OFFSITE DOSE CALCULATION MANUAL

GRAND GULF NUCLEAR STATION

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Revision No. 17

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GRAND GULF NUCLEAR STATION
OFFSITE DOSE CALCULATION MANUAL
SAFETY RELATED

EVALUATION APPLICABILITY

SAFETY EVALUATION	ENVIRONMENTAL EVALUATION
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INTRODUCTION

The Offsite Dose Calculation Manual (ODCM) describes the methodology and parameters used in the calculation of offsite doses resulting from radioactive liquid and gaseous effluents, in the calculation of liquid and gaseous effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Radiological Environmental Monitoring Program. The ODCM also contains (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by Technical Specification (TS) 5.5.4, and Technical Requirement 7.6.3.2, (2) descriptions of the information that is included in the Annual Radiological Environmental Operating and Annual Radioactive Effluent Release Reports required by TS 5.6.2 and 5.6.3, (3) a list and graphical description of the specific sample locations for the Radiological Environmental Monitoring Program, and (4) diagrams of the liquid and gaseous radwaste treatment systems.

Procedural details not associated with solid radioactive wastes which were previously located in the TS have been relocated to Appendix A of the ODCM. ODCM Revision 17 incorporates changes resulting from the Technical Specification Improvement Program (TSIP). Changes include:

- relocation of some information from Limiting Conditions for Operation (LCO) and Surveillance Requirements (SR) to the BASES,
- deletion of redundant information (e.g. definitions, LCO/SR applicabilities, SR frequencies and information previously maintained in both the TS and the ODCM),
- reformatting the LCO and SR,
- deleting blank pages,
- incorporating updated meteorological data into gaseous effluent dose calculations.

The ODCM will be maintained at the station for use as a reference guide and training document of accepted methodologies and calculations. Changes in the calculational methods or parameters will be incorporated into the ODCM in order to assure that the ODCM represents the present methodology in all applicable areas. Computer software to perform the described calculations will be maintained current with the ODCM.

Changes to the ODCM shall be accomplished as specified in TS 5.5.1. Records of reviews performed for changes made to the ODCM shall be retained for the duration of the Unit Operating License.

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1. Boegli, T. S., R. R. Bellamy, W. L. Britz, and R. L. Waterfield, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," NUREG-0133 (October 1978).

2. Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance witn 10CFR50, Appendix I, U.S. NRC Regulatory Guide 1.109 (March 1976).

3. Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR50, Appendix I, U.S. NRC Regulatory Guide 1.109, Rev. 1 (October 1977).

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5. "Final Safety Analysis Report," Mississippi Power and Light Company, Grand Gulf Nuclear Statica.

6. Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light - Water - Cooled Reactors, U.S. NRC Regulatory Guide 1.111 (March 1976).

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8. Age-Specific Radiation Dose Commitment Factors for a One-Year Chronic Intake, NUREG-0172, November 1977.

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1.0 LIQUID EFFLUENTS

1.1 Liquid Effluent Monitor Setpoints

1.1.1 Liquid Radwaste Effluent Line Monitors

Liquid Radwaste Effluent Line Monitors provide alarm and automatic termination of release prior to exceeding ten times the concentration limits specified in 10CFR20, Appendix B, Table 2, Column 2 at the release point to the unrestricted area. To meet this specification and for the purpose of implementation of LCO 6.3.9, the alarm/trip setpoints for liquid effluent monitors and flow measurement devices are set to assure that the following equation is satisfied:

$$\frac{cf}{F + f} \leq C \qquad (1)$$

where:

C = ten times the effluent concentration limit (LCO 6.11.1) implementing 10CFR20 for the site, in µCi/ml.

c = The setpoint, representative of a radioactivity concentration in µCi/ml, of the radioactivity monitor measuring the radioactivity in the waste tank effluent line prior to dilution and subsequent release; the setpoint, which is inversely proportional to the volumetric flow of the effluent line and directly proportional to the volumetric flow of the dilution stream plus the waste tank effluent stream, represents a value which, if exceeded, would result in concentrations exceeding ten times the limits of 10CFR20 in the unrestricted area.

f = the waste tank effluent flow setpoint as measured at the radiation monitor location, in volume per unit time, but in the same units as F, below.

F = the dilution water flow setpoint as measured prior to the release point, in volume per unit time.

At Grand Gulf Unit 1, the available dilution water flow (F) should be constant for a given release, and the waste tank flow (f) and monitor setpoint (c) are set to meet the condition of equation 1 for a given effluent concentration, C. The method by which this is accomplished is as follows:

Step 1) The isotopic concentration for a waste tank to be released is obtained from the sum of the measured concentrations as determined by the analysis required in ODCM Table 6.11.1-1:

$$\sum_i C_i = \sum_g C_g + C_a + \sum_s C_s + C_t + C_f \qquad (2)$$

where:

$\sum_g C_g$ = the sum of concentrations C_g of each measured gamma emitter observed by gamma-ray spectroscopy of the waste sample.

C_a = the concentration C_a of gross alpha emitters in liquid waste as measured in the monthly composite sample.

$\sum_s C_s$ = the measured concentrations of Sr-89 and Sr-90 in liquid waste as observed in the quarterly composite sample.

C_t = the measured concentration of H-3 in liquid waste as determined from analysis of the monthly composite sample.

C_f = the concentration of Fe-55 in liquid waste as measured in the quarterly composite sample.

The C_g term will be included in the analysis of each waste tank batch to be released; terms for alpha, strontiums, tritium and iron are included if analysis of liquid waste has shown the presence of these isotopes.

Step 2) The measured radionuclide concentrations are used to calculate a Dilution Factor, D.F., which is the ratio of total dilution flow rate to waste tank effluent flow rate required to assure that ten times the limiting concentration of 10CFR20, Appendix B, Table 2, Column 2 are met at the point of discharge.

$$D.F. = \left[\sum_i \frac{C_i}{EC_i}\right] \times S.F.$$

$$= \left[\sum_g \frac{C_g}{EC_g} + \frac{C_a}{EC_a} + \sum_s \frac{C_s}{EC_s} + \frac{C_t}{EC_t} + \frac{C_f}{EC_f}\right] \times S.F. \quad (3)$$

where:

C_i = C_g, C_a, C_s, C_t and C_f; measured concentrations as defined in Step 1. Terms C_a, C_s, C_t and C_f will be included in the calculation as appropriate.

EC_i = EC_g, EC_a, EC_s, EC_t and EC_f are ten times the limiting concentrations of the appropriate radionuclide from 10CFR20, Appendix B, Table 2, Column 2. For dissolved or entrained noble gases, the concentration shall be limited to 2.0E-4 µCi/ml total activity.

S.F. = an administrative safety factor normally applied at Grand Gulf which causes the calculated Dilution Factor to be two (2) times larger than the dilution factor required for compliance with ten times 10CFR20 limits.

Step 3) The maximum permissible waste tank effluent flow rate prior to dilution, f_d, is calculated based on a fixed fraction of the dilution flow rate, F_d:

$$f_d = \frac{F_d + f_d}{D.F.} = \frac{F_d}{D.F.} \quad \text{for } F_d >> f_d \qquad (4)$$

where:

F_d = 0.9 x minimum expected dilution flow rate
f_d = maximum permissible waste tank effluent flow rate
D.F. = Dilution Factor from Step 2.

NOTE: Equation 4 is valid only for D.F.>1; for D.F.≤1, the waste tank effluent concentration meets the limits of ten times the limiting concentrations of 10CFR20 without dilution, and f_d may take on any desired value.

Step 4) The dilution flow rate setpoint for minimum dilution flow rate, F, and waste tank flow rate setpoint for maximum waste tank effluent flow rate, f, are calculated as follows:

$F = F_d$ = 0.9 x minimum expected dilution flow rate (5)

$f = 0.9 \times f_d$ = 0.9 x calculated maximum waste tank flow rate for the stated release conditions. (6)

Thus, if instrumentation indicates the dilution flow rate falls below the assumed flow rate of 90 percent of the actual dilution flow, or if the waste tank effluent flow rate exceeds 90 percent of the calculated maximum waste tank effluent flow rate, the release is terminated (manually or automatically).

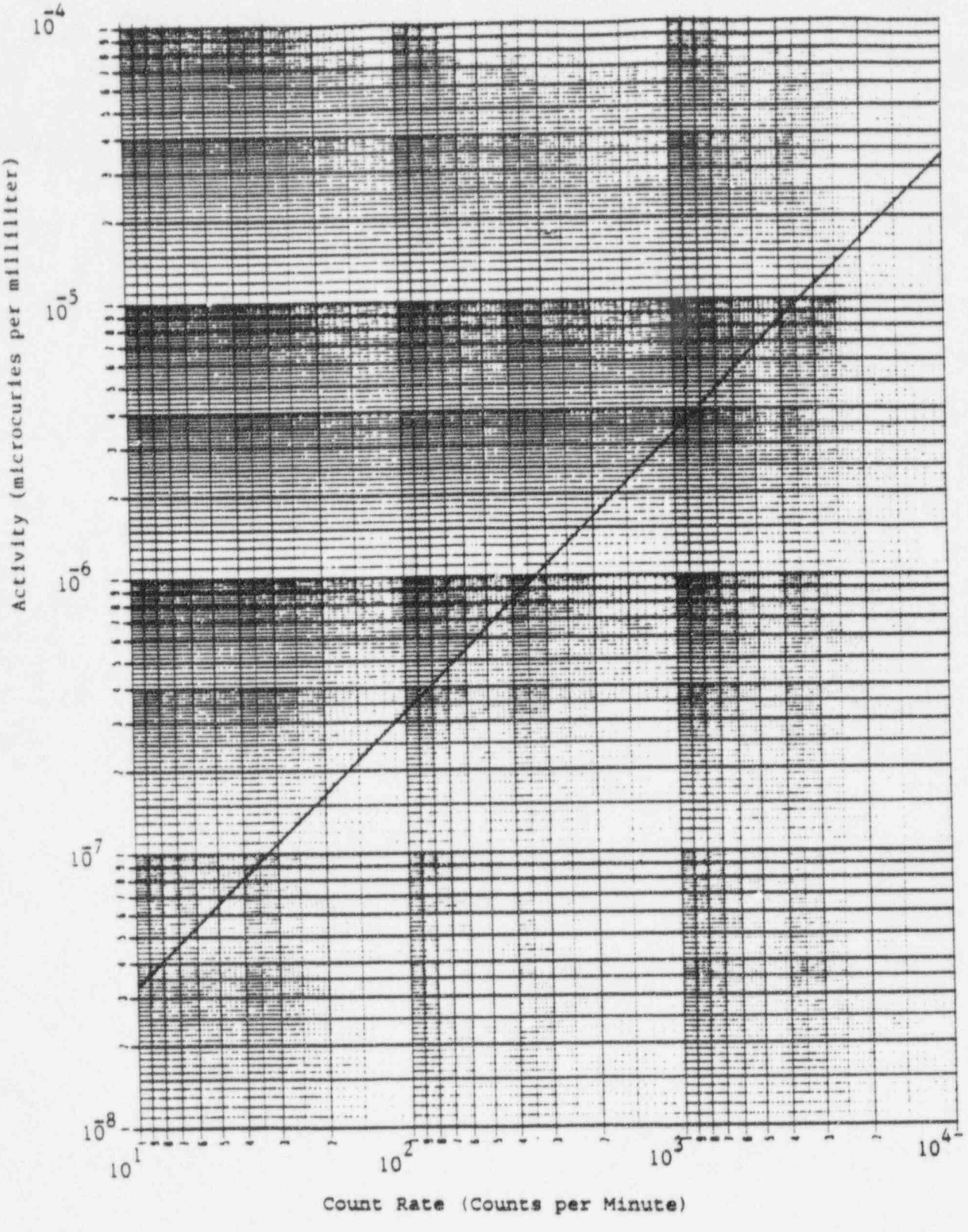
Step 5) The radioactivity monitor setpoint may now be specified based on the values of $\Sigma_i C_i$, F, and f which were specified to provide compliance with ten times the limits of 10CFR20, Appendix B, Table 2, Column 2. The monitor response is primarily to gamma radiation; therefore, the actual setpoint is based on $\Sigma_g C_g$. The setpoint concentration, C_m, is determined as follows:

$$C_m = \frac{f_d}{f_a} \Sigma C_g \quad (\mu Ci/ml) \qquad (7)$$

where f_a is the actual (or maximum expected) waste tank effluent flow rate. The value of C_m (μCi/ml) is used to determine the monitor setpoint (CPM) from a calibration curve similar to ODCM Figure 1.0-1.

NOTE: Setpoint adjustments are not required if the existing setpoint corresponds to a lower count rate than the calculated value. The actual monitor setpoint is determined from the measured concentration plus background for the detector. The setpoint contains a factor of conservatism, even if the calculated maximum waste tank flow rate is attainable, since the calculated rate contains the safety factor margin, waste tank effluent flow rate margin, and the dilution flow rate margin. In practice, the actual waste tank effluent flow rate normally is many times less than the calculated tank flow rate, thus providing an additional conservatism during release.

Figure 1.0-1
Example Calibration Curve for Liquid Effluent Monitor



1.2 Dose Calculations for Liquid Effluents

1.2.1 Maximum Exposed Individual Model

The dose contribution to the maximum exposed individual from all radionuclides identified in waste tank liquid effluents released to unrestricted areas is calculated for the purpose of implementing LCO 6.11.2, 6.11.3, and TS 5.6.3 using the following expression:

$$D_{Tau} = \sum_i \left[A_{iTau} \sum_{\ell=1}^{m} \Delta t_\ell \; C_{i\ell} \; F_\ell \right]^{(1)} \quad \text{(millirem)} \qquad (8)$$

where:

A_{iTau} = Site-related ingestion dose commitment factor for radionuclide i, in millirem/hr per μCi/ml.

$= K_o \; U_F \; BF_i \; DF_i$

Δt_ℓ = length of the time period over which $C_{i\ell}$ and F_ℓ are averaged for all waste tank liquid releases, in hours.

$C_{i\ell}$ = average concentration of radionuclide i observed in the undiluted waste tank liquid effluent during time period Δt_ℓ from any liquid release from the waste tank, in μCi/ml. Concentrations are determined primarily from a gamma isotopic analysis of the waste tank liquid effluent sample. For Fe-55, Sr-89, Sr-90, H-3, the last measured value from the most recent monthly and quarterly composite samples will be used in the dose calculation.

NOTE: LLD values are not used in dose calculations.

F_f = near field average dilution factor for C_{if} during any liquid effluent release. Defined as the ratio of the average undiluted liquid waste flow during release to the product of the average flow from the site discharge structure to unrestricted receiving waters times the applicable factor of 2 [5].

$$= \frac{\text{average undiluted liquid waste flow}}{\text{average flow from site discharge} \times 2}$$

K_o = units conversion factor 1.14×10^5

$$= 10^6 \frac{\text{pCi}}{\mu\text{Ci}} \times 10^3 \frac{\text{ml}}{\text{kg}} \div 8766 \frac{\text{hr}}{\text{yr}}$$

U_F = adult fish consumption (21 kg/yr) [3].

BF_i = Bioaccumulation factor for each nuclide, i, in fish, in pCi/kg per pCi/l from ODCM Table 1.2-1.

DF_i = Dose conversion factor for each nuclide, i, for adults in preselected organ, Tau, in mrem/pCi, from ODCM Table 1.2-2.

Calculated values of A_{iTau} for radionuclides which might be observed in liquid effluents are given in ODCM Table 1.2-3.

1.2.2 Dose Projection

Doses from liquid effluents to UNRESTRICTED AREAS are projected at least every 31 days as required by LCO 6.11.3. These projections are made by averaging the doses (D_{Tau}) from previous operating history (normally the previous six months) which is indicative of expected future operations.

TABLE 1.2-1

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

ELEMENT	FRESHWATER FISH	INVERTEBRATE
H	9.0E-01	9.0E-01
C	4.6E+03	9.1E+03
NA	1.0E+02	2.0E+02
P	1.0E+05	2.0E+04
CR	2.0E+02	2.0E+03
MN	4.0E+02	9.0E+04
FE	1.0E+02	3.2E+03
CO	5.0E+01	2.0E+02
NI	1.0E+02	1.0E+02
CU	5.0E+01	4.0E+02
ZN	2.0E+03	1.0E+04
BR	4.2E+02	3.3E+02
RB	2.0E+03	1.0E+03
SR	3.0E+01	1.0E+02
Y	2.5E+01	1.0E+03
ZR	3.3E+00	6.7E+00
NB	3.0E+04	1.0E+02
MO	1.0E+01	1.0E+01
TC	1.5E+01	5.0E+00
RU	1.0E+01	3.0E+02
RH	1.0E+01	3.0E+02
SB	1.0E+00	1.0E+01
TE	4.0E+02	6.1E+03
I	1.5E+01	5.0E+00
CS	2.0E+03	1.0E+03
BA	4.0E+00	2.0E+02
LA	2.5E+01	1.0E+03
CE	1.0E+00	1.0E+03
PR	2.5E+01	1.0E+03
ND	2.5E+01	1.0E+03
W	1.2E+03	1.0E+01
NP	1.0E+01	4.0E+02

* Values in Table 1.2-1 are taken from Reference 3, Table A-1, except for SB which was taken from Reference 2, Table A-8.

TABLE 1.2-2

INGESTION DOSE CONVERSION FACTORS FOR ADULTS, (DF_i)
(mrem per pCi ingested) *

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	NO DATA	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
C 14	2.84E-06	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07	5.68E-07
NA 24	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06	1.70E-06
P 32	1.93E-04	1.20E-05	7.46E-06	NO DATA	NO DATA	NO DATA	2.17E-05
CR 51	NO DATA	NO DATA	2.66E-09	1.59E-09	5.86E-10	3.53E-09	6.69E-07
MN 54	NO DATA	4.57E-06	8.72E-07	NO DATA	1.36E-06	NO DATA	1.40E-05
MN 56	NO DATA	1.15E-07	2.04E-08	NO DATA	1.46E-07	NO DATA	3.67E-06
FE 55	2.75E-06	1.90E-06	4.43E-07	NO DATA	NO DATA	1.06E-06	1.09E-06
FE 59	4.34E-06	1.02E-05	3.91E-06	NO DATA	NO DATA	2.85E-06	3.40E-05
CO 58	NO DATA	7.45E-07	1.67E-06	NO DATA	NO DATA	NO DATA	1.51E-05
CO 60	NO DATA	2.14E-06	4.72E-06	NO DATA	NO DATA	NO DATA	4.02E-05
NI 63	1.30E-04	9.01E-06	4.36E-06	NO DATA	NO DATA	NO DATA	1.88E-06
NI 65	5.28E-07	6.86E-08	3.13E-08	NO DATA	NO DATA	NO DATA	1.74E-06
CU 64	NO DATA	8.33E-08	3.91E-08	NO DATA	2.10E-07	NO DATA	7.10E-06
ZN 65	4.84E-06	1.54E-05	6.96E-06	NO DATA	1.03E-05	NO DATA	9.70E-06
ZN 69	1.03E-08	1.97E-08	1.37E-09	NO DATA	1.28E-08	NO DATA	2.96E-09
BR 83	NO DATA	NO DATA	4.02E-08	NO DATA	NO DATA	NO DATA	5.79E-08
BR 84	NO DATA	NO DATA	5.21E-08	NO DATA	NO DATA	NO DATA	4.09E-13
BR 85	NO DATA	NO DATA	2.14E-09	NO DATA	NO DATA	NO DATA	LT E-24
RB 86	NO DATA	2.11E-05	9.83E-06	NO DATA	NO DATA	NO DATA	4.16E-06
RB 88	NO DATA	6.05E-08	3.21E-08	NO DATA	NO DATA	NO DATA	8.36E-19
RB 89	NO DATA	4.01E-08	2.82E-08	NO DATA	NO DATA	NO DATA	2.33E-21
SR 89	3.08E-04	NO DATA	8.84E-06	NO DATA	NO DATA	NO DATA	4.94E-05
SR 90	7.58E-03	NO DATA	1.86E-03	NO DATA	NO DATA	NO DATA	2.19E-04
SR 91	5.67E-06	NO DATA	2.29E-07	NO DATA	NO DATA	NO DATA	2.70E-05
SR 92	2.15E-06	NO DATA	9.30E-08	NO DATA	NO DATA	NO DATA	4.26E-05
Y 90	9.62E-09	NO DATA	2.58E-10	NO DATA	NO DATA	NO DATA	1.02E-04
Y 91M	9.09E-11	NO DATA	3.52E-12	NO DATA	NO DATA	NO DATA	2.67E-10
Y 91	1.41E-07	NO DATA	3.77E-09	NO DATA	NO DATA	NO DATA	7.76E-05
Y 92	8.45E-10	NO DATA	2.47E-11	NO DATA	NO DATA	NO DATA	1.48E-05

* Values taken from Reference 3, Table E-11.

TABLE 1.2-2 (Continued)

INGESTION DOSE CONVERSION FACTORS FOR ADULTS, (DF_i)
(mrem per pCi ingested) *

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
Y 93	2.68E-09	NO DATA	7.40E-11	NO DATA	NO DATA	NO DATA	8.50E-05
ZR 95	3.04E-08	9.75E-09	6.60E-09	NO DATA	1.53E-08	NO DATA	3.09E-05
ZR 97	1.68E-09	3.39E-10	1.55E-10	NO DATA	5.12E-10	NO DATA	1.05E-04
NB 95	6.22E-09	3.46E-09	1.86E-09	NO DATA	3.42E-09	NO DATA	2.10E-05
MO 99	NO DATA	4.31E-06	8.20E-07	NO DATA	9.76E-06	NO DATA	9.99E-06
TC 99M	2.47E-10	6.98E-10	8.89E-09	NO DATA	1.06E-08	3.42E-10	4.13E-07
TC101	2.54E-10	3.66E-10	3.59E-09	NO DATA	6.59E-09	1.87E-10	1.10E-21
RU103	1.85E-07	NO DATA	7.97E-08	NO DATA	7.06E-07	NO DATA	2.16E-05
RU105	1.54E-08	NO DATA	6.08E-09	NO DATA	1.99E-07	NO DATA	9.42E-06
RU106	2.75E-06	NO DATA	3.48E-07	NO DATA	5.31E-06	NO DATA	1.78E-04
AG110M	1.60E-07	1.48E-07	8.79E-08	NO DATA	2.91E-07	NO DATA	6.04E-05
SB124	2.80E-06	5.29E-08	1.11E-06	6.79E-09	0.0	2.18E-06	7.95E-05
SB125+D	1.79E-06	2.00E-08	4.26E-07	1.82E-09	0.0	1.38E-06	1.97E-05
SB126	1.15E-06	2.34E-08	4.15E-07	7.04E-09	0.0	7.05E-07	9.40E-05
SB127	2.58E-07	5.65E-09	9.90E-08	3.10E-09	0.0	1.53E-07	5.90E-05
TE125M	2.68E-06	9.71E-07	3.59E-07	8.06E-07	1.09E-05	NO DATA	1.07E-05
TE127M	6.77E-06	2.42E-06	8.25E-07	1.73E-06	2.75E-05	NO DATA	2.27E-05
TE127	1.10E-07	3.95E-08	2.38E-08	8.15E-08	4.48E-07	NO DATA	8.68E-06
TE129M	1.15E-05	4.29E-06	1.82E-06	3.95E-06	4.80E-05	NO DATA	5.79E-05
TE129	3.14E-08	1.18E-08	7.65E-09	2.41E-08	1.32E-07	NO DATA	2.37E-08
TE131M	1.73E-06	8.46E-07	7.05E-07	1.34E-06	8.57E-06	NO DATA	8.40E-05
TE131	1.97E-08	8.23E-09	6.22E-09	1.62E-08	8.63E-08	NO DATA	2.79E-09
TE132	2.52E-06	1.63E-06	1.53E-06	1.80E-06	1.57E-05	NO DATA	7.71E-05
I 130	7.56E-07	2.23E-06	8.80E-07	1.89E-04	3.48E-06	NO DATA	1.92E-06
I 131	4.16E-06	5.95E-06	3.41E-06	1.95E-03	1.02E-05	NO DATA	1.57E-06
I 132	2.03E-07	5.43E-07	1.90E-07	1.90E-05	8.65E-07	NO DATA	1.02E-07
I 133	1.42E-06	2.47E-06	7.53E-07	3.63E-04	4.31E-06	NO DATA	2.22E-06
I 134	1.06E-07	2.88E-07	1.03E-07	4.99E-06	4.58E-07	NO DATA	2.51E-10
I 135	4.43E-07	1.16E-06	4.28E-07	7.65E-05	1.86E-06	NO DATA	1.31E-06
CS134	6.22E-05	1.48E-04	1.21E-04	NO DATA	4.79E-05	1.59E-05	2.59E-06
CS136	6.51E-06	2.57E-05	1.85E-05	NO DATA	1.43E-05	1.96E-06	2.92E-06

* Values taken from Reference 3, Table E-11, except for SB values which were taken from Reference 8, Table 4.

