OFFSITE DOSE CALCULATION MANUAL

INDIANA & MICHIGAN POWER COMPANY

DONALD C. COOK NUCLEAR PLANT UNIT NOS. 1 & 2

BRIDGMAN, MICHIGAN

Docket Nos. 50-315 and 50-316

License Nos. DPR-58 and DPR-74

Section 1

Set Point Determination

Table 1 through 9 summarizes the details of the Instruments used to monitor radioactive effluents at the D. C. Cook Nuclear Plant.

The methodology used to determine the variable setpoints for the liquid and gaseous effluent monitors are discussed below.

A. Liquid Effluent Monitors

The basic equation to calculate the variable setpoints for liquid effluents is

$$\text{Stpt} = \frac{C(f + F)}{f}$$

where: A-1

Stpt = The setpoint, in uCi/ml, of the radioactivity monitor measuring the radioactivity concentration in the effluent line prior to dilution and subsequent release; the setpoint, which is proportional to the volumetric flow of the effluent line and inversely proportional to the volumetric flow of the dilution stream plus the effluent stream, represents a value which, if exceeded, would result in concentrations exceeding the limits of 10 CFR 20 in the unrestricted area

f = the 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.

and $$C = \sum_i \frac{C_i}{\text{Total MPC Fraction}}$$

$$\text{Total MPC Fraction} = \sum_i \frac{C_i}{MPC_i}$$

A more conservative operation alarm setpoint for each monitor may be specified by the Plant Radiation Protection Supervisor.

The administrative controls, surveillance requirements and calibration procedure are given in Plant Procedure.

B. Gaseous Effluent Monitors

(1) Noble Gase Monitors

The variable setpoints for noble gas monitors are derived assuming a maximum site boundary, beta dose of 500 MR/Yr and a site boundary gamma dose of 1500 MR/Yr. X/Q value used is that of the North Sector at the site boundary (namely 7.7 x 10-6 at 610 meters). The beta and gamma radiation doses are computed using equations for a semi infinite cloud. Assuming these, one can write the equations for release rate of noble gases in the form:

$$\sum_i \left(112\,\overline{E}_{\beta i} + 45\,\overline{E}_{\gamma i}\right) Q_i \leq 1$$

$$\sum_j Q_j = Q_{tot}\,(Ci/sec)$$

$$\left(\sum_j Q_j\right)\left[\frac{112\Sigma_i\, Q_i\, \overline{E}_{\beta i}}{\sum_j Q_j} + \frac{45\,\Sigma\,\overline{E}_{\gamma i}\, Q_i}{\Sigma\, Q_j}\right] \leq 1$$

$$\therefore Q_{tot} = \frac{1}{112\,E_{\beta} + 45\,E_{\gamma}} \qquad i,j = \text{isotopes}$$

where $E_{\beta} = \dfrac{\sum_i Q_i\, \overline{E}_{\beta i}}{\sum_j Q_j}$ and $E_{\gamma} = \dfrac{\sum_i Q_i\, \overline{E}_{\gamma i}}{\sum_j Q_j}$

$$\text{Setpoint} = \frac{Q_{tot} \quad *10^6}{\text{Flow (cc/sec)}} \quad (uCi/cc)$$

.....B-1

$\overline{E_{\beta i}}$ and $\overline{E_{\gamma i}}$ are taken from the attached Table A.

A more conservative operation alarm setpoint for each monitor may be specified by the Plant Radiation Protection Supervisor.

(2) Radioiodine and Particulate Monitors

The variable setpoints for radioiodines and particulates are obtained using the following equation:

$$1.5 * 10^5 \quad Q_v = 1$$

where:

Q_v= Release Rate (ci/sec)

To determine this equation, dose calculations have been made for the critical sectors and critical pathways for all radioiodines and radioactive material in particulate form, with half-lives greater than eight days. The calculations consider site meteorology for these releases.

For radioiodines and radioactive materials in particulate form, the controlling sector for unit vent releases is the N sector at a distance of 610 meters ($X/Q = 7.7 \times 10^{-6}$ sec/m^3) for the dose due to inhalation. The nearest milk cow is located in the ENE sector at a distance of 2900 meters. The applicable X/Q at the nearest milk cow is 1.5×10^{-7} sec/m^3. The grass-cow-milk child thyroid chain is controlling.

The assumptions used for these calculations are: (1) on-site meteorological data for the most critical 22.5 degree sector; (2) credit for building wake; and (3) a reconcentration factor 243 and a grazing factor of 0.4 was applied for possible ecological chain effects from radioactive iodine and particulate releases.

$$\text{Setpoint (uCi/cc)} = \frac{Q_v \text{ (uCi/sec)}}{\text{Flow (cc/sec)}}$$

Section 2 - Liquid Effluent Concentration

Donald C. Cook Nuclear Plant Procedure No. 12 THP 6061 RAD 332 furnishes, the equations and methodology used in the determination of concentration and total curie discharge during batch liquid effluent releases. The pre release analysis is performed by using plant Procedure No. 12 THP 6020 LAB 070. The post release analysis performed using the actual release parameters such as flow rate,

effluent concentration etc., at the time of release. Each batch release is authorized by the supervisory personnel in the Chemical Section and is verified by the Radiation Protection Section.

Section 3 - Gaseous Effluent Dose Rate

The dose rates for noble gases are estimated by using:

$$\sum_i (.23 \bar{E}_{\beta i} + .275 \bar{E}_{\gamma i}) Q_i * X/Q$$

where $X/Q = 7.7E\text{-}6$ sec/m^3 (N sector of the site boundary)

$\bar{E}_{\beta i}$ and $\bar{E}_{\gamma i}$ are also from the attached table A

The radioiodine and particulate dose rates are estimated by using:

$$\sum_I Q_i \left[DF_i *(X/Q)_1 + DFC_i *(X/Q)_2 \right]$$

.....C-1

where:

DF = dose factor for inhalation (see Table B)

$(X/Q)_1$ = dilution factor inhalation (7.7×10^{-6} sec/m^3)

DFC = child thyroid dose conversion factor (see Table D)

$(X/Q)_2$ = dilution factor for child thyroid pathway (1.5×10^{-7} sec/m^3)

Section 4 - Liquid Effluent Dose

The equation and methodology used at the plant for determining the doses due to liquid effluents are based on the models presented in Appendix F to WASH 1258. Site specific usage factors and dilution factors are given below.

Pathway	Usage Factor	Dilution Factor
Drinking Water	1 liter/day	.1
Fish Consumption	6.9 Kg/Yr	.1
*Shoreline Activity	47 Hr/Yr	.1
Swimming	47 Hr/Yr	.1
Boating	47 Hr/Yr	.1

*Other parameters for shoreline activity
*Deposition coefficient 2.5 liters/Kg-day
Shore width factor 0.3
Sediment surface density 40.0 Kg/m^2

The liquid effluent doses are calculated using a computer program written to meet the guidelines of WASH 1258.

If the program is unavailable, doses will be computed using fish consumption as the limitation pathway.

The following equation from WASH-1258 may be used to compute the dose obtained from each nuclide contributing to personal exposure via the fish consumption pathway.

$$(DR)_{pr} = 1119 \frac{U_p M_p}{F} \sum_{i=1} Q_i \cdot R_i \bar{B}_{ip} D_{ipr} \exp(-\lambda_i t_p)$$

$(DR)_{pr}$ = Dose rate to organ r from all of the nuclides i in pathway p (mrem/year)

U_p = Usage factor associated with P; in this case, fish consumption (6.9 Kg / yr)

M_p = Mixing ratio at the point of exposure = .1 (unitless)

F = Flow rate of the liquid effluent (ft^3/sec)

Q_i = Release rate of nuclide i (Ci/yr)

R_i = Reconcentration factor = 1 (unitless)

B_{ip} = Bioaccumulation factor for nuclides i in pathway P (pCi/Kg per pCi/liter) (see Table C)

D_{ipr} = A dose factor (see Table B)

λ = Radiological decay constant of nuclide i (hours $^{-1}$)

tp = Transit time required for nuclides to reach the point of exposure (hrs)

1119 = A constant which converts from (Ci/yr) / (ft^3/sec) to pCi / liter

Section 5 - Gaseous Effluent

Doses due to gaseous effluents are estimated using the atmospheric dispersion models given in Equation (3) of Regulatory Guide 1.111 and dose calculation models and the dose models discussed in Draft Regulatory Guide 1.AA. If the computer is not available for analysis, the doses will be estimated using the limiting Infant Thyroid pathway dose equation C-1.

Section 6 - Projected Doses

The doses will be projected by using a "Rolling Quarter" technique. At a given time, the operator will be able to obtain the cummulative doses for the preceding 92 days, and also a maximum instantaneous dose for the same period from a computer program. In the event of computer unavailability, a conservative estimate may be made by adopting the following procedure:

a) Compute the doses since the last computer report.

b) Add these to the totals from the last available computer program.

Section 7 - Operability of Equipment

The flow diagrams defining treatment paths and components of the radioactive liquids, gaseous and solid waste management systems that are to be maintained and used are shown in Figures 1 through 2.

Section 8 - Sample Location

A map of the Radiological Environmental monitoring sample locations within the site boundary and within a 20 mile radius is presented on Figure 3.12-1A and 3.12-1B of the attached Effluent Technical Specifications.

TABLE A

AVERAGE ENERGY PER DISINTEGRATION

Isotope	$\bar{E}_\gamma$, Mev/dis	(Ref)	$\bar{E}_\beta$, Mev/dis[3]	(Ref)
Kr-83m	0.00248	(1)	0.0371	(1)
Kr-85	0.0022	(1)	0.250	(1)
Kr-85m	0.159	(1)	0.253	(1)
Kr-87	0.793	(1)	1.32	(1)
Kr-88	1.95	(1)	0.377	(1)
Kr-89	2.22	(2)	1.37	(2)
Kr-90	2.10	(2)	1.01	(2)
Xe-131m	0.0201	(1)	0.143	(1)
Xe-133	0.0454	(1)	0.135	(1)
Xe-133m	0.042	(1)	0.19	(1)
Xe-135	0.247	(1)	0.317	(1)
Xe-135m	0.432	(1)	0.095	(1)
Xe-137	0.194	(1)	1.64	(1)
Xe-138	1.18	(1)	0.611	(1)

(1) ORNL-4923, Radioactive Atoms - Supplement I, M. S. Martin, November 1973.

(2) NEDO-12037, "Summary of Gamma and Beta Emitters and Intensity Data," M. E. Meek, R. S. Gilbert, January 1970. (The average β energy was not computed using the 1/3 value assumption as used in this reference. It was computed from the maximum energy using the equation in the Report of Committee II on Permissible Dose for Internal Radiation (1959), ICRP Publication 2, Pergamon Press, 1960.)

(3) The average β energy includes conversion electrons.

MASTER LIST OF ADULT DOSE FACTORS.

