18E 02	1.69E 03
Sb	126	9.85E 01	2.00E 00	3.55E 01	6.03E-01	0.00E-01	6.04E 01	8.05E 03
Co	57	0.00E-01	3.55E 01	5.90E 01	0.00E-01	0.00E-01	0.00E-01	9.01E 02

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-2
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
TEEN

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	6.34E 00	6.34E 00	6.34E 00	6.34E 00	6.34E 00	6.34E 00
C	14	3.43E 04	6.86E 03	6.86E 03	6.86E 03	6.86E 03	6.86E 03	6.86E 03
NA	24	5.53E 02	5.53E 02	5.53E 02	5.53E 02	5.53E 02	5.53E 02	5.53E 02
P	32	5.04E 07	3.12E 06	1.95E 06	0.00E-01	0.00E-01	0.00E-01	4.23E 06
CR	51	0.00E-01	0.00E-01	1.52E 00	8.46E-00	3.34E-00	2.17E 00	2.56E 02
MN	54	0.00E-01	4.65E 03	9.22E 02	0.00E-01	1.39E 03	0.00E-01	9.53E 03
MN	56	0.00E-01	1.24E 02	2.21E 01	0.00E-01	1.58E 02	0.00E-01	8.19E 03
FE	55	9.09E 02	6.45E 02	1.50E 02	0.00E-01	0.00E-01	4.09E 02	2.79E 02
FE	59	1.41E 03	3.30E 03	1.27E 03	0.00E-01	0.00E-01	1.04E 03	7.79E 03
CO	58	0.00E-01	1.45E 02	3.35E 02	0.00E-01	0.00E-01	0.00E-01	2.00E 03
CO	60	0.00E-01	4.20E 02	9.45E 02	0.00E-01	0.00E-01	0.00E-01	5.47E 03
NI	63	4.26E 04	3.01E 03	1.44E 03	0.00E-01	0.00E-01	0.00E-01	4.79E 02
NI	65	1.80E 02	2.30E 01	1.05E 01	0.00E-01	0.00E-01	0.00E-01	1.25E 03
CU	64	0.00E-01	1.72E 01	8.08E 00	0.00E-01	4.35E 01	0.00E-01	1.33E 03
ZN	65	2.13E 04	7.41E 04	3.46E 04	0.00E-01	4.74E 04	0.00E-01	3.14E 04
ZN	69	5.45E 01	1.04E 02	7.26E 00	0.00E-01	6.78E 01	0.00E-01	1.91E 02
BR	83	0.00E-01	0.00E-01	4.73E 01	0.00E-01	0.00E-01	0.00E-01	8.24E-16
BR	84	0.00E-01	0.00E-01	5.95E 01	0.00E-01	0.00E-01	0.00E-01	8.24E-16
BR	85	0.00E-01	0.00E-01	2.51E 00	0.00E-01	0.00E-01	0.00E-01	8.24E-16
RB	86	0.00E-01	1.10E 05	5.19E 04	0.00E-01	0.00E-01	0.00E-01	1.63E 04
RB	88	0.00E-01	3.16E 02	1.68E 02	0.00E-01	0.00E-01	0.00E-01	2.71E-05
RB	89	0.00E-01	2.04E 02	1.44E 02	0.00E-01	0.00E-01	0.00E-01	3.12E-07
SR	89	4.97E 04	0.00E-01	1.42E 03	0.00E-01	0.00E-01	0.00E-01	5.91E 03
SR	90	9.37E 05	0.00E-01	2.31E 05	0.00E-01	0.00E-01	0.00E-01	2.63E 04
SR	91	9.11E 02	0.00E-01	3.62E 01	0.00E-01	0.00E-01	0.00E-01	4.13E 03
SR	92	3.44E 02	0.00E-01	1.47E 01	0.00E-01	0.00E-01	0.00E-01	8.77E 03
Y	90	1.42E 00	0.00E-01	3.83E-01	0.00E-01	0.00E-01	0.00E-01	1.17E 04
Y	91M	1.34E-01	0.00E-01	5.11E-03	0.00E-01	0.00E-01	0.00E-01	6.32E-01
Y	91	2.09E 01	0.00E-01	5.59E-00	0.00E-01	0.00E-01	0.00E-01	8.55E 03
Y	92	1.26E-00	0.00E-01	3.63E-02	0.00E-01	0.00E-01	0.00E-01	3.44E 03
Y	93	3.97E-00	0.00E-01	1.09E-01	0.00E-01	0.00E-01	0.00E-01	1.21E 04
ZR	95	2.64E 00	8.34E-01	5.74E-00	0.00E-01	1.23E 00	0.00E-01	1.92E 03
ZR	97	1.52E-00	3.01E-02	1.39E-01	0.00E-01	4.56E-01	0.00E-01	8.15E 03
NB	95	4.50E 02	2.50E 02	1.37E 02	0.00E-01	2.42E 02	0.00E-01	1.07E 06
MO	99	0.00E-01	4.61E 02	8.78E 01	0.00E-01	1.05E 03	0.00E-01	8.25E 02
TC	99M	2.84E-01	7.92E-02	1.03E 00	0.00E-01	1.18E 00	4.39E-01	5.20E 01

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TABLE A.4-2 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
TEEN

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	3.08E-01	4.38E-02	4.30E-00	0.00E-01	7.92E-00	2.67E-01	7.48E-09
RU	103	1.95E 01	0.00E-01	8.33E 00	0.00E-01	6.87E 01	0.00E-01	1.63E 03
RU	105	1.67E 00	0.00E-01	6.46E-00	0.00E-01	2.10E 01	0.00E-01	1.34E 03
RU	106	2.99E 02	0.00E-01	3.77E 01	0.00E-01	5.77E 02	0.00E-01	1.44E 04
AG	110M	1.28E 01	1.21E 01	7.36E 00	0.00E-01	2.31E 01	0.00E-01	3.40E 03
TE	125M	3.02E 03	1.09E 03	4.03E 02	8.43E 02	0.00E-01	0.00E-01	8.90E 03
TE	127M	7.62E 03	2.70E 03	9.06E 02	1.81E 03	3.09E 04	0.00E-01	1.90E 04
TE	127	1.24E 02	4.41E 01	2.68E 01	8.59E 01	5.04E 02	0.00E-01	9.61E 03
TE	129M	1.28E 04	4.77E 03	2.03E 03	4.14E 03	5.37E 04	0.00E-01	4.82E 04
TE	129	3.53E 01	1.32E 01	8.59E 00	2.52E 01	1.48E 02	0.00E-01	1.93E 02
TE	131M	1.92E 03	9.22E 02	7.69E 02	1.39E 03	9.61E 03	0.00E-01	7.40E 04
TE	131	2.20E 01	9.06E 00	6.87E 00	1.69E 01	9.61E 01	0.00E-01	1.80E 00
TE	132	2.75E 03	1.74E 03	1.64E 03	1.84E 03	1.67E 04	0.00E-01	5.51E 04
I	130	8.81E 01	2.55E 02	1.02E 02	2.08E 04	3.92E 02	0.00E-01	1.96E 02
I	131	5.00E 02	7.00E 02	3.76E 02	2.04E 05	1.21E 03	0.00E-01	1.39E 02
I	132	2.39E 01	6.24E 01	2.24E 01	2.10E 03	9.83E 01	0.00E-01	2.72E 01
I	133	1.72E 02	2.92E 02	8.89E 01	4.07E 04	5.11E 02	0.00E-01	2.21E 02
I	134	1.25E 01	3.31E 01	1.19E 01	5.51E 02	5.22E 01	0.00E-01	4.36E-01
I	135	5.22E 01	1.34E 02	4.98E 01	8.64E 03	2.12E 02	0.00E-01	1.49E 02
CS	134	3.10E 05	7.30E 05	3.39E 05	0.00E-01	2.32E 05	8.86E 04	9.08E 03
CS	136	3.18E 04	1.25E 05	8.41E 04	0.00E-01	6.82E 04	1.07E 04	1.01E 04
CS	137	4.15E 05	5.52E 05	1.92E 05	0.00E-01	1.88E 05	7.30E 04	7.86E 03
CS	138	2.88E 02	5.52E 02	2.76E 02	0.00E-01	4.08E 02	4.74E 01	2.51E-01
BA	139	9.10E 00	6.40E-03	2.65E-00	0.00E-01	6.03E-02	4.41E-02	8.11E 01
BA	140	1.86E 03	2.28E 00	1.20E 02	0.00E-01	7.72E-00	1.53E 00	2.87E 03
BA	141	4.39E 00	3.28E-03	1.47E-00	0.00E-01	3.04E-02	2.24E-02	9.36E-06
BA	142	1.96E 00	1.96E-03	1.20E-00	0.00E-01	1.66E-02	1.30E-02	6.01E-12
LA	140	3.61E-00	1.77E-01	4.72E-01	0.00E-01	0.00E-01	0.00E-01	1.02E 04
LA	142	1.86E-01	8.25E-03	2.05E-02	0.00E-01	0.00E-01	0.00E-01	2.51E 02
CE	141	7.98E-00	5.32E-01	6.12E-01	0.00E-01	2.51E-00	0.00E-01	1.52E 03
CE	143	1.41E-00	1.03E 02	1.15E-01	0.00E-01	4.60E-01	0.00E-01	3.08E 03
CE	144	4.17E 01	1.73E 01	2.24E 00	0.00E-01	1.03E 01	0.00E-01	1.05E 04
PR	143	1.36E 00	5.43E-01	6.76E-01	0.00E-01	3.15E-00	0.00E-01	4.47E 03
PR	144	4.46E-02	1.83E-03	2.26E-03	0.00E-01	1.05E-02	0.00E-01	4.92E-06
ND	147	9.73E-00	1.06E 00	6.34E-01	0.00E-01	6.21E-00	0.00E-01	3.82E 03
W	187	3.28E 02	2.67E 02	9.37E 01	0.00E-01	0.00E-01	0.00E-01	7.24E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-2 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
TEEN

NUCLIDE	BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP 239	1.34E-00	1.27E-02	7.04E-02	0.00E-01	3.98E-01	0.00E-01	2.04E 03
Sb 124	2.32E 02	4.28E 00	9.05E 01	5.26E-00	0.00E-01	2.03E 02	4.68E 03
Sb 125	1.49E 02	1.63E 00	3.48E 01	1.42E-00	0.00E-01	1.31E 02	1.16E 03
Sb 126	9.53E 01	1.95E 00	3.42E 01	5.39E-00	0.00E-01	6.84E 01	5.64E 03
Co 57	0.00E-01	3.55E 01	5.96E 01	0.00E-01	0.00E-01	0.00E-01	6.63E 02

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-3
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCi/ML
CHILD

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	1.19E 01	1.19E 01	1.19E 01	1.19E 01	1.19E 01	1.19E 01
C	14	4.45E 04	8.90E 03	8.90E 03	8.90E 03	8.90E 03	8.90E 03	8.90E 03
NA	24	7.93E 02	7.93E 02	7.93E 02	7.93E 02	7.93E 02	7.93E 02	7.93E 02
P	32	6.49E 07	3.04E 06	2.50E 06	0.00E-01	0.00E-01	0.00E-01	1.79E 06
CR	51	0.00E-01	0.00E-01	1.92E 00	1.06E 00	2.91E-00	1.94E 00	1.02E 02
MN	54	0.00E-01	3.99E 03	1.06E 03	0.00E-01	1.12E 03	0.00E-01	3.35E 03
MN	56	0.00E-01	1.25E 02	2.81E 01	0.00E-01	1.51E 02	0.00E-01	1.80E 04
FE	55	1.57E 03	8.34E 02	2.59E 02	0.00E-01	0.00E-01	4.72E 02	1.55E 02
FE	59	2.26E 03	3.65E 03	1.82E 03	0.00E-01	0.00E-01	1.06E 03	3.80E 03
CO	58	0.00E-01	1.75E 02	5.37E 02	0.00E-01	0.00E-01	0.00E-01	1.02E 03
CO	60	0.00E-01	5.16E 02	1.52E 03	0.00E-01	0.00E-01	0.00E-01	2.86E 03
NI	63	7.36E 04	3.94E 03	2.50E 03	0.00E-01	0.00E-01	0.00E-01	2.65E 02
NI	65	3.04E 02	2.86E 01	1.67E 01	0.00E-01	0.00E-01	0.00E-01	3.50E 03
CU	64	0.00E-01	2.39E 01	1.44E 01	0.00E-01	5.77E 01	0.00E-01	1.12E 03
ZN	65	2.23E 04	5.95E 04	3.70E 04	0.00E-01	3.75E 04	0.00E-01	1.05E 04
ZN	69	7.15E 01	1.03E 02	9.54E 00	0.00E-01	6.26E 01	0.00E-01	6.51E 03
BR	83	0.00E-01	0.00E-01	6.64E 01	0.00E-01	0.00E-01	0.00E-01	3.89E-16
BR	84	0.00E-01	0.00E-01	7.69E 01	0.00E-01	0.00E-01	0.00E-01	3.89E-16
BR	85	0.00E-01	0.00E-01	3.54E 00	0.00E-01	0.00E-01	0.00E-01	3.89E-16
RB	86	0.00E-01	1.09E 05	6.72E 04	0.00E-01	0.00E-01	0.00E-01	7.03E 03
RB	88	0.00E-01	3.10E 02	2.15E 02	0.00E-01	0.00E-01	0.00E-01	1.52E 01
RB	89	0.00E-01	1.91E 02	1.70E 02	0.00E-01	0.00E-01	0.00E-01	1.66E 00
SR	89	1.08E 05	0.00E-01	3.08E 03	0.00E-01	0.00E-01	0.00E-01	4.18E 03
SR	90	1.39E 06	0.00E-01	3.52E 05	0.00E-01	0.00E-01	0.00E-01	1.87E 04
SR	91	1.96E 03	0.00E-01	7.41E 01	0.00E-01	0.00E-01	0.00E-01	4.33E 03
SR	92	7.38E 02	0.00E-01	2.96E 01	0.00E-01	0.00E-01	0.00E-01	1.40E 04
Y	90	3.20E 00	0.00E-01	8.56E-01	0.00E-01	0.00E-01	0.00E-01	9.10E 03
Y	91M	2.97E-01	0.00E-01	1.08E-02	0.00E-01	0.00E-01	0.00E-01	5.82E 01
Y	91	4.68E 01	0.00E-01	1.25E-01	0.00E-01	0.00E-01	0.00E-01	6.24E 03
Y	92	2.80E-00	0.00E-01	8.01E-02	0.00E-01	0.00E-01	0.00E-01	8.09E 03
Y	93	8.87E-00	0.00E-01	2.44E-01	0.00E-01	0.00E-01	0.00E-01	1.32E 04
ZR	95	7.05E 00	1.55E 00	1.38E 00	0.00E-01	2.22E 00	0.00E-01	1.62E 03
ZR	97	4.25E-00	6.13E-02	3.62E-01	0.00E-01	8.81E-01	0.00E-01	9.29E 03
NB	95	5.32E 02	2.07E 02	1.48E 02	0.00E-01	1.95E 02	0.00E-01	3.83E 05
MO	99	0.00E-01	8.78E 02	2.17E 02	0.00E-01	1.87E 03	0.00E-01	7.26E 02
TC	99M	6.46E-01	1.27E-01	2.10E 00	0.00E-01	1.84E 00	6.43E-01	7.20E 01

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-3 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCi/ML
CHILD

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	7.48E-01	7.83E-02	9.93E-00	0.00E-01	1.34E 00	4.14E-01	2.49E-01
RU	103	4.83E 01	0.00E-01	1.85E 01	0.00E-01	1.21E 02	0.00E-01	1.25E 03
RU	105	4.26E 00	0.00E-01	1.54E 00	0.00E-01	3.74E 01	0.00E-01	2.78E 03
RU	106	7.72E 02	0.00E-01	9.64E 01	0.00E-01	1.04E 03	0.00E-01	1.20E 04
AG	110M	3.23E 01	2.18E 01	1.74E 01	0.00E-01	4.06E 01	0.00E-01	2.60E 03
TE	125M	4.25E 03	1.15E 03	5.67E 02	1.19E 03	0.00E-01	0.00E-01	4.10E 03
TE	127M	1.08E 04	2.90E 03	1.28E 03	2.58E 03	3.07E 04	0.00E-01	8.72E 03
TE	127	1.76E 02	4.73E 01	3.77E 01	1.22E 02	5.00E 02	0.00E-01	6.86E 03
TE	129M	1.82E 04	5.07E 03	1.70E 03	5.85E 03	5.33E 04	0.00E-01	2.21E 04
TE	129	5.00E 01	1.39E 01	1.19E 01	3.56E 01	1.46E 02	0.00E-01	3.11E 03
TE	131M	2.68E 03	9.28E 02	9.88E 02	1.91E 03	8.98E 03	0.00E-01	3.77E 04
TE	131	3.09E 01	9.43E 00	9.21E 00	2.37E 01	9.36E 01	0.00E-01	1.63E 02
TE	132	3.77E 03	1.67E 03	2.01E 03	2.43E 03	1.55E 04	0.00E-01	1.68E 04
I	130	2.04E 02	4.13E 02	2.13E 02	4.55E 04	6.17E 02	0.00E-01	1.93E 02
I	131	1.20E 03	1.21E 03	6.88E 02	4.00E 05	1.99E 03	0.00E-01	1.08E 02
I	132	5.60E 01	1.03E 02	4.73E 01	4.77E 03	1.57E 02	0.00E-01	1.21E 02
I	133	4.14E 02	5.12E 02	1.94E 02	9.51E 04	8.53E 02	0.00E-01	2.06E 02
I	134	2.93E 01	5.44E 01	2.50E 01	1.25E 03	8.32E 01	0.00E-01	3.61E 01
I	135	1.22E 02	2.20E 02	1.04E 02	1.95E 04	3.38E 02	0.00E-01	1.68E 02
CS	134	3.82E 05	6.26E 05	1.32E 05	0.00E-01	1.94E 05	6.97E 04	3.38E 03
CS	136	3.83E 04	1.05E 05	6.82E 04	0.00E-01	5.61E 04	8.37E 03	3.70E 03
CS	137	5.33E 05	5.11E 05	7.54E 04	0.00E-01	1.66E 05	5.99E 04	3.20E 03
CS	138	3.72E 02	5.17E 02	3.28E 02	0.00E-01	3.64E 02	3.92E 01	2.38E 02
BA	139	2.54E 01	1.35E-02	7.35E-00	0.00E-01	1.18E-01	7.97E-02	1.47E 03
BA	140	5.09E 03	4.46E 00	2.97E 02	0.00E-01	1.45E 00	2.66E 00	2.58E 03
BA	141	1.23E 01	6.86E-03	3.99E-00	0.00E-01	5.94E-02	4.03E-01	6.99E 00
BA	142	5.36E 00	3.85E-03	2.99E-00	0.00E-01	3.12E-02	2.27E-02	6.99E-02
LA	140	7.86E-00	2.75E-01	9.26E-01	0.00E-01	0.00E-01	0.00E-01	7.66E 03
LA	142	4.08E-01	1.30E-02	4.07E-02	0.00E-01	0.00E-01	0.00E-01	2.58E 03
CE	141	2.34E 00	1.17E 00	1.73E-00	0.00E-01	5.11E-00	0.00E-01	1.46E 03
CE	143	4.12E-00	2.23E 02	3.24E-01	0.00E-01	9.37E-01	0.00E-01	3.27E 03
CE	144	1.23E 02	3.84E 01	6.54E 00	0.00E-01	2.13E 01	0.00E-01	1.00E 04
PR	143	3.06E 00	9.18E-01	1.52E-00	0.00E-01	4.97E-00	0.00E-01	3.30E 03
PR	144	1.00E-01	3.10E-03	5.05E-03	0.00E-01	1.64E-02	0.00E-01	6.68E 00
ND	147	2.17E 00	1.76E 00	1.36E-00	0.00E-01	9.65E-00	0.00E-01	2.79E 03
W	187	4.30E 02	2.55E 02	1.14E 02	0.00E-01	0.00E-01	0.00E-01	3.58E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-3 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCi/ML
CHILD

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP	239	3.47E-00	2.49E-02	1.75E-01	0.00E-01	7.19E-01	0.00E-01	1.84E 03
Sb	124	6.54E 02	8.49E 00	2.29E 02	1.44E 00	0.00E-01	3.63E 02	4.09E 03
Sb	125	4.22E 02	3.25E 00	8.84E 01	3.91E-00	0.00E-01	2.35E 02	1.01E 03
Sb	126	2.59E 02	3.97E 00	9.31E 01	1.52E 00	0.00E-01	1.24E 02	5.23E 03
Co	57	0.00E-01	4.81E 01	9.73E 01	0.00E-01	0.00E-01	0.00E-01	3.94E 02

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-4
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
INFANT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	1.16E 01	1.16E 01	1.16E 01	1.16E 01	1.16E 01	1.16E 01
C	14	8.92E 02	1.90E 02	1.90E 02	1.90E 02	1.90E 02	1.90E 02	1.90E 02
NA	24	3.80E 02	3.80E 02	3.80E 02	3.80E 02	3.80E 02	3.80E 02	3.80E 02
P	32	6.40E 04	3.76E 03	2.48E 03	0.00E-01	0.00E-01	0.00E-01	8.65E 02
CR	51	0.00E-01	0.00E-01	5.30E-01	3.46E-01	7.56E-02	6.73E-01	1.55E 01
MN	54	0.00E-01	7.49E 02	1.70E 02	0.00E-01	1.66E 02	0.00E-01	2.75E 02
MN	56	0.00E-01	3.08E 01	5.30E 00	0.00E-01	2.64E 01	0.00E-01	2.80E 03
FE	55	5.23E 02	3.38E 02	9.03E 01	0.00E-01	0.00E-01	1.65E 02	4.29E 01
FE	59	1.16E 03	2.02E 03	7.98E 02	0.00E-01	0.00E-01	5.98E 02	9.67E 02
CO	58	0.00E-01	1.35E 02	3.38E 02	0.00E-01	0.00E-01	0.00E-01	3.37E 02
CO	60	0.00E-01	4.06E 02	9.59E 02	0.00E-01	0.00E-01	0.00E-01	9.67E 02
NI	63	2.39E 04	1.47E 03	8.28E 02	0.00E-01	0.00E-01	0.00E-01	7.34E 01
NI	65	1.77E 02	2.00E 01	9.10E 00	0.00E-01	0.00E-01	0.00E-01	1.52E 03
CU	64	0.00E-01	2.29E 01	1.06E 01	0.00E-01	3.87E 01	0.00E-01	4.70E 02
ZN	65	6.92E 02	2.37E 03	1.09E 03	0.00E-01	1.15E 03	0.00E-01	2.01E 03
ZN	69	3.51E 00	6.32E 00	4.70E-01	0.00E-01	2.63E 00	0.00E-01	5.15E 02
BR	83	0.00E-01	0.00E-01	1.37E 01	0.00E-01	0.00E-01	0.00E-01	3.76E-17
BR	84	0.00E-01	0.00E-01	1.44E 01	0.00E-01	0.00E-01	0.00E-01	3.76E-17
BR	85	0.00E-01	0.00E-01	7.30E-01	0.00E-01	0.00E-01	0.00E-01	3.76E-17
RB	86	0.00E-01	6.40E 03	3.16E 03	0.00E-01	0.00E-01	0.00E-01	1.64E 02
RB	88	0.00E-01	1.87E 01	1.03E 01	0.00E-01	0.00E-01	0.00E-01	1.82E 01
RB	89	0.00E-01	1.08E 01	7.41E 00	0.00E-01	0.00E-01	0.00E-01	3.66E 00
SR	89	9.44E 04	0.00E-01	2.71E 03	0.00E-01	0.00E-01	0.00E-01	1.94E 03
SR	90	6.96E 05	0.00E-01	1.77E 05	0.00E-01	0.00E-01	0.00E-01	8.69E 03
SR	91	1.88E 03	0.00E-01	6.81E 00	0.00E-01	0.00E-01	0.00E-01	2.23E 03
SR	92	7.22E 02	0.00E-01	2.68E 01	0.00E-01	0.00E-01	0.00E-01	7.79E 03
Y	90	3.27E 00	0.00E-01	8.77E-02	0.00E-01	0.00E-01	0.00E-01	4.51E 03
Y	91M	3.05E-02	0.00E-01	1.04E-03	0.00E-01	0.00E-01	0.00E-01	1.02E 02
Y	91	4.25E 01	0.00E-01	1.13E 00	0.00E-01	0.00E-01	0.00E-01	3.05E 03
Y	92	2.88E-01	0.00E-01	8.09E-03	0.00E-01	0.00E-01	0.00E-01	5.49E 03
Y	93	9.14E-01	0.00E-01	2.49E-02	0.00E-01	0.00E-01	0.00E-01	7.22E 03
ZR	95	7.75E 00	1.89E 00	1.34E 00	0.00E-01	2.04E 00	0.00E-01	9.41E 02
ZR	97	5.57E-01	9.56E-02	4.36E-02	0.00E-01	9.63E-02	0.00E-01	6.09E 03
NB	95	1.58E 00	6.51E-01	3.76E-01	0.00E-01	4.66E-01	0.00E-01	5.49E 02
MO	99	0.00E-01	1.28E 03	2.49E 02	0.00E-01	1.91E 03	0.00E-01	4.21E 02
TC	99M	7.22E-02	1.49E-01	1.92E 00	0.00E-01	1.60E 00	7.79E-02	4.33E 01

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-4 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
INFANT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	8.54E-02	1.08E-01	1.06E 00	0.00E-01	1.28E 00	5.87E-02	1.83E 01
RU	103	5.57E 01	0.00E-01	1.86E 01	0.00E-01	1.16E 02	0.00E-01	6.77E 02
RU	105	5.12E 00	0.00E-01	1.72E 00	0.00E-01	3.76E 01	0.00E-01	2.04E 03
RU	106	9.07E 02	0.00E-01	1.13E 02	0.00E-01	1.07E 03	0.00E-01	6.88E 03
AG	110M	3.75E 01	2.73E 01	1.81E 01	0.00E-01	3.91E 01	0.00E-01	1.42E 03
TE	125M	8.77E 02	2.93E 02	1.19E 02	2.95E 02	0.00E-01	0.00E-01	4.18E 02
TE	127M	2.20E 03	7.30E 02	2.66E 02	6.36E 02	5.42E 03	0.00E-01	8.88E 02
TE	127	3.76E 01	1.26E 01	8.09E 00	3.06E 01	9.18E 01	0.00E-01	7.90E 02
TE	129M	3.76E 03	1.29E 03	5.79E 02	1.44E 03	9.41E 03	0.00E-01	2.25E 03
TE	129	1.07E 01	3.68E 00	2.49E 00	8.95E 00	2.66E 01	0.00E-01	8.54E 02
TE	131M	5.72E 02	2.30E 02	1.90E 02	4.66E 02	1.58E 03	0.00E-01	3.87E 03
TE	131	6.62E 00	2.45E 00	1.86E 00	5.91E 00	1.69E 01	0.00E-01	2.67E 02
TE	132	7.82E 02	3.87E 02	3.62E 02	5.72E 02	2.42E 03	0.00E-01	1.43E 03
I	130	2.26E 02	4.97E 02	1.99E 02	5.57E 04	5.45E 02	0.00E-01	1.06E 02
I	131	1.35E 03	1.59E 03	7.00E 02	5.23E 05	1.86E 03	0.00E-01	5.68E 01
I	132	6.24E 01	1.27E 02	4.51E 01	5.94E 03	1.41E 02	0.00E-01	1.03E 02
I	133	4.70E 02	6.85E 02	2.01E 02	1.25E 05	8.05E 02	0.00E-01	1.16E 02
I	134	3.27E 01	6.70E 01	2.38E 01	1.56E 03	7.49E 01	0.00E-01	6.92E 01
I	135	1.37E 02	2.72E 02	9.93E 01	2.44E 04	3.04E 02	0.00E-01	9.86E 01
CS	134	1.42E 04	2.64E 04	2.67E 03	0.00E-01	6.81E 03	2.42E 03	7.19E 01
CS	136	1.73E 03	5.08E 03	1.90E 03	0.00E-01	2.02E 03	4.14E 02	7.71E 01
CS	137	1.96E 04	2.30E 04	1.63E 03	0.00E-01	6.17E 03	2.50E 03	7.19E 01
CS	138	1.81E 01	2.94E 01	1.43E 01	0.00E-01	1.47E 01	2.29E 00	4.70E 01
BA	139	3.31E 01	2.20E-02	9.59E-01	0.00E-01	1.32E-02	1.33E-02	2.10E 03
BA	140	6.43E 03	6.43E 00	3.31E 02	0.00E-01	1.53E 00	3.95E 00	1.58E 03
BA	141	1.60E 01	1.09E-02	5.04E-01	0.00E-01	6.58E-03	6.66E-03	1.95E 02
BA	142	6.92E 00	5.76E-03	3.41E-01	0.00E-01	3.31E-03	3.48E-03	2.86E 01
LA	140	7.94E-01	3.13E-01	8.05E-02	0.00E-01	0.00E-01	0.00E-01	3.68E 03
LA	142	4.14E-02	1.52E-02	3.64E-03	0.00E-01	0.00E-01	0.00E-01	2.58E 03
CE	141	2.96E 00	1.81E 00	2.13E-01	0.00E-01	5.57E-01	0.00E-01	9.33E 02
CE	143	5.57E-01	3.69E 02	4.21E-02	0.00E-01	1.08E-01	0.00E-01	2.16E 03
CE	144	1.12E 02	4.59E 01	6.28E 00	0.00E-01	1.85E 01	0.00E-01	6.43E 03
PR	143	3.06E 00	1.14E 00	1.52E-01	0.00E-01	4.25E-01	0.00E-01	1.61E 03
PR	144	1.03E-02	3.99E-03	5.19E-04	0.00E-01	1.44E-03	0.00E-01	1.85E 02
ND	147	2.08E 00	2.14E 00	1.31E-01	0.00E-01	8.24E-01	0.00E-01	1.35E 03
W	187	3.40E 01	2.36E 01	8.16E 00	0.00E-01	0.00E-01	0.00E-01	1.39E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.4-4 (cont'd)
SITE RELATED DOSE COMMITMENT FACTOR AIT
MREM/HR PER µCI/ML
INFANT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
NP	239	4.18E-01	3.74E-02	2.11E-02	0.00E-01	7.45E-02	0.00E-01	1.08E 03
Sb	124	8.05E 02	1.19E 01	2.49E 02	2.14E 00	0.00E-01	5.04E 02	2.48E 03
Sb	125	4.63E 02	4.48E 00	9.52E 01	5.79E-00	0.00E-01	2.90E 02	6.17E 02
Sb	126	3.03E 02	5.94E 00	1.09E 02	2.33E 00	0.00E-01	1.91E 02	3.14E 03
Co	57	0.00E-01	4.33E 01	7.03E 01	0.00E-01	0.00E-01	0.00E-01	1.47E 02

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-1
INHALATION DOSE PARAMETER FOR THE CHILD, PI
MREM/YR per $\mu Ci/M^3$

H-3	1.12E 03	RU-103	6.62E 05
C-14	3.59E 04	RU-105	9.95E 04
NA-24	1.61E 04	RU-106	1.43E 07
P-32	2.60E 06	AG-110M	5.48E 06
CR-51	1.70E 04	TE-125M	4.77E 05
MN-54	1.58E 06	TE-127M	1.48E 06
MN-56	1.23E 05	TE-127	5.62E 04
FE-55	1.11E 05	TE-129M	1.76E 06
FE-59	1.27E 06	TE-129	2.55E 04
CO-58	1.11E 06	TE-131M	3.08E 05
CO-60	7.07E 06	TE-131	2.05E 03
NI-63	8.21E 05	TE-132	3.77E 05
NI-65	8.40E 04	I-130	1.85E 06
CU-64	3.67E 04	I-131	1.62E 07
ZN-65	9.95E 05	I-132	1.94E 05
ZN-69	1.02E 04	I-133	3.85E 06
BR-83	4.74E 02	I-134	5.07E 04
BR-84	5.48E 02	I-135	7.92E 05
BR-85	2.53E 01	CS-134	1.01E 06
RB-86	1.98E 05	CS-136	1.71E 05
RB-88	5.62E 02	CS-137	9.07E 05
RB-89	3.45E 02	CS-138	8.40E 02
SR-89	2.16E 06	BA-139	5.77E 04
SR-90	1.01E 08	BA-140	1.74E 06
SR-91	1.74E 05	BA-141	2.92E 03
SR-92	2.42E 05	BA-142	1.64E 03
Y-90	2.68E 05	LA-140	2.26E 05
Y-91M	2.81E 03	LA-142	7.59E 04
Y-92	2.39E 05	CE-141	5.44E 05
Y-93	3.89E 05	CE-143	1.27E 05
ZR-95	2.23E 06	PR-143	4.33E 05
ZR-97	3.51E 05	PR-144	1.57E 03
NB-95	6.14E 05	ND-147	3.28E 05
MO-99	1.35E 05	W-187	9.10E 04
TC-99M	4.81E 03	NP-239	6.40E 04
TC-101	5.85E 02		

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-2
INHALATION PATHWAY FACTOR
MREM/YR PER $\mu CI/M^3$
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E 01	1.26E 03	1.26E 03	1.26E 03	1.26E 03	1.26E 03	1.26E 03
C	14	1.82E 04	3.41E 03	3.41E 03	3.41E 03	3.41E 03	3.41E 03	3.41E 03
NA	24	1.02E 04	1.02E 04	1.02E 04	1.02E 04	1.02E 04	1.02E 04	1.02E 04
P	32	1.32E 06	7.71E 04	5.01E 04	0.00E-01	0.00E-01	0.00E-01	8.64E 04
CR	51	0.00E 01	0.00E 01	1.00E 02	5.95E 01	2.28E 01	1.44E 04	3.32E 03
MN	54	0.00E 01	3.96E 04	6.30E 03	0.00E-01	9.84E 03	1.40E 06	7.74E 04
MN	56	0.00E 01	1.24E 00	1.83E-00	0.00E-01	1.30E 00	9.44E 03	2.02E 04
FE	55	2.46E 04	1.70E 04	3.94E 03	0.00E-01	0.00E-01	7.21E 04	6.03E 03
FE	59	1.18E 04	2.78E 04	1.06E 04	0.00E-01	0.00E-01	1.02E 06	1.88E 05
CO	58	0.00E 01	1.58E 03	2.07E 03	0.00E-01	0.00E-01	9.28E 05	1.06E 05
CO	60	0.00E 01	1.15E 04	1.48E 04	0.00E-01	0.00E-01	5.97E 06	2.85E 05
NI	63	4.32E 05	3.14E 04	1.45E 04	0.00E-01	0.00E-01	1.78E 05	1.34E 04
NI	65	1.54E 00	2.10E-01	9.12E-02	0.00E-01	0.00E-01	5.60E 03	1.23E 04
CU	64	0.00E 01	1.46E 00	6.15E-01	0.00E-01	4.62E 00	6.78E 03	4.90E 04
ZN	65	3.24E 04	1.03E 05	4.66E 04	0.00E-01	6.90E 04	8.64E 05	5.34E 04
ZN	69	3.38E-02	6.51E-02	4.52E-03	0.00E-01	4.22E-02	9.20E 02	1.63E 01
BR	83	0.00E-01	0.00E-01	2.41E 02	0.00E-01	0.00E-01	0.00E-01	2.32E 02
BR	84	0.00E-01	0.00E-01	3.13E 02	0.00E-01	0.00E-01	0.00E-01	1.64E-03
BR	85	0.00E-01	0.00E-01	1.28E 01	0.00E-01	0.00E-01	0.00E-01	8.00E-15
RB	86	0.00E-01	1.35E 05	5.90E 04	0.00E-01	0.00E-01	0.00E-01	1.66E 04
RB	88	0.00E-01	3.87E 02	1.93E 02	0.00E-01	0.00E-01	0.00E-01	3.34E-09
RB	89	0.00E-01	2.56E 02	1.70E 02	0.00E-01	0.00E-01	0.00E-01	9.28E-12
SR	89	3.04E 05	0.00E-01	8.72E 03	0.00E-01	0.00E-01	1.40E 06	3.50E 05
SR	90	9.92E 07	0.00E-01	6.10E 06	0.00E-01	0.00E-01	9.60E 06	7.22E 05
SR	91	6.19E 01	0.00E-01	2.50E 00	0.00E-01	0.00E-01	3.65E 04	1.91E 05
SR	92	6.74E 00	0.00E-01	2.91E-01	0.00E-01	0.00E-01	1.65E 04	4.30E 04
Y	90	2.09E 03	0.00E-01	5.61E 01	0.00E-01	0.00E-01	1.70E 05	5.06E 05
Y	91M	2.61E-01	0.00E-01	1.02E-02	0.00E-01	0.00E-01	1.92E 03	1.33E 00
Y	91	4.62E 05	0.00E-01	1.24E 04	0.00E-01	0.00E-01	1.70E 06	3.85E 05
Y	92	1.03E 01	0.00E-01	3.02E-01	0.00E-01	0.00E-01	1.57E 04	7.35E 04
Y	93	9.44E 01	0.00E-01	2.61E 00	0.00E-01	0.00E-01	4.85E 04	4.22E 05
ZR	95	1.07E 05	3.44E 04	2.33E 04	0.00E-01	5.42E 04	1.77E 06	1.50E 05
ZR	97	9.68E 01	1.96E 01	9.04E 00	0.00E-01	2.97E 01	7.87E 04	5.23E 05
NB	95	1.41E 04	7.82E 03	4.21E 03	0.00E-01	7.74E 03	5.05E 05	1.04E 05
MO	99	0.00E-01	1.21E 02	2.30E 01	0.00E-01	2.91E 02	9.12E 04	2.48E 05
TC	99M	1.03E-03	2.91E-03	3.70E-02	0.00E-01	4.42E-02	7.64E 02	4.16E 03

