RIVER BEND STATION

GULF STATES UTILITIES

OFFSITE DOSE CALCULATION MANUAL (ODCM)

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1.0 INTRODUCTION

This manual provides the methodology to calculate radiation doses to individuals in the vicinity of the River Bend Station (RBS). It also provides the methodology for calculating effluent monitoring setpoints and allowable release rates to ensure compliance with the Radiological Effluent Technical Specifications (RETS) of Gulf States Utilities, River Bend Station. This manual also contains a description of the radiological Environmental Monitoring Program which includes sample point descriptions for both onsite and offsite locations and sampling and analysis frequencies.

The ODCM follows the methodology and models suggested by the "Guidance Manual for Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants" (NUREG-0133, dated October 1978) and "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I" (Regulatory Guide 1.109, Rev. 1, dated October 1977). Simplifying assumptions have been applied where applicable to provide a more workable document for implementing the technical specifications requirements. Alternate calculational methods may be used from those presented as long as the overall methodology does not change or as long as the alternative methods provide results that are more limiting. Also, as available, the most up-to-date revision of Regulatory Guide 1.109 dose conversion factors and site-specific environmental transfer factors may be substituted for those currently included and used in this document.

2.0 LIQUID EFFLUENT METHODOLOGY

2.1 River Bend Station Site Description

The River Bend Station Final Safety Analysis Report (FSAR) contains the official description of the site characteristics. The description that follows is a brief summary for dose calculation purposes:

The River Bend Station (RBS) is on a site in West Feliciana Parish, Louisiana, located approximately 24 miles north- northwest of Baton Rouge, Louisiana. This site is just east of the Mississippi River which is used as the source of the RBS major water requirements and which receives the RBS liquid effluents.

2.2 Compliance with 10CFR20 (Liquids)

2.2.1 Requirements

In accordance with Technical Specification 3.11.1.1, the concentration of radioactive material released in liquid effluents to Unrestricted Areas (Figure 1) shall be limited to the concentrations specified in 10CFR20, Appendix B, Table II, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} uCi/ml total activity. The concentration of radionuclides in liquid waste is determined by sampling and analysis in accordance with Technical Specification Table 4.11.1.1-1.

2.2.2 Methodology

This section describes the calculational method to be used to determine F_L, the fraction of 10CFR20 limits of release concentrations of liquid radioactive effluents.

2.2.2.1 General Approach

Liquid effluent releases from River Bend Station are discharged through the cooling tower water blowdown which is directed to the Mississippi River. Principal sources of radwaste are from floor drains, phase separators/backwash tank subsystem and reactor water cleanup as shown in Figure 2. The liquid radwaste system is operated as a batch system. Only one tank of liquid radwaste is released at a time and is considered a batch.

The radioactive content of each batch release will be determined prior to release in accordance with Table 4.11.1.1-1 of the RBS Technical Specifications. Compliance with 10CFR20 limits will be determined with the following equation:

$$F_L = \frac{f_1}{f_2} \cdot \sum_{i=1}^{n} \frac{C_i}{(MPC)_i} \qquad 2.2.2.1\text{-}1$$

where:

F_L = The fraction of 10CFR20 MPC limits resulting from the release source being discharged

f_1 = The undiluted release rate of the release source at the monitor location, in gpm

f_2 = The cooling tower blowdown release rate, in gpm

C_i = The undiluted concentration of nuclide (i), in uCi/ml from sample assay.

Note: When isotopic analyses indicate that activity is present at less than or equal to the Lower Limit of Detectability (LLD), utilize the laboratory determined LLD values for I-131 and the principal gamma emitters as defined in Tech Spec Table 4.11.1.1.1-1 for C_i.

$(MPC)_i$ = Maximum Permissible Concentration of nuclide (i) from Appendix A, in uCi/ml

as long as F_L is less than 1.0 the concentration of the tank is within compliance with 10CFR20 limits.

2.2.2.2 Simplified Approach

For purposes of simplifying the calculations, the value of 3×10^{-8} uCi/ml (unidentified 10CFR20 MPC value) could be substituted for $(MPC)_i$ and the cumulative concentration (C-Total = sum of all identified radionuclide concentrations) or the gross beta-gamma concentration should be substituted for C_i. As long as the diluted concentration (C-Total $\cdot$ f_1/f_2) is less than 3×10^{-8} uCi/ml, the nuclide by nuclide calculation is not required to demonstrate compliance with 10CFR20 MPC limits.

2.3 Determination of Setpoints for Radioactive Liquid Effluent Monitors

2.3.1 Requirements

Technical Specification 3.3.7.10 requires the radioactive liquid effluent monitor be operable with their high alarm/trip setpoints set to ensure that limits of Technical Specification 3.11.1.1 are not exceeded. The high alarm/trip setpoints shall be determined and adjusted by the methodology which follows.

The high alarm setpoint for the liquid effluent radiation monitor is derived from the concentration limit provided in 10CFR20, Appendix B, Table II, Column 2 applied at the restricted area boundary where the discharge flows into the Mississippi River.

2.3.2 Methodology

The high alarm setpoint does not consider dilution, dispersion, or decay of radioactive material beyond the site boundary. That is, the alarm setpoint is based on a concentration limit at the end of the discharge.

A sample of each batch of liquid radwaste is analyzed for I-131 and other principal gamma emitters as specified in Table 4.11.1.1-1 of Technical Specification 3.11.1.1, for total activity concentration prior to release. The fraction F_L of the 10CFR20 MPC limits for unrestricted areas is determined in accordance with the preceding section for the activity concentration released.

The liquid radwaste effluent line radiation monitor alarm setpoint is determined with the equation:

$$S = \frac{A}{F_L} \times \frac{f_2 + f_1}{f_1} \times g \qquad 2.3.2\text{-}1$$

where:

S	=	The radiation monitor setpoint (cpm or uCi/ml)
A	=	The counting rate (cpm/ml) or activity concentration (uCi/ml) of the sample as determined in the laboratory
g	=	The ratio of effluent radiation monitor counting rate or activity concentration to laboratory counting rate or activity concentration in a given batch of liquid (cpm per cpm/ml or uCi/ml per uCi/ml)
f_1	=	Release rate of undiluted batch release line (ml/sec, gpm, or other consistent units of vol/time)
f_2	=	Minimum dilution flow of cooling tower blowdown in the discharge (ml/sec, gpm, or other consistent units of vol/time)

Note: A/F_L represents the counting rate of a solution having the same radionuclide distribution as the sample and having the maximum permissible concentration (MPC) of that mixture.

2.4 Determining the Dose for Radioactive Liquid Effluents

2.4.1 Requirements

Technical Specification 3.11.1.2 requires the dose or dose commitment to a person offsite due to radioactive material released in liquid effluents be calculated on a cumulative basis at least every 31 days. Dose or dose commitment shall be limited to:

a) Less than or equal to 1.5 mRems to the total body and to less than or equal to 5 mRems to any organ, during any quarter; and

b) Less than or equal to 3 mRems to the total body and less than or equal to 10 mRems to any organ during any calendar year.

2.4.2 Methodology

This section provides the methodology to calculate dose to all age groups and organs from all radionuclides identified in the liquid effluents.

The method is based on the methodology suggested by Sections 4.3 and 4.3.1 of NUREG-0133, Rev. 1, November 1978. The site-specific dose factors $A_{i\tau}$ for all viable pathways are listed in Appendix B.

The following equation provides for a dose calculation to the total body or any organ for a given age group ($D_{\tau a}$) based on actual release conditions during a specific time interval for radioactive liquid releases:

$$D_{\tau a} = \sum_{i=1}^{n} D_{i\tau} = \sum_{i=1}^{n} \frac{A_{i\tau} \Delta t_1 \, Q_{i1}}{(DF)_1 \, D_w} \qquad 2.4.2\text{-}1$$

$D_{i\tau}$ = Dose commitment in mRem from radionuclide (i) received by organ (τ) of age group (a) resulting from releases during the time interval Δt_1

$A_{i\tau}$ = Site related dose commitment factor to the total body or any organ (τ) for each identified radionuclide (i). The $A_{i\tau}$ values listed in Appendix B are site-related to RBS and have the units (mRem/hr per uCi/ml)

Δt_1 = Number of hours that the release occurred

Q_{i1} = The total quantity of nuclide (i) released during the time period Δt_1 (uCi)

Dw = The near field dilution factor. Site specific value is 11.4 (River Bend E.R. p.5.4-5, section 5.4.2.3.1)

$(DF)_1$ = The total volume of dilution that occurred during the release time period Δt_1 (i.e., the cooling tower blowdown flow rate multiplied by the time) (ml).

The doses associated with each release may then be summed to provide the cumulative dose over a desired time period (e.g., sum all dose for releases during a 31 day period, calendar quarter, or a year).

The following equation is used to calculate the total doses for the desired time interval:

$$D_{TOTAL\tau} = \sum_{i=1}^{n} (D_{\tau a})_i \qquad 2.4.2\text{-}2$$

where:

$D_{TOTAL\tau}$ = The total dose commitment to the organ (τ) due to all releases during the desired time interval in mRem.

$D_{\tau a_i}$ = The dose commitment in mRem to the organ (τ) of age group (a) due to liquid release (i) during the desired time interval.

2.5 Projecting Dose for Radioactive Liquid Effluents

2.5.1 Requirements

Technical Specification 3.11.1.3 requires the liquid radwaste treatment system be used to reduce the radioactive materials in liquid wastes prior to their discharge when projected doses due to liquid effluents, to unrestricted areas (Figure 1) would exceed 0.06 mRem to the total body or 0.2 mRem to any organ in a 31 day period.

2.5.2 Methodology

The following calculational methodology shall be performed at least once per 31 day period:

$$PD_{\tau a} = \frac{X}{X_D} \cdot D_{TOTAL_\tau} \qquad 2.5.2\text{-}1$$

where:

$PD_{\tau a}$ = Projected dose commitment (mRem) to organ (τ) of age group (a) during the 31 day period

X = The number of days in the 31 day period

X_D = The number of days to date in the 31 day period

$D_{TOTAL\tau}$ = The total dose commitment (mRem) to an organ (τ) of age group (a) to date during the 31 day period. The age group (a) is selected based upon highest dose commitment.

3.0 GASEOUS EFFLUENT METHODOLOGY

3.1 Introduction

The River Bend Station discharges gaseous effluents through the Main Plant Exhaust Duct, Fuel Building Exhaust Duct, and Radwaste Building Exhaust Duct. The location of these release points in relation to the River Bend site is found in Figure 3. The gaseous effluent streams, radioactivity monitoring points, and effluent discharge points are shown schematically in Figure 4. For purposes of simplicity, Fuel Building exhaust effluents are included in the Main Plant exhaust duct releases. All gaseous effluent releases are assumed to be ground level releases.

3.2 Data Requirements for Gaseous Effluents

For the purpose of estimating offsite radionuclide concentrations and radiation doses, measured radionuclide concentrations in gaseous effluents and in ventilation air exhausted from the station are relied upon. Table 4.11.2.1.2-1 in the Technical Specifications identifies the radionuclides in gaseous discharges for which sampling and analysis is done.

When a nuclide concentration is below the LLD for the analysis, it is not reported as being present in the sample.

Real meteorological data factors are calculated and used in dose calculations for the Semi-annual Effluent Release Report. Historical information and conservative receptor assumptions are only used for ease of Limiting Condition of Operation (LCO) dose limit calculations. Dose calculations performed with actual occurring data will describe the source of the data in the report. Modeling will be performed in accordance with Regulatory Guide 1.111, Rev. 1.

3.3 Instantaneous Release Rate and Setpoint Determination

3.3.1 Instantaneous Release Rate Determination

The instantaneous release rate determination is performed to show compliance with the limits set forth in 10CFR20.

3.3.1.1 Requirements

Technical Specification 3.11.2.1 states that the dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the site boundary (see Figure 1) shall be limited to the following:

a. For noble gases: Less than or equal to 500 mRem/year to the total body and less than or equal to 3,000 mRem/year to the skin; and

b. For I-131, I-133, tritium, and for all radionuclides in particulate form with half-lives greater than 8 days: less than or equal to 1,500 mRem/year to any organ.

3.3.1.2 Methodology

3.3.1.2.1 General Approach - Total Body and Skin Instantaneous Release Rate Calculations

To determine the dose rate from noble gases in unrestricted areas, the following formulae are used:

$$DR_{TB} = 3.15 \times 10^7 \cdot \sum_{i=1}^{n} K_i \, (\overline{X/Q}) \quad Q_i \qquad 3.3.1.2.1\text{-}1$$

$$DR_{skin} = 3.15 \times 10^7 \cdot \sum_{i=1}^{n} (L_i + 1.1\, M_i) \, (\overline{X/Q}) \quad Q_i \qquad 3.3.1.2.1\text{-}2$$

where:

DR_{TB} = Dose rate to the total body in mRem/year.

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide (i) in mRem/sec per uCi/m^3. Appendix C.

L_i = Skin dose factor due to beta emissions for each identified noble gas radionuclide (i) in mRem/sec per uCi/m^3. Appendix C.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide (i) in mRad/sec per uCi/m^3. Appendix C.

$(\overline{X/Q})$ = The highest calculated annual average relative concentration for any area at or beyond the restricted area boundary in sec/m^3. For either elevated (stack) or vent releases. Appendix F.

Q_i = The release rate of radionuclide (i) in gaseous effluents from all releases in uCi/sec.

1.1 = Conversion factor for M_i from mRad to mRem.

3.15×10^7 = Number of sec/year.

In order to comply with the limits of 10CFR20, $DR_{TB} \leq 500$ mRem/year and $DR_{skin} \leq 3{,}000$ mRem/year must be met at the most limiting location.

The radionuclide mix was based upon source terms tabulated in the River Bend Station FSAR, Table 11.3-1 and are summarized in Appendix D.

The X/Q values utilized in equations 3.3.1.2.1-1 and 3.3.1.2.1-2 are based upon maximum long-term annual average $\overline{(X/Q)}$ in the unrestricted area. Appendix F lists the maximum X/Q values for the RBS release points at the restricted area boundary.

To select the most limiting location, the highest X/Q for each release point is used (from Appendix F):

$$(X/Q)_s = 2.91 \times 10^{-6} \text{ sec/m}^3$$

$$(X/Q)_v = 3.84 \times 10^{-5} \text{ sec/m}^3$$

where:

$(X/Q)_s$ = Chi/Q for Main Plant exhaust duct and Fuel Building exhaust duct

$(X/Q)_v$ = Chi/Q for Radwaste Building exhaust duct

Appendix F contains the maximum X/Q and D/Q values used in calculating individual doses.

Release rates for all release points must be considered at the same time. If releases are occurring at the same time, the total instantaneous dose for all releases must be less than the limits of Technical Specification 3.11.2.1. An administrative control limits the release rates for each of the three release points to 1/3 the total Technical Specification doses.

3.3.1.2.2 Limited Analysis Approach - Instantaneous Noble Gas Release Rate

The above methodology can be simplified to provide for a rapid determination of cumulative noble gas release limits based on the requirements specified in Section 3.3.1.1. Beginning with equation 3.3.1.2.1-1 the simplication proceeds as follows:

From an evaluation of projected releases, an effective total body dose factor (K_{eff}) can be derived. This dose factor is, in effect, a weighted average total body dose factor. See Appendix C for a detailed explanation and evaluation of K_{eff}. The value of K_{eff} has been derived from the radioactive noble gas effluents listed in RBS-FSAR and included in Appendix D. The values are:

Radwaste Building Exhaust Duct:

$$K_{eff} = 8.05 \times 10^{-5} \text{ [mRem-m}^3\text{/uCi-sec]}$$

Main Plant Exhaust Duct and Fuel Building Exhaust Duct:

$$K_{eff} = 3.56 \times 10^{-5} \text{ [mRem-m}^3\text{/uCi-sec]}$$

Either of these values, as appropriate, may be used in conjunction with the total noble gas release rate ($\Sigma \dot{Q}_i$) to verify that the instantaneous dose rate is within the allowable limits. To compensate for any unexpected variability in the radionuclide distribution, a conservatism factor of 0.8 is introduced into the calculation. The simplified equation is:

$$DR_{TB} = \frac{K_{eff} \cdot \overline{(X/Q)}}{0.8} \sum_{i=1}^{n} \dot{Q}_i \qquad 3.3.1.2.2\text{-}1$$

where:

DR_{TB} = Total body dose rate from noble gases in airborne releases in mRem/sec.