TABLE 1.2-2 (Continued)

INGESTION DOSE CONVERSION FACTORS FOR ADULTS, (DF_i)
(mrem per pCi ingested) *

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
CS137	7.97E-05	1.09E-04	7.14E-05	NO DATA	3.70E-05	1.27E-05	2.11E-06
CS138	5.52E-08	1.09E-07	5.40E-08	NO DATA	8.01E-08	7.91E-09	4.65E-13
BA139	9.70E-08	6.91E-11	2.84E-09	NO DATA	6.46E-11	3.92E-11	1.72E-07
BA140	2.03E-05	2.55E-08	1.33E-06	NO DATA	8.67E-09	1.46E-08	4.18E-05
BA141	4.71E-08	3.56E-11	1.59E-09	NO DATA	3.31E-11	2.02E-11	2.22E-17
BA142	2.13E-08	2.19E-11	1.34E-09	NO DATA	1.85E-11	1.24E-11	3.00E-26
LA140	2.50E-09	1.26E-09	3.33E-10	NO DATA	NO DATA	NO DATA	9.25E-05
LA142	1.28E-10	5.82E-11	1.45E-11	NO DATA	NO DATA	NO DATA	4.25E-07
CE141	9.36E-09	6.33E-09	7.18E-10	NO DATA	2.94E-09	NO DATA	2.42E-05
CE143	1.65E-09	1.22E-06	1.35E-10	NO DATA	5.37E-10	NO DATA	4.56E-05
CE144	4.88E-07	2.04E-07	2.62E-08	NO DATA	1.21E-07	NO DATA	1.65E-04
PR143	9.20E-09	3.69E-09	4.56E-10	NO DATA	2.13E-09	NO DATA	4.03E-05
PR144	3.01E-11	1.25E-11	1.53E-12	NO DATA	7.05E-12	NO DATA	4.33E-18
ND147	6.29E-09	7.27E-09	4.35E-10	NO DATA	4.25E-09	NO DATA	3.49E-05
W 187	1.03E-07	8.61E-08	3.01E-08	NO DATA	NO DATA	NO DATA	2.82E-05
NP239	1.19E-09	1.17E-10	6.45E-11	NO DATA	3.65E-10	NO DATA	2.40E-05

* Values taken from Reference 3, Table E-11

TABLE 1.2-3

SITE RELATED INGESTION DOSE COMMITMENT FACTOR, (A_{iTau})
(mrem/hr per µCi/ml)*

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01	2.26E-01
C-14	3.13E+04	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03	6.26E+03
Na-24	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02	4.07E+02
P-32	4.62E+07	2.87E+06	1.79E+06	0.00E+00	0.00E+00	0.00E+00	5.19E+06
Cr-51	0.00E+00	0.00E+00	1.27E+00	7.61E-01	2.81E-01	1.69E+00	3.20E+02
Mn-54	0.00E+00	4.38E+03	8.35E+02	0.00E+00	1.30E+03	0.00E+00	1.34E+04
Mn-56	0.00E+00	1.10E+02	1.95E+01	0.00E+00	1.40E+02	0.00E+00	3.51E+03
Fe-55	6.58E+02	4.55E+02	1.06E+02	0.00E+00	0.00E+00	2.54E+02	2.61E+02
Fe-59	1.04E+03	2.44E+03	9.36E+02	0.00E+00	0.00E+00	6.82E+02	8.14E+03
Co-58	0.00E+00	8.92E+01	2.00E+02	0.00E+00	0.00E+00	0.00E+00	1.81E+03
Co-60	0.00E+00	2.56E+02	5.65E+02	0.00E+00	0.00E+00	0.00E+00	4.81E+03
Ni-63	3.11E+04	2.16E+03	1.04E+03	0.00E+00	0.00E+00	0.00E+00	4.50E+02
Ni-65	1.26E+02	1.64E+01	7.49E+00	0.00E+00	0.00E+00	0.00E+00	4.17E+02
Cu-64	0.00E+00	9.97E+00	4.68E+00	0.00E+00	2.51E+01	0.00E+00	8.50E+02
Zn-65	2.32E+04	7.37E+04	3.33E+04	0.00E+00	4.93E+04	0.00E+00	4.64E+04
Zn-69	4.93E+01	9.43E+01	6.56E+00	0.00E+00	6.13E+01	0.00E+00	1.42E+01
Br-83	0.00E+00	0.00E+00	4.04E+01	0.00E+00	0.00E+00	0.00E+00	5.82E+01
Br-84	0.00E+00	0.00E+00	5.24E+01	0.00E+00	0.00E+00	0.00E+00	4.11E-04
Br-85	0.00E+00	0.00E+00	2.15E+00	0.00E+00	0.00E+00	0.00E+00	1.01E-15
Rb-86	0.00E+00	1.01E+05	4.71E+04	0.00E+00	0.00E+00	0.00E+00	1.99E+04
Rb-88	0.00E+00	2.90E+02	1.54E+02	0.00E+00	0.00E+00	0.00E+00	4.00E-09
Rb-89	0.00E+00	1.92E+02	1.35E+02	0.00E+00	0.00E+00	0.00E+00	1.12E-11
Sr-89	2.21E+04	0.00E+00	6.35E+02	0.00E+00	0.00E+00	0.00E+00	3.55E+03
Sr-90	5.44E+05	0.00E+00	1.34E+05	0.00E+00	0.00E+00	0.00E+00	1.57E+04
Sr-91	4.07E+02	0.00E+00	1.64E+01	0.00E+00	0.00E+00	0.00E+00	1.94E+03
Sr-92	1.54E+02	0.00E+00	6.68E+00	0.00E+00	0.00E+00	0.00E+00	3.06E+03
Y-90	5.76E-01	0.00E+00	1.54E-02	0.00E+00	0.00E+00	0.00E+00	6.10E+03
Y-91m	5.44E-03	0.00E+00	2.11E-04	0.00E+00	0.00E+00	0.00E+00	1.60E-02
Y-91	8.44E+00	0.00E+00	2.26E-01	0.00E+00	0.00E+00	0.00E+00	4.64E+03
Y-92	5.06E-02	0.00E+00	1.48E-03	0.00E+00	0.00E+00	0.00E+00	8.86E+02
Y-93	1.60E-01	0.00E+00	4.43E-03	0.00E+00	0.00E+00	0.00E+00	5.09E+03
Zr-95	2.40E-01	7.70E-02	5.21E-02	0.00E+00	1.21E-01	0.00E+00	2.44E+02
Zr-97	1.33E-02	2.68E-03	1.22E-03	0.00E+00	4.04E-03	0.00E+00	8.30E+02
Nb-95	4.47E+02	2.48E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06
Mo-99	0.00E+00	1.03E+02	1.96E+01	0.00E+00	2.34E+02	0.00E+00	2.39E+02
Tc-99m	8.87E-03	2.51E-02	3.19E-01	0.00E+00	3.81E-01	1.23E-02	1.48E+01
Tc-101	9.12E-03	1.31E-02	1.29E-01	0.00E+00	2.37E-01	6.72E-03	3.95E-14
Ru-103	4.43E+00	0.00E+00	1.91E+00	0.00E+00	1.69E+01	0.00E+00	5.17E+02
Ru-105	3.69E-01	0.00E+00	1.46E-01	0.00E+00	4.76E+00	0.00E+00	2.26E+02

* Calculated from Equation 8.

TABLE 1.2-3 (Continued)

SITE RELATED INGESTION DOSE COMMITMENT FACTOR, (A_{iTau})
(mrem/hr per µCi/ml)*

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
Ru-106	6.58E+01	0.00E+00	8.33E+00	0.00E+00	1.27E+02	0.00E+00	4.26E+03
Ag-110m	8.81E-01	8.15E-01	4.84E-01	0.00E+00	1.60E+00	0.00E+00	3.30E+02
Sb-124	6.70E+00	1.27E-01	2.66E+00	1.63E-02	0.00E+00	5.22E+00	1.90E+02
Sb-125	4.29E+00	4.79E-02	1.02E+00	4.36E-03	0.00E+00	3.30E+00	4.72E+01
Sb-126	2.75E+00	5.60E-02	9.94E-01	1.69E-02	0.00E+00	1.69E+00	2.25E+02
Sb-127	6.18E-01	1.35E-02	2.37E-01	7.42E-03	0.00E+00	3.66E-01	1.41E+02
Te-125m	2.57E+03	9.30E+02	3.44E+02	7.72E+02	1.04E+04	0.00E+00	1.02E+04
Te-127m	6.48E+03	2.32E+03	7.90E-02	1.66E+03	2.63E+04	0.00E+00	2.17E+04
Te-127	1.05E+02	3.78E+01	2.28E+01	7.80E+01	4.29E+02	0.00E+00	8.31E+03
Te-129m	1.10E+04	4.11E+03	1.74E+03	3.78E+03	4.60E+04	0.00E+00	5.54E+04
Te-129	3.01E+01	1.13E+01	7.33E+00	2.31E+01	1.26E+02	0.00E+00	2.27E+01
Te-131m	1.66E+03	8.10E+02	6.75E+02	1.28E+03	8.21E+03	0.00E+00	8.04E+04
Te-131	1.89E+01	7.88E+00	5.96E+00	1.55E+01	8.26E+01	0.00E+00	2.67E+00
Te-132	2.41E+03	1.56E+03	1.47E+03	1.72E+03	1.50E+04	0.00E+00	7.38E+04
I-130	2.71E+01	8.01E+01	3.16E+01	6.79E+03	1.25E+02	0.00E+00	6.89E+01
I-131	1.49E+02	2.14E+02	1.22E+02	7.00E+04	3.66E+02	0.00E+00	5.64E+01
I-132	7.29E+00	1.95E+01	6.82E+00	6.82E+02	3.11E+01	0.00E+00	3.66E+00
I-133	5.10E+01	8.87E+01	2.70E+01	1.30E+04	1.55E+02	0.00E+00	7.97E+01
I-134	3.81E+00	1.03E+01	3.70E+00	1.79E+02	1.64E+01	0.00E+00	9.01E-03
I-135	1.59E+01	4.17E+01	1.54E+01	2.75E+03	6.68E+01	0.00E+00	4.70E+01
Cs-134	2.98E+05	7.09E+05	5.79E+05	0.00E+00	2.29E+05	7.61E+04	1.24E+04
Cs-136	3.12E+04	1.23E+05	8.86E+04	0.00E+00	6.85E+04	9.38E+03	1.40E+04
Cs-137	3.82E+05	5.22E+05	3.42E+05	0.00E+00	1.77E+05	5.89E+04	1.01E+04
Cs-138	2.64E+02	5.22E+02	2.59E+02	0.00E+00	3.84E+02	3.79E+01	2.23E-03
Ba-139	9.29E-01	6.62E-04	2.72E-02	0.00E+00	6.19E-04	3.75E-04	1.65E+00
Ba-140	1.94E+02	2.44E-01	1.27E+01	0.00E+00	8.30E-02	1.40E-01	4.00E+02
Ba-141	4.51E-01	3.41E-04	1.52E-02	0.00E+00	3.17E-04	1.93E-04	2.13E-10
Ba-142	2.04E-01	2.10E-04	1.28E-02	0.00E+00	1.77E-04	1.19E-04	2.87E-19
La-140	1.50E-01	7.54E-02	1.99E-02	0.00E+00	0.00E+00	0.00E+00	5.54E+03
La-142	7.66E-03	3.48E-03	8.68E-04	0.00E+00	0.00E+00	0.00E+00	2.54E+01
Ce-141	2.24E-02	1.52E-02	1.72E-03	0.00E+00	7.04E-03	0.00E+00	5.79E+01
Ce-143	3.95E-03	2.92E+00	3.23E-04	0.00E+00	1.29E-03	0.00E+00	1.09E+02
Ce-144	1.17E+00	4.88E-01	6.27E-02	0.00E+00	2.90E-01	0.00E+00	3.95E+02
Pr-143	5.51E-01	2.21E-01	2.73E-02	0.00E+00	1.27E-01	0.00E+00	2.41E+03
Pr-144	1.80E-03	7.48E-04	9.16E-05	0.00E+00	4.22E-04	0.00E+00	2.59E-10
Nd-147	3.76E-01	4.35E-01	2.60E-02	0.00E+00	2.54E-01	0.00E+00	2.09E+03
W-187	2.96E+02	2.47E+02	8.65E+01	0.00E+00	0.00E+00	0.00E+00	8.10E+04
Np-239	2.85E-02	2.80E-03	1.54E-03	0.00E+00	8.74E-03	0.00E+00	5.75E+02

* Calculated from Equation 8.

1.3 Liquid Radwaste Treatment System

The essential components of the liquid radwaste treatment system are indicated on the following page by an asterisk (*).

NOTES for Figure 1.3-1

(1) The essential components outlined on the following page are those necessary to collect, process and sample liquid radwaste prior to discharge to the environment.

(2) Only one of the following is required in order to process liquid waste.

a. Equipment drain filter

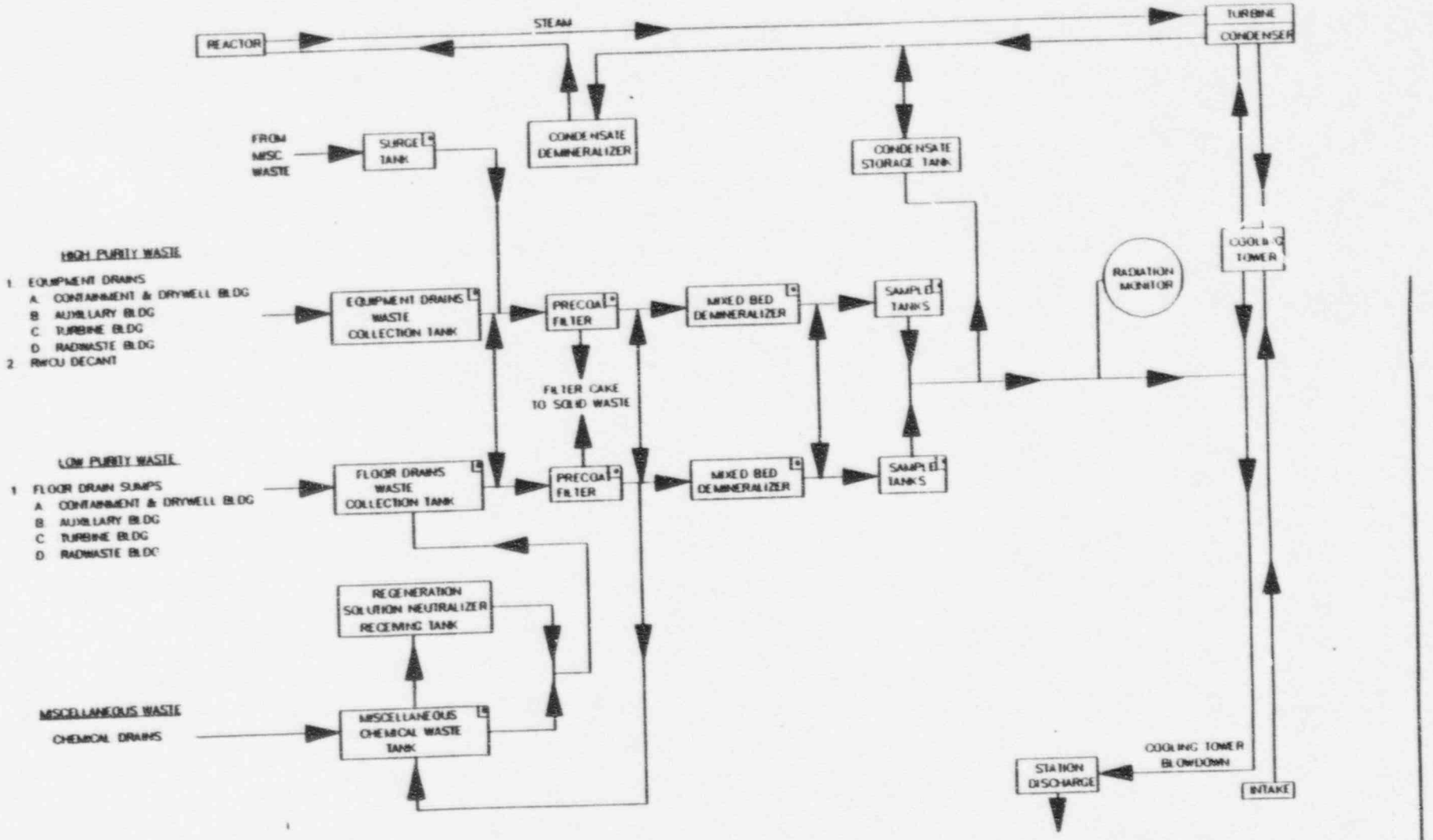
b. Floor drain filter

c. Equipment drain demineralizer

d. Floor drain demineralizer

(3) One of the Waste Surge Tanks may be used to replace the Floor Drain Waste Collection Tank.

Figure 1.3-1
Liquid Radwaste Treatment System



2.0 GASEOUS EFFLUENTS

2.1 Gaseous Effluent Monitor Setpoints

2.1.1 Continuous Ventilation Monitors

For the purpose of implementation of LCO 6.3.10, the alarm setpoint level for continuous ventilation noble gas monitors will be calculated as follows:

S_V = count rate (cpm) above background of vent noble gas monitor at the alarm setpoint level

= the lesser of $PF \times R_t \times D_{TB}$ or $PF \times R_s \times D_{ss}$

where:

PF = product of allocation factor (AF) and safety factor (SF), normally set at 0.1

AF = allocation factor allowing for a total of four normal effluent release points, normally set at 0.25

SF = safety factor allowing for cumulative uncertainties of measurements, normally set at 0.4

D_{TB} = dose rate limit to the total body of an individual at the SITE BOUNDARY or at UNRESTRICTED AREAS inside the SITE BOUNDARY required to limit dose to 500 mrem in one year

= 500 mrem/yr

D_{ss} = dose rate limit to the skin of the body of an individual at the SITE BOUNDARY or at UNRESTRICTED AREAS inside the SITE BOUNDARY required to limit dose to 3000 mrem in one year

= 3000 mrem/yr

R_t = count rate (cpm) per mrem/yr to the total body

$= C \div [\overline{X/Q} \sum_i K_i Q'_i]$

where:

C = count rate (cpm) above background of the vent monitor corresponding to grab sample radionuclide concentrations

$\overline{X/Q}$ = highest sector annual average atmospheric dispersion at the SITE BOUNDARY or at UNRESTRICTED AREAS inside the SITE BOUNDARY

= 8.9×10^{-6}* sec/m^3 in the SW sector

K_i = total body dose factor due to gamma emissions from each noble gas radionuclide i (mrem/yr per $\mu Ci/m^3$) from ODCM Table 2.1-1

Q'_i = rate of release of noble gas radionuclide i ($\mu Ci/sec$) from the release point

R_s = count rate (cpm) per mrem/yr to the skin

$= C \div \overline{X/Q} [\sum_i (L_i + 1.1 M_i) Q'_i]$

L_i = skin dose factor due to beta emissions from isotope i (mrem/yr per $\mu Ci/m^3$) from ODCM Table 2.1-1

1.1 = mrem skin dose per mrad air dose

M_i = air dose factor due to gamma emissions from isotope i (mrad/yr per $\mu Ci/m^3$) from ODCM Table 2.1-1

* The highest annual average X/Q for the GGNS SITE BOUNDARY or UNRESTRICTED AREAS inside the SITE BOUNDARY is at the SITE BOUNDARY, (SW sector, 0.85 miles). This value is taken from ODCM Reference 9, Table 2.

2.1.2

TEXT DELETED

NOTES For Section 2.1.1

1) The calculated setpoint values will determine the allowable bounds for the actual setpoint adjustments. That is, setpoint adjustments are not required to be performed if the existing setpoint level corresponds to a count rate that is less than or equal to + 25% of the calculated value. If radionuclides are not detected in the grab sample, then the previously calculated setpoint may remain as the valid setpoint.

2) A more conservative setpoint may be calculated using the conservative Kr-89 total body dose factor. This method may be used when there are no valid isotopics available. The conservative setpoint will be calculated as follows:

S_v = count rate (cpm) above background of vent noble gas monitor at the alarm setpoint level*

$= PF' \times D_{TB} \times R_t"$

where:

PF' = product of allocation factor (AF) and safety factor (SF'), normally set at 0.2

AF = allocation factor allowing for a total of four normal effluent release points, normally set at 0.25

SF' = safety factor allowing for cumulative uncertainties of measurements, normally set at 0.8

$R_t"$ = conservative count rate per mrem/yr to the total body (Xe-133 detection, Kr-89 dose)

$$= \frac{(3.53E\text{-}5)\ (60)}{\overline{X/Q}\ (X)\ (V)\ (K)}$$

* The setpoint calculation based on a Kr-89 skin dose is not required because the setpoint based on a Kr-89 total body dose will always be more conservative.

where:

X = Xe-133 volume efficiency factor of the detector system in $\mu Ci/cc/cpm$ as determined by the primary calibration*

V = maximum designed ventilation flow rate in cubic feet per minute (cfm)

3.53E-5 = conversion factor, ft^3 per cc

60 = conversion factor, seconds per minute

K = total body dose factor for Kr-89, the most restrictive isotope, from Table 2.1-1

= 1.66E + 04 mrem/yr per $\mu Ci/m^3$

Other variables as defined in Section 2.1.1

* The instrument calibration procedures will include checks to ensure that the detector efficiency does not vary by more than ± 25%.

TABLE 2.1-1

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

Nuclide	Y-Body** (K)i	B-Skin** (L)i	Y-Air* (M)i	B-Air* (N)i
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

Values taken from Reference 3, Table B-1

* $\frac{\text{mrad} \cdot \text{m}^3}{\mu\text{Ci} \cdot \text{yr}}$

** $\frac{\text{mrem} \cdot \text{m}^3}{\mu\text{Ci} \cdot \text{yr}}$

*** 1.17E+03 = 1.17×10^3

2.2 Gaseous Effluent Dose Calculations

2.2.1 Unrestricted Area Boundary Dose Rate

a. For the purpose of implementation of LCO 6.11.4.a, the dose rate at the SITE BOUNDARY or at UNRESTRICTED AREAS within the SITE BOUNDARY due to noble gases shall be calculated as follows:

D_{tb} = average total body dose rate in current year (mrem/yr)

$$= \overline{X/Q} \sum_i K_i Q'_i$$

D_s = average skin dose rate in current year (mrem/yr)

$$= \overline{X/Q} \sum_i (L_i + 1.1M_i) Q'_i$$

b. Organ dose rate due to tritium, I-131, I-133 and all radioactive materials in particulate form, with half-lives greater than eight days will be calculated for the purpose of implementation of LCO 6.11.4.b as follows:

D_o = average organ dose rate in current year (mrem/yr)

$$= \sum_i W_i \overline{Q'_i}$$

where:

W = controlling sector annual average atmospheric dispersion at the SITE BOUNDARY or UNRESTRICTED AREAS inside the SITE BOUNDARY for the appropriate pathway

$\overline{X/Q}$ = $8.9 \times 10^{-6*}$ sec/m^3 for inhalation and all tritium pathways

or

$\overline{D/Q}$ = $1.6 \times 10^{-8**}$ m^{-2} for food and ground plane pathways

P_i = the total dose parameter for radionuclide i, (mrem/yr per µCi/m^3) for inhalation and all tritium pathways and (m^2 . mrem/yr per µCi/sec) for food and ground plane pathways, from ODCM Tables 2.2-1a-b

Q'_i = rate of release of noble gas radionuclide i (µCi/sec) from the release point

$\overline{Q'_i}$ = average release rate of isotope i of tritium, I-131, I-133 or other radionuclide in particulate form, with half-lives greater than eight (8) days in the current year (µCi/sec)

* The highest annual average X/Q for the GGNS SITE BOUNDARY or UNRESTRICTED AREAS inside the SITE BOUNDARY is at the SITE BOUNDARY, in the SW sector (0.85 miles). This value is taken from ODCM Reference 9, Table 2.

** The highest annual average D/Q for the GGNS SITE BOUNDARY or UNRESTRICTED AREAS inside the SITE BOUNDARY is at the SITE BOUNDARY in the SSE sector (0.46 miles). This value is taken from ODCM Reference 9, Table 2.

2.2.2 Unrestricted Area Dose to Individual

a. For the purpose of implementation of LCO 6.11.5, the air dose at the SITE BOUNDARY or at UNRESTRICTED AREAS within the SITE BOUNDARY shall be determined as follows:

D_γ = air dose due to gamma emissions from noble gas radionuclide i (mrad)

$$= 3.17 \times 10^{-8} \sum_i M_i \overline{X/Q'} Q_i$$

where:

$\overline{X/Q'}$ = relative concentration for the SITE BOUNDARY or at UNRESTRICTED AREAS within the SITE BOUNDARY.

$$= 8.9 \times 10^{-6*} \text{ sec/m}^3$$

M_i = air dose factor due to gamma emissions from noble gas radionuclide i (mrad/yr per μCi/m^3) from ODCM Table 2.1-1

* The highest annual average X/Q for the GGNS SITE BOUNDARY or at UNRESTRICTED AREAS within the SITE BOUNDARY is at the SITE BOUNDARY, SW Sector, 0.85 miles. This value is taken from ODCM Reference 9 Table 2.

Q_i = cumulative release of radionuclide i of noble gas, tritium, I-131, I-133, or material in particulate form over the period of interest (μCi)

Note: 3.17×10^{-8} is the inverse of the number of seconds per year, and

D_β = air dose due to beta emissions from noble gas radionuclide i (mrad)

$$= 3.17 \times 10^{-8} \sum_i N_i \overline{X/Q'} Q_i$$

where:

N_i = air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per $\mu Ci/m^3$) from ODCM Table 2.1-1

$\overline{X/Q'}$ = relative concentration the SITE BOUNDARY or at UNRESTRICTED AREAS within the SITE BOUNDARY.

$= 8.9 \times 10^{-6}$ sec/m^3

Q_i = cumulative release of radionuclide i of noble gas, tritium, I-131, I-133, or material in particulate form over the period of interest (μCi)

* The highest annual average X/Q for the GGNS SITE BOUNDARY or at UNRESTRICTED AREAS within the SITE BOUNDARY is at the SITE BOUNDARY, SW Sector, 0.85 miles. This value is taken from ODCM Reference 9 Table 2.

2.2.2 Unrestricted Area Dose to Individual

b. Dose to an individual from tritium, I-131, I-133 and radioactive materials in particulate form, with half-lives greater than eight (8) days will be calculated for the purpose of implementation of LCO 6.11.6 as follows:

D_p = dose to an individual from tritium, I-131, I-133 and radionuclides in particulate form, with half-life greater than eight days (mrem)

$$= 3.17 \times 10^{-8} \sum_i R_i \; W' \; Q_i$$

where:

W' = relative concentration at a controlling location for an individual

$\overline{X/Q'}$ = $8.3 \times 10^{-6*}$ sec/m^3 for inhalation and all tritium pathways

or

$\overline{D/Q'}$ = $6.7 \times 10^{-9*}$ m^{-2} for food and ground plane pathways

R_i = the total dose factor for radionuclide i, (mrem/yr per $\mu Ci/m^3$) for inhalation and all tritium pathways and (m^2 . mrem/yr per μCi/sec) for food and ground plane pathways from Tables 2.2-2a - d

* The highest annual average X/Q and D/Q at or beyond the SITE BOUNDARY is in the SW Sector (0.89 miles). These values are for the controlling offsite receptor. These values are taken from ODCM Reference 9, Table 2.

2.2.2 Unrestricted Area Dose to Individual

Q_i = cumulative release of radionuclide i of noble gas, tritium, I-131, I-133, or material in particulate form over the period of interest (μCi)

c. For the purpose of implementing TS 5.6.3, dose calculations will be performed using the above equations or with the substitution of average meteorological parameters (most limiting parameters will be used) which prevailed for the period of the report.

2.2.3 Dose Projection

Doses from gaseous effluents to UNRESTRICTED AREAS are projected at least every 31 days as required by LCO 6.11.8. These projections are made by averaging the doses (D_γ, D_β, D_p) from previous operating history (normally the previous six months) which is indicative of future expected operations.

