December 27, 1990

SUBJECT: Offsite Dose Calculation Manual
Revision 30

The General Office Radiation Protection staff is transmitting to you this date, Revision 30 of the Offsite Dose Calculation Manual. As this revision only affects Catawba Nuclear Station, the approval of other station managers is not required. Please update your copy No. ____, and discard the affected pages.

REMOVE THESE PAGES	INSERT THESE PAGES
C-1 Rev. 12	C-1 Rev. 30
C-2 Rev. 12	C-2 Rev. 30
Figure C1.0-2 Rev. 4 (1 of 2)	Figure C1.0-2 Rev. 30 (1 of 2)
C-5 Rev. 19	C-5 Rev. 30
C-11 Rev. 12	C-11 Rev. 30
C-12 Rev. 25	C-12 Rev. 30
C-12a Rev. 25	C-12a Rev. 30
Pages C-14 thru Page C-22 Rev. 25	Pages C-14 thru Page C-22 Rev. 30
C-23 Rev. 25	C-23 Rev. 30

NOTE: As this letter, with its attachments, contains "LOEP" information, please insert this in front of the December 26, 1990 letter.

Approval Date: 12/17/90 | Approval Date: 12/17/90

Effective Date: 1/1/91 | Effective Date: 1/1/91

Mary L. Birch
Mary L. Birch
Radiation Protection Manager

J W Hampton
J. W. Hampton, Manager
Catawba Nuclear Station

If you have any questions concerning Revision 30, please call Jim Stewart at (704) 373-5444.

James M. Stewart, Jr.
James M. Stewart, Jr.
Scientist
Radiation Protection

JMS/prm.091

JUSTIFICATIONS FOR REVISION 30

Page C-1	Updated section C1.1 to more accurately describe actual station operation.
Page C-2	Corrected spelling of "Adsorber". Added additional description to section C1.2. Updated section C1.2.1 to more accurately describe actual station operation.
Figure C1.0-2	Corrected spelling of "Adsorber". Updated flow rates to agree with values listed in FSAR.
Page C-5	Updated section C2.1.2 Part d. to more accurately describe actual station operation.
Page C-11	Changed containment purge rate and Auxiliary Building flow-rate to agree with values used in FSAR. Updated associated calculations using new flowrate rates.
Pages C-12 and C-12a	Updated sections using dose calculations based on 1990 Effluent Release Data (first nine months) and the 1990 Land Use Census Data.
Pages C-14 thru C-22	Updated sections using dose calculations based on 1990 Effluent Release Data (first nine months) and the 1990 Land Use Census Data.

C1.0 CATAWBA NUCLEAR STATION RADWASTE SYSTEMS

C1.1 LIQUID RADWASTE PROCESSING

The liquid radwaste system at Catawba Nuclear Station (CNS) is used to collect and treat fluid chemical and radiochemical by-products of unit operation. The system produces 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 - All waste sources are filtered during processing. In some cases, such as the Laundry and Hot Shower Tank (LHST) Subsystem of the Liquid Waste (WL) System, filtration may be the only treatment required.

B) Adsorption - Adsorption of halides and organic chemicals by activated charcoal (Carbon Filtration) can be used as needed for the waste streams in the WL System.

C) Ion Exchange - Ion exchange is used to remove radioactive cations (cobalt, manganese) and anions (iodone) from the waste streams. This process can be used on all waste streams as needed.

D) Gas Stripping - The fluids processed in the WL System does not contain entrained fission gases. Those fluids that are processed for recycle, however, do contain entrained fission gases. Removal of these gaseous radioactive fission products is accomplished in both the NB and WL Evaporators. These gases are stored in the Waste Gas Holdup System for decay prior to release.

E) Distillation and Concentration - Evaporation is used to process recyclable liquids for reuse in the primary systems. However, the evaporators can be used to process non-recyclable fluids in an emergency situation. In this case, the distillate would be recycled to the primary systems while the concentrates would be solidified and routed to an approved low-level waste disposal site.

Figure C1.0-1 is a schematic representation of the liquid radwaste system at Catawba.