$\overline{(X/Q)}$ = For ground level or elevated releases, the highest calculated annual long-term historic relative concentration for any of the 16 sectors, at or beyond the unrestricted area boundary, in sec/m^3 (Appendix F).

$\dot{Q}_i$ = The total release rate of all noble gas nuclides from the release source of interest in uCi/sec.

3.3.1.2.3 Determining the Radioiodine and 8-day Particulate Release Rates

The following calculational method is provided for determining the dose rate from radioiodine and particulates with half-lives greater than 8 days and to determine if they are within the limits listed in Section 3.3.1.1-b.

In the calculation to show compliance with 10CFR20, only the inhalation pathway is considered, since it is the most limiting pathway.

Inhalation Pathway:

$$DR_{I\&8DPt} = \sum_{i=1}^{n} P_i \cdot \overline{(X/Q)}_D \cdot \dot{Q}_i \qquad 3.3.1.2.3\text{-}1$$

where:

τ = The organ of interest for the age group of interest.

$\dot{Q}_i$ = Release rate of nuclide (i), [uCi/sec].

$DR_{I\&8DP_\tau}$ = Dose rate to the organ τ for the age group of interest from iodines and 8 day particulates via the inhalation pathway [in mRem/yr].

$(\overline{X/Q})_D$ = The long-term depieted and 8 day decayed CHI/Q value based on historical meteorological data (Appendix E) [in sec/m^3]. Note: No credit for decay or depletion has been taken.

P_i = The dose factor for applicable environmental pathway [in units of mRem/yr per uCi/m^3] (Appendix G).

Note: For calculations involving tritium, use $(X/Q)_D$ in sec/m^3.

The determination of limiting location for implementation of 10CFR20 for radioiodines and particulates is a function of the same parameters as for noble gases.

Values for P_i were calculated for an infant for various radionuclides for the inhalation pathway using the methodology of NUREG-0133. The P_i values are presented in Appendix G. The values of P_i reflect, for each radionuclide, the maximum P_i value for any organ for the inhalation pathway.

3.3.2 Setpoint Determination

3.3.2.1 Requirements

Instrumentation is provided to monitor beta-gamma radiation from radioactive materials released from the River Bend Station in gaseous effluents. Each release point process monitor listed in Tech. Spec. Table 4.11.2.1.2-1 includes an alarm that is set to report when the radioactive noble gas in gaseous effluents (Main Plant exhaust duct, Fuel Building exhaust duct or Radwaste Building exhaust duct) is expected to cause a noble gas concentration at ground level offsite equal to or greater than specified in 10CFR20 Appendix B, Table 2, Column 1 for the mixture. MPC values for gaseous radionuclides are listed in Appendix H.

The distribution of radioactive noble gases in a gaseous effluent stream is determined by gamma spectrum analysis of identifiable radionuclides in effluent gas sample(s). Results of one or more previous analyses may be averaged to obtain a representative spectrum. In the event the distribution is unobtainable from measured data, the distribution of radioactive noble gases based on past data or calculated by the BWR-GALE code appearing in Appendix D may be assumed.

To allow for multiple sources of releases from the three different release points, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release to each of the release sources.

3.3.2.2 Methodology

This section describes the methodology for determining alarm/trip setpoints for the three release points.

<u>Step 1</u>

Determine the Q_{TB} (maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent [uCi/sec]) based upon the whole body exposure limit of 500 mRem/year for all release points by:

$$Q_{TB} = 3.17 \times 10^{-8} \cdot \frac{500}{(\overline{X/Q}) \sum_i K_i \; f_i} = 3.17 \times 10^{-8} \cdot \frac{500(0.8)}{(\overline{X/Q}) \cdot K_{eff}} \qquad 3.3.2.2\text{-}1$$

where:

$(\overline{X/Q})$ = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all sections (sec/m^3). Appendix F.

K_i = The total whole body dose factor due to gamma emissions from noble gas radionuclide (i) (mrem/sec per uCi/m^3) from Appendix C, Table C-1.

f_i = Fraction of noble gas radionuclide (i) to total noble gas concentration.

K_{eff} = $\sum_i K_i \cdot f_i$, effective dose factor (mrem/sec per uCi/m^3) from Appendix C, Table C-3.

3.17×10^{-8} = Inverse of number of seconds per year in year/sec.

0.8 = Conservative factor to account for changing isotopic inventory.

Step 2

Determine Q_s (the maximum acceptable release rate of all gas radionuclides in the gaseous effluent [uCi/sec]) based upon the skin exposure limit of 3,000 mRem/year for all release points by:

$$Q_s = 3.17 \times 10^{-8} \cdot \frac{3,000}{(\overline{X/Q}) \sum_i [L_i + 1.1M_i) f_i]} = 3.17 \times 10^{-8} \cdot \frac{3,000\ (0.8)}{(\overline{X/Q})(L+1.1M)_{eff}}$$

3.3.2.2-2

where:

$L_i + 1.1M_i$ = Total skin dose factor due to emission from noble gas radionuclide (i) ($mRem/sec/uCi/m^3$) from Appendix C.

$(L+1.1M)_{eff}$ = $\sum_i (1_i + 1.1\ M_i) \cdot f_i$, effective total skin dose factor ($mrem/sec/uCi/m^3$) from Appendix C, Table C-4.

Step 3

Determine C_m (the maximum acceptable total radioactivity concentration of all noble gas radionuclides for each release point in the gaseous effluent [uCi/cc].

$$C_m = \frac{2.12\ E\text{-}3\ Q}{F} \qquad 3.3.2.2\text{-}3$$

Note: Use the lower of the Q values obtained in Steps 1 and 2. This will protect both the skin and total body from being exposed to the limit.

where:

F = The maximum acceptable effluent flow rate at the point of release based on design flow rates (cfm).

2.12 E-3 = Unit conversion factor to convert uci/sec/cfm to uCi/cc.

Step 4

Determine CR (the calculated monitor count rate above background attributed to the noble gas radionuclides [cpm]) by:

$$CR = (C_m)\ (E_m) \qquad 3.3.2.2\text{-}4$$

where:

E_m = Efficiency of the applicable effluent monitor (cpm/uCi/cc).

Step 5

Determine the HSP (the monitor high alarm setpoint including background [cmp]) by:

$$HSP = T_m CR + Bkg \qquad 3.3.2.2\text{-}5$$

where:

T_m = Fraction of the radioactivity from the site that may be released via the monitored pathway to ensure that the site boundary limit is not exceeded due to simultaneous releases from several pathways.

T_m = .33 for all release points.

Bkg	=	The background count rate (cpm) due to internal contamination and the radiation levels in the area in which the monitor is installed when the detector sample chamber is filled with uncontaminated air.

3.4 Cumulative Dose Determination for Radioactive Gaseous Effluents

3.4.1 Noble Gases

3.4.1.1 Requirements

Technical Specification 3.11.2.2 states that the air dose due to noble gases released in gaseous effluents from each reactor unit to areas at and beyond the site boundary (see Figure 1) shall be limited to the following:

a. During any calendar quarter: less than or equal to 5 mRads for gamma radiation and less than or equal to 10 mRads for beta radiation; and

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

3.4.1.2 Methodology

This section provides the methodology to calculate the doses to all age groups and organs from all noble gas radionuclides identified in the gaseous effluents.

The method is based on the methodology suggested by sections 5.3 and 5.3.1 of NUREG-0133, Rev. 1, November, 1978. The site related dose factors for all viable pathways are listed in Appendix I. Dose factors are compiled by age groups, for all organs and radionuclides common to a BWR environment.

The following equations provide for air dose calculations based on actual noble gas release rates during a specific time interval for radioactive gaseous release sources at the site boundary:

$$D_{Gamma-Air} = \sum_{i=1}^{n} M_i \times (\overline{X/Q}) \times Q_i \qquad 3.4.1.2\text{-}1$$

$$D_{Beta-Air} = \sum_{i=1}^{n} N_i \times (\overline{X/Q}) \times Q_i \qquad 3.4.1.2\text{-}2$$

where:

$D_{Gamma-Air}$ = The gamma air dose from radioactive noble gases in mRad.

M_i = The gamma air dose factor for radioactive noble gas nuclide (i) in $mRad\text{-}m^3/uCi\text{-}sec$ (Appendix C).

$(\overline{X/Q})$ = The long-term atmospheric dispersion factor for ground level (annual average) for the year of interest. Actual meteorological data and sector wind frequency distributions will be used to determine annual X/Q for the year of interest in sec/m^3 (Appendix E).

Q_i = The number of uCi of nuclide (i) released during the period of interest.

$D_{Beta-Air}$ = Beta air dose from radioactive noble gases in mRad.

N_i = The beta air dose factor for radioactive noble gas nuclide (i) in $mRad\text{-}m^3/uCi\text{-}sec$ (Appendix C), Table C-1.

3.4.1.3 Simplified Approach

A single effective gamma air dose factor (M_{eff}) and beta air dose factor (N_{eff}) have been derived, which are representative of the radionuclide abundances and corresponding dose contributions that are projected in the RBS FSAR. (See Appendix C for a detailed explanation and evaluation of M_{eff} and N_{eff}.) The values of M_{eff} and N_{eff} which have been derived from the projected radioactive noble gas effluents are:

Radwaste Building Exhaust Duct:

M_{eff} = 8.07×10^{-5} $mRad\text{-}m^3/uCi\text{-}sec$

N_{eff} = 7.40×10^{-5} $mRad\text{-}m^3/uCi\text{-}sec$

Main Plant Exhaust Duct and Fuel Building Exhaust Duct:

M_{eff} = 5.96×10^{-5} $mRad\text{-}m^3/uCi\text{-}sec$

N_{eff} = 8.99×10^{-5} $mRad\text{-}m^3/uCi\text{-}sec$

The effective gamma air dose factor may be used in conjunction with the total noble gas release (Σ Q_i) to simplify the dose evaluation and to verify that the cumulative gamma and beta air dose is within the equivalence of the limits of Technical Specification 3.11.2.2. To compensate for any unexpected variability in the radionuclide distribution, a conservatism factor of 0.8 is introduced into the calculation. The simplified equation is:

$$D_{Gamma\text{-}Air} = \frac{(M_{eff}) \cdot (\overline{X/Q})}{0.8} \cdot \sum_{i=1}^{n} Q_i \qquad 3.4.1.3\text{-}1$$

$$D_{Beta\text{-}Air} = \frac{(N_{eff}) \cdot (\overline{X/Q})}{0.8} \cdot \sum_{i=1}^{n} Q_i \qquad 3.4.1.3\text{-}2$$

3.4.2 Determining the Radioiodine and 8 Day Particulate Dose to Any Organ from Cumulative Releases

3.4.2.1 Requirements

Technical Specification 3.11.2.3 states that the dose to a Member of the Public from iodine-131, iodine-133, tritium, and all radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from each reactor unit, to areas at and beyond the site boundary shall be limited to the following:

a. During any calendar quarter: less than or equal to 7.5 mRem to any organ; and

b. During any calendar year: less than or equal to 15 mRem to any organ.

3.4.2.2 Methodology

The following calculational method is provided for determining the critical organ dose due to releases of radioiodines and particulates. It is based on Section 5.3.1 of NUREG-0133, Rev. 1, November 1978. The equation can be used for any age group provided that the appropriate dose factors are used and the total dose reflects only those pathways that are applicable to the age group. The symbol $(X/Q)_D$ represents a depleted (X/Q) which is different from the noble gas (X/Q) in that $(X/Q)_D$ takes into account the loss of iodines, 8 day particulates, and tritium from the plume as the semi-infinite cloud travels over a given distance. The dispersion factor (D/Q) represents the rate of fallout from the cloud that affects a square meter of ground at various distances from the site. The total dose to an organ can then be determined by summing the pathways that apply to the receptor in the sector. The equations are:

Inhalation Pathway: 3.4.2.2-1

$$D_{I\&8DP} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{X/Q})_D \cdot Q_i$$

Ground Plane Pathway: 3.4.2.2-2

$$D_{I\&8DP} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{D/Q}) \cdot Q_i$$

Contaminated Forage/Cow/Milk Pathway: 3.4.2.2-3

$$D_{I\&8DP} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{D/Q}) \cdot Q_i$$

Total Dose: 3.4.2.2-4

$$D = \sum_{z=1}^{n} D_{I\&8DP\tau}$$

where:

τ	=	The organ of interest in a specified age group.
z	=	All the applicable pathways for the age group of interest.
$D_{I\&8DP\tau}$	=	Dose in mRem to the organ (τ) of a specified age group from radioiodines and 8 day particulates due to a particular pathway.
D	=	Total dose in mRem to the organ (τ) of a specified age group from gaseous iodine and particulate effluents, summed over all applicable pathways (z).
3.17×10^{-8}	=	The inverse of the number of seconds per year [in years/sec].

$R_{i\tau}$ = The dose factor for nuclide (i) for pathway (z) to organ (τ) of the specified age group. The units are either:

$\frac{mRem\text{-}m^3}{yr\text{-}uCi}$ for pathways using $(\overline{X/Q})_D$

or

$\frac{mRem\text{-}m^2\text{-}sec}{yr\text{-}uCi}$ for pathways using (D/Q) (See Appendix I.)

$(\overline{X/Q})_D$ = The depleted (X/Q) value for a specific location where the receptor is located. The units are [sec/m^3]. (See Appendix F.) Note: No credit is taken for depletion and decay. $(\overline{X/Q})_D = (\overline{X/Q})$

$(\overline{D/Q})$ = The deposition value for a specific location where the receptor is located. The units are [m^{-2}]. (See Appendix F.)

Q_i = The number of microcuries of nuclide (i) released (or projected) during the dose calculation exposure period.

3.4.2.3 Limited Analysis Approach

The contaminated forage/cow/milk pathway has been identified in Section 5.4 of the RBS ER-OLS as the most limiting, with the infant thyroid being the most critical age group and organ. It is possible to demonstrate compliance with the dose limit of Technical Specification 3.11.2.3 for radioiodines and particulates by only evaluating the infant's thyroid dose due to the release of radioiodines via the contaminated forage/cow/milk pathway.

The calculational method to be used includes a conservatism factor of 0.8 which assures that the calculated dose is always greater than or equal to the actual dose despite possible atypical distributions of radionuclides in the gaseous effluent. The simplified dose equation reduces to:

3.4.2.3-1

$$D = [3.17 \times 10^{-8} \, (\overline{D/Q}) \sum_{iodines} R_i \cdot Q_i] / 0.8$$

3.4.2.4 Approach Selection Criteria

The limited analysis may be used in all cases to demonstrate compliance with the dose limit of Technical Specification 3.11.2.3 (7.5 mRem/qtr) for radioiodines and particulates.

However, for the dose assessment included in the Semi-annual Radioactive Effluent Release Report, doses will be evaluated for all designated age groups and organs via all designated pathways from radioiodines and particulates measured in the gaseous effluents according to sampling and analyses required by the Technical Specifications.