TABLE 2.2-1a

PATHWAY DOSE FACTORS FOR LCO 6.11.4 and SECTION 2.2.1.b, (P_i)

AGE GROUP	(INFANT)	(N.A.)	(INFANT)
ISOTOPE	INHALATION	GROUND PLANE	FOOD
H-3	6.468E+02	0.000E+00	2.382E+03
C-14	2.646E+04	0.000E+00	2.340E+09
NA-24	1.056E+04	1.979E+07	1.542E+07
P-32	2.030E+06	0.000E+00	1.602E+11
CR-51	1.284E+04	7.864E+06	4.700E+06
MN-54	9.996E+05	1.287E+09	3.900E+07
MN-56	7.168E+04	1.525E+06	2.862E+00
FE-55	8.694E+04	0.000E+00	1.351E+08
FE-59	1.015E+06	4.562E+08	3.919E+08
CO-58	7.770E+05	6.194E+08	6.055E+07
CO-60	4.508E+06	5.172E+09	2.098E+08
NI-63	3.388E+05	0.000E+00	3.493E+10
NI-65	5.012E+04	4.930E+05	3.020E+01
CU-64	1.498E+04	9.823E+05	3.807E+06
ZN-65	6.468E+05	7.907E+08	1.904E+10
ZN-69	1.322E+04	0.000E+00	3.855E-09
BR-83	3.808E+02	1.011E+04	9.339E-01
BR-84	4.004E+02	3.376E+05	1.256E-22
BR-85	2.044E+01	0.000E+00	0.000E+00
RB-86	1.904E+05	1.478E+07	2.234E+10
RB-88	5.572E+02	5.399E+04	1.874E-44
RB-89	3.206E+02	2.075E+05	4.193E-53
SR-89	2.030E+06	3.560E+04	1.258E+10
SR-90	4.088E+07	0.000E+00	1.216E+11
SR-91	7.336E+04	3.587E+06	3.215E+05
SR-92	1.400E+05	1.233E+06	5.005E+01
Y-90	2.688E+05	7.583E+03	9.406E+05
Y-91M	2.786E+03	1.658E+05	1.876E-15
Y-91	2.450E+06	1.702E+06	5.251E+06
Y-92	1.266E+05	3.060E+05	1.026E+01
Y-93	1.666E+05	3.620E+05	1.776E+04
ZR-95	1.750E+06	3.975E+08	8.257E+05
ZR-97	1.400E+05	4.921E+06	4.446E+04
NB-95	4.788E+05	2.291E+08	2.062E+08
MO-99	1.348E+05	6.608E+06	3.108E+08
TC-99M	2.030E+03	3.013E+05	1.646E+04
TC-101	8.442E+02	3.253E+04	1.423E-56
RU-103	5.516E+05	1.804E+08	1.055E+05
RU-105	4.844E+04	1.030E+06	3.204E+00
RU-106	1.156E+07	3.590E+08	1.445E+06
AG-110M	3.668E+06	3.649E+09	1.461E+10

TABLE 2.2-1a (Continued)

PATHWAY DOSE FACTORS FOR LCO 6.11.4 and SECTION 2.2.1.b, (P_i)

AGE GROUP	(INFANT)	(N.A.)	(INFANT)
ISOTOPE	INHALATION	GROUND PLANE	FOOD
TE-125M	4.466E+05	3.001E+06	1.508E+08
TE-127M	1.312E+06	1.395E+05	1.037E+09
TE-127	2.436E+04	4.704E+03	1.359E+05
TE-129M	1.680E+06	3.290E+07	1.392E+09
TE-129	2.632E+04	4.395E+04	1.678E-07
TE-131M	1.988E+05	1.351E+07	2.288E+07
TE-131	8.218E+03	4.929E+07	1.384E-30
TE-132	3.402E+05	7.098E+06	6.513E+07
I-130	1.596E+06	9.560E+06	8.754E+08
I-131	1.484E+07	2.985E+07	1.053E+12
I-132	1.694E+05	2.075E+06	1.188E+02
I-133	3.556E+06	4.259E+06	9.601E+09
I-134	4.452E+04	7.578E+05	8.402E-10
I-135	6.958E+05	4.210E+06	2.002E+07
CS-134	7.028E+05	3.282E+09	6.801E+10
CS-136	1.345E+05	2.432E+08	5.795E+09
CS-137	6.118E+05	1.337E+09	6.024E+10
CS-138	8.764E+02	5.860E+05	2.180E-22
BA-139	5.096E+04	1.705E+05	2.874E-05
BA-140	1.596E+06	3.352E+07	2.410E+08
BA-141	4.746E+03	6.762E+04	3.141E-44
BA-142	1.554E+03	7.234E+04	0.000E+00
LA-140	1.680E+05	3.114E+07	1.880E+05
LA-142	5.950E+04	1.269E+06	6.019E-06
CE-141	5.166E+05	2.199E+07	1.366E+07
CE-143	1.162E+05	3.753E+06	1.536E+06
CE-144	9.842E+06	6.761E+07	1.334E+08
PR-143	4.326E+05	0.000E+00	7.845E+05
PR-144	4.284E+03	3.017E+03	1.171E-48
ND-147	3.220E+05	1.441E+07	5.743E+05
W-187	3.962E+04	3.915E+06	2.501E+06
NP-239	5.950E+04	2.823E+06	9.400E+04

Units: Inhalation and all tritium pathways - mrem/yr per $\mu Ci/m^3$
Others - m^2 . mrem/yr per $\mu Ci/sec$

Values based on standard NUREG-0133, Section 5.2.1 assumptions unless otherwise indicated.

TABLE 2.2-1b

PATHWAY DOSE FACTORS FOR LCO 6.11.4 and SECTION 2.2.1.b, (P_i)

AGE GROUP	(CHILD)	(N. A.)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	GRS/ANL/MEAT
H-3	1.125E+03	0.000E+00	1.826E+02
C-14	3.589E+04	0.000E+00	2.991E+08
NA-24	1.610E+04	1.385E+07	1.345E-03
P-32	2.605E+06	0.000E+00	5.781E+09
CR-51	1.698E+04	5.506E+06	3.636E+05
MN-54	1.576E+06	1.625E+09	6.249E+06
MN-56	1.232E+05	1.068E+06	1.901E-51
FE-55	1.110E+05	0.000E+00	3.566E+08
FE-59	1.269E+06	3.204E+08	4.943E+08
CO-58	1.106E+06	4.464E+08	7.485E+07
CO-60	7.067E+06	2.532E+10	2.993E+08
NI-63	8.214E+05	0.000E+00	2.272E+10
NI-65	8.399E+04	3.451E+05	3.167E-51
CU-64	3.670E+04	6.876E+05	1.087E-05
ZN-65	9.953E+05	8.583E+08	7.801E+08
ZN-69	1.018E+04	0.000E+00	0.000E+00
BR-83	4.736E+02	7.079E+03	7.425E-57
BR-84	5.476E+02	2.363E+05	0.000E+00
BR-85	2.531E+01	0.000E+00	0.000E+00
RB-86	1.983E+05	1.035E+07	4.536E+08
RB-88	5.624E+02	3.779E+04	0.000E+00
RB-89	3.452E+02	1.452E+05	0.000E+00
SR-89	2.157E+06	2.509E+04	3.756E+08
SR-90	1.010E+08	0.000E+00	8.111E+09
SR-91	1.739E+05	2.511E+06	4.128E-10
SR-92	2.424E+05	8.631E+05	2.724E-48
Y-90	2.679E+05	5.308E+03	3.806E+05
Y-91M	2.812E+03	1.161E+05	0.000E+00
Y-91	2.627E+06	1.207E+06	1.872E+08
Y-92	2.390E+05	2.142E+05	5.428E-35
Y-93	3.885E+05	2.534E+05	1.207E-07
ZR-95	2.231E+06	2.837E+08	4.763E+08
ZR-97	3.511E+05	3.445E+06	5.471E-01
NB-95	6.142E+05	1.605E+08	1.738E+09
MO-99	1.354E+05	4.626E+06	1.915E+05
TC-99M	4.810E+03	2.109E+05	5.394E-18
TC-101	5.846E+02	2.277E+04	0.000E+00
RU-103	6.623E+05	1.265E+08	3.127E+09
RU-105	9.953E+04	7.212E+05	4.590E-25
RU-106	1.432E+07	5.049E+08	5.384E+10
AG-110M	5.476E+06	4.019E+09	5.259E+08

TABLE 2.2-1b (Continued)

PATHWAY DOSE FACTORS FOR LCO 6.11.4 and SECTION 2.2.1.b, (P_i)

AGE GROUP	(CHILD)	(N. A.)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	GRS/ANL/MEAT*
TE-125M	4.773E+05	2.128E+06	4.438E+08
TE-127M	1.480E+06	1.083E+05	3.947E+09
TE-127	5.624E+04	3.293E+03	1.254E-08
TE-129M	1.761E+06	2.305E+07	4.091E+09
TE-129	2.549E+04	3.076E+04	0.000E+00
TE-131M	3.078E+05	9.459E+06	7.656E+03
TE-131	2.054E+03	3.450E+07	0.000E+00
TE-132	3.774E+05	4.968E+06	7.274E+06
I-130	1.846E+06	6.692E+06	5.271E-04
I-131	1.624E+07	2.089E+07	4.293E+09
I-132	1.935E+05	1.452E+06	1.895E-57
I-133	3.848E+06	2.981E+06	1.017E+02
I-134	5.069E+04	5.305E+05	0.000E+00
I-135	7.918E+05	2.947E+06	8.104E-15
CS-134	1.014E+06	8.007E+09	1.180E+09
CS-136	1.709E+05	1.702E+08	3.452E+07
CS-137	9.065E+05	1.201E+10	1.040E+09
CS-138	8.399E+02	4.102E+05	0.000E+00
BA-139	5.772E+04	1.194E+05	0.000E+00
BA-140	1.743E+06	2.346E+07	3.420E+07
BA-141	2.919E+03	4.734E+04	0.000E+00
BA-142	1.643E+03	5.064E+04	0.000E+00
LA-140	2.257E+05	2.180E+07	4.284E+02
LA-142	7.585E+04	8.886E+05	0.000E+00
CE-141	5.439E+05	1.540E+07	1.078E+07
CE-143	1.273E+05	2.627E+06	1.963E+02
CE-144	1.195E+07	8.032E+07	1.476E+08
PR-143	4.329E+05	0.000E+00	2.815E+07
PR-144	1.565E+03	2.112E+03	0.000E+00
ND-147	3.282E+05	1.009E+07	1.174E+07
W-187	9.102E+04	2.740E+06	2.176E+00
NP-239	6.401E+04	1.976E+06	1.741E+03

Units: Inhalation and all tritium pathways - mrem/yr per $\mu Ci/m^3$
Others - m^2 . mrem/yr per $\mu Ci/sec$

Values based on standard NUREG-0133, Section 5.3.1 assumptions unless otherwise indicated.

* Meat consumption assumed 75 percent beef and 25 percent mutton.

TABLE 2.2-2a

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(INFANT)	(N.A.)	(INFANT)	(INFANT)	(INFANT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
H-3	6.468E+02	0.000E+00	2.382E+03	0.000E+00	0.000E+00
C-14	2.646E+04	0.000E+00	2.340E+09	0.000E+00	0.000E+00
NA-24	1.056E+04	1.385E+07	1.542E+07	0.000E+00	0.000E+00
P-32	2.030E+06	0.000E+00	1.602E+11	0.000E+00	0.000E+00
CR-51	1.284E+04	5.506E+06	4.700E+06	0.000E+00	0.000E+00
MN-54	9.996E+05	1.625E+09	3.900E+07	0.000E+00	0.000E+00
MN-56	7.168E+04	1.068E+06	2.862E+00	0.000E+00	0.000E+00
FE-55	8.694E+04	0.000E+00	1.351E+08	0.000E+00	0.000E+00
FE-59	1.015E+06	3.204E+08	3.919E+08	0.000E+00	0.000E+00
CO-58	7.770E+05	4.464E+08	6.055E+07	0.000E+00	0.000E+00
CO-60	4.508E+06	2.532E+10	2.098E+08	0.000E+00	0.000E+00
NI-63	3.388E+05	0.000E+00	3.493E+10	0.000E+00	0.000E+00
NI-65	5.012E+04	3.451E+05	3.020E+01	0.000E+00	0.000E+00
CU-64	1.498E+04	6.876E+05	3.807E+06	0.000E+00	0.000E+00
ZN-65	6.468E+05	8.583E+08	1.904E+10	0.000E+00	0.000E+00
ZN-69	1.302E+04	0.000E+00	3.855E-09	0.000E+00	0.000E+00
BR-83	3.808E+02	7.079E+03	9.339E-01	0.000E+00	0.000E+00
BR-84	4.004E+02	2.363E+05	1.256E-22	0.000E+00	0.000E+00
BR-85	2.044E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	1.904E+05	1.035E+07	2.234E+10	0.000E+00	0.000E+00
RB-88	5.572E+02	3.779E+04	1.874E-44	0.000E+00	0.000E+00
RB-89	3.206E+02	1.452E+05	4.193E-53	0.000E+00	0.000E+00
SR-89	2.030E+06	2.509E+04	1.258E+10	0.000E+00	0.000E+00
SR-90	4.088E+07	0.000E+00	1.216E+11	0.000E+00	0.000E+00
SR-91	7.336E+04	2.511E+06	3.215E+05	0.000E+00	0.000E+00
SR-92	1.400E+05	8.631E+05	5.005E+01	0.000E+00	0.000E+00
Y-90	2.688E+05	5.308E+03	9.406E+05	0.000E+00	0.000E+00
Y-91M	2.786E+03	1.161E+05	1.876E-15	0.000E+00	0.000E+00
Y-91	2.450E+06	1.207E+06	5.251E+06	0.000E+00	0.000E+00
Y-92	1.266E+05	2.142E+05	1.026E+01	0.000E+00	0.000E+00
Y-93	1.666E+05	2.534E+05	1.776E+04	0.000E+00	0.000E+00
ZR-95	1.750E+06	2.837E+08	8.257E+05	0.000E+00	0.000E+00
ZR-97	1.400E+05	3.445E+06	4.446E+04	0.000E+00	0.000E+00
NB-95	4.788E+05	1.605E+08	2.062E+08	0.000E+00	0.000E+00
MO-99	1.348E+05	4.626E+06	3.108E+08	0.000E+00	0.000E+00
TC-99M	2.030E+03	2.109E+05	1.646E+04	0.000E+00	0.000E+00
TC-101	8.442E+02	2.277E+04	1.423E-56	0.000E+00	0.000E+00
RU-103	5.516E+05	1.265E+08	1.055E+05	0.000E+00	0.000E+00
RU-105	4.844E+04	7.212E+05	3.204E+00	0.000E+00	0.000E+00
RU-106	1.156E+07	5.049E+08	1.445E+06	0.000E+00	0.000E+00
AG-110M	3.668E+06	4.019E+09	1.461E+10	0.000E+00	0.000E+00

TABLE 2.2-2a (Continued)

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(INFANT)	(N.A.)	(INFANT)	(INFANT)	(INFANT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
TE-125M	4.466E+05	2.128E+06	1.508E+08	0.000E+00	0.000E+00
TE-127M	1.312E+06	1.083E+05	1.037E+09	0.000E+00	0.000E+00
TE-127	2.436E+04	3.293E+03	1.359E+05	0.000E+00	0.000E+00
TE-129M	1.680E+06	2.305E+07	1.392E+09	0.000E+00	0.000E+00
TE-129	2.632E+04	3.076E+04	1.678E-07	0.000E+00	0.000E+00
TE-131M	1.988E+05	9.459E+06	2.288E+07	0.000E+00	0.000E+00
TE-131	8.218E+03	3.450E+07	1.384E-30	0.000E+00	0.000E+00
TE-132	3.402E+05	4.968E+06	6.513E+07	0.000E+00	0.000E+00
I-130	1.596E+06	6.692E+06	8.754E+08	0.000E+00	0.000E+00
I-131	1.484E+07	2.089E+07	1.053E+12	0.000E+00	0.000E+00
I-132	1.694E+05	1.452E+06	1.188E+02	0.000E+00	0.000E+00
I-133	3.556E+06	2.981E+06	9.601E+09	0.000E+00	0.000E+00
I-134	4.452E+04	5.305E+05	8.402E-10	0.000E+00	0.000E+00
I-135	6.958E+05	2.947E+06	2.002E+07	0.000E+00	0.000E+00
CS-134	7.028E+05	8.007E+09	6.801E+10	0.000E+00	0.000E+00
CS-136	1.345E+05	1.702E+08	5.795E+09	0.000E+00	0.000E+00
CS-137	6.118E+05	1.201E+10	6.024E+10	0.000E+00	0.000E+00
CS-138	8.764E+02	4.102E+05	2.180E-22	0.000E+00	0.000E+00
BA-139	5.096E+04	1.194E+05	2.874E-05	0.000E+00	0.000E+00
BA-140	1.596E+06	2.346E+07	2.410E+08	0.000E+00	0.000E+00
BA-141	4.746E+03	4.734E+04	3.141E-44	0.000E+00	0.000E+00
BA-142	1.554E+03	5.064E+04	0.000E+00	0.000E+00	0.000E+00
LA-140	1.680E+05	2.180E+07	1.880E+05	0.000E+00	0.000E+00
LA-142	5.950E+04	8.886E+05	6.019E-06	0.000E+00	0.000E+00
CE-141	5.166E+05	1.540E+07	1.366E+07	0.000E+00	0.000E+00
CE-143	1.162E+05	2.627E+06	1.536E+06	0.000E+00	0.000E+00
CE-144	9.842E+06	8.032E+07	1.334E+08	0.000E+00	0.000E+00
PR-143	4.326E+05	0.000E+00	7.845E+05	0.000E+00	0.000E+00
PR-144	4.284E+03	2.112E+03	1.171E-48	0.000E+00	0.000E+00
ND-147	3.220E+05	1.009E+07	5.743E+05	0.000E+00	0.000E+00
W-187	3.962E+04	2.740E+06	2.501E+06	0.000E+00	0.000E+00
NP-239	5.950E+04	1.976E+06	9.400E+04	0.000E+00	0.000E+00

Units: Inhalation and all tritium pathways - mrem/yr per $\mu Ci/m^3$
Others - m^2 . mrem/yr per $\mu Ci/sec$

Values based on standard NUREG-0133, Section 5.3.1 assumptions unless otherwise indicated.

TABLE 2.2-2b

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(CHILD)	(N.A.)	(CHILD)	(CHILD)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
H-3	1.125E+03	0.000E+00	1.570E+03	2.341E+02	4.008E+03
C-14	3.589E+04	0.000E+00	1.195E+09	3.834E+08	8.894E+08
NA-24	1.610E+04	1.385E+07	8.853E+06	1.725E-03	3.729E+05
P-32	2.605E+06	0.000E+00	7.775E+10	7.411E+09	3.366E+09
CR-51	1.698E+04	5.506E+06	5.398E+06	4.661E+05	6.213E+06
MN-54	1.576E+06	1.625E+09	2.097E+07	8.011E+06	6.648E+08
MN-56	1.232E+05	1.068E+06	1.865E+00	2.437E-51	2.723E+03
FE-55	1.110E+05	0.000E+00	1.118E+08	4.571E+08	8.012E+08
FE-59	1.269E+06	3.204E+08	2.025E+08	6.338E+08	6.693E+08
CO-58	1.106E+06	4.464E+08	7.080E+07	9.596E+07	3.771E+08
CO-60	7.067E+06	2.532E+10	2.391E+08	3.838E+08	2.095E+09
NI-63	8.214E+05	0.000E+00	2.964E+10	2.912E+10	3.949E+10
NI-65	8.399E+04	3.451E+05	1.909E+01	4.061E-51	1.211E+03
CU-64	3.670E+04	6.876E+05	3.502E+06	1.393E-05	5.159E+05
ZN-65	9.953E+05	8.583E+08	1.101E+10	1.000E+09	2.164E+09
ZN-69	1.018E+04	0.000E+00	1.123E-09	0.000E+00	9.893E-04
BR-83	4.736E+02	7.079E+03	4.399E-01	9.519E-57	5.369E+00
BR-84	5.476E+02	2.363E+05	6.508E-23	0.000E+00	3.822E-11
BR-85	2.531E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	1.983E+05	1.035E+07	8.804E+09	5.816E+08	4.584E+08
RB-88	5.624E+02	3.779E+04	7.150E-45	0.000E+00	4.374E-22
RB-89	3.452E+02	1.452E+05	1.715E-53	0.000E+00	1.642E-26
SR-89	2.157E+06	2.509E+04	6.618E+09	4.815E+08	3.593E+10
SR-90	1.010E+08	0.000E+00	1.117E+11	1.040E+10	1.243E+12
SR-91	1.739E+05	2.511E+06	2.878E+05	5.292E-10	1.157E+06
SR-92	2.424E+05	8.631E+05	4.134E+01	3.492E-48	1.378E+04
Y-90	2.679E+05	5.308E+03	9.171E+05	4.879E+05	6.569E+07
Y-91M	2.812E+03	1.161E+05	5.198E-16	0.000E+00	1.737E-05
Y-91	2.627E+06	1.207E+06	5.199E+06	2.400E+08	2.484E+09
Y-92	2.390E+05	2.142E+05	7.310E+00	6.959E-35	4.576E+04
Y-93	3.885E+05	2.534E+05	1.573E+04	1.547E-07	4.482E+06
ZR-95	2.231E+06	2.837E+08	8.786E+05	6.106E+08	8.843E+08
ZR-97	3.511E+05	3.445E+06	4.199E+04	7.015E-01	1.248E+07
NB-95	6.142E+05	1.605E+08	2.287E+08	2.228E+09	2.949E+08
MO-99	1.354E+05	4.626E+06	1.738E+08	2.456E+05	1.647E+07
TC-99M	4.810E+03	2.109E+05	1.474E+04	6.915E-18	5.255E+03
TC-101	5.846E+02	2.277E+04	5.593E-58	0.000E+00	4.123E-29
RU-103	6.623E+05	1.265E+08	1.108E+05	4.009E+09	3.971E+08
RU-105	9.953E+04	7.212E+05	2.493E+00	5.885E-25	5.981E+04
RU-106	1.432E+07	5.049E+08	1.437E+06	6.902E+10	1.159E+10
AG-110M	5.476E+06	4.019E+09	1.678E+10	6.742E+08	2.581E+09

TABLE 2.2-2b (Continued)

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(CHILD)	(N.A.)	(CHILD)	(CHILD)	(CHILD)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
TE-125M	4.773E+05	2.128E+06	7.377E+07	5.690E+08	3.506E+08
TE-127M	1.480E+06	1.083E+05	5.932E+08	5.060E+09	3.769E+09
TE-127	5.624E+04	3.293E+03	1.191E+05	1.607E-08	3.903E+05
TE-129M	1.761E+06	2.305E+07	7.961E+08	5.245E+09	2.460E+09
TE-129	2.549E+04	3.076E+04	6.166E-08	0.000E+00	7.204E-02
TE-131M	3.078E+05	9.459E+06	2.244E+07	9.815E+03	2.163E+07
TE-131	2.054E+03	3.450E+07	8.489E-32	0.000E+00	1.349E-14
TE-132	3.774E+05	4.968E+06	4.551E+07	9.325E+06	3.111E+07
I-130	1.846E+06	6.692E+06	3.845E+08	6.758E-04	1.370E+08
I-131	1.624E+07	2.089E+07	4.333E+11	5.503E+09	4.754E+10
I-132	1.935E+05	1.452E+06	5.129E+01	2.429E-57	7.314E+03
I-133	3.848E+06	2.981E+06	3.945E+09	1.304E+02	8.113E+08
I-134	5.069E+04	5.305E+05	3.624E-10	0.000E+00	6.622E-03
I-135	7.918E+05	2.947E+06	8.607E+06	1.039E-14	9.973E+06
CS-134	1.014E+06	8.007E+09	3.715E+10	1.513E+09	2.631E+10
CS-136	1.709E+05	1.702E+08	2.773E+09	4.426E+07	2.247E+08
CS-137	9.065E+05	1.201E+10	3.224E+10	1.334E+09	2.392E+10
CS-138	8.399E+02	4.102E+05	5.528E-23	0.000E+00	9.133E-11
BA-139	5.772E+04	1.194E+05	1.231E-05	0.000E+00	2.950E+00
BA-140	1.743E+06	2.346E+07	1.171E+08	4.384E+07	2.767E+08
BA-141	2.919E+03	4.734E+04	1.210E-45	0.000E+00	1.605E-21
BA-142	1.643E+03	5.064E+04	0.000E+00	0.000E+00	4.105E-39
LA-140	2.257E+05	2.180E+07	1.894E+05	5.492E+02	3.166E+07
LA-142	7.585E+04	8.886E+05	2.904E-06	0.000E+00	1.582E+01
CE-141	5.439E+05	1.540E+07	1.361E+07	1.382E+07	4.082E+08
CE-143	1.273E+05	2.627E+06	1.488E+06	2.516E+02	1.364E+07
CE-144	1.195E+07	8.032E+07	1.326E+08	1.893E+08	1.039E+10
PR-143	4.329E+05	0.000E+00	7.754E+05	3.609E+07	1.575E+08
PR-144	1.565E+03	2.112E+03	2.040E-50	0.000E+00	3.829E-23
ND-147	3.282E+05	1.009E+07	5.712E+05	1.505E+07	9.197E+07
W-187	9.102E+04	2.740E+06	2.420E+06	2.790E+00	5.380E+06
NP-239	6.401E+04	1.975E+06	9.138E+04	2.232E+03	1.357E+07

Units: Inhalation and all tritium pathways - mrem/yr per $\mu Ci/m^3$
Others - m^2 . mrem/yr per $\mu Ci/sec$

Values based on standard NUREG-0133, Section 5.3.1 assumptions unless otherwise indicated.

