RIVER BEND STATION

GULF STATES UTILITIES

OFFSITE DOSE CALCULATION MANUAL (ODCM)

REVISION 2

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1.0 INTRODUCTION

1.1 PURPOSE

This manual provides a concise description of the environmental dose models and techniques used to calculate offsite doses resulting from measured or projected releases of radioactive materials from Gulf States Utilities' River Bend Nuclear Station. 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). 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.

1.2 RERERENCES

1.2.1 NUREG 0133; Guidance Manual for Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants; October, 1978.

1.2.2 REG. GUIDE 1.109, Rev. 1, October, 1977; Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Compliance with 10 CFR Part 50, Appendix I.

1.2.3 U.S. Code of Federal Regulations; 10CFR20.

1.2.4 River Bend Environmental Report, OLS.

1.2.5 REG. GUIDE 1.111; Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water - Cooled Reactors.

1.2.6 River Bend Station FSAR

1.2.7 River Bend Technical Specifications; Section 3/4.11.

1.2.8 River Bend Environmental Report, CPS.

1.2.9 U.S. Code Of Federal Regulations, 10CFR50.

1.2.10 U.S. Code of Federal Regulations, 40CFR190.

1.2.11 NUREG 0543, Methods for Demonstrating LWR Compliance with the EPA Uranium Fuel Cycle Standard (40CFR Part 190)

1.2.12 QAFR # P-86-03-004

1.2.13 QAFR # P-86-03-005

1.2.14 QAFR # P-86-03-002

1.2.15 CONDITION REPORT # 86-0495

1.2.16 River Bend Technical Specification; Section 6.14.

1.2.17 River Bend Technical Specification 3.3.7.10

1.2.18 River Bend Station Radiological Environmental Operating Report for 1985

1.2.19 QAFR #P-86-03-003

1.3 DEFINITIONS

1.3.1 MEMBER(s) OF THE PUBLIC -

MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the utility, its contractors or vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational or other purposes not associated with the plant.

1.3.2 OFFSITE DOSE CALCULATION MANUAL -

The OFFSITE DOSE CALCULATION MANUAL shall contain the methodology and parameters used in the calculation of offsite doses due to radioactive gaseous and liquid effluents and in the calculation of gaseous and liquid effluent monitoring alarm/trip setpoints. It shall also contain a table and figure defining current radiological environmental monitoring sample locations.

1.3.3 SITE BOUNDARY -

The SITE BOUNDARY shall be that line beyond which the land is not owned, leased, or otherwise controlled by the licensee.

1.3.4 UNRESTRICTED AREA -

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

1.3.5 VENTILATION EXHAUST TREATMENT SYSTEM -

A VENTILATION EXHAUST TREATMENT SYSTEM is any system designed and installed to reduce gaseous radioiodine or radioactive material in particulate form in effluents by passing ventilation or vent exhaust gases through charcoal absorbers and/or HEPA filters for the purpose of removing iodines or particulates from the gaseous exhaust stream prior to the release to the environment (such a system is not considered to have any effect on noble gas effluents). Engineered Safety Feature (ESF) atmospheric cleanup systems are not considered to be VENTILATION EXHAUST TREATMENT SYSTEM components.

1.4 <u>REQUIRED EQUIPMENT</u>

1.4.1 None

1.5 <u>PRECAUTIONS AND LIMITATIONS</u>

1.5.1 As per Reference 1.2.16, Licensee-initiated changes to the ODCM/Procedure shall be submitted to the Commission in the Semiannual Radioactive Effluent Release Report for the period in which the change(s) was made effective.

1.5.2 No changes(s) shall be made to the ODCM/Procedure that will reduce the accuracy or reliability of dose calculations or setpoint determinations.

1.5.3 Any change(s) shall be recorded on the ODCM Revision Sheet and made in accordance with Reference 1.2.16.

1.6 <u>PREREQUISITES</u>

1.6.1 None

2.0 LIQUID EFFLUENT METHODOLOGY

2.1 River Bend 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.

The reactor is a General Electric boiling water reactor of the BWR-6 or 1972 product line. Containment is of the Mark 3 design, a free-standing cylindrical steel structure surrounded by a reinforced concrete shield building.

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, sample recovery tanks, and reactor water cleanup (as shown in Figure 4). 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:

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

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.

$(MPC)_i$ = 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 x $f_1/(f_1 + f_2)$) 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.

2.3.1.2 Liquid Effluent Monitors

Two General Atomics RD-53 monitors are provided to ensure compliance with Technical Specification limits for liquid releases. The RD-53 is an offline gamma scintillation (NaI) monitor designed for detecting radioactivity in liquids. The monitors consists of a removable sample canister surrounded by Pb shielding. A well inside the canister holds the detector within the sample fluid. The two monitors are as follows:

1. Cooling Tower Blowdown Line Monitor (1RMS-RE108)

   a. Range: 10^1 to 10^7 cpm

2. Liquid Radwaste Effluent Monitor (1RMS-RE107)

   a. Range: 10^1 to 10^7 cpm

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 blowdown line discharge.

2.3.2.1 Liquid Radwaste Effluent Monitor (1RMS-RE107)

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 monitor will terminate a liquid radwaste discharge if activity levels exceed the Technical Specifications limits. The automatic actions associated with a trip of the monitor are:

1. 1LWS-FV197 closes
2. 1LWS-AOV258 opens

An alarm will also be annunciated in the main control room.

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

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

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 to laboratory counting rate or activity concentration in a given batch of liquid (cpm per cpm/ml, cpm per uCi/ml, or uCi/ml per uCi/ml)

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.

2.3.2.2 Cooling Tower Blowdown Line Monitor (1RMS-RE108)

The cooling tower monitor alarms at high levels of radioactivity in the normal plant service water / circulating water effluent to the Mississippi River. An alarm will be annunciated in the main control room if predetermined setpoints are exceeded.

The cooling tower monitor alarm setpoint is determined by the equation:

$$S = 2 \times BKG \qquad 2.3.2.2\text{-}1$$

where:

S = the radiation monitor setpoint (cpm or uCi/ml)

BKG = monitor background value (cpm or uCi/ml)

The cooling tower blowdown line is not expected to be a contaminated stream and normally would serve as a dilution source for the final radwaste system effluent discharge. Any significant upward fluctuation in the background level is indicative of a release which could approach 10CFR50 Appendix I limits or 10CFR20 limits when combined with the liquid radwaste effluent.

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 dose factors $A_{i\tau}$ for all viable pathways are listed in Appendix B.

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

$$D_{i\tau} = \frac{A_{i\tau} * \Delta t * Q_i}{DF * D_w} \qquad 2.4.2\text{-}1$$

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

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

$A_{i\tau}$ = 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)

Δ t = The time interval in hours that the batch release occurred

Q_i = The total quantity of nuclide (i) released during the batch release interval Δt (uCi)

D_w = The near field dilution factor. Site specific value is 77.4

DF = The total volume of dilution that occurred during the batch release time interval Δt (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 doses for releases during a 31 day period, calendar quarter, or a year).

The following equation is used to calculate the total dose for the desired time period:

$$D_{TOTAL\,\tau} = \sum_{j=1}^{n} D_{\tau aj} \qquad 2.4.2\text{-}3$$

where:

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

$D_{\tau aj}$ = The dose commitment in mrem to the organ (τ) of age group (a) due to a batch liquid release (j).

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:

$$L_{PD} = \frac{\Sigma D_{TOTAL\ \tau}}{X_D} * 31 \qquad 2.5.2\text{-}1$$

L_{PD} = Projected dose commitment (mrem) to organ (τ) of age group (a) during the 31 day period from liquid effluents.

X_D = Number of days to date in the current quarter

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 5. For purposes of simplicity, Fuel Building exhaust effluents are included in the Main Plant exhaust duct releases. All gaseous effluent releases from the Radwaste Building Exhaust Duct are assumed to be ground level releases. The Main Plant Exhaust Duct routine releases are treated as a wake split (conditionally elevated) release.

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.

In the absence of real-time meteorological data, historical information will be used to calculate off-site dose. Modelling will be performed in accordance with the methodologies described in Reg. 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:

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

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

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 dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors (sec/m^3). Appendix F.

$\dot{Q}_i$ = 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} ≤500 mrem/year and DR_{skin} ≤3,000 mrem/year must be met at the most limiting location, at or beyond the site boundary.

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 appropriate receptor locations.

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

$$(X/Q)_s = 3.31 \times 10^{-6} \ sec/m^3$$

$$(X/Q)_v = 4.21 \times 10^{-5} \ sec/m^3$$

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

NOTE

This approach for K_{eff} and $(L + 1.1M)_{eff}$ should only be used if the relative abundances of the noble gas radionuclides in the effluent stream are similar to those listed in Appendix D or of the previous SemiAnnual Effluent Report, as appropriate. (Reference 1.2.19)

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:

$$K_{eff} = 5.56 \times 10^{-5} \text{ (mrem-m}^3\text{/uCi-sec)}$$

Either of these values, as appropriate, may be used in conjunction with the total noble gas release rate ($\dot{Q}_i$) 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:

$$DR_{TB} = \frac{(3.15 \times 10^7)(K_{eff})(\overline{X/Q})}{0.8} \sum_{i=1}^{n} \dot{Q}_i \qquad 3.3.1.2.2\text{-}1$$

where:

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

$(\overline{X/Q})$ = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors (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.

