September 8, 1986

SUBJECT: Offsite Dose Calculation Manual
Revision 11

The General Office Radwaste Engineering staff is transmitting to you this date, Revision 11 of the Offsite Dose Calculation Manual. As this revision only affects Oconee Nuclear Station, the approval of other station managers is not necessary. Please update your copy No. 1, and discard affected pages.

REMOVE THESE PAGES		INSERT THESE PAGES	
A-1	Rev. 10	A-1	Rev. 11
Figure A1.0-1	No Rev. #	Figure A1.0-1	Rev. 11
Figure A1.0-2 Page 4 of 4	No Rev. #	Figure A1.0-2 Page 4 of 4	Rev. 11
A-3	Rev. 3	A-3	Rev. 11
		A-3a	Rev. 11
A-4	Rev. 3	A-4	Rev. 11
A-5	Rev. 10	A-5	Rev. 11
A-6	Rev. 10	A-6	Rev. 11
		A-6a	Rev. 11
A-7	Rev. 3	A-7	Rev. 11
A-9	Rev. 10	A-9	Rev. 11

NOTE: As this letter contains "LOEP" information, please insert this in front of the December 17, 1985 letter.

Approval Date: 9/8/86

Effective Date: 9/12/86

Mary L. Birch
Mary L. Birch
System Radwaste Engineer

Approval Date: 9/12/86

Effective Date: 9/12/86

M. S. Tuckman
M. S. Tuckman, Manager
Oconee Nuclear Station

If you have any questions concerning Revision 11, please call Jim Stewart at (704) 373-5444.

James M. Stewart, Jr.
James M. Stewart, Jr.
Associate Health Physicist
Radwaste Engineering

JMS/pja.020

Enclosures

JUSTIFICATIONS FOR REVISION 11

Section A1.1(E) (Page A-1)	Added reference to VR dryer located in the new Radwaste Facility.
Figure A1.0-1	Incorporated Radwaste Facility into drawing.
Figure A1.0-2 (Page 4 of 4)	Incorporated Radwaste Facility into drawing.
Section A2.1.1 (Page A-3)	Changed title; added/changed words for clarification purposes; no change in meaning.
Section A2.1.2 (Page A3-a)	New page, Updated description of #3 Chemical Treatment Pond and incorporated Radwaste Facility into description.
Page A-4	No change in content, only location of information.
Page A-5	No change in content, only location of information.
Page A-6	No change in content, only location of information.
Section A3.0 (Page A-6)	Added information to show differences between gas monitor systems of the Radwaste Facility and other station gas monitors.
Section A3.1.1 (Page A-6)	Retitled section to clarifly topic; added detail to to the information given on monitor setpoints.
Section A-3.1.3 (Page A-6a)	New page and section, incorporated Radwaste Facility Effluent Discharge Line radiation monitor setpoint information.
Page A-7	No change in content, only location of information.
Section A3.2.6 (Page A-9)	New section, incorporated Radwaste Facility Ventilation Exhaust information.

A1.0 OCONEE NUCLEAR STATION RADWASTE SYSTEMS

A1.1 LIQUID RADWASTE PROCESSING

The liquid radwaste system at Oconee Nuclear Station (ONS) is used to collect and treat fluid chemical and radiochemical by-products of unit operation. The systems produce effluents which can be reused in the plant or discharged in small, dilute quantities to the environment. The means of treatment vary with waste type and desired product in the various systems:

A) Filtration - waste sources are filtered prior to processing as necessary.