ISOTOPE	--AIR SUBMERSION-- MREM/HOUR PER PCI/CUBIC METER		----------INGESTION---------- MREM PER PCI INTAKE				-SHORELINE- MREM/HOUR PER PCI/SQUARE METER		-SWIMMING-- MREM/HOUR PER PCI/LITER	
	BODY	SKIN	BODY	GI-LLI	THYROID	BONE	SKIN	BODY	SKIN	BODY
1 H-3	0	0	1.27E-07	6.40E-08	1.27E-07	0	0	0	0	0
2 C-14	1.4E-11	3.5E-09	5.29E-07	3.20E-07	5.29E-07	2.64E-06	0	0	3.80E-09	0
3 N-13	8.5E-07	1.4E-06	0	0	0	0	8.80E-09	7.60E-09	2.60E-06	1.90E-06
4 F-18	8.2E-07	1.1E-06	7.00E-08	1.93E-08	0	6.30E-07	8.00E-09	6.80E-09	2.30E-06	1.80E-06
5 NA-22	1.8E-06	2.3E-06	1.77E-05	3.20E-06	1.77E-05	1.77E-05	1.80E-08	1.60E-08	4.80E-06	4.00E-06
6 NA-24	3.5E-06	4.5E-06	1.71E-06	3.73E-06	1.71E-06	1.71E-06	2.90E-08	2.50E-08	9.30E-06	7.80E-06
7 P-32	3.0E-09	6.2E-07	7.44E-06	2.15E-05	0	1.93E-04	0	0	6.80E-07	6.40E-09
8 AR-39	3.3E-10	1.2E-07	0	0	0	0	0	0	1.30E-07	6.20E-10
9 AR-41	1.1E-06	1.6E-06	0	0	0	0	0	0	3.20E-06	2.40E-06
10 SC-46	1.7E-06	2.0E-06	3.67E-09	5.10E-05	0	5.26E-09	1.50E-08	1.30E-08	4.30E-06	3.70E-06
11 CR-51	2.4E-08	2.9E-08	2.67E-09	6.49E-07	1.59E-09	0	2.60E-10	2.20E-10	6.40E-08	5.20E-08
12 MN-54	7.0E-07	8.1E-07	8.60E-07	1.30E-05	0	0	6.80E-09	5.80E-09	1.80E-06	1.50E-06
13 MN-56	1.5E-06	2.4E-06	2.04E-08	3.66E-06	0	0	1.30E-08	1.10E-08	4.60E-06	3.20E-06
14 FE-55	3.5E-11	1.0E-09	1.48E-07	8.41E-07	0	6.78E-07	0	0	3.60E-10	6.40E-11
15 FE-59	1.0E-06	1.2E-06	5.60E-06	3.31E-05	0	4.12E-06	9.40E-09	8.00E-09	2.60E-06	2.20E-06
16 CO-57	1.0E-07	1.2E-07	2.92E-07	4.47E-06	0	0	1.00E-09	9.10E-10	2.70E-07	2.20E-07
17 CO-58	8.2E-07	1.1E-06	1.60E-06	1.52E-05	0	0	8.20E-09	7.00E-09	2.30E-06	1.80E-06
18 CO-60	2.0E-06	2.5E-06	4.70E-06	3.99E-05	0	0	2.00E-08	1.70E-08	5.40E-06	4.60E-06
19 NI-63	0	0	1.26E-06	1.61E-06	0	3.02E-05	0	0	0	0
20 NI-65	4.8E-07	1.1E-06	5.22E-08	1.09E-06	0	5.46E-07	4.30E-09	3.70E-09	1.90E-06	1.00E-06
21 CU-64	1.7E-07	2.8E-07	3.91E-08	6.85E-06	0	0	1.70E-09	1.50E-09	5.20E-07	3.70E-07
22 ZN-65	4.9E-07	5.6E-07	5.08E-06	9.78E-06	0	3.40E-06	4.60E-09	4.00E-09	1.20E-06	1.10E-06
23 ZN-69M	3.4E-07	6.8E-07	3.66E-08	2.40E-05	0	1.65E-07	3.40E-09	2.90E-09	1.20E-06	7.50E-07
24 ZN-69	7.1E-10	2.5E-07	1.34E-09	2.90E-09	0	1.60E-08	0	0	2.80E-07	1.60E-09
25 BR-82	2.4E-06	2.9E-06	2.34E-06	2.53E-06	0	0	2.20E-08	1.90E-08	6.30E-06	5.30E-06
26 BR-83+D	7.5E-09	2.7E-07	5.87E-08	5.61E-08	0	0	9.30E-11	6.40E-11	3.10E-07	1.70E-08
27 BR-84	1.0E-06	3.0E-06	5.26E-08	4.15E-13	0	0	1.40E-08	1.20E-08	5.30E-06	3.50E-06
28 RB-86	6.7E-09	9.7E-07	2.29E-09	0	0	0	0	0	1.10E-06	1.40E-08
29 RB-86M	0	7.6E-10	0	0	0	0	0	0	7.90E-09	3.10E-09
30 RB-88	1.3E-07	3.2E-07	0	0	0	0	0	0	5.10E-07	2.80E-07
31 RB-89	2.2E-09	1.6E-07	0	0	0	0	0	0	1.80E-07	4.70E-09
32 SR-87	1.3E-06	2.7E-06	0	0	0	0	0	0	4.60E-06	2.70E-06
33 SR-89	1.9E-08	2.3E-06	0	0	0	0	0	0	4.10E-06	3.30E-06
34 SR-90	8.3E-08	6.0E-07	1.00E-05	4.27E-06	0	0	7.20E-10	6.30E-10	8.50E-07	1.70E-07
35 SR-91	5.0E-07	2.7E-06	3.26E-08	0	0	0	4.00E-09	3.50E-09	3.00E-06	1.20E-06
36 SR-92	2.1E-06	2.4E-06	2.88E-08	0	0	0	1.80E-08	1.50E-08	5.80E-06	4.50E-06
37 Y-90	2.1E-09	4.9E-07	9.13E-06	4.98E-05	0	3.20E-04	6.50E-13	5.60E-13	5.40E-07	4.60E-09
38 Y-91M	2.4E-10	1.3E-07	6.95E-05	1.23E-04	0	3.36E-04	0	0	1.50E-07	5.40E-10
39 Y-91	6.1E-09	8.6E-07	2.65E-10	1.65E-04	0	9.86E-04	2.60E-12	2.20E-12	9.60E-07	1.30E-08
40 Y-92	8.9E-07	1.6E-06	2.43E-07	2.87E-05	0	5.82E-06	3.30E-09	2.10E-09	2.90E-06	1.90E-06
41 Y-93	1.1E-06	1.5E-06	9.35E-08	4.31E-05	0	2.16E-06	1.00E-08	9.00E-09	3.10E-06	2.60E-06
42 Y-90	6.1E-09	8.0E-07	2.66E-10	1.65E-04	0	9.86E-09	2.60E-12	2.20E-12	9.60E-07	1.30E-08
43 Y-91M	4.0E-07	5.6E-07	3.48E-12	2.91E-10	0	8.89E-11	4.40E-09	3.80E-09	1.20E-06	1.05E-06
44 Y-91	3.1E-09	5.2E-07	3.60E-09	7.50E-05	0	1.36E-07	2.70E-11	2.40E-11	5.70E-07	6.70E-09
45 Y-92	2.1E-07	1.0E-06	2.50E-11	1.49E-05	0	8.57E-10	1.90E-09	1.60E-09	2.00E-06	4.60E-07
46 Y-93	8.7E-08	1.2E-06	5.53E-11	6.31E-05	0	1.98E-09	7.80E-10	5.70E-10	1.40E-06	1.90E-07
47 ZR-95	6.8E-07	8.4E-07	6.34E-09	2.93E-05	0	2.70E-08	5.80E-09	5.00E-09	1.80E-06	1.50E-06