3.15×10^7 = Number of seconds/year

This limited analysis approach methodology is also available for determining skin dose rates from noble gas release rates:

Beginning with equation 3.3.1.2.1-2, the simplification proceeds as follows:

From an evaluation of projected releases, an effective skin dose factor, $(L + 1.1M)_{eff}$, can be derived. This dose factor is, in effect, a weighted average skin dose factor. See Appendix C for a detailed explanation and evaluation of $(L + 1.1M)_{eff}$. The value of $(L + 1.1M)_{eff}$ 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:

$(L + 1.1M)_{eff} = 1.59 \times 10^{-4}$ (mrem -m^3/uCi-sec)

Main Plant Exhaust Duct and Fuel Building Exhaust Duct:

$(L + 1.1M)_{eff} = 1.36 \times 10^{-4}$ (mrem -m^3/uCi-sec)

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

$$DR_{Skin} = \frac{(3.15 \times 10^7)\ (L + 1.1M)_{eff}\ \overline{(X/Q)}}{0.8} \sum_{i=1}^{n} \dot{Q}_i \qquad 3.3.1.2.2\text{-}2$$

where:

DR_{Skin} = **Skin dose rate from noble gases in airborne releases in mrem/year.**

$\overline{(X/Q)}$ = **The highest** calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors (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.

3.15×10^7 = Number of seconds/year

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 (I-131, I-133), tritium 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:

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

where:

$DR_{I\&8DP\tau}$ = Dose rate to the organ τ for the age group of interest from radioiodines (I/131, I-133), Tritium and 8 day particulates via the inhalation pathway (in mrem/yr).

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

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

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

Values for P_i were calculated for a child using the inhalation pathway methodology of NUREG-0133. The P_i values are presented in Appendix G.

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 (HIGH ALARM) that is set to report when the radioactive noble gas in gaseous effluents (Main Plant exhaust duct, Fuel Building exhaust duct and/or Radwaste Building exhaust duct) is expected to cause a noble gas concentration at ground level offsite resulting in a dose rate equal to or greater than 500 mrem/yr to the total body and/or 3000 mrem/yr to the skin.

The ALERT alarm is set to report when the radioactive noble gas in gaseous effluents (Main Plant exhaust duct, Fuel Building exhaust duct and/or Radwaste Building exhaust duct) is expected to cause a noble gas concentration at ground level offsite that would result in meeting or exceeding either the 5 mrad per quarter gamma air dose or 10 mrad per quarter beta air dose limit (Technical Specification 3.11.2.2). It is permissible to set the ALERT alarm at twice (2.0) normal (approximately 100 % unit power) detector background if nuisance alarms would result from setpoints based on gamma and beta air dose. (Reference 1.2.12)

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

a. HIGH ALARM Setpoint Determination

This section describes the methodology for determining HIGH ALARM/trip setpoints for the three release points:

i. Wide Range Gas Monitor (WRGM)

Step 1

Determine $\dot{Q}_{TB}$ utilizing one of the following methods:

$$\dot{Q}_{TB} = \frac{(3.17 \times 10^{-8}) \quad (500)\ (0.8)}{(\overline{X/Q}) \quad (K_{eff})} \qquad 3.3.2.2\text{-}1$$

or

NOTE

The K_i methodology for determining $\dot{Q}_{TB}$ should be used only if isotopic analyses is available and the relative abundances of noble gas nuclides in the effluent stream are not similar to those listed in Appendix D or not similar to the noble gas isotopic mixture described in the previous Semiannual Effluent Report. (Reference 1.2.19)

$$\dot{Q}_{TB} = \frac{3.17 \times 10^{-8} \quad (500)}{(\overline{X/Q}) \sum_i (K_i)\ (f_i)} \qquad 3.3.2.2\text{-}2$$

where:

$\dot{Q}_{TB}$ = maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent [uCi/sec].

$(\overline{X/Q})$ = The highest calculated annual average relative dispersion factor for any area at or beyond the unrestricted area boundary for all Sectors (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} = $\Sigma_i K_i \quad f_i$, 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.

500 = Whole body exposure limits of 500 mrem/year.

$3.17x10^{-8}$ = Inverse of number of seconds per year in year/sec.

Step 2

Determine $\dot{Q}_s$ utilizing one of the following methods.

$$\dot{Q}_s = \frac{(3.17 \times 10^{-8}) \quad (3,000)\ (0.8)}{(\overline{X/Q})\ (L+1.1M)_{eff}} \qquad 3.3.2.2\text{-}3$$

or

NOTE

The $(L + 1.1M)_i$ methodology for determining $\dot{Q}_S$ should be used only if isotopic analyses is available and the relative abundances of noble gas nuclides in the effluent stream are not similar to those listed in Appendix D or not similar to the noble gas isotopic mixture described in the previous Semiannual Effluent Report. (Reference 1.2.19)

$$\dot{Q}_s = \frac{(3.17 \times 10^{-8}) \quad (3,000)}{(\overline{X/Q})\ \sum_i\ [(L_i + 1.1M_i)f_i]} \qquad 3.3.2.2\text{-}4$$

$\dot{Q}_s$ = the maximum acceptable release rate of all gas radionuclides in the gaseous effluent [uCi/sec])

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

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

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

3000 = Skin exposure limit of 3000 mrem/year

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

Step 3

Select the lower of the $\dot{Q}$ values ($\dot{Q}_{TB}$ or $\dot{Q}_s$) obtained in Step 1 and Step 2.

NOTE

Actual alarm setpoint in the data-base may be modified to account for loop accuracy.

Step 4

Multiply the $\dot{Q}$ value selected in Step 3 by 0.33. By multiplying the $\dot{Q}$ value by a factor of 0.33, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release rate to each of the release points. The resultant product will be the actual ODCM release rate HIGH ALARM setpoint for the appropriate WRGM Monitor.

ii. Particulate and Gas Monitor (P&G) (gas channel only).

Step 1

Perform Steps 1 through 3 of Section 3.3.2.2a.i above

Step 2

Determine C_m (the maximum acceptable total radioactivity concentration of all noble gases radionuclides for all release points in the gaseous effluent [uCi/cc]):

$$C_m = \frac{(2.12 \times 10^{-3})\ \dot{Q}}{F} \qquad 3.3.2.2\text{-}5$$

where: 2.12×10^{-3} = Unit conversion factor to convert uCi/sec/cfm to uCi/cc.

$\dot{Q}$ = lower of the two $\dot{Q}$ values, $\dot{Q}_{TB}$ or $\dot{Q}_s$.

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

NOTE

Actual alarm setpoint in the data-base may be modified to account for loop accuracy.

Step 3

Multiply the C_m value determined in Step 2 by 0.33. By multiplying the C_m value by a factor of 0.33, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release to each of the release points. The resultant product will be the actual ODCM activity concentration HIGH ALARM setpoint for the appropriate P&G monitor gas channel.

b. ALERT Setpoint Determination (Reference 1.2.12)

i. Wide Range Gas Monitor (WRGM)

Step 1

Determine $\dot{Q}_{G-A}$ utilizing one of the following methods:

$$\dot{Q}_{G-A} = \frac{(1.26 \times 10^{-7})(5)(0.8)}{(\overline{X/Q})\ (M_{eff})} \qquad 3.3.2.2\text{-}6$$

OR

NOTE

The M_i methodology for determining $\dot{Q}_{G-A}$ should be used only if isotopic analyses is available and the relative abundances of noble gas nuclides in the effluent stream are not similar to those listed in Appendix D or not similar to the noble gas isotopic mixture described in the previous Semiannual Effluent Report. (Reference 1.2.19)

$$\dot{Q}_{G-A} = \frac{(1.26 \times 10^{-7})(5)}{(\overline{X/Q})\ \sum_i M_i f_i} \qquad 3.3.2.2\text{-}7$$

Where:

$\dot{Q}_{G-A}$ = maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluent [uCi/sec]

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

M_{eff} = Effective gamma air dose factor ($mrad\text{-}m^3/uCi\text{-}sec$). See Appendix C, Table C-5 for applicable values.

5 = 5 mrads/quarter (92 days) gamma air dose limit at the unrestricted area boundary.

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

f_i = The fractional abundance of noble gas radionuclide i

1.26×10^{-7} = Inverse of number of seconds per quarter in quarters/second

0.8 = Conservatism factor to account for changing isotopic inventory

Step 2

Determine $\dot{Q}_{B-A}$ utilizing one of the following methods:

$$\dot{Q}_{B-A} = \frac{(1.26 \times 10^{-7})\ (10)\ (0.8)}{(\overline{X/Q})\ (N_{eff})} \qquad 3.3.2.2\text{-}8$$

or

NOTE

The N_i methodology for determining $\dot{Q}_{B-A}$ should be used only if isotopic analyses is available the relative abundances of noble gas nuclides in the effluent stream are not similar to those listed in Appendix D or the previous Semiannual Effluent Report. (Reference 1.2.19)

$$\dot{Q}_{B-A} = \frac{(1.26 \times 10^{-7})\ (10)}{(\overline{X/Q})\ \Sigma\ (N_i)\ (f_i)} \qquad 3.3.2.2\text{-}9$$

Where:

$\dot{Q}_{B-A}$ = maximum acceptable total release rate of all noble gas radionuclides in the gaseous effluents [uCi/sec]

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

10 = 10 mrad/quarter (92 days) beta air dose limit at the unrestricted area BOUNDARY.