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TABLE A.5-2 (cont'd)
INHALATION PATHWAY FACTOR
MREM/YR PER µCI/M^3
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	4.18E-05	6.02E-05	5.90E-04	0.00E-01	1.08E-03	3.99E 02	1.09E-11
RU	103	1.53E 03	0.00E-01	6.58E 02	0.00E-01	5.83E 03	5.05E 05	1.10E 05
RU	105	7.90E-01	0.00E-01	3.11E-01	0.00E-01	1.02E 00	1.10E 04	4.82E 04
RU	106	6.91E 04	0.00E-01	8.72E 03	0.00E-01	1.34E 05	9.36E 06	9.12E 05
AG	110M	1.08E 04	1.00E 04	5.94E 03	0.00E-01	1.97E 04	4.63E 06	3.02E 05
TE	125M	3.42E 03	1.58E 03	4.67E 02	1.05E 03	1.24E 04	3.14E 05	7.06E 04
TE	127M	1.26E 04	5.77E 03	1.57E 03	3.29E 03	4.58E 04	9.60E 05	1.50E 05
TE	127	1.40E 00	6.42E-01	3.10E-01	1.06E 00	5.10E 00	6.51E 03	5.74E 04
TE	129M	9.76E 03	4.67E 03	1.58E 03	3.44E 03	3.66E 04	1.16E 06	3.83E 05
TE	129	4.98E-02	2.39E-02	1.24E-02	3.90E-02	1.87E-01	1.94E 03	1.57E 02
TE	131M	6.99E 01	4.36E 01	2.90E 01	5.50E 01	3.09E 02	1.46E 05	5.56E 05
TE	131	1.11E-02	5.95E-03	3.59E-03	9.36E-02	4.37E-02	1.39E-03	1.84E 01
TE	132	2.60E 02	2.15E 02	1.62E 02	1.90E 02	1.46E 03	2.88E 05	5.10E 05
I	130	4.58E 03	1.34E 04	5.28E 03	1.14E 06	2.09E 04	0.00E-01	7.69E 05
I	131	2.52E 04	3.58E 04	2.05E 04	1.19E 07	6.13E 04	0.00E-01	6.28E 03
I	132	1.16E 03	3.26E 03	1.16E 03	1.14E 05	5.18E 03	0.00E-01	4.06E 02
I	133	8.64E 03	1.48E 04	4.52E 03	2.15E 06	2.58E 04	0.00E-01	8.88E 03
I	134	6.44E 02	1.73E 03	6.15E 02	2.98E 04	2.75E 03	0.00E-01	1.01E 00
I	135	2.68E 03	6.98E 03	2.57E 03	4.48E 05	1.11E 04	0.00E-01	5.25E 03
CS	134	3.73E 05	8.48E 05	7.28E 05	0.00E-01	2.87E 05	9.76E 04	1.04E 04
CS	136	3.90E 04	1.46E 05	1.10E 05	0.00E-01	8.56E 04	1.20E 04	1.17E 04
CS	137	4.78E 05	6.21E 05	4.28E 05	0.00E-01	2.22E 05	7.52E 04	8.40E 03
CS	138	3.31E 02	6.21E 02	3.24E 02	0.00E-01	4.80E 02	4.86E 01	1.86E-03
BA	139	9.36E-01	6.66E-04	2.74E-02	0.00E-01	6.22E-04	3.76E 03	8.96E 02
BA	140	3.90E 04	4.90E 01	2.57E 03	0.00E-01	1.67E 01	1.27E 06	2.18E 05
BA	141	1.00E-01	7.53E-05	3.36E-03	0.00E-01	7.00E-05	1.94E 03	1.16E-07
BA	142	2.63E-02	2.70E-05	1.66E-03	0.00E-01	2.29E-05	1.19E 03	1.57E-16
LA	140	3.44E 02	1.74E 02	4.58E 01	0.00E-01	0.00E-01	1.36E 05	4.58E 05
LA	142	6.83E-01	3.10E-01	7.72E-02	0.00E-01	0.00E-01	6.33E 03	2.11E 03
CE	141	1.99E 04	1.35E 04	1.53E 03	0.00E-01	6.26E 03	3.62E 05	1.20E 05
CE	143	1.86E 02	1.38E 02	1.53E 01	0.00E-01	6.08E 01	7.98E 04	2.26E 05
CE	144	3.43E 06	1.43E 06	1.84E 05	0.00E-01	8.48E 05	7.78E 06	8.16E 05
PR	143	9.36E 03	3.75E 03	4.64E 02	0.00E-01	2.16E 03	2.81E 05	2.00E 05
PR	144	3.10E-02	1.25E-02	1.53E-03	0.00E-01	7.05E-03	1.02E 03	2.15E-08
ND	147	5.27E 03	6.10E 03	3.65E 02	0.00E-01	3.56E 03	2.21E 05	1.73E 05
W	187	8.48E 00	7.08E 00	2.48E 00	0.00E-01	0.00E-01	2.90E 04	1.55E 05
NP	239	2.30E 02	2.26E 01	1.24E 01	0.00E-01	7.00E 01	3.76E 04	1.19E 05

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TABLE A.5-3
INHALATION PATHWAY FACTOR
MREM/YR PER μCI/M^3
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	1.27E 03	1.27E 03	1.27E 03	1.27E 03	1.27E 03	1.27E 03
C	14	2.60E 04	4.87E 03	4.87E 03	4.87E 03	4.87E 03	4.87E 03	4.87E 03
NA	24	1.38E 04	1.38E 04	1.38E 04	1.38E 04	1.38E 04	1.38E 04	1.38E 04
P	32	1.89E 06	1.10E 05	7.16E 04	0.00E-01	0.00E-01	0.00E-01	9.28E 04
CR	51	0.00E-01	0.00E-01	1.35E 02	7.50E 01	3.07E 01	2.10E 04	3.00E 03
MN	54	0.00E-01	5.11E 04	8.40E 03	0.00E-01	1.27E 04	1.98E 06	6.68E 04
MN	56	0.00E-01	1.70E 00	2.52E-01	0.00E-01	1.79E 00	1.53E 04	5.74E 04
FE	55	3.34E 04	2.38E 04	5.54E 03	0.00E-01	0.00E-01	1.24E 05	6.39E 03
FE	59	1.59E 04	3.70E 04	1.43E 04	0.00E-01	0.00E-01	1.53E 06	1.78E 05
CO	58	0.00E-01	2.07E 03	2.78E 03	0.00E-01	0.00E-01	1.34E 06	9.52E 04
CO	60	0.00E-01	1.51E 04	1.98E 04	0.00E-01	0.00E-01	8.72E 06	2.59E 05
NI	63	5.80E 05	4.34E 04	1.98E 04	0.00E-01	0.00E-01	3.07E 05	1.42E 04
NI	65	2.18E 00	2.93E-01	1.27E-01	0.00E-01	0.00E-01	9.36E 03	3.67E 04
CU	64	0.00E-01	2.03E 00	8.48E-01	0.00E-01	6.41E 00	1.11E 04	6.14E 04
ZN	65	3.86E 04	1.34E 05	6.24E 04	0.00E-01	8.64E 04	1.24E 06	4.66E 04
ZN	69	4.83E-02	9.20E-02	6.46E-03	0.00E-01	6.02E-02	1.58E 03	2.85E 02
BR	83	0.00E-01	0.00E-01	3.44E 02	0.00E-01	0.00E-01	0.00E-01	8.00E-15
BR	84	0.00E-01	0.00E-01	4.33E 02	0.00E-01	0.00E-01	0.00E-01	8.00E-15
BR	85	0.00E-01	0.00E-01	1.83E 01	0.00E-01	0.00E-01	0.00E-01	8.00E-15
RB	86	0.00E-01	1.90E 05	8.40E 04	0.00E-01	0.00E-01	0.00E-01	1.77E 04
RB	88	0.00E-01	5.46E 02	2.72E 02	0.00E-01	0.00E-01	0.00E-01	2.92E-05
RB	89	0.00E-01	3.52E 02	2.33E 02	0.00E-01	0.00E-01	0.00E-01	3.38E-07
SR	89	4.34E 05	0.00E-01	1.25E 04	0.00E-01	0.00E-01	2.42E 06	3.71E 05
SR	90	1.08E 08	0.00E-01	6.68E 06	0.00E-01	0.00E-01	1.65E 07	7.65E 05
SR	91	8.80E 01	0.00E-01	3.51E 00	0.00E-01	0.00E-01	6.07E 04	2.59E 05
SR	92	9.52E 00	0.00E-01	4.06E-01	0.00E-01	0.00E-01	2.74E 04	1.19E 05
Y	90	2.98E 03	0.00E-01	8.00E 01	0.00E-01	0.00E-01	2.93E 05	5.59E 05
Y	91M	3.70E-01	0.00E-01	1.42E-02	0.00E-01	0.00E-01	3.20E 03	3.02E 01
Y	91	6.61E 05	0.00E-01	1.77E 04	0.00E-01	0.00E-01	2.94E 06	4.09E 05
Y	92	1.47E 01	0.00E-01	4.29E-01	0.00E-01	0.00E-01	2.68E 04	1.65E 05
Y	93	1.35E 02	0.00E-01	3.72E 00	0.00E-01	0.00E-01	8.32E 04	5.79E 05
ZR	95	1.46E 05	4.58E 04	3.15E 04	0.00E-01	6.74E 04	2.69E 06	1.49E 05
ZR	97	1.38E 02	2.72E 01	1.26E 01	0.00E-01	4.12E 01	1.30E 05	6.30E 05
NB	95	1.86E 04	1.03E 04	5.66E 03	0.00E-01	1.00E 04	7.51E 05	9.68E 04
MO	99	0.00E-01	1.69E 02	3.22E 01	0.00E-01	4.11E 02	1.54E 05	2.69E 05
TC	99M	1.38E-03	3.86E-03	4.99E-02	0.00E-01	5.76E-02	1.15E 03	6.13E 03

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TABLE A.5-3 (cont'd)
INHALATION PATHWAY FACTOR
MREM/YR PER $\mu CI/M^3$
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	5.92E-05	8.40E-05	8.24E-04	0.00E-01	1.52E-03	6.67E 02	8.72E-07
RU	103	2.10E 03	0.00E-01	8.96E 02	0.00E-01	7.43E 03	7.83E 05	1.09E 05
RU	105	1.12E 00	0.00E-01	4.34E-01	0.00E-01	1.41E 00	1.82E 04	9.04E 04
RU	106	9.84E 04	0.00E-01	1.24E 04	0.00E-01	1.90E 05	1.61E 07	9.60E 05
AG	110M	1.38E 04	1.31E 04	7.99E 03	0.00E-01	2.50E 04	6.75E 06	2.73E 05
TE	125M	4.88E 03	2.24E 03	6.74E 02	1.40E 03	0.00E-01	5.36E 05	7.50E 04
TE	127M	1.80E 04	8.16E 03	2.18E 03	4.38E 03	6.54E 04	1.66E 06	1.59E 05
TE	127	2.01E 00	9.12E-01	4.42E-01	1.42E 00	7.28E 00	1.12E 04	8.08E 01
TE	129M	1.39E 04	6.58E 03	2.25E 03	4.58E 03	5.19E 04	1.98E 06	4.05E 05
TE	129	7.10E-02	3.38E-02	1.76E-02	5.18E-02	2.66E-01	3.30E 03	1.62E 03
TE	131M	9.84E 01	6.01E 01	4.20E 01	7.25E 01	4.39E 02	2.38E 05	6.21E 05
TE	131	1.58E-02	8.32E-03	5.04E-03	1.24E-02	6.18E-02	2.34E 03	1.51E 01
TE	132	3.60E 02	2.90E 02	2.19E 02	2.46E 02	1.95E 03	4.49E 05	4.63E 05
I	130	6.24E 03	1.79E 04	7.17E 03	1.49E 06	2.75E 04	0.00E-01	9.12E 03
I	131	3.54E 04	4.91E 04	2.64E 04	1.46E 07	8.40E 04	0.00E-01	6.49E 03
I	132	1.59E 03	4.38E 03	1.58E 03	1.51E 05	6.92E 03	0.00E-01	1.27E 03
I	133	1.22E 04	2.05E 04	6.22E 03	2.92E 06	3.59E 04	0.00E-01	1.03E 04
I	134	8.88E 02	2.32E 03	8.40E 02	3.95E 04	3.66E 03	0.00E-01	2.04E 01
I	135	3.70E 03	9.44E 03	3.49E 03	6.21E 05	1.49E 04	0.00E-01	6.95E 03
CS	134	5.02E 05	1.13E 06	5.49E 05	0.00E-01	3.75E 05	1.46E 05	9.76E 03
CS	136	5.15E 04	1.94E 05	1.37E 05	0.00E-01	1.10E 05	1.78E 04	1.09E 04
CS	137	6.70E 05	8.48E 05	3.11E 05	0.00E-01	3.04E 05	1.21E 05	8.48E 03
CS	138	4.66E 02	8.56E 02	4.46E 02	0.00E-01	6.62E 02	7.87E 01	2.70E-01
BA	139	1.34E 00	9.44E-04	3.90E-02	0.00E-01	8.88E-04	6.46E 03	6.45E 03
BA	140	5.47E 04	6.70E 01	3.52E 03	0.00E-01	2.28E 01	2.03E 06	2.29E 05
BA	141	1.42E-01	1.06E-04	4.74E-03	0.00E-01	9.84E-05	3.29E 03	7.46E-04
BA	142	3.70E-02	3.70E-05	2.27E-03	0.00E-01	3.14E-05	1.91E 03	4.79E-10
LA	140	4.79E 02	2.36E 02	6.26E 01	0.00E-01	0.00E-01	2.14E 05	4.87E 05
LA	142	9.60E-01	4.25E-01	1.06E-01	0.00E-01	0.00E-01	1.02E 04	1.20E 04
CE	141	2.84E 04	1.90E 04	2.17E 03	0.00E-01	8.88E 03	6.14E 05	1.26E 05
CE	143	2.66E 02	1.94E 02	2.16E 01	0.00E-01	8.64E 01	1.30E 05	2.55E 05
CE	144	4.89E 06	2.02E 06	2.62E 05	0.00E-01	1.21E 06	1.34E 07	8.64E 05
PR	143	1.34E 04	5.31E 03	6.62E 02	0.00E-01	3.09E 03	4.83E 05	2.14E 05
PR	144	4.30E-02	1.76E-02	2.18E-03	0.00E-01	1.01E-02	1.75E 03	2.35E-04
ND	147	7.86E 03	8.56E 03	5.13E 02	0.00E-01	5.02E 03	3.72E 05	1.82E 05
W	187	1.20E 01	9.76E 00	3.43E 00	0.00E-01	0.00E-01	4.74E 04	1.77E 05
NP	239	3.38E 02	3.19E 01	1.77E 01	0.00E-01	1.00E 02	6.49E 04	1.32E 05

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-4
INHALATION PATHWAY FACTOR
MREM/YR PER $\mu CI/M^3$
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	1.12E 03	1.12E 03	1.12E 03	1.12E 03	1.12E 03	1.12E 03
C	14	3.59E 04	6.73E 03	6.73E 03	6.73E 03	6.73E 03	6.73E 03	6.73E 03
NA	24	1.61E 04	1.61E 04	1.61E 04	1.61E 04	1.61E 04	1.61E 04	1.61E 04
P	32	2.60E 06	1.14E 05	9.88E 04	0.00E-01	0.00E-01	0.00E-01	4.22E 04
CR	51	0.00E-01	0.00E-01	1.54E 02	8.55E 01	2.43E 01	1.70E 04	1.08E 03
MN	54	0.00E-01	4.29E 04	9.51E 03	0.00E-01	1.00E 04	1.58E 06	2.29E 04
MN	56	0.00E-01	1.66E 00	3.12E-01	0.00E-01	1.67E 00	1.31E 04	1.23E 05
FE	55	4.74E 04	2.52E 04	7.77E 03	0.00E-01	0.00E-01	1.11E 05	2.87E 03
FE	59	2.07E 04	3.34E 04	1.67E 04	0.00E-01	0.00E-01	1.27E 06	7.07E 04
CO	58	0.00E-01	1.77E 03	3.16E 03	0.00E-01	0.00E-01	1.11E 06	3.44E 04
CO	60	0.00E-01	1.31E 04	2.26E 04	0.00E-01	0.00E-01	7.07E 06	9.62E 04
NI	63	8.21E 05	4.63E 04	2.80E 04	0.00E-01	0.00E-01	2.75E 05	6.33E 03
NI	65	2.99E 00	2.96E-01	1.64E-01	0.00E-01	0.00E-01	8.18E 03	8.40E 04
CU	64	0.00E-01	1.99E 00	1.07E 00	0.00E-01	6.03E 00	9.58E 03	3.67E 04
ZN	65	4.26E 04	1.13E 05	7.03E 04	0.00E-01	7.14E 04	9.95E 05	1.63E 04
ZN	69	6.70E-02	9.66E-02	8.92E-03	0.00E-01	5.85E-02	1.42E 03	1.02E 04
BR	83	0.00E-01	0.00E-01	4.74E 02	0.00E-01	0.00E-01	0.00E-01	3.70E-15
BR	84	0.00E-01	0.00E-01	5.48E 02	0.00E-01	0.00E-01	0.00E-01	3.70E-15
BR	85	0.00E-01	0.00E-01	2.53E 01	0.00E-01	0.00E-01	0.00E-01	3.70E-15
RB	86	0.00E-01	1.98E 05	1.14E 05	0.00E-01	0.00E-01	0.00E-01	7.99E 03
RB	88	0.00E-01	5.62E 02	3.66E 02	0.00E-01	0.00E-01	0.00E-01	1.72E 01
RB	89	0.00E-01	3.45E 02	2.90E 02	0.00E-01	0.00E-01	0.00E-01	1.89E 00
SR	89	5.99E 05	0.00E-01	1.72E 04	0.00E-01	0.00E-01	2.16E 06	1.67E 05
SR	90	1.01E 08	0.00E-01	6.44E 06	0.00E-01	0.00E-01	1.48E 07	3.43E 05
SR	91	1.21E 02	0.00E-01	4.59E 00	0.00E-01	0.00E-01	5.33E 04	1.74E 05
SR	92	1.31E 01	0.00E-01	5.25E-01	0.00E-01	0.00E-01	2.40E 04	2.42E 05
Y	90	4.11E 03	0.00E-01	1.11E 02	0.00E-01	0.00E-01	2.62E 05	2.68E 05
Y	91M	5.07E-01	0.00E-01	1.84E-02	0.00E-01	0.00E-01	2.81E 03	1.72E 03
Y	91	9.14E 05	0.00E-01	2.44E 04	0.00E-01	0.00E-01	2.63E 06	1.84E 05
Y	92	2.04E 01	0.00E-01	5.81E-01	0.00E-01	0.00E-01	2.39E 04	2.39E 05
Y	93	1.86E 02	0.00E-01	5.11E 00	0.00E-01	0.00E-01	7.44E 04	3.89E 05
ZR	95	1.90E 05	4.18E 04	3.70E 04	0.00E-01	5.96E 04	2.23E 06	6.11E 04
ZR	97	1.88E 02	2.72E 01	1.60E 01	0.00E-01	3.88E 01	1.13E 05	3.51E 05
NB	95	2.35E 04	9.18E 03	6.55E 03	0.00E-01	8.62E 03	6.14E 05	3.70E 04
MO	99	0.00E-01	1.72E 02	4.25E 01	0.00E-01	3.92E 02	1.35E 05	1.27E 05
TC	99M	1.78E-03	3.48E-03	5.77E-02	0.00E-01	5.07E-02	9.51E 02	4.81E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-4 (cont'd)
INHALATION PATHWAY FACTOR
MREM/YR PER $\mu CI/M^3$
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	8.10E-05	8.51E-05	1.08E-03	0.00E-01	1.45E-03	5.85E 02	1.63E 01
RU	103	2.79E 03	0.00E-01	1.07E 03	0.00E-01	7.03E 03	6.62E 05	4.48E 04
RU	105	1.53E 00	0.00E-01	5.55E-01	0.00E-01	1.34E 00	1.59E 04	9.95E 04
RU	106	1.36E 05	0.00E-01	1.69E 04	0.00E-01	1.84E 05	1.43E 07	4.29E 05
AG	110M	1.69E 04	1.14E 04	9.14E 03	0.00E-01	2.12E 04	5.48E 06	1.00E 05
TE	125M	6.73E 03	2.33E 03	9.14E 02	1.92E 03	0.00E-01	4.77E 05	3.38E 04
TE	127M	2.49E 04	8.55E 03	3.02E 03	6.07E 03	6.36E 04	1.48E 06	7.14E 04
TE	127	2.77E 00	9.51E-01	6.10E-01	1.96E 00	7.07E 00	1.00E 04	5.62E 04
TE	129M	1.92E 04	6.85E 03	3.04E 03	6.33E 03	5.03E 04	1.76E 06	1.82E 05
TE	129	9.77E-02	3.50E-02	2.38E-02	7.14E-02	2.57E-01	2.93E 03	2.55E 04
TE	131M	1.34E 02	5.92E 01	5.07E 01	9.77E 01	4.00E 02	2.06E 05	3.08E 05
TE	131	2.17E-02	8.44E-03	6.59E-03	1.70E-02	5.88E-02	2.05E 03	1.33E 03
TE	132	4.81E 02	2.72E 02	2.63E 02	3.17E 02	1.77E 03	3.77E 05	1.38E 05
I	130	8.18E 03	1.64E 04	8.44E 03	1.85E 06	2.45E 04	0.00E-01	5.11E 03
I	131	4.81E 04	4.81E 04	2.73E 04	1.62E 07	7.88E 04	0.00E-01	2.84E 03
I	132	2.12E 03	4.07E 03	1.88E 03	1.94E 05	6.25E 03	0.00E-01	3.20E 03
I	133	1.66E 04	2.03E 04	7.70E 03	3.85E 06	3.38E 04	0.00E-01	5.48E 03
I	134	1.17E 03	2.16E 03	9.95E 02	5.07E 04	3.30E 03	0.00E-01	9.55E 02
I	135	4.92E 03	8.73E 03	4.14E 03	7.92E 05	1.34E 04	0.00E-01	4.44E 03
CS	134	6.51E 05	1.01E 06	2.25E 05	0.00E-01	3.30E 05	1.21E 05	3.85E 03
CS	136	6.51E 04	1.71E 05	1.16E 05	0.00E-01	9.55E 04	1.45E 04	4.18E 03
CS	137	9.07E 05	8.25E 05	1.28E 05	0.00E-01	2.82E 05	1.04E 05	3.62E 03
CS	138	6.33E 02	8.40E 02	5.55E 02	0.00E-01	6.22E 02	6.81E 01	2.70E 02
BA	139	1.84E 00	9.84E-04	5.36E-02	0.00E-01	8.62E-04	5.77E 03	5.77E 04
BA	140	7.40E 04	6.48E 01	4.33E 03	0.00E-01	2.11E 01	1.74E 06	1.02E 05
BA	141	1.96E-01	1.09E-04	6.36E-03	0.00E-01	9.47E-05	2.92E 03	2.75E 02
BA	142	4.99E-02	3.60E-05	2.79E-03	0.00E-01	2.91E-05	1.64E 03	2.74E 00
LA	140	6.44E 02	2.25E 02	7.55E 01	0.00E-01	0.00E-01	1.83E 05	2.26E 05
LA	142	1.29E 00	4.11E-01	1.29E-01	0.00E-01	0.00E-01	8.70E 03	7.59E 04
CE	141	3.92E 04	1.95E 04	2.90E 03	0.00E-01	8.55E 03	5.44E 05	5.66E 04
CE	143	3.66E 02	1.99E 02	2.87E 01	0.00E-01	8.36E 01	1.15E 05	1.27E 05
CE	144	6.77E 06	2.12E 06	3.61E 05	0.00E-01	1.17E 06	1.20E 07	3.89E 05
PR	143	1.85E 04	5.55E 03	9.14E 02	0.00E-01	3.00E 03	4.33E 05	9.73E 04
PR	144	5.96E-02	1.85E-02	3.00E-03	0.00E-01	9.77E-03	1.57E 03	1.97E 02
ND	147	1.08E 04	8.73E 03	6.81E 02	0.00E-01	4.81E 03	3.28E 05	8.21E 04
W	187	1.63E 01	9.66E 00	4.33E 00	0.00E-01	0.00E-01	4.11E 04	9.10E 04
NP	239	4.66E 02	3.34E 01	2.35E 01	0.00E-01	9.73E 01	5.81E 04	6.40E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-5
INHALATION PATHWAY FACTOR
MREM/YR PER µCI/M^3
INFANT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	6.47E 02	6.47E 02	6.47E 02	6.47E 02	6.47E 02	6.47E 02
C	14	2.65E 04	5.31E 03	5.31E 03	5.31E 03	5.31E 03	5.31E 03	5.31E 03
NA	24	1.06E 04	1.06E 04	1.06E 04	1.06E 04	1.06E 04	1.06E 04	1.06E 04
P	32	2.03E 06	1.12E 05	7.74E 04	0.00E-01	0.00E-01	0.00E-01	1.61E 04
CR	51	0.00E-01	0.00E-01	8.95E 01	5.75E 01	1.32E 01	1.28E 04	3.57E 02
MN	54	0.00E-01	2.53E 04	4.98E 03	0.00E-01	4.98E 03	1.00E 06	7.06E 03
MN	56	0.00E-01	1.54E 00	2.21E-01	0.00E-01	1.10E 00	1.25E 04	7.17E 04
FE	55	1.97E 04	1.17E 04	3.33E 03	0.00E-01	0.00E-01	8.69E 04	1.09E 03
FE	59	1.36E 04	2.35E 04	9.48E 03	0.00E-01	0.00E-01	1.02E 06	2.48E 04
CO	58	0.00E-01	1.22E 03	1.82E 03	0.00E-01	0.00E-01	7.77E 05	1.11E 04
CO	60	0.00E-01	8.02E 03	1.18E 04	0.00E-01	0.00E-01	4.51E 06	3.19E 04
NI	63	3.39E 05	2.04E 04	1.16E 04	0.00E-01	0.00E-01	2.09E 05	2.42E 03
NI	65	2.39E 00	2.84E-01	1.23E-01	0.00E-01	0.00E-01	8.12E 03	5.01E 04
CU	64	0.00E-01	1.88E 00	7.74E-01	0.00E-01	3.98E 00	9.30E 03	1.50E 04
ZN	65	1.93E 04	6.26E 04	3.11E 04	0.00E-01	3.25E 04	6.47E 05	5.14E 04
ZN	69	5.39E-02	9.67E-02	7.18E-03	0.00E-01	4.02E-02	1.47E 03	1.32E 04
BR	83	0.00E-01	0.00E-01	3.81E 02	0.00E-01	0.00E-01	0.00E-01	1.40E-15
BR	84	0.00E-01	0.00E-01	4.00E 02	0.00E-01	0.00E-01	0.00E-01	1.40E-15
BR	85	0.00E-01	0.00E-01	2.04E 01	0.00E-01	0.00E-01	0.00E-01	1.40E-15
RB	86	0.00E-01	1.90E 05	8.82E 04	0.00E-01	0.00E-01	0.00E-01	3.04E 03
RB	88	0.00E-01	5.57E 02	2.87E 02	0.00E-01	0.00E-01	0.00E-01	3.39E 02
RB	89	0.00E-01	3.21E 02	2.06E 02	0.00E-01	0.00E-01	0.00E-01	6.82E 01
SR	89	3.98E 05	0.00E-01	1.14E 04	0.00E-01	0.00E-01	2.03E 06	6.40E 04
SR	90	4.09E 07	0.00E-01	2.59E 06	0.00E-01	0.00E-01	1.12E 07	1.31E 05
SR	91	9.56E 01	0.00E-01	3.46E 00	0.00E-01	0.00E-01	5.26E 04	7.34E 04
SR	92	1.05E 01	0.00E-01	3.91E-01	0.00E-01	0.00E-01	2.38E 04	1.40E 05
Y	90	3.29E 03	0.00E-01	8.82E 01	0.00E-01	0.00E-01	2.69E 05	1.04E 05
Y	91M	4.07E-01	0.00E-01	1.39E-02	0.00E-01	0.00E-01	2.79E 03	2.35E 03
Y	91	5.88E 05	0.00E-01	1.57E 04	0.00E-01	0.00E-01	2.45E 06	7.03E 04
Y	92	1.64E 01	0.00E-01	4.61E-01	0.00E-01	0.00E-01	2.45E 04	1.27E-05
Y	93	1.50E 02	0.00E-01	4.07E 00	0.00E-01	0.00E-01	7.64E 04	1.67E 05
ZR	95	1.15E 05	2.79E 04	2.03E 04	0.00E-01	3.11E 04	1.75E 06	2.17E 04
ZR	97	1.50E 02	2.56E 01	1.17E 01	0.00E-01	2.59E 01	1.10E 05	1.40E 05
NB	95	1.57E 04	6.43E 03	3.78E 03	0.00E-01	4.72E 03	4.79E 05	1.27E 04
MO	99	0.00E-01	1.65E 02	3.23E 01	0.00E-01	2.65E 02	1.35E 05	4.87E 04
TC	99M	1.40E-04	2.88E-03	3.72E-02	0.00E-01	3.11E-02	8.11E 02	2.03E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-5 (cont'd)
INHALATION PATHWAY FACTOR
MREM/YR PER $\mu CI/M^3$
INFANT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	6.51E-05	8.23E-05	8.12E-04	0.00E-01	9.79E-04	5.84E 02	8.44E 02
RU	103	2.02E 03	0.00E-01	6.79E 02	0.00E-01	4.24E 03	5.52E 05	1.61E 04
RU	105	1.22E 00	0.00E-01	4.10E-01	0.00E-01	8.99E-01	1.57E 04	4.84E 04
RU	106	8.68E 04	0.00E-01	1.09E 04	0.00E-01	1.07E 05	1.16E 07	1.64E 05
AG	110M	9.98E 03	7.22E 03	5.00E 03	0.00E-01	1.09E 04	3.67E 06	3.30E 04
TE	125M	4.76E 03	1.99E 03	6.58E 02	1.62E 03	0.00E-01	4.47E 05	1.29E 04
TE	127M	1.67E 04	6.90E 03	2.07E 03	4.87E 03	3.75E 04	1.31E 06	2.73E 04
TE	127	2.23E 00	9.53E-01	4.89E-01	1.85E 00	4.86E 00	1.03E 04	2.44E 04
TE	129M	1.41E 04	6.09E 03	2.23E 03	5.47E 03	3.18E 04	1.68E 06	6.90E 04
TE	129	7.88E-02	3.47E-02	1.88E-02	6.75E-02	1.75E-01	3.00E 03	2.63E 04
TE	131M	1.07E 02	5.50E 01	3.63E 01	8.93E 01	2.65E 02	1.99E 05	1.19E 05
TE	131	1.74E-02	8.22E-03	5.00E-03	1.58E-02	3.99E-02	2.06E 03	8.22E 03
TE	132	3.72E 02	2.37E 02	1.76E 02	2.79E 02	1.03E 03	3.40E 05	4.41E 04
I	130	6.36E 03	1.39E 04	5.57E 03	1.60E 06	1.53E 04	0.00E-01	1.99E 03
I	131	3.79E 04	4.44E 04	1.96E 04	1.48E 07	5.18E 04	0.00E-01	1.06E 03
I	132	1.69E 03	3.54E 03	1.26E 03	1.69E 05	3.95E 03	0.00E-01	1.90E 03
I	133	1.32E 04	1.92E 04	5.60E 03	3.56E 06	2.24E 04	0.00E-01	2.16E 03
I	134	9.21E 02	1.88E 03	6.65E 02	4.45E 04	2.09E 03	0.00E-01	1.29E 03
I	135	3.86E 03	7.60E 03	2.77E 03	6.96E 05	8.47E 03	0.00E-01	1.83E 03
CS	134	3.96E 05	7.03E 05	7.45E 04	0.00E-01	1.90E 05	7.97E 04	1.33E 03
CS	136	4.83E 04	1.35E 05	5.29E 04	0.00E-01	5.64E 04	1.18E 04	1.43E 03
CS	137	5.49E 05	6.12E 05	4.55E 04	0.00E-01	1.72E 05	7.13E 04	1.33E 03
CS	138	5.05E 02	7.81E 02	3.98E 02	0.00E-01	4.10E 02	6.54E 01	8.76E 02
BA	139	1.48E 00	9.84E-04	4.30E-02	0.00E-01	5.92E-04	5.95E 03	5.10E 04
BA	140	5.60E 04	5.60E 01	2.90E 03	0.00E-01	1.34E 01	1.60E 06	3.84E 04
BA	141	1.57E-01	1.08E-04	4.97E-03	0.00E-01	6.50E-05	2.97E 03	4.75E 03
BA	142	3.98E-02	3.30E-05	1.96E-03	0.00E-01	1.90E-05	1.55E 03	6.93E 02
LA	140	5.05E 02	2.00E 02	5.15E 01	0.00E-01	0.00E-01	1.68E 05	8.48E 04
LA	142	1.03E 00	3.77E-01	9.04E-02	0.00E-01	0.00E-01	8.22E 03	5.95E 04
CE	141	2.77E 04	1.67E 04	1.99E 03	0.00E-01	5.25E 03	5.17E 05	2.16E 04
CE	143	2.93E 02	1.93E 02	2.21E 01	0.00E-01	5.64E 01	1.16E 05	4.97E 04
CE	144	3.19E 06	1.21E 06	1.76E 05	0.00E-01	5.38E 05	9.84E 06	1.48E 05
PR	143	1.40E 04	5.24E 03	6.99E 02	0.00E-01	1.97E 03	4.33E 05	3.72E 04
PR	144	4.79E-02	1.85E-02	2.41E-03	0.00E-01	6.72E-03	1.61E 03	4.28E 03
ND	147	7.94E 03	8.13E 03	5.00E 02	0.00E-01	3.15E 03	3.22E 05	3.12E 04
W	187	1.30E 01	9.02E 00	3.12E 00	0.00E-01	0.00E-01	3.96E 05	3.56E 04
NP	239	3.71E 02	3.32E 01	1.88E 01	0.00E-01	6.62E 01	5.95E 04	2.49E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-6
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	7.63E 02	7.63E 02	7.63E 02	7.63E 02	7.63E 02	7.63E 02
C	14	2.63E 08	5.27E 07	5.27E 07	5.27E 07	5.27E 07	5 27E 07	5.27E 07
NA	24	2.44E 06	2.44E 06	2.44E 06	2.44E 06	2.44E 06	2.44E 06	2.44E 06
P	32	1.71E 10	1.06E 09	6.60E 08	0.00E-01	0.00E-01	0.00E-01	1.92E 09
CR	51	0.00E-01	0.00E-01	2.86E 04	0.00E-01	6.30E 03	3.79E 04	7.19E 06
MN	54	0.00E-01	8.41E 06	1.61E 06	0.00E-01	0.00E-01	0.00E-01	2.58E 07
MN	56	0.00E-01	4.16E-03	7.38E-04	0.00E-01	5.28E-03	0.00E-01	1.33E-01
FE	55	2.51E 07	1.73E 07	4.04E 06	0.00E-01	0.00E-01	9.67E 06	9.95E 06
FE	59	2.97E 07	6.98E 07	2.68E 07	0.00E-01	0.00E-01	1.95E 07	2.33E 08
CO	58	0.00E-01	4.71E 06	1.06E 07	0.00E-01	0.00E-01	0.00E-01	9.56E 07
CO	60	0.00E-01	1.64E 07	3.62E 07	0.00E-01	0.00E-01	0.00E-01	3.08E 08
NI	63	6.73E 09	4.71E 08	2.26E 08	0.00E-01	0.00E-01	0.00E-01	9.73E 07
NI	65	4.63E-01	6.02E-02	2.75E-02	0.00E-01	0.00E-01	0.00E-01	1.53E 00
CU	64	0.00E-01	2.39E 04	1.12E 04	0.00E-01	6.02E 04	0.00E-01	2.03E 06
ZN	65	1.37E 09	4.37E 09	1.97E 09	0.00E-01	2.92E 09	0.00E-01	2.75E 09
ZN	69	5.22E-12	9.99E-12	6.95E-13	0.00E-01	6.49E-12	0.00E-01	1.50E-12
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	2.59E 09	1.21E 09	0.00E-01	0.00E-01	0.00E-01	5.12E 08
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	1.45E 09	0.00E-01	4.16E 07	0.00E-01	0.00E-01	0.00E-01	2.33E 08
SR	90	4.68E 10	0.00E-01	1.15E 10	0.00E-01	0.00E-01	0.00E-01	1.35E 09
SR	91	2.87E 04	0.00E-01	1.16E 03	0.00E-01	0.00E-01	0.00E-01	1.37E 05
SR	92	4.90E-01	0.00E-01	2.12E-02	0.00E-01	0.00E-01	0.00E-01	9.70E 00
Y	90	7.07E 01	0.00E-01	1.90E 00	0.00E-01	0.00E-01	0.00E-01	7.50E 05
Y	91M	6.03E-20	0.00E-01	2.34E-21	0.00E-01	0.00E-01	0.00E-01	1.77E-19
Y	91	8.59E 03	0.00E-01	2.30E 02	0.00E-01	0.00E-01	0.00E-01	4.73E 06
Y	92	5.59E-05	0.00E-01	1.63E-06	0.00E-01	0.00E-01	0.00E-01	9.79E-01
Y	93	2.33E-01	0.00E-01	6.44E-03	0.00E-01	0.00E-01	0.00E-01	7.39E 03
ZR	95	9.44E 02	3.03E 02	2.05E 02	0.00E-01	4.75E 02	0.00E-01	9.59E 05
ZR	97	4.33E-01	8.75E-05	4.00E-02	0.00E-01	1.32E-00	0.00E-01	2.71E 04
NB	95	8.26E 04	4.59E 04	2.47E 04	0.00E-01	4.54E 04	0.00E-01	2.79E 08
MO	99	0.00E-01	2.48E 07	4.71E 06	0.00E-01	5.61E 07	0.00E-01	5.74E 07
TC	99M	3.33E 00	9.40E 00	1.20E 02	0.00E-01	1.43E 02	4.60E 00	5.56E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-6 (cont'd)
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	1.02E 03	0.00E-01	4.38E 02	0.00E-01	3.88E 03	0.00E-01	1.19E 05
RU	105	8.58E-04	0.00E-01	3.39E-04	0.00E-01	1.11E-02	0.00E-01	5.25E-01
RU	106	2.04E 04	0.00E-01	2.58E 03	0.00E-01	3.94E 04	0.00E-01	1.32E 06
AG	110M	5.82E 07	5.39E 07	3.20E 07	0.00E-01	1.06E 08	0.00E-01	2.20E 10
TE	125M	1.63E 07	5.90E 06	2.18E 06	4.90E 06	6.63E 07	0.00E-01	6.50E 07
TE	127M	4.58E 07	1.64E 07	5.58E 06	1.17E 07	1.86E 08	0.00E-01	1.54E 08
TE	127	6.54E 02	2.35E 02	1.41E 02	4.84E 02	2.66E 03	0.00E-01	5.16E 04
TE	129M	6.02E 07	2.25E 07	9.53E 06	2.07E 07	2.51E 08	0.00E-01	3.03E 08
TE	129	2.84E-10	1.07E-10	6.29E-11	2.18E-10	1.19E-09	0.00E-01	2.14E-10
TE	131M	3.61E 05	1.77E 05	1.47E 05	2.80E 05	1.79E 06	0.00E-01	1.73E 07
TE	131	3.67E-33	1.53E-33	1.16E-33	3.01E-33	1.61E-32	0.00E-01	0.00E-01
TE	132	2.40E 06	1.55E 06	1.46E 06	1.72E 06	1.50E 07	0.00E-01	7.35E 07
I	130	4.20E 05	1.24E 06	4.89E 05	1.05E 08	1.94E 06	0.00E-01	1.07E 06
I	131	2.96E 08	4.24E 08	2.43E 08	1.39E 11	7.26E 08	0.00E-01	1.12E 08
I	132	1.65E-01	4.41E-01	1.54E-01	1.54E 01	7.02E-01	0.00E-01	8.28E-02
I	133	3.87E 06	6.73E 06	2.05E 06	9.90E 08	1.18E 07	0.00E-01	6.05E 06
I	134	2.03E-12	5.52E-12	1.98E-12	9.57E-11	8.78E-12	0.00E-01	4.81E-15
I	135	1.29E 04	3.37E 04	1.24E 04	2.22E 06	5.40E 04	0.00E-01	3.80E 04
CS	134	5.65E 09	1.35E 10	1.10E 10	0.00E-01	4.35E 09	1.45E 09	2.35E 08
CS	136	2.61E 08	1.03E 09	7.42E 08	0.00E-01	5.73E 08	7.86E 07	1.17E 08
CS	137	7.38E 09	1.01E 10	6.61E 09	0.00E-01	3.43E 09	1.14E 09	1.95E 08
CS	138	9.16E-24	1.81E-23	8.97E-24	0.00E-01	1.33E-23	1.31E-24	7.72E-29
BA	139	4.56E-08	3.25E-11	1.34E-09	0.00E-01	3.04E-11	1.84E-11	8.09E-08
BA	140	2.69E 07	3.38E 04	1.76E 06	0.00E-01	1.15E 04	1.93E 04	5.54E 07
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	4.52E 00	2.28E 00	6.02E-01	0.00E-01	0.00E-01	0.00E-01	1.67E 05
LA	142	9.39E-12	4.27E-12	1.06E-12	0.00E-01	0.00E-01	0.00E-01	3.12E-08
CE	141	4.84E 03	3.28E 03	3.72E 02	0.00E-01	1.52E 03	0.00E-01	1.25E 07
CE	143	4.16E 01	3.07E 04	3.40E 00	0.00E-01	1.35E 01	0.00E-01	1.15E 06
CE	144	3.58E 05	1.50E 05	1.92E 04	0.00E-01	8.87E 04	0.00E-01	1.21E 08
PR	143	1.58E 02	6.33E 01	7.83E 00	0.00E-01	3.66E 01	0.00E-01	6.92E 05
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	9.46E 01	1.09E 02	6.55E 00	0.00E-01	6.40E 01	0.00E-01	5.25E 05
W	187	6.56E 03	5.49E 03	1.92E 03	0.00E-01	0.00E-01	0.00E-01	1.80E 06
NP	239	3.67E 00	3.61E-01	1.99E-01	0.00E-01	1.13E 00	0.00E-01	7.41E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-7
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	9.94E 02	9.94E 02	9.94E 02	9.94E 02	9.94E 02	9.94E 02
C	14	4.86E 08	9.72E 07	9.72E 07	9.72E 07	9.72E 07	9.72E 07	9.72E 07
NA	24	4.26E 06	4.26E 06	4.26E 06	4.26E 06	4.26E 06	4.26E 06	4.26E 06
P	32	3.15E 10	1.95E 09	1.22E 09	0.00E-01	0.00E-01	0.00E-01	2.65E 09
CR	51	0.00E-01	0.00E-01	4.99E 04	2.77E 04	1.09E 04	7.13E 04	8.39E 06
MN	54	0.00E-01	1.40E 07	2.78E 06	0.00E-01	4.18E 06	0.00E-01	2.87E 07
MN	56	0.00E-01	7.37E-03	1.31E-03	0.00E-01	9.33E-03	0.00E-01	4.85E-01
FE	55	4.45E 07	3.16E 07	7.36E 06	0.00E-01	0.00E-01	2.00E 07	1.37E 07
FE	59	5.18E 07	1.21E 08	4.67E 07	0.00E-01	0.00E-01	3.81E 07	2.86E 08
CO	58	0.00E-01	7.94E 06	1.83E 07	0.00E-01	0.00E-01	0.00E-01	1.09E 08
CO	60	0.00E-01	2.78E 07	6.26E 07	0.00E-01	0.00E-01	0.00E-01	3.62E 08
NI	63	1.18E 10	8.35E 08	4.01E 08	0.00E-01	0.00E-01	0.00E-01	1.33E 08
NI	65	8.48E-01	1.08E-01	4.94E-02	0.00E-01	0.00E-01	0.00E-01	5.88E 00
CU	64	0.00E-01	4.25E 04	2.00E 04	0.00E-01	1.08E 05	0.00E-01	3.30E 06
ZN	65	2.11E 09	7.31E 09	3.41E 09	0.00E-01	4.68E 09	0.00E-01	3.10E 09
ZN	69	9.62E-12	1.83E-11	1.28E-12	0.00E-01	1.20E-11	0.00E-01	3.38E-11
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	4.73E 09	2.22E 09	0.00E-01	0.00E-01	0.00E-01	7.00E 08
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0 00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	2.67E 09	0.00E-01	7.66E 07	0.00E-01	0.00E-01	0.00E-01	3.19E 08
SR	90	6.61E 10	0.00E-01	1.63E 10	0.00E-01	0.00E-01	0.00E-01	1.86E 09
SR	91	5.27E 04	0.00E-01	2.10E 03	0.00E-01	0.00E-01	0.00E-01	2.39E 05
SR	92	8.96E-01	0.00E-01	3.82E-02	0.00E-01	0.00E-01	0.00E-01	2.28E 01
Y	90	1.30E 02	0.00E-01	3.50E 00	0.00E-01	0.00E-01	0.00E-01	1.07E 06
Y	91M	1.11E-19	0.00E-01	4.22E-21	0.00E-01	0.00E-01	0.00E-01	5.22E-18
Y	91	1.58E 04	0.00E-01	4.24E 02	0.00E-01	0.00E-01	0.00E-01	6.48E 06
Y	92	1.03E-04	0.00E-01	2.99E-06	0.00E-01	0.00E-01	0.00E-01	2.83E 00
Y	93	4.30E-01	0.00E-01	1.18E-02	0.00E-01	0.00E-01	0.00E-01	1.31E 04
ZR	95	1.65E 03	5.21E 02	3.58E 02	0.00E-01	7.65E 02	0.00E-01	1.20E 06
ZR	97	7.89E-01	1.56E-01	7.19E-02	0.00E-01	2.37E-01	0.00E-01	4.23E 04
NB	95	1.41E 05	7.81E 04	4.30E 04	0.00E-01	7.57E 04	0.00E-01	3.34E 08
MO	99	0.00E-01	4.47E 07	8.53E 06	0.00E-01	1.02E 08	0.00E-01	8.01E 07
TC	99M	5.77E 00	1.61E 01	2.08E 02	0.00E-01	2.40E 02	8.93E 00	1.06E 04