C1.2 GASEOUS RADWASTE SYSTEMS

The gaseous waste disposal system for Catawba is designed with the capability of processing the fission-product gases from contaminated reactor coolant fluids resulting from operation. The system shown schematically in Fig. C1.0-2 is designed to allow for the retention and subsequent decay of the gaseous fission products generated from the reactor coolant system via the chemical and volume control system and/or the boron recycle system in order to limit the need for intentional discharge of high level radioactive gases from the waste gas holdup tanks. Sources of low-level radioactive gaseous discharge to the environment include periodic purging operations of the containment, the auxiliary building ventilation system, the secondary system air ejector and decayed WG Tanks. With respect to purging operations, the potential contamination is expected to arise from uncollectible reactor coolant leakage. With respect to the air ejector, the potential source of contamination will be from leakage of the reactor coolant to the secondary system through defects in steam generator tubes. The gaseous waste disposal system includes two waste gas compressors, two catalytic hydrogen recombiners, six gas decay storage tanks for use during normal power generation, and two gas decay storage tanks for use during shutdown and startup operations, and for pressure relief

C1.2.1 Gas Collection System

The gas collection system combines the waste hydrogen and fission gases from the volume control tanks and that from the boron recycle gas stripper evaporator produced during normal operation with the gas collected during the shutdown degasification (high percentage of nitrogen) and cycle it through the catalytic recombiners converting all the hydrogen to water. After the water is removed, the resulting gas stream is transferred from the recombiner into the gas decay tanks, where the accumulated activity may be contained. From the decay tanks the gas will flow back to the compressor suction to complete the circuit.

C1.2.2 Containment and Auxiliary Building Ventilation

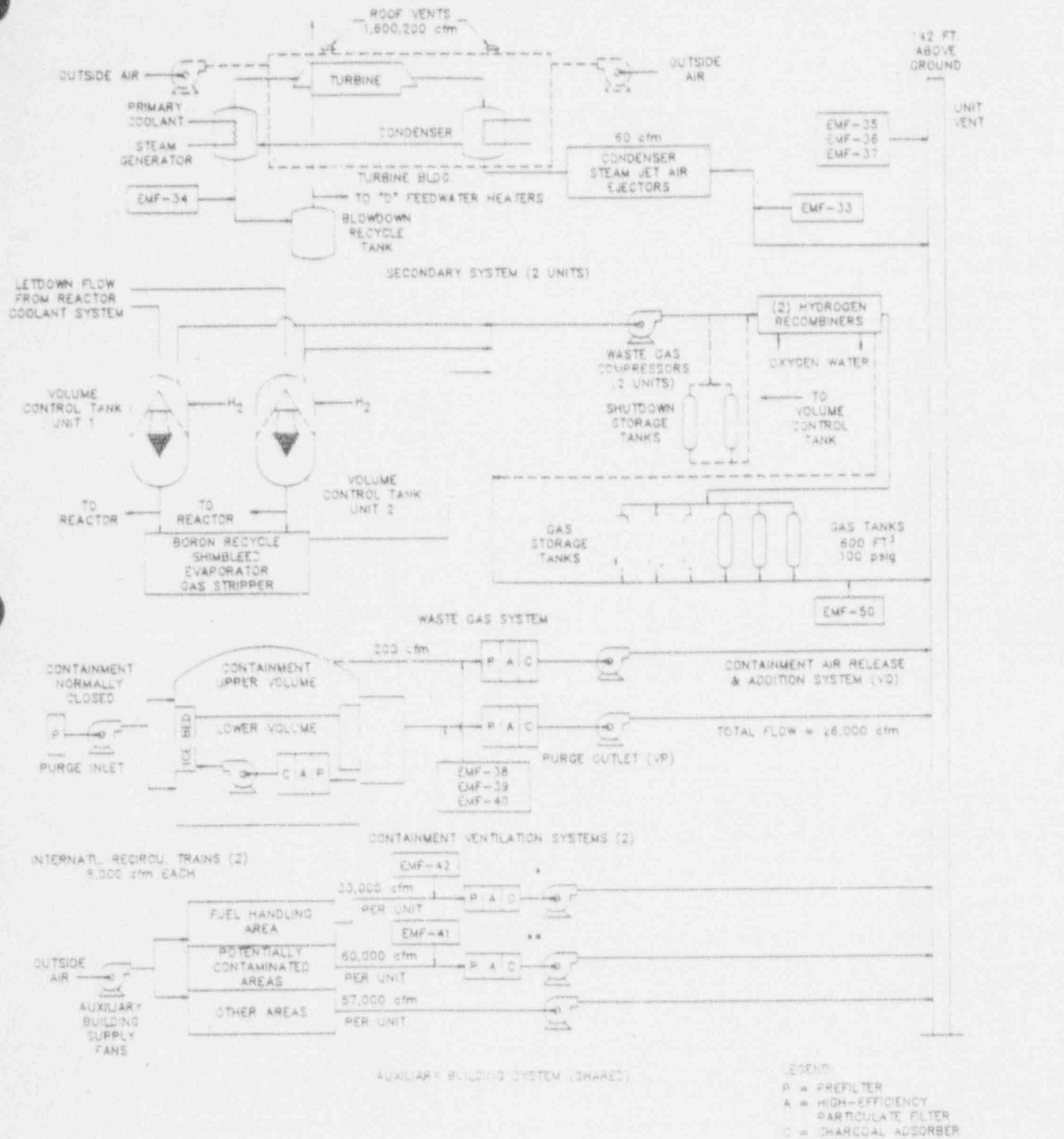
Nonrecyclable reactor coolant leakage occurring either inside the containment or inside the auxiliary building will generate gaseous activity. Gases resulting from leakage inside the containment will be contained until the containment air is released through the VQ or VP system. The containment atmosphere will be discharged through a charcoal adsorber and a particulate filter prior to release to the atmosphere.