N_{eff} = Effective beta air dose factor (mrad - m^3/uCi-sec). See Appendix C, Table C-5 for applicable values.

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

f_i = The fractional abundance of noble gas radionuclide i.

1.26×10^{-7} = Inverse of number of seconds per quarter in quarters/second.

0.8 = Conservatism factor to account for changing isotopic inventory.

Step 3

Select the lower of the $\dot{Q}$ values obtained in Steps 1 and 2, either $\dot{Q}_{G-A}$ or $\dot{Q}_{B-A}$.

Step 4

Multiply the $\dot{Q}$ value selected in Step 3 by 0.33. By multiplying the $\dot{Q}$ value by this factor, the allowable operating setpoints will be administratively controlled to allocate one-third (1/3) of the total allowable release rate to each of the release points. The resultant product will be the actual ODCM ALERT setpoint to be entered into the applicable WRGM's RM-80.

Step 5

If the actual ODCM ALERT setpoint determined in Step 4 is less than two (2.0) times the detector background, it is permissible to enter an ALERT setpoint equal to two (2.0) times the normal (approximately 100% unit power) detector background to reduce the possibility of nuisance alarms. The twice background setpoint should provide sufficient indication that an offsite dose limit could possibly be exceeded.

ii. Particulate and Gas Monitor (P&G) (gas channel only)

Step 1

Perform Steps 1 through 3 of Section 3.3.2.2.b.i above.

Step 2

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

$$C_m = \frac{(2.12 \times 10^{-3})\ \dot{Q}}{F} \qquad 3.3.2.2\text{-}10$$

Where: 2.12×10^{-3} = Unit conversion factor to convert uCi/sec/cfm to uCi/cc.

$\dot{Q}$ = Lower of the two $\dot{Q}$ values, $\dot{Q}_{G-A}$ or $\dot{Q}_{B-A}$

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

Step 3

Multiply the C_m value determined in Step 2 by 0.33. By multiplying the C_m value by this factor, the allowable operating setpoints will be administratively controlled to allocate (1/3) of the total allowable release to each of the release points. The resultant product will be the actual ODCM activity concentration ALERT setpoint. This value is the setpoint to be entered into the applicable P&G monitor's RM-80.

Step 4

If the actual ODCM ALERT setpoint determined in Step 3 is less than two (2.0) times the gas detector background, it is permissible to enter an ALERT setpoint equal to two (2.0) times the normal (approximately 100% unit power) gas detector background to reduce the possibility of nuisance alarms. The twice background setpoint should provide sufficient indication that an offsite dose limit could possibly be exceeded.

3.4 Cumulative Dose Determination for Radioactive Gaseous Effluents

3.4.1 Noble Gases

3.4.1.1 Requirements

a. Air Dose

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:

i. 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

ii. 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.

b. Total Body and Skin Dose (Reference 1.2.13)

i. Technical Specification 3.11.4 states that the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC, due to releases of radioactivity and to radiation from uranium fuel cycle sources, shall be limited to less than or equal to 25 mrems to the total body or any organ, except the thyroid, which shall be limited to less than or equal to 75 mrems.

ii. Technical Specification 6.9.1.8 (Semi-Annual Effluent Release Report) requires that an assessment of radiation doses to the likely most-exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources (including doses from primary effluent pathways and direct radiation) be performed for the previous calendar year to show conformance with 40 CFR190, Environmental Radiation Protection Standards for Nuclear Power Operation.

Cummulative doses from liquid effluents and gaseous pathways (radioiodines (I-131, I-133), Tritium and particulates with T 1/2 > 8 days) are determined in accordance with Sections 2.4.2 and 3.4 2.5. Cummulative total body and skin doses from noble gas releases are determined in accordance with Section 3.4.1.2b.

3.4.1.2 Methodology

a. Air Dose

This section provides the methodology to calculate the gamma and beta air doses to a maximum receptor location at the site boundary 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 dose factors for beta and gamma air dose are listed in Appendix C and are obtained from Table B-1 of RG 1.109, Revision 1, October 1977.

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

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

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

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-m^3/uCi-sec (Appendix C).

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

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-m^3/uCi-sec (Appendix C), Table C-1.

b. Total Body and Skin Dose (Reference 1.2.13)

This section provides the methodology to calculate the total body and skin doses to the likely most-exposed MEMBER OF THE PUBLIC from all noble gas radionuclides identified in the gaseous effluents.

The method is based on the methodology suggested in Section C.2 and Appendix B of RG 1.109, Revision 1, October, 1977. The dose transfer factors required for the calculations are listed in Appendix C of this document and are obtained from Table B-1 of RG 1.109, Revision 1, October, 1977.

The following equations provide for total body and skin dose calculations based on actual noble gas releases during a specific time interval for radioactive gaseous release sources at the site boundary:

$$D_{Total\ Body} = S_F \sum_{i=1}^{n} (K_i)(\overline{X/Q})(Q_i) \qquad 3.4.1.2b.-1$$

$$D_{Skin} = S_F \sum_{i=1}^{n} (L_i + 1.1M_i)(\overline{X/Q})(Q_i) \qquad 3.4.1.2b.-2$$

Where:

$D_{Total\ Body}$ = The total body dose from radioactive noble gases in mrem.

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

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

NOTE

For purposes of calculating $D_{Total\ Body}$ and D_{Skin} for the Semiannual Radioactive Effluent Release Report, X/Q values based on meteorological data for the actual considered time period should

be used rather than historical $(\overline{X/Q})$ values. If at all possible, these real time X/Q values should also be used when determining 40CFR190 compliance when Technical Specification limits have been exceeded by a factor of two (2.0).

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

D_{Skin} = The skin dose from radioactive noble gases in mrem.

M_i = The gamma air dose factor due to gamma emissions from each noble gas radionuclide (i) released.

L_i = The skin dose factor due to beta emissions from noble gas radionuclide (i) (mrem/sec per uCi/m^3) from Appendix C, Table C-1.

1.1 = Average ratio of tissue to air energy absorption coefficients.

S_F = 0.7, attenuation factor accounting for shielding provided by residential structures for maximally exposed individual.

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-m^3/uCi-sec

N_{eff} = 7.40×10^{-5} mrad-m^3/uCi-sec

Main Plant Exhaust Duct and Fuel Building Exhaust Duct:

M_{eff} = 5.96×10^{-5} mrad-m^3/uCi-sec

N_{eff} = 8.99×10^{-5} mrad-m^3/uCi-sec

NOTE

The M_{eff} and N_{eff} factors should only be used if the actual effluent is similar to that described in Appendix D or similar to the noble gas isotopic mixture described in the previous Semiannual Effluent Report. (Reference 1.2.19)

The effective gamma air dose factor may be used in conjunction with the total noble gas release (ΣQ_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:

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

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

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 (I131, I133), trituim 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 t... 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 radioiodines (I-131, I-133), 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:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \quad \overline{(X/Q)_D} \quad (Q_i) \qquad 3.4.2.2\text{-}1$$

Ground Plane Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \quad \overline{(D/Q)} \quad (Q_i) \qquad 3.4.2.2\text{-}2$$

Contaminated Forage/Cow/Milk Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \quad \overline{(D/Q)} \quad (Q_i) \qquad 3.4.2.2\text{-}3$$

Total Dose:

$$D = \sum_{z=1}^{n} D_{I\&8DP\tau} \qquad 3.4.2.2\text{-}4$$

<u>IMPORTANT</u>

When calculating organ doses due to the release of C-14 and/or tritium (H-3), X/Q values (not D/Q values) must be used for cow milk, goat milk, meat and vegetation pathway calculations.

where:

$D_{I\&8DP\tau}$ = Dose in mrem to the organ (τ) of a specified age group from radioiodines (I-131, I-133), Tritium and 8 day particulates due to a particular pathway.

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

D = Total dose in mrem to the organ (τ) of a specified age group from gaseous radioiodine (I-131, I-133), tritium 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 $(\overline{D/Q})$ (See Appendix I.)

$(\overline{X/Q})_D$ = The depleted $(\overline{X/Q})$ 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.)

NOTE

For purpose of calculating $D_{I\&8DP\tau}$ for the Semiannual Radioactive Effluent Release Report, X/Q_D and D/Q values based on meteorological data for the actual considered time period should be used rather than historical $(\overline{X/Q})_D$ and $(\overline{D/Q})$ values. If at all possible, real time X/Q_D and D/Q values should also be used when determining 40CFR190 compliance when Technical Specification limits have been exceeded by a factor of two (2.0).

