ENCLOSURE 2

CORRECTED PAGES

OFFSITE DOSE CALCULATION MANUAL

SAN ONOFRE NUCLEAR GENERATING STATION
UNIT 1

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UNIT 1

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ODCM

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1.0 LIQUID EFFLUENTS

1.1 Liquid Effluent Monitor Setpoints (3.15.1)

Liquid Radwaste Effluent Line Monitors provide alarm and automatic termination of release prior to exceeding the concentration limits specified in 10CFR20, Appendix B, Table II, Column 2 at the release point to the unrestricted area. To meet specification 4.5.1.B and for the purpose of implementation of specification 3.15.1, the alarm/trip setpoints for liquid effluent monitors and flow measurement devices are set to assure that the following equation is satisfied:

$$\frac{cR}{F+R} \leq C_{MPC} \qquad (1\text{-}1)$$

where:

C_{MPC}= the effluent concentration limit 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 effluent line prior to dilution and subsequent release.

$$C_T = \Sigma_i C_{\gamma i} + C_\alpha + C_s + C_t + C_{Fe} \qquad (1\text{-}2)$$

Where:

C_T = The total concentration

$\sum_i C_{\gamma i}$ = The sum of the measured concentrations for each radionuclide, i, in the gamma spectrum.

C_{Fe} = The Fe-55 concentration as determined in the previous quarterly composite sample.

C_α = The gross alpha concentration determined in the previous monthly composite sample.

C_s = The Sr-89 and Sr-90 concentrations as determined in the previous quarterly composite sample.

C_t = The H-3 concentration as determined in the previous monthly composite sample.

Table 1-1[a]

Liquid Effluent Radiation Monitor
Calibration Constants**

Monitor	Co-60*	I-131*	Cs-137*
RT-1216	2.21 E-8	2.64 E-8	3.61 E-8
RT-1218	9.52 E-9	2.62 E-8	2.50 E-8
RT-2101	2.08 E-9	3.17 E-9	4.61 E-9
RT-2100			

* μ Ci/cc/cpm

**Limiting isotopes

(a)This table provides typical (±20%) calibration constants for the liquid effluent radiation monitors.

1.2 Dose Calculation for Liquid Effluents (3.15.2)

The dose commitment to an individual from radioactive materials in liquid effluents released to unrestricted areas are calculated for the purpose of implementing Specification 3.15.2 using the following expression.

$$D_\tau = \Sigma_i \left[A_{i\tau} \quad \Sigma_l \left(\Delta t_l \; C_{il} \; F_l \right) \right] \tag{1-12}$$

where:

$A_{i\tau}$ = the site related adult ingestion dose commitment factor to the total body or an organ, τ, for each identified principal gamma and beta emitter, i, from Table 1-2 in mrem/hr per μCi/ml.

C_{il} = the average concentration of radionuclide, i, in the undiluted liquid effluent during time period, Δt_l in μCi/ml.

D_τ = the dose commitment to the total body or an organ, τ, from the liquid effluents for the time period, Δt_l, in mrem.

2.0 GASEOUS EFFLUENTS

2.1 Gaseous Effluent Monitor Setpoints (3.16.1)

Administrative values are used to reduce each setpoint to account for the potential activity in other releases. These administrative values shall be periodically reviewed based on actual release data and revised in accordance with the Unit Technical Specifications.

2.1.1 Plant Stack - RT-1214, RT-1219, RT-1254

For the purpose of implementation of Specification 3.16.1, the alarm setpoint level for noble gas monitors is based on the gaseous effluent flow rate and meteorological dispersion factor.

