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VICE PRESIDENT
NUCLEAR PRODUCTION

TELEPHONE
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May 29, 1984

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Ms. E. G. Adensam, Chief
Licensing Branch No. 4

Re: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414

Dear Mr. Denton:

In regard to your April 10, 1984 letter requesting additional information, please find attached three (3) copies of Duke's responses to the questions pertaining to the Offsite Dose Calculation Manual for the Catawba Nuclear Station. Please be advised that Section C4.3, "Fuel Cycle Calculations," is incomplete. This information will be provided by June 4, 1984.

Very truly yours,

H.B. Tucker

Hal B. Tucker

RWO/php

Attachments

cc: (w/attachment)
Mr. James P. O'Reilly
Regional Administrator
U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

(w/o attachment)
NRC Resident Inspector
Catawba Nuclear Station

Mr. Robert Guild, Esq.
Attorney-at-Law
P. O. Box 12097
Charleston, South Carolina 29412

Palmetto Alliance
2135½ Devine Street
Columbia, South Carolina 29205

cc: (w/o attachment)
Mr. Jesse L. Riley
Carolina Environmental Study Group
854 Henley Place
Charlotte, North Carolina 28207

Subject: Figure C1.0.1 - Liquid Radwaste Treatment System

Commenting Agency: Franklin Research Center

Comment: Effluent environmental release points not clearly identified; end discharge point not designated.

Response: Effluent environmental release points are designated on Figure 5.1.3 of Catawba's Technical Specifications. Duke Power Company feels that this would be a duplication of information already presented in a controlled document. With this explanation, no action is planned.

The end discharge points of liquid waste releases will be clarified on Figure C1.0.1.

Subject: Figure C.1.0.2 - Gaseous Radwaste Treatment System

Commenting Agency: Franklin Research Center

Comment: Monitors are not designated for the following effluent streams; Hydrogen Monitors at the recombiners; Vent System; Containment Purge System; Auxiliary Building Ventilation; Fuel Storage Area Ventilation System.

Response: EMF designation will be added to each of the above locations except "Hydrogen Monitors at the Recombiners." This is not an effluent stream and no EMF monitor is required by Catawba's Technical Specifications.

Subject:	Page C-4, Liquid Release Rate Calculation
Commenting Agency:	Franklin Research Center
Comment:	Method not provided for determining the liquid radioactivity concentrations for both batch and continuous releases. (See Section 2 of the attached NRC Staff Positions.)
Response:	The requirement to list the methods and procedures for obtaining a representative sample and performing analyses in accordance with the ODCM has been deleted from Catawba's Technical Specifications. No action is planned.

Subject: Page C-8, Liquid Radiation Monitors

Commenting Agency: Franklin Research Center

Comment: In liquid setpoint calculations, Licensee has not addressed the possibility of simultaneous releases. Also setpoints for service water and component cooling water are not provided.

Response: Section 1.0, page 1-1, "Release Rate Calculations" addresses the possibility of simultaneous releases by stating that such releases could be administratively controlled so that the limitations addressed on page iii would not be exceeded. Duke Power Company uses this same type of control (via station procedures) at both its Oconee and McGuire plants without any problems.

The service water monitor and component cooling water monitor are not longer considered to be effluent monitors and have been deleted from Catawba's Technical Specifications (Tables 3.3-12 and 4.3-8).

With this explanation, no action is planned.

Subject: Page C-11, Gas Monitors

Commenting Agency: Franklin Research Center

Comment: Licensee should justify using only Xe-133 in the setpoint calculation.

Response: Historical data as well as Table 11.3.3.1 in the Catawba FSAR show that >80% of the curies found in gaseous effluents are from the radionuclide Xe-133. This information will be added to Section C3.2.

Comment: Setpoints should be calculated for all monitors proposed by the Licensee in Table 3.3-13 of the RETS submittal.

Response: Typical setpoint calculations for each gaseous effluent stream monitor listed in Table 3.3-13 of the RETS submittal are shown on page C-11 of the ODCM. With this explanation, no action is planned.

Comment: Also, possible simultaneous releases from effluent lines are not addressed.

Response: Section 1.0, page 1-1, "Release Rate Calculations" addresses the possibility of simultaneous releases by stating that such releases could be administratively controlled so that the limitations addressed on page iii are not exceeded. Duke Power Company uses the same type of control (via station procedures) at both its Oconee and McGuire plants without any problems. No action is planned.

Subject:	Page C-13 Liquid Effluent
Commenting Agency:	Franklin Research Center
Comment:	1) Licensee should provide the basis for the near field dilution factor D_W (37.7).
Response:	Basis for D_W will be added to pages C-12 and C-13.
Comment:	2) Units are not assigned for dose D_{WB} and data provided in Table C.4.0-3.
Response:	The units "mrem/hr per µCi/ml," inadvertently left off, will be added.
Comment:	3) According to NUREG-0133 (Section 4.3.1) only adult fish consumption will be considered. Can Licensee justify child fish consumption is more conservative?
Response:	Section C4.3.1, Case 2, will be changed to reflect adult fish consumption.

Subject: Page C-12, Section C4.2.2.2
Page C-15, Section C4.3.2.2

Commenting Agency: Franklin Research Center

Comment: As method to obtain doses from Tritium is different from that for Iodine-131, Licensee should also include the method for the Tritium dose calculation in these sections.

Response: Historical data has shown that I-131 contributes >95% of the dose to the thyroid of an infant. The factor "1.05" allows the remaining 5%, of which Tritium comprises some 3%, to be considered. Additionally, should a user need to calculate the Tritium dose, the method is provided in Section 3.1.2.2. With this explanation, no action is planned.

Subject:	Page 15, Gaseous Effluents (C4.3.2.1)
Commenting Agency:	Franklin Research Center
Comment:	The assumption that Xe-133 contributes 45% to the dose is inconsistent with Section C3.2 where Licensee assumes 100% contribution (is) from Xe-133 for dose rate calculation(s).
Response:	Section C3.2 deals with typical setpoint calculation for gaseous radiation monitors. As previously stated, >80% of the curies in a gaseous effluent release is from Xe-133, and therefore, radiation monitors are calibrated to the most abundant radionuclide. Section C4.3.2.1 deals with simplified dose estimates. Historically, approximately 45% of the Gamma dose and Beta air dose is from the radionuclide Xe-133. No further action is planned.

Subject:	Table C5.0-2, Sampling Locations
Commenting Agency:	Franklin Research Center
Comment:	Licensee has not identified pathways that are corresponding to the sampling locations listed in the Table, i.e., fish, broad leaf vegetables, etc.
Response:	The column headings, inadvertently left off, will be added.

Subject:	Liquid Dose Projection
Commenting Agency:	Franklin Research Center
Comment:	Licensee has not specifically addressed (that) site-specific monthly dose projection(s). To (will) be used for Liquid Radwaste Treatment Actions.
Response:	Technical Specification 4.11.1.3.1 states that "Doses .... shall be projected .... in accordance with ... the ODCM." Section C4.1 of the ODCM states "Dose projections shall be performed using simplified dose estimates." No action is planned.
Comment:	Licensee claimed in Section 3.2 that site-specific information will be provided, but it was not found in Appendix C.
Response:	All necessary site-specific information required to perform dose calculations has been provided in Appendix C. Example: Section C4.3.1 contains the method and site-specific information to calculate doses from liquid effluents. No action is planned.

Subject: Gaseous Dose Projection

Commenting Agency: Franklin Research Center

Comment: Licensee has not specifically addressed (that) site-specific monthly dose projection(s). To (will) be used for gaseous radwaste treatment actions.

Response: Technical Specification 4.11.2.4.1 states that "Doses ... shall be projected ... in accordance with ... the ODCM." Section C4.1 of the ODCM states "Dose projections shall be performed using simplified dose estimates." No action is planned.

Comment: Licensee claimed in Section 3.2 that site-specific information will be provided, but it was not found in Appendix C.

Response: All necessary site-specific information required to perform dose calculations has been provided in Appendix C. Example: Section C4.3.2 contains the method and site-specific information to calculate doses from gaseous effluents. No action is planned.