ATTACHMENT A
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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-7 (cont'd)
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	1.81E 03	0.00E-01	7.74E 02	0.00E-01	6.38E 03	0.00E-01	1.51E 05
RU	105	1.57E-03	0.00E-01	6.08E-04	0.00E-01	1.98E-02	0.00E-01	1.27E 00
RU	106	3.75E 04	0.00E-01	4.73E 03	0.00E-01	7.23E 04	0.00E-01	1.80E 06
AG	110M	9.63E 07	9.11E 07	5.54E 07	0.00E-01	1.74E 08	0.00E-01	2.56E 10
TE	125M	3.00E 07	1.08E 07	4.02E 06	8.39E 06	0.00E-01	0.00E-01	8.86E 07
TE	127M	8.44E 07	2.99E 07	1.00E 07	2.01E 07	3.42E 08	0.00E-01	2.10E 08
TE	127	1.21E 03	4.29E 02	2.61E 02	8.36E 02	4.91E 03	0.00E-01	9.35E 04
TE	129M	1.10E 08	4.09E 07	1.74E 07	3.55E 07	4.61E 08	0.00E-01	4.13E 08
TE	129	5.23E-10	1.95E-10	1.27E-10	3.74E-10	2.20E-09	0.00E-01	2.86E-09
TE	131M	6.57E 05	3.15E 05	2.63E 05	4.74E 05	3.29E 06	0.00E-01	2.53E 07
TE	131	6.70E-33	2.76E-33	2.09E-33	5.16E-33	2.93E-32	0.00E-01	5.50E-34
TE	132	4.29E 06	2.72E 06	2.56E 06	2.87E 06	2.61E 07	0.00E-01	8.61E 07
I	130	7.39E 05	2.14E 06	8.54E 05	1.74E 08	3.26E 06	0.00E-01	1.64E 06
I	131	5.37E 08	7.52E 08	4.04E 08	2.20E 11	1.30E 09	0.00E-01	1.49E 08
I	132	2.92E-01	7.65E-01	2.74E-01	2.58E 01	1.20E 00	0.00E-01	3.33E-01
I	133	7.07E 06	1.20E 07	3.66E 06	1.67E 09	2.10E 07	0.00E-01	9.08E 06
I	134	3.61E-12	9.58E-12	3.44E-12	1.60E-10	1.51E-11	0.00E-01	1.26E-13
I	135	2.28E 04	5.88E 04	2.18E 04	3.78E 06	9.28E 04	0.00E-01	6.51E 04
CS	134	9.82E 09	2.31E 10	1.07E 10	0.00E-01	7.34E 09	2.80E 09	2.87E 08
CS	136	4.44E 08	1.75E 09	1.17E 09	0.00E-01	9.52E 08	1.50E 08	1.41E 08
CS	137	1.34E 10	1.78E 10	6.20E 09	0.00E-01	6.06E 09	2.35E 09	2.53E 08
CS	138	1.66E-23	3.19E-23	1.60E-23	0.00E-01	2.36E-23	2.74E-24	1.45E-26
BA	139	8.44E-08	5.94E-11	2.46E-09	0.00E-01	5.60E-11	4.09E-11	7.53E-07
BA	140	4.85E 07	5.95E 04	3.13E 06	0.00E-01	2.02E 04	4.00E 04	7.48E 07
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	8.12E 00	3.99E 00	1.06E 00	0.00E-01	0.00E-01	0.00E-01	2.29E 05
LA	142	1.69E-11	7.52E-12	1.87E-12	0.00E-01	0.00E-01	0.00E-01	2.29E-07
CE	141	8.88E 03	5.93E 03	6.81E 02	0.00E-01	2.79E 03	0.00E-01	1.70E 07
CE	143	7.64E 01	5.56E 04	6.21E 00	0.00E-01	2.49E 01	0.00E-01	1.67E 06
CE	144	6.58E 05	2.72E 05	3.54E 04	0.00E-01	1.63E 05	0.00E-01	1.66E 08
PR	143	2.90E 02	1.16E 02	1.44E 01	0.00E-01	6.73E 01	0.00E-01	9.55E 05
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	1.82E 02	1.98E 02	1.19E 01	0.00E-01	1.16E 02	0.00E-01	7.15E 05
W	187	1.20E 04	9.78E 03	3.43E 03	0.00E-01	0.00E-01	0.00E-01	2.65E 06
NP	239	7.01E 00	6.61E-01	3.67E-01	0.00E-01	2.07E 00	0.00E-01	1.06E 05

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-8
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	1.57E 03	1.57E 03	1.57E 03	1.57E 03	1.57E 03	1.57E 03
C	14	1.19E 09	2.39E 08	2.39E 08	2.39E 08	2.39E 08	2.39E 08	2.39E 08
NA	24	8.86E 06	8.86E 06	8.86E 06	8.86E 06	8.86E 06	8.86E 06	8.86E 06
P	32	7.77E 10	3.64E 09	3.00E 09	0.00E-01	0.00E-01	0.00E-01	2.15E 09
CR	51	0.00E-01	0.00E-01	1.02E 05	5.65E 04	1.54E 04	1.03E 05	5.40E 06
MN	54	0.00E-01	2.10E 07	5.59E 06	0.00E-01	5.88E 06	0.00E-01	1.76E 07
MN	56	0.00E-01	1.29E-02	2.90E-03	0.00E-01	1.56E-02	0.00E-01	1.86E 00
FE	55	1.12E 08	5.93E 07	1.84E 07	0.00E-01	0.00E-01	3.35E 07	1.10E 07
FE	59	1.20E 08	1.94E 08	9.69E 07	0.00E-01	0.00E-01	5.64E 07	2.02E 08
CO	58	0.00E-01	1.21E 07	3.71E 07	0.00E-01	0.00E-01	0.00E-01	7.07E 07
CO	60	0.00E-01	4.32E 07	1.27E 08	0.00E-01	0.00E-01	0.00E-01	2.39E 08
NI	63	2.96E 10	1.59E 09	1.01E 09	0.00E-01	0.00E-01	0.00E-01	1.07E 08
NI	65	2.07E 00	1.95E-01	1.14E-01	0.00E-01	0.00E-01	0.00E-01	2.39E 01
CU	64	0.00E-01	7.47E 04	4.51E 04	0.00E-01	1.81E 05	0.00E-01	3.51E 06
ZN	65	4.13E 09	1.10E 10	6.85E 09	0.00E-01	6.94E 09	0.00E-01	1.93E 09
ZN	69	2.36E-11	3.42E-11	3.16E-12	0.00E-01	2.07E-10	0.00E-01	2.15E-09
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	8.77E 09	5.39E 09	0.00E-01	0.00E-01	0.00E-01	5.64E 08
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	6.62E 09	0.00E-01	1.89E 08	0.00E-01	0.00E-01	0.00E-01	2.56E 08
SR	90	1.12E 11	0.00E-01	2.83E 10	0.00E-01	0.00E-01	0.00E-01	1.50E 09
SR	91	1.29E 05	0.00E-01	4.88E 03	0.00E-01	0.00E-01	0.00E-01	2.85E 05
SR	92	2.19E 00	0.00E-01	8.78E-02	0.00E-01	0.00E-01	0.00E-01	4.15E 01
Y	90	3.22E 02	0.00E-01	8.61E 00	0.00E-01	0.00E-01	0.00E-01	9.15E 05
Y	91M	2.70E-19	0.00E-01	9.82E-21	0.00E-01	0.00E-01	0.00E-01	5.29E-16
Y	91	3.90E 04	0.00E-01	1.04E 03	0.00E-01	0.00E-01	0.00E-01	5.20E 06
Y	92	2.54E-04	0.00E-01	7.26E-06	0.00E-01	0.00E-01	0.00E-01	7.33E 00
Y	93	1.06E 00	0.00E-01	2.90E-02	0.00E-01	0.00E-01	0.00E-01	1.57E 04
ZR	95	3.83E 03	8.43E 02	7.50E 02	0.00E-01	1.21E 03	0.00E-01	8.79E 05
ZR	97	1.92E 00	2.77E-01	1.64E-01	0.00E-01	3.98E-01	0.00E-01	4.20E 04
NB	95	3.18E 05	1.24E 05	8.85E 04	0.00E-01	1.16E 05	0.00E-01	2.29E 08
MO	99	0.00E-01	8.14E 07	2.01E 07	0.00E-01	1.74E 08	0.00E-01	6.73E 07
TC	99M	1.32E 01	2.59E 01	4.30E 02	0.00E-01	3.77E 02	1.32E 01	1.48E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-8 (cont'd)
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	4.28E 03	0.00E-01	1.65E 03	0.00E-01	1.08E 04	0.00E-01	1.11E 05
RU	105	3.83E-03	0.00E-01	1.39E-03	0.00E-01	3.36E-02	0.00E-01	2.50E 00
RU	106	9.24E 04	0.00E-01	1.15E 04	0.00E-01	1.25E 05	0.00E-01	1.44E 06
AG	110M	2.09E 08	1.41E 08	1.13E 08	0.00E-01	2.63E 08	0.00E-01	1.68E 10
TE	125M	7.38E 07	2.00E 07	9.84E 06	2.07E 07	0.00E-01	0.00E-01	7.12E 07
TE	127M	2.08E 08	5.60E 07	2.47E 07	4.97E 07	5.93E 08	0.00E-01	1.68E 08
TE	127	2.98E 03	8.03E 02	6.39E 02	2.06E 03	8.47E 03	0.00E-01	1.16E 05
TE	129M	2.71E 08	7.58E 07	4.21E 07	8.75E 07	7.97E 08	0.00E-01	3.31E 08
TE	129	1.29E-09	3.60E-10	3.06E-10	9.21E-10	3.78E-09	0.00E-01	8.03E-08
TE	131M	1.60E 06	5.53E 05	5.89E 05	1.14E 06	5.36E 06	0.00E-01	2.24E 07
TE	131	1.64E-32	5.01E-33	4.89E-33	1.26E-32	4.97E-32	0.00E-01	8.64E-32
TE	132	1.02E 07	4.54E 06	5.48E 06	6.61E 06	4.21E 07	0.00E-01	4.57E 07
I	130	1.73E 06	3.49E 06	1.80E 06	3.85E 08	5.22E 06	0.00E-01	1.63E 06
I	131	1.30E 09	1.31E 09	7.45E 08	4.33E 11	2.15E 09	0.00E-01	1.17E 08
I	132	6.91E-01	1.27E 00	5.84E-01	5.89E 01	1.94E 00	0.00E-01	1.49E 00
I	133	1.72E 07	2.12E 07	8.04E 06	3.95E 09	3.54E 07	0.00E-01	8.56E 06
I	134	8.55E-12	1.59E-11	7.31E-12	3.65E-10	2.43E-11	0.00E-01	1.05E-11
I	135	5.41E 04	9.73E 04	4.60E 04	8.62E 06	1.49E 05	0.00E-01	7.41E 04
CS	134	2.27E 10	3.72E 10	7.84E 09	0.00E-01	1.15E 10	4.13E 09	2.00E 08
CS	136	1.00E 09	2.76E 09	1.78E 09	0.00E-01	1.47E 09	2.19E 08	9.69E 07
CS	137	3.22E 10	3.09E 10	4.55E 09	0.00E-01	1.01E 10	3.62E 09	1.93E 08
CS	138	4.03E-23	5.60E-23	3.55E-23	0.00E-01	3.94E-23	4.24E-24	2.58E-23
BA	139	2.07E-07	1.11E-10	6.01E-09	0.00E-01	9.67E-11	6.51E-11	1.20E-05
BA	140	1.17E 08	1.03E 05	6.84E 06	0.00E-01	3.34E 04	6.12E 04	5.94E 07
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	1.94E 01	6.80E 00	2.29E 00	0.00E-01	0.00E-01	0.00E-01	1.89E 05
LA	142	4.09E-11	1.30E-11	4.08E-12	0.00E-01	0.00E-01	0.00E-01	2.58E-06
CE	141	2.19E 04	1.09E 04	1.62E 03	0.00E-01	4.78E 03	0.00E-01	1.36E 07
CE	143	1.88E 02	1.02E 05	1.47E 01	0.00E-01	4.27E 01	0.00E-01	1.49E 06
CE	144	1.62E 06	5.09E 05	8.66E 04	0.00E-01	2.82E 05	0.00E-01	1.33E 08
PR	143	7.18E 02	2.16E 02	3.56E 01	0.00E-01	1.17E 02	0.00E-01	7.75E 05
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	4.47E 02	3.62E 02	2.80E 01	0.00E-01	1.99E 02	0.00E-01	5.73E 05
W	187	2.91E 04	1.72E 04	7.73E 03	0.00E-01	0.00E-01	0.00E-01	2.42E 06
NP	239	1.72E 01	1.24E 00	8.70E-01	0.00E-01	3.58E 00	0.00E-01	9.16E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-9
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
INFANT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	2.38E 03	2.38E 03	2.38E 03	2.38E 03	2.38E 03	2.38E 03
C	14	2.34E 09	5.00E 08	5.00E 08	5.00E 08	5.00E 08	5.00E 08	5.00E 08
NA	24	1.54E 07	1.54E 07	1.54E 07	1.54E 07	1.54E 07	1.54E 07	1.54E 07
P	32	1.60E 11	9.42E 09	6.21E 09	0.00E-01	0.00E-01	0.00E-01	2.17E 09
CR	51	0.00E-01	0.00E-01	1.61E 05	1.05E 05	2.30E 04	2.05E 05	4.70E 06
MN	54	0.00E-01	3.90E 07	8.84E 06	0.00E-01	8.64E 06	0.00E-01	1.43E 07
MN	56	0.00E-01	3.15E-02	5.43E-03	0.00E-01	2.71E-02	0.00E-01	2.86E 00
FE	55	1.35E 08	8.72E 07	2.33E 07	0.00E-01	0.00E-01	4.26E 07	1.11E 07
FE	59	2.24E 08	3.92E 08	1.54E 08	0.00E-01	0.00E-01	1.16E 08	1.87E 08
CO	58	0.00E-01	2.43E 07	6.05E 07	0.00E-01	0.00E-01	0.00E-01	6.04E 07
CO	60	0.00E-01	8.82E 07	2.08E 08	0.00E-01	0.00E-01	0.00E-01	2.10E 08
NI	63	3.49E 10	2.16E 09	1.21E 09	0.00E-01	0.00E-01	0.00E-01	1.07E 08
NI	65	4.39E 00	4.97E-01	2.26E-01	0.00E-01	0.00E-01	0.00E-01	3.78E 01
CU	64	0.00E-01	1.86E 05	8.60E 04	0.00E-01	3.14E 05	0.00E-01	3.81E 06
ZN	65	5.55E 09	1.90E 10	8.78E 09	0.00E-01	9.23E 09	0.00E-01	1.61E 10
ZN	69	5.04E-11	9.07E-11	6.75E-12	0.00E-01	3.77E-11	0.00E-01	7.40E-09
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	2.23E 10	1.10E 10	0.00E-01	0.00E-01	0.00E-01	5.70E 08
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	1.26E 10	0.00E-01	3.61E 08	0.00E-01	0.00E-01	0.00E-01	2.59E 08
SR	90	1.22E 11	0.00E-01	3.10E 10	0.00E-01	0.00E-01	0.00E-01	1.52E 09
SR	91	2.69E 05	0.00E-01	9.75E 02	0.00E-01	0.00E-01	0.00E-01	3.19E 05
SR	92	4.66E 00	0.00E-01	1.73E-01	0.00E-01	0.00E-01	0.00E-01	5.02E 01
Y	90	6.80E 02	0.00E-01	1.82E 01	0.00E-01	0.00E-01	0.00E-01	9.39E 05
Y	91M	5.72E-19	0.00E-01	1.95E-20	0.00E-01	0.00E-01	0.00E-01	1.91E-15
Y	91	7.33E 04	0.00E-01	1.95E 03	0.00E-01	0.00E-01	0.00E-01	5.25E 06
Y	92	5.39E-04	0.00E-01	1.51E-05	0.00E-01	0.00E-01	0.00E-01	1.03E 01
Y	93	2.25E 00	0.00E-01	6.13E-02	0.00E-01	0.00E-01	0.00E-01	1.78E 04
ZR	95	6.81E 03	1.66E 03	1.18E 03	0.00E-01	1.79E 03	0.00E-01	8.26E 05
ZR	97	4.06E 00	6.98E-01	3.19E-01	0.00E-01	7.03E-01	0.00E-01	4.45E 04
NB	95	5.94E 05	2.45E 05	1.41E 05	0.00E-01	1.75E 05	0.00E-01	2.06E 08
MO	99	0.00E-01	2.08E 08	4.06E 07	0.00E-01	3.11E 08	0.00E-01	6.85E 07
TC	99M	2.75E 01	5.68E 01	7.31E 02	0.00E-01	6.11E 02	2.97E 01	1.65E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-9 (cont'd)
GRASS-COW-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
INFANT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	8.67E 03	0.00E-01	2.90E 03	0.00E-01	1.80E 04	0.00E-01	1.05E 05
RU	105	8.07E-03	0.00E-01	2.72E-02	0.00E-01	5.93E-01	0.00E-01	3.21E 00
RU	106	1.90E 05	0.00E-01	2.38E 04	0.00E-01	2.25E 05	0.00E-01	1.44E 06
AG	110M	3.86E 08	2.82E 08	1.86E 08	0.00E-01	4.03E 08	0.00E-01	1.46E 10
TE	125M	1.51E 08	5.04E 07	2.04E 07	5.07E 07	0.00E-01	0.00E-01	7.18E 07
TE	127M	4.21E 08	1.40E 08	5.10E 07	1.22E 08	1.04E 09	0.00E-01	1.70E 08
TE	127	6.32E 03	2.12E 03	1.36E 03	5.15E 03	1.54E 04	0.00E-01	1.33E 05
TE	129M	5.57E 08	1.91E 08	8.58E 07	2.14E 08	1.39E 09	0.00E-01	3.33E 08
TE	129	2.74E-09	9.43E-10	6.39E-09	2.29E-08	6.81E-08	0.00E-01	2.19E-07
TE	131M	3.38E 06	1.36E 06	1.12E 06	2.76E 06	9.36E 06	0.00E-01	2.29E 07
TE	131	3.49E-32	1.29E-32	9.78E-32	3.11E-31	8.91E-31	0.00E-01	1.41E-30
TE	132	2.11E 07	1.05E 07	9.75E 06	1.54E 07	6.53E 07	0.00E-01	3.87E 07
I	130	3.55E 06	7.81E 06	3.14E 06	8.76E 08	8.58E 06	0.00E-01	1.68E 06
I	131	2.72E 09	3.21E 09	1.41E 09	1.05E 12	3.74E 09	0.00E-01	1.14E 08
I	132	1.43E 00	2.91E 00	1.04E 00	1.37E 02	3.25E 00	0.00E-01	2.36E 00
I	133	3.63E 07	5.28E 07	1.55E 07	9.61E 09	6.21E 07	0.00E-01	8.94E 06
I	134	1.77E-11	3.63E-11	1.29E-10	8.47E-09	4.06E-10	0.00E-01	3.76E-11
I	135	1.12E 05	2.24E 05	8.15E 04	2.00E 07	2.49E 05	0.00E-01	8.09E 04
CS	134	3.65E 10	6.80E 10	6.87E 09	0.00E-01	1.75E 10	6.21E 09	1.85E 08
CS	136	1.96E 09	5.76E 09	2.15E 09	0.00E-01	2.30E 09	4.70E 08	8.75E 07
CS	137	5.15E 10	6.02E 10	4.27E 09	0.00E-01	1.62E 10	6.55E 09	1.88E 08
CS	138	8.50E-23	1.38E-22	6.70E-22	0.00E-01	6.89E-22	1.08E-23	2.21E-22
BA	139	4.41E-07	2.93E-10	1.28E-07	0.00E-01	1.76E-09	1.77E-10	2.80E-05
BA	140	2.41E 08	2.41E 08	1.24E 07	0.00E-01	5.72E 04	1.48E 05	5.92E 07
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	4.06E 01	1.60E 01	4.12E 00	0.00E-01	0.00E-01	0.00E-01	1.88E 05
LA	142	8.59E-11	3.15E-11	7.55E-11	0.00E-01	0.00E-01	0.00E-01	5.36E-06
CE	141	4.34E 04	2.64E 04	3.11E 03	0.00E-01	8.16E 03	0.00E-01	1.37E 07
CE	143	3.97E 02	2.63E 05	3.00E 01	0.00E-01	7.67E 01	0.00E-01	1.54E 06
CE	144	2.33E 06	9.52E 05	1.30E 05	0.00E-01	3.85E 05	0.00E-01	1.33E 08
PR	143	1.49E 03	5.56E 02	7.36E 01	0.00E-01	2.07E 02	0.00E-01	7.84E 05
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	8.86E 02	9.10E 02	5.57E 01	0.00E-01	3.51E 02	0.00E-01	5.77E 05
W	187	6.12E 04	4.26E 04	1.47E 04	0.00E-01	0.00E-01	0.00E-01	2.50E 06
NP	239	3.65E 01	3.26E 00	1.84E 00	0.00E-01	1.50E 00	0.00E-01	9.43E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-10
GRASS-COW-MEAT PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	3.25E 02	3.25E 02	3.25E 02	3.25E 02	3.25E 02	3.25E 02
C	14	2.41E 08	4.83E 07	4.83E07	4.83E 07	4.83E 07	4.83E 07	4.83E 07
NA	24	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03	1.36E-03
P	32	4.65E 09	2.89E 08	1.80E 08	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CR	51	0.00E-01	0.00E-01	7.05E 03	4.21E 03	1.55E 03	9.35E 03	1.77E 06
MN	54	0.00E-01	9.18E 06	1.75E 06	0.00E-01	2.73E 06	0.00E-01	2.81E 07
MN	56	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
FE	55	2.93E 08	2.20E 08	4.72E 07	0.00E-01	0.00E-01	1.13E 08	1.16E 08
FE	59	2.65E 08	6.24E 08	2.39E 08	0.00E-01	0.00E-01	1.74E 08	2.08E 09
CO	58	0.00E-01	1.82E 07	4.09E 07	0.00E-01	0.00E-01	0.00E-01	3.70E 08
CO	60	0.00E-01	7.52E 07	1.66E 08	0.00E-01	0.00E-01	0.00E-01	1.41E 09
NI	63	1.89E 10	1.32E 09	6.33E 08	0.00E-01	0.00E-01	0.00E-01	2.73E 08
NI	65	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CU	64	0.00e-01	2.73E-07	1.28E-07	0.00E-01	6.89E-07	0.00E-01	2.33E-05
ZN	65	3.56E 08	1.13E 09	5.12E 08	0.00E-01	7.57E 08	0.00E-01	7.13E 08
ZN	69	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	4.87E 08	2.27E 08	0.00E-01	0.00E-01	0.00E-01	9.61E 07
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	3.02E 08	0.00E-01	8.66E 06	0.00E-01	0.00E-01	0.00E-01	4.84E 07
SR	90	1.24E 10	0.00E-01	3.05E 09	0.00E-01	0.00E-01	0.00E-01	3.59E 08
SR	91	1.43E-10	0.00E-01	5.73E-12	0.00E-01	0.00E-01	0.00E-01	6.76E-10
SR	92	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	90	1.07E 02	0.00E-01	2.86E 00	0.00E-01	0.00E-01	0.00E-01	1.13E 06
Y	91M	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	91	1.13E 06	0.00E-01	3.03E 04	0.00E-01	0.00E-01	0.00E-01	6.23E 08
Y	92	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	93	6.59E-12	0.00E-01	1.82E-13	0.00E-01	0.00E-01	0.00E-01	2.09E-07
ZR	95	1.87E 06	6.01E 05	4.07E 05	0.00E-01	9.43E 05	0.00E-01	1.90E 09
ZR	97	2.08E-05	4.19E-06	1.92E-06	0.00E-01	6.33E-06	0.00E-01	1.30E 00
NB	95	2.30E 06	1.28E 06	6.88E 05	0.00E-01	1.26E 06	0.00E-01	7.76E 09
MO	99	0.00E-01	9.99E 04	1.90E 04	0.00E-01	2.26E 05	0.00E-01	2.32E 05
TC	99M	4.50E-21	1.27E-20	1.62E-10	0.00E-01	1.93E-19	6.23E-21	7.53E-18
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-10 (cont'd)
GRASS-COW-MEAT PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU	103	1.05E 08	0.00E-01	4.53E 07	0.00E-01	4.01E 08	0.00E-01	1.23E 10
RU	105	5.87E-28	0.00E-01	2.32E-28	0.00E-01	7.58E-27	0.00E-01	3.59E-25
RU	106	2.80E 09	0.00E-01	3.54E 08	0.00E-01	5.40E 09	0.00E-01	1.81E 11
AG	110M	6.68E 06	6.18E 06	3.67E 06	0.00E-01	1.22E 07	0.00E-01	2.52E 09
TE	125M	3.59E 08	1.30E 08	4.81E 07	1.08E 08	1.46E 09	0.00E-01	1.43E 09
TE	127M	1.12E 09	3.99E 08	1.36E 08	2.85E 08	4.53E 09	0.00E-01	3.74E 09
TE	127	2.14E-10	7.68E-11	4.63E-11	1.58E-10	8.71E-10	0.00E-01	1.69E-08
TE	129M	1.13E 09	4.23E 08	1.80E 08	3.90E 08	4.73E 09	0.00E-01	5.71E 09
TE	129	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
TE	131M	4.52E 02	2.21E 02	1.84E 02	3.50E 02	2.24E 03	0.00E-01	2.20E 04
TE	131	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
TE	132	1.42E 06	9.19E 05	8.63E 05	1.01E 06	8.85E 06	0.00E-01	4.35E 07
I	130	2.12E-06	6.26E-06	2.47E-06	5.30E-04	9.76E-06	0.00E-01	5.39E-06
I	131	1.07E 07	1.54E 07	8.81E 06	5.04E 09	2.64E 07	0.00E-01	4.06E 06
I	132	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
I	133	3.67E-01	6.38E-01	1.94E-01	9.37E 01	1.11E 00	0.00E-01	5.73E-01
I	134	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
I	135	4.47E-17	1.17E-16	4.32E-17	7.73E-15	1.88E-16	0.00E-01	1.32E-16
CS	134	6.58E 08	1.56E 09	1.28E 09	0.00E-01	5.06E 08	1.68E 08	2.74E 07
CS	136	1.18E 07	4.66E 07	3.35E 07	0.00E-01	2.59E 07	3.55E 06	5.24E 06
CS	137	8.72E 08	1.19E 09	7.81E 08	0.00E-01	4.05E 08	1.35E 08	2.31E 07
CS	138	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	139	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	140	2.87E 07	3.61E 04	1.88E 06	0.00E-01	1.23E 04	2.07E 04	5.92E 07
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	3.76E-02	1.89E-02	5.00E-03	0.00E-01	0.00E-01	0.00E-01	1.39E 03
LA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CE	141	1.40E 04	9.50E 03	1.08E 03	0.00E-01	4.41E 03	0.00E-01	3.63E 07
CE	143	2.01E-02	1.49E 01	1.65E-03	0.00E-01	6.55E-03	0.00E-01	5.56E 02
CE	144	1.46E 06	6.09E 05	9.83E 04	0.00E-01	3.61E 05	0.00E-01	4.93E 08
PR	143	2.10E 04	8.41E 03	1.04E 03	0.00E-01	4.86E 03	0.00E-01	9.19E 07
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	7.17E 03	8.29E 03	4.96E 02	0.00E-01	4.84E 03	0.00E-01	3.98E 07
W	187	2.17E-02	1.81E-02	6.33E-03	0.00E-01	0.00E-01	0.00E-01	5.93E 00
NP	239	2.59E-01	2.55E-02	1.40E-02	0.00E-01	7.94E-02	0.00E-01	5.22E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-11
GRASS-COW-MEAT PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	1.94E 02	1.94E 02	1.94E 02	1.94E 02	1.94E 02	1.94E 02
C	14	2.04E 08	4.08E 07	4.08E 07	4.08E 07	4.08E 07	4.08E 07	4.08E 07
NA	24	1.09E-03	1.09E-03	1.09E-03	1.09E-03	1.09E-03	1.09E-03	1.09E-03
P	32	3.93E 09	2.44E 08	1.52E 08	0.00E-01	0.00E-01	0.00E-01	3.30E 08
CR	51	0.00E-01	0.00E-01	5.64E 03	3.13E 03	1.24E 03	8.05E 03	9.47E 05
MN	54	0.00E-01	7.00E 06	1.39E 06	0.00E-01	2.09E 06	0.00E-01	1.44E 07
MN	56	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
FE	55	2.38E 08	1.69E 08	3.93E 07	0.00E-01	0.00E-01	1.07E 08	7.30E 07
FE	59	2.12E 08	4.95E 08	1.01E 08	0.00E-01	0.00E-01	1.56E 08	1.17E 09
CO	58	0.00E-01	1.41E 07	3.24E 07	0.00E-01	0.00E-01	0.00E-01	1.94E 08
CO	60	0.00E-01	5.83E 07	1.31E 08	0.00E-01	0.00E-01	0.00E-01	7.60E 08
NI	63	1.52E 10	1.07E 09	5.15E 08	0.00E-01	0.00E-01	0.00E-01	1.71E 08
NI	65	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CU	64	0.00E-01	2.23E-07	1.05E-07	0.00E-01	5.64E-07	0.00E-01	1.73E-05
ZN	65	2.50E 08	8.69E 08	4.05E 08	0.00E-01	5.56E 08	0.00E-01	3.68E 08
ZN	69	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	4.07E 08	1.91E 08	0.00E-01	0.00E-01	0.00E-01	6.02E 07
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	2.55E 08	0.00E-01	7.29E 06	0.00E-01	0.00E-01	0.00E-01	3.03E 07
SR	90	8.05E 09	0.00E-01	1.99E 09	0.00E-01	0.00E-01	0.00E-01	2.26E 08
SR	91	1.19E-10	0.00E-01	4.75E-12	0.00E-01	0.00E-01	0.00E-01	5.41E-10
SR	92	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	90	8.98E 01	0.00E-01	2.42E 00	0.00E-01	0.00E-01	0.00E-01	7.41E 05
Y	91M	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	91	9.54E 05	0.00E-01	2.56E 04	0.00E-01	0.00E-01	0.00E-01	3.91E 08
Y	92	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	93	5.56E-12	0.00E-01	1.53E-13	0.00E-01	0.00E-01	0.00E-01	1.70E-07
ZR	95	1.50E 06	4.73E 05	3.26E 05	0.00E-01	6.96E 05	0.00E-01	1.09E 09
ZR	97	1.73E-05	3.42E-06	1.58E-06	0.00E-01	5.19E-06	0.00E-01	9.27E-01
NB	95	1.80E 06	9.96E 05	5.48E 05	0.00E-01	9.66E 05	0.00E-01	4.26E 09
MO	99	0.00E-01	8.26E 04	1.58E 04	0.00E-01	1.89E 05	0.00E-01	1.48E 05
TC	99M	3.58E-21	9.97E-21	1.29E-19	0.00E-01	1.49E-19	5.54E-21	6.55E-18

