OFFSITE DOSE CALCULATION MANUAL - TABLE OF CONTENTS

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SECTION **PAGE**

1.0 RECORD OF REVISION

Revision No.	Date	Reason for Revision
1	December - 1998	Changed word “waste” to “effluent” in section 1.0, changed 1st sentence in section 2.0 to exact wording in T.S., added section 3.0 to reference section 1.0 word change to LAR 39.
2	October - 2000	Moved previous ODCM-03.01 (GASEOUS EFFLUENTS) into this section and renamed this section “GASEOUS EFFLUENTS CALCULATIONS” to facilitate moving the Radiological Effluents Tech Specs to the ODCM. Moved associated figures and tables into this section to make the section easier to use. Removed references to the unused MIDAS System. Revised references to the X/Q and D/Q values now located in Appendix A.
3	November - 2001	Replaced maximum acceptable flow rate in equation 2.1-9 (85.5 cfm) to the effluent flowrate at the Offgas Pretreatment Monitor.
4	January - 2004	Fixed typographical errors on equations 2.1-4, 2.5-4 and 2.5-5. Removed plant activity uptake through soil factors from equations 2.5-5, 2.5-7 and 2.5-9. This term models plant activity uptake through the soil. Experience has shown this to be an insignificant pathway and the NRC drops it from consideration in NUREG 0133. Removed reference to 10CFR20 in sections 2.0.B., 2.2.1, 2.2, 2.2.1 and 2.2.2. With the revision to 10CFR20, the connection between the 400 and 3000 mRem/yr dose rate limits for gaseous effluent monitor alarm setpoints was broken. These limits still exist, but they are Technical Specification only requirements. Moved sentence about real time x/Q and MIDAS XP computer program in section 2.2.3 to section 2.2.2 where it belongs. Added sentence about historical atmospheric dispersion factors (D/Q) being used to determine critical receptor to section 2.2.3.

2.0 GASEOUS EFFLUENT CALCULATIONS

This section describes the procedures used by MNGP to:

A. Determine alarm point settings for gaseous effluent monitors;

B. Determine that dose rates at the site boundary from noble gases, particulates, and iodines remain below the limits of Technical Specifications, and

C. Determine that the total dose from airborne effluents for the year is within the limits of Appendix I of 10CFR50.

The computations of this section may be done manually, by use of computer programs which implement these algorithms.

2.1 Monitor Alarm Setpoint Determination

This procedure determines the effluent monitor alarm setpoint that indicates if the dose rate at or beyond the site boundary due to noble gas radionuclides in the gaseous effluent released from the site exceeds 500 mrem/year to the whole body or exceeds 3000 mrem/year to the skin. Accident monitors are set to limit effluent releases to a small fraction of the limits specified in 10CFR100. In addition this section calculates the maximum activity permitted in each off-gas storage tank.

Monitor high alarm or isolation setpoints are established in one of the following ways:

1. Monthly calculation of setpoints using the methodology of Section 2.1.1 for noble gas nuclides in releases during the previous month.

2. Prior to each containment purge, recalculation of the setpoint using the methodology of Section 2.1.1 based on the sample taken prior to purging.

2.1.1 Effluent Monitors

Monitor alarm setpoints are determined to assure compliance with Technical Specifications. The setpoints indicate that the dose rate at or beyond the site boundary due to noble gas radionuclides in the gaseous effluent released from the site exceeds 500 mrem/year to the whole body or exceeds 3000 mrem/year to the skin.

Monitor alarm setpoints are calculated for the Reactor Building Ventilation Plenum Noble Gas monitors and the Stack Noble Gas monitors once per month. These calculations are based on the noble gas isotopes in releases made during the previous month. The calculations are performed by the DOSGAS computer program.

In addition, prior to containment purging, the monitor setpoint for the monitor release point is recalculated. This calculation is performed by the DWCAL computer program. The monitor setpoint is determined as follows:

1. If no detectable noble gas activity is found in the purge sample, the values used as the basis for the alarm point setting are from the column, “Drywell purging” in Table 1, Gaseous Source Terms.

2. If any calculated setpoint is less than the existing monitor setpoint, the setpoint is reduced to the new value.

3. If the calculated setpoint is greater than the existing monitor setpoint, the setpoint may remain at the lower value or be increased to the new value.

4. The setpoint during purging may not be increased above the setpoint determined for continuous releases, however.

Except for containment inerting and deinerting, all containment purging and venting is done via the standby gas treatment system and plant stack. Containment inerting and deinerting releases are made via the Reactor Building vent. The small amount of containment atmosphere released by the containment sampling system on a continuous basis is not considered a venting operation.

A. Reactor Building Vent Alarm Setpoint

The following method applies to gaseous releases via the Reactor Building vent when determining the high-high alarm setpoint for the Reactor Building Vent Noble Gas Monitor . This method is applied to both continuous releases and batch releases (containment inerting and deinerting).

1. Determine the “mix” (noble gas radionuclides and composition) of the gaseous effluent.

   a. Determine the gaseous source terms that are representative of the “mix” of the gaseous effluent. Gaseous source terms are the total curies of each noble gas released during the previous month or a representative analysis of the gaseous effluent. Table 1 source terms may be used if the Reactor Building releases for the previous month were below the lower limits of detection (LLD), or, in the case of inerting and deinerting releases, no detectable activity was found in the grab sample taken prior to purging.

b. Determine S_i, the fraction of the total radioactivity in the gaseous effluent comprised by noble gas radionuclide "i", for each individual noble gas radionuclide in the gaseous effluent.

$$S_i = \frac{A_i}{\sum_i A_i} \qquad 2.1\text{-}1$$

where

A_i = The radioactivity of noble gas radionuclide "i" in the gaseous effluent.

2. Determine Q_t, the maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent (μCi/sec), based upon the whole body exposure limit (500 mrem/yr).

$$Q_t = \frac{500}{(\chi/Q)_v \sum_i K_i S_i} \qquad 2.1\text{-}2$$

where

$(\chi/Q)_v$ = The highest calculated average relative concentration of effluents released via the Reactor Building vent for any area at or beyond the site boundary for all sectors (sec/M^3) from Appendix A, Table 3. For purge releases, substitute the value obtained from Chemistry Manual Procedure I.6.07 (ATMOSPHERIC DISPERSION DETERMINATION).

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide "i" (mrem/year/μCi/m^3) from Table 2.

3. Determine Q_t based upon the skin exposure limit (3000 mrem/yr).

$$Q_t = \frac{3000}{(\chi/Q)_v \sum_i (L_i + 1.1\, M_i)\, S_i} \qquad 2.1\text{-}3$$

where

$L_i + 1.1\ M_i$ = the total skin dose factor due to emissions from noble gas radionuclide "i" (mrem/year/μCi/m^3) from Table 2.

4. Determine HHSP (the monitor high-high alarm setpoint above background (net μCi/sec)).

<u>NOTE</u>: Use the <u>lower</u> of the Q_t values obtained in Sections 2.1.1.A.2. and 2.1.1.A.3.

$$\text{HHSP} = 0.50\, Q_t \qquad 2.1\text{-}4$$

0.50 = Fraction of the total radioactivity from the site via the monitored release point to ensure that the site boundary limit is not exceeded due to simultaneous releases from several release points.

B. Stack Isolation Setpoint

The following method applies to gaseous releases via the Stack when determining the high-high alarm setpoint for the Stack Gas Monitor which initiates isolation of Stack releases. The method is applied to both continuous releases and batch releases (containment purges). Mechanical vacuum pump releases (relatively insignificant) will be controlled using the continuous setpoint.

1. Determine the "mix" (noble gases and composition) of the gaseous effluent.

   a. Determine the gaseous source terms that are representative of the "mix" of the gaseous effluent. Gaseous source terms are the total curies of each noble gas released during the previous month or a representative analysis of the gaseous effluent. Table 1 source terms may be used if the Stack releases for the previous month were below the lower limits of detection (LLD).

b. Determine S_i, the fraction of the total radioactivity in the gaseous effluent comprised by noble gas radionuclide "i", for each individual noble gas radionuclide in the gaseous effluent.

$$S_i = \frac{A_i}{\sum_i A_i} \qquad 2.1\text{-}5$$

where

A_i = The radioactivity of noble gas radionuclide "i" in the gaseous effluent.

2. Determine Q_t, the maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent (μCi/sec), based upon the whole body exposure limit (500 mrem/yr).

$$Q_t = \frac{500}{\sum_i V_i S_i} \qquad 2.1\text{-}6$$

<u>NOTE</u>: For short-term batch releases (equal to or less than 500 hrs/yr) via drywell purging, substitute v_i for V_i in Equation 2.1-6.

where

V_i = The constant for long-term releases (greater than 500 hr/yr) for noble gas radionuclide "i" accounting for the gamma radiation from the elevated finite plume (mrem/year/μCi/sec) from Table 2.

v_i = The constant for short-term releases (equal to or less than 500hr/yr) for noble gas radionuclide "i" accounting for the gamma radiation from the elevated finite plume (mrem/yr/μCi/sec) from Table 2.

3. Determine Q_t based upon the skin exposure limit (3000 mrem/yr).

$$Q_t = \frac{3000}{\Sigma_i \left(L_i (\chi/Q)_s + 1.1 B_i\right) S_i} \qquad 2.1\text{-}7$$

NOTE: For short-term batch releases (equal to or less than 500 hours per year) via drywell purging, use the short-term $(\chi/q)_s$ value and substitute b_i for B_i in Equation 2.1-7.

where

$L_i(\chi/Q)_s + 1.1B_i$ = The total skin dose constant for long-term releases (greater than 500 hours per year) due to emissions from noble gas radionuclide "i", Table 2, (mrem/year/μCi/sec);

$L_i(\chi/q)_s + 1.1b_i$ = The total skin dose constant for short-term releases (less than or equal to 500 hours per year) due to emissions from noble gas radionuclide "i", Table 2, (mrem/year/μCi/sec).

4. Determine HHSP (the monitor high-high alarm setpoint above background (μCi/sec).

NOTE: Use the lower of the Q_t values obtained in sections 2.1.1.B.2. and 2.1.1.B.3.

$$HHSP = 0.50\ Q_t \qquad 2.1\text{-}8$$

0.50 = Fraction of the total radioactivity from the site via the monitored release point to ensure that the site boundary limit is not exceeded due to simultaneous releases from several release points.

2.1.2 Accident Monitors

The gross radioactivity in noble gases removed from the main condenser by means of steam jet air ejectors as measured prior to entering the treatment, adsorption, and delay systems ***SHALL*** be limited by an alarm setpoint for the Offgas Monitor.

This procedure determines the monitor alarm setpoint that indicates if the potential body accident dose to an individual at or beyond the site boundary due to noble gas radionuclides in the gaseous effluent released from the site exceeds a small fraction of the limits specified in 10CFR100 in the event this effluent, including the radioactivity accumulated in the treatment system, is inadvertently discharged directly to the environment without treatment. This calculation is performed by the OFFGAS computer program on a routine or an as needed basis. Offgas flow is automatically terminated when this setpoint is reached.

A. Maximum Release Rate

Determine Q_t, the maximum acceptable total release rate in μCi/sec of all noble gas radionuclides in the gaseous effluent at the Offgas Monitor after a 5-minute decay, based on the maximum acceptable total release rate of 2.60E5 μCi/sec after a 30-minute decay.

1. Determine the offgas mixture of the gaseous effluent. The offgas mixture is the fraction of the offgas noble gas radioactivity caused by each recoil diffusion, and equilibrium component. The offgas mixture is determined at least once per month.

2. Determine Q_t based on the offgas mixture using Table 3. This table was prepared using a variation of the EBARR computer code.

B. Maximum Concentration

Determine C_t, the maximum acceptable total radioactivity concentration of all noble gas radionuclides in the gaseous effluent (μCi/cc).

$$C_t = 2.12\text{ E-03 } \frac{Q_t}{f} \qquad 2.1\text{-}9$$

where

f = The effluent flowrate at the Offgas Pretreatment Monitor (cfm);

C. Monitor Reading

Determine C.R., the calculated monitor reading above background attributed to the noble gas radionuclides (mR/hr).

$$C.R. = \frac{C_t}{E} \qquad 2.1\text{-}10$$

where

E = The detection efficiency of the monitor for noble gas radionuclides represented in main condenser offgas (μCi/cc/mR/hr) from Plant Chemistry Surveillance procedures.

D. Monitor High High Setpoint

The monitor high-high alarm setpoint above background (mr/hr) should be set at or below the C.R. value.

2.1.3 Offgas Storage Tank Maximum Activity

The maximum activity in each storage tank is limited to less than 22,000 curies of noble gas (considered as dose equivalent Xe-133) after 12 hours of holdup. To verify that this limit is not exceeded, Table 3 is used.

The gross radioactivity of noble gases from the main condenser air ejector is determined by isotopic analysis monthly and whenever a significant increase in offgas activity is noted. Analysis of this data is used to determine the primary mode of fission product release from the fuel (recoil, equilibrium, or diffusion) and the gross release rate. This information combined with the condenser air inleakage rate (cfm) and the air ejector monitor release rate is used to confirm that the maximum tank contents limit is not exceeded. This calculation is performed by the OFFGAS computer program on a routine or as needed basis.

Table 3 is entered with the offgas mixture (fraction recoil, diffusion, and equilibrium rounded to one decimal place) and the air inleakage rate (in cfm). The resulting tank activity is multiplied by the current total release rate after a 30 minute decay (μCi/sec) and divided by the maximum permitted air ejector release rate of 260,000 μCi/sec. Linear interpolation of air inleakage is used.

As noted earlier, Table 3 is derived from the EBARR computer program described in Section 2.4. It is extremely unlikely that the maximum tank activity limit will be exceeded.

2.2 Gaseous Effluent Dose Rate - Compliance With Technical Specifications

Dose rates resulting from the release of noble gases, and from radioiodines and particulates must be calculated to show compliance with 10CFR20. The dose rate limits of Technical Specifications are conservatively applied on an instantaneous basis at the hypothetical worst case location.

2.2.1 Noble Gases

The dose rate in unrestricted areas resulting from noble gas effluents is limited to 500 mrem/yr to the total body and 3000 mrem/yr to the skin. The setpoint determinations discussed in the previous section are based on the dose rate calculation method presented in NUREG-0133(4). This represents a backward solution to the limiting dose rate equations in NUREG-0133. Setting alarm trip setpoints in this manner will ensure that the limits of Technical Specifications are met for noble gas releases. Therefore, no routine dose rate calculations for noble gases will be needed to show compliance with this part. Routine calculations are made for dose rates from noble gas releases to show compliance with 10CFR50, Appendix I by performing the DOSGAS computer program.

2.2.2 Radioiodine and Radioactive Particulates and Other Radionuclides

The dose rate in unrestricted areas resulting from the release of radioiodines and particulates with half lives greater than 8 days is limited by Technical Specifications to 1500 mrem/yr to any organ. The calculation of dose rate from radioiodines and particulates is performed for drywell purges prior to the release and weekly for all releases. This calculation is performed by the DWCAL computer program for drywell purges and 1/week by the IPART computer program for all releases. The calculations are based on the results of analyses obtained pursuant to Surveillance Requirement 3.1.4.B. To show compliance with Technical Specifications, Equation 2.2-1 will be evaluated for I-131, I-133, tritium, and radioactive particulates with half lives greater than eight days.

$$\Sigma P_{i_I} [(\chi/Q_v) Q_{iv} + (\chi/Q_s) Q_{is}] < 1500 \text{ mrem/yr} \qquad 2.2\text{-}1$$

where

P_{i_I} = child critical organ dose parameter for radionuclide i for the inhalation pathway, mrem/yr per $\mu Ci/m^3$; (Table 4)

$(\chi/Q)_v$ = annual average relative concentration for long-term release from the Reactor Building vent at the critical location, sec/m^3 (Appendix A, Table 3);

$(\chi/Q)_s$ = annual average relative concentration for long-term releases from the offgas stack at the critical location, sec/m_3 (Appendix A, Table 6);

Q_{iv} = the release rate of radionuclide i from the Reactor Building vent for the week of interest, μCi/sec;

Q_{is} = the release rate of radionuclide i from the offgas stack for the week of interest, μCi/sec.

The χ/Q values presented in Appendix A, Tables 3 and 6 have been calculated using the USNRC computer code “XOQDOQ”(5). Dose rate calculations using Equation 2.2-1 are made once per week. The source terms Q_{iv} and Q_{is} are determined from the results of analysis of weekly stack and Reactor Building particulate filters and charcoal cartridges. These source terms include all gaseous releases from MNGP. They are recorded and reported as the total dose for compliance with Technical Specifications.