Subject: Page 3-7, Total Dose

Commenting Agency: Franklin Research Center

Comment:

1) Licensee should specifically address how total dose will be calculated with respect to 40 CRF 190 Requirements, i.e., a method to sum up various doses calculated in (the) ODCM.

Response: Section C4.3 will be revised to provide this information.

2) A method to calculate direct dose should be provided. Section 3.1.3 is not adequate to address the direct dose.

Response: Section 3.1.3 states that the point kernel method was used to calculate offsite dose rates. Since the calculated dose rates to an individual are negligible, <0.01 mrem/yr, Duke Power Company feels that it is unnecessary to provide these calculations in this document. Duke Power Company also feels that it is unnecessary to routinely re-calculate these doses unless warranted by a change in plant operating conditions. Additionally, this section has been previously approved by the Franklin Research Center and the Nuclear Regulatory Commission for both our Oconee and McGuire plants. With this response, no action is planned.

Subject: Interlaboratory Comparison Program

Commenting Agency: Franklin Research Center

Comment: Licensee has not provided a description on (the) Interlaboratory Comparison Program as committed in the RETS submittal.

Response: Section C5.0, page C-17, in the ODCM states that Duke Power Company participates in the Environmental Protection Agency's Environmental Radioactivity Laboratory Intercomparison Studies (crosscheck) Program. Verbatim paragraphs have been previously approved by the Franklin Research Center and the Nuclear Regulatory Commission for both our Oconee and McGuire plants. As Duke Power Company feels that this section is still adequate, no action is planned.

Subject: Figure C1.0-1, Liquid Radwaste Treatment System

Commenting Agency: Nuclear Regulatory Commission

Comment: 1) Indicate route of off-normal steam generator blowdown and how it is monitored.

Response: Figure C1.0-1 will be revised to provide this information.

Comment: 2) Indicate how flows from liquid radwaste, conventional waste water treatment, nuclear service water, and low pressure service water are monitored for flow, monitored or continuously sampled for radiation, and merged prior to discharge.

Response: Figure C1.0-1 will be revised to provide this information.

Comment: 3) Identify all environmental release points.

Response: Liquid effluent environmental release points are designated on Figure 5.1-3 of Catawba's Technical Specifications. Duke Power Company feels that this would be a duplication of information already presented in a more tightly controlled document. With this explanation, no action is planned.

Subject:	Figure C1.0-2 - Gaseous Treatment System
Commenting Agency:	Nuclear Regulatory Commission
Comment:	1) Indicate route of off-normal steam generator blowdown vent exhaust.
Response:	Figure C1.0-2 will be revised to provide this information.
Comment:	2) Indicate where hydrogen and oxygen are monitored in the waste gas holdup system.
Response:	Oxygen and hydrogen monitors are located upstream and downstream of the hydrogen recombiners. Since these monitors are not on an effluent stream and do not monitor radiation, Duke Power Company feels that they should not be presented in a document which deals with off-site doses.
Comment:	3) Indicate (the) location of flow and radiation monitors and continuous samplers and type of continuous samplers for effluents from the waste gas holdup, condenser evacuation, auxiliary building ventilation, fuel storage area ventilation, containment purge, containment ventilation, and vent systems.
Response:	EMF designations will be added to each of above locations.
Comment:	Identify all environmental release points.
Response:	Gaseous effluent environmental release points are designated on Figure 5.1-4 of Catawba's Technical Specifications. Duke Power Company feels that this would be a duplication of information already presented in a more tightly controlled document. With this explanation, no action is planned.

Subject:	Page C-4, Liquid Release Rate Calculations
Commenting Agency:	Nuclear Regulatory Commission
Comment:	Explain why simultaneous batch releases need not be considered, or provide method for considering simultaneous batch releases.
Response:	Section 1.0, page 1-1, addresses the possibility of simultaneous releases by stating that such releases could be administratively controlled so that the limitations addressed on page iii would not be exceeded. Duke Power Company has successfully used this type of control (via station procedures) at both its Oconee and McGuire plants. With this explanation, no action is planned.

Subject:	Page C-5, Liquid Release Rate Calculations
Commenting Agency:	Nuclear Regulatory Commission
Comment:	Provide method of considering releases of radioactive materials from the conventional waste water treatment (system) and how this is to be considered in the methodology for determining the undiluted effluent flow (f) in C2.1.1.
Response:	Section C2.1.2 states that three of the water sources that normally flow into the conventional waste water treatment system will be diverted to the Radwaste Treatment System should these water sources become radioactive. At this time their flow (f) will be the undiluted flow referenced in Section C2.1.1. With this explanation, no action is planned.

Subject: Page C-7, Gaseous Release Rate Information

Commenting Agency: Nuclear Regulatory Commission

Comment: Provide method for considering releases of radioactive materials from the steam generator blowdown vent.

Response: An off-normal mode of operation is provided to accommodate situations when it is not possible to either vent the steam generator blowdown tank to the "D" heater or pump the liquid to the condensate system. In this mode of operation, the steam generator blowdown tank releases steam to the atmosphere while its liquid level is maintained by directing the pumped liquid to the Turbine Building sump. Radioactivity levels in the Steam Generator Blowdown System are monitored for activity by EMF-34. If activity should be detected, each blowdown flow control valve, the atmospheric vent, and the valve to the Turbine Building Sump will close. Blowdown can only be continued by venting the steam to "D" heater and pumping the liquid to the condensate system. As a result, no gaseous radioactive materials can be released via this pathway. With this explanation, no action is planned.

Subject: Page C-8, Liquid Radiation Monitor Setpoints

Commenting Agency: Nuclear Regulatory Commission

Comment: Address how simultaneous releases from liquid radwaste and conventional waste water treatment will affect the setpoint of the radiation monitor for the Liquid Radwaste Effluent Line.

Response: Section C2.1.2 states that if any of the conventional waste water treatment water sources become radioactive, they can be diverted to the Radwaste Treatment System and be discharged through the Liquid Radwaste Effluent Line.

Section 1.0, page 1-1, "Release Rate Calculations" addresses the possiblity of simultaneous releases, by stating that such releases could be administratively controlled so that the limitations addressed on page iii are not exceeded. Duke Power Company uses this same type of control (via station procedures) at both its Oconee and McGuire plants without any problems.

With this explanation, no action is planned.

Subject: Page C-11, Gaseous Radiation Monitor Setpoints

Commenting Agency: Nuclear Regulatory Commission

Comment: 1) Provide basis for using f = 151,000 cfm

Response: This is only a typical flowrate. Exact flowrates that will be used to calculate radiation monitor setpoints will be listed in station procedures. The wording associated with this 151,000 cfm flowrate, as well as this 28,000 cfm flowrate listed on page C-11, will be changed to clarify this item.

Comment: 2) Provide method for considering simultaneous releases.

Response: Section 1.0, page 1-1, addresses the possibility of simultaneous releases by stating that such releases could be administratively controlled so that the limitations addressed on page iii would be not be exceeded. Duke Power Company has successfully used this type of control (via Station Procedures) at both its Oconee and McGuire plants. With this explanation, no action is planned.

Comment: 3) Provide method for determining setpoints for the waste gas holdup system, containment purge, and containment ventilation monitors.

Response: The monitor setpoint calculations are fully described in Section C3.2, page C-10. No action is planned.

Comment: 4) Provide method for determining setpoints for the radiation monitor on the steam generator blowdown to terminate venting to the atmosphere through the Turbine Building vent.

Response: No gaseous radiation monitor on the steam generator blowdown vent is required by Catawba's Technical Specifications, since this is not a gaseous effluent release point. Therefore, no setpoint calculation is given. Please see our response to your comment on page C-7, Gaseous Release Rate Calculations. No action is planned.

Subject: Page C-4.0, Dose Calculation

Commenting Agency: Nuclear Regulatory Commission

Comment: 1) Provide a numbered and captioned figure showing the site boundary and the unrestricted area boundary for gaseous and liquid effluents.

Response: This information is provided in Figures 5.1-3 and 5.1-4 of Catawba's Technical Specifications. This placement of information in the Technical Specifications has been previously approved by the Franklin Research Center and the Nuclear Regulatory Commission for both our Oconee and McGuire plants. As Duke Power Company feels that this would a duplication of information already presented in a more tightly controlled document, no action is planned.