3.4.2.5 Annual Dose Due to Radioiodine and 8-Day Particulates

Technical Specification 3.11.2.3 required the annual dose be calculated at least once per 31 days for all pathways. The following formulae are used to calculate the annual dose for radioiodines and 8-day particulates:

Inhalation Pathways: 3.4.2.5-1

$$D_{I\&8DP_{\tau}} = 3.17 \times 10^{-8} \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{X/Q})_D \cdot Q_i$$

Ground Plane Pathway: 3.4.2.5-2

$$D_{I\&8DP_{\tau}} = 3.17 \times 10^{-8} \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{D/Q}) \cdot Q_i$$

Contaminated Forage/Cow/Milk Pathway: 3.4.2.5-3

$$D_{I\&8DP_{\tau}} = 3.17 \times 10^{-8} \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{D/Q}) \cdot Q_i$$

Contaminated Forage/Goat/Milk Pathway: 3.4.2.5-4

$$D_{I\&8DP_{\tau}} = 3.17 \times 10^{-8} \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{D/Q}) \cdot Q_i$$

Contaminated Forage/Meats: 3.4.2.5-5

$$D_{I\&8DP_\tau} = 3.17 \times 10^{-8} \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{D/Q}) \cdot Q_i$$

Fresh Fruits and Vegetables: 3.4.2.5-6

$$D_{I\&8DP_\tau} = 3.17 \times 10^{-8} \sum_{i=1}^{n} R_{i\tau} \cdot (\overline{D/Q}) \cdot Q_i$$

Total Dose: 3.4.2.5-7

$$D_\tau = \sum_{z=1}^{n} D_{I\&8DP\tau}$$

where:

τ = The organ of interest in a specified age group.

z = All the applicable pathways for the age group of interest.

$DR_{I\&8DP_{\tau}}$ = Dose rate to the organ (τ) for the age group of interest from iodines and 8-day particulates via the pathway of interest in mRem/yr. For radioiodines, the entire source term was used to calculate these values.

Q_i = The number of uCi of nuclide (i) released during the year of interest.

$R_{i\tau}$ = The dose factor for nuclide (i) for organ (τ) for the pathway specified [units vary with pathway]. For tritium, a site-specific absolute humidity (H) value of 12.9 gm/m^3 was used for calculation. (See Appendix I.)

$(\overline{D/Q})$ = A long-term relative deposition value for elevated and ground level releases. A factor with units of m^{-2} which describes the deposition of particulate matter from a plume at a point downrange from the source. Actual meteorological data and sector wind frequency distribution will be used to determine annual average D/Q for the year of interest.

$(\overline{X/Q})_D$ = A long-term depleted and 8-day decayed relative concentration value for elevated and ground level release. It describes the physical dispersion characteristics of a semi-infinite cloud travelling downwind. Since iodines and particulates settle out (fallout of the cloud) on the ground, the $(\overline{X/Q})_D$ represents what physically remains of the cloud at a given location downwind from the release point. Actual meteorological data and sector wind frequency distributions will be used to determine annual average $(\overline{X/Q})_D$ for the year of interest. Total body and organ doses will be calculated for pathway and age group on an annual basis using the above-described methodology (sec/m^3).

3.17×10^{-8} = The inverse of the number of seconds per year (in year/sec).

Meteorological data ($\overline{X/Q}$, $\overline{X/Q_D}$, $\overline{D/Q}$) will be determined from actual meteorological data and sector wind frequency distributions for the year of interest. Release rates (uCi/year) will be based on total activity released through elevated and ground level (total of all vent pathways) as reported in the Semi-annual Radioactive Effluent Release Report.

3.5 Dose Projection - Determination of Need to Operate Ventilation Exhaust Treatment System

3.⁵.1 Requirement

Technical Specification 3.11.2.5 requires that the ventilation exhaust treatment system be used to reduce radioactive material in waste prior to discharge when the projected dose due to gaseous effluents would exceed 0.3 mRem to any organ in a 31 day period.

3.5.2 Methodology

The following calculation method is provided for determining the projected doses:

$$PD_\tau = \frac{X}{X_D} \cdot D_\tau \qquad 3.5.2\text{-}1$$

where:

PD_τ = Projected dose due to all radioactive gaseous effluents during the current 31 day period (mRem).

X = Number of days in the 31 day period.

X_D = The number of days to date in the 31 day period.

D_τ = Cumulative total dose due to all radioactive gaseous effluents during the 31 day period to date (mRem).

A formal dose projection would be based on the latest results of the monthly calculations of the gamma air dose (Section 3.4.1.2). The doses calculated would be divided by the number of days that the plant was operational during that 31 day period. The value may need to be adjusted to account for any changes in operating conditions that could significantly alter the actual releases, such as failed fuel, or changes in ventilation flow rate.

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Table 4.1 contains the sample point description, sampling and collection frequency, analysis, and analysis frequency for various exposure pathways in the vicinity of RBS for the radiological monitoring program. Figures 1 and 5 indicate the locations of the various onsite and offsite sampling points and TLD locations.

This section describes only those elements of the radiological environmental monitoring program required by the RBS Technical Specifications. Additional exposure pathways, sample points, analyses, and/or frequencies are performed as described in ER-OLS Section 6.2.

Samples of groundwater are taken from onsite wells located to intercept any potential contamination of the Upland Terrace Aquifer so that any such contamination would be detected before migrating beyond RBS site boundaries.

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

	Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
1.	Airborne Particulates and Radioiodines	Samples from 5 locations:		
		AA1. River Bend Training Center; 1.7 km N.	Continuous air sampler with filter collection weekly or as required by dust loading, whichever is more frequent.	Charcoal cartridge: analysis weekly for I-131. Particulate sampler: gross beta activity following filter changes; composite for gamma isotopic quarterly.
		AR1. River Bend Station North Access Road at Gate #3; 0.8 km NNW.		
		AP1. Near River Bend Station Onsite Garden #1; 0.9 km WNW.		
		AQS2. St. Francis Substation on US Hwy. (Bus.) 61 in St. Francisville; 5.8 km NW (Community Location).		
		ALC. Parlange Power Center in Oscar; 20 km SW (Control).		

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 2)

	Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
2.	Direct Radiation	Measurements from 40 locations:		
		INDICATOR STATIONS		
		TA1. River Bend Training Center; 1.7 km N.	Thermoluminescence dosimeters (TLDs); deployment/retrieval quarterly.	Gamma dose quarterly.
		TA2. GSU utility pole #246 at Jct. of LA Hwy. 10 and WF2 in Elm Park; 8 km N.		
		TB1. River Bend Station iron yard area; 0.5 km NNE.		
		TB2. Stub pole at Jct. LA Hwy. 965 and Audubon Lane (WF17); 5 km NNE.		
		TC1. Stub pole at Jct. US Hwy. 61 and Old Highway 61; 1.7 km NE.		
		TC2. Stub pole along LA Hwy. 966, 0.6 km S of Jct. LA Hwys. 9.66 and 965; 7 km NE.		
		TD1. Stub pole along WF7, 150m S of Jct. WF7 and US Hwy. 61; 1.6 km ENE.		
		TD2. Stub pole along LA Hwy. 966, 4 km S of Jct. LA Hwys. 966 and 965; 6.3 km ENE.		
		TE1. Stub pole along WF7, 1 km S of Jct. WF7 and US Hwy. 61; 1.3 km NE.		
		TE2. Gravel Power Center on LA Hwy. 68, 2 km N of Jct. LA Hwys. 68 and 964; 10 km E.		
		TF1. Stub pole along WF7, 1.6 km S of Jct. WF7 and US Hwy. 61; 1.3 km ESE.		

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 3)

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
	TF2. McKowen Dairy on LA Hwy. 954, 0.6 km N of Jct. LA Hwy. 954 and US Hwy. 61; 6 km ESE.		
	TG1. Stub pole along WF7, 2 km S of Jct. WF7 and US Hwy. 61; 1.6 km SE.		
	TG2. Telephone pole at gate to Marathon Tank Farm on US Hwy. 61, near Delombre, 7.5 km SE.		
	TH1. Stub pole at Illinois Central Gulf RR crossing of WF7 (near Grants Bayou); 1.7 km SSE.		
	TH2. First telephone pole on LA Hwy. 964 N of entrance to C-Z papermill; 5.5 km SSE.		
	TJ1. Stub pole near River Bend Station Gate #23 on Powell Station Road (LA Hwy. 965); 1.5 km S.		
	TJ2. Large tree along River Road, 100 m N of C-Z papermill intake structure; 5.8 km S.		
	TK1. GSU utility pole #L10178 on Powell Station Road (LA Hwy. 965), 20 m S of River Bend Station River Access Road; 0.9 km SSW.		
	TK2. Stub pole at Jct. LA Hwys. 414 and 415; 8 km SSW.		
	TL1. Second utility pole on Powell Station Road (LA Hwy. 965) S of Illinois Central Gulf RR crossing; 1.0 km SW.		

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 4)

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
	TL2. Second utility pole along LA Hwy. 415 E of Louisiana and Arkansas RR crossing (near Patin's Dike); 9.5 km SW.		
	TM1. First utility pole on Powell Station Road (LA Hwy. 965) N of Illinois Central Gulf RR crossing; 0.9 km WSW.		
	TM2. Utility pole along LA Hwy. 981, about 3 km S of Jct. LA Hwys. 981 and 10 (west bank ferry landing); 4.2 km WSW.		
	TN1. Utility pole along Powell Station Road (LA Hwy. 965), between River Bend Station Gates #13 and 14; 0.9 km W.		
	TN2. Utility pole with electrical meter near west bank ferry landing (LA Hwy. 10); 6.0 km W.		
	TP1. Near River Bend Station Onsite Garden #1; 0.9 km WNW.		
	TP2. Stub pole about 1.5 km N of Illinois Central Gulf RR trestle on Tunica Street, western outskirts of St. Francisville, 7.3 km WNW.		
	TQ1. GSU property sign pole along Powell Station Road (LA Hwy. 965), about 1 km N of River Bend Station North Access Road; 1.4 km NW.		
	TQ2. GSU pole with street lights at Jct. North Commerce and American Beauty Streets, St. Francisville; 6.9 km NW.		

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 5)

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
	TR1. River Bend Station North Access Road at Gate #3; 0.8 km NNW.		
	TR2. Stub pole along WF2 at gravel road about 1.8 km E of Jct. WF2 and US Hwy 61; 8 km NNW.		
	CONTROL/SPECIAL STATIONS		
	TAC. Telephone pole along US Hwy. 61 about 200 m N of Hamilton Station Water Tower, near Wakefield; 18 km N (Control).		
	TLC. Parlange Power Center in Oscar; 20 km SW (Control).		
	TQS1. Behind Pentecostal Church (opposite West Feliciana Hospital) near Jct. US Hwy. 61 and Ferdinand Street; 4 km NW (Special).		
	TQS2. St. Francis Substation on U.S. Hwy. (Bus.) 61 in St. Francisville; 5.8 km NW (Special).		
	TLS. Utility pole near False River Academy sign at edge of New Roads; 9.9 km SW (Special).		
	TCS. Utility pole at gate to East Louisiana State Hospital in Jackson; 12.3 km NE (Special).		
	TGS1. GSU Service Center compound in Zachary; 17 km SE (Special).		
	TGS2. Roof of GSU Service Office Building, North Blvd., Baton Rouge; 40 km SE (Special).		

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 6)

	Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
3.	Waterborne	SURFACE WATER (1)		
		SWU. Mississippi River about 4 km upstream from the plant liquid discharge outfall, near LA Hwy. 10 ferry crossing.	Weekly grabs composited over monthly and quarterly periods.	Monthly composite: gamma isotopic analysis; Quarterly composite: tritium analysis.
		SWD. Mississippi River about 4 km downstream from plant liquid discharge outfall, near Crown-Zellerbach papermill.		
		Discharge Line. At blowdown line along River Access Road.	Hourly grabs composited over monthly and quarterly periods.	
		GROUNDWATER		
		WU. Upland Terrace Aquifer well upgradient from plant, about 470 m NNE.	Quarterly grab.	Gamma isotopic and tritium analyses quarterly.
		WD. Upland Terrace Aquifer well downgradient from plant, about 470 m SW.		
		SHORELINE SEDIMENT		
		SED. Mississippi River about 4 km downstream from plant liquid discharge outfall, near Crown-Zellerbach papermill.	Semiannual grab.	Gamma isotopic analysis quarterly.

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 7)

	Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
4.	Ingestion	MILK (2)		
		MF2. McKowen Dairy on LA Hwy. 954, 0.6 km N of Jct. LA Hwy. 954 and US Hwy. 61, 6 km ESE (nearerst source of milk for consumption).	Semimonthly when animals on pasture; monthly at other times.	Gamma isotopic and I-131 analyses semimonthly or monthly.
		MQC. LA State Penitentiary at Angola, 35 km NW (Control).		
		FISH AND INVERTEBRATES		
		FU. One sample of each of three commercially and/or recreationally important species from upstream area not influenced by plant discharge.	Seasonally when available or semiannually.	Gamma isotopic analysis on edible portions.
		FD. One sample of each of three commercially and/or recreationally important species from downstream area influenced by plant discharge.		
		PRODUCE		
		G1/G2. Two samples of each of three different kinds of leafy vegetables from onsite gardens near the site boundary of highest calculated annual average ground-level D/Q if three milk sampling areas not available.	Monthly during growing season.	Gamma isotopic and I-131 analyses monthly.
		GQC. One sample of each of the the similar vegetables from LA State Penitentiary at Angola, 35 km NW (Control).		

NOTES:

1. The upstream sample will be taken at a distance beyond influence of the plant discharge. The downstream sample will be taken in an area beyond but near the mixing zone.

2. If milk-producing animals become available within a 5-km radius of the plant, up to 3 samples from these animals will be analyzed in lieu of the leafy vegetable samples from onsite gardens in high dose-potential areas.

5.0 40CFR190 CONSIDERATIONS

5.1 Compliance with 40CFR190

Compliance with 40CFR190 as prescribed by Technical Specification 3.11.4 is to be demonstrated only when one or more of Technical Specification(s) 3.11.1.2.a, 3.11.1.2.b, 3.11.2.2.a, 3.11.2.2.b, 3.11.2.3a, and 3.11.2.3.b, including direct radiation are exceeded by a factor of 2. Once this occurs, GSU has 30 days to submit a report in accordance with Specification 3.11.4.

5.2 Calculations Evaluating Conformance with 40CFR190

To perform the calculations to evaluate conformance with 40CFR190, an effort is made to develop doses that are realistic by removing assumptions that lead to overestimates of dose to a Member of the Public (i.e., calculations for compliance with 10CFR50 Appendix I). To accomplish this, the following calculational rules are used:

5.2.1 Doses to Members of the Public via the liquid release pathway are considered to be <1 mRem/yr (Ref NUREG-0543).

5.2.2 Doses to a member of the Public due to a milk pathway will be evaluated only as can be shown to exist. Otherwise, doses via this pathway will be estimated as <1 mRem/yr.

5.2.3 Environmental sampling data which demonstrate that no pathway exists may be used to delete a pathway to man from a calculaion.

5.2.4 To sum numbers represented as "less than" (<), use the value of the largest number in the group.

e.g., <5 + <1 + <1 + <3 = 5

5.2.5 When doses via direct radiation are added to doses via inhalation pathway, they will be calculated for the same distance in the same sector.

5.2.6 The calculational locations for a Member of the Public will only be at residences or places of employment.

Note: Additional assumptions may be used to provide situation specific parameters, provided they are documented along with their concomitant bases.

5.3 Calculations of Total Body Dose

Estimates will be made for each of the following exposure pathways to the same location by age class. Only those age classes known to exist at a location are considered.

5.3.1 Direct Radiation

The component of dose to a Member of the Public due to direct radiation will be determined by thermoluminescent dosimeters (TLDs).

5.3.2 Inhalation Dose

The inhalation dose will be determined at the calculational locations for each age group according to the methods outlined in Sections 2.0 and 3.0 of this manual.

