OFFSITE DOSE CALCULATION MANUAL

FOR

PUBLIC SERVICE ELECTRIC AND GAS COMPANY

HOPE CREEK GENERATING STATION

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HOPE CREEK GENERATING STATION
OFFSITE DOSE CALCULATION MANUAL

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INTRODUCTION

The Hope Creek Offsite Dose Calculation Manual (ODCM) describes the methodology and parameters used in: 1) the calculation of radioactive liquid and gaseous effluent monitoring instrumentation alarm/trip setpoints; and 2) the calculation of radioactive liquid and gaseous concentrations, dose rates and cumulative quarterly and yearly doses. The methodology stated in this manual is acceptable for use in demonstrating compliance with 10 CFR 20.106, 10 CFR 50, Appendix I and 40 CFR 190.

More conservative calculation methods and/or conditions (e.g., location and/or exposure pathways) expected to yield higher computed doses that appropriate for the maximally exposed person may be assumed in the dose evaluations.

The ODCM will be maintained at the station for use as a reference guide and training document of accepted methodologies and calculation. Changes will be made to the ODCM calculation methodologies and parameters as is deemed necessary to ensure reasonable conservatism in keeping with the principles of 10 CFR 50.36a and Appendix I for demonstrating radioactive effluents are ALARA.

NOTE: As used throughout this document, excluding acronyms, words appearing all capitalized denote the application of definitions as used in the Hope Creek Technical Specifications.

1.0 LIQUID EFFLUENTS

1.1 Radiation Monitoring Instrumentation and Controls

The liquid effluent monitoring instrumentation and controls at Hope Creek for controlling and monitoring normal radioactive material releases in accordance with the Hope Creek Radiological Effluent Technical Specifications are summarized as follows:

1) Alarm (and Automatic Termination) - Liquid Radwaste Discharge Line Monitor provides the alarm and automatic termination of liquid (RE4861) radioactive material releases from the liquid waste management system as required by Technical Specification 3.3.7.10.

2) Alarm (Only) - The Cooling-Tower Blowdown Effluent Monitor (RE8817) provides an Alarm function only for releases into the environment as required by Technical Specification 3.3.7.10.

Liquid radioactive waste flow diagrams with the applicable, associated radiation monitoring instrumentation and controls are presented in Figure 1-1.

1.2 Liquid Effluent Monitor Setpoint Determination

Per the requirements of Technical Specification 3.3.3.10, alarm setpoints shall be established for the liquid monitoring instrumentation to ensure that the release concentration limits of Specification 3.11.1.1 are met (i.e., the concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to the concentrations specified in 10 CFR 20 Appendix B. Table II, column 2, for radionuclides and 2.0E-04 uCi/ml for dissolved or entrained noble gases). The following equation* must be satisfied to meet the liquid effluent restrictions:

$$c \leq \frac{C\ (F + f)}{f} \qquad (1.1)$$

where:

C = the effluent concentration limit of Technical Specification (3.11.1.1) implementing the 10 CFR 20 MPC for the site, in uCi/ml.

c = the setpoint, in uCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint, represents a value which, if exceeded, would result in concentrations exceeding the limits of 10 CFR 20 in the UNRESTRICTED AREA.

---------------* Adopted from NUREG-0133

f = the flow rate at the radiation monitor location, in volume per unit time, but the same units as F, below.
F = the dilution water flow rate as measured prior to the release point, in volume per unit time.

[Note that if no dilution is provided, $c \leq C$. Also, note that when (F) is large compared to (f), then $(F + f) = F$.]

1.2.1 **Liquid Effluent Monitors**

The setpoints for the liquid effluent monitors at the Hope Creek Generating Station are determined by the following equation:

$$SP \leq \frac{MPC_e * CTBD}{RR} + bkg \qquad (1.2)$$

with:

$$MPC_e = \frac{\Sigma\, C_i}{\Sigma\, (C_i/MPC_i)} \qquad (1.3)$$

where:

SP = alarm setpoint corresponding to the maximum allowable release rate (uCi/ml).
MPC_e = an effective MPC value for the mixture of radionuclides in the effluent stream, (uCi/ml).
C_i = the concentration of radionuclide in the liquid effluent (uCi/ml)*.

*NOTE: The concentration mix must include the most recent composite of alpha emitters, Sr-89, Sr-90, Fe-55 and H-3 as per Technical Specification 3.11.1.1.

MPC_i	=	the MPC value corresponding to radionuclide i from 10 CFR 20, Appendix B, Table II, Column 2 (uCi/ml).
CTBD	=	the Cooling-Tower Blowdown Discharge rate at the time of release (gal/min).
RR	=	the liquid effluent release rate (gal/min) at the monitor location (i.e., at the liquid radwaste monitor or at the CTBD monitor).
bkg	=	the background of the monitor (uCi/ml).

The radioactivity monitor setpoint equation (1.2) remains valid during outages when the Cooling-Tower Blowdown discharge is potentially as its lowest value. Reduction of the waste stream flow (RR) may be necessary during these periods to meet the discharge criteria. Procedural restrictions prevent simultaneous liquid releases.

1.2.2 Conservative Default Values

Conservative alarm setpoints may be determined through the use of default parameters. Table 1-1 summarized all current default values in use for Hope Creek. They are based upon the following:

a) substitution of the effective MPC value with a default value of 1.60E-05 uCi/ml for radwaste releases (Refer to Appendix A for justification);
b) substitutions of the Cooling-Tower Blowdown discharge rate with the minimum average flow, in gal/min; and,
c) substitutions of the effluent release rate with the highest allowed rate, in gal/min.

With preestablished alarm setpoints, it is possible to control the radwaste release rate (RR) to ensure the inequality of equation (1.2) is maintained under changing values for MPCe and for differing Cooling-Tower Blowdown discharge.

1.3 Liquid Effluent Concentration Limits - 10 CFR 20

Technical Specification 3.11.1.1 limits the concentration of radioactive material in liquid effluents (after dilution in the Cooling-Tower Blowdown Discharge System) to less than the concentrations as specified in 10 CFR 20, Appendix B, Table II, Column 2 for radionuclides other than noble gases. Noble gases are limited to a diluted concentration of 2.0E-04 uCi/ml. Release rates are controlled and radiation monitor alarm setpoints are established as addressed above to ensure that these concentration limits are not exceeded. However, in the event any liquid release results in an alarm setpoint being exceeded, an evaluation of compliance with the concentration limits of Technical Specification 3.11.1.1 may be performed using the following equation:

$$\frac{C_i}{MPC_i} * \frac{RR}{CTBD + RR} \leq 1 \qquad (1.4)$$

where:

C_i = actual concentration of radionuclide i as measured in the undiluted liquid effluent (uCi/ml).

MPC_i = the MPC value corresponding to radionuclide i from 10 CFR 20, Appendix B, Table II, Column 2 (uCi/ml).
= 2E-04 uCi/ml for dissolved or entrained noble gases.

RR = the actual liquid effluent release rate (gal/min)

CTBD = the actual Cooling-Tower Blowdown discharge at the time of release (gal/min).

1.4 Liquid Effluent Dose Calculation - 10 CFR 50

1.4.1 MEMBER OF THE PUBLIC Dose - Liquid Effluents

Technical Specification 3.11.1.2 limits the dose or dose commitment to MEMBERS OF THE PUBLIC from radioactive materials in liquid effluents from Hope Creek Generating Station to:

- during any calendar quarter:
≤ 1.5 mrem to total body
≤ 5.0 mrem to any organ

- during any calendar year:
≤ 3.0 mrem to total body
≤ 10.0 mrem to any organ

Per the surveillance requirements to Technical Specification 4.11.1.2, the following calculation methods shall be used for determining the dose or dose commitment due to the liquid radioactive effluents from Hope Creek.

$$D_o = \frac{8.35E-04 * VOL}{CTBD} * \Sigma (C_i * A_io) \qquad 1.5$$

where:

D_o = dose or dose commitment to organ o, including total body (mrem).
A_io = site-related ingestion dose commitment factor to the total body or any organ o for radionuclide i (mrem/hr per uCi/ml).
C_i = average concentration of radionuclide i, in undiluted liquid effluent representative of volume VOL (uCi/ml).
VOL = volume of liquid effluent released (gal).
CTBD = Average Cooling-Tower Blowdown discharge rate during release period (gal/min).
8.35E-04 = conversion factor (1.67E-2 hr/min) and a near field dilution factor of 0.05 (refer to Appendix B, Page B-4 for definition).

The site-related ingestion dose/dose commitment factors (A_{io}) are presented in Table 1-2 and have been derived in accordance with a NUREG-0133 by the equation:

$$A_{io} = 1.14E5\ [(UI * BI_i) + (UF * BF_i)]\ DF_i \qquad (1.6)$$

where:

A_{io}	=	composite dose parameter for the total body or critical organ o of an adult for radionuclide i, for the fish and invertebrate ingestion pathways (mrem/hr per uCi/ml).
1.14E5	=	conversion factor (pCi/uCi * ml/kg per hr/yr).
UI	=	adult invertebrate consumption (5 kg/yr).
BI_i	=	bioaccumulation factor for radionuclide i in invertebrates from Table 1-3 (pCi/kg per pCi/l).
UF	=	adult fish consumption (21 kg/yr).
BF_i	=	bioaccumulation factor for nuclide i in fish from Table 1-4 (pCi/kg per pCi/l).
DF_i	=	dose conversion factor for nuclide i for adults in preselected organ, o, from Table E-11 of Regulatory Guide 1.109 (mrem/pCi).

The radionuclides included in the periodic dose assessment per the requirements of Technical Specification 3/4.11.1.2 are those as identified by gamma spectral analysis of the liquid waste samples collected and analyzed per the requirements of Technical Specification 3/4.11.1.1, Table 4.11.1.1.1-1.

Radionuclides requiring radiochemical analysis (e.g., Sr-89 and Sr-90) will be added to the dose analysis at a frequency consistent with the required minimum analysis frequency of Technical Specification Table 4.11.1.1.1-1.

1.4.2 **Simplified Liquid Effluent Dose Calculation**

In lieu of the individual radionuclide dose assessment as presented in Section 1.4.1, the following simplified dose calculation equation may be used for demonstrating compliance with the dose limits of Technical Specification 3.11.1.2. (Refer to Appendix B for the derivation and justification for this simplified method.)

Total Body

$$D_{tb} = \frac{1.94E+02 \; * \; VOL}{CTBD} \; * \; \Sigma \; C_i \qquad (1.7)$$

Maximum Organ

$$D_{max} = \frac{4.28E+02 \; * \; VOL}{CTBD} \; * \; \Sigma \; C_i \qquad (1.8)$$

where:

D_{tb} = conservatively evaluated total body dose (mrem).

D_{max} = evaluated maximum organ dose (mrem).

C_i = average concentration of radionclide i, in undiluted liquid effluent representative of the volume VOL (uCi/ml).

VOL = volume of liquid effluent released (gal).

CTBD = average Cooling-Tower Blowdown discharge rate during release period (gal/min).

1.94E+02 = conversion factor (1.67E-2 hr/min) the ingestion dose commitment factor (Zn-65, total body -- 2.32E5 mrem/hr per uCi/ml), and the near field dilution factor of 0.05 (See Appendix B).

4.28E+02 = conversion factor (1.67E-2 hr/min) the ingestion maximum organ dose commitment factor (Zn-65, Liver -- 5.13E5 mrem/hr per uCi/ml), and the near field dilution factor of 0.05 (See Appendix B).

1.5 Liquid Effluent Dose Projections

Technical Specification 3.11.1.3 requires that the liquid radioactive waste processing system be used to reduce the radioactive material levels in the liquid waste prior to release when the 31-day projected doses exceed:

- 0.05 mrem to the total body, or
- 0.2 mrem to any organ.

The applicable liquid waste processing system for maintaining radioactive material releases ALARA are the drain filters and deminerializers as delineated in Figure 1-1.

Dose projections are made at least once per 31-days by the following equations:

$$D_{tbp} = (D_{tb} / d) * 31d \quad (1.9)$$

$$D_{maxp} = (D_{max} / d) * 31d \quad (1.10)$$

where:

D_{tbp} = the total body dose projection for current 31-day period (mrem).

D_{tb} = the total body dose to date for current calendar quarter as determined by equation (1.5) or (1.7).

D_{maxp} = the maximum organ dose to date for current calendar quarter as determined by equation (1.5 or (1.8) (mrem).

d = the number of days in current calendar quarter at the end of the release.

31d = the number of days of concern,

2.0 GASEOUS EFFLUENTS

2.1 Radiation Monitoring Instrumentation and Controls

The gaseous effluent monitoring instrumentation and controls at Hope Creek for controlling and monitoring normal radioactive material releases in accordance with the Radiological Effluent Technical Specifications are summarized as follows:

1) Filtration, Recirculation, and Ventilation System -

   The FRVS is maintained in a standby condition. Upon reactor building isolation, the FRVS recirculation system recirculates the reactor building air through HEPA and charcoal filters. Releases are made to the atmosphere via a reactor building vent or the South Plant Vent depending on mode of operation. Noble gas monitoring is provided by RE-4811A.

2) South Plant Vent -

   The SPV received discharge from the radwaste evaporator, reactor building purge, auxiliary building radwaste area, condensate deminerializer, pipe chase, feedwater heater, and untreated ventilation sources. Effluents are monitored (for noble gas) by the RE-4875A monitor.

3) North Plant Vent -

   The NPV received discharges from the gaseous radwaste treatment system (Offgas system) and untreated ventilation air sources. Effluents are monitored (for noble gases) by the RE-4873B monitor.

Gaseous radioactive waste flow diagrams with the applicable, associated radiation monitoring instrumentation controls are presented in Figures 2-1 and 2-2.

2.2 Gaseous Effluent Monitor Setpoint Determination

2.2.1 Plant Vent and FRVS Vent Monitors

Per the requirements of Technical Specification 3.3.7.11, alarm setpoints shall be established for the gaseous effluent monitoring instrumentation to ensure that the release rate of noble gases does not exceed the limits of Specification 3.11.2.1, which corresponds to a dose rate at the SITE BOUNDARY of 500 mrem/year to the total body or 3000 mrem/year to the skin. Based on a grab sample analysis of the applicable release (i.e., of FRVS, pipe chase, gaseous radwaste treatment system air, etc.), the radiation monitoring alarm setpoints may be established by the following calculation method. The measured radionuclide concentrations and release rate are used to calculate the fraction of the allowable release rate, as limited by Specification 3.11.2.1, by the equation:

$$FRAC = [4.72E{+}02 * X/Q * VF * (C_i * K_i)] / 500 \quad (2.1)$$

$$FRAC = [4.72E{+}02 * X/Q * VF * (C_i * (L_i + 1.1M_i))] / 3000 \quad (2.2)$$

where:

FRAC = fraction of the allowable release rate based on the identified radionuclide concentrations and the release flow rate.

X/Q = annual average meteorological dispersion to the controlling site boundary location (sec/m3).

VF = ventilation system flow rate for the applicable release point and monitor (ft3/min).

C_i = concentration of noble gas radionuclide i as determined by radioanalysis of grab sample (uCi/cm3)
K_i = total body dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m3), from Table 2-1
L_i = beta skin dose conversion factor for noble gas radionuclide i (mrem/yr per uCi/m3), from Table 2-1
M_i = gamma air dose conversion factor for noble gas radionuclide i (mrad/yr per uCi/m3), from Table 2-1
1.1 = mrem skin dose per mrad gamma air dose (mrem/mrad)
4.72E+02 = conversion factor (cm3/ft3 * min/sec)
500 = total body dose rate limit (mrem/yr)
3000 = skin dose rate limit (mrem/yr)

Based on the more limiting FRAC (i.e., higher value) as determined above, the alarm setpoints for the applicable monitors may be calculated by the equation:

$$SP = [AF * \Sigma C_i \ / \ FRAC] + bkg \quad (2.3)$$

where:

SP = alarm setpoint corresponding to the maximum allowable release rate (uCi/cc).
FRAC = highest fraction of the allowable release rate as determined in equation 2.1 or 2.2.
bkg = background of the monitor (uCi/cc).
AF = administrative allocation factor for the specific monitor (0.2 NPV, 0.2 SPV, 0.1 FRVS).

The allocation factor (AF) is an administrative control imposed to ensure that combined releases from Salem Units 1 and 2 and Hope Creek will not exceed the regulatory limits on release rate from the site (i.e., the release rate limits of Technical Specification

3.11.2.1). Normally, the combined AF value for Salem Units 1 and 2 is 0.5 (0.25 per unit), with the remainder 0.5 allocated to Hope Creek. Any increase in AF above 0.5 for the Hope Creek Generating Station will be coordinated with the Salem Generating Station to ensure that the combined allocation factors for all units do not exceed 1.0.