Radioiodines and particulates may be released from both the offgas stack and the Reactor Building vent. As specified in NUREG-0133, the critical receptor location is identified based on the Reactor Building vent χ/Q.

A component of the total stack or vent source term may be due to short term releases occurring as a result of containment drywell purging. Dose rate calculations are made on this component separately to further assure compliance with Technical Specifications prior to release. The calculated dose rate is used only to determine whether or not the drywell can be purged. All dose rates from drywell purges will be accounted for and reported through the weekly calculations discussed above. Release rates are determined from the results of analyses of samples from the drywell. The real time atmospheric dispersion factor (χ/Q) is calculated by performing the MIDAS XP Computer Program IAW MNGP Procedure I.06.07 (ATMOSPHERIC DISPERSION DETERMINATION).

The term Q_{is} for the calculation of drywell purge dose rate is determined by multiplying the concentration of each nuclide in the drywell by the rate of release. Credit will be taken for the expected reduction in radionuclide concentration due to use of the standby gas treatment system. Equation 2.2-2 is used to calculate purge dose rates. Only one source term is used depending on the release point (stack or Reactor Building vent). Short term values of χ/q from Appendix A, Table 9 or Table 12 are used in the purge dose rate calculation. the limiting dose rate limit for each purge is determined using:

$$BL = 1500 - (D_{cv} + D_{cs} - D_{dw}) \qquad 2.2\text{-}2$$

where

BL = limiting dose rate for the batch, mrem/yr;

D_{cv} = previous week’s dose rate from Reactor Building continuous and batch releases, mrem/yr;

D_{cs} = previous week's dose rate from offgas stack continuous and batch releases, mrem/yr;

D_{dw} = previous week's total dose rate from drywell purge releases, mrem/yr, for the purge release point.

Although mechanical vacuum pump releases are batch mode, they cannot be sampled prior to release. For this reason, no prerelease dose rate calculations can be made from this source. Experience has shown mechanical vacuum pump release to be well within Technical Specifications limits.

2.2.3 Critical Receptor Identification

As stated in 5.2.1 of NUREG-0133, when the critical receptor is different for stack and vent releases, the controlling location for vent releases should be used. For this reason, the Reactor Building vent dispersion parameters are used to identify the critical receptor. (Historical Atmospheric Dispersion factors (D/Q) are used for determining the critical receptor (App A, Table 5).) As discussed previously, weekly and batch dose rate calculations are performed for the critical boundary location. The critical boundary location is based on reactor vent long term χ/Q (Appendix A, Table 3) is 0.43 miles in the SSE sector.

2.3 Gaseous Effluents - Compliance With 10CFR50

Doses resulting from the release of noble gases, and radioiodines and particulates must be calculated to show compliance with Appendix I of 10CFR50. The calculations are performed monthly for all gaseous effluents. Calculations of the doses received due to the release of noble gases is performed by the DOSGAS computer program. Similarly the dose received due to the release of radioiodines and particulates is calculated by the DOSPIT computer program. These two programs are performed monthly or as required.

This section describes the methods and equations used at MNGP to perform the dose evaluation using manual methods based on historical meteorological dispersion parameters.

2.3.1 Noble Gases

The air dose in unrestricted areas at MNGP is limited to:

A. for any calendar quarter:

$D_\gamma \leq$ 5 mrad due to gamma radiation; and
$D_\beta \leq$ 10 mrad due to beta radiation; and

B. for any calendar year:

$D_\gamma \leq$ 10 mrad due to gamma radiation; and
$D_\beta \leq$ 20 mrad due to beta radiation.

Air doses may be calculated using historical meteorological data using the highest normalized concentration statistics as the best estimator of the atmospheric dispersion.

A. Air Dose Based on Historical Meteorology

The limiting air dose, D, based on historical meteorology is based on the critical receptor in the unrestricted area. For air doses the critical receptor is described by the off-site location with the highest long term annual average relative concentration (χ/Q) at or beyond the restricted area boundary. For short-term vent releases (less than 500 hours per year), the location with the highest short-term average relative concentration (χ/q) is chosen. The critical receptor is described in section 2.3.5.

For gamma radiation, the air dose is given by:

$$D_\gamma = 3.17 \times 10^{-8} \sum_i \left(M_i[(\chi/Q)_v Q_{iv} + (\chi/q)_v \; q_{iv}] + B_i Q_{is} + b_i q_{is}\right) \qquad 2.3\text{-}1$$

The historical meteorological data base is the basis for the method described in the original MNGP ODCM.

For beta radiation, the air dose is:

$$D_\beta = 3.17 \times 10^{-8} \sum_i N_i \left[(\chi/Q)_v Q_{iv} + (\chi/q)_v q_{iv} + (\chi/Q)_s Q_{is} + (\chi/q)_s q_{is}\right] \qquad 2.3\text{-}2$$

where

M_i = The air dose factor due to gamma emission for each identified noble gas radionuclide i, mrad/yr per μCi/m^3; (Table 5)

N_i = the air dose factor due to beta emissions for each identified noble gas radionuclide i, mrad/yr per μCi/m^3; (Table 5)

$(\chi/Q)_v$ = the annual average relative concentration for areas at or beyond the site boundary for long-term Reactor Building vent releases (greater than 500 hr/yr), sec/m^3, (Appendix A, Table 3);

$(\chi/q)_v$ = the relative concentration for areas at or beyond the site boundary for short-term Reactor Building vent releases (equal to or less than 500 hr/yr), sec/m^3, (Appendix A, Table 12);

$(\chi/Q)_s$ = the annual average relative concentration for areas at or beyond the site boundary for long-term offgas stack releases (greater than 500 hr/yr), sec/m^3 (Appendix A, Table 6);

$(\chi/q)_s$ = the relative concentration for areas at or beyond the site boundary for short-term offgas stack releases (equal to or less than 500 hr/yr), sec/m^3 (Appendix A, Table 9);

q_{is} = the average release of the noble gas radionuclide i in gaseous effluents for short-term offgas stack releases (equal to or less than 500 hr/yr), μCi;

q_{iv} = the average total release of the noble gas radionuclide i in gaseous effluents for short-term Reactor Building vent releases (equal to or less than 500 hr/yr), μCi;

Q_{is} = the total release of noble gas radionuclide i in gaseous releases for long-term offgas stack releases (greater than 500 hr/yr), μCi;

Q_{iv} = the total release of noble gas radionuclide i in gaseous effluents for long-term Reactor Building vent releases (greater than 500 hr/yr), μCi;

B_i = the constant for long-term releases (greater than 500 hr/yr) for each identified noble gas radionuclide i accounting for the gamma radiation from the elevated finite plume, mrad/yr per μCi/sec (Table 6);

b_i = the constant for short-term releases (less than or equal to 500hr/yr) for each identified noble gas radionuclide i accounting for the gamma radiation from the elevated finite plume, mrad/yr per μCi/sec (Table 6);

$3.17 \times 10_{-8}$ = the inverse of the number of seconds in a year.

Noble gases are continuously released from the Reactor Building vent and the plant stack. These long-term releases rates are determined from the continuous noble gas monitor readings and periodic radionuclide analyses. There are infrequent containment purges from either release point. To separate the short-term release from the long term release (the continuous monitor records both), the drywell source term should be subtracted from the total source term whenever a purge release occurs. Periodic radionuclide analysis of main condenser offgas and radionuclide analysis of each purge prior to release are used in conjunction with the total activity measured by the monitor to quantify individual noble gas nuclides released.

Long-term and short-term χ/Q's are given in Appendix A for both the Reactor Building vent and the plant stack. Short-term χ/q's were calculated using the USNRC computer code "XOQDOQ" assuming 144 hours per year drywell purge. Values of M and N were calculated using the methodology presented in NUREG-0133 and are given in Table 5. Table 6 presents values of B_i and b_i calculated using the USNRC computer code "RABFIN." This code was also used to calculate values of V_i presented in section 1.0. Values of v_i, were calculated by multiplying V_i by the ratio of b_i to B_i. The v_i, iB_i, and b_i values of Table 6 are the maximum values for the site boundaries location. This location, 0.51 mi SSE, is different than the critical site boundary location based upon the Reactor Building vent χ/Q.

2.3.2 Radioiodine, Particulates, and Other Radionuclides

The dose, D_{aj}, to an individual from radioiodines, radioactive materials in particulate form and radionuclides other than noble gases with half lives greater than eight days in gaseous effluents released to unrestricted areas ***SHALL*** be limited to:

$D_{aj} \leq$ 7.5 mrem for any calendar quarter

$D_{aj} \leq$ 15 mrem for any calendar year

These limits apply to the receptor location where the combination of existing pathways and age groups indicates the maximum exposure.

A. Dose from Radioiodines and Particulates Based on Historical Meteorology

The worst case dose to an individual from I-131, tritium and radioactive particulates with half-lives greater than eight days in gaseous effluents released to unrestricted areas is determined by the following expressions:

$$D_{aj} = 3.17 \text{ X } 10^{-8} \sum_{pi}\sum R_{iapj} \left[W_v Q_{iv} + W_v q_{iv} + W_s Q_{is} + W_s q_{is}\right] \qquad 2.3\text{-}3$$

where

Q_{is} = release of radionuclide i for long-term offgas stack releases (greater than 500 hr/yr), μCi;

Q_{iv} = release of radionuclide i for long-term Reactor Building vent releases (greater than 500 hr/yr), μCi;

q_{is} = release of radionuclide i for short-term offgas stack purge releases (equal to or less than 500 hr/yr); μCi;

q_{iv} = release of radionuclide i for short-term Reactor Building vent purge releases (equal to or less than 500 hr/yr); μCi;

W_s = the dispersion parameter for estimating the dose to an individual at the controlling location for long-term offgas stack releases (greater than 500 hr/yr), sec/m^3 or m^{-2};

W_v = the dispersion parameter for estimating the dose to an individual at the controlling location for long-term Reactor Building vent releases (greater than 500 hr/yr), sec/m^3 or m^{-2};

W_s = the dispersion parameter for estimating the dose to an individual at the controlling location for short-term offgas stack releases (equal to or less than 500 hr/yr), sec/m^3 or m^{-2};

W_v = the dispersion parameter for estimating the dose to an individual at the controlling location for short-term Reactor Building vent releases (equal to or less than 500 hr/yr), sec/m^3 or m^{-2}

3.17×10^{-8} = the inverse of the number of seconds in a year.

R_{iapj} = the dose factor for each identified radionuclide i, pathway p, age group a, and organ j, m^2 mrem/yr per μCi/sec or mrem/yr per μCi/m^3.

The above equation is applied to each combination of age group and organ. Values of R_{iapj} have been calculated using the methodology given in NUREG-0133 and are given in Tables 7 through 25. The equation is applied to a controlling location which will be one of the following:

A. residence,

B. vegetable garden,

C. milk animal.

The selection of the actual receptor is discussed in section 2.3.5. The W values are in terms of χ/Q (sec/m^3) for the inhalation pathways and for tritium and in terms of D/Q (m^{-2}) for all other pathways.

Section 2.5.2 contains the methodology for calculating R_{iapj} values. This method will be used to compute dose factors for nuclides not tabulated in Tables 7 through 25 if they are encountered.

2.3.3 Cumulation of Doses

Doses calculated monthly are summed for comparison with quarterly and annual limits. The monthly results are added to the doses cumulated from the other months in the quarter of interest and in the year of interest and compared to the limits given in section 2.3.1 and 2.3.2. This summation is performed by the DOSGAS and the DOSPIT computer programs for doses from exposures due to noble gas, and radioiodine and particulates respectively. If these limits are exceeded, a Special Report will be submitted to the USNRC. If twice the limits are exceeded, a Special Report showing compliance with 40CFR190[9] will be submitted.

2.3.4 Projection of Doses

Projection of doses is not necessary. The ODCM requires the offgas holdup system to be operated at all times.

2.3.5 Critical Receptor Identification

The critical receptors for compliance with 10CFR50, Appendix I will be identified. For the noble gas specification the critical location is based on the external dose pathway only. This location is the off-site location with the highest long-term Reactor Building vent χ/Q and is selected using the χ/Q values given in Appendix A, Table 4. The critical receptor location is used for showing compliance with 10CFR20 and remains the same unless meteorological data is re-evaluated or the site boundary changes.

The critical location for the radioiodine and particulate pathway is selected once per year. This selection follows the annual land use census performed within 5 miles of the MNGP. Each of the following locations is evaluated as a potential critical receptor before implementing the effluent technical specifications:

A. Residences in each sector.

B. Vegetable garden producing leafy green vegetables.

C. All identified milk animal locations.

The critical receptor is selected based on this evaluation.

Following the annual survey, doses are calculated using Equation 2.3-3 for all newly identified receptors and those receptors whose characteristics have changed significantly. The calculation includes appropriate information shown to exist at each location. The dispersion parameters given in this manual should be employed. The total releases reported for the previous calendar year should be used as the source term.

2.4 Summary of EBARR Computer Program

The basic task performed by EBARR is to predict the offgas composition and activity at various stages of waste gas treatment and at the time of release (Table 26). The basic data supplied to EBARR consists of the release rate, in μCi/sec measured at the SJAE, of six readily measurable fission product noble gases: Xe-133, Xe-135, Kr-85M, Kr-88, Kr-87, and Xe-138. There are nine other noble gases of interest from a radioactive effluent point of view. They are: Kr-90, Xe-139, Kr-89, Xe-137, Xe-135m, Kr-83m, Xe-133m, Xe-131m, and Kr-85. Many of these nine gases are not directly measurable in the presence of the others. By establishing the offgas release mode from the six measured release rates, EBARR computes the release rates of the other nine gases known to be present.

The first step performed by EBARR is to correct the release rates of the six measured noble gases for decay during their transit from the reactor vessel to the SJAE:

$$A_i(0) = A_i(t_{dly}) \quad e^{\lambda_i t_{dly}} \qquad 2.4\text{-}1$$

where

$A_i(t)$ = release rate of noble gas i at the time t after leaving reactor, μCi/sec;

t_{dly} = transit time from reactor to SJAE, sec;

λ_i = decay constant of noble gas i, sec^{-1}.

EBARR then uses a least square fitting routine to determine the values of B_1, B_2, and B_3 giving the best fit to $A_1(0)$ through $A_6(0)$ in the equation:

$$\log \left| \frac{A_i}{y_i \lambda_i} \right| = \log \left| B_1 + \frac{B_2}{\sqrt{\lambda_i}} + \frac{B_3}{\lambda_i} \right| \qquad 2.4\text{-}2$$

where

y_i = fraction of all fissions yielding noble gas i.

This equation consists of three terms; a recoil release mode term, a diffusion release mode term, and an equilibrium release mode term. This is the standard General Electric offgas distribution model.

The values of B_1, B_2, and B_3, are used by EBARR to characterize the offgas release mechanism in terms of percent recoil, percent diffusion, and percent equilibrium type release. This characterization is useful in fuel performance evaluation. The equation for these three fractions are:

$$\% \text{ Recoil} = 100 \text{ X } \frac{\sum_{i=1,6} B_1 y_i \lambda_i}{\sum_{i=1,6} (B_1 y_i \lambda_i + B_2 y_i \sqrt{\lambda_i} + B_3 y_i)} \qquad 2.4\text{-}3$$

$$\% \text{ Diffusion} = 100 \text{ X } \frac{\sum_{i=1,6} B_2 y_i \sqrt{\lambda_i}}{\sum_{i=1,6} (B_1 y_i \lambda_i + B_2 y_i \sqrt{\lambda_i} + B_3 y_i)} \qquad 2.4\text{-}4$$

$$\% \text{ Equilibrium} = 100 \text{ X } \frac{\sum_{i=1,6} B_3 y_i}{\sum_{i=1,6} (B_1 y_i \lambda_i + B_2 y_i \sqrt{\lambda_i} + B_3 y_i)} \qquad 2.4\text{-}5$$

The release rate from the reactor vessel for the nine noble gases not measured is then:

$$A_i(0) = B_1 y_i \lambda_i + B_2 y_i \sqrt{\lambda_i} + B_3 y_i \qquad 2.4\text{-}6$$

At any time, t, after leaving the reactor vessel the release rate is:

$$A_i(t) = A_i(0)\, e^{-\lambda_i t_i} \quad \text{, for i = 3 through 14} \qquad 2.4\text{-}7$$

and

$$A_i(t) = A_i(0)\, e^{-\lambda_i t} + \frac{\propto_i \lambda_i A_j(0)}{\lambda_i - \lambda_j} \left(e^{-\lambda_j t} - e^{-\lambda_i t}\right) \text{, for 1 = 1, 2, and 15} \qquad 2.4\text{-}8$$

where

$\propto_i$ = fraction of disintegrations of isotope j producing isotope i.