The concentration at the detector is determined by using:

$$C \leq (2120) \frac{(MCB)}{(X/Q)\ (\text{flow rate})} \qquad (2\text{-}1)$$

where:

C = the maximum instantaneous concentration at the detector in μCi/cc

MCB = Maximum Concentration permitted at the site Boundary, corresponding to dose rate limits of Specification 3.16.1 in μCi/cc determined by:

$$MCB = \left(\text{lower of } \frac{5\times10^{-4}}{\Sigma F_i K_i} \text{ or } \frac{3\times10^{-3}}{\Sigma F_i (L_i + 1.1\times M_i)}\right). \quad (2\text{-}1a)$$

where:

F_i = fractional abundance of the i^{th} radionuclide as obtained by sample analysis

K_i = Total body dose conversion factor, from Table 2-2, in $\frac{\text{mrem-m}^3}{\mu\text{Ci-yr}}$

L_i = Skin dose conversion factor, from Table 2-2, in $\frac{\text{mrem-m}^3}{\mu\text{Ci-yr}}$

M_i = Gamma air dose conversion factor, from Table 2-2, in $\frac{\text{mrem-m}^3}{\mu\text{Ci-yr}}$

flow rate = the plant vent flow rate in cfm

= 20,000 cfm/fan (x no. of fans to be run)

(X/Q) = 6.1 E-5 sec/m^3 the annual average atmosphere dispersion

2120 = conversion of cfm to m^3/sec

The alarm setting is determined by using the conversion constants for the applicable Plant Stack Airborne Monitor given in Table 2-1.

The alarm setpoint is the cpm value corresponding to the concentration, C, which is conservatively assumed to be the isotope of least sensitivity for the monitor.

2.1.2 <u>Containment Purge</u> - RT-1212

For the purpose of implementation of Specification 3.16.1, the alarm setpoint level for noble gas monitors is based on the gaseous effluent flow rate and meteorological dispersion factor.

The concentration at the detector is determined by using:

$$C \leq (2120) \frac{(MCB)}{(X/Q)\ (\text{flow rate})} \qquad (2\text{-}2)$$

where:

C = the maximum instantaneous concentration at the detector in μCi/cc

MCB = as defined in Section 2.1.1

flow rate = the containment purge flow rate in cfm

= 20,000 cfm full purge

(X/Q) = 6.1 E-5 sec/m^3 the annual average atmosphere dispersion

2120 = conversion of cfm to m^3/sec

The alarm setting is determined by using the calibration constants for the Containment Airborne Monitor given in Table 2-1.

The alarm setpoint is the cpm value corresponding to the concentration, C, which is conservatively assumed to be the isotope of least sensitivity for the monitor.

2.1.3 Waste Gas Header - RT-1214

For the purpose of Specification 3.16.1, the alarm setpoint level for noble gas monitors is based on the gaseous effluent flow rate and meteorological dispersion factor. Since the waste gas header discharges to the plant vent stack, RT-1214 is used to monitor waste gas header releases.

When plant vent stack monitor RT-1214 is being used to monitor waste gas header releases, the setpoint determined by equation (2-1) will provide automatic termination of release from the waste gas header.

Determine the maximum permissible waste gas header effluent flow rate corresponding to the vent stack monitor setpoint in accordance with the following:

$$f \leq \frac{(0.9)\ C\ F}{\sum_i C_{\gamma i}} \qquad (2\text{-}3)$$

Where:

f = waste gas header effluent flow rate

F = plant vent stack flow rate used in equation (2-1)

C = maximum instantaneous concentration at the detector in μCi/cc as defined in Equation (2-1)

$\sum_i C_{\gamma i}$ = total gamma activity (μCi/cc) of the waste gas holdup tank to be released, as determined from the pre-release sample analysis.

The 0.9 is an administrative value to account for the potential activity from other releases in the same release pathway.

$\sum_k R_{ik}W_k$ = the sum of all pathways k for radionuclide, i, of the R_i, W product in mrem/yr per µCi/sec. The $\sum_k R_{ik}W_k$ value for each radionuclide, i, is given in Table 2-4. The given is the maximum $\sum_k R_{ik}W_k$ for all locations and is based on the most restrictive age groups.

