UNION ELECTRIC Callaway Plant	CALLAWAY PLANT EMERGENCY PREPAREDNESS DEPARTMENT CALCULATION COVER SHEET	EPCI - 94 - 03 Rev. 0 Page 1 of 21

SUBJECT:

PC Dose Calculation Bases

PURPOSE AND SCOPE:

This bases documents the mathematical model used by PC Dose.

ASSUMPTIONS:

1. Only decay of short lived radioiodines based on default isotopic mixtures is considered in the calculations for holdup in Containment or Auxiliary buildings.
2. For Field Monitoring Team Iodine Sampling and Analysis, all iodines are assumed to be based on measured or default isotopic mixes. Since Iodine 131 has the highest conversion factor for μCi/cc to Rem/hr of all the radioiodines, decay of short lived radioiodines will be performed when using default isotopic mixtures.
3. Readings from Wide Range Gas Monitors (WRGM) are assumed to be from noble gases.
4. All releases are assumed to be ground level releases since all possible release points are effectively lower than two and one-half times the height of adjacent solid structures (ref. 4).
5. Building wake affect is not considered. This is a conservative assumption.
6. Effective Dose Equivalent (EDE) from external exposure to gamma emitting radiation, as referred to in ref. 2, is assumed to be equal to the Deep Dose Equivalent (DDE).
7. The Deep Dose Equivalent is assumed to be measurable by Field Monitoring Team survey instruments.
8. The contribution to TEDE by ground shine cannot be properly measured until the plume has past. A calculated value for ground shine can be derived from plume shine measurements and air samples obtained in the field.
9. Plume meander is not considered for wind speeds less than 6 meters per second. This is a conservative assumption.

	CHECKLIST	
PREPARED BY: Paul Sichak Administrator Nuclear Affairs 9/12/94 (Signature/Title/Date)	Purpose & Scope	☒
	Results	☐
REVIEWED BY: [signature] Supv. Engr. - Radiological Engr. 9/15/94 (Signature/Title/Date)	Assumptions	☒
	References	☒
APPROVED BY: [signature] Supervisor, EP 9/16/94 (Signature/Title/Date)	Attachments	☒
	Analysis	☒

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ASSUMPTIONS (cont'd):

10. The equations in this calculation assume a straight line Gaussian Model where the material being diffused is a stable gas or aerosol which remains suspended for long periods of time and where the materials exhibit normal distribution in both horizontal and vertical directions.

11. The source term (ref 6) used for a LOCA is primarily due to an unfiltered release from containment directly into the atmosphere. It does however, consider a portion of the release through the ECCS system to be filtered. it is conservative then, to use the default LOCA source term for all LOCA events even though a release may be through the Unit Vent, a filtered release path.

REFERENCES:

1. "Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I", USNRC Regulatory Guide 1.109, Revision 1, October, 1977.
2. "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents", EPA-400-R-92-001, October, 1991.
3. "Unit Vent Wide Range Gas Monitor Correction Factors for LOCA and SGTR Accident Based on EP Dose Assessment Source Term", Union Electric Licensing and Fuels Calculation ZZ-355, Rev. 0, August, 1994.
4. "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants", USNRC Regulatory Guide 1.145, Revision 1, November, 1982.
5. "Radiological Assessment, A Textbook on Environmental Dose Analysis", USNRC Nureg/CR-3332, September, 1983.
6. "EP Dose Assessment Source Term", Union Electric Calculation ZZ-341, Revision 0, June, 1994.
7. "10 CFR" 20.1003, Organ Weighting Factor
8. "Radiological Health Handbook", USDHEW, January, 1970.
9. SFR-GF-052A
10. SFR-GC-039A
11. RFR-00416A, 9-07-84
12. Purchase Specification No. 10466-J-374A, Rev. 7, Appendix S, Steam Release Calculation and Table 3, Ventilation System Flows.
13. "PORV Monitors Conversion Factor and Response Based on a Realistic Steam Generator Tube Rupture Accident", Union Electric Calculation ZZ-345, Rev. 0, June, 1994.

14. "Turbine Driven Auxiliary Feedwater Pump Exhaust Monitor Conversion Factor and Response Based on a Realistic Steam Generator Tube Rupture Accident", Union Electric Calculation ZZ-347, Rev. 0, June, 1994.