TABLE 2.2-2c

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(TEENAGER)	(N.A.)	(TEENAGER)	(TEENAGER)	(TEENAGER)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
H-3	1.272E+03	0.000E+00	9.941E+02	1.938E+02	2.588E+03
C-14	2.600E+04	0.000E+00	4.859E+08	2.040E+08	3.690E+08
NA-24	1.376E+04	1.385E+07	4.255E+06	1.084E-03	2.389E+05
P-32	1.888E+06	0.000E+00	3.153E+10	3.931E+09	1.608E+09
CR-51	2.096E+04	5.506E+06	8.387E+06	9.471E+05	1.037E+07
MN-54	1.984E+06	1.625E+09	2.875E+07	1.436E+07	9.320E+08
MN-56	5.744E+04	1.068E+06	4.856E-01	8.302E-52	9.451E+02
FE-55	1.240E+05	0.000E+00	4.454E+07	2.382E+08	3.259E+08
FE-59	1.528E+06	3.204E+08	2.861E+08	1.171E+09	9.895E+08
CO-58	1.344E+06	4.464E+08	1.095E+08	1.942E+08	6.034E+08
CO-60	8.720E+06	2.532E+10	3.621E+08	7.600E+08	3.238E+09
NI-63	5.800E+05	0.000E+00	1.182E+10	1.519E+10	1.606E+10
NI-65	3.672E+04	3.451E+05	4.692E+00	1.305E-51	3.966E+02
CU-64	6.144E+04	6.876E+05	3.293E+06	1.713E-05	6.465E+05
ZN-65	1.240E+06	8.583E+08	7.315E+09	8.688E+08	1.471E+09
ZN-69	1.584E+03	0.000E+00	1.760E-11	0.000E+00	2.067E-05
BR-83	3.440E+02	7.079E+03	1.790E-01	5.066E-57	2.911E+00
BR-84	4.328E+02	2.363E+05	2.877E-23	0.000E+00	2.251E-11
BR-85	1.832E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	1.904E+05	1.035E+07	4.746E+09	4.101E+08	2.772E+08
RB-88	5.456E+02	3.779E+04	3.886E-45	0.000E+00	3.168E-22
RB-89	3.520E+02	1.452E+05	9.774E-54	0.000E+00	1.247E-26
SR-89	2.416E+06	2.509E+04	2.674E+09	2.545E+08	1.513E+10
SR-90	1.080E+08	0.000E+00	6.612E+10	8.049E+09	7.507E+11
SR-91	2.592E+05	2.511E+06	2.409E+05	5.794E-1?	1.291E+06
SR-92	1.192E+05	8.631E+05	2.277E+01	2.516E-48	1.012E+04
Y-90	5.592E+05	5.308E+03	1.074E+06	7.470E+05	1.025E+08
Y-91M	3.200E+03	1.161E+05	5.129E-18	0.000E+00	2.285E-07
Y-91	2.936E+06	1.207E+06	6.475E+06	3.910E+08	3.212E+09
Y-92	1.648E+05	2.142E+05	2.828E+00	3.522E-35	2.360E+04
Y-93	5.792E+05	2.534E+05	1.312E+04	1.688E-07	4.983E+06
ZR-95	2.688E+06	2.837E+08	1.201E+06	1.092E+09	1.253E+09
ZR-97	6.304E+05	3.445E+06	4.225E+04	9.231E-01	1.673E+07
NB-95	7.512E+05	1.605E+08	3.338E+08	4.251E+09	4.551E+08
MO-99	2.688E+05	4.626E+06	1.023E+08	1.892E+05	1.293E+07
TC-99M	6.128E+03	2.109E+05	1.055E+04	6.471E-18	5.011E+03
TC-101	6.672E+02	2.277E+04	3.287E-58	0.000E+00	3.229E-29
RU-103	7.832E+05	1.265E+08	1.513E+05	7.162E+09	5.706E+08
RU-105	9.040E+04	7.212E+05	1.263E+00	3.900E-25	4.039E+04
RU-106	1.608E+07	5.049E+08	1.799E+06	1.130E+11	1.484E+10
AG-110M	6.752E+06	4.019E+09	2.559E+10	1.345E+09	4.031E+09

TABLE 2.2-2c (Continued)

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(TEENAGER)	(N.A.)	(TEENAGER)	(TEENAGER)	(TEENAGER)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
TE-125M	5.360E+05	2.128E+06	8.863E+07	8.941E+08	4.375E+08
TE-127M	1.656E+06	1.083E+05	3.420E+08	3.816E+09	2.236E+09
TE-127	8.080E+04	3.293E+03	9.572E+04	1.689E-08	4.180E+05
TE-129M	1.976E+06	2.305E+07	4.602E+08	3.966E+09	1.508E+09
TE-129	3.296E+03	3.076E+04	2.196E-09	0.000E+00	3.418E-03
TE-131M	6.208E+05	9.459E+06	2.529E+07	1.447E+04	3.248E+07
TE-131	2.336E+03	3.450E+07	2.879E-32	0.000E+00	6.099E-15
TE-132	4.632E+05	4.968E+06	8.581E+07	2.300E+07	7.818E+07
I-130	1.488E+06	6.692E+06	1.742E+08	4.005E-04	8.276E+07
I-131	1.464E+07	2.089E+07	2.195E+11	3.645E+09	3.140E+10
I-132	1.512E+05	1.452E+06	2.242E+01	1.389E-57	4.262E+03
I-133	2.920E+06	2.981E+06	1.674E+09	7.234E+01	4.587E+08
I-134	3.952E+04	5.305E+05	1.583E-10	0.000E+00	3.854E-03
I-135	6.208E+05	2.947E+06	3.777E+06	5.963E-15	5.832E+06
CS-134	1.128E+06	8.007E+09	2.310E+10	1.231E+09	1.671E+10
CS-136	1.936E+05	1.702E+08	1.759E+09	3.671E+07	1.708E+08
CS-137	8.480E+05	1.201E+10	1.781E+10	9.634E+08	1.348E+10
CS-138	8.560E+02	4.102E+05	3.149E-23	0.000E+00	6.935E-11
BA-139	6.464E+03	1.194E+05	7.741E-07	0.000E+00	2.472E-01
BA-140	2.032E+06	2.346E+07	7.483E+07	3.663E+07	2.130E+08
BA-141	3.288E+03	4.734E+04	4.922E-46	0.000E+00	8.699E-22
BA-142	1.912E+03	5.064E+04	0.000E+00	0.000E+00	2.269E-39
LA-140	4.872E+05	2.180E+07	2.291E+05	8.689E+02	5.104E+07
LA-142	1.200E+04	8.886E+05	2.574E-07	0.000E+00	1.868E+00
CE-141	6.136E+05	1.540E+07	1.696E+07	2.252E+07	5.404E+08
CE-143	2.552E+05	2.627E+06	1.671E+06	3.695E+02	2.040E+07
CE-144	1.336E+07	8.032E+07	1.655E+08	3.089E+08	1.326E+10
PR-143	4.832E+05	0.000E+00	9.553E+05	5.817E+07	2.310E+08
PR-144	1.752E+03	2.112E+03	1.238E-53	0.000E+00	3.097E-26
ND-147	3.720E+05	1.009E+07	7.116E+05	2.452E+07	1.424E+08
W-187	1.768E+05	2.740E+06	2.646E+06	3.989E+00	7.839E+06
NP-239	1.320E+05	1.976E+06	1.060E+05	3.387E+03	2.097E+07

Units: Inhalation and all tritium pathways mrem/yr per $\mu Ci/m^3$
Others - m^2 . mrem/yr per $\mu Ci/sec$

Values based on standard NUREG-0133, Section 5.3.1 assumptions unless otherwise indicated.

TABLE 2.2-2d

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(ADULT)	(N. A.)	(ADULT)	(ADULT)	(ADULT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
H-3	1.264E+03	0.000E+00	7.629E+02	3.248E+02	2.260E+03
C-14	1.816E+04	0.000E+00	2.634E+08	2.414E+08	2.276E+08
NA-24	1.024E+04	1.385E+07	2.438E+06	1.356E-03	2.690E+05
P-32	1.320E+06	0.000E+00	1.709E+10	4.651E+09	1.403E+09
CR-51	1.440E+04	5.506E+06	7.187E+06	1.772E+06	1.168E+07
MN-54	1.400E+06	1.625E+09	2.578E+07	2.812E+07	9.585E+08
MN-56	2.024E+04	1.068E+06	1.328E-01	4.958E-52	5.082E+02
FE-55	7.209E+04	0.000E+00	2.511E+07	2.933E+08	2.096E+08
FE-59	1.016E+06	3.204E+08	2.326E+08	2.080E+09	9.875E+08
CO-58	9.280E+05	4.464E+08	9.565E+07	3.703E+08	6.252E+08
CO-60	5.969E+06	2.532E+10	3.082E+08	1.413E+09	3.139E+09
NI-63	4.320E+05	0.000E+00	6.729E+09	1.888E+10	1.040E+10
NI-65	1.232E+04	3.451E+05	1.219E+00	7.405E-52	2.026E+02
CU-64	4.896E+04	6.876E+05	2.031E+06	2.307E-05	7.841E+05
ZN-65	8.640E+05	8.583E+08	4.365E+09	1.132E+09	1.009E+09
ZN-69	9.200E+02	0.000E+00	5.207E-12	0.000E+00	1.202E-05
BR-83	2.408E+02	7.079E+03	1.399E-01	8.648E-57	4.475E+00
BR-84	3.128E+02	2.363E+05	1.609E-23	0.000E+00	2.475E-11
BR-85	1.280E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
RB-86	1.352E+05	1.035E+07	2.604E+09	4.914E+08	2.217E+08
RB-88	3.872E+02	3.779E+04	2.139E-45	0.000E+00	3.428E-22
RB-89	2.560E+02	1.452E+05	5.523E-54	0.000E+00	1.385E-26
SR-89	1.400E+06	2.509E+04	1.451E+09	3.014E+08	9.961E+09
SR-90	9.920E+07	0.000E+00	4.680E+10	1.244E+10	6.046E+11
SR-91	1.912E+05	2.511E+06	1.377E+05	7.233E-10	1.451E+06
SR-92	4.304E+04	8.631E+05	9.675E+00	2.334E-48	8.452E+03
Y-90	5.056E+05	5.308E+03	7.511E+05	1.141E+06	1.410E+08
Y-91M	1.920E+03	1.161E+05	1.743E-19	0.000E+00	1.527E-08
Y-91	1.704E+06	1.207E+06	4.726E+06	6.231E+08	2.814E+09
Y-92	7.352E+04	2.142E+05	9.772E-01	2.657E-35	1.603E+04
Y-93	4.216E+05	2.534E+05	7.388E+03	2.075E-07	5.517E+06
ZR-95	1.768E+06	2.837E+08	9.587E+05	1.903E+09	1.194E+09
ZR-97	5.232E+05	3.445E+06	2.707E+04	1.292E+00	2.108E+07
NB-95	5.048E+05	1.605E+08	2.786E+08	7.748E+09	4.798E+08
MO-99	2.480E+05	4.626E+06	5.741E+07	2.318E+05	1.426E+07
TC-99M	4.160E+03	2.109E+05	5.553E+03	7.439E-18	5.187E+03
TC-101	3.992E+02	2.277E+04	1.813E-58	0.000E+00	3.502E-29
RU-103	5.048E+05	1.265E+08	1.189E+05	1.229E+10	5.577E+08
RU-105	4.816E+04	7.212E+05	5.240E-01	3.533E-25	3.294E+04
RU-106	9.360E+06	5.049E+08	1.320E+06	1.811E+11	1.247E+10
AG-110M	4.632E+06	4.019E+09	2.198E+10	2.523E+09	3.979E+09

TABLE 2.2-2d (Continued)

PATHWAY DOSE FACTORS FOR LCO 6.11.6 AND SECTION 2.2.2.b, (R_i)

AGE GROUP	(ADULT)	(N. A.)	(ADULT)	(ADULT)	(ADULT)
ISOTOPE	INHALATION	GROUND PLANE	GRS/COW/MILK	GRS/COW/MEAT	VEGETATION
TE-125M	3.136E+05	2.128E+06	6.626E+07	1.460E+09	3.927E+08
TE-127M	9.600E+05	1.083E+05	1.860E+08	4.531E+09	1.418E+09
TE-127	5.736E+04	3.293E+03	5.278E+04	2.034E-08	4.532E+05
TE-129M	1.160E+06	2.305E+07	3.028E+08	5.698E+09	1.261E+09
TE-129	1.936E+03	3.076E+04	9.167E-10	0.000E+00	2.806E-03
TE-131M	5.560E+05	9.459E+06	1.753E+07	2.190E+04	4.428E+07
TE-131	1.392E+03	3.450E+07	1.578E-32	0.000E+00	6.575E-15
TE-132	5.096E+05	4.968E+06	7.324E+07	4.287E+07	1.312E+08
I-130	1.136E+06	6.692E+06	1.050E+08	5.272E-04	9.809E+07
I-131	1.192E+07	2.089E+07	1.388E+11	5.034E+09	3.785E+10
I-132	1.144E+05	1.452E+06	1.342E+01	1.816E-57	5.016E+03
I-133	2.152E+06	2.981E+06	9.891E+08	9.336E+01	5.331E+08
I-134	2.984E+04	5.305E+05	9.491E-11	0.000E+00	4.544E-03
I-135	4.480E+05	2.947E+06	2.217E+06	7.644E-15	6.731E+06
CS-134	8.480E+05	8.007E+09	1.345E+10	1.565E+09	1.110E+10
CS-136	1.464E+05	1.702E+08	1.036E+09	4.724E+07	1.675E+08
CS-137	6.208E+05	1.201E+10	1.010E+10	1.193E+09	8.696E+09
CS-138	6.208E+02	4.102E+05	1.786E-23	0.000E+00	7.730E-11
BA-139	3.760E+03	1.194E+05	8.322E-08	0.000E+00	5.225E-02
BA-140	1.272E+06	2.346E+07	5.535E+07	5.917E+07	2.646E+08
BA-141	1.936E+03	4.734E+04	2.677E-46	0.000E+00	9.305E-22
BA-142	1.192E+03	5.064E+04	0.000E+00	0.000E+00	2.463E-39
LA-140	4.584E+05	2.180E+07	1.672E+05	1.385E+03	7.327E+07
LA-142	6.328E+03	8.886E+05	3.503E-08	0.000E+00	4.999E-01
CE-141	3.616E+05	1.540E+07	1.253E+07	3.632E+07	5.097E+08
CE-143	2.264E+05	2.627E+06	1.149E+06	5.547E+02	2.758E+07
CE-144	7.776E+06	8.032E+07	1.209E+08	4.928E+08	1.112E+10
PR-143	2.808E+05	0.000E+00	6.923E+05	9.204E+07	2.748E+08
PR-144	1.016E+03	2.112E+03	6.716E-54	0.000E+00	3.303E-26
ND-147	2.208E+05	1.009E+07	5.231E+05	3.935E+07	1.853E+08
W-187	1.552E+05	2.740E+06	1.796E+06	5.512E+00	1.046E+07
NP-239	1.192E+05	1.976E+06	7.385E+04	5.152E+03	2.872E+07

Units: Inhalation and all tritium pathways - mrem/yr per $\mu Ci/m^3$
Others - m^2 . mrem/yr per $\mu Ci/sec$

Values based on standard NUREG-0133, Section 5.3.1 assumptions unless otherwise indicated.

TABLE 2.2-3

CONTROLLING RECEPTORS, LOCATIONS, AND ATMOSPHERIC DISPERSION PARAMETERS* for LCO 6.11.5, 6.11.6, AND 6.11.8

SECTOR	DIRECTION	NEAREST RESIDENCE, MILES**	x/Q	NEAREST GARDEN, MILES**	D/Q
A	N	0.92	3.30E-6	>5	N/A
B	NNE	0.75	2.95E-6	>5	N/A
C	NE	0.66	2.30E-6	4.78	2.18E-10
D	ENE	2.67	2.00E-7	2.8	4.90E-10
E	E	0.61	1.60E-6	0.81	2.96E-09
F	ESE	2.3	2.57E-7	>5	N/A
G	SE	2.11	3.10E-7	>5	N/A
H	SSE	1.13	1.40E-6	4.16	3.92E-10
J	S	3.11	4.95E-7	>5	N/A
K	SSW	2.17	1.40E-6	2.17	1.30E-9
L	SW	0.89	8.30E-6	0.89	6.70E-9
M	WSW	>5	N/A	>5	N/A
N	W	>5	N/A	>5	N/A
P	WNW	4.78	4.73E-7	4.78	2.30E-10
Q	NW	>5	N/A	>5	N/A
R	NNW	1.08	2.60E-6	>5	N/A

Table 2.2-3 based on 1994 Land Use Census

The most limiting age group, child, is assumed.

* Values from ODCM Reference 9.

** Distances shown are actual miles in each sector. In cases where dispersion parameters were not available for a location they were taken from the closest distance interval to the plant.

N/A: No residence/garden within 5 miles.

TABLE 2.2-3a

SITE BOUNDARY ATMOSPHERIC DISPERSION PARAMETERS*
for LCO 6.11.4

SECTOR	DIRECTION	SITE BOUNDARY DISTANCE, MILES**	x/Q	D/Q
A	N	0.79	4.1E-6	8.2E-9
B	NNE	0.66	3.6E-6	7.7E-9
C	NE	0.63	2.5E-6	6.6E-9
D	ENE	0.63	2.0E-6	5.8E-9
E	E	0.55	1.9E-6	4.9E-9
F	ESE	0.55	2.0E-6	5.9E-9
G	SE	0.51	2.8E-6	8.2E-9
H	SSE	0.46	5.6E-6	1.6E-8
J	S	0.61	5.8E-6	1.2E-8
K	SSW	0.65	8.4E-6	1.0E-8
L	SW	0.85	8.9E-6	7.2E-9
M	WSW	1.07	8.4E-6	5.1E-9
N	W	1.14	5.4E-6	3.4E-9
P	WNW	1.34	2.6E-6	1.9E-9
Q	NW	1.37	1.6E-6	1.6E-9
R	NNW	1.02	2.8E-6	4.0E-9

The most limiting age group, infant, is assumed.

* Values from ODCM Reference 9.

** Distances shown are actual miles in each sector.

TABLE 2.2-3b

ADDITIONAL RECEPTOR LOCATIONS WITHIN THE SITE BOUNDARY

SECTOR	DIRECTION	MILES	DESCRIPTION	x/Q	D/Q
B	NNE	0.5	Recreational Vehicle Laydown Area	5.438E-6	1.204E-8
R	NNW	0.5	Energy Services Center[1]	8.422E-6	1.310E-8
Q	NW	0.75	Gin Lake[1]	3.958E-6	4.531E-9
P	WNW	0.75	Hamilton Lake[1]	6.266E-6	5.215E-9

[1]These locations occupy multiple sectors. In each case the SITE BOUNDARY locations used in the dose calculation was limiting.

2.3 Meteorological Model

2.3.1 Atmospheric Dispersion

The atmospheric dispersion for gaseous releases may be calculated using a ground level, wake-split form of the straight line flow model.

X/Q = atmospheric dispersion (sec/m^3)

$$\frac{2.03\ \delta\ k}{ruE}$$

where:

r = distance (m) from release point to location of interest

δ = plume depletion factor at distance r from ODCM Figure 2.3-1

u = wind speed at ground level (m/sec)

k = open terrain recirculation factor at distance r, from ODCM Figure 2.3-4 (not used)

E = the lesser of $(\sigma^2 + \frac{b^2}{\pi})^{\frac{1}{2}}$ or $\sqrt{3}\ \sigma$

where:

σ = vertical standard deviation (m) of the plume at distance r for ground level releases under the stability category indicated by $\dot{T}$, from ODCM Figure 2.3-2

$\dot{T}$ = temperature differential with vertical separation (°K/100m)

b = height of the reactor building = 53.3m

2.3.2 Deposition

Relative deposition per unit area for all releases is calculated for a ground level release as follows:

D/Q = relative deposition per unit area (m^{-2})

$$= \frac{2.55}{r} (D_g)$$

where:

D_g = relative deposition rate at distance r for ground level releases from ODCM Figure 2.3-3

X/Q and D/Q values were calculated using the methodology of NUREG/CR-2919 "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations".

GGNS gaseous releases are ground level.

Additional information on the X/Q and D/Q calculations can be found in ODCM References 9 and 10.

"TEXT DELETED"

2.4 Definitions of Gaseous Effluents Parameters

b = height of reactor building (m) (2.3.1)

C = count rate of the station vent monitor corresponding to grab sample radionuclide concentrations (2.1.1)

C' = count rate of station vent monitor corresponding to a 1.0 μCi/ml concentration of Xe-133 (2.1.2)

D_g = relative deposition rate for ground level releases from Figure 2.3-3 (m^{-1}) (2.3.2)

D_o = average organ dose rate in current year (mrem) (2.2.1.b)

D_p = dose to an individual from radioiodines and radionuclides in particulate form, with half-life greater than eight days (mrem) (2.2.2.b)

D_s = average skin dose rate in current year (mrem) (2.2.1.a)

D_{tb} = average total body dose rate in current year (mrem) (2.2.1.a)

D_β = air dose due to beta emissions from noble gas radio-nuclide i (mrad) (2.2.2.a)

D_γ = air dose due to gamma emissions from noble gas radio-nuclide i (mrad) (2.2.2.a)

D/Q = relative deposition per unit area (m^{-2}) (2.3.2)

σ = plume depletion factor at distance r for appropriate stability class and effective height from Figures 2.3-2 and 2.3-3 (2.3.1)

F = fraction of current year elapsed at time of calculation (2.1.1)

k = open terrain recirculation factor at distance r from Figure 2.3-1 (2.3.1)

2.4 Definitions of Gaseous Effluents Parameters (Continued)

K = total body dose factor for Kr-89, the most restrictive isotope (mrem/yr per $\mu Ci/m^3$), from Table 2.1-1 (2.1.2)

K_i = total body dose factor due to gamma emissions from isotope i (mrem/yr per $\mu Ci/m^3$) from Table 2.1-1 (2.1.1)

D_{TB} = limiting dose rate to the total body based on the limit of 500 mrem in one year. (2.1.1)

D_{ss} = limiting dose rate to the skin based on the limit of 3000 mrem in one year. (2.1.1)

L = skin dose factor for Kr-89, the most restrictive isotope (mrem/yr per $\mu Ci/m^3$) from Table 2.1-1 (2.1.2)

L_i = skin dose factor due to beta emissions from isotope i (mrem/yr per $\mu Ci/m^3$), from Table 2.1-1 (2.1.1)

M = air dose factor for Kr-89, the most restrictive isotope (mrad/yr per $\mu Ci/m^3$) from Table 2.1-1 (2.1.2)

M_i = air dose factor due to gamma emissions from isotope i (mrad/yr per $\mu Ci/m^3$) from Table 2.1-1 (2.1.1)

N_i = air dose factor due to beta emissions from noble gas radionuclide i (mrad/yr per $\mu Ci/m^3$) from Table 2.1-1 (2.2.2.a)

P_i = dose parameter for radionuclide i, (mrem/yr per $\mu Ci/m^3$) for inhalation from (m^3 · mrem/yr per μCi/sec) for other pathways, from Table 2.2-1 (2.2.1.b).

Q_i' = rate of release of noble gas radionuclide i (μCi/sec) (2.1.1)

$\overline{Q'_i}$ = average release rate for the current year (μCi/sec) of isotope i of tritium, I-131, I-133 or other radionuclide in particulate form, with half-life greater than eight (8) days (2.2.1.b)

Q_i = cumulative release of radionuclide i of noble gas, tritium, I-131, I-133, or material in particulate form over the period of interest (μCi) (2.2.2.a) (2.2.2.b)

2.4 Definitions of Gaseous Effluents Parameters (Continued)

$\overline{Q''_i}$ = assigned release rate value of, for example, 1.0 μCi/sec, Xe-133; related to definition of C' for the vent. (Note 3)

R_i = dose factor for radionuclide i, (mrem/yr per μCi/m³) or (m^2 · mrem/yr per μCi/sec)

R_s = count rate per mrem/yr to the skin. (2.1.1)

R_t = count rate per mrem/yr to the total body. (2.1.1)

R''_s = conservative count rate per mrem/yr to the skin. (2.1.2)

R''_t = conservative count rate per mrem/yr to the total body (Xe-133 detection, Kr-89 dose). (2.1.2)

r = distance (m) from release point to location of interest for dispersion calculation. (2.3.1)

2.4 Definitions of Gaseous Effluents Parameters (Continued)

S_v = count rate of station vent noble gas monitor at alarm setpoint level. (2.1.1)

Σ = vertical standard deviation of the plume with building wake correction (m). (2.3.1)

σ = vertical standard deviation (m) of the plume at distance r for effective height under stability category indicated by T(m) from Figure 2.3-2. (2.3.1)

$\dot{T}$ = temperature differential with vertical separation (°K/100m). (2.3.1)

u = wind speed at ground level (m/sec). (2.3.1)

W = controlling sector annual average atmospheric dispersion at the site boundary for the appropriate pathway (sec/m³). (2.2.1.b)

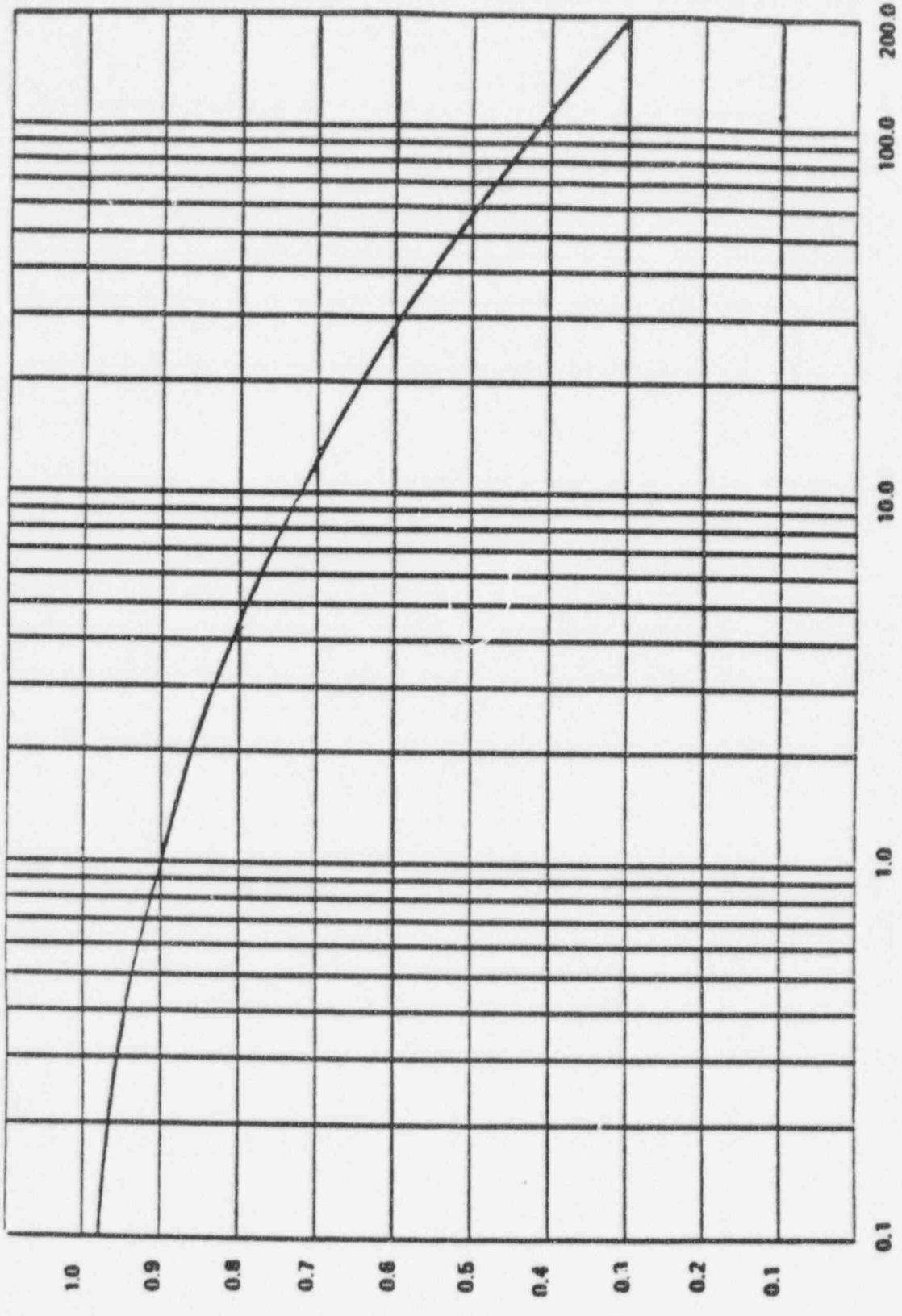
W' = relative concentration for unrestricted areas (sec/m³). (2.2.2.b)

X/Q = atmospheric dispersion (sec/m³) (2.3.1)

$\overline{X/Q}$ = highest sector annual average atmospheric dispersion at the unrestricted area boundary (sec/m³) (2.1.1)