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-11 (cont'd)
GRASS-COW-MEAT PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	8.56E 07	0.00E-01	3.66E 07	0.00E-01	3.02E 08	0.00E-01	7.15E 09
RU	105	4.91E-28	0.00E-01	1.91E-28	0.00E-01	6.91E-27	0.00E-01	3.96E-25
RU	106	2.36E 09	0.00E-01	2.97E 08	0.00E-01	4.55E 09	0.00E-01	1.13E 11
AG	110M	5.06E 06	4.79E 06	2.91E 06	0.00E-01	9.13E 06	0.00E-01	1.35E 09
TE	125M	3.03E 08	1.09E 08	4.05E 07	8.47E 07	0.00E-01	0.00E-01	8.94E 08
TE	127M	9.42E 08	3.34E 08	1.12E 08	2.24E 08	3.82E 09	0.00E-01	2.35E 09
TE	127	1.81E-10	6.43E-11	3.91E-11	1.25E-09	7.35E-10	0.00E-01	1.40E-08
TE	129M	9.50E 08	3.53E 08	1.50E 08	3.07E 08	3.97E 09	0.00E-01	3.57E 09
TE	129	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
TE	131M	3.77E 02	1.81E 02	1.51E 02	2.72E 02	1.88E 03	0.00E-01	1.45E 04
TE	131	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
TE	132	1.16E 06	7.36E 05	6.93E 05	7.76E 05	7.06E 06	0.00E-01	2.33E 07
I	130	1.71E-06	4.94E-06	1.97E-06	4.03E-04	7.61E-06	0.00E-01	3.80E-06
I	131	8.93E 06	1.25E 07	6.72E 06	3.65E 09	2.15E 07	0.00E-01	2.47E 06
I	132	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
I	133	3.07E-01	5.20E-01	1.59E-01	7.26E 01	9.12E-01	0.00E-01	3.93E-01
I	134	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
I	135	3.64E-17	9.37E-17	3.47E-17	6.03E-15	1.48E-16	0.00E-01	1.04E-16
CS	134	5.23E 08	1.23E 09	5.71E 08	0.00E-01	3.91E 08	1.49E 08	1.53E 07
CS	136	9.20E 06	3.62E 07	2.43E 07	0.00E-01	1.97E 07	3.11E 06	2.91E 06
CS	137	7.24E 08	9.63E 08	3.36E 08	0.00E-01	3.28E 08	1.27E 08	1.37E 07
CS	138	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	139	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	140	2.38E 07	2.91E 04	1.53E 06	0.00E-01	9.88E 03	1.96E 04	3.67E 07
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	3.09E-02	1.52E-02	4.04E-03	0.00E-01	0.00E-01	0.00E-01	8.72E 02
LA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CE	141	1.18E 04	7.88E 03	9.05E 02	0.00E-01	3.71E 03	0.00E-01	2.25E 07
CE	143	1.69E-02	1.23E 01	1.38E-03	0.00E-01	5.53E-03	0.00E-01	3.70E 02
CE	144	1.23E 06	5.08E 05	6.60E 04	0.00E-01	3.04E 05	0.00E-01	3.09E 08
PR	143	1.77E 04	7.05E 03	8.78E 02	0.00E-01	4.10E 03	0.00E-01	5.81E 07
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	6.32E 03	6.87E 03	4.11E 02	0.00E-01	4.03E 03	0.00E-01	2.48E 07
W	187	1.81E-02	1.48E-02	5.18E-03	0.00E-01	0.00E-01	0.00E-01	4.00E 00
NP	239	2.26E-01	2.13E-02	1.19E-02	0.00E-01	6.70E-07	0.00E-01	3.43E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-12
GRASS-COW-MEAT PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	2.34E 02	2.34E 02	2.34E 02	2.34E 02	2.34E 02	2.34E 02
C	14	3.83E 08	7.67E 07	7.67E 07	7.67E 07	7.67E 07	7.67E 07	7.67E 07
NA	24	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03	1.73E-03
P	32	7.41E 09	3.47E 08	2.86E 08	0.00E-01	0.00E-01	0.00E-01	2.05E 08
CR	51	0.00E-01	0.00E-01	8.79E 03	4.88E 03	1.33E 03	8.91E 03	4.66E 05
MN	54	0.00E-01	8.01E 06	2.13E 06	0.00E-01	2.25E 06	0.00E-01	6.72E 06
MN	56	0.00E-01	1.63E-53	3.67E-54	0.00E-01	1.97E-53	0.00E-01	2.36E-51
FE	55	4.57E 08	2.42E 08	7.50E 07	0.00E-01	0.00E-01	1.37E 08	4.49E 07
FE	59	3.76E 08	6.09E 08	3.03E 08	0.00E-01	0.00E-01	1.76E 08	6.34E 08
CO	58	0.00E-01	1.64E 07	5.03E 07	0.00E-01	0.00E-01	0.00E-01	9.58E 07
CO	60	0.00E-01	6.93E 07	2.04E 08	0.00E-01	0.00E-01	0.00E-01	3.84E 08
NI	63	2.91E 10	1.56E 09	9.91E 08	0.00E-01	0.00E-01	0.00E-01	1.05E 08
NI	65	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CU	64	0.00E-01	3.00E-07	1.81E-07	0.00E-01	7.24E-07	0.00E-01	1.41E-05
ZN	65	3.75E 08	1.00E 09	6.22E 08	0.00E-01	6.30E 08	0.00E-01	1.76E 08
ZN	69	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	5.77E 08	3.55E 08	0.00E-01	0.00E-01	0.00E-01	3.71E 07
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	4.82E 08	0.00E-01	1.38E 07	0.00E-01	0.00E-01	0.00E-01	1.87E 07
SR	90	1.04E 10	0.00E-01	2.64E 09	0.00E-01	0.00E-01	0.00E-01	1.40E 08
SR	91	2.24E-10	0.00E-01	8.45E-12	0.00E-01	0.00E-01	0.00E-01	4.94E-10
SR	92	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	90	1.70E 02	0.00E-01	4.55E 00	0.00E-01	0.00E-01	0.00E-01	4.84E 05
Y	91M	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	91	1.80E 06	0.00E-01	4.82E 04	0.00E-01	0.00E-01	0.00E-01	2.40E 08
Y	92	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
Y	93	1.04E-11	0.00E-01	2.87E-13	0.00E-01	0.00E-01	0.00E-01	1.56E-07
ZR	95	2.66E 06	5.86E 05	5.21E 05	0.00E-01	8.38E 05	0.00E-01	6.11E 08
ZR	97	3.22E-05	4.65E-06	2.74E-06	0.00E-01	6.68E-06	0.00E-01	7.05E-01
NB	95	3.10E 06	1.21E 06	8.63E 05	0.00E-01	1.13E 06	0.00E-01	2.23E 09
MO	99	0.00E-01	1.15E 05	2.84E 04	0.00E-01	2.45E 05	0.00E-01	9.51E 04
TC	99M	6.27E-21	1.23E-20	2.04E-19	0.00E-01	1.79E-19	6.24E-21	7.00E-18

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-12 (cont'd)
GRASS-COW-MEAT PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	1.55E 08	0.00E-01	5.95E 07	0.00E-01	3.90E 08	0.00E-01	4.00E 09
RU	105	9.16E-28	0.00E-01	3.32E-28	0.00E-01	8.05E-27	0.00E-01	5.98E-25
RU	106	4.44E 09	0.00E-01	5.54E 08	0.00E-01	5.99E 09	0.00E-01	6.90E 10
AG	110M	8.34E 06	5.67E 06	4.53E 06	0.00E-01	1.06E 07	0.00E-01	6.74E 08
TE	125M	5.69E 08	1.54E 08	7.59E 07	1.60E 08	0.00E-01	0.00E-01	5.49E 08
TE	127M	1.77E 09	4.78E 08	2.11E 08	4.24E 08	5.06E 09	0.00E-01	1.44E 09
TE	127	3.41E-10	9.20E-11	7.32E-11	2.36E-10	9.71E-10	0.00E-01	1.33E-08
TE	129M	1.79E 09	5.00E 08	2.78E 08	5.77E 08	5.26E 09	0.00E-01	2.18E 09
TE	129	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
TE	131M	7.01E 02	2.43E 02	2.58E 02	4.99E 02	2.35E 03	0.00E-01	9.84E 03
TE	131	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
TE	132	2.12E 06	9.39E 05	1.13E 06	1.37E 06	8.72E 06	0.00E-01	9.46E 06
I	130	3.05E-06	6.17E-06	3.18E-06	6.80E-04	9.22E-06	0.00E-01	2.89E-06
I	131	1.66E 07	1.67E 07	9.47E 06	5.51E 09	2.74E 07	0.00E-01	1.48E 06
I	132	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
I	133	5.70E-01	7.04E-01	2.66E-01	1.31E 02	1.17E 00	0.00E-01	2.84E-01
I	134	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
I	135	6.59E-17	1.19E-16	5.61E-17	1.05E-14	1.82E-16	0.00E-01	9.04E-17
CS	134	9.22E 08	1.51E 09	3.19E 08	0.00E-01	4.69E 08	1.68E 08	8.16E 06
CS	136	1.59E 07	4.36E 07	2.82E 07	0.00E-01	2.32E 07	3.46E 06	1.53E 06
CS	137	1.33E 09	1.28E 09	1.88E 08	0.00E-01	4.16E 08	1.50E 08	7.99E 06
CS	138	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	139	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	140	4.39E 07	3.84E 04	2.56E 06	0.00E-01	1.25E 04	2.29E 04	2.22E 07
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	5.66E-02	1.98E-02	6.66E-03	0.00E-01	0.00E-01	0.00E-01	5.51E 02
LA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
CE	141	2.22E 04	1.11E 04	1.64E 03	0.00E-01	4.86E 03	0.00E-01	1.38E 07
CE	143	3.18E-02	1.72E 01	2.50E-03	0.00E-01	7.23E-03	0.00E-01	2.52E 02
CE	144	2.32E 06	7.26E 05	1.24E 05	0.00E-01	4.02E 05	0.00E-01	1.89E 08
PR	143	3.34E 04	1.00E 04	1.66E 03	0.00E-01	5.43E 03	0.00E-01	3.60E 07
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	1.19E 04	9.60E 03	7.43E 02	0.00E-01	5.27E 03	0.00E-01	1.52E 07
W	187	3.36E-02	1.99E-02	8.94E-03	0.00E-01	0.00E-01	0.00E-01	2.80E 00
NP	239	4.26E-01	3.06E-02	2.15E-02	0.00E-01	8.84E-02	0.00E-01	2.26E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-13
VEGETATION PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	2.26E 03	2.26E 03	2.26E 03	2.26E 03	2.26E 03	2.26E 03
C	14	2.38E 08	4.55E 07	4.55E 07	4.55E 07	4.55E 07	4.55E 07	4.55E 07
NA	24	2.69E 05	2.69E 05	2.69E 05	2.69E 05	2.69E 05	2.69E 05	2.69E 05
P	32	1.40E 09	8.73E 07	5.42E 07	0.00E-01	0.00E-01	0.00E-01	1.58E 08
CR	51	0.00E-01	0.00E-01	4.64E 04	2.78E 04	1.02E 04	6.16E 04	1.17E 07
MN	54	0.00E-01	3.13E 08	5.97E 07	0.00E-01	9.31E 07	0.00E-01	9.58E 08
MN	56	0.00E-01	1.59E 01	2.82E 00	0.00E-01	2.02E 01	0.00E-01	5.08E 02
FE	55	2.09E 08	1.45E 08	3.37E 07	0.00E-01	0.00E-01	8.06E 07	8.29E 07
FE	59	1.26E 08	2.96E 08	1.14E 08	0.00E-01	0.00E-01	8.28E 07	9.83E 08
CO	58	0.00E-01	3.07E 07	6.89E 07	0.00E-01	0.00E-01	0.00E-01	6.23E 08
CO	60	0.00E-01	1.67E 08	3.69E 08	0.00E-01	0.00E-01	0.00E-01	3.14E 09
NI	63	1.04E 10	7.28E 08	3.49E 08	0.00E-01	0.00E-01	0.00E-01	1.50E 08
NI	65	6.93E 01	9.01E 00	4.11E 00	0.00E-01	0.00E-01	0.00E-01	2.28E 02
CU	64	0.00E-01	9.21E 03	4.32E 03	0.00E-01	2.32E 04	0.00E-01	7.85E 05
ZN	65	3.17E 08	1.01E 09	4.56E 08	0.00E-01	6.75E 08	0.00E-01	6.36E 08
ZN	69	8.77E-06	1.68E-05	1.17E-06	0.00E-01	1.09E-05	0.00E-01	2.52E-06
BR	83	0.00E-01	0.00E-01	3.11E 00	0.00E-01	0.00E-01	0.00E-01	4.48E 00
BR	84	0.00E-01	0.00E-01	2.49E-11	0.00E-01	0.00E-01	0.00E-01	1.96E-16
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	2.19E 08	1.02E 08	0.00E-01	0.00E-01	0.00E-01	4.33E 07
RB	88	0.00E-01	3.47E-22	1.84E-22	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	1.41E-26	9.88E-27	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	9.97E 09	0.00E-01	2.86E 08	0.00E-01	0.00E-01	0.00E-01	1.60E 09
SR	90	6.05E 11	0.00E-01	1.48E 11	0.00E-01	0.00E-01	0.00E-01	1.75E 10
SR	91	3.03E 05	0.00E-01	1.22E 04	0.00E-01	0.00E-01	0.00E-01	1.44E 06
SR	92	4.27E 02	0.00E-01	1.85E 01	0.00E-01	0.00E-01	0.00E-01	8.46E 03
Y	90	1.33E 04	0.00E-01	3.56E 02	0.00E-01	0.00E-01	0.00E-01	1.41E 08
Y	91M	5.24E-09	0.00E-01	2.03E-10	0.00E-01	0.00E-01	0.00E-01	1.54E-08
Y	91	5.11E 06	0.00E-01	1.37E 05	0.00E-01	0.00E-01	0.00E-01	2.81E 09
Y	92	9.16E-01	0.00E-01	2.68E-02	0.00E-01	0.00E-01	0.00E-01	1.60E 04
Y	93	1.74E 02	0.00E-01	4.81E 00	0.00E-01	0.00E-01	0.00E-01	5.52E 06
ZR	95	1.18E 06	3.77E 05	2.55E 05	0.00E-01	5.92E 05	0.00E-01	1.20E 09
ZR	97	3.37E 02	6.81E 01	3.11E 01	0.00E-01	1.03E 02	0.00E-01	2.11E 07
NB	95	1.43E 05	7.93E 04	4.26E 04	0.00E-01	7.84E 04	0.00E-01	4.81E 08
MO	99	0.00E-01	6.15E 06	1.17E 06	0.00E-01	1.39E 07	0.00E-01	1.43E 07
TC	99M	3.10E 00	8.77E 00	1.12E 02	0.00E-01	1.33E 02	4.30E 00	5.19E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-13 (cont'd)
VEGETATION PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	8.34E-31	1.20E-30	1.18E-29	0.00E-01	2.16E-29	6.14E-31	0.00E-01
RU	103	4.76E 06	0.00E-01	2.05E 06	0.00E-01	1.82E 07	0.00E-01	5.56E 08
RU	105	5.39E 01	0.00E-01	2.13E 01	0.00E-01	6.97E 02	0.00E-01	3.30E 04
RU	106	1.93E 08	0.00E-01	2.44E 07	0.00E-01	3.72E 08	0.00E-01	1.25E 10
AG	110M	1.05E 07	9.75E 06	5.79E 06	0.00E-01	1.92E 07	0.00E-01	3.98E 09
TE	125M	9.66E 07	3.50E 07	1.29E 07	2.90E 07	3.93E 08	0.00E-01	3.86E 08
TE	127M	3.49E 08	1.25E 08	4.26E 07	8.93E 07	1.42E 09	0.00E-01	1.17E 09
TE	127	5.66E 03	2.03E 03	1.23E 03	4.20E 03	2.31E 04	0.00E-01	4.47E 05
TE	129M	2.51E 08	9.38E 07	3.98E 07	8.63E 07	1.05E 09	0.00E-01	1.27E 09
TE	129	7.65E-04	2.87E-04	1.86E-04	5.87E-04	3.22E-03	0.00E-01	5.77E-04
TE	131M	9.12E 05	4.46E 05	3.72E 05	7.07E 05	4.52E 06	0.00E-01	4.43E 07
TE	131	1.51E-15	6.32E-16	4.78E-16	1.24E-15	6.63E-15	0.00E-01	2.14E-16
TE	132	4.30E 06	2.78E 06	2.61E 06	3.07E 06	2.68E 07	0.00E-01	1.32E 08
I	130	3.95E 05	1.16E 06	4.57E 05	9.81E 07	1.81E 06	0.00E-01	9.97E 05
I	131	8.08E 07	1.16E 08	6.62E 07	3.79E 10	1.98E 08	0.00E-01	3.05E 07
I	132	5.77E 01	1.54E 02	5.40E 01	5.40E 03	2.46E 02	0.00E-01	2.90E 01
I	133	2.09E 06	3.63E 06	1.11E 06	5.33E 08	6.33E 06	0.00E-01	3.26E 06
I	134	9.69E-05	2.63E-04	9.42E-05	4.56E-03	4.19E-04	0.00E-01	2.30E-07
I	135	3.90E 04	1.02E 05	3.77E 04	6.74E 06	1.64E 05	0.00E-01	1.15E 05
CS	134	4.67E 09	1.11E 10	9.08E 09	0.00E-01	3.59E 09	1.19E 09	1.94E 08
CS	136	4.20E 07	1.66E 08	1.19E 08	0.00E-01	9.22E 07	1.26E 07	1.88E 07
CS	137	6.36E 09	8.70E 09	5.70E 09	0.00E-01	2.95E 09	9.81E 08	1.68E 08
CS	138	3.94E-11	7.78E-11	3.86E-11	0.00E-01	5.72E-11	5.65E-12	3.32E-16
BA	139	2.90E-02	2.07E-05	8.50E-04	0.00E-01	1.93E-05	1.17E-05	5.15E-02
BA	140	1.29E 08	1.61E 05	8.42E 06	0.00E-01	5.49E 04	9.25E 04	2.65E 08
BA	141	1.28E-21	9.64E-25	4.31E-23	0.00E-01	8.96E-25	5.47E-25	6.01E-31
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	1.98E 03	9.99E 02	2.64E 02	0.00E-01	0.00E-01	0.00E-01	7.33E 07
LA	142	1.42E-04	6.44E-05	1.61E-05	0.00E-01	0.00E-01	0.00E-01	4.70E-01
CE	141	1.97E 05	1.33E 05	1.51E 04	0.00E-01	6.19E 04	0.00E-01	5.10E 08
CE	143	9.98E 02	7.38E 05	8.17E 01	0.00E-01	3.25E 02	0.00E-01	2.76E 07
CE	144	3.29E 07	1.38E 07	1.77E 06	0.00E-01	8.16E 06	0.00E-01	1.11E 10
PR	143	6.26E 04	2.51E 04	3.11E 03	0.00E-01	1.45E 04	0.00E-01	2.74E 08
PR	144	3.13E-26	1.30E-26	1.59E-27	0.00E-01	7.32E-27	0.00E-01	0.00E-01
ND	147	3.36E 04	3.89E 04	2.32E 03	0.00E-01	2.27E 04	0.00E-01	1.87E 08
W	187	3.82E 04	3.20E 04	1.12E 04	0.00E-01	0.00E-01	0.00E-01	1.05E 07
NP	239	1.43E 03	1.40E 02	7.74E 01	0.00E-01	4.38E 02	0.00E-01	2.88E 07

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-14
VEGETATION PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	2.59E 03	2.59E 03	2.59E 03	2.59E 03	2.59E 03	2.59E 03
C	14	3.69E 08	7.38E 07	7.38E 07	7.38E 07	7.38E 07	7.38E 07	7.38E 07
NA	24	2.39E 05	2.39E 05	2.39E 05	2.39E 05	2.39E 05	2.39E 05	2.39E 05
P	32	1.61E 09	9.96E 07	6.23E 07	0.00E-01	0.00E-01	0.00E-01	1.35E 08
CR	51	0.00E-01	0.00E-01	6.17E 04	3.43E 04	1.35E 04	8.81E 04	1.04E 07
MN	54	0.00E-01	4.54E 08	9.01E 07	0.00E-01	1.36E 08	0.00E-01	9.32E 08
MN	56	0.00E-01	1.44E 01	2.55E 00	0.00E-01	1.82E 01	0.00E-01	9.45E 02
FE	55	3.25E 08	2.31E 08	5.38E 07	0.00E-01	0.00E-01	1.46E 08	9.98E 07
FE	59	1.79E 08	4.18E 08	1.62E 08	0.00E-01	0.00E-01	1.32E 08	9.90E 08
CO	58	0.00E-01	4.36E 07	1.01E 08	0.00E-01	0.00E-01	0.00E-01	6.01E 08
CO	60	0.00E-01	2.49E 08	5.60E 08	0.00E-01	0.00E-01	0.00E-01	3.24E 09
NI	63	1.61E 10	1.13E 09	5.44E 08	0.00E-01	0.00E-01	0.00E-01	1.81E 08
NI	65	6.45E 01	8.24E 00	3.76E 00	0.00E-01	0.00E-01	0.00E-01	4.47E 02
CU	64	0.00E-01	8.34E 03	3.92E 03	0.00E-01	2.11E 04	0.00E-01	6.47E 05
ZN	65	4.24E 08	1.47E 09	6.86E 08	0.00E-01	9.42E 08	0.00E-01	6.23E 08
ZN	69	8.21E-06	1.56E 05	1.10E-06	0.00E-01	1.02E-05	0.00E-01	2.88E-05
BR	83	0.00E-01	0.00E-01	2.92E 00	0.00E-01	0.00E-01	0.00E-01	5.08E-16
BR	84	0.00E-01	0.00E-01	2.27E-11	0.00E-01	0.00E-01	0.00E-01	3.14E-28
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	2.74E 08	1.29E 08	0.00E-01	0.00E-01	0.00E-01	4.05E 07
RB	88	0.00E-01	3.21E-22	1.71E-22	0.00E-01	0.00E-01	0.00E-01	2.75E-29
RB	89	0.00E-01	1.26E-26	8.94E-27	0.00E-01	0.00E-01	0.00E-01	1.94E-35
SR	89	1.51E 10	0.00E-01	4.34E 08	0.00E-01	0.00E-01	0.00E-01	1.80E 09
SR	90	7.51E 11	0.00E-01	1.85E 11	0.00E-01	0.00E-01	0.00E-01	2.11E 10
SR	91	2.83E 05	0.00E-01	1.13E 04	0.00E-01	0.00E-01	0.00E-01	1.28E 06
SR	92	3.98E 02	0.00E-01	1.70E 01	0.00E-01	0.00E-01	0.00E-01	1.01E 04
Y	90	1.24E 04	0.00E-01	3.34E 02	0.00E-01	0.00E-01	0.00E-01	1.02E 08
Y	91M	4.88E-09	0.00E-01	1.87E-10	0.00E-01	0.00E-01	0.00E-01	2.30E-07
Y	91	7.84E 06	0.00E-01	2.10E 05	0.00E-01	0.00E-01	0.00E-01	3.21E 09
Y	92	8.61E-01	0.00E-01	2.49E-02	0.00E-01	0.00E-01	0.00E-01	2.36E 04
Y	93	1.63E 02	0.00E-01	4.47E 00	0.00E-01	0.00E-01	0.00E-01	4.99E 06
ZR	95	1.72E 06	5.44E 05	3.74E 05	0.00E-01	7.99E 05	0.00E-01	1.25E 09
ZR	97	3.12E 02	6.18E 01	2.85E 01	0.00E-01	9.37E 01	0.00E-01	1.67E 07
NB	95	1.93E 05	1.07E 05	5.88E 04	0.00E-01	1.04E 05	0.00E-01	4.57E 08
MO	99	0.00E-01	5.65E 06	1.08E 06	0.00E-01	1.29E 07	0.00E-01	1.01E 07
TC	99M	2.74E 00	7.64E 00	9.90E 01	0.00E-01	1.14E 02	4.24E 00	5.02E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-14 (cont'd)
VEGETATION PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	7.76E-31	1.10E-30	1.08E-29	0.00E-01	2.00E-29	6.72E-31	0.00E-01
RU	103	6.81E 06	0.00E-01	2.91E 06	0.00E-01	2.40E 07	0.00E-01	5.69E 08
RU	105	5.01E 01	0.00E-01	1.94E 01	0.00E-01	6.32E 02	0.00E-01	4.04E 04
RU	106	3.09E 08	0.00E-01	3.90E 07	0.00E-01	5.97E 08	0.00E-01	1.48E 10
AG	110M	1.52E 07	1.43E 07	8.72E 06	0.00E-01	2.74E 07	0.00E-01	4.03E 09
TE	125M	1.48E 08	5.34E 07	1.98E 07	4.14E 07	0.00E-01	0.00E-01	4.39E 08
TE	127M	5.52E 08	1.96E 08	6.56E 07	1.31E 08	2.24E 09	0.00E-01	1.37E 09
TE	127	5.34E 03	1.89E 03	1.15E 03	3.68E 03	2.16E 04	0.00E-01	4.12E 05
TE	129M	3.62E 08	1.34E 08	5.73E 07	1.17E 08	1.51E 09	0.00E-01	1.36E 09
TE	129	7.16E-04	2.67E-04	1.74E-04	5.12E-04	3.01E-03	0.00E-01	3.92E-03
TE	131M	8.44E 05	4.05E 05	3.38E 05	6.09E 05	4.22E 06	0.00E-01	3.25E 07
TE	131	1.41E-14	5.80E-16	4.40E-16	1.08E-15	6.15E-15	0.00E-01	1.15E-16
TE	132	3.91E 06	2.48E 06	2.33E 06	2.61E 06	2.37E 07	0.00E-01	7.84E 07
I	130	3.51E 05	1.02E 06	4.05E 05	8.28E 07	1.56E 06	0.00E-01	7.80E 05
I	131	7.69E 07	1.08E 08	5.78E 07	3.14E 10	1.85E 08	0.00E-01	2.13E 07
I	132	5.20E 01	1.36E 02	4.89E 01	4.59E 03	2.14E 02	0.00E-01	5.93E 01
I	133	1.94E 06	3.29E 06	1.00E 06	4.59E 08	5.77E 06	0.00E-01	2.49E 06
I	134	8.76E-05	2.32E-04	8.34E-05	3.87E-03	3.66E-04	0.00E-01	3.06E-06
I	135	3.52E 04	9.07E 04	3.36E 04	5.84E 06	1.43E 05	0.00E-01	1.01E 05
CS	134	7.10E 09	1.67E 10	7.75E 09	0.00E-01	5.31E 09	2.03E 09	2.08E 08
CS	136	4.28E 07	1.68E 08	1.13E 08	0.00E-01	9.16E 07	1.44E 07	1.35E 07
CS	137	1.01E 10	1.35E 10	4.69E 09	0.00E-01	4.59E 09	1.78E 09	1.92E 08
CS	138	3.64E-11	6.98E-11	3.49E-11	0.00E-01	5.15E-11	6.00E-12	3.17E-14
BA	139	2.73E-02	1.92E-05	7.96E-04	0.00E-01	1.81E-05	1.32E-05	2.44E-01
BA	140	1.38E 08	1.69E 05	8.91E 06	0.00E-01	5.74E 04	1.14E 05	2.13E 08
BA	141	1.19E-21	8.90E-25	3.98E-23	0.00E-01	8.27E-25	6.10E-25	2.54E-27
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	1.81E 03	8.89E 02	2.37E 02	0.00E-01	0.00E-01	0.00E-01	5.11E 07
LA	142	1.30E-04	5.78E-05	1.44E-05	0.00E-01	0.00E-01	0.00E-01	1.76E 00
CE	141	2.83E 05	1.89E 05	2.17E 04	0.00E-01	8.90E 04	0.00E-01	5.41E 08
CE	143	9.33E 02	6.79E 05	7.58E 01	0.00E-01	3.04E 02	0.00E-01	2.04E 07
CE	144	5.27E 07	2.18E 07	2.83E 06	0.00E-01	1.30E 07	0.00E-01	1.33E 10
PR	143	7.01E 04	2.80E 04	3.49E 03	0.00E-01	1.63E 04	0.00E-01	2.31E 08
PR	144	2.93E-26	1.20E-26	1.49E-27	0.00E-01	6.88E-27	0.00E-01	3.23E-29
ND	147	3.66E 04	3.98E 04	2.38E 03	0.00E-01	2.34E 04	0.00E-01	1.44E 08
W	187	3.56E 04	2.90E 04	1.02E 04	0.00E-01	0.00E-01	0.00E-01	7.84E 06
NP	239	1.39E 02	1.31E 02	7.26E 01	0.00E-01	4.10E 02	0.00E-01	2.10E 07

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TABLE A.5-15
VEGETATION PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	4.01E 03	4.01E 03	4.01E 03	4.01E 03	4.01E 03	4.01E 03
C	14	8.89E 08	1.78E 08	1.78E 08	1.78E 08	1.78E 08	1.78E 08	1.78E 08
NA	24	3.73E 05	3.73E 05	3.73E 05	3.73E 05	3.73E 05	3.73E 05	3.73E 05
P	32	3.37E 09	1.58E 08	1.30E 08	0.00E-01	0.00E-01	0.00E-01	9.30E 07
CR	51	0.00E-01	0.00E-01	1.17E 05	6.50E 04	1.78E 04	1.19E 05	6.21E 06
MN	54	0.00E-01	6.65E 08	1.77E 08	0.00E-01	1.86E 08	0.00E-01	5.58E 08
MN	56	0.00E-01	1.88E 01	4.24E 00	0.00E-01	2.27E 01	0.00E-01	2.72E 03
FE	55	8.00E 08	4.24E 08	1.31E 08	0.00E-01	0.00E-01	2.40E 08	7.86E 07
FE	59	3.97E 08	6.43E 08	3.20E 08	0.00E-01	0.00E-01	1.86E 08	6.69E 08
CO	58	0.00E-01	6.44E 07	1.97E 08	0.00E-01	0.00E-01	0.00E-01	3.76E 08
CO	60	0.00E-01	3.78E 08	1.12E 09	0.00E-01	0.00E-01	0.00E-01	2.10E 09
NI	63	3.95E 10	2.11E 09	1.34E 09	0.00E-01	0.00E-01	0.00E-01	1.42E 08
NI	65	1.18E 02	1.11E 01	6.51E 00	0.00E-01	0.00E-01	0.00E-01	1.37E 03
CU	64	0.00E-01	1.10E 04	6.65E 03	0.00E-01	2.66E 04	0.00E-01	5.16E 05
ZN	65	8.12E 08	2.16E 09	1.35E 09	0.00E-01	1.36E 09	0.00E-01	3.80E 08
ZN	69	1.51E-05	2.19E-05	2.02E-06	0.00E-01	1.33E-05	0.00E-01	1.38E-03
BR	83	0.00E-01	0.00E-01	5.38E 00	0.00E-01	0.00E-01	0.00E-01	3.14E-17
BR	84	0.00E-01	0.00E-01	3.85E-11	0.00E-01	0.00E-01	0.00E-01	1.94E-28
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	4.52E 08	2.78E 08	0.00E-01	0.00E-01	0.00E-01	2.91E 07
RB	88	0.00E-01	4.43E-22	3.08E-22	0.00E-01	0.00E-01	0.00E-01	2.17E-23
RB	89	0.00E-01	1.67E-26	1.48E-26	0.00E-01	0.00E-01	0.00E-01	1.45E-28
SR	89	3.60E 10	0.00E-01	1.03E 09	0.00E-01	0.00E-01	0.00E-01	1.39E 09
SR	90	1.24E 12	0.00E-01	3.15E 11	0.00E-01	0.00E-01	0.00E-01	1.67E 10
SR	91	5.21E 05	0.00E-01	1.97E 04	0.00E-01	0.00E-01	0.00E-01	1.15E 06
SR	92	7.29E 02	0.00E-01	2.92E 01	0.00E-01	0.00E-01	0.00E-01	1.38E 04
Y	90	2.30E 04	0.00E-01	6.17E 02	0.00E-01	0.00E-01	0.00E-01	6.56E 07
Y	91M	8.95E-09	0.00E-01	3.26E-10	0.00E-01	0.00E-01	0.00E-01	1.75E-05
Y	91	1.86E 07	0.00E-01	4.99E 03	0.00E-01	0.00E-01	0.00E-01	2.48E 09
Y	92	1.59E 00	0.00E-01	4.54E-02	0.00E-01	0.00E-01	0.00E-01	4.58E 04
Y	93	3.01E 02	0.00E-01	8.26E 00	0.00E-01	0.00E-01	0.00E-01	4.48E 06
ZR	95	3.86E 06	8.49E 05	7.56E 05	0.00E-01	1.22E 06	0.00E-01	8.85E 08
ZR	97	5.70E 02	8.24E 01	4.86E 01	0.00E-01	1.18E 02	0.00E-01	1.25E 07
NB	95	4.11E 05	1.60E 05	1.14E 05	0.00E-01	1.50E 05	0.00E-01	2.96E 08
MO	99	0.00E-01	7.71E 06	1.91E 06	0.00E-01	1.65E 07	0.00E-01	6.38E 06
TC	99M	4.71E 00	9.24E 00	1.51E 02	0.00E-01	1.34E 02	4.69E 00	5.26E 03

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-15 (cont'd)
VEGETATION PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD (RI FACTORS)