2.2.2 Conservative Default Values

A conservative alarm setpoint can be established, in lieu of the individual radionclide evaluation based on the grab sample analysis, to eliminate the potential of periodically having to adjust the setpoint to reflect minor changes in radionuclide distribution and variations in release flow rate. The alarm setpoint may be conservatively determined by the default values presented in Table 2-2.

These values are based upon:

- the maximum ventilation (or purge) flow rate;
- a radionuclide distribution adopted from ANSI N237-1976/ANS 18.1 "Source Term Specifications", Table 5 and;
- an administrative allocation factor of 0.5 to conservatively ensure that any releases from Hope Creek to not exceed the maximum allowable release rate.

For the noble gas radionclide distribution from ANSI N237-1976/ANS 18.1 (Note Table C-1), the alarm setpoint based on the total body dose rate is more restrictive than the

corresponding setpoint based on the skin dose rate. The resulting conservative, default setpoints are presented in Table 2-2.

2.3 Gaseous Effluent Instantaneous Dose Rate Calculations - 10 CFR 20

2.3.1 Site Boundary Dose Rate - Noble Gases

Technical Specification 3.11.2.1a limits the dose rate at the SITE BOUNDARY due to noble gas releases to ≤ 500 mrem/yr, total body and ≤ 3000 mrem/yr, skin. Radiation monitor alarm setpoints are established to ensure that these release limits are not exceeded. In the event any gaseous releases from the station results in an alarm setpoint (as determined in Section 2.2.1) being exceeded, an evaluation of the SITE BOUNDARY dose rate resulting from the release shall be performed using the following equations:

$$D_{tb} = X/Q \ * \ \Sigma\ (K_i \ * \ Q_i) \qquad (2.4)$$

and

$$D_s = X/Q \ * \ \Sigma\ ((L_i + 1.1M_i) \ * \ Q_i \qquad (2.5)$$

where:

D_{tb} = Total body dose rate (mrem/yr).

D_s = skin dose rate (mrem/yr).

X/Q = atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m3).

Q_i = average release rate of radionuclide i over the release period under evaluation (uCi/sec).

K_i = total body dose conversion factor for noble gasradionuclide i (mrem/yr per uCi/m3), from Table 2-1

L_i = beta skin dose conversion factor for noble gas radionuclide i (mred/yr per uCi/m3), from Table 2-1

M_i = gamma air dose conversion factor for noble gasradionuclide i (mrad/yr per uCi/m3, from Table 2-1).

1.1 = mrem skin dose per mrad gamma air dose (mrem/mrad)

As appropriate, simultaneous releases from Salem Units 1 and 2 and Hope Creek will be considered in evaluating compliance with the release rate limits of Specification 3.11.2.1a, following any releases exceeding the above prescribed alarm setpoints. Monitor indications (readings) may be averaged over a time period not to exceed 15 minutes when determining noble gas release rate based on correlation of the monitor reading and monitor sensitivity. The 15-minute averaging is needed to allow for reasonable monitor response to potentially changing radioactive material concentrations and to exclude potential electronic spikes in monitor readings that may be unrelated to radioactive material releases. As identified, any electronic spiking monitor responses may be excluded from the analysis.

NOTE: For administrative purposes, more conservative alarm setpoints than those as prescribed above may be imposed. However, conditions exceeding these more limiting alarm setpoints do not necessarily indicate radioactive material release rates exceeding the dose limits of Technical Specification 3.11.2.1a. Provided actual releases do not result in radiation monitor indications exceeding alarm setpoint values based on the above criteria, no further analyses are required for demonstrating compliance with the limits of Specification 3.11.2.1a.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3 may be used for evaluating the gaseous effluent dose rate.

2.3.2 Site Boundary Dose Rate - Radioiodine and Particulates

Technical Specification 3.11.2.1b limits the dose rate to ≤ 1500 mrem/yr to any organ for I-131, I-133, tritium and particulates with half-lives greater than 8 days. To demonstrate compliance with this limit, an evaluation is performed at a frequency no greater than that corresponding to the sampling and analysis time period (e.g., nominally once per 7 days). The following equation shall be used for the dose rate evaluation:

$$D_o = X/Q * \Sigma (R_{io} * Q_i) \quad (2.6)$$

where:

D_o = average organ dose rate over the sampling time period (mrem/yr).

X/Q = atmospheric dispersion to the controlling SITE BOUNDARY location for the inhalation pathway (sec/m3).

R_{io} = dose parameter for radionuclide i (mrem/yr per uCI/m3) and organ o for the child inhalation pathway from Table 2-4.

Q_i = average release rate over the appropriate sampling period and analysis frequency for radionuclide i - - I-131, I-133, tritium or other radionuclide in particulate form with half-live greater than 8 days (uCi/sec).

By substituting 1500 mrem/yr for Do and solving for Q, an allowable release rate for I-131 can be determined. Based on the annual average meteorological dispersion (See Table 2-3) and the most limiting potential pathway, age group and organ (inhalation, child, thyroid -- Ri = 1.62E+07 mrem/yr per uCi/m3), the allowable release rate for I-131 is 34.7 uCi/sec. Reducing this release rate by a factor of 2 to account for potential dose contributions from other radioactive particulate material and other release points (e.g., Salem), the corresponding release rate allocated to Hope Creek is 17.4 uCi/sec. For a 7-day period, which is the nominal sampling and analysis frequency for I-131, the cumulative release is 10.5 Ci. Therefore, as long as the I-131 release in any 7-day period do not exceed 10.5 Ci, no additional analyses are needed for verifying compliance with the Technical Specification 3.11.2.1.b limits on allowable release rate.

2.4 Noble Gas Effluent Dose Calculations - 10 CFR 50

2.4.1 UNRESTRICTED AREA Dose - Noble Gases

Technical Specification 3.11.2.2 requires a periodic assessment of releases of noble gases to evaluate compliance with the quarterly dose limits of ≤ 5 mrad, gamma-air and ≤ 10 mrad, beta-air and the calendar year limits ≤ 10 mrad, gamma-air and ≤ 20 mrad, beta-air. The limits are applicable separately to each generating station and are not combined site limits. The following equations shall be used to calculate the gamma-air and beta-air doses.

$$D_g = 3.17E\text{-}08 * X/Q * \Sigma (M_i * Q_i) \quad (2.7)$$

and

$$D_b = 3.17E\text{-}08 * X/Q * \Sigma (N_i * Q_i) \quad (2.8)$$

where:

D_g = air dose due to gamma emissions for noble gas radionuclides (mrad).

D_b = air dose due to beta emissions for noble gas radionuclides (mrad).

X/Q = atmospheric dispersion to the controlling SITE BOUNDARY location (sec/m3).

Q_i = cumulative release of noble gas radionuclide i over the period of interest (uCi).

M_i = air dose factor due to gamma emission from noble gas radionuclide i (mrad/yr per uCi/m3, from Table 2-1).

N_i = air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per uCi/m3, Table 2-1).

3.17E-08 = conversion factor (yr/sec).

2.4.2 Simplified Dose Calculation for Noble Gases

In lieu of the individual noble gas radionuclide dose assessment as presented above, the following simplified dose calculation equations may be used for verifying compliance with the dose limits of Technical Specification 3.11.2.2 (Refer to Appendix C for the derivation and justification of this simplified method).

$$D_g = \frac{3.17E\text{-}08}{0.50} * X/Q * M_{eff} * \Sigma Q_i \qquad (2.9)$$

and

$$D_b = \frac{3.17E\text{-}08}{0.50} * X/Q * N_{eff} * \Sigma Q_i \qquad (2.10)$$

where:

M_{eff} = 8.1E3, effective gamma-air dose factor (mrad/yr per uCi/m3).

N_{eff} = 8.5E3, effective beta-air dose factor (mrad/yr per uCi/m3).

Q_i = cumulative release for all noble gas radionuclides (uCi).

0.50 = conservatism factor to account for potential variability in the radionuclide distribution.

Actual meteorological conditions concurrent with the release period or the default, annual average dispersion parameters as presented in Table 2-3, may be used for the evaluation of the gamma-air and beta-air doses.

2.5 Radioiodine and Particulate Dose Calculations - 10 CFR 50

2.5.1 UNRESTRICTED AREA Dose - Radioiodine and Particulates

In accordance with the requirements of Technical Specification 3.11.2.3, a periodic assessment shall be performed to evaluate compliance with the quarterly dose limit ≤ 15 mrem to any organ. The following equation shall be used to evaluate the maximum organ dose due to release of I-131, I-133, tritium and particulates with half-lives greater than 8 days:

$$D_{aop} = 3.17E-08 * W * SF_p * \Sigma (R_{iop} * Q_i) \quad (2.11)$$

where:

D_{aop} = dose or dose commitment via all pathways p and age group a (as identified in Table 2-3) to organ o, including the total body (mrem).

W = atmospheric dispersion parameter to the controlling location(s) as identified in Table 2-3.

- X/Q = atmospheric dispersion for inhalation pathway and H-3 dose contribution via other pathways (sec/m3).
- D/Q = atmospheric deposition for vegetation, milk and ground plane exposure pathways (1/m2).

R_{iop} = dose factor for radionuclide i (mrem/yr per uCi/m3 or m2 - mrem/yr per uCi/sec) and organ o from Table 2-4 for each age group a and the applicable pathway p as identified in Table 2-3. Values for R_{iop} were derived in accordance with the methods described in NUREG-0133.

Q_i = cumulative release over the period of interest for radionuclide i -- I-131, I-133, H-3 or radioactive material in particulate form with half-life greater than 8 days (uCi).

SF_p = annual seasonal correction factor to account for the fraction of the year that the applicable exposure pathway does not exist.

1) For mild and vegetation exposure pathways:= A six month fresh vegetation and grazing season (May through October).
= 0.5

2) For inhalation and ground plane exposure pathways:
= 1.0

For evaluating the maximum exposed individual, the infant age group is controlling for the milk pathway. Only the controlling age group as identified in Table 2-3 need be evaluated for compliance with Technical Specification 3.11.2.3.

2.5.2 Simplified Dose Calculation for Radioiodines and Particulates

In lieu of the individual radionuclide (I-131, I-133 and particulates) dose assessment as presented above, the following simplified dose calculation equation may be used for verifying compliance with the dose limits of Technical Specification 3.11.2.3 (Refer to Appendix D for the derivation and justification of this simplified method).

$$D_{max} = 3.17E-08 * W * SF_p * RI\text{-}131 * \Sigma Q_i \quad (2.12)$$

where:

D_{max} = maximum organ dose (mrem).

RI-131 = I-131 dose parameter for the thyroid for the identified controlling pathway.
= 1.05E12, infant thyroid dose parameter with the cow-milk pathway controlling (m2 - mrem/yr per uCi/sec).

W = D/Q for radioiodine, 2.87E-10 1/m2.

Q_i = cumulative release over the period of interest for radionuclide i -- I-131 or radioactive material in particulate from with half-life greater than 8 days (uCi).

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Hope Creek as identified by the annual land-use census (Technical Specification 3.12.2). Otherwise, the dose will be evaluated based on the predetermined controlling pathways as identified in Table 2-3.

2.6 Gaseous Effluent Dose Projection

Technical Specification 3.11.2.5 requires that the VENTILATION EXHAUST TREATMENT SYSTEM be used to reduce radioactive material levels prior to discharge when projected doses in 31-days exceed:

- 0.2 mrad to air from gamma radiation, or
- 0.4 mrad to air from beta radiation, or
- 0.3 mrad to any organ of a MEMBER OF THE PUBLIC

The applicable gaseous processing systems for maintaining radioactive material releases ALARA are the Gaseous Radwaste Treatment System and Exhaust Treatment System as delineated in Figures 2-1 and 2-2.

Dose projection are performed at least once per 31-days by the following equations:

$$D_{gp} = (D_g / d) * 31d \quad (2.17)$$

$$D_{bp} = (D_b / d) * 31d \quad (2.18)$$

$$D_{maxp} = (D_{max} / d) * 31d \quad (2.19)$$

where:

D_{gp} = gamma air dose projection for current 31-day period(mrad).

D_g = gamma air dose to date for current calendar quarter asdetermined by equation (2.7) or (2.9) (mrad).

D_{bp} = beta air dose projection for current 31-day period (mrad).

D_b = beta air dose to date for current calendar quarter as determined by equation (2.8) or (2.10) (mrad).

D_{maxp} = maximum organ dose projection for current 31-day period (mrem).
D_{max} = maximum organ dose to date for current calendar quarter as determined by equation (2.11) or (2.12) (mrem).
d = number of days in current calendar quarter at the end of the release.
31d = the number of days of concern.

3.0 SPECIAL DOSE ANALYSIS

3.1 Doses Due to Activities Inside the SITE BOUNDARY

In accordance with Technical Specification 6.9.1.7, the Radioactive Effluent Release Report (RERR) submitted within 60-days after January 1st of each year shall include an assessment of radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY.

The calculation methods as presented in Sections 1.4 and 2.5 may be used for determining the maximum potential dose to a MEMBER OF THE PUBLIC based on the parameters from Table 2-3 and the number of hours per visit per year. The default value for the meteorological dispersion data as presented in Table 2-3 may be used if current year meteorology is unavailable at the time of NRC reporting. However, a follow-up evaluation shall be performed when the data becomes available.

3.2 Total Dose to MEMBERS OF THE PUBLIC - 40 CFR 190

The Radioactive Effluent Release Report (RERR) submitted within 60-days after January 1st of each year shall also include an assessment of the radiation dose to the likely most exposed MEMBER OF THE PUBLIC for reactor releases and other nearby uranium fuel cycle courses (including dose contributions from effluents and direct radiation from on-site sources). For the likely most exposed MEMBER OF THE PUBLIC in the vicinity of Artificial Island, the sources of exposure need only consider the Salem Generating Station and the Hope Creek Generating Station: No other fuel cycle facilities contribute to the MEMBER OF THE PUBLIC dose for the Artificial Island vicinity.

The dose contribution from the operation of Salem Generating Stations will be estimated based on the methods as presented in the Salem Offsite Dose Calculation Manual (SGS ODCM).

As appropriate for demonstrating/evaluating compliance with the limits of Technical Specification 3.11.4 (40 CFR 190), the results of the environmental monitoring program may be used for providing data on actual measured levels of radioactive material in the actual pathways of exposure.

3.2.1 **Effluent Dose Calculations**

For purposes of implementing the surveillance requirements of Technical Specification 3/4.11.4 and the reporting requirements of 6.9.1.11 (RERR), dose calculations for the Hope Creek Generating Station may be performed using the calculation methods contained within the ODCM; the conservative controlling pathways and locations of Table 2-3 or the actual pathways and locations as identified by the land use census (Technical Specification 3/4.12.1) may be used. Average annual meteorological dispersion parameters or meteorological conditions concurrent with the release period under evaluation may be used.

3.2.2 **Direct Exposure Dose Determination**

Any potentially significant direct exposure contribution to off-site individual doses may be evaluated based on the results of the environmental measurements (e.g., TLD, ion chamber measurements) and/or by the use of a radiation transport and shielding calculation method. Only during a non-typical condition will there exist any potential for significant on-site sources at Hope Creek that would yield potentially significant off-site doses (i.e.., in excess of 1 mrem per year to a MEMBER OF THE PUBLIC), that would require detailed evaluation for demonstrating compliance with

40 CFR 190. However, should a situation exist whereby the direct exposure contribution is potentially significant, on-site measurements, off-site measurements and/or calculational techniques will be used for determination of dose for assessing 40 CFR 190 compliance.

4.0 RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

4.1 Sampling Program

The operational phase of the Radiological Environmental Monitoring Program (REMP) is conducted in accordance with the requirements of Appendix A Technical Specification 3.12. The objectives of the program are:

- To determine whether any significant increases occur in the concentration of radionuclides in the critical pathways of exposure in the vicinity of Artificial Island;
- To determine if the operation of the Hope Creek Generating Station has resulted in any increase in the inventory of long lived radionuclides in the environment;
- To detect any changes in the ambient gamma radiation levels; and
- To verify that HCGS operations have no detrimental effects on the health and safety of the public or on the environment.

The sampling requirements (type of samples*, collection frequency and analysis) and sample locations are presented in Appendix E.