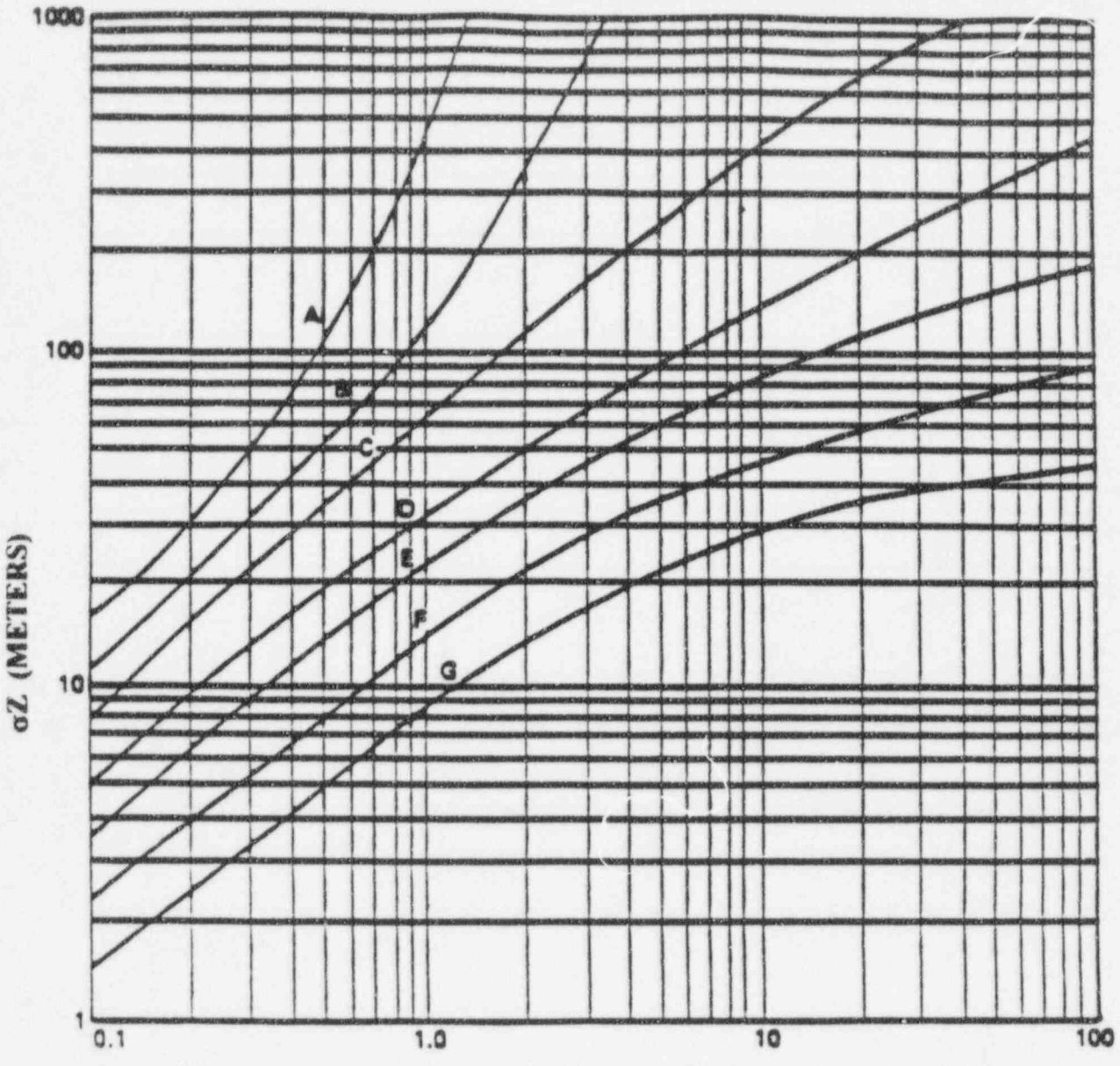
$\overline{X/Q}'$ = relative concentration for unrestricted areas (sec/m³) (2.2.2.a)

Figure 2.3-1
Plume Depletion Effect for Ground-Level Releases
(All Atmospheric Stability Classes)



Graph taken f. Reference 7, Figure 2

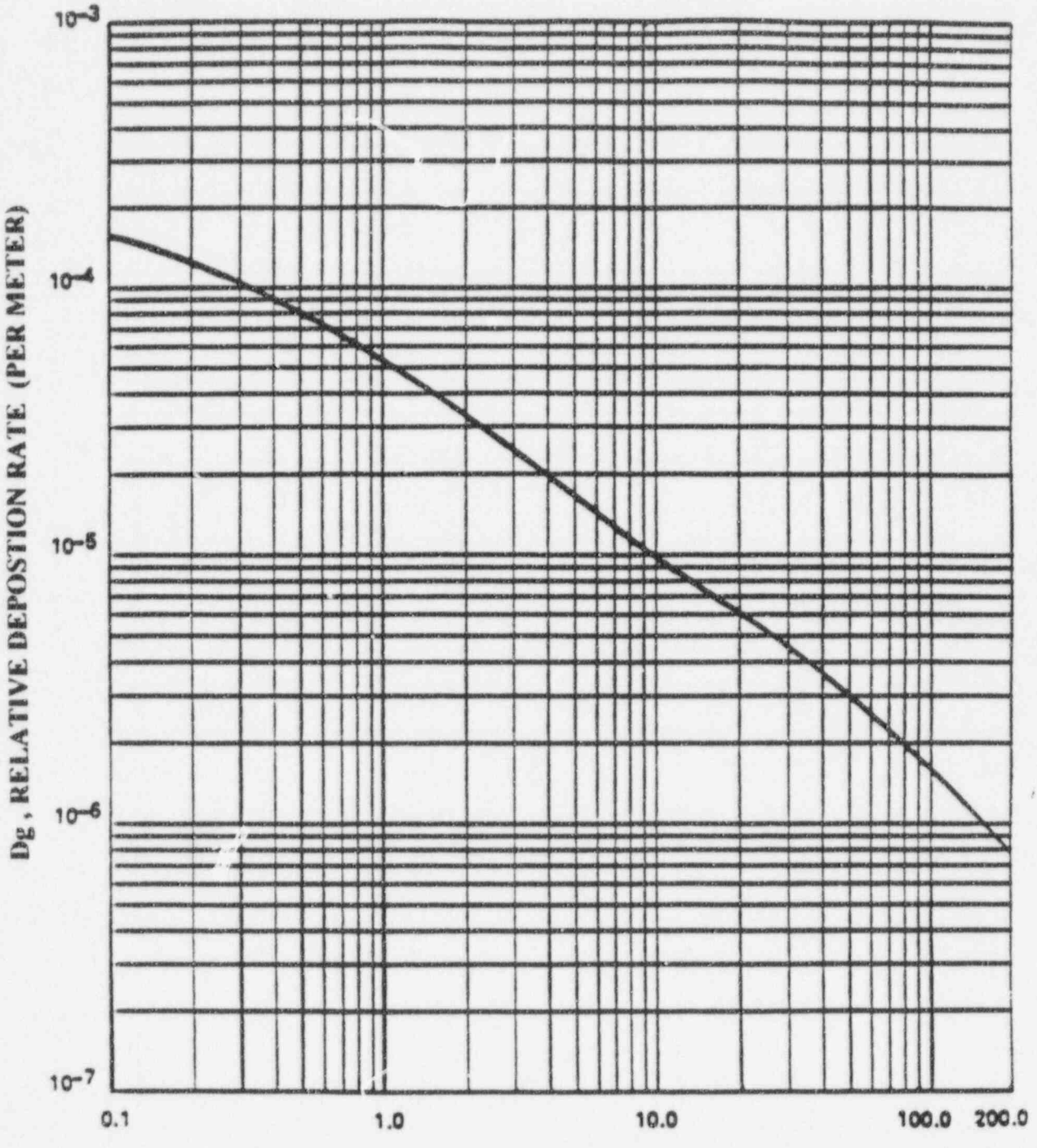
Figure 2.3-2
Vertical Standard Deviation of Material in a Plume
(Letters denote Pasquill Stability Class)



Temperature Change with Height (ΔT) (°K/100m)	Pasquill Category	Stability Classification
< -1.9	A	Extremely unstable
-1.9 to -1.7	B	Moderately unstable
-1.7 to -1.5	C	Slightly unstable
-1.5 to -0.5	D	Neutral
-0.5 to 1.5	E	Slightly stable
1.5 to 4.0	F	Moderately stable
> 4.0	G	Extremely stable

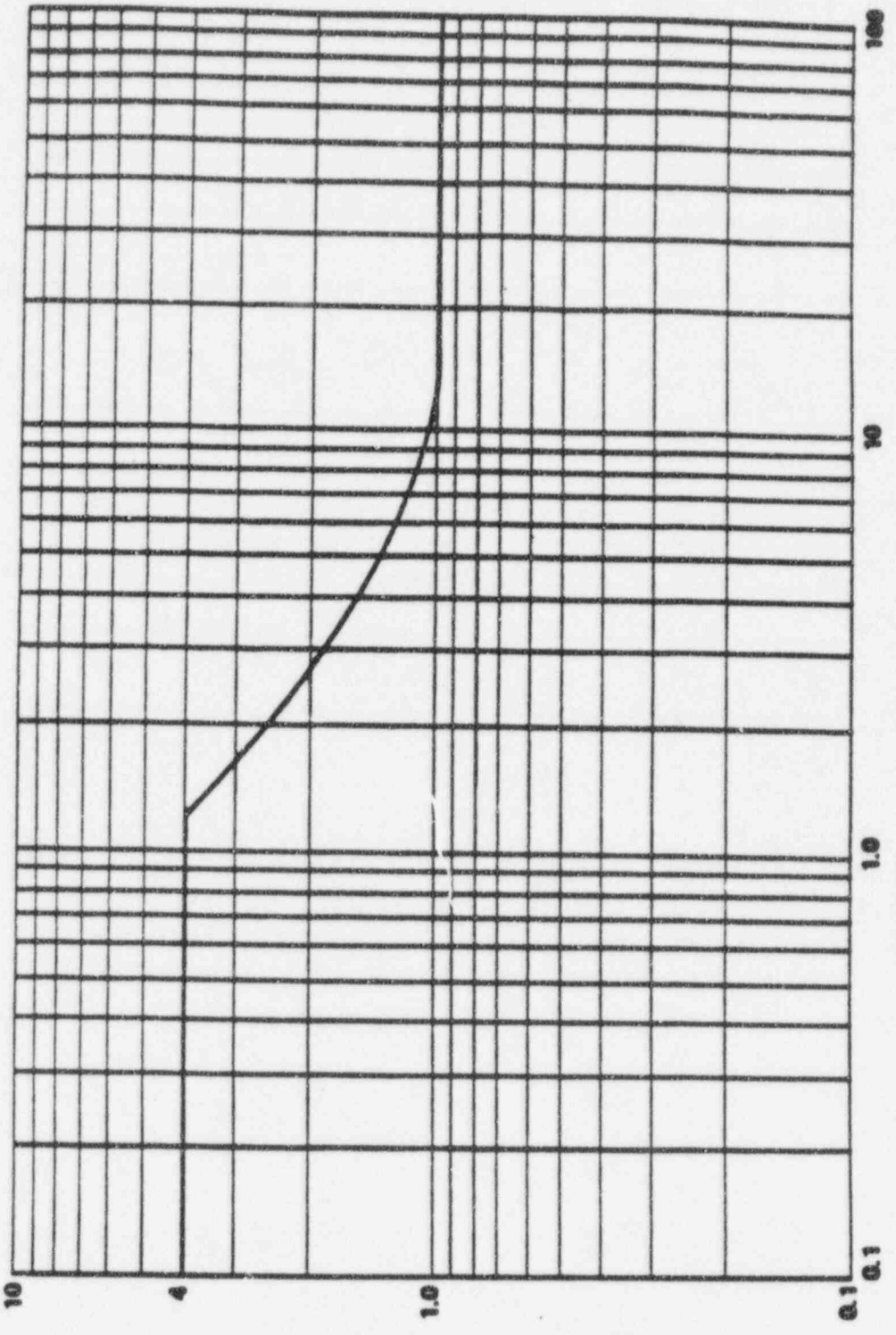
Graph taken from Reference 7, Figure 1

Figure 2.3-1
Relative Deposition for Ground-Level Releases
(All Atmospheric Stability Classes)



Graph taken from Reference 7, Figure 6

Figure 2.3-4 Open Terrain Recirculation Factor



Graph taken from Reference 6, Figure 2

2.5 Gaseous Radwaste Treatment System

The instruments required to be checked by LCO 6.11.7 to ensure that the GASEOUS RADWASTE TREATMENT (Offgas) SYSTEM is functioning are:

1. Adsorber train bypass switch (1N64-HS-M611)
2. Bypass valve indication (1N64-F045)

When the adsorber train bypass switch is in the TREAT position and the bypass valve indicates closed, the GASEOUS RADWASTE TREATMENT (Offgas) SYSTEM is functioning.

NOTES for ODCM Figure 2.5-1

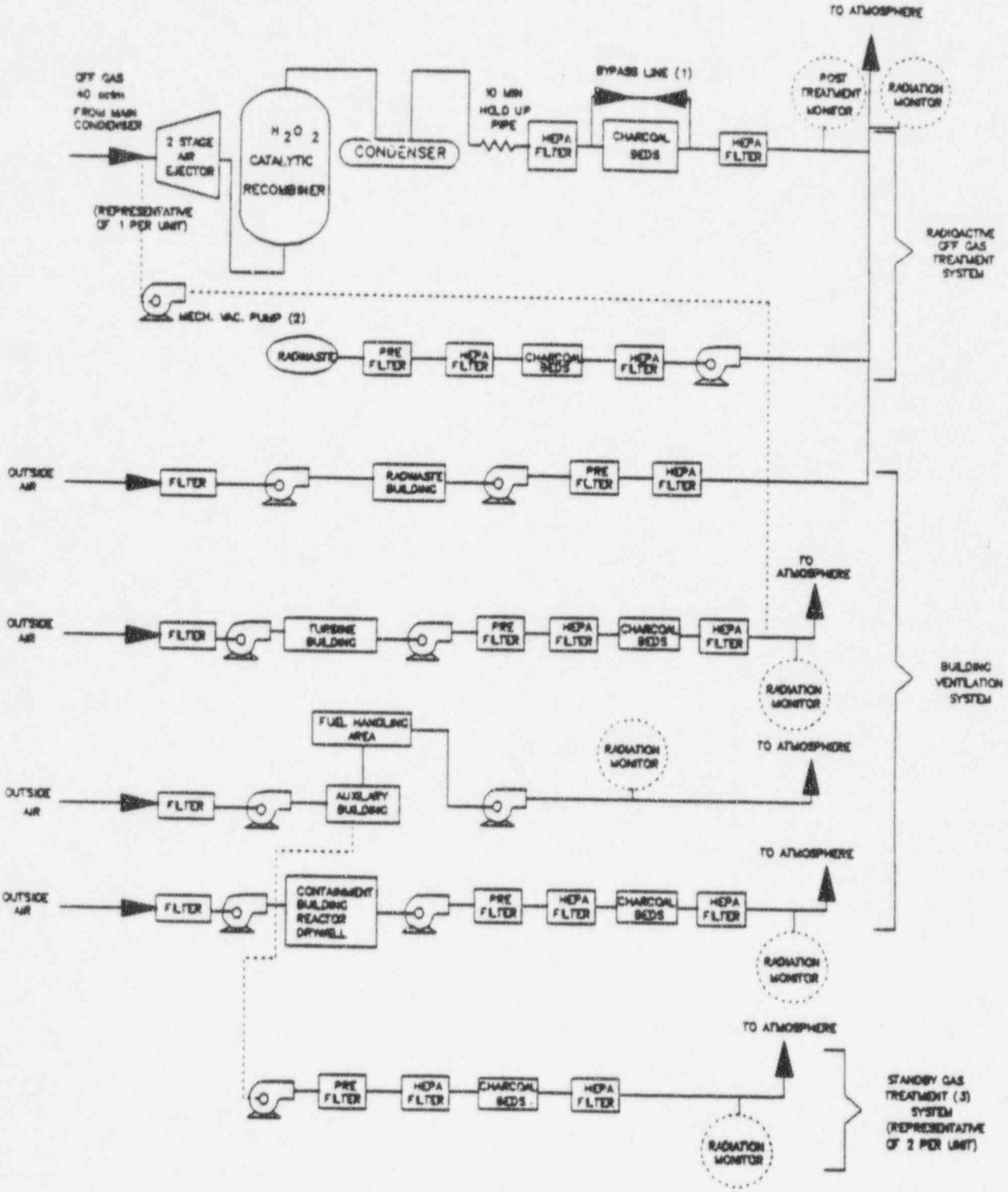
A flow diagram for the Gaseous Radwaste Treatment System is provided on the following page. Notes for the diagram are listed below.

(1) The charcoal beds are bypassed during startup until an adequate dewpoint is obtained in the process stream.

(2) This pathway may be utilized for power levels ≤ 5%.

(3) Standby Gas Treatment System not normally operated.

Figure 2.5-1
Gaseous Radwaste Treatment System



2.6 Annual Dose Commitment

If required, the annual (calendar year) dose or dose commitment to any MEMBER OF THE PUBLIC will be calculated by summing the following doses for the calendar year:

- Direct radiation dose
- Liquid effluent dose (D_{Tau})
- Noble gas dose (D_{γ}, D_{β})
- Particulate dose (D_{p})

These calculations are required only if the liquid or gaseous effluents exceed twice the limits of LCOs 6.11.2, 6.11.5 and 6.11.6.

2.6.1 Direct Radiation Dose Measurement

LCOs 6.11.2, 6.11.5 and 6.11.6 require the determination of cumulative dose contributions to a MEMBER OF THE PUBLIC from direct radiation from the reactor units and from radwaste storage tanks. This requirement is applicable only under conditions set forth in Action B.1 of the applicable LCO. This determination is made by the utilization of direct radiation measurements from indicator thermoluminescent dosimeters (TLDs) located near the GGNS property line in each of the 16 meteorological sectors.

Measurements from these TLDs represent the direct radiation generated by the facility plus normal background radiation. The locations are identified in ODCM Table 3.0-3 by the following TLD numbers:

M-16	M-22	M-41	M-86
M-20	M-25	M-23	M-92
M-19	M-27	M-17	M-93
M-21	M-28	M-45	M-94

Control TLDs are also utilized to differentiate between background radiation and direct radiation from the facility. The following two TLDs are designated as controls based on the criterion that they are located ten miles or greater from the facility. Exact locations are identified in ODCM Table 3.0-3.

M-14
M-33

The difference between the averaged quarterly radiation measurements of the indicator TLDs and the control TLDs represents the direct radiation dose to a MEMBER OF THE PUBLIC from the operating facility.

3.0 RADIOLOGICAL ENVIRONMENTAL MONITORING

3.1 Sampling Locations

Sampling locations to fulfill the requirements of LCO 6.12.1, as described in ODCM Table 6.12.1-1, are identified in ODCM Tables 3.0-1 through 3.0-3 and shown on maps in ODCM Figures 3.0-1 and 3.0-2.

ODCM

TABLE 3.0-1

AIR SAMPLER COLLECTION SITES

AIR SAMPLERS

NUMBER	FIGURE	LOCATION
AS-1 PG	3.0-2	Southeast of GGNS at the Port Gibson City Barn (Sector G Radius, 5.5 miles)
AS-3 61VA	3.0-2	NNE of GGNS on Hwy. 61, north of the Vicksburg Airport (Sector B Radius, 18 miles)
AS-5 TC	3.0-1	S of GGNS at the former Training Center (Sector J Radius, 0.4 miles)
AS-6 BF	3.0-1	SSW of GGNS at the GGNS Ball Field (Sector K Radius, 0.4 miles)
AS-7 UH	3.0-1	SSE of GGNS at the IBEW Union Hall (Sector H Radius, 0.5 miles)

TABLE 3.0-2

MISCELLANEOUS COLLECTION SITES

MILK SAMPLES (CONTROL LOCATION)	FIGURE	
ALCONT	3.0-2	Located SSW of GGNS at Alcorn State University (Sector K Radius 10.5 miles)
CISTERN WATER		
McGee Cistern	3.0-1	Located north of GGNS at the McGee house on Frazier Road (Sector A Radius 0.9 miles)
Willis Cistern	3.0-2	Located at the C. E. Willis house on Shiloh Road ENE of GGNS near the Shiloh Baptist Church (Sector D Radius 6 miles)
GROUND WATER		
PGWELL	3.0-1	PORT GIBSON WELLS - Taken from distribution system or one of the five wells (Sector G Radius 5.0 miles)
AAWELL	3.0-1	Arnold Acres Well (Sector J Radius 1.1 miles)

ODCM

TABLE 3.0-2 (Continued)

MISCELLANEOUS COLLECTION SITES

	FIGURE	
SURFACE WATER		
Upstream	3.0-1	At least 4500 ft upstream of the GGNS discharge point into the Mississippi River to allow adequate mixing of the Mississippi and Big Black Rivers (Sector Q-R, 1.8 miles)
Downstream	3.0-1	At least 5000 ft downstream of the GGNS discharge point into the Mississippi River near Radial Well No. 1 (Sector N, 1.6 miles)
Discharge Basin	3.0-1	WNW of GGNS in parking lot, YRD-133-PKG-LOT A (Sector P, 0.2 miles)
SEDIMENT SAMPLES		
SEDHAM	3.0-1	Downstream of the GGNS discharge point in the Mississippi River near Hamilton Lake outlet (Sector N, 1.6 miles)
VEGETATION		
Broadleaf Vegetation	3.0-1	S of GGNS near former Training Center on Bald Hill Road (Sector J, 0.4 miles)
		SSE of GGNS between the former training center and the IBEW Union Hall on Bald Hill Road (Sector H, 0.4 miles)
NOTE:		The above locations are gardens maintained by GGNS inside the SITE BOUNDARY. These two sampling sites exceed the requirements of LCO 6.12.1.
		Alcorn State University SSW of GGNS (Sector K, 10.5 miles) when available, otherwise a location 15-30 km distant
FISH SAMPLES		
Fish and Invertebrates		Downstream of the GGNS discharge point into the Mississippi River
		Upstream of the GGNS discharge point into the Mississippi River uninfluenced by plant operations

ODCM

TABLE 3.0-3

TLD LOCATIONS

TLD NO.	LOCATION	FIGURE	SECTOR	MILE
M-01	Across the road from Lake Claiborne entry gate	3.0-2	E	3.5
M-07	AS-1 PG, Port Gibson City Barn	3.0-2	G	5.5
M-09	Warner Tully Y-Camp	3.0-2	D	3.5
M-10	Grand Gulf Military Park	3.0-1	A	1.5

TABLE 3.0-3 (Continued)

TLD LOCATIONS

TLD NO.	LOCATION	FIGURE	SECTOR	MILE
M-14 (CONTROL)	AS-3-61VA, Hwy. 61, north of Vicksburg Airport	3.0-2	B	18.0
M-16	Meteorological Tower	3.0-1	A	0.9
M-17	S Side, Grand Gulf Road	3.0-1	C	0.5
M-19	Eastern SITE BOUNDARY property line, NNE of HWSA	3.0-1	E	0.5
M-20	Hazardous waste storage area (HWSA)	3.0-1	F	0.5
M-21	AS-5-TC, near former Training Center Building, on Bald Hill Road	3.0-1	J	0.4
M-22	Former RR entrance crossing on Bald Hill Road	3.0-1	G	0.5
M-23	Gin Lake Road 50 yards north of Heavy Haul Road on power pole	3.0-1	Q	0.5
M-25	Radial Well Number 1	3.0-1	N	1.6
M-27	WSW near SITE BOUNDARY property line, (Near Bucksnort Road)	3.0-1	M	1.5
M-28	Former Glodjo residence	3.0-1	L	0.9

TABLE 3.0-3 (Continued)

TLD LOCATIONS

TLD NO.	LOCATION	FIGURE	SECTOR	MILE
M-33 (Control)	Newellton, Louisiana, Water Tower	3.0-2	P	12.5
M-36	Curve on HW 608, point nearest GGNS at power pole	3.0-2	P	5.0
M-38	Lake Bruin State Park, entrance road	3.0-?	M	9.5
M-39	St. Joseph, Louisiana, Aux. Water Tank	3.0-2	M	13.0
M-40	International Paper Road, South of River Mile Marker	3.0-2	M	5.0
M-41	Radial Well Number 4	3.0-1	P	1.3
M-45	Old Visitor Center gate	3.0-1	D	0.5

TABLE 3.0-3 (Continued)

TLD LOCATIONS

TLD NO.	LOCATION	FIGURE	SECTOR	MILE
M-47	Bridge 0.6 miles west of Rodney-Westside Road/Mont Gomer Road intersection, north side	3.0-2	L	5.2
M-48	0.4 miles South on Mont Gomer Road on west side	3.0-2	K	4.8
M-49	Fork in Bessie Weathers Road/ Shaifer Road	3.0-2	H	4.5
M-50	Panola Hunting Club entrance	3.0-2	B	5.3
M-51	Ingelside Karnac Ferry Road between Deer Camp Road and Y-camp Road	3.0-2	C	4.2
M-55	Near Ingelside Karnac Ferry Road/ Ashland Road Intersection	3.0-2	D	5.0
M-56	H. W. Watson Elementary and Junior High School	3.0-2	G	4.2
M-57	Hwy. 61, behind the Welcome to Port Gibson sign at Glensdale Subdivision	3.0-2	F	4.5
M-58	Hwy. 61, Big Bayou Pierre bridge, southeast end	3.0-2	E	5.0
M-59	Off levee at Winter Quarters Hunting Camp	3.0-2	N	5.1

"TEXT DELETED"

TABLE 3.0-3 (Continued)

TLD LOCATIONS

TLD NO.	LOCATION	FIGURE	SECTOR	MILE
M-86	North Site Access Road entrance near SITE BOUNDARY	3.0-1	B	0.5
M-88	River mile marker 409.5	3.0-1	A	4.2
M-89	Middle Ground Island	3.0-1	R	4.4
M-90	Across from Middle Ground Island, near Louisiana State Line (Yucatan cutoff of 1929)	3.0-1	Q	3.5

TABLE 3.0-3 (Continued)

TLD LOCATIONS

TLD NO.	LOCATION	FIGURE	SECTOR	MILE
M-91	Transmission line by pond (Off Shaifer Road near Widows Creek)	3.0-1	J	4.5
M-92	Fence behind orchard (Bald Hill Road)	3.0-1	K	0.4
M-93	Underground cable sign (Bald Hill Road)	3.0-1	H	0.4
M-94	Sector R near Meterological tower	3.0-1	R	0.8