Comment: 2) The ODCM should include a table that contains the following information for each sector: sector, the distance to the controlling receptor location, the pathway of exposure, the age group, the $\overline{X/Q}$ and $\overline{D/Q}$ values.

Response:

a. Sector information was inadvertently left off Figure C5.0-1. It will be added.

b. The distance to the controlling receptor location is listed in the Section of the ODCM that bases its calculations on this information, i.e., Section C4.3.2.2, page C-15. Duplication of information is unnecessary. No action is planned.

c. Exposure pathway information is also listed in this manner, i.e., Section C4.3.2.2, page C-15. Again this would be a duplication of information and is unnecessary. No action is planned.

d. Age group information has been provided in the assumption for each calculation where this information is used, i.e., Section C4.3.2.2, page C-15. Again this would be a duplication of information and is unnecessary. No action is planned.

e. $\overline{X/Q}$ and $\overline{D/Q}$ values are listed on Tables C-4.0-1 and C-4.0-2. No action is planned.

Comment: Provide the date of the land-use census that was used in identifying the controlling receptor locations.

Response: This information will be added to Section C5.0, page C-16.

Subject: Page C-5.0, Radiological Environmental Monitoring

Commenting Agency: Nuclear Regulatory Commissi n

Comment: 1) Tables C5.0-1, 2 and 3 list the number of samples, but do not provide the locations for all samples. The tables should contain the following columns: (1) exposure pathway and/or sample; (2) criteria for selection of sample number and location; (3) sampling and collecting frequency; (4) sample location number (it should refer to a figure in the ODCM); (5) location (distance and direction); (6) type and frequency of analysis.

Response:

a) Sample locations are provided in these tables, i.e., Table C5.0-2 states that sample location 213 is located 7.5 m ESE at the Fort Mill water supply. No action is planned.

b) Exposure pathway and/or sample information is also provided on Table C5.0-2. With the exception of adding the column heading addressed elsewhere in these responses, no action is planned.

c) Section C5.0, page C-16, states that the Radiation Environmental Monitoring Program shall be conducted in accordance with Technical Specification 3/4.12. The cr.teria for selection of sample number and location is based on this specification. With this explanation, no action is planned.

d) Sample locations are listed by number on Tables C5.0-1 and C5.0-2. These numbers correspond to Figure C5.0-1. No action is planned.

e) Tables C5.0-1 and C5.0-2 do provide sample location and distance information, i.e., Table C5.0-2 states that sample location 213 is 7.5m ESE at the Fort Mill supply. No action is planned.

f) Type and frequency of analysis has been provided in Table C5.0-3. No action is planned.

Comment: 2) A foldout figure is needed for Figure C5.0-1 (in order) to make it readable.

Response: Ten copies of a two-color 8½ x 17 foldout were included with the ODCM submittal. Additional copies will be submitted with these responses.

Subject: Page C5.0, Radiological Environmental Monitoring (Continued)

Comment: 3) Presumably the methodology described in the ODCM will be implemented via computer codes. The computer codes should be verified. After the codes are verified, provide a reference (individual or company name, title of document, and date) in the ODCM to document the validation of the codes.

Response: As stated in the introduction to the ODCM, the programs "LADTAP" and "GASPAR", written and distributed by the Nuclear Regulatory Commission, will normally be used to determine dose assessments. The method outlined in the ODCM is merely a hand-calculational method to be used only when "LADTAP" and/or "GASPAR" is unavailable. However, we do use our own computer programs to calculate release rates and prepare reports required by Regulatory Guide 1.2.1. The codes are benchmarked (verified by hand calculations) by Duke Power Company personnel prior to implementation. Benchmarks are also audited by our QA department and documented. These records are available for NRC audit. Therefore, as a result of our tight controls, Duke Power Company does not feel that this information need be duplicated in the ODCM.

Subject:	Page C6/C2.2, $\overline{X/Q}$ and $\overline{D/Q}$ Values
Commenting Agency:	Nuclear Regulatory Commission
Comment:	Identify the location (distance and direction) for the $\overline{X/Q}$ and $\overline{D/Q}$ values presented for gaseous release rate calculations.
Response:	The distance and direction information will be added to those sections in question.

Subject: C4.0, Dose Calculation/Meteorology

Commenting Agency: Nuclear Regulatory Commission

Comment: Provide a description of the atmospheric dispersion and deposition models and methodology used to calculated $\overline{X/Q}$ and $\overline{D/Q}$ values for inclusion in the ODCM. Also identify the source of meteorological data and period of record used for these calculations.

Response: The $\overline{X/Q}$ and $\overline{D/Q}$ values provided in Tables C4.0-1 and C4.0-2 were generated using the computer program XOQDOQ in NUREG/CR-2919 and all assumptions outlined in NRC Regulatory Guide 1.111 USNRC, 1977. The period of record was December 17, 1975 - December 16, 1977. With this explanation, no action is planned.

Subject: Tables C4.0-1 ($\overline{X/Q}$) and C4.0-2 ($\overline{D/Q}$)

Commenting Agency: Nuclear Regulatory Commission

Comment: The $\overline{X/Q}$ and $\overline{D/Q}$ values presented in these tables differ significantly from those calculated by the staff. For example, at 1.0 mi. in the north-northeast sector, TC4.0-1 indicates a $\overline{X/Q}$ value of 2.6E-07, while the staff has calculated a $\overline{D/Q}$ value of 7.7E-06 at the same location. Similarly, TC4.0-2 indicates a $\overline{D/Q}$ value of 1.7E-09 at 0.5 mi. in the south sector, while the staff's $\overline{D/Q}$ value for this location is 7.2E-08. These large differences are probably attributable to characterization of the aerodynamics of the releases from the plant vents. The staff has assumed that these releases occur at ground level with mixing in the turbulent wake of plant structures. The $\overline{X/Q}$ and $\overline{D/Q}$ values presented in TC4.0-1 and TC4.0-2 are typical of those calculated for a mixed-mode release. The staff did not accept the rationale presented in the Section 2.3.5 of the FSAR for deviating from the R.G. 1.111 position that states "For effluents released from points less than the weight of adjacent solid structures, a ground-level release should be assumed." The top of the vent stacks at Catawba are about 4m below the top of the reactor building. Another source of difference is adjustments to the straight-line airflow model to consider spatial and temporal variations in airflow. Either provide revised tables of $\overline{X/Q}$ and $\overline{D/Q}$ values reflecting assumptions used by the staff, or provide additional information (beyond that already reviewed by the staff) to substitute the $\overline{X/Q}$ and $\overline{D/Q}$ values proposed in the ODCM.

Response: Tables C4.0-1 and C4.0-2 have been revised using the computer program XOQDOQ (NUREG/CR-2919) and all assumption outlined in NRC Regulatory Guide 1.111 (USNRC, 1977).

ADDITIONAL NRC COMMENTS
TO ODCM REQUESTED
BY TELECON

Subject:	Table C4.0-3
Commenting Agency:	Ed Branagan, USNRC
Comment:	Remove comment on Table C4.0-3 which states "Methodology for Table provided by: M. E. Wrangler, RAB:NRR:NRC on 3/17/83," and take responsibility for values.
Response:	Duke Power Company will only stand behind the values generated using the subroutine and site-specific information but not the subroutine itself as it was provided by the NRC. A copy of the letter and subroutine is provided. No action is planned.

ROUTING AND TRANSMITTAL SLIP

Date: 3/17/83

TO: (Name, office symbol, room number, building, Agency/Post)	Initials	Date
1. J. Stewart		
2. Duke Power Co.		
3.		
4.		
5.		

Action	File	Note and Return
Approval	For Clearance	Per Conversation
As Requested	For Correction	Prepare Reply
Circulate	For Your Information	See Me
Comment	Investigate	Signature
Coordination	Justify	

REMARKS

Pursuant to our conversation of 3/16 attached is a copy of a subroutine that can be used with LADTAP to produce the ODCM A_{it}. Let me know if you need any further information.

DO NOT use this form as a RECORD of approvals, concurrences, disposals, clearances, and similar actions

FROM: (Name, org. symbol, Agency/Post)	Room No.—Bldg.
Michael E. Wangler	Phone No.