TABLE B

48	ZR-95D	6.4E-07	7.5E-07	1.81E-09	2.63E-05	0	5.56E-09	6.00E-09	5.10E-09	1.60E-06	1.40E-06
49	ZR-97	6.9E-07	1.4E-06	1.59E-10	1.67E-04	0	1.69E-09	6.40E-09	5.50E-09	2.40E-06	1.50E-06
50	ZR-97D	5.6E-07	1.1E-06	4.70E-12	4.69E-08	0	5.00L-11	5.40E-09	4.60E-09	1.90E-06	1.20E-06
51	NB-95	6.4E-07	7.5E-07	1.81E-09	2.63E-05	0	5.56E-09	6.00E-09	5.10E-09	1.60E-06	1.40E-06
52	NB-97	5.6E-07	1.1E-06	4.70E-12	4.69E-08	0	5.00L-11	5.40E-09	4.60L-09	1.90E-06	1.20E-06
53	MO-99+D	2.2E-07	5.8L-07	7.92E-07	9.05L-06	0	0	2.20E-09	1.90E-09	9.10E-07	4.70E-07
54	MO-99D	1.1E-07	1.3L-07	2.01E-06	2.60E-06	0	1.77L-09	9.50E-10	8.30L-10	2.40E-07	2.10E-07
55	TC-99M	1.1E-07	1.3E-07	2.01E-08	2.60E-06	0	1.77L-09	1.10E-09	9.60L-10	2.70E-07	2.40E-07
56	TC-99	5.9E-11	2.4L-08	4.44E-08	5.36E-06	0	1.11L-07	0	0	2.60E-10	1.30E-10
57	TC-101	3.6E-07	7.6E-07	3.56E-09	6.54E-22	0	2.51L-10	3.00E-09	2.70E-09	1.20E-06	6.00E-07
58	RU-103+D	4.1E-07	4.9E-07	7.87E-08	2.69E-05	0	1.72L-07	4.20E-09	3.60L-09	1.10E-06	8.90E-07
59	RU-105+D	5.4E-07	1.0E-06	6.03E-09	9.10E-06	0	1.49L-08	5.10E-09	4.50L-09	1.80E-06	1.20E-06
60	RU-106+D	1.7E-07	1.5E-06	3.56E-07	1.81E-04	0	2.79L-06	1.80E-09	1.50L-09	1.90E-06	3.80E-07
61	RH-105	7.8E-08	1.6E-07	5.82E-08	1.36E-05	0	1.15L-07	7.70E-10	6.60E-10	3.90E-07	1.70E-07
62	PD-109+D	4.3E-09	3.9E-07	4.16E-08	2.65E-05	0	0	4.00E-11	3.50L-11	3.40E-07	9.30E-09
63	AG-110M+D	2.2E-06	2.4E-06	8.70E-08	5.92E-05	0	1.46L-07	2.10E-08	1.80L-08	5.30E-06	4.90E-06
64	AG-111	2.2E-08	3.2E-07	1.21E-08	4.34E-05	0	5.74L-08	2.10E-10	1.80L-10	3.60E-07	4.80E-08
65	SN-125	7.3E-06	9.1L-07	3.79E-07	1.60E-04	1.40E-07	8.33L-06	6.60E-10	5.70L-10	1.10E-06	1.40E-07
66	SB-124	1.6E-06	2.2E-06	1.10E-06	7.90E-05	6.74E-09	2.80L-06	1.50E-08	1.30E-08	4.50E-06	3.60E-06
67	SB-125	3.6E-07	4.5E-07	4.17E-07	1.80E-05	1.72L-09	1.57E-06	3.50E-10	3.10L-09	9.50E-07	7.80E-07
68	SB-127	6.7E-07	9.2L-07	1.18E-07	6.54E-05	4.67L-09	3.57L-07	6.60E-09	5.70L-09	1.80E-06	1.50E-06
69	TE-125M	1.7E-09	1.1E-08	5.49E-07	1.65E-05	7.94E-07	2.72E-06	4.80E-11	3.50E-11	1.50E-08	3.60E-09
70	TE-127M	1.2E-10	1.6L-09	7.62E-07	2.10E-05	1.61L-06	6.40L-06	1.30E-12	1.10L-12	1.80E-09	2.60E-10
71	TE-127	1.2E-09	1.6E-07	2.21E-08	8.13E-06	7.53E-08	1.03L-07	1.10E-11	1.00E-11	1.70E-07	2.80E-09
72	TE-129M+D	9.4E-08	5.7E-07	1.77E-06	5.79E-05	4.50E-06	1.17E-05	9.00E-10	7.70L-10	7.40E-07	2.10E-07
73	TE-129	8.7E-08	5.3E-07	7.61E-09	2.12L-08	2.40L-08	3.13L-03	8.40E-10	7.10L-10	7.80E-07	1.90E-07
74	TE-131M	1.0E-06	1.3E-06	4.71E-07	3.84E-05	6.92L-07	8.02L-07	9.90E-09	8.40E-09	2.70E-06	2.20E-06
75	TE-131	3.4E-07	1.1E-06	6.25E-09	3.58E-14	1.63L-08	1.95L-08	2.60E-09	2.20E-09	1.60E-06	7.40E-07
76	TE-132	1.8E-07	2.3E-07	1.54E-06	7.79E-05	1.82L-06	2.50E-06	2.00E-09	1.70L-09	4.40E-07	4.00E-07
77	TE-132D	2.0E-06	2.7E-06	1.96E-07	1.57E-07	7.33L-05	2.88E-07	2.00E-08	1.70L-08	5.50E-06	4.40E-06
78	TE-133M+D	1.6E-06	2.4E-06	2.35E-06	1.45E-09	3.52E-08	4.69E-08	1.70E-08	1.50E-08	5.00E-06	3.90E-06
79	TE-134	1.2E-07	1.9E-07	2.20E-06	4.40E-09	2.85L-08	3.29E-08	1.20E-09	1.00E-09	3.50E-07	2.50E-07
80	I-129	1.1E-09	4.0E-09	6.01E-06	3.67E-07	6.18L-03	2.49L-06	9.60E-12	7.00E-12	6.20E-09	2.30E-09
81	I-130	1.8E-06	2.3E-06	8.77E-07	1.89E-06	2.60E-04	7.49E-07	1.70E-08	1.40E-08	4.30E-06	3.90E-06
82	I-131	3.1E-07	4.9L-07	3.37E-06	1.53E-06	1.06L-03	3.93L-06	3.40E-09	2.60E-09	9.30E-07	6.80E-07
83	I-132	2.0E-06	2.7E-06	1.96E-07	1.67E-07	7.33L-05	2.48E-07	2.00E-08	1.70L-08	5.50E-06	4.40E-06
84	I-133	4.4E-07	6.0L-07	7.02E-07	2.25E-06	4.02L-04	1.43L-06	4.50E-09	3.70L-09	1.50E-06	9.60E-07
85	I-134	2.0E-06	2.9L-06	1.02E-07	2.25L-10	3.73L-05	1.87L-07	1.90E-08	1.60E-08	5.50E-06	4.20E-06
86	I-135	1.5E-06	2.0E-06	4.50E-07	1.41E-06	1.76L-04	5.01L-07	1.40E-08	1.20E-08	4.30E-06	3.30E-06
87	XE-131M	2.0E-09	4.8E-08	0	0	0	0	0	0	5.60E-08	6.20E-09
88	XE-133M	2.7E-08	6.3E-08	0	0	0	0	0	0	1.30E-07	6.00E-08
89	XE-133	2.5E-08	6.9E-08	0	0	0	0	0	0	1.10E-07	5.70E-08
90	XE-135M	3.5E-07	5.3E-07	0	0	0	0	0	0	1.30E-06	7.60E-07
91	XE-135	2.1L-07	4.9L-07	0	0	0	0	0	0	7.90E-07	4.50E-07
92	XE-137	1.2E-07	1.8E-06	0	0	0	0	0	0	2.10E-06	2.70E-07
93	XE-138	1.2E-06	1.7L-06	0	0	0	0	0	0	3.40E-06	2.60E-06
94	CS-134M	7.3E-08	9.1E-08	2.43E-08	1.63E-06	0	2.25L-08	7.30E-10	6.20E-10	1.90E-07	1.60E-07
95	CS-134	1.3E-06	1.7L-06	1.00E-04	2.50E-06	0	5.29E-05	1.40E-08	1.20L-08	3.50E-06	2.90E-06
96	CS-135	2.8E-11	8.6L-09	5.64E-06	3.71E-08	0	1.44L-05	0	0	1.10E-08	6.60E-11
97	CS-136	1.9E-06	2.4L-06	1.81E-05	2.80E-06	0	6.24E-06	1.70E-08	1.50E-08	4.60E-06	4.10E-06
98	CS-137	4.7L-07	7.0L-07	5.60E-05	2.65E-06	0	6.37E-05	4.90E-09	4.20L-09	1.40E-06	1.00E-06
99	CS-138	1.9E-06	3.1E-06	5.49E-08	4.09E-13	0	5.66E-08	2.40E-08	2.10L-08	5.70E-06	4.00E-06
100	CS-139	3.0E-07	2.1L-06	1.97E-08	3.54E-30	0	3.14L-04	7.20E-09	6.30L-09	3.20E-06	1.70E-06
101	BA-139	3.7E-08	8.9L-07	2.80E-07	1.60E-07	0	9.85L-08	2.70E-09	2.40L-09	1.00E-06	7.70E-08
102	BA-140	2.2E-07	4.4E-07	1.33E-06	4.62E-05	0	2.02L-05	2.40E-09	2.10L-09	7.60E-07	4.90E-07

TABLE B

TABLE 8

103	BA-140D	1.9E-06	2.7E-06	3.34E-10	9.32E-05	0	2.53E-09	1.70E-08	1.50E-08	5.30E-06	4.10E-06
104	BA-141	5.2E-07	1.6E-06	1.73E-09	1.40E-17	0	5.18E-08	4.90E-09	4.30E-09	2.40E-06	1.10E-06
105	BA-142	1.0E-06	1.6E-06	1.37E-09	0	0	2.20E-08	9.00E-09	7.90E-09	3.00E-06	2.20E-06
106	LA-140	1.9E-06	2.7E-06	3.34E-10	9.32E-05	0	2.53E-09	1.70E-08	1.50E-08	5.30E-06	4.10E-06
107	LA-141	2.3E-09	9.2E-07	2.03E-11	1.24E-05	0	3.90E-10	2.80E-10	2.50E-10	1.00E-06	5.10E-08
108	LA-142	2.0E-06	3.1E-06	1.44E-11	4.10E-07	0	1.29E-10	1.80E-08	1.50E-08	5.90E-06	4.50E-06
109	CE-141	5.9E-08	1.5E-07	6.88E-10	2.28E-05	0	8.43E-09	6.20E-10	5.50E-10	2.40E-07	1.30E-07
110	CE-143	2.6E-07	6.3E-07	1.33E-10	4.39E-05	0	1.60E-09	2.50E-09	2.20E-09	1.00E-06	5.70E-07
111	CE-144,D	4.0E-08	1.2E-06	1.98E-08	1.09E-04	0	3.27E-07	3.70E-10	3.20E-10	1.40E-06	8.60E-08
112	PR-143	7.5E-10	2.5E-07	4.39E-10	3.80E-05	0	8.90E-09	0	0	2.80E-07	1.60E-09
113	PR-144	2.6E-08	1.2E-06	1.59E-12	4.51E-10	0	5.15E-11	2.30E-10	2.00E-10	1.30E-06	5.60E-08
114	ND-147	1.3E-07	3.1E-07	4.33E-10	3.39E-05	0	5.45E-09	1.20E-09	1.00E-09	5.00E-07	2.80E-07
115	PM-147	3.3E-11	1.2E-08	1.22E-09	7.93E-06	0	2.30E-08	0	0	1.30E-08	7.50E-11
116	PM-149	5.2E-07	1.2E-06	6.11E-10	9.43E-05	0	7.27E-09	5.30E-09	4.60E-09	2.00E-06	1.10E-06
117	PM-149	6.9E-09	3.1E-07	8.64E-11	4.60E-05	0	1.50E-09	2.90E-11	2.50E-11	3.50E-07	1.50E-08
118	PM-151	2.3E-07	5.3E-07	6.96E-11	3.35E-05	0	7.23E-10	2.30E-09	2.20E-09	8.40E-07	5.00E-07
119	SM-153	3.0E-08	2.3E-07	5.98E-11	2.80E-05	0	9.86E-10	3.00E-10	2.70E-10	2.50E-07	6.50E-08
120	EU-155	9.0E-07	1.5E-06	1.69E-09	7.24E-05	0	1.30E-08	8.70E-09	7.60E-09	2.60E-06	2.10E-06
121	W-181	2.5E-10	3.2E-10	3.49E-10	3.68E-07	0	1.01E-08	2.80E-12	2.10E-12	6.80E-10	5.30E-10
122	W-185	1.4E-10	7.2E-08	1.41E-08	1.60E-05	0	4.20E-07	0	0	7.90E-08	3.20E-10
123	W-187	3.3E-07	8.5E-07	3.12E-08	3.61E-05	0	1.11E-07	3.60E-09	3.10E-09	1.20E-06	8.30E-07
124	U-237	1.2E-07	1.6E-07	1.47E-10	1.94E-05	0	5.53E-10	1.30E-09	1.00E-09	3.40E-07	2.60E-07
125	NP-239	3.5E-07	5.7E-07	2.11E-10	3.43E-05	0	4.27E-09	3.20E-09	2.80E-09	1.10E-06	7.70E-07
126	NP-239	1.1E-07	2.1E-07	6.46E-11	2.46E-05	0	1.20E-09	1.10E-09	9.50E-10	3.70E-07	2.40E-07
127	NP-239	6.9E-11	1.7E-09	4.39E-07	7.76E-05	0	1.70E-05	1.80E-11	1.30E-12	4.80E-09	1.50E-10
128	PU-239	5.6E-11	7.8E-10	4.12E-07	6.66E-05	0	1.65E-05	7.70E-12	7.90E-13	1.70E-09	1.20E-10
129	PU-240	8.5E-11	1.7E-09	4.16E-07	6.78E-05	0	1.65E-05	1.80E-11	1.30E-12	4.60E-09	1.40E-10
130	PU-240D	2.8E-11	4.2E-11	4.21E-10	6.78E-07	0	1.49E-08	6.80E-12	4.60E-12	9.50E-11	6.10E-11
131	PU-242	9.1E-11	1.8E-09	3.92E-07	6.53E-05	0	1.57E-05	1.60E-11	1.10E-12	3.80E-09	1.10E-10
132	AM-241	1.8E-08	2.7E-08	1.46E-06	7.42E-05	0	1.83E-05	2.60E-10	1.80E-10	6.10E-08	3.90E-08
133	AM-241D	1.4E-07	2.5E-07	1.41E-06	9.73E-05	0	1.77E-05	1.50E-09	1.30E-09	4.80E-07	3.10E-07
134	CM-242	1.0E-10	2.1E-09	8.20E-07	7.92E-05	0	1.25E-05	2.30E-11	5.50E-12	4.70E-09	3.40E-10
135	CM-244	1.2E-10	1.7E-09	1.51E-06	7.55E-05	0	2.26E-05	1.80E-11	2.90E-12	3.90E-09	2.60E-10
136	CF-252	6.0E-06	7.9E-06	1.16E-06	2.88E-04	0	4.65E-05	7.20E-08	6.60E-08	1.70E-05	1.40E-05