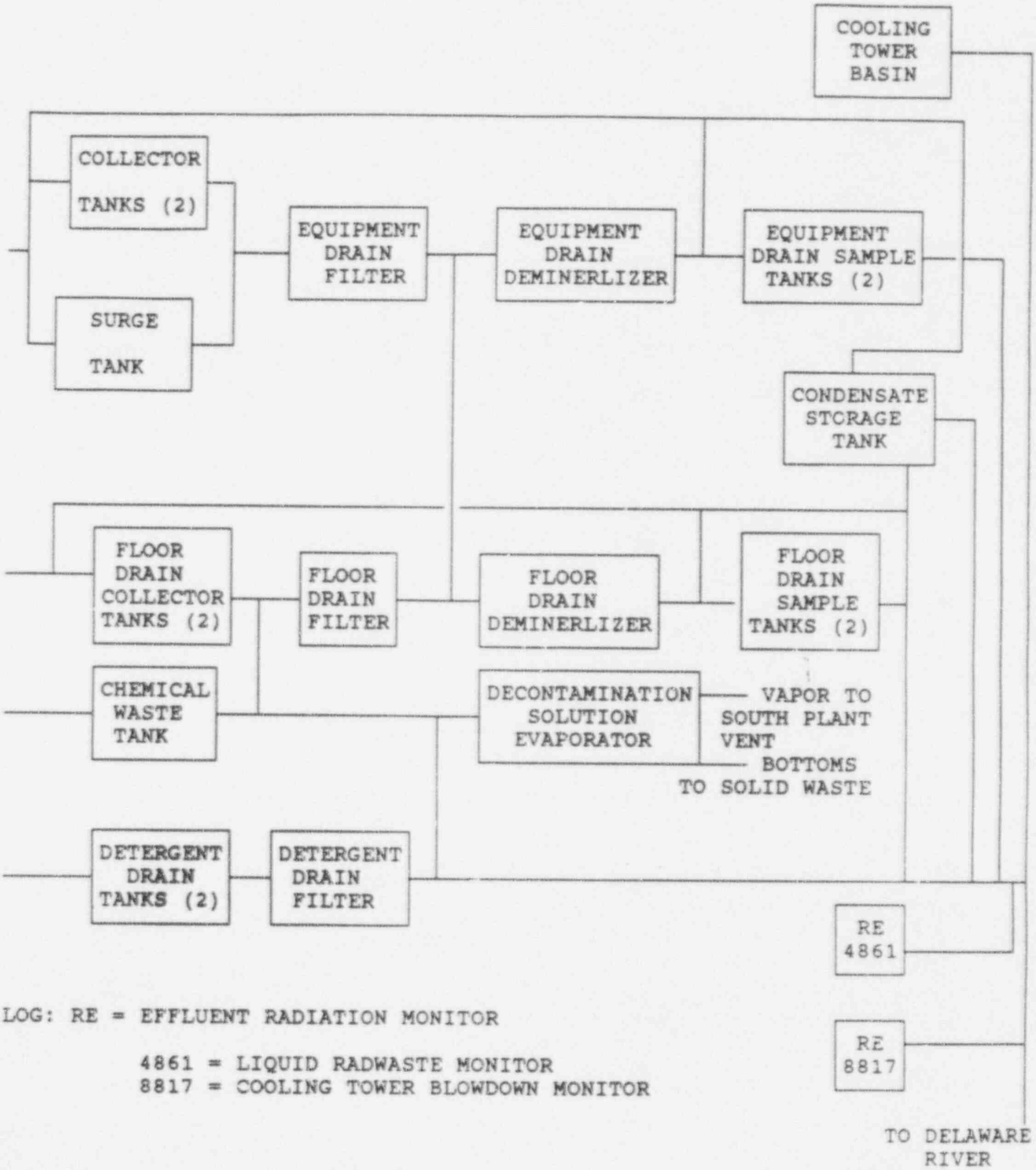
***NOTE:** No public drinking water samples or irrigation water samples are taken as these pathways are not directly effected by liquid effluents discharged from Hope Creek Generating Station.

4.2 Interlaboratory Comparison Program

Technical Specification 3.12.3 requires analyses be performed on radioactive material supplied as part of an Interlaboratory Comparison.

Participation in an approved Interlaboratory Comparison Program provides a check on the preciseness of measurements of radioactive materials in environmental samples. A summary of the Interlaboratory Comparison Program results will be provided in the Annual Radiological Environmental Operating Report pursuant to Technical Specifications 6.9.1.7.

FIGURE 1-1
LIQUID RADWASTE TREATMENT SYSTEM



LOG: RE = EFFLUENT RADIATION MONITOR

4861 = LIQUID RADWASTE MONITOR
8817 = COOLING TOWER BLOWDOWN MONITOR

FIGURE 1-2
SOLID RADWASTE PROCESSING SYSTEM

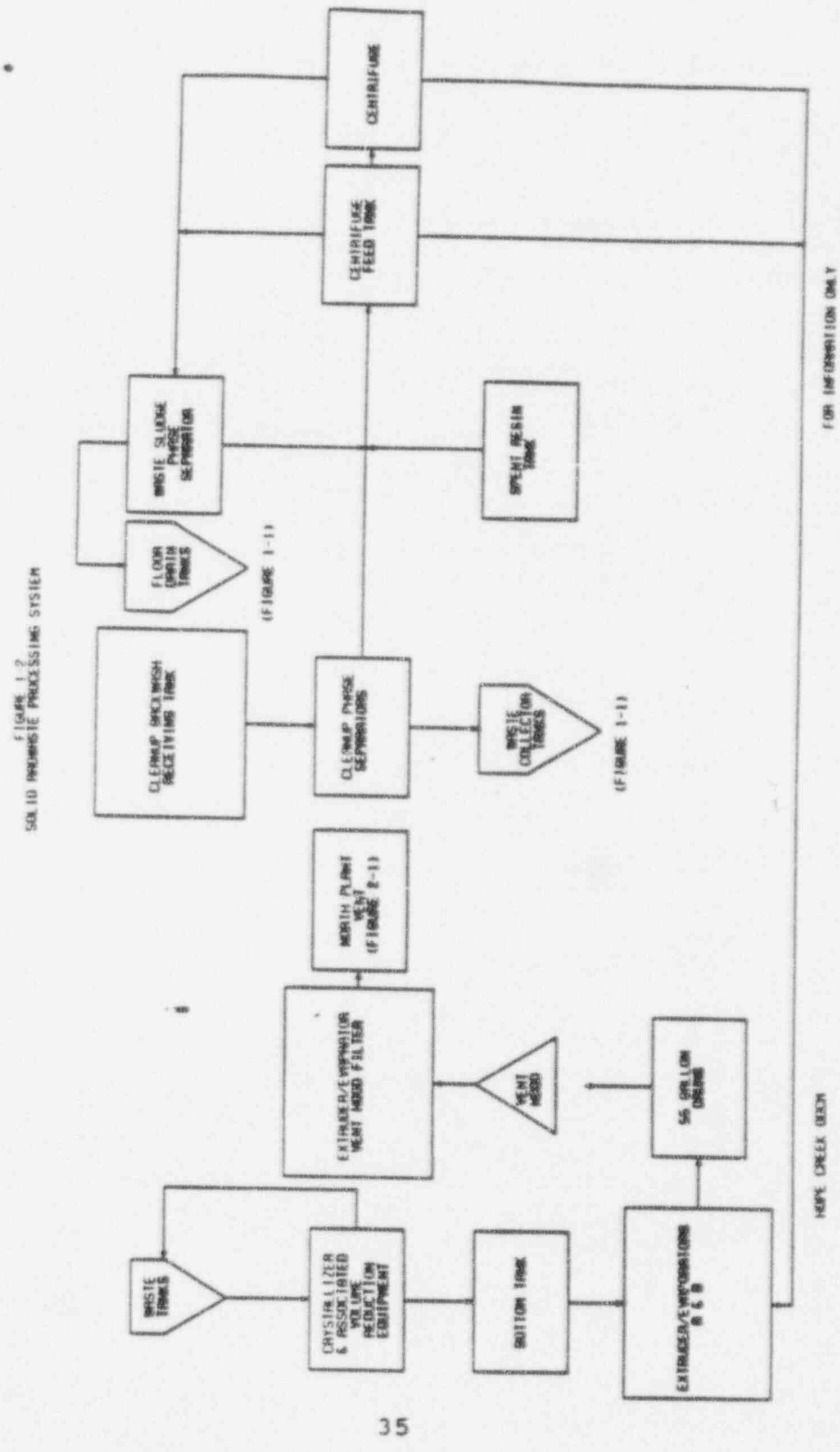


TABLE 1-1
PARAMETERS FOR LIQUID ALARM SETPOINT DETERMINATION

Parameter	Actual Value	Default Value	Units	Comments
MPCe	Calculated	1.60E-5	uCi/ml*	Calculated for each batch to be released
MPC I-131	3.0E-07	N/A	uCi/ml	Taken from 10 CFR 20, Appendix B, Table II, Column 2
C_i	Measured	N/A	uCi/ml	Taken from gamma spectral analysis of liquid effluent
MPC_i	As Determined	N/A	uCi/ml	Taken from 10 CFR 20, Appendix B, Table II, Column 2
CTBD	As Determined	1.20E4	gpm	Cooling tower blowdown discharge
RR	As Determined	176 1300	gpm or gpm (CST)	Determined prior to release; release rate can be adjusted for Technical Specification compliance
SP				
A) RE4861	Calculated	1.09E-03	uCi/ml	Default alarm setpoints; more conservative values may be used as deemed appropriate and desirable for ensuring regulatory compliance and for maintaining releases ALARA
RE8817	Calculated	1.60E-05	uCi/ml	
B) RE4861	Calculated	1.48E-04	uCi/ml	These setpoints are for condensate storage tank releases
RE8817	Calculated	1.60E-05	uCi/ml	

* See Appendix A for basis

TABLE 1-2
SITE RELEATED INGESTION DOSE COMMITMENT FACTOR, A_{io}
(FISH AND INVERTEBRATE CONSUMPTION)
(mrem/hr per uCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
H-3	-	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1	2.82E-1
C-14	1.45E+4	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3	2.90E+3
Na-24	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1	4.57E-1
P-32	4.69E+6	2.91E+5	1.81E+5	-	-	-	5.27E+5
Cr-51	-	-	5.58E+0	3.34E+0	1.23E+0	7.40E+0	1.40E+3
Mn-54	-	7.06E+3	1.35E+3	-	2.10E+3	-	2.16E+4
Mn-56	-	1.78E+2	3.15E+1	-	2.26E+2	-	5.67E+3
Fe-55	5.11E+4	3.53E+4	8.23E+3	-	-	1.97E+4	2.03E+4
Fe-59	8.06E+4	1.90E+5	7.27E+4	-	-	5.30E+4	6.32E+5
Co-57	-	1.42E+2	2.36E+2	-	-	-	3.59E+3
Co-58	-	6.03E+2	1.35E+3	-	-	-	1.22E+4
Co-60	-	1.73E+3	3.82E+3	-	-	-	3.25E+4
Ni-63	4.96E+4	3.44E+3	1.67E+3	-	-	-	7.18E+2
Ni-65	2.02E+2	2.62E+1	1.20E+1	-	-	-	6.65E+2
Cu-64	-	2.14E+2	1.01E+2	-	5.40E+2	-	1.83E+4
Zn-65	1.61E+5	5.13E+5	2.32E+5	-	3.43E+5	-	3.23E+5
Zn-69	3.43E+2	6.56E+2	4.56E+1	-	4.26E+2	-	9.85E+1
Br-82	-	-	4.07E+0	-	-	-	4.67E+0
Br-83	-	-	7.25E-2	-	-	-	1.04E-1
Br-84	-	-	9.39E-2	-	-	-	7.37E-7
Br-85	-	-	3.86E-3	-	-	-	-
Rb-86	-	6.24E+2	2.91E+2	-	-	-	1.23E+2
Rb-88	-	1.79E+0	9.49E-1	-	-	-	2.47E-11
Rb-89	-	1.19E+0	8.34E-1	-	-	-	6.89E-14
Sr-89	4.99E+3	-	1.43E+2	-	-	-	8.00E+2
Sr-90	1.23E+5	-	3.01E+4	-	-	-	3.55E+3
Sr-91	9.18E+1	-	3.71E+0	-	-	-	4.37E+2
Sr-92	3.48E+1	-	1.51E+0	-	-	-	6.90E+2
Y-90	6.06E+0	-	1.63E-1	-	-	-	6.42E+4
Y-91m	5.73E-2	-	2.22E-3	-	-	-	1.68E-1
Y-91	8.88E+1	-	2.37E+0	-	-	-	4.89E+4
Y-92	5.32E-1	-	1.56E-2	-	-	-	9.32E+3
Y-93	1.69E+0	-	4.66E-2	-	-	-	5.35E+4
Zr-95	1.59E+1	5.11E÷0	3.46E+0	-	8.02E+0	-	1.62E+4
Zr-97	8.81E-1	1.78E-1	8.13E-2	-	2.68E-1	-	5.51E+4
Nb-95	4.47E+2	2.49E+2	1.34E+2	-	2.46E+2	-	1.51E+6
Nb-97	3.75E+0	9.49E-1	3.46E-1	-	1.11E+0	-	3.50E+3
Mo-99	-	1.28E+2	2.43E+1	-	2.89E+2	-	2.96E+2
Tc-99m	1.30E-2	3.66E-2	4.66E-1	-	5.56E-1	1.79E-2	2.17E+1
Tc-101	1.33E-2	1.92E-2	1.88E-1	-	3.46E-1	9.81E-3	5.77E-14

TABLE 1-2 (cont'd)
SITE RELEATED INGESTION DOSE COMMITMENT FACTOR, A_{io}
(FISH AND INVERTEBRATE CONSUMPTION)
(mrem/hr per uCi/ml)

Nuclide	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
Ru-103	1.07E+2	-	4.60E+1	-	4.07E+2	-	1.25E+4
Ru-105	8.89E+0	-	3.51E+0	-	1.15E+2	-	5.44E+3
Ru-106	1.59E+3	-	2.01E+2	-	3.06E+3	-	1.03E+5
Rh-103m	-	-	-	-	-	-	-
Rh-106	-	-	-	-	-	-	-
Ag-110m	1.56E+3	1.45E+3	8.60E+2	-	2.85E+3	-	5.91E+5
Sb-124	2.77E+2	5.23E+0	1.10E+2	6.71E-1	-	2.15E+2	7.86E+3
Sb-125	1.77E+2	1.98E+0	4.21E+1	1.80E-1	-	1.36E+2	1.95E+3
Te-125m	2.17E+2	7.86E+1	2.91E+1	6.52E+1	8.82E+2	-	8.66E+2
Te-127m	5.48E+2	1.96E+2	6.68E+1	1.40E+2	2.23E+3	-	1.84E+3
Te-127	8.90E+0	3.20E+0	1.93E+0	6.60E+0	3.63E+1	-	7.03E+2
Te-129m	9.31E+2	3.47E+2	1.47E+2	3.20E+2	3.89E+3	-	4.69E+3
Te-129	2.54E+0	9.55E-1	6.19E-1	1.95E+0	1.07E+1	-	1.92E+0
Te-131m	1.40E+2	6.85E+1	5.71E+1	1.08E+2	6.94E+2	-	6.80E+3
Te-131	1.59E+0	6.66E-1	5.03E-1	1.31E+0	6.99E+0	-	2.26E-1
Te-132	2.04E+2	1.32E+2	1.24E+2	1.46E+2	1.27E+3	-	6.24E+3
I-130	3.96E+1	1.17E+2	4.61E+1	9.91E+3	1.82E+2	-	1.01E+2
I-131	2.18E+2	3.12E+2	1.79E+2	1.02E+5	5.35E+2	-	8.23E+1
I-132	1.06E+1	2.85E+1	9.96E+0	9.96E+2	4.54E+1	-	5.35E+0
I-133	7.45E+1	1.30E+2	3.95E+1	1.90E+4	2.26E+2	-	1.16E+2
I-134	5.56E+0	1.51E+1	5.40E+0	2.62E+2	2.40E+1	-	1.32E-2
I-135	2.32E+1	6.08E+1	2.24E+1	4.01E+3	9.75E+1	-	6.87E+1
Cs-134	6.84E+3	1.63E+4	1.33E+4	-	5.27E+3	1.75E+3	2.85E+2
Cs-136	7.16E+2	2.83E+3	2.04E+3	-	1.57E+3	2.16E+2	3.21E+2
Cs-137	8.77E+3	1.20E+4	7.85E+3	-	4.07E+3	1.35E+3	2.32E+2
Cs-138	6.07E+0	1.20E+1	5.94E+0	-	8.81E+0	8.70E-1	5.12E-5
Ba-139	7.85E+0	5.59E-3	2.30E-1	-	5.23E-3	3.17E-3	1.39E+1
Ba-140	1.64E+3	2.06E+0	1.08E+2	-	7.02E-1	1.18E+0	3.38E+3
Ba-141	3.81E+0	2.88E-3	1.29E-1	-	2.68E-3	1.63E-3	1.80E-9
Ba-142	1.72E+0	1.77E-3	1.08E-1	-	1.50E-3	1.00E-3	2.43E-18
La-140	1.57E+0	7.94E-1	2.10E-1	-	-	-	5.83E+4
La-14	8.06E-2	3.67E-2	9.13E-3	-	-	-	2.68E+2
Ce-141	3.43E+0	2.32E+0	2.63E-1	-	1.08E+0	-	8.86E+3
Ce-143	6.04E-1	4.46E+2	4.94E-2	-	1.97E-1	-	1.67E+4
Ce-144	1.79E+2	7.47E+1	9.59E+0	-	4.43E+1	-	6.04E+4
Pr-143	5.79E+0	2.32E+0	2.87E-1	-	1.34E+0	-	2.54E+4
Pr-144	1.90E-2	7.87E-3	9.64E-4	-	4.44E-3	-	2.73E-9
Nd-147	3.96E+0	4.58E+0	2.74E-1	-	2.68E+0	-	2.20E+4
W-187	9.16E+0	7.66E+0	2.68E+0	-	-	-	2.51E+3
Np-239	3.53E-2	3.47E-3	1.91E-3	-	1.08E-2	-	7.11E+2