Gases resulting from leakage inside the auxiliary building are released, without further decay, to the atmosphere via the auxiliary building ventilation system. The ventilation exhaust from potentially contaminated areas in the auxiliary building is normally unfiltered. However, on a radiation monitor alarm, the exhaust is passed through charcoal adsorbers to reduce releases to the atmosphere.

C1.2.3 Secondary Systems

Normally, condensate flow and steam generator blowdown will go parallel

UNITS 1 & 2



* FUEL HANDLING AREA IS NORMALLY UNFILTERED. UPON A RADIATION ALARM BY EMF-42, THE EXHAUST WILL BE DIVERTED TO THE FILTER MODE.

** POTENTIALLY CONTAMINATED AREAS OF THE AUXILIARY BUILDING ARE NORMALLY UNFILTERED. UPON A RADIATION ALARM BY EMF-41, THE EXHAUST WILL BE DIVERTED TO THE FILTERED MODE.

FIGURE C1.0-2
CATAWBA NUCLEAR STATION
GASEOUS RADWASTE SYSTEM
PAGE 1 OF 2

REVISION 30
1/1/91

9912?0

C2.1.2 Conventional Waste Water Treatment System Effluent Line (WC)

The conventional waste water treatment system effluent is potentially radioactive; that is, it is possible the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by periodic analysis of the composite sample collected on that line. The water sources listed below that are normally discharged via the conventional waste water treatment system and/or the Turbine Building Sump will be diverted if they will cause the WC discharge to exceed administrative limits designed to ensure that station release limits will not be exceeded.

a. Containment Ventilation Unit Condensate Effluent Line

The containment ventilation unit condensate effluent line could potentially discharge into the Turbine Building sump, but if activity is detected above its monitor's setpoint, the discharge will be terminated and an alarm actuated. The containment ventilation unit condensate tank will then be pumped to the RHT or WMT, recirculated, sampled, processed thru the WL system if necessary, and then discharged through the liquid waste effluent line and monitored.

b. Auxiliary Feedwater Sump Pumps and Floor Drain Sump Pump Line

Normally the discharge line coming from these sumps will discharge into the Turbine Building sump, but if activity is detected above its monitor's setpoint, the discharge flow will automatically be routed to the floor drain tank for processing and later be discharged through the liquid waste effluent line. Subsequent radioactive releases may be allowed to discharge into the TBS if administratively controlled to assure that release limits are not exceeded.

c. Steam Generator Blowdown Line

Normally the discharge from the Steam Generator Blowdown will be pumped to the Turbine Building Sump, but if activity is detected above its monitor's setpoint, each blowdown flow control valve, the atmospheric vent, and the valve to the Turbine Building Sump will close, thus terminating the discharge. Blowdown can only be continued by venting the steam to "D" heater and pumping the liquid to the condensate system.

d. Turbine Building Sump Discharge Line

Normally the discharge from the Turbine Building sump will go into the conventional waste water treatment system, but if activity is detected above its monitor's setpoint, the sump pumps A, B, and C will stop and an alarm actuated. The Turbine Building sump discharge line can then either be routed to the steam generator drain tanks for processing, or allowed to continue being discharged via the circuit with proper administrative controls implemented to assure that release limits are not exceeded.