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 (I-131, I-133), Tritium 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:

$$D = \frac{(3.17 \times 10^{-8})\ (\overline{D/Q})}{0.8} \sum_{\text{radioiodines}} (R_i)\ (Q_i) \qquad 3.4.2.3\text{-}1$$

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 (I-131, I-133), tritium 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 (I-131, I-133), tritium 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 Radioiodines (I-131, I-133), tritium, 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, (I-131, I-133), tritium and 8- day particulates:

Inhalation Pathways:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \, (\overline{X/Q})_D \, (Q_i) \qquad 3.4.2.5\text{-}1$$

Ground Plane Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \, (\overline{D/Q}) \, (Q_i) \qquad 3.4.2.5\text{-}2$$

Contaminated Forage/Cow/Milk Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \, (\overline{D/Q}) \, (Q_i) \qquad 3.4.2.5\text{-}3$$

Contaminated Forage/Goat/Milk Pathway:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \, (\overline{D/Q}) \, (Q_i) \qquad 3.4.2.5\text{-}4$$

Contaminated Forage/Meats:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \, (\overline{D/Q}) \, (Q_i) \qquad 3.4.2.5\text{-}5$$

Fresh Fruits and Vegetables:

$$D_{I\&8DP\tau} = (3.17 \times 10^{-8}) \sum_{i=1}^{n} (R_{i\tau}) \overline{(D/Q)} (Q_i) \qquad 3.4.2.5\text{-}6$$

Total Dose:

$$D_{\tau} = \sum_{z=1}^{n} DI\&8DP\tau \qquad 3.4.2.5\text{-}7$$

where:

$DR_{I\&8DP\tau}$ = Dose rate to the organ (τ) for the age group of interest from radioiodines (I-131, I-133), tritium and 8-day particulates via the pathway of interest in mrem/yr. For radioiodines (I-131, I-133), the entire source term was used to calculate these values.

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

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 traveling downwind. Since radioiodines (I-131, I-133), and particulates settle out (fallout of the cloud) on the ground, the $(X/Q)_D$ 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).

IMPORTANT

When calculating organ doses due to the release of C-14 and/or tritium (H-3), (X/Q) values (not D/Q values) must be used for cow milk, goat milk, meat and vegetation pathway calculations.

NOTE

For purposes of calculating $DR_{I\&8DP\tau}$ for the Semiannual Radioactive Effluent Release Report, X/Q_D and D/Q values based on meteorological data for the actual considered time period should be used rather than historical $\overline{(X/Q)}_D$ and $\overline{(D/Q)}$ values. If at all possible, real time X/Q_D and D/Q values should also be used when determining 40CFR190 compliance when Technical Specification limits have been exceeded by a factor of two (2.0).

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 (radioiodines (I-131, I-133), particulates T 1/2 > 8 days and H-3) would exceed 0.3 mrem to any organ in a 31 day period.

NOTE

The ventilation exhaust treatment system does not reduce the noble gas concentration in plant effluents (See Definition 1.3.5).

3.5.2 Methodology

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

$$G_{PD} = \frac{\Sigma D_{\tau}}{X_D} * 31 \qquad 3.5.2\text{-}1$$

where:

G_{PD} = Projected dose due to radioiodines (I-131, I-133), particulates with $T_{1/2}$ > 8 days and H-3 during the current 31 day period (mrem).

X_D = The number of days to date in the current quarter

D_{τ} = Cumulative total dose due to radioiodines (I-131, I-133), particulates with T 1/2 > 8 days and H-3 during the current quarter (mrem).

A dose projection would be based on the latest results of the monthly calculations of the dose due to radioiodines (I-131, I-133), particulates with T 1/2 > 8 days, and H-3 (Section 3.4.2.5). 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 I-131	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.		

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
	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.		
	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 papermill; 5.5 km SSE.		

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
	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 o. 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.		
	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.		

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
	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 6)

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).		

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
	TGS. GSU Service Center compound in Zachary; 17 km SE (Special).		
	THS. Roof of GSU Service Office Building, North Blvd., Baton Rouge; 40 km SSE (Special).		
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 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.		

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 8)

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
	SHORELINE SEDIMENT		
	SED. Mississippi River about 4 km downstream from plant liquid discharge outfall, near papermill.	Semiannual grab.	Gamma isotopic analysis semi-annually.
4. Ingestion	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.
	F[illegible]. One sample of each of three commercially and/or recreationally important species from downstream area influenced by plant discharge.		

TABLE 4.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM
(Page 9)

Exposure Pathway and/or Sample	Sample Point, Description, Distance, and Direction	Sampling and Collection Frequency	Type and Frequency of Analysis
	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 (2).	Monthly during growing season.	Gamma isotopic and I-131 analyses monthly.
	GQC. One sample of each of three 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 calculation.

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.

5.2.7 If at all possible; X/Q, X/Q_D, and D/Q values based on meterological data for the actual considered time period should be used in determining compliance with 40CFR190.

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 (from storage tanks, N-16 sources, etc.)

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 (cow milk, goat milk, meat, vegetation)

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 Total Body Noble Gas Immersion Dose

This dose will be calculated in accordance with Section 3.4.1.2b. for the maximally exposed MEMBER OF THE PUBLIC in the limiting sector.

5.3.5 Ground Plane Deposition

5.3.6 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 the limiting sector as the sum of:

5.4.1 Direct Radiation (from storage tanks, N-16 sources, etc.)

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

5.4.2 Inhalation Dose

The inhalation dose to the thyroid 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.

5.4.3 Ingestion Pathway (cow milk, goat milk, meat, vegetation)

The dose to the thyroid 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.

5.4.4 Noble Gas Immersion Dose

It is assumed that an external total body dose from noble gases irradiates internal body organs at the same numerical rate (Reference 1.2.11). This dose for the thyroid will therefore be equal to the dose calculated in Step 5.3.4 above.

5.4.5 Ground Plane Deposition

5.4.6 Other Uranium Fuel Cycle Sources

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

5.5 Organ Dose (other than thyroid and skin)

The dose to any organ will be calculated for the limiting sector as the sum of:

5.5.1 Direct Radiation (from storage tanks, N-16 sources, etc.)

The component of dose to an organ due to direct radiation will be determined by thermoluminescent dosimeters (TLDs).

5.5.2 Inhalation Dose

The inhalation dose to an organ 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.

5.5.3 Ingestion Pathway (cow milk, goat milk, meat, vegetation)

The dose to an organ 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.

5.5.4 Noble Gas Immersion Dose

It is assumed that an external total body dose from noble gases irradiates internal body organs at the same numerical rate (Reference 1.2.11). This dose for an organ will therefore be equal to the dose calculated in Step 5.3.4 above.

5.5.5 Ground Plane Deposition

5.5.6 Other Uranium Fuel Cycle Sources

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

5.6 Skin Dose

The dose to the skin will be calculated for the limiting sector as the sum of:

5.6.1 Direct Radiation (from storage tanks, N-16 sources, etc.)

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

5.6.2 Inhalation Dose

The inhalation dose to the skin (only tritium is considered) 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.

5.6.3 Ingestion Pathway (cow milk, goat milk, meat, vegetation)

The dose to the skin via the ingestion pathway (only tritium and C-14 considered) 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.

5.6.4 Skin Noble Gas Immersion Dose

This dose will be calculated in accordance with Section 3.4.1.2b for the maximally exposed MEMBER OF THE PUBLIC in the limiting sector(s).

5.6.5 Ground Plane Deposition

5.6.6 Other Uranium Fuel Cycle Sources

This dose from other fuel cycle sources will be treated as < 1 mrem/yr.

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)

$A_{i\tau}$, mrem/hr per uCi/ml

Radionuclide	Total Body	Critical Organ
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 invertebrates (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 t (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 K_i mrem/(uCi sec/m3)	Beta L_i 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 M_i mrad/(uCi sec/m3)	Beta N_i 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}, $(L + 1.1M)_{eff}$, 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.

Use of effective dose factors should only be used if isotopic analyses are not available (i.e., prior to initial criticality), if the relative abundances of the noble gas isotopic mixture are similar to those listed in Appendix D or if the relative abundances of the noble gas isotopic mixture are similar to those listed in the previous Seminannual Radioactive Effluent Release Report. (Reference 1.2.19)

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.

TABLE C-2

TECHNICAL BASES FOR EFFECTIVE DOSE FACTORS
(Continued)

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.

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-m^3/uCi-sec)	Radwaste Building Exhaust Duct K_{eff} (mrem-m^3/uCi-sec)
Projected**	5.56E (-5)***	8.05E (-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.

*** 5.56E (-5) = 5.56×10^{-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-m^3/uCi-sec)	Radwaste Building Exhaust Duct $(L+1.1M)_{eff}$ (mrem-m^3/uCi-sec)
Projected**	1.36E (-4)	1.59E (-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.

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**	5.96E(-5)	8.99E(-5)	8.07E (-5)	7.40E (-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.