TABLE 1-3

BIOACCUMULATION FACTORS
(pCi/kg per pCi/liter)*

ELEMENT	SALTWATER FISH	SALTWATER INVERTEBRATES
H	9.0E-01	9.3E-01
C	1.8E+03	1.4E+03
Na	6.7E-02	1.9E-01
P	3.0E+03	3.0E+04
Cr	4.0E+02	2.0E+03
Mn	5.5E+02	4.0E+02
Fe	3.0E+03	2.0E+04
Co	1.0E+02	1.0E+03
Ni	1.0E+02	2.5E+02
Cu	6.7E+02	1.7E+03
Zn	2.0E+03	5.0E+04
Br	1.5E-02	3.1E+00
Rb	8.3E+00	1.7E+01
Sr	2.0E+00	2.0E+01
Y	2.5E+01	1.0E+03
Zr	2.0E+02	8.0E+01
Nb	3.0E+04	1.0E+02
Mo	1.0E+01	1.0E+01
Tc	1.0E+01	5.0E+01
Ru	3.0E+00	1.0E+03
Rh	1.0E+01	2.0E+03
Ag	3.3E+03	3.3E+03
Sb	4.0E+01	5.4E+00
Te	1.0E+01	1.0E+02
I	1.0E+01	5.0E+01
Cs	4.0E+01	2.5E+01
Ba	1.0E+01	1.0E+02
La	2.5E+01	1.0E+03
Ce	1.0E+01	6.0E+02
Pr	2.5E+01	1.0E+03
Nd	2.5E+01	1.0E+03
W	3.0E+01	3.0E+01
Np	1.0E+01	1.0E+01

* Values in this table are taken from Regulatory Guide 1.109 except for phosphurus (fish) which is adapted from NUREG/CR-1336 and silver and antimony which are taken from UCRL 50564, Rev. 1, October 1972.

FIGURE 2-1

GASEOUS RADWASTE TREATMENT SYSTEM

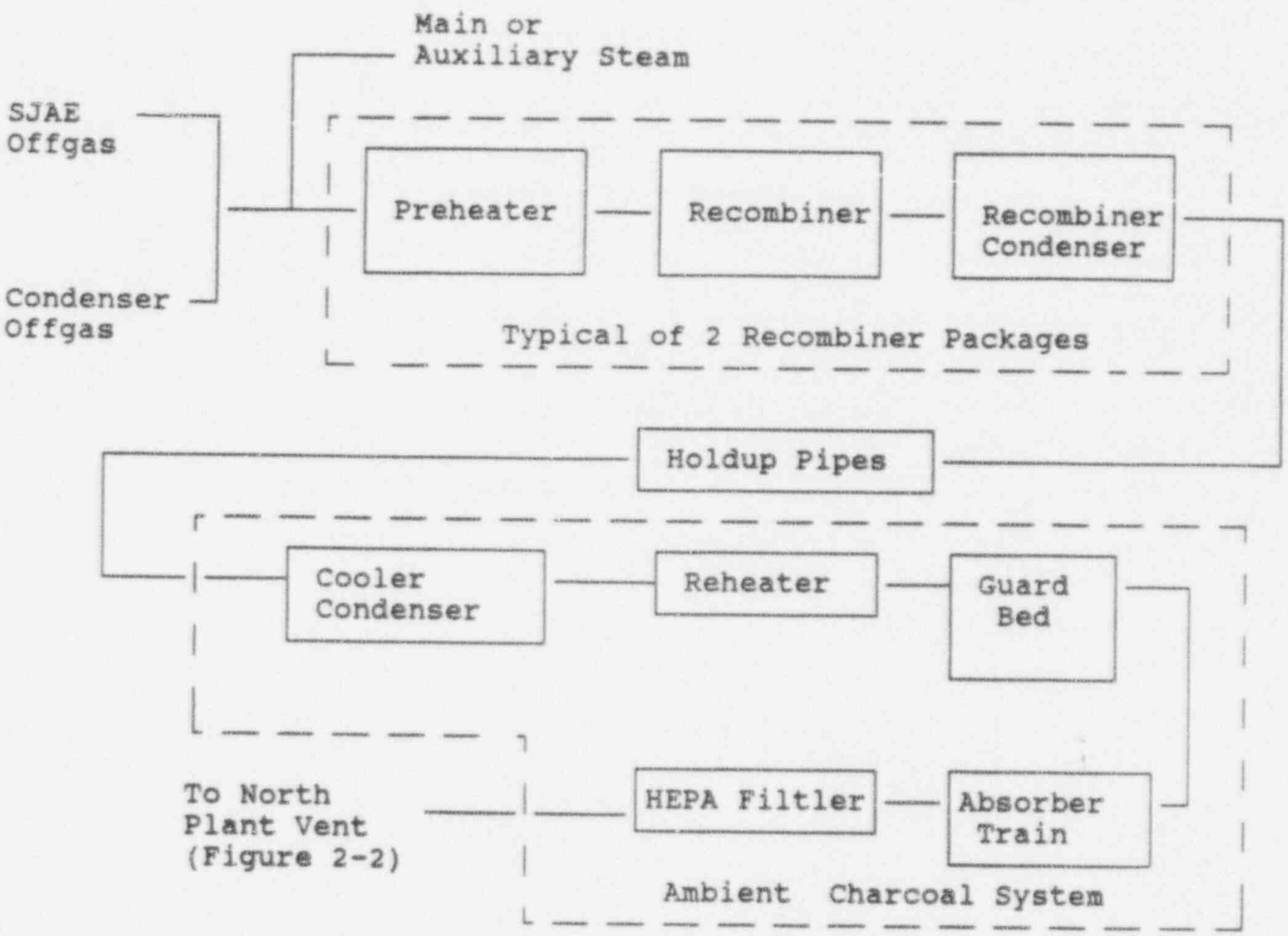
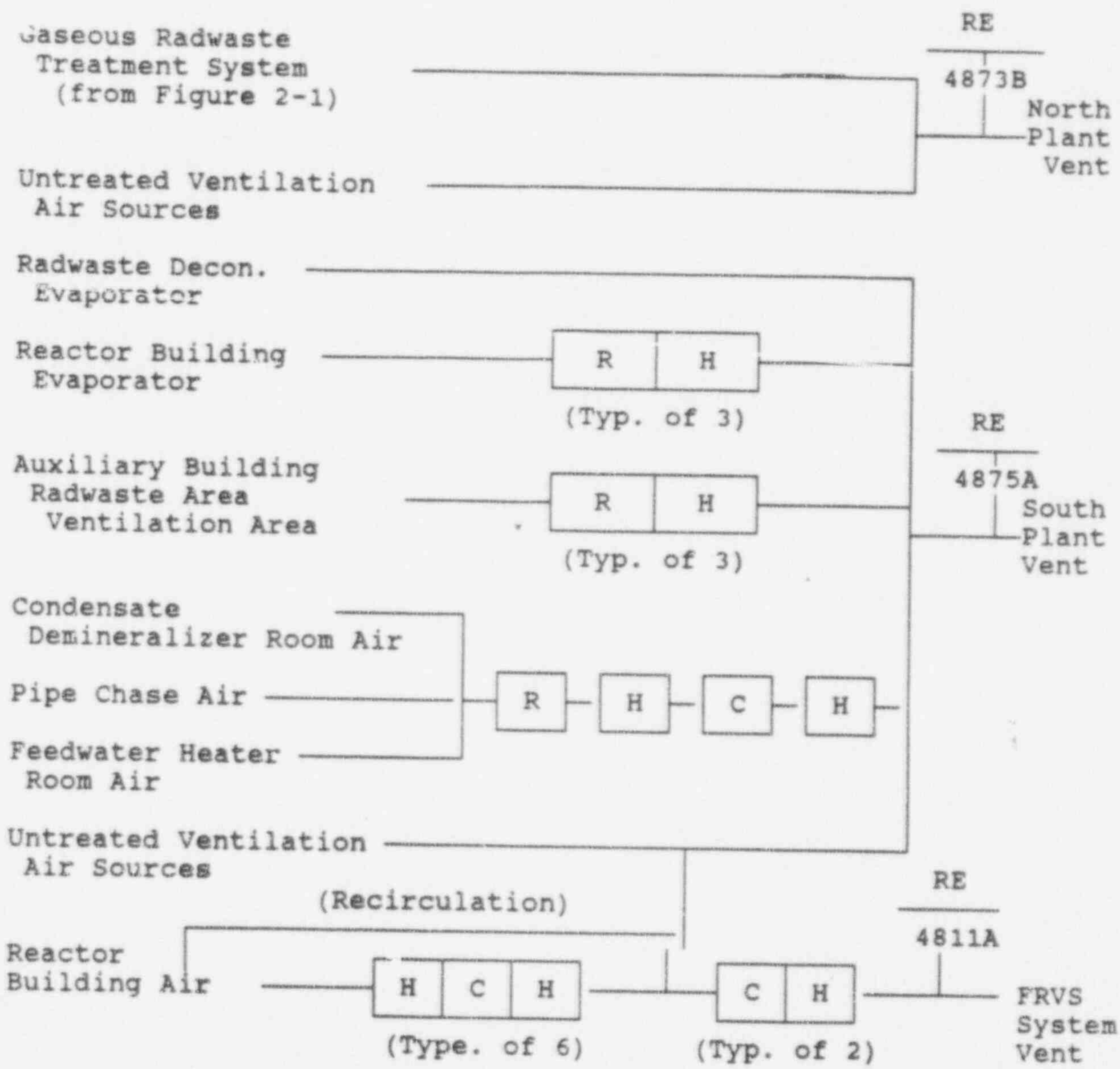


FIGURE 2-2
VENTILATION EXHAUST TREATMENT SYSTEM



Legend: R = Roughing Filter
C = Charcoal Filter
H = HEPA Filter
RE = Effluent Radiation Monitor

TABLE 2-1

DOSE FACTORS FOR NOBLE GASES

Radionuclide	Total Body Dose Factor Ki (mrem/yr per uCi/m3)	Skin Dose Factor Li (mrem/yr per uCi/m3)	Gamma Air Dose Factor Mi (mrad/yr per uCi/m3)	Beta Air Dose Factor Ni (mrad/yr per uCi/m3
Kr-83m	7.56E-02	-	1.93E+01	2.88E+02
Kr-85m	1.17E+03	1.46E+03	1.23E+03	1.97E+03
Kr-85	1.61E+01	1.34E+03	1.72E+01	1.95E+03
Kr-87	5.92E+03	9.73E+03	6.17E+03	1.03E+04
Kr-88	1.47E+04	2.37E+03	1.52E+04	2.93E+03
Kr-89	1.66E+04	1.01E+04	1.73E+04	1.06E+04
Kr-90	1.56E+04	7.29E+03	1.63E+04	7.83E+03
Xe-131m	9.15E+01	4.76E+02	1.56E+02	1.11E+03
Xe-133m	2.51E+02	9.94E+02	3.27E+02	1.48E+03
Xe-133	2.94E+02	3.06E+02	3.53E+02	1.05E+03
Xe-135m	3.12E+03	7.11E+02	3.36E+03	7.39E+02
Xe-135	1.81E+03	1.86E+03	1.92E+03	2.46E+03
Xe-137	1.42E+03	1.22E+04	1.51E+03	1.27E+04
Xe-138	8.83E+03	4.13E+03	9.21E+03	4.75E+03
Ar-41	8.84E+03	2.69E+03	9.30E+03	3.28E+03

TABLE 2-2
PARAMETERS FOR GASEOUS ALARM
SETPOINT DETERMINATION HOPE CREEK

Parameter	Actual Value	Default Value	Units	Comments
X/Q	Calculated	2.67E-6	sec/m3	From FSAR Table 2.3-31 0.5 mile, N
VF (NPV)	Measured	41900	ft^3/min	Maximum Operation
VF (SPV)	Measured	440,180	ft^3/min	Maximum Operation
VF (FRVS)	Measured	9000	ft^3/min	Maximum Operation
AF (NPV)	Coordinated with SGS	0.2	Unitless	Administrative allocation factor to ensure releases do not exceed release rate limit
AF (SPV)		0.2	Unitless	
AF (FRVS)		0.1	Unitless	
C_i	Measured	N/A	uCi/cm^3	
K_i	Nuclide Specific	N/A	(mrem/yr per uCi/m^3	Table 2-1
L_i	Nuclide Specific	N/A	(mrem/yr per uCi/m^3)	Table 2-1
M_i	Nuclide Specific	N/A	mrad/yr per uCi/m^3	Table 2-1
Sv: NPV SPV FRVS	Calculated Calculated Calculated	2.43E-4 2.31E-5 5.56E-4	uCi/cc uCi/cc uCi/cc	Default alarm Setpoints; more conservative valves may be used as deemed appropriate for ensuring ALARA & regulatory compliance
Sv (Q) NPV SPV FRVS	Calculated Calculated Calculated	4.8E3 4.8E3 2.4E3	uCi/sec uCi/sec uCi/sec	Determined by multiplying set-point (uCi/cc) times vent flow rates

TABLE 2-3

CONTROLLING LOCATIONS, PATHWAYS AND

ATOMSPHERIC DISPERSION FOR DOSE CALCULATIONS*

Tech Spec	Location	Pathway(s)	Controlling Age Group	X/Q (sec/m3)	D/Q (1/m2)
3.11.2.1a	Site Boundary 0.5 Mile, N	Noble Gases direct exposure	N/A	2.67E-06	N/A
3.11.2.1b	Site Boundary 0.5 Mile, N	Inhalation	Child	2.67E-06	N/A
3.11.2.2	Site Boundary 0.5 Mile, N	Gamma-Air Beta-Air	N/A	2.67E-06	N/A
3.11.2.3	Residence/ Dairy - 4.9 Miles, W	Milk, ground plane and inhalation	Infant	7.2E-08	2.87E-10

* The identified controlling locations, pathways and atomspheric dispersion are from the Artificial Island Radiological Monitoring Program and the Hope Creek FSAR.