Equation (2.4-8) contains an additional factor to account for the decay of Xe-131m to Xe-133, Xe-135m to Xe-135, and Kr-85m to Kr-85. This factor is normally small.

As shown in Table 26, the plant stack noble gas release consists of three components:

A. main condenser non-condensibles;

B. gland exhaust; and

C. stack dilution air drawn from Reactor and Turbine Buildings.

Source C is considered to be negligible compared to sources A and B. The composition of the gland exhaust release is assumed to be identical to the offgas mixture at the SJAE. Therefore, the stack release rate of isotope i is:

$$R_i(t) = A_i(t) + F_{loc}A_i(t_{dly}) \qquad 2.4\text{-}9$$

where

F_{loc} = fraction of main steam flow diverted to gland seal steam supply and the total noble gas release rate at any time is:

$$R_{tot}(t) = \sum_{i=1,\,15} [A_i(t) + F_{loc}A_i\ (t_{dly})] \qquad 2.4\text{-}10$$

EBARR also performs a secondary task of computing the compressed offgas storage tank contents in terms of dose equivalent Xe-133. Control 2.4.1.B in ODCM-03.01 limits this quantity to 22,000 Curies 12 hours after placing a tank in storage (when the discharge valve interlock permits the tank to be released).

Prior to reaching the storage tanks (Table 26), the offgas stream is delayed several hours flowing from the recombiners to the compressors via the 42-inch holdup pipe. Offgas reaching the tanks is therefore delayed by:

$$t_{ddly} = t_{dly} + \frac{P_{42}V_{42}}{P_aL} \qquad 2.4\text{-}11$$

where

V_{42} = 42-inch pipe volume;

P_{42} = 42-inch pipe pressure;

L = total air inleakage, SCFM, (Bleed air and condenser inleakage);

P_a = atmospheric pressure.

While a tank is being filled, offgas enters the tank at rate L. The activity of each isotope in the tank, C_i, is a function of time from the start of filling, t_f, is computed by EBARR using.

$$C_i(t_f) = \frac{A_i(t_{ddly})}{\lambda_i} \left(1 - e^{-\lambda_i t_f}\right) \text{ for i = 3 to 14} \qquad 2.4\text{-}12$$

and

$$C_i(t_f) = \frac{A_i(t_{ddly})}{i} \left(1 - e^{-\lambda_i t_f}\right) + \frac{\alpha_i \lambda_i A_j(t_{ddly})}{\lambda_j} \left[\frac{e^{-\lambda_i t_f} - e^{-\lambda_j t_f}}{\lambda_i - \lambda_j} + \frac{1 - e^{-\lambda_i t_f}}{\lambda_i}\right]$$

$$\text{for i = 1, 2, and 15} \qquad 2.4\text{-}13$$

Equation 2.4-13 contains an additional factor to account for the decay of Xe-133m to Xe-133, Xe-135m to Xe-135, and Kr-85m to Kr-85. This factor is normally small.

Pressure builds up in the tank at the rate:

$$p(t_f) = \frac{t_f L\, P_a}{V_{tk}} \qquad 2.4\text{-}14$$

where

V_{tk} = volume of storage tank.

When the pressure in the tank reaches the design value, P_{max}, at t_{fill}, EBARR assumes the tank is full. Total tank activity, C, and total tank Xe-133 dose equivalent activity, D, is computed at t_{rel} when the interlock on the tank discharge valve permits the tank to be released after an additional delay of t_{intk}:

$$t_{fill} = \frac{P_{max} V_{tk}}{P_a L} \qquad 2.4\text{-}15$$

$$t_{rel} = t_{fill} + t_{intk} \qquad 2.4\text{-}16$$

$$C_i(t_{rel}) = C_i(t_{fill})\, e^{-\lambda_i t_{intk}} \text{, for i = 3 through 14} \qquad 2.4\text{-}17$$

and

$$C_i(t_{rel}) = (C_i(t_{fill})\, e^{-\lambda_i t_{intk}} + \frac{\alpha_i \lambda_i\, C_j(t_{fill})}{\lambda_i - \lambda_j} \left(e^{-\lambda_j t_{intk}} - e^{-\lambda_i t_{intk}}\right) \text{ for i = 1, 2, and 15}$$

$$2.4\text{-}18$$

$$C(t_{rel}) = \sum_{i=1,15} C(t_{rel}) \qquad 2.4\text{-}19$$

$$D(t_{rel}) = \frac{\sum_{i=1,15} C_i(t_{rel})\, K_i}{K_i} \qquad 2.4\text{-}20$$

where

K_i = value of K_i for Xe-133 (i = 1) from Table 5.

The minimum offgas holdup time is:

$$t_{holdup} = t_{ddly} + t_{rel} \qquad 2.4\text{-}21$$

When the system is operating normally; however, with all five holdup tanks in service, the holdup time is given by:

$$t_{holdup} = t_{ddly} + 4\, t_{fill} \qquad 2.4\text{-}22$$

2.5 Dose Parameters for Radioiodines, Particulates and Tritium

This section contains the methodology which was used to calculate the dose parameters for radioiodines, particulates, and tritium to show compliance with 10CFR20 and Appendix I of 10CFR50 for gaseous effluents. These dose parameters, P_i and R_i were calculated using the methodology outlines in NUREG-0133 along with Regulatory Guide 1.109 Revision 1. The following sections provide the specific methodology which was utilized in calculating the P_i and R_i values for the various exposure pathways.

2.5.1 Calculation of P_i

The parameter, P_i, contained in the radioiodine and particulates portion of Section 2.2, includes pathway transport parameters of the ith radionuclide, the receptor's usage of the pathway media and the dosimetry of the exposure. Pathway usage rates and the internal dosimetry are functions of the receptor's age; however, the child age group will always receive the maximum dose under the exposure conditions assumed.

A. Inhalation Pathway

$$P_{i_I} = K' \, (BR) \, DFA_i \qquad 2.5\text{-}1$$

where

P_{i_I} = dose parameter for radionuclide i for the inhalation pathway, mrem/yr per $\mu Ci/m^3$;

K' = a constant of unit conversion,

= 10^6 pCi/μCi;

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

DFA_i = the maximum organ inhalation dose factor for the child age group for radionuclide i, mrem/pCi.

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 Revision 1. 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. The total body is considered as an organ in the selection of DFA_i.

The incorporation of breathing rate of the child and the unit conversion factor results in the following:

$$P_{i_I} = 3.7E9 \text{ X } DFA_i \qquad 2.5\text{-}2$$

2.5.2 Calculation of R_i

The radioiodine and particulate Control 2.3.1.A. is applicable to the location in the unrestricted area where the combination of existing pathways and receptor age groups indicates the maximum potential exposure occurs. The inhalation and ground plane exposure pathways ***SHALL*** be considered to exist at all locations. The grass-goat-milk, the grass-cow-milk, grass-cow-meat, and vegetation pathways are considered based on their existence at the various locations. R_i values have been calculated for the adult, teen, child, and infant age groups for the ground plane, cow milk, goat milk, vegetable and beef ingestion pathways. The methodology which was utilized to calculate these values is presented below.

A. Inhalation Pathway

$$R_{i_I} = K'(BR)_a\,(DFA_i)_a \qquad 2.5\text{-}3$$

where

R_{i_I} = dose factor for each identified radionuclide i of the organ of interest, mrem/yr per $\mu Ci/m^3$;

K' = a constant of unit conversion,

= 10^6 pCi/μCi;

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

$(DFA_i)_a$ = organ inhalation dose factor for radionuclide i for the receptor of age group a, mrem/pCi.

The breathing rates $(BR)_a$ for the various age groups are tabulated below, as given in Table E-5 of the Regulatory Guide1.109 Revision 1.

Age Group (a)	Breathing Rate (m^3/yr)
Infant	1400
Child	3700
Teen	8000
Adult	8000

Inhalation dose factors $(DFA_i)_a$ for the various age groups are given in Tables E-7 through E-10 of Regulatory Guide 1.109 Revision 1.

B. Ground Plane Pathway

$$R_{i_G} = \frac{I_i K' K'' (SF) DFG_i \left(1 - e^{-\lambda t}\right)}{\lambda_i} \qquad 2.5\text{-}4$$

where

R_{i_G} = dose factor for the ground plane pathway for each identified radionuclide i for the organ of interest; mrem/yr per µCi/sec per m^{-2};

K' = a constant of unit conversion,

= 10^6 pCi/µCi;

K'' = a constant of unit conversion,

= 8760 hr/yr;

λ_i = the radiological decay constant for radionuclide i, sec $^{-1}$;

t = the exposure time, sec,

= 4.73×10^8 sec (15 years);

DFG_i = the ground plane dose conversion factor for radionuclide i,

mrem/hr per pCi/m^2

SF = the shielding factor (dimensionless);

I_i = factor to account for fractional deposition of radionuclide i.

For radionuclides other than iodine, the factor I_i is equal to one. For radioiodines, the value of I_i may vary. However, a value of 1.0 was used in calculating the R values in Table 7.

A shielding factor of 0.7 is suggested in Table E-15 of Regulatory Guide 1.109 Revision 1. A tabulation of DFG_i values is presented in Table E-6 of Regulatory Guide 1.109 Revision 1.

C. Grass-Cow or Goat-Milk Pathway

$$R_{i_M} = I_i K' Q_F U_{ap} F_m (DFL_i)_a \, e^{-\lambda_i t_f} \left[f_p f_s \left[\frac{r(1-e^{-\lambda_{E_i} t_{ep}})}{Y_p \lambda_{E_i}} \right] + (I-f_p f_s) \left[\frac{r(1-e^{-\lambda_{E_i} t_{es}})}{Y_s \lambda_{E_i}} \right] + e^{-\lambda_i t_h} \right] \quad 2.5\text{-}5$$

where

R_{i_M} = dose factor for the cow milk or goat milk pathway, for each identified radionuclide i for the organ of interest, mrem/yr per μCi/sec per m^{-2};

K′ = a constant of unit conversion,

= 10^6 pCi/μCi;

Q_F = the cow or goat feed consumption rate, kg/day (wet weight);

U_{ap} = the receptor's milk consumption rate for age group a, liters/yr;

Y_p = the agricultural productivity by unit area of pasture feed grass, kg/m^2

Y_s = the agricultural productivity by unit area of stored feed, kg/m^2

F_m = the stable element transfer coefficients, pCi/liter per pCi/day;

r = fraction of deposited activity retained on cow feed grass;

$(DFL_i)_a$ = the organ ingestion dose factor for radionuclide i for the receptor in age group a, mrem/pCi;

λ_{E_i} = $\lambda_i + \lambda_w$

λ_i = the radiological decay constant for radionuclide i, sec^{-1}

λ_w = the decay constant for removal of activity on leaf and plant surfaces by weathering, sec^{-1},

= 5.73×10^{-7} sec^{-1} (corresponding to a 14 day half-life);

t_f = the transport time from feed to cow or goat, to milk, to receptor, sec;

t_h = the transport time from harvest, to cow or goat, to consumption, sec;

t_b = period of time that activity builds up in soil, sec;

B_{iv} = concentration factor for uptake of radionuclide i from the soil by the edible parts of crops, pCi/kg (wet weight) per pCi/kg (dry soil);

P = effective surface density for soil, kg (dry soil)/m^2;

f_p = fraction of the year that the cow or goat is on pasture;

f_s = fraction of the cow feed that is pasture grass while the cow is on pasture;

t_{ep} = period of pasture grass and crop exposure during the growing season, sec;

t_{es} = period of crop exposure during the growing season (stored feed); sec;

I_i = factor to account for fractional deposition of radionuclide i.

For radionuclides other than iodine, the factor l_i is equal to one. For radioiodines, the value of l_i may vary. However, a value of 1.0 was used in calculating the R values Tables 14 through 21.

Milk cattle and goats are considered to be fed from two potential sources, pasture grass and stored feeds. Following the development in Regulatory Guide 1.109 Revision 1, the value of f_s is considered unity in lieu of site-specific information. The value of f_p is 0.500 based upon an 6 month grazing period.

Appendix C, Table 1 contains the appropriate parameter values and their source in Regulatory Guide 1.109 Revision 1.

The concentration of tritium in milk is based on the airborne concentration rather than the deposition. Therefore, the R_i is based on χ/Q:

$$R_{T_M} = K'K'''F_m Q_F U_{ap} (DFL_i)_a \ 0.75(0.5/H) \quad 2.5\text{-}6$$

where

R_{T_M} = dose factor for the cow or goat milk pathway for tritium for the organ of interest, mrem/yr per mCi/m^3;

K''' = a constant of conversion,

= 10^3 gm/kg;

H = absolute humidity of the atmosphere, gm/m^3;

0.75 = the fraction of total feed that is water;

0.5 = the ratio of the specific activity of the feed grass water to the atmospheric water;

and the other parameters and values are as given above. A value for H of 8 grams/m^3, was used in lieu of site-specific information.

D. Grass-Cow-Meat Pathway

The integrated concentration in meat follows in a similar manner to the development for the milk pathway, therefore:

$$R_{i_B} = I_i K' Q_F U_{ap} F_m (DFL_i)_a \, e^{-\lambda_i t_f} \left[f_p f_s \left[\frac{r(l - e^{-\lambda_{E_i} t_{ep}})}{Y_p \lambda_{E_i}} \right] + (l - f_p f_s) \left[\frac{r(l - e^{-\lambda_{E_i} t_{es}})}{Y_s \lambda_{E_i}} \right] + e^{-\lambda_i t_h} \right] \quad 2.5\text{-}7$$

where

R_{i_B} = dose factor for the meat ingestion pathway for radionuclide i for any organ of interest, mRem/yr per µCi/sec per m^{-2};

F_f = the stable element transfer coefficient, pCi/kg per pCi/day;,

U_{ap} = the receptor's milk consumption rate for age group a, liters/yr;

t_s = the transport time from slaughter to meat consumption, sec;

t_h = the transport time from harvest, to animal consumption, sec;

t_{ep} = period of pasture grass exposure during the growing season, sec;

t_{es} = period of crop exposure during the growing season (stored feed); sec;

I_i = factor to account for fractional deposition of radionuclide i.

For radionuclides other than iodine, the factor I_i is equal to one. For radioiodines, the value of I_i may vary. However, a value of 1.0 was used in calculating R values in Tables 11 through 13.

All other terms remain the same as defined in Equation 2.5-5. Appendix C, Table 2 contains the values which were used in calculating R_i for the meat pathway.

The concentration of tritium in meat is based on its airborne concentration rather than the deposition. Therefore, the R_i is based on χ/Q.

$$R_{T_B} = K'K'''F_fQ_FU_{ap}(DFL_i)_a \; 0.75(0.5/H) \quad 2.5\text{-}8$$

where

R_{T_B} = dose factor for the meat ingestion pathway for tritium for any organ of interest, mrem/yr per mCi/m^3,

All other terms are defined in Equation 2.5-6 and 2.5-7, above.

E. Vegetation Pathway

The integrated concentration in vegetation consumed by man follows the expression developed in the derivation of the milk factor. Man is considered to consume two types of vegetation (fresh and stored) that differ only in the time period between harvest and consumption, therefore:

$$R_{i_V} = I_iK'(DFL_i)_a \left[U_a^L f_L e^{-\lambda_i t_L} \left[\frac{r(l-e^{-\lambda_{E_i} t_e})}{Y_V \lambda_{E_i}} \right] + U_a^S f_g e^{-\lambda_i t_h} \left[\frac{r(l-e^{-\lambda_{E_i} t_e}}{Y_V \lambda_{E_i}} \right] \right] \quad 2.5\text{-}9$$

where

R_{i_v} = dose factor for vegetable pathway for radionuclide i for the organ of interest, mrem/yr per μCi/sec per m^{-2};

K' = a constant of unit conversion,

= 10^6 pCi/μCi;

U_a^L = the consumption rate of fresh leafy vegetationby the receptor in age group a, kg/yr;

U_a^S = the consumption rate of stored vegetation by the receptor in age group a, kg/yr;

f_L = the fraction of the annual intake of fresh leafy vegetation grown locally;

f_g = the traction of the annual intake of stored vegetation grown locally;

t_L = the average time between harvest of leafy vegetation and its consumption, sec;

t_h = the average time between harvest of stored vegetation and its consumption, sec;

Y_v = the vegetation areal density, kg/m^2;

t_e = period of leafy vegetable exposure during growing season, sec;

I_i = factor to account for fractional deposition of radionuclide i.

