December 26, 1991

SUBJECT: Offsite Dose Calculation Manual
Revision 34

The General Office Radwaste Processing & Management Staff is transmitting to you this date, Revision 34 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. 51, and discard the affected pages.

Instructions:

Please replace the entire contents of Section "C" except Figure C5.0-1 (1 of 2) with the attached package.

NOTE: As this letter, with its attachments, contains "LOEP" information, please insert this in front of the December 24, 1991 letter.

Approval Date: 12/23/91	Approval Date: 12/18/91
Effective Date: 1/1/92	Effective Date: 1/1/92
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APPENDIX C

CATAWBA NUCLEAR STATION

SITE SPECIFIC INFORMATION

APPENDIX C - TABLE OF CONTENTS

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.

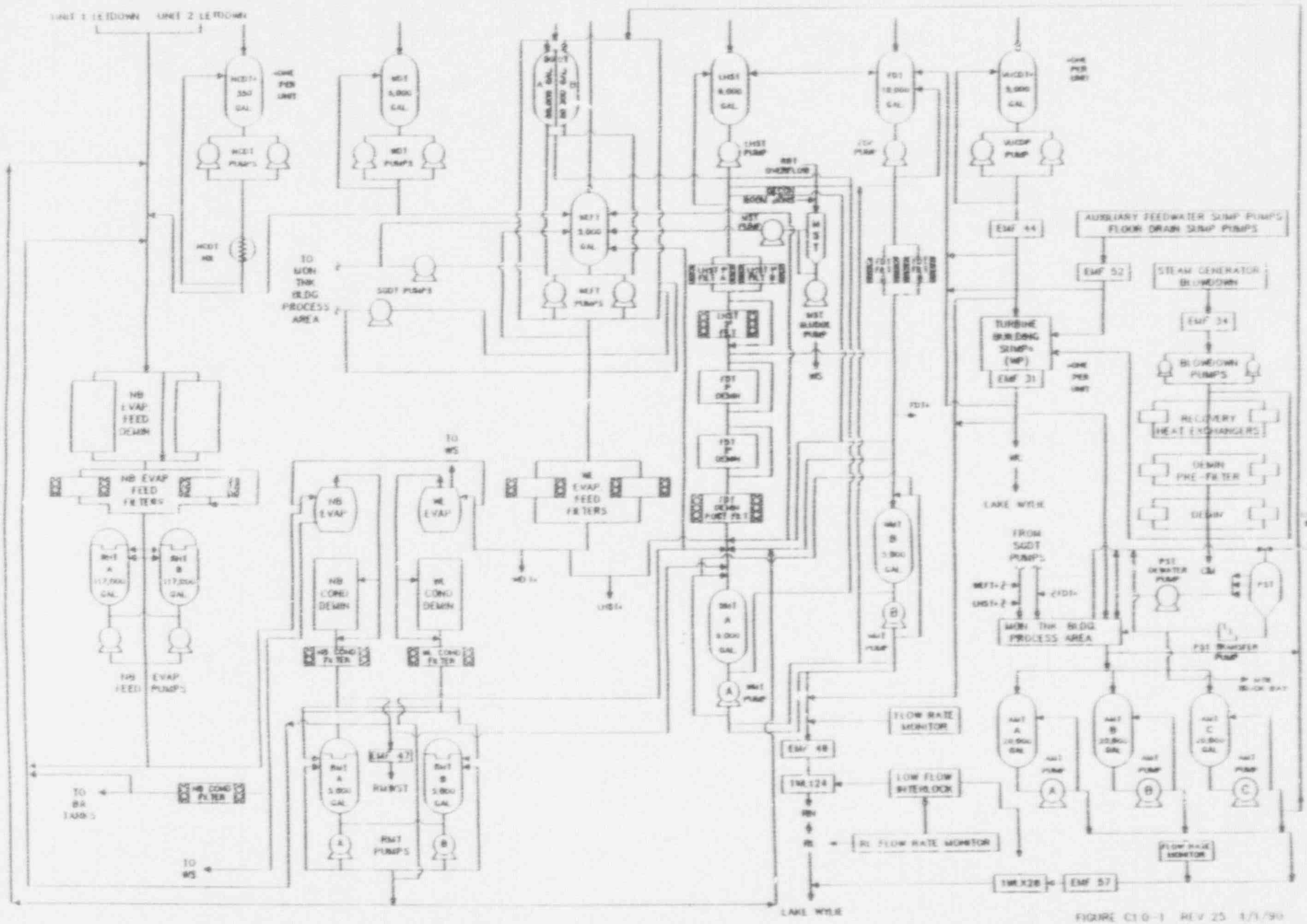


FIGURE C10-1 REV 25 1/1/90
CATAWBA NUCLEAR STATION
LIQUID RADWASTE SYSTEM

Table C1.0-1
ABBREVIATIONS

Systems:

- CM - Condensate System
- KC - Component Cooling
- NB - Boron Recycle
- RL - Low Pressure Service Water
- RN - Nuclear Service Water System
- WC - Conventional Waste Water Treatment
- WL - Liquid Waste Recycle
- WP - Turbine Building Sump
- WS - Nuclear Solid Waste Disposal

Tanks:

- BA - Boric Acid Tank
- FDT - Floor Drain Tank
- LHST - Laundry and Hot Shower Tank
- MST - Mixing and Settling Tank
- NCDT - Reactor Coolant Drain Tank
- RHT - Recycle Holdup Tank
- RMT - Recycle Monitor Tank
- RMWST - Reactor Makeup Water Storage Tank
- SGDT - Steam Generator Drain Tank
- VUCDT - Ventilation Unit Condensate Drain Tank
- WDT - Waste Drain Tank
- WEFT - Waste Evaporator Feed Tank
- WMT - Waste Monitor Tank

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

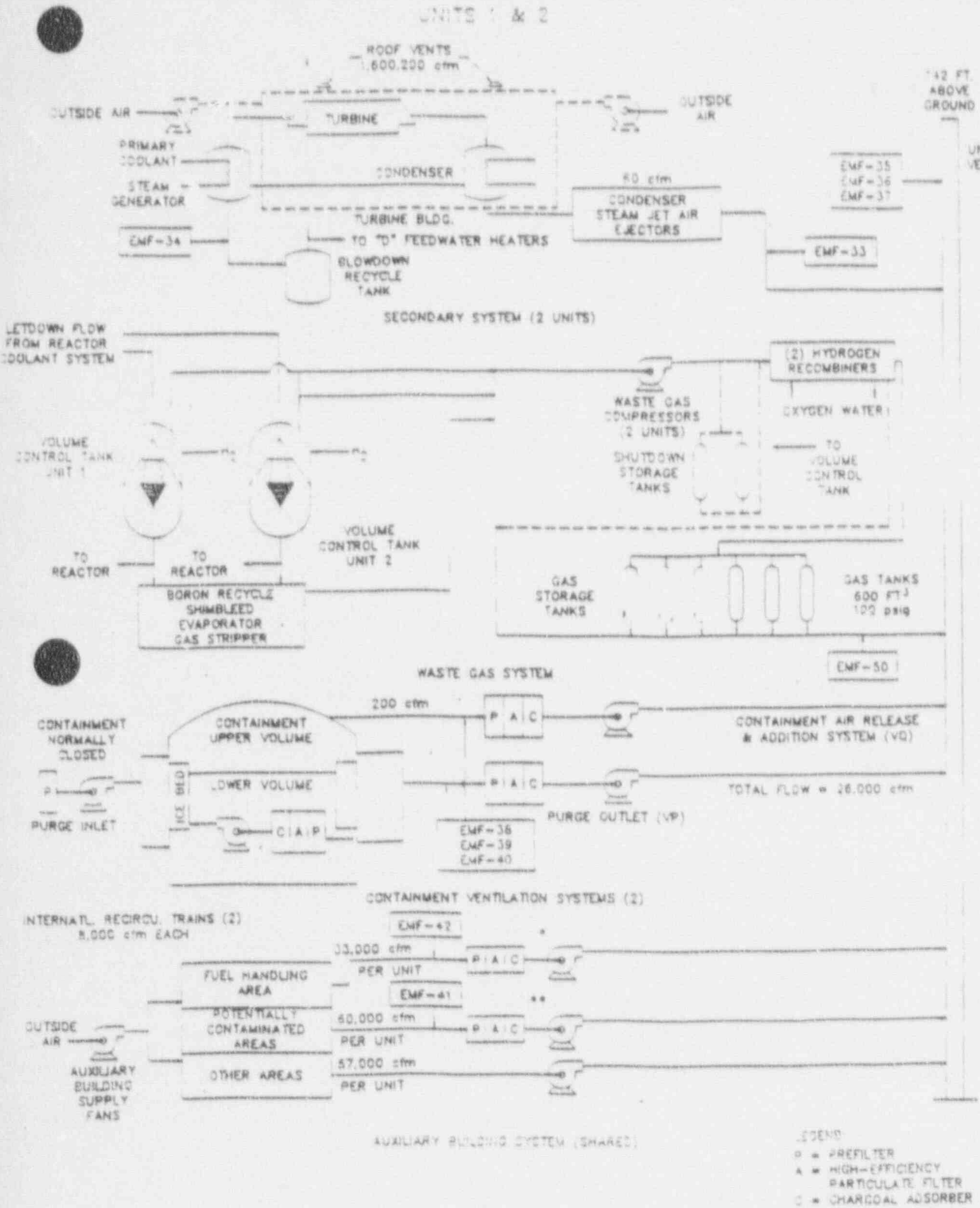
Nonrecyclable reactor coolant leakage occurring either inside the containment or inside the auxiliary building will generate gaseous activity. Gases result-ing from leakage inside the containment will be contained until the containment air is released through the VQ or VP system. The containment atmosphere 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 through 4 of the 5 condensate polishing demineralizers to remove activity and harmful ions from the water. Noncondensable gases will be taken from the secondary system by the condenser steam air ejector and are passed through a radiation monitor to the unit vent.

Figure C1.0-2 is a schematic representation of the gaseous radwaste system at Catawba.



* 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
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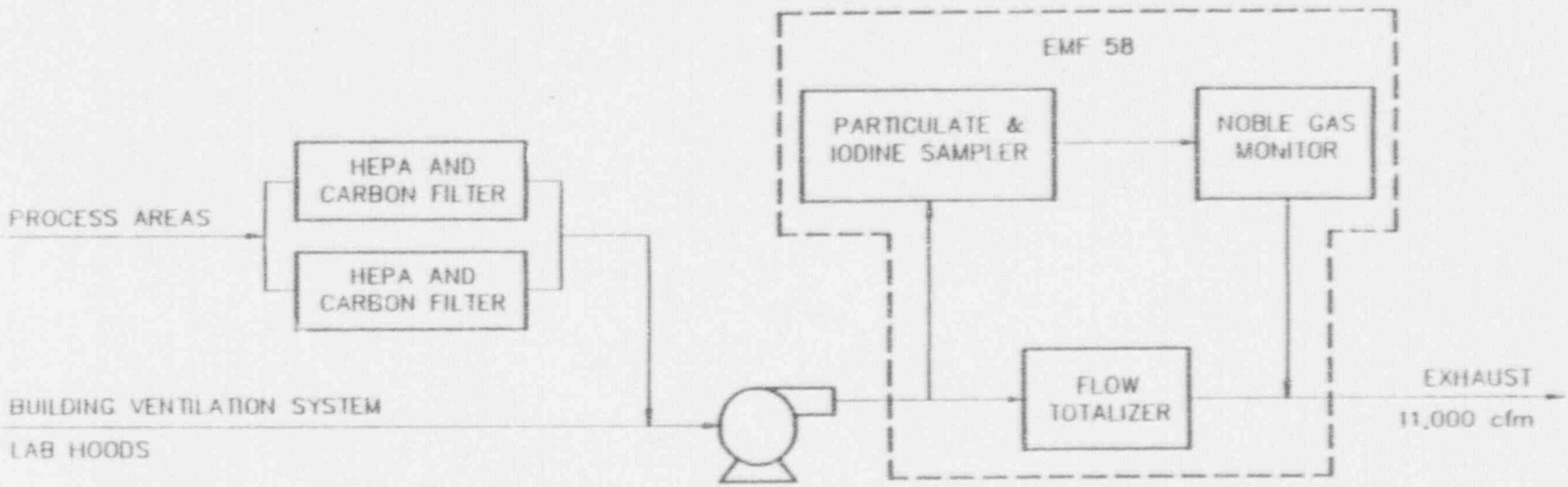
AUXILIARY MONITOR TANK BUILDING



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

REVISION 25
1/1/90

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C2.0 RELEASE RATE CALCULATION

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

C2.1 LIQUID RELEASE RATE CALCULATIONS

There are two potential release points at Catawba. They are as follows:

1. Liquid Waste Effluent Discharge Line (WL)
2. Conventional Waste Water Treatment System Effluent Line (WC)

C2.1.1 Liquid Waste Effluent Discharge Line (WL)

There are three low-pressure service water pumps with a minimum flow rate of 16,500 gpm each and four nuclear service water pumps with a minimum flow rate of 9,000 gpm each which provide the required dilution water needed for a release. The LPSW system flow rate monitor has a variable setpoint which terminates the release by closing an isolation valve should the dilution flow fall below the setpoint. Releases can either be made via EMF-49 which uses isolation valve 1WL124, or EMF-57 which uses isolation valve 1WLX28. The following is a typical equation which can be used to calculate a discharge flow, in gpm.