Figure 3.0-1
Collection Site Location, 0-5 Mile Area Map

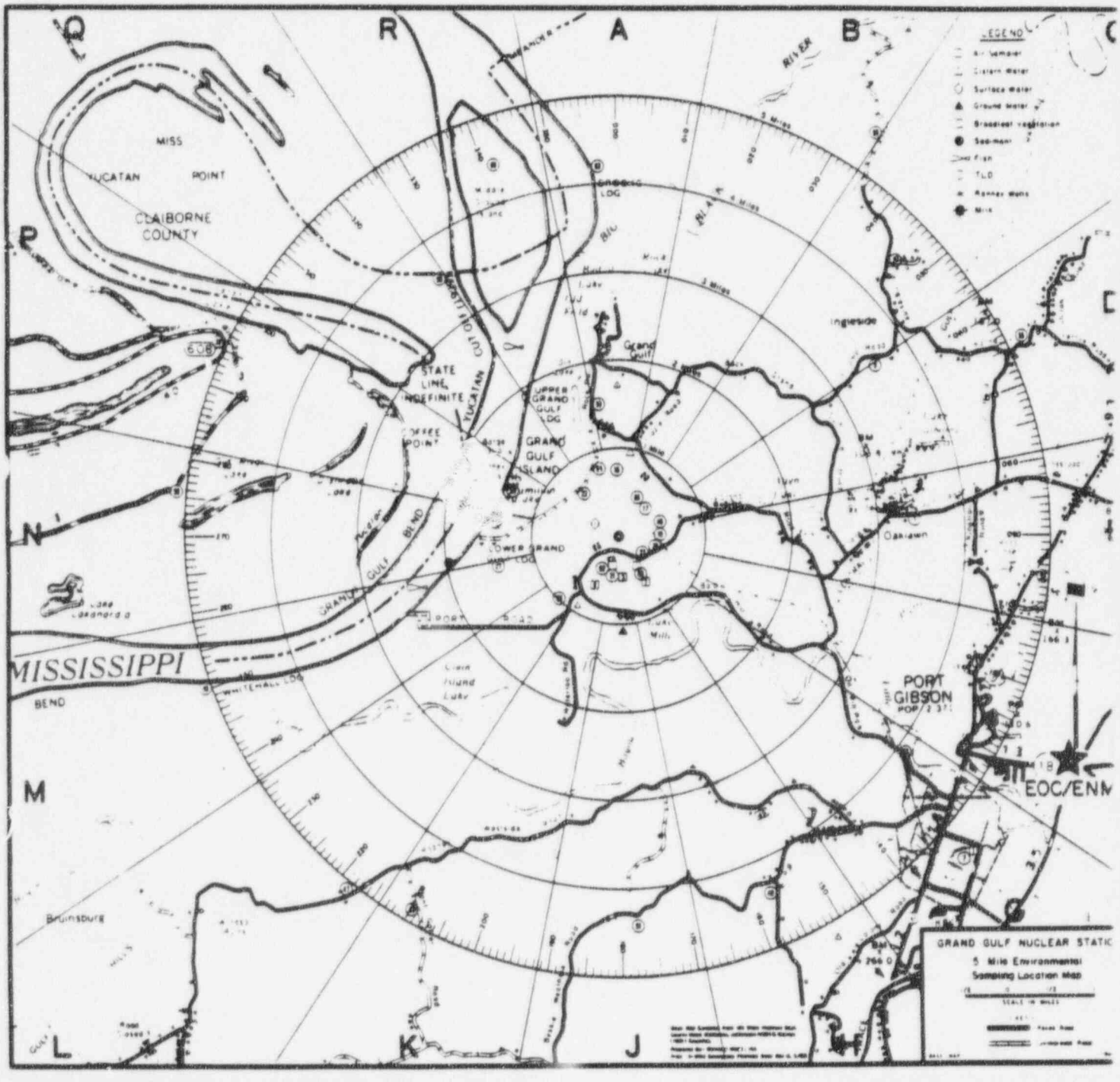
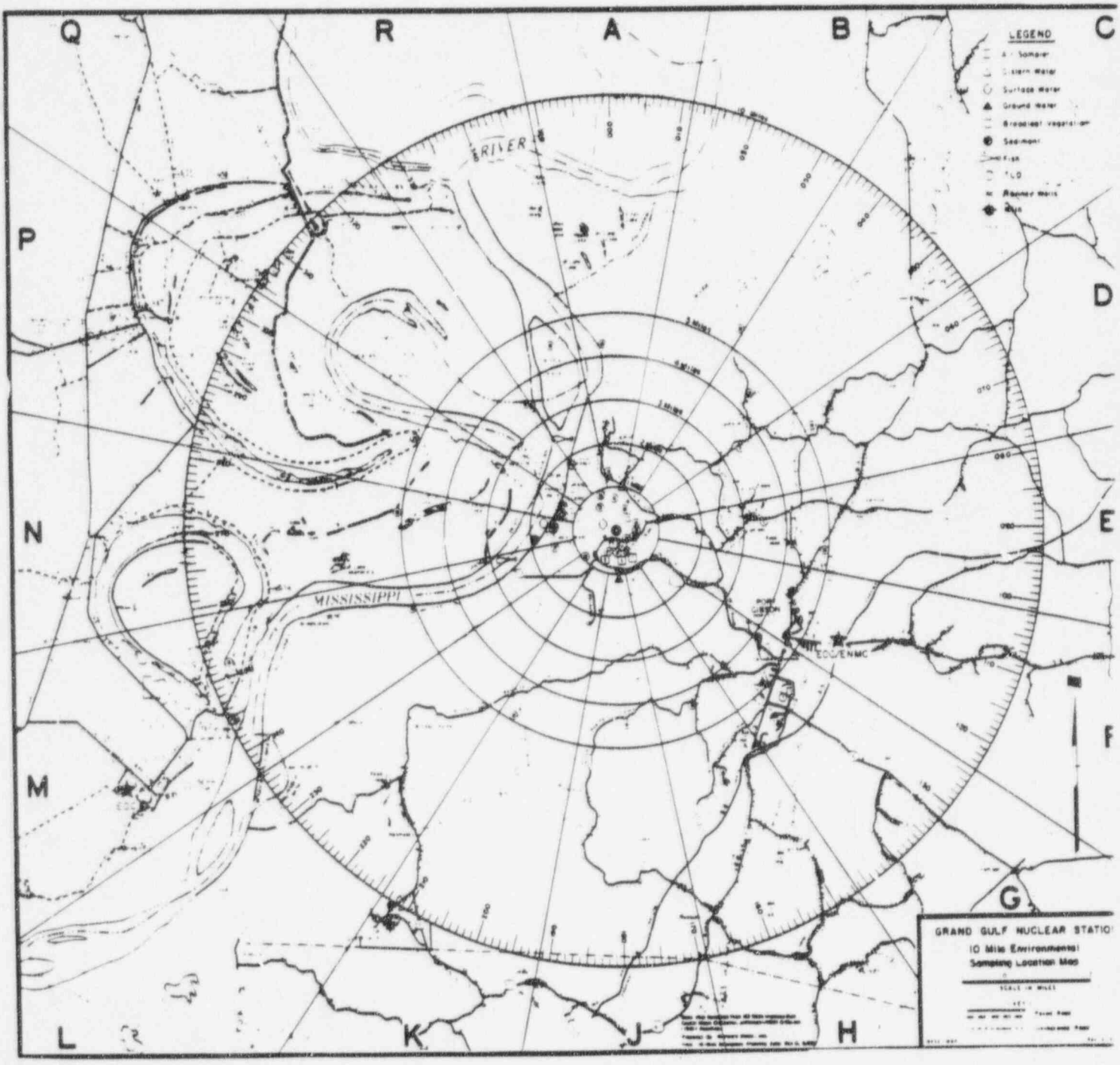


Figure 3.0-2
Collection Site Locations, General Area Map,
0-10 Mile Area Map



OFFSITE DOSE CALCULATION MANUAL

APPENDIX A

RADIOLOGICAL EFFLUENT CONTROLS AND RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAMS

"TEXT DELETED"

1.0 DEFINITIONS

GASEOUS RADWASTE TREATMENT (OFFGAS) SYSTEM

1.1 The GASEOUS RADWASTE TREATMENT (OFFGAS) SYSTEM is the system designed and installed to reduce radioactive gaseous effluents by collecting primary coolant system offgases from the primary system and providing for delay or holdup for the purpose of reducing the total radioactivity prior to release to the environment.

MEMBER(S) OF THE PUBLIC

1.2 MEMBER(S) OF THE PUBLIC shall include individuals in a controlled or unrestricted area. However, an individual is not a member of the public during any period in which the individual receives an occupational dose.

OFFSITE DOSE CALCULATION MANUAL (ODCM)

1.3 The OFFSITE DOSE CALCULATION MANUAL (ODCM) shall contain the methodology and parameters used in the calculation of offsite doses resulting from radioactive gaseous and liquid effluents, in the calculation of gaseous and liquid effluent monitoring Alarm/Trip Setpoints, and in the conduct of the Environmental Radiological Monitoring Program. The ODCM shall also contain (1) the Radioactive Effluent Controls and Radiological Environmental Monitoring Programs required by Technical Specification 5.5.4 and Technical Requirement 7.6.3.2 and (2) descriptions of the information that should be included in the Annual Radiological Environmental Operating and Annual Radioactive Effluent Release Reports required by Technical Specifications 5.6.2 and 5.6.3.

PROCESS CONTROL PROGRAM (PCP)

1.4 The PROCESS CONTROL PROGRAM (PCP) shall contain the current formulas, sampling, analyses, test, and determinations to be made to ensure that processing and packaging of solid radioactive wastes based on demonstrated processing of actual or simulated wet solid wastes will be accomplished in such a way as to assure compliance with 10CFR Parts 20, 61, and 71, State regulations, burial ground requirements, and other requirements governing the disposal of solid radioactive waste.

SITE BOUNDARY

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

UNRESTRICTED AREA

1.6 An UNRESTRICTED AREA shall be any area, at or beyond the SITE BOUNDARY, access to which is not controlled by the licensee for the purposes of protection of individuals from exposure to radiation and radioactive materials, or any area within the SITE BOUNDARY used for residential quarters or for industrial commercial, institutional, and/or recreational purposes. The UNRESTRICTED AREA and SITE BOUNDARY are synonymous with the exception of areas over bodies of water.

VENTILATION EXHAUST TREATMENT SYSTEM

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

Additional Definitions are listed in Technical Specification Section 1.1.

TABLE 1.1

SURVEILLANCE FREQUENCY NOTATION

Surveillance Frequencies are specified in individual LCOs. For more information see Technical Specificaiton Section 1.4.

TABLE 1.2

MODES

Modes of operation are shown in Technical Specification Table 1.1-1

3.0 APPLICABILITY

LIMITING CONDITION FOR OPERATION (LCO)

See Technical Specification Section 3.0 for LCO Applicability.

APPLICABILITY

SURVEILLANCE REQUIREMENTS (SR)

See Technical Specification Section 3.0 for SR applicability.

SECTION 5.0

ADMINISTRATIVE CONTROLS

5.6.2 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

Routine radiological environmental operating reports covering the operation of the unit during the previous calendar year shall be submitted before May 1 of each year.

The annual radiological environmental operating reports shall include summaries, interpretations, and an analysis of trends of the results of the radiological environmental surveillance activities for the report period, including a comparison with preoperational studies, operational controls (as appropriate), and previous environmental surveillance reports and an assessment of the observed impacts of the plant operation on the environment. The reports shall also include the results of land use censuses required by LCO 6.12.2. If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to alleviate the problem.

The annual radiological environmental operating reports shall include summarized and tabulated results in the format of Regulatory Guide 4.8, December 1975 of all radiological environmental samples taken during the report period. Deviations from the sampling program identified in LCO 6.12.1 shall be reported. In the event that some results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted as soon as possible in a supplementary report.

The reports shall also include the following:

1) a summary description of the radiological environmental monitoring program;

2) a map of all sampling locations keyed to a table giving distances and directions from one reactor;

3) and the results of licensee (or offsite laboratory's) participation in the Interlaboratory Comparison Program, required by LCO 6.12.1.

5.6.3 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT

A Radioactive Effluent Release Report covering the operation of the unit during the previous year shall be submitted before May 1 of each year.

a. The Radioactive Effluent Release Report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit as outlined in Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974, with data summarized on a quarterly basis following the format of Appendix B thereof. For solid wastes, the format for Table 3 and Appendix B shall be supplemented with three additional categories: class of solid wastes (as defined by 10 CFR Part 61), type of container (e.g., Steel Liner, High Integrity Container) and SOLIDIFICATION Agent or absorbent (e.g., cement, urea formaldehyde).

The Radioactive Effluent Release Report shall include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability.* This same report shall include an assessment of the radiation doses due to the radioactive liquid and gaseous effluents released from the unit or station during the previous calendar year. This same report shall also include an assessment of the radiation doses from radioactive liquid and gaseous effluents to MEMBERS OF THE PUBLIC due to their activities inside the SITE BOUNDARY during the reporting period. All assumptions used in making these assessments, i.e., specific activity, exposure time, and location, shall be included in these reports. The meteorological conditions concurrent with the time of release of radioactive materials in gaseous effluents, as determined by sampling frequency and measurement or historical annual average meteorological conditions, shall be used for determining the gaseous pathway doses. The assessment of radiation doses shall be performed in accordance with the methodology and parameters in the OFFSITE DOSE CALCULATION MANUAL (ODCM).

The Radioactive Effluent Release Report shall also include an assessment of radiation doses to the likely most exposed MEMBER OF THE PUBLIC from reactor releases and other nearby uranium fuel cycle sources, including doses from primary effluent pathways and direct radiation, for the previous calendar year to show conformance with 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operation." Acceptable methods for calculating the dose contribution from liquid and gaseous effluents are given in Regulatory Guide 1.109, Rev 1, October 1977 and NUREG - 0133.

The Radioactive Effluent Release Report shall include a list and description of unplanned releases from the site to UNRESTRICTED AREAS of radioactive materials in gaseous and liquid effluents made during the reporting period.

The Radioactive Effluent Release Report shall include any changes made during the reporting period to the OFFSITE DOSE CALCULATION MANUAL (ODCM), pursuant to Technical Specification 5.5.1, as well as any major change to Liquid, Gaseous, or Solid Radwaste Treatment Systems. It shall also include a listing of new locations for dose calculations and/or environmental monitoring identified by the Land Use Census pursuant to LCO 6.12.2.

* In lieu of submission with the Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meterological data onsite in a file that shall be provided to the NRC on request.

5.6.3 ANNUAL RADIOACTIVE EFFLUENT RELEASE REPORT (Continued)

The Radioactive Effluent Release Report shall also include the following: an explanation as to why the inoperability of liquid or gaseous effluent monitoring instrumentation was not corrected within the time specified in LCOs 6.3.9 or 6.3.10, and description of the events leading to liquid holdup tanks exceeding the limits of Technical Specification 5.5.8.b.

b. Major changes to the Radioactive Waste Treatment System (liquid, gaseous and solid**) shall be reported to the Commission in the Annual Radioactive Effluent Release Report for the period in which the evaluation was reviewed by the PSRC.

(1) A summary of the evaluation that led to the determination that the change could be made in accordance with 10 CFR 50.59;

(2) Sufficient detailed information to totally support the reason for the change without benefit of additional or supplemental information;

(3) A detailed description of the equipment, components and processed involved and the interfaces with other plant systems;

(4) An evaluation of the change which shows the predicted releases of radioactive materials in liquid and gaseous effluents and/or quantity of solid waste that differ from those previously predicted in the license application and amendments thereto;

(5) An evaluation of the change which shows the expected maximum exposures to MEMBERS OF THE PUBLIC in the UNRESTRICTED AREA and to the general population that differ from those previously estimated in the license application and amendments thereto;

(6) A comparison of the predicted releases of radioactive materials, in liquid and gaseous effluents and in solid waste, to the actual releases for the period before when the changes are to be made;

(7) An estimate of the exposure to plant operating personnel as a result of the change; and

(8) Documentation of the fact that the change was reviewed and found acceptable by the PSRC.

** The information called for in this Specification may be submitted as part of the next UFSAR update.

SECTION 6.0

LIMITING CONDITIONS FOR OPERATION

AND

SURVEILLANCE REQUIREMENTS

6.3 INSTRUMENTATION

6.3.9 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

LCO 6.3.9 The radioactive liquid effluent monitoring instrumentation channels shown in Table 6.3.9-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of LCO 6.11.1 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY: At all times.

ACTIONS

----------NOTES----------

1. Separate Condition entry is allowed for each Channel.

2. The provisions of LCO 3.0.3 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more required channels inoperable.	A.1 Suspend release of radiactive effluent via affected pathway. OR ----------NOTES---------- Once required Action A.2 is entered the Completion Time for Condition B or C can not be restarted by reentering Required Action A.1. ---------- A.2 Enter the Condition referenced in Table 6.3.9-1 for the channel.	Immediately Immediately

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. As required by Required Action A.2 and referenced in Table 6.3.9-1.	B.1 At least two independent samples are analyzed in accordance with LCO 6.11.1.	Prior to each release.
	AND	
	B.2 At least two technically qualified members of the Facility Staff independently verify the release rate calculations and discharge path valve line-up.	Prior to each release.
	AND	
	B.3 Restore channel to operable.	14 days
C. As required by Required Action A.2 and referenced in Table 6.3.9-1.	C.1 Estimate the flow rate for the affected pathway during actual releases. Pump curves may be used to estimate flow.	Once per 4 hours
	AND	
	C.2 Restore channel to operable.	30 days
D. Required Action and associated Completion Time of Condition B or C not met.	D.1 Suspend release of radiactive effluent via affected pathway.	Immediately
	AND	
	D.2 Initiate action to explain why this inoperability was not corrected in a timely manner in the next Annual Radioactive Effluent Release Report.	Immediately

SURVEILLANCE REQUIREMENTS

----------NOTES----------
Refer to Table 6.3.9-1 to determine which SRs apply to each channel.

	SURVEILLANCE	FREQUENCY
SR 6.3.9.1	----------NOTE---------- For flow rate measurement devices a CHANNEL CHECK shall consist of verifying indication of flow during periods of release. A CHANNEL CHECK shall be made at least once per 24 hours on days which batch releases are made. --- Perform CHANNEL CHECK.	24 hours
SR 6.3.9.2	Perform a source check, a qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.	Prior to each release.
SR 6.3.9.3	----------NOTE---------- The CHANNEL FUNCTIONAL TEST shall also demonstrate that automatic isolation of this pathway and control room alarm annunciation occur if any of the following conditions exists: 1. Instrument indicates measured levels above the alarm/trip setpoint. 2. Circuit failure. 3. Instrument indicates a downscale failure. 4. Instrument controls not set in operate mode. --- Perform CHANNEL FUNCTIONAL TEST.	92 days

(continued)

	SURVEILLANCE	FREQUENCY
SR 6.3.9.4	Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 6.3.9.5	----------NOTE---------- The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used. ---------- Perform a CHANNEL CALIBRATION.	12 months
SR 6.3.9.6	Perform a CHANNEL CALIBRATION	18 months

TABLE 6.3.9-1

RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

	INSTRUMENT	MINIMUM CHANNELS OPERABLE	CONDITIONS REFERENCED FROM REQUIRED ACTION A.1	SURVEILLANCE REQUIREMENTS
1.	GROSS RADIOACTIVITY MONITORS PROVIDING ALARM AND AUTOMATIC TERMINATION OF RELEASE			
	a. Liquid Radwaste Effluent Line	1	B	6.3.9.1 6.3.9.2 6.3.9.5 6.3.9.3
2.	FLOW RATE MEASUREMENT DEVICES			
	a. Liquid Radwaste Effluent Line	1	C	6.3.9.1 6.3.9.6 6.3.9.4
	b. Discharge Canal or Circulating Water Blowdown	1	C	6.3.9.1 6.3.9.6 6.3.9.4

6.3 INSTRUMENTATION

6.3.10 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

LCO 6.3.10 The radioactive gaseous effluent monitoring instrumentation channels shown in Table 6.3.10-1 shall be OPERABLE with their alarm/trip setpoints set to ensure that the limits of LCO 6.11.4 are not exceeded. The alarm/trip setpoints of these channels shall be determined in accordance with the OFFSITE DOSE CALCULATION MANUAL (ODCM).

APPLICABILITY: As shown in Table 6.3.10-1

ACTIONS

----------NOTES----------

1. Separate Condition entry is allowed for each Channel.
2. The provisions of Specification 3.0.3 and 3.0.4 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more required channels inoperable.	A.1 Suspend release of radiactive effluent via affected pathway. OR ----------NOTES---------- Once required Action A.2 is entered the Completion Time for Condition Referenced on Table 6.3.10-1 can not be restarted by reentering Required Action A.1. ---------- A.2 Enter the Condition referenced in Table 6.3.10-1 for the channel.	Immediately Immediately

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. As required by Required Action A.2 and referenced in Table 6.3.10-1.	B.1 Take grab samples during release. AND B.2 Analyze the above required samples for gross activity. AND B.3 Restore channel to operable.	Once per 8 hours Within 24 hours of taking the sample 30 days
C. As required by Required Action A.2 and referenced in Table 6.3.10-1.	C.1 Establish an alternate means to collect samples required by Table 6.11.4-1. AND C.2 Restore channel to operable.	Immediately 30 days
D. As required by Required Action A.2 and referenced in Table 6.3.10-1.	D.1 Estimate flow rate. AND D.2 Restore channel to operable.	Once per 8 hours 30 days

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. As required by Required Action A.2 and referenced in Table 6.3.10-1.	E.1 Place the inoperable channel in downscale trip. OR ----------NOTE---------- With both required monitors inoperable take Required Actions E.2. ----------	1 hour
	E.2.1 Take grab samples during release. AND	Once per 8 hours
	E.2.2 Analyze the above required samples for gross activity. AND	Within 24 hours of taking the sample
	E.2.3 Restore channel to operable.	30 days
F. As required by Required Action A.2 and referenced in Table 6.3.10-1.	F.1 Verify the offgas system is not bypassed, except for filtration system bypass during plant startups. AND	Immediately
	F.2 Verify by administrative means that the offgas post-treatment monitoring system is operable. AND	Immediately
	F.3 Restore channel to operable.	72 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
G. As required by Required Action A.2 and referenced in Table 6.3.10-1.	G.1 Take grab samples during release. AND G.2 Analyze the above required samples for gross activity. AND G.3 Restore channel to operable.	Once per 4 hours Within 24 hours of taking the sample 30 days
H. Required Actions and associated Completion Times of Condition B,C,D,E or G not met.	H.1 Suspend release of radiactive effluent via this pathway. AND H.2 Initiate action to explain why this inoperability was not corrected in a timely manner in the next Annual Radioactive Effluent Release Report.	Immediately Immediately
I. Required Action and associated Completion Time of Condition F not met.	I.1 Be in MODE 3 AND I.2 Be in MODE 4	12 hours 36 hours

SURVEILLANCE REQUIREMENTS

----------NOTES----------

1. Refer to Table 6.3.10-1 to determine which SRs apply to each channel.

2. When a monitor is placed in an inoperable status solely for performance of required Surveillance's, entry into associated Conditions and Required Actions in accordance with LCO 6.3.10 may be delayed for up to 1 hour.

	SURVEILLANCE	FREQUENCY
SR 6.3.10.1	Perform CHANNEL CHECK.	24 hours
SR 6.3.10.2	Perform CHANNEL CHECK.	7 days
SR 6.3.10.3	----------NOTE---------- 1. Not required to be performed in MODES 1 and 2 for the offgas pre-treatment monitor if inaccessibile due to a high radiation area. 2. Not required to be performed for the offgas pretreatment monitor when entering MODES 3 and 4 from MODES 1 or 2 until 8 hours after entering MODE 3 or 4 if monitor was inaccessible due to a high radiation area. ---------- Perform SOURCE CHECK , a qualitative assessment of channel response when the channel sensor is exposed to a radioactive source.	31 days
SR 6.3.10.4	----------NOTE---------- The CHANNEL FUNCTIONAL TEST shall also demonstrate the automatic isolation capability of the instrumentation for this pathway and the control room alarm annunciation capability, if any of the following conditions exists: 1. Instrument indicates measured levels above the alarm/trip setpoint. 2. Circuit failure. 3. Instrument indicates a downscale failure. 4. Instrument controls not set in operate mode. ---------- Perform CHANNEL FUNCTIONAL TEST.	92 days

(continued)

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 6.3.10.5	----------NOTE---------- The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occur if any of the following conditions exists: 1. Instrument indicates measured levels above the alarm/trip setpoint. 2. Circuit failure. 3. Instrument indicates a downscale failure. 4. Instrument controls not set in operate mode. ---------- Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 6.3.10.6	----------NOTE---------- Compare the measured flow rate to the expected design flow rate for existing plant conditions. ---------- Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 6.3.10.7	----------NOTE---------- 1. The initial CHANNEL CALIBRATION shall be performed using one or more of the reference standards certified by the National Institute of Standards and Technology (NIST) or using standards that have been obtained from suppliers that participate in measurement assurance activities with NIST. These standards shall permit calibrating the system over its intended range of energy and measurement range. For subsequent CHANNEL CALIBRATION, sources that have been related to the initial calibration shall be used. 2. The offgas pre-treatment and offgas post-treatment sensors will be calibrated for mr/hr or cpm from the calibration standard. The conversion to release rate will be performed during subsequent unit operation, but within one week. ---------- Perform a CHANNEL CALIBRATION.	12 months
SR 6.3.10.8	Perform a CHANNEL CALIBRATION	18 months

TABLE 6.3.10-1

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	CONDITIONS REFERENCED FROM REQUIRED ACTION A.2	SURVEILLANCE REQUIREMENTS
1. RADWASTE BUILDING VENTILATION MONITORING SYSTEM				
a. Noble Gas Activity Monitor Providing Alarm	1	(a)	B	6.3.10.1 6.3.10.3 6.3.10.5 6.3.10.7
b. Iodine Sampler	1	(a)	C	6.3.10.2
c. Particulate Sampler	1	(a)	C	6.3.10.2
d. Effluent System Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.6 6.3.10.8
e. Sampler Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.8
2. CONTAINMENT VENTILATION MONITORING SYSTEM				
a. Noble Gas Activity Monitor Providing Alarm	1	(a)	B	6.3.10.1 6.3.10.3 6.3.10.5 6.3.10.7

TABLE 6.3.10-1 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	CONDITIONS REFERENCED FROM REQUIRED ACTION A.2	SURVEILLANCE REQUIREMENTS
b. Iodine Sampler	1	(a)	C	6.3.10.2
c. Particulate Sampler	1	(a)	C	6.3.10.2
d. Effluent System Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.6 6.3.10.8
e. Sampler Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.8
3. TURBINE BLDG. VENTILATION MONITORING SYSTEM				
a. Noble Gas Activity Providing Alarm	1	(a)	B	6.3.10.1 6.3.10.3 6.3.10.5 6.3.10.7
b. Iodine Sampler	1	(a)	C	6.3.10.2
c. Particulate Sampler	1	(a)	C	6.3.10.2
d. Effluent System Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.6 6.3.10.8
e. Sampler Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.8

TABLE 6.3.10-1 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	CONDITIONS REFERENCED FROM REQUIRED ACTION A.2	SURVEILLANCE REQUIREMENTS
4. FUEL HANDLING AREA VENTILATION MONITORING SYSTEM				
a. Noble Gas Activity Providing Alarm	1	(a)	B	6.3.10.1 6.3.10.3 6.3.10.5 6.3.10.7
b. Iodine Sampler	1	(a)	C	6.3.10.2
c. Particulate Sampler	1	(a)	C	6.3.10.2
d. Effluent Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.6 6.3.10.8
e. Sampler Flow Rate Measuring Device	1	(a)	D	6.3.10.1 6.3.10.8
5. OFFGAS PRE-TREATMENT MONITOR				
a. Noble Gas Activity Monitor Providing Alarm	1	(c)	F	6.3.10.1 6.3.10.3 6.3.10.5 6.3.10.7

TABLE 6.3.10-1 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

INSTRUMENT	MINIMUM CHANNELS OPERABLE	APPLICABILITY	CONDITIONS REFERENCED FROM REQUIRED ACTION A.2	SURVEILLANCE REQUIREMENTS
6. OFFGAS POST-TREATMENT MONITOR				
a. Noble Gas Activity Monitor Providing Alarm and Automatic Termination of Release	2	(b)	E	6.3.10.1 6.3.10.3 6.3.10.4 6.3.10.7
7. STANDBY GAS TREATMENT EXHAUST MONITORING SYSTEM (A&B)				
a. Noble Gas Activity Monitor Provding Alarm	1/system	(a)	G	6.3.10.1 6.3.10.3 6.3.10.5 6.3.10.7

TABLE 6.3.11-1 (Continued)

RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION
TABLE NOTATION

(a) At all times.
(b) During main condenser offgas treatment system operation.
(c) When any steam jet air ejector (SJAE) is in operation.