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	1.43E-30	1.49E-30	1.89E-29	0.00E-01	2.55E-29	7.90E-31	4.75E-30
RU	103	1.53E 07	0.00E-01	5.88E 06	0.00E-01	3.85E 07	0.00E-01	3.96E 08
RU	105	9.17E 01	0.00E-01	3.33E 01	0.00E-01	8.06E 02	0.00E-01	5.99E 04
RU	106	7.45E 08	0.00E-01	9.30E 07	0.00E-01	1.01E 09	0.00E-01	1.16E 10
AG	110M	3.21E 07	2.17E 07	1.73E 07	0.00E-01	4.04E 07	0.00E-01	2.58E 09
TE	125M	3.51E 08	9.50E 07	4.67E 07	9.84E 07	0.00E-01	0.00E-01	3.38E 08
TE	127M	1.32E 09	3.56E 08	1.57E 08	3.16E 08	3.77E 09	0.00E-01	1.07E 09
TE	127	9.85E 03	2.66E 03	2.11E 03	6.82E 03	2.80E 04	0.00E-01	3.85E 05
TE	129M	8.41E 08	2.35E 08	1.30E 08	2.71E 08	2.47E 09	0.00E-01	1.03E 09
TE	129	1.33E-03	3.70E-04	3.15E-04	9.46E-04	3.88E-03	0.00E-01	8.25E-02
TE	131M	1.54E 06	5.33E 05	5.68E 05	1.10E 06	5.16E 06	0.00E-01	2.16E 07
TE	131	2.59E-15	7.90E-16	7.71E-16	1.98E-15	7.84E-15	0.00E-01	1.36E-14
TE	132	7.00E 06	3.10E 06	3.74E 06	4.51E 06	2.88E 07	0.00E-01	3.12E 07
I	130	6.16E 05	1.24E 06	6.41E 05	1.37E 08	1.86E 06	0.00E-01	5.82E 05
I	131	1.43E 08	1.44E 08	8.17E 07	4.76E 10	2.36E 08	0.00E-01	1.28E 07
I	132	9.23E 01	1.70E 02	7.80E 01	7.87E 03	2.60E 02	0.00E-01	2.00E 02
I	133	3.53E 06	4.37E 06	1.65E 06	8.12E 08	7.28E 06	0.00E-01	1.76E 06
I	134	1.56E-04	2.89E-04	1.33E-04	6.65E-04	4.42E-04	0.00E-01	1.92E-04
I	135	6.26E 04	1.13E 05	5.33E 04	9.98E 06	1.73E 05	0.00E-01	8.59E 04
CS	134	1.60E 10	2.63E 10	5.55E 09	0.00E-01	8.15E 09	2.93E 09	1.42E 08
CS	136	8.04E 07	2.21E 08	1.43E 08	0.00E-01	1.18E 08	1.76E 07	7.77E 06
CS	137	2.39E 10	2.29E 10	3.38E 09	0.00E-01	7.46E 09	2.68E 09	1.43E 08
CS	138	6.61E-11	9.20E-11	5.83E-11	0.00E-01	6.47E-11	6.96E-12	4.24E-11
BA	139	5.04E-02	2.69E-05	1.46E-03	0.00E-01	2.35E-05	1.58E-05	2.91E 00
BA	140	2.77E 08	2.43E 05	1.62E 07	0.00E-01	7.90E 04	1.45E 05	1.40E 08
BA	141	2.20E-21	1.23E-24	7.16E-23	0.00E-01	1.07E-24	7.24E-24	1.25E-21
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	3.25E 03	1.14E 03	3.83E 02	0.00E-01	0.00E-01	0.00E-01	3.17E 07
LA	142	2.36E-04	7.51E-05	2.35E-05	0.00E-01	0.00E-01	0.00E-01	1.49E 01
CE	141	6.56E 05	3.27E 05	4.86E 04	0.00E-01	1.43E 05	0.00E-01	4.08E 08
CE	143	1.72E 03	9.31E 05	1.35E 02	0.00E-01	3.91E 02	0.00E-01	1.36E 07
CE	144	1.27E 08	3.98E 07	6.78E 06	0.00E-01	2.21E 07	0.00E-01	1.04E 10
PR	143	1.46E 05	4.38E 04	7.23E 03	0.00E-01	2.37E 04	0.00E-01	1.57E 08
PR	144	5.44E-26	1.68E-26	2.74E-27	0.00E-01	8.90E-27	0.00E-01	3.62E-23
ND	147	7.24E 04	5.86E 04	4.54E 03	0.00E-01	3.22E 04	0.00E-01	9.29E 07
W	187	6.47E 04	3.83E 04	1.72E 04	0.00E-01	0.00E-01	0.00E-01	5.38E 07
NP	239	2.56E 03	1.84E 02	1.29E 02	0.00E-01	5.31E 02	0.00E-01	1.36E 07

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-16
GROUND PLANE PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
(RI FACTOR)

H-3	0.00E 00	Y-91M	1.00E 05	CS-134	6.86E 09
C-14	0.00E 00	Y-91	1.07E 06	CS-136	1.49E 08
NA-24	1.19E 07	Y-92	1.80E 05	CS-137	1.03E 10
P-32	0.00E 00	Y-93	1.85E 05	CS-138	3.59E 05
CR-51	4.66E 06	ZR-95	2.45E 08	BA-139	1.06E 05
MN-54	1.39E 09	ZR-97	2.96E 06	BA-140	2.05E 07
MN-56	9.03E 05	NB-95	1.37E 08	BA-141	4.18E 04
FE-55	0.00E 00	MO-99	3.99E 06	BA-142	4.49E 04
FE-59	2.73E 08	TC-99M	1.84E 05	LA-140	1.92E 07
		TC-101	2.04E 04		
CO-58	3.79E 08	RU-103	1.08E 08	LA-142	7.37E 05
CO-60	2.15E 10	RU-105	6.36E 05	CE-141	1.37E 07
NI-63	0.00E 00	RU-106	4.21E 08	CE-143	2.31E 06
NI-65	3.02E 05	AG-110M	3.44E 09	CE-144	6.96E 07
CU-64	6.07E 05	TE-125M	1.55E 06	PR-143	0.00E 00
ZN-65	7.46E 08	TE-127M	9.17E 04	PR-144	1.83E 03
ZN-69	0.00E 00	TE-127	2.98E 03	ND-147	8.46E 06
BR-83	4.87E 03	TE-129M	1.98E 07	W-187	2.36E 06
BR-84	2.03E 05	TE-129	2.62E 04	NP-239	1.71E 06
BR-85	0.00E 00	TE-131M	8.03E 06		
RB-86	8.99E 06	TE-131	2.92E 04		
RB-88	3.31E 04	TE-132	4.23E 06		
RB-89	1.21E 05	I-130	5.51E 06		
SR-89	2.16E 04	I-131	1.72E 07		
SR-90	0.00E 00	I-132	1.25E 06		
SR-91	2.14E 06	I-133	2.45E 06		
SR-92	7.77E 05	I-134	4.47E 05		
Y-90	4.49E 03	I-135	2.53E 06		

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-17
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	1.56E 03	1.56E 03	1.56E 03	1.56E 03	1.56E 03	1.56E 03
C	14	2.63E 08	5.27E 07	5.27E 07	5.27E 07	5.27E 07	5.27E 07	5.27E 07
NA	24	2.93E 05	2.93E 05	2.93E 05	2.93E 05	2.93E 05	2.93E 05	2.93E 05
P	32	2.05E 10	1.27E 09	7.93E 08	0.00E-01	0.00E-01	0.00E-01	2.31E 09
CR	51	0.00E-01	0.00E-01	3.43E 03	2.05E 03	7.55E 02	4.55E 03	8.62E 05
MN	54	0.00E-01	1.01E 06	1.93E 05	0.00E-01	3.00E 05	0.00E-01	3.09E 06
MN	56	0.00E-01	4.99E-03	8.85E-04	0.00E-01	6.34E-03	0.00E-01	1.59E-01
FE	55	3.26E 05	2.25E 05	5.26E 04	0.00E-01	0.00E-01	1.26E 05	1.29E 05
FE	59	3.86E 05	9.07E 05	3.48E 05	0.00E-01	0.00E-01	2.54E 05	3.02E 06
CO	58	0.00E-01	5.66E 05	1.27E 06	0.00E-01	0.00E-01	0.00E-01	1.15E 07
CO	60	0.00E-01	1.97E 06	4.34E 06	0.00E-01	0.00E-01	0.00E-01	3.70E 07
NI	63	8.07E 08	5.65E 07	2.71E 07	0.00E-01	0.00E-01	0.00E-01	1.17E 07
NI	65	5.56E-02	7.22E-03	3.30E-03	0.00E-01	0.00E-01	0.00E-01	1.83E-01
CU	64	0.00E-01	2.66E 03	1.25E 03	0.00E-01	6.70E 03	0.00E-01	2.27E 05
ZN	65	1.65E 08	5.24E 08	2.37E 08	0.00E-01	3.50E 08	0.00E-01	3.30E 08
ZN	69	6.27E-13	1.20E-12	8.34E-14	0.00E-01	7.79E-13	0.00E-01	1.80E-13
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	3.11E 08	1.45E 08	0.00E-01	0.00E-01	0.00E-01	6.14E 07
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	3.05E 09	0.00E-01	8.75E 07	0.00E-01	0.00E-01	0.00E-01	4.89E 08
SR	90	9.83E 10	0.00E-01	2.41E 10	0.00E-01	0.00E-01	0.00E-01	2.84E 09
SR	91	6.02E 04	0.00E-01	2.43E 03	0.00E-01	0.00E-01	0.00E-01	2.87E 05
SR	92	1.03E 00	0.00E-01	4.45E-01	0.00E-01	0.00E-01	0.00E-01	2.04E 01
Y	90	8.49E 00	0.00E-01	2.28E-00	0.00E-01	0.00E-01	0.00E-01	9.00E 04
Y	91M	7.24E-21	0.00E-01	2.80E-22	0.00E-01	0.00E-01	0.00E-01	2.13E-20
Y	91	1.03E 03	0.00E-01	2.76E 01	0.00E-01	0.00E-01	0.00E-01	5.67E 05
Y	92	6.71E-06	0.00E-01	1.96E-07	0.00E-01	0.00E-01	0.00E-01	1.18E-01
Y	93	2.80E-02	0.00E-01	7.73E-04	0.00E-01	0.00E-01	0.00E-01	8.87E 02
ZR	95	1.13E 02	3.63E 01	2.46E 01	0.00E-01	5.70E 01	0.00E-01	1.15E 05
ZR	97	5.20E-02	1.05E-01	4.80E-03	0.00E-01	1.58E-01	0.00E-01	3.25E 03
NB	95	9.91E 03	5.51E 03	2.96E 03	0.00E-01	5.45E 03	0.00E-01	3.35E 07
MO	99	0.00E-01	2.97E 06	5.65E 05	0.00E-01	6.73E 06	0.00E-01	6.89E 06
TC	99M	3.99E-01	1.13E 00	1.44E 01	0.00E-01	1.71E 01	5.53E-01	6.67E 02

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-17 (cont'd)
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
ADULT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	1.22E 02	0.00E-01	5.26E 01	0.00E-01	4.66E 02	0.00E-01	1.43E 04
RU	105	1.03E-04	0.00E-01	4.07E-05	0.00E-01	1.33E-03	0.00E-01	6.30E-02
RU	106	2.45E 03	0.00E-01	3.10E 02	0.00E-01	4.73E 03	0.00E-01	1.58E 05
AG	110M	6.99E 06	6.46E 06	3.84E 06	0.00E-01	1.27E 07	0.00E-01	2.64E 09
TE	125M	1.95E 06	7.08E 05	2.62E 05	5.88E 05	7.95E 06	0.00E-01	7.81E 06
TE	127M	5.49E 06	1.96E 06	6.70E 05	1.40E 06	2.23E 07	0.00E-01	1.84E 07
TE	127	7.84E 01	2.82E 01	1.70E 01	5.81E 01	3.19E 02	0.00E-01	6.19E 03
TE	129M	7.22E 06	2.69E 06	1.14E 06	2.48E 06	3.02E 07	0.00E-01	3.64E 07
TE	129	3.41E-11	1.28E-11	8.31E-12	2.62E-11	1.43E-10	0.00E-01	2.57E-11
TE	131M	4.33E 04	2.12E 04	1.77E 04	3.36E 04	2.15E 05	0.00E-01	2.10E 06
TE	131	4.40E-34	1.84E-34	1.39E-34	3.62E-34	1.93E-33	0.00E-01	6.23E-35
TE	132	2.88E 05	1.86E 05	1.75E 05	2.06E 05	1.80E 06	0.00E-01	8.82E 06
I	130	5.04E 05	1.49E 06	5.87E 05	1.26E 08	2.32E 06	0.00E-01	1.28E 06
I	131	3.55E 08	5.08E 08	2.91E 08	1.67E 11	8.71E 08	0.00E-01	1.34E 08
I	132	1.98E-00	5.29E-00	1.85E-00	1.85E 01	8.43E-00	0.00E-01	9.94E-01
I	133	4.65E 06	8.08E 06	2.46E 06	1.19E 09	1.41E 07	0.00E-01	7.26E 06
I	134	2.44E-12	6.63E-12	2.37E-12	1.15E-10	1.05E-11	0.00E-01	5.78E-15
I	135	1.54E 04	4.04E 04	1.49E 04	2.66E 06	6.48E 04	0.00E-01	4.56E 04
CS	134	1.70E 10	4.04E 10	3.30E 10	0.00E-01	1.31E 10	4.34E 09	7.06E 08
CS	136	7.83E 08	3.09E 09	2.23E 09	0.00E-01	1.72E 09	2.36E 08	3.51E 08
CS	137	2.21E 10	3.03E 10	1.98E 10	0.00E-01	1.03E 10	3.42E 09	5.86E 08
CS	138	2.75E-23	5.43E-23	2.69E-23	0.00E-01	3.99E-23	3.94E-24	2.32E-28
BA	139	5.48E-09	3.90E-12	1.60E-10	0.00E-01	3.65E-12	2.21E-12	9.71E-09
BA	140	3.23E 06	4.05E 03	2.11E 05	0.00E-01	1.38E 03	2.32E 03	6.64E 06
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	5.43E-01	2.73E-01	7.23E-02	0.00E-01	0.00E-01	0.00E-01	2.01E 04
LA	142	1.13E-12	5.12E-13	1.28E-13	0.00E-01	0.00E-01	0.00E-01	3.74E-09
CE	141	5.81E 02	3.93E 02	4.46E 01	0.00E-01	1.83E 02	0.00E-01	1.50E 06
CE	143	4.99E 00	3.69E 03	4.08E-00	0.00E-01	1.62E 00	0.00E-01	1.38E 05
CE	144	4.29E 04	1.79E 04	2.30E 03	0.00E-01	1.06E 04	0.00E-01	1.45E 07
PR	143	1.90E 01	7.60E 00	9.39E-00	0.00E-01	4.39E 00	0.00E-01	8.30E 04
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	1.14E 01	1.31E 01	7.85E-01	0.00E-01	7.67E 00	0.00E-01	6.30E 04
W	187	7.87E 02	6.58E 02	2.30E 02	0.00E-01	0.00E-01	0.00E-01	2.16E 05
NP	239	4.41E-01	4.33E-02	2.39E-02	0.00E-01	1.35E-01	0.00E-01	8.89E 03

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TABLE A.5-18
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	2.03E 03	2.03E 03	2.03E 03	2.03E 03	2.03E 03	2.03E 03
C	14	4.86E 08	9.72E 07	9.72E 07	9.72E 07	9.72E 07	9.72E 07	9.72E 07
NA	24	5.11E 05	5.11E 05	5.11E 05	5.11E 05	5.11E 05	5.11E 05	5.11E 05
P	32	3.78E 10	2.34E 09	1.47E 09	0.00E-01	0.00E-01	0.00E-01	3.18E 09
CR	51	0.00E-01	0.00E-01	5.99E 03	3.33E 03	1.31E 03	8.55E 03	1.01E 06
MN	54	0.00E-01	1.68E 06	3.34E 05	0.00E-01	5.02E 05	0.00E-01	3.45E 06
MN	56	0.00E-01	8.85E-04	1.57E-04	0.00E-01	1.12E-03	0.00E-01	5.82E-02
FE	55	5.79E 05	4.10E 05	9.57E 04	0.00E-01	0.00E-01	2.60E 05	1.78E 05
FE	59	6.74E 05	1.57E 06	6.07E 05	0.00E-01	0.00E-01	4.96E 05	3.72E 06
CO	58	0.00E-01	9.52E 05	2.19E 06	0.00E-01	0.00E-01	0.00E-01	1.31E 07
CO	60	0.00E-01	3.34E 06	7.52E 06	0.00E-01	0.00E-01	0.00E-01	4.35E 07
NI	63	1.42E 09	1.00E 08	4.81E 07	0.00E-01	0.00E-01	0.00E-01	1.59E 07
NI	65	1.02E-01	1.30E-02	5.92E-03	0.00E-01	0.00E-01	0.00E-01	7.05E-01
CU	64	0.00E-01	4.74E 03	2.23E 03	0.00E-01	1.20E 04	0.00E-01	3.67E 05
ZN	65	2.53E 08	8.78E 08	4.09E 08	0.00E-01	5.62E 08	0.00E-01	3.72E 08
ZN	69	1.15E-12	2.20E-12	1.54E-13	0.00E-01	1.44E-12	0.00E-01	4.05E-12
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	5.67E 08	2.67E 08	0.00E-01	0.00E-01	0.00E-01	8.40E 07
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	5.62E 09	0.00E-01	1.61E 08	0.00E-01	0.00E-01	0.00E-01	6.69E 08
SR	90	1.39E 11	0.00E-01	3.43E 10	0.00E-01	0.00E-01	0.00E-01	3.90E 09
SR	91	1.11E 05	0.00E-01	4.40E 03	0.00E-01	0.00E-01	0.00E-01	5.02E 05
SR	92	1.88E 00	0.00E-01	8.02E-02	0.00E-01	0.00E-01	0.00E-01	4.80E 01
Y	90	1.56E 01	0.00E-01	4.20E-00	0.00E-01	0.00E-01	0.00E-01	1.29E 05
Y	91M	1.33E-20	0.00E-01	5.07E-22	0.00E-01	0.00E-01	0.00E-01	6.26E-19
Y	91	1.90E 03	0.00E-01	5.08E 01	0.00E-01	0.00E-01	0.00E-01	7.77E 05
Y	92	1.24E-05	0.00E-01	3.59E-07	0.00E-01	0.00E-01	0.00E-01	3.40E-01
Y	93	5.16E-02	0.00E-01	1.41E-03	0.00E-01	0.00E-01	0.00E-01	1.56E 03
ZR	95	1.98E 02	6.25E 01	4.30E 01	0.00E-01	9.18E 01	0.00E-01	1.44E 05
ZR	97	9.47E-02	1.87E-02	8.63E-03	0.00E-01	2.84E-02	0.00E-01	5.07E 03
NB	95	1.69E 04	9.37E 03	5.16E 03	0.00E-01	9.09E 03	0.00E-01	4.01E 07
MO	99	0.00E-01	5.37E 06	1.02E 06	0.00E-01	1.23E 07	0.00E-01	9.61E 06
TC	99M	6.92E-00	1.93E 00	2.50E 01	0.00E-01	2.88E 01	1.07E 00	1.27E 03
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-18 (cont'd)
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
TEEN

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU	103	2.17E 02	0.00E-01	9.28E 01	0.00E-01	7.66E 02	0.00E-01	1.81E 04
RU	105	1.88E-04	0.00E-01	7.30E-05	0.00E-01	2.37E-03	0.00E-01	1.52E-01
RU	106	4.50E 03	0.00E-01	5.67E 02	0.00E-01	8.68E 03	0.00E-01	2.16E 05
AG	110M	1.16E 07	1.09E 07	6.65E 06	0.00E-01	2.08E 07	0.00E-01	3.07E 09
TE	125M	3.60E 06	1.30E 06	4.82E 05	1.01E 06	0.00E-01	0.00E-01	1.06E 07
TE	127M	1.01E 07	3.59E 06	1.20E 06	2.41E 06	4.10E 07	0.00E-01	2.52E 07
TE	127	1.45E 02	5.15E 01	3.13E 01	1.00E 02	5.89E 02	0.00E-01	1.12E 04
TE	129M	1.32E 07	4.90E 06	2.09E 06	4.26E 06	5.53E 07	0.00E-01	4.96E 07
TE	129	6.28E-11	2.34E-11	1.53E-11	4.48E-11	2.63E-10	0.00E-01	3.43E-10
TE	131M	7.89E 04	3.78E 04	3.16E 04	5.69E 04	3.94E 05	0.00E-01	3.04E 06
TE	131	8.04E-34	3.31E-34	2.51E-34	6.19E-34	3.51E-33	0.00E-01	6.60E-35
TE	132	5.15E 05	3.26E 05	3.07E 05	3.44E 05	3.13E 06	0.00E-01	1.03E 07
I	130	8.87E 05	2.57E 06	1.02E 06	2.09E 08	3.95E 06	0.00E-01	1.97E 06
I	131	6.45E 08	9.03E 08	4.85E 08	2.63E 11	1.55E 09	0.00E-01	1.79E 08
I	132	3.51E-01	9.18E-01	3.29E-01	3.09E 01	1.45E 00	0.00E-01	4.00E-01
I	133	8.49E 06	1.44E 07	4.39E 06	2.01E 09	2.52E 07	0.00E-01	1.09E 07
I	134	4.34E-12	1.15E-11	4.13E-12	1.92E-10	1.81E-11	0.00E-01	1.51E-13
I	135	2.74E 04	7.05E 04	2.61E 04	4.54E 06	1.11E 05	0.00E-01	7.82E 04
CS	134	2.94E 10	6.93E 10	3.22E 10	0.00E-01	2.20E 10	8.41E 09	8.62E 08
CS	136	1.33E 09	5.25E 09	3.52E 09	0.00E-01	2.86E 09	4.50E 08	4.22E 08
CS	137	4.02E 10	5.34E 10	1.86E 10	0.00E-01	1.82E 10	7.06E 09	7.60E 08
CS	138	4.99E-23	9.58E-23	4.79E-23	0.00E-01	7.07E-23	8.23E-24	4.34E-26
BA	139	1.01E-08	7.13E-12	2.95E-10	0.00E-01	6.72E-12	4.91E-12	9.04E-08
BA	140	5.82E 06	7.14E 03	3.75E 05	0.00E-01	2.42E 03	4.08E 03	8.98E 06
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	9.75E-01	4.79E-01	1.27E-01	0.00E-01	0.00E-01	0.00E-01	2.75E 04
LA	142	2.03E-12	9.03E 13	2.25E-13	0.00E-01	0.00E-01	0.00E-01	2.75E-08
CE	141	1.07E 03	7.12E 02	8.18E 01	0.00E-01	3.35E 02	0.00E-01	2.04E 06
CE	143	9.17E 00	6.67E 03	7.45E-00	0.00E-01	2.99E 00	0.00E-01	2.01E 05
CE	144	7.90E 04	3.27E 04	4.24E 03	0.00E-01	1.95E 04	0.00E-01	1.99E 07
PR	143	3.48E 01	1.39E 00	1.73E 00	0.00E-01	8.08E 00	0.00E-01	1.15E 05
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	2.19E 01	2.38E 01	1.42E 00	0.00E-01	1.40E 01	0.00E-01	8.57E 04
W	187	1.44E 03	1.17E 03	4.11E 02	0.00E-01	0.00E-01	0.00E-01	3.18E 05
NP	239	8.41E-01	7.93E-02	4.41E-02	0.00E-01	2.49E-01	0.00E-01	1.28E 04

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OFFSITE DOSE CALCULATION MANUAL

TABLE A.5-19
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	3.20E 03	3.20E 03	3.20E 03	3.20E 03	3.20E 03	3.20E 03
C	14	1.19E 09	2.39E 08	2.39E 08	2.39E 08	2.39E 08	2.39E 08	2.39E 08
NA	24	1.06E 06	1.06E 06	1.06E 06	1.06E 06	1.06E 06	1.06E 06	1.06E 06
P	32	9.33E 10	4.37E 09	3.60E 09	0.00E-01	0.00E-01	0.00E-01	2.58E 09
CR	51	0.00E-01	0.00E-01	1.22E 04	6.78E 03	1.85E 03	1.24E 04	6.48E 05
MN	54	0.00E-01	2.52E 06	6.70E 05	0.00E-01	7.06E 05	0.00E-01	2.11E 06
MN	56	0.00E-01	1.54E-03	3.48E-04	0.00E-01	1.87E-03	0.00E-01	2.24E-01
FE	55	1.45E 06	7.70E 05	2.39E 05	0.00E-01	0.00E-01	4.36E 05	1.43E 05
FE	59	1.56E 06	2.53E 06	1.26E 06	0.00E-01	0.00E-01	7.33E 05	2.63E 06
CO	58	0.00E-01	1.46E 06	4.45E 06	0.00E-01	0.00E-01	0.00E-01	8.49E 06
CO	60	0.00E-01	5.18E 06	1.53E 07	0.00E-01	0.00E-01	0.00E-01	2.87E 07
NI	63	3.56E 09	1.90E 08	1.21E 08	0.00E-01	0.00E-01	0.00E-01	1.28E 07
NI	65	2.49E-01	2.34E-02	1.37E-02	0.00E-01	0.00E-01	0.00E-01	2.87E 00
CU	64	0.00E-01	8.23E 03	5.03E 03	0.00E-01	2.01E 04	0.00E-01	3.91E 05
ZN	65	4.96E 08	1.32E 09	8.22E 08	0.00E-01	8.33E 08	0.00E-01	2.32E 06
ZN	69	2.84E-12	4.10E-12	3.79E-13	0.00E-01	2.49E-12	0.00E-01	2.58E-10
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	1.05E 09	6.47E 08	0.00E-01	0.00E-01	0.00E-01	6.77E 07
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	1.39E 10	0.00E-01	3.97E 08	0.00E-01	0.00E-01	0.00E-01	5.38E 08
SR	90	2.35E 11	0.00E-01	5.95E 10	0.00E-01	0.00E-01	0.00E-01	3.16E 09
SR	91	2.71E 05	0.00E-01	1.02E 04	0.00E-01	0.00E-01	0.00E-01	5.99E 05
SR	92	4.60E 00	0.00E-01	1.84E-01	0.00E-01	0.00E-01	0.00E-01	8.71E 01
Y	90	3.86E 01	0.00E-01	1.03E-00	0.00E-01	0.00E-01	0.00E-01	1.10E 05
Y	91M	3.24E-20	0.00E-01	1.18E-21	0.00E-01	0.00E-01	0.00E-01	6.34E-17
Y	91	4.68E 03	0.00E-01	1.25E 00	0.00E-01	0.00E-01	0.00E-01	6.24E 05
Y	92	3.04E-05	0.00E-01	8.71E-07	0.00E-01	0.00E-01	0.00E-01	8.79E-01
Y	93	1.27E-01	0.00E-01	3.48E-03	0.00E-01	0.00E-01	0.00E-01	1.89E 03
ZR	95	4.60E 02	1.01E 02	9.00E 01	0.00E-01	1.45E 02	0.00E-01	1.05E 05
ZR	97	2.30E-01	3.33E-02	1.96E-02	0.00E-01	4.78E-02	0.00E-01	5.04E 03
NB	95	3.82E 04	1.49E 04	1.06E 04	0.00E-01	1.40E 04	0.00E-01	2.75E 07
MO	99	0.00E-01	9.76E 06	2.42E 06	0.00E-01	2.08E 07	0.00E-01	8.07E 06
TC	99M	1.59E 00	3.11E 00	5.16E 01	0.00E-01	4.52E 01	1.58E 00	1.77E 03
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01

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TABLE A.5-19 (cont'd)
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
CHILD

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU	103	5.14E 02	0.00E-01	1.97E 02	0.00E-01	1.29E 03	0.00E-01	1.33E 04
RU	105	4.59E-04	0.00E-01	1.67E-04	0.00E-01	4.04E-03	0.00E-01	3.00E-01
RU	106	1.11E 04	0.00E-01	1.38E 03	0.00E-01	1.50E 04	0.00E-01	1.72E 05
AG	110M	2.51E 07	1.69E 07	1.35E 07	0.00E-01	3.15E 07	0.00E-01	2.01E 09
TE	125M	8.85E 06	2.40E 06	1.18E 06	2.48E 06	0.00E-01	0.00E-01	8.54E 06
TE	127M	2.50E 07	6.72E 06	2.96E 06	5.97E 06	7.12E 07	0.00E-01	2.02E 07
TE	127	3.57E 02	9.64E 01	7.67E 01	2.47E 02	1.02E 03	0.00E-01	1.40E 04
TE	129M	3.26E 07	9.09E 06	5.05E 06	1.05E 07	9.56E 07	0.00E-01	3.97E 07
TE	129	1.55E-10	4.32E-11	3.68E-11	1.11E-10	4.53E-10	0.00E-01	9.64E-09
TE	131M	1.92E 05	6.64E 04	7.07E 04	1.37E 05	6.43E 05	0.00E-01	2.69E 06
TE	131	1.97E-33	6.01E-34	5.87E-34	1.51E-33	5.97E-33	0.00E-01	1.04E-32
TE	132	1.23E 06	5.44E 05	6.58E 05	7.93E 05	5.05E 06	0.00E-01	5.48E 06
I	130	2.07E 06	4.19E 06	2.16E 06	4.62E 08	6.27E 06	0.00E-01	1.96E 06
I	131	1.56E 09	1.57E 09	8.94E 08	5.20E 11	2.58E 09	0.00E-01	1.40E 08
I	132	8.30E-01	1.52E 00	7.01E-01	7.07E 01	2.33E 00	0.00E-01	1.79E 00
I	133	2.06E 07	2.55E 07	9.65E 06	4.74E 09	4.25E 07	0.00E-01	1.03E 07
I	134	1.03E-11	1.91E-11	8.77E-12	4.39E-10	2.92E-11	0.00E-01	1.26E-11
I	135	6.49E 04	1.17E 05	5.52E 04	1.03E 07	1.79E 05	0.00E-01	8.90E 04
CS	134	6.79E 10	1.11E 11	2.35E 10	0.00E-01	3.45E 10	1.24E 10	6.01E 08
CS	136	3.01E 09	8.27E 09	5.35E 09	0.00E-01	4.40E 09	6.57E 08	2.91E 08
CS	137	9.67E 10	9.26E 10	1.37E 10	0.00E-01	3.02E 10	1.09E 10	5.80E 08
CS	138	1.21E-22	1.68E-22	1.07E-22	0.00E-01	1.18E-22	1.27E-23	7.74E-23
BA	139	2.49E-08	1.33E-11	7.21E-10	0.00E-01	1.16E-11	7.82E-12	1.44E-06
BA	140	1.41E 07	1.23E 04	8.21E 05	0.00E-01	4.01E 03	7.34E 03	7.12E 06
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	2.33E 00	8.16E-00	2.75E-01	0.00E-01	0.00E-01	0.00E-01	2.27E 04
LA	142	4.91E-12	1.56E-12	4.90E-13	0.00E-01	0.00E-01	0.00E-01	3.10E-07
CE	141	2.63E 03	1.31E 03	1.94E 02	0.00E-01	5.74E 02	0.00E-01	1.63E 06
CE	143	2.25E 01	1.22E 04	1.77E 00	0.00E-01	5.12E 00	0.00E-01	1.79E 05
CE	144	1.95E 05	6.11E 04	1.04E 04	0.00E-01	3.38E 04	0.00E-01	1.59E 07
PR	143	8.62E 01	2.59E 01	4.28E 00	0.00E-01	1.40E 01	0.00E-01	9.30E 04
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	5.36E 01	4.34E 01	3.36E 00	0.00E-01	2.38E 01	0.00E-01	6.88E 04
W	187	3.49E 03	2.07E 03	9.28E 02	0.00E-01	0.00E-01	0.00E-01	2.90E 05
NP	239	2.07E 00	1.49E-01	1.04E-01	0.00E-01	4.30E-01	0.00E-01	1.10E 04

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TABLE A.5-20
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
INFANT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
H	3	0.00E-01	4.86E 03	4.86E 03	4.86E 03	4.86E 03	4.86E 03	4.86E 03
C	14	2.34E 09	5.00E 08	5.00E 08	5.00E 08	5.00E 08	5.00E 08	5.00E 08
NA	24	1.85E 06	1.85E 06	1.85E 06	1.85E 06	1.85E 06	1.85E 06	1.85E 06
P	32	1.92E 11	1.13E 10	7.45E 09	0.00E-01	0.00E-01	0.00E-01	2.60E 09
CR	51	0.00E-01	0.00E-01	1.94E 04	1.26E 04	2.76E 03	2.46E 04	5.64E 05
MN	54	0.00E-01	4.68E 06	1.06E 06	0.00E-01	1.04E 06	0.00E-01	1.72E 06
MN	56	0.00E-01	3.78E-03	6.51E-04	0.00E-01	3.25E-03	0.00E-01	3.43E-01
FE	55	1.76E 06	1.13E 06	3.03E 06	0.00E-01	0.00E-01	5.54E 05	1.44E 05
FE	59	2.92E 06	5.09E 06	2.01E 06	0.00E-01	0.00E-01	1.51E 06	2.43E 06
CO	58	0.00E-01	2.91E 06	7.26E 06	0.00E-01	0.00E-01	0.00E-01	7.25E 06
CO	60	0.00E-01	1.06E 07	2.50E 07	0.00E-01	0.00E-01	0.00E-01	2.52E 07
NI	63	4.19E 09	2.59E 08	1.45E 08	0.00E-01	0.00E-01	0.00E-01	1.29E 07
NI	65	5.27E-01	5.96E-02	2.71E-02	0.00E-01	0.00E-01	0.00E-01	4.54E 00
CU	64	0.00E-01	2.07E 04	9.58E 03	0.00E-01	3.50E 04	0.00E-01	4.25E 05
ZN	65	6.66E 08	2.28E 09	1.05E 09	0.00E-01	1.11E 09	0.00E-01	1.93E 09
ZN	69	6.04E-12	1.09E-11	8.10E-13	0.00E-01	4.52E-12	0.00E-01	8.87E-10
BR	83	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	84	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BR	85	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	86	0.00E-01	2.67E 09	1.32E 09	0.00E-01	0.00E-01	0.00E-01	6.83E 07
RB	88	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RB	89	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
SR	89	2.64E 10	0.00E-01	7.58E 08	0.00E-01	0.00E-01	0.00E-01	5.43E 08
SR	90	2.55E 11	0.00E-01	6.50E 10	0.00E-01	0.00E-01	0.00E-01	3.19E 09
SR	91	5.65E 05	0.00E-01	2.05E 03	0.00E-01	0.00E-01	0.00E-01	6.69E 05
SR	92	9.78E 00	0.00E-01	3.63E-01	0.00E-01	0.00E-01	0.00E-01	1.05E 02
Y	90	8.16E 01	0.00E-01	2.19E 00	0.00E-01	0.00E-01	0.00E-01	1.13E 05
Y	91M	6.87E-20	0.00E-01	2.34E-21	0.00E-01	0.00E-01	0.00E-01	2.29E-16
Y	91	8.79E 03	0.00E-01	2.34E 02	0.00E-01	0.00E-01	0.00E-01	6.30E 05
Y	92	6.47E-05	0.00E-01	1.82E-06	0.00E-01	0.00E-01	0.00E-01	1.23E 00
Y	93	2.70E-01	0.00E-01	7.36E-03	0.00E-01	0.00E-01	0.00E-01	2.13E 03
ZR	95	8.17E 02	1.99E 02	1.41E 02	0.00E-01	2.14E 02	0.00E-01	9.91E 04
ZR	97	4.88E-01	8.37E-02	3.82E-02	0.00E-01	8.44E-02	0.00E-01	5.34E 03
NB	95	7.12E 04	2.93E 04	1.70E 04	0.00E-01	2.10E 04	0.00E-01	2.48E 07
MO	99	0.00E-01	2.50E 07	4.87E 06	0.00E-01	3.73E 07	0.00E-01	8.22E 06
TC	99M	3.30E 00	6.81E 00	8.77E 01	0.00E-01	7.33E 01	3.56E 00	1.98E 03

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TABLE A.5-20 (cont'd)
GRASS-GOAT-MILK PATHWAY FACTOR
M^2 MREM/YR PER µCI/SEC
INFANT

NUCLIDE		BONE	LIVER	T BODY	THYROID	KIDNEY	LUNG	GI-LLI
TC	101	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
RU	103	1.04E 03	0.00E-01	3.48E 02	0.00E-01	2.16E 03	0.00E-01	1.26E 04
RU	105	9.68E-04	0.00E-01	3.26E-04	0.00E-01	7.12E-03	0.00E-01	3.85E-01
RU	106	2.28E 04	0.00E-01	2.85E 03	0.00E-01	2.70E 04	0.00E-01	1.73E 05
AG	110M	4.63E 07	3.38E 07	2.24E 07	0.00E-01	4.83E 07	0.00E-01	1.75E 09
TE	125M	1.81E 07	6.05E 06	2.45E 06	6.09E 06	0.00E-01	0.00E-01	8.62E 06
TE	127M	5.05E 07	1.68E 07	6.12E 06	1.46E 07	1.24E 08	0.00E-01	2.04E 07
TE	127	7.59E 02	2.54E 02	1.63E 02	6.18E 02	1.85E 03	0.00E-01	1.59E 04
TE	129M	6.69E 07	2.29E 07	1.03E 07	2.57E 07	1.67E 08	0.00E-01	3.99E 07
TE	129	3.28E-10	1.13E-10	7.66E-11	2.75E-10	8.17E-10	0.00E-01	2.62E-08
TE	131M	4.05E 05	1.63E 05	1.35E 05	3.31E 05	1.12E 06	0.00E-01	2.75E 06
TE	131	4.18E-33	1.54E-33	1.17E-33	3.73E-33	1.07E-32	0.00E-01	1.69E-31
TE	132	2.53E 06	1.25E 06	1.17E 06	1.85E 06	7.84E 06	0.00E-01	4.64E 06
I	130	4.26E 06	9.38E 06	3.76E 06	1.05E 09	1.03E 07	0.00E-01	2.01E 06
I	131	3.26E 09	3.85E 09	1.69E 09	1.26E 12	4.49E 09	0.00E-01	1.37E 08
I	132	1.72E 00	3.49E 00	1.24E 00	1.64E 02	3.90E 00	0.00E-01	2.83E 00
I	133	4.35E 07	6.34E 07	1.86E 07	1.15E 10	7.45E 07	0.00E-01	1.07E 07
I	134	2.13E-11	4.36E-11	1.55E-11	1.02E-09	4.88E-11	0.00E-01	4.51E-11
I	135	1.35E 05	2.68E 05	9.79E 04	2.41E 07	2.99E 05	0.00E-01	9.71E 04
CS	134	1.09E 11	2.04E 11	2.06E 10	0.00E-01	5.25E 10	1.86E 10	5.54E 08
CS	136	5.88E 09	1.73E 10	6.45E 09	0.00E-01	6.89E 09	1.41E 09	2.63E 08
CS	137	1.54E 11	1.81E 11	1.28E 10	0.00E-01	4.85E 10	1.96E 10	5.65E 08
CS	138	2.55E-22	4.15E-22	2.01E-22	0.00E-01	2.07E-22	3.23E-23	6.63E-22
BA	139	5.30E-08	3.51E-11	1.53E-09	0.00E-01	2.11E-11	2.13E-11	3.35E-06
BA	140	2.89E 07	2.89E 04	1.49E 06	0.00E-01	6.87E 03	1.78E 04	7.11E 06
BA	141	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
BA	142	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
LA	140	4.88E 00	1.92E 00	4.94E-00	0.00E-01	0.00E-01	0.00E-01	2.26E 04
LA	142	1.03E-11	3.78E-12	9.06E-13	0.00E-01	0.00E-01	0.00E-01	6.43E-07
CE	141	5.20E 03	3.17E 03	3.74E 02	0.00E-01	9.79E 02	0.00E-01	1.64E 06
CE	143	4.76E 01	3.16E 04	3.61E 00	0.00E-01	9.21E 00	0.00E-01	1.84E 05
CE	144	2.79E 05	1.14E 05	1.56E 04	0.00E-01	4.62E 04	0.00E-01	1.60E 07
PR	143	1.78E 02	6.67E 01	8.84E 00	0.00E-01	2.48E 01	0.00E-01	9.41E 04
PR	144	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01	0.00E-01
ND	147	1.06E 02	1.09E 02	6.69E 00	0.00E-01	4.21E 01	0.00E-01	6.92E 04
W	187	7.35E 03	5.11E 03	1.77E 03	0.00E-01	0.00E-01	0.00E-01	3.00E 05
NP	239	4.38E 00	3.91E-01	2.21E-01	0.00E-01	7.80E-01	0.00E-01	1.13E 04

APPENDIX B

Meteorological Model

APPENDIX B

09/04

The X/Q's and D/Q's are calculated using the guidance of Reg. Guide 1.111.