For radionuclides other than iodine, the factor I_i is equal to one. For radioiodines, the value of I_i may vary. However, a value of 1.0 was used in calculating the R values in Tables 8 through 10. All other factors were defined above.

Appendix C, Table 3 presents the appropriate parameter values and their source in Regulatory Guide 1.109 Revision 1.

In lieu of site-specific data, default values for f_L and f_g, 1.0 and 0.76, respectively, were used in the calculation of R_i. These values were obtained from Table E-15 of Regulatory Guide 1.109 Revision 1.

The concentration of tritium in vegetation is based on the airborne concentration rather than the deposition. Therefore, the R_i is based on χ/Q:

$$R_{T_v} = K'K'''[U_a^L f_L = U_a^S f_g] (DFL_i)_a \; 0.75(0.5/H) \qquad 2.5\text{-}10$$

where

R_{T_v} = dose factor for the vegetable pathway for tritium for any organ of interest, mrem/yr per mCi/m^3,

All other terms remain the same as those in Equations 2.5-6 and 2.5-9.

2.6 References

1. Monticello Nuclear Generating Plant Technical Specifications, TS-B.2.4-Radioactive Effluents, Specification 2.4.3F Rev. 25.

2. USNRC, Title 10, Code of Federal Regulation, Part 50, “Domestic Licensing of Production and Utilization Facilities”, Appendix I, “Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion ’As Low as is Reasonably Achievable’ for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents”.

3. NSP - Monticello Nuclear Generating Plant, Appendix I Analysis - Supplement No. 1 - Docket No. 50-263, Table 2.1-3.

4. Boegli, J.S., et. al. Eds, “Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants, NUREG-0133, 1978, NTIS, Springfield Va.

5. Sangendorf, J.F. and J. T. Goll, “XOQDOQ - Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations”, NUREG-0324, 1977, USNRC, Washington, D.C.

6. USNRC, 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 50, Appendix I”, Rev. 1, Oct. 1977, USNRC, Washington.

7. USNRC, Regulatory Guide 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors”, July 1977. USNRC, Washington, D.C.

8. EPA, Title 40, Code of Federal Regulations, Part 190 “Environmental Radiation Protection Standards for Nuclear Power Operations”.

Figure 1 Gaseous Radwaste

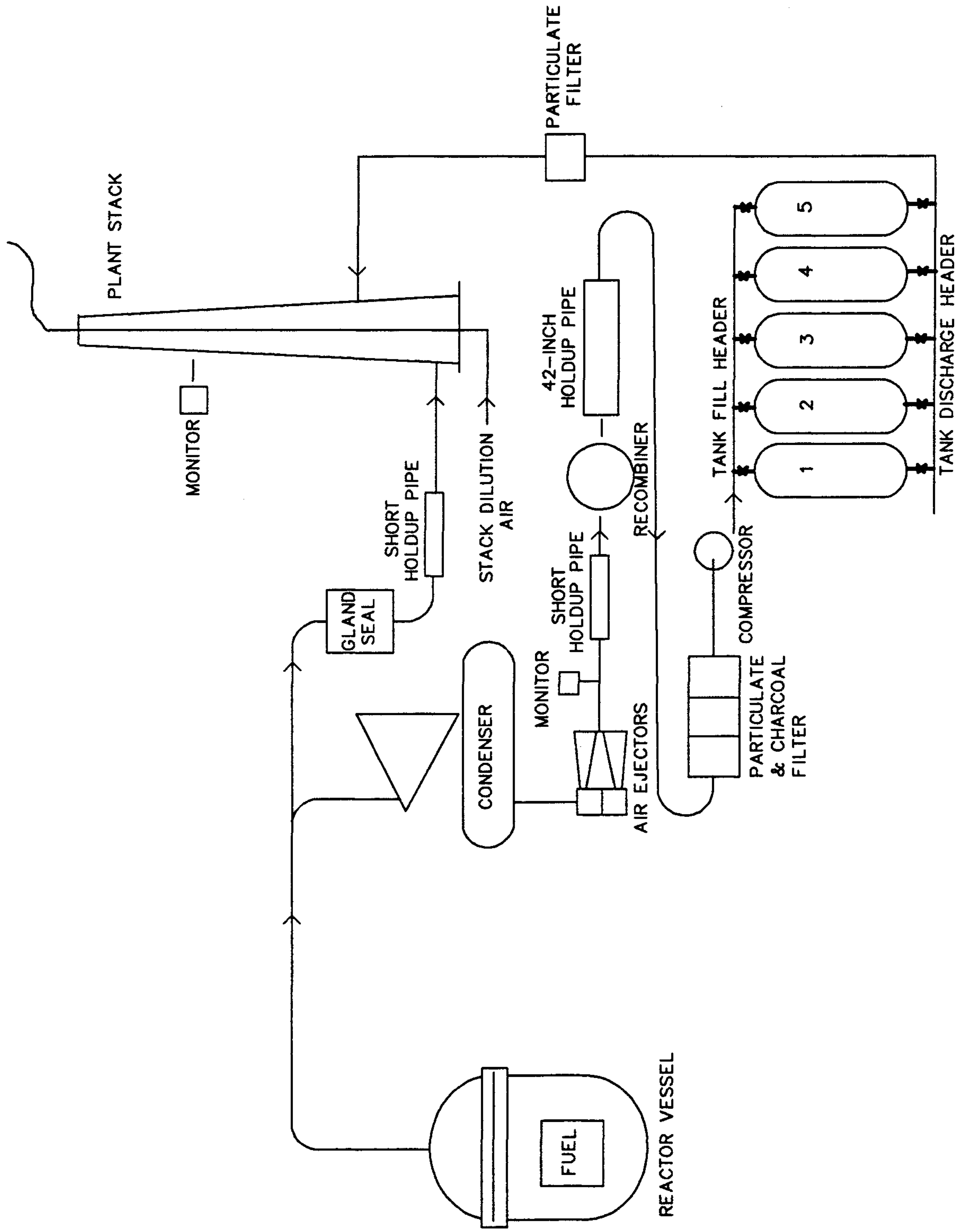

Figure 2 Ventilation System

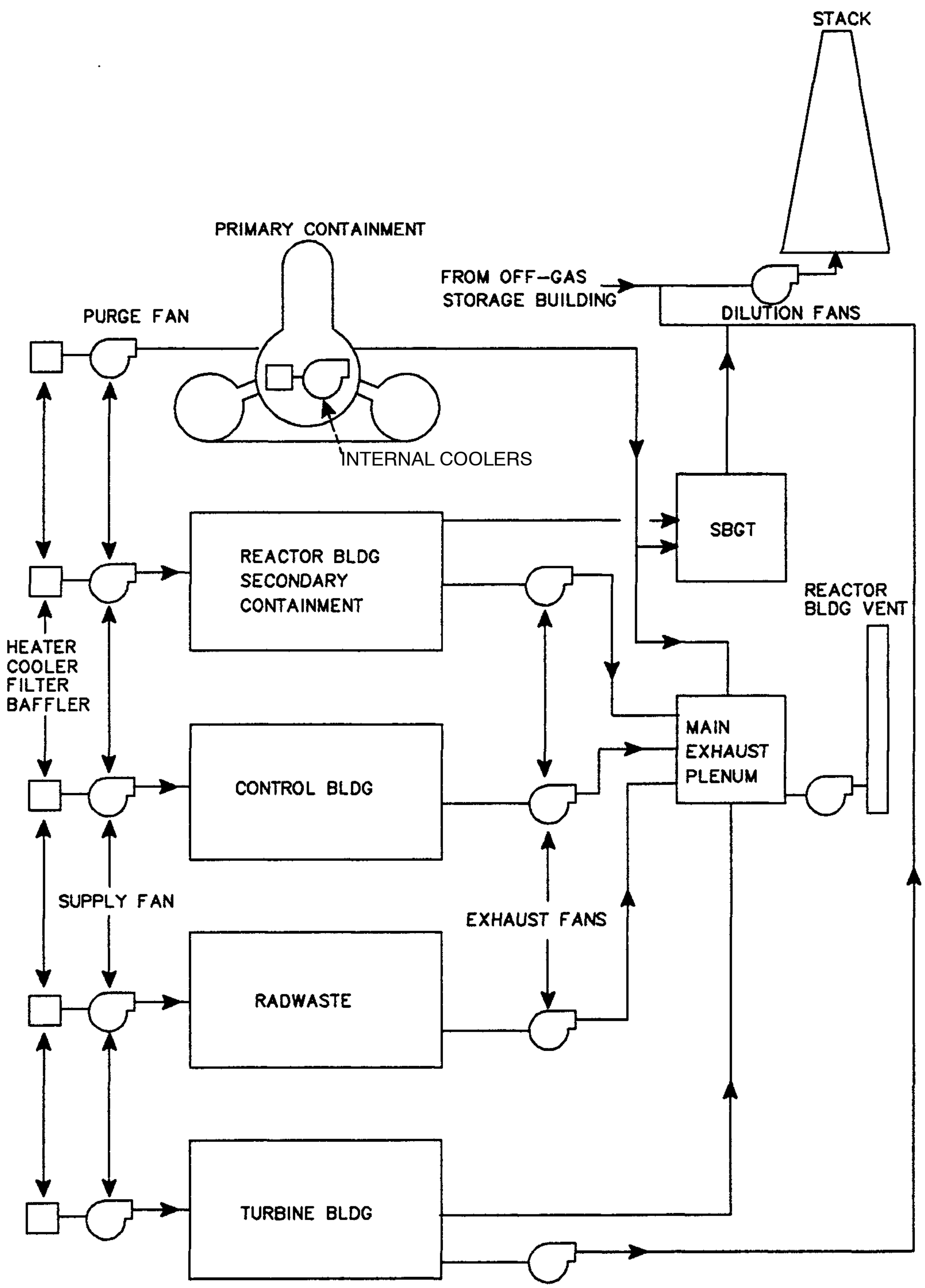

Table 1 Gaseous Source Terms(3) A_i, Ci/yr

Radionuclide	Reactor Building Vent	Gland Seal	Mechanical Vacuum Pump	Gaseous Radwaste	Drywell Purging
Kr-83m	- -	2.3E 01	- -	- -	- -
Kr-85m	7.1E 01	4.1E 01	- -	- -	3.0E 00
Kr-85	- -	- -	- -	1.3E 02	- -
Kr-87	1.33E 02	1.4E 02	- -	- -	3.0E 00
Kr-88	2.33E 02	1.4E 02	- -	- -	3.0E 00
Kr-89	- -	6.0E 02	- -	- -	- -
Kr-90	- -	- -	- -	- -	- -
Xe-131m	- -	- -	- -	4.5E 01	- -
Xe-133m	- -	2.0E 00	- -	2.7E 01	- -
Xe-133	3.26E 02	5.6E 01	2.3E 03	8.9E 03	6.6E 01
Xe-135m	6.96E 02	1.7E 01	- -	- -	4.6E 01
Xe-135	7.09E 02	1.5E 02	3.5E 02	- -	3.4E 01
Xe-137	- -	7.3E 02	- -	- -	- -
Xe-138	1.41E 03	5.6E 02	- -	- -	7.0E 00
Xe-139	- -	- -	- -	- -	- -
Ar-41	- -	- -	- -	- -	- -
Total	3.58E 03	2.46E 03	2.65E 03	9.10E 03	1.62E 02

Table 2 Dose Factors and Constants for the Total Body and Skin for Gaseous Radionuclides

Radionuclide	Total Whole Body Dose Factor K_i (mrem/yr per μCi/m3)	Total Skin Dose Factor $L +_i 1.1M_i$ (mrem/yr per μCi/m3)	Total Body Dose Constant for Long Term Releases V_i (mrem/yr per μCi/sec)
Kr-83m	7.56E-02	2.12E 01	2.61E-09
Kr-85m	1.17E 03	2.81E 03	1.39E-04
Kr-85	1.61E 01	1.36E 03	2.10E-06
Kr-87	5.92E 03	1.65E 04	6.33E-04
Kr-88	1.47E 04	1.91E 04	1.66E-03
Kr-89	1.66E 04	2.91E 04	1.12E-03
Kr-90	1.56E 04	2.52E 04	1.61E-04
Xe-131m	9.15E 01	6.48E 02	3.31E-05
Xe-133m	2.51E 02	1.35E 03	2.51E-05
Xe-133	2.94E 02	6.94E 02	2.61E-05
Xe-135m	3.12E 03	4.41E 03	3.34E-04
Xe-135	1.81E 03	3.97E 03	2.24E-04
Xe-137	1.42E 03	1.39E 04	9.99E-05
Xe-138	8.83E 03	1.43E 04	9.90E-04
Xe-139	5.02E 03	7.10E 04	5.79E-05
Ar-41	8.84E 03	1.29E 04	1.20E-03

Table 2 Dose Factors and Constants for the Total Body and Skin for Gaseous Radionuclides (cont'd)

Radionuclide	Total Body Dose Constant for Short Term Releases v_i (mrem/yr per μCi/sec)	Total Skin Dose Constant for Long Term Releases $L_i(\chi/Q)_s.1.1B_i$* (mrem)/yr per μCi/sec)	Total Dose Constant for Short Term Releases $L_i(\chi/q)_s.1.1b_i$* (mrem)/yr per μCi/sec)
Kr-83m	2.99E-09	4.15E-07	4.75E-07
Kr-85m	1.59E-04	3.90E-04	7.07E-04
Kr-85	2.40E-06	1.52E-04	4.14E-04
Kr-87	7.25E-04	2.13E-03	4.18E-03
Kr-88	1.90E-03	3.00E-03	4.86E-03
Kr-89	1.28E-03	2.97E-03	5.20E-03
Kr-90	1.85E-04	1.08E-03	2.54E-03
Xe-131m	3.79E-05	1.10E-04	2.11E-04
Xe-133m	2.87E-05	1.55E-04	3.56E-04
Xe-133	2.99E-05	7.88E-05	1.45E-04
Xe-135m	3.82E-04	6.36E-04	8.54E-04
Xe-135	2.57E-04	5.77E-04	9.94E-04
Xe-137	1.14E-04	1.52E-03	3.92E-03
Xe-138	1.13E-03	2.10E-03	3.13E-03
Xe-139	6.63E-05	7.33E-03	2.01E-02
Ar-41	1.57E-03	2.28E-03	3.10E-03

* $(\chi/Q)_s$, $(\chi/q)_s$, B_i, and b_i values obtained from other tables in the ODCM.