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

where:

f = the undiluted effluent flow, in gpm.

F_{RL} = actual low pressure service water flowrate, in gpm.

σ = the recirculation factor at equilibrium (dimensionless), 1.027.

$$\sigma = 1 + \frac{Q_R}{Q_H} = 1 + \frac{120 \text{ cfs}}{4400 \text{ cfs}} = 1.027$$

where:

Q_R = average dilution flow (120 cfs)

Q_H = average flow past Wylie Dam (4400 cfs)

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-04 μCi/ml.

X = factor used to reduce the WL flowrate (f) to allow the WC system to release simultaneously. For example, 0.9 would allow 10% of the stations releases to be WC.

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. Section Deleted 1/1/92 Revision 34

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.

C2.2 GASEOUS RELEASE RATE CALCULATIONS

The unit vent is the release point for waste gas decay tanks, containment air releases, 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 measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring measurements and/or 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 C.3.0 on radiation monitoring setpoints.

The Auxiliary Monitor Tank Building (AMTB) ventilation system and lab hoods are exhausted directly through a vent on the AMTB. The process areas of the AMTB ventilation pass through particulate and charcoal filters. The effluent is normally considered nonradioactive; however, the potential for release of radioactive effluents remains with certain job evolutions that may take place in the AMTB.

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 C2.2.1 and C2.2.2 shall control the release rate for a single release point. 98% of the controlling release rate calculated is apportioned to the unit vent and 2% is apportioned to the AMTB vent (assuring simultaneous releases from both points do not exceed the controlling release rate for a single point).

C2.2.1 Noble Gases

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

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

where the terms are defined below.

C2.2.2 Radioiodines, Particulates, and Other Radionuclides With T 1/2 > 8 Days

$$\sum_i P_i \; [W \tilde{Q}_i] < 1500 \text{ mrem/yr}$$

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 1.2-2. 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.

$(\overline{X/Q})$ = 3.10E-05 sec/m^3. The highest calculated annual average relative concentration (dispersion parameter) for any area at or beyond the unrestricted area boundary. The location is the NNE sector @ 0.5 miles.

W = The highest calculated annual average dispersion parameter for estimating the dose to an individual at a 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.

W = 3.1E-05 sec/m^3, for the inhalation pathway. The location is the NNE sector @ 0.5 miles.

W = 1.1E-07 meter^{-2}, for the food and ground plane pathways. The location is the NNE sector @ 0.5 miles.

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

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, 2.83E4 ml/ft^3

k_2 = conversion factor, 6E1 sec/min

C3.0 RADIATION MONITOR SETPOINTS

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

All radiation monitors for Catawba are off-line except EMF-50 (Waste Gas System) which is in-line. These monitors alarm on low flow; the minimum flow alarm level for both the liquid monitors and the gas monitors is based on the manufacturer's recommendations except EMF-50. These monitors measure the activity in the liquid or gas volume exposed to the detector. Liquid monitors are independent of flow rate if a minimum flow rate is assured. Gaseous monitors are dependent on pressure or vacuum. Particulate monitors are dependent on flow rates.

Radiation monitoring setpoints calculated in the following sections are expressed in activity concentrations; in reality the monitor readout is in counts per minute. Station radiation monitor setpoint procedures which correlate concentration and counts per minute shall be based on the following relationship:

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

where:

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

For those occurrences when simultaneous releases of radioactive material must be made, monitor setpoints will be adjusted downward in accordance with Station Procedures to insure that instantaneous concentrations will not be exceeded.

C3.1 LIQUID RADIATION MONITORS

C3.1.1 Waste Liquid Effluent Line - EMF 49 and EMF 57

As described in Section C2.1.1 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 determined by laboratory analyses and used to calculate the release rate. A typical radiation monitor setpoint may be calculated as follows:

$$c \leq \frac{MPC \times F}{\sigma f} \leq 2.48E\text{-}05 \ \mu Ci/ml$$

where:

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

f = the flow from the tank may vary from 0-100 gpm but, for this calculation, is assumed to be 100 gpm.

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

σ = 1.027 (See Section C2.1.1)

F = the dilution flow may vary as described in section C2.1.1, but is conservatively estimated at 25,500 gpm, the minimum flow available.

Normally, discharges from the WL system will be limited to either EMF-49 or EMF-57. Simultaneous releases may occur, however, if proper station procedures are followed to insure that instantaneous concentration limits will not be exceeded.

C3.1.2 Section Deleted 1/1/92 Revision 34

C3.1.3 <u>Auxiliary Feedwater Sump Pumps and Floor Drain Sump Pump - EMF 52</u>

As described in Section C2.1.2 on release rate calculations for the auxiliary feedwater sump pumps and floor drain sump pump effluents, it is possible that the effluent will contain measurable activity above background. It is assumed that the effluent activity is less than the monitors setpoint until indicated by a radiation alarm. Since the sumps are discharged automatically, the radiation monitor setpoint will initially be set at 1.0E-06 μCi/ml (the monitor's minimum practical setpoint) plus background to assure that no activity is unknowingly discharged into the Turbine Building sump. The set-point may be changed after initial detection to allow positive control of effluent releases using the guidance given in Section C3.1.5.

C3.1.4 <u>Steam Generator Blowdown Line - EMF 34</u>

As described in Section C2.1.2 on Release Rate Calculations for the Steam Generator Blowdown, it is possible that the effluent will contain measurable activity above its monitors setpoint. It is assumed that no activity is present in the effluent until indicated by radiation monitoring. Since the Steam Generator Blowdown line is discharged automatically, the radiation monitor setpoint will be initially set at 1.0E-06 μCi/ml (the monitor's minimum practical setpoint) plus background to assure no activity is unknowingly discharged into the Turbine Building sump. The setpoint may be changed after detection to allow positive control of effluent releases using the guidance given in Section C3.1.5.

C3.1.5 Turbine Building Sump Discharge Line - EMF 31

As described in Section C2.1.2 on release rate calculations for the turbine building sumps, it is possible that the effluent will contain measurable activity above its monitor setpoint. Since the sump contents are discharged automatically, the radiation monitor setpoint will be initially set at 1.0E-06 µCi/ml (the monitor's minimum practical setpoint) plus background to assure that no activity is unknowingly discharged into the WC system. Should radioactive effluent releases need to be made from the TBS via the WC system a typical monitor setpoint may be calculated as follows:

$$c \leq \frac{MPC \times F}{\sigma f} \leq 1.42E\text{-}06\ \mu Ci/ml$$

where:

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

f = the undiluted effluent flow in gpm; for this example the flow is from the Turbine Building Sumps and is assumed to be 250,000 gallons/day or ≈175 gpm.

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

σ = 1.027 (See Section C2.1.1)

F = the dilution flow, in gpm, available to dilute the undiluted effluent discharge flow (f); for this example it is assumed that 2550 gpm (10% of the stations RL minimum flow) will be used to dilute the discharge of the WC system. This flowrate will allow the WC system to discharge 10% of the stations MPC and dose limits.

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):

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

$\tilde{Q}_i = 4.72E{+}02\ C_i f$ (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 $\mu Ci/m^3$

$\overline{X/Q}$ = 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. The Auxiliary Monitor Tank Building (AMTB) vent is the release point for the AMTB ventilation. 98% of the single point controlling release rate is apportioned to the unit vent and 2% is apportioned to the AMTB vent.

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

$C_i < .98(116/f) = 6.46E{-}4$

where:

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

For releases from the AMTB ventilation a typical radiation monitor setpoint may be calculated as follows:

$C_i < .02(116/f) = 2.11E{-}4$

where:

f = 11,000 cfm (AMTB ventilation)

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 or the LADTAP and GASPAR computer programs. Example input templates for Catawba LADTAP and GASPAR computer program calculations are provided in Figures C4.0-1 and C4.0-2. One of these methods shall also be used for any special reports.

Station long-term historical and dose projection calculations are periodically performed to determine the station's status with respect to meeting annual ALARA goals specified in the Catawba Nuclear Station Selected Licensing Commitment Manual. Such calculations are used to verify that adequate margin remains during a report period to allow normal stations and radwaste system operation, including anticipated operational occurrences, for the remainder of the report period withouit exceeding applicable goals. Station dose projections can be performed using generic methodology, LADTAP and/or GASPAR, or simplified dose calculation methods presented in Section C4.3.

Dose calculations that are required for individual pre-release calculations, and/or abnormal releases shall not be calculated using simplified dose calculation methods. 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 sections or the LADTAP and/or GASPAR computer codes.

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 or the LADTAP and GASPAR computer programs.

C4.2 DOSE MODELS FOR MAXIMUM EXPOSED INDIVIDUAL

C4.2.1 Liquid Effluents

Generic methodology for calculating liquid pathway exposures to the maximum individual is presented in Section 3.1.1. Catawba site specific parameters to be used in the generic methodology are presented as follows:

A_{ait} = Tables C4.0-3 through C4.0-6

$F_t = (f \times \sigma) / (F + f)$ (0.027 default for projections)

Where:

f = Catawba average liquid radwaste flow, gpm (5.39E+04 default for projections - based on 120 cfs)

σ = Recirculation factor at equilibrium, 1.027

F = Catawba average dilution flow for period of interst, gpm (1.97E+06 default for projections - based on 4400 cfs)

An input template for Catawba LADTAP computer program calculations is provided in Figure C4.0-1. The input template includes default dilution parameters. Radionuclide release input (Ci/period) and optional non-default dilution flow (CFS) parameters are necessary to perform LADTAP calculations to determine offsite dose impact from specific releases during the period that dilution flow is averaged over.

C4.2.2 Gaseous Effluents

C4.2.2.1 Noble Gases

Gamma Air and Beta Air Dose

Generic methodology for calculating noble gas airborne pathway gamma air (D_γ) and beta air (D_β) doses is presented in Section 3.1.2.1. Catawba site specific parameters to be used in the generic methodology are presented as follows:

$\overline{(X/Q)}$ = 3.10E-5 sec/m^3. The highest calculated annual average relative concentration for any area at or beyond the unrestricted area boundary. The location is the NNE sector @ 0.5 miles.

An input template for Catawba GASPAR computer program noble gas airborne pathway gamma air (D_γ) and beta air (D_β) dose calculations is provided in Figure C4.0-2, Location 1. The input template includes the maximum Catawba site specific annual average relative concentration parameters. Radionuclide release input (Ci/period) and optional non-default relative concentration parameters are necessary to perform GASPAR calculations to determine offsite dose impact from specific releases.

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

Generic methodology for calculating airborne pathway maximum organ (D_{mo}) exposures to the maximum individual is presented in Section 3.1.2.2. External exposure from deposited ground contamination and inhalation exposure pathways are considered to exist at all locations offsite. Food pathways (i.e., vegetable, meat and milk) are analyzed only at locations where site surveys have verified vegetable gardens, meat producing animals, or cow/goat milk producing animals exist, however. Therefore, the location of the maximum individual may vary depending on the mixture and levels of radionuclides released during a period of time. Additionally, the critical (or limiting) age group and organ will vary based on the location (i.e., combination of dose pathways contributing dose) and mixture/level of radionuclide releases during the release period.

Performing calculations separately for all potential maximum locations, age groups and organs assures that a maximum location is identified, and that a conservative estimate is obtained for maximum offsite dose impact to any organ or age group. Catawba site specific meteorological dispersion ($\overline{X/Q}$) and deposition ($\overline{D/Q}$) parameters and applicable terrestrial/food pathways for the potential maximum locations to be analyzed using generic methodology are presented in Table C4.0-7.