ATTACHMENTS:

Attachment 1	WRGM Detector Correction Factors
Attachment 2	$\frac{X}{Q}$ Values
Attachment 3	Corrected ΔT Values for the Callaway Primary Met Tower
Attachment 4	Default Flowrate for Ventilation Systems
Attachment 5	Default Isotopic Mix for LOCA
Attachment 6	Default Isotopic Mix for SGTR
Attachment 7	Filter Correction Factors
Attachment 8	Decay Data

ANALYSIS:

I. BASIC CALCULATION

The PC Dose Model is a straight-line Gaussian Plume Diffusion Model that calculates the relative concentrations and resulting doses downwind from a radiological release. Two doses are calculated by the Model. The two are:

1. Total Effective Dose Equivalent;
2. Committed Dose Equivalent to the thyroid.

The general equation calculates the doses D in Rem from a ground level release at points of interest using the following relationship (eq. B-4, ref. 1).

$$D = \sum_i \frac{X}{Q} \bullet Q_i \bullet DCF_i \bullet T \bullet \text{[illegible]} \qquad \text{(eq. 1)}$$

where

i	=	Index of radionuclide.
Q_i	=	Release rate of radionuclide i, in μCi/sec.
DCF_i	=	Dose correction factor for radionuclide i (Table 5-1, ref. 2, for TEDE and Table 5-2, ref. 2, for CDE Thyroid), in Rem - cc/μCi-hr.

T = Time of exposure, in hours.

$\frac{X}{Q}$ = Atmospheric dispersion factor, in sec/m^3.

UCF = Unit Correction Factor $1.0E-6\frac{m^3}{cc}$ (ref. 8).

A. Atmospheric Dispersion Factor ($\frac{X}{Q}$)

All possible points of release from the Callaway Plant are effectively lower than two and one-half times the height of adjacent solid structures and, since plume meander is not considered (assumption 9), the following equation is selected for the ground level centerline $\frac{X}{Q}$ values (eq. 1, ref. 4):

$$\frac{X}{Q} = \frac{1}{\overline{U}_{10}(\pi\sigma_y\sigma_z + \frac{A}{2})} \quad \text{(eq. 2)}$$

where

π = 3.14159.

$\overline{U}_{10}$ = Wind speed at 10 meters above plant grade, in m/sec.

σ_y = Lateral plume spread, in m, a function of atmospheric stability and distance (Fig. 1, ref. 4).

σ_z = Vertical plume spread, in m, a function of atmospheric stability and distance (Fig. 2, ref. 4).

A = Smallest vertical-plane cross-sectional area of the reactor building, in m^2. (Other structures or a directional consideration may be justified when appropriate.) The value $\frac{A}{2}$ is assumed to be equal to 0 since this value will provide the most conservative $\frac{X}{Q}$.

$\frac{X}{Q}$ = Atmospheric dispersion factor, in $\frac{sec}{m^3}$.

$\frac{\chi \bar{U}}{Q}$ values for various stability classes and distances are provided in Attachment 2.

B. Stability Class (A-G)

Seven classes of atmospheric stability have been developed that correlate atmospheric stability with change in temperature at various heights (Table 2.4, ref. 5) and with the standard deviation of wind direction (Table 2.5, ref. 3). Attachment 3 provides the temperature change with height (°C/100 m) and the corrected values applicable to the Callaway Plant meteorological tower (90 meter primary tower). The following relation applies.

$$T_C = T_o \bullet \frac{100\,m}{\Delta H} \quad \text{(eq. 3)}$$

where

T_C	=	Corrected temperature for various stability classes, in °C.
T_O	=	Temperature change for various stability classes per 100 meters, (Table 2.4, ref. 5), in °C.
ΔH	=	Difference in height between the two temperature detectors located on the primary meteorological tower.

C. Release Rate Determination (Q_i)

Two accident types have been analyzed (ref. 6) that have sufficient source terms that could result in protective action recommendations being made for the general public. They are:

1. Loss of Coolant Accident (LOCA);
2. Steam Generator Tube Rupture (SGTR).

For the LOCA, the only monitored release path is through the unit vent which is filtered. Unmonitored release paths include the Auxiliary Building or a direct release from Containment which are unfiltered. For a SGTR, three monitored release paths exist. One is through the Steam Generator Power Operated Relief Valves (PORVs) and the second is through the Auxiliary Feed Pump Turbine Discharge. Both of these are unfiltered. The other is through the Condenser Air Removal System and out the Unit Vent which is a filtered release.