5041-102

OPTIONAL FORM 41 (Rev. 7-76)
Prescribed by GSA
FPMR (41 CFR) 101-11.206

* GPO : 1981 O - 361-529 (148)

```
*INSERT MAIN00,44
      CALL AITAU(A..CF)
*ADDFILE,INPUT,SOURCE
*DECK AITAU
      SUBROUTINE AITAU
      DIMENSION ATAU(200,7)
      COMMON/DATA/PERA,PERT,PERC,US,PLNTLF,TPROCF,TPROCW,YIELD,GROW,Q1
     1,Q2,Q3,Q4,FRAC,THTH,RZONE,TDF,TDC,TDA,TDW,TDS,TDSW,TDB,CHF,CHC,
     2CHA,CHW,CHS,CHSW,CHB,TAF,TAC,TAA,TAW,TAS,TASW,TAB,FIUS,CRUS,
     3ALUS,WUSE,SHU,SWU,SUSE,CHCSW,TACSW,CRUSSW,FLOODP(8,4),WHYP(12),
     4WATERP(3),FACCF(100),FACCI(100),FACCA(100),SACCF(100),SACCI(100),
     5SACCA(100),ZMET(100),ZMLK(100),SOIL(100)
      COMMON/SORCE/IZ(700),IMASS(700),META(700),NLIBA,NLIBT,NLIBC,NLIBI
      COMMON Q(200),PL,CFS,NSOR,LT,RECO(200),LIST(200,4),LCT,LZ,CON,
     1KIT,POP
      COMMON/DFLIB/DFL(700,7),EXG(170,2),TAU(170),EXS(170,2),EFF(170,8)
      COMMON/ELEMEN/IELEM(100)
      DW=1.
      PRINT 50
      DO 30 I=1,NSOR
      DO 20 J=1,7
      LL=LIST(I,1)
      IK=IZ(LL)
      IF(LT.GT.0)GOTO 10
      ATAU(I,J)=1.14E+05*(730/DW+21*FACCF(IK))*DFL(LL,J)
      GOTO 20
 10   CONTINUE
      ATAU(I,J)=1.14E+05*(21*SACCF(IK)+5*SACCI(IK))*DFL(LL,J)
 20    CONTINUE
      PRINT 60,IK,IELEM(IK),IMASS(LL),META(LL),(ATAU(I,J),J=1,7)
 30    CONTINUE
 50    FORMAT(1H1,/54X,'LIQUID EFFLUENT DOSE '
     1'PARAMETERS'//57X,'A(I) MREM/HR PER UCI/ML'//16X,'RADIONUCLIDE
     2',3X,'BONE',9X,'LIVER',6X,'TOTAL BODY',6X,'THYROID',6X,
     3' KIDNEY',9X,'LUNG',9X,'GI-LLI'/)
 60   FORMAT(1H ,15X,I2,1X,A2,I4,A1,7(6X,1PE8.2))
      STOP
      END
```

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 efflucents 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 Floor Drain Tank (FDT) 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 Filter) is used primarily in treating waste in the Laundry and Hot Shower Tank (LHST) Subsystem of the WL System. FDT waste may also be treated by this method.

C) Ion Exchange - Ion exchange is used to remove radioactive cations from solution, as in the case of either LHST or FDT waste in the WL System after removal of organics by carbon filtration (adsorption). Ion exchange is also used in removing both cations (cobalt, manganese) and anions (chloride, fluoride) from evaporator distillates in order to purify the distillates for reuse as makeup water. Distillate from the Waste Evaporator in the WL System and the Boron Recycle Evaporator in the Boron Recycle System (NB) can be treated by this method, as well as FDT, LHST waste, and letdown.

D) Gas Stripping - Removal of gaseous radioactive fission products is accomplished in both the WL Evaporator and the NB Evaporator.

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

F) Concentration - In both the WL and NB Evaporators, dissolved chemicals are concentrated in the lower shell as water is boiled away. In the case of the WL Evaporator, the volume of water containing waste chemicals and radioactive cations is reduced so that the waste may be more easily and cheaply solidified and shipped for burial. In the NB Evaporator, the dilute boron is concentrated to 4% so that it may be reused for makeup to the reactor coolant system.

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

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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, through the plant lifetime, of all the gaseous fission products to be discharged from the reactor coolant system to the chemical and volume control system or the boron recycle system, to limit the need for intentional discharge of radioactive gases from the waste gas holdup tanks. Thus, the only unavoidable sources of low-level radioactive gaseous discharge to the environment will be from periodic purging operations of the containment, from the auxiliary building ventilation system, and through the secondary system air ejector. With respect to the former, the potential contamination is expected to arise from uncollectable 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.

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 will cycle it through the catalytic recombiners to convert all the hydrogen to water. After the water vapor is removed, the resulting gas stream will be transferred from the recombiner into the gas decay tanks, where the accumulated activity may be contained in six approximately equal parts. From the decay tanks the gas will flow back to the compressor suction to complete the loop circuit.

C1.2.2 Containment and Auxiliary Building Ventilation

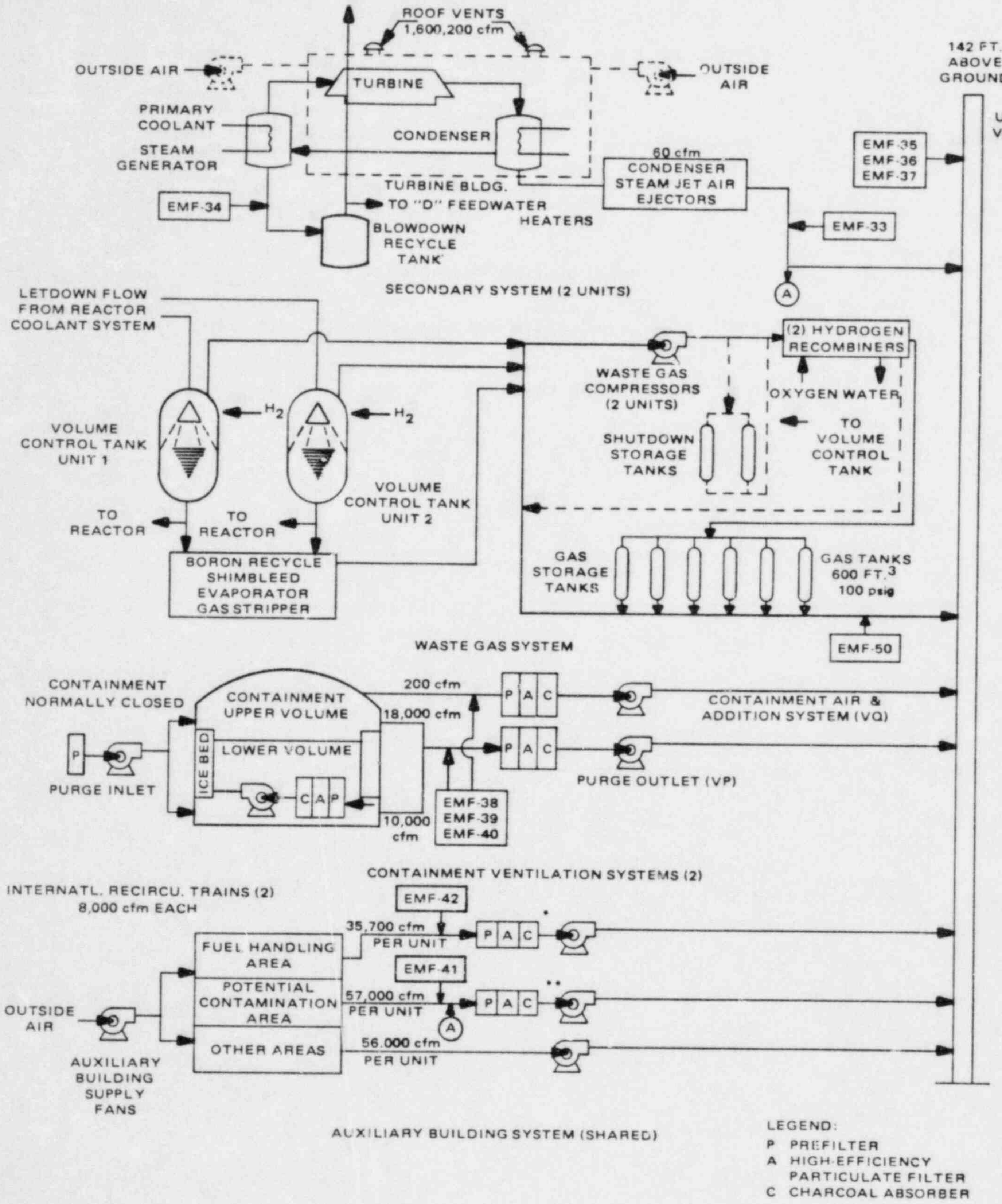
Nonrecyclable reactor coolant leakage occurring either inside the containment or inside the auxiliary building will generate gaseous activity. Gases resulting from leakage inside the containment will be contained until the containment air is released through the VQ or VP system. The containment atmosphere 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 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 FILTERED MODE.