An input template for Catawba GASPAR computer program airborne pathway maximum organ (D_{mo}) dose calculations is provided in Figure C4.0-3, Locations 1 - 5. Radionuclide release input (Ci/period) and optional non-default meterological parameters and pathway applicability flags are necessary to perform GASPAR calculations to determine offsite dose impact from specific releases.

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.

$$D_{WB} = 6.26E+05 \sum_{\ell=1}^{m} (F_\ell)(T_\ell)\ (C_{Cs-134} + 0.59\ C_{Cs-137})$$

where:

$$6.26E+05 = 1.14E+05\ (U_{aw}/D_w + U_{af}\ BF_i)\ DF_{ait}\ (1.08)$$

where:

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

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)

1.08 = factor derived from the assumption that 93% of dose is from Cs-134 and Cs-137 or 100% ÷ 93% = 1.08

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

And where:

T_f = The length of time, in hours, over which C_{Cs-134}, C_{Cs-137}, and F_f are averaged.

C_{Cs-134} = the average concentration of Cs-134 in undiluted effluent, in µCi/ml, during the time period considered.

C_{Cs-137} = the average concentration of Cs-137 in undiluted effluent, in µCi/ml, during the time period considered.

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

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 45% of the gamma air dose and 80% of the beta air dose.

$$D_\gamma = 3.47E\text{-}10\ [\bar{Q}]_{Xe\text{-}133}\ (2.22)$$

$$D_\beta = 1.03E\text{-}09\ [\bar{Q}]_{Xe\text{-}133}\ (1.25)$$

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/m^3, as defined in Section C2.2.2

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

2.22 = factor derived from the assumption that 45% of the gamma air dose is contributed by Xe-133.

1.25 = factor derived from the assumption that 80% 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 78% 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:

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

where:

w = 2.5E-05 = $\overline{X/Q}$ for vegetable garden pathway, in sec/m^3 from Table C4.0-1 for the controlling location (S sector at 0 [illegible] miles).

$(\bar{Q})_{H\text{-}3}$ = 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.

1.28 = factor derived from the assumption that 78% 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:

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

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

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.

A fuel cycle dose calculation worksheet is provided in Figure C.4.0-4.

C4.4.1 Liquid Effluents

Liquid pathway dose estimates are calculated using generic methodology or the LADTAP computer program. The values for $D_{WB}(l_c)$ liquid pathway dose contributions are calculated based on the methodology, values and assumptions presented in Section C4.2.1. The values for $D_{WB}(l_m)$ and $D_{MO}(l_m)$ liquid dose contributions are calculated using the LADTAP template shown in Figure A4.0-1, and using the Catawba average dilution flow value for the period of interest (4400 cfs default value).

C4.4.2 Gaseous Effluents

Total Body

The methodology for calculating noble gas airborne pathway whole body exposures to the maximum individual, D_{WB}' is derived from Section 3.1.2.1 generic methodology for gamma air and beta air dose calculations as follows:

$$D_{WB} = 3.17E\text{-}8 \sum_{i=1} K_i \, [(\overline{X/Q})Q_i] \quad \text{mrem/yr}$$

Generic methodology parameters K_i are described in Section 1.2.1. The Catawba site specific parameter X/Q value is 3.10E-5 sec/m^3 as described in Section C4.2.2.1 for Catawba gamma air and beta air dose calculations. Dose contributions by McGuire via the airborne pathway to the Catawba fuel cycle whole body dose are trivial and need not be calculated unless a significant (beyond Tech Spec) release takes place at McGuire during the period of interst.

Maximum Organ

Airborne pathway maximum organ dose estimates are calculated using generic methodology or the GASPAR computer program. The maximum organ dose is established by calculating doses to all organs for each potential maximum offsite location identified in Table C4.0-7. A conservative estimate (i.e., overestimate) of the fuel cycle maximum organ dose is obtained by 1) determining the locations with the highest exposure releases for each organ, 2) adding the highest exposure value for the airborne release to the same organ dose resulting from liquid releases, and 3) comparing values obtained when the liquid and airborne pathway components are added for all organs and age groups to determine the maximum (or limiting) organ and age group. Dose contributions by McGuire via the airborne pathway to the Catawba fuel cycle maximum organ dose are trivial and need not be calculated unless a significant (beyond Tech Spec) release takes place at McGuire during the period of interest.

TABLE C4.0-1

(1 of 2)

CATAWBA NUCLEAR STATION

DISPERSION PARAMETER ($\overline{X/Q}$) FOR LONG TERM RELEASES > 500 HR/YR OR > 125 HR/QTR

(sec/m³)

Sector	Distance to the control location, (miles) 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
N	2.6E-5	6.5E-6	2.7E-6	1.5E-6	9.7E-7	6.9E-7	5.2E-7	4.1E-7	3.3E-7	2.8E-7
NNE	3.1E-5	8.1E-6	3.3E-6	1.8E-6	1.2E-6	8.2E-7	6.2E-7	4.9E-7	4.0E-7	3.3E-7
NE	3.0E-5	7.8E-6	3.2E-6	1.8E-6	1.1E-6	8.0E-7	6.07E-7	4.7E-7	3.9E-7	3.2E-7
ENE	1.5E-5	3.9E-6	1.6E-6	8.9E-7	5.7E-7	4.1E-7	3.1E-7	2.4E-7	2.0E-7	1.6E-7
E	1.4E-5	3.7E-6	1.5E-6	8.4E-7	5.4E-7	3.8E-7	2.9E-7	2.3E-7	1.9E-7	1.6E-7
ESE	9.0E-6	2.3E-6	9.5E-7	5.3E-7	3.4E-7	2.4E-7	1.8E-7	1.4E-7	1.2E-7	9.7E-8
SE	9.2E-6	2.4E-6	9.8E [illegible]	5.4E-7	3.5E-7	2.4E-7	1.8E-7	1.4E-7	1.2E-7	9.8E-8
SSE	1.1E-5	2.9E-6	1.2E-6	6.4E-7	4.1E-7	2.9E-7	2.2E-7	1.7E-7	1.4E-7	1.1E-7
S	2.5E-5	6.4E-6	2.6E-6	1.5E-6	9.3E-7	6.6E-7	5.0E-7	3.9E-7	3.2E-7	2.7E-7
SSW	1.7E-5	4.4E-6	1.8E-6	1.0E-6	6.4E-7	4.5E-7	3.4E-7	2.7E-7	2.2E-7	1.8E-7
SW	1.3E-5	3.4E-6	1.4E-6	7.4E-7	4.7E-7	3.3E-7	2.4E-7	1.9E-7	1.5E-7	1.3E-7
WSW	7.0E-6	1.8E-6	7.2E-7	3.9E-7	2.5E-7	1.7E-7	1.3E-7	1.0E-7	8.2E-8	6.8E-8
W	8.9E-6	2.3E-6	9.3E-7	5.0E-7	3.2E-7	2.2E-7	1.7E-7	1.3E-7	1.1E-7	8.7E-8
WNW	6.6E-6	1.7E-6	6.8E-7	3.7E-7	2.4E-7	1.7E-7	1.3E-7	9.8E-8	8.0E-8	6.6E-8
NW	1.0E-5	2.6E-6	1.1E-6	5.9E-7	3.8E-7	2.7E-7	2.0E-7	1.6E-7	1.3E-7	1.1E-7
NNW	1.3E-5	3.3E-6	1.4E-6	7.5E-7	4.8E-7	3.4E-7	2.6E-7	2.0E-7	1.6E-7	1.4E-7

CATAWBA NUCLEAR STATION

he values presented in this table were generated by using the computer program OQDOQ (NUREQ/CR-2919) which implements NRC Regulatory Guide 1.111 (1977) and the ollowing assumptions:

1. Data Collection Period, 12/17/75 to 12/16/77.
2. Ground Level Releases.
3. Height of The Vent's Building = 47 meters.
4. Open Terrain Recirculation Correction Factors.

TABLE C4.0-2

(1 of 2)

CATAWBA NUCLEAR STATION

DEPOSITION PARAMETER (D/Q) FOR LONG TERM RELEASES > 500 HR/YR OR > 125 HR/QTR

(meter $^{-2}$)

Sector	Distance to the control location, (miles) 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
N	6.4E-8	1.6E-8	5.6E-9	2.8E-9	1.6E-9	1.1E-9	7.5E-10	5.6E-10	4.3E-10	3.4E-10
NNE	1.1E-7	2.7E-8	9.6E-9	4.7E-9	2.8E-9	1.8E-9	1.3E-9	9.5E-10	7.4E-10	5.8E-10
NE	1.1E-7	2.6E-8	9.3E-9	4.6E-9	2.7E-9	1.8E-9	1.3E-9	9.3E-10	7.2E-10	5.7E-10
ENE	4.1E-8	1.0E-8	3.6E-9	1.8E-9	1.1E-9	6.9E-10	4.9E-10	3.6E-10	2.8E-10	2.2E-10
E	3.6E-8	8.8E-9	3.2E-9	1.6E-9	9.3E-10	6.1E-10	4.3E-10	3.2E-10	2.4E-10	1.9E-10
ESE	2.5E-8	6.0E-9	2.2E-9	1.1E-9	6.3E-10	4.2E-10	2.9E-10	2.2E-10	1.7E-10	1.3E-10
SE	3.0E-8	7.3E-9	2.6E-9	1.3E-9	7.7E-10	5.0E-10	3.5E-10	2.6E-10	2.0E-10	1.6E-10
SSE	3.8E-8	9.3E-9	3.3E-9	1.7E-9	9.7E-10	6.4E-10	4.5E-10	3.3E-10	2.6E-10	2.0E-10
S	7.2E-8	1.8E-8	6.3E-9	3.1E-9	1.8E-9	1.2E-9	8.5E-10	6.3E-10	4.8E-10	3.8E-10
SSW	6.6E-8	1.6E-8	5.8E-9	2.9E-9	1.7E-9	1.1E-9	7.8E-10	5.8E-10	4.4E-10	3.5E-10
SW	5.7E-8	1.4E-8	5.0E-9	2.5E-9	1.5E-9	9.6E-10	6.7E-10	5.0E-10	3.9E-10	3.1E-10
WSW	2.4E-8	5.7E-9	2.1E-9	1.0E-9	6.0E-10	4.0E-10	2.8E-10	2.1E-10	1.6E-10	1.3E-10
W	2.8E-8	6.7E-9	2.4E-9	1.2E-9	7.0E-10	4.6E-10	3.2E-10	2.4E-10	1.9E-10	1.5E-10
WNW	1.9E-8	4.6E-9	1.7E-9	8.2E-10	4.8E-10	3.2E-10	2.2E-10	1.6E-10	1.3E-10	1.0E-10
NW	2.9E-8	7.0E-9	2.5E-9	1.3E-9	7.3E-10	4.8E-10	3.4E-10	2.5E-10	1.9E-10	1.5E-10
NNW	4.1E-8	9.9E-9	3.6E-9	1.8E-9	1.0E-9	6.8E-10	4.8E-10	3.6E-10	2.7E-10	2.2E-10

TABLE C4.0-2
(2 of 2)
CATAWBA NUCLEAR STATION

The values presented in this table were generated by using the computer program XOQDOQ (NUREQ/CR-2919) which implements NRC Regulatory Guide 1.111 (1977) and the following assumptions:

1. Data Collection Period, 12/17/75 to 12/16/77.

2. Ground Level Releases.

3. Height of The Vent's Building = 47 meters.

4. Open Terrain Recirculation Correction Factors.

TABLE C4.0-3

LIQUID EFFLUENT DOSE - ADULT PARAMETERS
CATAWBA NUCLEAR STATION
$A_{(i)}$ MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	0.00E+00	4.64E-01	4.64E-01	4.64E-01	4.64E-01	4.64E-01	4.64E-01
NA 24	4.11E+02	4.11E+02	4.11E+02	4.11E+02	4.11E+02	4.11E+02	4.11E+02
CR 51	0.00E+00	0.00E+00	1.28E+00	7.65E-01	2.82E-01	1.70E+00	3.22E+02
MN 54	0.00E+00	4.39E+03	8.37E+02	0.00E+00	1.31E+03	0.00E+00	1.34E+04
MN 56	0.00E+00	1.10E+02	1.96E+01	0.00E+00	1.40E+02	0.00E+00	3.52E+03
FE 55	6.65E+02	4.59E+02	1.07E+02	0.00E+00	0.00E+00	2.56E+02	2.63E+02
FE 59	1.05E+03	2.47E+03	9.45E+02	0.00E+00	0.00E+00	6.89E+02	8.22E+03
CO 58	0.00E+00	9.09E+01	2.04E+02	0.00E+00	0.00E+00	0.00E+00	1.84E+03
CO 60	0.00E+00	2.61E+02	5.76E+02	0.00E+00	0.00E+00	0.00E+00	4.90E+03
NI 63M	3.14E+04	2.18E+03	1.05E+03	0.00E+00	0.00E+00	0.00E+00	4.54E+02
NI 65	1.28E+02	1.66E+01	7.56E+00	0.00E+00	0.00E+00	0.00E+00	4.21E+02
CU 64	0.00E+00	1.02E+01	4.77E+00	0.00E+00	2.56E+01	0.00E+00	8.66E+02
ZN 65	2.32E+04	7.38E+04	3.33E+04	0.00E+00	4.93E+04	0.00E+00	4.65E+04
BR 83	0.00E+00	0.00E+00	4.05E+01	0.00E+00	0.00E+00	0.00E+00	5.83E+01
BR 85	0.00E+00	0.00E+00	2.16E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB 86	0.00E+00	1.01E+05	4.71E+04	0.00E+00	0.00E+00	0.00E+00	1.99E+04
RB 88	0.00E+00	2.90E+02	1.54E+02	0.00E+00	0.00E+00	0.00E+00	4.00E-09
RB 89	0.00E+00	1.92E+02	1.35E+02	0.00E+00	0.00E+00	0.00E+00	1.[illegible]2E-11
SR 89	2.28E+04	0.00E+00	6.55E+02	0.00E+00	0.00E+00	0.00E+00	3.66E+03
SR 90	2.84E+05	0.00E+00	7.63E+04	0.00E+00	0.00E+00	0.00E+00	1.62E+04
SR 91	4.20E+02	0.00E+00	1.70E+01	0.0[illegible]+00	0.00E+00	0.00E+00	2.00E+03
SR 92	1.59E-02	0.00E+00	6.89E+00	0.00E+00	0.00E+00	0.00E+00	3.16E+03
Y 90	5.98E-01	0.00E+00	1.60E-02	0.00E+00	0.00E+00	0.00E+00	6.34E+03
Y 91M	5.65E-03	0.00E+00	2.19E-04	0.00E+00	0.00E+00	0.00E+00	1.66E-02
Y 91	8.76E+00	0.00E+00	2.34E-01	0.00E+00	0.00E+00	0.00E+00	4.82E+03
Y 92	5.25E-02	0.00E+00	1.53E-03	0.00E+00	0.00E+00	0.00E+00	9.19E+02
Y 93	1.66E-01	0.00E+00	4.60E-03	0.00E+00	0.00E+00	0.00E+00	5.28E+03
ZR 95	3.09E-01	9.91E-02	6.71E-02	0.00E+00	1.56E-01	0.00E+00	3.14E+02
ZR 97	1.71E-02	3.45E-03	1.58E-[illegible]	0.00E+00	5.21E-03	0.00E+00	1.07E+03
NB 95	4.47E+02	2.49E+02	1.34E+02	0.00E+00	2.46E+02	0.00E+00	1.51E+06
MO 99	0.00E+00	1.13E+02	2.15E+01	0.00E+00	2.56E+02	0.00E+00	2.62E+02
TC 99M	9.43E-03	2.66E-02	3.39E-01	0.00E+00	4.05E-01	1.31E-02	1.58E+01
TC 101	9.70E-03	1.40E-02	1.37E-01	0.00E+00	2.52E-01	7.14E-03	4.20E-14

TABLE C4.0-3

(2 of 2)

LIQUID EFFLUENT DOSE - ADULT PARAMETERS
CATAWBA NUCLEAR STATION
$A_{i\tau}$ MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU 103	4.85E+00	0.00E+00	2.09E+00	0.00E+00	1.85E+01	0.00E+00	5.66E+02
RU 105	4.04E-01	0.00E+00	1.59E-01	0.00E+00	5.22E+00	0.00E+00	2.47E+02
RU 106	7.21E+01	0.00E+00	9.12E+00	0.00E+00	1.39E+02	0.00E+00	4.66E+03
AG 110M	1.24E+00	1.15E+00	6.83E-01	0.00E+00	2.26E+00	0.00E+00	4.70E+02
TE 125	2.57E+03	9.32E+02	3.45E+02	7.74E+02	1.05E+04	0.00E+00	1.03E+04
TE 127M	6.50E+03	2.32E+03	7.92E+02	1.66E+03	2.64E+04	0.00E+00	2.18E+04
TE 127	1.06E+02	3.79E+01	2.28E+01	7.82E+01	4.30E+02	0.00E+00	8.33E+03
TE 129M	1.10E+04	4.12E+03	1.75E+03	3.79E+03	4.61E+04	0.00E+00	5.56E+04
TE 129	3.01E+01	1.13E+01	7.34E+00	2.31E+01	1.27E+02	0.00E+00	2.27E+01
TE 131M	1.66E+03	8.12E+02	6.77E+02	1.29E+03	8.23E+03	0.00E+00	8.06E+04
TE 131	1.89E+01	7.90E+00	5.97E+00	1.55E+01	8.28E+01	0.00E+00	2.68E+00
TE 132	2.42E+03	1.56E+03	1.47E+03	1.73E+03	1.51E+04	0.00E+00	7.[illegible]0E+04
I 130	2.89E+01	8.51E+01	3.36E+01	7.22E+03	1.33E+02	0.00E+00	7.33E+01
I 131	1.59E+02	2.27E+02	1.30E+02	7.44E+04	3.89E+02	0.00E+00	5.99E+01
I 132	7.75E+00	2.07E+01	7.25E+00	7.25E+02	3.30E+01	0.00E+00	3.89E+00
I 133	5.42E+01	9.43E+01	2.87E+01	1.39E+04	1.65E+02	0.00E+00	8.48E+01
I 135	1.69E+01	4.43E+01	1.63E+01	2.92E+03	7.10E+01	0.00E+00	5.00E+01
CS 134	2.98E+05	7.09E+05	5.80E+05	0.00E+00	2.29E+05	7.62E+04	1.24E+04
CS 136	3.12E+04	1.23E+05	8.86E+04	0.00E+00	6.85E+04	9.39E+03	1.40E+04
CS 137	3.82E+05	5.22E+05	3.42E+05	0.00E+00	1.77E+05	5.89E+04	1.01E+04
CS 138	2.64E+02	5.22E+02	2.59E+02	0.00E+00	3.84E+02	3.79E+01	2.23E-03
BA 139	1.15E+00	8.18E-04	3.36E-02	0.00E+00	7.65E-04	4.64E-04	2.04E+00
BA 140M	2.40E+02	3.02E-01	1.58E+01	0.00E+00	1.03E-01	1.73E-01	4.95E+02
BA 141	5.58E-01	4.22E-04	1.88E-02	0.00E+00	3.92E-04	2.39E-04	2.63E-10
BA 142	2.52E-01	2.59E-04	1.59E-02	0.00E+00	2.19E-04	1.47E-04	3.55E-19
LA 140	1.55E-01	7.83E-02	2.07E-02	0.00E+00	0.00E+00	0.00E+00	5.75E+03
LA 142	7.95E-03	3.62E-03	9.01E-04	0.00E+00	0.00E+00	0.00E+00	2.64E+01
CE 141	4.36E-02	2.95E-02	3.35E-03	0.00E+00	1.37E-02	0.00E+00	1.13E+02
CE 143	7.69E-03	5.69E+00	6.29E-04	0.00E+00	2.50E-03	0.00E+00	2.13E+02
CE 144	2.27E+00	9.51E-01	1.22E-01	0.00E+00	5.64E-01	0.00E+00	7.69E+02
PR 143	5.71E-01	2.29E-01	2.83E-02	0.00E+00	1.32E-01	0.00E+00	2.50E+03
PR 144	1.87E-03	7.76E-04	9.50E-05	0.00E+00	4.38E-04	0.00E+00	2.69E-10
ND 147	3.91E-01	4.52E-01	2.70E-02	0.00E+00	2.64E-01	0.00E+00	2.17E+03
W 187	2.96E+02	2.48E+02	8.65E+01	0.00E+00	0.00E+00	0.00E+00	8.11E+04
NP 239	3.12E-02	3.07E-03	1.69E-03	0.00E+00	9.57E-03	0.00E+00	6.29E+02

TABLE C4.0-4

(1 of 2)

LIQUID EFFLUENT DOSE - TEEN PARAMETERS
CATAWBA NUCLEAR STATION
A_{it} MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	0.00E+00	3.42E-01	3.42E-01	3.42E-01	3.42E-01	3.42E-01	3.42E-01
NA 24	4.23E+02	4.23E+02	4.23E+02	4.23E+02	4.23E+02	4.23E+02	4.23E+02
CR 51	0.00E+00	0.00E+00	1.32E+00	7.33E-01	2.89E-01	1.88E+00	2.22E+02
MN 54	0.00E+00	4.31E+03	8.55E+02	0.00E+00	1.29E+03	0.00E+00	8.85E+03
MN 56	0.00E+00	1.16E+02	2.05E+01	0.00E+00	1.46E+02	0.00E+00	7.60E+03
FE 55	6.95E+02	4.93E+02	1.15E+02	0.00E+00	0.00E+00	3.13E+02	2.13E+02
FE 59	1.08E+03	2.52E+03	9.73E+02	0.00E+00	0.00E+00	7.95E+02	5.96E+03
CO 58	0.00E+00	9.02E+01	2.08E+02	0.00E+00	0.00E+00	0.00E+00	1.24E+03
CO 60	0.00E+00	2.61E+02	5.87E+02	0.00E+00	0.00E+00	0.00E+00	3.40E+03
NI 63M	3.26E+04	2.30E+03	1.10E+03	0.00E+00	0.00E+00	0.00E+00	3.66E+02
NI 65	1.38E+02	1.76E+01	8.02E+00	0.00E+00	0.00E+00	0.00E+00	9.55E+02
CU 64	0.00E+00	1.07E+01	5.02E+00	0.00E+00	2.70E+01	0.00E+00	8.28E+02
ZN 65	2.10E+04	7.30E+04	3.41E+04	0.00E+00	4.67E+04	0.00E+00	3.09E+04
BR 83	0.00E+00	0.00E+00	4.41E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR 85	0.00E+00	0.00E+00	2.34E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB 86	0.00E+00	1.09E+05	5.11E+04	0.00E+00	0.00E+00	0.00E+00	1.61E+04
RB 88	0.00E+00	3.11E+02	1.66E+02	0.00E+00	0.00E+00	0.00E+00	2.66E-05
RB 89	0.00E+00	2.01E+02	1.42E+02	0.00E+00	0.00E+00	0.00E+00	3.08E-07
SR 89	2.48E+04	0.00E+00	7.09E+02	0.00E+00	0.00E+00	0.00E+00	2.95E+03
SR 90	2.52E+05	0.00E+00	6.76E+04	0.00E+00	0.00E+00	0.00E+00	1.31E+04
SR 91	4.54E+02	0.00E+00	1.81E+01	0.00E+00	0.00E+00	0.00E+00	2.06E+03
SP 92	1.72E+02	0.00E+00	7.32E+00	0.00E+00	0.00E+00	0.00E+00	4.37E+03
Y 90	6.46E-01	0.00E+00	1.74E-02	0.00E+00	0.00E+00	0.00E+00	5.33E+03
Y 91M	6.09E-03	0.00E+00	2.33E-04	0.00E+00	0.00E+00	0.00E+00	2.87E-01
Y 91	9.48E+00	0.00E+00	2.54E-01	0.00E+00	0.00E+00	0.00E+00	3.89E+03
Y 92	5.71E-02	0.00E+00	1.65E-03	0.00E+00	0.00E+00	0.00E+00	1.57E+03
Y 93	1.81E-01	0.00E+00	4.95E-03	0.00E+00	0.00E+00	0.00E+00	5.52E+03
ZR 95	3.13E-01	9.88E-02	6.80E-02	0.00E+00	1.45E-01	0.00E+00	2.28E+02
ZR 97	1.80E-02	3.57E-03	1.64E-03	0.00E+00	5.41E-03	0.00E+00	9.66E+02
NB 95	4.50E+02	2.50E+02	1.37E+02	0.00E+00	2.42E+02	0.00E+00	1.07E+06
MC 99	0.00E+00	1.20E+02	2.28E+01	0.00E+00	2.74E+02	0.00E+00	2.14E+02
TC 99M	9.61E-03	2.68E-02	3.47E-01	0.00E+00	3.99E-01	1.49E-02	1.76E+01
TC 101	1.04E-02	1.48E-02	1.46E-01	0.00E+00	2.68E-01	9.03E-03	2.53E-09