Table 2-4
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - ADULT
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3	1.26E+3
C-14	1.82E+4	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3	3.41E+3
P-32	1.32E+6	7.71E+4	-	-	-	8.64E+4	5.01E+4
Cr-51	-	-	5.95E+1	2.28E+1	1.44E+4	3.32E+3	1.00E+2
Mn-54	-	3.96E+4	-	9.84E+3	1.40E+6	7.74E+4	6.30E+3
Fe-55	2.46E+4	1.70E+4	-	-	7.21E+4	6.03E+3	3.94E+3
Fe-59	1.18E+4	2.78E+4	-	-	1.02E+6	1.88E+5	1.06E+4
Co-57	-	6.92E+2	-	-	3.70E+5	3.14E+4	6.71E+2
Co-58	-	1.58E+3	-	-	9.28E+5	1.06E+5	2.07E+3
Co-60	-	1.15E+4	-	-	5.97E+6	2.85E+5	1.48E+4
Ni-63	4.32E+5	3.14E+4	-	-	1.78E+5	1.34E+4	1.45E+4
Zn-65	3.24E+4	1.03E+5	-	6.90E+4	8.64E+5	5.34E+4	4.66E+4
Rb-86	-	1.35E+5	-	-	-	1.66E+4	5.90E+4
Sr-89	3.04E+5	-	-	-	1.40E+6	3.50E+5	8.72E+3
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+6
Y-91	4.62E+5	-	-	-	1.70E+6	3.85E+5	1.24E+4
Zr-95	1.07E+5	3.44E+4	-	5.42E+4	1.77E+6	1.50E+5	2.33E+4
Nb-95	1.41E+4	7.82E+3	-	7.74E+3	5.05E+5	1.04E+5	4.21E+3
Ru-103	1.53E+3	-	-	5.83E+3	5.05E+5	1.10E+5	6.58E+2
Ru-106	6.91E+4	-	-	1.34E+5	9.36E+6	9.12E+5	8.72E+3
Ag-110m	1.08E+4	1.00E+4	-	1.97E+4	4.63E+6	3.02E+5	5.94E+3
Sb-124	3.12E+4	5.89E+2	7.55E+1	-	2.48E+6	4.06E+5	1.24E+4
Sb-125	5.34E+4	5.95E+2	5.40E+1	-	1.74E+6	1.01E+5	1.26E+4
Te-125m	3.42E+3	1.58E+3	1.05E+3	1.24E+4	3.14E+5	7.06E+4	4.67E+2
Te-127m	1.26E+4	5.77E+3	3.29E+3	4.58E+4	9.60E+5	1.50E+5	1.57E+3
Te-129m	9.76E+3	4.67E+3	3.44E+3	3.66E+4	1.16E+6	3.83E+5	1.58E+3
I-131	2.52E+4	3.58E+4	1.19E+7	6.13E+4	-	6.28E+3	2.05E+4
Cs-134	3.73E+5	8.48E+5	-	2.87E+5	9.76E+4	1.04E+4	7.28E+5
Cs-136	3.90E+4	1.46E+5	-	8.56E+4	1.20E+4	1.17E+4	1.10E+5
Cs-137	4.78E+5	6.21E+5	-	2.22E+5	7.52E+4	8.40E+3	4.28E+5
Ba-140	3.90E+4	4.90E+1	-	1.67E+1	1.27E+6	2.18E+5	2.57E+3
Ce-141	1.99E+4	1.35E+4	-	6.26E+3	3.62E+5	1.20E+5	1.53E+3
Ce-144	3.43E+6	1.43E+6	-	8.48E+5	7.78E+6	8.16E+5	1.84E+5
Pr-143	9.36E+3	3.75E+3	-	2.16E+3	2.81E+5	2.00E+5	4.64E+2
Nd-147	5.27E+3	6.10E+3	-	3.56E+3	2.21E+5	1.73E+5	3.65E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - TEENAGER
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3	1.27E+3
C-14	2.60E+4	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3	4.87E+3
P-32	1.89E+6	1.10E+5	-	-	-	9.28E+4	7.16E+4
Cr-51	-	-	7.50E+1	3.07E+1	2.10E+4	3.00E+3	1.35E+2
Mn-54	-	5.11E+4	-	1.27E+4	1.98E+6	6.68E+4	8.40E+3
Fe-55	3.34E+4	2.38E+4	-	-	1.24E+5	6.39E+3	5.54E+3
Fe-59	1.59E+4	3.70E+4	-	-	1.53E+6	1.78E+5	1.43E+4
Co-57	-	6.92E+2	-	-	5.86E+5	3.14E+4	9.20E+2
Co-58	-	2.07E+3	-	-	1.34E+6	9.52E+4	2.78E+3
Co-60	-	1.51E+4	-	-	8.72E+6	2.59E+5	1.98E+4
Ni-63	5.80E+5	4.34E+4	-	-	3.07E+5	1.42E+4	1.98E+4
Zn-65	3.86E+4	1.34E+5	-	8.64E+4	1.24E+6	4.66E+4	6.24E+4
Rb-86	-	1.90E+5	-	-	-	1.77E+4	8.40E+4
Sr-89	4.34E+5	-	-	-	2.42E+6	3.71E+5	1.25E+4
Sr-90	1.08E+8	-	-	-	1.65E+7	7.65E+5	6.68E+6
Y-91	6.61E+5	-	-	-	2.94E+6	4.09E+5	1.77E+4
Zr-95	1.46E+5	4.58E+4	-	6.7[illegible]E+4	2.69E+6	1.49E+5	3.15E+4
Nb-95	1.86E+4	1.03E+4	-	1.00E+4	7.51E+5	9.68E+4	5.66E+3
Ru-103	2.10E+3	-	-	7.43E+3	7.83E+5	1.09E+5	8.96E+2
Ru-106	9.84E+4	-	-	1.90E+5	1.61E+7	9.60E+5	1.24E+4
Ag-110m	1.38E+4	1.31E+4	-	2.50E+4	6.75E+6	2.73E+5	7.99E+3
Sb-124	4.30E+4	7.94E+2	9.76E+1	-	3.85E+6	3.98E+5	1.68E+4
Sb-125	7.38E+4	8.08E+2	7.04E+1	-	2.74E+6	9.92E+4	1.72E+4
Te-125m	4.88E+3	2.24E+3	1.40E+3	-	5.36E+5	7.50E+4	6.67E+2
Te-127m	1.80E+4	8.16E+3	4.38E+3	6.54E+4	1.66E+6	1.59E+5	2.18E+3
Te-129m	1.39E+4	6.58E+3	4.58E+3	5.19E+4	1.98E+6	4.05E+5	2.25E+3
I-131	3.54E+4	4.91E+4	1.46E+7	8.40E+4	-	6.49E+3	2.64E+4
Cs-134	5.02E+5	1.13E+6	-	3.75E+5	1.46E+5	9.76E+3	5.49E+5
Cs-136	5.15E+4	1.94E+5	-	1.10E+5	1.78E+4	1.09E+4	1.37E+5
Cs-137	6.70E+5	8.48E+5	-	3.04E+5	1.21E+5	8.48E+3	3.11E+5
Ba-140	5.47E+4	6.70E+1	-	2.28E+1	2.03E+6	2.29E+5	3.52E+3
Ce-141	2.84E+4	1.90E+4	-	8.88E+3	6.14E+5	1.26E+5	2.17E+3
Ce-144	4.89E+6	2.02E+6	-	1.21E+6	1.34E+7	8.64E+5	2.62E+5
Pr-143	1.34E+4	5.31E+3	-	3.09E+3	4.83E+5	2.14E+5	6.62E+2
Nd-147	7.86E+3	8.56E+3	-	5.02E+3	3.72E+5	1.82E+5	5.13E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - CHILD
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3	1.12E+3
C-14	3.59E+4	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3	6.73E+3
P-32	2.60E+6	1.14E+5	-	-	-	4.22E+4	9.88E+
Cr-51	-	-	8.55E+1	2.43E+1	1.70E+4	1.08E+3	1.54E+2
Mn-54	-	4.29E+4	-	1.00E+4	1.58E+6	2.29E+4	9.51E+3
Fe-55	4.74E+4	2.52E+4	-	-	1.11E+5	2.87E+3	7.77E+3
Fe-59	2.07E+4	3.34E+4	-	-	1.27E+6	7.07E+4	1.67E+4
Co-57	-	9.03E+2	-	-	5.07E+5	1.32E+4	1.07E+3
Co-58	-	1.77E+3	-	-	1.11E+6	3.44E+4	3.16E+3
Co-60	-	1.31E+4	-	-	7.07E+6	9.62E+4	2.26E+4
Ni-63	8.21E+5	4.63E+4	-	-	2.75E+5	6.33E+3	2.80E+4
Zn-65	4.26E+4	1.13E+5	-	7.14E+4	9.95E+5	1.63E+4	7.03E+4
Rb-86	-	1.98E+5	-	-	-	7.99E+3	1.14E+5
Sr-89	5.99E+5	-	-	-	2.16E+6	1.67E+5	1.72E+4
Sr-90	1.01E+8	-	-	-	1.48E+7	3.43E+5	6.44E+6
Y-91	9.14E+5	-	-	-	2.63E+6	1.84E+5	2.44E+4
Zr-95	1.90E+5	4.18E+4	-	5.96E+4	2.23E+6	6.11E+4	3.70E+4
Nb-95	2.35E+4	9.18E+3	-	8.62E+3	6.14E+5	3.70E+4	6.55E+3
Ru-103	2.79E+3	-	-	7.03E+3	6.62E+5	4.48E+4	1.07E+3
Ru-106	1.36E+5	-	-	1.84E+5	1.43E+7	4.29E+5	1.69E+4
Ag-110m	1.69E+4	1.14E+4	-	2.12E+4	5.48E+6	1.00E+5	9.14E+3
Sb-124	5.74E+4	7.40E+2	1.26E+2	-	3.24E+6	1.64E+5	2.00E+4
Sb-125	9.84E+4	7.59E+	29.10E+1	-	2.32E+6	4.03E+4	2.07E+4
Te-125m	6.73E+3	2.33E+3	1.92E+3	-	4.77E+5	3.38E+4	9.14E+2
Te-127m	2.49E+4	8.55E+3	6.07E+3	6.36E+4	1.48E+6	7.14E+4	3.02E+3
Te-129m	1.92E+4	6.85E+3	6.33E+3	5.03E+4	1.76E+6	1.82E+5	3.04E+
I-131	4.81E+4	4.81E+4	1.62E+7	7.88E+4	-	2.84E+3	2.73E+4
Cs-134	6.51E+5	1.01E+6	-	3.30E+5	1.21E+5	3.85E+3	2.25E+5
Cs-136	6.51E+4	1.71E+5	-	9.55E+4	1.45E+4	4.18E+3	1.16E+5
Cs-137	9.07E+5	8.25E+5	-	2.82E+5	1.04E+5	3.62E+3	1.28E+5
Ba-140	7.40E+4	6.48E+1	-	2.11E+1	1.74E+6	1.02E+5	4.33E+3
Ce-141	3.92E+4	1.95E+4	-	8.55E+3	5.44E+5	5.66E+4	2.90E+3
Ce-144	6.77E+6	2.12E+6	-	1.17E+6	1.20E+7	3.89E+5	3.61E+5
Pr-143	1.85E+4	5.55E+3	-	3.00E+3	4.33E+5	9.73E+4	9.14E+2
Nd-147	1.08E+4	8.73E+3	-	4.81E+3	3.28E+5	8.21E+4	6.81E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Inhalation Pathway Dose Factors - INFANT
(mrem/yr per uCi/m3)

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2	6.47E+2
C-14	2.65E+4	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3	5.31E+3
P-32	2.03E+6	1.12E+5	-	-	-	1.61E+4	7.74E+4
Cr-51	-	-	5.75E+1	1.32E+1	1.28E+4	3.57E+2	8.95E+1
Mn-54	-	2.53E+4	-	4.98E+3	1.00E+6	7.06E+3	4.98E+3
Fe-55	1.97E+4	1.17E+4	-	-	8.69E+4	1.09E+3	3.33E+3
Fe-59	1.36E+4	2.35E+4	-	-	1.02E+6	2.48E+4	9.48E+3
Co-57	-	6.51E+2	-	-	3.79E+5	4.86E+3	6.41E+2
Co-58	-	1.22E+3	-	-	7.77E+5	1.11E+4	1.82E+3
Co-60	-	8.02E+3	-	-	4.51E+6	3.19E+4	1.18E+4
Ni-63	3.39E+5	2.04E+4	-	-	2.09E+5	2.42E+3	1.16E+4
Zn-65	1.93E+4	6.26E+4	-	3.25E+4	6.47E+5	5.14E+4	3.11E+4
Rb-86	-	1.90E+5	-	-	-	3.04E+3	8.82E+4
Sr-89	3.98E+5	-	-	-	2.03E+6	6.40E+4	1.14E+4
Sr-90	4.09E+7	-	-	-	1.12E+7	1.31E+5	2.59E+6
Y-91	5.88E+5	-	-	-	2.45E+6	7.03E+4	1.57E+4
Zr-95	1.15E+5	2.79E+4	-	3.11E+4	1.75E+6	2.17E+4	2.03E+4
Nb-95	1.57E+4	6.43E+3	-	4.72E+3	4.79E+5	1.27E+4	3.78E+3
Ru-103	2.02E+3	-	-	4.24E+3	5.52E+5	1.61E+4	6.79E+2
Ru-106	8.68E+4	-	-	1.07E+5	1.16E+7	1.64E+5	1.09E+4
Ag-110m	9.98E+3	7.22E+3	-	1.09E+4	3.67E+6	3.30E+4	5.00E+3
Sb-124	3.79E+4	5.56E+2	1.01E+2	-	2.65E+6	5.91E+4	1.20E+4
Sb-125	5.17E+4	4.77E+2	6.23E+1	-	1.64E+6	1.47E+4	1.09E+4
Te-125m	4.76E+3	1.99E+3	1.62E+3	-	4.47E+5	1.29E+4	6.58E+2
Te-127m	1.67E+4	6.90E+3	4.87E+3	3.75E+4	1.31E+6	2.73E+4	2.07E+3
Te-129m	1.41E [illegible]	6.09E+3	5.47E+3	3.18E+4	1.68E+6	6.90E+4	2.23E+3
I-131	3.79E+4	4.44E+4	1.48E+7	5.18E+4	-	1.06E+3	1.96E+4
Cs-134	3.96E+5	7.03E+5	-	1.90E+5	7.97E+4	1.33E+3	7.45E+4
Cs-136	4.83E+4	1.35E+5	-	5.64E+4	1.18E+4	1.43E+3	5.29E+4
Cs-137	5.49E+5	6.12E+5	-	1.72E+5	7.13E+4	1.33E+3	4.55E+4
Ba-140	5.60E+4	5.60E+1	-	1.34E+1	1.60E+6	3.84E+4	2.90E+3
Ce-141	2.77E+4	1.67E+4	-	5.25E+3	5.17E+5	2.16E+4	1.99E+3
Ce-144	3.19E+6	1.21E+6	-	5.38E+5	9.84E+6	1.48E+5	1.76E+5
Pr-143	1.40E+4	5.24E+3	-	1.97E+3	4.33E+5	3.72E+4	6.99E+2
Nd-147	7.94E+3	8.13E+3	-	3.15E+3	3.22E+5	3.12E+4	5.00E+2

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - ADULT
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2	7.63E+2
C-14	3.63E+5	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4	7.26E+4
P-32	1.71E+10	1.06E+9	-	-	-	1.92E+9	6.60E+8
Cr-51	-	-	1.71E+4	6.30E+3	3.80E+4	7.20E+6	2.86E+4
Mn-54	-	8.40E+6	-	2.50E+6	-	2.57E+7	1.60E+6
Fe-55	2.51E+7	1.73E+7	-	-	9.67E+6	9.95E+6	4.04E+6
Fe-59	2.98E+7	7.00E+7	-	-	1.95E+7	2.33E+8	2.68E+7
Co-57	-	1.28E+6	-	-	-	3.25E+7	2.13E+6
Co-58	-	4.72E+6	-	-	-	9.57E+7	1.06E+7
Co-60	-	1.64E+7	-	-	-	3.08E+8	3.62E+7
Ni-63	6.73E+9	4.66E+8	-	-	-	9.73E+7	2.26E+8
Zn-65	1.37E+9	4.36E+9	-	2.92E+9	-	2.75E+9	1.97E+9
Rb-86	-	2.59E+9	-	-	-	5.11E+8	1.21E+
Sr-89	1.45E+9	-	-	-	-	2.33E+8	4.16E+7
Sr-90	4.68E+10	-	-	-	-	1.35E+9	1.15E+1
Y-91	8.60E+3	-	-	-	-	4.73E+6	2.30E+2
Zr-95	9.46E+2	3.03E+2	-	4.76E+2	-	9.62E+5	2.05E+2
Nb-95	8.25E+4	4.59E+4	-	4.54E+4	-	2.79E+8	2.47E+4
Ru-103	1.02E+3	-	-	3.89E+3	-	1.19E+5	4.39E+2
Ru-106	2.04E+4	-	-	3.94E+4	-	1.32E+6	2.58E+3
Ag-110m	5.83E+7	5.39E+7	-	1.06E+8	-	2.20E+10	3.20E+7
Sb-124	2.57E+7	4.86E+5	6.24E+4	-	2.00E+7	7.31E+8	1.02E+7
Sb-125	2.04E+7	2.28E+5	2.08E+4	-	1.58E+7	2.25E+8	4.86E+6
Te-125m	1.63E+7	5.90E+6	4.90E+6	6.63E+7	-	6.50E+7	2.18E+6
Te-127m	4.58E+7	1.64E+7	1.17E+7	1.86E+8	-	1.54E+8	5.58E+6
Te-129m	6.04E+7	2.25E+7	2.08E+7	2.52E+8	-	3.04E+8	9.57E+6
I-131	2.96E+8	4.24E+8	1.39E+11	7.27E+8	-	1.12E+8	2.43E+8
Cs-134	5.65E+9	1.34E+10	-	4.35E+9	1.44E+9	2.35E+8	1.10E+10
Cs-136	2.61E+8	1.03E+9	-	5.74E+8	7.87E+7	1.17E+8	7.42E+8
Cs-137	7.38E+9	1.01E+10	-	3.43E+9	1.14E+9	1.95E+8	6.61E+9
Ba-140	2.69E+7	3.38E+4	-	1.15E+4	1.93E+4	5.54E+7	1.76E+6
Ce-141	4.84E+3	3.27E+3	-	1.52E+3	-	1.25E+7	3.71E+2
Ce-144	3.58E+5	1.50E+5	-	8.87E+4	-	1.21E+8	1.92E+4
Pr-143	1.59E+2	6.37E+1	-	3.68E+1	-	6.96E+5	7.88E+0
Nd-147	9.42E+1	1.09E+2	-	6.37E+1	-	5.23E+5	6.52E+0