5.3.3 Ingestion Pathway

The dose via the ingestion pathway will be calculated at the consumer locations for the consumers at risk. If no milk pathway exists in a sector, the dose via this pathway will be treated as <1 mRem/yr.

5.3.4 Other Uranium Fuel Cycle Sources

The dose from other fuel sources will be treated as <1 mRem/yr.

5.4 Thyroid Dose

The dose to the thyroid will be calculated for each sector as the sum of inhalation dose and milk ingestion dose (if existing). The calculational methods will be those identified in Section 3.0 of this manual.

6.0 INTERLABORATORY COMPARISON STUDIES

6.1 Requirement

Technical Specification 3.12.3 states "Analyses shall be performed on radioactive materials supplied as part of an Interlaboratory Comparison Program that has been approved by the Commission."

6.2 Program

6.2.1 Environmental Sample Analyses Comparison Program

Environmental samples from the River Bend Station are to be analyzed by the River Bend Station Environmental Services Group or by a qualified contracting laboratory. These laboratories will participate in the U.S. Environmental Protection Agency's Environmental Radioactivity Laboratory Intercomparison Studies (Crosscheck) Program or an equivalent program. This participation will include all of the determinations (sample-radionuclide combinations) that are offered by EPA and that are also included in the licensee's environmental monitoring program. Results of the Interlaboratory Program will be included in the Annual Radiological Environmental Operating Report.

6.2.2 Effluent Release Analyses Program

RBS Chemistry Group will perform sample analyses for gamma-emitting radionuclides in effluent releases. The radiochemistry laboratory will participate annually in a corporate interlaboratory comparison study or an equivalent study. The results of these studies will be provided to the NRC upon request.

6.2.3 Abnormal Results

If the GSU laboratory or vendor laboratory results lie at greater than three (3) standard deviations from the "recognized value," an evaluation will be performed to identify any recommended remedial actions to reduce anomalous errors. Complete documentation on the evaluation will be available to RBS Environmental Services Group and will be provided to the NRC upon request.

APPENDIX A

LIQUID MPC VALUES

MAXIMUM PERMISSIBLE CONCENTRATIONS
IN WATER IN UNRESTRICTED AREAS

Nuclide*	MPC (uCi/ml)	Nuclide*	MPC (uCi/ml)	Nuclide*	MPC (uCi/ml)
H-3	3 E-3	Y-90	2 E-5	Te-129	8 E-4
Na-24	3 E-5	Y-91	3 E-3	Te-131m	4 E-5
P-32	2 E-5	Y-91	3 E-5	Te-131	None
Cr-51	2 E-3	Y-92	6 E-5	Te-132	2 E-5
Mn-54	1 E-4	Y-93	3 E-5	I-130	3 E-6
Mn-56	1 E-4	Zr-95	6 E-5	I-131	3 E-7
Fe-55	8 E-4	Zr-97	2 E-5	I-132	8 E-6
Fe-59	5 E-5	Nb-95	1 E-4	I-133	1 E-6
Co-57	4 E-4	Nb-97	9 E-4	I-134	2 E-5
Co-58	9 E-5	Mo-99	4 E-5	I-135	4 E-6
Co-60	3 E-5	Tc-99m	3 E-3	Cs-134	9 E-6
Ni-65	1 E-4	Tc-101	None	Cs-136	6 E-5
Cu-64	2 E-4	Ru-103	8 E-5	Cs-137	2 E-5
Zn-65	1 E-4	Ru-105	1 E-4	Cs-138	None
Zn-69	2 E-3	Ru-106	1 E-5	Ba-139	None
Br-82	4 E-5	Ag-110m	3 E-5	Ba-140	2 E-5
Br-83	3 E-6	Sn-113	8 E-5	Ba-141	None
Br-84	None**	In-113m	1 E-3	Ba-142	None
Br-85	None	Sb-122	3 E-5	La-140	2 E-5
Rb-86	2 E-5	Sb-124	2 E-5	La-142	None
Rb-88	None	Sb-125	1 E-4	Ce-141	9 E-5
Rb-89	None	Te-125m	1 E-4	Ce-143	4 E-5
Sr-89	3 E-6	Te-127m	5 E-5	Ce-144	1 E-5
Sr-90	3 E-7	Te-127	2 E-4	Pr-144	None
Sr-91	5 E-5	Te-129m	2 E-5	W-187	6 E-5
Sr-92	6 E-5			Np-239	1 E-4

* If a nuclide is not listed, refer to 10CFR20, Appendix B and use the most conservative insoluble/soluble MPC where they are given in Table II, Column 2.

** None (as per 10CFR20, Appendix B) "No MPC limit for any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-lives less than 2 hours."

APPENDIX B

LIQUID ENVIRONMENTAL DOSE TRANSFER FACTORS

$A_{i\tau}$

TABLE B-1

LIQUID EFFLUENT DOSE PARAMETERS

(Page 1)

Radionuclide	Total Body ($A_{i\tau}$, mRem/hr per uCi/ml)	Critical Organ ($A_{i\tau}$, mRem/hr per uCi/ml)
Na-24	6.13E02	6.13E02
P-32	1.87E06	4.84E07
Cr-51	4.31	1.08E03
Mn-54	4.56E04	7.32E05
Mn-56	1.07E03	1.92E05
Fe-55	9.14E02	5.67E03
Fe-59	8.07E03	7.02E04
Co-58	4.02E02	3.64E03
Co-60	1.14E03	9.68E03
Ni-63	1.29E03	3.85E04
Ni-65	9.28	5.16E02
Cu-64	1.36E01	2.47E03
Zn-65	7.30E04	1.61E05
Zn-69	1.40E01	2.07E02
Sr-89	1.20E03	4.19E04
Sr-90	2.50E05	1.03E06
Sr-91	3.01E01	3.68E03
Sr-92	1.30E01	5.80E03
Y-91	2.37	4.89E04
Y-92	1.56E-02	9.32E03
Y-93	4.66E-02	5.35E04
Zr-95	7.74E-02	3.62E02
Zr-97	1.82E-03	1.23E03
Nb-95	1.34E02	1.51E06
Mo-99	6.84	2.96E02
Tc-99m	3.45E-01	1.60E01
Tc-101	1.39E-01	2.55E-01
Ru-103	1.55E01	4.21E03
Ru-105	1.19	1.84E03
Ru-106	6.78E01	3.47E04
Ag-110M	1.21E01	8.35E03
Te-129M	6.08E03	2.57E05
Te-131M	3.13E03	3.73E05
Te-132	6.80E03	3.42E05
Ba-139	3.51E-01	2.13E01
Ba-140	1.64E02	5.17E03
Ba-141	1.96E-01	5.82
Ba-142	1.66E-01	2.63
La-142	9.13E-03	2.68E02
Ce-141	4.11E-01	1.39E04
Ce-143	7.73E-02	2.61E04
Ce-144	1.50E01	9.44E04

TABLE B-1

LIQUID EFFLUENT DOSE PARAMETERS

(Page 2)

Radionuclide	Total Body	Critical Organ
Pr-143	2.87E-01	2.54E04
Nd-147	2.74-01	2.20E04
W-187	8.66E01	8.12E04
Np-239	1.70E-02	6.22E03
Br-83	4.80E01	6.91E01
Br-84	6.22E01	6.22E01
I-131	1.57E02	8.98E04
I-132	8.75	8.75E02
I-133	3.49E01	1.68E04
I-134	4.74	2.30E02
I-135	1.97E01	3.52E03
Rb-89	1.51E02	2.15E02
Cs-134	6.49E05	7.94E05
Cs-136	9.93E04	1.38E05
Cs-137	3.83E05	5.85E05
Cs-138	2.90E02	5.85E02
H-3	2.80E-01	2.88E-01

TABLE B-2

CALCULATIONAL ASSUMPTIONS FOR $A_{i\tau}$

$A_{i\tau} = 1.14 \times 10^5 \; (Uw/Dw + U_F BF_i + U_I BI_i) DF_i$

Uw = 730 kg/yr adult water consumption (Reg. Guide 1.109 Table E-5)

Dw = 24,800 dilution factor for potable water intake (RBS Environmental Report page 5.4-5)

U_F = 21 kg/yr adult fish consumption (Reg. Guide 1.109 Table E-5)

BF_i = bioaccumulation factor for nuclide i in fish (pCi/kg per pCi/ℓ

RBS Environmental Report Table 5.4-3 (Table B-3)
Reg. Guide 1.109 Table A-1
RBS ER-CPS Appendix N, "Stable Element Study"

U_I = 5 kg/yr adult invertebrate consumption (Reg. Guide 1.109 Table E-5)

BI_i = bioaccumulation factor for nuclide i in invertebrated (pCi/kg per pCi/ℓ)

Reg. Guide 1.109 Table A-1

DF_i = dose conversion factor for nuclide i for adults

in pre-selected organ τ (mRem/pCi).
Reg. Guide 1.109, Table E-11.

APPENDIX C

K_i L_i AIR DOSE TRANSFER FACTORS

TABLE C-1

DOSE TRANSFER FACTORS FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF RADIOACTIVE NOBLE GASES

DOSE TRANSFER FACTORS

Nuclide	Gamma Ki mRem/uCi sec/m3	Beta Li mRem/uCi sec/m3	Beta and Gamma (L+1.1M)i mRem/uCi sec/m3
Kr-83m	2.4E-9	---	6.7E-7
Kr-85m	3.7E-5	4.6E-5	8.9E-5
Kr-85	5.1E-7	4.2E-5	4.3E-5
Kr-87	1.9E-4	3.1E-4	5.3E-4
Kr-88	4.7E-4	7.5E-5	6.0E-4
Kr-89	5.3E-4	3.2E-4	9.3E-4
Kr-90	4.9E-4	2.3E-4	8.0E-4
Xe-131m	2.9E-6	1.5E-5	2.0E-5
Xe-133m	8.0E-6	3.1E-5	4.2E-5
Xe-133	9.3E-6	9.7E-6	2.2E-5
Xe-135m	9.9E-5	2.3E-5	1.4E-4
Xe-135	5.7E-5	5.9E-5	1.3E-4
Xe-137	4.5E-5	3.9E-4	4.4E-4
Xe-138	2.8E-4	1.3E-4	4.5E-4
Ar-41	2.8E-4	8.5E-5	4.0E-4

AIR DOSE TRANSFER FACTORS

Nuclide	Gamma Mi mRad/uCi sec/m3	Beta Ni mRad/uCi sec/m3
Kr-83m	6.1E-7	9.1E-6
Kr-85m	3.9E-5	6.2E-5
Kr-85	5.4E-7	6.2E-5
Kr-87	2.0E-4	3.3E-4
Kr-88	4.8E-4	9.3E-5
Kr-89	5.5E-4	3.4E-4
Kr-90	5.2E-4	2.5E-4
Xe-131m	4.9E-6	3.5E-5
Xe-133m	1.0E-5	4.7E-5
Xe-133	1.1E-5	3.3E-5
Xe-135m	1.1E-4	2.3E-5
Xe-135	6.1E-5	7.8E-5
Xe-137	4.8E-5	4.0E-4
Xe-138	2.9E-4	1.5E-4
Ar-41	2.9E-4	1.0E-4

Ref. Regulatory Guide 1.109, Revision 1, Table B-1.

TABLE C-2

TECHNICAL BASES FOR EFFECTIVE DOSE FACTORS

The evaluation of doses due to releases of radioactive material to the atmosphere can be simplified by the use of effective dose transfer factors instead of using dose factors which are radionuclide specific. These effective factors, which are based on the typical radionuclide distribution in the releases, can be applied to the total radioactivity released to approximate the dose in the environment, i.e., instead of having to sum the isotopic distribution multiplied by the isotope specific dose factor only a single multiplication (K_{eff}, M_{eff}, or N_{eff}) times the total quantity of radioactive material released, would be needed. This approach provides a reasonable estimate of the actual dose while eliminating the need for a detailed calculational technique.

Determination of Effective Dose Factors

The effective dose transfer factors should be based on past operating data. The radioactive effluent distribution for the past years can be used to derive single effective factors by the following equations:

EQUATION C-1 $$K_{eff} = \sum_i K_i \cdot f_i$$

where

K_{eff} = The effective total body dose factor due to gamma emissions from all noble gases released.

K_i = The total body dose factor due to gamma emissions from each noble gas radionuclide "i" released.

f_i = The fractional abundance of noble gas radionuclide "i" of the total noble gas radionuclide.

EQUATION C-2 $$(L + 1.1\ M)_{eff} = \sum_i (L_i + 1.1\ M_i) \cdot f_i$$

where

$(L + 1.1.\ M)_{eff}$ = The effective skin dose factor due to beta and gamma emissions from all noble gases released.

$(L_i + 1.1\ M_i)$ = The skin dose factor due to beta and gamma emissions from each noble gas radionuclide "i" released.

TABLE C-2

TECHNICAL BASES FOR EFFECTIVE DOSE FACTORS
(Continued)

EQUATION C-3 $$M_{eff} = \sum_i M_i \cdot f_i$$

where

M_{eff} ≡ The effective air dose factor due to gamma emissions from all noble gases released.

M_i ≡ The air dose factor due to gamma emissions from each noble gas radionuclide "i" released.

EQUATION C-4 $$N_{eff} = \sum_i N_i \cdot f_i$$

where

N_{eff} ≡ The effective air dose factor due to beta emissions from all noble gases released.

N_i ≡ The air dose factor due to beta emissions from each noble gas radionuclide "i".

To provide an additional degree of conservatism, a factor of 0.8 is introduced into the dose calculation process when the effective dose transfer factor is used. This added conservatism provides additional assurance that the evaluation of dose by the use of a single effective factor will not significantly under-estimate any actual dose in the environment.

Each year the dose factors should be determined and the average annual values be used.

TABLE C-3

EFFECTIVE DOSE FACTORS FOR NOBLE GASES
TOTAL BODY EFFECTIVE DOSE - K_{eff}

Year	Main Plant Exhaust Duct* K_{eff} ($mRem\text{-}m^3/uCi\text{-}sec$)	Radwaste Building Exhaust Duct K_{eff} ($mRem\text{-}m^3/uCi\text{-}sec$)
Projected**	5.56 (-5)***	8.05 (-5)

* Main Plant exhaust duct contains contributions from Fuel Building.

** Projected values from RBS FSAR. When RBS becomes operational, actual release rates reported in semi-annual effluent report should be used to generate effective dose factors.

*** 5.56 (-5) $\equiv$ 5.56 x 10^{-5}

TABLE C-4

EFFECTIVE DOSE FACTORS FOR NOBLE GASES
SKIN EFFECTIVE DOSE $(L + 1.1\ M)_{eff}$

Year	Main Plant Exhaust Duct* $(L+1.1M)_{eff}$ ($mRem\text{-}m^3/uCi\text{-}sec$)	Radwaste Building Exhaust Duct $(L+1.1M)_{eff}$ ($mRem\text{-}m^3/uCi\text{-}sec$)
Projected**	1.36 (-4)***	1.59 (-4)

* Main Plant exhaust duct contains contributions from Fuel Building.

** Projected values from RBS FSAR. When RBS becomes operational, actual release rates reported in semi-annual effluent report should be used to generate effective dose factors.

*** $1.36\ (-4) \equiv 1.36 \times 10^{-4}$

TABLE C-5

EFFECTIVE DOSE FACTORS FOR NOBLE GASES
AIR DOSES M_{eff} and N_{eff}

Year	Main Plant Exhaust Duct* ($mRad\text{-}m^3/uCi\text{-}sec$) Gamma Air M_{eff}	Beta Air N_{eff}	Radwaste Building Exhaust Duct ($mRad\text{-}m^3/uCi\text{-}sec$) Gamma Air M_{eff}	Beta Air N_{eff}
Projected**	5.96(-5)***	8.99(-5)	8.07 (-5)	7.40(-5)

* Main Plant exhaust duct contains contributions from Fuel Building.