Unmonitored releasepaths could involve the Containment Building, the Steam Generator Safeties, the Auxiliary Building, or the Turbine Building. Release pathways can be categorized into three main groups:

1. Unit Vent;
2. S/G PORVs, AFTD;
3. Unmonitored Release Pathways.

When gross release rates (SG PORVs and AFTD) and Noble Gas release rates (Unit Vent) can be obtained directly from either the plant computer or the RM-11 system, release rates for radionuclide i (Q_i) can be obtained as follows:

For Unit Vent WRGM:

$$Q_i = Q \div MCF \bullet \frac{X_i \bullet ICF_i \bullet FCF_i}{\sum X_{NG_i}} \quad \text{(eq. 4)}$$

For PORV and AFTD Monitors:

$$Q_i = Q \bullet \frac{X_i \bullet ICF_i \bullet FCF_i}{\sum X_i \bullet ICF_i \bullet FCF_i} \quad \text{(eq. 5)}$$

where

i = Index of radionuclide

Q_i = Release rate for radionuclide i, in μCi/sec

MCF = Monitor Correction Factor for the Wide Range Gas Monitors, see Attachment 1 from ref. 3. The lowest correction value for the mid and high range monitor was used. This is conservative. The highest value measurable on the low range monitor would not provide sufficient projected dose to warrant making protective action recommendations. For an accident involving a significant release, the low and mid range monitors would more than likely be isolated. For all other monitors, this value is = 1.

Q = Release rate obtained from release rate monitor, or calculated value (see eq. 6).

X_i = Concentration of radionuclide i, in μCi/cc. This value can be from a default isotopic spectrum (Attachments 5 and 6) in Ci, or from a grab sample isotopic analysis.

X_{NG_i} = Concentration of noble gas radionuclide *i* in μCi/cc. This value can be from a default isotopic spectrum (Attachments 5 and 6) in Ci, or from a grab sample isotopic analysis.

ICF_i = Iodine Correction Factor for default spectrums. For radioiodines, this value can be derived from eq. 7. For all other radionuclides, this value is equal to one (1).

FCF_i = Filter Correction Factor. For noble gases, this value is 1. For radioiodines, see Attachment 7.

Where a release rate is not available but a gross monitor concentration is, the release rate (Q) can be obtained as follows:

$$Q = FR \bullet X \qquad \text{(eq. 6)}$$

where

Q = Release rate

FR = Flowrate into the atmosphere, in cc/sec

X = Concentration from effluent monitor, in μCi/cc

1) Flowrate (FR)

The flowrate can be obtained from the following sources:

a. Default flowrate based on design;

b. Measured flowrate;

c. Calculated flowrate based on system parameters.

For releases during emergencies, default flowrates or calculated flowrates are used. Default flowrates based on design and plant computer calculated flowrates based on system parameters are included in Attachment 4. Default flowrates and calculated flowrates based on system parameters can be obtained from the Plant Computer System (ref. 9, 10, 11, 12).

D. Iodine Correction Factor (ICF_i)

The Iodine Correction Factor is used for calculations where default isotopic spectrums are used. Since I-132, I-133, I-134, and I-135 all have half lives shorter than I-131, over a period

of time (2-3 hours), the ratio of I-131 to these other iodines would increase. Since I-131 would be at a higher ratio, the dose rate to gross iodine concentration would increase since I-131 has the highest dose rate conversion factor of all the default iodines. To use the default spectrums without allowing for decay of short lived radioiodines would be nonconservative. Since the default isotopic mix is assumed to be at 100% power, a new mixture will have to be calculated to allow for decay based on the time after shutdown. This new spectrum can be obtained as follows:

$$ICF_i = \frac{A_{n_i}}{A_{o_i}} = e^{-\lambda_i t} \qquad \text{(eq. 7)}$$

where

i	=	Index of radioiodines
ICF_i	=	Iodine Correction Factor, unitless
A_{n_i}	=	New Activity of default spectrum for radioiodine i, in Ci
A_{o_i}	=	Original Activity of default spectrum for radioiodine i, in Ci
λ_i	=	Decay constant for radioiodine i, in min^{-1}
t	=	Time after shutdown, in minutes

II. FIELD MONITORING DATA DOSE CALCULATION

Dose calculations can be performed using data from field monitoring teams. Doses can be calculated from:

1. Gamma dose rate survey instruments;
2. Gross Iodine grab samples (Thyroid Dose only);
3. A combination of gamma dose rate survey readings and gross iodine grab samples.