** POTENTIALLY CONTAIMINATED 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

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
2. Conventional Waste Water Treatment System Effluent Line

C2.1.1 Liquid Waste Effluent Discharge Line

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 the isolation valve, 1 WL124 should the dilution flow fall below the setpoint. The following equation shall be used to calculate a discharge flow, in gpm.

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

where:

f = the undiluted effluent flow, in gpm.

F_{RL} = actual low pressure service water flowrate, in gpm, from the sum of the flowrate monitors located in the Control Room.

σ = the recirculation factor at equilibrim (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.

C2.1.2 Conventional Waste Water Treatment System Effluent Line

The conventional waste water treatment system 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 by periodic analyses 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 become radioactive.

a. Containment Ventilation Unit Condensate Effluent Line

Normally the containment ventilation unit condensate effluent line would discharge into the Turbine Building sump, but if radiation is detected above background, the discharge will be terminated and an alarm actuated. The containment ventilation unit condensate tank will then be recirculated, sampled and then discharged through the liquid waste effluent line and monitored or processed thru the WL system.

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 radiation is detected above background, the discharge flow will automatically be routed to the floor drain tank for processing and later be discharged through the liquid waste effluent line.

c. Turbine Building Sump Discharge Line

Normally the discharge from the Turbine Building sump will go into the conventional waste water treatment system, but if radiation is detected above background, the sump pumps A, B, and C will stop and an alarm actuated. The Turbine Building sump discharge line can either be routed to the floor drain tank for processing or routed directly to the liquid waste effluent discharge line.

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 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.

C2.2.1 Noble Gases

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

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

where the terms are defined below.

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

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

where:

K_i = The total body dose factor due to gamma emissions for each identified noble gas radionuclide, in mrem/yr per μCi/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 μCi/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 μCi/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 μCi/m^3 and for the food and ground plane pathways in m^2·(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 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 the controlling location:

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

W = 1.1E-07 meter^{-2}, for the food and ground plane pathways. The location is the unrestricted area boundary in the NE/NNE sector @ 0.5 miles (nearest residence, and vegetable garden).

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

where:

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

f = the undiluted effluent flow, in cfm

k_1 = conversion factor, 2.83E4 ml/ft^3

k_2 = conversion factor, 6E1 sec/min

C3.0 RADIATION MONITOR SETPOINTS

Using the generic calculations presented in Section 2.0, 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. These monitors measure the activity in the liquid or gas volume exposed to the detector and are independent of flow rate if a minimum flow rate is assured.

Radiation monitoring setpoints calculated in the following sections are expressed in activity concentrations; in reality the monitor readout is in counts per minute. The relationship between concentration and counts per minute is established by a station procedure using the following relationship:

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

where:

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

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

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.

C3.1.2 Containment Ventilation Unit Condensate Effluent Line - EMF-44

As described in Section C2.1.2 on release rate calculations for the containment ventilation unit condensate effluent, it is possible but unlikely that the effluent will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring. Since the tank contents are discharged automatically, the radiation monitor setpoint will be set at 1.0E-06 µCi/ml (the monitor's lowest level of detection) plus background to assure that release limits are not exceeded.

C3.1.3 Auxiliary Feedwater Sump Pumps and Floor Drain Sump Pump - EMF 52

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 but unlikely that the effluents will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring. Since the sumps are discharged automatically, the radiation monitor setpoint will be set at 1.0E-06 µCi/ml (the monitor's lowest level of detection) plus background to assure that release limits are not exceeded.

C3.1.4 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 but unlikely that the effluents will contain measurable activity above background. It is assumed that no activity is present in the effluent until indicated by radiation monitoring. Since the sump contents are discharged automatically, the radiation monitor setpoint will be set at 1.0E-06 µCi/ml (the monitor's lowest level of detection) plus background 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 most predominant isotope):

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

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

$$C_i < 1.16/f$$

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.

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

$$C_i < 1.16/f = 6.5E{-}06$$

where:

f = 151,000 cfm (auxiliary building ventilation) + 28,000 cfm (containment purge) = 179,000 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:

$$C_i < 1.16/f = 7.7E{-}06$$

where:

f = 151,000 cfm (auxiliary building ventilation)

C4.0 DOSE CALCULATIONS

C4.1 FREQUENCY OF CALCULATIONS

Dose contributions to the maximum exposed individual shall be calculated every 31 days, quarterly, semiannually, and annually (as required by Technical Specifications) using the methodology in the generic information sections. This methodology shall also be used for any special reports. Dose projections shall be performed using simplified estimates. Fuel cycle dose calculations shall be performed annually or as required by special reports. Dose contributions may 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, one of the two following cases will apply:

1. If the radionuclides Co-58 and/or Co-60 have been detected and Cs-134 and/or Cs-137 have not been detected (i.e., plants without any fuel failure) dose calculations will be based upon an adult who consumed fish caught in the discharge canal and who drank water from the nearest "downstream" potable water intake. The dose from these two radionuclides has been calculated to be 13% of that individual's total body dose.

2. If the radionuclides Cs-134 and/or Cs-137 have been detected, dose calculations 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 these two radionuclides has been calculated to be 90% 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 on the site boundary in each meteorological sectors.

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 an infant who breathes the air and consumes milk from the nearest goat or cow in each meteorological sector.

C4.3 SIMPLIFIED DOSE ESTIMATE

C4.3.1 Liquid Effluents

For dose estimates, two simplified calculations using the assumptions presented in Section C4.2.1 and source terms presented in the FSAR are presented. Once operational source term data is available, this information shall be used to revise these calculations, if necessary.

Case 1 - No Cs-134 or Cs-137 present in effluent.

$$D_{WB} = 1.57E{+}03 \sum_{\ell=1}^{m} (F_{\ell})(T_{\ell})\ (C_{Co\text{-}60} + 0.35\ C_{Co\text{-}58})$$

where:

$1.57E{+}03 = 1.14E{+}05\ (U_{aw}/D_{w} + U_{af}\ BF_{i})\ DF_{ai\tau}\ (7.69)$

where:

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

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

D_{w} = 37.7, dilution factor from the near field area to the nearest potable water intake.

where:

$D_{W} = \dfrac{\sigma}{Q_{R} + Q_{H}}$ (See Section C2.1.1)

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

BF_{i} = 5.0E+01, bioaccumulation factor for Cobalt (Table 3.1-1)

$DF_{ai\tau}$ = 1.67E-06, adult, total body, ingestion dose factor for Co-60 (Table 3.1-2)

7.69 = factor derived from assumption that 13% of dose is from Co-58 and Co-60 or 100% ÷ 13% = 7.69

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_ℓ = The length of time, in hours, over which C_{Co-58}, C_{Co-60}, and F_ℓ are averaged.

C_{Co-58} = the average concentration of Co-58 in undiluted effluent, in μCi/ml, during the time period considered.

C_{Co-60} = the average concentration of Co-60 in undiluted effluent, in μCi/ml, during the time period considered.

0.35 = The ratio of the adult total body ingestion dose factors for Co-58 and Co-60 or 1.67E-06 ÷ 4.72E-06 - Table 3.1-2.

Case 2 - Cs-134 and/or Cs-137 present in effluent.