** Projected values from RBS FSAR. When RBS becomes operational, actual release rates reported in semi-annual effluent report should be used to generate effective dose factors.

*** 5.96 (-5) $\equiv 5.96 \times 10^{-5}$

APPENDIX D

EXPECTED GASEOUS RADIONUCLIDE MIXTURE

EXPECTED RELEASE OF RADIOACTIVE NOBLE GASES
IN GASEOUS EFFLUENTS FROM RIVER BEND STATION FSAR*

Nuclide	Containment Building** Ci/yr	Containment Building** Fraction	Radwaste Building Ci/yr	Radwaste Building Fraction
Kr-83m	4.7(-2)	1.07(-5)	<1	---
Kr-85m	218	0.050	<1	---
Kr-85	210	0.048	<1	---
Kr-87	14.2	0.003	<1	---
Kr-88	47.2	0.011	<1	---
Kr-89	118	0.027	29	.03
Xe-131m	21	0.005	<1	---
Xe-133m	6.6(-2)	1.504(-5)	<1	---
Xe-133	2,340	0.533	220	.19
Xe-135	693	0.158	280	.24
Xe-135m	140	0.032	530	.46
Xe-137	380	0.087	83	.07
Xe-138	208	0.047	2	1.75×10^{-3}
	4,389.	1.0000	1,144	.99

* RBS FSAR Table 11.3-1

** Containment Building contains releases from Fuel Building

APPENDIX E

$\overline{X/Q}$ AND $\overline{D/Q}$ VALUES FOR RESTRICTED AREA BOUNDARY

Long Term Diffusion Estimates

E.1 Objective

Annual average CHI/Q and D/Q estimates for continuous and intermittent releases were calculated for each of the sixteen 22.5-deg sectors at receptor locations used to determine the maximum individual and population dose receptors. The methodology described in Regulatory Guide 1.111, Rev. 1 provided guidance for the aforementioned analysis. The resultant CHI/Q and D/Q values for the maximum individual dose receptors are displayed in Appendix F.

E.2 Calculation Techniques

Nomenclature

2.032	$= (2/\pi)^{1/2)} (2\pi/16)^{-1}$	(dimensionless)
π	= 3.14159...	(dimensionless)
exp	= 2.71828...	(dimensionless)
E_T	= Entrainment coefficient	(dimensionless)
Ω_k	= Terrain recirculation factor	(dimensionless)
x	= Downwind receptor distance	(m)
σ_z	= Vertical dispersion (plume spread) coefficient	(m)
$\bar{u}_{30}$	= 30-ft average wind speed corresponding to a given hour of onsite meteorological data	($m\ sec^{-1}$)
$\bar{u}_{150}$	= 150-ft average wind speed corresponding to a given hour of onsite meteorological data	($m\ sec^{-1}$)
(CHI/Q)	= Average concentration normalized by source strength	($sec\ m^{-3}$)
(CHI/Q_D)	= Depleted CHI/Q	($sec\ m^{-3}$)
F_M	= Momentum flux	($m^4\ sec^{-3}$)

h_b	= Maximum adjacent building height	(m)
h_r	= Release height	(m)
h_e	= Effective release height	(m)
h_{pr}	= Nonbuoyant plume rise	(m)
h_t	= Topographic height of receptor above plant grade	(m)
d	= Stack or vent diameter	(m)
u_e	= Efflux velocity	(m sec^{-1})
N	= Total number of valid hours of onsite wind data in all sectors for applicable averaging period	(dimensionless)
δ/Q	= Relative deposition rate normalized by source strength	(m^{-1})
D/Q	= Relative deposition per unit area normalized by source strength	(m^{-2})
G	= Ground release (subscript)	(dimensionless)
i	= Index for atmospheric stability group (Classes A through G)	(dimensionless)
j	= Index for number of hours	(dimensionless)
k	= Index for a particular receptor distance	(dimensionless)
ℓ	= Index for a particular 22.5-deg sector	(dimensionless)
n	= Number of hours onsite wind data in a particular 22.5-deg sector	(dimensionless)
S	= Stability parameter	(sec^{-2})

E.3 CHI/Q Modeling Technique

Annual average values of relative concentration were calculated for continuous gaseous releases of activity from the containment building vent and the radwaste building vent according to the straight-line airflow (Gaussian) model described in Regulatory Guide 1.111, Rev. 1. An adjustment was made to the model to characterize the regional airflow pattern. The equation of this model is as follows:

$$\frac{CHI}{Q}_{k\ell} = \frac{2.032}{N} \sum_{j=1}^{n_j} \left(\frac{\Omega}{x}\right)_k \left[\frac{E_T}{\bar{u}_{30}\left(\sigma_{z_{j,k}}^2 + 0.5h_b^2/\pi\right)^{1/2}} + \frac{(1-E_T)\exp\left(-\frac{1}{2}\left(\frac{h_e}{\sigma_{z_{j,k}}}\right)^2\right)}{\bar{u}_{150}\,\sigma_{z_{j,k}}} \right] \quad \text{E.3-1}$$

Since the River Bend Station site is located in relatively open terrain, the terrain recirculation factor $(\Omega)_k$ (presented in Figure 2 of Regulatory Guide 1.111) was applied.

The entrainment coefficient (E_T) is a function of the ratio of efflux velocity (u_e) to elevated wind speed (u_{150}) for the conditionally elevated release points.

For vent releases occuring below the level of a nearby structure, 100 percent downwash (total entrainment) is conservatively assumed (E_T = 1). For vent releases occuring between 1 and 2 times the height of a nearby structure, a conditionally elevated release is assumed, and the entrainment coefficient is defined as follows:

$E_T = 0.0$ when $u_e/\bar{u}_{150} > 5.0$ (totally elevated)

$E_T = 0.30-0.06\ (u_e/\bar{u}_{150})$

when $1.5 < u_e/\bar{u}150 \leq 5.0$ (partially entrained)

$E_T = 2.58-158\ (u_e/\bar{u}_{150})$

when $1.0 < u_e/\bar{u}150 \leq 1.5$ (partially entrained)

$E_T = 1.0$ when $u_e/\bar{u}_{150} \leq 1.0$ (totally entrained)

E.3-2

Within 5 km in each downwind sector, Equation E.3-1 was evaulated by sector at the property and restricted area boundaries and nearest resident, vegetable garden, milk cow, and meat animal. There were no

goats whose milk is consumed in the area of interest. This evaluation was performed for each continuously emitting release point and the intermittent release from the mechanical vacuum pump with onsite data collected during the period of March 17, 1977 through March 16, 1979.

The effective release height was computed from the following equation:

$$h_e = h_r - (h_t)_k + h_{pr}$$

where the downwash correction factor (as defined by Equation (5) in Regulatory Guide 1.111, Rev. 1) is included in the equation for h_{pr} (see Equation E.3-5).

Values of topographic heights were conservatively assessed as the maximum height within a particular annulus-sector (annsect). An annsect is an area bounded by a 22.5-deg sector and any two radial distances from the release point.

For A-D stability conditions, plume rise for nonbuoyant sources was calculated by the following algorithm:

when

$$u_e/\bar{u}_{150} > 1.5$$

$$h_{pr} = 1.44 \left(\frac{u_e}{u_{150}}\right)^{2/3} \left(\frac{x}{d}\right)^{1/3} d \qquad \text{E.3-4}$$

when

$$u_e/\bar{u}_{150} < 1.5,$$

$$h_{pr} = 1.44 \left(\frac{u_e}{u_{150}}\right)^{2/3} \left(\frac{x}{d}\right)^{1/3} d - 3 \left(1.5 - \frac{u_e}{u_{150}}\right) d \qquad \text{E.3-4}$$

and

$$h_{pr} \leq 3 \left(\frac{u_e}{u_{150}}\right) d \qquad \text{E.3-6}$$

The result from Equation E.3-4 or E.3-5 (whichever condition exists) is then compared to Equation E.3-6 and the smaller value of h_{pr} is used.

For E-G stability conditons, Equations E.3-4, E.3-5, and E.3-6 are compared with:

$$h_{pr} = 4 \left(F_m/s\right)^{\frac{1}{4}}$$

and,

$$h_{pr} = 1.5 \left(F_m/\bar{u}_{150}\right)^{1/3} S^{-1/6}$$

where

$$F_m = \frac{\left(u_e\right)^2 d^2}{4}$$

and the smallest value was chosen.

In the ground level portion of Equation E.3-1, the vertical dispersion term:

$$\left(\sigma_{z_{i,k}}^{2} + 0.5h_b^{2}/\pi\right)^{1/2}$$

was constrained to be less than or equal to $1.732\sigma_{z_{i,k}}$.

E.4 (CHI/Q) and D/Q Modeling Techniques

Annual average depleted relative concentration values were conservatively assumed to be equal to annual average relative concentration values (CHI/Q - $(CHI/Q)_D$). Therefore, no credit was taken for attendant plume depletion of radioiodines and particulates.

Annual average relative deposition values were calculated using Regulatory Guide 1.111, Rev. 1 with the following equation:

$$\left(\frac{D}{Q}\right)_{k\ell} = \left(\frac{\Omega}{x}\right)_k \left(\frac{2\pi N}{16}\right)^{-1} \left\{ \sum_{j=i}^{n_\ell} \left[n_\ell \left\{ \left(\frac{\delta}{Q}\right)_{G_k} E_T + \frac{1}{n_\ell} \sum_{n=1}^{3} \left[1 - \left(E_T\right)_1 \right] n_{i\ell} \left(\frac{\delta}{Q}\right)_{ik} \right\} \right] \right\}$$

For the conditionally elevated release points, Figures 6 through 9 of Regulatory Guide 1.111, Rev. 1 were used to calculate the $(\delta/Q)_G$ and $(\delta/Q)_i$ values, while for the ground level release points, Figure 6 was utilized to calculate the $(\delta/Q)_G$ value.

E.5 Methodology Employed for Intermittent Release

The methodology employed in the calculation of intermittent release CHI/Qs and D/Qs was as follows:

1. Two-hour sector-averaged CHI/Q values were calculated without terrain recirculation factors.

2. The 15 percent, 1 hour value was plotted at 2 hours on log-log coordinates, while the annual average value was plotted at 8,760 hr. A straight line connecting the two points was drawn.

3. Log-log interpolation based on total ground intermittent release hours versus annual hours yielded a CHI/Q multiplier.

4. The multiplier was applied to annual average CHI/Q and D/Q values to obtain intermittent CHI/Q and D/Q values.

For River Bend Station, a 320 hr/yr intermittent release through the containment building vent from the mechanical vacuum pump was evaluated.

TABLE E-1

ANNUAL AVERAGE CHI/Q VALUES x 10^{-7} (sec/m^3)
FOR RESTRICTED AREA BOUNDARY

Sector	Main Plant Exhaust Duct (Continuous)	Radwaste Building Exhaust Duct (Continuous)
S	12.4	105
SSW	13.1	121
SW	11.2	152
WSW	14.7	247
W	19.7	578
WNW	29.1	384
NW	14.4	262
NNW	12.1	138
N	15.0	180
NNE	20.0	211
NE	12.9	150
ENE	9.86	146
E	7.37	168
ESE	8.33	154
SE	6.99	93.1
SSE	6.53	45.6

TABLE E-2

ANNUAL AVERAGE D/Q VALUES x 10^{-9} (m^{-2})
FOR RESTRICTED AREA BOUNDARY

Sector	Main Plant Exhaust Duct (Continuous)	Radwaste Building Exhaust Duct (Continuous)
S	9.37	21.4
SSW	8.47	25.1
SW	8.62	25.3
WSW	8.75	29.0
W	13.1	61.1
WNW	18.1	46.0
NW	9.18	40.8
NNW	9.92	24.7
N	11.0	28.6
NNE	10.6	27.1
NE	7.77	22.3
ENE	9.27	22.7
E	7.53	23.0
ESE	7.06	24.6
SE	6.30	17.2
SSE	5.01	11.8

APPENDIX F

MAXIMUM $\overline{X/Q}$ AND $\overline{D/Q}$ VALUES FOR INDIVIDUAL LOCATIONS

TABLE F-1

ATMOSPHERIC DISPERSION AND DEPOSITION RATES FOR THE MAXIMUM INDIVIDUAL DOSE CALCULATIONS*

Analysis	Location (meters)	Radwaste Bldg. Exhaust Duct	Main Plant Exhaust Duct
Gamma air dose (1) and Beta Air Dose	914 m NNE	CHI/Q1(5) - 384.0	CHI/Q2 - 29.1
Maximum Receptor (2)	1,260 m NW	CHI/Q1 - 216.0	CHI/Q2 - 11.4
Resident	Same	D/Q1(6) - 32.9	D/Q2 - 6.92
Garden	Same		
Meat animal	Same		
Immersion	Same		
Resident (3)	2,000 m NW	CHI/Q1 - 4.57	CHI/Q2 - 75.5
Garden	Same	D/Q1 - 2.32	D/Q2 - 10.1
Milk animal	1,300 m NNW	CHI/Q1 - 124.0 D/Q1 - 22.0	CHI/Q2 -10.3 D/Q2 - 8.16
Hypothetical milk animal (4)	1,173 m NNW	CHI/Q1 - 138.0 D/Q1 - 24.7	CHI/Q2 -12.1 D/Q1 - 9.92

* Ref. Table 5.4-1 RBS ER-OLS

Notes:

(1) Maximum offsite location (property boundary) with highest CHI/Q (unoccupied). The WNW sector is the controlling sector.
(2) Maximum occupied offsite location with highest CHI/Q and D/Q.
(3) Maximum occupied location associated with maximum milk cow grazing pasture.
(4) Hypothetical maximum grazing location for milk cow (see (3) above).
(5) All CHI/Q = 10^{-7} sec/m^3
(6) All D/Q = 10^{-9} m^{-2}

APPENDIX G

INSTANTANEOUS DOSE TRANSFER FACTOR TABLES

TABLE G-1

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS P(i) FOR GASEOUS DISCHARGE

PATHWAY = INHALATION
AGE GROUP = INFANT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (mRem/yr per uCi/m³) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	4984	7056	0	25340	4984	0	999600	.0
CO-60	11774	31920	0	8022	0	0	.4508E+07	.0
ZN-65	31080	51380	19320	62580	32480	0	646800	.0
SR-89	11410	63980	397600	0	0	0	.203E+07	.0
SR-90	.259E07	131040	.4088E+08	0	0	0	.11242E+08	.0
CS-134	74480	1334.2	396200	702800	190400	0	79660	.0
CS-137	45500	1334.2	548800	611800	172200	0	71260	.0
BA-140	2898	38360	56000	56	13.426	0	.1596E+07	.0
CE-141	1988	21560	27720	16660	5250	0	516600	.0
I-131	3.92E+04	2.12E+03	7.59E+04	8.88E+04	1.04E+05	2.97E+07	0	.0
I-133	1.12E+04	4.31E+03	2.65E+04	3.84E+04	4.48E+04	7.11E+06	0	.0
H-3	6.47E+02	6.47E+02	.0	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

APPENDIX H

GASEOUS MPC VALUES

TABLE H-1

MAXIMUM PERMISSIBLE CONCENTRATIONS
IN AIR IN UNRESTRICTED AREAS

Nuclide*	MPC (uCi/cc)	Nuclide*	MPC (uCi/cc)
Ar-41	4 E-8	Y-91	1 E-9
Kr-83m	3 E-6	Zr-95	1 E-9
Kr-85m	1 E-7	Nb-95	3 E-9
Kr-85	3 E-7	Ru-103	3 E-9
Kr-87	2 E-8	Ru-106	2 E-10
Kr-88	2 E-8	Ag-110m	3 E-10
Kr-89	3 E-8	Sn-113	2 E-9
Kr-90	3 E-8	In-113m	2 E-7
Xe-131m	4 E-7	Sn-123	1 E-10
Xe-133m	3 E-7	Sn-126	1 E-10
Xe-133	3 E-7	Sb-124	7 E-10
Xe-135m	3 E-8	Sb-125	9 E-10
Xe-135	1 E-7	Te-125m	4 E-9
Xe-137	3 E-8	Te-127m	1 E-9
Xe-138	3 E-8	Te-129m	1 E-9
H-3	2 E-7	I-130	1 E-10
P-32	2 E-9	I-131	1 E-10
Cr-51	8 E-8	I-132	3 E-9
Mn-54	1 E-9	I-133	4 E-10
Fe-59	2 E-9	I-134	6 E-9
Co-57	6 E-9	I-135	1 E-9
Co-58	2 E-9	Cs-134	4 E-10
Co-60	3 E-10	Cs-136	6 E-9
Zn-65	2 E-9	Cs-137	5 E-10
Rb-86	2 E-9	Ba-140	1 E-9
Sr-89	3 E-10	La-140	4 E-9
Sr-90	3 E-11	Ce-141	5 E-9
Rb-88	3 E-8	Ce-144	2 E-10

* If a nuclide is not listed, refer to 10CFR20 Appendix B and use the most conservative insoluble/soluble MPC where they are given in Table II, Column I.