Table 3 Air Ejector Monitor Trip Setting and Storage Tank Contents Storage Tank Activity in Dose Equivalent Curies Xe-133 12 Hours After Completion of Tank Fill Release Rate Set to 1.00 of Maximum Trip Setting

			Condenser Air Inleakage, CFM									
Recoil/Diff/Eq	Qtot(5 Min)	Qtot(30 Min)	3	6	9	12	15	18	21	24	27	30
1.0 0.0 0.0	2.149E 06	2.600E 05	956.	1492.	1806.	1970	2045.	2068.	2062.	2039.	2005.	1965.
0.9 0.1 0.0	1.876E 06	2.600E 05	2008.	2459.	2743.	2880.	2923.	2912.	2872.	2815.	2750.	2680.
0.9 0.0 0.1	2.042E 06	2.600E 05	2480.	2585.	2702.	2747.	2738.	2697.	2639.	2572.	2502.	2431.
0.8 0.2 0.0	1.664E 06	2.600E 05	2823.	3206.	3469.	3584.	3602.	3565.	3499.	3416.	3326.	3234.
0.8 0.1 0.1	1.772E 06	2.600E 05	3371.	3444.	3556.	3589.	3558.	3490.	3403.	3308.	3209.	3111.
0.8 0.2 0.2	1.925E 06	2.600E 05	4145.	3779.	3680.	3595.	3495.	3384.	3269.	3155.	3045.	2939.
0.7 0.3 0.0	1.495E 06	2.600E 05	3471.	3802.	4046.	4144.	4143.	4086.	3998.	3895.	3785.	3674.
0.7 0.2 0.1	1.565E 06	2.600E 05	4053.	4102.	4211.	4233.	4186.	4098.	3989.	3871.	3751.	3633.
0.7 0.1 0.2	1.661E 06	2.600E 05	4842.	4507.	4434.	4554.	4243.	4114.	3977.	3840.	3705.	3576.
0.7 0.0 0.3	1.797E 06	2.600E 05	5971.	5088.	4752.	4526.	4325.	4137.	3960.	3794	3640.	3496.
0.6 0.4 0.0	1.385E 06	2.600E 05	4000.	4288.	4517.	4602.	4585.	4510.	4405.	4285.	4160.	4034.
0.6 0.3 0.1	1.402E 06	2.600E 05	4593.	4621.	4728.	4743.	4682.	4578.	4452.	4317.	4180.	4045.
0.6 0.2 0.2	1.460E 06	2.600E 05	5370.	5059.	5005.	4928.	4810.	4667.	4514.	4358.	4206.	4060.
0.6 0.1 0.3	1.540E 06	2.600E 05	6435.	5659.	5383.	5182.	4985.	4789.	4598.	4415.	4242.	4080.
0.6 0.0 0.4	1.655E 06	2.600E 05	7982.	6530.	5934.	5551.	5240.	4967.	4721.	4498.	4295.	4109.
0.5 0.5 0.0	1.243E 06	2.600E 05	4440.	4691.	4909.	4982.	4951.	4862.	4743.	4609.	4471.	4332.
0.5 0.4 0.1	1.270E 06	2.600E 05	5030.	5043.	5148.	5156.	5084.	4967.	4827.	4678.	4527.	4379.
0.5 0.3 0.2	1.303E 06	2.600E 05	5784.	5492.	5453.	5379.	5254.	5101.	4934.	4765.	4599.	4439.
0.5 0.2 0.3	1.347E 06	2.600E 05	6782.	6086.	5856.	5673.	5479.	5278.	5076.	4881.	4694.	4518.
0.5 0.1 0.4	1.408E 06	2.600E 05	8165.	6909.	6415.	6082.	5791.	5523.	5273.	5041.	4826.	4627.
0.5 0.0 0.5	1.498E 06	2.600E 05	10208.	8126.	7241.	6685.	6552.	5885.	5663.	5277.	5021.	4788.
0.4 0.6 0.0	1.147E 06	2.600E 05	4811.	5032.	5240.	5302.	5261.	5160.	5028.	4883.	4733.	4584.
0.4 0.5 0.1	1.160E 06	2.600E 05	5391.	5391.	5494.	5497.	5417.	5289.	5137.	4976.	4814.	4655.
0.4 0.4 0.2	1.176E 06	2.600E 05	6118.	5840.	5813.	5741.	5612.	5450.	5273.	5092.	4915.	4744.
0.4 0.3 0.3	1.197E 06	2.600E 05	7052.	6418.	6223.	6055.	5864.	5657.	5448.	5242.	5045.	4858.
0.4 0.2 0.4	1.225E 06	2.600E 05	8300.	7190.	6771.	6475.	6199.	5934.	5681.	5442.	5218.	5010.
0.4 0.1 0.5	1.265E 06	2.600E 05	10051.	8273.	7540.	7063.	6670.	6322.	6008.	5723.	5462.	5223.
0.4 0.0 0.6	1.324E 06	2.600E 05	12686.	9902.	8697.	7948.	7378.	6907.	6501.	6145.	5828.	5544.

Table 3 Air Ejector Monitor Trip Setting and Storage Tank Contents Storage Tank Activity in Dose Equivalent Curies Xe-133 12 Hours After Completion of Tank Fill Release Rate Set to 1.00 of Maximum Trip Setting (cont'd)

			Condenser Air Inleakage, CFM									
Recoil/Diff/Eq	Qtot(5 Min)	Qtot(30 Min)	3	6	9	12	15	18	21	24	27	30
0.3 0.7 0.0	1.064E 06	2.600E 05	5148.	5324.	5522.	5577.	5526.	5415.	5273.	5117.	4948.	4800.
0.3 0.6 0.1	1.068E 06	2.600E 05	5695.	5684.	5786.	5784.	5697.	5559.	5398.	5227.	5055.	4887.
0.3 0.5 0.2	1.072E 06	2.600E 05	6392.	6127.	6110.	6040.	5907.	5737.	5551.	5362.	5175.	4995.
0.3 0.4 0.3	1.078E 06	2.600E 05	7268.	6684.	6517.	6361.	6171.	5961.	5744.	5531.	5325.	5129.
0.3 0.3 0.4	1.085E 06	2.600E 05	8404.	7406.	7046.	6777.	6513.	6251.	5995.	5751.	5521.	5304.
0.3 0.2 0.5	1.092E 06	2.600E 05	9937.	8380.	7758.	7338.	6975.	6642.	6333.	6047.	5784.	5540.
0.3 0.1 0.6	1.108E 06	2.600E 05	12115.	9765.	8771.	8136.	7632.	7197.	6813.	6469.	6158.	5876.
0.3 0.0 0.7	1.129E 06	2.600E 05	15459.	11891.	10326.	9361.	8639.	8051.	7550.	7115.	6732.	6391.
0.2 0.8 0.0	9.929E 05	2.600E 05	5403.	5576.	5767.	5814.	5755.	5635.	5484.	5320.	5153.	4987.
0.2 0.7 0.1	9.894E 05	2.600E 05	5954.	5934.	6034.	6029.	5935.	5790.	5620.	5441.	5261.	5085.
0.2 0.6 0.2	9.052E 05	2.600E 05	6621.	6366.	6358.	6289.	6153.	5977.	5784.	5587.	5393.	5204.
0.2 0.5 0.3	9.799E 05	2.600E 05	7444.	6901.	6757.	6610.	6422.	6209.	5987.	5768.	5555.	5352.
0.2 0.4 0.4	9.733E 05	2.600E 05	8487.	7577.	7263.	7017.	6762.	6502.	6244.	5996.	5760.	5538.
0.2 0.3 0.5	9.646E 05	2.600E 05	9849.	8462.	7924.	7548.	7207.	6885.	6508.	6295.	6029.	5782.
0.2 0.2 0.6	9.528E 05	2.600E 05	11706.	9667.	8825.	8272.	7814.	7406.	7038.	6702.	6395.	6114.
0.2 0.1 0.7	9.357E 05	2.600E 05	14384.	11405.	10124.	9316	8689	8159.	7698.	7289.	6923.	6593.
0.2 0.0 0.8	9.090E 05	2.600E 05	18586.	14132.	12163.	10954	10061	9340.	8734.	8210.	7751.	7345.
0.1 0.9 0.0	9.305E 05	2.600E 05	5643.	5796.	5981.	6022.	5955.	5827.	5669.	5497.	5322.	5150.
0.1 0.8 0.1	9.217E 05	2.600E 05	6178.	6149.	6249.	6240.	6141.	5989.	5812.	5625.	5439.	5256.
0.1 0.7 0.2	9.112E 05	2.600E 05	6816.	6570.	6568.	6501.	6362.	6181.	5982.	5778.	5577.	5383.
0.1 0.6 0.3	8.985E 05	2.600E 05	7591.	7082.	6957.	6818.	6631.	6415.	6190.	5964.	5964.	5537.
0.1 0.5 0.4	8.826E 05	2.600E 05	8554.	7717.	7440.	7212.	6995.	6706.	6447.	6195.	5955.	5728.
0.1 0.4 0.5	8.624E 05	2.600E 05	9781.	8526.	8055.	7713.	7309.	7076.	6775.	6490.	6222.	5972.
0.1 0.3 0.6	8.358E 05	2.600E 05	11397.	9593.	8865.	8374.	7951.	7564.	7207.	6877.	6573.	6293.
0.1 0.2 0.7	7.992E 05	2.600E 05	13625.	11062.	9982.	9284.	8723.	8236.	7802.	7411.	7058.	6736.
0.1 0.1 0.8	7.454E 05	2.600E 05	16890.	13216.	11619.	10619.	9856.	9222.	8675.	8194.	7768.	7385.
0.1 0.0 0.9	6.591E 05	2.600E 05	22138.	16679.	14250.	12764.	11676.	10805.	10077.	9453.	8909.	8428.
0.0 1.0 0.0	8.755E 05	2.600E 05	5855.	5990.	6169.	6205.	6132.	5997.	5832.	5653.	5472.	5293.
0.0 0.9 0.1	8.628E 05	2.600E 05	6372.	6336.	6435.	6424.	6320.	6162.	5979.	5786.	5593.	5405.
0.0 0.8 0.2	8.477E 05	2.600E 05	6983.	6745.	6750.	6683.	6542.	6357.	6152.	5943.	5732.	5536.
0.0 0.7 0.3	8.296E 05	2.600E 05	7716.	7235.	7126.	6994.	6808.	6590.	6361.	6131.	5908.	5694.
0.0 0.6 0.4	8.075E 05	2.600E 05	8610.	7832.	7586.	7373.	7133.	6875.	6615.	6360.	6117.	5886.

Table 3 Air Ejector Monitor Trip Setting and Storage Tank Contents Storage Tank Activity in Dose Equivalent Curies Xe-133 12 Hours After Completion of Tank Fill Release Rate Set to 1.00 of Maximum Trip Setting (cont'd)

			Condenser Air Inleakage, CFM									
Recoil/Diff/Eq	Qtot(5 Min)	Qtot(30 Min)	3	6	9	12	15	18	21	24	27	30
0.0 0.5 0.5	7.799E 05	2.600E 05	9725	8578.	8160.	7846.	7538.	7231.	6932.	6647.	6378.	6126.
0.0 0.4 0.6	7.446E 05	2.600E 05	11156.	9533.	8897.	8454.	8058.	7687.	7339.	7014.	6713.	6433.
0.0 0.3 0.7	6.976E 05	2.600E 05	13059.	10807.	9876.	9261.	8749.	8293.	7880.	7508.	7158.	6843.
0.0 0.2 0.8	6.320E 05	2.600E 05	15713.	12581.	11241.	10386.	9713.	9139.	8634.	8184.	7779.	7413.
0.0 0.1 0.9	5.342E 05	2.600E 05	19670.	15227.	13277.	12065.	11151.	10401.	9759.	9200.	8705.	8264.
0.0 0.0 1.0	3.727E 05	2.600E 05	26207.	19597.	16640.	14838.	13527.	12484.	11617.	10878.	10235.	9670.

Table 4 Child Critical Organ Dose Parameters for Radionuclide i for the Inhalation Pathway

Nuclide	P_i I mrem/yr μCi/m³
H-3	1.12E 03
Cr-51	1.70E 04
Mn-54	1.58E 06
Fe-59	1.27E 06
Co-58	1.11E 06
Co-60	7.07E 06
Zn-65	9.95E 05
Rb-86	1.98E 05
Sr-89	2.16E 06
Sr-90	1.01E 08
Y-91	2.63E 06
Zr-95	2.23E 06
Nb-95	6.14E 05
Ru-103	6.62E 05
Ru-106	1.43E 07
Ag-110m	5.48E 06
Te-127m	1.48E 06
Te-129m	1.76E 06
Cs-134	1.01E 06
Cs-136	1.71E 05
Cs-137	9.07E 05
Ba-140	1.74E 06
Ce-141	5.44E 05
Ce-144	1.20E 07
I-131	1.62E 07
I-133	3.85E 06
I-135	7.92E 05

Table 5 Dose Factors for Noble Gases and Daughters That May Be Detected in Gaseous Effluents

Radionuclide	Total Body Dose Factor K_i mrem/yr μCi/m³	Skin Dose Factor L_i mrem/yr μCi/m³	Gamma Air Dose Factor M_i mrad/yr μCi/m³	Beta Air Dose Factor N_i mrad/yr μCi/m³
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-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+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
Xe-139	5.02E+03	6.52E+04	5.28E+03	6.52E+04
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

Table 6 Dose Parameters for Finite Evaluated Plumes for the Critical Boundary Location 0.51 mi from the Stack in the SSE Sector

	Long Term Release*		Short Term Release**	
Noble Gas Radionuclide	Total Body V_i mrem/yr / Ci/sec	Gamma Air B_i mrad/yr / Ci/sec	Total Body v_i mrem/yr / Ci/sec	Gamma Air b_i mrad/yr / Ci/sec
Kr-83m	2.61E-09	3.77E-07	2.99E-09	4.32E-07
Kr-85m	1.39E-04	2.07E-04	1.59E-04	2.37E-04
Kr-85	2.10E-06	3.18E-06	2.40E-06	3.64E-06
Kr-87	6.33E-04	9.52E-04	7.25E-02	1.09E-03
Kr-88	1.66E-03	2.49E-03	1.90E-03	2.85E-03
Kr-89	1.12E-03	1.68E-03	1.28E-03	1.92E-03
Kr-90	1.61E-04	2.42E-04	1.85E-04	2.78E-04
Xe-131m	3.31E-05	5.21E-05	3.79E-05	5.97E-05
Xe-133m	2.51E-05	4.09E-05	2.87E-05	4.68E-05
Xe-133	2.61E-05	4.08E-05	2.99E-05	4.67E-05
Xe-135m	3.34E-04	5.06E-04	3.82E-04	5.79E-04
Xe-135	2.24E-04	3.37E-04	2.57E-04	3.89E-04
Xe-137	9.99E-05	1.51E-04	1.14E-04	1.73E-04
Xe-138	9.90E-04	1.49E-03	1.13E-03	1.70E-03
Xe-139	5.79E-05	8.69E-05	6.63E-05	9.95E-05
Ar-41	1.20E-03	1.80E-03	1.38E-03	2.07E-03

* Values are annual average

** Values are for 144 hours per year purge.

Table 7 R_i Values for the Monticello Nuclear Generating Plant Ground Pathway

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
Cr-51	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	4.66E 06	5.51E 06
Mn-54	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.34E 09	1.57E 09
Fe-59	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	2.75E 08	3.23E 08
Co-58	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	3.79E 08	4.44E 08
Co-60	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.15E 10	2.52E 10
Zn-65	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	7.49E 08	8.69E 10
Sr-89	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.23E 04	2.58E 04
Zr-95	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.49E 08	2.89E 08
I-131	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	1.72E 07	2.09E 07
I-133	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	2.47E 06	3.00E 06
I-135	2.52E 06	2.52E 06	2.52E 06	2.52E 06	2.52E 06	2.52E 06	2.52E 06	2.94E 06
Cs-134	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	6.82E 09	7.96E 09
Cs-136	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.49E 08	1.69E 08
Cs-137	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.03E 10	1.20E 10
Ba-140	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.05E 07	2.34E 07
Ce-141	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.36E 07	1.53E 07
Ce-144	6.96E 07	6.96E 07	6.96E 07	6.96E 07	6.96E 07	6.96E 07	6.96E 07	8.04E 07
Nb-95	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.36E 08	1.60E 08
Ru-103	1.08E 08	1.08E 08	1.08E 08	1.08E 08	1.08E 08	1.08E 08	1.08E 08	1.26E 08