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	4.7E (-2)	1.07E (-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	6.6E (-2)	1.504E (-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	1.75E (-3)
	4,389.	1.0000	1,144	.99

* RBS FSAR Table 11.3-1

** Containment Building contains releases from Fuel Building

APPENDIX E

X/Q AND 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_T	=	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:

$$\frac{CHI}{Q}_{kd} = \frac{2.032}{x}\sum_{j=1}^{n}\left(\frac{\Omega}{n}\right)_k\left[\frac{E_T}{\bar{u}_{10}\left(\sigma_{z_{j,k}}^2+0.5h_b^2/\pi\right)^{1/2}}+\frac{(1-E_T)\exp\left[-\frac{1}{2}\left(\frac{h_e}{\sigma_{z_{j,k}}}\right)^2\right]}{\bar{u}_{150}\,\sigma_{z_{j,k}}}\right] \qquad \text{E.3-1}$$

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 = $2.58-1.58\,(u_e/\bar{u}_{150})$

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)

Within 5 km in each downwind sector, Equation E.3-1 was evaluated 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:

$$h_e = h_r - (h_t)_k + h_{pr} \qquad \text{E.3-2}$$

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.3-4).

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:

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

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

when:

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

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

and

$$h_{pr} \leq 3 \left(\frac{u_e}{\bar{u}_{150}}\right) d \qquad \text{E.3-5}$$

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

For E-G stability conditions, Equations E.3-3, E.3-4, and E.3-5 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:

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

was constrained to be less than or equal to $1.732\sigma_{z_{ik}}$

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

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:

$$\left(\frac{D}{Q}\right)_{k\ell} = \left(\frac{\Omega}{x}\right)_{k} \left(\frac{2\pi N}{16}\right)^{-1} \left\{ \sum_{j=1}^{n_\ell} \left[n_\ell \left\{ \left(\frac{\delta}{Q}\right)_{G_k} E_T + \frac{1}{n_\ell} \sum_{n=1}^{3} \left[1 - \left(E_T\right)_1 \right]^{n_{i\ell}} \left(\frac{\delta}{Q}\right)_{ik} \right\} \right] \right\} \qquad \text{E.4-1}$$

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 <u>Methodology Employed for Intermittent Release</u>

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	11.4	105
SSW	19.7	186
SW	16.4	215
WSW	19.5	326
W	23.6	654
WNW	33.1	421
NW	15.7	262
NNW	14.8	138
N	18.8	180
NNE	24.9	211
NE	16.6	150
ENE	12.2	146
E	9.07	168
ESE	10.4	154
SE	8.19	93.1
SSE	7.69	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	7.61	21.4
SSW	11.3	39.6
SW	10.4	36.1
WSW	9.79	38.5
W	13.8	68.8
WNW	18.0	50.3
NW	8.68	40.8
NNW	10.5	24.7
N	11.8	28.6
NNE	11.2	27.1
NE	8.26	22.3
ENE	9.73	22.7
E	7.75	23.0
ESE	7.76	24.6
SE	6.60	17.2
SSE	5.34	11.8

APPENDIX F

MAXIMUM X/Q AND 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 (3) and Beta Air Dose	994 m WNW (Containment)	CHI/Q1(5) - 421.0	CHI/Q2 - 33.1
Maximum Receptor (4)	1,290 m NW	CHI/Q1 - 216.0	CHI/Q2 - 13.9
Resident	Same	D/Q1(6) - 32.9	D/Q2 - 7.55
Garden	Same		
Meat animal	Same		
Immersion	Same		
Milk animal (5)	7,000 m NNW	CHI/Q1 - 3.58 D/Q1 - 0.38	CHI/Q2 -.870 D/Q2 - .223
Onsite garden (6)	994 m WNW	CHI/Q1 - 421.0 D/Q1 - 50.3	CHI/Q2 - 33.1 D/Q2 - 18.1

* Reference 1.2.16 and 1.2.18

Notes:

(1) All CHI/Q = 10-7 sec/m3
(2) All D/Q = 10-9 m-2
(3) Maximum offsite location (property boundary) with highest CHI/Q (unoccupied).
(4) Maximum occupied offsite location with highest CHI/Q and D/Q.
(5) No milk animal within 5 miles radius, Hypothetical location in worst sector.
(6) Maximum receptor vegetation pathways dose calculations should be made for this location.

APPENDIX G

INSTANTANEOUS DOSE TRANSFER FACTOR TABLES

TABLE G-1

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

PATHWAY = INHALATION
AGE GROUP = CHILD

			Organ Dose Factors (mrem/yr per uCi/m^3)					
Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
CR-51	0.154E+03	0.108E+04	0.000E+00	0.000E+00	0.243E+02	0.855E+02	0.170E+05	0.000E+00
MN-54	0.951E+04	0.[illegible]29E+05	0.000E+00	0.429E+05	0.100E+05	0.000E+00	0.158E+07	0.000E+00
FE-59	0.167E+05	0.707E+05	0.207E+05	0.334E+05	0.000E+00	0.000E+00	0.127E+07	0.000E+00
CO-58	0.316E+04	0.344E+05	0.000E+00	0.177E+04	0.000E+00	0.000E+00	0.111E+07	0.000E+00
CO-60	0.226E+05	0.962E+05	0.000E+00	0.131E+05	0.000E+00	0.000E+00	0.707E+07	0.000E+00
ZN-65	0.703E+05	0.163E+05	0.426E+05	0.113E+06	0.714E+05	0.000E+00	0.9[illegible]E+06	0.000E+00
SR-89	0.172E+0[illegible]	0.167E+[illegible]	0.599E+06	0.000E+00	0.000E+00	0.000E+00	0.216E+07	0.000E+00
SR-90	0.644E+07	0.343E+06	0.101E+09	0.000E+00	0.000E+00	0.000E+00	0.148E+08	0.000E+00
CS-134	0.225E+06	0.385E+04	0.651E+06	0.101E+07	0.330E+06	0.000E+00	0.121E+06	0.000E+00
CS-137	0.128E+06	0.362E+04	0.907E+06	0.825E+06	0.282E+06	0.000E+00	0.104E+06	0.000E+00
BA-140	0.433E+04	0.102E+06	0.740E+05	0.648E+02	0.211E+02	0.000E+00	0.174E+07	0.000E+00
CE-141	0.290E+04	0.566E+05	0.392E+05	0.195E+05	0.855E+04	0.000E+00	0.544E+06	0.000E+00
I-131	0.273E+05	0.284E+04	0.481E+05	0.481E+05	0.788E+05	0.162E+08	0.000E+00	0.000E+00
I-133	0.770E+04	0.548E+04	0.166E+05	0.203E+05	0.338E+05	0.385E+07	0.000E+00	0.000E+00
H-3	0.112E+04	0.112E+04	0.000E+00	0.112E+04	0.112E+04	0.112E+04	0.112E+04	0.112E+04

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

			Organ Dose Factors (mrem/yr per uCi/m-)					
Nuclide	T. Body	GI-Tract	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.

<u>NOTE:</u> 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

			Organ Dose Factors (mrem/yr per uCi/m-)					
Nuclide	T. Body	GI-Tract	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/m3).

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-) 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 relerse 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-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-) 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	.259E+07	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.

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

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 (m2-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.

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

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 (m2-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	.2548[illegible]5E+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.

<u>Note:</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

TABLE I-7

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

PATHWAY = COW MILK
AGE GROUP = TEEN

			Organ Dose Factors (m2-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	3.65E+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+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.

<u>Note:</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

TABLE I-8

ENVIRONMENTAL PATHWAY - DOSE CONVERSION FACTORS R FOR GASEOUS DISCHARGE

PATHWAY = COW MILK
AGE GROUP = CHILD

			Organ Dose Factors (m2-mrem/yr per uCi/sec)					
Nuclide	T. Body	GI-Tract	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	3.32E+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/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

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 (m2-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	.217367E+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/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

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 (m2-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+02	.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.

<u>Note;</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

TABLE I-11

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

PATHWAY = GOAT MILK
AGE GROUP = TEEN

			Organ Dose Factors (m2-mrem/yr per uCi/sec)					
Nuclide	T. Body	GI-Tract	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/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

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 (m2-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	.442[illegible]83E+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	.192987E+12	.0	.0	.0	.0	.0
CS-134	.183E+11	.467667E+09	.528667E+11	.867556E+11	.268852E+11	.0	.964704E+10	.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	1.99E+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.

<u>Note:</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

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 (m2-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	.17[illegible]89E+10	.593732E+09	.203611E+10	.987402E+09	.0	.0	.0
SR-89	.64[illegible]E+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	6.95E+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.

<u>Note:</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

TABLE I-14

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

PATHWAY = MEAT
AGE GROUP = ADULT

			Organ Dose Factors (m2-mrem/yr per uCi/sec)					
Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
CO-60	.13E+09	.11072E+10	.0	.589707E+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	.732E+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	2.01E+02	.0	2.01E+02	2.01E+02	2.01E+02	2.01E+02	2.01E+02
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/m3), i.e. X/Q values are to used when calculating doses form H-3 and C-14.

TABLE I-15

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

PATHWAY = MEAT
AGE GROUP = TEEN

			Organ Dose Factors (m2-mrem/yr per uCi/sec)					
Nuclide	T. Body	GI-Tract	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+04	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/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

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 (m2-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.