**None (as per 10CFR20, Appendix B) "no MPC limit for any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-lives less than 2 hours."

APPENDIX I

ENVIRONMENTAL DOSE TRANSFER FACTORS FOR GASEOUS EFFLUENTS

TABLE I-1

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = INHALATION
AGE GROUP = ADULT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (mRem/yr per uCi/m³) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	6296	77360	0	39600	9840	0	.14E+07	.0
CO-60	14800	284800	0	11520	0	0	.5968E+07	.0
ZN-65	46560	53440	32400	103200	68960	0	864000	.0
SR-89	8720	349600	304000	0	0	0	.14E+07	.0
SR-90	.61E+07	722074	.992651E+08	0	0	0	.96063E+07	.0
CS-134	728000	10400	372800	848000	287200	0	97600	.0
CS-137	428000	8400	478400	620800	222400	0	75200	.0
BA-140	2568	218400	39040	49.04	16.72	0	.1272E+07	.0
CE141	1528	120000	19920	13520	6264	0	361600	.0
I-131	40960	12560	50400	66720	122560	2.38E+07	0	.0
I-133	9040	17760	17280	29600	51280	4.3E+06	0	.0
H-3	1.26E+03	1.26E+03	.0	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m³).

TABLE I-2

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = INHALATION
AGE GROUP = TEEN

Nuclide	T. Body	GI-Tract	Organ Dose Factors (mRem/yr per uCi/m^3) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	8400	66800	0	51120	12720	0	.1984E+07	.0
CO-60	19840	259200	0	15120	0	0	.872E+07	.0
ZN-65	62400	46640	38560	133600	86400	0	.124E+07	.0
SR-89	12480	371200	434400	0	0	0	.2416E+07	.0
SR-90	.668E+07	764800	.108E+09	0	0	0	.1648E+08	.0
CS-134	548800	9760	502400	.1128E+07	375200	0	146400	.0
CS-137	311200	8480	670400	848000	304000	0	120800	.0
BA-140	3520	228800	54720	68.64	22.8	0	.2032E+07	.0
C-141	2168	126400	28400	18960	8880	0	613600	.0
I-131	5.28E+04	1.30E+04	7.09E+04	9.82E+04	1.68E+05	2.93E+07	0	.0
I-133	1.24E+04	2.06E+04	2.43E+04	4.10E+04	7.18E+04	5.84E+06	0	.0
H-3	1.27E+03	1.27E+03	.0	1.27E+03	1.27E+03	1.27E+03	1.27E+03	1.27E+03

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-3

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = INHALATION
AGE GROUP = CHILD

Nuclide	T. Body	GI-Tract	Organ Dose Factors (mRem/yr per uCi/m^3)					
			Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	9509	22903	0	42920	10027	0	.15762E+07	.0
CO-60	22644	96200	0	13135	0	0	.7067E+07	.0
ZN-65	70300	16317	42550	113220	71410	0	995300	.0
SR-89	17242	167240	599400	0	0	0	.21571E+07	.0
SR-90	.644E+07	343467	.101041E+09	0	0	0	.147676E+08	.0
CS-134	224590	3848	651200	.10138E+07	330410	0	120990	.0
CS-137	128390	3618.6	906500	825100	282310	0	103970	.0
BA-140	4329	101750	74000	64.75	21.27	0	.17427E+07	.0
CE-141	2897.1	56610	39220	19536	8547	0	543900	.0
I-131	5.45E+04	5.68E+03	9.62E+04	9.62E+04	1.58E+05	3.25E+07	0	.0
I-133	1.54E+04	1.10E+04	3.32E+04	4.06E+04	6.76E+04	7.70E+06	0	.0
H-3	1.12E+03	1.12E+03	.0	1.12E+03	1.12E+03	1.12E+03	1.12E+03	1.12E+03

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem;year per uCi/m^3).

TABLE I-4

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = INHALATION
AGE GROUP = INFANT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (mRem/yr uCi/m^3) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	4984	7056	0	25340	4984	0	999600	.0
CO-60	11774	31920	0	8022	0	0	.4508E+07	.0
ZN-65	31080	51380	19320	62580	32480	0	646800	.0
SR-89	11410	63980	397600	0	0	0	.203E+07	.0
SR-90	.259E07	131040	.4088E+08	0	0	0	.11242E+08	.0
CS-134	74480	1334.2	396200	702800	190400	0	79660	.0
CS-137	45500	1334.2	548800	611800	172200	0	71260	.0
BA-140	2898	38360	56000	56	13.426	0	.1596E+07	.0
CE-141	1988	21560	27720	16660	5250	0	516600	.0
I-131	3.92E+04	2.12E+03	7.59E+04	8.88E+04	1.04E+05	2.97E+07	0	.0
I-133	1.12E+04	4.31E+03	2.65E+04	3.84E+04	4.48E+04	7.11E+06	0	.0
H-3	6.47E+02	6.47E+02	.0	6.47E+02	6.47E+02	6.47E+02	6.47E+02	6.47E+02

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-5

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = GROUND PLANE DEPOSITION
AGE GROUP = ALL

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec)					
			Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.39E+09	1.63E+09
CO-60	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.15E+10	2.55E+10
ZN-65	7.45E+08	7.45E+08	7.45E+08	7.45E+08	7.45E+08	7.45E+08	7.45E+08	8.62E+08
SR-89	2.17E+04	2.17E+04	2.17E+04	2.17E+04	2.17E+04	2.17E+04	2.17E+04	2.52E+04
CS-134	6.85E+09	6.85E+09	6.85E+09	6.85E+09	6.85E+09	6.85E+09	6.85E+09	8.00E+09
CS-137	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.03E+10	1.21E+07
BA-140	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.05E+07	2.36E+07
CE-141	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.37E+07	1.55E+07
I-131	3.46E+07	3.46E+07	3.46E+07	3.46E+07	3.46E+07	3.46E+07	3.46E+07	4.18E+07
I-133	4.90E+06	4.90E+06	4.90E+06	4.90E+06	4.90E+06	4.90E+06	4.90E+06	5.96E+06

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-6

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = COW MILK
AGE GROUP = ADULT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
CO-60	.284E+08	.241881E+09	.0	.128763E+08	.0	.0	.0	.0
MN-54	.127E+07	.203899E+08	.0	.665585E+07	.198073E+07	.0	.0	.0
ZN-65	.176E+10	.245287E+10	.122391E+10	.389425E+10	.26046E+10	.0	.0	.0
SR-89	.351E+08	.196147E+09	.122294E+10	.0	.0	.0	.0	.0
SR-90	.946E+10	.111384E+10	.38552E+11	.0	.0	.0	.0	.0
CS-134	.857E+10	.18344E+09	.44054E+10	.104823E+11	.339259E+10	.0	.112614E+10	.0
CS-137	.529E+10	.156329E+09	.590494E+10	.807577E+10	.274132E+10	.0	.911303E+09	.0
BA-140	.167E+07	.524857E+08	.254895E+08	32018.8	10886.4	.0	18332.3	.0
CE-141	324.468	.109361E+08	4229.83	2860.56	1328.6	.0	.0	.0
I-131	2.38E+08	1.10E+08	2.90E+08	4.16E+08	7.12E+08	1.36E+11	.0	.0
I-133	2.06E+06	6.04E+06	3.86E+06	6.72E+06	1.17E+07	9.88E+08	.0	.0
H-3	4.73E+02	4.73E+02	.0	4.73E+02	4.73E+02	4.73E+02	4.73E+02	4.73E+02
C-14	7.33E+04	7.33E+04	3.67E+05	7.33E+04	7.33E+04	7.33E+04	7.33E+04	7.33E+04

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-7

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = COW MILK
AGE GROUP = TEEN

	Organ Dose Factors (m^2-mRem/yr per uCi/sec)							
Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.22E+07	.227521E+08	.0	.11094E+08	.33094E+07	.0	.0	.0
CO-60	.491E+08	.283896E+09	.0	.217964E+08	.0	.0	.0	.0
ZN-65	.304E+10	.275979E+10	.187678E+10	.651661E+10	.417063E+10	.0	.0	.0
SR-89	.646E+08	.268654E+09	.225587E+10	.0	.0	.0	.0	.0
SR-90	.134E+11	.152302E+10	.542537E+11	.0	.0	.0	.0	.0
CS-134	.836E+10	.224092E+09	.765571E+10	.180188E+11	.572578E+10	.0	.218604E+10	.0
CS-137	.496E+10	.202605E+09	.107037E+11	.142397E+11	.484532E+10	.0	.18827E+10	.0
BA-140	.297E+07	.710852E+08	.460918E+08	56478.7	19150.8	.0	37997.1	.0
CE-141	594.76	.148107E+08	7755.2	5177.91	2437.35	.0	.0	.0
I-131	3.96E+08	1.46E+08	5.26E+08	7.38E+08	1.27E+09	2.16E+11	.0	.0
I-133	3.66E+06	9.08E+06	7.08E+06	1.20E+07	2.10E+07	1.68E+09	.0	.0
H-3	6.16E+02	6.16E+02	.0	6.16E+02	6.16E+02	6.16E+02	6.16E+02	6.16E+02
C-14	1.35E+05	1.35E+05	6.67E+05	1.35E+05	1.35E+05	1.35E+02	1.35E+05	1.35E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-8

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS P(i) FOR GASEOUS DISCHARGE

PATHWAY = COW MILK
AGE GROUP = CHILD

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.441E+07	.138954E+08	.0	.165568E+08	.464211E+07	.0	.0	.0
CO-60	.999E+08	.187633E+09	.0	.338763E+08	.0	.0	.0	.0
ZN-65	.611E+10	.172533E+10	.368753E+10	.982445E+10	.619075E+10	.0	.0	.0
SR-89	.159E+09	.215515E+09	.556711E+10	.0	.0	.0	.0	.0
SR-90	.233E+11	.123798E+10	.919026E+11	.0	.0	.0	.0	.0
CS-134	.611E+10	.156144E+09	.176511E+11	.289659E+11	.897642E+10	.0	.322095E+10	.0
CS-137	.364E+10	.154424E+09	.257636E+11	.246606E+11	.803636E+10	.0	.289152E+10	.0
BA-140	.649E+07	.563359E+08	.1112E+09	97416.9	31714	.0	58075.5	.0
CE-141	1410	.118459E+08	19039.8	9495.92	4162.86	.0	.0	.0
I-131	7.3E+08	1.14E+08	1.28E+09	1.28E+09	2.1E+09	4.24E+11	.0	.0
I-133	8.04E+06	8.56E+06	1.72E+07	2.12E+07	3.54E+07	3.94E+09	.0	.0
H-3	9.73E+02	9.73E+02	.0	9.73E+02	9.73E+02	9.73E+02	9.73E+02	9.73E+02
C-14	3.34E+02	3.32E+05	1.66E+06	3.32E+05	3.32E+05	3.32E+05	3.32E+05	3.32E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-9

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = COW MILK
AGE GROUP = INFANT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.698E+07	.113135E+08	.0	.307987E+08	.682523E+07	.0	.0	.0
CO-60	.163E+09	.164278E+09	.0	.690353E+08	.0	.0	.0	.0
ZN-65	.783E+10	.143415E+11	.495093E+10	.169785E+11	.823361E+10	.0	.0	.0
SR-89	.304E+09	.217867E+09	.105978E+11	.0	.0	.0	.0	.0
SR-90	.254E+11	.124573E+10	.997665E+11	.0	.0	.0	.0	.0
CS-134	.536E+10	.144192E+09	.284608E+11	.530715E+11	.136642E+11	.0	.560158E+10	.0
CS-137	.341E+10	.150418E+09	.41109E+11	.48113E+11	.129155E+11	.0	.522919E+10	.0
BA-140	.118E+08	.562543E+08	.229035E+09	229035	54379.1	.0	140636	.0
CE-141	2720	.119391E+08	37887.4	23108	7124.96	.0	.0	.0
I-131	1.38E+09	1.12E+08	2.66E+09	3.38E+09	3.66E+09	1.03E+12	.0	.0
I-133	1.55E+07	8.96E+06	3.64E+07	5.30E+07	6.22E+07	9.62E+09	.0	.0
H-3	1.48E+03	1.48E+03	.0	1.48E+03	1.48E+03	1.48E+03	1.48E+03	1.48E+03
C-14	6.95E+05	6.95E+05	3.26E+06	6.95E+05	6.95E+05	6.95E+05	6.95E+05	6.95E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-10

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = GOAT MILK
AGE GROUP = ADULT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
CO-60	.341E+07	.290428E+08	.0	.154606E+07	.0	.0	.0	.0
MN-54	.152E+06	.244037E+07	.0	796606	237064	.0	.0	.0
ZN-65	.211E+09	.294066E+09	.14673E+09	.466868E+09	.312256E+09	.0	.0	.0
SR-89	.738E+08	.412412E+09	.257131E+10	.0	.0	.0	.0	.0
SR-90	.198E+11	.233129E+10	.806903E+11	.0	.0	.0	.0	.0
CS-134	.257E+11	.550107E+09	.132111E+11	.314347E+11	.101738E+11	.0	.337711E+10	.0
CS-137	.159E+11	.469874E+09	.177483E+11	.242731E+11	.82395E+10	.0	.273908E+10	.0
BA-140	201000	.631714E+07	.306789E+07	3853.76	1310.28	.0	2206.47	.0
CE-141	38.936	.131233E+07	507.578	343.266	159.432	.0	.0	.0
I-131	2.86E+08	1.31E+08	3.48E+08	4.98E+08	8.52E+08	1.63E+11	.0	.0
I-133	2.46E+06	7.26E+06	4.64E+06	8.06E+06	1.41E+07	1.19E+09	.0	.0
H-3	9.65E+02	9.65E+01	.0	9.65E+02	9.65E+02	9.65E+02	9.65E+02	9.65E+02
C-14	7.33E+04	7.33E+04	3.67E+05	7.33E+04	7.33E+04	7.33E+04	7.33E+04	7.33E+04

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-11

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = GOAT MILK
AGE GROUP = TEEN