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - TEENAGER
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2	9.94E+2
C-14	6.70E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5	1.34E+5
P-32	3.15E+10	1.95E+9	-	-	-	2.65E+9	1.22E+9
Cr-51	-	-	2.78E+4	1.10E+4	7.13E+4	8.40E+6	5.00E+4
Mn-54	-	1.40E+7	-	4.17E+6	-	2.87E+7	2.78E+6
Fe-55	4.45E+7	3.16E+7	-	-	2.00E+7	1.37E+7	7.36E+6
Fe-59	5.20E+7	1.21E+8	-	-	3.82E+7	2.87E+8	4.68E+7
Co-57	-	2.25E+6	-	-	-	4.19E+7	3.76E+6
Co-58	-	7.95E+6	-	-	-	1.10E+8	1.83E+7
Co-60	-	2.78E+7	-	-	-	3.62E+8	6.26E+7
Ni-63	1.18E+10	8.35E+8	-	-	-	1.33E+8	4.01E+8
Zn-65	2.11E+9	7.31E+9	-	4.68E+9	-	3.10E+9	3.41E+9
Rb-86	-	4.73E+9	-	-	-	7.00E+8	2.22E+9
Sr-89	2.67E+9	-	-	-	-	3.18E+8	7.66E+7
Sr-90	9.92E+7	-	-	-	9.60E+6	7.22E+5	6.10E+
Y-91	1.58E+4	-	-	-	-	6.48E+6	4.24E+2
Zr-95	1.65E+3	5.22E+2	-	7.67E+2	-	1.20E+6	3.59E+2
Nb-95	1.41E+5	7.80E+4	-	7.57E+4	-	3.34E+8	4.30E+4
Ru-103	1.81E+3	-	-	6.40E+3	-	1.52E+5	7.75E+2
Ru-106	3.75E+4	-	-	7.23E+4	-	1.80E+6	4.73E+3
Ag-110m	9.63E+7	9.11E+7	-	1.74E+8	-	2.56E+10	5.54E+7
Sb-124	4.59E+7	8.46E+5	1.04E+5	-	4.01E+7	9.25E+8	1.79E+7
Sb-125	3.65E+7	3.99E+5	3.49E+4	-	3.21E+7	2.84E+8	8.54E+6
Te-125m	3.00E+7	1.08E+7	8.39E+6	-	-	8.86E+7	4.02E+6
Te-127m	8.44E+7	2.99E+7	2.01E+7	3.42E+8	-	2.10E+8	1.00E+7
Te-129m	1.11E+8	4.10E+7	3.57E+7	4.62E+8	-	4.15E+8	1.75E+7
I-131	5.38E+8	7.53E+8	2.20E+11	1.30E+9	-	1.49E+8	4.04E+8
Cs-134	9.81E+9	2.31E+10	-	7.34E+9	2.80E+9	2.87E+8	1.07E+10
Cs-136	4.45E+8	1.75E+9	-	9.53E+8	1.50E+8	1.41E+8	1.18E+9
Cs-137	1.34E+10	1.78E+10	-	6.06E+9	2.35E+9	2.53E+8	6.20E+9
Ba-140	4.85E+7	5.95E+4	-	2.02E+4	4.00E+4	7.49E+7	3.13E+6
Ce-141	8.87E+3	1.35E+4	-	2.79E+3	-	1.69E+7	6.81E+2
Ce-144	6.58E+5	2.72E+5	-	1.63E+5	-	1.66E+8	3.54E+4
Pr-143	2.92E+2	1.17E+2	-	6.77E+1	-	9.61E+5	1.45E+1
Nd-147	1.81E+2	1.97E+2	-	1.16E+2	-	7.11E+5	1.18E+1

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - CHILD
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3	1.57E+3
C-14	1.65E+6	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5	3.29E+5
P-32	7.77E+10	3.64E+9	-	-	-	2.15E+9	3.00E+9
Cr-51	-	-	5.66E+4	1.55E+4	1.03E+5	5.41E+6	1.02E+5
Mn-54	-	2.09E+7	-	5.87E+6	-	1.76E+7	5.58E+6
Fe-55	1.12E+8	5.93E+7	-	-	3.35E+7	1.10E+7	1.84E+7
Fe-59	1.20E+8	1.95E+8	-	-	5.65E+7	2.03E+8	9.71E+7
Co-57	-	3.84E+6	-	-	-	3.14E+7	7.77E+6
Co-58	-	1.21E+7	-	-	-	7.08E+7	3.72E+7
Co-60	-	4.32E+7	-	-	-	2.39E+8	1.27E+8
Ni-63	2.96E+10	1.59E+9	-	-	-	1.07E+8	1.01E+9
Zn-65	4.13E+9	1.10E+10	-	6.94E+9	-	1.93E+9	6.85E+9
Rb-86	-	8.77E+9	-	-	-	5.64E+8	5.39E+9
Sr-89	6.62E+9	-	-	-	-	2.56E+8	1.89E+8
Sr-90	1.12E+11	-	-	-	-	1.51E+9	2.83E+10
Y-91	3.91E+4	-	-	-	-	5.21E+6	1.04E+3
Zr-95	3.84E+3	8.45E+2	-	1.21E+3	-	8.81E+5	7.52E+2
Nb-95	3.18E+5	1.24E+5	-	1.16E+5	-	2.29E+8	8.84E+4
Ru-103	4.29E+3	-	-	1.08E+4	-	1.11E+5	1.65E+3
Ru-106	9.24E+4	-	-	1.25E+5	-	1.44E+6	1.15E+4
Ag-110m	2.09E+8	1.41E+8	-	2.63E+8	-	1.68E+10	1.13E+8
Sb-124	1.09E+8	1.41E+8	2.40E+5	-	6.03E+7	6.79E+8	3.81E+7
Sb-125	8.70E+7	1.41E+6	8.06E+4	-	4.85E+7	2.08E+8	1.82E+7
Te-125m	7.38E+7	2.00E+7	2.07E+7	-	-	7.12E+7	9.84E+6
Te-127m	2.08E+8	5.60E+7	4.97E+7	5.93E+8	-	1.68E+8	2.47E+7
Te-129m	2.72E+8	7.61E+7	8.78E+7	8.00E+8	-	3.32E+8	4.23E+7
I-131	1.30E+9	1.31E+9	4.34E+11	2.15E+9	-	1.17E+8	7.46E+8
Cs-134	2.26E+10	3.71E+10	-	1.15E+10	4.13E+9	2.00E+8	7.83E+9
Cs-136	1.00E+9	2.76E+9	-	1.47E+9	2.19E+8	9.70E+7	1.79E+9
Cs-137	3.22E+10	3.09E+10	-	1.01E+10	3.62E+9	1.93E+8	4.55E+9
Ba-140	1.17E+8	1.03E+5	-	3.34E+4	6.12E+4	5.94E+7	6.84E+6
Ce-141	2.19E+4	1.09E+4	-	4.78E+3	-	1.36E+7	1.62E+3
Ce-144	1.62E+6	5.09E+5	-	2.82E+5	-	1.33E+8	8.66E+4
Pr-143	7.23E+2	2.17E+2	-	1.17E+2	-	7.80E+5	3.59E+1
Nd-147	4.45E+2	3.60E+2	-	1.98E+2	-	5.71E+5	2.79E+1

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Grass-Cow-Milk Pathway Dose Factors - INFANT
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3	2.38E+3
C-14	3.23E+6	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5	6.89E+5
P-32	1.60E+11	9.42E+9	-	-	-	2.17E+9	6.21E+9
Cr-51	-	-	1.05E+5	2.30E+4	2.05E+5	4.71E+6	1.61E+5
Mn-54	-	3.89E+7	-	8.63E+6	-	1.43E+7	8.83E+6
Fe-55	1.35E+8	8.72E+7	-	-	4.27E+7	1.11E+7	2.33E+7
Fe-59	2.25E+8	3.93E+8	-	-	1.16E+8	1.88E+8	1.55E+8
Co-57	-	8.95E+6	-	-	-	3.05E+7	1.46E+7
Co-58	-	2.43E+7	-	-	-	6.05E+7	6.06E+7
Co-60	-	8.81E+7	-	-	-	2.10E+8	2.08E+8
Ni-63	3.49E+10	2.16E+9	-	-	-	1.07E+8	1.21E+9
Zn-65	5.55E+9	1.90E+10	-	9.23E+9	-	1.61E+10	8.78E+9
Rb-86	-	2.22E+10	-	-	-	5.69E+8	1.10E+10
Sr-89	1.26E+10	-	-	-	-	2.59E+8	3.61E+8
Sr-90	1.22E+11	-	-	-	-	1.52E+9	3.10E+10
Y-91	7.33E+4	-	-	-	-	5.26E+6	1.95E+3
Zr-95	6.83E+3	1.66E+3	-	1.79E+3	-	8.28E+5	1.18E+3
Nb-95	5.93E+5	2.44E+5	-	1.75E+5	-	2.06E+8	1.41E+5
Ru-103	8.69E+3	-	-	1.81E+4	-	1.06E+5	2.91E+3
Ru-106	1.90E+5	-	-	2.25E+5	-	1.44E+6	2.38E+4
Ag-110m	3.86E+8	2.82E+8	-	4.03E+8	-	1.46E+10	1.86E+8
Sb-124	2.09E+8	3.08E+6	5.56E+5	-	1.31E+8	6.46E+8	6.49E+7
Sb-125	1.49E+8	1.45E+6	1.87E+5	-	9.38E+7	1.99E+8	3.07E+7
Te-125m	1.51E+8	5.04E+7	5.07E+7	-	-	7.18E+7	2.04E+7
Te-127m	4.21E+8	1.40E+8	1.22E+8	1.04E+9	-	1.70E+8	5.10E+7
Te-129m	5.59E+8	1.92E+8	2.15E+8	1.40E+9	-	3.34E+8	8.62E+7
I-131	2.72E+9	3.21E+9	1.05E+12	3.75E+9	-	1.15E+8	1.41E+9
Cs-134	3.65E+10	6.80E+10	-	1.75E+10	7.18E+9	1.85E+8	6.87E+9
Cs-136	1.96E+9	5.77E+9	-	2.30E+9	4.70E+8	8.76E+7	2.15E+9
Cs-137	5.15E+10	6.02E+10	-	1.62E+10	6.55E+9	1.88E+8	4.27E+9
Ba-140	2.41E+8	2.41E+5	-	5.73E+4	1.48E+5	5.92E+7	1.24E+7
Ce-141	4.33E+4	2.64E+4	-	8.15E+3	-	1.37E+7	3.11E+3
Ce-144	2.33E+6	9.52E+5	-	3.85E+5	-	1.33E+8	1.30E+5
Pr-143	1.49E+3	5.59E+2	-	2.08E+2	-	7.89E+5	7.41E+1
Nd-147	8.82E+2	9.06E+2	-	3.49E+2	-	5.74E+5	5.55E+1

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Vegetation Pathway Dose Factors - ADULT
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3	2.26E+3
C-14	8.97E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5	1.79E+5
P-32	1.40E+9	8.73E+7	-	-	-	1.58E+8	5.42E+7
Cr-51	-	-	2.79E+4	1.03E+4	6.19E+4	1.17E+7	4.66E+4
Mn-54	-	3.11E+8	-	9.27E+7	-	9.54E+8	5.94E+7
Fe-55	2.09E+8	1.45E+8	-	-	8.06E+7	8.29E+7	3.37E+7
Fe-59	1.27E+8	2.99E+8	-	-	8.35E+7	9.96E+8	1.14E+8
Co-57	-	1.17E+7	-	-	-	2.97E+8	1.95E+7
Co-58	-	3.09E+7	-	-	-	6.26E+8	6.92E+7
Co-60	-	1.67E+8	-	-	-	3.14E+9	3.69E+8
Ni-63	1.04E+10	7.21E+8	-	-	-	1.50E+8	3.49E+8
Zn-65	3.17E+8	1.01E+9	-	6.75E+8	-	6.36E+8	4.56E+8
Rb-86	-	2.19E+8	-	-	-	4.32E+7	1.02E+8
Sr-89	9.96E+9	-	-	-	-	1.60E+9	2.86E+8
Sr-90	6.05E+11	-	-	-	-	1.75E+10	1.48E+10
Y-91	5.13E+6	-	-	-	-	2.82E+9	1.37E+5
Zr-95	1.19E+6	3.81E+5	-	5.97E+5	-	1.21E+9	2.58E+5
Nb-95	1.42E+5	7.91E+4	-	7.81E+4	-	4.80E+8	4.25E+4
Ru-103	4.80E+6	-	-	1.83E+7	-	5.61E+8	2.07E+6
Ru-106	1.93E+8	-	-	3.72E+8	-	1.25E+10	2.44E+7
Ag-110m	1.06E+7	9.76E+6	-	1.92E+7	-	3.98E+9	5.80E+6
Sb-124	1.04E+8	1.96E+6	2.52E+5	-	8.08E+7	2.95E+9	4.11E+7
Sb-125	1.36E+8	1.52E+6	1.39E+5	-	1.05E+8	1.50E+9	3.25E+7
Te-125m	9.66E+7	3.50E+7	2.90E+7	3.93E+8	-	3.86E+8	1.29E+7
Te-127m	3.49E+8	1.25E+8	8.92E+7	1.42E+9	-	1.17E+9	4.26E+7
Te-129m	2.55E+8	9.50E+7	8.75E+7	1.06E+9	-	1.28E+9	4.03E+7
I-131	8.09E+7	1.16E+8	3.79E+10	1.98E+8	-	3.05E+7	6.63E+7
Cs-134	4.66E+9	1.11E+10	-	3.59E+9	1.19E+9	1.94E+8	9.07E+9
Cs-136	4.20E+7	1.66E+8	-	9.24E+7	1.27E+7	1.89E+7	1.19E+8
Cs-137	6.36E+9	8.70E+9	-	2.95E+9	9.81E+8	1.68E+8	5.70E+9
Ba-140	1.29E+8	1.62E+5	-	5.49E+4	9.25E+4	2.65E+8	8.43E+6
Ce-141	1.96E+5	1.33E+5	-	6.17E+4	-	5.08E+8	1.51E+4
Ce-144	3.29E+7	1.38E+7	-	8.16E+6	-	1.11E+10	1.77E+6
Pr-143	6.34E+4	2.54E+4	-	1.47E+4	-	2.78E+8	3.14E+3
Nd-147	3.34E+4	3.86E+4	-	2.25E+4	-	1.85E+8	2.31E+3

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Vegetation Pathway Dose Factors - TEENAGER
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3	2.59E+3
C-14	1.45E+6	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5	2.91E+5
P-32	1.61E+9	9.96E+7	-	-	-	1.35E+8	6.23E+7
Cr-51	-	-	3.44E+4	1.36E+4	8.85E+4	1.04E+7	6.20E+4
Mn-54	-	4.52E+8	-	1.35E+8	-	9.27E+8	8.97E+7
Fe-55	3.25E+8	2.31E+8	-	-	1.46E+8	9.98E+7	5.38E+7
Fe-59	1.81E+8	4.22E+8	-	-	1.33E+8	9.98E+8	1.63E+8
Co-57	-	1.79E+7	-	-	-	3.34E+8	3.00E+7
Co-58	-	4.38E+7	-	-	-	6.04E+8	1.01E+8
Co-60	-	2.49E+8	-	-	-	3.24E+9	5.60E+8
Ni-63	1.61E+10	1.13E+9	-	-	-	1.81E+8	5.45E+8
Zn-65	4.24E+8	1.47E+9	-	9.41E+8	-	6.23E+8	6.86E+8
Rb-86	-	2.73E+8	-	-	-	4.05E+7	1.28E+8
Sr-89	1.51E+10	-	-	-	-	1.80E+9	4.33E+8
Sr-90	7.51E+11	-	-	-	-	2.11E+10	1.85E+11
Y-91	7.87E+6	-	-	-	-	3.23E+9	2.11E+5
Zr-95	1.74E+6	5.49E+5	-	8.07E+5	-	1.27E+9	3.78E+5
Nb-95	1.92E+5	1.06E+5	-	1.0[illegible]E+5	-	4.55E+8	5.86E+4
Ru-103	6.87E+6	-	-	2.42E+7	-	5.74E+8	2.94E+6
Ru-106	3.09E+8	-	-	5.97E+8	-	1.48E+10	3.90E+7
Ag-110m	1.52E+7	1.44E+7	-	2.74E+7	-	4.04E+9	8.74E+6
Sb-124	1.55E+8	2.85E+6	3.51E+5	-	1.35E+8	3.11E+9	6.03E+7
Sb-125	2.14E+8	2.34E+6	2.04E+5	-	1.88E+8	1.66E+9	5.00E+7
Te-125m	1.48E+8	5.34E+7	4.14E+7	-	-	4.37E+8	1.98E+7
Te-127m	5.51E+8	1.96E+8	1.31E+8	2.24E+9	-	1.37E+9	6.56E+7
Te-129m	3.67E+8	1.36E+8	1.18E+8	1.54E+9	-	1.38E+9	5.81E+7
I-131	7.70E+7	1.08E+8	3.14E+10	1.85E+8	-	2.13E+7	5.79E+7
Cs-134	7.09E+9	1.67E+10	-	5.30E+9	2.02E+9	2.08E+8	7.74E+9
Cs-136	4.29E+7	1.69E+8	-	9.19E+7	1.45E+7	1.36E+7	1.13E+8
Cs-137	1.01E+10	1.35E+10	-	4.59E+9	1.78E+9	1.92E+8	4.69E+9
Ba-140	1.38E+8	1.69E+5	-	5.75E+4	1.14E+5	2.13E+8	8.91E+6
Ce-141	2.82E+5	1.88E+5	-	8.86E+4	-	5.38E+8	2.16E+4
Ce-144	5.27E+7	2.18E+7	-	1.30E+7	-	1.33E+10	2.83E+6
Pr-143	7.12E+4	2.84E+4	-	1.65E+4	-	2.34E+8	3.55E+3
Nd-147	3.63E+4	3.94E+4	-	2.32E+4	-	1.42E+8	2.36E+3