TABLE C4.0-4

(1 of 2)

LIQUID EFFLUENT DOSE - TEEN PARAMETERS
CATAWBA NUCLEAR STATION
A_{it} MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU 103	5.06E+00	0.00E+00	2.16E+00	0.00E+00	1.78E+01	0.00E+00	4.22E+02
RU 105	4.32E-01	0.00E+00	1.68E-01	0.00E+00	5.45E+00	0.00E+00	3.49E+02
RU 106	7.77E+01	0.00E+00	9.79E+00	0.00E+00	1.50E+02	0.00E+00	3.73E+03
AG 110M	1.18E+00	1.12E+00	6.82E-01	0.00E+00	2.14E+00	0.00E+00	3.15E+02
TE 125	2.80E+03	1.01E+03	3.74E+02	7.82E+02	0.00E+00	0.00E+00	8.26E+03
TE 127M	7.07E+03	2.51E+03	8.41E+02	1.68E+03	2.87E+04	0.00E+00	1.76E+04
TE 127	1.16E+02	4.09E+01	2.49E+01	7.97E+01	4.68E+02	0.00E+00	8.92E+03
TE 129M	1.19E+04	4.42E+03	1.89E+03	3.85E+03	4.99E+04	0.00E+00	4.47E+04
TE 129	3.28E+01	1.22E+01	7.97E+00	2.34E+01	1.37E+02	0.00E+00	1.79E+02
TE 131M	1.78E+03	8.55E+02	7.14E+02	1.29E+03	8.92E+03	0.00E+00	6.87E+04
TE 131	2.04E+01	8.41E+00	6.38E+00	1.57E+01	8.92E+01	0.00E+00	1.67E+00
TE 132	2.55E+03	1.62E+03	1.52E+03	1.70E+03	1.55E+04	0.00E+00	5.12E+04
I 130	2.98E+01	8.63E+01	3.44E+01	7.03E+03	1.33E+02	0.00E+00	6.63E+01
I 131	1.69E+02	2.37E+02	1.27E+02	6.92E+04	4.08E+02	0.00E+00	4.69E+01
I 132	8.08E+00	2.11E+01	7.58E+00	7.12E+02	3.33E+01	0.00E+00	9.20E+00
I 133	5.82E+01	9.87E+01	3.01E+01	1.38E+04	1.73E+02	0.00E+00	7.47E+01
I 135	1.77E+01	4.54E+01	1.68E+01	2.92E+03	7.18E+01	0.00E+00	5.04E+01
CS 134	3.05E+05	7.19E+05	3.34E+05	0.00E+00	2.28E+05	8.72E+04	8.94E+03
CS 136	3.13E+04	1.23E+05	8.28E+04	0.00E+00	6.72E+04	1.06E+04	9.93E+03
CS 137	4.09E+05	5.44E+05	1.89E+05	0.00E+00	1.85E+05	7.19E+04	7.74E+03
CS 138	2.83E+02	5.44E+02	2.72E+02	0.00E+00	4.01E+02	4.67E+01	2.47E-01
BA 139	1.23E+00	8.66E-04	3.60E-02	0.00E+00	8.19E-04	5.99E-04	1.10E+01
BA 140M	2.52E+02	3.09E-01	1.63E+01	0.00E+00	1.05E-01	2.08E-01	3.89E+02
BA 141	5.96E-01	4.45E-04	1.99E-02	0.00E+00	4.13E-04	3.05E-04	1.27E-06
BA 142	2.66E-01	2.66E-04	1.63E-02	0.00E+00	2.25E-04	1.77E-04	8.15E-13
LA 140	1.64E-01	8.07E-02	2.15E-02	0.00E+00	0.00E+00	0.00E+00	4.63E+03
LA 142	8.45E-03	3.75E-03	9.34E-04	0.00E+00	0.00E+00	0.00E+00	1.14E+02
CE 141	4.53E-02	3.03E-02	3.48E-03	0.00E+00	1.42E-02	0.00E+00	8.66E+01
CE 143	8.01E-03	5.83E+00	6.51E-04	0.00E+00	2.61E-03	0.00E+00	1.75E+02
CE 144	2.37E+00	9.82E-01	1.27E-01	0.00E+00	5.86E-01	0.00E+00	5.96E+02
PR 143	6.18E-01	2.47E-01	3.08E-02	0.00E+00	1.43E-01	0.00E+00	2.03E+03
PR 144	2.03E-03	8.30E-04	1.03E-04	0.00E+00	4.77E-04	0.00E+00	2.24E-06
ND 147	4.43E-01	4.81E-01	2.88E-02	0.00E+00	2.83E-01	0.00E+00	1.74E+03
W 187	3.20E+02	2.61E+02	9.13E+01	0.00E+00	0.00E+00	0.00E+00	7.05E+04
NP 239	3.49E-02	3.29E-03	1.83E-03	0.00E+00	1.03E-02	0.00E+00	5.29E+02

TABLE C4.0-5

(1 of 2)

LIQUID EFFLUENT DOSE - CHILD PARAMETERS
CATAWBA NUCLEAR STATION
$A_{i\tau}$ MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	0.00E+00	4.65E-01	4.65E-01	4.65E-01	4.65E-01	4.65E-01	4.65E-01
NA 24	4.65E+02	4.65E+02	4.65E+02	4.65E+02	4.65E+02	4.65E+02	4.65E+02
CR 51	0.00E+00	0.00E+00	1.41E+00	7.85E-01	2.15E-01	1.43E+00	7.50E+01
MN 54	0.00E+00	3.38E+03	9.01E+02	0.00E+00	9.49E+02	0.00E+00	2.84E+03
MN 56	0.00E+00	1.06E+02	2.38E+01	0.00E+00	1.28E+02	0.00E+00	1.53E+04
FE 55	9.23E+02	4.89E+02	1.52E+02	0.00E+00	0.00E+00	2.77E+02	9.07E+01
FE 59	1.32E+03	2.14E+03	1.07E+03	0.00E+00	0.00E+00	6.21E+02	2.23E+03
CO 58	0.00E+00	7.36E+01	2.25E+02	0.00E+00	0.00E+00	0.00E+00	4.30E+02
CO 60	0.00E+00	2.16E+02	6.38E+02	0.00E+00	0.00E+00	0.00E+00	1.20E+03
NI 63M	4.32E+04	2.31E+03	1.47E+03	0.00E+00	0.00E+00	0.00E+00	1.56E+02
NI 65	1.78E+02	1.68E+01	9.79E+00	0.00E+00	0.00E+00	0.00E+00	2.05E+03
CU 64	0.00E+00	1.00E+01	6.06E+00	0.00E+00	2.42E+01	0.00E+00	4.71E+02
ZN 65	2.16E+04	5.75E+04	3.57E+04	0.00E+00	3.62E+04	0.00E+00	1.01E+04
BR 83	0.00E+00	0.00E+00	5.68E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR 85	0.00E+00	0.00E+00	3.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB 86	0.00E+00	1.06E+05	6.49E+04	0.00E+00	0.00E+00	0.00E+00	6.79E+03
RB 88	0.00E+00	2.99E+02	2.08E+02	0.00E+00	0.00E+00	0.00E+00	1.47E+01
RB 89	0.00E+00	1.84E+02	1.64E+02	0.00E+00	0.00E+00	0.00E+00	1.61E+00
SR 89	3.32E+04	0.00E+00	9.49E+02	0.00E+00	0.00E+00	0.00E+00	1.29E+03
SR 90	2.85E+05	0.00E+00	7.63E+04	0.00E+00	0.00E+00	0.00E+00	5.77E+03
SR 91	6.04E+02	0.00E+00	2.28E+01	0.00E+00	0.00E+00	0.00E+00	1.33E+03
SR 92	2.27E+02	0.00E+00	9.12E+00	0.00E+00	0.00E+00	0.00E+00	4.31E+03
Y 90	8.73E-01	0.00E+00	2.34E-02	0.00E+00	0.00E+00	0.00E+00	2.49E+03
Y 91M	8.12E-03	0.00E+00	2.95E-04	0.00E+00	0.00E+00	0.00E+00	1.59E+01
Y 91	1.28E+01	0.00E+00	3.42E-01	0.00E+00	0.00E+00	0.00E+00	1.70E+03
Y 92	7.65E-02	0.00E+00	2.19E-03	0.00E+00	0.00E+00	0.00E+00	2.21E+03
Y 93	2.42E-01	0.00E+00	6.65E-03	0.00E+00	0.00E+00	0.00E+00	3.61E+03
ZR 95	4.85E-01	1.07E-01	9.49E-02	0.00E+00	1.53E-01	0.00E+00	1.11E+02
ZR 97	2.92E-02	4.22E-03	2.49E-03	0.00E+00	6.06E-03	0.00E+00	6.40E+02
NB 95	5.31E+02	2.07E+02	1.48E+02	0.00E+00	1.94E+02	0.00E+00	3.82E+05
MO 99	0.00E+00	1.26E+02	3.11E+01	0.00E+00	2.68E+02	0.00E+00	1.04E+02
TC 99M	1.24E-02	2.42E-02	4.01E-01	0.00E+00	3.52E-01	1.23E-02	1.38E+01
TC 101	1.43E-02	1.50E-02	1.90E-01	0.00E+00	2.56E-01	7.92E-03	4.76E-02

TABLE C4.0-5

(2 of 2)

LIQUID EFFLUENT DOSE - CHILD PARAMETERS
CATAWBA NUCLEAR STATION
A_{it} MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU 103	6.91E+00	0.00E+00	2.66E+00	0.00E+00	1.74E+01	0.00E+00	1.79E+02
RU 105	6.10E-01	0.00E+00	2.21E-01	0.00E+00	5.36E+00	0.00E+00	3.98E+02
RU 106	1.11E+02	0.00E+00	1.38E+01	0.00E+00	1.49E+02	0.00E+00	1.72E+03
AG 110[illegible]	[illegible]83E+00	1.24E+00	9.87E-01	0.00E+00	2.30E+00	0.00E+00	1.47E+02
TE 125	3.60E+03	9.77E+02	4.81E+02	1.01E+03	0.00E+00	0.00E+00	3.48E+03
TE 127M	9.14E+03	2.46E+03	1.08E+03	2.19E+03	2.61E+04	0.00E+00	7.40E+03
TE 127	1.49E+02	4.02E+01	3.19E+01	1.03E+02	4.24E+02	0.00E+00	5.82E+03
TE 129M	1.54E+04	4.30E+03	2.39E+03	4.96E+03	4.52E+04	0.00E+00	1.88E+04
TE 129	4.24E+01	1.18E+01	1.01E+01	3.02E+01	1.24E+02	0.00E+00	2.64E+03
TE 131M	2.28E+03	7.87E+02	8.38E+02	1.62E+03	7.62E+03	0.00E+00	3.19E+04
TE 131	2.62E+01	8.00E+00	7.81E+00	2.01E+01	7.94E+01	0.00E+00	1.38E+02
TE 132	3.19E+03	1.41E+03	1.71E+03	2.06E+03	1.31E+04	0.00E+00	1.42E+04
I 130	3.91E+01	7.90E+01	4.07E+01	8.70E+03	1.18E+02	0.00E+00	3.69E+01
I 131	2.30E+02	2.32E+02	1.32E+02	7.66E+04	3.80E+02	0.00E+00	2.06E+01
I 132	1.07E+01	1.97E+01	9.05E+00	9.13E+02	3.01E+01	0.00E+00	2.32E+01
I 133	7.92E+01	9.80E+01	3.71E+01	1.82E+04	1.63E+02	0.00E+00	3.95E+01
I 135	2.34E+01	4.22E+01	1.99E+01	3.73E+03	6.46E+01	0.00E+00	3.21E+01
CS 134	3.68E+05	6.05E+05	1.28E+05	0.00E+00	1.87E+05	6.72E+04	3.26E+03
CS 136	3.70E+04	1.02E+05	6.58E+04	0.00E+00	5.42E+04	8.08E+03	3.57E+03
CS 137	5.15E+05	4.93E+05	7.28E+04	0.00E+00	1.61E+05	5.78E+04	3.09E+03
CS 138	3.59E+02	4.99E+02	3.17E+02	0.00E+00	3.51E+02	3.78E+01	2.30E+02
BA 139	1.96E+00	1.05E-03	5.68E-02	0.00E+00	9.13E-04	6.15E-04	1.13E+02
BA 140M	3.93E+02	3.44E-01	2.29E+01	0.00E+00	1.12E-01	2.05E-01	1.99E+02
BA 141	9.46E-01	5.30E-04	3.08E-02	0.00E+00	4.58E-04	3.11E-03	5.39E-01
BA 142	4.13E-01	2.98E-04	2.31E-02	0.00E+00	2.41E-04	1.75E-04	5.39E-03
LA 140	2.15E-01	7.50E-02	2.53E-02	0.00E+00	0.00E+00	0.00E+00	2.09E+03
LA 142	1.11E-02	3.55E-03	1.11E-03	0.00E+00	0.00E+00	0.00E+00	7.03E+02
CE 141	9.41E-02	4.69E-02	6.97E-03	0.00E+00	2.06E-02	0.00E+00	5.86E+01
CE 143	1.66E-02	8.99E+00	1.30E-03	0.00E+00	3.77E-03	0.00E+00	1.32E+02
CE 144	4.93E+00	1.55E+00	2.63E-01	0.00E+00	8.56E-01	0.00E+00	4.03E+02
PR 143	8.35E-01	2.51E-01	4.14E-02	0.00E+00	1.36E-01	0.00E+00	9.01E+02
PR 144	2.74E-03	8.48E-04	1.38E-04	0.00E+00	4.48E-04	0.00E+00	1.63E+00
ND 147	5.93E-01	4.80E-01	3.72E-02	0.00E+00	2.63E-01	0.00E+00	7.61E+02
W 187	4.06E+02	2.40E+02	1.08E+02	0.00E+00	0.00E+00	0.00E+00	3.38E+04
NP 239	4.96E-02	3.56E-03	2.50E-03	0.00E+00	1.03E-02	0.00E+00	2.64E+02