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	264000	.273026E+07	.0	.133128E+07	397128	.0	.0	.0
CO-60	.59E+07	.341137E+08	.0	.261912E+07	.0	.0	.0	.0
ZN-65	.365E+09	.331356E+09	.225338E+09	.782422E+09	.50075E+09	.0	.0	.0
SR-89	.136E+09	.565587E+09	.474921E+10	.0	.0	.0	.0	.0
SR-90	.282E+11	.320517E+10	.114176E+12	.0	.0	.0	.0	.0
CS-134	.25E+11	.670131E+09	.228939E+11	.53884E+11	.171225E+11	.0	.65372E+10	.0
CS-137	.149E+11	.608632E+09	.321541E+11	.427765E+11	.145555E+11	.0	.565568E+10	.0
BA-140	356000	.852066E+07	.552481E+07	6769.84	2295.52	.0	4552.13	.0
CE-141	71.37	.177725E+07	930.609	621.339	292.477	.0	.0	.0
I-131	4.76E+08	1.75E+08	6.32E+08	8.84E+08	1.52E+09	2.58E+12	.0	.0
I-133	4.40+06	1.09E+07	8.48E+05	1.44E+07	2.52E+07	2.00E+09	.0	.0
H-3	1.26E+03	1.26E+03	.0	1.26E+03	1.26E+03	1.26E+03	1.26E+03	1.26E+03
C-14	1.35E+05	1.35E+05	6.76E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05	1.35E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-12

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = GOAT MILK
AGE GROUP = CHILD

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	530000	.166996E+07	.0	.198982E+07	557895	.0	.0	.0
CO-60	.12E+08	.225385E+08	.0	.406923E+07	.0	.0	.0	.0
ZN-65	.733E+09	.206984E+09	.442383E+09	.117861E+10	.742687E+09	.0	.0	.0
SR-89	.335E+09	.454072E+09	.117294E+11	.0	.0	.0	.0	.0
SR-90	.489E+11	.259817E+10	.1929377+12	.0	.0	.0	.0	.0
CS-134	.183E+11	.467667E+09	.528667E+11	.867556E+11	.268852E+11	.0	.964704E+1	.0
CS-137	.109E+11	.462424E+09	.771493E+11	.738463E+11	.240649E+11	.0	.865866E+10	.0
BA-140	779000	.676204E+07	.133474E+08	11693	3806.7	.0	6970.9	.0
CE-141	170	.142823E+07	2295.58	1144.9	501.905	.0	.0	.0
I-131	8.76E+08	1.37E+08	1.53E+09	1.54E+09	2.52E+03	5.10E+11	.0	.0
I-133	9.66E+06	1.03E+07	2.12E+07	2.56E+07	4.26E+07	4.74E+09	.0	.0
H-3	1.99E+03	1.99E+03	.0	1.99E+03	1.99E+03	1.00E+03	1.99E+03	1.99E+03
C-14	3.32E+05	3.32E+05	1.66E+06	3.32E+05	3.32E+05	3.32E+05	3.32E+05	3.32E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-13

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = GOAT MILK
AGE GROUP = INFANT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.838E+06	.135827E+07	.0	.369761E+07	.819419E+06	.0	.0	.0
CO-60	.196E+08	.197537E+08	.0	.830118E+07	.0	.0	.0	.0
ZN-65	.939E+09	.171989E+10	.593732E+09	.203611E+10	.987402E+09	.0	.0	.0
SR-89	.64E+09	.458667E+09	.223111E+11	.0	.0	.0	.0	.0
SR-90	.535E+11	.262389E+10	.210138E+12	.0	.0	.0	.0	.0
CS-134	.161E+11	.433113E+09	.854887E+11	.159413E+12	.410437E+11	.0	.168256E+11	.0
CS-137	.102E+11	.449931E+09	.122965E+12	.143931E+12	.386328E+11	.0	.156416E+11	.0
BA-140	.141E+07	.672191E+07	.273678E+08	27367.8	6497.84	.0	16804.8	.0
CE-141	326	.143094E+07	4540.92	2769.56	853.947	.0	.0	.0
I-131	1.66E+09	1.35E+08	3.2E+09	3.78E+09	4.4E+09	1.24E+12	.0	.0
I-133	1.86E+07	1.07E+07	4.36E+07	6.36E+07	7.46E+07	1.16E+10	.0	.0
H-3	3.01E+03	3.01E+03	.0	3.01E+03	3.01E+03	3.01E+03	3.01E+03	3.01E+03
C-14	6.9eE+05	6.95E+05	3.26E+06	6.95E+05	6.95E+05	6.95E+05	6.95E+05	6.95E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-14

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = MEAT
AGE GROUP = ADULT

			Organ Dose Factors (m^2-mRem/yr per uCi/sec)					
Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
CO-60	.13E+09	.11072E+10	.0	.589407E+08	.0	.0	.0	.0
MN-54	.138E+07	.22156E+08	.0	.723234E+07	.215229E+07	.0	.0	.0
ZN-65	.456E+09	.635517E+09	.317103E+09	.100897E+10	.674828E+09	.0	.0	.0
SR-89	.732+07	.409059E+08	.255041E+09	.0	.0	.0	.0	.0
SR-90	.251E+10	.295532E+09	.102289E+11	.0	.0	.0	.0	.0
CS-134	.998E+09	.213621E+08	.513022E+09	.122069E+10	.395076E+09	.0	.131142E+09	.0
CS-137	.625E+09	.184699E+08	.697654E+09	.954132E+09	.32388E+09	.0	.107668E+09	.0
BA-140	.179E+07	.562571E+08	.273211E+08	34319.6	11668.6	.0	19649.6	.0
CE-141	941.49	.317327E+08	12273.5	8300.32	3855.13	.0	.0	.0
I-131	8.68E+06	4.0E+06	1.06E+07	1.51E+07	2.6E+07	4.96E+09	.0	.0
I-133	2.00E-01	5.80E-01	3.8E-01	6.40E-01	1.12	9.5E+01	.0	.0
H-3	2.01E+02	2.02E+02	.0	2.01E+02	2.01E+02	2.01E+04	2.01E+04	2.01E+04
C-14	6.72E+04	6.72E+04	3.36E+05	6.72E+04	6.72E+04	6.72E+04	6.72E+04	6.72E+04

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-15

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = MEAT
AGE GROUP = TEEN

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.11E+07	.113761E+08	.0	.554701E+07	.16547E+07	.0	.0	.0
CO-60	.103E+09	.595545E+09	.0	.457235E+08	.0	.0	.0	.0
ZN-65	.361E+09	.327725E+09	.222868E+09	.773848E+09	.495263E+09	.0	.0	.0
SR-89	.616E+07	.256178E+08	.215111E+09	.0	.0	.0	.0	.0
SR-90	.164E+10	.1864E+09	.664E+10	.0	.0	.0	.0	.0
CS-134	.445E+09	.119283E+08	.407511E+09	.959136E+09	.304781E+09	.0	.116362E+09	.0
CS-137	.268E+09	.109472E+08	.578343E+09	.769403E+09	.261803E+09	.0	.101726E+09	.0
BA-140	.146E+07	.349443E+08	.226579E+08	27763.9	9414.21	.0	18668.9	.0
CE-141	790.3	.1968E+08	10304.9	6880.26	3238.68	.0	.0	.0
I-131	6.62E+06	2.44E+06	8.80E+06	1.23E+07	2.12E+07	3.6E+09	.0	.0
I-133	1.60E-01	4.00E-01	3.2E-01	5.2E-01	9.20E-01	7.37E+01	.0	.0
H-3	1.20E+02	1.20E+02	.0	1.20E+02	1.20E+02	1.20E+02	1.20E+02	1.20E+02
C-14	5.67E+04	5.67+04	2.84E+05	5.67E+04	5.67E+04	5.67E+05	5.67E+04	5.67E+04

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-16

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = MEAT
AGE GROUP = CHILD

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m^2-mRem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.169E+07	.532498E+07	.0	.634491E+07	.177895E+07	.0	.0	.0
CO-60	.16E+09	.300513E+09	.0	.542564E+08	.0	.0	.0	.0
ZN-65	.554E+09	.156438E+09	.334352E+09	.890793E+09	.561322E+09	.0	.0	.0
SR-89	.116E+08	.157231E+08	.406154E+09	.0	.0	.0	.0	.0
SR-90	.217E+10	.115297E+09	.855917E+10	.0	.0	.0	.0	.0
CS-134	.249E+09	.636333E+07	.719333E+09	.118044E+10	.365815E+09	.0	.131263E+09	.0
CS-137	.151E+09	.640606E+07	.106877E+10	.102301E+10	.333377E+09	.0	.11995E+09	.0
BA-140	.243E+07	.210934E+08	.416357E+08	36475.1	11874.4	.0	21744.7	.0
CE-141	1440	.12098E+08	19444.9	9697.96	4251.43	.0	.0	.0
I-131	9.34E+06	1.46E+06	1.63E+07	1.64E+07	2.70E+07	5.42E+09	.0	.0
I-133	2.80E-01	2.80E-01	5.80E-01	7.2E-01	1.18	1.33E+02	.0	.0
H-3	1.45E+02	1.45E+02	.0	1.45E+02	1.45E+02	1.45E+02	1.45E+02	1.45E+02
C-14	1.07E+05	1.07E+05	5.33E+05	1.07E+05	1.07E+05	1.07E+05	1.07E+05	1.07E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-17

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = VEGETATION
AGE GROUP = ADULT

			Organ Dose Factors (m^2-mRem/yr per uCi/sec)					
Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
CO-60	.36E+09	.30661E+10	.0	.16322E+09	.0	.0	.0	.0
MN-54	.576E+08	.924771E+09	.0	.301872E+09	.898349E+08	.0	.0	.0
ZN-65	.548E+09	.763736E+09	.38108E+09	.121253E+10	.810977E+09	.0	.0	.0
SR-89	.277E+09	.154794E+10	.965113E+10	.0	.0	.0	.0	.0
SR-90	.159E+12	.18721E+11	.647968E+12	.0	.0	.0	.0	.0
CS-134	.869E+10	.186009E+09	.446709E+10	.106291E+11	.344009E+10	.0	.114191E+10	.0
CS-137	.579E+10	.171105E+09	.646307E+10	.883908E+10	.300042E+10	.0	.997437E+09	.0
BA-140	.883E+07	.2618E+09	.127142E+09	159711	54301.6	.0	91442.1	.0
CE-141	14700	.49546E+09	191632	129598	60192.2	.0	.0	.0
I-131	6.6E+07	3.04E+07	8.04E+07	1.15E+08	1.97E+08	3.78E+10	.0	.0
I-133	1.1E+06	3.24E+06	2.08E+06	3.62E+06	6.30E+06	5.30E+08	.0	.0
H-3	1.40E+03	1.40E+03	.0	1.40E+03	1.40E+03	1.40E+03	1.40E+03	1.40E+03
C-14	1.81E+05	1.81E+05	9.05E+05	1.81E+05	1.81E+05	1.81E+05	1.81E+05	1.81E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-18

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = VEGETATION
AGE GROUP = TEEN

	Organ Dose Factors (m^2-mRem/yr per uCi/sec)							
Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.871E+08	.900778E+09	.0	.439222E+09	.131022E+09	.0	.0	.0
CO-60	.548+09	.316853E+10	.0	.243267E+09	.0	.0	.0	.0
ZN-65	.838E+09	.760757E+09	.517351E+09	.179636E+10	.114967E+10	.0	.0	.0
SR-89	.419E+09	.174251E+10	.146317E+11	.0	.0	.0	.0	.0
SR-90	.201E+12	.228454E+11	.813805E+12	.0	.0	.0	.0	.0
CS-134	.723E+10	.193802E+09	.662091E+10	.155833E+11	.495184E+10	.0	.189056E+10	.0
CS-137	.48E+10	.196069E+09	.103584E+11	.137803E+11	.468902E+10	.0	.182197E+10	.0
BA-140	.88E+07	.210623E+09	.136568E+09	167344	56743.2	.0	112525	.0
CE-141	21100	.525431E+09	275127	183694	86468.6	.0	.0	.0
I-131	5.76E+07	2.12E+07	7.66E+07	1.07E+08	1.85E+08	3.12E+10	.0	.0
I-133	9.98E+05	2.48E+06	1.93E+06	3.28E+06	5.74E+06	4.56E+08	.0	.0
H-3	1.60E+03	1.60E+03	.0	1.60E+03	1.60E+03	1.60E+03	1.60E+03	1.60E+03
C-14	2.93E+05	2.93E+05	1.47E+06	2.93E+05	2.93E+05	2.93E+05	2.93E+05	2.93E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

TABLE I-19

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R(i) FOR GASEOUS DISCHARGE

PATHWAY = VEGETATION
AGE GROUP = CHILD

Nuclide	Organ Dose Factors (m^2-mRem/yr per uCi/sec) T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.171E+09	.5388E+09	.0	.642E+09	.18E+09	.0	.0	.0
CO-60	.109E+10	.204724E+10	.0	.369622E+09	.0	.0	.0	.0
ZN-65	.165E+10	.465925E+09	.995815E+09	.265308E+10	.167181E+10	.0	.0	.0
SR-89	.993E+09	.134595E+10	.347682E+11	.0	.0	.0	.0	.0
SR-90	.342E+12	.181712E+11	.134896E+13	.0	.0	.0	.0	.0
CS-134	.532E+10	.135956E+09	.153689E+11	.252207E+11	.78158E+10	.0	.280449E+10	.0
CS-137	.346E+10	.146788E+09	.244896E+11	.234411E+11	.763896E+10	.0	.274853E+10	.0
BA-140	.16E+08	.138887E+09	.274144E+09	240165	78185.6	.0	143175	.0
CE-141	47300	.397384E+09	638711	318551	139648	.0	.0	.0
I-131	8.14E+07	1.28E+07	1.42E+08	1.43E+08	2.36E+08	4.74E+10	.0	.0
I-133	1.64E+06	1.75E+06	3.50E+06	4.34E+06	7.22E+06	8.06E+08	.0	.0
H-3	2.49E+03	2.49E+03	.0	2.49E+03	2.49E+03	2.49E+03	2.49E+03	2.49E+03
C-14	7.07E+05	7.07E+05	3.54E+06	7.07E+05	7.07E+05	7.07E+05	7.07E+05	7.07E+05

Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

Note: The units for C-14 and H-3 are (mRem/year per uCi/m^3).