R_{ik} = the dose factor for each identified radionuclide, i, for pathway k (for the inhalation pathway in mrem/yr per µCi/m^3 and for the food and ground plane pathways in m^2- mrem/yr per µCi/sec) at the controlling location. The R_{ik}'s for each controlling location for each age group are given in Tables 2-5 thru 2-13. The R_{ik} values to these tables are obtained using the NRC supplied computer code, PARTS (NUREG-0133), utilizing default and site specific (where available) parameters listed in Table 2-14.

W_k = the annual average dispersion parameter for estimating the dose to an individual at the controlling location for pathway k.

= $\overline{(X/Q)}$ for the inhalation pathway in sec/m^3. The $\overline{(X/Q)}$ for each controlling location are given in Tables 2-5 thru 2-13.

TABLE 2-3

DOSE PARAMETER P_{ik}

CHILD AGE GROUP

Radionuclide	Inhalation Pathway (mrem/yr per μCi/m^3)	Radionuclide	Inhalation Pathway (mrem/yr per μCi/sec)
H - 3	1.1 E+3	Tc - 101	5.8 E+2
C - 14	3.6 E+4	Ru - 103	6.6 E+5
Na - 24	1.6 E+4	Ru - 105	1.0 E+5
P - 32	2.6 E+6	Ru - 106	1.4 E+7
Cr - 54	1.7 E+4	Ag - 110M	5.5 E+6
Mn - 54	1.6 E+6	Te - 125M	4.8 E+5
Mn - 56	1.2 E+5	Te - 127M	1.5 E+6
Fe - 55	1.1 E+5	Te - 127	5.6 E+4
Fe - 59	1.7 E+6	Te - 129M	1.8 E+6
Co - 58	1.1 E+6	Te - 129	2.5 E+4
Co - 60	7.1 E+6	Te - 131M	3.1 E+5
Ni - 63	8.2 E+5	Te - 131	2.1 E+3
Ni - 65	8.4 E+4	Te - 132	3.8 E+5
Cu - 64	3.7 E+4	I - 130	1.8 E+6
Zn - 65	1.0 E+6	I - 131	1.6 E+7
Zn - 69	1.0 E+4	I - 132	1.9 E+5
Br - 83	4.7 E+2	I - 133	3.8 E+6
Br - 84	5.5 E+2	I - 134	5.1 E+4
Br - 85	2.5 E+1	I - 135	7.9 E+5
Rb - 86	2.0 E+5	Cs - 134	1.0 E+6
Rb - 88	5.6 E+2	Cs - 136	1.7 E+5
Rb - 89	3.5 E+2	Cs - 137	9.1 E+5
Sr - 89	2.2 E+6	Cs - 138	8.4 E+2
Sr - 90	1.0 E+8	Ba - 139	5.8 E+4
Sr - 91	1.7 E+5	Ba - 140	1.7 E+6
Sr - 92	2.4 E+5	Ba - 141	2.9 E+3
Y - 90	2.7 E+5	Ba - 142	1.6 E+3
Y - 91M	2.8 E+3	La - 140	2.3 E+5
Y - 91	2.6 E+6	La - 142	7.6 E+4
Y - 92	2.4 E+5	Ce - 141	5.4 E+5
Y - 93	3.9 E+5	Ce - 143	1.3 E+5
Zr - 95	2.2 E+6	Ce - 144	1.2 E+7
Zr - 97	3.5 E+5	Pr - 143	4.3 E+5
Nb - 95	6.1 E+5	Pr - 144	1.6 E+3
Mo - 99	1.4 E+5	Nd - 147	3.3 E+5
Tc - 99M	4.8 E+3	W - 187	9.1 E+4
		Np - 239	6.4 E+4

2.4 Total Dose Calculations (3.17)

2.4.1 Total Dose to Most Likely Member of the Public

The total annual dose or total dose commitment to any member of the public, due to releases of radioactivity and to radiation, from uranium fuel cycle sources within 5 miles of the site is calculated using the following expressions. This methodology is used to meet the dose limitations of 40 CFR 190 per twelve consecutive months. The transportation of radioactve material is excluded from the dose calculations.