TABLE C

SYSTEM LIST OF CONCENTRATION FACTORS

ISOTOPE	LAMBDA 1/SEC	LAMBDA 1/HOURS	SALT WATER CONCENTRATION FACTORS, LITER/KG				FRESH WATER CONCENTRATION FACTORS, LITER/KG			
			FISH	CRUSTACEA	MOLLUSCS	ALGAE	FISH	CRUSTACEA	MOLLUSCS	ALGAE
1 H-3	1.79E-09	6.45E-06	1	1	1	1	1	1	1	1
2 C-14	3.83E-12	1.38E-08	1	1	1	1	4600	9100	9100	4600
3 NA-13	1.16E-03	4.18E+00	0	0	0	0	0	0	0	0
4 F-18	1.04E-04	3.75E-01	4	4	4	1	10	100	100	2
5 NA-24	3.44E-05	1.24E-01	1	1	1	1	100	200	200	500
6 NA-24	1.28E-05	4.62E-02	1	1	1	1	100	200	200	500
7 P-32	5.61E-07	2.02E-03	100000	10000	10000	1000000	100000	20000	20000	5000000
8 AR-37	8.17E-11	2.94E-07	1	1	1	1	1	1	1	1
9 AR-41	1.05E-04	3.79E-01	1	1	1	1	1	1	1	1
10 SC-46	9.56E-08	3.44E-04	100	100	500	1000	2	1000	1000	10000
11 CR-51	2.69E-07	1.04E-03	100	1000	1000	1000	20	2000	2000	4000
12 MN-54	2.65E-08	9.53E-05	3000	10000	50000	10000	400	20000	20000	10000
13 MN-56	7.47E-05	2.69E-01	3000	10000	50000	10000	400	20000	20000	10000
14 FE-55	8.94E-09	3.22E-05	1000	4000	20000	6000	100	3200	3200	1000
15 FE-59	1.78E-07	6.42E-04	1000	4000	20000	6000	100	3200	3200	1000
16 CO-57	2.97E-08	1.07E-04	100	1000	500	100	50	200	200	200
17 CO-58	1.12E-07	4.05E-04	100	1000	500	100	50	200	200	200
18 CO-60	4.17E-09	1.50E-05	100	1000	500	100	50	200	200	200
19 NI-63	2.39E-10	8.60E-07	500	100	100	100	100	100	100	50
20 NI-65	7.53E-05	2.71E-01	100	100	100	100	100	100	100	50
21 CU-64	1.51E-05	5.44E-02	1000	5000	5000	1000	50	400	400	2000
22 ZN-65	3.28E-08	1.18E-04	5000	5000	50000	1000	2000	16000	16000	20000
23 ZN-69M	1.39E-05	5.02E-02	5000	5000	50000	1000	2000	16000	16000	20000
24 ZN-69	2.02E-04	7.29E-01	5000	5000	50000	1000	2000	16000	16000	20000
25 GE-68	5.44E-06	1.96E-02	3	10	10	100	420	330	330	50
26 GE-68+D	8.03E-05	2.89E-01	3	10	10	100	420	330	330	50
27 GE-69	3.64E-04	1.31E+00	3	10	10	100	420	330	330	50
28 GE-68	3.80E-05	1.37E-01	3	10	10	100	420	330	330	50
29 AS-73	1.34E-08	4.83E-05	1	1	1	1	1	1	1	1
30 AS-74	4.39E-05	1.58E-01	1	1	1	1	1	1	1	1
31 AS-76	2.34E-07	7.55E-04	1	1	1	1	1	1	1	1
32 AS-77	1.32E-05	5.47E-02	1	1	1	1	1	1	1	1
33 AS-78	8.89E-05	3.20E-01	1	1	1	1	1	1	1	1
34 SE-75	4.31E-07	1.55E-03	50	50	10	10	2000	1000	1000	1000
35 SE-79	6.42E-09	2.31E-05	50	50	10	10	2000	1000	1000	1000
36 BR-80	7.50E-04	2.70E+00	50	50	10	10	2000	1000	1000	1000
37 BR-82	1.54E-07	5.55E-04	1	1	1	20	50	100	100	500
38 BR-83	7.70E-10	2.77E-06	1	1	1	20	50	100	100	500
39 BR-84	7.73E-10	2.78E-06	1	1	1	20	50	100	100	500
40 BR-84	1.99E-05	7.17E-02	1	1	1	20	50	100	100	500
41 BR-82	7.11E-05	2.56E-01	1	1	1	20	50	100	100	500
42 Y-90	3.08E-06	1.11E-02	50	100	100	300	25	1000	1000	5000
43 Y-91M	2.31E-04	8.32E-01	50	100	100	300	25	1000	1000	5000
44 Y-91	1.30E-07	4.68E-04	50	100	100	300	25	1000	1000	5000
45 Y-92	5.44E-05	1.96E-01	50	100	100	300	25	1000	1000	5000
46 Y-93	1.60E-05	5.76E-02	50	100	100	300	25	1000	1000	5000
47 ZR-95	1.23E-07	4.44E-04	50	100	100	1000	330	7	7	1000

TABLE C

48	ZR-95b	1.23E-07	4.44E-04	30	100	100	1000	330	7	7	1000
49	ZR-97	1.13E-05	4.08E-02	30	100	100	1000	330	7	7	1000
50	ZR-97	1.13E-05	4.08E-02	30	100	100	1000	330	7	7	1000
51	NB-95	2.29E-07	1.25E-04	100	200	200	100	30000	100	100	800
52	NB-97	1.61E-04	5.78E-01	100	200	200	100	30000	100	100	800
53	MO-99+D	2.60E-06	1.03E-02	10	100	100	100	10	10	10	1000
54	MO-99	2.60E-06	1.03E-02	10	100	100	100	10	10	10	1000
55	TC-99	3.22E-05	1.16E-01	10	100	100	1000	15	5	5	40
56	TC-99	1.09E-13	3.73E-10	10	100	100	1000	15	5	5	40
57	TC-101	8.25E-09	2.97E-06	10	100	100	1000	15	5	5	40
58	RU-103	2.02E-07	7.29E-04	3	100	100	1000	10	300	300	2000
59	RU-105	4.53E-05	1.56E-01	3	100	100	1000	10	300	300	2000
60	RU-106	2.19E-03	7.47E-00	3	100	100	1000	10	300	300	2000
61	RH-105	5.16E-06	1.93E-02	10	100	100	100	10	300	300	200
62	RH-105M	1.45E-05	5.19E-02	10	100	100	100	10	300	300	200
63	AG-110M	3.17E-08	1.14E-04	1000	5000	5000	1000	2	770	770	200
64	AG-111	1.37E-06	5.05E-03	1000	5000	5000	1000	2	770	770	200
65	CD-115	8.53E-07	3.07E-03	3	3	3	10	3000	1000	1000	100
66	SN-123	1.39E-07	4.81E-04	1000	1000	1000	10000	1	10	10	1500
67	SN-125	4.19E-09	2.93E-05	1000	1000	1000	10000	1	10	10	1500
68	SB-127	2.37E-06	7.48E-03	1000	1000	1000	10000	1	10	10	1500
69	TE-125M	1.38E-07	4.36E-04	10	10	100	1000	400	75	75	100
70	TE-127M	7.36E-06	2.65E-02	10	10	100	1000	400	75	75	100
71	TE-127	2.05E-05	7.37E-02	10	10	100	1000	400	75	75	100
72	TE-129M	2.36E-07	1.49E-04	10	10	100	1000	400	75	75	100
73	TE-129	1.00E-04	6.05E-01	10	10	100	1000	400	75	75	100
74	TE-131M	6.42E-06	2.31E-02	10	10	100	1000	400	75	75	100
75	TE-131	4.01E-04	1.66E+00	10	10	100	1000	400	75	75	100
76	TE-132	2.47E-06	8.89E-03	10	10	100	1000	400	75	75	100
77	I-129	2.47E-08	8.89E-05	10	10	100	1000	400	75	75	100
78	I-131M+D	2.31E-04	8.32E-01	10	10	100	1000	400	75	75	100
79	I-131	2.75E-04	9.89E-01	10	10	100	1000	400	75	75	100
80	I-132	1.29E-05	4.65E-02	20	100	100	10000	15	5	5	40
81	I-133	1.55E-05	5.59E-02	20	100	100	10000	15	5	5	40
82	I-134	9.17E-07	3.30E-03	20	100	100	10000	15	5	5	40
83	I-135	8.30E-06	2.99E-02	20	100	100	10000	15	5	5	40
84	I-136	9.17E-08	3.30E-04	20	100	100	10000	15	5	5	40
85	I-138	2.82E-05	1.01E-01	20	100	100	10000	15	5	5	40
86	I-139	2.06E-05	1.03E-01	20	100	100	10000	15	5	5	40
87	XE-131M	6.41E-07	2.49E-03	1	1	1	1	1	1	1	1
88	XE-133M	5.50E-06	1.98E-02	1	1	1	1	1	1	1	1
89	XE-133	1.52E-06	5.48E-03	1	1	1	1	1	1	1	1
90	XE-135M	7.42E-09	1.67E+00	1	1	1	1	1	1	1	1
91	XE-135	2.09E-06	7.54E-03	1	1	1	1	1	1	1	1
92	XE-137	2.07E-03	1.67E+01	1	1	1	1	1	1	1	1
93	XE-138	6.11E-06	2.48E+00	1	1	1	1	1	1	1	1
94	CS-134M	8.69E-05	3.13E-01	50	50	10	10	2000	100	100	500
95	CS-134	1.87E-06	6.73E-03	50	50	10	10	2000	100	100	500
96	CS-135	7.13E-09	2.57E-05	50	50	10	10	2000	100	100	500
97	CS-136	9.17E-07	3.30E-03	50	50	10	10	2000	100	100	500
98	CS-137	7.31E-10	2.63E-06	50	50	10	10	2000	100	100	500
99	CS-138	3.59E-04	1.29E+00	50	50	10	10	2000	100	100	500
100	CS-139	1.22E-03	4.38E+00	50	50	10	10	2000	100	100	500
101	BA-139	1.19E-04	5.62E-01	3	3	3	100	4	200	200	500
102	BA-140	8.28E-07	2.98E-03	3	3	3	100	4	200	200	500