The constant mean wind direction model, as defined in equation 3 of Reg. Guide 1.111, is used to calculated X/Q values.

$$(X/Q)_D = \frac{2.032 \sum_{ij} n_{ij} \exp\left[-h^2_e / 2\,\sigma^2 zj\,(x)\right]}{N \times \overline{U}_i \sum_{zj}(x)}$$

Where:

h_e = effective release height (m). (All releases from Wolf Creek Generating Station are considered as ground releases therefore he = 0.)

n_{ij} = hours of valid data for weather conditions in given direction, windspeed class I, and atmospheric stability class j.

N = total house of valid data

$\overline{U}_i$ = midpoint of windspeed class (m/s)

x = distance downwind (m)

$\sigma_{zj}(x)$ = vertical plume spread without volumetric correction at distance x and stability class j. See Figure B.1.

$\Sigma_{zj}(x)$ = vertical plume spread with columetric correction for release within buildings wake cavity, at distance x and stability class j.

For ground level releases $\Sigma_{zj}(x)$ is the lesser of

$$\left(\sigma^2_{zj}(x) + 0.5\,D^2 z / \pi\right)^{1/2} \text{ or } \sqrt{3\ \sigma_{zj}(x)}$$

APPENDIX B (CONT'D)

Where:

D_z = maximum adjacent building height either up- or down-wind from the release point

$2.032 = (2/\pi)^{1/2}$ divided by width, in radians, of a 22.5 sector

$(X/Q)_D$ = Average effluent concentration, X, normalized to source strength, Q, at distance x in sector D.

For WCGS the above Meteorological Model will simplify to the following equation for X/Q:

$$(X/Q)_D = \frac{2.032 \sum_{ij} n_{ij}}{N\,\overline{U}_i\, x \sum_{ij}(x)}$$

The calculation of the relative disposition per unit area, D/Q, is performed using the deposition rate graphs found in Reg. Guide 1.111. For a 22.5 sector, since the effluent concentration is assumed uniform across the sector, the relative deposition per unit area is assumed uniform across the sector.

The calculation of D/Q is determined from relative deposition by the following relationship:

$$D/Q = \frac{D_{ij}(x) \bullet DEPL_{ij}(x)}{(2\pi/16)\,x}$$

Where:

$D_{ij}(x)$ = Relative deposition rate for windspeed class i and stability class j at downwind distance x (1/m). See Figure B.3.

$(2\pi/16)x$ = length of arc across sector at downwind distance x (m).

D/Q = relative deposition per unit area (m)

APPENDIX B (CONT'D)

$DEPL_{ij}(x)$ = Reduction factor due to plume depletion at distance x for windspeed i and stability class j.

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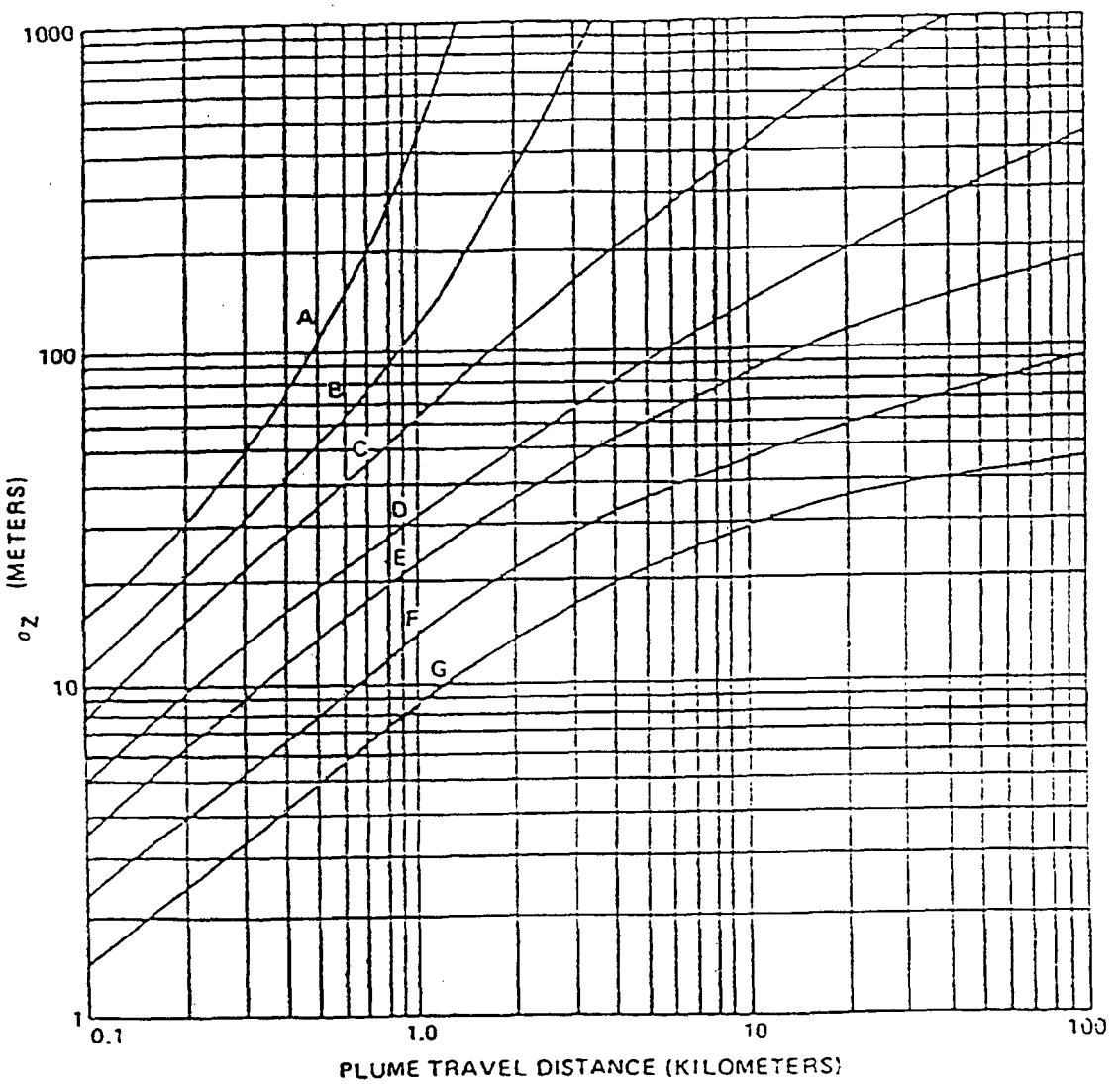
Figure B.1



Vertical Standard Deviation of Material in a Plume (Letters denote Pasquill Stability Class)

NOTE: THESE ARE STANDARD RELATIONSHIPS AND MAY HAVE TO BE MODIFIED FOR CERTAIN TYPES OF TERRAIN AND/OR CLIMATIC CONDITIONS (E.G. VALLEY DESERT OVER WATER).

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Figure B.2

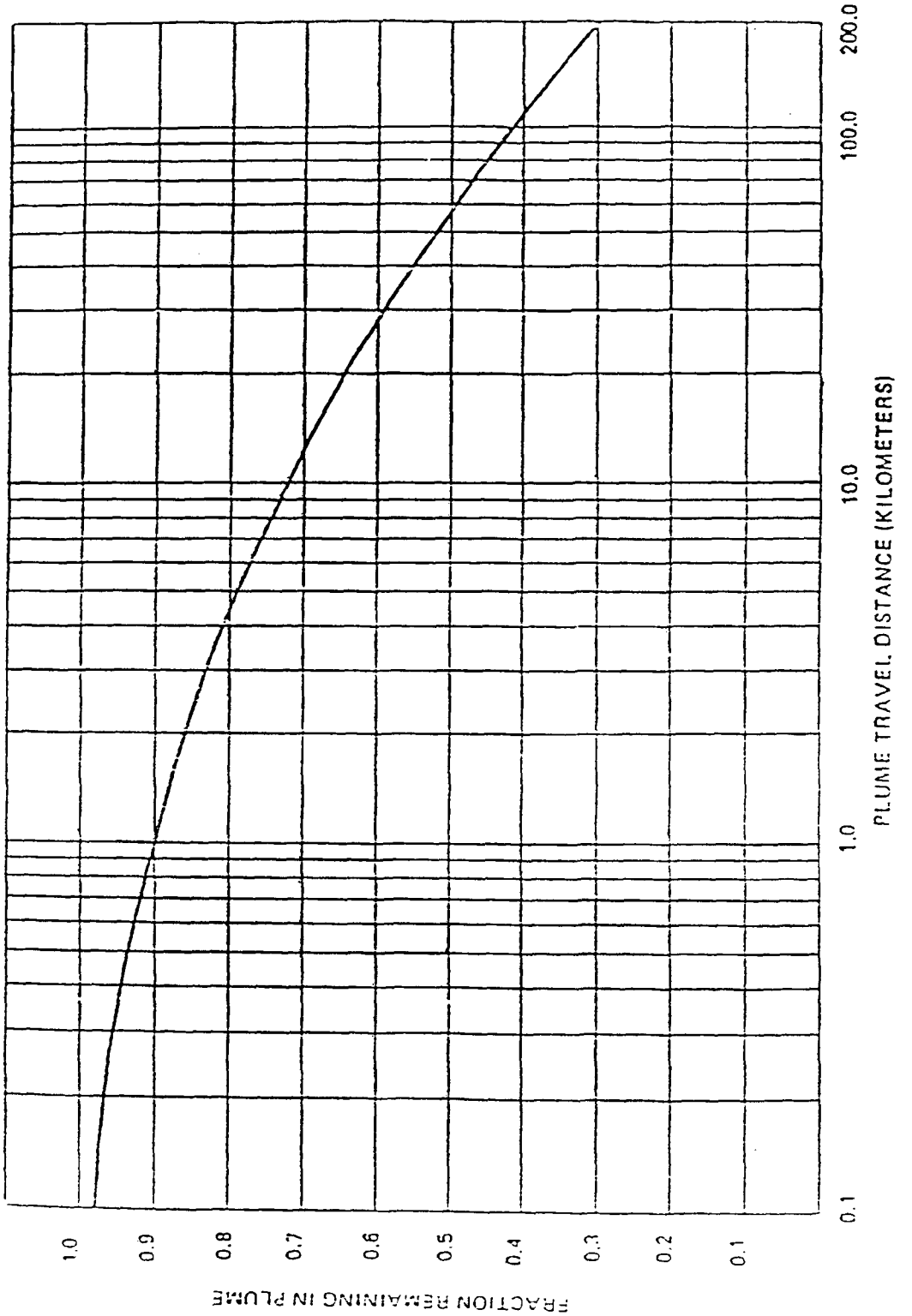

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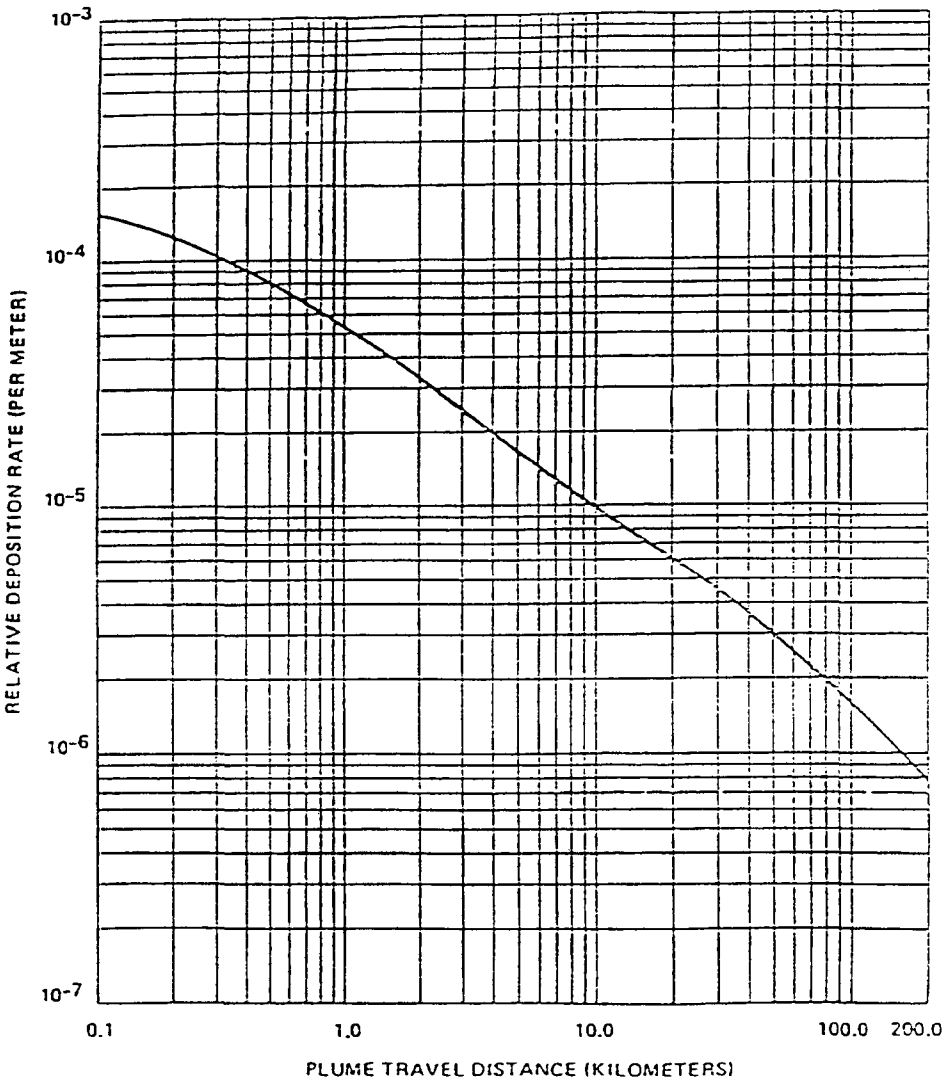
Figure B.3



B-6

- END -

ATTACHMENT II

Wolf Creek Nuclear Operating Corporation

Administrative Procedure AP 07B-004, Revision 13,

"Offsite Dose Calculation Manual (Radiological Environmental Monitoring Program)"

WOLF CREEK
NUCLEAR OPERATING CORPORATION

AP 07B-004

OFFSITE DOSE CALCULATION MANUAL (RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM)

Responsible Manager

Manager Regulatory Affairs

Revision Number	13
Use Category	Reference
Administrative Controls Procedure	Yes
Management Oversight Evolution	No
Program Number	07B

DC38 1/30/2007

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1.0 PURPOSE

1.1 This procedure contains the Offsite Dose Calculation Manual (ODCM) Radiological Environmental Monitoring Program (REMP) requirements.

1.2 This procedure also contains the Special Scope Quality Program for the REMP to assure the quality of the results of measurements of radioactive materials in the environment.

2.0 SCOPE

2.1 Technical Specifications 5.6.2 and 5.5.1 shall be implemented by this procedure.

2.2 Procedure AP 07B-003, OFFSITE DOSE CALCULATION MANUAL has been split into two procedures. Requirements for the REMP are now contained in this procedure.

2.3 ATTACHMENT B, SPECIAL SCOPE QUALITY ASSURANCE FOR THE REMP, ensures the requirements of Technical Specification 5.4.1.c are met.

2.4 The requirements of the Special Scope Quality Program do not apply to hardware.

2.5 For Nuclear Energy Institute (NEI) Industry Initiative on Ground Water Protection reporting requirements, see AI 07B-004, REPORTING REQUIREMENTS OF THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM and AI 07-007, ONSITE GROUNDWATER MONITORING PROGRAM. 08/06

3.0 REFERENCES AND COMMITMENTS

3.1 References

3.1.1 AP 07B-003, OFFSITE DOSE CALCULATION MANUAL

3.1.2 Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979

3.1.3 PIR 1998-0112, Revising the ODCM with an OTSC

3.1.4 Technical Specification 5.5.1

3.1.5 Technical Specification 5.6.2

3.1.6 PIR 1998-3887, Wind Direction Frequency Rankings

3.1.7 Engineering Calculation AN-04-045, Calculation of Relative Deposition per Unit Area (D/Q)

3.1.8 Regulatory Guide 4.15 - Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment

3.1.9 WCGS Technical Specification 5.4.1.c

3.1.10 AP 20A-003, AUDIT/SURVEILLANCE SCHEDULING

3.1.11 PIR 2001-1604, REMP Quality Program Requirements

3.1.12 PIR 2001-1640, REMP Air Sample Control Location

3.1.13 PIR 2002-0975, Changes to the ODCM

3.2 Commitments

3.2.1 None

4.0 DEFINITIONS

4.1 None

5.0 RESPONSIBILITIES

5.1 Manager Regulatory Affairs

5.1.1 Ensures that a quality program has been developed for radiological environmental monitoring.

5.1.2 Ensures that the Offsite Dose Calculation Manual (Radiological Environmental Monitoring Program) has been established, implemented and is maintained in accordance with Technical Specification 5.5.1.

5.2 Manager Quality

5.2.1 Ensures that internal and external audits are performed and documented.

5.3 Supervisor Regulatory Support

5.3.1 Implements and maintains the radiological environmental monitoring program.

5.3.2 Ensures procedures are developed and maintained which describe sample collection, sample preparation and sample shipping.

5.3.3 Ensures procedures are developed and maintained which describe equipment maintenance and calibration.

5.3.4 Ensures procedures are developed and maintained which describe data review and reporting requirements.

5.3.5 Ensures personnel have received the required training prior to performing REMP-related activities.

5.4 Environmental Management

5.4.1 Ensures the REMP is established, implemented and maintained.

6.0 PROCEDURE

6.1 Revisions to This Procedure

NOTE

To comply with Technical Specification 5.5.1, revisions to this procedure are not permitted via APF 15C-004-04, ON THE SPOT CHANGE form (Reference Step 3.1.3).

6.1.1 Revisions to this procedure are to be submitted through the Manager Regulatory Affairs via APF 15C-004-01, DOCUMENT REVISION REQUEST (DRR).

6.1.2 Changes to ATTACHMENT A shall include:

1. Sufficient information to support the change(s) together with the appropriate analyses or evaluations justifying the change(s) and (Reference Step 3.1.4)

NOTE

Changes to the REMP will have no impact upon the level of radioactive effluent control nor will impact the accuracy or reliability of effluent dose or setpoint calculations.

2. A determination that the change(s) maintain the levels of radioactive effluent control required by 10 CFR 20.1302, 40 CFR 190, 10 CFR 50.36a, and 10 CFR 50, Appendix I, and not adversely impact the accuracy or reliability of effluent dose, or setpoint calculations. (Reference Step 3.1.4)

6.1.3 The changes shall become effective after the approval of the Plant Manager. (Reference Step 3.1.4)

6.1.4 IF Figure 5.2 or Figure 5.3 are revised, THEN Emergency Planning should be notified so that the Radiological Emergency Response Plan may be revised accordingly.

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6.2 ODCM Submittal To NRC

NOTE

To comply with Technical Specification 5.5.1, a copy of this procedure must be submitted to the NRC with the Radioactive Effluent Release Report.

6.2.1 Changes to the ODCM shall be submitted to the NRC in the form of a complete, legible copy of the entire ODCM as a part of or concurrent with the Radioactive Effluent Release Report for the period of the report in which any change in the ODCM was made. Each change shall be identified by markings in the margin of the affected pages, clearly indicating the area of the page that was changed, and shall indicate the date (i.e., month and year) the change was implemented. (Reference Step 3.1.4)

7.0 RECORDS

7.1 The following is a lifetime QA Record:

7.1.1 AP 07B-004, OFFSITE DOSE CALCULATION MANUAL (RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM)

8.0 FORMS

8.1 None

- END -

ATTACHMENT A
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OFFSITE DOSE CALCULATION MANUAL (REMP)

Wolf Creek Generating Station

Offsite Dose Calculation Manual
Radiological Environmental Monitoring Program

ATTACHMENT A
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OFFSITE DOSE CALCULATION MANUAL (REMP)

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1.0 Introduction

This attachment contains the ODCM for the Radiological Environmental Monitoring Program which was previously contained in AP 07B-003. This program is provided to monitor the radiation and radionuclides in the environs of the plant. The program provides (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. This program conforms to the guidance of Appendix I to 10 CFR part 50 and includes the following:

1. Monitoring, sampling, analysis and reporting of radiation and radionuclides in the environment.

2. A Land Use Census to ensure that changes in the use of areas at and beyond the site boundary are identified and the 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.

This attachment also provides a description of the information that should be included in the Annual Radiological Environmental Operating Report.

2.0 Liquid Effluents (Contained in AP 07B-003)

3.0 Gaseous Effluents (Contained in AP 07B-003)

4.0 Total Dose (Contained in AP 07B-003)

5.0 Radiological Environmental Monitoring Program

This section describes the Radiological Environmental Monitoring Program for Wolf Creek Generating Station.

5.1 Monitoring Program

Table 5-1 provides a schedule which describes the pathways, specific locations, sample collection frequencies, and analyses to be performed to implement the Radiological Environmental Monitoring Program.

Figures 5.1 through 5.5 contain maps depicting sampling locations in relation to the WCGS site. Table 5-2 lists distances and directions to these locations from the WCGS site.

Table 5-3 lists required detection capabilities for the analyses performed.

5.2 Land Use Census

A Land Use Census shall be conducted annually during the growing season to identify the nearest (1) milk animal, (2) residence, and (3) garden of greater than 500 square feet producing broadleaf vegetation in each of the 16 meteorological sections within five miles of the WCGS site. (Broadleaf vegetation sampling of available vegetation may be performed at the site boundary in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census. Specifications for broadleaf vegetation sampling in Table 5-1 shall be followed, including analysis of control samples.) Methods shall be used in conducting the census that provide the best results, such as door-to-door surveys, telephone surveys, consulting the U.S.D.A. office in Burlington, inspection of aerial photographs of the area, or reviewing leasing records for area farms and residences.

If a location(s) is identified which yields a calculated dose or dose commitment (via the same exposure pathway) 20% greater than at a location from which samples are currently being obtained, and the cooperator agrees, the new location(s) shall be added to the Radiological Environmental Monitoring Program. The indicator sampling location(s) having the lowest calculated dose or dose commitment may then be deleted from the monitoring program.

The results of the Land Use Census shall be included in the Annual Radiological Environmental Operating Report described in Section 7.1.

5.3 Interlaboratory Comparison Program

The analysis laboratory contracted to analyze samples from the Radiological Environmental Monitoring Program participates in a Laboratory Intercomparison Program. 02106

A summary of intercomparison results shall be included in the Annual Radiological Environmental Operating Report described in Section 7.1.

5.4 Reporting Requirements

5.4.1 Annual Radiological Environmental Operating Report

To meet the requirements of Wolf Creek Technical Specification 5.6.2, the Annual Radiological Environmental Operating Report covering the operation of the unit during the previous calendar year shall be submitted to the NRC before May 1 of each year. The content of this report is described in Section 7.1.

5.4.2 Special Reports

A special report shall be prepared and submitted to the NRC within 30 days if levels of radioactivity as a result of plant effluents detected in an environmental medium at a specified location exceed the reporting levels of Table 5-4 when averaged over any calendar quarter. The special report shall identify the cause(s) for exceeding the limit(s) and define 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 Wolf Creek Technical Specification 5.5.4. When one or more of the radionuclides in Table 5-4 is detected in the sampling medium, this report shall be submitted if:

$$\frac{\text{Concentration (1)}}{\text{Reporting Level (1)}} + \frac{\text{Concentration (2)}}{\text{Reporting Level (2)}} + .. \geq 1.0$$

When radionuclides other than those in Table 5-4 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 Technical Specification 5.5.4. (*The methodology and parameters used to estimate the potential annual dose to a member of the public shall be indicated in this report.)

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway/ Sample Type	Number of Samples and Sample Locations (1)	Sample Collection Frequency	Type and Frequency of Analysis
1. AIRBORNE	FIGURES 5.1 & 5.5		
Radioiodine and Particulates	Samples from six locations	Continuous sampler operation with sample collection weekly, or more frequently if required, by dust loading	Analyze radioiodine canister weekly for I-131
	Samples from locations near the site boundary in three sectors having the highest calculated annual average D/Q (Locations 2, 37, 49 and supplemental location 18 on Figure 5.1);		Analyze particulate filter weekly for gross beta activity (2); perform quarterly gamma isotopic analysis (3) composite (by location).
	Sample from the vicinity of a community having the highest calculated annual average D/Q (Location 32 on Figure 5.1, New Strawn);		
	Sample from a control location 9.5 to 18.5 miles distant in a low ranked D/Q sector (Location 48 on Figure 5.5). (11)		
2. DIRECT RADIATION (4)	FIGURES 5.2 AND 5.5		
	40 routine monitoring stations with two or more dosimeters measuring dose continuously, placed as follows:	Quarterly	Gamma dose quarterly
	An inner ring of stations, one in each meteorological sector 0-3 mile range from the site (Locations 1, 7, 9, 11-13, 18, 26, 27, 29, 30, 37, 38, 46, 47 & 49 on Figure 5.2).		

01/07

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-1 (Continued)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway/ Sample Type	Number of Samples and Sample Locations (1)	Sample Collection Frequency	Type and Frequency of Analysis
DIRECT RADIATION (4) (CONTINUED)	An outer ring of stations, one in each meteorological sector in the 3 to 5 mile range from the site (Locations 4, 5, 15-17, 19, 22-25, 32, 34-36, 50 & 51 on Figure 5.2). Four sectors [A, B, G & J] contain an additional station (Locations 2, 8, 14 & 20)		01/07
	The balance of the stations to be placed in special interest areas such as population centers (Locations 23, 32 & 52), nearby residences (many locations are near a residence), schools (Locations 23 & 52), Environmental Education Area (44), CCL Public Fishing Area (46) and in two areas to serve as control stations 10-20 miles distant from the site (Locations 39 and 48 on Figure 5.5)(11)		01/07
3. WATERBORNE	FIGURE 5.3		
Surface	One sample upstream (5) (Location JRR on Figure 5.3) and one sample downstream (Location SP on Figure 5.3)	Monthly grab sample	Monthly gamma isotopic analysis (3) and composite for tritium analysis quarterly.
Ground	Samples from one or two sources only if likely to be affected	Quarterly grab sample	Quarterly gamma isotopic analysis (3) and tritium analysis.
	Indicator samples at locations hydrologically down-gradient of the site (Locations C-10, C-49, F-1, G-2, J-1 and J-2 on Figure 5.3); control sample at a location hydrologically upgradient of the site (Location B-12 on Figure 5.3)(6)		02/06

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-1 (Continued)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway/ Sample Type	Number of Samples and Sample Locations (1)	Sample Collection Frequency	Type and Frequency of Analysis
3. WATERBORNE (CONT.) Drinking	Sample of municipal water supply at an indicator location downstream of the site (Location IO-DW on Figure 5.5); control sample from location upstream of the site (Location BW-15 on Figure 5.3)	Monthly composite (7)	Monthly gamma isotopic analysis (3) and gross beta analysis of composite sample. Quarterly tritium analysis of composites (8). 08/06
Shoreline Sediment	One sample from the vicinity of Coffey County Lake discharge cove (Location DC on Figure 5.3); control sample from John Redmond Reservoir (Location JRR on Figure 5.3).	Semiannually	Semiannual gamma isotopic analysis (3) 08/06
4. INGESTION	FIGURES 5.4 AND 5.5		
Milk	Samples from milking animals at three indicator locations within 5 miles of the site having the highest dose potential (currently there are no locations producing milk for human consumption within 5 miles of the site); one sample from a control location greater than 10 miles from the site if indicator locations are sampled. (11)	Semimonthly April to November; monthly December-March (9)	Gamma isotopic analysis (3) and I-131 analysis of each sample.
Fish	Indicator samples of 1 to 3 recreationally important species from Coffey County Lake (several sampling areas indicated in Figure 5.4); control samples of similar species from John Redmond Reservoir Spillway (indicated on Figure 5.4).	Semiannually	Gamma isotopic analysis (3) on edible portions 08/06

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-1 (Continued)
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway/ Sample Type	Number of Samples and Sample Locations (1)	Sample Collection Frequency	Type and Frequency of Analysis
4. INGESTION (CONT.) Food Products	Samples of available broadleaf vegetation from two indicator locations (using the criteria from the "Land Use Census" section) with highest calculated annual average D/Q (Locations Q-6 and N-1 and alternate Location C-2 on Figure 5.4); sample of similar broadleaf vegetation from a control location 9.5 to 18.5 miles distant in a low ranked D/Q sector (Location D-1 or alternate location D-2 on Figure 5.5).(11)	Monthly when available (9)	Gamma isotopic analysis (3) on edible portions. 058/06
Food Products	Sample of crops irrigated with water from the Neosho River downstream of the Neosho River-Wolf Creek confluence (locations will vary from year to year, e.g., Location NR-D1 & NR-D2 on Figure 5.5).	At time of harvest (10)	Gamma isotopic analysis (3) on edible portions

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-1 (Continued)
TABLE NOTATIONS

(1) Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment, and other legitimate reasons. If specimens are unobtainable due to sampling equipment malfunction, every effort shall be made to complete corrective action prior to the end of the next sampling period. All deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report described in Section 7.1.

It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances, suitable specific alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made.

(2) Airborne particulate sample filters shall be analyzed for gross beta radioactivity 24 hours or more, preferably after 72 hours, after sampling to allow for Rn-220 and Rn-222 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.

(3) Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

(4) One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purposes of this table, a thermoluminescent dosimeter (TLD) is considered to be one phosphor; two or more phosphors in a packet are considered as two or more dosimeters. Film badges shall not be used as dosimeters for measuring direct radiation. The 40 stations are not an absolute number. The number of direct radiation monitoring stations may be reduced according to geographical limitations, e.g., some sectors are over water so that the number of dosimeters may be reduced accordingly. The frequency or analysis or readout for the TLD system depends upon the characteristics of the specific system used and is selected to obtain optimum dose information with minimal fading.

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-1 (Continued)
TABLE NOTATIONS

(5) The "upstream" sample is taken at a distance beyond significant influence of the discharge.

(6) Ground water samples shall be taken when this source is tapped for drinking or irrigation purposes in areas where the hydraulic gradient or recharge properties are suitable for contamination.

(7) A composite sample is one in which the quantity (aliquot) of liquid sampled is consistent over the sampling period and in which the method of sampling employed results in a specimen that is representative of the liquid concentrate. In this program, composite sample aliquots shall be collected at time intervals that are very short (e.g., every two hours) relative to the compositing period (e.g., monthly) in order to assure obtaining a representative sample.

(8) If the dose calculated for consumption of water (using ODCM methodology and parameters) exceeds one millirem per year, composite sampling at the indicator location shall be performed every two weeks and I-131 analysis shall be performed on the composite samples.

(9) Milk and broadleaf vegetation samples are often temporarily, but not permanently, unavailable at the scheduled sample collection times. Alternate sampling locations may therefore be listed in the Table and used at these times to provide continued monitoring of these pathways. If samples are considered permanently unavailable at a location, another location will be selected (if available) as described in Note (1).

(10) If harvest occurs more than once a year, sampling shall be performed during each discrete harvest. If harvest occurs continuously, sampling shall be monthly. Attention shall be paid to including samples of tuberous and root food products.

(11) The purpose of this sample is to obtain background information. If it is not practical to establish control locations in accordance with the distance and wind direction criteria, other sites that provide valid background data may be substituted.

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-2
SAMPLING LOCATION NUMBERS, DISTANCES (miles) AND DIRECTIONS

Sample Type	Location Identifier	Distance from Reactor	Direction	Sector
Air Particulates and Radioiodine	2	2.7	N	A
	18	3.0	SSE	H
	32	3.1	WNW	P
	37	2.0	NNW	R
	48	14.7	ENE	D
	49	0.8	NNE	B
TLDs	1	1.4	N	A
	2	2.7	N	A
	4	4.1	NNE	B
	5	4.1	NE	C
	7	2.1	NE	C
	8	1.7	NNE	B
	9	2.0	ENE	D
	11	1.7	E	E
	12	1.9	ESE	F
	13	1.6	SE	G
	14	2.5	SE	G
	15	4.6	ESE	F
	16	4.3	E	E
	17	3.7	SE	G
	18	3.0	SSE	H
	19	3.9	SSE	H
	20	3.3	S	J
	22	3.9	SSW	K
	23	4.3	SW	L
	24	4.1	WSW	M
	25	3.4	W	N
	26	2.4	WSW	M
	27	2.2	SW	L
	29	2.7	SSW	K
	30	2.5	W	N
	32	3.1	WNW	P
	34	4.4	NW	Q
	35	4.6	NNW	R
	36	4.2	N	A
	37	2.0	NNW	R
	38	1.2	NW	Q
	39	13.1	N	A
	44	3.0	NNW	R
	46	1.6	WNW	P

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-2 (Cont.)
SAMPLING LOCATION NUMBERS, DISTANCES (miles) AND DIRECTIONS

Sample Type	Location Identifier	Distance from Reactor	Direction	Sector
TLDs	47	0.16	S	J
	48	14.7	ENE	D
	49	0.8	NNE	B
	50	3.6	ENE	D
	51	4.0	S	J
	52	3.6	SW	L
Surface Water	JRR	3.7	W	N
	SP	3.2	SSE	H
Ground Water	B-12	1.9	NNE	B
	C-10	2.7	W	N
	C-49	2.8	SW	L
	F-1	2.5	ESE	F
	G-2	3.6	SE	G
	J-1	3.8	S	J
	J-2	4.3	S	J
Drinking Water	BW-15	3.9	SW	L
	IO-DW	26.1	SSE	H
Shoreline Sediment	DC	0.8	WNW	P
	JRR	3.6	W	N
Fish	CCL	0.6	WNW	P
	JRR	3.7	W	N
Food/Garden	C-2	1.9	NE	C
	D-1	14.7	ENE	D
	D-2	14.8	ENE	D
	N-1	2.4	W	N
	Q-6	2.4	NW	Q
Crops	NR-D1	8.9	S	J
	NR-D2	11.5	S	J

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-3

DETECTION CAPABILITIES FOR ENVIRONMENTAL SAMPLE ANALYSIS (1)(2)
Lower Limit of Detection (LLD) (3)

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)	SEDIMENT (pCi/kg, dry)
Gross Beta	4*	0.01				
H-3	2,000**					
Mn-54	15		130			
Co-58	15		130			
Fe-59	30		260			
Co-60	15		130			
Zn-65	30		260			
Zr-Nb-95	15					
I-131	1***	0.07		1	60	
Cs-134	15	0.05	130	15	60	150
Cs-137	18	0.06	150	18	80	180
Ba-La-140	15			15		

* LLD for drinking water samples.
** LLD for drinking water and ground water samples. For surface water samples, a value of 3,000 pCi/l may be used.
***LLD for drinking water and ground water samples. For surface water samples, a value of 15 pCi/l may be used.