The TEDE which is used to determine protective action recommendations is equal to the sum of the CEDE from inhalation, the DDE from emersion in a gamma emitting radioactive plume (plume shine), and the DDE from exposure to deposited radioactive materials on the ground (ground shine). The CEDE can be evaluated from field monitoring air sample results. The DDE from plume shine can be measured by field monitoring teams using direct reading survey instruments. The DDE from ground shine cannot be immediately measured by field monitoring teams for two reasons. The dose rate from ground shine is directly related to a time integrated air concentration. The dose rate due to ground shine will continually increase during the plume phase (allowing for decay and daughter products) and a decrease in plume concentration will not result in an

instantaneous decrease in ground shine dose rates (unlike plume shine). Therefore, ground shine dose cannot be calculated from ground shine dose rates during the early phase of a release when there is significant background radiation from plume shine and the amount of deposited radioactive materials is relatively small. It is not until the plume has passed and an actual radiation survey of the ground can be completed that a measurable dose rate can be obtained. This is too late for PARs based on plume phase dose assessment. Additionally, the DDE contribution to the EPA Protective Action Guide TEDE limit from ground shine is based on a 96 hour exposure period. A relationship can be established between the air concentration measured by FMT air sample analysis, or from direct reading FMT survey instruments, and the resulting ground shine DDE based on a 96 hour exposure period. Dose Correction Factors (Table 5-5 and 5-3, ref. 2) can be used to calculate DDE from ground shine based on this relationship.

The results can be used to obtain:

1. TEDE
2. Thyroid CDE

A. Doses Based Solely on Gross Iodine Samples

Where only a centerline gross iodine air sample is obtained without a respective gamma dose rate measurement, an estimation of the Thyroid CDE can be obtained.

1. To obtain Thyroid CDE:

$$CDE_{Thy} = \sum_i I_{Conc} \bullet DCFI_i \bullet \frac{XI_i \bullet ICF_i \bullet FCF_i}{\sum_i XI_i \bullet ICF_i \bullet FCF_i} \bullet T \qquad \text{(eq. 8)}$$

where

CDE_{Thy} = Committed Dose Equivalent (CDE) to the Thyroid, in Rem.

I_{Conc} = Gross iodine concentration from grab sample, in μCi/cc.

DCF_i = Dose Conversion Factor for I_i (Table 5-4, ref. 2), in Rem - cc/μCi - hr.

T = Time of exposure (release duration), in hours.

XI_i = Concentration for radioiodine i, μCi/cc LOCA and SGTR default spectrums. (Attachments 5 and 6) may be used if a representative mix from a grab sample is not available. If defaults are used, units are in Ci.

ICF_i = Iodine Correction Factor for default spectrums (see eq. 7).

FCF_i = Filter Correction Factor. For noble gases, this value is 1. For radioiodines, see Attachment 7.

B. Doses Based On Gamma Dose Rate and Gross Iodine

Where both a gamma dose rate survey and a gross iodine sample are obtained for the plume centerline, the TEDE and Thyroid CDE may be obtained.

1. To obtain Thyroid CDE, use eq. 7.
2. To obtain TEDE, the following equation is used:

$$TEDE = DDE_{PS} + CDE_{Thy} \bullet W_T + DDE_{GS} \qquad \text{(eq. 9)}$$

where

$TEDE$ = Total Effective Dose Equivalent from internal and external exposure, in Rem.

DDE_{PS} = Deep Dose Equivalent from external gamma exposure due to plume shine. This is the measured dose rate, in R/hr, times the exposure time (release duration), in hours.

CDE_{Thy} = Committed Dose Equivalent (CDE) to the thyroid, in Rem (from eq. 8)

W_T = Organ Dose Weighting Factor (ref. 7). For the thyroid, this value = .03.

$$DDE_{GS} = DDE_{PS} \bullet \frac{\sum_i DCF_{DDE_{GS_i}} \bullet X_i \bullet ICF_i \bullet FCF_i}{\sum_i DCF_{DDE_{PS_i}} \bullet X_i \bullet ICF_i \bullet FCF_i} \qquad \text{(eq. 10)}$$

where

i = Index of radionuclide.