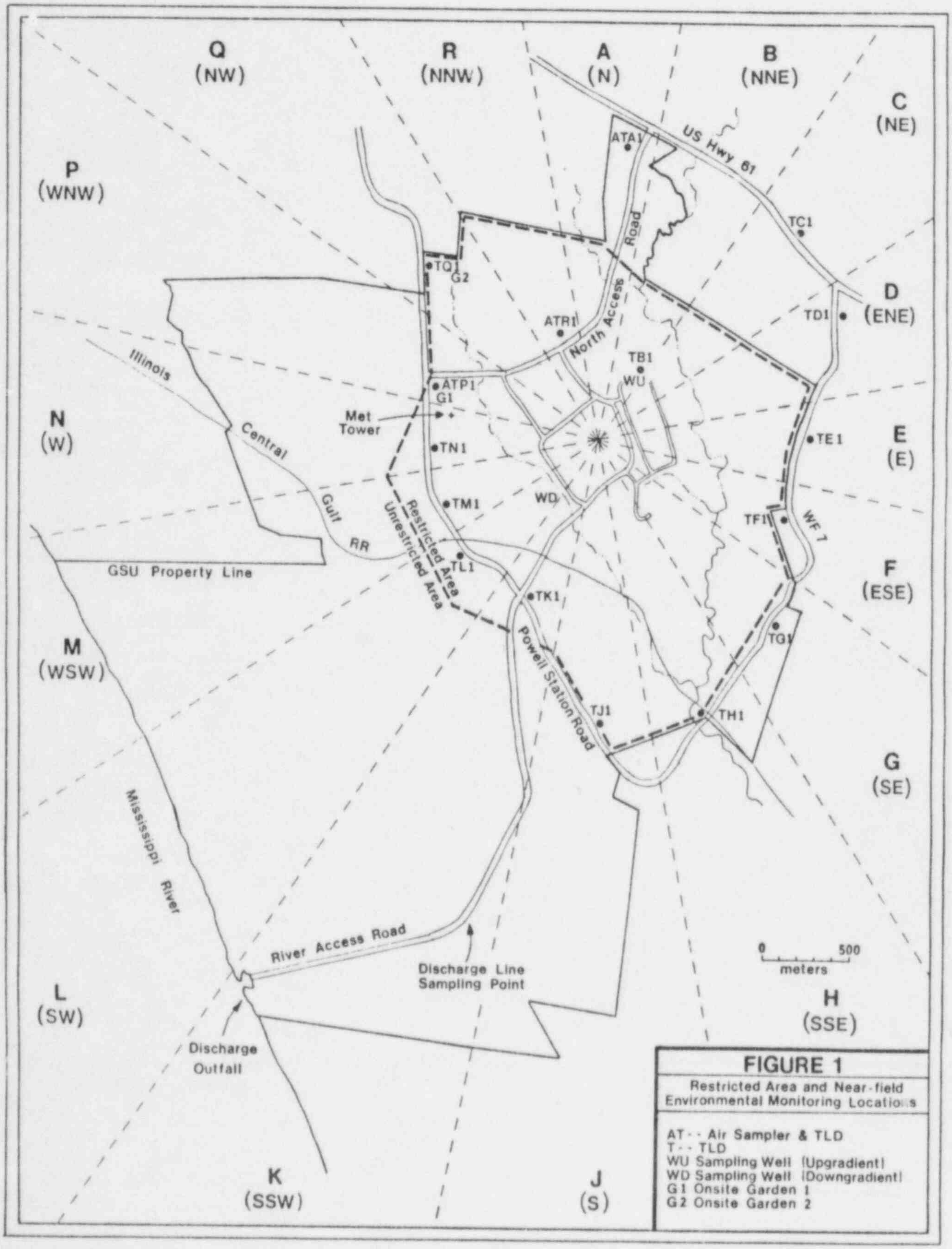


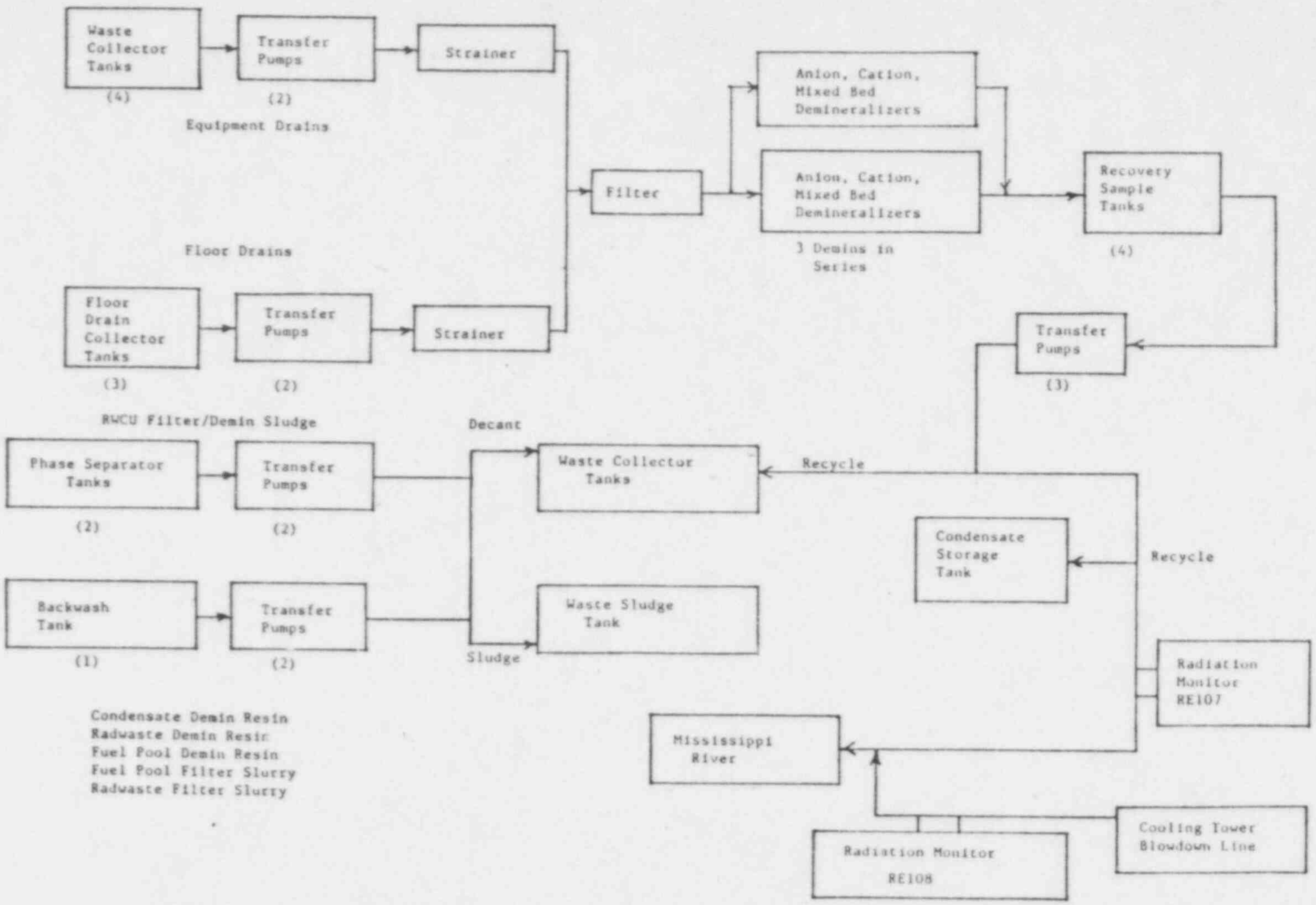
FIGURE 1

Restricted Area and Near-field Environmental Monitoring Locations

AT - - Air Sampler & TLD
T - - TLD
WU Sampling Well (Upgradient)
WD Sampling Well (Downgradient)
G1 Onsite Garden 1
G2 Onsite Garden 2

FIGURE 2

LIQUID RADWASTE SYSTEM



GASEOUS EFFLUENT RELEASE POINTS

NO.	VENT	MIN DISTANCE TO BOUNDARY LINE	RELEASE ELEVATION (msl)
1	TURBINE BLDG STANDBY GAS TRMNT CONTAINMENT PIPE TUNNELS AUXILIARY BLDG	3000 ± FT	290 ± FT
2	RADWASTE BLDG	2850 ± FT	211 ± FT
3	CONTROL BLDG SMOKE REMOVAL BATTERY RMS MECH. RM UTILITY RMS	2850 ± FT	132 ± FT
4	FUEL BLDG	2900 ± FT	177 ± FT
5	CONTROL RM INTAKE	2800 ± FT	161 ± FT
6	CONTROL RM REMOTE AIR INTAKE	2750 ± FT	194 ± FT

500 0 500 1000 1500 2000 2500
FEET

100 0 100 200 300 400 500
METERS

NOTE
1 DISTANCE FROM CENTERLINE REACTOR NO 1 TO PROPERTY BOUND = 3033.13

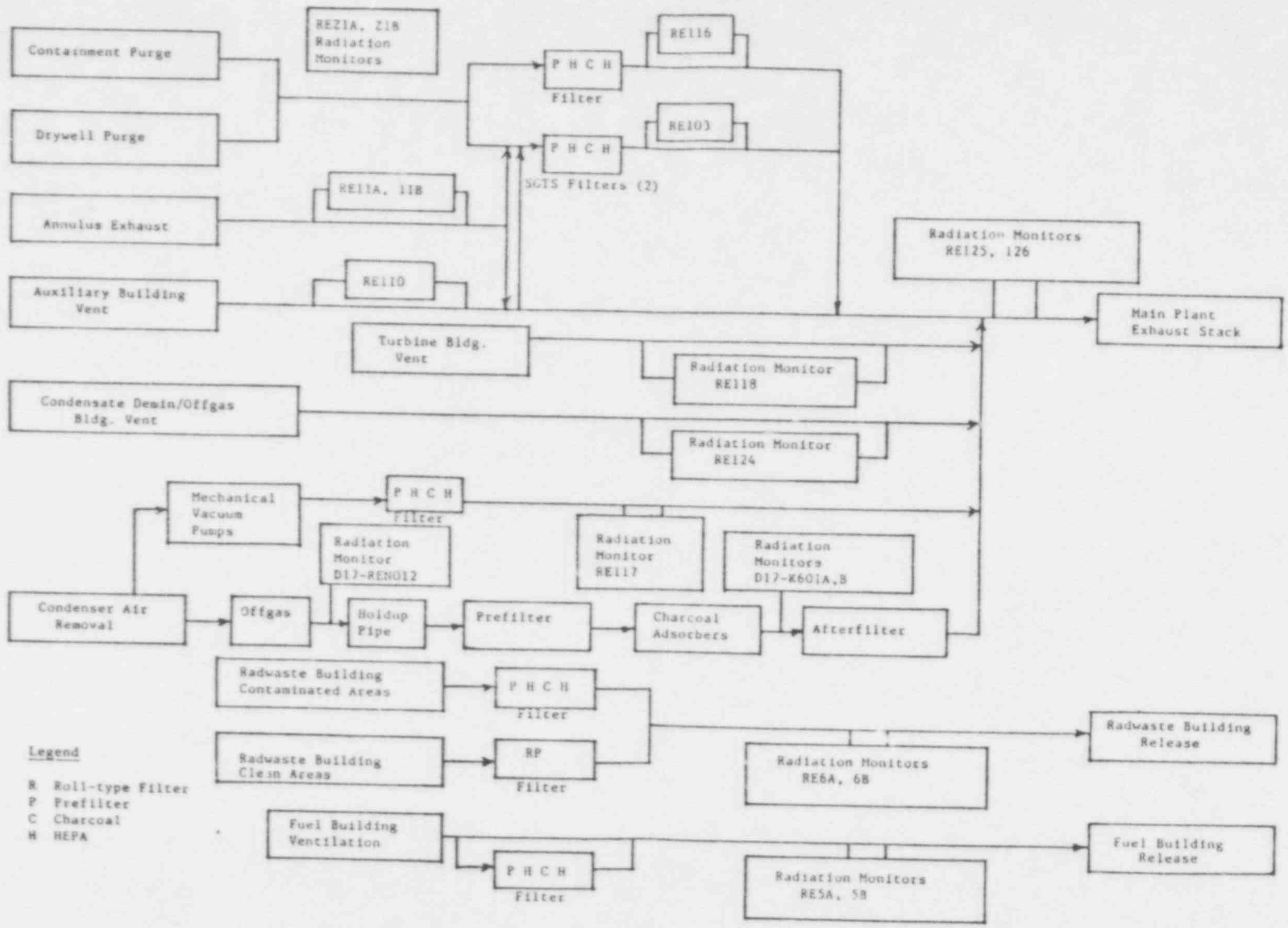
FIGURE 3

EFFLUENT RELEASE POINTS

RIVER BEND STATION

FIGURE 4

GASEOUS RADWASTE SYSTEM



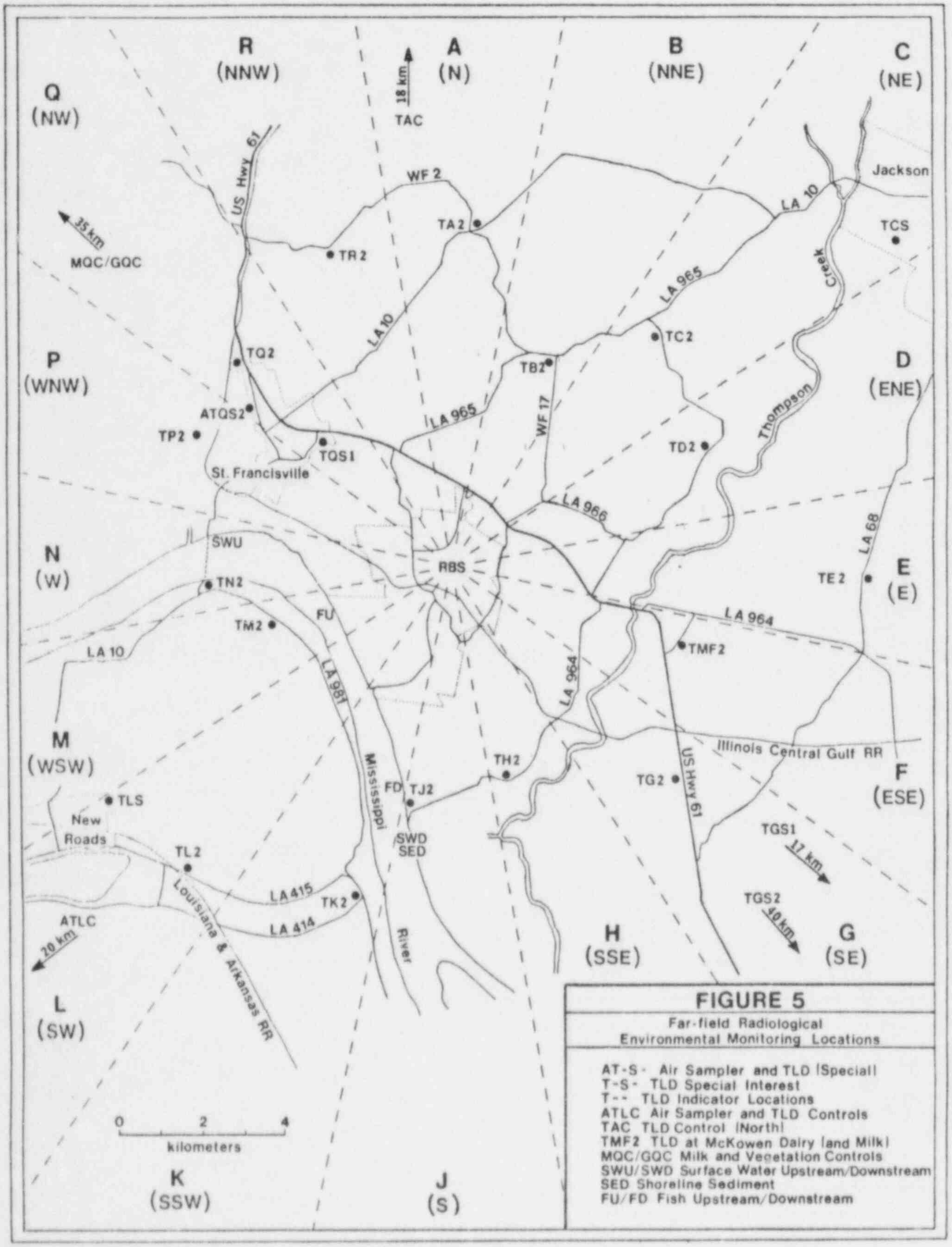


FIGURE 5

Far-field Radiological Environmental Monitoring Locations

AT-S- Air Sampler and TLD (Special)
T-S- TLD Special Interest
T-- TLD Indicator Locations
ATLC Air Sampler and TLD Controls
TAC TLD Control (North)
TMF2 TLD at McKowen Dairy (and Milk)
MQC/GQC Milk and Vegetation Controls
SWU/SWD Surface Water Upstream/Downstream
SED Shoreline Sediment
FU/FD Fish Upstream/Downstream

GULF STATES UTILITIES COMPANY
POST OFFICE BOX 2951 • BEAUMONT, TEXAS 77704
AREA CODE 409 838-6631

September 16, 1985
RBG- 22,117
File No. G9.5

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton:

River Bend Station-Unit 1
Docket No. 50-458

In accordance with the commitment in our August 5, 1985 letter, Gulf States Utilities Company encloses Revision 3 to the Offsite Dose Calculation Manual. The contents of this document have been previously discussed with your Staff and their comments appropriately included.

Any comments or questions should be directed to Mr. James Cook of my staff at (409) 839-3013.

Sincerely,

for J. E. Booker
Manager-Engineering,
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/WJR/JWC/kt

Enclosure

A009
1/39