TABLE C4.0-6

(1 of 2)

LIQUID EFFLUENT DOSE - INFANT PARAMETERS
CATAWBA NUCLEAR STATION
A_{io} MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	0.00E+00	3.16E-01	3.16E-01	3.16E-01	3.16E-01	3.16E-01	3.16E-01
NA 24	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01	1.04E+01
CR 51	0.00E+00	0.00E+00	1.45E-02	9.43E-03	2.06E-03	1.83E-02	4.21E-01
MN 54	0.00E+00	2.04E+01	4.62E+00	0.00E+00	4.52E+00	0.00E+00	7.49E+00
MN 56	0.00E+00	8.39E-01	1.45E-01	0.00E+00	7.21E-01	0.00E+00	7.62E+01
FE 55	1.42E+01	9.21E+00	2.46E+00	0.00E+00	0.00E+00	4.50E+00	1.17E+00
FE 59	3.16E+01	5.51E+01	2.17E+01	0.00E+00	0.00E+00	1.63E+01	2.63E+01
CO 58	0.00E+00	3.69E+00	9.21E+00	0.00E+00	0.00E+00	0.00E+00	9.19E+00
CO 60	0.00E+00	1.11E+01	2.61E+01	0.00E+00	0.00E+00	0.00E+00	2.63E+01
NI 63M	6.50E+02	4.02E+01	2.26E+01	0.00E+00	0.00E+00	0.00E+00	2.00E+00
NI 65	4.82E+00	5.45E-01	2.48E-01	0.00E+00	0.00E+00	0.00E+00	4.15E+01
CU 64	0.00E+00	6.24E-01	2.89E-01	0.00E+00	1.06E+00	0.00E+00	1.28E+01
ZN 65	1.89E+01	6.47E+01	2.98E+01	0.00E+00	3.14E+01	0.00E+00	5.46E+01
BR 83	0.00E+00	0.00E+00	3.72E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BR 85	0.00E+00	0.00E+00	1.99E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RB 86	0.00E+00	1.74E+02	8.61E+01	0.00E+00	0.00E+00	0.00E+00	4.46E+00
RB 88	0.00E+00	5.10E-01	2.80E-01	0.00E+00	0.00E+00	0.00E+00	4.97E-01
RB 89	0.00E+00	2.93E-01	2.02E-01	0.00E+00	0.00E+00	0.00E+00	9.98E-02
SR 89	2.57E+03	0.00E+00	7.38E+01	0.00E+00	0.00E+00	0.00E+00	5.29E+01
SR 90	1.28E+04	0.00E+00	3.45E+03	0.00E+00	0.00E+00	0.00E+00	2.37E+02
SR 91	5.13E+01	0.00E+00	1.86E+00	0.00E+00	0.00E+00	0.00E+00	6.07E+01
SR 92	1.97E+01	0.00E+00	7.31E-01	0.00E+00	0.00E+00	0.00E+00	2.12E+02
Y 90	8.91E-02	0.00E+00	2.39E-03	0.00E+00	0.00E+00	0.00E+00	1.23E+02
Y 91M	8.30E-04	0.00E+00	2.83E-05	0.00E+00	0.00E+00	0.00E+00	2.77E+00
Y 91	1.16E+00	0.00E+00	3.09E-02	0.00E+00	0.00E+00	0.00E+00	8.30E+01
Y 92	7.84E-03	0.00E+00	2.20E-04	0.00E+00	0.00E+00	0.00E+00	1.50E+02
Y 93	2.49E-02	0.00E+00	6.79E-04	0.00E+00	0.00E+00	0.00E+00	1.97E+02
ZR 95	2.11E-01	5.15E-02	3.65E-02	0.00E+00	5.55E-02	0.00E+00	2.56E+01
ZR 97	1.52E-02	2.60E-03	1.19E-03	0.00E+00	2.62E-03	0.00E+00	1.66E+02
NB 95	4.31E-02	1.77E-02	1.03E-02	0.00E+00	1.27E-02	0.00E+00	1.50E+01
MO 99	0.00E+00	3.49E+01	6.80E+00	0.00E+00	5.21E+01	0.00E+00	1.15E+01
TC 99M	1.97E-03	4.06E-03	5.23E-02	0.00E+00	4.37E-02	2.12E-03	1.18E+00
TC 101	2.33E-03	2.93E-03	2.90E-02	0.00E+00	3.49E-02	1.60E-03	4.98E-01

TABLE C4.0-6

(2 of 2)

LIQUID EFFLUENT DOSE – INFANT PARAMETERS
CATAWBA NUCLEAR STATION
$A_{i\tau}$ MREM/HR PER UCI/ML

NUCLIDE	BONE	LIVER	T. BODY	THYROID	KIDNEY	LUNG	GI-LLI
RU 103	1.52E+00	0.00E+00	5.07E-01	0.00E+00	3.16E+00	0.00E+00	1.85E+01
RU 105	1.39E-01	0.00E+00	4.69E-02	0.00E+00	1.03E+00	0.00E+00	5.55E+01
RU 106	2.47E+01	0.00E+00	3.09E+00	0.00E+00	2.92E+01	0.00E+00	1.88E+02
AG 110M	1.02E+00	7.45E-01	4.93E-01	0.00E+00	1.07E+00	0.00E+00	3.86E+01
TE 125	2.39E+01	7.99E+00	3.23E+00	8.04E+00	0.00E+00	0.00E+00	1.14E+01
TE 127M	6.00E+01	1.99E+01	[illegible].26E+00	1.73E+01	1.48E+02	0.00E+00	2.42E+01
TE 127	1.03E+00	3.43E-01	2.20E-01	8.34E-01	2.50E+00	0.00E+00	2.15E+01
TE 129M	1.03E+02	3.52E+01	1.58E+01	3.94E+01	2.56E+02	0.00E+00	6.12E+01
TE 129	2.91E-01	1.00E-01	6.80E-02	2.44E-01	7.25E-01	0.00E+00	2.33E+01
TE 131M	1.56E+01	6.27E+00	5.18E+00	1.27E+01	4.32E+01	0.00E+00	1.06E+02
TE 131	1.80E-01	6.66E-02	5.06E-02	1.61E-01	4.61E-01	0.00E+00	7.29E+00
TE 132	2.13E+01	1.06E+01	9.85E+00	1.56E+01	6.60E+01	0.00E+00	3.91E+01
I 130	6.15E+00	1.35E+01	5.43E+00	1.52E+03	1.49E+01	0.00E+00	2.90E+00
I 131	3.68E+01	4.34E+01	1.91E+01	1.42E+04	5.06E+01	0.00E+00	1.55E+00
I 132	1.70E+00	3.45E+00	1.23E+00	1.62E+02	3.85E+00	0.00E+00	2.80E+00
I 133	1.28E+01	1.87E+01	5.46E+00	3.39E+03	2.19E+01	0.00E+00	3.16E+00
I 135	3.73E+00	7.42E+00	2.71E+00	6.65E+02	8.27E+00	0.00E+00	2.69E+00
CS 134	3.86E+02	7.21E+02	7.28E+01	0.00E+00	1.86E+02	7.61E+01	1.96E+00
CS 136	4.71E+01	1.38E+02	5.17E+01	0.00E+00	5.51E+01	1.13E+01	2.10E+00
CS 137	5.35E+02	6.26E+02	4.44E+01	0.00E+00	1.6[illegible]E+02	6.81E+01	1.96E+00
CS 138	4.93E-01	8.0[illegible]E-01	3.89E-01	0.00E+00	4.00E-01	6.24E-02	1.28E+00
BA 139	9.03E-01	5.99E-04	2.61E-02	0.00E+00	3.60E-04	3.63E-04	5.72E+01
BA 140M	1.75E+02	1.75E-01	9.03E+00	0.00E+00	4.16E-02	1.08E-01	4.31E+01
BA 141	4.36E-01	2.98E-04	1.37E-02	0.00E+00	1.79E-04	1.81E-04	5.32E+00
BA 142	1.89E-01	1.57E-04	9.29E-03	0.00E+00	9.03E-05	9.49E-05	7.78E-01
LA 140	2.16E-02	8.53E-03	2.19E-03	0.00E+00	0.00E+00	0.00E+00	1.00E+02
LA 142	1.13E-03	4.14E-04	9.91E-05	0.00E+00	0.00E+00	0.00E+00	7.03E+01
CE 141	8.07E-02	4.92E-02	5.79E-03	0.00E+00	1.52E-02	0.00E+00	2.54E+01
CE 143	1.52E-02	1.01E+01	1.15E-03	0.00E+00	2.93E-03	0.00E+00	5.87E+01
CE 144	3.05E+00	1.25E+00	1.71E-01	0.00E+00	5.05E-01	0.00E+00	1.75E+02
PR 143	8.33E-02	3.12E-02	4.13E-03	0.00E+00	1.16E-02	0.00E+00	4.40E+01
PR 144	2.81E-04	1.09E-04	1.41E-05	0.00E+00	3.94E-05	0.00E+00	5.05E+00
ND 147	5.67E-02	5.82E-02	3.57E-03	0.00E+00	2.24E-02	0.00E+00	3.69E+01
W 187	9.26E-01	6.44E-01	2.22E-01	0.00E+00	0.00E+00	0.00E+00	3.78E+01
NP 239	1.14E-02	1.02E-03	5.75E-04	0.00E+00	2.03E-03	0.00E+00	2.94E+01

Table C4.0-7 - Meteorological Parameter and Applicable Pathways for Potential Worst-case Offsite Locations

Worst-Case Locations *

	$(\overline{X/Q})$	$(\overline{D/Q})$	Applicable Food Pathways**
(1) Inhalation, Ground Site Boundary, NNE	3.1E-5	1.1E-7	
(2) Garden, 0.9 mi, S	2.5E-5	7.2E-8	Veg
(3) Meat Animal, 2.3 mi, NNW	7.5E-7	1.8E-9	Meat
(4) Milk Animal, ***	X.XE-X	X.XE-X	***
(5) Combination, 5.0 mi, NNE	3.3E-7	5.8E-10	Veg, Meat, Goat Milk

* Based on August 1991 Land Use Census Data (See Table C4.0-8)

** The food pathways to be included for exposure contribution to the maximum individual at this location. Inhalation and ground exposure pathways also considered at all locations.