TABLE C

103	BA-140D	6.28E-07	2.26E-03	3	3	3	100	4	200	200	500
104	BA-141	6.42E-04	2.31E+00	3	3	3	100	4	200	200	500
105	BA-142	1.05E-03	3.78E+00	3	3	3	100	4	200	200	500
106	LA-140	4.78E-06	1.72E-02	30	100	100	300	25	1000	1000	5000
107	LA-141	4.94E-05	1.78E-01	30	100	100	300	25	1000	1000	5000
108	LA-142	1.26E-04	4.52E-01	30	100	100	300	25	1000	1000	5000
109	CE-141	2.43E-07	8.75E-04	30	100	100	300	1	1000	1000	4000
110	CE-143	5.81E-06	2.09E-02	30	100	100	300	1	1000	1000	4000
111	CE-144	2.83E-08	1.02E-04	30	100	100	300	1	1000	1000	4000
112	PR-143	5.89E-07	2.12E-03	100	1000	1000	1000	25	1000	1000	5000
113	PR-144	6.09E-04	2.41E+00	100	1000	1000	1000	25	1000	1000	5000
114	ND-147	7.22E-07	2.60E-03	100	1000	1000	1000	25	1000	1000	5000
115	PM-147	8.39E-09	3.02E-05	100	1000	1000	1000	25	1000	1000	5000
116	PM-148	1.49E-06	5.35E-03	100	1000	1000	1000	25	1000	1000	5000
117	PM-149	3.64E-06	1.31E-02	100	1000	1000	1000	25	1000	1000	5000
118	PM-151	6.86E-06	2.47E-02	100	1000	1000	1000	25	1000	1000	5000
119	SM-153	4.08E-06	1.47E-02	100	1000	1000	1000	25	1000	1000	5000
120	EU-156	5.36E-07	1.93E-03	100	1000	1000	1000	25	1000	1000	5000
121	W-181	5.72E-08	2.06E-04	10	10	100	100	1200	10	10	1200
122	W-185	1.07E-07	3.85E-04	10	10	100	100	1200	10	10	1200
123	W-187	8.06E-06	2.90E-02	10	10	100	100	1200	10	10	1200
124	U-237	1.19E-06	4.28E-03	10	10	10	67	2	60	60	1
125	NP-238	3.63E-06	1.30E-02	10	10	10	6	10	400	400	300
126	NP-239	3.42E-06	1.23E-02	10	10	10	6	10	400	400	300
127	PU-238	2.50E-10	9.23E-07	3	200	200	1000	4	100	100	350
128	PU-239	9.03E-13	3.25E-09	3	200	200	1000	4	100	100	350
129	PU-240	3.33E-12	1.20E-08	3	200	200	1000	4	100	100	350
130	PU-241D	1.66E-09	5.99E-06	3	200	200	1000	4	100	100	350
131	PU-242	5.61E-14	2.09E-10	3	200	200	1000	4	100	100	350
132	AM-241	4.81E-13	1.73E-09	25	1000	1000	5000	25	1000	1000	5000
133	AM-243D	2.77E-12	9.96E-09	25	1000	1000	5000	25	1000	1000	5000
134	CM-242	4.92E-08	1.77E-04	25	1000	1000	5000	25	1000	1000	5000
135	CM-244	1.25E-09	4.50E-06	25	1000	1000	5000	25	1000	1000	5000
136	CF-252	8.31E-09	2.99E-05	25	1000	1000	5000	25	1000	1000	5000

TABLE D

FACTORS FOR CONVERTING AIR CONCENTRATIONS OF RADIOIODINES TO THYROID DOSE VIA THE MILK PATHWAY*
(AEC PARAMETERS)

(mrem/yr per pCi/m^3)

Age	I-129**	I-130	I-131	I-132	I-133	I-134	I-135
1 yr	26,700	70.2	3560##	2.35	151.0	0.468	16.7
4 yr	10,700	19.8	1470	1.010	61.8	0.202	7.12
14 yr	3,580	7.29	508	0.363	21.2	0.0726	2.54
Adult	2,680	5.67	396	0.280	16.0	0.0561	1.96

*(1) Assuming grazing 365 days/yr.
(2) Consumption of 1 liter/day of milk.
(3) No decay between milking and consumption.
(4) No other radioiodine intake by cow or person. Factors for other grazing seasons can be obtained by multiplying tabulated values by fraction of year during which cows graze.
(5) All radioiodine is inorganic. If only Z% of radioiodine is in an inorganic form, then multiply DF's by (Z/100).

** Ignoring long-term accumulation in soil (which adds~1.4% in 1 yr or 42% in 30 years).

Thus an air concentration of 0.14 pCi/m^3 (1.4×10^{-13} uCi/cc) leads to a thyroid dose of 500 mrem/yr (0.14 x 3560).

Alarm Location	CONTROL ROOM
Monitor Description	Inline RadioGas Detector CONDENSER EVACUATION SYSTEM
Location	S.J.A.E. VENT
Power Source	120 VAC, DIST. CABINET CCRP-2, CIRC-20. CHECK SOURCE, ASSEMBLY SUPPLIED FROM CCRP-2, CIRC. 22. (For each unit)
Scale	5 DECADE
Range	5E10-6 - 1E-2 μCi/cc
Identification Number	SRA-401
Effluent Isolation Control Device	NONE
Location of Device	--
Power Source	N/A
Identification Number	--
Setpoint Type	FIXED
Equation to Determine Setpoint	B-1
Administrative Control	N/A
Calibration	PLANT PROCEDURE 12 THP 6010. RAD. 594
Surveillance	THP 4030 STP 063

Alarm Location	CONTROL ROOM
Monitor Description	LIQUID RADWASTE EFFLUENT LINE Inline Liquid Sample detector
Location	STN. LIQUID WASTE
Power Source	120 VAC, DIST. CABINET CCRP-2, CIRC-20. CHECK SOURCE, ASSEMBLY SUPPLIED FROM CCRP-2 CIRC. 22.
Scale	5 DECADES
Range	2E-4 - 2E-1. uCi/cc
Identification Number	RRC-285
Effluent Isolation Control Device	Discharge Valve RRV - 285 closes. Trips Waste Evaporator Condensate Tank Pumps.
Location of Device	LIQUID WASTE DISCHARGE LINE
Power Source	N/A
Identification Number	RRV-285
Setpoint Type	VARIABLE
Equation to Determine Setpoint	A-1
Administrative Control	PLANT PROCEDURE 12 THP 6010. RAD. 332
Calibration	PLANT PROCEDURE 12 THP 6010. RAD. 592
Surveillance	THP 4030 STP 066.

Alarm Location	CONTROL ROOM
Monitor Description	STEAM GENERATOR BLOWDOWN EFFLUENT LINE Inline liquid sample detector
Location	ESW - EFFLUENT LINE
Power Source	120 VAC, DIST. CABINET CCRP-2, CIRC-20. CHECK SOURCE, ASSEMBLY SUPPLIED FROM CCRP-2, CIRC. 22. (For each unit)
Scale	5 DECADES
Range	2E-5 - 2E-1 uCi/cc
Identification Number	DRA-300
Effluent Isolation Control Device	BLDN ISOLATION DCR-310, DCR-320, DCR-330, DRV-350, DCR-340 S.G. Bldn Sample Iso. Val DCR-301, 302, 303, 304
Location of Device	S.G. BLDN EFFLUENT LINE
Power Source	NA
Identification Number	
Setpoint Type	FIXED
Equation to Determine Setpoint	A-1
Administrative Control	
Calibration	PLANT PROCEDURE 12 THP 6010. RAD. 592
Surveillance	THP 4030 STP 067

Alarm Location	CONTROL ROOM
Monitor Description	SERVICE WATER SYSTEM EFFLUENT LINE (ESSENTIAL SERVICE WATER) Tee Inline Liquid Sample Detector
Location	ESW - EFFLUENT LINE
Power Source	120 VAC, DIST. CABINET CCRP. 2, CIRC-20. CHECK SOURCE, ASSEMBLY SUPPLIED FROM CCRP-2, CIRC. 22. (For each unit)
Scale	5 DECADES
Range	3E-5 - 2E-1 uCi/cc
Identification Number	WRA-714 , WRA - 713
Effluent Isolation Control Device	NONE
Location of Device	--
Power Source	N/A
Identification Number	--
Setpoint Type	FIXED
Equation to Determine Setpoint	A-1
Administrative Control	
Calibration	PLANT PROCEDURE 12 THP 6010. RAD. 592
Surveillance	THP 4030 STP 068

Alarm Location	CONTROL ROOM
Monitor Description	STEAM GENERATOR BLOWDOWN TREATMENT EFFLUENT LINE Inline Liquid Sample Detector
Location	SG BLDN TREATMENT EFFLUENT LINE
Power Source	120 VAC, DIST. CABINET. CCRP-2, CIRC-20. CHECK SOURCE ASSEMBLY SUPPLIED FROM CCRP-2, CIRC-22. (For each unit)
Scale	5 DECADES
Range	4E-6 - 1E-1 uCi/cc
Identification Number	DRA-353
Effluent Isolation Control Device	BLDN ISOLATION DCR-310, DCR-320, DCR-330, DCR-340, DRV-350 S.G. BLDN SAMPLES Iso. Valve DCR-301, 302, 303, 304
Location of Device	
Power Source	PNEUMATIC
Identification Number	
Setpoint Type	FIXED
Equation to Determine Setpoint	A-1
Administrative Control	
Calibration	PLANT PROCEDURE 12 THP 6010. RAD. 592
Surveillance	THP 4030 STP 071

Alarm Location	CONTROL ROOM
Monitor Description	AIR PARTICULATE DETECTOR
Location	UNIT VENT
Power Source	120 VAC, DIST. CABINET CCRP-2, CIRC-20. PUMP 1.5 HP IS FED FROM 600 V AUX BUS 21D, MCC-2AM-D (ESS). PUMP CONTROL IS OFF 120 VAC DIST. CABINET CCRP-2 Circ-22 (Unit 2) 600v Aux Bus 11D, MCC-1AM-D(ESS), Pump Control is off 120VAC Dist. Cab CCRP-2, CRC-22 (Unit 1)
Scale	5 DECADES
Range	8E-11-6E-7 uCi/cc
Identification Number	VRA-314
Effluent Isolation Control Device	NONE
Location of Device	--
Power Source	N/A
Identification Number	--
Setpoint Type	FIXED
Equation to Determine Setpoint	B-2
Administrative Control	NA
Calibration	PLANT PROCEDURE 12THP 6010. RAD. 597
Surveillance	THP 4030 STP 072

Alarm Location	CONTROL ROOM
Monitor Description	RADIOGAS SAMPLE DETECTOR
Location	UNIT VENT
Power Source	120 VAC, DIST. CABINET CCRP 2, CIRC-20 CHECK SOURCE, ASSEMBLY SUPPLIED FROM CCRP-2, CIRC. 22. (For each unit)
Scale	5 DECADE.
Range	1E-4 - 3E-2 uCi/cc
Identification Number	VRC-315
Effluent Isolation Control Device	ONLY INDICATION AT WASTE GAS DISPOSAL TANK DISCHARGE VALVE
Location of Device	GAS DECAY TANK DISCHARGE
Power Source	N/A
Identification Number	RRV-306
Setpoint Type	FIXED
Equation to Determine Setpoint	B-1
Administrative Control	NA
Calibration	PLANT PROCEDURE 12 THP 6010. RAD. 594
Surveillance	THP 4030 STP 073

Alarm Location	CONTROL ROOM
Monitor Description	SERVICE WATER SYSTEM EFFLUENT LINE (ESSENTIAL SERVICE WATER) Tee Inline Liquid Sample Detector
Location	ESW LINE
Power Source	120 VAC, DIST. CABINET CCRP 2, CIRC-20 CHECK SOURCE ASSEMBLY SUPPLIED FROM CCRP-2, CIRC-22 (For each unit)
Scale	5 DECADES
Range	1E-5- 2E-1 uCi/cc
Identification Number	WRA-718 WRA - 717
Effluent Isolation Control Device	NONE
Location of Device	--
Power Source	N/A
Identification Number	
Setpoint Type	FIXED
Equation to Determine Setpoint	A-1
Administrative Control	NA
Calibration	.Plant Procedure - 12 THP 6010 RAD .592
Surveillance	THP 4030 STP 075

Alarm Location	Control Room
Monitor Description	RADIOGAS DETECTOR.
Location	GLAND SEAL EXHAUST
Power Source	120 VAC, DIST. CABINET CCRP-2, CIRC-20 CHECK SOURCE ASSEMBLY SUPPLIED FROM CCRP-2, CIRC-22 (For each unit)
Scale	5 DECADES
Range	1E-6 - 3E-2 uCi/cc
Identification Number	SRA-201
Effluent Isolation Control Device	NONE
Location of Device	--
Power Source	N/A
Identification Number	
Setpoint Type	FIXED
Equation to Determine Setpoint	B-1
Administrative Control	NA
Calibration	PLANT PROCEDURE 12 THP 6010. RAD. 590
Surveillance	THP 4030 STP 062