<u>Note:</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

TABLE I-17

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

PATHWAY = VEGETATION
AGE GROUP = ADULT

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m2-mrem/yr per uCi/sec) 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/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

TABLE I-18

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

PATHWAY = VEGETATION
AGE GROUP = TEEN

Nuclide	T. Body	GI-Tract	Organ Dose Factors (m2-mrem/yr per uCi/sec) Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.871E+08	.900778E+09	.0	.439222E+09	.131022E+09	.0	.0	.0
CO-60	.548E+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 λ/Q and relative deposition.

<u>Note:</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. values are to be used when calculating doses from H-3 and C-14.

TABLE I-19

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

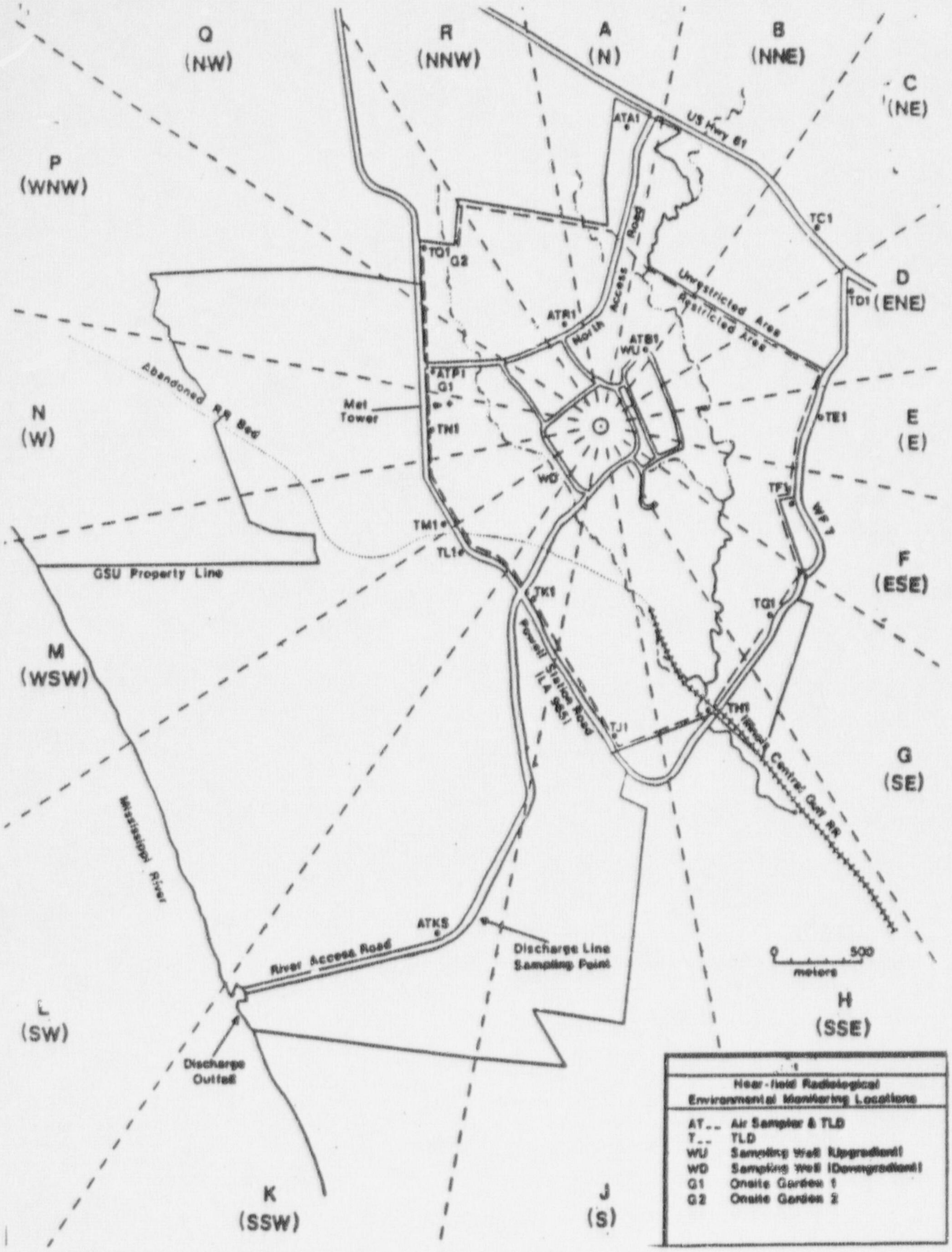
PATHWAY = VEGETATION
AGE GROUP = CHILD

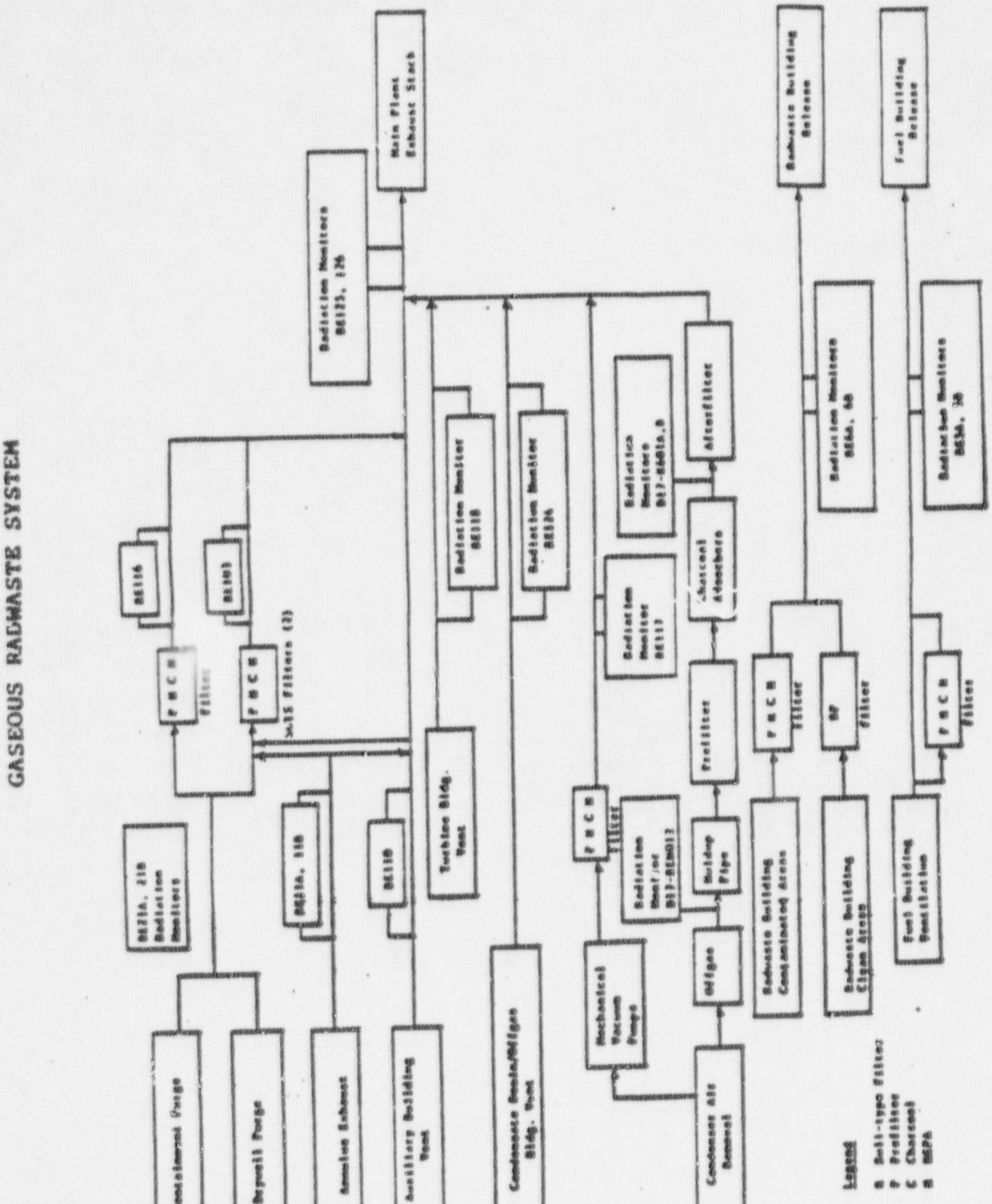
	Organ Dose Factors (m2-mrem/yr per uCi/sec)							
Nuclide	T. Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
MN-54	.171E+09	.5388E+09	.0	.642E+09	.18E+09	.0	.0	.0
CO-60	.109E+10	.204724E+10	.0	.369622E+09	.0	.0	.0	.0
ZN-65	.165E+10	.465925E+09	.995815E+09	.265308E+10	.167181E+10	.0	.0	.0
SR-89	.993E+09	.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	47369	.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