6.11 RADIOACTIVE EFFLUENTS

6.11.1 LIQUID EFFLUENTS CONCENTRATION

LCO 6.11.1 The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS shall be limited to ten times the effluent concentrations specified in 10 CFR Part 20, Appendix B, Table 2, Column 2 for radionuclides other than dissolved or entrained noble gases. For dissolved or entrained noble gases, the concentration shall be limited to 2×10^{-4} microcuries/ml total activity.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The concentration of radioactive material released in liquid effluents to UNRESTRICTED AREAS exceeds the above limits.	A.1 Restore the concentration to within the above limits. AND A.2 Declare the liquid effluent waste treatment system inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 6.11.1.1	The radioactivity content of each batch of radioactive liquid waste shall be determined before release by sampling and analysis in accordance with (ODCM) Table 6.11.1-1.	Per (ODCM) Table 6.11.1-1.
SR 6.11.1.2	Post-release analyses of samples composited from batch releases shall be performed in accordance with (ODCM) Table 6.11.1-1.	Per (ODCM) Table 6.11.1-1.

TABLE 6.11.1-1

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

Liquid Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml) (a)
A. Batch Waste Release Tanks(c)	Prior to Release Each Batch	Prior to Release Each Batch	Principal Gamma Emitters(d)	5×10^{-7}
			I-131	1×10^{-6}
	Prior to Release One Batch/M	31 days	Dissolved and Entrained Gases (Gamma emitters)	1×10^{-5}
	Prior to Release Each Batch	31 days Composite(b)	H-3	1×10^{-5}
			Gross Alpha	1×10^{-7}
	Prior to Release Each Batch	92 days Composite(b)	Sr-89, Sr-90	5×10^{-8}
			Fe-55	1×10^{-6}
B. SSW Basin (before blowdown)	Prior to Release Each Blowdown	Prior to Release Each Batch	Principal Gamma Emitters(d)	5×10^{-7}
			I-131	1×10^{-6}

TABLE 6.11.1-1 (Continued)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATION

a. The LLD is the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where

LLD is the "a priori" lower limit of detection as defined above (as μCi per unit mass or volume). (Current literature defines the LLD as the detection capability for the instrumentation only, and the MDC, minimum detectable concentration, as the detection capability for a given instrument, procedure, and type of sample.)

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22×10^6 is the number of disintegrations per minute per microcurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between sample collection (or end of the sample collection period) and time of counting

The value of s_b used in the calculation of the LLD for a particular measurement system should be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicated variance.

Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particular measurement.

TABLE 6.11.1-1 (Continued)

RADIOACTIVE LIQUID WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATION (Continued)

b. A composite sample is one in which the quantity of liquid sampled is proportional to the quantity of liquid waste discharged and in which the method of sampling employed results in a specimen which is representative of the liquids released.

c. A batch release is the discharge of liquid wastes of a discrete volume. Before sampling for analyses, each batch shall be isolated, and then thoroughly mixed to assure representative sampling.

d. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141, and Ce-144. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

6.11 RADIOACTIVE EFFLUENTS

6.11.2 LIQUID EFFUENT DOSE

LCO 6.11.2 The dose or dose commitment to a MEMBER OF THE PUBLIC from radioactive materials in liquid effluents released to UNRESTRICTED AREAS shall be:

a. ≤ 1.5 mrem to the total body and ≤ 5 mrem to any organ, during any calendar quarter, and

b. ≤ 3 mrem to the total body and ≤ 10 mrem to any organ, during any calendar year.

APPLICABILITY: At all times.

ACTIONS

----------NOTES----------

1. The provisions of Specification 3.0.3 are not applicable.

2. Separate Condition entry is allowed for each of the above limits.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The calculated dose from the release of radioactive materials in liquid effluents greater than any of the above limits.	A.1 Initiate action to prepare and submit a Special Report within 30 days. AND A.2 Declare the liquid effuent waste treatment system inoperable.	Immediately

(continued)

B. The calculated doses from the release of radioactive materials in liquid effluents greater than twice any of the above limits.	B.1 Initiate action to calculate the direct radiation contributions from the reactor unit and from outside storage tanks to determine whether the total annual dose or dose commitment to any MEMBER OF THE PUBLIC greater than: a) 25 mrem to the total body or any organ, except the thyroid. OR b) 75 mrem to the thyroid.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 6.11.2.1	Cumulative dose contributions from liquid effluents for the current calendar quarter and the current calendar year shall be determined in accordance with the methodology and parameters of the ODCM.	31 days

6.11 RADIOACTIVE EFFLUENTS

6.11.3 LIQUID EFFLUENT WASTE TREATMENT

LCO 6.11.3 The liquid radwaste system shall be used to reduce the radioactive materials in liquid wastes before their discharge when the projected doses due to the liquid effluent to UNRESTRICTED AREAS would be > 0.06 mrem to the total body or > 0.2 mrem to any organ, in a 31-day period.

APPLICABILITY: At all times.

ACTIONS

NOTES

The provisions of Specification 3.0.3 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Radioactive liquid waste being discharged without treatment and in excess of the above limits.	A.1 Initiate action to prepare and submit, a Special Report within 30 days.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 6.11.3.1	Doses due to liquid releases to UNRESTRICTED AREAS shall be projected in accordance with methodology and parameters in the ODCM. AND NOTE Not required to be met when the projected dose less than or equal to the above limit. Verify the liquid effluent waste treatment system is being used to reduce radioactive materials before discharge.	31 days

6.11 RADIOACTIVE EFFLUENTS

6.11.4 GASEOUS EFFLUENTS - DOSE RATE

LCO 6.11.4 The dose rate due to radioactive materials released in gaseous effluents from the site to areas at and beyond the SITE BOUNDARY shall be:

a. For noble gases: ≤ 500 mrem/yr to the total body and ≤ 3000 mrem/yr to the skin, and

b. For all iodine-131, iodine-133, tritium and all radionuclides in particulate form with half lives greater than 8 days: ≤ 1500 mrem/yr to any organ.

APPLICABILITY: At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Dose rate exceeding the above limits.	A.1 Decrease the release rate to within the above limit(s). AND A.2 Declare the ventilation exhaust treatment system inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 6.11.4.1	The dose rate due to noble gases in gaseous effluents shall be determined to be within the above limits by obtaining representative samples and performing analyses in accordance with (ODCM) Table 6.11.4-1.	Per (ODCM) Table 6.11.4-1.
SR 6.11.4.2	The dose rate due to iodine-131, iodine-133, tritium and to radionuclides in particulate form with half lives greater than 8 days in gaseous effluents shall be determined to be within the above limits by obtaining representative samples and performing analyses in accordance with (ODCM) Table 6.11.4-1.	Per (ODCM) Table 6.11.4-1.

TABLE 6.11.4-1

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

Gaseous Release Type	Sampling Frequency	Minimum Analysis Frequency	Type of Activity Analysis	Lower Limit of Detection (LLD) (μCi/ml) (a)
A. (1) Radwaste Building Ventilation Exhaust	31 days Grab Sample(f)	31 days	Principal Gamma Emitters(b,e)	$1x10^{-4}$
			H-3	$1x10^{-6}$
(2) Fuel Handling Area Ventilation Exhaust	Continuous(d) (f)	7 days(c) Charcoal Sample	I-131	$1x10^{-12}$
			I-133	$1x10^{-10}$
(3) Containment Ventilation Exhaust	Continuous(d) (f)	7 days(c) Particulate Sample	Principal Gamma Emitters(e) (I-131, Others)	$1x10^{-11}$
(4) Turbine Building Ventilation Exhaust	Continuous(d) (f)	31 days Composite Particulate Sample	Gross Alpha	$1x10^{-11}$
	Continuous(d) (f)	92 days Composite Particulate Sample	Sr-89, Sr-90	$1x10^{-11}$
	Continuous(f)	Noble Gas Monitor	Noble Gases Gross Beta or Gamma	$1x10^{-6}$
B. (1) Offgas Post Treatment Exhaust, whenever there is flow	31 days Grab Sample(f)	31 days	Principal Gamma Emitters(e)	$1x10^{-4}$
(2) Standby Gas Treatment A Exhaust, whenever there is flow				
(3) Standby Gas Treatment B Exhaust, whenever there is flow				

See "Table Notation" which follows.

TABLE 6.11.4-1 (Continued)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATION

a. The LLD is the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \times 10^6 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where

LLD is the "a priori" lower limit of detection as defined above (as μCi per unit mass or volume). (Current literature defines the LLD as the detection capability for the instrumentation only, and the MDC, minimum detectable concentration, as the detection capability for a given instrument, procedure, and type of sample.)

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22×10^6 is the number of disintegrations per minute per microcurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between sample collection (or end of the sample collection period) and time of counting

The value of s_b used in the calculation of the LLD for a particular measurement system should be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicated variance.

Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an a priori (before the fact) limit representing the capability of a measurement system and not as a posteriori (after the fact) limit for a particular measurement.

TABLE 6.11.4-1 (Continued)

RADIOACTIVE GASEOUS WASTE SAMPLING AND ANALYSIS PROGRAM

TABLE NOTATION (Continued)

b. Analyses shall also be performed following startup from cold shutdown, or a THERMAL POWER change exceeding 15 percent of the RATED THERMAL POWER within a one hour period. This requirement does not apply if:

(1) routine analysis required by the Surveillance Requirements of LCO 3.4.8 shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 3; and

(2) the noble gas monitor shows that effluent activity has not increased more than a factor of 3.

c. Samples shall be changed at least once per 7 days and analyses shall be completed within 48 hours after changing or after removal from sampler. Sampling and analyses shall be performed at least once per 24 hours for at least 7 days following each shutdown startup or THERMAL POWER change exceeding 15 percent of RATED THERMAL POWER in one hour. When samples collected for 24 hours are analyzed, the corresponding LLD's may be increased by a factor of 10. This requirement does not apply if:

(1) routine analysis required by the Surveillance Requirements of LCO 3.4.8 shows that the DOSE EQUIVALENT I-131 concentration in the primary coolant has not increased more than a factor of 3; and

(2) the noble gas monitor shows that effluent activity has not increased more than a factor of 3.

d. The ratio of the sample flow rate to the sampled stream flow rate shall be known for the time period covered by each dose or dose rate calculation made in accordance with LCOs 6.11.4 and 6.11.6.

e. The principal gamma emitters for which the LLD specification applies exclusively are the following radionuclides: Kr-87, Kr-88, Xe-133, Xe-133m, Xe-135, and Xe-138 for gaseous emissions and Mn-54, Fe-59, Co-58, Co-60, Zn-65, Mo-99, Cs-134, Cs-137, Ce-141 and Ce-144 for particulate emissions. This list does not mean that only these nuclides are to be detected and reported. Other peaks which are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

f. When a monitor is placed in an inoperable status solely for performance of required Surveillance's, entry into associated Conditions and Required Actions in accordance with LCO 6.3.10 may be delayed for up to 1 hour.

6.11 RADIOACTIVE EFFLUENTS

6.11.5 GASEOUS EFFLUENT DOSE - NOBLE GASES

LCO 6.11.5 The air dose due to noble gases released in gaseous effluents, from the site to areas at and beyond the SITE BOUNDARY shall be:

a. ≤ 5 mrad for gamma radiation and ≤ 10 mrad for beta radiation, during any calendar quarter and

b. ≤ 10 mrad for gamma radiation and ≤ 20 mrad for beta radiation during any calendar year.

APPLICABILITY: At all times.

ACTIONS

NOTES

1. The provisions of Specification 3.0.3 are not applicable.

2. Separate Condition entry is allowed for each of the above limits.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The calculated air dose from the radioactive noble gases in gaseous effluents greater than any of the above limits.	A.1 Initiate action to prepare and submit, a Special Report within 30 days. AND A.2 Declare the ventilation exhaust treatment system inoperable.	Immediately

(continued)

B. The calculated doses from the release of radioactive materials in gaseous effluents greater than twice any of the above limits.	B.1 Initiate action to calculate the direct radiation contributions from the reactor unit and from outside storage tanks to determine whether the total annual dose or dose commitment to any MEMBER OF THE PUBLIC greater than: a) 25 mrem to the total body or any organ, except the thyroid. OR b) 75 mrem to the thyroid.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 6.11.5.1	Cumulative dose contributions for noble gases for the current calendar quarter and current calendar year shall be determined in accordance with the methodology and parameters in the ODCM.	31 days

6.11 RADIOACTIVE EFFLUENTS

6.11.6 GASEOUS EFFLUENT DOSE - IODINE-131, IODINE-133, TRITIUM AND RADIONUCLIDES IN PARTICULATE FORM

LCO 6.11.6 The dose to a MEMBER OF THE PUBLIC from iodine-131, iodine-133, tritium and radionuclides in particulate form with half-lives greater than 8 days in gaseous effluents released, from the site to areas at and beyond the SITE BOUNDARY shall be:

a. ≤ 7.5 mrem to any organ during any calendar quarter, and

b. ≤ 15 mrem to any organ during any calendar year.

APPLICABILITY: At all times.

ACTIONS

----------NOTES----------

1. The provisions of Specification 3.0.3 are not applicable.

2. Separate Condition entry is allowed for each of the above limits.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The calculated dose from the release of iodine-131, iodine-133, tritium and radionuclides in particulate form, with half-lives greater than 8 days, in gaseous effluents greater than any of the above limits.	A.1 Initiate action to prepare and submit, a Special Report within 30 days. AND A.2 Declare the ventilation exhaust treatment system inoperable.	Immediately

(continued)

B. The calculated doses from the release of radioactive materials in gaseous effluents greater than twice any of the above limits.	B.1 Initiate action to calculate the direct radiation contributions from the reactor unit and from outside storage tanks to determine whether the total annual dose or dose commitment to any MEMBER OF THE PUBLIC greater than: a) 25 mrem to the total body or any organ, except the thyroid. OR b) 75 mrem to the thyroid.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 6.11.6.1	Cumulative dose contributions from iodine-131, iodine-133, tritium and radionuclides in particulate form with half-lives greater than 8 days for the current calendar quarter and current calendar year shall be determined in accordance with the methodology and parameters in the ODCM.	31 days

6.11 RADIOACTIVE EFFLUENTS

6.11.7 GASEOUS RADWASTE TREATMENT

LCO 6.11.7 The GASEOUS RADWASTE TREATMENT (OFFGAS) SYSTEM shall be in operation.

APPLICABILITY: When the steam jet air ejector (SJAE) is in operation.

ACTIONS

NOTES

The provisions of Specification 3.0.3 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Gaseous radwaste from the SJAE being discharged without treatment.	A.1 Restore treatment to this discharge.	7 days
B. Required Action A.1 and Associated Completion Time not met.	B.1 Initiate action to prepare and submit a Special Report to the Commission within 30 days.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 6.11.7.1	Ensure that the GASEOUS RADWASTE TREATMENT (OFFGAS) SYSTEM is operating.	12 hours

6.11 RADIOACTIVE EFFLUENTS

6.11.8 VENTILATION EXHAUST TREATMENT SYSTEM

LCO 6.11.8 The VENTILATION EXHAUST TREATMENT SYSTEM shall be used to reduce radioactive materials in gaseous waste before their discharge when the projected dose due to gaseous effluent releases to areas at and beyond the SITE BOUNDARY in a 31 day period would exceed 0.3 mrem to any organ.

APPLICABILITY: At all times.

ACTIONS

----------NOTES----------
The provisions of Specification 3.0.3 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Gaseous waste being discharged without treatment and greater than the above limit.	A.1 Initiate action to prepare and submit a Special Report to the Commission within 30 days.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 6.11.8.1	Doses due to gaseous releases to areas at and beyond the SITE BOUNDARY shall be projected in accordance with the methodology and parameters in the ODCM. AND ----------NOTE---------- 1. Not required to be met when the ventilation exhaust treatment system is undergoing routine maintenance. 2. Not required to be met when the projected dose less than or equal to the above limit. --- Verify the ventilation exhaust treatment system is operating.	31 days

6.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

6.12.1 MONITORING PROGRAM

LCO 6.12.1 The radiological environmental monitoring program shall be conducted as specified in ODCM Table 6.12.1-1. The results of this program shall be validated by use of an Interlaboratory Comparison Program corresponding to samples required by ODCM Table 6.12.1-1.

APPLICABILITY: At all times.

ACTIONS

NOTES

The provisions LCO 3.0.3 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. The radiological environmental monitoring program not being conducted as specified in ODCM Table 6.12.1-1. OR The required Interlaboratory Comparison Program not performed.	A.1 Initiate action to include in the next Annual Radiological Environmental Operating Report, a description of the reasons for not conducting the program as required and the plans for preventing a recurrence.	Immediately
B. The level of radioactivity as the result of plant effluent in an environmental sampling medium at a specified location exceeding the reporting levels of ODCM Table 6.12.1-2 when averaged over any calendar quarter.	B.1 Initiate action to prepare and submit a Special Report within 30 days.	Immediately

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Milk or broad leaf vegetation sampling is relocated from one or more of the sample locations required by ODCM Table 6.12.1-1.	C.1 Initiate action to identify this changed location(s) in the next Annual Radioactive Effluent Release Report. AND C.2 Add this location(s) to the radiological environmental monitoring program.	Immediately 30 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 6.12.1.1	Radiological environmental monitoring samples shall be collected pursuant to ODCM Table 6.12.1-1 from the locations given in the table and figures in the ODCM and shall be analyzed pursuant to the requirements of ODCM Tables 6.12.1-1 and 6.12.1-3.	Per ODCM Table 6.12.1-1.
SR 6.12.1.2	Conduct an Interlaboratory Comparison Program and include a summary of the results in the Annual Radiological Environmental Operating Report.	366 days

TABLE 6.12.1-1

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples(a) and Locations	Sampling and Collection Frequency(a)	Type and Frequency of Analysis
AIRBORNE			
Radioiodine and Particulates	Samples from 5 locations: 3 samples close to the SITE BOUNDARY (in different sectors) having the highest calculated annual average groundlevel D/Q. 1 sample from the vicinity of a community having the highest calculated annual average groundlevel D/Q. 1 sample from a control location 15-30 km (10-20 miles) distance(d)	Continuous sampler operation with sample collection per 7 days or as required by dust loading, whichever is more frequent	Radioiodine Cannister: I-131; 7 days Particulate Sampler: Gross beta radio-activity following filter change(b), composite (by location) for gamma isotopic(c); 92 days
DIRECT RADIATION(e)	40 stations with two or more dosimeters or one instrument for measuring and recording dose rate continuously to be placed in each accessible* sector as follows: 1) an inner ring of stations in the general areas of the SITE BOUNDARY 2) an outer ring approximately 3 to 5 miles from the site. The balance of the stations should be placed in special interest areas such as population centers, nearby residences, schools, and in 1 or 2 areas to serve as control stations.	92 days	Gamma dose; 92 days

TABLE 6.12.1-1 (Continued)

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples(a) and Locations	Sampling and Collection Frequency(a)	Type and Frequency of Analysis
WATERBORNE			
Surface(f)	1 sample upstream 1 sample downstream	31 days	Gamma isotopic(c); 31 days. Composite for tritium analyses; 92 days
	Discharge Basin	Composite sample over 31 day period(g)	
Ground	Samples from 2 sources	92 days	Gamma isotopic(c) and tritium; 92 days
Cistern Water	1 sample of the nearest source that could be affected 1 sample from a control location	31 days	I-131, Gross β and gamma isotopic(c); 31 days Composite for tritium; 92 days
Sediment from Shoreline	1 sample from downstream area	184 days	Gamma isotopic(c); 184 days
INGESTION			
Milk	Samples from milking animals in 3 locations within 5 km distant having the highest dose potential. If there are none then, 1 sample from milking	15 days when animals are on pasture, 31 days at other times	Gamma isotopic(c) and I-131; 15 days when animals are on pasture; 31 days at other times.

TABLE 6.12.1-1 (Continued)

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway and/or Sample	Number of Samples(a) and Locations	Sampling and Collection Frequency(a)	Type and Frequency of Analysis
Milk (cont'd)	animals in each of 3 areas between 5 to 8 km distant where doses are calculated to be greater than 1 mrem per year(h)		
	1 sample from milking animals at a control location (15-30 km distant)		
Fish and Invertebrates	1 sample of one species of commercially or recreationally important fish in vicinity of discharge point	184 days	Gamma isotopic(c) on edible portions; 184 days
	1 sample of same species in areas not influenced by plant discharge		
Food Products	Samples of 3 different kinds of broad leaf vegetation grown nearest each of two different offsite locations with highest anticipated annual average groundlevel D/Q if milk sampling is not performed	31 days when available	Gamma isotopic(c) and I-131; 31 days
	1 sample of each of the similar vegetation grown 15-30 km distant if milk sampling is not performed	31 days when available	Gamma isotopic(c) and I-131; 31 days

TABLE 6.12.1-1 (Continued)

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

TABLE NOTATION

* As described in the ODCM.

a Specific parameters of distance and direction sector from the centerline of one reactor, and additional description where pertinent, shall be provided for each and every sample location in Table 6.12.1-1 in the table(s) and figure(s) in the ODCM. Refer to NUREG-0133, "Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants," October 1978, and to Radiological Assessment Branch Technical Position, Revision 1, November 1979. Deviations are permitted from the required sampling schedule if specimens are unobtainable due to hazardous conditions, seasonal unavailability, malfunction of automatic sampling equipment and other legitimate reasons. If specimens are unobtainable due to sampling equipment, malfunction, every effort shall be made to complete corrective action before the end of the next sampling period. All above deviations from the sampling schedule shall be documented in the Annual Radiological Environmental Operating Report.

It is recognized that, at times, it may not be possible or practicable to continue to obtain samples of the media of choice at the most desired location or time. In these instances suitable alternative media and locations may be chosen for the particular pathway in question and appropriate substitutions made within 30 days in the radiological environmental monitoring program. Identify the cause of the unavailability of samples for that pathway and identify the new location(s) for obtaining replacement samples in the next Annual Radioactive Effluent Release Report and also include in the report a revised figure(s) and table(s) for the ODCM reflecting the new location(s).

b Particulate sample filters should be analyzed for gross beta 24 hours or more after sampling to allow for radon and thoron daughter decay. If gross beta activity in air or water is greater than ten times the yearly mean of control samples for any medium, gamma isotopic analysis should be performed on the individual samples.

c Gamma isotopic analysis means the identification and quantification of gamma-emitting radionuclides that may be attributable to the effluents from the facility.

d The purpose of this sample is to obtain background information.

TABLE 6.12.1-1 (Continued)

OPERATIONAL RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

- TABLE NOTATION (Continued)

e One or more instruments, such as a pressurized ion chamber, for measuring and recording dose rate continuously may be used in place of, or in addition to, integrating dosimeters. For the purpose of this table, a thermoluminescent dosimeter may be considered to be one phosphor and two or more phosphors in a packet may be considered as two or more dosimeters. Film badges should not be used for measuring direct radiation.

f The "upstream sample" should be taken at a distance beyond significant influence of the discharge. The "downstream" sample should be taken in an area beyond but near mixing zone.

g Composite samples should be collected with equipment (or equivalent) which is capable of collecting an aliquot at time intervals which are very short (e.g., hourly) relative to the compositing period (e.g., monthly).

h The dose shall be calculated using methodology contained in the ODCM.

TABLE 6.12.1-2

REPORTING LEVELS FOR RADIOACTIVITY CONCENTRATIONS IN ENVIRONMENTAL SAMPLES

Analysis	Reporting Levels[b] Water (pCi/l)	Airborne Particulate or Gases (pCi/m^3)	Fish (pCi/Kg, wet)	Milk (pCi/l)	Food Products (pCi/Kg, wet)
H-3	2×10^4[a]	NA	NA	NA	NA
Mn-54	1×10^3	NA	3×10^4	NA	NA
Fe-59	4×10^2	NA	1×10^4	NA	NA
Co-58	1×10^3	NA	3×10^4	NA	NA
Co-60	3×10^2	NA	1×10^4	NA	NA
Zn-65	3×10^2	NA	2×10^4	NA	NA
Zr-Nb-95	4×10^2	NA	NA	NA	NA
I-131	2	0.9	NA	3	1×10^2
Cs-134	30	10	1×10^3	60	1×10^3
Cs-137	50	20	2×10^3	70	2×10^3
Ba-La-140	2×10^2	NA	NA	3×10^2	NA

[a] For drinking water samples. This is a 40 CFR Part 141 value. If no drinking water pathway exists, a value of 3×10^4 pCi/l may be used.

[b] See BASES 6.12.1 for reporting requirements when multiple or unlisted radionuclides are detected.

TABLE 6.12.1-3

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD) (a,b)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fish (pCi/kg, wet)	Milk (pCi/l)	Broad Leaf Vegetation (pCi/kg, wet)	Sediment (pCi/kg, dry)
Gross beta	4	1×10^{-2}	NA	NA	NA	NA
H-3	2×10^{3} (d)	NA	NA	NA	NA	NA
Mn-54	15	NA	1.3×10^{2}	NA	NA	NA
Fe-59	30	NA	2.6×10^{2}	NA	NA	NA
Co-58,60	15	NA	1.3×10^{2}	NA	NA	NA
Zn-65	30	NA	2.6×10^{2}	NA	NA	NA
Zr-95	30	NA	NA	NA	NA	NA
Nb-95	15	NA	NA	NA	NA	NA
I-131	1 (c)	7×10^{-2}	NA	1	60	NA
Cs-134	15	5×10^{-2}	1.3×10^{2}	15	60	1.5×10^{2}
Cs-137	18	6×10^{-2}	1.5×10^{2}	18	80	1.8×10^{2}
Ba-140	60	NA	NA	60	NA	NA
La-140	15	NA	NA	15	NA	NA

TABLE 6.12.1-3 (Continued)

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)
TABLE NOTATION

a. Acceptable detection capabilities for thermoluminescent dosimeters used for environmental measurements are given in Regulatory Guide 4.13.

b. Table 6.12.1-3 indicates acceptable detection capabilities for radioactive materials in environmental samples. These detection capabilities are tabulated in terms of the lower limits of detection (LLDs). The LLD is defined, for purposes of this guide, as the smallest concentration of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

For a particular measurement system (which may include radiochemical separation):

$$LLD = \frac{4.66\ s_b}{E \cdot V \cdot 2.22 \cdot Y \cdot \exp(-\lambda \Delta t)}$$

where

LLD is the "a priori" lower limit of detection as defined above (as pCi per unit mass or volume). (Current literature defines the LLD as the detection capability for the instrumentation only, and the MDC, minimum detectable concentration, as the detection capability for a given instrument, procedure, and type of sample.)

s_b is the standard deviation of the background counting rate or of the counting rate of a blank sample as appropriate (as counts per minute)

E is the counting efficiency (as counts per disintegration)

V is the sample size (in units of mass or volume)

2.22 is the number of disintegrations per minute per picocurie

Y is the fractional radiochemical yield (when applicable)

λ is the radioactive decay constant for the particular radionuclide

Δt is the elapsed time between sample collection (or end of the sample collection period) and time of counting

The value of s_b used in the calculation of the LLD for a particular measurement system should be based on the actual observed variance of the background counting rate or of the counting rate of the blank samples (as appropriate) rather than on an unverified theoretically predicated variance.

TABLE 6.12.1-3 (Continued)

MAXIMUM VALUES FOR THE LOWER LIMITS OF DETECTION (LLD)

TABLE NOTATION (Continued)

Typical values of E, V, Y and Δt should be used in the calculation.

It should be recognized that the LLD is defined as an *a priori* (before the fact) limit representing the capability of a measurement system and not as *a posteriori* (after the fact) limit for a particular measurement. Occasionally background fluctuations, unavoidable small sample size, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors should be identified and described in the Annual Radiological Environmental Operating Report.

c. LLD for drinking water samples. If no drinking water pathway exists, the LLD of gamma isotopic may be used.

d. If no drinking water pathway exists, a value of 3×10^3 pCi/l may be used.