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-3 (Continued)
TABLE NOTATIONS

(1) This list does not mean that only these nuclides are to be considered. Other peaks that are identifiable, together with those of the above nuclides, shall also be analyzed and reported in the Annual Radiological Environmental Operating Report described in Section 7.1.

(2) Required detection capabilities for thermoluminescent dosimeters used for environmental measurements shall be in accordance with the recommendations of Regulatory Guide 4.13, Revision 1, 1977.

(3) The LLD is defined, as the smallest concentration of radioactive material in a sample that will yield a net count, above system background, that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system, which may include radiochemical separation:

$$LLD = \frac{4.66\, s_b}{E \bullet V \bullet 2.22 \bullet Y \bullet \exp(-\lambda\, \Delta t)}$$

Where:

LLD = the "a priori" lower limit of detection (picoCuries per unit mass or volume),

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

E = the counting efficiency (counts per disintegration),

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

2.22 = the number of disintegrations per minute per picoCurie,

Y = the fractional radiochemical yield, when applicable,

λ = the radioactive decay constant for the particular radionuclide (sec^{-1}), and

Δt = the elapsed time between sample collection, or end of the sample collection period, and time of counting (sec).

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

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-3 (Continued)
TABLE NOTATIONS

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an 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, unavoidable small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors shall be identified and described in the Annual Radiological Environmental Operating Report described in Section 7.1.

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OFFSITE DOSE CALCULATION MANUAL (REMP)

TABLE 5-4

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

ANALYSIS	WATER (pCi/l)	AIRBORNE PARTICULATE OR GASES (pCi/m^3)	FISH (pCi/kg, wet)	MILK (pCi/l)	FOOD PRODUCTS (pCi/kg, wet)
H-3	20,000*				
Mn-54	1,000		30,000		
Co-58	1,000		30,000		
Fe-59	400		10,000		
Co-60	300		10,000		
Zn-65	300		20,000		
Zr-Nb-95	400				
I-131	2**	0.9		3	100
Cs-134	30	10	1,000	60	1,000
Cs-137	50	20	2,000	70	2,000
Ba-La-140	200			300	

* For drinking water and ground water samples. This is 40 CFR Part 141 value. For surface water samples, a value of 30,000 pCi/l may be used.

** For drinking water and ground water samples. For surface water samples, a value of 20 pCi/l may be used.

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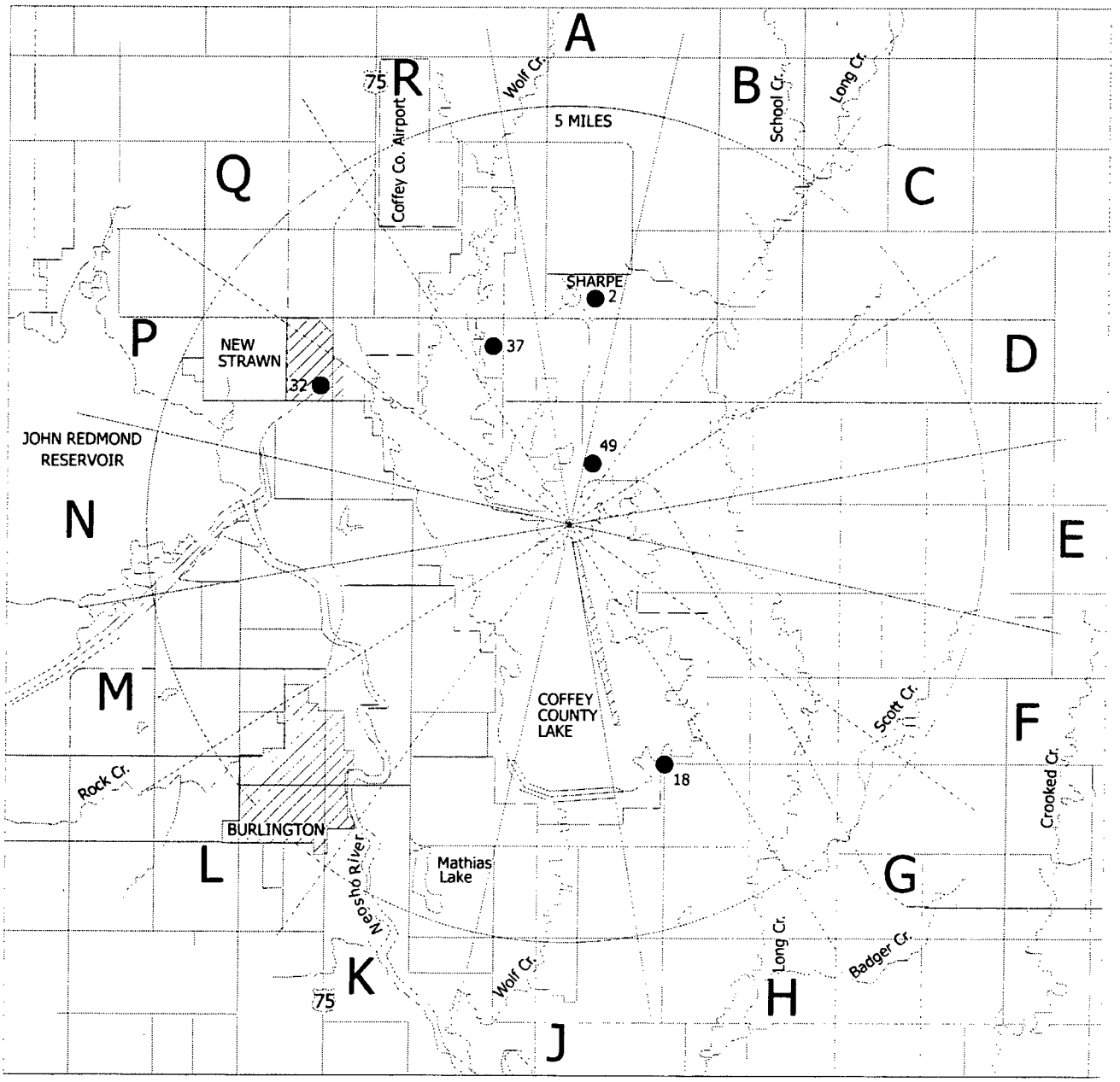
OFFSITE DOSE CALCULATION MANUAL (REMP)

FIGURE 5.1



AIRBORNE PATHWAY SAMPLING LOCATIONS

● = AIRBORNE PARTICULATE AND RADIOIODINE

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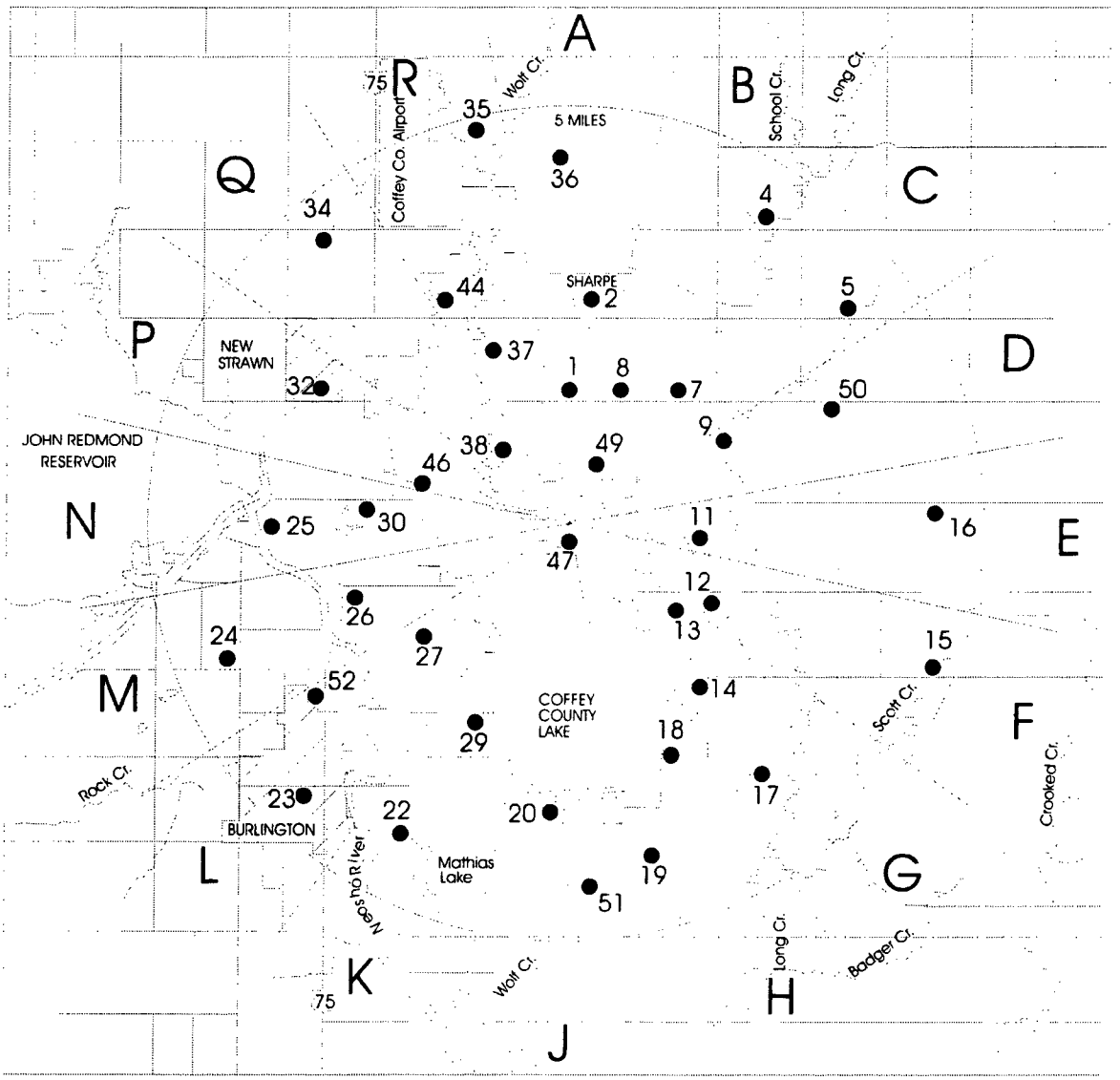
OFFSITE DOSE CALCULATION MANUAL (REMP)

FIGURE 5.2



DIRECT RADIATION PATHWAY SAMPLING LOCATIONS

● = TLD LOCATIONS

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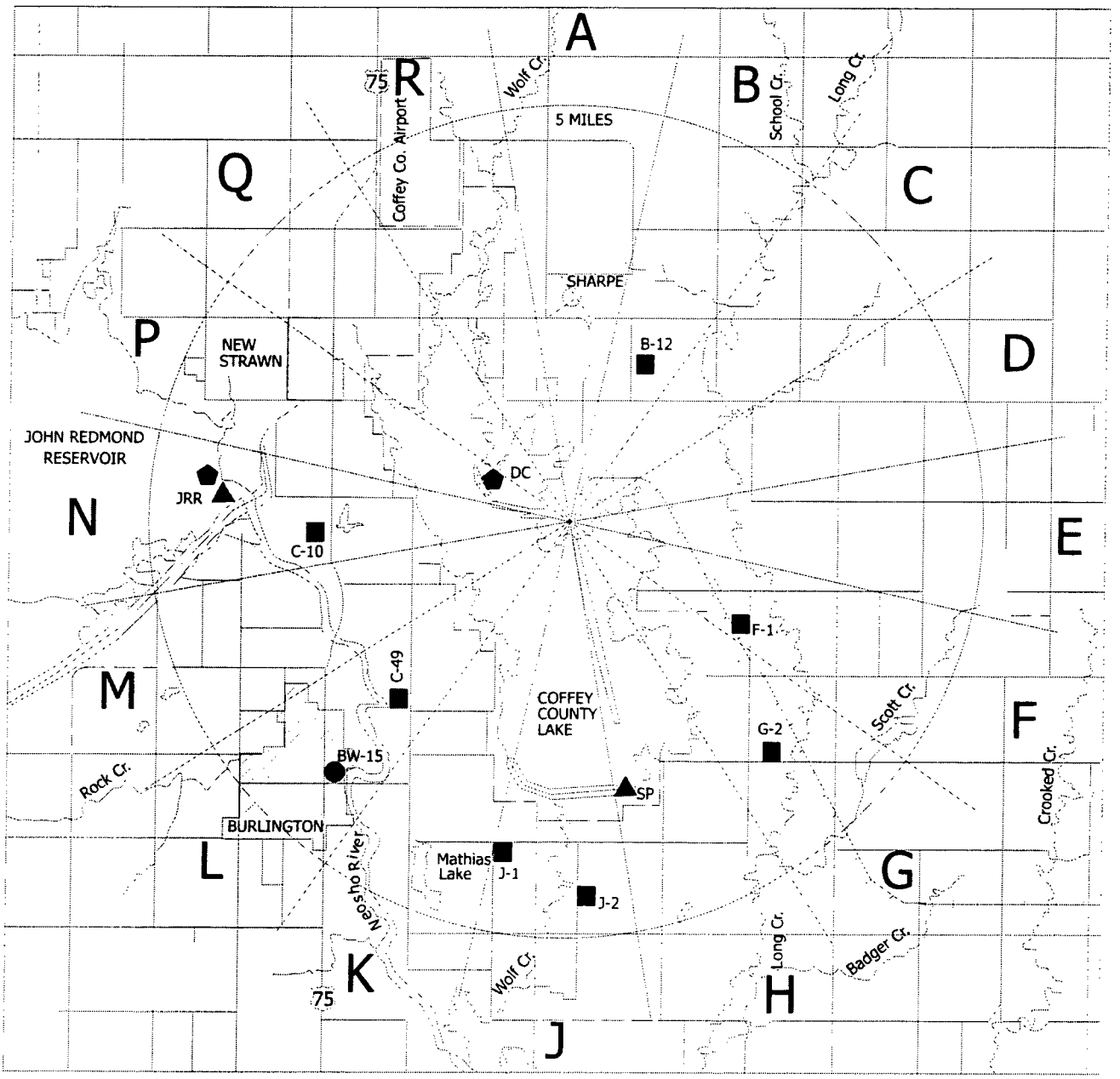
OFFSITE DOSE CALCULATION MANUAL (REMP)

FIGURE 5.3



WATERBORNE PATHWAY SAMPLING LOCATIONS

● = DRINKING WATER ▲ = SURFACE WATER

■ = GROUND WATER ⬟ = SHORELINE SEDIMENT

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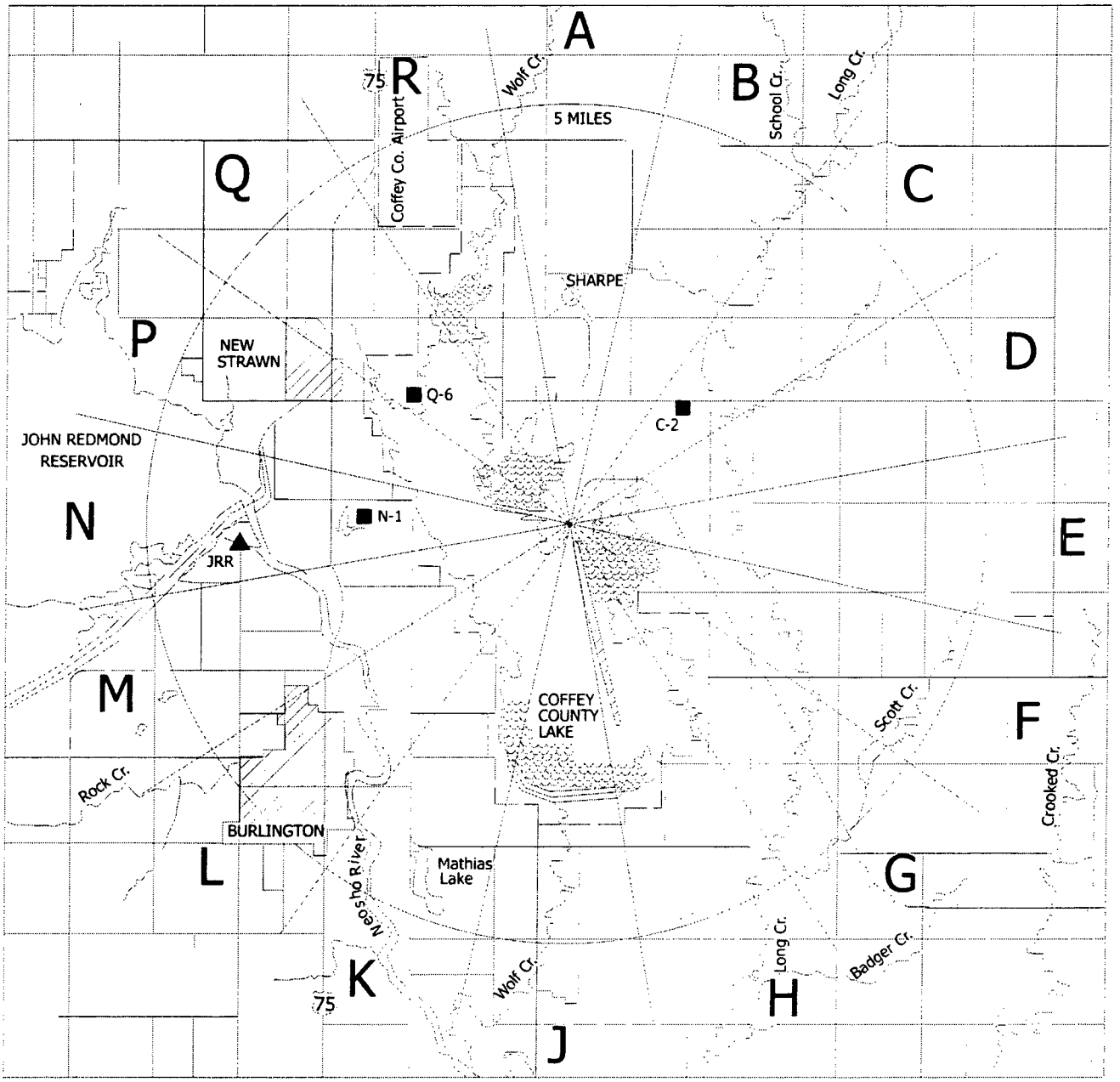
OFFSITE DOSE CALCULATION MANUAL (REMP)
FIGURE 5.4



INGESTION PATHWAY SAMPLING LOCATIONS

▲ = FISH (JRR) ■ = BROADLEAF VEGETATION

= FISH (CCL)

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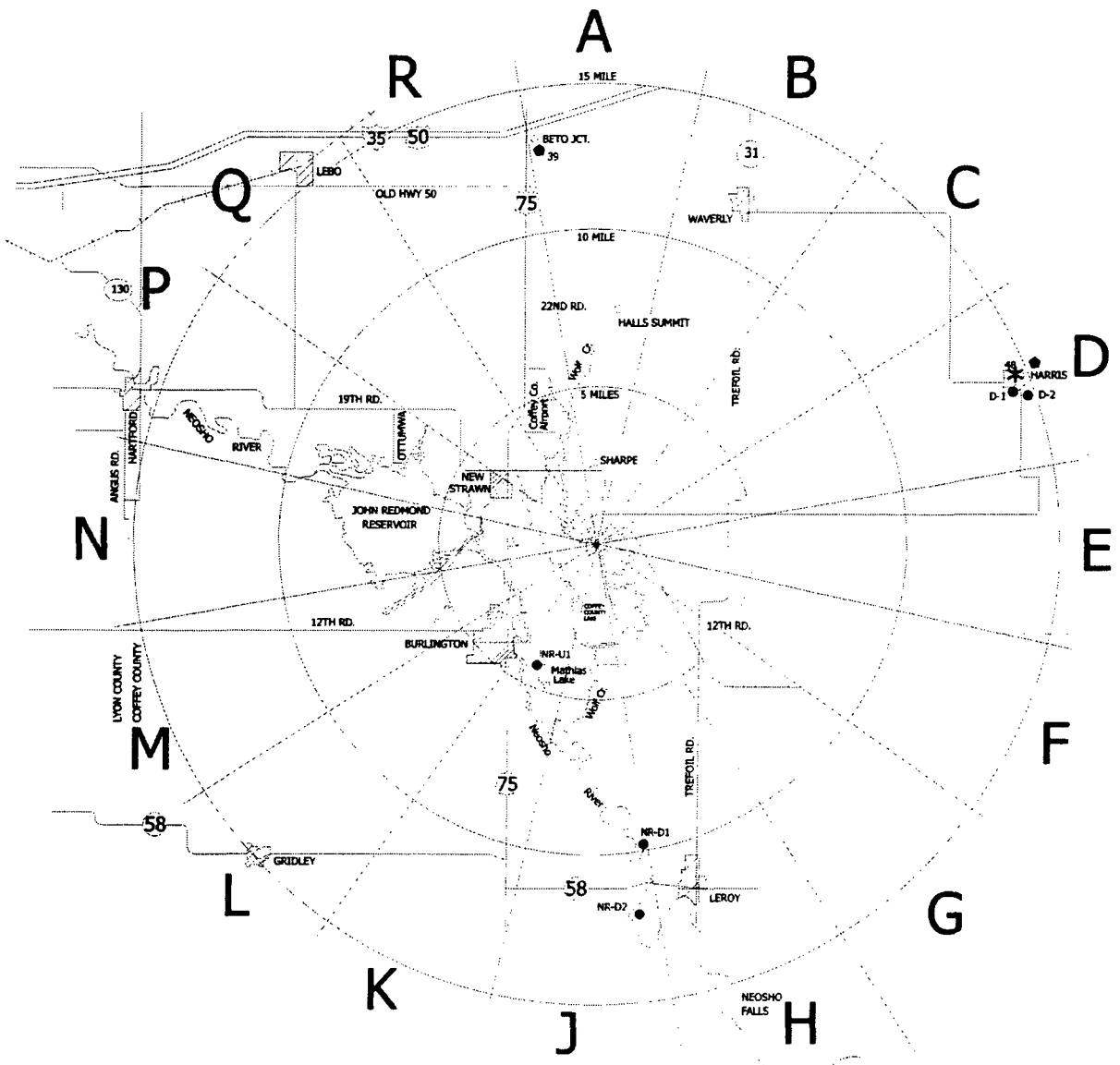
OFFSITE DOSE CALCULATION MANUAL (REMP)

FIGURE 5.5



08/06

6.0 Bases

The bases contained on the succeeding pages summarize the general requirements of Section 5.0 of the ODCM (REMP).

Section 2.0 Liquid Effluents (Contained in AP 07B-003)

Section 3.0 Gaseous Effluents (Contained in AP 07B-003)

Section 4.0 Total Dose (Contained in AP 07B-003)

Section 5.0 Radiological Environmental Monitoring Program

Section 5.1 Monitoring Program

The Radiological Environmental Monitoring Program provides representative measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and 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 the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979.

The required detection capabilities for environmental sample analyses are tabulated in terms of the lower limits of detection (LLDs). The LLDs are considered optimum for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as an a posteriori (after the fact) limit for a particular measurement.

Detailed discussion of the LLD, and other detection limits, can be found in HASL Procedures Manual, HASL-300 (revised annually), Currie, L.A., "Limits for Qualitative Detection and Quantitative Determination-Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968), and Hartwell, J.K., "Detection Limits for Radioanalytical Counting Techniques," Atlantic Richfield Hanford Company Report ARH-SA-215 (June 1975).

Section 5.2 Land Use Census

This section is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the Radiological Environmental Monitoring Program given in the ODCM are made if required by the results of this census. Information that will provide the best results, such as door-to-door survey, aerial survey, or consulting with local agricultural authorities, shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m^2 provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assume in Regulatory Guide 1.109 for consumption by a child.

To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broadleaf vegetation (i.e., similar to lettuce and cabbage), and (2) a vegetation yield of 2 kg/m^2.

Section 5.3 Interlaboratory Comparison Program

The requirement for participation in an approved Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

7.0 Reports

7.1 Annual Radiological Environmental Operating Report

The Annual Radiological Environmental Operating Report shall include summaries, interpretations, and analysis of trends of the results of the Radiological Environmental Monitoring Program for the reporting period. The material provided shall be consistent with the objectives outlined in (1) the ODCM and (2) Sections IV.B.2, IV.B.3 and IV.C of Appendix I to 10 CFR Part 50 (Reference Step 3.1.5), including a comparison with preoperational studies, with operational controls and with previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment. The report shall also include the results of the Land Use Census described in Section 5.2.

The Annual Radiological Environmental Operating Report shall include the results of analysis of all radiological environmental samples and of all environmental radiation measurements taken during the period pursuant to the locations specified in Table 5-1 as well as summarized and tabulated results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual 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 possible in a supplementary report.

The report shall also include the following: a summary description of the Radiological Environmental Monitoring Program; legible maps covering all sampling locations keyed to a table giving distances and directions from the centerline of the reactor; the results of licensee participation in the Interlaboratory Comparison Program and the corrective actions being taken if the specified program is not being performed as required by Section 5.3; reasons for not conducting the Radiological Environmental Program as required by Section 5.1 with plans for preventing a recurrence and discussion of all deviations from the sampling schedule of Table 5-1; discussion of environmental sample measurements that exceed the reporting levels of Table 5-4 but are not the result of plant effluents, and discussions of all analyses in which the LLD required by Table 5-3 was not achieved.

7.2 Annual Radioactive Effluent Release Report (Contained in AP 07B-003)

APPENDIX A Dose Conversion Factor Tables (Contained in AP 07B-003)

APPENDIX B Meteorological Model (Contained in AP 07B-003)

- END -

ATTACHMENT B
(Page 1 of 3)
SPECIAL SCOPE QUALITY ASSURANCE FOR THE REMP

B.1 QUALITY REQUIREMENTS

B.1.1 Review and Reporting of Data

1. Data from sample analysis are reviewed in accordance with approved procedures.

B.1.2 Organization

1. Section 5 of this procedure identifies the organizational structure, management positions and responsibilities.

B.1.3 Personnel Qualifications

1. Personnel responsible for collection and preparation of radiological environmental monitoring samples shall be qualified in accordance with approved procedures.

2. Personnel responsible for calibration of air sampler rotameters shall be qualified in accordance with approved procedures.

B.1.4 Procurement Document Control

1. Purchase orders for contracted services shall:

   a. Include quality requirements

   b. Specify technical requirements

   c. Identify documentation requirements

   d. Detail records requirements

   e. Extend applicable procurement document requirements to lower tier suppliers; and

   f. Specifying special requirements such as reporting program deficiencies, documentation requirements and applicable acceptance criteria.

2. Purchase orders for contracted laboratory services shall require participation in an interlaboratory comparison program.

ATTACHMENT B
(Page 2 of 3)
SPECIAL SCOPE QUALITY ASSURANCE FOR THE REMP

B.1.5 Instructions, Procedures and Drawings

1. This criterion applies to:

   a. Surveillances, test and calibrations,

   b. Environmental sampling, and

   c. Data processing and evaluation

2. Activities shall be accomplished using procedures, instructions and drawings approved prior to use.

3. Instructions, procedures or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

B.1.6 Control of Purchased Services

1. Controls shall be established to ensure that purchased services conform to procurement document requirements.

2. Controls shall include evaluation and selection of suppliers and surveillance or audit of supplied services.

B.1.7 Control of Measuring and Test Equipment

1. Measures shall be established to assure that tools, gages, instruments, and other measuring and testing devices used in activities affecting quality are properly controlled, calibrated and adjusted at specified periods to maintain accuracy within necessary limits.

B.1.8 Inspection, Test and Operating Status for Purchased Calibration Services

1. These inspections and tests shall be completed in accordance with approved procedures.

ATTACHMENT B
(Page 3 of 3)
SPECIAL SCOPE QUALITY ASSURANCE FOR THE REMP

B.1.9 Quality Assurance Records

1. All documentation shall be legible, reproducible and or microfilmable quality.

2. Documented records shall be maintained to show objective evidence of quality.

3. Quality records shall not be destroyed or disposed of without written authorization.

4. For the vendor laboratory, data sheets and finished records shall be retained by the contactor for a period of five years.

B.1.10 Audits

1. Audits shall be performed in accordance with USAR step 17.2.18.5 to verify compliance to requirements and to verify the effectiveness of the implemented activities affecting quality. 01|07

2. Vendor audits shall be performed a minimum of once every 3 years unless commitments require more frequent audits.

- END -

ATTACHMENT III

Wolf Creek Nuclear Operating Corporation

Administrative Procedure AP 31A-100, Revision 6,

"Solid Radwaste Process Control Program"

WOLF CREEK
NUCLEAR OPERATING CORPORATION

AP 31A-100

SOLID RADWASTE PROCESS CONTROL PROGRAM

Responsible Manager

Manager Chemistry/Radiation Protection

Revision Number	6
Use Category	Reference
Administrative Controls Procedure	Yes
Management Oversight Evolution	No
Program Number	25A

DC12 09/01/2006

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1.0 PURPOSE

1.1 This procedure provides instructional guidance and a description of the solid waste Process Control Program (PCP). The PCP describes the methods used for processing wet low-level radioactive waste into a waste form acceptable for disposal, in accordance with 10 CFR 61 requirements, at a licensed land disposal facility.

2.0 SCOPE

2.1 This procedure describes current and planned practice for sampling, sample evaluation, classification, processing and packaging of radioactive material. This procedure does not address irradiated hardware which will be managed on a case-by-case basis under the direction of the Manager Chemistry/Radiation Protection. System descriptions and operating practices are described in the following steps.

2.2 Waste Steam Identification - The station had initially identified eight different waste streams and treats each separately for classification purposes. The identification listing may be consolidated, expanded and streams deleted at the discretion of radwaste management without revising the PCP.

EXAMPLES

For Information Only

- o Dry Active Waste (DAW)
- o Steam Generator Blowdown Bead Resin
- o Chemical and Volume Control System Bead Resin (1) (CVCS)
- o Reactor Coolant System Filters
- o Ultra Filtration Skid Waste
- o Spent Fuel Pool Filters
- o Radwaste Resins
- o Steam Generator Blowdown Filters (2)

(1) May contain combination of CVCS, Diversified, and Spent Fuel Pool Resins

(2) May be disassembled and components handled as DAW

2.3 Non-Waste Stream Identification - The station has identified two different sources and treats each separately for classification purposes.

- o Non-irradiated material removed from the Spent Fuel Pool.
- o Any other radioactive material generated by the station.

2.4 Disposition of Radioactive Material Sent to a Vendor for Intermediate Processing - Practices include sending radioactive material packages generated by the station to Duratek, Studsvik or other vendors for volume reduction (VR)/processing instead of directly to a burial site.

2.4.1 This procedure addresses the requirements for 10 CFR 61.55 (Waste Classification) for radioactive material sent to vendor facilities.

2.4.2 This procedure does NOT address the requirements for 10 CFR 61.56 (Waste Characteristics), since the final processing and packaging are performed at the vendor facilities.

2.4.3 Possible types of radioactive material include, but are NOT limited to the following:

- o DAW
- o Surface Contaminated Objects
- o Bead Resins and Charcoal
- o Cartridge Filters
- o Contaminated Oil
- o Contaminated Soil

2.5 Disposition of Waste Sent Directly to a Burial Site - This procedure addresses both the 10 CFR 61.55 and 61.56 requirements for the waste streams listed in Step 2.2.

2.6 Waste Management Practices

2.6.1 DAW

- o This waste stream consists of plastic, wood, paper, metal, cloth, etc. generated at various locations within the station.
- o The material may be sent to intermediate processors or directly to a burial site.

- The station may preprocess DAW by compacting.
- Practices include shipping DAW classified as either SCO or LSA in numerous possible containers, such as:
  - 30 to 85 gallon drums
  - B-25 type boxes
  - SeaLand containers
  - Large liners
- Prepacking inspection criteria includes the removal of liquid, protective clothing and equipment, paints, solvents, lead, instruments, gages and other valuable plant equipment.

2.6.2 Steam Generator Blowdown Bead Resin (S/G BD)

- This waste stream consists of only S/G blowdown resin. The depleted resins are sluiced from the individual processing vessels to the S/G Blowdown Resin Storage Tank and then to a CNSI 6-80 or 8-120 High Integrity Container (HIC), OR any other container approved by the Health Physics Supervisor Radwaste (HPSR).
- Once a container is full, the resins are then dewatered using plant equipment and approved vendor dewatering procedures.
- Practice may include shipping resins to a volume reduction processor for incineration or release.

2.6.3 Chemical and Volume Control System Bead Resin (CVCS)

- This waste stream consists of CVCS, various DURATEK media and Spent Fuel Pool resins. The depleted charcoal filter media and resins are sluiced from the individual processing vessels to a common Spent Resin Storage Tank. The media is then transferred in a batch mode to a CNSI 6-80 or 8-120 HIC, OR any other container approved by the HPSR.
- Once a container is full or the transfer has been terminated, the filter media (charcoal) and resins are then dewatered per RPP 07-131, BEAD RESIN/ACTIVATED CARBON DEWATERING PROCEDURE FOR CNSI 14-215 OR SMALLER LINERS.

2.6.4 Cartridge Filters

- This category includes several waste streams which were defined in Step 2.2 and includes all filters generated by the station.
- Filters are removed from service based on operating parameters determined by the Operations Department.
- The filter housings are drained prior to filter removal. The filters are then gravity drained prior to being placed into an intermediate storage container OR the final disposal container.
- With containers equipped with a dewatering internal, a final dewatering verification is performed on the disposal container after it has been loaded with filters.
- Absorbent material may be added to the disposal liner after final dewatering verification at the discretion of the HPSR.

2.6.5 Solidification/Encapsulation Methods

- Present and planned practice is NOT to solidify or encapsulate any waste streams.
- All liquid waste is dewatered to less than 0.5 percent or 1 percent depending on the container type by volume prior to shipment.

2.6.6 Operation and Maintenance of dewatering Systems and Equipment

- Present and planned practice is to utilize station personnel to operate and maintain dewatering systems and equipment using station procedures.
- All disposal liners are manufactured by and purchased from QA approved vendors.

2.6.7 High Integrity Container Usage

- High Integrity Containers (fabricated from high density cross-linked polyethylene) may be used as the disposal package for any waste.
- All classes of waste, unless specifically exempted by the South Carolina Department of Health and Environmental Control must be disposed in vaults (approved concrete overpack structures) at the Barnwell burial site.