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Vegetation Pathway Dose Factors - CHILD
(mrem/yr per uCi/m3) for H-3 and C-14
(m2 * mrem/yr per uCi/sec) for others

Nuclide	Bone	Liver	Thyroid	Kidney	Lung	GI-LLI	T.Body
H-3	-	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3	4.01E+3
C-14	3.50E+6	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5	7.01E+5
P-32	3.37E+9	1.58E+8	-	-	-	9.30E+7	1.30E+8
Cr-51	-	-	6.54E+4	1.79E+4	1.19E+5	6.25E+6	1.18E+5
Mn-54	-	6.61E+8	-	1.85E+8	-	5.55E+8	1.76E+8
Fe-55	8.00E+8	4.24E+8	-	-	2.40E+8	7.86E+7	1.31E+8
Fe-59	4.01E+8	6.49E+8	-	-	1.88E+8	6.76E+8	3.23E+8
Co-57	-	2.99E+7	-	-	-	2.45E+8	6.04E+7
Co-58	-	6.47E+7	-	-	-	3.77E+8	1.98E+8
Co-60	-	3.78E+8	-	-	-	2.10E+9	1.12E+9
Ni-63	3.95E+10	2.11E+9	-	-	-	1.42E+8	1.34E+9
Zn-65	8.12E+8	2.16E+9	-	1.36E+9	-	3.80E+8	1.35E+9
Rb-86	-	4.52E+8	-	-	-	2.91E+7	2.78E+8
Sr-89	3.59E+10	-	-	-	-	1.39E+9	1.03E+9
Sr-90	1.24E+12	-	-	-	-	1.67E+10	3.15E+11
Y-91	1.87E+7	-	-	-	-	2.49E+9	5.01E+5
Zr-95	3.90E+6	8.58E+5	-	1.23E+6	-	8.95E+8	7.64E+5
Nb-95	4.10E+5	1.59E+5	-	1.50E+5	-	2.95E+8	1.14E+5
Ru-103	1.55E+7	-	-	3.89E+7	-	3.99E+8	5.94E+6
Ru-106	7.45E+8	-	-	1.01E+9	-	1.16E+10	9.30E+7
Ag-110m	3.22E+7	2.17E+7	-	4.05E+7	-	2.58E+9	1.74E+7
Sb-124	3.52E+8	4.57E+6	7.78E+5	-	1.96E+8	2.20E+9	1.23E+8
Sb-125	4.99E+8	3.85E+6	4.62E+5	-	2.78E+8	1.19E+9	1.05E+8
Te-125m	3.51E+8	9.50E+7	9.84E+7	-	-	3.38E+8	4.67E+7
Te-127m	1.32E+9	3.56E+8	3.16E+8	3.77E+9	-	1.07E+9	1.57E+8
Te-129m	8.54E+8	2.39E+8	2.75E+8	2.51E+9	-	1.04E+9	1.33E+8
I-131	1.43E+8	1.44E+8	4.76E+10	2.36E+8	-	1.28E+7	8.18E+7
Cs-134	1.60E+10	2.63E+10	-	8.14E+9	2.92E+9	1.42E+8	5.54E+9
Cs-136	8.06E+7	2.22E+8	-	1.18E+8	1.76E+7	7.79E+6	1.43E+8
Cs-137	2.39E+10	2.29E+10	-	7.46E+9	2.68E+9	1.43E+8	3.38E+9
Ba-140	2.77E+8	2.43E+5	-	7.90E+4	1.45E+5	1.40E+8	1.62E+7
Ce-141	6.35E+5	3.26E+5	-	1.43E+5	-	4.07E+8	4.84E+4
Ce-144	1.27E+8	3.98E+7	-	2.21E+7	-	1.04E+10	6.78E+6
Pr-143	1.48E+5	4.46E+4	-	2.41E+4	-	1.60E+8	7.37E+3
Nd-147	7.16E+4	5.80E+4	-	3.18E+4	-	9.18E+7	4.49E+3

Table 2-4 (cont'd)
Pathway Dose Factors - Atmospheric Releases
R(io), Ground Plane Pathway Dose Factors
(m2 * mrem/yr per uCi/sec)

Nuclide	Any Organ
H-3	-
C-14	-
P-32	-
Cr-51	4.68E+6
Mn-54	1.34E+9
Fe-55	-
Fe-59	2.75E+8
Co-58	3.82E+8
Co-60	2.16E+10
Ni-63	-
Zn-65	7.45E+8
Rb-86	8.98E+6
Sr-89	2.16E+4
Sr-90	-
Y-91	1.08E+6
Zr-95	2.48E+8
Nb-95	1.36E+8
Ru-103	1.09E+8
Ru-106	4.21E+8
Ag-110m	3.47E+9
Te-125m	1.55E+6
Te-127m	9.17E+4
Te-129m	2.00E+7
I-131	1.72E+7
Cs-134	6.75E+9
Cs-136	1.49E+8
Cs-137	1.04E+10
Ba-140	2.05E+7
Ce-141	1.36E+7
Ce-144	6.95E+7
Pr-143	-
Nd-147	8.40E+6

APPENDIX A

EVALUATION OF DEFAULT MPC VALUES

FOR LIQUID EFFLUENTS

APPENDIX A

Evaluation of Default MPC Value

for Liquid Effluent

In accordance with the requirements of Technical Specification 3.3.7.10 the radioactive effluent monitors shall be operable with alarm setpoints established to ensure that the concentration of radioactive material at the discharge point does not exceed the MPC value of 10 CFR 20, Appendix B, Table II, Column 2. The determination of allowable radionuclide concentration and corresponding alarm setpoint is a function of the individual monitor.

In order to limit the need for routinely having to reestablish the alarm setpoints as a function of changing radionuclide distributions, a default alarm setpoint can be established. This default setpoint can be based on an evaluation of the radionuclide distribution from the 1989 to 1991 release data of the liquid effluents from Hope Creek and the effective MPC value for this distribution.

The effective MPC value for a radionuclide distribution is calculated by the equation:

$$MPC_e = \frac{\Sigma\, C_i \text{ (gamma emitters only)}}{\Sigma \dfrac{C_i \text{ (gamma)}}{MPC_i} + \Sigma \dfrac{C_i \text{ (non-gamma)}}{MPC_i}} \qquad \text{(A.1)}$$

where:

MPC_e = an effective MPC value for a mixture of radionuclides (uCi/ml)

C_i = concentration of radionuclide i in the mixture

MPC_i = the 10 CFR 20, Appendix B, Table II, Column 2 MPC value for radionuclide (uCi/ml)

Considering the average effective MPC values from 1989 thru 1991 releases it is reasonable to select an MPC value of 1.6E-05 uCi/ml as typical of liquid radwaste discharges. This value will be reviewed and adjusted as necessary based on the distribution history of effluents from Hope Creek. Using the value of 1.6E-5 uCi/ml to calculate the default alarm setpoint, results in a setpoint that:

1) Will not require frequent re-adjustment due to minor variations in the nuclide distribution which are typical of routine plant operations, and;

2) Will provide for a liquid radwaste discharge rate (as evaluated for each batch release) that is compatible with plant operations (Refer to Table 1-1).

3) Will account for alpha emitters, H-3, Sr-90, Sr-89, and Fe-55 as required by Technical Specification 3.11.1.1.

TABLE A-1
CALCULATION OF EFFECTIVE MPC
HOPE CREEK

NUCLIDE	MPC	1991 ACTIVITY RELEASED (Ci)	1990 ACTIVITY RELEASED (Ci)	1989 ACTIVITY RELEASED (Ci)
Na-24	3.0E-05	2.05E-04	2.06E-05	9.28E-03
Cr-51	2.0E-03	5.60E-02	7.48E-02	1.85E-01
Mn-54	1.0E-04	3.42E-02	1.58E-01	2.02E-01
As-76	2.0E-05	8.39E-0	N/D	N/D
Co-58	9.0E-05	8.86E-04	8.07E-03	1.69E-02
Fe-59	6.0E-05	5.54E-03	8.76E-03	5.77E-02
Co-60	3.0E-05	7.51E-03	3.65E-02	4.56E-02
Zn-65	1.0E-04	5.94E-02	2.64E-01	3.22E-01
Y-91m	3.0E-03	2.48E-05	N/D	N/D
Y-91	3.0E-05	N/D	3.36E-05	N/D
Sr-92	7.0E-05	3.26E-04	5.57E-04	3.83E-04
Nb-95	1.0E-04	2.01E-05	N/D	4.33E-06
Nb-97	9.0E-04	N/D	N/D	2.14E-05
Tc-99m	6.0E-03	1.03E-05	N/D	4.61E-04
Sb-124	2.0E-05	N/D	1.49E-05	N/D
Sb-125	1.0E-04	N/D	N/D	5.82E-05
I-131	3.0E-07	N/D	6.73E-06	1.33E-05
I-133	1.0E-06	7.91E-06	N/D	N/D
Cs-137	2.0E-05	2.09E-05	N/D	3.94E-03
Hg-203	2.0E-05	2.72E-06	N/D	N/D
H-3	3.0E-03	2.45E+01	1.18E+01	1.04E+01
Fe-55	8.0E-04	6.23E-01	8.40E-01	2.06E-01
Total Curies (Gamma)		1.65E-01	5.52E-01	6.62E-01
Total Curies (Non-Gamma)		2.51E+01	1.26E+01	1.06E+01
SUM (Ci/MPCi) (Gamma)		1.39E+03	5.82E+03	6.93E+03
SUM (Ci/MPCi) (Non-Gamma)		8.95E+03	4.98E+03	3.71E+03
MPCe (uCi/ml) (Beta Corrected)		1.60E-05	5.11E-05	6.22E-05

N/D=Not detected

APPENDIX B

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS

LIQUID RADIOACTIVE EFFLUENT

APPENDIX B

Technical Basis for Effective Dose Factors - Liquid Effluent Releases

The radioactive liquid effluents from Hope Creek from 1989 through 1991 were evaluated to determine the dose contribution of the radionuclide distribution. This analysis was performed to evaluate the use of a limited dose analysis for determining environmental doses, providing a simplified method of determining compliance with the dose limits of Technical Specification 3.11.1.2. For the expected radionuclide distribution of effluent from Hope Creek during 1989 to 1991, the controlling organ is the liver. The calculated liver dose is predominately a function of the Zn-65 and Fe-55 releases. The radionuclides, Zn-65 and Fe-55 also contribute the large majority of the calculated total body dose. The results of this evaluation are presented in Table B-1.

For purposes of simplifying the details of the dose calculation process, it is conservative to identify a controlling, dose significant radionuclide and limit the calculation process to the use of the dose conversion factor for this nuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a dose calculation method that is simplified while also being conservative.

For the evaluation of the maximum organ dose, it is conservative to use the Zn-65 dose conversion factor (5.13E5 mrem/hr per uci/ml). By this approach, the maximum organ dose will be overestimated since this nuclide has the highest organ dose fraction of all the radionuclides evaluated. For the total body calculation, the Zn-65 dose factor (2.32E5 mrem/hr per uCi/ml, total body) is the highest among the identified dominant nuclides.

For evaluating compliance with the dose limits of technical Specification 3.11.1.2, the following simplified equations may be used:

<u>Total Body</u>

$$D_{tb} = \frac{8.35E\text{-}04 * Vol}{CTBD} * A_{i,tb} * C_i \qquad (B.1)$$

Where:

D_{tb} = dose to the total body (mrem)
$A_{i,tb}$ = 2.32E5, total body ingestion dose conversion factor for Zn-65 where A is dose conversion factor, i is isotope which is Zn-65, and TB is the total body (mrem/hr per uCi/ml)
VOL = volume of liquid effluent released (gal)
C_i = total concentration of all radionuclides (uCi/ml)
CTBD = average cooling tower blowdown discharge rate during release period (gal/min)
8.35E-04 = conversion factor (1.67E-2 hr/min) and the near field dilution factor 0.05

Substituting the value for the Zn-65 total body dose conversion factor, the equation simplified to:

$$D_{tb} = \frac{1.94E2 * VOL}{CTBD} * \Sigma C_i \qquad (B.2)$$

Maximum Organ

$$Dmax = \frac{8.35E\text{-}4 * VOL * Aio, Liver}{CTBD} * \Sigma C_i \qquad (B.3)$$

Where:

Dmax = maximum organ dose (mrem)

Aio, Liver = 5.13E5, liver ingestion dose conversion factor for Zn-65 where A is dose conversion factor, i is isotope which is Zn-65 and O is maximum organ which is the liver (mrem/hr per uCi/ml).

Substituting the value for Aio the equation simplifies to:

$$Dmax = \frac{4.28E2 * VOL}{CTBD} * \Sigma C_i \qquad (B.4)$$

Tritium is not included in the limited analysis dose assessment for liquid releases, because the potential dose resulting from normal reactor releases is relatively negligible.

Near Field Dilution Factor

The near field dilution factor stems from NuReg-0133, Section 4.1. For plants with cooling towers, such as Hope Creek, a dilution factor is applicable so that the product of the average blowdown flow (in CFS) and the dilution factor is 1000 cfs or less. The average minimum cooling tower blowdown for Hope Creek is 1.90E4 GPM (from FSAR 11.2). This converts to 42 CFS, for conservatism a dilution factor of 20 will be used, giving a dilution flow of 880 CFS. This near field dilution factor of 20 is inverted to a multiple of 0.05, multiplied times the liquid effluent dose equations.

TABLE B-1
Adult Dose Contributions
Fish and Invertebrate Pathways
Hope Creek

Nuclide	Release (Ci)	TB Dose Frac.	GI-LLI Dose Frac.	Liver Dose Frac.	Year
Fe-55	2.06E-1	0.02	0.03	0.04	1989
Fe-55	8.40E-1	0.10	0.15	0.18	1990
Fe-55	6.23E-1	0.26	0.34	0.41	1991
Mn-54	2.02E-1	*	*	*	1989
Mn-54	1.58E-1	*	0.03	*	1990
Mn-54	3.42E-2	*	0.02	*	1991
Co-58	1.69E-2	*	*	*	1989
Co-58	8.07E-3	*	*	*	1990
Co-58	8.86E-4	*	*	*	1991
Fe-59	5.77E-2	0.05	0.25	0.06	1989
Fe-59	8.76E-3	*	0.05	*	1990
Fe-59	5.54E-3	0.02	0.09	0.02	1991
Co-60	4.56E-2	*	0.01	*	1989
Co-60	3.65E-2	*	0.01	*	1990
Co-60	7.51E-3	*	*	*	1991
Zn-65	3.22E-1	0.92	0.70	0.90	1989
Zn-65	2.64E-1	0.89	0.75	0.81	1990
Zn-65	5.94E-2	0.71	0.52	0.57	1991

* = Less than 0.01

APPENDIX C

TECHNICAL BASIS FOR EFFECTIVE DOSE FACTORS

GASEOUS RADIOACTIVE EFFLUENTS

APPENDIX C

Technical Basis for Effective Dose Factors - Gaseous Radioactive Effluents

Overview

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 typical radionuclide distributions of releases, can be applied to the total radioactivity releases to approximate the dose in the environment. Instead of having to perform individual radionuclide dose analysis only a single multiplication (i.e., Keff, Meff, or Neff times the total quantity of radioactive material releases) would be needed. The approach provides a reasonable estimate of the actual dose while eliminating the need for a detailed calculation technique.