C3.2 GAS MONITORS

The following equation shall be used to calculate noble gas radiation monitor setpoints based on Xe-133 (Historical data shows that Xe-133 is the predominant isotope):

$$K(\overline{X/Q})\tilde{Q}_i < 500 \qquad \text{(see Section C2.2.1)}$$

$$\tilde{Q}_i = 4.72E{+}02\ C_i f \quad \text{(see Section C2.2.2)}$$

$$C_i < 116/f$$

where:

C_i = the gross activity in undiluted effluent, in µCi/ml

f = the flow from the tank or building sources, in cfm

K = from Table 1.2-1 for Xe-133, 2.94E+2 mrem/yr per µCi/m^3

$\overline{X/Q}$ = 3.1E-05, as defined in Section C.2.2.2

As stated in Section C2.2, the unit vent is the release point for the containment purge ventilation system, the containment air release and addition system, the condenser air ejector, and auxiliary building ventilation.

For releases from the containment purge ventilation system, a typical radiation monitor setpoint may be calculated as follows:

$$C_i < 116/f = 6.59E{-}04$$

where:

f = 150,000 cfm (auxiliary building ventilation) + 26,000 cfm (containment purge) = 176,000 cfm

For release from the containment air release and addition system, the waste gas decay tanks, the condenser air ejectors, and the auxiliary building ventilation, a typical radiation monitor setpoint may be calculated as follows:

$$C_i < 116/f = 7.73E{-}04$$

where:

f = 150,000 cfm (auxiliary building ventilation)

C4.0 DOSE CALCULATIONS

C4.1 FREQUENCY OF CALCULATIONS

Dose contributions to the maximum individual shall be calculated at least every 31 days, quarterly, semiannually, and annually (or as required by Technical Specifications) using the methodology in the generic information sections. This methodology shall also be used for any special reports. Dose calculations that are required for individual pre-release calculations, and/or abnormal releases shall not be calculated by using the simplified dose calculations. Station dose projections for these types and others that are known to vary from the station historical averages shall be calculated by using the methodology in the generic information section. STATION Dose projections may be performed using simplified dose estimates.

Fuel cycle dose calculations shall be performed annually or as required by special reports. Dose contributions shall be calculated using the methodology in the appropriate generic information sections.

C4.2 DOSE MODELS FOR MAXIMUM EXPOSED INDIVIDUAL

C4.2.1 Liquid Effluents

For dose contributions from liquid radioactive releases, dose calculations based on operational source term data and NUREG-0133 guidance indicate that the maximum exposed individual would be an adult who consumed fish caught in the discharge canal and who drank water from the nearest "downstream" potable water intake. The dose from Cs-134 and Cs-137 has been calculated to be 91% of that individual's total body dose.

C4.2.2 Gaseous Effluents

C4.2.2.1 Noble Gases

For dose contributions from exposure to beta and gamma radiation from noble gases, it is assumed that the maximum exposed individual is an adult at a controlling location in the unrestricted area where the total noble gas dose is determined to be a maximum.

C4.2.2.2 Radioiodines, Particulates, and Other Radionuclides T 1/2 > 8 days

For dose contributions from radioiodines, particulates and other radionuclides; it is assumed that the maximum exposed individual is a child or infant at a controlling location in the unrestricted area where the total inhalation, food and ground plane pathway dose is determined to be a maximum based on operational source term data, land use surveys, and NUREG-0133 guidance.

C4.3 SIMPLIFIED DOSE ESTIMATE

C4.3.1 Liquid Effluents

For dose estimates, a simplified calculation based on the assumptions presented in Section C4.2.1 and operational source term data is presented below. Updated operational source term data shall be used to revise these calculations as necessary.

$$D_{WB} = 6.38E+05 \sum_{\ell=1}^{m} (F_\ell)(T_\ell)\ (C_{Cs-134} + 0.59\ C_{Cs-137})$$

where:

$$6.38E+05 = 1.14E+05\ (U_{aw}/D_w + U_{af}\ BF_i)\ DF_{ait}\ (1.10)$$

where:

$1.14E+05 = 10^6 pCi/\mu Ci \times 10^3 ml/kg \div 8760\ hr/yr$

U_{aw} = 730 ℓ/yr, adult water consumption

D_w = 37.7, dilution factor from the near field area to the nearest potable water intake.