3.0 REFERENCES AND COMMITMENTS

3.1 References

3.1.1 WCGS Technical Specifications, Section 6.13 (TR 5.5.4)

3.1.2 RPP 07-101, CONTROL OF RADIOACTIVE MATERIAL MANAGEMENT SOFTWARE AND DATA BASES

3.1.3 RPP 07-120, PREPARATION AND SHIPMENT OF RADIOACTIVE WASTE

3.1.4 RPP 07-121, PREPARATION AND SHIPMENT OF RADIOACTIVE MATERIAL

3.1.5 RPP 07-131, BEAD RESIN/ACTIVATED CARBON DEWATERING PROCEDURE FOR CNSI 14-215 OR SMALLER LINERS

3.1.6 10 CFR 20, "Standard For Protection Against Radiation"

3.1.7 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste"

3.1.8 10 CFR 71, "Packaging and Transportation of Radioactive Materials"

3.1.9 40 CFR 302, "Reportable Quantity Adjustment - Radionuclides"

3.1.10 49 CFR 171, "General Information, Regulations, and Definitions"

3.1.11 49 CFR 172, "Shippers' General Requirements for Shipments and Packaging"

3.1.12 49 CFR 177, "Carriage by Public Highway"

3.1.13 Barnwell Waste Management Facility Site Disposal Criteria; CNSI-S20-AD-010

3.1.14 CNSI's South Carolina Department of Health and Environmental Control (DHEC) Radioactive Materials License No. 097

3.1.15 South Carolina DHEC Regulation 61-83, Transportation of Radioactive Waste Into or Within South Carolina

3.1.16 USNRC Branch Technical Position on Radioactive Waste Classification, May 1983

3.1.17 USNRC Branch Technical Position on Waste Form, January 1991

3.1.18 USNRC Branch Technical Position on Concentration Averaging and Encapsulation, Revision in Part To Waste Classification Technical Position, January 1995

3.1.19 NRC Bulletin No. 79-19, "Packaging of Low Level Radioactive Waste for Transport and Burial"

3.1.20 NRC Information Notice No. 80-24, "Low Level Radioactive Waste Burial Criteria"

3.1.21 NRC Information Notice No. 83-33, "Non-Representative Sampling of Contaminated Oil"

3.1.22 NRC Information Notice No. 85-92, "Surveys of Wastes Before Disposal from Nuclear Reactor Facilities"

3.1.23 NRC Information Notice No. 86-20, "Low Level Radioactive Waste Scaling Factors, 10 CFR 61"

3.1.24 NRC Information Notice No. 88-101, "Shipment of Contaminated Equipment Between Nuclear Power Stations"

3.1.25 WMG-SW-006, "Computer Software Quality Assurance Program"

3.1.26 WMG-QA-001, "Quality Assurance Program"

3.1.27 WMG-P-065 "RADMAN Operating Manual"

3.1.28 RADMAN Computer Code, Main Topical Report to the USNRC

3.1.29 WMG-P-069, "FILTRK Operating Procedure"

3.1.30 WMG-P-070, "RAMSHP Operating Procedure"

3.1.31 WMG-P-075, "OSM Operating Procedure"

3.1.32 WMG Report #9006, "Computer Program Dose to Curie Methodology Verification and Validation"

3.1.33 U.S. Nuclear Regulatory Commission, "Radiological Effluent Technical Specifications for PWRs," NUREG-0472

3.1.34 NRC Guidelines for Preparation and Implementation of Solid Waste Process Control Program "DRAFT," Revision 4, October 1986

3.1.35 CNSI FO-AD-002, "Operating Guidelines for Use of Polyethylene High Integrity Containers"

3.1.36 CNSI, FO-OP-023, "Bead Resin/Activated Carbon Dewatering Procedure for CNSI 14-215 or Smaller Liners"

3.1.37 NRC Generic Letter No. 91-02, "Reporting Mishaps Involving LLW Forms Prepared For Disposal"

3.1.38 WMG-9217, "10 CFR 61 Practice Assessment at Wolf Creek Generating Station, 1992"

3.1.39 AP 25-001, RADIATION PROTECTION QUALITY PROGRAM REQUIREMENTS

3.1.40 Letter from Rodney Wingard to Jimmy Still concerning the disposal of dried solids (HP 01-00601)

3.2 Commitments

3.2.1 None

4.0 DEFINITIONS

4.1 Abbreviations

4.1.1 Activity/A_2/g - Package activity divided by (A_2) divided by gram

4.1.2 BTP - Branch Technical Position

4.1.3 CNSI - Chem Nuclear System, Inc.

4.1.4 HPSR - Health Physics Supervisor Radwaste

4.1.5 LLD - Lower Limit of Detection

4.1.6 MCA - Multi-Channel Analyzer

4.2 Activity Correction Factor

4.2.1 The µCi/cc or µCi/g values may have to be corrected (plus or minus) if the waste stream specific 10 CFR 61 sample results (independent laboratory) and the replicate in-house specific activity values differ by more than 20 percent, and the differences cannot be resolved to the satisfaction of the HPSR, alternatively, the dose-to-curie characterization methodology can be used without applying correction factors.

4.3 As Generated Waste

4.3.1 Radioactive waste generated at a frequency contrary to the sampling requirements of waste classes A, B or C.

4.4 Batch

4.4.1 An isolated quantity of feed waste to be processed having essentially constant physical and chemical characteristics. (The addition or removal of water will not be considered to create a new batch).

4.5 Chelating Agents

4.5.1 EDTA, DTPA, hydroxyl-carboxylic acids, citric acid, carbolic acid and glucinic acid.

4.6 Confirmatory Analysis

4.6.1 Verification of Gross radioactivity measurements using MCA and independent laboratory sample data.

4.7 Density Correction

4.7.1 Density corrections may be required to convert sample data reported in μCi/g to μCi/cc or vice versa when comparing sample data with unlike units.

4.8 Dewatered Waste

4.8.1 Dewatered Waste refers to wet waste that has been processed by means other than solidification, encapsulation, or absorption to meet the free standing liquid requirements of 10 CFR 61.56 (a)(3) and (b)(2).

4.9 Encapsulation

4.9.1 Encapsulation is a means of providing stability for certain types of waste by surrounding the waste by an appropriate encapsulation media.

4.10 Gamma-Spectral Analysis

4.10.1 Also known as IG, MCA, GE/Li and gamma spectroscopy.

4.11 Gross Radioactivity Measurements

4.11.1 More commonly known as Dose to Curies conversion for packaged waste characterization and classification.

4.12 Homogeneous

4.12.1 Of the same kind or nature; essentially alike. Most waste streams are considered to have the radioactivity distributed throughout for purposes of waste classification.

4.13 Legacy Waste

4.13.1 Radioactive waste generated from past Plant processes.

4.14 Low-Level Radioactive Waste (LLW)

4.14.1 Those low-level radioactive wastes containing source, special nuclear, or by-product material that are acceptable for disposal in a land disposal facility. For the purposes of this definition, low-level radioactive waste has the same meaning as in the Low-Level Waste Policy Act, that is, radioactive waste not classified as high-level radioactive waste, transuranic waste, spent nuclear fuel, or by-product material as defined in Section 113.(2) of the Atomic Energy Act (uranium or thorium tailings and waste).

4.15 Measurement of Specific Radionuclides

4.15.1 More commonly known as core sample or package sample using MCA data for packages waste characterization and classification.

4.16 Operable

4.16.1 A system, subsystem, train, component or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified function(s), and when all necessary attendant instrumentation, controls, electrical power, cooling or seal water, lubrication or other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its function(s) are also capable of performing their related support function(s).

4.17 Pre-qualification Program

4.17.1 The testing program implemented to demonstrate that the proposed method of wet waste processing will result in a waste form acceptable to the land disposal facility.

4.18 QA Verification Sample

4.18.1 A representative sample of the waste that is tested to demonstrate control of the waste processing. The sample shall be obtained from at least every tenth batch of each type of wet radioactive waste processed for stabilization.

4.19 Quality Assurance/Quality Control

4.19.1 As used in this document, "quality assurance" comprises all those planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. Quality assurance includes quality control, which comprises those quality assurance actions related to control of the physical characteristics and quality of a material structure, component, or system to predetermined requirements.

4.20 Sampling Plan

4.20.1 A sampling program implemented to ensure that representative samples from the feed waste and the final waste form are obtained and tested for conformance with parameters stated in the PCP and waste form acceptance criteria.

4.21 Scaling Factor

4.21.1 A dimensionless number which relates the concentration of an easy to measure nuclide (gamma emitter) to one which is difficult to measure (beta/alpha emitters).

4.22 Shipping Paper

4.22.1 At WCGS the shipping paper consists of an NRC form 540 and 541(or equivalent). Additional documentation may be provided (i.e., bill of lading) but is not consecutively number as part of the shipping papers.

4.23 Significant Quantity

4.23.1 For purposes of sample evaluation, waste classification and manifesting radionuclides on shipping papers, the following radionuclide limits shall be considered significant:

- Any LLD value for a 10 CFR Part 20, Appendix G required radionuclide.
- Any radionuclide representing greater than 5 percent of the relative A_2 fraction hazard.

- Any real value for a radionuclide specifically listed in 10 CFR Part 61.55.
- Any radionuclide representing greater than 1 percent of the total activity.
- Any radionuclide greater than 0.5 RQ value.

4.24 Special Nuclides

4.24.1 RADMAN Computer Code user term for 10 CFR Part 20, Appendix G required nuclides.

4.25 Stability

4.25.1 As used in this document, "stability" means structural stability. Stability requires that the waste form maintain its structural integrity under the expected disposal conditions.

4.26 Waste Container

4.26.1 A vessel of any shape, size, and composition used to contain the final or intermediate processed waste.

4.27 Waste Form

4.27.1 Waste in a stable waste form or container acceptable for disposal at a licensed disposal facility.

4.28 Waste Processing

4.28.1 Changing, modifying, packaging the commercial nuclear power plant generated wet radioactive waste into a form that is acceptable to a disposal facility.

4.29 Waste Stream

4.29.1 A station specific and constant source of waste with a distinct radionuclide content and distribution.

4.30 Waste Type

4.30.1 A single packaging configuration tied to a specific waste stream, or multiple package types tied to the same waste stream.

5.0 RESPONSIBILITIES

5.1 Health Physics Supervisor Radwaste is responsible for:

5.1.1 Implementing this procedure.

5.1.2 Ensuring that radioactive waste is classified and characterized in accordance with 10 CFR 61.55 receiving facility criteria.

5.1.3 Designating other approved procedures (if required) to be implemented in the packaging of any specific batch of waste.

6.0 PROCEDURE

6.1 The precautions/limitations of this procedure are listed below.

6.1.1 All plant personnel that have any involvement with the RADMAN, TRASHP, and FILTRK computer codes shall be familiar with its functions, operation, and maintenance.

6.1.2 Only authorized personnel will characterize or package radioactive waste or radioactive materials.

6.1.3 Radioactive materials shall be handled in accordance with applicable Radiation Protection Procedures.

6.1.4 Pressure and heat may be encountered during the operation of liquid waste processing systems.

1. Caution must be exercised during disassembly and disconnection of lines or equipment and valve realignments.

6.1.5 Each HIC is matched with specific closure components and seals at time of manufacture.

1. All components are identified using a common serial number.

2. Should components become mismatched, contact the HPSR for instructions prior to use.

6.1.6 Waste must NOT be packaged for disposal in cardboard or fiberboard boxes.

6.1.7 Liquid waste must be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.

6.1.8 Solid waste containing liquid shall contain as little free standing and non-corrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1 percent of the volume in HIC's and 0.5% in a steel liner.

6.1.9 Waste must NOT be readily capable of detonation or of explosive decomposition or reaction at normal pressures and temperatures, or of explosive reaction with water.

6.1.10 Waste must NOT contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to persons transporting, handling, or disposing of the waste. This does NOT apply to radioactive gaseous waste packaged in accordance with Step 6.1.12 of this section.

6.1.11 Waste must NOT be pyrophoric. Pyrophoric materials contained in waste shall be treated, prepared, and packaged to be non-flammable.

6.1.12 Waste in a gaseous form must be packaged at a pressure that does not exceed 1.5 atmospheres at 20°C. Total activity must not exceed 100 curies per container.

6.1.13 Waste containing hazardous, biological, pathogenic, or infectious material must be treated to reduce to the maximum extent practicable the potential hazard from the non-radiological materials.

6.1.14 All data entries should use three significant figures only (i.e., X.XXE-x). IF more significant figures are provided, round off to generate three significant figures.

6.1.15 Use only those isotopes reported as real values, ignore all isotopes reported as LLD values, except those nuclides listed in Step 6.6.7.

6.1.16 Ignore all radioisotopes with half-lives less than eight (8) days based on I-131.

6.1.17 Changes to this procedure shall be documented with a form APF 31A-100-04, PROCESS CONTROL PROGRAM CHANGE RECORD submitted with the revised procedure and form APF 15C-004-01, DOCUMENT REVISION REQUEST. Form APF 31A-100-04 shall contain (Step 3.1.1):

1. Sufficient information to support the change together with the appropriate analyses or evaluation justifying the change(s).

   AND

2. A determination that the change will maintain the overall conformance of the waste product to existing requirements of Federal, State, or other applicable regulations.

6.2 Special equipment, material, and parts needed to perform tasks are shown below.

6.2.1 Required tools and equipment will vary depending on the specific process and waste container that is used.

6.2.2 The various tools and equipment which may be required are detailed in the vendor procedures listed in Steps 3.1.36 and 3.1.37.

6.3 <u>Prerequisites before beginning work with this procedure</u>.

6.3.1 Ensure that a current set of DOT, NRC and burial site regulations is maintained at the station and is available for reference.

6.3.2 Ensure that representative sample data is on file for each waste stream. Data is considered to be current if it meets the following:

1. The waste stream must be sampled at least every two years for NRC Class A waste.

2 The waste stream must be sampled at least every year for NRC Class B or C waste. Exceptions are:

a.legacy waste

b.as generated waste

3. Non-waste radioactive material shall be sampled on an annual or as generated basis with (non-irradiated) fuel pool material differentiated from balance of plant material.

6.3.3 A training program shall be developed and implemented for personnel having responsibilities related to waste processing operations to ensure the waste processing shall be performed within the requirements of the PCP.

1. The training program shall be repeated and the personnel requalified on a periodic schedule, not to exceed three years.

2. The individual's training records shall be maintained and available for audit and inspection.

6.3.4 Additional requirements for contracted vendors processing waste.

1. Management shall review vendor(s) topical reports.

NOTE

The PCP does NOT have to include the vendors Topical Report if it has NRC approval, or has been previously submitted to the NRC.

a. This review will assure the vendors operations and requirements are compatible with the responsibilities and operation of the plant.

b. The training requirements and records listed in Step 6.3.3 also apply to contracted vendors.

c. The station shall maintain copies of records to verify training of vendor personnel.

6.4 Procedure For Performing Work

6.4.1 Methods and frequency for determining the radionuclide concentration for each waste stream.

1. Ensure samples are representative of the final waste form.

2. Determine the base line density for each waste stream (NOT applicable for DAW and filters). The density is determined by waste weight and volume.

NOTE

For WCGS, waste stream radionuclide content is considered to be distributed throughout for purpose of waste classification.

6.4.2 Treat each waste stream separately for classification purposes.

6.4.3 Send all NRC Class A waste samples to an independent laboratory for gamma, beta and alpha analysis at least once every two years.

1. Perform an in-house analysis for gamma emitting radionuclides for each sample sent to an independent lab for future comparison.

2. Periodically perform in-house analysis for gamma emitting nuclides for comparison to the current data base values for gamma emitters (the current data base is usually based on the most recent independent laboratory results).

6.4.4 Send all NRC Class B and C waste samples to an independent laboratory for gamma, beta and alpha analysis at least once a year, except as defined in 6.3.2. The additional steps required are identical to Substeps 1 and 2 of Step 6.4.3.

6.4.5 Determine the status (real value, LLD or not present) of the 10 CFR 20 Appendix G required nuclides for each waste stream from the recent independent laboratory data.

6.4.6 Document and track all samples per RPP 07-101, CONTROL OF RADIOACTIVE MATERIAL MANAGEMENT SOFTWARE AND DATA BASES.

6.5 Current and planned practice for each waste stream is as follows:

6.5.1 DAW

1. Obtain composite smears from various contaminated areas of the plant on a semi-annual basis and analyze (IG) them in-house for gamma emitters.

2. Compare the results of the semi-annual samples to the database to ensure adequacy of sample frequency.

3. Send the most recent group of composite smears to an independent laboratory for analysis biennially or more often IF determined necessary by the HPSR.

4. Maintain records for all samples for nuclide identification, distribution and scaling factors.

NOTE

The specific activity (μCi/cc or μCi/g) is NOT required since all characterization/classification calculations are performed using a dose/curie methodology which only relies on fractional abundance.

5. Both in-house and independent laboratory results are normally reported in μCi/sample.

6. Forward the results from the independent laboratory to the HP Dosimetry/Calibration Lab for evaluation on RPF 01-405-05, "DETERMINATION OF DETECTABLE VS. NON-DETECTABLE ACTIVITY FOR RELEASE FROM THE RCA".

6.5.2 S/G Blowdown Resin

1. Obtain several (as determined by the HPSR) composite samples from the resin transfer line during liner loading operations on an "as generated" basis.

NOTE

Each liner is considered a different batch for sampling and classification purposes.

2. Analyze the samples in-house (IG) and retain the results for future comparison to the replicate independent laboratory results.

3. Send the samples to an independent laboratory for analysis biennially or as generated.

4. Maintain records for all samples for nuclide identification, distribution and scaling factors.

5. Both in-house independent laboratory results are normally reported in the same units (μCi/g or μCi/cc).

6.5.3 CVCS Resin

1. The sampling procedure is exactly the same as listed above for S/G Blowdown Resin in Step 6.5.2 except the analysis frequency is annual or as generated.

6.5.4 Filters

1. Obtain samples from each individual filter waste stream defined in Step 2.2 on an annual OR as generated basis.

NOTE

Samples may be taken from the actual filter media, from a smear of the filter media, from a smear of the filter housing, or a crud sample, as determined by the HPSR.

2. Perform an in-house (IG) analysis of the sample (or replicate sample) and retain the output record for future comparison to the independent laboratory results.

3. Send the sample to an independent laboratory for analysis once per year or more often if determine necessary by the HPSR.

4. Maintain records for all samples for nuclide identification, distribution and scaling factors.

NOTE

CORRECTIVE ACTION FOR ADJUSTING Co-58 SCALING FACTORS FOR FILTERS DURING CRUD BURSTS ENCOUNTERED WITH CHEMICAL INJECTIONS AND 100% LOAD REJECTIONS

5. The Co-58 scaling factors should be adjusted when the total radioactivity increases for filters during the above conditions, the activity increase is primarily Co-58 not Co-60, if the scaling factors are not adjusted the filters can be overestimated for NRC waste classification.

   a. Step 1, Obtain a filter sample.

   b. Step 2, Count the sample in-house, it is not necessary to perform an independent laboratory analysis.

   c. Step 3, Divide the Co-58 value by the Co-60 value, this is the scaling factor.

   d. Step 4, Obtain a hard copy of the Part 61 filter waste stream.

e. Step 5, Apply the Step 3 scaling factor to the database Co-60 value.

f. Step 6, Create a new (crud burst) Part 61 waste stream with the new Co-58 value.

g. Step 7, Characterize filters.

NOTES

- **Document that there are two Part 61 waste streams for the same filters depending on operating conditions.**
- **The specific activity (µCi/cc or µCi/g) is not required since all characterization/classification calculations are performed using a dose/curie methodology which only relies on fractional abundance.**

6. Both in-house and laboratory results are normally reported in µCi/sample.

6.6 Sample Evaluation

6.6.1 Infrequent or Abnormal Waste Types

1. Infrequent or abnormal waste types that may be generated must be evaluated on a case-by-case basis.

2. The HPSR will determine if the waste can be correlated to an existing waste stream.

3. If the radioactive material cannot be correlated to an existing waste stream, the HPSR shall determine specific off-site sampling and analysis requirements necessary to properly classify the material.

6.6.2 Examples of these radioactive materials include, but are not limited to:

- Contaminated Soil
- Contaminated Oil
- Special Filters or Resin
- A mixture of radioactive material types in one container.

6.6.3 Requirements for analysis to be performed by an off-site vendor are as follows:

1. All sample results must reference the quantity received.

2. All sample results shall be decay corrected to a reference date provided by the station which is normally the sample date.

3. The sample results shall be reported in µCi/sample, µCi/g or µCi/cc as determined the HPSR.

NOTE

Outside analysis is NOT performed for any radionuclides with a half-life less than eight days.

6.6.4 The vendor shall perform analysis for the following radionuclides listed in Table 1 of 10 CFR 61.55.

1. C-14, Tc-99, I-129, Pu-241, Cm-242 and the following alpha emitting transuranics (TRUs) with half-lives greater than five years, Np-237, Pu-238, Pu-239/240, Pu-242, Am-241, and Cm-243/244.

   a. Additionally Ni-59 and Nb-94 are required for Rx cavity and fuel pool filters.

NOTE

If evaluation of several sets (i.e., three or more) of waste stream specific historical sample data shows that some TRUs with half-life greater than five years are consistently reported as LLD values, sample analysis may be discontinued for those specific radionuclides.

2. Analysis for the "activated metal" radionuclides listed in Table 1 of 10 CFR Part 61 are only required for the fuel pool filters and reactor cavity filters waste streams identified at WCNOC.

3. It is NOT necessary to contract for an offsite vendor to perform analysis for enriched uranium or other naturally occurring radionuclides not delineated in this procedure.

4. Radionuclides listed in Table 1 of 10 CFR 61.55 shall be specifically identified and the quantities reported on shipping manifests if they are significant for purposes of classification.

6.6.5 The vendor shall perform analysis for the following radionuclides listed in Table 2 of 10 CFR 61.55.

1. H-3, Co-60, Ni-63, Sr-90 and Cs-137

2. Radionuclides listed in Table 2 of 10 CFR 61.55 shall be specifically identified and the quantities reported on shipping manifests if they are significant for purposes of classification.

6.6.6 The vendor shall perform analysis for the following radionuclides NOT listed in Table 1 or Table 2 of 10 CFR 61.

1. Activation Products - Cr-51, Mn-54, Fe-55, Co-58, Fe-59, Sb-124, Sb-125, Zn-65, Ag-110M and any other nuclides identified in significant quantities by in-house IG equipment.

2. Fission Products - Zr-95, Nb-95, Ru-103, Ru-106, Cs-134, Ce-141, Sr-89, Ce-144 and any other nuclides identified in significant quantities by in-house IG equipment.

6.6.7 A waste stream specific database must include the following radionuclides, even if they are reported as LLD values:

1. H-3, C-14, Tc-99, I-129 required by 10 CFR 20 Appendix G (H-3 is considered real or LLD for DAW because "not present" cannot be substantiated).

2. Co-60, Cs-137, and Ce-144 (only if TRUs are reported) required by the RADMAN computer code. They are used as the primary scaling radionuclides.

3. The HPSR can change the base scaling radionuclides.

NOTE

Samples sent to offsite laboratories for analysis should contain sufficient activity to determine the presence of transuranic nuclides. The minimum recommended sample activity level is 50,000 dpm. If that level cannot be attained, the highest activity should be used for offsite analysis.

6.7 Sample Analysis and Comparison

6.7.1 Whenever a sample is sent off-site for analysis, count the same sample (or replicate) in-house with the station IG system.

NOTE

Isotopic results that are not considered statistically positive at the 99.9% confidence level are considered "suspect" values and shall be discarded as necessary.

6.7.2 Comparison of on-site versus off-site analysis shall be evaluated by the HPSR to identify and resolve any discrepancies. As a minimum, the comparison shall include:

- o Specific activity by gamma emitting radionuclides. (NOT applicable for DAW or filter samples.)
- o Co-60/Cs-137 Ratio
- o Presence or absence of radionuclides
- o Predominant radionuclides
- o Individual radionuclide fractional abundance
- o Scaling factors

6.7.3 Records of on-site and off-site sample analysis and evaluations by waste type are maintained by the HPSR.

6.7.4 IF a comparison between the in-house and independent laboratory results shows a variance of 20 percent or greater for specific activity, the MCA results may be adjusted until the discrepancy is resolved. Reported MDC should be consistent with the measurement uncertainty. The relative uncertainty (1σ) of the measurement should be ~30% at the MDC and should get smaller as the measured concentration increases above the MDC level.

1. Any discrepancies should be resolved (if possible) in-house or with the independent laboratory as soon as possible.
2. The use of these activity correction factors is only valid if other conditions defined in Step 6.7.2 above compare favorably, otherwise the sample set should be considered suspect and the data should not be used. This would require another sample as soon as possible. (3.1.38)

6.7.5 Radionuclides with a half-life less than eight days are also ignored from internal MCA reports.

6.7.6 New sample data shall be periodically obtained and evaluated.

6.7.7 New sample data may be either off-site analysis or in-house MCA analysis.

6.7.8 Once a database has been established, based on off-site analysis, the MCA results are primarily used as a "flag" to obtain and send additional samples off-site. Exceptions to this may occur during crud burst situations were it is necessary to adjust the scaling factor relationship of the activation products. An example would be the $^{58}Co/^{60}Co$ ratio after hydrogen peroxide additions.

6.7.9 The analyze utility program may be utilized to evaluate multiple sets of data.

NOTE

Isotopic results that are NOT considered statistically positive at the 99.9% confidence level are considered "suspect" values and shall be discarded as necessary.

6.7.10 Several comparisons to the existing database shall be considered when evaluating new sample data.

1. Radionuclide fractional abundance and scaling factor relationships
2. Specific activity by radionuclide
3. Swings in driving classifications radionuclides
4. Radionuclides present in database, but NOT present in new sample or vice versa
5. Total activity by sample set

6.8 Sample Frequency

6.8.1 The following may require increased sampling:

1. Increase in failed fuel fraction as determined by:
   - o D.E.I. 25% of Technical Specification limit
   - o Increase of I-131/I-133
   - o Np-239 greater than 0.01 μCi/cc in reactor coolant
   - o Positive in-house gross alpha sample results on any type of smear survey
2. Crud burst during 100% load rejection or chemical cleaning
3. Extended reactor shutdown (>90 days)
4. Changes to liquid waste processing, such as bypassing filters, utilizing filters or a change in ion exchange media

6.9 Scaling Factors

6.9.1 WCGS has established an inferential measurement program, whereby, concentrations of radioisotopes which cannot be readily measured are estimated through ratioing to concentrations of radioisotopes which can be readily measured.

6.9.2 Scaling factors have been developed on a facility and waste stream specific basis, and are periodically confirmed through direct measurements.

6.9.3 Correlations between measured and inferred radionuclides are currently as follows, but can be changed at the HPSR discretion:

1. Ce-144 to transuranic nuclides
2. Co-60 to activation product nuclides and C-14
3. Cs-137 to fission product nuclides

6.10 Waste Classification

NOTE

The volume and mass of the waste form (not the waste container) is used for most waste classification calculations.

6.10.1 Determine the waste classification (Class A stable or unstable, Class C) by the concentration of certain radionuclides in the final waste form as listed in 10 CFR 61.55.

6.10.2 Determine the radionuclide concentrations per RPP 07-120, PREPARATION AND SHIPMENT OF RADIOACTIVE MATERIAL, as follows:

1. DAW - "Gross Radioactivity Measurements" in conjunction with the RADMAN computer code or hand calculations

2. Filters - "Gross Radioactivity Measurements" in conjunction with the FILTRK computer code or hand calculations

3. All other waste streams - "Direct Measurement of Individual Radionuclides" in conjunction with the RADMAN computer code or hand calculations

6.11 Quality Control For Sampling And Classification

6.11.1 The RADMAN computer code provides a mechanism to assist WCGS in conducting a quality control program to aid in compliance with the waste classification requirements listed in 10 CFR 61.55.

6.11.2 Management audits of the WCNOC Sampling and Classification Program shall be performed in accordance with AP 25-001, RADIATION PROTECTION QUALITY PROGRAM REQUIREMENTS.

6.11.3 The audits are performed and documented by any of the following:

*Health Physics Department

*Corporate Radwaste and Document Services Department

*Quality Assurance Department

OR

*Qualified Vendors

6.12 Non-Waste Classification

6.12.1 Determine the radioactive material classification (Excepted Package, LSA, SCO, Type A, >Type A or Type B) by the total activity or activity as listed in DOT regulations and the receiver's radioactive material licenses.

6.12.2 Determine the radionuclide concentrations per RPP 07-121, PREPARATION AND SHIPMENT OF RADIOACTIVE MATERIAL, as follows:

1. Non-irradiated material removed from the spent fuel pool - "Gross Radioactivity Measurements," "Direct Measurement of Individual Radionuclides", or "Measurement of Surface Contamination Levels" for non-radioactive material contaminated with radioactive material in conjunction with the RAMSHP computer code or hand calculations.

2. Any other radioactive material generated by the station - The same methods listed for fuel pool material may be used with a separate radionuclide database.

6.13 Processing General Requirements

NOTE

The dewatering capabilities are verified by vendor Topical Reports or operating and testing procedures.

6.13.1 Verify the wastes contain only trace amounts of drainable liquid, and in NO case may the volume of free liquid exceed one percent of the waste volume when wastes are disposed of in containers designed to provide stability.

NOTE

The following verification is performed on a case-by-case basis for each package using independent laboratory data and MCA data in conjunction with computer codes or hand calculations.

6.13.2 Verify that resins are NOT processed that have loadings which will produce greater than 1.0 E+8 rads (350 μCi/cc) total accumulated dose. This only applies to two radionuclides, Cs-137 and Sr-90.

6.13.3 The as generated waste must be compatible with the disposal container.

6.14 Processing Requirements During Dewatering Operations

6.14.1 Perform all dewatering operations per RPP 07-131, BEAD RESIN/ACTIVATED CARBON DEWATERING PROCEDURE FOR CNSI 14-215 OR SMALLER LINERS.

NOTE

This procedure may only be used to dewater CNSI's 14-215 or smaller liners containing bead-type ion exchange resins and activated carbon with less than 1 percent oil.

6.14.2 Complete form RPF 07-131-01, HIC DEWATERING COMPLETION RECORD, for each liner prior to final closure.

6.14.3 Form RPF 07-131-01, HIC DEWATERING COMPLETION RECORD, must be included in the shipping paperwork package with the shipment.

6.14.4 The final transfer/dewatering cycle shall be counted as the first pumping cycle IF after the transfer is completed, the liner is dewatering per this procedure.

6.14.5 Final dewatering verification is determined by the following:

1. 1% Free-Standing Water or Less

   a. After a minimum of two (2) pumping cycles for bead resins or five (5) cycles for activated carbon, a measured volume of less than five (5) gallons on the next eight (8) hours of pumping shall be the acceptance criteria.

   b. IF five (5) gallons or more are collected, the waiting/pumping cycle shall be repeated until less than five (5) gallons are collected.

2. 0.5% Free-Standing Water or Less

   a. After a minimum of five (5) pumping cycles for bead resins or eight (8) pumping cycles for activated carbon, a measured volume of less than two (2) gallons on the next eight (8) hours of pumping shall be the acceptance criteria.

   b. IF two (2) gallons or more are collected, the waiting/pumping cycle shall be repeated until less than two (2) gallons are collected.

6.15 Packaging General Requirements

NOTE

The following general requirements are normally verified by review of a HIC's Certificate of Compliance (C of C) and State/NRC approval.

6.15.1 Ensure that the waste is in a container or structure that provides stability after disposal.

6.15.2 Ensure that the container is resistant to degradation caused by radiation effects.

6.15.3 Ensure the container is resistant to bio-degradation.

6.15.4 Verify that the container will remain stable under the compressive loads inherent in the disposal environment.

6.15.5 Verify that the container will remain stable if exposed to moisture or water after disposal.

6.15.6 Ensure that the "as generated" waste is compatible with the container.

6.16 Packaging Vendor Requirements

6.16.1 Perform all inspection, handling and loading operations per CNSI, FO-AD-002.

NOTE

Prior to use, each user will have on file within Chem-Nuclear System, Inc. Regulatory Affairs Department a "Polyethylene High Integrity Container Certification Statement."

6.16.2 IF not already on file, complete form FO-AD-002 HIC USER'S CHECKLIST, and transmit it to CNSI, maintain a copy of file in the HPSR office.

6.16.3 Complete form FO-AD-002 HIC USER'S CHECKLIST, for each HIC liner to be shipped to CNSI.

6.16.4 Form FO-AD-002 HIC USER'S CHECKLIST, must be included in the shipping paperwork package with the shipment.

6.16.5 Complete form FO-AD-002 CERTIFICATION STATEMENT FOR DISPOSAL OF POLYETHYLENE HIGH INTEGRITY CONTAINERS, for each HIC liner to be shipped to CNSI.

6.16.6 Form FO-AD-002 CERTIFICATION STATEMENT FOR DISPOSAL OF POLYETHYLENE HIGH INTEGRITY CONTAINERS, must be included in the shipping paperwork package with the shipment.

6.16.7 Storage Conditions

NOTES

- **Containers stored out-of-doors in direct sunlight must be used within one year of fabrication.**
- **The design of the storage facility must preclude the possibility of a wet or damp environment and any prolonged exposure of the container to any source of ultraviolet light.**

1. Ensure that containers are stored out of direct sunlight (if possible) and away from any other sources of ultraviolet radiation.
2. Store all containers in such a way that the bottom is flat and that no weight is located over the manway/fill port area.
3. Each container shall be stored with its designated closure assemblies to prevent mismatching.
4. Following filling and closure of the container, it may be stored on-site prior to shipment for burial.

6.16.8 Inspection Prior To Use

1. Visually inspect thread and seal areas to verify they are free of foreign matter that could impair the seal or thread engagement.
2. Visually inspect the exterior surfaces for damage that may have occurred during transport or storage that could lessen container integrity.

6.16.9 Handling And Lift Requirements

NOTE

Due to the nature of the container material, some bowing and deformation may be evident during lifting.

1. Use only lift band(s), lift lugs and slings provided with the liner for lifting.

2. Inspect the underdrain assembly prior to use if the container was dropped or banged against another object.

6.17 Additional Barnwell Waste Management Facility Requirements

6.17.1 Each package of waste must be clearly labeled to identify whether it is Class A, Class B, or Class C waste, in accordance with 10 CFR 61.55.

6.17.2 All waste received at the Barnwell facility must be disposed in approved disposal overpacks.

6.17.3 Void spaces within the waste and between the waste and its packaging shall be reduced to the extent practicable, but in NO case shall the container be less than eighty-five percent (85%) full. This requirement is not applicable to waste in DHEC approved HICs and irradiated hardware containers.

NOTE

The South Carolina DHEC and CNSI recognize that filters and irradiated hardware will NOT routinely meet the 85% condition. Provided that containers of these waste types are packaged to the fullest extent practicable, no written justification is required.

6.17.4 The HPSR must apply for a variance request prior to shipment if the 85 percent fill requirement is NOT achievable.

6.17.5 Ensure that a copy of the Certificate of Compliance (C of C) for the approved High Integrity Container(s) as issued and amended by DHEC is on file with Barnwell Regulatory Affairs/Licensing Department.

7.0 RECORDS

7.1 The following QA Records are generated by this procedure.

7.1.1 Completed HIC USER'S CHECKLIST (FO-AD-002)

7.1.2 Completed CERTIFICATION STATEMENT FOR DISPOSAL OF POLYETHYLENE HIGH INTEGRITY CONTAINERS (FO-AD-002)

7.1.3 Completed PROCESS CONTROL PROGRAM CHANGE RECORD (APF 31A-100-04)

7.2 The following Non-QA Record is generated by this procedure.

7.2.1 Completed POLYETHYLENE HIGH INTEGRITY CONTAINER CERTIFICATION STATEMENT (FO-AD-002)

8.0 FORMS

8.1 FO-AD-002, HIC USER'S CHECKLIST

8.2 FO-AD-002, CERTIFICATION STATEMENT FOR DISPOSAL OF POLYETHYLENE HIGH INTEGRITY CONTAINERS

8.3 FO-AD-002, POLYETHYLENE HIGH INTEGRITY CONTAINER CERTIFICATION STATEMENT

8.4 APF 31A-100-04, PROCESS CONTROL PROGRAM CHANGE RECORD

- END -

ATTACHMENT A
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TECHNICAL SPECIFICATION AMENDMENT CHANGES

Solidification

The conversion of wet wastes into a form that meets shipping and burial ground requirements.

ADMINISTRATIVE CONTROLS AND REPORTING REQUIREMENTS

Limiting Condition of Operation

Radioactive wastes shall be solidified or dewatered in accordance with the Process Control Program to meet shipping and transportation requirements during transit, and disposal site requirement when received at the disposal site.

Applicability

At all times

Remedial Action

a. With solidification or dewatering not meeting disposal site and shipping and transportation requirements, suspend shipment of the inadequately processed wastes and correct the Process Control Program, the procedures and/or the Solid Wastes System as necessary to prevent recurrence.

b. With solidification or dewatering not performed in accordance with the Process Control Program, test the improperly processed waste in each container to ensure that it meets burial ground shipping requirements and take appropriate administrative action to prevent recurrence.

Surveillance Requirements

Solidification of at least one representative test specimen from at least every tenth batch of each type of wet radioactive wastes (e.g., filter sludges, spent resins, evaporator bottoms, boric acid solutions and sodium sulfate solutions) shall be verified in accordance with the Process Control Program:

ATTACHMENT A
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TECHNICAL SPECIFICATION AMENDMENT CHANGES

a. If any test specimen fails to verify solidification, the solidification of the batch under test shall be suspended until such time as additional test specimens can be obtained, alternative solidification parameters can be determined in accordance with the Process Control Program, and a subsequent test verifies solidification.

   Solidification of the batch may then be resumed using the alternative solidification parameters determined by the Process Control Program;

b. If the initial test specimen from a batch of waste fails to verify solidification, the Process Control Program shall provide for the collection and testing of representative test specimens from each consecutive batch of the same type of wet waste until at least three consecutive initial test specimens demonstrate solidification. The Process Control Program shall be modified as required, as provided in WCGS Technical Specifications 6.13 (TR 5.5.4), to assure solidification of subsequent batches of waste; and

c. With the installed equipment incapable of meeting this Administrative Control or declared out-of-service, restore the equipment to operable status or provide for contract capability to process wastes as necessary to satisfy all applicable transportation and disposal requirements.

Basis

This Administrative Control implements the requirements of 10 CFR 50.36.a and General Design Criteria 60 Appendix A to 10 CFR 50. The process parameters included in establishing the Process Control Program may include, but are not limited to, waste type, waste pH, waste/liquid/solidification agent/catalyst ratios, waste oil content, waste principal chemical constituents, and mixing and curing times.

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TECHNICAL SPECIFICATION AMENDMENT CHANGES

REPORTING REQUIREMENTS

Annual Radioactive Effluent Release Report

The Annual Radioactive Effluent Release Reports covering the operation of the unit during the previous calendar year shall be submitted before May 1 of each year. The report shall include a summary of the quantities of radioactive liquid, gaseous effluents and solid waste released from the Unit. The material provided shall be (1) consistent with the objectives outline in the ODCM and PCP, and (2) in conformance with 10 CFR 50.36a and Section IV.B.1 of Appendix I to 10 CFR Part 50.

Changes to the PCP

a. Shall be documented and records of reviews performed shall be retained for the duration of the Unit Operating License. This documentation shall contain:

   1. Sufficient information to support the change together with the appropriate analyses or evaluations justifying the change(s).

   2. The determination that the change will maintain the overall conformance of solidified waste product to existing requirements of Federal, State, or other applicable regulations.

b. Shall become effective after review and acceptance by the PSRC and the approval of the Plant Manager.

- END -