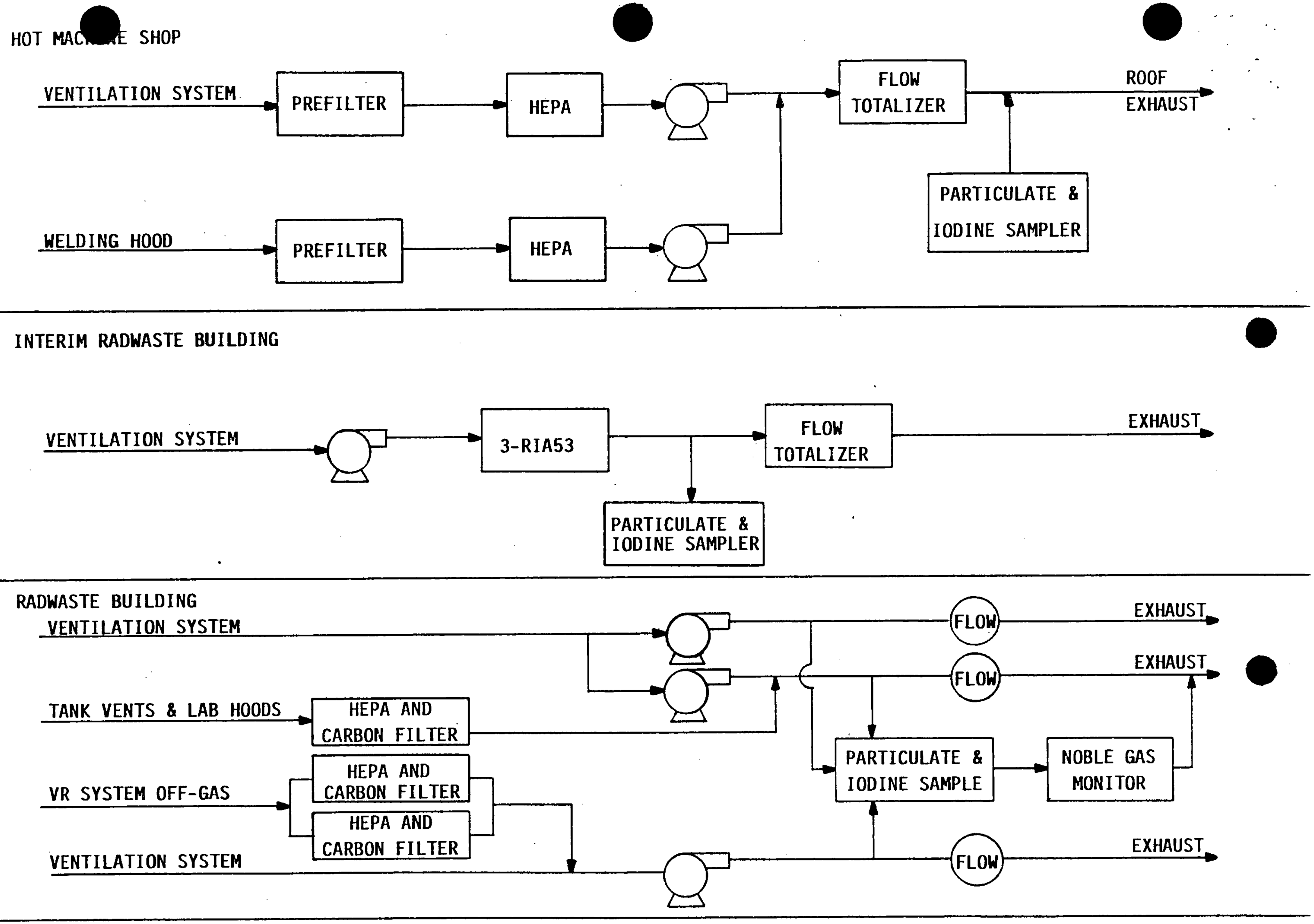
B) Ion Exchange - ion exchange is used to remove radioactive ions from solution. Also, ion exchange is normally used in removing cations (cobalt, manganese) and anions (chloride, flouride) from evaporator feed and/or distillates in order to purify the distillates for reuse as makeup water. Distillate from the Waste Evaporator System or the Waste and Recycle Evaporator can be treated by this method.

C) Gas Stripping - removal of gaseous radioactive fission products is accomplished in Evaporators and the venting of atmospheric holdup tanks.

D) Distillation - production of pure water from the waste by boiling it away from the contaminated solution which originally contained it is accomplished by both evaporators. Proper control of the process will yield water which can be reused for makeup. Polishing of this product can be achieved by ion exchange as pointed out above.