DDE_{GS} = Deep Dose Equivalent from external gamma radiation from deposited material, in Rem.

DDE_{PS} = Deep Dose Equivalent from external gamma exposure due to plume shine, in Rem.

$DCF_{DDE\ GS_i}$ = Deep Dose Equivalent Dose Conversion Factor for radionuclide *i* due to ground shine (Table 5-5, ref. 2), in Rem - cc/μCi-hr.

$DCF_{DDE\ PS_i}$ = Deep Dose Equivalent Dose Conversion Factor for radionuclide *i* due to plume shine (Table 5-3, ref. 2) in Rem - cc/μCi-hr.

X_i = Concentration for radionuclide *i*, in μCi/cc. LOCA and SGTR default spectrums (Attachments 5 and 6) may be used if grab sample data are not available. If default spectrums are used, units are in Ci.

ICF_i = Iodine Correction Factor for default spectrums. For radioiodines, this value can be derived using eq. 7. For all other radionuclides, this value is equal to one (1).

FCF_i = Filter Correction Factor. For noble gases, this value is 1. For radioiodines, see Attachment 7.

C. Doses Based Solely on Gamma Dose Rate Measurement

Where only a centerline dose rate reading from plume shine is obtained without a respective iodine grab sample, an estimation of the thyroid CDE and TEDE can be obtained.

1. To obtain Thyroid CDE:

$$CDE_{Thy} = DDE_{PS} \bullet \frac{\sum_i DCF_{Thy_i} \bullet X_i \bullet ICF_i \bullet FCF_i}{\sum_i DCF_{DDE_{PS_i}} \bullet X_i \bullet ICF_i \bullet FCF_i} \qquad \text{(eq. 11)}$$

where

i = Index of radionuclide.

CDE_{Thy} = Committed Dose Equivalent (CDE) to the thyroid, in Rem.

DDE_{PS} = Deep Dose Equivalent from plume shine, in Rem. This is measured dose rate, in R/hr times the exposure rate, in hours.

DCF_{Thy_i} = Thyroid Dose Conversion Factor for radionuclide *i* due to plume inhalation (Table 5-4, ref. 2), in Rem - cc/μCi-hr.

$DCF_{DDE\ PS_i}$ = Deep Dose Equivalent Dose Conversion Factor for radionuclide *i* due to plume shine (Table 5-3, ref. 2), in Rem - cc/μCi-hr.

X_i = Concentration for radionuclide *i*, in μCi/cc. LOCA and SGTR default spectrums (Attachments and 6) may be used if grab sample data are not available. If default spectrums are used, units are in Ci.

ICF_i = Iodine Correction Factor for default spectrums. For radioiodines, this value can be derived using eq. 7. For all other radionuclides, this value is equal to one (1).

FCF_i = Filter Correction Factor. For noble gases, this value is 1. For radioiodines, see Attachment 7.

2. To obtain TEDE:

$$TEDE = DDE_{PS} \bullet \frac{\sum_i DCF_{TEDE_i} \bullet X_i \bullet ICF_i \bullet FCF_i}{\sum_i DCF_{DDE\ PS_i} \bullet X_i \bullet ICF_i \bullet FCF_i} \qquad \text{(eq. 12)}$$

where

i = Index of radionuclide.

$TEDE$ = Total Effective Dose Equivalent, in Rem.

DDE_{PS} = Deep Dose Equivalent from plume shine, in Rem.

DCF_{TEDE_i} = Total Effective Dose Equivalent Dose Conversion Factor for radionuclide *i* (Table 5-1, ref. 2), in Rem - cc/μCi-hr.

$DCF_{DDE\ PS_i}$ = Deep Dose Equivalent Dose Conversion Factor for radionuclide *i* due to plume shine (Table 5-3, ref. 2), in Rem - cc/μCi-hr.

X_i = Concentration for radionuclide i, in μCi/cc. LOCA and SGTR default spectrums (Attachments 5 and 6) may be used if grab sample data are not available. If default spectrums are used, units are in Ci.

ICF_i = Iodine Correction Factor for default spectrums. For radioiodines, this value can be derived using eq. 7. For all other radionuclides, this value is equal to one (1).