*** No milk animal is currently located within 5.0 miles of Catawba Nuclear Station

TABLE C4.0-8

PATHWAY APPLICABILITY FOR ALL LOCATIONS BASED ON SITE SURVEY
CATAWBA NUCLEAR STATION

SECTOR	Distance to the control location in miles									
	0-0.5*	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0**
N	X	X	V	V	V	V	V	V	V	VMG
NNE	X	X	X	X	X	X	X	X	X	VMG
NE	X	X	X	X	X	X	X	X	X	VMG
ENE	X	V	V	V	V	V	V	V	V	VMG
E	X	V	V	V	V	V	V	VM	VM	VMG
ESE	X	V	V	V	V	V	V	V	V	VMG
SE	X	X	V	V	V	V	V	V	V	VMG
SSE	X	X	X	V	V	V	V	V	V	VMG
S	X	V	V	V	V	V	V	V	VM	VMG
SSW	X	V	V	V	V	V	VM	VM	VM	VMG
SW	X	V	V	V	V	VM	VM	VM	VM	VMG
WSW	X	V	V	V	V	V	VM	VM	VM	VMG
W	X	X	X	X	X	M	M	M	M	VMG
WNW	X	X	V	VM	VM	VM	VM	VM	VM	VMG
NW	X	X	X	VM	VM	VM	VM	VM	VM	VMG
NNW	X	X	X	V	VM	VM	VM	VM	VM	VMG

PATHWAYS: X - None V - VEGETABLE M - MEAT G - GOAT MILK C - COW MILK

* No pathways exist within the Site Boundary (Exclusion Area Boundary)
** No milk pathway is identified within 5 miles of the plant. Therefore, it is assumed that the Goat (conservative vs Cow) Milk pathway exists at every 5.0 mile sector. Also, since there is no site survey data outside of 5 miles from the plant, it is conservative to assume that a Vegetable and Meat pathway exists at every 5 mile location.

FIGURE C4.0-1

CATAWBA LADTAP INPUT TEMPLATE
FOR LIQUID RADIONUCLIDE RELEASE OFFSITE DOSE CALCULATIONS

```
****** ***************************** TOP OF DATA ********************************
=COLS> ----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
       LADTAP INPUT FOR CATAWBA ODCM METHOD - DEFAULT DILUTION
               0    1.2E+02       1.0          1
            1.0
       LIQUID RELEASE SOURCE TERMS - CURIES PER RELEASE PERIOD
       H 3          0.00E+00
       NA24         0.00E+00
       CR51         0.00E+00
       MN54         0.00E+00
       MN56         0.00E+00
       FE55         0.00E+00
       FE59         0.00E+00
       CO58         0.00E+00
       CO60         0.00E+00
       NI63         0.00E+00
       NI65         0.00E+00
       CU64         0.00E+00
       ZN65         0.00E+00
       ZN69         0.00E+00
       BR83         0.00E+00
       BR85         0.00E+00
       RB86         0.00E+00
       RB88         0.00E+00
       RB89         0.00E+00
       SR89         0.00E+00
       SR90         0.00E+00
       SR91         0.00E+00
       SR92         0.00E+00
       Y 90         0.00E+00
       Y 91 M       0.00E+00
       Y 91         0.00E+00
       Y 92         0.00E+00
       Y 93         0.00E+00
       ZR95         0.00E+00
       ZR97         0.00E+00
       NB95         0.00E+00
       MO99         0.00E+00
       TC99 M       0.00E+00
       TC101        0.00E+00
       RU103        0.00E+00
       RU105        0.00E+00
       RU106        0.00E+00
       AG110M       0.00E+00
       TE125M       0.00E+00
       TE127M       0.00E+00
       TE127        0.00E+00
       TE129M       0.00E+00
       TE129        0.00E+00
       TE131M       0.00E+00
       TE131        0.00E+00
       TE132        0.00E+00
       I 130        0.00E+00
       I 131        0.00E+00
       I 132        0.00E+00
       I 133        0.00E+00
       I 135        0.00E+00
       CS134        0.00E+00
       CS136        0.00E+00
       CS137        0.00E+00
       CS138        0.00E+00
       BA139        0.00E+00
       BA140        0.00E+00
       BA141        0.00E+00
       BA142        0.00E+00
```

FIGURE C4.0-1 (Cont'd)

CATAWBA LADTAP INPUT TEMPLATE
FOR LIQUID RADIONUCLIDE RELEASE OFFSITE DOSE CALCULATIONS

```
=COLS> ----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
000064   LA140     0.00E+00
000065   LA142     0.00E+00
000066   CE141     0.00E+00
000067   CE143     0.00E+00
000068   CE144     0.00E+00
000069   PR143     0.00E+00
000070   PR144     0.00E+00
000071   ND147     0.00E+00
000072   W 187     0.00E+00
000073   NP239     0.00E+00
000074
000075
000076                  0.3     0.974     0.974      37.7        0.0        0.0
000077
000078
000079
****** **************************** BOTTOM OF DATA ****************************
```

FIGURE C4.0-2

CATAWBA GASPAR INPUT TEMPLATE
FOR NOBLE GAS RADIONUCLIDE RELEASE WORST-CASE LOCATION

```
****** ***************************** TOP OF DATA ******************************
=COLS> ----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
000001 GASPAR INPUT FOR CATAWBA ODCM METHOD - MAX NOBLE GAS DOSE CALCULATIONS
000002  0         0.0        0.0        0.0        0.0
000003  1 1
000004      1.0      1.0      1.0    0.76      1.0
000005 NOBLE GAS SOURCE TERM - CURIES PER RELEASE PERIOD
000006        1.0
000007   AR41       0.00E+00
000008   KR83 M     0.00E+00
000009   KR85       0.00E+00
000010   KR85 M     0.00E+00
000011   KR87       0.00E+00
000012   KR88       0.00E+00
000013   KR90       0.00E+00
000014   XE131M     0.00E+00
000015   XE133      0.00E+00
000016   XE133M     0.00E+00
000017   XE135      0.00E+00
000018   XE135M     0.00E+00
000019   XE137      0.00E+00
000020   XE138      0.00E+00
000021
000022   LOCATION 1        NNE 0.50      3.1E-05   3.1E-05   3.1E-05   1.1E-07
****** **************************** BOTTOM OF DATA ****************************
```

FIGURE C4.0-3

CATAWBA GASPAR INPUT TEMPLATE
FOR PARTICULATE, IODINE AND OTHER NUCLIDES WORST-CASE LOCATIONS

```
****** ***************************** TOP OF DATA ******************************
=COLS> ----+----1----+----2----+----3----+----4----+----5----+----6----+----7--
000001 GASPAR INPUT FOR CATAWBA ODCM METHOD - PART, I, AND OTHER - INHALATION
000002  0          0.0        0.0        0.0        0.0
000003  1 1
000004       1.0      1.0      1.0    0.76      1.0
000005 PART, I AND OTHER NUCLIDES SOURCE - CURIES PER RELEASE PERIOD
000006          1.0
000007   H 3       0.00E+00
000008   CR51      0.00E+00
000009   MN54      0.00E+00
000010   FE55      0.00E+00
000011   FE59      0.00E+00
000012   CO58      0.00E+00
000013   CO60      0.00E+00
000014   ZN65      0.00E+00
000015   SR89      0.00E+00
000016   SR90      0.00E+00
000017   ZR95      0.00E+00
000018   MO99      0.00E+00
000019   I 131     0.00E+00
000020   I 133     0.00E+00
000021   CS134     0.00E+00
000022   CS136     0.00E+00
000023   CS137     0.00E+00
000024   BA140     0.00E+00
000025   CE141     0.00E+00
000026   CE144     0.00E+00
000027
000028   LOCATION 1        NNE 0.50     3.1E-05   3.1E-05   3.1E-05   1.1E-07
000029
000030
000031
****** **************************** BOTTOM OF DATA ****************************
```

<u>FOR OTHER LOCATIONS, REPLACE FOLLOWING INPUT LINES:</u>

LOCATION 2 - WORST VEGETABLE GARDEN

```
000001 GASPAR INPUT FOR CATAWBA ODCM METHOD - PART, I, AND OTHER - GARDEN
000002  0          1.0        1.0        0.0        0.0
000028   LOCATION 2        S   0.90     2.5E-05   2.5E-05   2.5E-05   7.2E-08
```

LOCATION 3 - WORST MEAT ANIMAL

```
000001 GASPAR INPUT FOR CATAWBA ODCM METHOD - PART, I, AND OTHER - MEAT
000002  0          1.0        1.0        0.0        0.0
000028   LOCATION 3        NNW 2.30     7.5E-07   7.5E-07   7.5E-07   1.8E-09
```

LOCATION 4 - WORST MILK ANIMAL

(ENVELOPED BY LOCATION 5)

LOCATION 5 - WORST COMBINATION

```
000001 GASPAR INPUT FOR CATAWBA ODCM METHOD - PART, I, AND OTHER - COMBINATION
000002  0          1.0        1.0        0.0        1.0
000028   LOCATION 5        NNE 5.00     3.3E-07   3.3E-07   3.3E-07   5.8E-10
```

Table C4.0-7 - Meteorological Parameter and Applicable Pathways for Potential Worst-case Offsite Locations

Worst-Case Locations *

	$(\overline{X/Q})$	$(\overline{D/Q})$	Applicable Food Pathways**
(1) Inhalation, Ground Site Boundary, NNE	3.1E-5	1.1E-7	
(2) Garden, 0.9 mi, S	2.5E-5	7.2E-8	Veg
(3) Meat Animal, 2.3 mi, NNW	7.5E-7	1.8E-9	Meat
(4) Milk Animal, ***	X.XE-X	X.XE-X	***
(5) Combination, 5.0 mi, NNE	3.3E-7	5.8E-10	Veg, Meat, Goat Milk

* Based on August 1991 Land Use Census Data (See Table C4.0-8)

** The food pathways to be included for exposure contribution to the maximum individual at this location. Inhalation and ground exposure pathways also considered at all locations.

*** No milk animal is currently located within 5.0 miles of Catawba Nuclear Station

Figure C4.0-4 (Cont'd) - Fuel Cycle Dose Calculation Worksheet for Organ Doses

Adult Age Group

Location 1 - Worst-Case Inhalation/Ground Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 2 - Worst-Case Vegetable Garden Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 3 - Worst-Case Meat Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 4 - Worst-Case Milk Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a-o}(g_m)$							
$D_{a,o}(T)$							

Figure C4.0-4 (Cont'd) - Fuel Cycle Dose Calculation Worksheet for Organ Doses

Location 5_1 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 5_2 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 5_N - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Adult Organ Maximums**

Maximum Total

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(T_{max})$							

Figure C4.0-4 (Cont'd) - Fuel Cycle Dose Calculation Worksheet for Organ Doses

Teen Age Group

Location 1 - Worst-Case Inhalation/Ground Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$	______	______	______	______	______	______	______
$D_{a,o}(l_m)$	______	______	______	______	______	______	______
$D_{a,o}(g_c)$	______	______	______	______	______	______	______
$D_{a,o}(g_m)$	______	______	______	______	______	______	______
$D_{a,o}(T)$	______	______	______	______	______	______	______

Location 2 - Worst-Case Vegetable Garden Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$	______	______	______	______	______	______	______
$D_{a,o}(l_m)$	______	______	______	______	______	______	______
$D_{a,o}(g_c)$	______	______	______	______	______	______	______
$D_{a,o}(g_m)$	______	______	______	______	______	______	______
$D_{a,o}(T)$	______	______	______	______	______	______	______

Location 3 - Worst-Case Meat Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$	______	______	______	______	______	______	______
$D_{a,o}(l_m)$	______	______	______	______	______	______	______
$D_{a,o}(g_c)$	______	______	______	______	______	______	______
$D_{a,o}(g_m)$	______	______	______	______	______	______	______
$D_{a,o}(T)$	______	______	______	______	______	______	______

Location 4 - Worst-Case Milk Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$	______	______	______	______	______	______	______
$D_{a,o}(l_m)$	______	______	______	______	______	______	______
$D_{a,o}(g_c)$	______	______	______	______	______	______	______
$D_{a,o}(g_m)$	______	______	______	______	______	______	______
$D_{a,o}(T)$	______	______	______	______	______	______	______

Figure C4.0-4 (Cont'd) - Fuel Cycle Dose Calculation Worksheet for Organ Doses

Location 5_1 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$	____	____	____	____	____	____	____
$D_{a,o}(1_m)$	____	____	____	____	____	____	____
$D_{a,o}(g_c)$	____	____	____	____	____	____	____
$D_{a,o}(g_m)$	____	____	____	____	____	____	____
$D_{a,o}(T)$	____	____	____	____	____	____	____

Location 5_2 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$	____	____	____	____	____	____	____
$D_{a,o}(1_m)$	____	____	____	____	____	____	____
$D_{a,o}(g_c)$	____	____	____	____	____	____	____
$D_{a,o}(g_m)$	____	____	____	____	____	____	____
$D_{a,o}(T)$	____	____	____	____	____	____	____