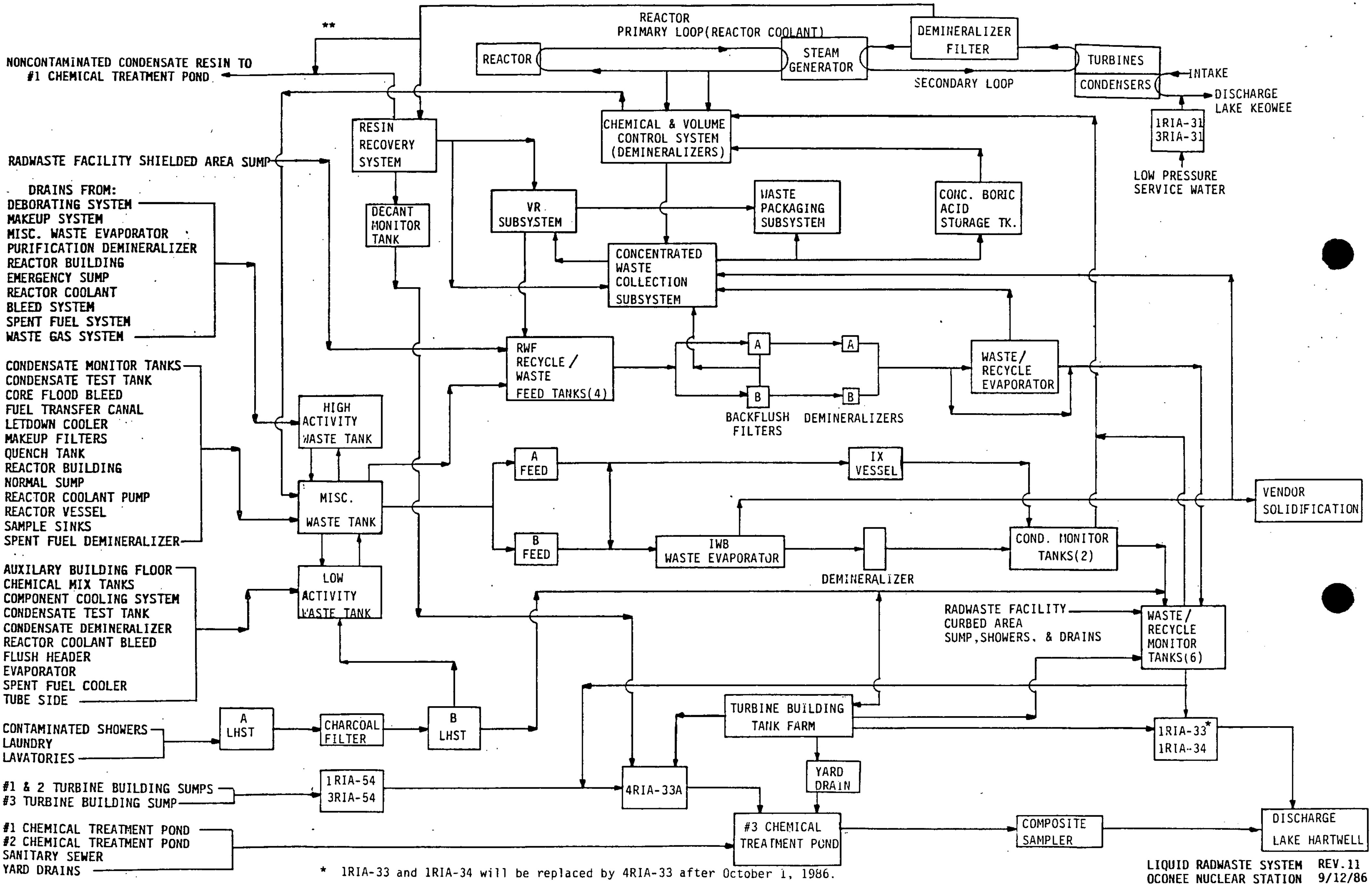
E) Concentration - in all Evaporators, radioactivity and dissolved chemicals are concentrated as water is boiled away. In the case of the Waste Evaporator, the volume of water containing waste chemicals and radionuclides is reduced so that the waste may be more easily and cheaply solidified and shipped for burial. In the case of the VR dryer, all water is removed and the dry salts are solidified for burial.

Figure A1.0-1 is a schematic representation of the liquid radwaste system at Oconee.



GASEOUS WASTE SYSTEM
OCONEE NUCLEAR STATION
FIGURE A1.0-2
PAGE 4 OF 4

REV. 11
9/12/86



* 1RIA-33 and 1RIA-34 will be replaced by 4RIA-33 after October 1, 1986.

** Temporary line - will be removed January 1, 1987.

LIQUID RADWASTE SYSTEM
OCONEE NUCLEAR STATION
FIGURE A1.0-1

REV.11
9/12/86

A2.0 RELEASE RATE CALCULATION

Generic release rate calculations are presented in Section 1.0; these calculations will be used to calculate release rates from Oconee Nuclear Station.