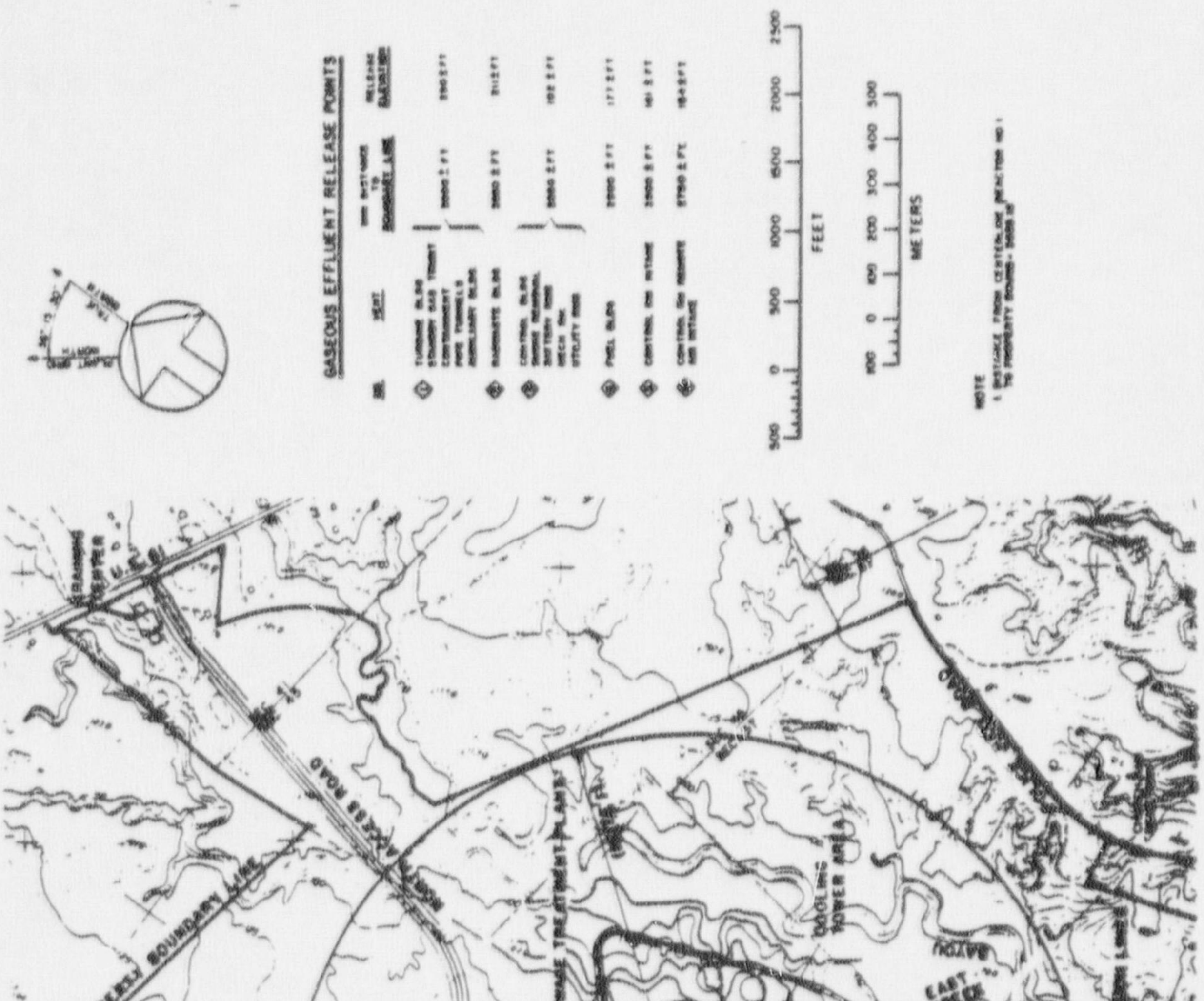
Based on 1 uCi/sec release rate of each nuclide (i) and a value of 1.0 for X/Q and relative deposition.

<u>Note:</u> The units for C-14 and H-3 are (mrem/year per uCi/m3), i.e. X/Q values are to be used when calculating doses from H-3 and C-14.

RESTRICTED AREA AND NEAR-FIELD ENVIRONMENTAL MONITORING LOCATIONS




GASEOUS RADWASTE SYSTEM
Containment Purge
Drywell Purge
Annulus Exhaust
Auxiliary Building Vent
Turbine Bldg. Vent
Condenser Air Removal
Mechanical Vacuum Pumps
Main Plant Exhaust Stack
Radwaste Building Release
Fuel Building Release
Fuel Building Ventilation
Prefilter
Afterfilter
Filter
Legend


GASEOUS EFFLUENT RELEASE POINTS
FEET
METERS
PROPERTY BOUNDARY LINE
SEWAGE TREATMENT PLANT
COOLING TOWER AREA
EAST CREEK
MICROWAVE TOWER
METEOROLOGICAL STATION
PLANT ACCESS RD
GREEN