U_{af} = 21 kg/yr, adult fish consumption

BF_i = 2.00E+03, bioaccumulation factor for Cesium (Table 3.1-1)

DF_{ait} = 1.21E-04, adult, total body, ingestion dose factor for Cs-134 (Table 3.1-2)

1.10 = factor derived from the assumption that 91% of dose is from Cs-134 and Cs-137 or 100% ÷ 91% = 1.10

And where:

$$F_\ell = \frac{f\sigma}{F + f}$$

where:

f = liquid radwaste flow, in gpm

σ = recirculation factor at equilibrium, 1.027 (see Section C2.1.1)

F = dilution flow, in gpm

C4.3.2 Gaseous Effluents

Meteorological data is provided in Tables C4.0-1 and C4.0-2.

C4.3.2.1 Noble Gases

For dose estimates, simplified dose calculations based on the assumptions in C4.2.2.1 and operational source term data are presented below. Updated operational source term data shall be used to revise these calculations as necessary. These calculations further assume that the annual average dispersion parameter is used and that Xenon-133 contributes 61% of the gamma air dose and 54% of the beta air dose.

$$D_{\gamma} = 3.47E\text{-}10\ [\tilde{Q}]_{Xe\text{-}133}\ (1.22)$$

$$D_{\beta} = 1.03E\text{-}09\ [\tilde{Q}]_{Xe\text{-}133}\ (1.06)$$

where:

3.47E-10 = (3.17E-8)(353) $(\overline{X/Q})$, derived from equation presented in Section 3.1.2.1.

1.03E-09 = (3.17E-08) (1050) $(\overline{X/Q})$, derived from equation presented in Section 3.1.2.1.

$\overline{X/Q}$ = 3.1E-05 sec/m³, as defined in Section C2.2.2

$[\tilde{Q}]_{Xe\text{-}133}$ = the total Xenon-133 activity released in μCi

1.64 = factor derived from the assumption that 61% of the gamma air dose is contributed by Xe-133.

1.85 = factor derived from the assumption that 54% of the beta air dose is contributed by Xe-133.

C4.3.2.2 Radioiodines, Particulates, and Other Radionuclides with T 1/2 > 8 days

For dose estimates, simplified dose calculations based on the assumptions in C4.2.2.2 and operational source term data are presented below. Updated operational source term data shall be used to revise these calculations as necessary. These calculations further assume that the annual average dispersion/deposition parameters are used and that 82% of the dose results from H-3 ingested by the maximally exposed individual via the vegetable garden pathway at the controlling location. The simplified dose estimate for exposure to the thyroid of a child is:

$$D = 1.28E\text{-}04\ w\ (\tilde{Q})_{H\text{-}3}\ (1.22)$$

where:

w = 3.0E-05 = $\overline{X/Q}$ for vegetable garden pathway, in sec/m³ from Table C4.0-1 for the controlling location (NE sector at 0.5 miles).

$(Q)_{H-3}$ = the total Tritium activity released in µCi.

1.28E-04 = (3.17E-08)(R_i^V $[\overline{X/Q}]$) with the appropriate substitutions for child thyroid vegetable pathway factor, R_i^V $[\overline{X/Q}]$ for H-3. See Section 3.1.2.2.

1.22 = factor derived from the assumption that 82% of the total inhalation, food and ground plane pathway dose to the maximally exposed individual is contributed by H-3 via the vegetable garden pathway.

C4.4 FUEL CYCLE CALCULATIONS

As discussed in Section 3.3.5, more than one nuclear power station site may contribute to the doses to be considered in accordance with 40CFR190. The fuel cycle dose assessments for Catawba Nuclear Station must include liquid and gaseous dose contributions from McGuire Nuclear Station, which is located approximately thirty miles NNE of Catawba. For this dose assessment, the total body and maximum organ dose contributions to the maximum exposed individual from the combined Catawba and McGuire liquid and gaseous releases are estimated using the following calculations:

$$D_{WB}(T) = D_{WB}(l_m) + D_{WB}(l_c) + D_{WB}(g_m) + D_{WB}(g_c)$$

$$D_{MO}(T) = D_{MO}(l_m) + D_{MO}(l_c) + D_{MO}(g_m) + D_{MO}(g_c)$$

where:

$D_{WB}(T)$ = Total estimated fuel cycle whole body dose commitment resulting from the combined liquid and gaseous effluents of Catawba and McGuire during the calendar year of interest, in mrem.