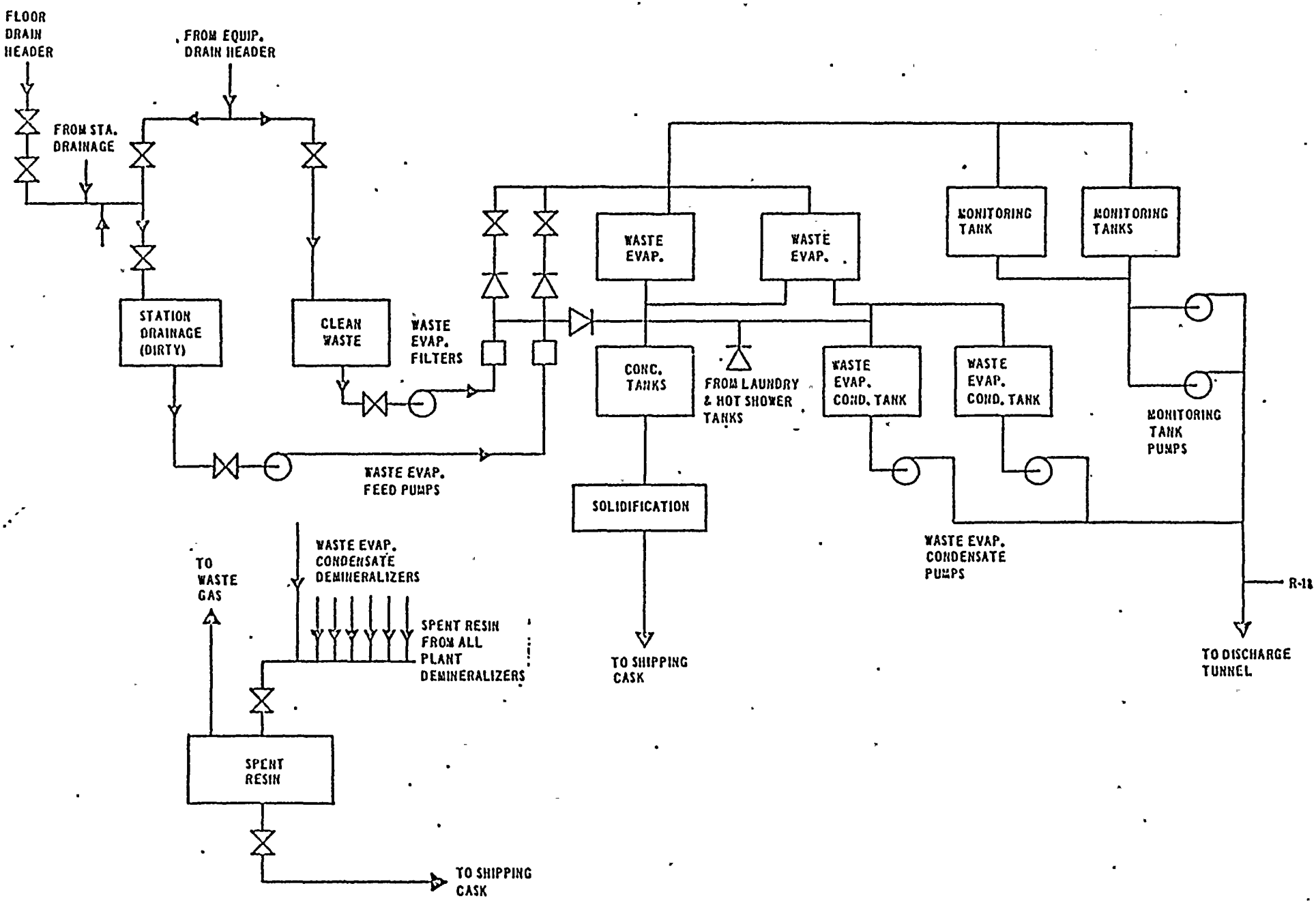
FLOOR DRAIN HEADER
FROM EQUIP. DRAIN HEADER
FROM STA. DRAINAGE
STATION DRAINAGE (DIRTY)
CLEAN WASTE
WASTE EVAP. FILTERS
WASTE EVAP. FEED PUMPS
WASTE EVAP.
WASTE EVAP.
CONC. TANKS
FROM LAUNDRY & HOT SHOWER TANKS
SOLIDIFICATION
TO SHIPPING CASK
MONITORING TANK
MONITORING TANKS
WASTE EVAP. COND. TANK
WASTE EVAP. COND. TANK
MONITORING TANK PUMPS
WASTE EVAP. CONDENSATE PUMPS
R-18
TO DISCHARGE TUNNEL
TO WASTE GAS
WASTE EVAP. CONDENSATE DEMINERALIZERS
SPENT RESIN FROM ALL PLANT DEMINERALIZERS
SPENT RESIN
TO SHIPPING CASK

Figure 1

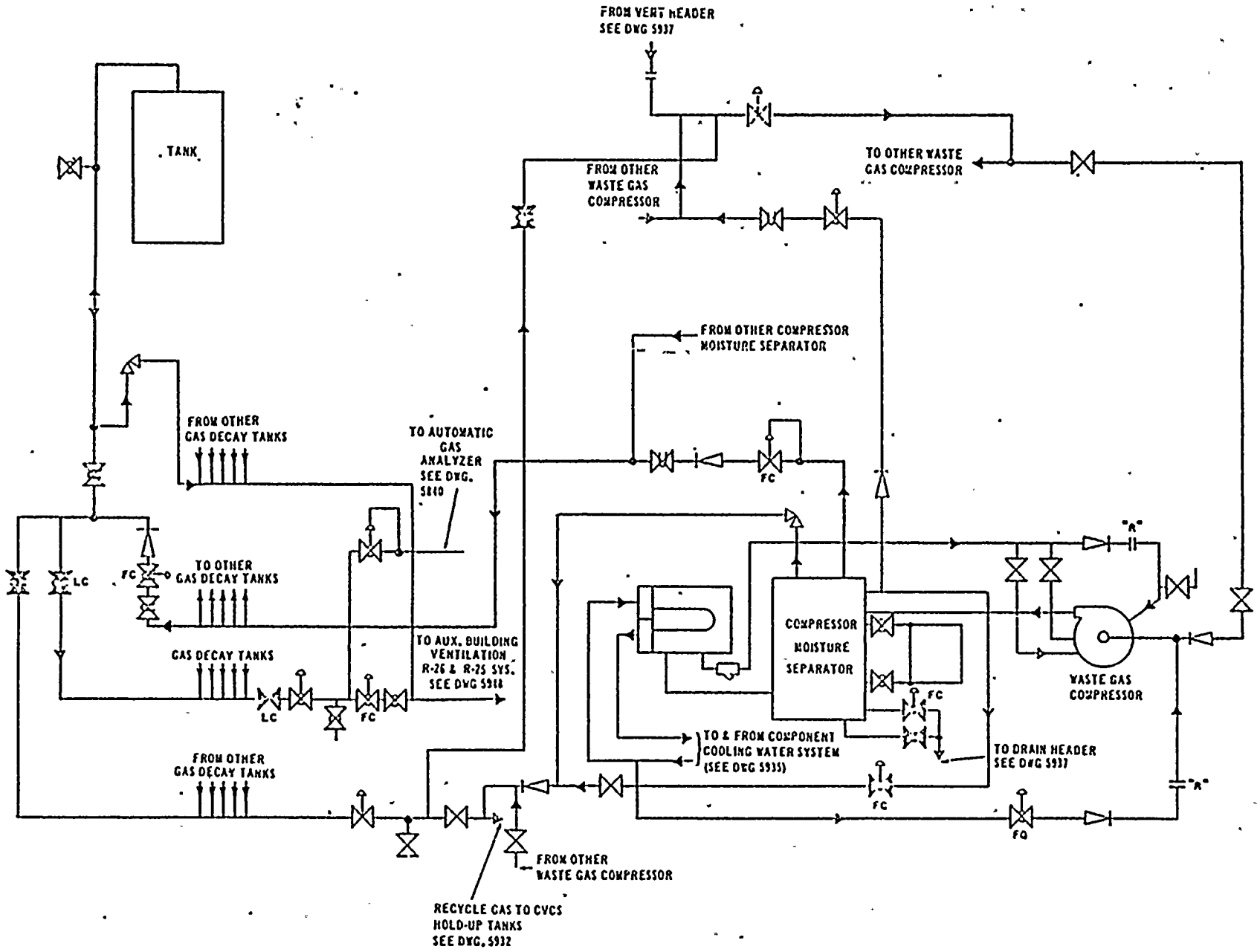
FROM VENT HEADER
SEE DWG 5937
TANK
FROM OTHER
WASTE GAS
COMPRESSOR
TO OTHER WASTE
GAS COMPRESSOR
FROM OTHER COMPRESSOR
MOISTURE SEPARATOR
FROM OTHER
GAS DECAY TANKS
TO AUTOMATIC
GAS
ANALYZER
SEE DWG.
5840
FC
LC
TO OTHER
GAS DECAY TANKS
GAS DECAY TANKS
TO AUX. BUILDING
VENTILATION
R-26 & R-25 SYS.
SEE DWG 5918
COMPRESSOR
MOISTURE
SEPARATOR
WASTE GAS
COMPRESSOR
TO & FROM COMPONENT
COOLING WATER SYSTEM
(SEE DWG 5935)
TO DRAIN HEADER
SEE DWG 5937
FROM OTHER
GAS DECAY TANKS
FROM OTHER
WASTE GAS COMPRESSOR
RECYCLE GAS TO CVCS
HOLD-UP TANKS
SEE DWG. 5932

Figure 2

DPR Nos. 58 and 74

Attachment II .

Requested Changes to the
Environmental Technical Specifications (Appendix B)
for the Donald C. Cook Nuclear Plant Units 1 and 2

Note: A vertical black line in the right-hand margin indicates the location of a proposed change.

Addendum A

Discussion of Requested Changes to the Environmental Technical Specifications (Appendix B) for the Donald C. Cook Nuclear Plant Units 1 and 2

1. On page 4.1-7, modification to Technical Specification 4.1.1.3 "Erosion" is requested. The Company believes that if no detrimental erosional and depositional processes affecting the stability of beaches in the vicinity of the site have been observed by March 30, 1980, then the erosion monitoring program should be abandoned. Two winters of two-unit operation will provide enough data to adequately assess the effects of the Plant's circulating water discharge, riprap scour bed, and stationary shore pilings.

   The existing paragraph dealing with requests for termination (Specification 4.1.1.3) which begins, "This program shall be continued . . . " is proposed to read as follows:

   > This program shall be continued until March 30, 1980. If at that time no detrimental erosional or depositional processes affecting the stability of beaches in the vicinity have been observed, then the erosion monitoring program will be terminated. Erosion and winter shore-ice studies through April 1979 will be reported to the Regulatory staff in the 1979 Annual Operating Report and will constitute the Company's basis for terminating the erosion studies after March 1980.

2. On page 4.1-16, revision is requested to Technical Specification 4.1.1.7.3 under the heading of "Monitoring Requirements" and to Specification 4.1.1.7.4 under the heading of "Basis". The sentences referring to the sampling of the turbine building sump during ten regenerations of the makeup water system demineralizer should be deleted and replaced by a statement that the requirement of the plant NPDES permit will be followed. Ten regenerations during initial Unit 1 and 2 operation have already taken place.