FCF_i = Filter Correction Factor. For noble gases, this value is 1. For radioiodines, see Attachment 7.

D. Projecting Doses at Other Locations from FMT Data

After plume centerline doses are determined at one location, an estimation of doses at other plume centerline locations can be obtained. The following relation applies:

$$D_{LX} = D_{LK} \bullet \frac{X / Q_{LX}}{X / Q_{LK}} \quad \text{(eq. 13)}$$

where

D_{LX} = Unknown dose at plume centerline location X, in Rem.

D_{LK} = Measured or calculated dose at plume centerline location K, in Rem.

X/Q_{LX} = Atmospheric Dispersion Factor at plume centerline location X, in sec/m^3.

X/Q_{LK} = Atmospheric Dispersion Factor at plume centerline location K, in sec/m^3.

WRGM CORRECTION FACTORS

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Accident Type	Correction Factor
LOCA	1.11
SGTR	1.30

DISPERSION FACTOR Xu/Q (SEC-M/SEC-M^3)

	DISTANCE										
Stability Class	EAB	1 Mile	2 Miles	3 Miles	4 Miles	5 Miles	6 Miles	7 Miles	8 Miles	9 Miles	10 Miles
A	2.0E-6	1.1E-6	5.4E-7	4.0E-7	3.2E-7	2.5E-7	2.1E-7	1.9E-7	1.8E-7	1.7E-7	1.6E-7
B	1.2E-5	7.2E-6	9.0E-7	5.0E-7	4.0E-7	3.2E-7	2.7E-7	2.3E-7	2.1E-7	2.1E-7	1.9E-7
C	3.2E-5	2.1E-5	5.9E-6	2.8E-6	1.8E-6	1.3E-6	9.9E-7	8.1E-7	6.3E-7	5.4E-7	4.5E-7
D	1.1E-4	8.1E-5	2.3E-5	1.2E-5	8.1E-6	5.9E-6	4.4E-6	3.7E-6	3.3E-6	2.7E-6	2.2E-6
E	2.1E-4	1.4E-4	4.0E-5	2.4E-5	1.5E-5	1.3E-5	9.9E-6	8.6E-6	7.2E-6	6.8E-6	5.4E-6
F	5.0E-4	3.4E-4	1.1E-4	5.9E-5	4.0E-5	3.2E-5	2.4E-5	2.2E-5	1.9E-5	1.6E-5	1.4E-5
G	1.1E-3	8.6E-4	2.7E-4	1.4E-4	1.0E-4	8.1E-5	6.3E-5	5.4E-5	4.5E-5	4.2E-5	3.7E-5

Note: To obtain X/Q, divide the above dispersion factors (Xu/Q) by the wind speed in M/S.

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ATTACHMENT 3

CORRECTED DELTA T VALUES
FOR THE CALLAWAY PLANT PRIMARY MET TOWER

Stability Class	NUREG/CR 3332 (°C/100m)	90m-10m (°C/80m)	60m-10m (°C/50m)
A	$\Delta T \leq -1.9$	$\Delta T \leq -1.52$	$\Delta T \leq -0.95$
B	$-1.9 < \Delta T \leq -1.7$	$-1.52 < \Delta T \leq -1.36$	$-0.95 < \Delta T \leq -0.85$
C	$-1.7 < \Delta T \leq -1.5$	$-1.36 < \Delta T \leq -1.20$	$-0.85 < \Delta T \leq -0.75$
D	$-1.5 < \Delta T \leq -0.5$	$-1.20 < \Delta T \leq -0.40$	$-0.75 < \Delta T \leq -0.25$
E	$-0.5 < \Delta T \leq +1.5$	$-0.40 < \Delta T \leq +1.20$	$-0.25 < \Delta T \leq +0.75$
F	$+1.5 < \Delta T \leq +4.0$	$+1.20 < \Delta T \leq +3.20$	$+0.75 < \Delta T \leq +2.00$
G	$+4.0 < \Delta T$	$+3.20 < \Delta T$	$+2.00 < \Delta T$