A2.1 LIQUID RELEASE RATE CALCULATIONS

There are two potential release points at Oconee, the liquid radwaste effluent line to the Keowee Hydroelectric Unit Tailrace and the #3 Chemical Treatment Pond effluent line to the Keowee River.

A2.1.1 Liquid Radwaste Effluent Line To The Keowee Hydroelectric Unit Tailrace

To simplify calculations for the liquid radwaste effluent line, it is assumed that no activity above background is present in the #3 Chemical Treatment Pond effluent. This assumption shall be confirmed by radiation monitoring measurements on the pond's inputs and by periodic analysis of the composite sample collected at the #3 Chemical Treatment Pond discharge. For the liquid radwaste effluent line the following calculation shall be performed to determine a discharge flow, in gpm:

$$f \leq F \div [\sigma \sum_{i=1}^{n} \frac{C_i}{MPC_i}]$$

where:

f = the undiluted effluent flow, in gpm.

C_i = the concentration of radionuclide, 'i', in undiluted effluent as determined by laboratory analyses, in µCi/ml.

MPC_i = the concentration of radionuclide, 'i', from 10CFR20, Appendix B, Table II, Column 2. If radionuclide, 'i', is a dissolved noble gas, the MPC_i = 2.0E-4 µCi/ml.

F = the dilution flow available, in gpm

typical flow rates are:

17059 gpm (based on a leakage rate of 38 cfs, the minimum flow available)

2.9E+6 gpm (based on one hydro unit operating at 50% power, 6600 cfs)

σ = the recirculation factor at equilibrium is 1.0. (See Section 1.1)

A2.1.2 #3 Chemical Treatment Pond Effluent Line

The #3 Chemical Treatment Pond effluent is the release point for station effluents that are normally considered to be non-radioactive; that is, the pond's effluent will not normally contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring measurements on the pond's inputs and/or by periodic analyses of the composite sample collected at the pond's discharge point. Inputs to this pond include the plant's yard drain system, the decant water from the Powdex system, the discharge from the Turbine Building Sump system, and Radwaste Facility monitor tanks whose contents have been determined to be below background. Inputs that have radiation monitors associated with them will be set to assure that Technical Specification 3.9.1 will not be exceeded.

The #3 Chemical Treatment Pond may also be the discharge path for large volumes of slightly contaminated water following a primary-secondary leak so long as administrative procedures are implemented to assure that release rate calculations similiar to that used in Section A2.1.1 are performed, that all detectable radionuclides will be accounted for, and that no station limits will be exceeded.

A2.1.3 Low Pressure Service Water Effluent Line

The Low Pressure Service water effluent is normally considered nonradioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring measurements. Radiation monitoring alarm setpoints, in conjunction with administrative controls, assure that release limits are not exceeded.

A2.2 GASEOUS RELEASE RATE CALCULATIONS

The unit vent is the release point for waste gas decay tanks, containment building purges, the condenser air ejector, and auxiliary building ventilation. The condenser air ejector effluent is normally considered nonradioactive; that is, it is unlikely the effluent will contain measureable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring measurements and by analyses of periodic samples collected on that line. Radiation monitoring alarm/trip setpoints in conjunction with administrative controls assure that release limits are not exceeded; see section on radiation monitoring setpoints.

The following calculations, when solved for flowrate, are the release rates for noble gases and for radioiodines, particulates and other radionuclides with half-lives greater than 8 days; the most conservative of release rates calculated in A2.2.1 and A2.2.2 shall control the release rates for a single release point.

A2.2.1 Release rate limit for noble gases:

$$\sum_{1} K_i \, [(\overline{X/Q})\tilde{Q}_i] < 500 \text{ mrem/yr, and}$$

$$\sum_{1} (L_i + 1.1\, M_i) \, [(\overline{X/Q})\tilde{Q}_i] < 3000 \text{ mrem/yr}$$

where the terms are defined below:

A2.2.2 Release rate limit for all radioiodines and radioactive materials in particulate form and radionuclides other than noble gases:

$$\sum_{1} P_i \, [W \, \tilde{Q}_i] < 1500 \text{ mrem/yr}$$

where:

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$ from Table 1.2-1.