Determination of Effective Dose Factors

Effective dose transfer factors are calculated by the following equations:

$$K_{eff} = \Sigma (K_i * f_i) \quad (C.1)$$

Where:

K_{eff} = the effective total body 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 relative to the total noble gas activity.

$$(L + 1.1M)_{eff} = \Sigma ((L_i + 1.1 M_i) * f_i) \quad (C.2)$$

Where:
$(L + 1.1M)_{eff}$ = 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.

$$M_{eff} = \Sigma (M_i * f_i) \tag{C.3}$$

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.

$$N_{eff} = \Sigma (N_i * f_i) \tag{C.4}$$

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 released.

Normally, it would be expected that past radioactive effluent data would be used for the determination of the effective dose factors. However, the noble gas releases from Hope Creek have a short history and with continued excellent fuel performance, has hampered efforts in collecting and detecting appreciable noble gas mixes of radionuclides. So, to provide a reasonable basis for the derivation of the effective noble gas dose factors, the source terms from ANSI N237-1976/ANS-18.1, "Source Term Specifications", Table 5 has been used as representing a typical distribution. The effective dose factors as derived are presented in Table C-1.

<u>Application</u>

To provide an additional degree of conservatism, a factor of 0.50 is introduced into the dose calculation process when the effective dose transfer factor is used. This conservatism provides additional assurance that the evaluation of doses by the use of a single effective factor will not significantly underestimate any actual doses in the environment.

For evaluating compliance with the dose limits of Technical Specification 3.11.2.2, the following simplified equations may be used:

$$D_g = \frac{3.17E-08}{0.50} * X/Q * M_{eff} * \Sigma Q_i \quad (C.5)$$

and

$$D_b = \frac{3.17E-08}{0.50} * X/Q * N_{eff} * \Sigma Q_i \quad (C.6)$$

Where:

D_g = air dose due to gamma emissions for the cumulative release of all noble gases (mrad)
D_b = air dose due to beta emissions for the cumulative release of all noble gases (mrad)
X/Q = atmospheric dispersion to the controlling site boundary (sec/m^3)
M_{eff} = 8.1E3, effective gamma-air dose factor (mrad/yr per uCi/m^3)
N_{eff} = 8.5E3, effective beta-air dose factor (mrad/yr per uCi/m^3)
Q_i = cumulative release for all noble gas radionuclides (uCi)
3.17E-08 = conversion factor (yr/sec)
0.50 = conservatism factor to account for the variability in the effluent data

Combining the constants, the dose calculation equations simplify to:

$$D_g = 5.14E-4 * X/Q * \Sigma Q_i \quad (C.7)$$
$$D_b = 5.39E-4 * X/Q * \Sigma Q_i \quad (C.8)$$

The effective dose factors are to be used on a limited basis for the purpose of facilitating the timely assessment of radioactive effluent releases, particularly during periods of computer malfunction where a detailed dose assessment may be unavailable.

TABLE C-1

Effective Dose Factors

Noble Gases - Total Body and Skin

Radionuclide	fi*	Total Body Effective Keff (mrem/y per uCi/m^3)	Skin Effective (L + 1.1 M) eff (mrem/y per uCi/m^3)
Kr83m	0.01	-----	-----
Kr85m	0.01	1.0E1	2.8E1
Kr87	0.04	2.4E2	6.6E2
Kr88	0.04	5.9E2	7.6E2
Kr89	0.27	4.5E3	7.9E3
Xe133	0.02	5.9E0	1.4E1
Xe135	0.05	9.0E1	2.0E2
Xe135m	0.06	1.9E2	2.6E2
Xe137	0.31	4.4E2	4.3E3
Xe138	0.19	1.7E3	2.7E3
Total		7.8E3	1.7E4

Noble Gases - Air

Radionuclide	fi*	Total Body Effective Keff (mrem/y per uCi/m^3)	Skin Effective (L + 1.1 M) eff (mrem/y per uCi/m^3)
Kr83m	0.01	------	3.0E0
Kr85m	0.01	1.2E1	2.0E1
Kr87	0.04	2.5E2	4.1E2
Kr88	0.04	6.1E2	1.2E2
Kr89	0.27	4.7E3	2.9E3
Xe133	0.02	7.0E0	2.1E1
Xe135	0.05	9.6E1	1.2E2
Xe135m	0.06	2.0E2	4.4E1
Xe137	0.31	4.7E2	3.9E3
Xe138	0.19	1.8E3	9.0E2
Total		8.1E3	8.4E3

* Based on noble gas distribution from ANSI N237-1976/ANS-18.1, "Source Term Specification".

APPENDIX D

TECHNICAL BASIS FOR EFFECTIVE DOSE PARAMETERS

GASEOUS RADIOACTIVE EFFLUENTS

APPENDIX D

Technical Basis for Effective Dose Parameters Gaseous Radioactive Effluent Releases

The pathway dose factors for the controlling infant age group were evaluated to determine the controlling pathway, organ and radionuclide. This analysis was performed to provide a simplified method for determining compliance with Technical Specification 3.11.2.3. For the infant age group, the controlling pathway is the grass - cow - milk (g/c/m) pathway. An infant receives a greater radiation dose from the g/c/m pathway than any other pathway. Of this g/c/m pathway, the maximum exposed organ including the total body, is the thyroid, and the highest dose contributor is radionuclide I-131. The results of this evaluation are presented in Table D-1.

For purposes of simplifying the details of the dose calculation process, it is conservative to identify a controlling, dose significant organ and radionuclide and limit the calculation process to the use of the dose conversion factor for the organ and radionuclide. Multiplication of the total release (i.e., cumulative activity for all radionuclides) by this dose conversion factor provides for a dose calculation method that is simplified while also being conservative.

For the evaluation of the dose commitment via a controlling pathway and age group, it is conservative to use the infant, g/c/m, thyroid, I-131 pathway dose factor (1.67E12m_2*mrem/yr per uCi/sec). By this approach, the maximum dose commitment will be overestimated since I-131 has the highest pathway dose factor of all radionuclides evaluated.

For evaluating compliance with the dose limits of Technical Specification 3.11.2.3, the following simplified equation may be used:

$$D_{max} = 3.17E-8 * W * RI-131 * \Sigma Q_i \quad (D.1)$$

Where:

D_{max} = maximum organ dose (mrem)

W = atmospheric dispersion parameter to the controlling location (s) as identified in Table 2-3.

X/Q = Atmospheric dispersion for inhalation pathway (sec/m^3)

D/Q = atmospheric disposition for vegetation, milk and ground plane exposure pathways (m^{-2})

Q_i = cumulative release over the period of interest for radioiodines and particulates (uCi).

3.17E-8 = conversion factor (yr/sec)

RI-131 = I-131 dose parameter for the thyroid for the identified controlling pathway.

= 1.05E12, infant thyroid dose parameter with the grass - cow - milk pathway controlling (m^2mrem/yr per uCi/sec)

The ground plane exposure and inhalation pathways need not be considered when the above simplified calculational method is used because of the overall negligible contribution of these pathways to the total thyroid dose. It is recognized that for some particulate radionuclides (e.g., Co-60 and Cs-137), the ground exposure pathway may represent a higher dose contribution than either the vegetation or milk pathway. However, use of the I-131 thyroid dose parameter for all radionuclides will maximize the organ dose calculation, especially considering that no other radionuclides has a higher dose parameter for any organ via any pathway than I-131 for the thyroid via the milk pathway.

The location of exposure pathways and the maximum organ dose calculation may be based on the available pathways in the surrounding environment of Hope Creek as identified by the annual land-use census (Technical Specification 3.12.2). Otherwise, the dose will be evaluated based on the predetermined controlling pathways as identified in Table 2-3.

TABLE D-1

Infant Dose Contributions

Fraction of Total Organ and Body Dose

	PATHWAYS	
Target Organs	Grass - Cow - Milk	Ground Plane
Total Body	0.02	0.15
Bone	0.23	0.14
Liver	0.09	0.15
Thyroid	0.59	0.15
Kidney	0.02	0.15
Lung	0.01	0.14
GI-LLI	0.02	0.15

TABLE D-2

Fraction of Dose Contribution by Pathway

Pathway	f
Grass-Cow-Milk	0.92
Ground Plane	0.08
Inhalation	N/A

APPENDIX E

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM - SAMPLE TYPE, LOCATION AND ANALYSIS

APPENDIX E
SAMPLE DESIGNATION

Samples are identified by a three part code. The first two letters are the power station identification code, in this case "SA". The next three letters are for the media sampled.

AIO = Air Iodine
APT = Air Particulates
ECH = Hard Shell Blue Crab
ESF = Edible Fish
ESS = Sediment
FPB = Beef
FPL = Green Leafy Vegetables
FPV = Vegetable (Various)
GAM = Game
IDM = Immersion Dose (TLD)
MLK = Milk
PWR = Potable Water (Raw)
PWT = Potable Water (Treated)
RWA = Rain Water (Precipitation)
SWA = Surface Water
VGT = Fodder Crops (Various)
WWA = Well Water

The last four symbols are a location code based on direction and distance from the site. Of these, the first two represent each of the sixteen angular sectors of 22.5 degrees centered about the reactor site. Sector one is divided evenly by the north axis and other sectors are numbered in a clockwise direction; i.e., 2=NNE, 3=NE, 4=ENE, etc. The next digit is a letter which represents the radial distance from the plant:

S = On-site location
A = 0-1 miles off-site
B = 1-2 miles off-site
C = 2-3 miles off-site
D = 3-4 miles off-site
E = 4-5 miles off-site
F = 5-10 miles off-site
G = 10-20 miles off-site
H = > 20 miles off-site

The last number is the station numerical designation within each sector and zone; e.g., 1,2,3,... For example; the designation SA-WWA-5D1 would indicate a sample in the SGS program (SA), consisting of well water (WWA), which had been collected in sector number 5, centered at 90' (due east) with respect to the reactor site at a radial distance of 3 to 4 miles off-site, (therefore, radial distance D). The number 1 indicated that this is sampling station #1 in that particular sector.

SAMPLING LOCATIONS

All sampling locations and specific information about the individual locations are given in Table E. Maps E-1 and E-2 show the locations of sampling stations with respect to the site.

TABLE E-1

STATION CODE	STATION LOCATION	SAMPLE TYPES
2S2	0.4 mi. NNE of vent	IDM
2S3	700 ft. NNE of vent; fresh water holding tank	WWA
5S1	1.0 mi. E of vent; site access road	AIO, APT, IDM
6S2	0.2 mi. ESE of vent; observation building	IDM,SOL
7SI	0.12 mi. SE of vent; station personnel gate	IDM
10S1	0.14 mi. SSW of vent; site shoreline	IDM
11S1	0.09 mi. SW of vent; site shoreline	IDM
11A1	0.2 mi. W of vent; outfall area	ECH, ESF, ESS, SWA
15A1	0.3 mi. NW of vent; cooling tower blowdown discharge line	ESS
16A1	0.7 mi. NNW of vent; south storm drain discharge line	ESS
12C1	2.5 mi. WSW of vent; west bank of Delaware River	ECH, ESF, ESS SWA
4D2	3.7 mi. ENE of vent; Alloway Creek Neck Road	IDM
5D1	3.5 mi. E of vent; Alloway Creek Neck Road	AIO, APT, IDM,
10D1	3.9 mi. SSW of vent; Taylor's Bridge Spur	IDM,SOL

TABLE E-1 (Cont'd)

STATION CODE	STATION LOCATION	SAMPLE TYPES
11D1	3.5 mi. SW of vent	GAM
14D1	3.4 mi. WNW of vent; Bay View, Delaware	IDM
2E1	4.4 mi. NNE of vent; local farm	IDM
3E1	4.1 mi. NE of vent; local	FPB, FPV, GAM, IDM, VGT, WWA
3E3	5.6 mi. NE of vent; local farm	FPV
7E1	4.5 mi. SE of vent; 1 mi. W of Mad Horse Creek	ESF, ESS, SWA
9E1	5.0 mi. SW of vent	IDM
11E2	5.0 mi. SW of vent	IDM
12E1	4.4 mi. WSW of vent; Thomas Landing	IDM
13E1	4.2 mi. W of vent; Diehl House Lab	IDM
16E1	4.1 mi. NNW of vent; Port Penn	AIO, APT, IDM SOL
1F1	5.8 mi. N of vent; Fort Elfsborg	AIO, APT, IDM SOL
1F2	7.1 mi. N of vent; midpoint of Delaware	SWA
2F2	8.7mi. NNE of vent; Salem Substation	AIO, APT, IDM, RWA
2F3	8.0 mi. NNE of vent; Salem Water Co.	PWR,PWT
2F4	6.3 mi. NNE of vent; local	FPV,FPL,SOL
2F5	7.5 mi. NNE of vent; Salem High School	IDM

TABLE E-1 (Cont'd)

STATION CODE	STATION LOCATION	SAMPLE TYPES
2F6	7.3 mi. NNE of vent; Southern Training Center	IDM
2F7	5.7 mi. NNE of vent; local farm	MLK,VGT,SOL
3F2	5.1 mi. NE of vent; Hancocks Bridge Municipal Building	IDM
3F3	8.6 mi. NE of vent; Quinton Township School	IDM
5F1	6.5 mi. E of vent	SOL,IDM
5F3	6.5 mi. E of vent; local farm	FPL
6F1	6.4 mi. ESE of vent; Stow Neck Road	IDM
7F2	9.1 mi. SE of vent; Bayside, NJ	IDM
10F2	5.8 mi. SSW of vent	IDM
11F1	6.2 mi. SW of vent; Taylor's Bridge Delaware	IDM
11F3	5.3 mi. SW of vent; Townsend, DE	MLK,VGT,SOL
12F1	9.4 mi. WSW of vent; Townsend Elem. School	IDM
13F2	6.5 mi. W of vent; Odessa, DE	IDM
13F3	9.3 mi. W of vent; Redding Middle School, Middletown, DE	IDM
13F4	9.8 mi. W of vent; Middletown, DE	IDM
14F2	6.6 mi. WNW of vent; Boyds Corner	IDM
14F3	5.4 mi. WNW of vent; local farm	FPV
14F4	7.6 mi. WNW of vent; local farm	MLK,SOL,VGT
15F3	5.4 mi. NW of vent	IDM

TABLE E-1 (Cont'd)

STATION CODE	STATION LOCATION	SAMPLE TYPES
16F1	6.9 mi. NNW of vent; C&D Canal	ESS, SWA
16F2	8.1 mi. NNW of vent; Delaware City Public School	IDM
1G1	10.3 mi. N of vent; local farm	FPV
1G3	19 mi. N of vent; Wilmington, DE	IDM
2G2	13.5 mi. NNE of vent; local farm	FPV
3G1	17 mi. NE of vent; local farm	IDM, MLK, VGT SOL
10G1	12 mi. SSW of vent; Smyrna, DE	IDM
16G1	15 mi. NNW of vent; Greater Wilmington Airport	IDM
3H1	32 mi. NE of vent; National Park, NJ	IDM
3H3	110 mi. NE of vent; Research and Testing Laboratory	AIO, APT, IDM
3H5	25 mi. NE of vent; local farm	FPL, FPV

SAMPLES COLLECTION AND ANALYSIS

Sample	Collection Method	Analysis
Air Particulate	Continuous low volume air sampler. Sample collected every week along with the filter change.	Gross Beta analysis on each weekly sample. Gamma spectrometry shall be performed if gross beta exceeds 10 times the yearly mean of the control station value. As well one sample is analyzed > 24 hrs after sampling to allow for radon and thorium daughter decay. Gamma isotopic analysis on quarterly composites.
Air Iodine	A TEDA impregnated charcoal cartridge is connected to air particulated air sampler and is collected weekly at filter change.	Iodine 131 analysis are performed on each weekly sample.
Crab and Fish	Two batch samples are sealed in a plastic bag or jar and frozen semi-annually or when in season.	Gamma isotopic analysis of edible portion on collection.
Sediment	A sediment sample is taken semi-annually.	Gamma isotopic analysis semi-annually.
Direct	2 TLD's will be collected from each location quarterly.	Gamma dose quarterly

SAMPLE COLLECTION AND ANALYSIS (Cont'd)

Sample	Collection Method	Analysis
Milk	Sample of fresh milk is collected for each farm semi-monthly when cows are in pasture, monthly at other times.	Gamma isotopic analysis and I-131 analysis on each sample on collection.
Water (Rain, Potable, Surface)	Sample to be collected monthly providing winter icing conditions allow.	Gamma isotopic monthly H-3 on quarterly surface sample, monthly on ground water sample.