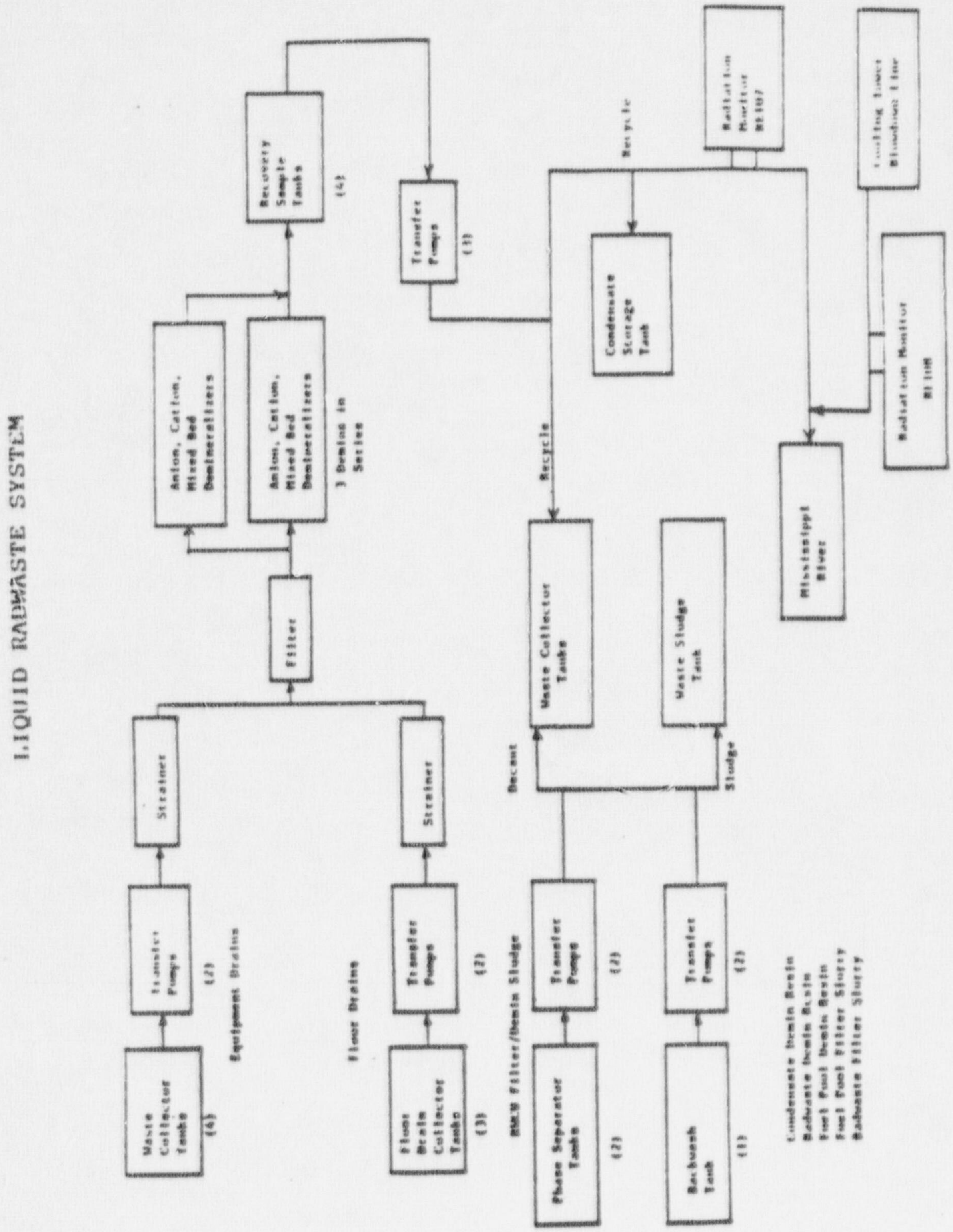
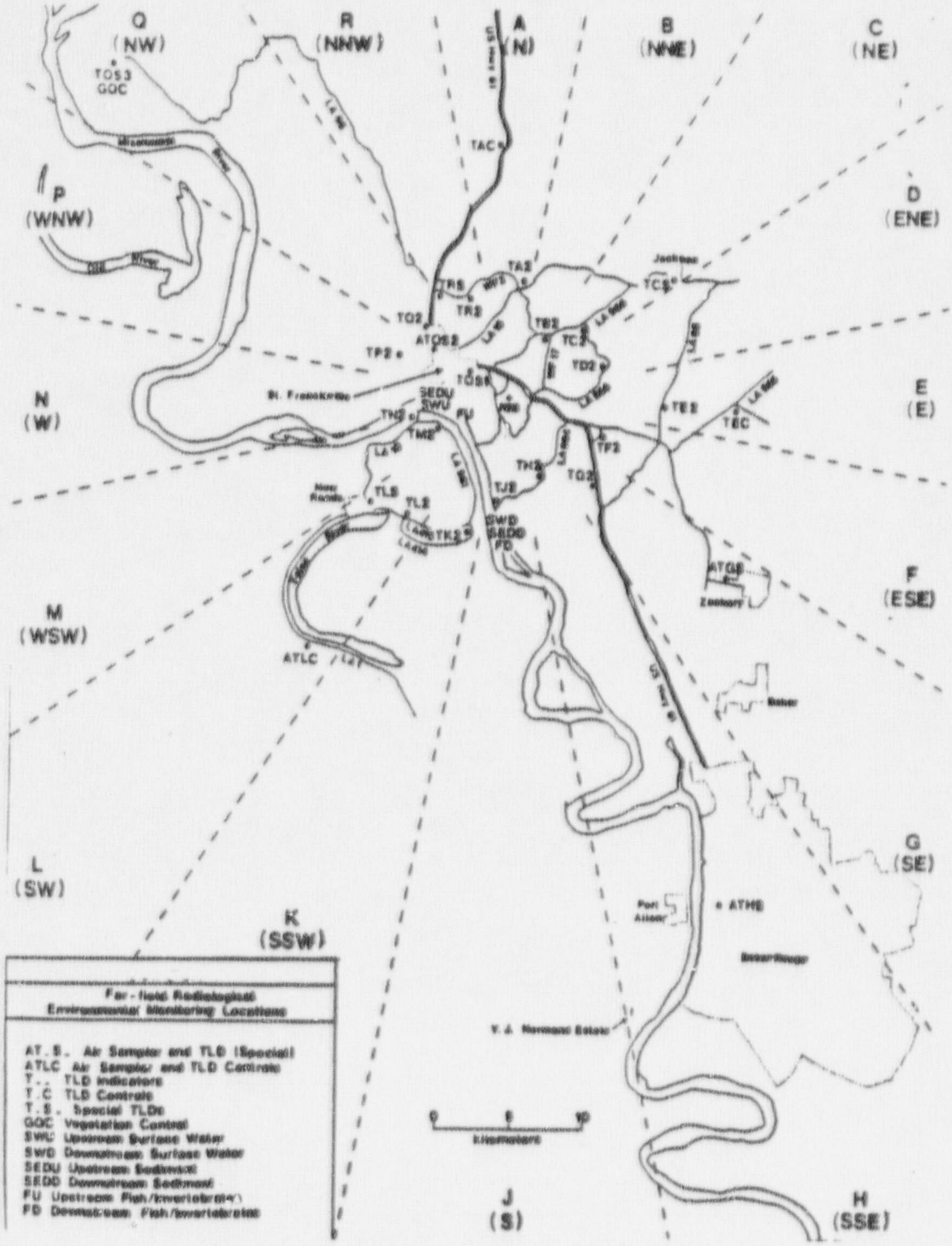
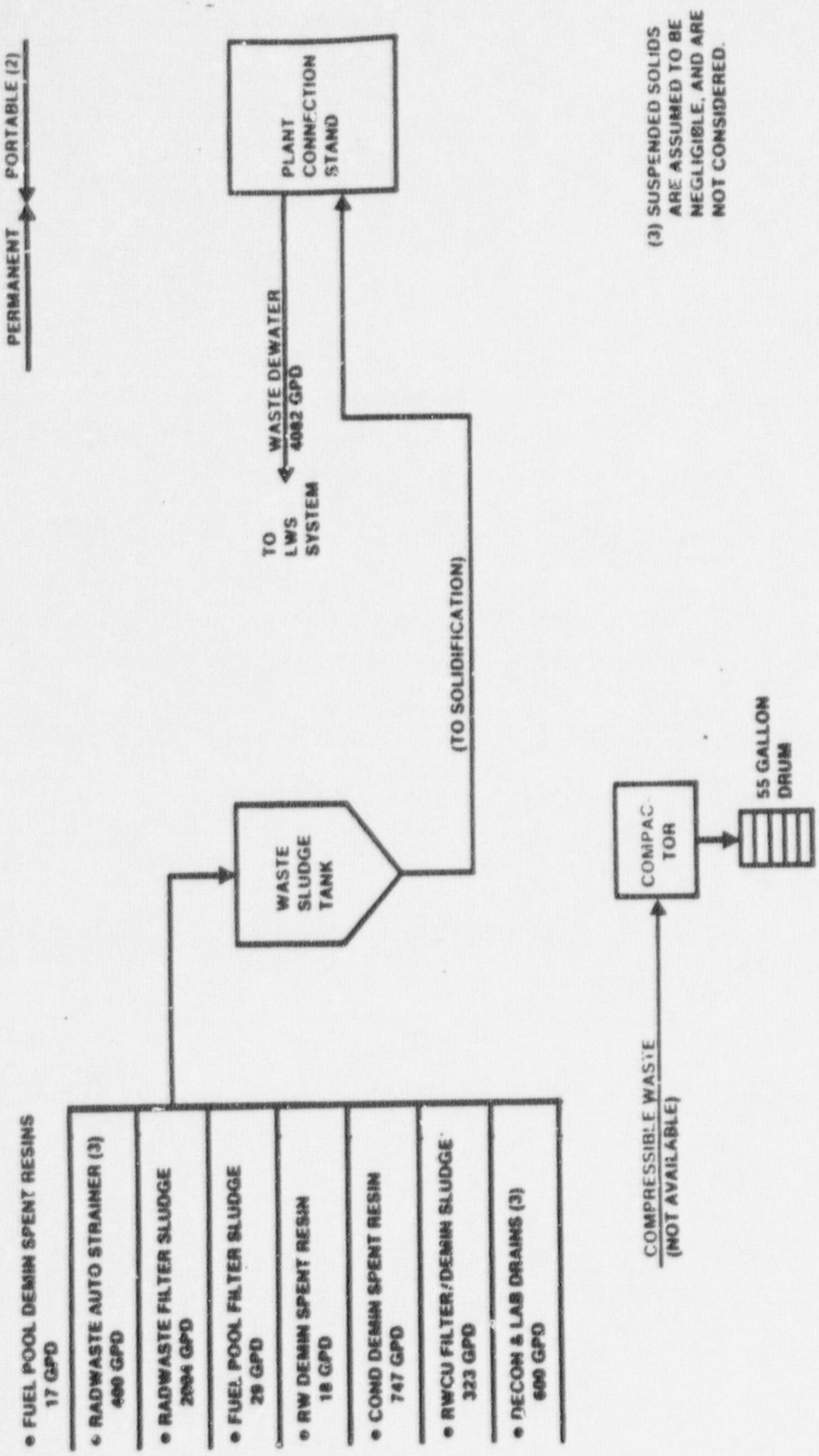

LIQUID RADWASTE SYSTEM
Waste Collector Tanks
(4)
Transfer Pumps
(2)
Equipment Drains
Strainer
Floor Drain Collector Tanks
(3)
Floor Drains
Transfer Pumps
(2)
Strainer
Filter
Anion, Cation, Mixed Bed Demineralizers
Anion, Cation, Mixed Bed Demineralizers
3 Demins in Series
Recovery Sample Tanks
(4)
Transfer Pumps
(3)
Phase Separator Tanks
(2)
RWCU Filter/Demin Sludge
Transfer Pumps
(2)
Backwash Tank
(1)
Transfer Pumps
(2)
Decant
Sludge
Waste Collector Tank
Waste Sludge Tank
Recycle
Recycle
Condensate Storage Tank
Radiation Monitor RE107
Cooling Tower Blowdown Line
Radiation Monitor RE108
Mississippi River
Condensate Demin Resin
Radwaste Demin Resin
Fuel Pool Demin Resin
Fuel Pool Filter Slurry
Radwaste Filter Slurry

FIGURE - 5 FAR-FIELD RADIOLOGICAL ENVIRONMENTAL MONITORING LOCATIONS





NOTES: (1) FLOWRATES INCLUDE TRANSFER WATER AND SOLIDS.
(2) REFER TO TOPICAL REPORT CNSI-2 (4314-01354-01P-A) FOR DETAILS.

DESCRIBE THE INFORMATION TO BE CHANGED INCLUDE THE RATIONALE FOR AND A COMPLETE DESCRIPTION OF THE CHANGE(S) MADE TO THE ODCM:

COMMENTS:

WILL THIS CHANGE REDUCE THE ACCURACY OR RELIABILITY OF DOSE CALCULATIONS OR SETPOINT DETERMINATIONS (TECHNICAL SPECIFICATION 6.14)? YES____ NO____

WILL THIS CHANGE REQUIRED REVISION TO LOWER TIER IMPLEMENTING PROCEDURES OR COMPUTER PROGRAMS. YES____ NO____

THESE CHANGES HAVE BEEN REVIEWED AND FOUND ACCEPTABLE, PURSUANT TO TECHNICAL SPECIFICATION 6.5.2.

REVIEWED, RADIOLOGICAL ENGINEERING SUPERVISOR: ______________________/__________
DATE

REVIEWED, DIRECTOR - RADIOLOGICAL PROGRAMS: ______________________/__________
DATE