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

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/μCi x 10^3ml/kg ÷ 8760 hr/yr

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

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

where:

$D_w = \dfrac{\sigma}{Q_R \div Q_H}$ (see Section C2.1.1)

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 90% of dose is from Cs-134 and Cs-137 or 100% ÷ 90% = 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

And where:

T_{ℓ} = The length of time, in hours, over which C_{Cs-134}, C_{Cs-137}, and F_{ℓ} 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 estimates using the assumptions in C4.2.2.1 and source terms in the FSAR are presented below. Once operational source term data is available, this information shall be used to revise these calculations, if necessary. These calculations further assume that the annual average dispersion parameter is used and that Xenon-133 contributes 45% of the dose.

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

$$D_{\beta} = 1.03E\text{-}09\ [\tilde{Q}]_{Xe-133}\ (2.22)$$

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

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

2.22 = factor derived from the conservative assumption (based on historical data) that 45% of the 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 estimates using the assumptions in C4.2.2.2 and source terms in the FSAR are presented below. Once operational source term data is available, this information shall be used to revise these calculations, if necessary. These calculations further assume that the annual average dispersion/deposition parameter is used and that 95% of the dose is from Iodine-131 concentrated in goat's milk. The simplified dose estimate to the thyroid of an infant is:

$$D = 1.84E{+}04 \ w \ (\tilde{Q})_{I-131} \ (1.05)$$

where:

$w = 7.3E{-}10 = \overline{D/Q}$ for food and ground plane pathway, in m^{-2} from Table C4.0-2 for location of nearest real goat (NW sector at 2.5 miles).

$(\tilde{Q})_{I-131}$ = the total Iodine-131 activity released in μCi.

1.84E+04 = $(3.17E{-}08)(R_i^C \, [\overline{D/Q}])$ with the appropriate substitutions for goat's milk in the grass-cow-milk-pathway factor, $R_i^C \, [\overline{D/Q}]$ for Iodine-131. See Section 3.1.2.2.

1.05 = factor derived from the conservative assumption (based on historical data) that 95% of the dose is contributed by I-131.

C4.3 FUEL CYCLE CALCULATIONS

This section will be submitted when complete.

TABLE C4.0-1

CATAWBA NUCLEAR STATION

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

(sec/m^3)

	Distance to the control location, (miles)									
Sector	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	6.0E-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-7	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	[illegible]	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

TABLE C4.0-2

(1 of 1)

CATAWBA NUCLEAR STATION

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

(meter $^{-2}$)

	Distance to the control location, (miles)									
Sector	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 C4.0-3 *

(1 of 3)

CATAWBA NUCLEAR STATION
ADULT $A_{ai\tau}$ DOSE PARAMETERS

mrem/hr per µCi/ml

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LLI
H 3	0.0	4.58E-01	4.58E-01	4.58E-01	4.58E-01	4.58E-01	4.58E-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	0.0	0.0	1.28E+00	7.65E-01	2.82E-01	1.70E+00	3.22E+02
MN 54	0.0	4.39E+03	8.37E+02	0.0	1.31E+03	0.0	1.34E+04
MN 56	0.0	1.10E+02	1.96E+01	0.0	1.40E+02	0.0	3.52E+03
FE 55	6.64E+02	4.59E+02	1.07E+02	0.0	0.0	2.56E+02	2.63E+02
FE 59	1.05E+03	2.46E+03	9.45E+02	0.0	0.0	6.89E+02	8.21E+03
CO 58	0.0	9.08E+01	2.04E+02	0.0	0.0	0.0	1.84E+03
CO 60	0.0	2.61E+02	5.75E+02	0.0	0.0	0.0	4.90E+03
NI 63	3.14E+04	2.18E+03	1.05E+03	0.0	0.0	0.0	4.54E+02
NI 65	1.28E+02	1.66E+01	7.56E+00	0.0	0.0	0.0	4.20E+02
CU 64	0.0	1.02E+01	4.77E+00	0.0	2.56E+01	0.0	8.66E+02
ZN 65	2.32E+04	7.38E+04	3.33E+04	0.0	4.93E+04	0.0	4.65E+04
ZN 69	4.93E+01	9.44E+01	6.56E+00	0.0	6.13E+01	0.0	1.42E+01
BR 83	0.0	0.0	4.05E+01	0.0	0.0	0.0	5.83E+01
BR 84	0.0	0.0	5.25E+01	0.0	0.0	0.0	4.12E-04
BR 85	0.0	0.0	2.16E+00	0.0	0.0	0.0	0.0
RB 86	0.0	1.01E+05	4.71E+04	0.0	0.0	0.0	1.99E+04
RB 88	0.0	2.90E+02	1.54E+02	0.0	0.0	0.0	4.00E-09
RB 89	0.0	1.92E+02	1.35E+02	0.0	0.0	0.0	1.12E-11
SR 89	2.28E+04	0.0	6.54E+02	0.0	0.0	0.0	3.66E+03
SR 90	2.84E+05	0.0	7.62E+04	0.0	0.0	0.0	1.62E+04
SR 91	4.20E+02	0.0	1.70E+01	0.0	0.0	0.0	2.00E+03
SR 92	1.59E+02	0.0	6.88E+00	0.0	0.0	0.0	3.15E+03
Y 90	5.97E-01	0.0	1.60E-02	0.0	0.0	0.0	6.33E+03
Y 91M	5.64E-03	0.0	2.18E-04	0.0	0.0	0.0	1.66E-02
Y 91	8.75E+00	0.0	2.34E-01	0.0	0.0	0.0	4.82E+03
Y 92	5.24E-02	0.0	1.53E-03	0.0	0.0	0.0	9.18E+02

* Methodology for table provided by: M. E. Wrangler, RAB:NRR:NRC on 3/17/83

TABLE C4.0-3

(2 of 3)

CATAWBA NUCLEAR STATION

ADULT $A_{ai\tau}$ DOSE PARAMETERS

mrem/hr per μCi/ml

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
Y 93	1.66E-01	0.0	4.59E-03	0.0	0.0	0.0	5.27E+03
ZR 95	3.07E-01	9.85E-02	6.67E-02	0.0	1.55E-01	0.0	3.12E+02
ZR 97	1.70E-02	3.43E-03	1.57E-03	0.0	5.18E-03	0.0	1.06E+03
NB 95	4.47E+02	2.49E+02	1.34E+02	0.0	2.46E+02	0.0	1.51E+06
MO 99	0.0	1.13E+02	2.14E+01	0.0	2.55E+02	0.0	2.61E+02
TC 99M	9.41E-03	2.66E-02	3.39E-01	0.0	4.04E-01	1.30E-02	1.57E+01
TC 101	9.68E-03	1.40E-02	1.37E-01	0.0	2.51E-01	7.13E-03	4.19E-14
RU 103	4.84E+00	0.0	2.08E+00	0.0	1.85E+01	0.0	5.65E+02
RU 105	4.03E-01	0.0	1.59E-01	0.0	5.20E+00	0.0	2.46E+02
RU 106	7.19E+01	0.0	9.10E+00	0.0	1.39E+02	0.0	4.65E+03
AG 110M	1.23E+00	1.14E+00	6.78E-01	0.0	2.24E+00	0.0	4.66E+02
TE 125M	2.57E+03	9.32E+02	3.45E+02	7.74E+02	1.05E+04	0.0	1.03E+04
TE 127M	6.50E+03	2.32E+03	7.92E+02	1.66E+03	2.64E+04	0.0	2.18E+04
TE 127	1.06E+02	3.79E+01	2.28E+01	7.82E+01	4.30E+02	0.0	8.33E+03
TE 129M	1.10E+04	4.12E+03	1.75E+03	3.79E+03	4.61E+04	0.0	5.56E+04
TE 129	3.01E+01	1.13E+01	7.34E+00	2.31E+01	1.27E+02	0.0	2.27E+01
TE 131M	1.66E+03	8.12E+02	6.77E+02	1.29E+03	8.23E+03	0.0	8.06E+04
TE 131	1.89E+01	7.90E+00	5.97E+00	1.55E+01	8.28E+01	0.0	2.68E+00
TE 132	2.42E+03	1.56E+03	1.47E+03	1.73E+03	1.51E+04	0.0	7.40E+04
I 130	2.88E+01	8.50E+01	3.35E+01	7.20E+03	1.33E+02	0.0	7.32E+01
I 131	1.59E+02	2.27E+02	1.30E+02	7.43E+04	3.89E+02	0.0	5.98E+01
I 132	7.74E+00	2.07E+01	7.24E+00	7.24E+02	3.30E+01	0.0	3.89E+00
I 133	5.41E+01	9.41E+01	2.87E+01	1.38E+04	1.64E+02	0.0	8.46E+01
I 134	4.04E+00	1.10E+01	3.93E+00	1.90E+02	1.75E+01	0.0	9.57E-03
I 135	1.69E+01	4.42E+01	1.63E+01	2.92E+03	7.09E+01	0.0	4.99E+01
CS 134	2.98E+05	7.09E+05	5.80E+05	0.0	2.29E+05	7.62E+04	1.24E+04
CS 136	3.12E+04	1.23E+05	8.86E+04	0.0	6.85E+04	9.39E+03	1.40E+04
CS 137	3.82E+05	5.22E+05	3.42E+05	0.0	1.77E+05	5.89E+04	1.01E+04
CS 138	2.64E+02	5.22E+02	2.59E+02	0.0	3.84E+02	3.79E+01	2.23E-03
BA 139	1.14E+00	8.14E-04	3.35E-02	0.0	7.61E-04	4.62E-04	2.03E+00