L_i = The skin dose factor due to beta emissions for each identified noble gas radionuclide, in mrem/yr per $\mu Ci/m^3$ from Table 1.2-1.

M_i = The air dose factor due to gamma emissions for each identified noble gas radionuclide, in mrad/yr per $\mu Ci/m^3$ from Table 1.2-1 (unit conversion constant of 1.1 mrem/mrad converts air dose to skin dose).

P_i = The dose parameter for radionuclides other than noble gases for the inhalation pathway, in mrem/yr per $\mu Ci/m^3$ and for the food and ground plane pathways in $m^2 \cdot$(mrem/yr) per μCi/sec from Table 1.1-2. The dose factors are based on the critical individual organ and most restrictive age group (child or infant).

$\tilde{Q}_i$ = The release rate of radionuclides, i, in gaseous effluent from all release points at the site, in µCi/sec.

$\overline{X/Q}$ = 4.1E-7 sec/m^3. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary.

W = The highest calculated annual average dispersion parameter for estimating the dose to an individual at the controlling location:

W = 7.5E-8 sec/m^3, for the inhalation pathway. The location is the unrestricted area boundary in the NE sector.

W = 2.7E-9 m^{-2}, for the food and ground plane pathways. The location is the unrestricted area boundary in the NE sector (nearest cow, and vegetable garden)

$\tilde{Q}_i = k_1 C_i f \div k_2 = 4.72E{+}2\ C_i f$

where:

C_i = the concentration of radionuclide, i, in undiluted gaseous effluent, in µCi/ml.

f = the undiluted effluent flow, in cfm

k_1 = conversion factor, 2.83E+04 ml/ft^3

k_2 = conversion factor, 6.0E+01 sec/min

A3.0 RADIATION MONITOR SETPOINTS

Using the generic calculations presented in Section 2.0, final radiation monitoring setpoints are calculated for monitoring as required by the Technical Specifications.

All final effluent radiation monitors for Oconee are off-line. These monitors alarm on low flow; the minimum flow alarm level for the liquid monitors is 3 gallons per minute and for all gas monitors, except in the Radwaste Facility, is 7 standard cubic feet per minute. These monitors measure the activity in the liquid or gas volume exposed to the detector and are independent of flow rate if a minimum flow rate is assured. The Radwaste Facility gas monitors have a minimum flow alarm level of 2 standard cubic feet per minute and adjusts flow rate as the line flow changes.

Radiation monitoring setpoints calculated in the following sections are expressed in activity concentrations; in reality the monitor readout is in counts per minute, except for the Radwaste Facility gas monitor where its readout is in (μCi/ml). The relationship between concentration and counts per minute shall be established by station procedure using the following relationship: Station radiation monitor setpoint procedures which correlate concentration and counts per minute shall be based on the formula below and will be determined using the monitor's correlation graph. The correlation graph shows concentration (μCi/ml) vs. monitor reading (cpm) based on empirical data.

$$c = \frac{r}{2.22 \times 10^6 e\ V}$$

where:

- c = the gross activity, in μCi/ml
- r = the count rate, in cpm
- 2.22×10^6 = the disintegration per minute per μCi
- e = the counting efficiency, cpm/dpm
- v = the volume of fluid exposed to the detector, in ml.

A3.1 LIQUID RADIATION MONITORS

A3.1.1 Liquid Radwaste Effluent Line To The Keowee Hydroelectric Unit Tailrace

As described in Section A2.1.1 of this manual on release rate calculations for the waste liquid effluent, the release is controlled by limiting the flow rate of effluent from the station. Although the release rate is flow rate controlled, the radiation monitor setpoint shall be set to terminate the release if the effluent activity should exceed that used to calculate the release rate. Also, a radiation monitor setpoint shall be set to alarm if the effluent activity should exceed that determined by laboratory analyses.

A3.1.2 Turbine Building Sump Discharge Line

As described in Section A2.1.2 of this manual on release rate calculations for the turbine building sump effluent, the effluent is normally considered nonradioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring and by routine analysis of the composite sample collected at the #3 Chemical Treatment Pond. Since the system discharges automatically, the maximum system concentration, which also is the radiation monitor setpoint, is calculated to assure compliance with release limits.