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 8 R_i Values for the Monticello Nuclear Generating Plant Vegetable Pathway Adult Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.28E 03	2.28E 03	0.00E 00	2.28E 03	2.28E 03	2.28E 03	2.28E 03	2.28E 03
Cr-51	4.60E 04	1.16E 07	0.00E 00	0.00E 00	1.01E 04	2.75E 04	6.10E 04	0.00E 00
Mn-54	5.83E 07	9.36E 08	0.00E 00	3.05E 08	9.09E 07	0.00E 00	0.00E 00	0.00E 00
Fe-59	1.12E 08	9.75E 08	1.24E 08	2.93E 08	0.00E 00	0.00E 00	8.17E 07	0.00E 00
Co-58	6.71E 07	6.07E 08	0.00E 00	2.99E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	3.67E 08	3.12E 09	0.00E 00	1.66E 08	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	5.77E 08	8.04E 08	4.01E 08	1.28E 09	8.54E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	2.87E 08	1.60E 09	1.00E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.64E 11	1.93E 10	6.70E 11	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	2.51E 05	1.17E 09	1.16E 06	3.71E 05	5.82E 05	0.00E 00	0.00E 00	0.00E 00
I-131	6.61E 07	3.04E 07	8.07E 07	1.15E 08	1.98E 08	3.78E 10	0.00E 00	0.00E 00
I-133	1.12E 06	3.30E 06	2.11E 06	3.67E 06	6.40E 06	5.39E 09	0.00E 00	0.00E 00
I-135	3.73E 04	1.14E 05	3.86E 04	1.01E 05	1.62E 05	6.67E 06	0.00E 00	0.00E 00
Cs-134	8.83E 09	1.89E 08	4.54E 09	1.08E 10	3.49E 09	0.00E 00	1.16E 09	0.00E 00
Cs-136	1.19E 08	1.88E 07	4.19E 07	1.66E 08	9.21E 07	0.00E 00	1.26E 07	0.00E 00
Cs-137	5.94E 08	1.76E 08	6.63E 09	9.07E 09	3.08E 09	0.00E 00	1.02E 09	0.00E 00
Ba-140	8.40E 06	2.64E 08	1.28E 08	1.61E 05	5.47E 04	0.00E 00	9.22E 04	0.00E 00
Ce-141	1.48E 04	4.99E 08	1.93E 05	1.31E 05	6.07E 04	0.00E 00	0.00E 00	0.00E 00
Ce-144	1.69E 06	1.07E 10	3.15E 07	1.32E 07	7.82E 06	0.00E 00	0.00E 00	0.00E 00
Nb-95	4.19E 04	4.73E 08	1.40E 05	7.80E 04	7.71E 04	0.00E 00	0.00E 00	0.00E 00
Ru-103	2.03E 06	5.51E 08	4.72E 06	0.00E 00	1.80E 07	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 9 R_i Values for the Monticello Nuclear Generating Plant Vegetable Pathway Teen Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.61E 03	2.61E 03	0.00E 00	2.61E 03	2.61E 03	2.61E 03	2.61E 03	2.61E 03
Cr-51	6.11E 04	1.03E 07	0.00E 00	0.00E 00	1.34E 04	3.39E 04	8.72E 04	0.00E 00
Mn-54	8.79E 07	9.09E 08	0.00E 00	4.43E 08	1.32E 08	0.00E 00	0.00E 00	0.00E 00
Fe-59	1.60E 08	9.78E 08	1.77E 08	4.14E 08	0.00E 00	0.00E 00	1.30E 08	0.00E 00
Co-58	9.79E 07	5.85E 08	0.00E 00	4.25E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	5.57E 08	3.22E 09	0.00E 00	2.47E 08	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	8.68E 08	7.88E 08	5.36E 08	1.86E 09	1.19E 09	0.00E 00	0.00E 00	0.00E 00
Sr-89	4.36E 08	1.81E 09	1.52E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	2.05E 11	2.33E 10	8.32E 11	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	3.68E 05	1.23E 09	1.69E 06	5.35E 05	7.86E 05	0.00E 00	0.00E 00	0.00E 00
I-131	5.77E 07	2.13E 07	7.68E 07	1.07E 08	1.85E 08	3.14E 10	0.00E 00	0.00E 00
I-133	1.01E 06	2.51E 06	1.96E 06	3.32E 06	5.83E 06	4.64E 08	0.00E 00	0.00E 00
I-135	3.33E 04	9.96E 04	3.49E 04	8.98E 04	1.42E 05	5.78E 06	0.00E 00	0.00E 00
Cs-134	7.54E 09	2.02E 08	6.90E 09	1.62E 10	5.16E 10	0.00E 00	1.97E 09	0.00E 00
Cs-136	1.13E 08	1.35E 07	4.28E 07	1.68E 08	9.16E 07	0.00E 00	1.44E 07	0.00E 00
Cs-137	4.90E 09	2.00E 08	1.06E 10	1.41E 10	4.78E 09	0.00E 00	1.86E 09	0.00E 00
Ba-140	8.88E 06	2.12E 08	1.38E 08	1.69E 05	5.72E 04	0.00E 00	1.14E 05	0.00E 00
Ce-141	2.12E 04	5.29E 08	2.77E 05	1.85E 05	8.70E 04	0.00E 00	0.00E 00	0.00E 00
Ce-144	2.72E 06	1.27E 10	5.05E 07	2.09E 07	1.25E 07	0.00E 00	0.00E 00	0.00E 00
Nb-95	5.78E 04	4.49E 08	1.89E 05	1.05E 05	1.02E 05	0.00E 00	0.00E 00	0.00E 00
Ru-103	2.88E 06	5.64E 08	6.75E 06	0.00E 00	2.38E 07	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 10 R_i Values for the Monticello Nuclear Generating Plant Vegetable Pathway Child Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	4.04E 03	4.04E 03	0.00E 00	4.04E 03	4.04E 03	4.04E 03	4.04E 03	4.04E 03
Cr-51	1.16E 05	6.15E 06	0.00E 00	0.00E 00	1.76E 04	6.44E 04	1.18E 05	0.00E 00
Mn-54	1.73E 08	5.44E 08	0.00E 00	6.49E 08	1.82E 08	0.00E 00	0.00E 00	0.00E 00
Fe-59	3.17E 08	6.62E 08	3.93E 08	6.36E 08	0.00E 00	0.00E 00	1.84E 08	0.00E 00
Co-58	1.92E 08	3.66E 08	0.00E 00	6.27E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	1.11E 09	2.08E 09	0.00E 00	3.76E 08	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	1.70E 09	4.81E 08	1.03E 09	2.74E 09	1.73E 09	0.00E 00	0.00E 00	0.00E 00
Sr-89	1.03E 09	1.40E 09	3.62E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	3.49E 11	1.86E 10	1.38E 12	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	7.44E 05	8.71E 08	3.80E 06	8.35E 05	1.20E 05	0.00E 00	0.00E 00	0.00E 00
I-131	8.16E 07	1.28E 07	1.43E 08	1.44E 08	2.36E 08	4.75E 10	0.00E 00	0.00E 00
I-133	1.67E 06	1.78E 06	3.57E 06	4.42E 06	7.36E 06	8.21E 08	0.00E 00	0.00E 00
I-135	5.28E 04	8.50E 04	6.20E 04	1.12E 05	1.71E 05	9.88E 06	0.00E 00	0.00E 00
Cs-134	5.40E 09	1.38E 08	1.56E 10	2.56E 10	7.93E 09	0.00E 00	2.84E 09	0.00E 00
Cs-136	1.43E 08	7.77E 06	8.04E 07	2.21E 08	1.18E 08	0.00E 00	1.76E 07	0.00E 00
Cs-137	3.52E 09	1.50E 08	2.40E 10	2.39E 10	7.78E 09	0.00E 00	2.80E 09	0.00E 00
Ba-140	1.61E 07	1.40E 08	2.76E 08	2.42E 05	7.87E 04	0.00E 00	1.44E 05	0.00E 00
Ce-141	4.75E 04	3.39E 08	6.42E 05	3.20E 05	1.40E 05	0.00E 00	0.00E 00	0.00E 00
Ce-144	6.50E 06	9.95E 09	1.22E 08	3.82E 07	2.11E 07	0.00E 00	0.00E 00	0.00E 00
Nb-95	1.12E 05	2.91E 08	4.04E 05	1.57E 05	1.48E 05	0.00E 00	0.00E 00	0.00E 00
Ru-103	5.83E 06	3.82E 08	1.52E 07	0.00E 00	3.82E 07	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 11 R_i Values for the Monticello Nuclear Generating Plant Meat Pathway Adult Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	3.27E 02	3.27E 02	0.00E 00	3.27E 02	3.27E 02	3.27E 02	3.27E 02	3.27E 02
Cr-51	3.26E 03	8.21E 05	0.00E 00	0.00E 00	7.19E 02	1.95E 03	4.33E 03	0.00E 00
Mn-54	8.98E 05	1.44E 07	0.00E 00	4.71E 06	1.40E 06	0.00E 00	0.00E 00	0.00E 00
Fe-59	1.12E 08	9.73E 08	1.24E 08	2.92E 08	0.00E 00	0.00E 00	8.16E 07	0.00E 00
Co-58	1.95E 07	1.76E 08	0.00E 00	8.68E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	8.87E 07	7.55E 08	0.00E 00	4.02E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	3.06E 08	4.27E 08	2.13E 08	6.78E 08	4.53E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	4.12E 06	2.30E 07	1.43E 08	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.76E 09	2.07E 08	7.17E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	1.94E 05	9.07E 08	8.92E 05	2.86E 05	4.49E 05	0.00E 00	0.00E 00	0.00E 00
I-131	4.33E 06	1.99E 06	5.28E 06	7.55E 06	1.29E 07	2.48E 09	0.00E 00	0.00E 00
I-133	1.13E-01	3.34E-01	2.14E-01	3.72E-01	6.49E-01	5.46E 01	0.00E 00	0.00E 00
I-135	1.78E-17	5.38E-17	1.82E-17	4.77E-17	7.64E-17	3.14E-15	0.00E 00	0.00E 00
Cs-134	6.68E 08	1.43E 07	3.43E 08	8.17E 08	2.64E 08	0.00E 00	8.78E 07	0.00E 00
Cs-136	1.61E 07	2.53E 06	5.65E 06	2.23E 07	1.24E 07	0.00E 00	1.70E 06	0.00E 00
Cs-137	4.33E 08	1.28E 07	4.83E 08	6.61E 08	2.24E 08	0.00E 00	7.46E 07	0.00E 00
Ba-140	9.01E 05	2.83E 07	1.38E 07	1.73E 04	5.87E 03	0.00E 00	9.89E 03	0.00E 00
Ce-141	4.96E 02	1.67E 07	6.47E 03	4.38E 03	2.03E 03	0.00E 00	0.00E 00	0.00E 00
Ce-144	3.94E 04	2.48E 08	7.34E 05	3.07E 05	1.82E 05	0.00E 00	0.00E 00	0.00E 00
Nb-95	3.00E 05	3.39E 09	1.01E 06	5.59E 05	5.52E 05	0.00E 00	0.00E 00	0.00E 00
Ru-103	2.00E 07	5.42E 09	4.64E 07	0.00E 00	1.77E 08	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 12 R_i Values for the Monticello Nuclear Generating Plant Meat Pathway Teen Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.95E 02	1.95E 02	0.00E 00	1.95E 02	1.95E 02	1.95E 02	1.95E 02	1.95E 02
Cr-51	2.61E 03	4.39E 05	0.00E 00	0.00E 00	5.72E 02	1.45E 03	3.75E 03	0.00E 00
Mn-54	7.12E 05	7.37E 06	0.00E 00	3.59E 06	1.07E 06	0.00E 00	0.00E 00	0.00E 00
Fe-59	8.95E 07	5.48E 08	9.93E 07	2.32E 08	0.00E 00	0.00E 00	7.31E 07	0.00E 00
Co-58	1.54E 07	9.22E 07	0.00E 00	6.69E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	7.03E 07	4.06E 08	0.00E 00	3.12E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	2.43E 08	2.20E 08	1.50E 08	5.20E 08	3.33E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	3.47E 06	1.44E 07	1.21E 08	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.15E 09	1.30E 08	4.64E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	1.55E 05	5.02E 08	7.15E 05	2.25E 05	3.31E 05	0.00E 00	0.00E 00	0.00E 00
I-131	3.30E 06	1.22E 06	4.39E 06	6.14E 06	1.06E 07	1.79E 09	0.00E 00	0.00E 00
I-133	9.25E-02	2.30E-01	1.79E-01	3.03E-01	5.32E-01	4.23E 01	0.00E 00	0.00E 00
I-135	1.41E-17	4.22E-17	1.48E-17	3.81E-17	6.02E-17	2.45E-17	0.00E 00	0.00E 00
Cs-134	2.98E 08	7.99E 06	2.73E 08	6.42E 08	2.04E 08	0.00E 00	7.79E 07	0.00E 00
Cs-136	1.16E 07	1.40E 06	4.41E 06	1.73E 07	9.44E 06	0.00E 00	1.49E 06	0.00E 00
Cs-137	1.86E 08	7.59E 06	4.01E 08	5.34E 08	1.82E 08	0.00E 00	7.06E 07	0.00E 00
Ba-140	7.33E 05	1.75E 07	1.14E 07	1.39E 04	4.72E 03	0.00E 00	9.37E 03	0.00E 00
Ce-141	4.17E 02	1.04E 07	5.43E 03	3.63E 03	1.71E 03	0.00E 00	0.00E 00	0.00E 00
Ce-144	3.32E 04	1.56E 08	6.18E 05	2.56E 05	1.53E 05	0.00E 00	0.00E 00	0.00E 00
Nb-95	2.39E 05	1.86E 09	7.84E 05	4.35E 05	4.22E 05	0.00E 00	0.00E 00	0.00E 00
Ru-103	1.62E 07	3.16E 09	3.79E 07	0.00E 00	1.33E 08	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 13 R_i Values for the Monticello Nuclear Generating Plant Meat Pathway Child Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.36E 02	2.36E 02	0.00E 00	2.36E 02	2.36E 02	2.36E 02	2.36E 02	2.36E 02
Cr-51	4.07E 03	2.16E 05	0.00E 00	0.00E 00	6.17E 02	2.26E 03	4.12E 03	0.00E 00
Mn-54	1.09E 05	3.45E 06	0.00E 00	4.11E 06	1.15E 06	0.00E 00	0.00E 00	0.00E 00
Fe-59	1.42E 08	2.79E 08	1.76E 08	2.85E 08	0.00E 00	0.00E 00	8.26E 07	0.00E 00
Co-58	2.39E 07	4.56E 07	0.00E 00	7.82E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	1.09E 08	2.05E 08	0.00E 00	3.70E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	3.72E 08	1.05E 08	2.25E 08	5.99E 08	3.77E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	6.55E 06	8.87E 06	2.29E 08	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.52E 09	8.08E 07	6.00E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	2.48E 05	2.91E 08	1.27E 06	2.79E 05	3.99E 05	0.00E 00	0.00E 00	0.00E 00
I-131	4.65E 06	7.29E 05	8.14E 06	8.19E 06	1.34E 07	2.71E 09	0.00E 00	0.00E 00
I-133	1.55E 01	1.66E 01	3.32E 01	4.11E 01	6.85E 01	7.63E 01	0.00E 00	0.00E 00
I-135	2.28E 17	3.67E 17	2.68E 17	4.82E 17	7.39E 17	4.27E 15	0.00E 00	0.00E 00
Cs-134	1.67E 08	4.26E 06	4.81E 08	7.90E 08	2.45E 08	0.00E 00	8.78E 07	0.00E 00
Cs-136	1.35E 07	7.34E 05	7.60E 06	2.09E 07	1.11E 07	0.00E 00	1.66E 06	0.00E 00
Cs-137	1.04E 08	4.43E 06	7.39E 08	7.07E 08	2.30E 08	0.00E 00	8.29E 07	0.00E 00
Ba-140	1.22E 06	1.06E 07	2.10E 07	1.84E 04	5.98E 03	0.00E 00	1.10E 04	0.00E 00
Ce-141	7.57E 02	6.36E 06	1.02E 04	5.10E 03	2.24E 03	0.00E 00	0.00E 00	0.00E 00
Ce-144	6.22E 04	9.53E 09	1.17E 06	3.66E 05	2.02E 05	0.00E 00	0.00E 00	0.00E 00
Nb-95	3.77E 05	9.74E 08	1.35E 06	5.27E 05	4.95E 05	0.00E 00	0.00E 00	0.00E 00
Ru-103	2.63E 07	1.77E 09	6.83E 07	0.00E 00	1.72E 08	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 14 R_i Values for the Monticello Nuclear Generating Plant Cow Milk Pathway Adult Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3								
Cr-51	1.32E 04	3.32E 06	0.00E 00	0.00E 00	2.91E 03	7.90E 03	1.75E 04	0.00E 00
Mn-54	8.25E 05	1.32E 07	0.00E 00	4.32E 06	1.29E 06	0.00E 00	0.00E 00	0.00E 00
Fe-59	1.25E 07	1.09E 08	1.39E 07	3.26E 07	0.00E 00	0.00E 00	9.10E 06	0.00E 00
Co-58	5.03E 06	4.55E 07	0.00E 00	2.24E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	1.93E 07	1.65E 08	0.00E 00	8.77E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	1.18E 09	1.65E 09	8.21E 08	2.61E 09	1.75E 09	0.00E 00	0.00E 00	0.00E 00
Sr-89	1.97E 07	1.10E 08	6.85E 08	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	6.62E 09	7.80E 08	2.70E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	9.72E 01	4.55E 05	4.48E 02	1.44E 02	2.25E 02	0.00E 00	0.00E 00	0.00E 00
I-131	1.19E 08	5.49E 07	1.45E 08	2.08E 08	3.57E 08	6.82E 10	0.00E 00	0.00E 00
I-133	1.05E 06	3.09E 06	1.98E 06	3.44E 06	6.01E 06	5.06E 08	0.00E 00	0.00E 00
I-135	5.70E 03	1.74E 04	5.90E 03	1.54E 04	2.48E 04	1.02E 06	0.00E 00	0.00E 00
Cs-134	5.74E 09	1.23E 08	2.95E 09	7.02E 09	2.27E 09	0.00E 00	7.54E 08	0.00E 00
Cs-136	3.35E 08	5.60E 07	1.25E 08	4.93E 08	2.74E 08	0.00E 00	3.76E 07	0.00E 00
Cs-137	3.66E 09	1.08E 08	4.09E 09	5.59E 09	1.90E 09	0.00E 00	6.31E 08	0.00E 00
Ba-140	8.43E 05	2.65E 07	1.29E 07	1.62E 04	5.49E 03	0.00E 00	9.25E 03	0.00E 00
Ce-141	1.71E 02	5.78E 06	2.24E 03	1.51E 03	7.02E 02	0.00E 00	0.00E 00	0.00E 00
Ce-144	4.67E 03	6.09E 07	1.80E 05	7.53E 04	4.46E 04	0.00E 00	0.00E 00	0.00E 00
Nb-95	1.08E 04	1.22E 08	3.60E 04	2.01E 04	1.98E 04	0.00E 00	0.00E 00	0.00E 00
Ru-103	1.93E 02	5.24E 04	4.49E 02	0.00E 00	1.71E 03	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per µCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per µCi/Sec for all others.