$D_{MO}(T)$ = Total estimated fuel cycle maximum organ dose commitment resulting from the combined liquid and gaseous effluents of Catawba and McGuire during the calendar year of interest, in mrem.

C4.4.1 Liquid Effluents

Liquid pathway dose estimates are based on values and assumptions presented in Sections B4.3.1. and C4.3.1. Operational source terms shall be used to update these simplified calculations as necessary.

C4.4.1.1 McGuire's Liquid Contributions

Based on operational history, the Catawba fuel cycle maximum exposed individual whole body dose resulting from McGuire liquid effluent releases ($D_{WB}(l_m)$) is estimated using the simplified dose calculation given below:

$$D_{WB}(l_m) = (7.66E+05)(F_\ell)(T_\ell)(C_{Cs-134} + 0.59\, C_{Cs-137})$$

where:

$$7.66E+05 = 1.14E+05 (U_{aw} + U_{af} \times BF_i) (DF_{ait}) (1.30)$$

where:

$$1.14E+05 = (1.0E+06 \text{ pCi/uCi} \times 1.0E+03 \text{ ml/kg}) / (8760 \text{ hr/yr})$$

U_{aw} = 730 ℓ/yr, Adult water consumption

U_{af} = 21 kg/yr, Adult fish consumption

BF_i = 2.00E+03, Bioaccumulation factor for Cesium (Table 3.1-1)

DF_{ait} = 1.21E-04, Adult total body ingestion dose factor for Cs-134 (Table 3.1-2)

1.30 = Factor derived from the assumption that 77% of the dose is derived from Cs-134 and Cs-137 or 100% / 77% = 1.30

where:

$$F_\ell = f / F$$

where:

f = McGuire's liquid radwaste flow, in gpm

F = 1.97E+06 gpm, the average flow past Lake Wylie Dam

where:

T_ℓ = 8760 hours, the time period of time over which C_{Cs-134}, C_{Cs-137} and F_ℓ are averaged.

C_{Cs-134} = The average concentration of Cs-134 in McGuire's undiluted effluent, in uCi/ml, during the calendar year of interest.

C_{Cs-137} = The average concentration of Cs-137 in McGuire's undiluted effluent, in uCi/ml, during the calendar year of interest.

0.59 = The ratio of the adult total body ingestion dose factors for Cs-134 and Cs-137 or 7.14E-05 / 1.21E-04 = 0.59

Based on operational history, the Catawba fuel cycle maximum exposed individual maximum organ dose (Adult-GI-LLI) resulting from McGuire's liquid effluent releases ($D_{MO}(1_m)$) is estimated using the simplified dose calculation given below:

$$D_{MO}(1_m) = (1.92E+06) (F_\ell) (T_\ell) (C_{Nb-95})$$

where:

$$1.92E+06 = (1.14E+05) (U_{aw} + U_{af} \times BF_i) (DF_{ait}) (1.27)$$

where:

$1.14E+05 = (1.0E+06 \text{ pCi/uCi} \times 1.0E+03 \text{ ml/kg}) / (8760 \text{ hr/yr})$

U_{aw} = 730 ℓ/yr, adult water consumption

U_{af} = 21 kg/yr, adult fish consumption

BF_i = 3.00E+04, Bioaccumulation factor for Nb (Table 3.1-1)

DF_{ait} = 2.10E-05, adult GI-LLI ingestion dose factor for Nb-95 (Table 3.1-2)

1.27 = Factor derived from the assumption that 79% of the adult GI-LLI dose is from Nb-95 or 100% / 79% = 1.27

where:

$F_\ell = f / F$

where:

f = McGuire's liquid radwaste flow, in gpm

F = 1.97E+06 gpm, the average flow past Lake Wylie Dam

where:

T_ℓ = 8760 hours, the time period of time over which C_{Nb-95} and F_ℓ are averaged.

C_{Nb-95} = The average concentration of Nb-95 in McGuire's undiluted effluent, in uCi/ml, during the calendar year of interest.