A typical setpoint is calculated as follows:

$$c \leq \frac{MPC \times F}{\sigma f} = 4.5E\text{-}6\ \mu Ci/ml$$

where:

c = the gross activity in undiluted effluent, in μCi/ml.

f = the flow rate of undiluted effluent which may vary from 0-375 gpm, but is assumed to be 375 gpm.

MPC = 1.0E-07 μCi/ml, the MPC for an unidentified mixture.

σ = 1 (See Section A2.1.1)

F = the flow may vary from 38 to 6,600 cfs, but is conservatively estimated at 38 cfs (1.7E+4 gpm), the minimum flow available.

A3.1.3 Radwaste Facility Effluent Line To CTP #3

As described in Section A2.1.2 of this manual on release rate calculations, the Radwaste Facility Effluent is normally considered non-radioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring and/or by routine analyses of the composite sample collected at the discharge of the #3 Chemical Treatment Pond. In order to assure that no activity is unknowingly discharged into the pond, the radiation monitor's setpoint will be initially set at 1.0E-06 μCi/ml (the monitor's lowest level of detection) plus background. The monitor's setpoint may be changed after initial detection to allow positive control of effluent releases using the guidance given in Sections A2.1.2 and A3.1.2.

A3.1.4 Low Pressure Service Water Discharge Line

As described in Section A2.1.3 of this manual on release rate calculations for the Low Pressure Service water effluent, the effluent is normally considered nonradioactive; that is, it is unlikely the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring equipment. Since the system discharges automatically, the maximum system concentration which is also the radiation monitor setpoint, is calculated to assure compliance with release limits.

A typical monitor setpoint is calculated as follows:

$$C \leq \frac{MPC \times F}{\sigma f} = 1.16E\text{-}5\ \mu Ci/ml$$

where:

C = the gross activity in undiluted effluent, in μCi/ml.

f = the flow rate of undiluted effluent which may vary from 0 to 10,500 gpm but is assumed to be 10,500 gpm.

MPC = 1.0E-07 μCi/ml, the MPC for an unidentified mixture.

σ = recirculation factor for Lake Keowee, 1.02.

F = the flow rate of the condensate cooling water is based on having seven CCW pumps in operation, 1.24E+06 gpm. Should the number of operating pumps decrease, the setpoint must be recalculated.

A3.2.3 Interim Radwaste Building Ventilation Exhaust

Ventilation exhaust from the Interim Radwaste Building is not released through the unit vent and is considered a separate release point. This exhaust is normally considered non-radioactive; that is, it is possible but unlikely that the effluent will contain measurable activity above background. Since the exhaust is continuous, a maximum concentration of gases in the exhaust, which also is the radiation monitor setpoint, is calculated to assure compliance with release limits. A typical radiation monitor setpoint may be calculated as follows:

$$C < 8.79E+3/f = 5.98E-1 \ \mu Ci/ml$$

where:

f = 1.47E+04 cfm

A3.2.4 Hot Machine Shop Building Ventilation Exhaust

Ventilation exhaust from the Hot Machine Shop is not released through the unit vent and is considered to be a separate release point. This filtered exhaust is sampled and analyzed for particulates and radioiodines to assure that the effluent released has not exceeded station release limits. Since it is assumed that no noble gases will be generated by machine shop work, no provision for monitoring noble gas releases are provided.

A3.2.5 Contaminated Oil Burning In Auxiliary Boiler

Contaminated oil is burned in the auxiliary boiler which is not released through the unit vent and is considered a separate release point. The contaminated oil is filtered, mixed, and sampled to determine the total activity to be released and the allowable release (burn) rate.

By Technical Specification, releases from the auxiliary boiler from incineration of contaminated oil must meet the instantaneous release rate for iodines and particulates given in Section A2.2.2. Also, the total dose due to these releases must be less than 0.1% of the allowable yearly dose from particulate gaseous effluents.

Doses from incineration of contaminated oil are calculated for all organs and all pathways using the models provided in Section 3.1.2.2 of this manual and the GASPAR computer program. Doses are calculated quarterly at a minimum.

All the activity in the contaminated oil is assumed to be released during incineration and the total is added to the station's quarterly and annual release records.

A3.2.6 Radwaste Facility Ventilation Exhaust

The ventilation exhaust from the Radwaste Facility is not released through the unit vent and is considered a separate release point. This exhaust is continuously sampled for iodine and particulates and monitored for noble gases. This data is used in calculations to assure that the effluents released have not exceeded station release limits.