ATTACHMENT 4

DEFAULT FLOWRATES for VENTILATION SYSTEMS

(RS) 9/16/94

	System Name	Fan Numbers	Flowrate (cfm)
Unit Vent			
	Area 5	CGF03A & CGF03B	16,500
	Condenser Air Removal	CGE01A &CGE01B	1,000
	Access Control Exhaust	CGK02A & CGK02B	6,000
	Fuel Bldg. Emerg. Exhaust	CGG02A & CGG02B	9,000
	Aux/Fuel Bldg. Normal Exhaust - Fast	CGL03A & CGL03B- Fast	32,000
	Aux/Fuel Bldg. Normal Exhaust - Slow	CGL03A & CGL03B- Slow	12,000
	Cont. SD Purge Exhaust	CGT01	20,000
	Cont. mini Purge Exhaust	CGT02	4,000
RW Vent	RW Bldg. Eff Flow	CGH01B & CGH01A	12,000

Default Isotopic Mix for LOCA

ISOTOPE	ACTIVITY RELEASED (Ci)	EPA-400 Table 5-1 TEDE DOSE RATE FACTOR rem-cm3/uCi-Hr	EPA-400 Table 5-4 Thyroid DOSE RATE FACTOR rem-cm3/uCi-Hr
* Kr-83m	2.79E+03	0.00E+00	
Kr-85	2.62E+04	1.30E+00	
Kr-85m	1.44E+04	9.30E+01	
Kr-87	8.01E+03	5.10E+02	
Kr-88	2.52E+04	1.30E+03	
Kr-89	5.72E+02	1.20E+03	
I-131	2.37E+03	5.30E+04	1.30E+06
Xe-131m	1.67E+04	4.90E+00	
I-132	1.16E+02	4.90E+03	7.70E+03
I-133	8.24E+02	1.50E+04	2.20E+05
Xe-133	1.65E+06	2.00E+01	
Xe-133m	2.54E+04	1.70E+01	
I-134	9.75E+01	3.10E+03	1.30E+03
I-135	3.32E+02	8.10E+03	3.80E+04
Xe-135	4.40E+04	1.40E+02	
Xe-135m	1.22E+03	2.50E+02	
Xe-138	4.82E+03	7.20E+02	

TOTAL N.G. 1.82E+06

* KR-83m is not included in the calculation for Unit Vent releases since the WRGM have a discriminator threshold level set at 60 KeV.

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Default Isotopic Mix for SGTR

ISOTOPE	ACTIVITY RELEASED (Ci)	EPA-400 Table 5-1 TEDE DOSE RATE FACTOR rem-cm3/uCi-Hr	EPA-400 Table 5-4 Thyroid DOSE RATE FACTOR rem-cm3/uCi-Hr
* Kr-83m	4.82E+00	0.00E+00	
Kr-85	1.77E+00	1.30E+00	
Kr-85m	2.38E+01	9.30E+01	
Kr-87	1.39E+01	5.10E+02	
Kr-88	4.45E+01	1.30E+03	
Kr-89	1.20E+00	1.20E+03	
I-131	3.13E-01	5.30E+04	1.30E+06
Xe-131m	4.19E+00	4.90E+00	
I-132	1.07E-01	4.90E+03	7.70E+03
I-133	4.37E-01	1.50E+04	2.20E+05
Xe-133	1.14E+03	2.00E+01	
Xe-133m	2.29E+01	1.70E+01	
I-134	4.42E-02	3.10E+03	1.30E+03
I-135	2.13E-01	8.10E+03	3.80E+04
Xe-135	6.81E+01	1.40E+02	
Xe-135m	3.11E+00	2.50E+02	
Xe-137	2.15E+00	1.10E+02	
Xe-138	1.05E+01	7.20E+02	

TOTAL 1.34E+03

* KR-83m is not included in the calculation for Unit Vent releases since the WRGM have a discriminator threshold level set at 60 KeV.

ATTACHMENT 7 FILTER CORRECTION FACTORS

PD 9/16/94

	NG FCF	IODINE FCF
LOCA	1	1
SGTR Unit Vent (Filtered)	1	.01
SGTR PORV/Safeties (Unfiltered)	1	1

ATTACHMENT 8

DECAY DATA

9/16/94

NUCLIDE	HALF LIFE	λ (min^{-1})
I-131	8.04 d	5.99 E-5
I-132	2.29 h	5.04 E-3
I-133	20.80 h	5.55 E-4
I-134	52.6 m	1.32 E-2
I-135	6.6 h	1.75 E-3