C4.4.1.2 Catawba's Liquid Contribution

Based on operational history, the Catawba fuel cycle maximum exposed individual whole body dose resulting from Catawba's liquid effluent releases ($D_{WB}(1_c)$) is estimated using the simplified dose calculation given below:

$$D_{WB}(1_c) = (6.38E+05) (F_\ell) (T_\ell) (C_{Cs-134} + 0.59\ C_{Cs-137})$$

where:

$$6.38E+05 = 1.14E+05 (U_{aw} / D_w + U_{af} \times BF_i) (DF_{ait}) (1.10)$$

where:

$1.14E+05 = (1.0E+06 \text{ pCi/uCi} \times 1.0E+03 \text{ ml/kg}) / (8760 \text{ hr/yr})$

U_{aw} = 730 ℓ/yr, Adult water consumption

D_w = 37.7, dilution factor from the near field area to the nearest potable water intake (Rock Hill Water Intake)

U_{af} = 21 kg/yr, Adult fish consumption

BF_i = 2.00E+03, Bioaccumulation factor for Cesium (Table 3.1-1)

DF_{ait} = 1.21E-04, Adult total body ingestion dose factor for Cs-134 (Table 3.1-2)

1.10 = Factor derived from the assumption that 91% of the dose is derived from Cs-134 and Cs-137 or 100% / 91% = 1.10

and where:

$F_\ell = (f) (\sigma) / (F + f)$

where:

f = Catawba's liquid radwaste flow, in gpm

σ = Recirculation factor at equilibrium, 1.027 (See section C2.2.1)

F = Catawba's dilution flow, in gpm

and where:

T_ℓ = 8760 hours, the time period of time over which C_{Cs-134}, C_{Cs-137} and F_ℓ are averaged.

C_{Cs-134} = The average concentration of Cs-134 in Catawba's undiluted effluent, in uCi/ml, during the calendar year of interest.

C_{Cs-137} = The average concentration of Cs-137 in Catawba's undiluted effluent, in uCi/ml, during the calendar year of interest.

0.59 = The ratio of the adult total body ingestion dose factors for Cs-134 and Cs-137 or 7.14E-05 / 1.21E-04 = 0.59

Based on operational history, the Catawba fuel cycle maximum exposed individual maximum organ dose (Adult, GI-LLI) resulting from Catawba's liquid effluent releases ($D_{MO}(1_c)$) is estimated using the simplified dose calculation given below:

$$D_{MO}(1_c) = (2.04E+06) (F_\ell) (T_\ell) (C_{Nb-95})$$

where:

$$2.04E+06 = (1.14+05) (U_{aw} / D_w + U_{af} \times BF_i) (DF_{ait}) (1.35)$$

where:

1.14E+05 = (1.0E+06 pCi/uCi x 1.0E+03 ml/kg) / 8760 hr/yr

U_{aw} = 730 ℓ/yr, Adult water consumption

D_w = 37.7, Dilution factor from the near field area to potable water intake.

U_{af} = 21 kg/yr, Adult fish consumption

BF_i = 3.00E+04, Bioaccumulation factor for Niobium (Table 3..-)

DF_{ait} = 2.10E-05, Adult GI-LLI ingestion dose factor for Nb-95 (Table 3.1-2)

1.35 = Factor derived from the assumption that 74% of adult GI-LLI dose is from Nb-95 or 100% / 74% = 1.35

where:

$$F_\ell = (f) (\sigma) / (F + f)$$

where:

f = Catawba's liquid radwaste flow, in gpm

σ = Recirculation factor at equilibrium, 1.027

F = Catawba's dilution flow, in gpm

where:

T_ℓ = 8760 hours, the time period of time over which C_{Nb-95} and F_ℓ are averaged.

C_{Nb-95} = The average concentration of Nb-95 in Catawba's undiluted effluent, in uCi/ml, during the calendar year of interest.

C4.4.2 Gaseous Effluents

Airborne effluent pathway dose estimates are based on the values and assumptions presented in Sections B4.3.2. and C4.3.2. Operational source term data shall be used to update these calculations as necessary.

C4.4.2.1 McGuire's Gaseous Contribution

Based on operational history, the Catawba fuel cycle maximum exposed individual whole body dose resulting from McGuire's gaseous effluent releases ($D_{WB}(g_m)$) is estimated using the simplified dose calculation given below:

$$D_{WB}(g_m) = (\ 9.32E\text{-}06\ )\ (\ w\ )\ (\ \tilde{Q}_{Xe\text{-}133}\ )\ (S_F)\ (\ 1.43\ )$$

where:

w = 1.50E-07 = $(\overline{X/Q})$ for the plume immersion factor pathway factor, in sec/m³ which corresponds to a location 5 miles SSW of the McGuire site (See table B4.0-1)

$\tilde{Q}_{Xe\text{-}133}$ = The total Xe-133 activity released from McGuire during the calendar year of interest, in uCi.