Table 15 R_i Values for the Monticello Nuclear Generating Plant Cow Milk Pathway Teen Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.00E 03	1.00E 03	0.00E 00	1.00E 03	1.00E 03	1.00E 03	1.00E 03	1.00E 03
Cr-51	2.31E 04	3.88E 06	0.00E 00	0.00E 00	5.06E 03	1.28E 04	3.30E 04	0.00E 00
Mn-54	1.43E 06	1.48E 07	0.00E 00	7.20E 06	2.15E 06	0.00E 00	0.00E 00	0.00E 00
Fe-59	2.18E 07	1.34E 08	2.42E 07	5.65E 07	0.00E 00	0.00E 00	1.78E 07	0.00E 00
Co-58	8.70E 06	5.12E 07	0.00E 00	3.78E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	3.35E 07	1.94E 08	0.00E 00	1.49E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	2.04E 09	1.85E 09	1.26E 09	4.38E 09	2.80E 09	0.00E 00	0.00E 00	0.00E 00
Sr-89	3.62E 07	1.50E 08	1.26E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	9.42E 09	1.07E 09	3.81E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	1.70E 02	5.70E 05	7.83E 02	2.47E 02	3.63E 02	0.00E 00	0.00E 00	0.00E 00
I-131	1.98E 08	7.31E 07	2.64E 08	3.69E 08	6.36E 08	1.08E 11	0.00E 00	0.00E 00
I-133	1.87E 06	4.64E 06	3.61E 06	6.13E 06	1.08E 07	8.56E 08	0.00E 00	0.00E 00
I-135	9.99E 03	2.99E 04	1.05E 04	2.70E 04	4.26E 04	1.74E 06	0.00E 00	0.00E 00
Cs-134	5.60E 09	1.50E 08	5.12E 09	1.21E 10	3.83E 09	0.00E 00	1.46E 09	0.00E 00
Cs-136	5.62E 08	6.73E 07	2.13E 08	8.37E 08	4.55E 08	0.00E 00	7.18E 07	0.00E 00
Cs-137	3.44E 09	1.40E 08	7.42E 09	9.87E 09	3.36E 09	0.00E 00	1.30E 09	0.00E 00
Ba-140	1.50E 06	3.58E 07	2.32E 07	2.84E 04	9.65E 03	0.00E 00	1.91E 04	0.00E 00
Ce-141	3.14E 02	7.83E 06	4.10E 03	2.74E 03	1.29E 03	0.00E 00	0.00E 00	0.00E 00
Ce-144	1.78E 04	8.33E 07	3.31E 05	1.37E 05	8.19E 04	0.00E 00	0.00E 00	0.00E 00
Nb-95	1.88E 04	1.46E 07	6.16E 04	3.42E 04	3.31E 04	0.00E 00	0.00E 00	0.00E 00
Ru-103	3.41E 02	6.67E 04	7.99E 02	0.00E 00	2.82E 03	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2 mRem/yr per $\mu Ci/Sec$ for all others.

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Table 16 R_i Values for the Monticello Nuclear Generating Plant Cow Milk Pathway Child Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.58E 03	1.58E 03	0.00E 00	1.58E 03	1.58E 03	1.58E 03	1.58E 03	1.58E 03
Cr-51	4.71E 04	2.50E 06	0.00E 00	0.00E 00	7.14E 03	2.61E 04	4.77E 04	0.00E 00
Mn-54	2.87E 06	9.04E 06	0.00E 00	1.08E 07	3.02E 06	0.00E 00	0.00E 00	0.00E 00
Fe-59	4.52E 07	9.45E 07	5.61E 07	9.08E 07	0.00E 00	0.00E 00	2.63E 07	0.00E 00
Co-58	1.77E 07	3.37E 07	0.00E 00	5.77E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	6.81E 07	1.28E 08	0.00E 00	2.31E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	4.10E 09	1.16E 09	2.47E 09	6.59E 09	4.15E 09	0.00E 00	0.00E 00	0.00E 00
Sr-89	8.93E 07	1.21E 08	3.13E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.63E 10	8.68E 08	6.44E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	3.56E 02	4.17E 05	1.82E 03	4.00E 02	5.72E 02	0.00E 00	0.00E 00	0.00E 00
I-131	3.66E 08	5.73E 07	6.40E 08	6.44E 08	1.06E 09	2.13E 11	0.00E 00	0.00E 00
I-133	4.11E 06	4.38E 06	8.78E 06	1.09E 07	1.81E 07	2.02E 09	0.00E 00	0.00E 00
I-135	2.11E 04	3.40E 04	2.48E 04	4.46E 04	6.85E 04	3.95E 06	0.00E 00	0.00E 00
Cs-134	4.09E 09	1.05E 08	1.18E 10	1.94E 10	6.01E 09	0.00E 00	2.16E 09	0.00E 00
Cs-136	8.53E 08	4.63E 07	4.80E 08	1.32E 09	7.02E 08	0.00E 00	1.05E 08	0.00E 00
Cs-137	2.52E 09	1.07E 08	1.79E 10	1.71E 10	5.57E 09	0.00E 00	2.00E 09	0.00E 00
Ba-140	3.27E 06	2.84E 07	5.60E 07	4.91E 04	1.60E 04	0.00E 00	2.93E 04	0.00E 00
Ce-141	7.47E 02	6.28E 06	1.01E 04	5.03E 03	2.21E 03	0.00E 00	0.00E 00	0.00E 00
Ce-144	4.36E 04	6.68E 07	8.17E 05	2.56E 05	1.42E 05	0.00E 00	0.00E 00	0.00E 00
Nb-95	3.87E 04	1.00E 08	1.39E 05	5.41E 04	5.09E 04	0.00E 00	0.00E 00	0.00E 00
Ru-103	7.26E 02	4.88E 04	1.89E 03	0.00E 00	4.75E 03	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 17 R_i Values for the Monticello Nuclear Generating Plant Cow Milk Pathway Infant Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.40E 03	2.40E 03	0.00E 00	2.40E 03	2.40E 03	2.40E 03	2.40E 03	2.40E 03
Cr-51	7.46E 04	2.17E 06	0.00E 00	0.00E 00	1.06E 04	4.87E 04	9.47E 04	0.00E 00
Mn-54	4.54E 06	7.36E 06	0.00E 00	2.00E 07	4.44E 06	0.00E 00	0.00E 00	0.00E 00
Fe-59	7.21E 07	8.74E 07	1.05E 08	1.83E 08	0.00E 00	0.00E 00	5.41E 07	0.00E 00
Co-58	2.88E 07	2.88E 07	0.00E 00	1.15E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	1.11E 08	1.12E 08	0.00E 00	4.71E 07	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	5.26E 09	9.63E 09	3.32E 09	1.14E 10	5.53E 09	0.00E 00	0.00E 00	0.00E 00
Sr-89	1.70E 08	1.22E 08	5.94E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.79E 10	8.75E 08	7.01E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	5.58E 02	3.92E 05	3.23E 03	7.87E 02	8.48E 02	0.00E 00	0.00E 00	0.00E 00
I-131	6.92E 08	5.62E 07	1.34E 09	1.57E 09	1.84E 09	5.17E 11	0.00E 00	0.00E 00
I-133	7.91E 06	4.57E 06	1.85E 07	2.70E 07	3.17E 07	4.91E 09	0.00E 00	0.00E 00
I-135	3.74E 04	3.71E 04	5.16E 04	1.03E 05	1.14E 05	9.20E 06	0.00E 00	0.00E 00
Cs-134	3.59E 09	9.65E 07	1.90E 10	3.55E 10	9.14E 09	0.00E 00	3.75E 09	0.00E 00
Cs-136	1.03E 09	4.19E 07	9.37E 08	2.76E 09	1.10E 09	0.00E 00	2.25E 08	0.00E 00
Cs-137	2.37E 09	1.04E 08	2.85E 10	3.34E 10	8.96E 09	0.00E 00	3.63E 09	0.00E 00
Ba-140	5.94E 06	2.83E 07	1.15E 08	1.15E 05	2.74E 04	0.00E 00	7.08E 04	0.00E 00
Ce-141	1.44E 03	6.30E 06	2.00E 04	1.22E 04	3.76E 03	0.00E 00	0.00E 00	0.00E 00
Ce-144	6.56E 04	6.72E 07	1.17E 06	4.79E 05	1.94E 05	0.00E 00	0.00E 00	0.00E 00
Nb-95	6.18E 09	9.02E 07	2.59E 05	1.07E 05	7.66E 04	0.00E 00	0.00E 00	0.00E 00
Ru-103	1.28E 03	4.65E 04	3.82E 03	0.00E 00	7.96E 03	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 18 R_i Values for the Monticello Nuclear Generating Plant Goat Milk Pathway Adult Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.57E 03	1.57E 03	0.00E 00	1.57E 03	1.57E 03	1.57E 03	1.57E 03	1.57E 03
Cr-51	1.59E 03	3.99E 05	0.00E 00	0.00E 00	3.49E 02	9.48E 02	2.11E 03	0.00E 00
Mn-54	9.89E 04	1.59E 06	0.00E 00	0.00E 00	1.59E 05	9.48E 02	0.00E 00	0.00E 00
Fe-59	1.62E 05	1.41E 06	1.80E 05	4.23E 05	0.00E 00	0.00E 00	1.18E 05	0.00E 00
Co-58	6.03E 05	5.46E 06	0.00E 00	2.69E 05	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	2.32E 06	1.98E 07	0.00E 00	1.05E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	1.42E 08	1.97E 08	9.85E 07	3.14E 08	2.10E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	4.13E 07	2.31E 08	1.44E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.39E 10	1.64E 09	5.67E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	1.17E 01	5.46E 04	5.37E 01	1.72E 01	2.70E 01	0.00E 00	0.00E 00	0.00E 00
I-131	1.43E 08	6.59E 07	1.74E 08	2.50E 08	4.28E 08	8.18E 10	0.00E 00	0.00E 00
I-133	1.26E 06	3.71E 06	2.37E 06	4.13E 06	7.21E 06	6.07E 08	0.00E 00	0.00E 00
I-135	6.83E 03	2.09E 04	7.08E 03	1.85E 04	2.97E 04	1.22E 06	0.00E 00	0.00E 00
Cs-134	1.72E 10	3.69E 08	8.85E 09	2.11E 10	6.82E 09	0.00E 00	2.26E 09	0.00E 00
Cs-136	1.06E 09	1.68E 08	3.75E 08	1.48E 09	8.25E 08	0.00E 00	1.13E 08	0.00E 00
Cs-137	1.10E 10	3.25E 08	1.23E 10	1.68E 10	5.70E 09	0.00E 00	1.89E 09	0.00E 00
Ba-140	1.01E 05	3.18E 06	1.54E 06	1.94E 03	6.59E 02	0.00E 00	1.11E 03	0.00E 00
Ce-141	2.06E 01	6.94E 05	2.68E 02	1.81E 02	8.43E 01	0.00E 00	0.00E 00	0.00E 00
Ce-144	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Nb-95	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Ru-103	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 19 R_i Values for the Monticello Nuclear Generating Plant Goat Milk Pathway Teen Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	2.04E 03	2.04E 03	0.00E 00	2.04E 03	2.04E 03	2.04E 03	2.04E 03	2.04E 03
Cr-51	2.77E 03	4.66E 05	0.00E 00	0.00E 00	6.07E 02	1.54E 02	3.95E 03	0.00E 00
Mn-54	1.71E 05	1.77E 06	0.00E 00	8.64E 05	2.58E 05	0.00E 00	0.00E 00	0.00E 00
Fe-59	2.83E 05	1.74E 06	3.14E 05	7.34E 05	0.00E 00	0.00E 00	2.31E 05	0.00E 00
Co-58	1.04E 06	6.25E 06	0.00E 00	4.53E 05	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	4.02E 06	2.32E 07	0.00E 00	1.78E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	2.45E 08	2.22E 08	1.51E 08	5.25E 08	3.36E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	7.59E 07	3.16E 08	2.65E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	1.98E 10	2.25E 09	8.01E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	2.04E 01	6.84E 04	9.40E 01	2.97E 01	4.36E 01	0.00E 00	0.00E 00	0.00E 00
I-131	2.38E 08	8.77E 07	3.17E 08	4.43E 08	7.63E 08	1.29E 11	0.00E 00	0.00E 00
I-133	2.24E 06	5.57E 06	4.34E 06	7.36E 06	1.29E 07	1.03E 09	0.00E 00	0.00E 00
I-135	1.20E 04	3.59E 04	1.26E 04	3.24E 04	5.11E 04	2.08E 06	0.00E 00	0.00E 00
Cs-134	1.68E 10	4.50E 08	1.54E 10	3.62E 10	1.15E 10	0.00E 00	4.39E 09	0.00E 00
Cs-136	1.69E 09	2.02E 08	6.38E 08	2.51E 09	1.37E 09	0.00E 00	2.15E 08	0.00E 00
Cs-137	1.03E 10	4.21E 08	2.22E 10	2.96E 10	1.01E 01	0.00E 00	3.91E 09	0.00E 00
Ba-140	1.80E 05	4.30E 06	2.79E 06	3.41E 03	1.16E 03	0.00E 00	2.30E 03	0.00E 00
Ce-141	3.77E 01	9.39E 05	4.92E 02	3.28E 02	1.55E 02	0.00E 00	0.00E 00	0.00E 00
Ce-144	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Nb-95	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Ru-103	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 20 R_i Values for the Monticello Nuclear Generating Plant Goat Milk Pathway Child Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	3.23E 03	3.23E 03	0.00E 00	3.23E 03	3.23E 03	3.23E 03	3.23E 03	3.23E 03
Cr-51	5.65E 03	3.00E 05	0.00E 00	0.00E 00	8.57E 02	3.14E 03	5.73E 03	0.00E 00
Mn-54	3.44E 05	1.08E 06	0.00E 00	1.29E 06	3.62E 05	0.00E 00	0.00E 00	0.00E 00
Fe-59	5.88E 05	1.23E 06	7.29E 05	1.18E 05	0.00E 00	0.00E 00	3.42E 05	0.00E 00
Co-58	2.12E 06	4.04E 06	0.00E 00	6.92E 05	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	8.17E 06	1.53E 07	0.00E 00	2.77E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	4.92E 08	1.39E 08	2.97E 08	7.19E 08	4.98E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	1.87E 08	2.54E 08	6.56E 09	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	3.43E 10	1.82E 09	1.35E 11	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	4.27E 01	5.01E 04	2.18E 02	4.80E 01	6.87E 01	0.00E 00	0.00E 00	0.00E 00
I-131	4.39E 08	6.88E 07	7.68E 08	7.72E 08	1.27E 09	2.55E 11	0.00E 00	0.00E 00
I-133	4.93E 06	5.25E 06	1.05E 07	1.30E 07	2.17E 07	2.42E 09	0.00E 00	0.00E 00
I-135	2.53E 04	4.08E 04	2.98E 04	5.36E 04	8.22E 04	4.74E 06	0.00E 00	0.00E 00
Cs-134	1.23E 10	3.14E 08	3.55E 10	5.82E 10	1.80E 10	0.00E 00	6.47E 09	0.00E 00
Cs-136	2.56E 09	1.39E 08	1.44E 09	3.96E 09	2.11E 09	0.00E 00	3.14E 08	0.00E 00
Cs-137	7.57E 09	3.21E 08	5.36E 10	5.13E 10	1.67E 10	0.00E 00	6.01E 09	0.00E 00
Ba-140	3.92E 05	3.41E 06	6.72E 06	5.89E 03	1.92E 03	0.00E 00	3.51E 03	0.00E 00
Ce-141	8.97E 01	7.45E 05	1.21E 03	6.04E 02	2.65E 02	0.00E 00	0.00E 00	0.00E 00
Ce-144	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Nb-95	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Ru-103	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 21 R_i Values for the Monticello Nuclear Generating Plant Goat Milk Pathway Infant Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	4.90E 03	4.90E 03	0.00E 00	4.90E 03	4.90E 03	4.90E 03	4.90E 03	4.90E 03
Cr-51	8.95E 03	2.61E 05	0.00E 00	0.00E 00	1.28E 03	5.84E 03	1.14E 04	0.00E 00
Mn-54	5.45E 05	8.83E 06	0.00E 00	2.40E 06	5.33E 05	0.00E 00	0.00E 00	0.00E 00
Fe-59	9.37E 05	1.14E 06	1.36E 06	2.38E 06	0.00E 00	0.00E 00	7.03E 05	0.00E 00
Co-58	3.45E 06	3.45E 06	0.00E 00	1.38E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Co-60	1.34E 07	1.35E 07	0.00E 00	5.65E 06	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zn-65	6.31E 08	1.16E 09	3.99E 08	1.37E 09	6.63E 08	0.00E 00	0.00E 00	0.00E 00
Sr-89	3.58E 08	2.57E 08	1.25E 10	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Sr-90	3.75E 10	1.84E 09	1.47E 11	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Zr-95	6.70E 01	4.70E 04	3.88E 02	9.45E 01	1.02E 02	0.00E 00	0.00E 00	0.00E 00
I-131	8.31E 08	6.74E 07	1.60E 09	1.89E 09	2.21E 09	6.21E 11	0.00E 00	0.00E 00
I-133	9.49E 06	5.48E 06	2.23E 07	3.24E 07	3.81E 07	5.89E 09	0.00E 00	0.00E 00
I-135	4.49E 04	4.46E 04	6.19E 04	1.23E 05	1.37E 05	1.10E 07	0.00E 00	0.00E 00
Cs-134	1.08E 10	2.89E 08	5.71E 10	1.07E 11	2.74E 10	0.00E 00	1.12E 10	0.00E 00
Cs-136	3.09E 09	1.26E 08	2.81E 09	8.27E 09	3.30E 09	0.00E 00	6.74E 08	0.00E 00
Cs-137	7.10E 09	3.13E 08	8.55E 10	1.00E 11	2.69E 10	0.00E 00	1.09E 10	0.00E 00
Ba-140	7.13E 05	3.40E 06	1.38E 04	1.38E 07	3.29E 03	0.00E 00	8.50E 03	0.00E 00
Ce-141	1.72E 02	7.57E 05	2.40E 03	1.46E 03	4.52E 02	0.00E 00	0.00E 00	0.00E 00
Ce-144	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Nb-95	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00
Ru-103	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 22 R_i Values for the Monticello Nuclear Generating Plant Inhalation Pathway Adult Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.26E 03	1.26E 03	0.00E 00	1.26E 03	1.26E 03	1.26E 03	1.26E 03	1.26E 03
Cr-51	9.99E 01	3.32E 03	0.00E 00	0.00E 00	2.28E 01	5.94E 01	1.44E 04	0.00E 00
Mn-54	6.29E 03	7.72E 04	0.00E 00	3.95E 04	9.83E 03	0.00E 00	4.10E 06	0.00E 00
Fe-59	1.05E 04	1.88E 05	1.17E 04	2.77E 04	0.00E 00	0.00E 00	1.01E 06	0.00E 00
Co-58	2.07E 03	1.06E 05	0.00E 00	1.58E 03	0.00E 00	0.00E 00	9.27E 05	0.00E 00
Co-60	1.48E 04	2.84E 05	0.00E 00	1.15E 04	0.00E 00	0.00E 00	5.96E 06	0.00E 00
Zn-65	4.65E 04	5.34E 04	3.24E 04	1.03E 05	6.89E 04	0.00E 00	8.63E 05	0.00E 00
Sr-89	8.71E 03	3.49E 05	3.04E 05	0.00E 00	0.00E 00	0.00E 00	1.40E 06	0.00E 00
Sr-90	6.09E 06	7.21E 05	9.91E 07	0.00E 00	0.00E 00	0.00E 00	9.59E 06	0.00E 00
Zr-95	2.32E 04	1.50E 05	1.07E 05	3.44E 04	5.41E 04	0.00E 00	1.77E 06	0.00E 00
I-131	2.05E 04	6.27E 03	2.52E 04	3.57E 04	6.12E 04	1.19E 07	0.00E 00	0.00E 00
I-133	4.51E 03	8.87E 03	8.63E 03	1.48E 04	2.58E 04	2.15E 06	0.00E 00	0.00E 00
I-135	2.57E 03	5.25E 03	2.68E 03	6.98E 03	1.11E 04	4.48E 05	0.00E 00	0.00E 00
Cs-134	7.27E 05	1.04E 04	3.72E 05	8.47E 05	2.87E 05	0.00E 00	9.75E 04	0.00E 00
Cs-136	1.10E 05	1.17E 04	3.90E 04	1.46E 05	8.55E 04	0.00E 00	1.20E 04	0.00E 00
Cs-137	4.27E 05	8.39E 03	4.78E 05	6.20E 05	2.22E 05	0.00E 00	7.51E 04	0.00E 00
Ba-140	2.56E 03	2.18E 05	3.90E 04	4.90E 01	1.67E 01	0.00E 00	1.27E 06	0.00E 00
Ce-141	1.53E 03	1.20E 05	1.99E 04	1.35E 04	6.25E 03	0.00E 00	3.61E 05	0.00E 00
Ce-144	1.84E 05	8.16E 05	3.43E 06	1.43E 06	8.48E 05	0.00E 00	7.78E 06	0.00E 00
Nb-95	4.21E 03	1.04E 05	1.41E 03	7.82E 03	7.72E 03	0.00E 00	5.05E 05	0.00E 00
Ru-103	6.58E 02	1.10E 05	1.53E 03	0.00E 00	5.83E 03	0.00E 00	5.05E 05	0.00E 00