TABLE C4.0-3

(3 of 3)

CATAWBA NUCLEAR STATION
ADULT $A_{ai\tau}$ DOSE PARAMETERS

mrem/hr per μCi/ml

NUCLIDE	BONE	LIVER	T.BODY	THYROID	KIDNEY	LUNG	GI-LII
BA 140	2.39E+02	3.00E-01	1.57E+01	0.0	1.02E-01	1.72E-01	4.93E+02
BA 141	5.55E-01	4.19E-04	1.87E-02	0.0	3.90E-04	2.38E-04	2.62E-10
BA 142	2.51E-01	2.58E-04	1.58E-02	0.0	2.18E-04	1.46E-04	3.54E-19
LA 140	1.55E-01	7.82E-02	2.07E-02	0.0	0.0	0.0	5.74E+03
LA 142	7.94E-03	3.61E-03	9.00E-04	0.0	0.0	0.0	2.64E+01
CE 141	4.31E-02	2.91E-02	3.30E-03	0.0	1.35E-02	0.0	1.11E+02
CE 143	7.59E-03	5.61E+00	6.21E-04	0.0	2.47E-03	0.0	2.10E+02
CE 144	2.25E+00	9.39E-01	1.21E-01	0.0	5.57E-01	0.0	7.59E+02
PR 143	5.71E-01	2.29E-01	2.83E-02	0.0	1.32E-01	0.0	2.50E+03
PR 144	1.87E-03	7.76E-04	9.49E-05	0.0	4.38E-04	0.0	2.69E-10
ND 147	3.90E-01	4.51E-01	2.70E-02	0.0	2.64E-01	0.0	2.17E+03
W 187	2.96E+02	2.48E+02	8.65E+01	0.0	0.0	0.0	8.11E+04
NP 239	3.11E-02	3.06E-03	1.69E-03	0.0	9.54E-03	0.0	6.28E+02

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.

Site specific characteristics make groundwater sampling, special low-level I-131 analyses on drinking water, and food product sampling unnecessary. Groundwater recharge is from precipitation and the groundwater gradient is toward the effluent discharge area; therefore, contamination of groundwater from liquid effluents is highly improbable. Special low-level I-131 analyses in drinking water will not be performed routinely since the expected I-131 dose from this pathway is less than 1 mrem/year. Food products will not be sampled since lakewater irrigation is not practiced in the vicinity.

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 Intercomparsion 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 10/26/82 - 10/28/82. These dates will not be changed unless a subsequent census changes a controlling receptor's location.

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

(TLD LOCATIONS)

SAMPLING LOCATION DESCRIPTION			SAMPLING LOCATION DESCRIPTION		
200	SITE BOUNDARY	(0.7M 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 ENE)	234	4.5 MILE RADIUS	(4.5M E)
203	SITE BOUNDARY	(0.5M SE)	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	(0.6M 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	(0.8M NNW)	239	4-5 MILE RADIUS	(4.6M SSW)
212	SPECIAL INTEREST	(2.7M ESE)	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	(0.5M E)	243	4-5 MILE RADIUS	(4.6M WNW)
224	SITE BOUNDARY	(0.7M ESE)	244	4-5 MILE RADIUS	(4.1M NW)
225	SITE BOUNDARY	(0.5M SSE)	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	(8.2M SSE)
229	SITE BOUNDARY	(0.9M 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)

TABLE C5.0-2
(1 of 1)
CATAWBA RADIOLOGICAL MONITORING PROGRAM SAMPLING LOCATIONS
(OTHER SAMPLING LOCATIONS)

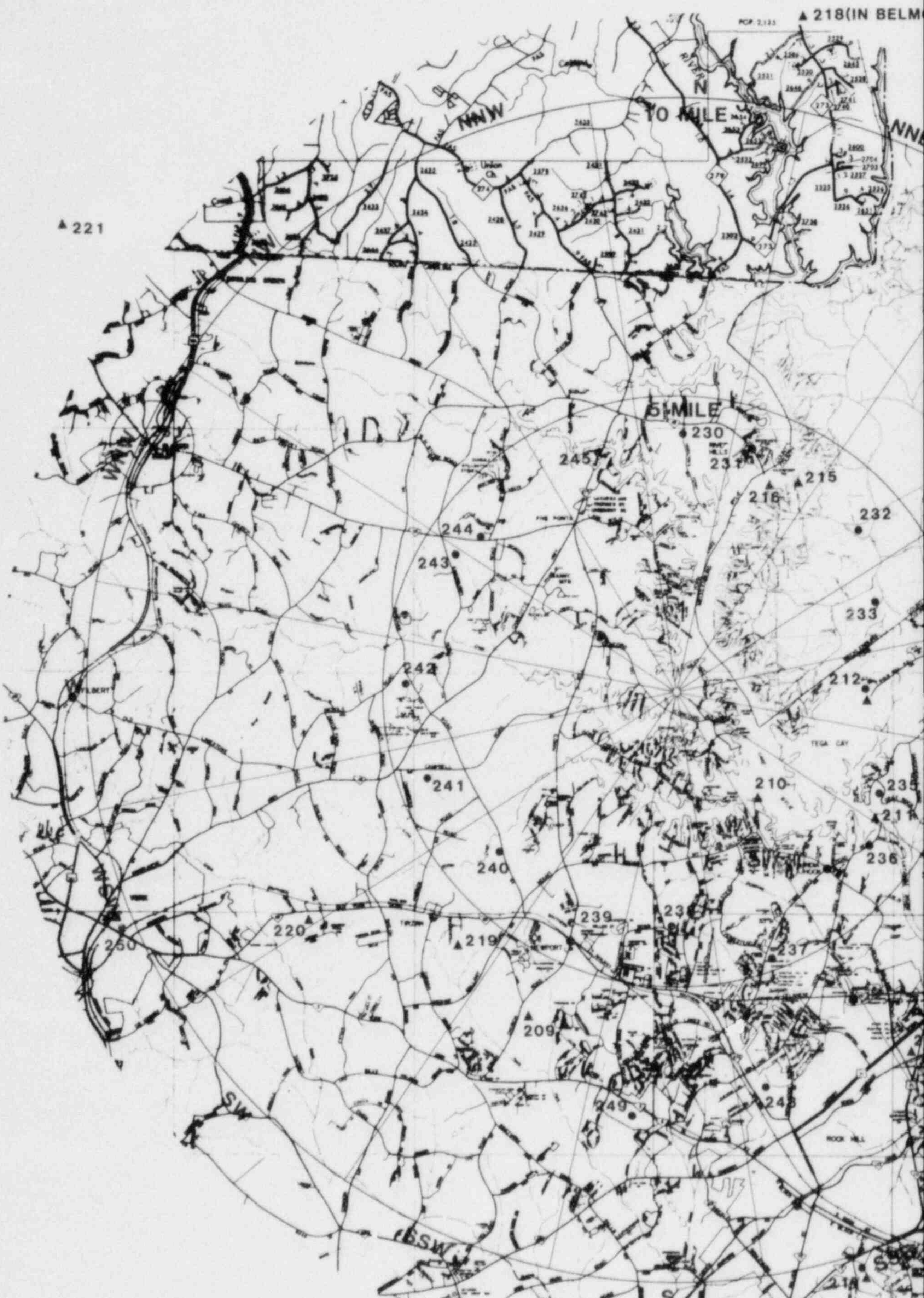
CODE:

W - Weekly　　Q - Quarterly
SM - Semimonthly　　SA - Semiannual
M - Monthly

	SAMPLING LOCATION DESCRIPTION	Air Radioiodines & Particulates	Surface Water	Drinking Water	Shoreline Sediment	Milk	Fish	Broadleaf Vegetation
200	Site Boundary (0.7m NNE)	W						
201	Site Boundary (0.5m NE)	W						M
205	Site Boundary (0.6m SW)	W						
208	Discharge Canal (0.5m S)		M		SA		SA	
209	Dairy (7.0m SSW)					SM		
210	Ebenezer Access (2.4m SE)				SA			
211	Wylie Dam (4.0m ESE)		M					
212	Tega Cay (2.7m ESE)	W						
213	Fort Mill Water Supply (7.5m ESE)			M				
214	Rock Hill Water Supply (7.3m SSE)			M				
215	Camp Steere-Hwy 49 (4.1m NNE) Control				SA			
216	Hwy 49 Bridge (4.0m NNE) Control		M				SA	
217	Rock Hill Substation (10.0m SSE) Control	W						M
218	Belmont Water Supply (13.5m N) Control			M				
219	Dairy (6.0m SW)					SM		
220	Dairy (8.0m WSW)					SM		
221	Dairy (13.0m NW) Control					SM		

TABLE C5.0-3
(1 of 1)
CATAWBA RADIOLOGICAL MONITORING PROGRAM ANALYSES

SAMPLE MEDIUM	ANALYSIS SCHEDULE	ANALYSES: GAMMA ISOTOPIC	TRITIUM	LOW LEVEL I-131	GROSS BETA	TLD
1. Air Radioiodine and Particulates	Weekly	X				
2. Direct Radiation	Quarterly					X
3. Surface Water	Monthly	X				
	Quarterly Composite		X			
4. Drinking Water	Monthly	X			X	
	Quarterly Composite		X			
5. Shoreline Sediment	Semiannually	X				
6. Milk	Semimonthly	X		X		
7. Fish	Semiannually	X				
8. Broadleaf Vegetation	Monthly	X				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N
NNW
10 MILE
NNE
Union Ch.
5 MILE
230
231
245
215
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ROCK HILL
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SSW
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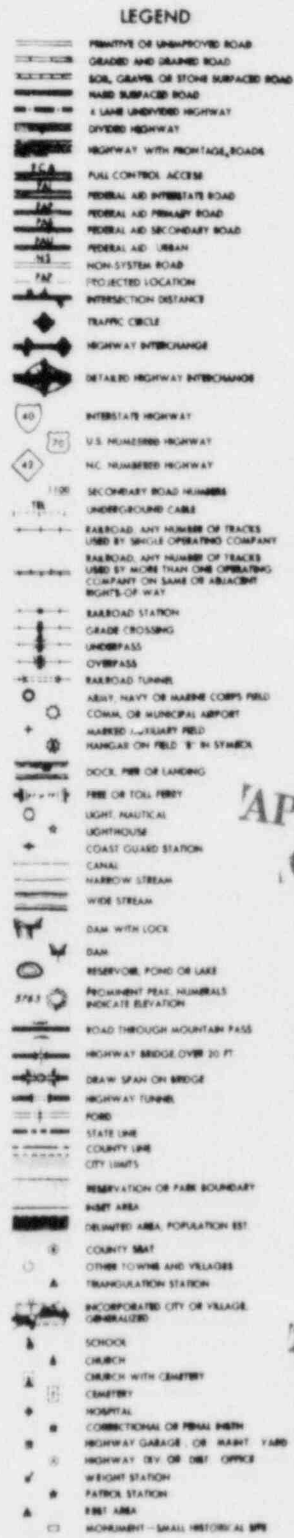

CATAWBA NUCLEAR STATION

MONITORING PROGRAM LOCATIONS

FIGURE C5.0-1

(1 OF 2)

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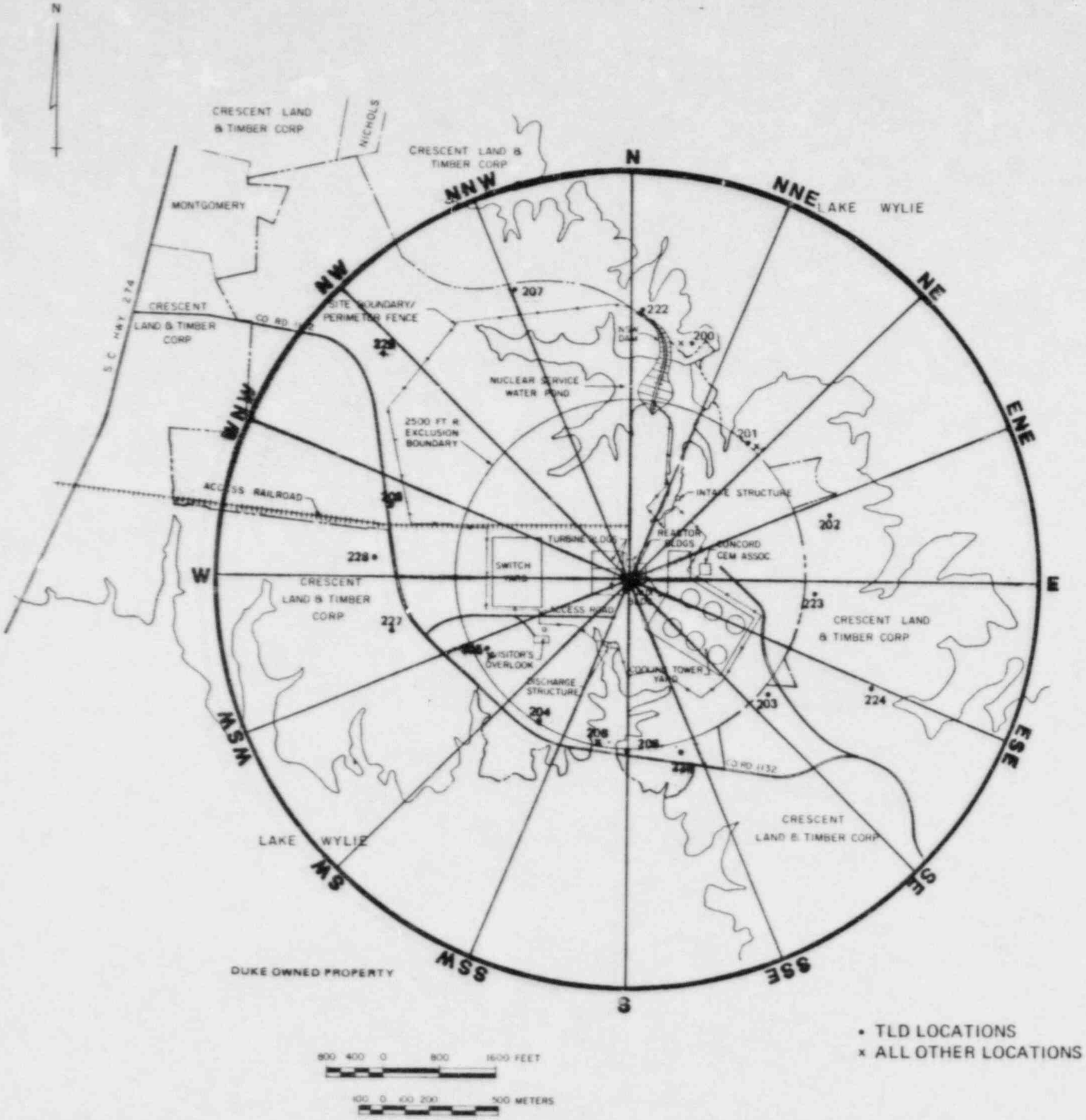

• TLD LOCATIONS
× ALL OTHER LOCATIONS

MONITORING PROGRAM LOCATIONS
FIGURE C5.0 1
(2 OF 2)
CATAWBA NUCLEAR STATION