   Also, on page 4.1-16 under Technical Specification 4.1.1.7.4 "Basis", the reference to sump water analysis during initial operation can now be deleted. Initial operation of the sump has already taken place.

3. On page 4.1-19, under the heading of "General Ecological Survey", the Company requests that the paragraph which states that the program will be continued for a minimum of three years after Unit 2 is licensed to operate be rewritten to state that all general ecological surveys will terminate January 1, 1981. It is the Company's and University of Michigan's (The Great Lakes Research Division) opinion that three years of two-unit operation is adequate to determine plant influence upon the studied biological systems.

As proposed, the fourth paragraph on page 4.1-19 would be replaced by the following:

> All general ecological surveys will terminate on January 1, 1981.

4. On page 4.1-26, under the heading of "Periphyton", deletion of the paragraph which begins "Monthly samples of entrained phytoplankton . . ." is requested. Periphyton monitoring during April through October by diver observation and wet sampling is adequate to determine which periphytic species exist in the Plant area.

5. On page 4.1-29, under the heading of "Fish Larvae", a change is requested to require larvae tows only during the night. University of Michigan experience (The Great Lakes Research Division) shows that more larvae are caught at night when the organisms do not see the nets, and for this reason that the Company is requesting deletion of the day sampling requirement. Under the existing Specification, fish larvae samples from ten stations are collected during the day and night.

   In addition, the Company requests that fish larvae collection stations E and W, which are the 21.3-M sampling stations, be omitted except during the months of April and May. Fish larvaes seldom are collected at these Stations, and April and May are months when burbot, four horned sculpin, and bloater may be present.

   See Attachment II for the requested language changes.

6. On page 4.1-31, under the heading of "Impingement Studies of Fish", a change in reporting requirements is requested. The Company proposes to continue impingement sampling of fish until January 1981 but requests that the reporting requirements be deleted. The existing Specification requires monthly reporting of fish impingement until one year after Units 1 and 2 begin operation. The one year of two-unit operation requirement will be satisfied by July 1, 1979; very near the time all necessary approvals can be obtained.

7. On page 4.1-32, under the heading of "Fish Entrainment and Entrainable Benthos", the Company requests that, beginning January 1, 1980, fish entrainment samples be collected twice per month during April, May, and September, weekly during the months of June, July, and August, and once per month for the remaining months. The present Specification requires that samples shall be collected twice monthly for each eight-hour segment during a 24-hour period except June, July, and August when such samples shall be collected weekly. Weekly sampling shall continue through the first year of Unit 2 operation. The Company feels weekly sampling during June, July, and August are necessary for making accurate estimates of entrained fish, fish eggs, and fish larvae. Past experience has shown entrainment rates during April, May, and September are much lower than June, July, and August, and that samples collected every two weeks are sufficient to make accurate estimates of total entrainment. During the months October through March fish eggs and larvae are rarely collected.

The existing Specification language speaks of testing to determine existence or nonexistence of vertical stratification in the intake and discharge forebays. This testing has been performed on Unit 1 and will be performed on Unit 2 during 1979. Since this Specification will be satisfied very near the time all necessary approvals for deletion can be obtained, the Company now requests that mention of vertical stratification determination be deleted. Please refer to Attachment II for the requested deletion locations.

Also on page 4.1-32, the Company requests that entrainable benthos be collected once per month during the year. The existing Specification calls for entrainable benthos sampling to be conducted during all months of the year except June, July, and August when samples are to be collected twice monthly for each eight-hour segment during a 24-hour period. University of Michigan experience has shown that the present, more intensive sampling is not justified. Benthos are entrained at a very low rate in comparison to the estimated populations near the Cook Nuclear Plant; therefore, a very precise estimate of the numbers entrained is unwarranted and unjustifiable.

8. On page 4.1-33, under the heading of "Zooplankton Entrainment", the Company requests that language dealing with preliminary experiments to determine whether horizontal or vertical stratification exists be deleted. These preliminary studies have already been performed, and a representative sampling position and sampling procedure has been developed.

   It is requested that beginning on January 1, 1980, zooplankton samples be collected once per month only from the intake forebay. Under the present Specification, zooplankton samples are collected once per month from both the intake and discharge. The University of Michigan's experience (The Great Lakes Research Division) has shown that samples collected from the intake and discharge forebays contain similar zooplankton densities, and it is unnecessary to sample both locations.

   Also under the heading of "Zooplankton Entrainment", the Company requests that live/dead studies be discontinued beginning January 1, 1980. The Great Lakes Research Division of the University of Michigan will have by that time gathered enough live/dead zooplankton data to adequately assess the plant's impact on zooplankton. Please refer to Attachment II for the requested language changes.

9. On pages 4.1-33 and 4.1-34, under the heading of "Phytoplankton Entrainment", the Company requests that discharge forebay phytoplankton sampling be deleted. Experience has shown the sampling can be reduced from intake and discharge bay at three times during one 24-hour period (monthly) to intake forebay once per 24-hour period (monthly). As stated in the existing Specification, sampling intensity is dependent on the presence of a diurnal pattern. Since no diurnal pattern has been observed, a less intensive sampling program is proposed.

The existing Specification calls for chlorophyll a and phaeo-pigment analysis for each sample. The Company feels that it now has adequate chlorophyll a and phaeo-pigment data to assess viability. The long- and short-term effects of condenser passage on phytoplankton have been adequately studied, and the Company requests that this requirement, along with the discharge forebay sampling requirements, be deleted.

In addition, the Company proposes adding a requirement to perform monthly nutrient analyses of Lake Michigan water. Samples taken until December 21, 1980, would be analyzed for orthophosphate, dissolved silica and nitrates/nitrites. Nutrient analysis of the water has been added to the monitoring program at the Cook Nuclear Plant to aid in the interpretation of phytoplankton data. Please refer to Attachment II for the proposed new language.

10. On pages 4.1-34 and 4.1-35, under the heading of "Visual Observation of the Intake and Discharge Structure Areas" a change, to become effective January 1, 1980, is requested to allow a minimum of one observation dive per month rather than five dives per month, weather permitting, April-October. As proposed, observations of the physical and ecological conditions will be made and reported for the spring, summer, and fall. Observation of discharge scour is proposed on a once-per-year basis during the refueling shutdown of each unit. The existing Specification language calls for five dives per month with monthly observation of the discharge areas.

    This reduced effort is warranted bases on the Company's and University of Michigan's experience with the more intensive observation schedule. Please refer to Attachment II for the proposed language changes.

11. On pages 4.1-36 and 4.1-37, under the heading of "Land Management", the Company requests that this Specification be deleted. ROW maintenance for Indiana & Michigan Power Company and for Indiana & Michigan Electric Company is handled by the General Office in Fort Wayne, Indiana. Objectives of the existing Specification are already satisfied by other federal and state regulations, e.g., U.S. EPA and the State of Michigan.

Addendum B

4.1.1.3 Erosion

Objective

A beach erosion monitoring program is to be conducted to determine the effects of the Plant's circulating water discharge, rip rap scour bed, and stationary shore pilings on the erosional and depositional processes affecting the stability of beaches in the vicinity of the site.

Specification

Visual and photographic observations are to be made each winter of the behavior of the ice masses and the attached ice barriers along the beach at the Plant site with particular regard to the possible effects of the discharge of circulating water from the Plant on these floating or attached ice barriers.

Profiles of the lake bottom by sounding and the aerial survey of the shoreline have been completed.

This program shall be continued until March 30, 1980. If at that time no detrimental erosional or depositional processes affecting the stability of beaches in the vicinity have been observed, then the erosion monitoring program will be terminated. Erosion and winter Shore-ice studies through April 1979 will be reported to the Regulatory Staff in the 1979 Annual Operating Report and will constitute the Company's basis for terminating the erosion studies after March 1980.

Reporting Requirements

As specified in Section 5.4. Results of all monitoring and special studies shall be reported, or reference given to separate published or docketed reports, in the annual Operating Report.

4.1.1.7.3 Monitoring Requirements

During operation, samples of a steam generator's blowdown liquid shall be analyzed for boron a minimum of four times a week whenever primary-to-secondary leakage occurs in that steam generator.

Samples of processed wastes from the radiological waste disposal system shall be analyzed for boron whenever these wastes are discharged to the lake.

During normal plant operation, the pH of the sump discharge shall be determined and composite samples taken and analyzed for sodium, calcium, magnesium, sulfate, chloride and total solids once a week.

Samples of the sump discharge will be collected and analyzed whenever any chemicals, other than spent regenerants, are drained to the sump.

4.1.1.7.4 Basis

The only discharges to the lake containing chemicals used in the plant are the steam generator blowdown liquid and the liquid from the radiological waste processing system.

Spent regenerant solutions are drained to the turbine room sump where they are diluted prior to pumping to the onsite absorption field. In addition, other waste water consisting of condensate and service water is drained to this sump.

The monitoring of the pH at the stated intervals will assure that sump discharge remains near the neutral pH point and that local ground water pH will not be strongly affected. The environs monitoring program (Section 4) will determine the effect of onsite absorption field discharges on local groundwater quality.

The analysis of the sump water samples subsequent to initial operation has provided guidelines for diluting sump water, as necessary, to reduce the concentration of spent regenerants.

There may be several occasions during the life of the plant when spent chemical cleaning solutions will be discharged to the absorption field.

Sampling frequency for each phase of the monitoring program is contingent on weather and seasonal conditions.

Techniques and schedules used to study each biological group differ, so that separate discussion is given to each of the groups. As mentioned previously, the relative intensity of effort given to the general ecological survey will vary but at no time will individual efforts on specific biological systems be curtailed below levels necessary for valid statistical data analysis. The statistical significance of any observed changes in natural populations will be tested using the analysis of variance. A discussion of the statistical procedure to be used in the data analysis and evaluation of Plant effects is given in Part XVIII of the Benton Harbor Power Plant Limnological report series. Further specification of statistical methodology is presented in Section 4.1.2.4.

A schedule of months and station designations used for the General Ecological survey are given in Table 4.1.2-1, with differentiations made when necessary, between intensity of effort given in 1973, years during which entrainment and impingement studies are running concurrently, and years when no entrainment and impingement studies are scheduled. Station designations are further explained in Table 4.1.2-2. The total number of field samples for each year (1973-1978) for four categories, are shown in Table 4.1.2-3.

All general ecological surveys will terminate on January 1, 1981.

The general ecological survey at the Cook Plant is broad in scope and covers the range from algae to fish. Changes in the aquatic ecosystem may be measured by alterations in species composition, density, or species diversity. While different techniques are used for each study group to detect such changes, most techniques have certain common features, including:

1. Long-Term Study - the survey period covers several years.

2. Wide Study Area - including control and potentially affected areas.

3. Frequent Sampling - at least monthly at selected locations and seasonally at a larger number of locations.

4. Multiple Sample Analysis - in most studies, either several samples are taken, or single samples split for replicate analyses.

Specification

Field Method

Periphyton on the intake and discharge structures and the surrounding riprap shall be visually inspected and samples hand-collected during the months of April through October (see Specification 4.1.2.1.4.).

Preservation of samples shall be the same as for samples collected in the regular sampling scheme of the general ecological survey.