* R_i values are in units of mRem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 23 R_i Values for the Monticello Nuclear Generating Plant Inhalation Pathway Teen Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.27E 03	1.27E 03	0.00E 00	1.27E 03	1.27E 03	1.27E 03	1.27E 03	1.27E 03
Cr-51	1.35E 02	3.00E 03	0.00E 00	0.00E 00	3.07E 01	7.49E 01	2.09E 04	0.00E 00
Mn-54	8.39E 03	6.67E 04	0.00E 00	5.10E 04	1.27E 04	0.00E 00	1.98E 06	0.00E 00
Fe-59	1.43E 04	1.78E 05	1.59E 04	3.69E 04	0.00E 00	0.00E 00	1.53E 06	0.00E 00
Co-58	2.77E 03	9.51E 04	0.00E 00	2.07E 03	0.00E 00	0.00E 00	1.34E 06	0.00E 00
Co-60	1.98E 04	2.59E 05	0.00E 00	1.51E 04	0.00E 00	0.00E 00	8.71E 06	0.00E 00
Zn-65	6.23E 04	4.66E 04	3.85E 04	1.33E 05	8.63E 04	0.00E 00	1.24E 06	0.00E 00
Sr-89	1.25E 04	3.71E 05	4.34E 05	0.00E 00	0.00E 00	0.00E 00	2.41E 06	0.00E 00
Sr-90	6.67E 06	7.64E 05	1.08E 08	0.00E 00	0.00E 00	0.00E 00	1.65E 07	0.00E 00
Zr-95	3.15E 04	1.49E 05	1.45E 05	4.58E 04	6.73E 04	0.00E 00	2.68E 06	0.00E 00
I-131	2.64E 04	6.48E 03	3.54E 04	4.90E 04	8.39E 04	1.46E 07	0.00E 00	0.00E 00
I-133	6.21E 03	1.03E 04	1.21E 04	2.05E 04	3.59E 04	2.92E 06	0.00E 00	0.00E 00
I-135	3.49E 03	6.95E 03	3.70E 03	9.44E 03	1.49E 04	6.21E 05	0.00E 00	0.00E 00
Cs-134	5.48E 05	9.75E 03	5.02E 05	1.13E 05	3.75E 05	0.00E 00	1.46E 05	0.00E 00
Cs-136	1.37E 05	1.09E 04	5.14E 04	1.93E 05	1.10E 05	0.00E 00	1.77E 04	0.00E 00
Cs-137	3.11E 05	8.47E 03	6.69E 05	8.47E 05	3.04E 05	0.00E 00	1.21E 05	0.00E 00
Ba-140	3.51E 03	2.28E 05	5.46E 04	6.69E 01	2.28E 01	0.00E 00	2.03E 06	0.00E 00
Ce-141	2.16E 03	1.26E 05	2.84E 04	1.89E 04	8.87E 03	0.00E 00	6.13E 05	0.00E 00
Ce-144	2.62E 05	8.64E 05	4.89E 06	2.02E 06	1.21E 06	0.00E 00	1.34E 07	0.00E 00
Nb-95	5.66E 03	9.68E 04	1.86E 04	1.03E 04	1.00E 04	0.00E 00	7.51E 05	0.00E 00
Ru-103	8.96E 02	1.09E 05	2.10E 03	0.00E 00	7.43E 03	0.00E 00	7.83E 05	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 24 R_i Values for the Monticello Nuclear Generating Plant Inhalation Pathway Child Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	1.21E 03	1.12E 03	0.00E 00	1.12E 03	1.12E 03	1.12E 03	1.12E 03	1.12E 03
Cr-51	1.54E 02	1.08E 03	0.00E 00	0.00E 00	2.43E 01	8.53E 01	1.70E 04	0.00E 00
Mn-54	9.50E 03	2.29E 04	0.00E 00	4.29E 04	1.00E 04	0.00E 00	1.57E 06	0.00E 00
Fe-59	1.67E 04	7.06E 04	2.07E 04	3.34E 04	0.00E 00	0.00E 00	1.27E 06	0.00E 00
Co-58	3.16E 03	3.43E 04	0.00E 00	1.77E 03	0.00E 00	0.00E 00	1.10E 06	0.00E 00
Co-60	2.26E 04	9.61E 04	0.00E 00	1.31E 04	0.00E 00	0.00E 00	7.06E 06	0.00E 00
Zn-65	7.02E 04	1.63E 04	4.25E 04	1.13E 05	7.13E 04	0.00E 00	9.94E 05	0.00E 00
Sr-89	1.72E 04	1.67E 05	5.99E 05	0.00E 00	0.00E 00	0.00E 00	2.15E 06	0.00E 00
Sr-90	6.43E 06	3.43E 05	1.01E 08	0.00E 00	0.00E 00	0.00E 00	1.47E 07	0.00E 00
Zr-95	3.69E 04	6.10E 04	1.90E 05	4.17E 04	5.95E 04	0.00E 00	2.23E 06	0.00E 00
I-131	2.72E 04	2.84E 03	4.80E 04	4.80E 04	7.87E 04	1.62E 07	0.00E 00	0.00E 00
I-133	7.68E 03	5.47E 03	1.66E 04	2.03E 04	3.37E 04	3.84E 06	0.00E 00	0.00E 00
I-135	4.14E 03	4.44E 03	4.92E 03	8.73E 03	1.34E 04	7.92E 05	0.00E 00	0.00E 00
Cs-134	2.24E 05	3.84E 03	6.50E 05	1.01E 05	3.30E 05	0.00E 00	1.21E 05	0.00E 00
Cs-136	1.16E 05	4.17E 03	6.50E 04	1.71E 05	9.53E 04	0.00E 00	1.45E 04	0.00E 00
Cs-137	1.28E 05	3.61E 03	9.05E 05	8.24E 05	2.82E 05	0.00E 00	1.04E 05	0.00E 00
Ba-140	4.32E 03	1.02E 05	7.39E 04	6.47E 01	2.11E 01	0.00E 00	1.74E 06	0.00E 00
Ce-141	2.89E 03	5.65E 04	3.92E 04	1.95E 04	8.53E 03	0.00E 00	5.43E 05	0.00E 00
Ce-144	3.61E 05	3.88E 05	6.77E 06	2.12E 06	1.17E 06	0.00E 00	1.19E 07	0.00E 00
Nb-95	6.55E 03	3.70E 04	2.35E 04	9.18E 03	8.62E 03	0.00E 00	6.14E 05	0.00E 00
Ru-103	1.07E 03	4.48E 04	2.79E 03	0.00E 00	7.03E 03	0.00E 00	6.62E 05	0.00E 00

* R_i values are in units of mRem/yr per μCi/m^3 for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 25 R_i Values for the Monticello Nuclear Generating Plant Inhalation Pathway Infant Age Group

Nuclide	T. Body	GI Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
H-3	6.46E 02	6.46E 02	0.00E 00	6.46E 02	6.46E 02	6.46E 02	6.46E 02	6.46E 02
Cr-51	8.93E 01	3.56E 02	0.00E 00	0.00E 00	1.32E 01	5.75E 01	1.28E 04	0.00E 00
Mn-54	4.98E 03	7.05E 03	0.00E 00	2.53E 04	4.98E 03	0.00E 00	9.98E 05	0.00E 00
Fe-59	9.46E 03	2.47E 04	1.35E 04	2.35E 04	0.00E 00	0.00E 00	1.01E 06	0.00E 00
Co-58	1.82E 03	1.11E 04	0.00E 00	1.22E 03	0.00E 00	0.00E 00	7.76E 05	0.00E 00
Co-60	1.18E 04	3.19E 04	0.00E 00	8.01E 03	0.00E 00	0.00E 00	4.50E 06	0.00E 00
Zn-65	3.10E 04	5.13E 04	1.93E 04	6.25E 04	3.24E 04	0.00E 00	6.46E 05	0.00E 00
Sr-89	1.14E 04	6.39E 05	3.97E 05	0.00E 00	0.00E 00	0.00E 00	2.03E 06	0.00E 00
Sr-90	2.59E 06	1.31E 05	4.08E 07	0.00E 00	0.00E 00	0.00E 00	1.12E 07	0.00E 00
Zr-95	2.03E 04	2.17E 04	1.15E 05	2.78E 04	3.10E 00	0.00E 00	1.75E 06	0.00E 00
I-131	1.96E 04	1.06E 03	3.79E 04	4.43E 04	5.17E 04	1.48E 07	0.00E 00	0.00E 00
I-133	5.59E 03	2.15E 03	1.32E 04	1.92E 04	2.24E 04	3.55E 06	0.00E 00	0.00E 00
I-135	2.27E 03	1.83E 03	3.86E 03	7.60E 03	8.47E 03	6.96E 05	0.00E 00	0.00E 00
Cs-134	7.44E 04	1.33E 03	3.96E 05	7.02E 05	1.90E 05	0.00E 00	7.95E 04	0.00E 00
Cs-136	5.28E 04	1.43E 03	4.82E 04	1.34E 05	5.63E 04	0.00E 00	1.17E 04	0.00E 00
Cs-137	4.54E 04	1.33E 03	5.48E 05	6.11E 05	1.72E 05	0.00E 00	7.12E 04	0.00E 00
Ba-140	2.89E 03	3.83E 04	5.59E 04	5.59E 01	1.34E 01	0.00E 00	1.59E 06	0.00E 00
Ce-141	1.99E 03	2.15E 04	2.77E 04	1.66E 04	5.24E 03	0.00E 00	5.16E 05	0.00E 00
Ce-144	1.76E 05	1.48E 05	3.19E 06	1.21E 06	5.38E 06	0.00E 00	9.84E 06	0.00E 00
Nb-95	3.78E 03	1.27E 04	1.57E 04	4.79E 05	4.72E 03	0.00E 00	4.79E 05	0.00E 00
Ru-103	6.79E 02	1.61E 04	2.02E 03	0.00E 00	4.24E 03	0.00E 00	5.52E 05	0.00E 00

* R_i values are in units of mRem/yr per $\mu Ci/m^3$ for inhalation and tritium, and in units of m^2 mRem/yr per μCi/Sec for all others.

Table 26 Table of Radioisotope Constants Used by EBARR

i	Isotope	Fission Yield	Decay Constant
1	Xe-133	0.0669	0.00000152
2	Xe-135	0.0630	0.0000210
3	Kr-85m	0.0130	0.0000438
3	Kr-88	0.0356	0.00000690
4	Kr-87	0.0253	0.000152
5	Xe-138	0.0590	0.000814
6	Kr-90	0.0500	0.0210
7	Xe-139	0.0540	0.0169
8	Kr-89	0.0459	0.00361
10	Xe-137	0.0600	0.00296
11	Xe-135m	0.00720	0.000722
12	Kr-83m	0.00520	0.000103
13	Xe-133m	0.00160	0.00000348
14	Xe-131m	0.000170	0.000000668
15	Kr-85	0.00271	0.00000000204