Location 5_N - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$	____	____	____	____	____	____	____
$D_{a,o}(1_m)$	____	____	____	____	____	____	____
$D_{a,o}(g_c)$	____	____	____	____	____	____	____
$D_{a,o}(g_m)$	____	____	____	____	____	____	____
$D_{a,o}(T)$	____	____	____	____	____	____	____

Teen Organ Maximums**

Maximum Total

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(T_{max})$	____	____	____	____	____	____	____

Child Age Group

Location 1 - Worst-Case Inhalation/Ground Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(i_c)$							
$D_{a,o}(i_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 2 - Worst-Case Vegetable Garden Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(i_c)$							
$D_{a,o}(i_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 3 - Worst-Case Meat Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(i_c)$							
$D_{a,o}(i_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 4 - Worst-Case Milk Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(i_c)$							
$D_{a,o}(i_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Figure C4.0-4 (Cont'd) - Fuel Cycle Dose Calculation Worksheet for Organ Doses

Location S_1 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$							
$D_{a,o}(1_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location S_2 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$							
$D_{a,o}(1_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location S_N - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$							
$D_{a,o}(1_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Child Organ Maximums**

Maximum Total

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(T_{max})$							

Figure C4.0-4 (Cont'd) - Fuel Cycle Dose Calculation Worksheet for Organ Doses

Infant Age Group

Location 1 - Worst-Case Inhalation/Ground Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 2 - Worst-Case Vegetable Garden Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 3 - Worst-Case Meat Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 4 - Worst-Case Milk Animal Location *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(l_c)$							
$D_{a,o}(l_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Figure C4.0-4 (Cont'd) - Fuel Cycle Dose Calculation Worksheet for Organ Doses

Location 5_1 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$							
$D_{a,o}(1_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 5_2 - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$							
$D_{a,o}(1_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Location 5_N - Worst-Case Combination 1,2...N Location(s) *

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(1_c)$							
$D_{a,o}(1_m)$							
$D_{a,o}(g_c)$							
$D_{a,o}(g_m)$							
$D_{a,o}(T)$							

Infant Organ Maximums**

Maximum Total

	Bone	Liver	T.Body	Thyroid	Kidney	Lung	GI-LLI
$D_{a,o}(T_{max})$							

All Age Groups

Maximum Organ Dose ***

Organ = xxxxxxxxxx

Age Group = xxxxxxxxxx

Dose = x.xE-xx mrem/yr

Notes:

* Fuel cycle dose for each age group, a, and organ, o, at analyzed limiting food pathway locations.
$D_{a,o}(T) = D_{a,o}(l_{c,m}) + D_{a,o}(g_{c,m})$

** Limiting dose estimates for each organ for age group, a, (maximums of dose values calculated for Locations 1 through 5.)

*** Limiting dose estimate for any organ or age group (maximum of dose values calculated for any age group)

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 land use census that was used to identify the controlling receptor locations was conducted during August, 1991.

The 1991 Land Use Census identified no locations where Radiological Environmental Monitoring Program samples are required to be collected but are unavailable for collection.

TABLE C5.0-1
(1 of 1)
CATAWBA RADIOLOGICAL MONITORING PROGRAM SAMPLING LOCATIONS

(TLD LOCATIONS)

	SAMPLING LOCATION DESCRIPTION			SAMPLING LOCATION DESCRIPTION	
200	SITE BOUNDARY	(0.6M NNE)	232	4-5 MILE RADIUS	(4.1M NE)
201	SITE BOUNDARY	(0.5M NE)	233	4-5 MILE RADIUS	(4.0M ENE)
202	SITE BOUNDARY	(0.6M E) Deleted	234	4-5 MILE RADIUS	(4.5M E)
203	SITE BOUNDARY	(0.4M ESE)	235	4-5 MILE RADIUS	(4.0M ESE)
204	SITE BOUNDARY	(0.5M SSW)	236	4-5 MILE RADIUS	(4.2M SE)
205	SITE BOUNDARY	(0.3M SW)	237	4-5 MILE RADIUS	(4.8M SSE)
206	SITE BOUNDARY	(0.7M WNW)	238	4-5 MILE RADIUS	(4.2M S)
207	SITE BOUNDARY	(0.9M NNW)	239	4-5 MILE RADIUS	(4.6M SSW)
212	SPECIAL INTEREST	(3.3M E)	240	4-5 MILE RADIUS	(4.1M SW)
217	CONTROL	(10.0M SSE)	241	4-5 MILE RADIUS	(4.7M WSW)
222	SITE BOUNDARY	(0.7M N)	242	4-5 MILE RADIUS	(4.6M W)
223	SITE BOUNDARY	(0.6M E)	243	4-5 MILE RADIUS	(4.6M WNW)
224	SITE BOUNDARY	(0.6M ESE) Deleted	244	4-5 MILE RADIUS	(4.1M NW)
225	SITE BOUNDARY	(0.7M SE)	245	4-5 MILE RADIUS	(4.2M NNW)
226	SITE BOUNDARY	(0.5M S)	246	SPECIAL INTEREST	(8.1M ENE)
227	SITE BOUNDARY	(0.5M WSW)	247	CONTROL	(7.5M ESE)
228	SITE BOUNDARY	(0.6M W)	248	SPECIAL INTEREST	(7.0M SSE)
229	SITE BOUNDARY	(0.8M NW)	249	SPECIAL INTEREST	(8.1M S)
230	4-5 MILE RADIUS	(4.4M N)	250	SPECIAL INTEREST	(10.3M WSW)
231	4-5 MILE RADIUS	(4.2M NNE)	251	CONTROL	(9.8M WNW)
255	SITE BOUNDARY	(0.6M ENE)			
256	SITE BOUNDARY	(0.6M SSE)			

TABLE [illegible].0-3
(1 of 1)
CATAWBA RADIOLOGICAL MONITORING PROGRAM ANALYSES

SAMPLE MEDIUM	ANALYSIS SCHEDULE	ANALYSIS: GAMMA ISOTOPIC	TRITIUM	LOW LEVEL I-131	GROSS BETA	TLD
1. Radioiodine and Particulates	Weekly	X X			 X	
2. Direct Radiation	Quarterly					X
3. Surface Water	Biweekly Monthly Composite Quarterly Composite	 X 	 X	X 		
4. Drinking Water	Biweekly Monthly Composite Quarterly Composite	 X 	 X	X 	 X 	
5. Shoreline Sediment	Semiannually	X				
6. Milk	Semimonthly	X		X		
7. Fish	Semiannually	X				
8. Broadleaf Vegetation	Monthly	X				
9. Groundwater	Quarterly	X	X	X		
10. Food Products	Monthly (a)	X				

(a) during harvest season

TABLE C5.0-2

([illegible] 1)

CATAWBA RADIOLOGICAL MONITORING PROGRAM SAMPLING LOCATIONS

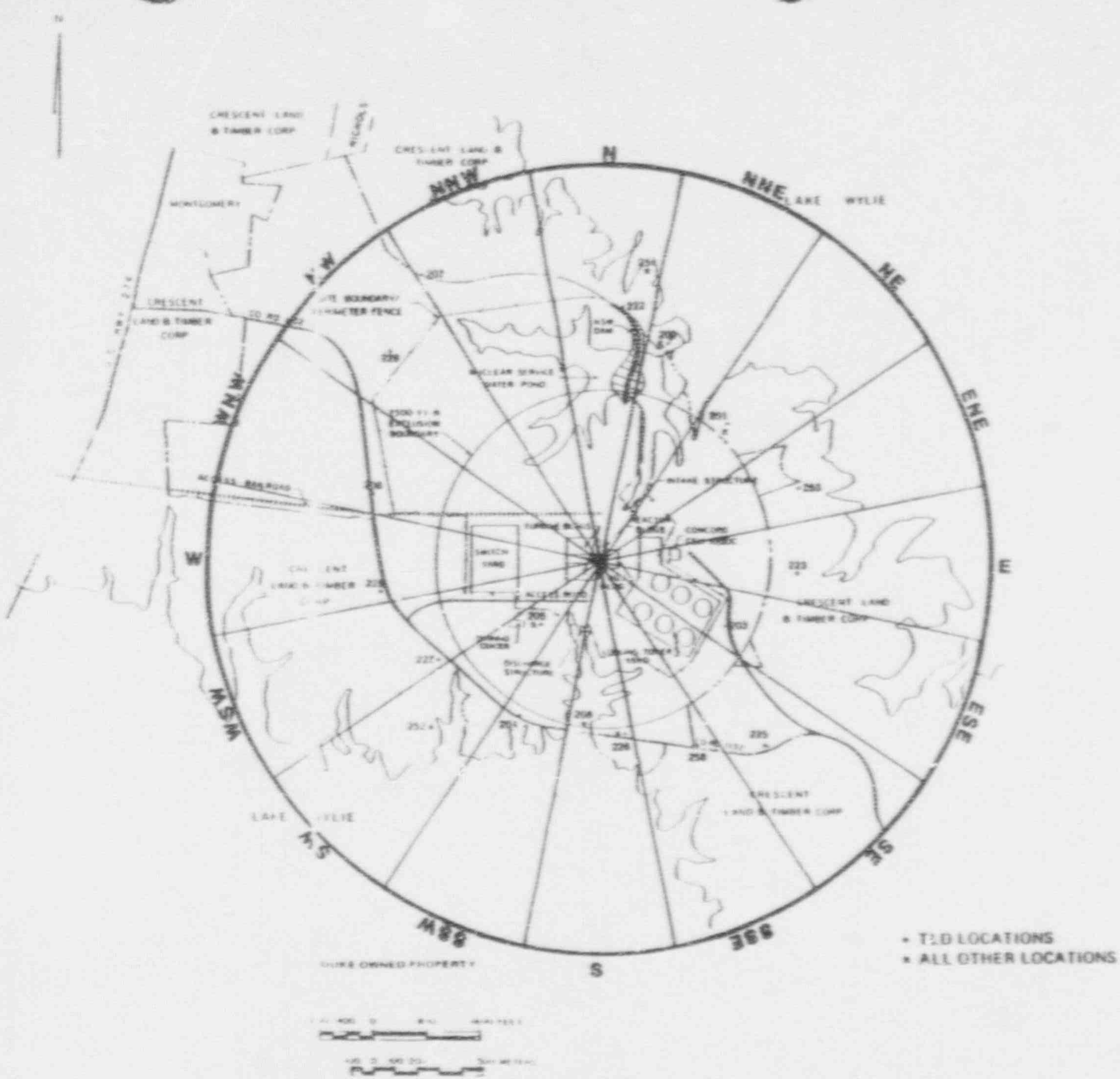
(OTHER SAMPLING LOCATIONS)

CODE:
W - Weekly SM - Semimonthly
BW - Biweekly Q - Quarterly
M - Monthly SA - Semiannually

Sampling Location Description		Air Radio-iodines and Particulates	Surface Water	Drinking Water	Shoreline Sediment	Milk	Fish	Broadleaf Vegetation	Groundwater	Food Products
200	Site Boundary (0.6m NNE)	W						M		
201	Site Boundary (0.5m NE)	W						M		
203	Site Boundary (0.4m ESE) Deleted							M		
205	Site Boundary (0.3m SW)	W								
208	Discharge Canal (0.5m S)		BW		SA		SA			
209	Dairy (7.0m SSW)					SM				
210	Ebenezer Access (2.4m SE)				SA					
211	Wylie Dam (4.0m ESE)		BW							
212	Tega Cay (3.3m E)	W								
213	Fort Mill Water Supply (7.5m ESE)			BW						
214	Rock Hill Water Supply (7.3m SSE)			BW						
215	River Pointe - Hwy 49 (4.1m NNE) Control		BW		SA					
216	Hwy 49 Bridge (4.0m NNE) Control						SA			
217	Rock Hill Substation (10.0m SSE) Control	W						M		
218	Belmont Water Supply (13.5m N) Control			BW						
219	Dairy (6.0m SW)					SM				
220	Dairy (8.0m WSW) Deleted					SM				
221	Dairy (13.0m NW) Control					SM				
226	Site Boundary (0.5m S)							M		
252	Residence (0.7m SW)								Q	
253	Irrigated Gardens (Downstream within 5 mile radius)									M(a)
254	Residence (0.8m N)								Q	

(a) during harvest season

Rev. 25
1/1/90



MONITORING PROGRAM LOCATIONS
FIGURE C5.0-1
(2 OF 2)

REVISION 25
1/1/90

CATAWBA NUCLEAR STATION