Laboratory Method

The laboratory methods used shall be the same as those used for phytoplankton in the regular sampling scheme of the general ecological survey—see Specification 4.1.2.1.1.2.—except that each month from April through October a wet-mounted sample from the intake structure shall be examined also.

Reporting Requirement

As specified in Section 5.4.

Basis

Periphyton are attached algae growing upon solid substrates, consequently they are fixed in position. If their substrates are located where the Plant discharge can reach them, the periphyton may respond by abundance changes, changes in population composition, changes in diversity, or changes in other population parameters. Statistically significant differences between preoperational and operational population parameters will be noted and the relationship to Plant operation investigated.

using a semiballon nylon trawl having a 4.9 m (16 feet) headrope and a 5.8 m (19 feet) footrope. The body of the net is composed of 3.8 cm (1.5 inches) stretch mesh, the cod-end of 2.3 cm (1.25 inches) stretch mesh, and the inner liner of 1.3 cm (0.5 inch) stretch mesh. All trawls shall be made at an average speed of 3 miles per hour. The trawl shall be towed paralliel to the shore following the 20- and 30-foot depth contours, one replicate going approximately north to south and the other south to north.

Gillnetting:

Nylon experimental gillnets, 160.1 m x 1.8 m (525 feet x 6 feet) shall be set parallel to shore on the bottom at stations (C, D, G, H, R) at least once per month for approximately 12 hours during daylight and 12 hours during the night. The net is composed of 12 panels of netting as follows: three 7.6 m (25 feet) sections of the following bar mesh sizes--1.3 cm (0.5 inch), 1.9 cm (0.75 inch), and 2.5 cm (1.0 inch) and nine 15.3 m (50 feet) sections of bar mesh sizes starting at 3.1 cm (1.25 inches) and increasing to 7.6 cm (3 inches) plus one 10 cm (4 inches) panel.

Fish Larvae:

A 0.5 m diameter plankton net of No. 2 mesh (351 micron aperture) shall be used to collect fish larvae samples. Samples from 10 stations shall be collected during the night. For the inshore stations (A, B F) a set of at least duplicate samples shall be obtained by towing two nets simultaneously by hand against the current a distance of 61 m (200 feet) once during the night in water depth of 1-1.3 m (3 to 4 feet). At stations C, G and R (6 m stations) 5 minute tows shall be made at 0.5 m, 2 m, 4 m, and 5.5 m, the 0.5 tow representing the 0-1 m, and the 2 m tow representing the 2-3 m, the 4 m tow representing the 4-5 m and the 5.5 m tow representing the 6 m depths. At stations D and H (9 m stations) 5 minute tows shall be conducted at 0.5 m (representing 0-1 m), 2.5 m (representing 2-3 m), 4.5 m (representing 4-5 m), 6.5 m (representing 6-7 m), and 9.5 m (representing 8-9 m). At stations E and W a 5 minute tow at 0, 7.5, 13.5, and 20.0 m will be conducted only during April and May, day and night.

Laboratory Treatment of Fish

Fish from seines, gillnets and trawls shall be thawed as needed at the laboratory, separated by species, then grouped according to size classes. When large numbers of a particular species are present, a subsample shall be randomly selected, and a mass weight of the remaining fish of that species taken. Length, weight, sex, gonad condition, condition factor as well as fin clips, lamprey scars, and evidence of disease and parasites

In the event that the effects of Plant operation are judged to have an unacceptable adverse impact on fish species in the vicinity of the Plant, a staff approved plan for appropriate design modifications of the circulating cooling water system will permit rapid implementation of corrective actions to minimize or eliminate further adverse impacts.

4.1.2.1.2 Impingement Studies of Fish

Objective

The impingement study is designed to monitor fish entrained in the three condenser cooling water intakes that are impinged on the traveling screens and trash racks, and to analyze these fish to provide short-term estimates of species composition, length, weight, and seasonal abundance of these impinged fish.

Specifications

All fish impinged on the traveling screens during start-up and during periods of preliminary intermittent testing of pumps prior to sustained pump operation, following the effective date of issuance of an operating license, shall be reported in the annual Operating Report. Daily collection of fish impinged on the traveling screens shall be made for 6 months, starting with the first sustained operation of the circulating cooling water pumps in 1974. These data shall be analyzed statistically to determine if collection of samples every fourth day rather than daily would still be statistically valid. Should statistics verify the validity of the every fourth day sampling scheme, then fish shall be collected for a 24-hour period every fourth day after the initial 6-month test period.

Fish shall be collected in fish collection baskets and examined for species, life stages, and quantity (number and weight) collected. A statistically valid subsample of each species shall be counted, measured, weighed and sexed. Also, breeding and general condition will be determined. All fish removed from the trash rack shall be recorded and reported as specified in Section 5.4.1.

Reporting Requirement

As specified in Section 5.4.

Basis

Collection baskets serve as an excellent sampling tool for gathering all fish that enter the intake structures. Little is known about the number of fish that will be impinged at the Cook Plant because of the unique intake design. Therefore, this part of the ecological monitoring program should contribute to the furtherance of knowledge about the species and sex composition as well as the abundance, condition and seasonal occurrence of all fish species impinged by the Plant.

4.1.2.1.3 Study of Plankton, Benthos, and Fish Egg and Larvae Intake Entrainment

Objective

Those plankton, fish eggs and larvae, and benthos organisms drawn into the cooling water system which are small enough to pass through the 3/8 inch mesh on the traveling screens will be drawn through the Plant and exposed to a variety of stresses, including: pressure changes, mechanical abrasion, temperature elevation, and periodic chlorination. This study shall provide short-term data on the abundance and seasonality of this entrainment, and shall determine the effects of condenser passage on the species entrained in relation to its impacts on these species population in the Plant vicinity.

Specifications

Fish Entrainment and Entrainable Benthos

Fish, fish larvae, fish eggs, and benthos shall be sampled at two locations: in the intake forebay and discharge forebay following passage through the condensors.

Forebay samples shall be taken by pumping measured volumes of water with a 80 gpm diaphram pump into a 1/2 m plankton net (351 micron mesh). The net should be suspended in a barrel of water in an upright position to prevent damage to organisms from impingement against the net.

During all months of the year except June, July, and August, samples, except for entrainable benthos samples, shall be collected twice monthly for each eight-hour segment during a 24-hour period. Entrainable benthos will be collected once per month during the year. Beginning January 1, 1980, fish entrainment samples shall be collected twice per month during April, May, and September, weekly during the months of June, July, and August, and once per month for the remaining months. Fish eggs shall be enumerated and attempts at identification made. Fish larvae shall be sorted by species and enumerated with living-dead distinctions anticipated. Methods for the rapid distinction

(under field conditions) between living and dead larvae are still in developmental stages. The same samples collected for fish eggs and larvae shall be inspected for benthic organisms. During the period through the first year of operation of Unit No. 2, samples of fish eggs and larvae shall be collected weekly for one and/or both Units for each 8-hour segment during a twenty-four hour period, in June, July, and August.

Zooplankton Entrainment

Zooplankton samples shall be collected in the intake forebay, discharge forebay following passage through the condenser on at least a monthly basis. Within the intake and discharge forebays the sample shall be collected by pumping water (with volume of water pumped being recorded) through a #10 plankton net suspended in a barrel of water.

Samples collected before January 1, 1980, from the intake and discharge forebays (two replicate samples) will be counted for live and dead organisms as soon as possible after collection

Beginning January 1, 1980, zooplankton samples shall be collected once per month only from the intake forebay, and live-dead counts will not be done.

The laboratory techniques described in the preoperational monitoring program report #13* shall be employed for the zooplankton

Phytoplankton Entrainment

Phytoplankton samples shall be collected in the intake forebay.

Sampling frequency shall be at least monthly. Samples shall be collected

*Benton Harbor Power Plant Limnological Studies. Part XIII. Cook Plant Preoperational Studies 1972. 281 p. March 1973.

once during one twenty-four hour period. Sampling intensity is dependent on the presence of diurnal pattern; since no diurnal pattern has been observed in the samples,** phytoplankton sampling has been reduced to intake forebay sampling only, once during one twenty-four hour period per month. Species composition and abundance shall be recorded for each sample.

The laboratory techniques in the preoperational monitoring program report # XIII shall be employed for phytoplankton.

Nutrient analysis of water samples collected monthly shall be performed on samples collected before January 1, 1981. These water samples shall be analyzed for orthophosphate, dissolved silica and nitrates/nitrites.

Reporting Requirement

As specified in Section 5.4.

Basis

The exact effect of Plant operation on zooplankton, fish eggs, and fish larvae is impossible to predict. It is therefore necessary to monitor the number of organisms passing through the cooling water system to estimate the probable effects. It will be necessary to establish numbers, species composition and data on biological viability so that gross environmental changes can be detected and total impact of Plant operation assessed. Comparison of samples from the different stations will allow assessment of condenser passage damage to species populations in the vicinity of the Plant.

4.1.2.1.4 Visual Observation of the Intake and Discharge Structure Areas

Objective

To provide firsthand knowledge of physical and ecological conditions as viewed through the eyes of trained divers in the areas about the structures and the adjacent lake bottom.

*Strickland, J. D. H. and T. R. Parsons (1972). A Practical Handbook of Seawater Analysis, Bulletin 167 Second Edition, Fisheries Research Board of Canada, 310 p.

**University of Michigan, Great Lakes Research Division, Special Report No. 44, Part XXIV.

Specification

A standard monthly underwater survey during April through October using divers shall be undertaken. Diving operations will be dependent on favorable weather conditions. The diving program shall be undertaken to provide visual observations of environmental conditions as viewed through the eyes of trained divers to complement segments of the general ecological survey.

Five dives are planned each month. Four of these dives shall be daylight dives; two shall be done in the area of the intake and discharge structures with the other two daylight dives being in control areas outside the plume. The intake and discharge locations shall be examined and sampled for algae, periphyton, decaying material, attached macrophytes, fish, mollusks and crayfish. In the area about the discharge, indications of bottom scouring shall be observed. The night dive shall be made in a depth of 30 feet and observations shall be made to compare day and night conditions (including fish). The preservation of samples and the laboratory techniques employed shall be the same as those employed for the samples collected on the regular preoperational sampling scheme of the general ecological survey. This program shall cease on December 31, 1979, and will be replaced by the program described in the following paragraph.

Beginning January 1, 1980, a monthly underwater survey will be undertaken, weather permitting during April through October. A minimum of one dive per month instead of five dives per month will be made. Observations of rip-rapped discharge flow path area for scour will be made once per year during refueling shut down of each unit. Observations of the physical and ecological conditions will be made and reported for the spring, summer, and fall.

Reporting Requirement

As specified in Section 5.4.

Basis

These dives will permit direct visual observations of the areas most subject to change, should changes occur due to Plant operation, and will supplement information obtained in the general ecological survey.

(Section 4.1.2.2 deleted)

4.1.2.3 Land Management

Land Management requirements have been deleted from the Technical Specifications. Original objectives of the Specification are satisfied by U.S. EPA and State of Michigan requirements.

(Land Management requirement deleted)

4.1.2.4 Statistical Methods for Sampling and Data Analysis*

Objective

Statistical methods and procedures to be utilized for sampling and data analysis are employed to (1) provide a quantitative description of biological, chemical and physical parameters, onsite and in the lake, in the vicinity of the Plant, (2) enable statistical comparison of spatial and/or temporal differences between samples collected from different areas and/or at different times, and (3) establish sampling schedules which will assure recognition of gross changes in biological, chemical and physical conditions in the environment resulting from Plant operation.