9.32E-06 = (3.17E-08) ($K_i[\overline{X/Q}]$), with appropriate substitutions for whole body exposure in a semi-infinite cloud of Xe-133. See Section 1.2.1.

S_F = 0.7 = External radiation shielding factor for individuals.

1.43 = The factor derived from the conservative assumption (based on historical data) that 70% of the whole body dose to the maximally exposed individual is contributed by Xe-133.

Based on operational history, the Catawba fuel cycle maximum exposed individual maximum organ dose (Adult-GI-LLI) resulting from McGuire's gaseous effluent releases ($D_{MO}(g_m)$) is estimated using the simplified dose calculation given below:

$$D_{MO}(g_m) = (\ 7.23E\text{-}05)\ (\ w\ )\ (\ \tilde{Q}_{H\text{-}3})\ (1.04)$$

where:

w = 1.5E-07 = $\overline{X/Q}$ for the food and ground plane pathway, in sec/m³, for a location 5 miles SSW of the McGuire site (Table B4.0-1)

$\tilde{Q}_{H\text{-}3}$ = The total H-3 activity released from McGuire during the calendar year of interest, in uCi.

7.23E-05 = (3.17E-08) ($R_i^G[\overline{X/Q}]$) with appropriate substitutions for the adult-vegetable garden pathway, $R_i^V[\overline{X/Q}]$ for H-3. See Section 3.1.2.2.

1.04 = The factor derived from the conservative assumption (based on historical data) that 96% of the total inhalation, food and ground plane pathway dose to the maximally exposed individual is contributed by H-3 via the vegetable pathway.

C4.4.2.2 Catawba's Gaseous Contribution

Based on operational history, the Catawba fuel cycle maximum exposed individual whole body dose resulting from Catawba's gaseous effluent releases ($D_{WB}(g_c)$) is estimated using the simplified dose calculation given below:

$$D_{WB}(g_c) = (9.32E-06) (w) (Q_{Xe-133}) (S_F) (1.72)$$

where:

w = 3.0E-05, $(\overline{X/Q})$ for the plume immersion factor pathway factor in sec/m which corresponds to a location 0.5 miles NE of the Catawba site (see Table C4.0-1)

Q_{Xe-133} = The total Xe-133 activity released from Catawba during the calendar year of interest, in uCi.

9.32E-06 = (3.17E-08) ($K_i[\overline{X/Q}]$), with appropriate substitutions for whole body exposure in a semi-infinite cloud of Xe-133. See Section 1.2.1.

S_F = 0.7 = External radiation shielding factor for individuals.

1.72 = The factor derived from the conservative assumption (based on historical data) that 58% of the whole body dose to the maximally exposed individual is contributed by Xe-133.

Based on design basis operation, the Catawba fuel cycle maximum exposed individual maximum organ dose (Adult-GI-LLI) resulting from Catawba's gaseous effluent releases ($D_{MO}(g_c)$) is estimated using the simplified dose calculation given below:

$$D_{MO}(g_c) = (7.23E-05) (w) (Q_{H-3}) (1.01)$$

where:

w = 3.0E-05 = $\overline{X/Q}$ for the food and ground plane pathway in sec/m³, for a location 0.5 miles NE of the Catawba site (see Table C4.0-1).

Q_{H-3} = The total H-3 activity released from Catawba during the calendar year of interest, in uCi.

7.23E-05 = (3.17E-08) ($R_i^V[\overline{X/Q}]$) with appropriate substitutions for the adult-vegetable garden pathway factor, $R_i^V[\overline{X/Q}]$ for H-3. See Section 3.1.2.2.

1.01 = The factor derived from the assumption that 99% of the total inhalation, food and ground plane pathway dose to the maximally exposed individual is contributed by H-3 via the vegetable garden pathway.

C5.0 Radiological Environmental Monitoring

The Radiological Environmental Monitoring Program shall be conducted in accordance with Technical Specification, Section 3/4.12.

The monitoring program locations and analyses are given in Tables C5.0-1 through C5.0-3 and Figure C5.0-1.

The laboratory performing the radiological environmental analyses shall participate in an interlaboratory comparison program which has been approved by the NRC. This program is the Environmental Protection Agency's (EPA's) Environmental Radioactivity Laboratory Intercomparison Studies (crosscheck) Program, our participation code is CP.

The dates of the land-use census that was used to identify the controlling receptor locations was 06/01/90 - 07/31/90.