6.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

6.12.2 LAND USE CENSUS

LCO 6.12.2 A land use census shall be conducted and shall identify within a distance of 8 km (5 miles) the location in each of the 16 meteorological sectors of the nearest milk animal, the nearest residence and the nearest garden of greater than 50 m^2 (500 ft^2) producing broad leaf vegetation. Broad leaf vegetation sampling of at least three different kinds of vegetation may be performed at the SITE BOUNDARY in each of two different direction sectors with the highest predicted D/Qs in lieu of the garden census.

APPLICABILITY: At all times.

ACTIONS

NOTES

The provisions of LCO 3.0.3 are not applicable.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. A land use census identifies a location(s) which yields a calculated dose or dose commitment greater than the values currently being calculated in LCO 6.11.6.	A.1 Initiate action to identify the new location(s) in the next Annual Radioactive Effluent Release Report.	Immediately
B. A land use census identifies a location(s) which yields a calculated dose or dose commitment (via the same exposure pathway) 20 percent greater than at a location from which samples are currently being obtained in accordance with LCO 6.12.1.	B.1 Initiate action to identify these higher dose location(s) in the next Annual Radioactive Effluent Release Report. AND B.2 Add these location(s) to the radiological environmental monitoring program.	Immediately 30 days

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 6.12.2.1	Conduct a land use census during the growing season. The land use census shall verify the appropriateness of the sample location used to fulfill the requirements of LCO 6.12.1	366 days

BASES FOR

SECTION 6.0

LIMITING CONDITIONS FOR OPERATION

AND

SURVEILLANCE REQUIREMENTS

6.3.9 RADIOACTIVE LIQUID EFFLUENT MONITORING INSTRUMENTATION

The LCO for radioactive liquid effluent monitoring instrumentation is provided to monitor and control, as applicable, the releases of radioactive materials in liquid effluents during actual or potential releases of liquid effluents. The alarm/trip setpoints for these instruments shall be calculated in accordance with the procedures in the ODCM to ensure that the alarm/trip will occur before exceeding ten times the effluent concentration limits of 10 CFR Part 20. The OPERABILITY and use of this instrumentation is consistent with the requirements of General design Criteria 60, 63 and 64 of Appendix A to 10 CFR 50.

6.3.10 RADIOACTIVE GASEOUS EFFLUENT MONITORING INSTRUMENTATION

The LCO for radioactive gaseous effluent monitoring instrumentation is provided to monitor and control, as applicable, gaseous effluents during actual or potential releases. Those instruments that monitor the activity of gaseous effluents being released to the environment shall have their alarm/trip setpoints calculated in accordance with the methods in the ODCM to ensure that the alarm/trip will occur before exceeding the limits of 10 CFR Part 20. Other instruments that monitor offgas processing, (i.e., Offgas Pre-Treatment Monitor and Offgas Post-Treatment Monitor) are calibrated according to plant procedures. The OPERABILITY and use of this instrumentation is consistent with the requirements of General Design Criteria 60, 63 and 64 of Appendix A to 10 CFR Part 50.

6.11 RADIOACTIVE EFFLUENTS

BASES

LIQUID EFFLUENTS

6.11.1 CONCENTRATION

This LCO is provided to ensure that the concentration of radioactive materials released in liquid waste effluents to UNRESTRICTED AREAS will be less than ten times the effluent concentration values specified in Appendix B, Table 2, Column 2 to 10 CFR 20.1001-20.2402. It provides operational flexibility for releasing liquid effluents in concentrations to follow the Section II.A and II.C design objectives of Appendix I to 10 CFR Part 50. This limitation provides reasonable assurance that the levels of radioactive materials in bodies of water in UNRESTRICTED AREAS will result in exposures within (1) the Section II.A design objectives of Appendix I, 10 CFR 50, to a MEMBER OF THE PUBLIC, and (2) restrictions authorized by 10 CFR 20.1301(a). The concentration limit for dissolved or entrained noble gases is based upon the assumption that Xe-135 is the controlling radionuclide and its effluent concentration in air (submersion) was converted to an equivalent concentration in water. This LCO does not affect the requirement to comply with the annual limitations of 10 CFR 20.1301(a).

The results of pre-release analyses and post release analyses (of composited samples) shall be used with the calculational methods and parameters in the ODCM to assure that the concentrations at the point of release are maintained within the limits.

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits, can be found in:

(1) HASL Procedures Manual, HASL-300.

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968).

(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Hanford Company Report ARH-2537 (June 22, 1972).

6.11.2 DOSE

This LCO is provided to implement the requirements of Sections II.A, III.A and IV.A of Appendix I, 10 CFR Part 50. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I which assure that the releases of radioactive material in liquid effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." Also, for fresh water sites with drinking water supplies which can be potentially affected by plant operations, there is reasonable assurance that the operation of the facility will not result in radionuclide concentrations in the finished drinking water that are in excess of the requirements of 40 CFR 141. The dose calculations in the ODCM implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated.

6.11.2 DOSE (Continued)

The equations specified in the ODCM for calculating the doses due to the actual release rates of radioactive materials in liquid effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.113, "Estimating Aquatic Dispersion of Effluent from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," April 1977.

This LCO, in conjunction with LCOs 6.11.5 and 6.11.6 is also provided to meet the dose limitation of 40 CFR 190 that has been incorporated into 10 CFR 20.1301(d). Even if a site contained up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR 190 if the individual reactors remain within twice the dose design objectives of 10 CFR 50 Appendix I, and the direct radiation doses from the units (including outside storage tanks, etc.) are kept small.

Special Report:

LCO 6.11.2 requires preparation and submittal of a report in accordance with 10 CFR 50.4 and as defined in 10 CFR 20.2203(a)(4), if the dose design objectives of 10 CFR 50 Appendix I are exceeded.

If either the quarterly or the annual limit is exceeded, the report will:

(1) identify the cause(s) for exceeding the limit(s),

(2) define the corrective actions that have been taken to reduce the releases, and

(3) define the corrective actions to be taken to ensure that future releases will be in compliance with the limits.

If a drinking water supply is taken from the receiving water body within three miles downstream of the plant discharge, the report shall also include:

(1) results of radiological analyses of the drinking water source, and

(2) the radiological impact on finished drinking water supplies with regard to the requirements of 40 CFR 141.

If the doses exceed the limits of 40 CFR 190, 25 mrems to the whole body or any organ, except the thyroid, which is limited to 75 mrems, the report shall:

(1) define the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits,

(2) include the schedule for achieving conformance with the above limits,

(3) include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report,

(4) describe the levels of radiation and concentrations of radioactive material involved,

(5) describe the cause of the exposure level or concentrations involved,

6.11.2 DOSE (Continued)

(6) describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR 190 limits.

For the purposes of the report it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that the dose distribution from other nuclear fuel cycle facilities at the same site or within a radius of 8 kilometers must be considered.

The Special Report with a request for a variance (provided the release conditions resulting in a violation of 40 CFR 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.2203(a)(4), is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed. The variance only relates to the limits of 40 CFR 190, and does not apply in any way to other requirements for dose limitations of 10 CFR 20, as addressed in LCOs 6.11.1 and 6.11.4. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

Demonstration of compliance with the limits of 40 CFR 190 or with the design objectives of Appendix I to 10 CFR 50 will be considered to demonstrate compliance with the 0.1 rem limit of 10 CFR 20.1301.

6.11.3 LIQUID WASTE TREATMENT

The LCO that the appropriate portions of this system be used when specified provides assurance that the releases of radioactive materials in liquid effluents will be kept "as low as is reasonably achievable." This LCO implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50 and the design objective given in Section II.D of Appendix I to 10 CFR Part 50. The specified limit governing the use of appropriate portions of the liquid radwaste treatment system were specified as a suitable fraction of the dose design objectives set forth in Section II.A of Appendix I, 10 CFR Part 50, for liquid effluents.

Special Report:

LCO 6.11.3 requires preparation and submittal of a report in accordance with 10 CFR 50.4 if radioactive liquid waste is being discharged without treatment and in excess of the limits. The report shall include:

(1) an explanation why liquid radwaste was being discharged without treatment,

(2) identification of any inoperable equipment or subsystems which resulted in liquid radwaste being discharged without treatment,

(3) the reason for the inoperability

(4) action(s) taken to restore the inoperable equipment to an OPERABLE status,

(5) summary descriptions of actions taken to prevent a recurrence.

GASEOUS EFFLUENTS

6.11.4 DOSE RATE

This LCO provides reasonable assurance that radioactive material discharged in gaseous effluents will not result in the exposure of a MEMBER OF THE PUBLIC in an UNRESTRICTED AREA, either at or beyond the SITE BOUNDARY in excess of the design objectives of Appendix I to 10 CFR Part 50. This specification is provided to ensure that gaseous effluents from all units on the site will be appropriately controlled. It provides operational flexibility for releasing gaseous effluents to satisfy the Section II.A and II.C design objectives of Appendix I to 10 CFR Part 50. For MEMBERS OF THE PUBLIC who may at times be within the SITE BOUNDARY, the occupancy of that MEMBER OF THE PUBLIC will usually be sufficiently low to compensate for the reduced atmosphere dispersion of gaseous effluents relative to that for the SITE BOUNDARY. The calculational methods and parameters in the ODCM are used to assure that the dose rates are maintained within the limits. Examples of calculations for such MEMBERS OF THE PUBLIC, with the appropriate occupancy factors, shall be given in the ODCM. The specified release rate limits restrict, at all times, the corresponding dose rates above background to a MEMBER OF THE PUBLIC at or beyond the SITE BOUNDARY to less than or equal to 500 mrem/year to the total body or to less than or equal to 3000 mrem/year to the skin. These releases rate limits also restrict, at all times, the corresponding thyroid dose rate above background to a child via the inhalation pathway to less than or equal to 1500 mrem/year. This specification does not affect the requirement to comply with the annual limitations of 10 CFR 20.1301(a).

The dose rate due to radioactive gaseous effluents shall be determined in accordance with the methodology and parameters of the ODCM.

6.11.4 DOSE RATE (Continued)

The required detection capabilities for radioactive materials in liquid waste samples are tabulated in terms of the lower limits of detection (LLDs). Detailed discussion of the LLD, and other detection limits, can be found in:

(1) HASL Procedures Manual, HASL-300 (revised annually).

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal. Chem. 40, 586-93 (1968).

(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Hanford Company Report ARH-2537 (June 22, 1972).

6.11.5 DOSE - NOBLE GASES

This LCO is provided to implement the requirements of Sections II.B, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Condition for Operation implements the guides set forth in Section II.B of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive material in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable."

The Surveillance Requirements implement the requirements in Section III.A of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The dose calculations established in the ODCM for calculating the doses due to the actual release rates of radioactive noble gases in gaseous effluents are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors," Revision 1, July 1977. The ODCM equations provided for determining the air doses at and beyond the SITE BOUNDARY are based upon the historical average atmospheric conditions.

This LCO, in conjunction with LCOs 6.11.2 and 6.11.6 is also provided to meet the dose limitation of 40 CFR 190 that has been incorporated into 10 CFR 1301(d). Even if a site contained up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR 190 if the individual reactors remain within twice the dose design objectives of 10 CFR 50 Appendix I, and if the direct radiation doses from the units (including outside storage tanks, etc.) are kept small.

6.11.5 DOSE - NOBLE GASES (Continued)

Special Report:

LCO 6.11.5 requires preparation and submittal of a report in accordance with 10 CFR 50.4 and as defined in 10 CFR 20.2203(a)(4), if the dose design objectives of 10 CFR 50 Appendix I are exceeded.

If either the quarterly or the annual limit is exceeded, the report will:

(1) identify the cause(s) for exceeding the limit(s),

(2) define the corrective actions that have been taken to reduce the releases, and

(3) define the corrective actions to be taken to ensure that future releases will be in compliance with the limits.

If the doses exceed the limits of 40 CFR 190, 25 mrems to the whole body or any organ, except the thyroid, which is limited to 75 mrems, the report shall:

(1) define the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits,

(2) include the schedule for achieving conformance with the above limits,

(3) include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report,

(4) describe the levels of radiation and concentrations of radioactive material involved,

(5) describe the cause of the exposure level or concentrations involved,

(6) describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR 190 limits.

For the purposes of the report it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that the dose distribution from other nuclear fuel cycle facilities at the same site or within a radius of 8 kilometers must be considered.

The Special Report with a request for a variance (provided the release conditions resulting in a violation of 40 CFR 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.2203(a)(4), is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed.

The variance only relates to the limits of 40 CFR 190, and does not apply in any way to other requirements for dose limitations of 10 CFR 20, as addressed in LCOs 6.11.1 and 6.11.4. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

Demonstration of compliance with the limits of 40 CFR 190 or with the design objectives of Appendix I to 10 CFR 50 will be considered to demonstrate compliance with the 0.1 rem limit of 10 CFR 20.1301.

6.11.6 DOSE - IODINE-131, IODINE-133, TRITIUM AND RADIONUCLIDES IN PARTICULATE FORM

This LCO is provided to implement the requirements of Sections II.C, III.A and IV.A of Appendix I, 10 CFR Part 50. The Limiting Conditions for Operation are the guides set forth in Section II.C of Appendix I. The ACTION statements provide the required operating flexibility and at the same time implement the guides set forth in Section IV.A of Appendix I to assure that the releases of radioactive materials in gaseous effluents to UNRESTRICTED AREAS will be kept "as low as is reasonably achievable." The ODCM calculational methods specified in the Surveillance Requirements implement the requirements in Section III.A. of Appendix I that conformance with the guides of Appendix I be shown by calculational procedures based on models and data, such that the actual exposure of a MEMBER OF THE PUBLIC through appropriate pathways is unlikely to be substantially underestimated. The ODCM calculational methods for calculating the doses due to the actual release rates of the subject materials are consistent with the methodology provided in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977 and Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977. These equations also provide for determining the actual doses based upon the historical average atmospheric conditions. The release rate specifications for iodine-131, iodine-133, tritium and radionuclides in particulate form are dependent on the existing radionuclide pathway to man in the areas at and beyond the SITE BOUNDARY. The pathways which were examined in the development of these calculations were: (1) individual inhalation of airborne radionuclides, (2) deposition of radionuclides onto green leafy vegetation with subsequent consumption by man, (3) deposition onto grassy areas where milk animals and meat-producing animals graze with consumption of the milk and meat by man, and (4) deposition on the ground with subsequent exposure of man.

This LCO, in conjunction with LCOs 6.11.2 and 6.11.5 is also provided to meet the dose limitation of 40 CFR 190 that has been incorporated into 10 CFR 1301(d). Even if a site contained up to four reactors, it is highly unlikely that the resultant dose to a MEMBER OF THE PUBLIC will exceed the dose limits of 40 CFR 190 if the individual reactors remain within twice the dose design objectives of 10 CFR 50 Appendix I, and if the direct radiation doses from the units (including outside storage tanks, etc.) are kept small.

Special Report:

LCO 6.11.6 requires preparation and submittal of a report in accordance with 10 CFR 50.4 and as defined in 10 CFR 20.2203(a)(4), if the dose design objectives of 10 CFR 50 Appendix I are exceeded.

If either the quarterly or the annual limit is exceeded, the report will:

(1) identify the cause(s) for exceeding the limit(s),

(2) define the corrective actions that have been taken to reduce the releases, and

(3) define the corrective actions to be taken to ensure that future releases will be in compliance with the limits.

6.11.6 DOSE - IODINE-131, IODINE-133, TRITIUM AND RADIONUCLIDES IN PARTICULATE FORM (Continued)

If the doses exceed the limits of 40 CFR 190, 25 mrems to the whole body or any organ, except the thyroid, which is limited to 75 mrems, the report shall:

(1) define the corrective action to be taken to reduce subsequent releases to prevent recurrence of exceeding the above limits,

(2) include the schedule for achieving conformance with the above limits,

(3) include an analysis that estimates the radiation exposure (dose) to a MEMBER OF THE PUBLIC from uranium fuel cycle sources, including all effluent pathways and direct radiation, for the calendar year that includes the release(s) covered by this report,

(4) describe the levels of radiation and concentrations of radioactive material involved,

(5) describe the cause of the exposure level or concentrations involved,

(6) describe a course of action that should result in the limitation of the annual dose to a MEMBER OF THE PUBLIC to within the 40 CFR 190 limits.

For the purposes of the report it may be assumed that the dose commitment to the MEMBER OF THE PUBLIC from other uranium fuel cycle sources is negligible, with the exception that the dose distribution from other nuclear fuel cycle facilities at the same site or within a radius of 8 kilometers must be considered.

The Special Report with a request for a variance (provided that release conditions resulting in a violation of 40 CFR 190 have not already been corrected), in accordance with the provisions of 40 CFR 190.11 and 10 CFR 20.2203(a)(4), is considered to be a timely request and fulfills the requirements of 40 CFR 190 until NRC staff action is completed.

The variance only relates to the limits of 40 CFR 190, and does not apply in any way to other requirements for dose limitations of 10 CFR 20, as addressed in LCOs 6.11.1 and 6.11.4. An individual is not considered a MEMBER OF THE PUBLIC during any period in which he/she is engaged in carrying out any operation that is part of the nuclear fuel cycle.

Demonstration of compliance with the limits of 40 CFR 190 or with the design objectives of Appendix I to 10 CFR 50 will be considered to demonstrate compliance with the 0.1 rem limit of 10 CFR 20.1301.

6.11.7 and 6.11.8 GASEOUS RADWASTE TREATMENT AND VENTILATION EXHAUST TREATMENT

The OPERABILITY of the GASEOUS RADWASTE TREATMENT (OFFGAS) SYSTEM and the VENTILATION EXHAUST TREATMENT SYSTEM ensures that the system will be available for use whenever gaseous effluents require treatment before release to the environment. The requirement that the appropriate portions of the system be used, when specified, provides reasonable assurance that the releases of radioactive materials in gaseous effluents will be kept "as low as is reasonably achievable." This specification implements the requirements of 10 CFR Part 50.36a, General Design Criterion 60 of Appendix A to 10 CFR Part 50, and the design objectives given in Section II.D of Appendix I to 10 CFR Part 50. The specified limits governing the use of appropriate portions of the system were specified as a suitable fraction of the dose design objectives set forth in Section II.B and II.C of Appendix I, 10 CFR 50, for gaseous effluents.

Special Report:

LCOs 6.11.7 and 6.11.8 require preparation and submittal of a report in accordance with 10 CFR 50.4 including:

(1) an explanation of why gaseous radwaste was being discharged without treatment,

(2) identification of the inoperable equipment or subsystems which resulted in gaseous radwaste being discharged without treatment,

(3) the reason for the inoperability,

(4) action(s) taken to restore the inoperable equipment to an OPERABLE status,

(5) summary descriptions of action(s) taken to prevent a recurrence.

LCO 6.11.8 is not applicable to the Turbine Building ventilation exhaust unless filtration media is installed.

Instruments checked to ensure the GASEOUS RADWASTE TREATMENT (OFFGAS) SYSTEM is functioning are:

(1) Adsorber Train Bypass Switch (1N64-HS-M611),

(2) Bypass Valve Indication (1N64-F045).

When the Adsorber Train Bypass Switch is in the TREAT position and the bypass valve indicates CLOSED, the GASEOUS RADWASTE TREATMENT (OFFGAS) SYSTEM is functioning.

6.12 RADIOLOGICAL ENVIRONMENTAL MONITORING

BASES

6.12.1 MONITORING PROGRAM

The radiological monitoring program required by this LCO provides measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides, which lead to the highest potential radiation exposures of MEMBERS OF THE PUBLIC resulting from the station operation. This monitoring program implements Section IV.B.2 of Appendix I to 10 CFR Part 50 and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and modeling of the environmental exposure pathways. The initially specified monitoring program will be effective for at least the first three years of commercial operation. Following this period, program changes may be initiated based on operational experience.

The detection capabilities required by Table 6.12.1-3 are state-of-the-art for routine environmental measurements in industrial laboratories. It should be recognized that the LLD is defined as an "a priori" (before the fact) limit representing the capability of a particular measurement. Analyses shall be performed in such a manner that the stated LLDs will be achieved under routine conditions. Occasionally background fluctuations, unavoidably small sample sizes, the presence of interfering nuclides, or other uncontrollable circumstances may render these LLDs unachievable. In such cases, the contributing factors will be identified and described in the Annual Radiological Environmental Operating Report.

For a more complete discussion of the LLD, and other detection limits, see the following:

(1) HASL Procedure Manual, HASL-300 (revised annually).

(2) Currie, L. A., "Limits for Qualitative Detection and Quantitative Determination - Application to Radiochemistry," Anal.Chem. 40, 586-93 (1968).

(3) Hartwell, J. K., "Detection Limits for Radioisotopic Counting Techniques," Atlantic Richfield Hanford Company Report ARH-2537 (June 22, 1972).

If milk or broadleaf vegetation sampling locations are relocated, the cause shall be reported in the next Annual Radioactive Effluent Release Report. Also, include in this report, revised ODCM figure(s) and table(s) reflecting the new locations. The specific locations from which samples were unavailable may then be deleted from the radiological environmental monitoring program and the table(s) in the ODCM, provided the locations from which the replacement samples were obtained are added to the table(s) as replacement locations.

The requirement for participation in an approved Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measures of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of Section IV.B.2 of Appendix I to 10 CFR Part 50.

6.12.1 MONITORING PROGRAM (Continued)

Special Report:

LCO 6.12.1 requires preparation and submittal of a report in accordance with 10 CFR 50.4 when:

(1) the level of radioactivity as a result of plant effluents in an environmental sampling medium at a specified location exceeds the reporting level(s) in ODCM Table 6.12.1-2 when averaged over a calendar quarter, or

(2) more than one of the radio nuclides in ODCM Table 6.12.1-2 are detected in the sampling medium and

$$\frac{\text{concentration (1)}}{\text{reporting level (1)}} + \frac{\text{concentration (2)}}{\text{reporting level (2)}} + \ldots \geq 1.0, \text{ or}$$

(3) radio nuclides other than those in ODCM Table 6.12.1-2 are detected, and the potential annual dose to a MEMBER OF THE PUBLIC is equal to or greater than the calendar year limits of LCOs 6.11.2, 6.11.5 and 6.11.6.

The report shall:

(1) identify the cause(s) for exceeding the limit(s), and

(2) define the corrective actions to be taken to reduce radioactive effluents so the potential annual dose to a MEMBER OF THE PUBLIC is less than the calendar year limits of LCOs 6.11.2, 6.11.5 and 6.11.6.

The Special Report is not required if the measured level of radioactivity is not the result of plant effluents; however in such an event, the condition shall be reported and identified in the Annual Radiological Environmental Operating Report.

6.12.2 LAND USE CENSUS

This LCO is provided to ensure that changes in the use of areas at and beyond the SITE BOUNDARY are identified and that modifications to the radiological environmental monitoring program are made if required by the results of the census. The best information from door-to-door survey, visual or aerial survey or from consulting with local agricultural authorities shall be used. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50. Restricting the census to gardens of greater than 50 m^2 provides assurance that significant exposure pathways via leafy vegetables will be identified and monitored since a garden of this size is the minimum required to produce the quantity (26 kg/year) of leafy vegetables assumed in Regulatory Guide 1.109 for consumption by a child. To determine this minimum garden size, the following assumptions were made: (1) 20% of the garden was used for growing broad leaf vegetation (i.e., similar to lettuce and cabbage), and (2) a vegetation yield of 2 kg/m^2. Specifications for broad leaf vegetation sampling in the Table 6.12.1-1 shall be followed, including analysis of control samples.

6.12.2 LAND USE CENSUS (Continued)

The land use census should utilize information which provides the best results, such as a door-to-door survey, an aerial survey or by consulting local agriculture authorities. The results of the land use census shall be included in the Annual Radiological Environmental Operating Report pursuant to Technical Specification 5.6.2.

When the Land Use Census requires addition of sampling location(s) to the Environmental Monitoring Program, the sampling locations(s) having the lowest calculated dose or dose commitments(s), via the same exposure pathway, may be deleted from the monitoring program. This deletion may take place after October 31 of the year in which this land use census was conducted.

The new sampling location(s) shall be identified in the next Annual Radioactive Effluent Release Report including a revised figure(s) and table(s) for the ODCM.

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II. DETAILED INFORMATION (CONT'D)

is increased to satisfy the requirements of footnote "c" of Table 1D, "Radioactive Gaseous Waste Sampling and Analysis," (GGNS ODCM Appendix A, Table 4.11.2.1.2-1 [6.11.4-1]. Presently, strontium analysis is performed by a qualified contract laboratory.

Appendix A of Regulatory Guide 1.21 states "In estimating releases for periods when analyses were not performed, the average of the two adjacent data points spanning this period should be used."

Releases from the Turbine Building, Fuel Handling Building and Containment Building exhausts were estimated using this guidance. These releases occurred during April, August, October and December 1994. Each release was evaluated and documented and found to have no significant effect on the total release from the site.

4. For Batch Releases: Gases

The processing of batch type releases (from Containment Purge) is analogous to that for continuous releases.

5. For Batch Releases: Liquid Effluents

The radionuclides listed below are considered when evaluating liquid effluents:

H-3	Mo-99
Co-58	Tc-99m
Co-60	I-131
Fe-55	I-132
Fe-59	I-133
Zn-65	I-135
Mn-54	Cs-134
Cr-51	Cs-137
Sr-89	Ba-140
Sr-90	La-140
Nb-95	Ce-141
Zr-95	Ce-144

Representative pre-release grab samples are obtained and analyzed as required by Table 2C. Isotopic analyses are performed using the computerized pulse height analysis system previously described. Aliquots of each pre-released sample, proportional to the waste volume released, are composited in accordance with the requirements of Table 2C. Strontium-89, 90 and Iron-55 values are obtained by chemical separation and counting the separated strontium and iron using liquid scintillation techniques. Gross alpha determinations are made using 2-pi gas flow proportional counter.

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III. RADIATION DOSE SUMMARY (CONT'D)

Direct Radiation

Direct radiation dose is calculated by subtracting average doses measured by thermoluminescent dosimeter (TLD) badges located at control locations from average doses measured by TLD badges located near the site boundary.

1994 Airborne Effluent Dose (mrem)

	1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	**TOTAL**
Iodine, Tritium & Particulates	9.46E-3	1.30E-2	3.09E-2	1.77E-2	7.11E-2
Fission and Activation	6.71E-3	3.97E-2	1.14E-2	1.76E-2	
(Skin dose, mrem/yr)	1.28E-2	6.68E-2	2.17E-2	2.77E-2	
Gamma Air dose*	1.43E-3	6.13E-3	1.71E-3	4.53E-3	1.38E-2
Beta Air dose*	1.54E-3	4.49E-3	1.86E-3	2.31E-3	1.02E-2
Direct Radiation	0	0	0.1	0	0.1

*Measurement units are mrad

IV. OFFFSITE DOSE CALCULATION MANUAL/
RADIOACTIVE WASTE TREATMENT SYSTEM CHANGES

A. Offsite Dose Calculation Manual (ODCM)

Revision 15 was issued in January 1994 implementing changes resulting from the revision of 10CFR Part 20. Revision 16 was issued in December 1994 to correct a typographical error. Revisions 15 and 16 affected pages are included in Attachment I.

B. Radioactive Waste Treatment Systems

No major changes were made during the report period.