The total air dose is calculated as follows:

$$DA = DA_1 \, \Delta t_B + DA_{23} \, \Delta t_B \qquad (2\text{-}13)$$

where:

DA = total air dose in mrem/year

DA_1 = Unit 1 total air dose in mrem/year

Δt_B = percent (decimal equivalent) meteorology in the beach sectors

DA_{23} = Units 2 and 3 total air dose in mrem/year from Equation 2-14 or 2-15 of the Unit 2/3 ODCM for the past 12 consecutive months

The total body liquid dose is determined by:

$$D_L = (D_{TB1} - D_{L1}) + (D_{TB23} - D_{L23}) \tag{2-14}$$

where:

D_L = total body liquid dose in mrem/year

D_{TB1} = total body dose for Unit 1 in mrem/year for the past 12 consecutive months

D_{L1} = total liquid dose for Unit 1 in mrem/year for the past 12 consecutive months

D_{TB23} = total body dose for Units 2 and 3 in mrem/year from Equation 1-9 of the Unit 2/3 ODCM for the past 12 consecutive months

D_{L23} = total liquid dose in mrem/year for Units 2 and 3 for the past 12 consecutive months

The background dose to an individual member of the public is obtained by calculating the average quarterly TLD dose of those TLD's from 5 to 50 miles distant from the site. The background is subtracted from the highest quarterly reading beach TLD to determine the direct dose in equation form:

$$D_D = D_{beach} - D_{back} \qquad (2\text{-}15)$$

where:

D_D = direct dose in mrem/year

D_{beach} = highest quarterly reading beach TLD in mrem/year

D_{back} = average quarterly TLD dose of those TLD's from 5 to 50 miles distant from the site

The total dose can now be determined by:

$$D_T = (D_A + D_D)\ T_o + D_L \qquad (2\text{-}16)$$

where:

D_T = total dose in mrem/year

D_A = total air dose in mrem/year from Equation 2-13

D_D = direct dose in mrem/year from Equation 2-15

T_o = beach occupancy time in years. The beach occupancy time has been determined to be 300 hours per year.

D_L = total body liquid dose in mrem/year from Equation 2-14

2.4.2 Thyroid Dose

The ingestion dose is calculated as follows:

$$D_I = (D_{T1} \times \Delta t_B) + (D_{T23} \times \Delta t_B) \qquad (2\text{-}17)$$

where:

D_I = total ingestion (thyroid) dose in mrem/year

D_{T1} = total thyroid dose for Unit 1 in mrem/year for the past 12 consecutive months

D_{T23} = total thyroid dose for Units 2 and 3 in mrem/year for the past 12 consecutive months

The thyroid dose - liquid is determined as follows:

$$D_{TL} = D_{TL1} + D_{TL23} \tag{2-18}$$

where:

D_{TL} = total thyroid dose - liquid in mrem/year

D_{TL1} = total Unit 1 thyroid dose - liquid in mrem/year for the past 12 consecutive months

D_{TL23} = total Unit 2/3 thyroid dose - liquid in mrem/year for the past 12 consecutive months

The thyroid dose from all effluents during the reporting period are calculated as follows:

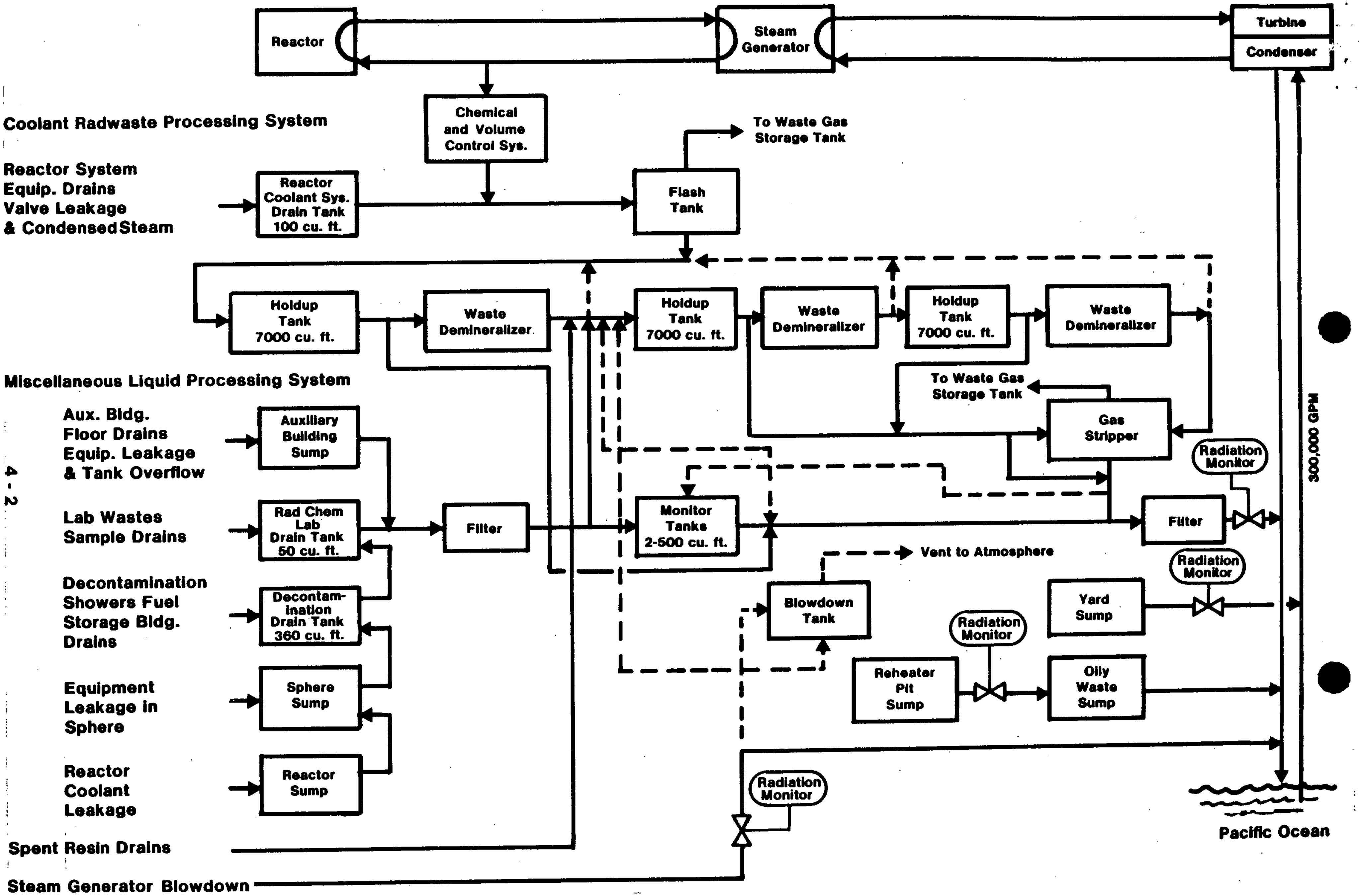
$$D_{TD} = D_I + D_{TL} \tag{2-19}$$

where:

D_{TD} = thyroid dose in mrem/year

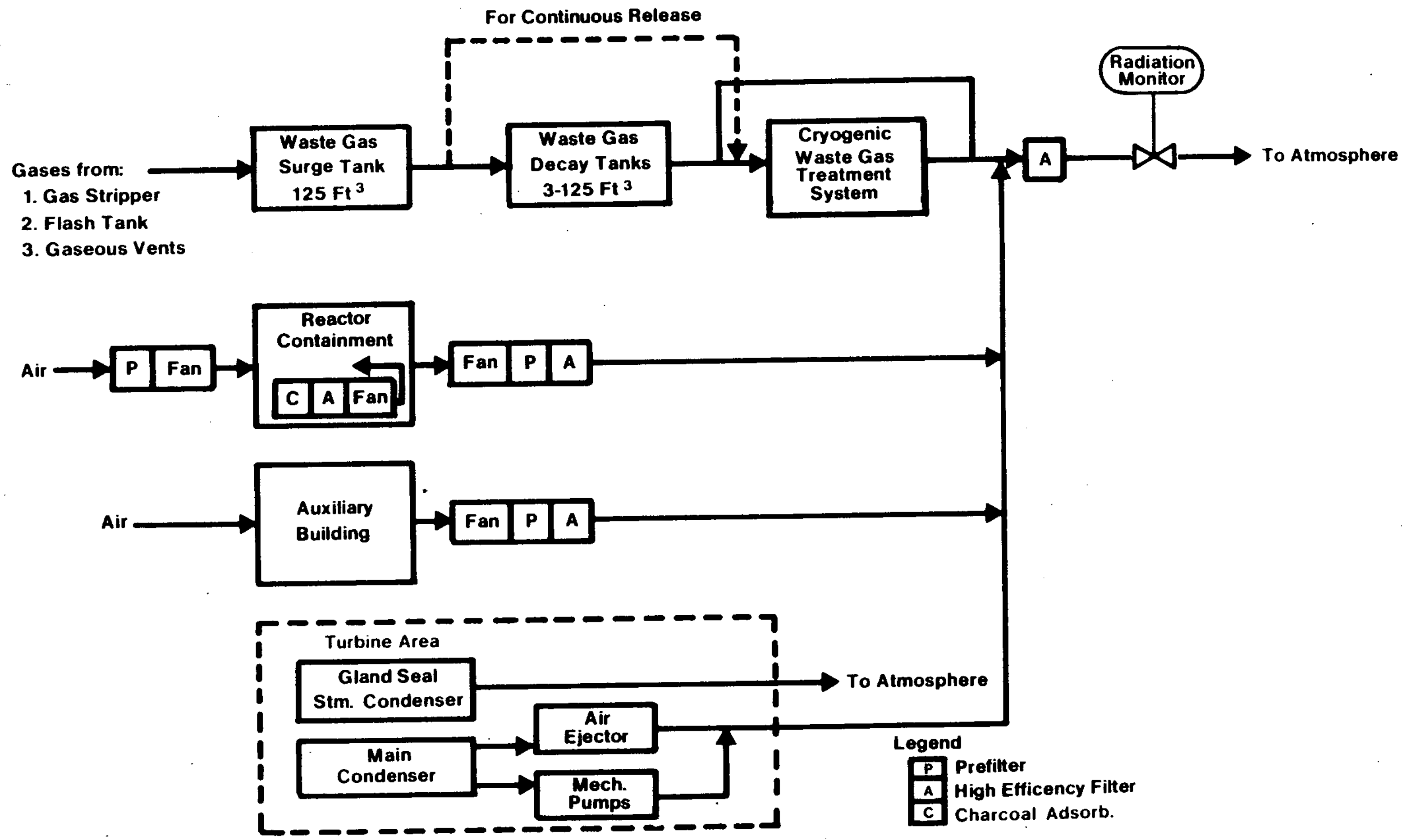
D_I = thyroid dose from gas effluents in mrem/year

D_{TL} = thyroid dose from liquid effluents in mrem/year



Liquid Waste-Discharge System

Figure 4-1



Containment, Auxiliary Building and Turbine Area Ventilation System

Radioactive Gaseous-Waste System

Figure 4 - 2